International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 336 - 339, 2015, ISSN:- 2319–8656

Heuristic Algorithm for Efficient Data Retrieval Scheduling in the Multichannel Wireless Broadcast Environments

A. Porselvi
Dept. of CSE
Panimalar Institute of Technology
Chennai,India

S.Brindha Devi
Dept. of CSE
Panimalar Institute of Technology
Chennai,India

Abstract: Wireless data broadcast is an efficient way of disseminating data to users in the mobile computing environments. From the server's point of view, how to place the data items on channels is a crucial issue, with the objective of minimizing the average access time and tuning time. Similarly, how to schedule the data retrieval process for a given request at the client side such that all the requested items can be downloaded in a short time is also an important problem. In this paper, we investigate the multi-item data retrieval scheduling in the push-based multichannel broadcast environments. The most important issues in mobile computing are energy efficiency and query response efficiency. However, in data broadcast the objectives of reducing access latency and energy cost can be contradictive to each other. Consequently, we define a new problem named Minimum Cost Data Retrieval Problem (MCDR) and Large Number Data Retrieval (LNDR) Problem. We also develop a heuristic algorithm to download a large number of items efficiently. When there is no replicated item in a broadcast cycle, we show that an optimal retrieval schedule can be obtained in polynomial time.
Keywords – Multichannel, Wireless data broadcast, MCDR, LNDR

1. INTRODUCTION

BROADCAST is a means by which a single server can transmit data to an unlimited number of clients in a scalable way [3], [4]. Unlike unicast transmission, broadcast is scalable because a single transmission of an item satisfies all outstanding requests for it Generally, there are two types of broadcast systems: push-based and pull-based.

In a push-based system, the server will broadcast a set of data items to the clients periodically according to a fixed schedule; while in a pull-based system, the clients will first send requests to the server and the server will provide timely broadcast according to the requests received. Response time is the time interval between the moment a client tunes in a broadcast system with a request of one or more data items to the moment all requested data are downloaded. It is obvious that shorter response time is more desirable. On the other hand, in wireless communication environments, most clients are mobile devices operating on batteries. The smaller the amount of energy consumed during retrieving data is, the longer the battery life of a mobile device will be. Therefore, saving energy is another important issue for designing wireless data broadcast system. The fast development of wireless communication technologies such as OFDM (Orthogonal frequency division multiplexing) makes efficiently broadcasting data through multiple channels possible [25]. How to allocate the data onto multiple channels to minimize the expected response time has become a hot research topic and lots of scheduling algorithms are proposed [11], [19], [21]. When a query requests only one data item, to schedule the retrieving process is straightforward. However, it is common that a query requests multiple data items at a time [9], [15], [18] (e.g., a user may submit a query of the top 10 stocks). In such cases, different retrieving schedules may result in different response time. Moreover, in a multi-channel broadcast system, retrieving data will probably need switchings among the channels, which not only consumes additional energy, but also causes possible conflicts [17], [22], [26]. The LNDR problem takes the "deadline" into consideration and therefore also describes the time-critical scenario. For push-based broadcast, we derive a polynomial time $(1-\frac{1}{e}-\epsilon)$-approximation scheme for LNDR, and we also propose a heuristic algorithm for it based on maximum independent set. For the case that all channels are synchronized, we propose a polynomial time optimal algorithm for LNDR. When channels are unsynchronized, we prove LNDR is NP-hard. When all the requested data items have to be downloaded, we formulate another problem, namely minimum cost data retrieval (MCDR), with the objective of minimizing the response time and energy consumption .We

investigate the approximability of MCDR in push-based broadcast. Due to the strong in-approximability, we develop a heuristic algorithm for MCDR.

2. RELATED WORKS

Scheduling is an important issue in the area of wireless data broadcast. Acharya et al. first proposed the scheduling problem for data broadcast [1], and Prabhakara et al. suggested the multi-channel model for data broadcast to improve the data delivery performance [14]. Since then, many works have been done for scheduling data on multiple channels to reduce the expected access time [20,22,2]. Besides, some researches began to study how to allocate dependent data on broadcast channels (see, e.g., [10,19,21,5,6]). With respect to index, many methods have been proposed to improve the search efficiency in data broadcast systems (see, e.g., [8,16,18,19,21]).

Jung et al. proposed a tree-structured index algorithm that allocates indices and data on different channels [11]. Lo and Chen designed a parameterized schema for allocating indices and data optimally on multiple channels such that the average expected access latency is minimized [12]. In terms of data retrieval scheduling, Hurson et al. proposed two heuristic algorithms for downloading multiple data items from multiple channels [7]. As both push-based and pull-based approaches have their own strengths and drawbacks [15,16], hybrid scheduling is regarded as a prospective approach to better scheduling.

N. Saxena et al. [17] proposed a probabilistic hybrid scheduling, which probabilistically selects push operation or pull operation based on the present system statistics. Their results show that hybrid scheduling generally outperforms other purely push-based or pull-based algorithms in terms of access time. However, the above are all non-real-time scheduling. Huang and Chen proposed a scheme based on a generic algorithm to handle a similar problem [5].

3. PROPOSED WORK

In graph theory, an independent set or stable set for a graph G is a subset of vertices that are pairwise non-adjacent. A maximum independent set is an independent set with the maximum cardinality. As we mentioned in Section 2, a valid retrieval schedule for an LNDR instance is a set of triples without conflicts. Thus, finding a valid schedule with the largest number of requested data items is equivalent to finding a maximum independent set, considering conflicts as edges and triples as vertices. Although finding a maximum independent set is NP-hard, we still can devise heuristics that provide solutions not necessarily provable, but usually efficient for practice. We next present a sequential greedy heuristic that guarantees a maximal valid retrieval schedule (i.e., a valid set of triples that is not a subset of others).

Heuristic Algorithm:

1. **Input**: an LNDR instance which is represented by a set of triples.
2. Construct a graph G of triples and add edges between conflicted triples;
3. Let P<-Ø (P denotes the set of triples selected);
4. **While** G is not empty **do**

select a triple in G with the minimum degree;
put it in P and delete its neighbors;

5.**end while**
6.output P;

Generally, when a subset of elements need to be selected, a greedy based algorithm will construct a solution by adding elements sequentially. Decisions on which element is to be added is based on certain rule. In SGH each time we add a triple with the minimum degree. It can be shown that choosing a vertex and removing its neighbors repeatedly will achieve a maximal independent set. Thus, the solution resulted by SGH is maximal. Moreover, based on our observation, SGH is very efficient in practice, e.g., in Fig. 2a, data item d1 appears twice and SGH will select the one at time 5, because of its relatively low degree. As a result, data item d2 can also be downloaded (the number below a data item indicates its vertex degree). In Fig. 2b, SGH will select data items in channel c1. As a result, three data items can be downloaded. If selecting data items in channel c2, at most two data items can be downloaded. We will demonstrate the efficiency of SGH through simulation in Section 6. Since we convert LNDR into MIS only based on the conflicts, it is clear that SGH can be applied for non-uniform size data items and non-uniform bandwidth channels.

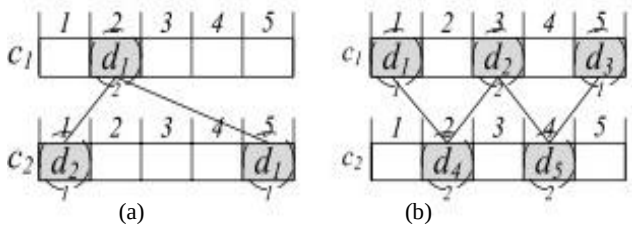


Fig 2: Two examples

MCDR Greedy Heuristic:

1. Input: a broadcast schedule with requested data item $d_1,d_2,\ldots,d_k$ and two parameters p and q $(p<q)$.
2. Let $P \leftarrow \emptyset$;
3. construct a set T_{di} for each data item d_i;
4. while $|P|< k$ do

5.let $\tau \leftarrow max_{1\le i\le k}\left(t_{Tr_f}(T_{d_i})\right)$;

6.if there exist a channel c and a time interval [x,y] such that $|c[x,y]| > p$,$y-x \le q$ and $y \le \tau$
then

7.Put that triples in c[x,y] into *P* and delete the conflicted triples;

8.else

let *Tr* be the triple with the maximum e(*Tr*);

9.put *Tr* into P, and delete the conflicted triples;
10.end if
11. end while
12. output P;

1) Let [x,y] be a time interval and c be a channel, define c[x,y] to be the set of data items in the time interval [x, y] of channel c.
2) For each triple Tr= (d_{Tr}; c_{Tr}; t_{Tr}), define e(*Tr*) to be the earliest time that data item d_{Tr} is downloadable if we do not download T_r at time t_{Tr}.
3) For each requested data item d, define T d to be the set of triples of d.
4) Let *T* be a set of triples, define $Tr_f(T)$ and $Tr_e(T)$, respectively, to be the first and last triples in *T* according to the broadcasting time.
In MGH (Algorithm 5), P holds the triples selected and t is the earliest possible time that all the requested data items can be downloaded. Each time MGH searches for a channel broadcasting a significant number of data items during a short time interval before t. If there exists such a channel, it downloads those data items; otherwise, it selects a triple Tr greedily with the maximum e(*Tr*). The two parameters p and q would be chosen according to α, λ_{Active}, λ_{Doze} and λ_{Switch}. When α=0 and λ_{Doze}=0, we can ignore the response time and set q to be greater than the cycle length, which converts the MCDR problem into a set cover problem, and thus brings an O(log k)-factor approximation solution. When α=1, we can decrease q and increase p to minimize the response time, regardless of the energy consumption.

4. CONCLUSION

In this paper, the data retrieval scheduling for multi-item requests over multiple channels is studied. Two optimization problems, LNDR and MCDR, are defined and some approximation and heuristic algorithms are proposed. The algorithms are analyzed both theoretically and practically. Their efficiencies are also demonstrated through simulation. For LNDR in push-based broadcast, MM can download the maximum number of data items when the channels are synchronized. When the channels are unsynchronized, SGH always achieves a better solution with respect to GL, NO, MM and RS, and it scales well. AS is slightly better than SGH but it cannot be applied to download a large number of data items. For LNDR in pull-based broadcast, GL is better than NO, and other algorithms cannot be applied. For MCDR, MGH always outperforms MH, GL, NO and RS.

RS is also an efficient scheduling when a large percentage of data items have to be downloaded. To the best of our knowledge, we do not find any algorithms in the literature which are designed for pull-based data scheduling at the server side over multiple unsynchronized channels. As a direction for further research, one can study the data scheduling problem for unsynchronized channels from the server's point of view.

6. REFERENCES

[1] J.E. Hopcroft and R.M. Karp, "An n5=2 Algorithm for Maximum Matchings in Bipartite Graphs," SIAM J. Computing, vol. 2, no. 4, pp. 225-231, 1973.
[2] H.D. Dykeman, M. Ammar, and J.W. Wong, "Scheduling Algorithms for Videotex Systems under Broadcast Delivery," Proc. IEEE Int'l Conf. Comm., pp. 1847-1851, 1986.
[3] S. Acharya, R. Alonso, M. Franklin, and S. Zdonik, "Broadcast
Disks: Data Management for Asymmetric Communication Environments," Proc. ACM SIGMOD Int'l Conf. Management of Data, pp. 199-210, 1995.
[4] N. Vaidya and S. Hameed, "Log Time Algorithms for Scheduling Single and Multiple Channel Data Broadcast," Proc. Ann. Int'l Conf. Mobile Computing and Networking, pp. 90-99, 1997.
[5] U. Feige, "A Threshold of lnn for Approximating Set Cover," J. ACM, vol. 45, no. 4, pp. 314-318, 1998.
[6] T. Imielinski, S. Viswanathan, and B.R. Badrinath, "Data on Air: Organization and Access," IEEE Trans. Knowledge and Data Eng., vol. 9, no. 3, pp. 353-372, May/June 1997.
[7] D. Aksoy and M. Franklin, "Scheduling for Large-Scale On-Demand Data Broadcasting," Proc. IEEE Int'l Conf. Computer Comm., pp. 651-659, 1998.
[8] D. Aksoy and M. Franklin, "R _W: A Scheduling Approach for Large-Scale On-Demand Data Broadcasting," IEEE/ACM Trans. Networking, vol. 7, no. 6, pp. 846-860, Dec. 1999.
[9] C. Kenyon and N. Schabanel, "The Data Broadcast Problem with Non-Uniform Transmission Time," Proc. ACM-SIAM Symp. Discrete Algorithms, pp. 547-556, 1999.
[10] C.D. Manning and H. Schutze, Foundations of Statistical Natural Language Processing. MIT Press, 1999.
[11] K. Prabhakara, K.A. Hua, and J. Oh, "Multi-Level Multi-Channel Air Cache Designs for Broadcasting in a Mobile Environment," Proc. IEEE Int'l Conf. Data Eng., pp. 167-176, 2000.
[12] W. Mao, "Competitive Analysis of On-line Algorithms for On- Demand Data Broadcast Scheduling," Proc. Int'l Symp. Parallel Architectures, Algorithms and Networks, pp. 292-296, 2000.
[13] Y.D. Chung and M.H. Kim, "Effective Data Placement for Wireless Broadcast," Distributed and Parallel Databases, vol. 9, no. 2, pp. 133-150, 2001.
[14] G. Lee, M.S. Yeh, S.C. Lo, and A. Chen, "A Strategy for Efficient Access of Multiple Data Items in Mobile Environments," Proc. IEEE Int'l Conf. Mobile Data Management, pp. 71-78, 2002.
[15] W.G.Yee , S.B. Navathe, E. Omiecinski, and C. Jermaine, "Efficient Data Allocation over Multiple Channels at Broadcast Servers," IEEE Trans. Computers, vol. 51, no. 10, pp. 1231-1236, Oct. 2002.
[16] W.G. Yee and S.B. Navathe, "Efficient Data Access to Multi- Channel Broadcast Programs," Proc. ACM Int'l Conf. Information and Knowledge Management, pp. 153-160, 2003.
[17] J.L. Huang, M.S. Chen, and W.C. Peng, "Broadcasting Dependent
Data for Ordered Queries without Replication in a Multi-Channel Mobile Environment," Proc. IEEE Int'l Conf. Data Eng., pp. 692- 694, 2003.
[18] M.V. Lawrence, L.S. Brakmo, and W.R. Hamburgen, "Energy Management on Handheld Devices," ACM Queue, vol. 1, pp. 44- 52, 2003.

[19] J.L. Huang and M.S. Chen, "Broadcast Program Generation for Unordered Queries with Data Replication," Proc. ACM Symp. Applied Computing, pp. 866-870, 2003.
[20] A.A. Ageev and M.I. Sviridenko, "Pipage Rounding: A New Method of Constructing Algorithms with Proven Performance Guarantee," J. Combinatorial Optimization, vol. 8, no. 3, pp. 307- 328, 2004.
[21] K. Foltz, L. Xu, and J. Bruck, "Scheduling for Efficient Data Broadcast over Two Channels," Proc. IEEE Int'l Symp. Information Theory,
pp. 113-116, 2004.
[22] J. Juran, A.R. Hurson, N. Vijaykrishnan, and S. Kim, "Data Organization and Retrieval on Parallel Air Channels: Performance and Energy Issues," Wireless Networks, vol. 10, no. 2, pp. 183-195, 2004.
[23] J.L. Huang and M.S. Chen, "Dependent Data Broadcasting for Unordered Queries in a Multiple Channel Mobile Environment," IEEE Trans. Knowledge and Data Eng., vol. 16, no. 9, pp. 1143-1156, Sept. 2004.
[24] E. Ardizzoni, A.A. Bertossi, S. Ramaprasad, R. Rizzi, and M.V.S. Shashanka, "Optimal Skewed Data Allocation on Multiple Channels with Flat Broadcast per Channel," IEEE Trans. Computers, vol. 54, no. 5, pp. 558-572, 2005.
[25] S. Jung, B. Lee, and S. Pramanik, "A Tree-Structured Index Allocation Method with Replication over Multiple Broadcast Channels in Wireless Environment," IEEE Trans. Knowledge and Data Eng., vol. 17, no. 3, pp. 311-325, Mar. 2005.
[26] B. Zheng, X. Wu, X. Jin, and D.L. Lee, "Tosa: A Near-Optimal Scheduling Algorithm for Multi-Channel Data Broadcast," Proc. IEEE Int'l Conf. Mobile Data Management, pp. 29-37, 2005.
[27] A.R. Hurson, A.M. Munoz-Avila, N. Orchowski, B. Shirazi, and Y. Jiao, "Power Aware Data Retrieval Protocols for Indexed Broadcast Parallel Channels," Pervasive and Mobile Computing, vol. 2, no. 1, pp. 85-107, 2006.
[28] Y. Yao, X. Tang, E.P. Lim, and A. Sun, "An Energy-Efficient and Access Latency Optimized Indexing Scheme for Wireless Data Broadcast," IEEE Trans. Knowledge and Data Eng., vol. 18, no. 8, pp. 1111-1124, Aug. 2006.
[29] J. Xu, W.C. Lee, X. Tang, Q. Gao, and S. Li, "An Error-Resilient and Tunable Distributed Indexing Scheme for Wireless Data Broadcast," IEEE Trans. Knowledge and Data Eng., vol. 18, no. 3, pp. 392-404, Mar. 2006.
[30] T. Jiang, W. Xiang, H.H. Chen, and Q. Ni, "Multicast Broadcast Services Support in OFDMA-Based WiMAX Systems," IEEE Comm. Magazine, vol. 45, no. 8, pp. 78-86, Aug. 2007.
[31] J. Chen, G. Huang, and V.C.S. Lee, "Scheduling Algorithm for Multi-Item Requests with Time Constraints in Mobile Computing Environments," Proc. Int'l Conf. Parallel and Distributed Systems, pp. 1-7, 2007.
[32] K. Liu and V.C.S. Lee, "On-demand Broadcast for Multi-Item Requests in a Multiple Channel Mobile Environment," Information Sciences, vol. 180, no. 22, pp. 4336-4352, 2010.
[33] Y. Shi, X. Gao, J. Zhong, and W. Wu, "Efficient Parallel Data Retrieval Protocols with MIMO Antennae for Data Broadcast in 4G Wireless Communications," Proc. Int'l Conf. Database and Expert Systems Applications, pp. 80-95, 2010.
[34] X. Gao, Z. Lu, W. Wu, and B. Fu, "Algebraic Algorithm for Scheduling Data Retrieval in Multi-channel Wireless Data Broadcast Environments," Proc. Int'l Conf. Combinatorial Optimization and Applications, pp. 74-81, 2011.
[35] J. Lv, V.C.S. Lee, M. Li, and E. Chen, "Profit-Based Scheduling and Channel Allocation for Multi-Item Requests in Real-Time On- Demand Data Broadcast Systems," Data & Knowledge Eng., vol. 73, pp. 23-42, 2012.
[36] Z. Lu, W. Wu, and B. Fu, "Optimal Data Retrieval Scheduling in the Multi-Channel Wireless Broadcast Environments," IEEE Trans. Computers, vol. 62, no. 12, pp. 2427-2439, Dec. 2013.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 340 - 343, 2015, ISSN:- 2319–8656

A Novel Constant size Cipher-text Scheme for Security in Real-time Systems

M.Dhivya
Department of Computer Science and Engineering
Panimalar Institute of Technology, Chennai, India

Tina Belinda Miranda
Department of Computer Science and Engineering
Panimalar Institute of Technology, Chennai, India

S.Venkatraman
Department of Computer Science and Engineering
Panimalar Institute of Technology, Chennai, India

Abstract: In this paper, we consider 'secure attribute based system with short ciphertext' is a tool for implementing fine-grained access control over encrypted data, and is conceptually similar to traditional access control methods such as Role-Based Access Control. However, current 'secure attribute based system with short ciphertext' schemes suffer from the issue of having long decryption keys, in which the size is linear to and dependent on the number of attributes.Ciphertext-Policy ABE (CP-ABE) provides a scalable way of encrypting data such that the encryptor defines the attribute set that the decryptor needs to possess in order to decrypt the ciphertext. We propose a novel 'secure attribute based system with short ciphertext' scheme with constant-size decryption keys independent of the number of attributes. We found that the size can be as small as 672 bits.

Keywords – Attribute Based Encryption, Ciphertext Policy, Short Decryption Key.

1. INTRODUCTION

LIGHTWEIGHT devices (e.g. Radio Frequency Identification (RFID) tags) have been well known to have many useful applications[1]. This is useful for creating passports, ID cards and secret data storage, such as cryptographic key storage. Authorized persons generate a cryptographic key for each individual user. Then the key embedded within a user's ID card. The user can extract the key from his/her ID card for a security use.

Lightweight devices usually have limited memory capacity. This has become a major challenge to applications such as key storage. Many encryption systems can offer short decryption keys. Attribute-based encryption (ABE) is an extension of identity-based encryption which allows users to encrypt and decrypt messages based on attributes and access structures. Ciphertext-policy attribute-based encryption (CP-ABE) is a type of ABE schemes where the decryption key is associated with a user's attribute set. The encryptor encrypt the attributes for protect the data. We generate the group key for each individual user for protect the sensitive data. The encryptor defines the access structure to protect sensitive data such that only users whose attributes satisfy the access structure can decrypt the messages.[1]

Many CP-ABE schemes have been proposed for various purposes such as short ciphertext and full security proofs. However, we found no CP-ABE scheme with expressive access structures in the literature addressing the size issue of decryption keys, which seems to be a drawback due to resource consumption. All existing CP-ABE schemes suffer from the issue of long decryption keys, in which the length is dependent on the number of attributes.[2]

This issue becomes more obvious, when CP-ABE decryption keys are applied to storage-constrained devices. Because of the popularity of lightweight devices and useful applications of CP-ABE, in this work, we propose a provably secure CP-ABE scheme that offers short decryption keys, which are applicable for key storage in lightweight devices.[1],[2]

2. ARCHITECTURE

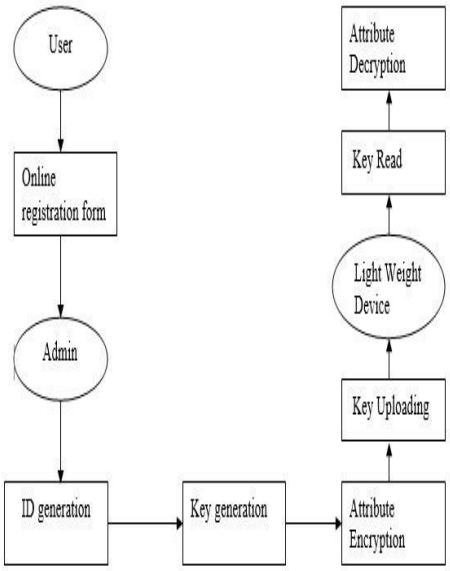


Fig.1. System Architecture

3. RELATED WORK

Attribute based Encryption consists of two variants of ABE: Key-Policy ABE and Ciphertext-Policy ABE.

KP-ABE: In a KP-ABE scheme, the ciphertext encrypting a message is associated with a set of attributes. A decryption key issued by an authority is associated with an access structure. The ciphertext can be decrypted with the decryption key if and only if the attribute set of ciphertext satisfies the access structure of decryption key.[12],[27]

CP-ABE: In a CP-ABE scheme, on the contrary, the ciphertext encrypts a message with an access structure while a decryption key is associated with a set of attributes. The decryption condition is similar: if and only if the attribute set fulfils the access structure[14].

John Bethencourt, Amit Sahai and Brent Waters presented a system for realizing complex access control on encrypted data that we call Ciphertext-Policy Attribute-Based Encryption. collusion attacks. Our methods are conceptually closer to traditional access control methods such as Role-Based Access Control (RBAC). Our system allows policies to be expressed as any monotonic tree access structure and is resistant to collusion attacks in which an attacker might obtain multiple remote keys.In addition, we provide an implementation of our system and give performance measurement.

Serge Vaudenay provide strong definitions for security and privacy. Our model captures the notion of a powerful adversary who can monitor all communications, trace tags within a limited period of time, corrupt tags, and get side channel information on the reader output. Prove some constructions: narrow-strong and forward privacy based on a public-key cryptosystem, narrow-destructive privacy based on a random oracle, and weak privacy based on a pseudo random function.[5]

Work by Omkant Pandey and Amit Sahai Presented the first construction of a ciphertext-policy attribute based encryption scheme having a security proof based on a number theoretic assumption and supporting advanced access structures.[33]

Guojun Wang,Qin Liu and Jie Wu propose a hierarchical attribute-based encryption model by combining a HIBE system and a CP-ABE system,to provide fine-grained access control and full delegation.Based on this model to achieve high performance.we construct several traits such as high performance, fine-grained access control, scalability and full delegation.

Charan, K.Dinesh kumar and D.Arun Kumar Reddy propose verifiability guarantees that a user can effectively check if the transformation is correctly and proved it is secure. Attribute based Encryption schemes are that the access policy can be classified as key-policy and cipher-text policy.[4]

Kan Yang and Xiaohua Jia propose a revocable multi-authority CP-ABE scheme and apply it as the underlying technique to design the data access control scheme which can be applied in any remote storage systems, onlinesocial networks, etc..Attribute revocation method is efficient and also it has less Communication cost and Computation cost and is secure it can achieve both backward security and for forward security.

Venkateshprasad.kalluri and D.Haritha presents a Attribute –Based access to the media in the cloud where it uses CP-ABE technique to create an access control structure.By using this technique the encrypted data is trustworthy even on the untrusted server and also this requires flexible,cryptographic key management to support difficult access policies Yi Mu proposed a novel dynamical identity-based authenticated key management protocol to optimize key management for a user with multiple options.[8]

4. PROPOSED SYSTEM

In this proposed system scheme with constant-size decryption keys independent of the number of attributes. We found that the size can be as small as 672 bits. In comparison with other schemes in the literature, the proposed scheme is the only with expressive access structures, which is suitable for ‘secure attribute based system with short ciphertext’ key storage in lightweight devices. Because of the popularity of lightweight devices and useful applications of secure attribute based system with short ciphertext’ , in this work, we propose a probably secure proposed system scheme that offers short decryption keys, which are applicable for key storage in lightweight devices.[17],[18],[19]

CP-ABE works under four ways Setup, Encrypt KeyGen and decrypt.

1. Setup:

The setup algorithm takes no input other than the implicit security parameter. It outputs the public parameters PK and a master key MK.

2. Encrypt (PK, M,A):

The encryption algorithm takes as input the public parameters PK, a message M, and an access structure A over the universe of attributes. The algorithm will encrypt M and produce a ciphertext CT such that only a user that possesses a set of attributes that satisfies the access structure will be able to decrypt the message. We will assume that the ciphertext implicitly contains A.[17]

3. Key Generation (MK, S):

The key generation algorithm takes as input the master key MK and a set of attributes S that describe the key. It outputs a private key SK.

4. Decrypt(PK,CT, SK):

The decryption algorithm takes as input the public parameters PK, a ciphertext CT, which contains an access policy A, and a private key SK, which is a private key or set S of attributes. If the set S of attributes satisfies the

access structure A then the algorithm will decrypt the ciphertext and return a message M.[5]

Efficiency:

The decryption key of our scheme is composed of two group elements only, and is independent of the number of attributes. Recently proposed attribute based encryption schemes in terms of policy type, access structure, security model, length of decryption key and length of ciphertext. We compare the efficiency of schemes under CPA (chosen plaintext attack) security only as previous schemes utilized different generalized security transformation from CPA to CCA.[6],[7]

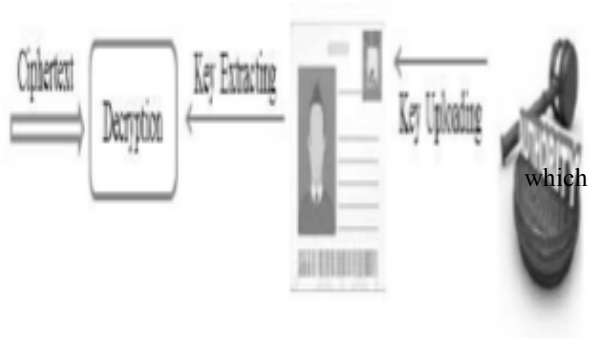


Fig.2. A Security use of decryption with decryption key stored in RFID tags embedded within ID cards.

Modules:

- Registration & ID Generation
- Key Generation & Encryption
- Uploading & Verification

Registration & ID Generation:

In this paper we develop a applying for Online Electronic Passport for this user has to register application form. User has to fill their own personal details and upload their individual photo for registration. After they submit the form authorized person will generate the ID for particular registered person. ID can be generated for every registered users.

Key Generation & Encryption:

Once Id has been generated authority will generate key for every registered person. This key contains public, private and secret key for each individual person. Based on the key only, attributes are encrypted and provide the cipher text values. Encryption is done independent on number of attributes with constant size decryption keys.

Uploading & Verification:

Authority generates a short decryption key and uploading into the device. Once encryption key has been generated it must be uploaded into the light weight devices. When user wants to see the content of his/her profile means he/she has to retrieve the key from the device. After key has been read from device they perform decryption and view full profile. Here verification is carried out, when the uploaded key and retrieved key are match means they perform some operations otherwise they didn't perform.

5. CONCLUSION

Light weight devices usually have limited memory storage, which could be too small to store decryption keys of secure attribute based system with short ciphertext schemes. We develop a project using ciphertext key for light weight devices. This CP-ABE should contain security, Performance and flexibility.[19]

Thus, the proposed scheme is very much useful in real time security systems. Future works may include schemes to reduce number of bits of key without compromising the security feature.

Thus, the proposed work can improve the real time systems.

6. REFERENCES

[1] S. Vaudenay, "On privacy models for RFID," in Proc. ASIACRYPT, 2007, vol. 4.

[2] C. Delerablée, "Identity-based broadcast encryption with constant size ciphertexts and private keys," in Proc. ASIACRYPT, 2007, vol. 4.

[3] F. Guo, Y. Mu, and W. Susilo, "Identity-based traitor tracing with short private key and short ciphertext," in Proc. ESORICS, 2012, vol. 7.

[4] F. Guo, Y. Mu, and Z. Chen, "Identity-based encryption: How to decrypt multiple ciphertexts using a single decryption key," in Proc. Pairing, 2007, vol. 4.

[5] F. Guo, Y. Mu, Z. Chen, and L. Xu, "Multi-identity single-key decryption without random oracles," in Proc. Inscrypt, 2007, vol. 4.

[6] H. Guo, C. Xu, Z. Li, Y. Yao, and Y. Mu, "Efficient and dynamic key management for multiple identities in identity-based systems," Inf. Sci., vol. 2, Feb. 2013.

[7] D. Boneh and M. K. Franklin, "Identity-based encryption from the weil pairing," in Proc. CRYPTO, 2001, vol. 2.

[8] G. Wang, Q. Liu, and J. Wu, "Hierarchical attribute-based encryption for fine-grained access control in cloud storage services," in Proc. ACM Conf. Comput. Commun. Security, 2010.

[9] J. Hur and D. K. Noh, "Attribute-based access control with efficient revocation in data outsourcing systems," IEEE Trans. Parallel Distrib. Syst., vol. 22, Jul. 2011.

[10] Z. Wan, J. Liu, and R. H. Deng, "Hasbe: A hierarchical attributebased solution for flexible and scalable access control in cloud computing," IEEE Trans. Inf. Forensics Security, vol. 7, Apr. 2012.

[11] V. Goyal, O. Pandey, A. Sahai, and B. Waters, "Attribute-based encryption for fine-grained access control of encrypted data," in Proc. ACM Conf. Comput. Commun. Security, 2006.

[12] J. Bethencourt, A. Sahai, and B. Waters, "Ciphertext-policy attribute based encryption," in Proc. IEEE Symp. Security Privacy, May 2007.

[13] L. Cheung and C. C. Newport, "Provably secure ciphertext policy abe," in Proc. ACM Conf. Comput. Commun. Security, 2007.

[14] B. Waters, "Ciphertext-policy attribute-based encryption: An expressive, efficient, and provably secure realization," in Proc. Public Key Cryptography., 2011, vol. 6.

[15] K. Emura, A. Miyaji, A. Nomura, K. Omote, and M. Soshi, "A ciphertext-policy attribute-based encryption scheme with constant ciphertext length," in Proc. ISPEC, 2009, vol. 5.

[16] Z. Zhou and D. Huang, "On efficient ciphertext-policy attribute based encryption and broadcast encryption: Extended abstract," in Proc. ACM Conf. Comput. Commun. Security, 2010.

[17] J. Herranz, F. Laguillaumie, and C. Råfols, "Constant size ciphertexts in threshold attribute-based encryption," in Proc. Public Key Cryptography, 2010, vol. 6.

[18] A. B. Lewko, T. Okamoto, A. Sahai, K.Takashima, and B. Waters, "Fully secure functional encryption: Attribute-based encryption and (hierarchical) inner product encryption," in Proc. EUROCRYPT, 2010, vol. 6.

[19] A. B. Lewko and B. Waters, "New proof methods for attribute-based encryption: Achieving full security through selective techniques," in Proc. CRYPTO, 2012, vol. 7.

[20] A. Sahai and B. Waters, "Fuzzy identity-based encryption," in Proc. EUROCRYPT, 2005, vol. 3.

[21] R. Ostrovsky, A. Sahai, and B. Waters, "Attribute-based encryption with non-monotonic access structures," in Proc. ACM Conf. Comput. Commun. Security, 2007.

[22] C. Chen et al., "Fully secure attribute-based systems with short ciphertexts/signatures and threshold access structures," in Proc. CT-RSA, 2013, vol. 7. GUO et al.: CP-ABE WITH CONSTANT-SIZE KEYS FOR LIGHTWEIGHT DEVICES 771

[23] N. Attrapadung, B. Libert, and E. de Panafieu, "Expressive key-policy attribute-based encryption with constant-size ciphertexts," in Proc. Public Key Cryptography., 2011, vol. 6.

[24] C. Chen, Z. Zhang, and D. Feng, "Efficient ciphertext policy attribute-based encryption with constant-size ciphertext and constant computation-cost," in Proc. ProvSec, 2011, vol. 6.

[25] A. Ge, R. Zhang, C. Chen, C. Ma, and Z. Zhang, "Threshold ciphertext policy attribute-based encryption with constant size ciphertexts," in Proc. ACISP, 2012, vol.
[26] T. Okamoto and K. Takashima, "Fully secure unbounded inner-product and attribute-based encryption," in Proc. ASIACRYPT, 2012, vol. 7.

[27] V. Goyal, A. Jain, O. Pandey, and A. Sahai, "Bounded ciphertext policy attribute based encryption," in Proc. 35th ICALP, 2008, vol. 5.

[28] A. Sahai and B. Waters, "Attribute-based encryption for circuits from multilinear maps", CoRR, vol. abs/1210.5287, 2012.

[29] M. Chase, "Multi-authority attribute based encryption," in Proc. TCC, 2007, vol. 4.

[30] T. Nishide, K. Yoneyama, and K. Ohta, "Attribute-based encryption with partially hidden encryptor-specified access structures," in Proc. ACNS, 2008, vol. 5.

[31] S. Hohenberger and B. Waters, "Attribute-based encryption with fast decryption," in Proc. Public Key Cryptography., 2013, vol.7.

[32] M. J. Hinek, S. Jiang, R. Safavi-Naini, and S. F. Shahandashti, "Attribute-based encryption without key cloning," IJACT, vol. 2, 2012.

[33]Z. Liu, Z. Cao, and D. Wong, "White-box traceable ciphertext-policy attribute-based encryption supporting any monotone access structures," IEEE Trans. Inf. Forensics Security, vol. 8, Jan. 2013.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 343 - 350, 2015, ISSN:- 2319–8656

Video Transmission over an Enhancement Approach Of IEEE802.11e

Abdirisaq M. Jama and Othman O. khalifa
Faculty of Engineering
International Islamic University
Malaysia

Diaa Eldein Mustafa Ahmed
Faculty of Computer Science and Information Technology, Sudan University for Science and Technology, Sudan

Abstract: Multimedia Video transmission is over Wireless Local Area Networks is expected to be an important component of many emerging multimedia applications. However, Wireless networks will always be bandwidth limited compared to fixed networks due to background noise, limited frequency spectrum, and varying degrees of network coverage and signal strength One of the critical issues for multimedia applications is to ensure that the Quality of Service (QoS) requirement to be maintained at an acceptable level. Modern mobile devices are equipped with multiple network interfaces, including 3G/LTE WiFi. Bandwidth aggregation over LTE and WiFi links offers an attractive opportunity of supporting bandwidth-intensive services, such as high-quality video streaming, on mobile devices. Achieving effective bandwidth aggregation in wireless environments raises several challenges related to deployment, link heterogeneity, Network congestion, network fluctuation, and energy consumption. In this work, an overview of schemes for video transmission over wireless networks is presented where an acceptable quality of service (QoS) for video applications required real-time video transmission is achieved.

Keywords: Video coding, video compression, wireless video transmission, Wireless Networks

1. INTRODUCTION

Video Transmission has been an important media for communications and entertainment for many decades. Initially video was captured and transmitted in analog form. The advent of digital integrated circuits and computers led to the digitization of video, and digital video enabled a revolution in the compression and communication of video. Video compression became an important area of research in the late 1980's and 1990's and enabled a variety of applications including video storage on DVD's and Video-CD's, video broadcast over digital cable, satellite and terrestrial (over-the-air) digital television (DTV), and video conferencing and videophone over circuit-switched networks. The growth and popularity of the Internet in the mid- 1990's motivated video communication over best-effort packet networks [1][2][3]. It is complicated by a number of factors including unknown and time -varying bandwidth, delay, and losses, as well as many additional issues such as how to fairly share the network resources amongst many flows and how to efficiently perform one-to-many communication for popular content. Figure 1 shows Internet Video Streaming Architecture where Raw video and audio data are pre-compressed by video compression and audio compression algorithms and then saved in storage devices[4][5].

Upon the client's request, a streaming server retrieves compressed video/audio data from storage devices and then the application-layer QoS control module adapts the video/audio bit-streams according to the network status and QoS requirements. After the adaptation, the transport protocols packetize the compressed bit-streams and send the video/audio packets to the Internet. Packets may be dropped or experience excessive delay inside the Internet due to congestion. For packets that are successfully delivered to the receiver, they first pass through the transport layers and then are processed by the application layer before being decoded at the video/audio decoder. With respect to the real-time transmission of video streams, the transmitting delay should be minimal. The high transmitting delay may cause the video packets not to been decoded. Adjustment of the bit rates of video stream is required for a reliable video transmission [6][7][8] . To achieve synchronization between video and audio presentations, media synchronization mechanisms are required.

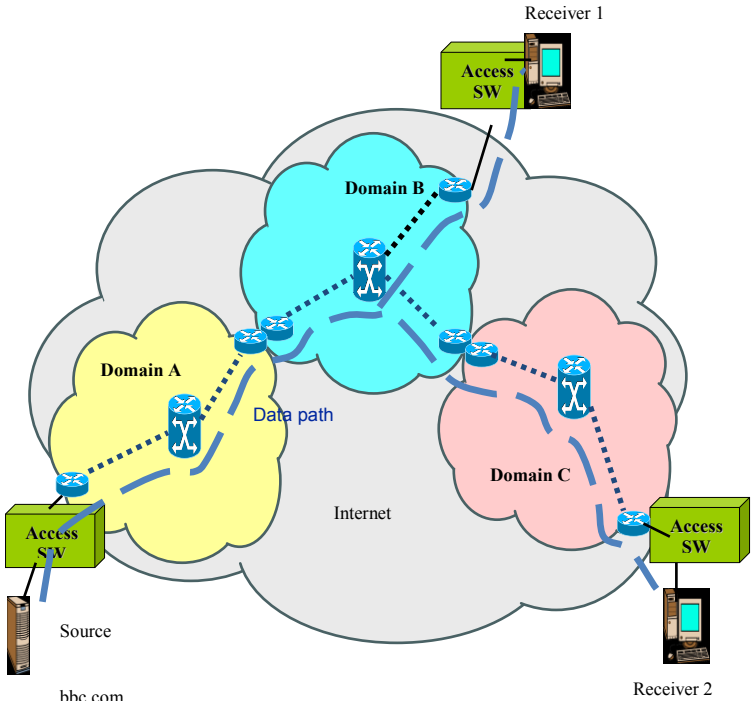


Figure .1 Internet Video Streaming

Upon the client's request, a streaming server retrieves compressed video/audio data from storage devices and then the application-layer QoS control module adapts the video/audio bit-streams according to the network status and QoS requirements [9][10][11]. After the

adaptation, the transport protocols packetize the compressed bit-streams and send the video/audio packets to the Internet [12][13][14]. Packets may be dropped or experience excessive delay inside the Internet due to congestion. For packets that are successfully delivered to the receiver, they first pass through the transport layers and then are processed by the application layer before being decoded at the video/audio decoder. With respect to the real-time transmission of video streams, the transmitting delay should be minimal. The high transmitting delay may cause the video packets not to been decoded. Adjustment of the bit rates of video stream is required for a reliable video transmission. To achieve synchronization between video and audio presentations, media synchronization mechanisms are required.

2. Taxonomy of Video Applications

There exist very diverse ranges of video communication. Video communication applications may be unicast, multicast, broadcast or anycast. The video may be pre-encoded (stored) or real- time encoded (e.g. videoconferencing applications). The communication channel may be static or dynamic, reserved or not, packet switched or circuit switched, may support some quality of service or may only provide best effort service. The specific properties of a video communication application strongly influence the design of the system. We continue by briefly discussing these properties.

2.1.1 Point-to-point, multicast, broadcast and anycast communications:

Probably the most popular form of video communication is one-to-many (basically one-to-all) communication or broadcast communication, where the most well-known example is broadcast television. Broadcast wastes bandwidth by sending the data to the whole network. It can also needlessly slow the performance of client machines because each client must process the broadcasted data whether or not the service is of interest. The main challenge for broadcasting is the scalability problem. Receivers may experience different channel characteristics, and the sender must cope with all the receivers. Another common form of communication is point-to-point or one-to-one communication, e.g. videophone and unicast video streaming over the Internet. In point -to-point communications, an important property is whether or not there is a back channel between the receiver and sender. If a back channel exists, the receiver can provide feedback to the sender which the sender can then use to adapt its processing. Unicast wastes bandwidth by sending multiple copies of the data. Another form of communication with properties that lie between point- to- point and broadcast is multicast. Multicast is a one-to-many communication, but it is not one-to-all as in broadcast. An example of multicast is IP- Multicast over the Internet. To communicate to multiple receivers, multicast is more efficient than multiple unicast connections (i.e. one dedicated unicast connection to each client), and overall multicast provides many of the same advantages and disadvantages as broadcast. The anycasting communication paradigm is designed to support server replications to easily select and communicate with the best server, according to some performance or policy criteria, in a group of content-equivalent servers.

2.1.2 Real-time encoding versus pre-encoded (stored) video

Video may be captured and encoded for real-time communication, or it may be pre-encoded and stored for later viewing. Interactive applications are one example of applications which require real-time encoding, e.g. videophone, video conferencing, or interactive games. In many applications video content is pre-encoded and stored for later viewing. The video may be stored locally or remotely. Examples of local storage include DVD and Video CD, and examples of remote storage include video-on-demand (VOD), and video streaming over the Internet (e.g. as provided by Real Networks and Microsoft). Pre-encoded video
has the advantage that it does not require a real-time encoding constraint, which enables more efficient encoding. On the other hand, it provides limited flexibility as, for example, the pre-encoded video can not be significantly adapted clients that support different display capabilities than that used in the original encoding.

2.1.3 Interactive versus Non-interactive Applications

Interactive applications have real-time data delivery constraints. The data sent has time bounded usefulness, after this time the received data is useless.
Various applications can be mapped onto axes of packet loss and one-way delay. The size and shape of the boxes provide a general indication of the limit of delay and information loss tolerable for each application class. The following classes of applications can be recognized:
- Interactive video applications. They need a few milliseconds of transfer delay such as conversational voice and video, interactive games, etc.
- Responsive video applications. Typically, these applications response in few seconds, so that human does not need to wait for a long time, such as voice and video messaging, transactions, Web, etc.
- Timely video application. The transfer delay can be about some second, such as streaming audio and video.
- Non-critical video application. The transfer delay is not a critical for those applications, such as audio and video download service. From loss point of view, we can find two types of applications:

- Error sensitive video applications such as highly compressed video.
- Error insensitive video applications such as non-compressed video.

The loss has a direct impact on the quality of the information finally presented to the user, whether it is voice, image, video or data. In this context, loss is not limited to the effects of bit errors or packet loss during transmission, but also includes the effects of any degradation introduced by media coding.

3. VIDEO TRANSMISIIN CHALLENGES

There are many different types of video transmission applications such as Video on Demand (VoD), real-time and near real-time video streaming and MMS. In addition video streams can be streamed with a one-to-one (i.e. Unicast) or one-to-many (i.e. Multicast/Broadcast). There is also a huge range of video content possible. For example, ask yourself what is a typical video clip? It is difficult even to characterize the characteristics of the content in terms of how much action and detail is contained in a video clip. Before video can be transmitted over the network, it must first be encoded. There are a huge number of ways in which video can be encoded – these include the choice of codec (i.e. MPEG-2, MPEG-4,

H.264, AVI, WMV etc.), the target bit rate, the frame rate, equalization parameter, the resolution and so on. The choice of these parameters will affect the delivery of the video on the network. Once the video has been encoded, it is then transmitted/streamed using a streaming server. The server can transmit the video in a number of ways using various transmission protocols and packetization schemes. The client periodically sends feedback to the server telling the server how much information has been received. The server uses this feedback to adapt the transmitted video stream so as to minimize the any negative effects of congestion in the network might have on the video stream. The ability of the server to optimally adapt the video stream depends on the frequency of the feedback and the relevance, usefulness, and accuracy of the feedback information [15][16]. There are a number of different techniques that can be used in the server to adapt the video quality including rate control, rate shaping, frame dropping, and stream switching. Finally, to add to the difficulties of video streaming, there are no accepted metrics to calculate video quality so as to correlate to the Human Visual System (HVS) or in other words human perception, e.g. PSNR, VQM, MPQM, PVQ etc [6]. There is a strong demand in modern societies for pioneering ICT services that will support modern social infrastructures. Emerging new techniques in the fields of wireless communication, network coding and video transmission, which can be used as a base for creating smart services that would serve people's everyday life in modern societies? Typical example of such services is video surveillance over wireless networks to support traffic monitoring, fire detection and real-time events (such as natural disasters) broadcasting for the societies of the smart cities , real time monitoring of patients in ICU.

4. VIDEO QUALITY EVALUATION

Several factors, such as network delay, packet loss etc., may lead to loss of video data that can distort the video sequence. Two types of methodologies have become popular that can measure the distortion: objective assessment and subjective assessment. We describe these approaches in the following text.

4.1 Objective Assessment

Objective Assessment methods use algorithms to measure the distortion in a given video sequence. These algorithms are fast and very easy to use [17] . Most of these algorithms require the original signal in order to compare it with the distorted signal. One of the most popular methods is to use the Peak Signal-to-Noise Ratio (PSNR) measure.

PSNR gives the distortion between the original and the processed (impaired) versions of a video sequence. Let's say that we have two sequences: S (original) and S′ (impaired). S(x, y, k) is the luminance of a pixel at position x, y in frame k from the original sequence and S′(x, y, k) is the luminance of a pixel at the corresponding position in the impaired version. The sequences are K frames long, the frame size is M * N pixels, and each pixel luminance is represented with 8 bits. The Mean Square Error is first obtained with the Equation.1.

$$MSE = \frac{1}{KMN}\sum_{k=1}^{K}\sum_{y=1}^{M}\sum_{x=1}^{N}[S(x,y,k) - S^{'}(x,y,k)]^2 \quad (1)$$

The MSE is the cumulative squared error between the original and the impaired images. A lower MSE means a smaller error. The PSNR is then computed with the following equation 2.:-

$$PSNR = 20\log_{10}\frac{255}{\sqrt{MSE}} \quad (2)$$

The unit of the PSNR is a decibel value (dB), 255 is the maximum possible pixel value of the image. When the pixels are represented using 8 bits per sample. Typical values for the PSNR image and video compression are between 30 and 50 dB, where higher is better. Acceptable values for PSNR are considered to be about 28 dB to 35 dB.

4.2 Subjective Assessment

Subjective assessment methods are supposed to be the best indicators of the video quality, for a video that will be watched by humans, because the assessment is done by real humans. In general a distorted sequence, in addition to the original sequence, is shown to the human subjects and they are asked to give a score to the sequence. Later, the scores from several subjects are statistically processed to give a mean score (the MOS or Mean Opinion Score) for that particular distorted sequence.

The ITU-R Recommendation (ITU-R, 2002) defines several standard methods and procedures for the subjective quality assessment of television pictures. One of the methods is called Double-Stimulus Impairment Scale (DSIS). In DSIS method, an assessor is first presented with the original video sequence, and then he is shown the distorted version. The assessor rates the degree of the impairment of the second image having the reference in mind. This is repeated with several pairs of sequences. The score for each sequence is taken from the impairment scale shown in Table 1.

Table 1 Impairment scale

Number Score	Impairment Scale	Quality of Scale
5	Imperceptible	Excellent
4	Perceptible, but not Annoying	Good
3	Slightly Annoying	Fair
2	Annoying	Poor
1	Very Annoying	Unsatisfactory

5. CONTENT DELIVERY CHOICE IMPLICATIONS

Each delivery technique has some inherent advantages and disadvantages. The selection of a means of delivery by training and education organizations should be primarily based on providing the best viewing experience to the learner as possible for a given instructional design. Familiarity with the various strengths and weaknesses of HTTP streaming, RTSP streaming, and CD content distribution methods are essential [18][19].

5.1 Streaming Quality

Between HTTP and RTSP streaming techniques, HTTP streaming usually permits content providers the ability to provide higher data rates. These higher data delivery rates permit higher quality files to be made available to viewers. The disadvantage of having the ability to support higher data delivery rates is the lengthy download times associated with the files. Additionally, viewers must be willing to wait for these files as well, often times needing a high-speed connection to endure the longer download times [20][21][22].

The HTTP streaming method guarantees the delivery of all of a given video files data, no matter how long it takes. The implication is there will be no dropped frames or

missing information data that will lead to picture quality degradation. With RSTP streaming, there is no guarantee for the complete delivery of data. Consequently, viewers may experience dropped frames, excessive pixilation of images, or "jerky" motions if the network cannot deliver all of the data on time. If the network becomes overly congested, viewers may be unable to view or hear all of the data intended for them. However, with RSTP streaming, viewers will experience what they do see at the intended time; similar to a broadcast. Depending on the type of training and education being offered, missing some of the data, some of the time, may become unacceptable from a learning perspective.

For best picture quality, the CD or DVD will provide the largest and richest quality pictures. Most of the streaming methods are designed to deliver a smaller picture, approximately 240 x 180, at 12 to 15 frames per second. Because there is no network transfer involved with a CD or DVD, picture quality can be as large as 720 x 480, at 30 frames per second. If picture quality of video multimedia is of paramount importance in the instructional design of a given the training and education module, then CDs and DVDs are the delivery means of choice.

5.2 File Size and Performance

For individual video files longer than five minutes, RTSP streaming is usually a better choice than HTTP streaming. When downloading larger files, HTTP streaming can present problems for viewer connecting to the network without a high speed connection. Additionally, those viewers lacking adequate hard drive storage space and system processor speeds on their local machines tend to be frustrated with HTTP streaming architectures. Simply, the files take too long to download and users become impatient waiting the video to play. With RTSP streaming, there is only a small "priming" file to download before the entire video file begins to play. Under an RTSP streaming architecture, viewers can easily fast forward ahead through a video file and only have to wait a few seconds until the video playback begins to play at the new start point. Such functionality is not possible with HTTP streaming. With HTTP streaming, viewers cannot randomly access portions of a particular clip without downloading the entire file first.

Both types of streaming are suitable depending on the instructional design of a given course. If the course is supported by videos that are most likely to be watched once, RTSP streaming is suitable. However, if it is anticipated that students will watch the video repeatedly, viewing the file on a CD or DVD will provide a more satisfying experience.

6. IEEE802.11E PERFORMANCE ANALYSIS FOR VIDEO TRANSMISSION

In this work, Networks were designed for non-real time traffic, like data are today being used to support real-time applications like Video streaming which are inherently different from data traffic. Video applications have very different requirements and characteristics compared to data traffic. Packet-loss affects the quality of video and degrades the user experience. End-to-end delay is also an important requirement, similar to that the throughput and bandwidth requirement is important. The traffic characteristics of the non-video flows were used in the simulations. The non-video flows were chosen to provide a mix of traffic types to compete in the medium & increase the network load since all the stations share the access to the same channel to evaluate the performance analysis.

In this Scenario, video is given higher priority that the other video traffics; Hence, video gets faster access to the medium.

Figure 2 shows the network topology used for the simulation experiments of the first and second scenario which is a single AP with thee traffic flows.

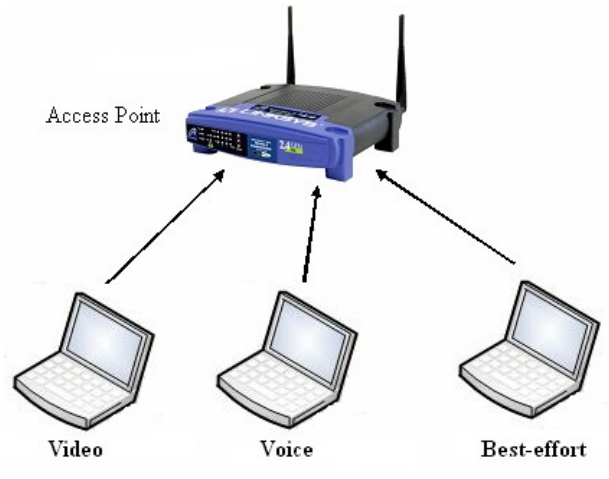


Figure 2 Three traffic flows

This scenario demonstrates three data flows. The number of mobile stations was increased from 3 to 15 to increase the network load. Three stations are added every simulation and each one of them transmits different data flow than others such as video, voice or best-effort data flow. This scenario is to calculate the throughput, delay and packet loss characteristics with the variation of number of stations.

For the second scenario is similar to the first one except that the number of mobile stations was increased from 3 to 9, there are 3 groups of stations with 3 stations each. The first group transmits video flow, while the second transmits voice flow, and the third transmits best-effort data flow. Relatively, delay and packet loss are calculated under the variation of the topology where the stations are moving from 100 to 1000 square meters. This is considered as a very difficult scenario and it may be used to design hotspots under different conditions. Table 2 shows the IEEE802.11e MAC parameters values used in the simulation for the two scenarios.

Table 2 IEEE802.11e MAC Parameters

Parameter	Value
Slot time	20 us
Beacon interval	100 ms
Fragmentation threshold	1024 Bytes
RTS threshold	500Bytes
SIFS	10 us
PIFS	40 us
DIFS	50 us
MSDU (Voice and Video)	60 ms
MSDU (data)	200 ms
Retry limit	7
TXOP limit	3428 us
CAP rate	21 us
CAP max	8000 us
CAP timer	5120 us

The number of mobile stations is increased from 3 to 15 with 3 stations at a time to increase the network load. As mentioned in the introduction of this simulation, every three QoS stations transmit three different types of flows (video, voice and best-effort data) to the same destination, which is the access point, and the PHY data rate is set 11 Mbps. Table 3 shows the simulation parameters used in the first & second scenario.

Table 3 Enhanced EDCA Simulation Parameters

Simulation Parameter	Video	Voice	Best effort
Transport Protocol	UDP	UDP	UDP
CW_{min}	3	7	15
CW_{max}	7	15	1023
AIFSN	1	2	3
Packet Size (bytes)	1028	160	1500
Packet Interval (ms)	10	20	12.5
Data rate (kbps)	822.40	64	960

All the simulation results are averaged over five simulations, with random starting time for each flow. There is a variation in the channel load by increasing the number of active QoS stations from 3 to 15 with 3 stations at a time. All stations are in the range of each other.

Table 4 shows the original IEEE802.11e parameters used in the first scenario & second scenario

Table 4 Original IEEE802.11e EDCA Simulation Parameters

Simulation Parameter	Video	Voice	Best-effort Data
CW_{min}	7	15	31
CW_{max}	15	31	1023
AIFSN	2	3	4

Results are based on the three basic performance metrics (Throughput, delay and packet loss) for the different access categories (video, voice and best-effort data). These metrics were selected due to their great effect on the IEEE802.11e performance for QoS support.

7. DEMONSTRATION RESULTS

In this section, a few simulation results of the two scenarios respectively as a comparative performance analysis of IEEE802.11e WLAN protocol are presented. These results include throughput, average end-to-end delay and packet loss. It also provides a detailed explanation of the behaviour of IEEE802.11e supported by graphs. The number of mobile stations is increased from 3 to 15 with 3 stations at a time to increase the network load. As mentioned in the introduction of this simulation, every three QoS stations transmit three different types of flows (video, voice and best-effort data) to the same destination, which is the access point, and the PHY data rate is set 11 Mbps. Table 4 shows the simulation parameters used in this scenario.

Table 4 Enhanced EDCA Simulation Parameters

Simulation Parameter	Video	Voice	Best effort
Transport Protocol	UDP	UDP	UDP
CW_{min}	3	7	15
CW_{max}	7	15	1023
AIFSN	1	2	3
Packet Size (bytes)	1028	160	1500
Packet Interval (ms)	10	20	12.5
Data rate (kbps)	822.40	64	960

All the simulation results are averaged over five simulations, with random starting time for each flow. There is a variation in the channel load by increasing the number of active QoS stations from 3 to 15 with 3 stations at a time. All stations are in the range of each other. Table 5 shows the original IEEE802.11e parameters used in this scenario.

Table 5 Original IEEE802.11e EDCA Simulation Parameters for the first & second scenario

Simulation Parameter	Video	Voice	Best-effort Data
CW_{min}	7	15	31
CW_{max}	15	31	1023
AIFSN	2	3	4

Results are based on the three basic performance metrics (Throughput, delay and packet loss) for the different access categories (video, voice and best-effort data). These metrics were selected due to their great effect on the IEEE802.11e performance for QoS support. The following analysis focuses the throughput results for the first scenario, which is shown in Figure 3.

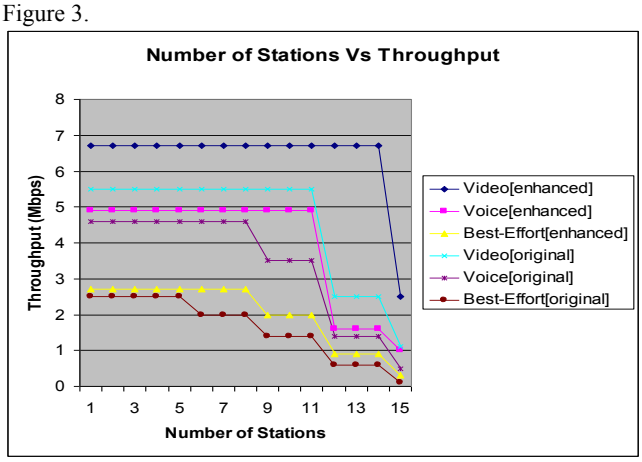


Figure 3 Effect of network load on throughput for different access categories (video, voice and best effort data) using original & enhanced EDCA values

The graph illustrates the effect of increasing the number of active QoS stations transmitting data to the access point on the throughput values for the three data flows. The sending rate in this simulation is 11 Mbps, while the CW_{min} and CW_{max} size and AIFSN values as stated in Table 4 &5. In comparison, Figure 3 illustrates the effect of increasing the number of active QoS stations transmitting data to the access point on the throughput values for the three data flows using IEEE802.11e standard (IEEE, 2003) CW size and AIFSN values shown in Table 5.

Enhanced CW size and AIFSN values provide better results considering the video and voice flows, this is clearly observed from Figure 3. In both cases, it is clearly seen from the graphs that IEEE802.11e provides service differentiation for different priorities when the system is heavily loaded by increasing the number of stations. When the number of stations is 3 or 6, all the data flows have equal channel capacity. However, in the case of 9, 12, and 15 stations, the channel is reserved for higher priority data flows. As explained in the beginning of this chapter, video flow has the highest priority among the others, while the best effort data flow has the lowest priority.

The average end-to-end delay is another important performance metric that should be taken into account. Figure 4 represent the results obtained from the simulations using the enhanced CW size and AIFSN values.

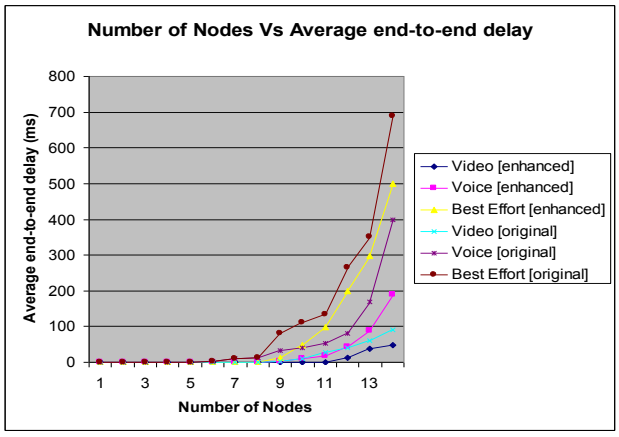


Figure 4 Effect of network load on the average end-to-end delay for different access categories (voice, video and best effort data) using original & enhanced EDCA values.

Figures 4 illustrate the effect of increasing the number of active QoS stations transmitting data to the access point on the average end-to-end delay values for the three data flows separately from source (mobile stations) to destination (access point). It was modified the first scenario so that all the stations transmit three types of data flows. The channel load was varied by increasing the number of active QoS stations from 1 to 14. The enhanced CW size and AIFSN values illustrates better performance with respect to the video and voice flows, but not for the best effort data flow. This is shown in Figure 5 when the active QoS stations are 11.

As comparison, Figure 6 similarly represents the simulation results using the CW size and AIFSN values in Table 5. These enhanced values provide better results than ours with respect to best effort data flow. Here, the main concern is to enhance the performance for Video flow.

Another important factor that has a great effect on the IEEE802.11e WLAN performance for QoS support is the packet drop and loss ratio. To calculate the number of packets dropped or lost in the transmission medium, we subtract the number of packet successfully received by the receiver (the access point in our case) from the total number of packets sent by the sender (mobile stations).

In Figure 5, illustrates the effect of increasing the number of active QoS stations on the packet drop and loss ratio. The network load was varied by 3 stations at a time sending three different data flows. In this simulation, is to compare the original with the enhanced IEEE802.11e parameters.

It is clearly observed from Figure 6 the service differentiation between the different data flows according to their priority levels. This difference appears more when the channel is heavily loaded by increasing the number of stations. For the best effort data flow, the packet drop starts when the number of stations is 3. That is due to the fact that best-effort data flow has the lowest priority. On the other hand, as the video flow is considered, the packet drop starts when the number of stations increases to 9.

This reflects the fact that video flow has the highest priority to reserve the channel when it is heavily loaded. The percentage of the packet drop reaches up to 82% for the maximum channel load considering the best effort data flow, while it reaches up to 19% for the video flow.

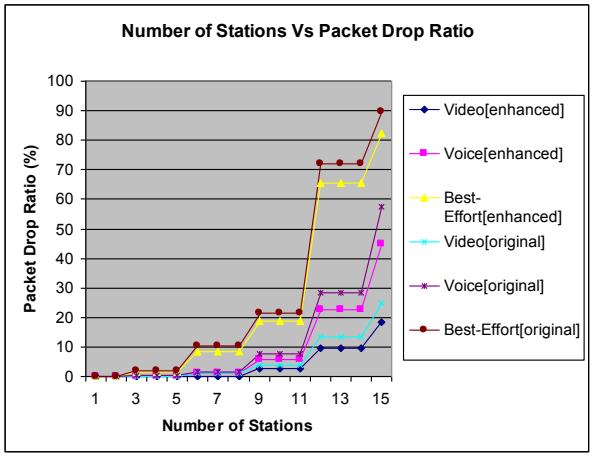


Figure 5 Effect of number of stations on the Packet drop ratio for different access categories (voice, video and best effort data) using original & enhanced EDCA values.

In fact, the system throughput is inversely proportional to the number of stations. And the number of stations is inversely proportional to the dropped and lost packets. In addition, packet drop has great effect on the network average end-to-end delay. Delay is directly proportional to the number of dropped packets.

8. CONCLUSION

Video transmission over wireless networks and the internet is a challenging task due to the stringent QoS required by video applications and also affected by many channel impairments. In this work, An Enhancement approaches of IEEE802.11e were presented. Different simulation scenarios such as average end-to-end delay, throughput and packet loss ratio to suite different environments under various conditions in performance analysis for MPEG-4 video transmission over WLANs were conducted. The level of performance such as

Packet loss, PSNR, Decodable Frame Rate (Q) were evaluated which shows better results for lower packet loss, higher Throughput, PSNR & Decodable Frame Rate (Q) for MPEG-4 video transmission over IEEE802.11e. The experimentation results have shown that MPEG-4 video streaming services performs well only when the SNR is above 30dB. However, the received video quality becomes unacceptable in 20 dB to 30 dB. Any traffic transmission will be easily denied when the SNR is below 20dB.

REFERENCES

[1] Vinod B Durdi, P. T. Kulkarni, and K. L. Sudha, Robust Video Transmission over Wireless Networks Using Cross Layer Approach" , Journal of Industrial and Intelligent Information Vol. 1, No. 2, June 2013:

[2] Kalvein Rantelobo, Wirawan, G. Hendrantoro, A. Affandi, and Hua-An Zhao, "A New Scheme for Evaluating Video Transmission over Broadband Wireless Network " , Future Wireless Networks and Information Systems, LNEE 143, pp. 335–341, Springerlink.com © Springer-Verlag Berlin Heidelberg 2012

[3] S.M. Koli, R.G. Purandare, S.P. Kshirsagar, and V.V. Gohokar, "A Survey on Video Transmission Using Wireless Technology ",CCSIT 2011, Part II, CCIS 132, pp. 137–147, Springer-Verlag Berlin Heidelberg 2011.

[4] Gopikrishnan.R , "An Efficient Real Time Video Multicasting Protocol and WLANs Cross-Layer Optimization in IEEE 802.11N ", IJCSMC, Vol. 3, Issue. 2, February 2014, pg.811 – 814

[5] S Kumar, Reactive and Proactive Routing Protocols for Wireless Mesh Network using Multimedia Streaming[A]. Proceedings of the International Conference on Recent Advances and Future Trends in Information Technology (iRAFIT 2012) (: International Journal of Computer Applications, Special Issue[C], 2012.

[6] T. Kim, "Scalable video streaming over internet", P h.D. Thesis, School of Electrical and Computer Engineering, Georgia Institute of Technology, Jan. 2005.

[7] D. Wu, Y. T. Hou, W. Zhu, Y.-Q. Zhang and J. M. Peha, "Streaming video over the internet: Approaches and directions," IEEE Trans. Circuits Syst. Video Technol., vol. 11, pp. 282–300, Mar. 2001.

[8] G. Conklin, G. Greenbaum, K. Lillevold, A. Lippman and Y. Reznik, "Video coding for streaming media delivery on the Internet," IEEE Trans. Circuits Syst. Video Technol., vol. 11, pp. 269–281, Mar. 2001.

[9] J.G. Apostolopoulos, W. Tan and S.J. Wee "Video Str eaming: Concepts, Algorithms, and Systems" Mobile and Media Systems L aboratory HP Laboratories Palo Alto, HPL-2002-260, Sept. 2002.

[10] F. Yang, Q. Zhang, W. Zhu and Y.Q. Zhang, "Bit Allo cation for Scalable Video Streaming over Mobile Wireless Internet", Infocom, 2004.

[11] F. Ziliani and J-C. Michelou, "Scalable Video Codin g in Digital Video Security", White paper, VisioWave, 2005.

[12] Y.-M. Hsiao, J.-F. Lee, J.-S. Chen, and Y.-S. Chu, "H.264 video transmissions over wireless networks: challenges and solutions," Computer Communications, vol. 34, no. 14, pp. 1661–1672, 2011. View at Publisher · View at Google Scholar · View at Scopus

[13] M. van der Schaar and N. S. Shankar, "Cross-layer wireless multimedia transmission: challenges, principles, and new paradigms," IEEE Wireless Communications, vol. 12, no. 4, pp. 50–58, 2005.

[14] Z. Han, G.-M. Su, A. Kwasinski, M. Wu, and K. J. R. Liu, "Multiuser distortion management of layered video over resource limited downlink multicode-CDMA," IEEE Transactions on Wireless Communications, vol. 5, no. 11, pp. 3056–3067, 2006. View at Publisher · View at Google Scholar · View at Scopus

[15] F. Fu and M. van der Schaar, "A systematic framework for dynamically optimizing multi-user wireless video transmission," IEEE Journal on Selected Areas in Communications, vol. 28, no. 3, pp. 308–320, 2010. View at Publisher · View at Google Scholar · View at Scopus

[16] F. Li, G. Liu, and L. He, "Cross-layer approach to multiuser H.264 video transmission over wireless networks," Journal of Multimedia, vol. 5, no. 2, pp. 110–117, 2010. View at Publisher · View at Google Scholar · View at Scopus

[17] D.-E. Meddour, A. Abdallah, T. Ahmed, and R. Boutaba, "A cross layer architecture for multicast and unicast video transmission in mobile broadband networks," Journal of Network and Computer Applications, vol. 35, no. 5, pp. 1377–1391, 2012. View at Publisher · View at Google Scholar · View at Scopus

[18] L. Superiori, M. Wrulich, P. Svoboda et al., "Content-aware scheduling for video streaming over HSDPA networks," in Proceedings of the 2nd International Workshop on Cross Layer Design (IWCLD '09), pp. 1–5, Palma de Mallorca, Spain, June 2009. View at Publisher · View at Google Scholar · View at Scopus

[19] A. Chan, H. Lundgren, and T. Salonidis, "Video-aware rate adaptation for MIMO WLANs," in Proceedings of the 19th IEEE International Conference on Network Protocols (ICNP '11), pp. 321–330, British Columbia, Canada, October 2011. View at Publisher · View at Google Scholar · View at Scopus

[20] J. Rexford, "Performance evaluation of smoothing algorithms for transmitting prerecorded variable-bit-rate video," IEEE Transactions on Multimedia, vol. 1, no. 3, pp. 302–312, 1999. View at Publisher · View at Google Scholar · View at Scopus

[21] A. Khalek, C. Caramanis, and R. Heath, "Video-aware MIMO precoding with packet prioritization and unequal modulation," in Proceedings of the 20th European Signal Processing Conference (EUSIPCO '12), pp. 1905–1909, Bucharest, Romania, August 2012.

[22] Ronak Dak, Dharm and Naveen Choudhary, A Technical Survey based on Secure Video Transmission Techniques, International Journal of Computer Applications.2014, Number 2, pp 19-23.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 351 - 354, 2015, ISSN:- 2319–8656

Frequent Data Mining in Data Publishing for Privacy Preservation

Sheikh Nargis Nasir
Matoshri COERC,
Nashik, India

Swati A. Bhawsar
Matoshri COERC,
Nashik, India

Abstract: Weighted frequent pattern mining is suggested to find out more important frequent pattern by considering different weights of each item. Weighted Frequent Patterns are generated in weight ascending and frequency descending order by using prefix tree structure. These generated weighted frequent patterns are applied to maximal frequent item set mining algorithm. Maximal frequent pattern mining can reduces the number of frequent patterns and keep sufficient result information. In this paper, we proposed an efficient algorithm to mine maximal weighted frequent pattern mining over data streams. A new efficient data structure i.e. prefix tree and conditional tree structure is used to dynamically maintain the information of transactions. Here, three information mining strategies (i.e. Incremental, Interactive and Maximal) are presented. The detail of the algorithms is also discussed. Our study has submitted an application to the Electronic shop Market Basket Analysis. Experimental studies are performed to evaluate the good effectiveness of our algorithm..

Keywords: Data Mining, Incremental mining, Interactive mining, Maximal mining, Support;

1. INTRODUCTION

Nowadays, many commercial applications have their data presented in the form of continuously transmitted stream, namely data streams. In such environments, data is generated at some end nodes or remote sites and received by a local system (to be processed and stored) with continuous transmission. It is usually desirable for decision makers to find out valuable information hidden in the stream. Data-stream mining [1][2] is just a technique to continuously discover useful information or knowledge from a large amount of running data elements. Apart from traditional databases, evolving data set has some special properties: continuous, unbounded, coming with high speed and time varying data distribution. Therefore, discovering knowledge from data streams masquerades some limitations as follows. First, traditional multi-scan algorithms are no more allowed on infinite data as it can't be stored. Second, the algorithm must be as fast as possible because of high arrival rate of the data; otherwise, the accuracy of mining results will be decreased. Third, the data distribution within the data streams should be kept to avoid concept drifting problem. Fourth, it needs incremental processes to process the existing data as less as possible.

On the other hand, the main problem exists in this work is that the actual profits of items are not considered. In many applications, such as e-business, this factor is often one of the most important factors for the results. To triumph over this problem, frequent pattern mining [3] emerges as a new research issue for discovering the itemsets with high weights, i.e., high profits. To discover useful information from data streams, we need not only efficient one-pass algorithms but also effective data summary techniques.

The remainder of this paper is organized as follows. In section 2, we describe motivation. In section 3, we develop our proposed technique weighted frequent pattern mining over data stream. In section 4, our experimental results are presented and analyzed. Lastly, in section 5, conclusions are drawn.

2. MOTIVATION

In the very beginning some weighted frequent pattern mining algorithms MINWAL [4], WARM [5], WAR[6] have been developed based on the Apriori Algorithm [7]. There are two main problems exist in relevant studies: (1) The utilities (e.g., importance or profits or weights) of items are not considered. Actual weights of patterns cannot be reflected in frequent patterns. (2) Existing weighted frequent pattern mining methods produce too many patterns and this makes it difficult for the users to filter useful patterns among the huge set of patterns. In examination of this, in this paper we proposed a framework, to find maximal high utility patterns from data streams.

Motivated by these real world scenarios, in this paper, we propose a tree based technique to mine weighted frequent patterns over data streams. It can discover useful recent knowledge from a data stream by using a single scan. Our technique exploits a tree growth mining approach to avoid level-wise candidate generation and test problem. Besides retail market data, our technique can be well applied for the area of mining weighted patterns. By considering different importance values for different items, our algorithm can discover very important knowledge about weighted frequent items in real time using only one scan of data stream. Downward closure property is used to prune the infrequent patterns [7].

Main contributions of this paper are as follows: (1) This is the first approach on mining the compact form of high utility patterns from data streams; (2) the proposed framework is an effective single-pass framework which meets the requirements of data stream mining; (3) It also generates patterns which are not only high utility but also maximal. This provides compact and intuitive hidden information in the data streams. An itemset is called maximal if it is not a subset of any other patterns [8].

3. TECHNIQUE USED:

An evolving dataset may have infinite number of transactions. A weighted support of pattern P is calculated over by multiplying its support with its weight. Therefore, pattern P is weighted frequent pattern if its weighted support is greater than or equal to the minimum threshold. For example, if minimum threshold is 3.0,"ab" is a weighted frequent pattern. Its weighted support is 4*0.55=2.2, which is greater than the minimum threshold. Let, X= (X1, X2, X3,....,Xm) Where, X is

pattern of item set, X ϵ I and k ϵ [1,m]. The weight of pattern (WT), P[X1,X2,X3,...,Xk] is given by:

$$\text{Weight}(P) = \frac{\sum_{q=1}^{\text{length}(P)} \text{Weight}(x_q)}{\text{length}(P)}$$

Our proposed technique consist of some preliminary steps like Generation of header table, Construction of tree structure, Calculate weighted support, pattern pruning and evaluation of maximal frequent patterns.

Initially, the database performs transactions according to the user choice viz; get transaction or remove transaction. Transactions are read one by one from a transaction database and insert it into the tree according to any predefined order. The header table gets updated according to weighted ascending order and frequency descending order simultaneously. Each entry in a header table explicitly maintains item-id, frequency and weight information for each item. Then, WFP mining takes into an account that generated weighted frequent item sets. The generated weighted frequent patterns are appended for the maximal weighted frequent itemset mining. Then, Vertical bitmap is maintained to keep the record of candidate patterns. It performs AND-ing operation on the items of transactions. lastly, the final output is generated from weighted frequent patterns i.e. Maximal weighted frequent pattens mining. The proposed work is divided into four major modules:

1. **Database Transaction:**

The weight of the items has to be taken into consideration so that the algorithm can be more effective in real world applications. The weight of the pattern is the average of the weight of the itemsets that constitute the pattern if the weighted support of the pattern is greater than or equal to the minimum threshold. Header table is generated to handle the item weights and frequency.

2. **Calculate Weighted Support:**

The value achieved when multiplying the support of a pattern with the weight of the pattern is the weighted support of that pattern. That is, given pattern P, the weighted support is defined as WSupport(P) = Weight(P)*Support(P). A pattern is called a weighted frequent pattern if the weighted support of the pattern is no less than the minimum support threshold.

3. **Pattern Pruning:**

If the value of Weighted Support is greater than or equal to the threshold, then it is considered as frequent pattern else pattern is pruned.

4. **Maximal Mining:**

From the resultant weighted frequent patterns, maximal weighted frequent patterns are extracted.

4. ALGORITHMIC STRATEGY:

When new transactions are inserted or deleted, the incremental algorithm is processed to update the discovered most frequent itemsets. These transactions can be partitioned into four parts according to whether they are high transaction-weighted utilization itemsets or not in the original database. Each part is then processed in its own procedure. A simple way of finding possible frequent itemsets is to mine frequent patterns from every possible transaction, and then calculate weighted support of the occurrences of these patterns. The details of the proposed incremental mining algorithm are described below.

4.1.1 Algorithmic Strategy to Implement Incremental Data Mining:

The important problem is extracting frequent item sets from a large uncertain database. Frequent patterns are interpreted by calculating the weighted support for each pattern under the weight and frequency of the item. This issue is technically challenging for an uncertain database which contains an exponential number of possible patterns. By observing that the mining process can be modeled as a Poisson binomial distribution, we develop an approximate algorithm, which can efficiently and accurately discover frequent item sets in a large uncertain database. We also study the important issue of maintaining the mining result for a database that is evolving (e.g., by inserting a transaction). Specifically, we implement incremental mining algorithms, which enable Probabilistic Frequent Item set (PFI) results to be refreshed. This reduces the need of re executing the whole mining algorithm on the new database, which is often more expensive and unnecessary.

Downward Closure Property:

The downward closure property [1] is used to prune the infrequent patterns. This property says that if a pattern is infrequent, then all of its super patterns must be infrequent. We can maintain the downward closure property by transaction weighted utilization. In this method a data structure, called prefix Tree, is introduced to maintain frequent item sets in evolving databases. Another structure, called conditional, arranges tree nodes in an order that is affected by changes in weighted support for candidate pattern. The data structure is used to support mining on a changing database. To our best knowledge, maintaining frequent item sets in evolving uncertain databases has not been examined before. Here, Static Algorithms do not handle database changes. Hence, any change in the database necessitates a complete execution of these algorithms.

Following are the input and output requirements for implementing this incremental data mining algorithm.

Input:

1. Database,
2. Weight Table,
3. Updated database,
4. Minimum threshold

Output:

1. Weighted Frequent Patterns

4.1.2 Algorithmic Strategy to Implement Interactive Data Mining:

The data structures of the existing frequent pattern mining algorithms do not have the "build once mine many" property. As a consequence, they cannot use their previous data structures and mining results for the new mining threshold. This property means that by building the data structure only once, several mining operations can be done for interactive mining. For example, if the algorithms presented in the previous works want to calculate which patterns cover 40% of the total profit, then their internal data structures are designed in such a way that they can only calculate the asked amount. If the amount is changed from 40% to 30% of the total profit, then they have to do the whole calculation from the very beginning. They cannot take any advantage from their previous design. They have shown that incremental prefix-tree structures are quite possible and efficient using currently available memory in the gigabyte range. In our real world, however, the users need to repeatedly change the minimum threshold for useful information extraction according to their application requirements. Therefore, the "build once mine many" property is essentially needed to solve these interactive mining problems.

Motivated by these real world scenarios, in this project, we presented a tree structure, called frequent pattern tree (or high utility stream tree) and an algorithm, called high utility pattern mining over stream data, for incremental and interactive weighted frequent pattern mining over data streams. By exploiting a pattern growth approach, this algorithm can successfully mine all the resultant patterns. Therefore, it can avoid the level-wise candidate generation-and-test problem completely and reduces a large number of candidate patterns. As a consequence, it significantly reduces the execution time and memory usage for stream data processing.

Input:

1. Database,
2. Weight Table,
3. Updated database,
4. Minimum threshold

Output:

1. Weighted Frequent Patterns

4.1.3 Algorithmic Strategy to Implement Maximal Weighted Frequent Pattern Mining:

In this Maximal Miner algorithm, a descending support or frequency count order method is used. A divide-and-conquer traversal paradigm is used to mine weighted FP-tree for mining closed weighted patterns in bottom-up manner. The Maximal frequent itemset tree is used to store so far found (global) maximal weighted frequent patterns. After mining the traversal transaction, the set of real maximal weighted frequent Patterns is generated. This is because weighted Maximal Mining carries out the maximal frequent pattern mining with weight constraints. This proposed approach can reduces search space effectively. As compared to other methods, FPmax method only does the maximal frequent pattern mining without weight constraints, its search space is larger than that of our algorithm. Following diagram shows the location maximal frequent itemsets in frequent itemsets and closed patterns.

In this algorithm, we use divide-and-conquer paradigm with a bottom-up pattern-growth method and incorporates the closure property with weight constrain to reduce effectively search space. This also includes anti-monotone property. The reason for that is weighted Maximal Mining has a weight constraint to reduce the search space than FPmax [27] which has not weight constraint. To reduce the calculation time, they have used bit vectors and TID-lists for each distinct item. But these lists become very large and inefficient when the numbers of distinct items and/or transactions become large.

Anti-monotone Property:

The main focus in weighted frequent pattern mining is on satisfying the anti-monotone property[27] since this property is generally broken when different weights are applied to different items. Even if a pattern is weighted as infrequent, its super patterns can be weighted as frequent since super patterns of a low weight pattern can receive a high weight after other items with higher weight are added.

Input:

1. Weight Table,
2. Frequent Patterns,
3. Minimum Threshold.

Output:

1. Maximal Weighted Frequent Patterns.

4.1.4 Mining Process:

Here, we develop scalable algorithms for finding frequent item sets (i.e., sets of attribute values that appear together frequently in tuples) for uncertain databases. Our algorithms can be applied to tuple or transactions uncertainty models. Here, every tuple or transaction is associated with a probability to indicate whether it exists. The frequent item sets discovered from uncertain data are naturally probabilistic, in order to reflect the confidence placed on the mining results.

5. EXPERIMENTAL RESULTS:

5.1 Experimental Environment & Datasets:

Experimentation is carried out on Customer purchase behaviors-supermarket basket databases. This synthetic dataset contain statistical information for predicting what a customer will buy in the future. The weight value associated with each item represents the chance that a customer may buy that item in the near future. These probability values may be obtained by analyzing the users' browsing histories. For instance, if customer visited the marketplace 10 times in the previous week, out of which video products were clicked five times, the marketplace may conclude that customer has a 50 percent chance of buying videos. Conceptually, a database is viewed as a set of deterministic instances (called possible patterns), each of which contains a set of items. To implement and test this system, we have used a market basket analysis- synthetic dataset in which various transactions are performed on the items of the market.

5.1.1 Observations of the system on sparse dataset:

Impact of Parameter Minimum Threshold (delta)

Following graph in the figure 5.1 is drawn by taking different minimum threshold values to the 15 number of transactions.

Analysis:

1. Time required by itemsets in frequency descending order is less than the time consumed by itemsets in weight ascending order.
2. As the threshold value increases, the run time required is decreases.

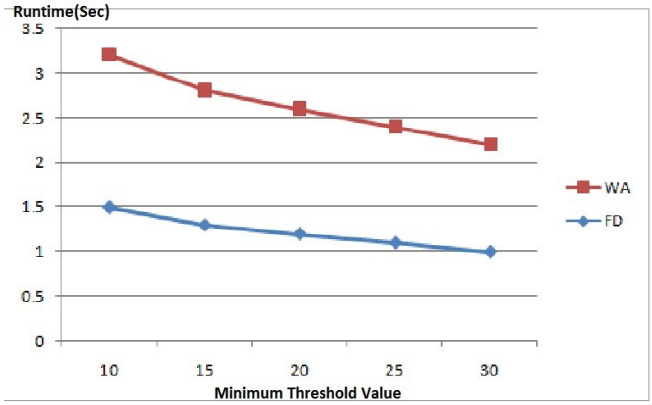


Figure 5.1 Impact of the No. of Transactions

Observations:

To observe the behavior of our proposed system under increased number of transactions, we applied a constant threshold value i.e. Threshold value = 40. Following graph is drawn from different number of transactions to the same input value, runtime is calculated. Figure 5.2: Impact of No. of transactions on efficiency

Analysis:

1. For any number of transactions, time required by the structure in weight ascending order is greater than the structure in frequency descending order.
2. As the number of transactions increases, the time required to execute transactions also increases.

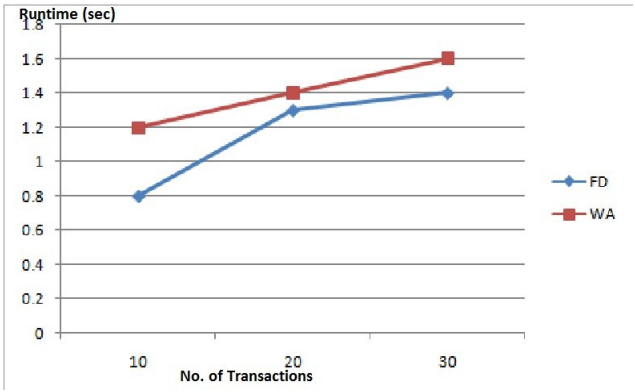


Figure 5.2 Impact of Modified Transactions

5.1.2 Comparison between Sorting Frequency in Descending Order and Weight in Ascending Order:

Analysis from Graph 1 and Graph 2:

1. IWFPTFD guarantees that non candidate item can't be passed in to the set of candidate patterns.
2. IWFPTFD creates tree structure from the candidate items generated from IWFPTWA. hence, speed up the tree creation process.
3. IWFPTED reduces memory space required to store items.
4. This speed up the overall time required to mine patterns.

Analysis:

1. When the newly discovered transactions are added to the existing dataset, existing tree structure in modified for the newly evolved transactions.
2. This reduces the processing overhead of the transactions.

Worst Case Scenario: When all the transactions are modified.

Best Case Scenario: When no transaction is modified.

6. CONCLUSION

The algorithm exploits two tree structures which employs weighted frequent pattern mining over data streams. The major objective of discovering recent weighted frequent patterns from uncertain database is fulfilled. By making use of efficient tree structure, our projected technique could capture newest data from a data stream. Since, it requires a single-pass of data stream for tree construction and mining operations. It is reasonably appropriate to apply maximal weighted frequent pattern mining algorithm to the operational database. The mining paradigm also prunes the unimportant patterns and reduces the size of the search space. We executed this work on synthetic dataset of Market Basket Analysis. The results show that our paradigm reduces the size required to search a frequently used patterns. Also, this could speed up the process to mine weighted frequent patterns.

7. REFERENCES

[1] Bifet, A., Holmes, G., Pfahringer, B., & Gavaldà, R. (2011). Mining frequent closed graphs on evolving data streams. In Proceedings of the 17th ACM SIGKDD conference on Knowledge Discovery and Data Mining (KDD 2011), San Diego, CA, USA (pp. 591–599).

[2] Cheng, J., Ke, Y., & Ng, W. (2008). A survey on algorithms for mining frequent itemsets over data streams. Knowledge and Information Systems, 16(1), 1–27.

[3] Agrawal, R., & Srikant, R. (1994). Fast algorithms for mining association rules. In Proceedings of the 20th international conference on very large data bases (pp. 487– 499).

[4] C. H. Cai, A.W. fu, C. H. Cheng and W. W. Kwong,"mining association rules with weighted items".Proc of int. database engineering and application symposiums, IDEAS 98,pp 68-7,Cardiff, Wales, UK, 1998.

[5] F. Tao,"Weighted association rules using weighted support and significant framework", Proc. Ninth ACM SIGKDD Int. conference on knowledge discovery and data mining,pp 661-666, 2003.

[6] W. Wang and J. Yang and P.S. Yu,"WAR: Weighted association rules for item intensities", Knowledge Information and Systems , vol 6, pp 203-229, 2004.

[7] Agrawal, R., Imielin´ ski, T., Swami, A. (1993). Mining association rules between sets of items in large databases. In Proceedings of the 12th ACM SIGMOD international conference on management of data, May (pp. 207–216).

[8] Gouda, K., & Zaki, M. J. (2001). Efficiently mining maximal frequent itemsets. In Proceedings of the IEEE international conference on data mining (ICDM), San Jose (pp. 163–170).

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 355 - 358, 2015, ISSN:- 2319–8656

Test-Case Optimization Using Genetic and Tabu Search Algorithm in Structural Testing

Tina Belinda Miranda
Department of Computer Science and Engineering
Panimalar Institute of Technology, Chennai, India

M. Dhivya
Department of Computer Science and Engineering
Panimalar Institute of Technology, Chennai, India

K. Sathyamoorthy
Department of Computer Science and Engineering
Panimalar Institute of Technology, Chennai, India

Abstract-- Software test-case generation is the process of identifying a set of test cases. It is necessary to generate the test sequence that satisfies the testing criteria. For solving this kind of difficult problem there were a lot of research works, which have been done in the past. The length of the test sequence plays an important role in software testing. The length of test sequence decides whether the sufficient testing is carried or not. Many existing test sequence generation techniques uses genetic algorithm for test-case generation in software testing. The Genetic Algorithm (GA) is an optimization heuristic technique that is implemented through evolution and fitness function. It generates new test cases from the existing test sequence. Further to improve the existing techniques, a new technique is proposed in this paper which combines the tabu search algorithm and the genetic algorithm. The hybrid technique combines the strength of the two meta-heuristic methods and produces efficient test- case sequence.

***Keywords*:** Test sequence, testing criteria, test case generation, genetic algorithm, tabu search algorithm.

1. INTRODUCTION

Software engineering is a discipline concerned with all aspects of software right from development to its retirement.[18] Software testing plays a prime role in software development life cycle[7]. It is aimed at discovering the faults in software to provide software quality. In white box testing it is necessary to design a set of test cases that satisfy testing criteria[9]. A test case executes software with a set of input values and then compares the expected output with the obtained output to see whether the test has passed or failed. In this paper we focus on branch coverage. As software testing consumes about 50% of software development effort, test data generation plays an important role[8].

Various approaches for test data generations have been developed. These can be classified into three broad categories: random, static and dynamic techniques. Some of the dynamic methods of test data generation using meta-heuristic techniques treat testing problem as search space or optimization problem. Due to the difficulty and complexity in the testing process, these techniques have to search a large space. Some of the meta-heuristic techniques suffer from the problems of local optimum, when software testing is done.

The solution that is best within neighboring space and not globally is local optimal solution. The search algorithms have a tendency to converge immaturely to local optimum. Because of this, test data generated will not satisfy the testing criteria. Particularly, Genetic algorithm has problems like slow convergence, blind search and risk of getting stuck into local optimum solution.

This paper analyzes test-sequence generation technique based on genetic and tabu search algorithms. Genetic algorithm generates new test data from previously generated good candidates. The tabu search is added to the mutation step of genetic algorithm to reduce the time of search.

The rest of this paper is organized as follows: The Section 2 deals with the related work. The Section 3 deals with the search algorithm. The Section 4 deals with the proposed solution. Section 5 deals with the experimental validation. The section 6 deals with the conclusion.

2. RELATED WORK

There are many search based meta heuristic algorithms that have been proposed to generate the test data. The main characteristic of meta heuristics is to find better solutions at each step by adjusting the sub solutions. Genetic algorithm is an important population-based algorithm. The way in which genetic algorithm was applied to testing the object-oriented software was done by Tonella[4]. A population of test sequences was evolved using evolutionary techniques. The main disadvantage of the paper was that in case of complex conditions in the code the evolutionary search was reduced to random search. Later many researchers used the genetic algorithm for test data generation. Ahmed used the genetic algorithm to generate the test data when path coverage was used as the test criteria[1]. This method covered more paths in one run thus improving structural coverage. The basic concepts of tabu search algorithm were explained by Glover [2]. The main concept of Tabu search to reduce the cost by providing maximum structural coverage. Many researchers used the tabu search algorithm for lot scheduling problems.

3. SEARCH ALGORITHM

There are several search algorithms. A search algorithm will not find a global optima in a fair amount of time. Therefore, it is common to put premature stopping criteria based on the available computational resources. In this paper two search algorithms are analyzed.

Genetic Algorithm:

Genetic algorithm is a famous meta-heuristic search based algorithm [10]. It has been demonstrated that the test cases generated by genetic algorithm are more efficient than the random search algorithm. Genetic algorithm generates new test data from already generated good candidates. This algorithm is inspired by Darwin's Theory. The algorithm uses evaluation, selection, crossover point and the mutation operators to generate new test cases from the existing test sequence. The evaluation procedure measures the fitness of each individual solution also known as chromosome in the population and assigns a value based on the optimizing criterion. The selection procedure selects individuals randomly in the current population for development of the next generation. The selection procedure chooses the individual solutions to be recombined and mutated out of the initial population. Recombination procedure reproduces the selected individuals and exchanges the information for generating new individuals. The information that is exchanged is called crossover. The crossover procedure chooses the two selected individuals and then combines them, thereby creating two new individuals. Mutation creates a small change to newly created individual. The resulting individuals are then evaluated through the fitness function. The fitness procedure measures how well chromosome satisfies the testing criteria. These concepts have been explained earlier in[5,6].

```
Choose population N uniformly at random
    from S(l)
While global optimum not found
Copy best a solutions from N to
N' While N' is not completely
filled
Select 2 parents from N according to selection
criterion
Generate two offspring that are same as their
parents
Apply crossover on
offspring Mutate each
offspring
Copy the 2 new offspring into
N' N=N'.
```

Pseudo code of Genetic Algorithm

There is an issue in using the genetic algorithm for generation of test cases because it suffers from problems like slow convergence, blind search and the risk of getting stuck to the local optimum solution. Local optimum is a solution that is best within the neighboring space but not globally.

Tabu Search Algorithm:

Tabu search is a meta heuristic approach which is used to solve the optimization problems[2,3]. It is designed in such a way to guide other methods to move away from the local optima. It provides memory to avoid falling into the local optima.

The main characteristics of Tabu Search are its flexible memory structure which is designed so that criteria as well the information regarding the search are exploited thoroughly. Tabu maintains two different types of memory a short term memory and the long term memory. The recent moves are captured in the short term memory and the related moves are captured in the long term memory. The intensification and the diversification strategies help the search process to give optimal results. The intensification strategies help to reinforce previous solutions that are found good. And the diversification strategies help to search new areas that have not been explored earlier. To avoid getting stuck in the local optima or searching the same solution, a list is created to maintain the most recently visited solutions. This list is called as the tabu list. The tabu list consists of a set of forbidden moves to prevent cycling and avoids getting stuck to the local optima. The tabu search will search for better solutions until the testing criteria are met.

```
Create an intial solution n
While the stopping criteria is not met
  Create a set of solutions K that are
the neighbors of n and that are not in
   tabu list
Choose a best solution n* in K
Update the tabu list based on
n*
Let n=n*
End
```

Pseudo code for Tabu Search Algorithm

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 355 - 358, 2015, ISSN:- 2319–8656

4. PROPOSED SOLUTION

A test suite is used to test the software. There is an issue in selecting the appropriate test cases for testing. The inappropriate and redundant test case selection will increase the test sequence length. The genetic algorithm suffers from local optima, in order to avoid this situation; The hybrid algorithm is proposed which is a combination of the genetic algorithm and the tabu search algorithm. The tabu search algorithm is added to the mutation step of genetic algorithm to reduce the randomness and the execution time of search and this enhances the quality of the end result. The genetic algorithm is used initially and its result is passed to the tabu search algorithm and this deals with repeated individuals by forbidding it from being chosen. This helps in generating new individuals in the next generation which is not present in the tabu list.

Initially a group of test cases are generated. Then a set of test cases are selected randomly. The selected test cases are set as the population size. Recursively select a number of best solutions from the population size. Then select two parent test cases according to the selection criteria. Generate two offspring that are the replica of their parents. Use crossover on the offspring with specified probability. Then mutate the offspring based on the long term and short term tabu list in order to avoid the unwanted new offspring generation. Then generate new offspring and put into the solution. This gives the optimized test sequence.

1. Generate Random Test cases and set population size
2. Define the Initial Population Size called PopSize
3. Generate the Random Population Set to represent the possible test sequences

   Define Fitness Function called Maximum Coverage
4. For i=1 to MaxIterations
   [Repeat Steps 6 to 10]
5. Select two Random Parents called P1 and P2 from Population Set
6. Perform crossover to generate new Child
7. Perform Mutation Operation Child=Mutation (Child) using tabu search list
8. Population=Population U Child
9. Return Optimized Test Sequence

5. EXPERIMENTAL VALIDATION

To evaluate the performance of this algorithm an experiment was conducted to analyze the test suite. Initially a sample voter validation form was created and then structural testing had to be done. So, a set test cases were generated for the form. Then the genetic algorithm was used to optimize the test cases.

There after the same experiment was carried out using the proposed hybrid algorithm and similarly the test cases were optimized . And then by comparing the test cases produced by genetic algorithm and hybrid algorithm it was found that test cases produced by the hybrid algorithm was more efficient than the test cases produced by the genetic algorithm.

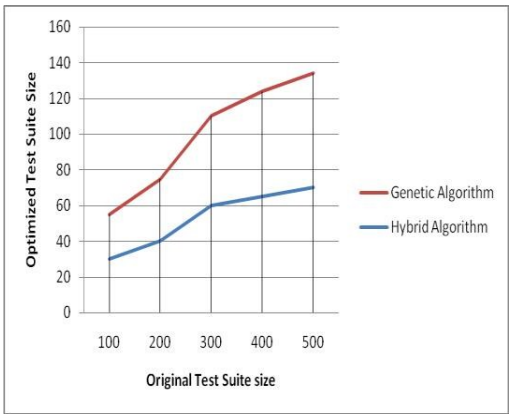


Fig.1. Test Suite size versus Optimized Test Suite Size

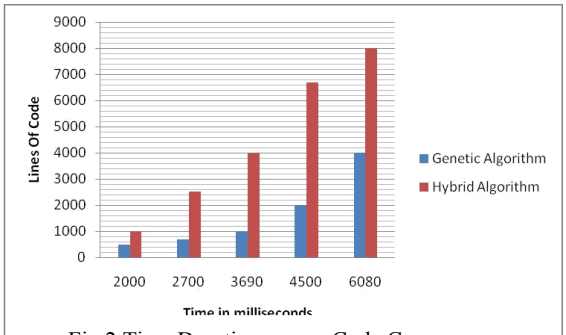


Fig.2.Time Duration versus Code Coverage

6. CONCLUSION

In this paper we have the analyzed the way in which the genetic algorithm and the tabu search algorithm are used for optimizing the test cases.

The disadvantages of the genetic algorithm are analyzed, the problem of getting stuck in the local optima are overcome by using the hybrid algorithm. The Hybrid algorithm proposed in this paper generates the test cases that satisfies the given test criteria. The results of optimized test case and statistical data support claim that this algorithm performs better than other related strategies.

7. REFERENCES

[1] Ahmed, M.A. and I. Hermadi, "GA-based multiple paths test data generator," Computers and Operations Research, 2008. 35(10): p. 3107-3124.

[2] F. Glover and M. Laguna, “Tabu Search,” Kluwer Academic Publishers, 1997.

[3] F. Glover, “Tabu Search Part I,” *ORSA Journal on Computing*, Vol. 1, No. 3, 1989, pp. 190-206.

[4] Tonella, P, "Evolutionary testing of classes," ACM SIGSOFT Software Engineering Notes.Boston, MA, United states: Association for Computing Machinery, p.119-128, 2004.

[5] B Jones et al. “Automatic Structural Testing Using Genetic Algorithms”, Software Engineering Journal, Vol.11, No.5, 1996.

[6] P McMinn, “Search-Based Software Test Data Generation: A Survey”, Software Testing, Verification and Reliability, Vol.14, No.2, pp. 105—156, 2004.

[7] I. Sommerville, “Software Engineering, Pearson Education,”7th Edition, Tata Mc-Graw Hill, India, 2005.

[8] B. Beizer, “Software Testing Techniques,” 2nd Edition,van Nostrand Reinhold, New York, 1990.

[9] G. Myers. *The Art of Software Testing.* Wiley, New York, 1979.

[10] M. Harman, S.A. Mansouri, and Y. Zhang,“Search Based Software Engineering: A Comprehensive Analysis and Review Of Trends Techniques and Applications,”Technical Report TR-09-03, King’s College, 2009.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 359 - 367, 2015, ISSN:- 2319–8656

Object Oriented Software Testability (OOST) Metrics Analysis

Pushpa R. Suri
Department of Computer Science and Applications, Kurukshetra University, Kurukshetra -136119, Haryana, India

Harsha Singhani
Institute of Information Technology & Management (GGSIPU), Janak Puri, New Delhi -110058, India

Abstract: One of the core quality assurance feature which combines fault prevention and fault detection, is often known as testability approach also. There are many assessment techniques and quantification method evolved for software testability prediction which actually identifies testability weakness or factors to further help reduce test effort. This paper examines all those measurement techniques that are being proposed for software testability assessment at various phases of object oriented software development life cycle. The aim is to find the best metrics suit for software quality improvisation through software testability support. The ultimate objective is to establish the ground work for finding ways reduce the testing effort by improvising software testability and its assessment using well planned guidelines for object-oriented software development with the help of suitable metrics.

Keywords: Software Testability, Testability Metrics, Object Oriented Software Analysis, OO Metrics

1. INTRODUCTION

The testing phase of the software life-cycle is extremely cost intensive 40% or more of entire resources from designing through implementation to maintenance are often spent on testing[1].This is due to the enlargement of software scale and complexity, leading to increasing testing problems. A major means to solve these problems is making testing easier or efficient by improving the software testability. Software testability analysis can help developing a more test friendly testable applications. Software testability analysis helps in quantifying testability value. Test designers can use this value to calculate the test cases number that is needed for a complete testing [2]. Software designers can use these values to compare different software components testability, find out the software weakness and improve it and project managers can use the value to judge the software quality, determine when to stop testing and release a program[3].

The purpose of this paper is to examine the software testability measurement metrics at various stages of software development life cycle in object oriented system. The study is done to analyze various OO metrics related to testability and study the literature for various other techniques and metrics for evaluation of testability at design and analysis phase as well as at coding and implementation phase respectively. The study is done because metrics are a good driver for the investigation of aspects of software. The evaluation of these metrics has direct or indirect impact on the testing effort and thus, it affects testability. So, by this study we would be able to serve two objectives: (1) Provide practitioners with information on the available metrics for Object Oriented Software Testability, if they are empirically validated (from the point of view of the practitioners, one of the most important aspects of interest, i.e., if the metrics are really fruitful in practice), (2) Provide researchers with an overview of the current state of metrics for object oriented software testability (OOST) from Design to Implementation phase, focusing on the strengths and weaknesses of each existing proposal. Thus, researchers can have a broad insight into the work already done.

Another aim of this work is to help reveal areas of research either lacking completion or yet to undertaken. This work is organised as follows: After giving a brief overview of software testability in section 2, the existing proposals of OO metrics that can be applied to OO software presented is in Section 3. Section 4 presents an overall analysis of all the proposals. Finally, Section 5 presents some concluding remarks and highlights the future trends in the field of metrics for object oriented software testability.

2. SOFTWARE TESTABILITY

Software Testability as defined by IEEE standards [4] as: "(1) Degree to which a system or component facilitates the establishment of test criteria and the performance of tests to determine whether those criteria have been met. (2) The degree to which a requirement is stated in terms that permit establishment of test criteria and the performance of tests to determine whether those criteria have been met."

Thus, Testability actually acts as a software support characteristic for making it easier to test. As stated by Binder and Freedman a Testable Software is one that can be tested easily, systematically and externally at the user interface level without any ad-hoc measure [5][6]. Whereas [2] describe it as complimentary support to software testing by easing down the method of finding faults within the system by focussing more on areas that most likely to deliver these faults. The insight provided by testability at designing, coding and testing phase is very useful as this additional information helps in product

quality and reliability improvisation [7][8]. All this has lead to a notion amongst practitioners that testability should be planned early in the design phase though not necessarily so. As seen by experts like Binder it involves factors like controllability and observability i.e. ability to control software input and state along with possibility to observe the output and state changes that occur in software. So, overall testable software has to be controllable and observable[5].But over the years more such quality factors like understandability, traceability, complexity and test–support capability have contributed to testability of a system[3].All these factors make testability a core quality factor.

Hence, over the years Testability has been diagnosed as one of the core quality indicators, which leads to improvisation of test process. Several approaches as Program Based , Model Based and Dependability Testability assessment for Testability estimation have been proposed [9]. The studies mostly revolve around the measurement methods or factors affecting testability. We would take this study further keeping focus on mainly object oriented system. As object oriented technology has become most widely accepted concept by software industry nowadays. But testability still is a taboo concept not used much amongst industry mainly due to lack of standardization, which may not be imposed for mandatory usage but just been looked upon for test support[10].

3. SIGNIFICANT OBJECT ORIENTED METRICS USED FOR TESTABILITY ASSESSMENT

Over the years a lot of OO design and coding metrics have been adopted or discussed by research practitioners for studying to be relevantly adopted in quantification of software testability. Most of these metrics are proposed by Chidamber and Kemerer [11], which is found to be easily understandable and applicable set of metrics suite. But along with that there are other metrics suites also available such as MOOD metrics suite [12].These metrics can be categorized as one of the following object oriented characteristic metrics- Size, Encapsulation, Polymorphism, Coupling, Cohesion, Inheritance and Complexity. Along with that from testability perspective, which is the main motive of study, we have discussed few important UML diagram metric suite too. So, now we present those OO metrics selected for consideration and that may best demonstrate the present-day context of metrics for OOST:

I. CK Metrics Suite [11],[1]

CK Metrics suite contains six metrics, which are indicative of object oriented design principle usage and implementation in software.

i. ***Number of Children (NOC):*** It is a basic size metrics which calculates the no of immediate descendants of the class. It is an inheritance metrics, indicative of level of reuse in an application. High NOC represents a class with more children and hence more responsibilities.

ii. ***Weighted Method per class (WMC):*** WMC is a complexity metrics used for class complexity calculation. Any complexity measurement method can be used for WMC calculation most popular amongst all is cyclomatic complexity method[13]. WMC values are indicators of required effort to maintain a particular class. Lesser the WMC value better will be the class.

iii. ***Depth of Inheritance Tree (DIT):*** DIT is an inheritance metrics whose measurement finds the level of inheritance of a class in system design. It is the length of maximum path from the node to the root of the hierarchy tree. It is a helps in understanding behaviour of class, measuring complexity of design and potential reuse also.

iv. ***Coupling between Objects (CBO):*** This is a coupling metrics which gives count of no of other classes coupled to a class, which method of one class using method or attribute of other class. The high CBO indicates more coupling and hence less reusability.

v. **Lack of Cohesion Metrics (LCOM)**: It is a cohesion metrics which measures count of methods pairs with zero similarity minus method pairs with non zero similarity. Higher cohesion values lead too complex class bringing cohesion down. So, practitioners keep cohesion high by keeping LCOM low. LCOM was later reformed as LCOM* by Henderson-Sellers [14] and used in few researches.

vi. **Response for a class (RFC):** RFC is the count of methods implemented within a class. Higher RFC value indicates more complex design and less understandability. Whereas, lower RFC is a sign of greater polymorphism. Hence, it is generally categorized as complexity metrics.

II. HS Metric Suite[14]

i. **Line of Code (LOC) or Line of Code per Class (LOCC):** It is a size metrics which gives total no of lines of code (non comment & non blank) in a class.

i. **Number of Classes (NC / NOC):** The total number of classes.

ii. **Number of Attributes (NA / NOA)**: The total number of attributes.

ii. **Number of Methods (NM / NOM)**: The total number of methods

iii. **Data Abstraction Coupling (DAC):** The DAC measures the coupling complexity caused by Abstract Data Types (ADTs)

iv. **Message Passing Coupling (MPC):** number of send statements defined in a class

v. **Number of Overriden Methods (NMO):** defined as number of methods overridden by a subclass.

III. **MOOD Metrics Suite** [12][1]

Metrics for object oriented design (MOOD) metrics suite consists of encapsulation (MHF, AHF), inheritance (MIF, AIF), polymorphism (POF) and coupling metrics (COF). This model was based on two major features of object oriented classes i.e. methods and attributes. Each feature is either hidden or visible from a given class. Each metrics thus calculates values between lowest (0%)-highest (100%) indicating the absence or presence of a particular feature. The metrics are as follows:

i. **Method Hiding Factor (MHF):** This metric is computed by dividing the methods hidden to the total methods defined in the class. By this an estimated encapsulation value is generated. High value indicates more private attribute and low value indicates more public attributes.

ii. **Attribute Hidden Factor (AHF):** It shows the attributes hidden to the total attributes defined in the class. By this an estimated encapsulation value is generated.

iii. **Method Inheritance Factor (MIF):** This metrics is the sum of all inherited methods in a class. Low value indicates no inheritance.

iv. **Attribute Inheritance Factor (AIF):** This is ratio of sum of all inherited attributes in all classes of the system. Low value indicates no inherited attribute in the class.

v. **Polymorphism Factor (POF):** This factor represents the actual number of possible polymorphic states. Higher value indicates that all methods are overridden in all derived classes.

vi. **Coupling Factor (COF):** The coupling here is same as CBO. It is measured as ratio of maximum possible couplings in the system to actual number of coupling. Higher value indicates rise in system complexity as it means all classes are coupled with each other thus increasing hence reducing system understandability and maintainability along with less reusability scope.

IV. **Genero's UML Class Diagram Metrics Suite** [15]

iii. **Number of Associations (NAssoc):** The total number of associations

iv. **Number of Aggregation (NAgg) :** The total number of aggregation relationships within a class diagram (each whole-part pair in an aggregation relationship)

v. **Number of Dependencies (NDep):** The total number of dependency relationships

vi. **Number of Generalisations (NGen):** The total number of generalisation relationships within a class diagram (each parent-child pair in a generalisation relationship)

vii. **Number of Aggregations Hierarchies (NAggH):** The total number of aggregation hierarchies in a class diagram.

viii. **Number of Generalisations Hierarchies (NGenH):** The total number of generalisation hierarchies in a class diagram

ix. **Maximum DIT:** It is the maximum between the DIT value obtained for each class of the class diagram. The DIT value for a class within a generalisation hierarchy is the longest path from the class to the root of the hierarchy.

x. **Maximum HAgg:** It is the maximum between the HAgg value obtained for each class of the class diagram. The HAgg value for a class within an aggregation hierarchy is the longest path from the class to the leaves.

xi. **Coupling Between Classes (CBC):** it is same as CBO.

V. **MTMOOD Metrics** [16]**:**

i. **Enumeration Metrics (ENM)**: it is the count of all the methods defined in a class.

ii. **Inheritance Metrics (REM):** it is the count of the number of class hierarchies in the design.

iii. **Coupling Metrics (CPM):** it is the count of the different number of classes that a class is directly related to.

iv. **Cohesion Metrics (COM):** This metric computes the relatedness among methods of a class based upon the parameter list of the methods [computed as LCOM, 1993 Li and Henry version]

VI. **Other Important OO Metrics:**

Apart from above mentioned metrics there are few other significant structural as well as object oriented metrics which have been significantly used in testability research:

i. **No of Object(NOO)** [14]: which gives the number of operations in a class

ii. **McCabe Complexity Metrics**[13] **Cyclomatic Complexity (CC):** It is equal to the number of decision statements plus one. It predicts the scope of the branch coverage testing strategy. CC gives the recommended number of tests needed to test every decision point in a program.

iii. **Fan-out (FOUT)**[17]: FOUT of any method A is the number of local flows

from method A plus the number of data structures which A updates. In other words FOUT estimates the number of methods to be stubbed, to carry out a unit testing of method A.

VII. Test Class Metrics:

These test class metrics used for the study actually correlate the various testability affecting factors identified through above metrics with testing effort required at unit testing or integration testing level in object oriented software's. Few of these metrics are TLOC/TLOCC (Test class line of code), TM(no of test methods), TA/TAssert (no of asserts/test cases per class), NTClass(no of test classes), TNOO (test class operation count), TRFC(test class RFC count), TWMC(test class complexity sum)[18], [19]. The metrics are calculated with respect to the unit test class generated for the specific module. These metrics are analytically correlated with specific metrics suite for analysing testing effort required at various testing level by many researchers.

4. SOFTWARE TESTABILITY MEASUREMENT SURVEY

Software testability measurement refers to the activities and methods that study, analyze, and measure software testability during a software product life cycle. Unlike software testing, the major objective of software testability measurement is to find out which software components are poor in quality, and where faults can hide from software testing. Now these measurements can be applied at various phases during software development life cycle of a system. In the past, there were a number of research efforts addressing software testability measurement. The focus of past studies was on how to measure software testability at the various development phase like Design Phase[5][20]–[22][8], [23] and Coding Phase[24][25] [26][18]. Quite recently there has been some focus on Testing & Debugging Phase also[27][28]. These metrics are closely related to the Software quality factors i.e. Controllability, Observability, Built in Test Capability, Understandability and Complexity, all these factors are independent to each other. All these measurement methods specifically from object oriented software systems perspectives are discussed below in brief in coming sections. Our work is the extension of work done by Binder[5] and Bousquet [29] along with giving a framework model for testability implementation during object oriented software development using testability metrics support in upcoming papers.

4.1 Metrics Survey at Design & Analysis Phase

Early stage software design improvisation techniques have highly beneficial impact on the final testing cost and its efficiency. Although software testability is most obviously relevant during testing, but paying attention to testability early in the development process can potentially enhance testing along with significantly improving testing phase effectiveness. Binder was amongst few of the early researchers who proposed design by testability concept [5] which revolved around a basic fishbone model for testability with six main affecting factors though not exactly giving any clear metrics for software design constructs, as all these factors namely Representation , Implementation , Built In Test, Test Suite, Test Tool & Test process are related to higher level abstraction. But his work highlighted some of the key features such as controllability, observability, traceability, complexity, built in test and understandability which were later used & identified as critical assessment attributes of testability. He identified various metrics from CK metric suite [11] and McCabe complexity metrics [13] which may be relatively useful for testability measurement. Later lot of work has been done focussed around Binders theory and lot of other new found factors for testability measurement. Voas and Miller [30] [31] also spoke about some factors but mainly in context with conventional structured programming design. Below is the brief description of major contributions made by researchers in the direction of software testability metrics in past few years.

Binder,1994 [5] suggested few basic popular structural metrics for testability assessment from encapsulation, inheritance, polymorphism, and complexity point of view to indicate complexity, scope of testing or both under all above mentioned features. The effect of all complexity metrics indicated the same: a relatively high value of the metric indicates decreased testability and relatively low value indicates increased testability. Scope metrics indicated the quantity of tests: the number of tests is proportional to the value of the metric.
Binder's work which was based on Ck metric suite along with few other object oriented metrics under review has been kept as benchmark during many studies found at later stages. The study and reviews did not lead to concrete testability metrics but laid a ground work for further assessment and analysis work.

McGregor & Srinivas, 1996 [32] study elaborated a Testability calculation technique using visibility component metrics. The proposed method used to estimate the effort that is needed to test a class, as early as possible in the development process by assessing the testability of a method in a class. Testability of a method into the class depends upon the visibility component as elaborated below:

- Testability of method is **Tm=k *(VC),** Where visibility component **(VC = Possible Output / Possible Input)** and
- Testability of the class is **Tc=min(Tm)**

The visibility component (VC) has been designed to be sensitive to object oriented features such as inheritance, encapsulation, collaboration and exceptions. Due to its role in early phases of a development process the VC calculations require an accurate and complete specification of documents.

Khan & Mustafa,2009 [16] proposed a design level testability metrics name Metrics Based Testability Model for Object Oriented Design (MTMOOD), which was calculated on the basis of key object oriented features such as encapsulation, Inheritance, coupling and cohesion. The models ability to

estimate overall testability from design information has been demonstrated using six functionally equivalent projects where the overall testability estimate computed by model had statistically significant correlation with the assessment of overall project characteristics determined by independent evaluators. The proposed testability metrics details are as follows:

- ***Testability= -0.08 * Encapsulation + 1.12 * Inheritance + 0.97 * Coupling***

The three standard metrics used for incorporating above object oriented features mentioned in the equation were ENM, REM & CPM respectively as explained in section 2. The proposed model for the assessment of testability has been validated by author using structural and functional information from object oriented software. Though the metrics is easy but is very abstract, it does not cover major testability affecting features of any object oriented software in consideration such as cohesion , polymorphism etc.

Khalid et. al. ,2011 [33] proposed five metrics model based on CK metrics suite[11] and MTMOOD[16] for measuring complexity & testability in OO designs based on significant design properties of these systems such as encapsulation, inheritance and polymorphism along with coupling & cohesion. These metrics are: AHF, MHF, DIT, NOC, and CBC, as explained in section 2. With findings that High AHF and MHF values implies less complexity and high testability value making system easy to test. On the other hand DIT, NOC and CBC are directly proportional to complexity as higher values of any of these will increase system complexity making it less testable and hence making system more non test friendly.

Nazir Khan,2013[34]–[36] did their research from object oriented design perspective. The model proposed was on the basis of two major quality factors affecting testability of object oriented classes at design level named- understandability and complexity. The measurement of these two factors was established with basic object oriented features in other research [34], [35] The metrics used for the assessment of these two factors were based on Genero metrics suite [15] as well as some basic coupling , cohesion and inheritance metrics.

- Understandability = 1.33515 + 0.12*NAssoc + 0.0463*NA + 0.3405*MaxDIT
- Complexity = 90.8488 + 10.5849*Coupling - 102.7527*Cohesion + 128.0856*Inheritance
- **Testability = - 483.65 + 300.92*Understandability - 0.86*Complexity**

Where the coupling, cohesion and Inheritance was measured using CPM, COM, INM metrics as explained in section 2. The Testability metrics was validated with very small scale C++ project data. Thus the empirical study with industrial data needs to be performed yet. Though the model found important from object oriented design perspective but lacked integrity in terms of complete elaboration of their study considering the frame work provided [37] by them. Also, not much elaborative study was conducted on complexity and understandability correlation establishment with basic object oriented features.

4.2 Metrics Survey at Coding & Implementation Phase

The metrics study at source code level has gained more popularity in the industry for planning and resource management. Generally the metrics used at this level is not for code improvisation but rather to help systems identify hidden faults. So, basically here the metrics is not for finding alternatives to a predefined system but for establishing relation between source code factors affecting testability in terms of test case generation factors, test case affecting factors etc. as noticed by Bruntink and others [38].

Voas & Miller 1992 [2], [7], [39] concentrated their study of testability in the context of conventional structured design. The technique is also known as PIE technique. PIE measurement helps computing the sensitivity of individual locations in a program, which refers to the minimum likelihood that a fault at that location will produce incorrect output, under a specified input distribution. The concept here is of execution, infection and propagation of fault within the code and it outputs.

- **Testability of a software statement T(s) = Re(s) ∗ Ri(s) ∗ Rp(s)**

Where, Re(s) is the probability of the statement execution, Ri(s) the probability of internal state infection and Rp(s) the probability of error propagation. PIE analysis determines the probability of each fault to be revealed. PIE original metric requires sophisticated calculations. It does not cover object-oriented features such as encapsulation, inheritance, polymorphism, etc. These studies were further analysed by many researchers [40] with many extensions and changes proposed to basic PIE model [41] .

Voas & Miller,1993 [42]proposed a simplification model of sensitivity analysis with the Domain-Range Ratio (DRR). DRR of a specification is defined as follows:

- **Domain-Range Ratio (DRR) =** it is defined as the ratio **d / r**, where d is the cardinality of the domain of the specification and r is the cardinality of the range
- **Testability =inversely proportional to (DRR).** It was found as the DRR of the intended function increases, the testability of an implementation of that function decreases. In other words, high DRR is thought to lead to low testability and vice versa.

DRR depends only on the number of values in the domain and the range, not on the relative probabilities that individual elements may appear in these sets.DRR evaluates application fault hiding capacity. It is a priori information, which can be considered as a rough approximation of testability. This ratio was later reformed and named dynamic range–to-domain ratio (DRDR)[43].Which is a inverse ratio of DRR and determined dynamically to establish a link between the testability and DRDR, the results were though not influential.

Bainbridge 1994[Bainbridge 1994] propose testability assessment on flow graphs. In this two flow graph metrics were defined axiomatically:

- ***Number of Trails*** metric which represents the number of unique simple paths through a flow graph (path with no repeated nodes),
- ***Mask*** [k=2] metric, which stands for "Maximal Set of K-Walks", where a k-walk is a walk through a flow graph that visits no node of the flow graph more than k times. Mask reflects a sequence of increasingly exhaustive loop-testing strategies.

These two metrics measure the structural complexity of the code. One of the main benefits of defining these testability metrics axiomatically is that flow graphs can be measured easily and efficiently with tools such as QUALMS.

Yeh & Lin,1998 [44] proposed two families of metrics in their research to evaluate the number of elements which has to be covered with respect to the data-flow graph testing strategies respectively :testable element in all- paths, visit-each-loop-paths, simple paths, structured, branches, statements, and to develop a metric on the properties of program structure that affect software testability.

- **8 testable elements:** no of non comment code lines(NCLOC), p-uses(PU), defs(DEFS), uses(U), edges(EDGE), nodes(NODE), d-u-paths(D_UP) and dominating paths(PATH). As per definition, all those metrics used for normalized source code predict the scope of the associated testing strategies.
- **Testability Metrics**: The testability of each of these factors is calculated individually by taking inverse of the factor value. Thus giving an idea of testing effort required for individual codes.

The model focussed on how to measure software testability under the relationships between definitions and references (uses) of variables that are the dominant elements in program testing. The proposed model represents a beginning of a research to formalize the software testability. This metric can be practiced easily because only a static analysis of the text of a program is required.

Jungmayr 2002 [45] study was basically on metrics based on software dependencies and certain system testability metrics. The study was based on four metrics required to analyse component testability from dependency perspective. Such dependencies called test-critical dependencies were identified and their impact was evaluated on overall testability. To automate the identification of test-critical dependencies a prototype tool called ImproveT. The Metrics used for the analysis were:

- **Average Component Dependency (ACD):** It is the total count of component dependency by total no of components in the system.
- **No of Feedback Dependency (NFD):** It is the total number of feedback dependency.
- **Number of Stubs to Break Cycles (NSBC):** It is the total number of stubs required to break cycles.
- **No of Component within Dependency Cycles (NCDC):** It is the total number of components within all dependency cycles.
- **Reduction metrics r(d)** – These metrics were further reduced in percentile form and named **rACD, rNFD, rNSBC, rNCDC**. These reduction metrics which are themselves not highly correlated were then studied for system structure, class coupling, etc. and other perspectives.

It was found in the research that smaller metric values mean better testability for all metrics described above. The approach was helpful in identifying design and test problems.

Bruntink 2003[19], [38] used various metrics based on source code factors for testability analysis using dependency of test case creation and execution on these factors. The number of test cases to be created and executed is determined by source code factors as well as the testing criterion. In many cases, the testing criterion determines which source code factors actually influence the number of required test cases. The testability was not directly quantified tough, but the results were influential in other research studies.

- The nine popular design metrics DIT, FOUT, LCOM, LOCC, NOC, NOF, NOM, RFC, and WMC from CK metrics suite [11] were identified and considered for analysing their impact on test case generation.
- dLOCC, dNOTC were the two proposed test suite metrics for analysing the effect of above metrics in test case construction.

The research resulted in finding the correlation between source code metrics themselves like LOCC & NOM and DIT & NOC. Also there is a significant correlation between class level metrics (most notably FOUT, LOCC, and RFC) and test level metrics (dLOCC and dNOTC). Though there was no quantification of testability as such but based on Binders theory of testability and factors which were studied further in this paper. Hence the study on source code factors: factors that influence the number of test cases required to test the system, and factors that influence the effort required to develop each individual test case, helped giving testability vision, which further need refinement.

Nguyen & Robach, 2005[46] focussed on controllability and observability issues. Testability of source code is measured in terms of controllability and observability of source data flow graph which was converted to ITG (Information Transfer graph) and further to ITN(Information transfer net) using SATAN tool. Basically the no of flows within these graphs and diagrams highlighted the scope of testability effort calculation by finding couple value of controllability and observability metrics.

- $\mathbf{TE_F(M)= (CO_F(M),OB_F(M))}$, the paired metrics for testability effort estimation for a module.
- $\mathbf{CO_F(M)}$=$T(I_F;I_M)$ / $C(I_M)$ denoted controllability, where $T(I_F;I_M)$ is the maximum information quantity that module M receives from inputs I_F of flow F and $C(I_M)$ is the total information quantity that module M would receive if isolated
- $\mathbf{OB_F(M)}$= $T(O_F;O_M)$ / $O(I_M)$ denoted observability measure of module M in flow graph. Where,

$T(O_F;O_M)$ is the maximum information quantity that the outputs of flow F may receive from the outputs O_M of module M and $C(O_M)$ is the total information quantity that module M can produce on its outputs.

The relative case study showed the testability effort of few flows was (1, 1) which is ideal for testing and for few flows (1, 0.083) which indicates low observability. The SATAN tool used can be used for flow analysis at design as well as code level.

Gonzalez 2009 [47] worked for Runtime testability in component based system with mainly two issues test sensitivity, and test isolation. Where test sensitivity characterises which operations, performed as part of a test, interfere with the state of the running system or its environment in an unacceptable way and Test isolation techniques are the means test engineers have of preventing test operations from interfering with the state or environment of the system. The Runtime testability thus is defined

- **$RTM=M_r / M^*$** where M^* is a measurement of all those features or requirements which are to be tested we want to test and M_r be the same measurement but reduced to the actual amount of features or requirements that can be tested at runtime.

It was found in the study that amount of runtime testing that can be performed on a system is limited by the characteristics of the system, its components, and the test cases themselves. Though the evaluation of accuracy of the predicted values and of the effect of runtime testability on the system's reliability was not yet established, but the study was useful from built in test capability of systems whether object oriented or component, which surely effects testability.

Singh & Saha (2010) [48]did empirical study to establish relation between various source code metrics from past [11][14] and test metrics proposed by [19] and others. The study was conducted on large Java system Eclipse. The study showed a strong correlation amongst four test metrics and all the source code metrics (explained briefly in section 2), which are listed below:

- Five Size Metrics: LOC, NOA, NOM, WMC and NSClass.
- Three Cohesion Metrics: LCOM, ICH and TCC
- Three Coupling Metrics: CBO, DAC, MPC, & RFC
- Two Inheritance Metrics: DIT & NOC.
- One Polymorphism Metrics: NMO
- Four Test Metrics : TLOC, TM, TA & NTClass

The study showed that all the observed source code metrics are highly correlated amongst themselves. Second observation was that, the test metrics are also correlated. The size metrics are highly correlated to testing metrics. Increase in Software Size, Cohesion, Coupling, Inheritance and Polymorphism metrics values decreases testability due to increase in testing effort.

M. Badri et. al.,2011 [18] study was based on adapted model MTMOOD proposed by [16], at source code level named as MTMOOP. They adapted this model to the code level by using the following source code metrics: NOO [14], DIT and CBO [11]. Using these three source code metrics they proposed a new testability estimation model. The model was empirically verified against various test class metrics of commercial java systems. The proposed testability metrics was:

- **Testability = -0.08*NOO + 1.12*DIT + 0.97*CBO**
- Five Test Class Metrics Used: TLOC, TAssert, TNOO, TRFC, TWMPC

The basic purpose was to establish the relationship between the MTMOOP model and testability of classes (measured characteristics of corresponding test classes).The result showed positive correlation between the two.

Badri et. al.,2012 [49], [50] further did study, which was basically to identify the relationship between major object oriented metrics and unit testing. Along with that they also studied the impact of various lack of cohesion metrics on testability at source code level from unit testing point of view using existing commercial java software's with junit test class. The cohesion metrics and other object oriented metrics used for the study were explained in section 2 already are listed below:

- Three Cohesion metrics: LCOM, LCOM* and LCD
- Seven object oriented metrics: CBO, DIT, NOC, RFC, WMC, LCOM, LOC
- Two Test class metrics used: TAssert , TLOC

The study performed at two stages actually showed significant correlation between the observed object oriented metrics and test class metrics.

5. CONCLUSION

This paper analysed and surveyed the role of various object oriented metrics in software testability. The purpose was to increase the basic understanding of testability evaluation and quantification techniques for object oriented systems using various researched metrics based on popular OO metrics suits. We mainly wanted to survey the existing relevant work related to metrics for object oriented software testability at various stages of software development, providing practitioners with an overall view on what has been done in the field and which are the available metrics that can help them in making decisions in the design as well as implementation phases of OO development. This work will also help researchers to get a more comprehensive view of the direction that work in OO testability measurement is taking.

During the study we found out the number of existent measures that can be applied to object oriented software at initial design stage is low in comparison with the large number of those defined for coding or implementation phase. What we found is that despite of all the efforts and new developments in research and international standardization during the last two decades, there is not a consensus yet on the concepts, techniques and standard methods used in the field of software testability. This, in turn, may serve as a basis for discussion from where the software engineering community can start paving the way to future agreements.

6. REFERENCES

[1] R S Pressman, *Software Engineering*. McGraw-Hills, 1992.

[2] J. M. Voas and K. W. Miller, "Software Testability : The New Verification," pp. 187–196, 1993.

[3] J. Fu, B. Liu, and M. Lu, "Present and future of software testability analysis," *ICCASM 2010 - 2010 Int. Conf. Comput. Appl. Syst. Model. Proc.*, vol. 15, no. Iccasm, 2010.

[4] IEEE, "IEEE Standard Glossary of Software Engineering Terminology (IEEE Std 610.12-1990)," 1990.

[5] R. V Binder, "Design For Testabity in Object-Oriented Systems," *Commun. ACM*, vol. 37, pp. 87–100, 1994.

[6] R. S. Freedman, "Testability of software components -Rewritten," *IEEE Trans. Softw. Eng.*, vol. 17, no. 6, pp. 553–564, 1991.

[7] J. M. Voas and K. W. Miller, "Improving the software development process using testability research," *Softw. Reliab. Eng. 1992. ...*, 1992.

[8] D. Esposito, "Design Your Classes For Testbility." 2008.

[9] M. Ó. Cinnéide, D. Boyle, and I. H. Moghadam, "Automated refactoring for testability," *Proc. - 4th IEEE Int. Conf. Softw. Testing, Verif. Valid. Work. ICSTW 2011*, pp. 437–443, 2011.

[10] J. W. Sheppard and M. Kaufman, "Formal specification of testability metrics in IEEE P1522," *2001 IEEE Autotestcon Proceedings. IEEE Syst. Readiness Technol. Conf. (Cat. No.01CH37237)*, no. 410, pp. 71–82, 2001.

[11] S. R. Chidamber and C. F. Kemerer, "A Metrics Suite for Object Oriented Design," *IEEE Trans. Softw. Eng.*, vol. 20, no. 6, pp. 476–493, 1994.

[12] A. Fernando, "Design Metrics for OO software system," *ECOOP'95, Quant. Methods Work.*, 1995.

[13] T. J. McCabe and C. W. Butler, "Design complexity measurement and testing," *Commun. ACM*, vol. 32, no. 12, pp. 1415–1425, 1989.

[14] B. Henderson and Sellers, *Object-Oriented Metric*. New Jersey: Prentice Hall, 1996.

[15] M. Genero, M. Piattini, and C. Calero, "Early measures for UML class diagrams," *L'Objet 6.4*, pp. 489–515, 2000.

[16] R. A. Khan and K. Mustafa, "Metric based testability model for object oriented design (MTMOOD)," *ACM SIGSOFT Softw. Eng. Notes*, vol. 34, no. 2, p. 1, 2009.

[17] S. Henry and D. Kafura, "Software structure metrics based on information flow," *IEEE Trans. Softw. Eng.*, vol. 7, no. 5, pp. 510–518, 1981.

[18] M. Badri, A. Kout, and F. Toure, "An empirical analysis of a testability model for object-oriented programs," *ACM SIGSOFT Softw. Eng. Notes*, vol. 36, no. 4, p. 1, 2011.

[19] M. Bruntink, "Testability of Object-Oriented Systems : a Metrics-based Approach," Universiy Van Amsterdam, 2003.

[20] S. Jungmayr, "Testability during Design," pp. 1–2, 2002.

[21] B. Pettichord, "Design for Testability," *Pettichord.com*, pp. 1–28, 2002.

[22] E. Mulo, "Design for testability in software systems," 2007.

[23] J. E. Payne, R. T. Alexander, and C. D. Hutchinson, "Design-for-Testability for Object-Oriented Software," vol. 7, pp. 34–43, 1997.

[24] Y. Wang, G. King, I. Court, M. Ross, and G. Staples, "On testable object-oriented programming," *ACM SIGSOFT Softw. Eng. Notes*, vol. 22, no. 4, pp. 84–90, 1997.

[25] B. Baudry, Y. Le Traon, G. Sunye, and J. M. Jézéquel, "Towards a ' Safe ' Use of Design Patterns to Improve OO Software Testability," *Softw. Reliab. Eng. 2001. ISSRE 2001. Proceedings. 12th Int. Symp.*, pp. 324–329, 2001.

[26] M. Harman, A. Baresel, D. Binkley, and R. Hierons, "Testability Transformation: Program Transformation to Improve Testability," in *Formal Method and Testing, LNCS*, 2011, pp. 320–344.

[27] S. Khatri, "Improving the Testability of Object-oriented Software during Testing and Debugging Processes," *Int. J. Comput. Appl.*, vol. 35, no. 11, pp. 24–35, 2011.

[28] A. González, R. Abreu, H.-G. Gross, and A. J. C. van Gemund, "An empirical study on the usage of testability information to fault localization in software," in *Proceedings of the ACM Symposium on Applied Computing*, 2011, pp. 1398–1403.

[29] M. R. Shaheen and L. Du Bousquet, "Survey of source code metrics for evaluating testability of object oriented systems," *ACM Trans. Comput. Log.*, vol. 20, pp. 1–18, 2014.

[30] J. M. Voas, "Factors that Affect Software Testability," 1994.

[31] B. W. N. Lo and H. Shi, "A preliminary testability model for object-oriented software," *Proceedings. 1998 Int. Conf. Softw. Eng. Educ. Pract. (Cat. No.98EX220)*, pp. 1–8, 1998.

[32] J. McGregor and S. Srinivas, "A measure of testing effort," in *Proceedings of the Conference on Object-Oriented Technologies, USENIX Association*, 1996, vol. 9, pp. 129–142.

[33] S. Khalid, S. Zehra, and F. Arif, "Analysis of object oriented complexity and testability using object oriented design metrics," in *Proceedings of the 2010 National Software Engineering Conference on - NSEC '10*, 2010, pp. 1–8.

[34] M. Nazir, R. A. Khan, and K. Mustafa, "A Metrics Based Model for Understandability Quantification," *J. Comput.*, vol. 2, no. 4, pp. 90–94, 2010.

[35] M. Nazir, "An Empirical Validation of Complexity Quatification Model," *Int. J. Adv. Res. Comput. Sci. Softw. Eng.*, vol. 3, no. 1, pp. 444–446, 2013.

[36] M. Nazir and K. Mustafa, "An Empirical Validation of Testability Estimation Model," *Int. J. Adv. Res. Comput. Sci. Softw. Eng.*, vol. 3, no. 9, pp. 1298–1301, 2013.

[37] M. Nazir, R. A. Khan, and K. Mustafa, "Testability Estimation Framework," *Int. J. Comput. Appl.*, vol. 2, no. 5, pp. 9–14, 2010.

[38] M. Bruntink and A. Vandeursen, "Predicting class testability using object-oriented metrics," in *Proceedings - Fourth IEEE International Workshop on Source Code Analysis and Manipulation*, 2004, pp. 136–145.

[39] J. M. Voas, L. Morell, and K. W. Miller, "Predicting where faults can hide from testing," *IEEE Softw.*, vol. 8, pp. 41–48, 1991.

[40] Z. a. Al-Khanjari, M. R. Woodward, and H. A. Ramadhan, "Critical Analysis of the PIE Testability Technique," *Softw. Qual. J.*, vol. 10, no. April 1998, pp. 331–354, 2002.

[41] J.-C. Lin and S. Lin, "An analytic software testability model," in *Proceedings of the 11th Asian Test Symposium, 2002. (ATS '02).*, 2002, pp. 1–6.

[42] J. M. Voas, K. W. Miller, and J. E. Payne, "An Empirical Comparison of a Dynamic Software Testability Metric to Static Cyclomatic Complexity," 1993.

[43] Z. a. Al-Khanjari and M. R. Woodward, "Investigating the Relationship Between Testability & The Dynamic Range To Domain Ratio," *AJIS*, vol. 11, no. 1, pp. 55–74, 2003.

[44] P.-L. Yeh and J.-C. Lin, "Software testability measurements derived from data flow analysis," in *Proceedings of the Second Euromicro Conference on Software Maintenance and Reengineering*, 1998, pp. 1–7.

[45] S. Jungmayr, "Testability measurement and software dependencies," 2002.

[46] T. B. Nguyen, M. Delaunay, and C. Robach, "Testability Analysis of Data-Flow Software," *Electron. Notes Theor. Comput. Sci.*, vol. 116, pp. 213–225, 2005.

[47] A. González, É. Piel, and H.-G. Gross, "A model for the measurement of the runtime testability of component-based systems," in *IEEE International Conference on Software Testing, Verification, and Validation Workshops, ICSTW 2009*, 2009, pp. 19–28.

[48] Y. Singh and A. Saha, "Predicting Testability of Eclipse: Case Study," *J. Softw. Eng.*, vol. 4, no. 2, pp. 122–136, 2010.

[49] L. Badri, M. Badri, and F. Toure, "An empirical analysis of lack of cohesion metrics for predicting testability of classes," *Int. J. Softw. Eng. its Appl.*, vol. 5, no. 2, pp. 69–86, 2011.

[50] M. Badri, "Empirical Analysis of Object-Oriented Design Metrics for Predicting Unit Testing Effort of Classes," *J. Softw. Eng. Appl.*, vol. 05, no. July, pp. 513–526, 2012.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 368 - 373, 2015, ISSN:- 2319–8656

Military Networks by Disruption Tolerant Network Technology

K.V Srikanth
Dept. Of C.S.E.
Bharath University
Chennai, India

B.Aravindsamy
Dept. Of C.S.E.
Bharath University
Chennai, India

S.Pothumani
Dept. Of C.S.E.
Bharath University
Chennai, India

Abstract*:* Mobile nodes in military environments like a field of battle or a hostile region ar seemingly to suffer from intermittent network property and frequent partitions. Disruption-tolerant network (DTN) technologieshave become eminent solutions that enable wireless devices carried by troopers to speak with one another and access the guidance or command faithfully by exploiting secondary storage nodes.a number of the foremost difficult problems during this state of affairs ar the social control of authorization policiesand also the policies update for secure information retrieval. Ciphertext- policy attribute-based secret writing (CP-ABE) could be a promising cryptologic resolution to the access management problems. However, the matter of applying CP-ABE in suburbanised DTNs introduces many security and privacy challenges with respect to the issued fromtotally different authorities. during this paper, we have a tendencyto propose se- cure information retrieval theme victimization CP-ABE for suburbanised DTNs wherever multiple key authorities manage their attributes severally. we have a tendency to demonstrate a way to apply the projected mechanism and with efficiency manage confidential information distributed within the disruption-tolerant military network.

Keyworsds: DTN- Disruption tolerant network, CP-ABE- Cipher text-Policy Attribute-Based Encryption, IBE- Identity Based Encryption2 PC-Protocol To Protocol, PKI-Public Key Infrastructure, ACG-Access Control Gadgets , DBDH- Decision Bilinear Diffie Hellman assumption, KGC-Key Generative Center.

I.INTRODUCTION

In several military network troopers is briefly disconnected by jam,environmental. Disruption-tolerant network (DTN) technologies have become successful solutions that enable nodes to speak with one another in these extreme networking access services specified knowledge access policies are outlined over user attributes or roles that are managed by disruption-tolerant military network, a commander might store a counseling at a 1" United Nations agency are taking part in "Region two." during this case, it's an inexpensive assumption that multiple key authorities are possible to manage their own dynamic attributes for troopers in their deployed regions or echelons, (ABE) [11]–[14] could be a promising approach that fulfills the wants forse-cure knowledge retrieval in DTNs. ABE options a mechanism that allows associate degree access management over encrypted knowledge exploitation access policies and ascribed attributes among personal keys and ciphertexts. Especially, ciphertext-policy ABE (CP-ABE) provides a scalable method of encrypting knowledge specified the encryptor defines the attribute set that the decryptor must possess so as to de-crypt the ciphertext [13].. However, the matter of applying the ABE to DTNs introduces many security their associated attributes at some purpose (for ex-ample, moving their region), or some personal keys could be compromised, key revocation (or update) for every attribute is in any single user in an attribute cluster would have an effect on the opposite users within the cluster. For ex-ample, if a user joins or leaves associate and decentralized to all or any the opposite members within the same cluster for backward or rekeying procedure, or security degradation as a result of the windows of vulnerability if the previous attribute key's not updated directly.

2. LITERATURE SURVEY

Identity-Based Encryption With Efficient Revocation, Identity-based encryption (IBE) is an exciting alternative to public-key encryption, as IBE eliminates the need for a Public Key Infrastructure (PKI). PKI- or identity-based, Its provide a revoke users from the system. Efficient revocation is a well-studied problem in the traditional PKI setting. The setting of IBE has been little work on studying the revocation mechanisms. The most practical solution requires the senders to also use time periods when encrypting, and all the receivers (regardless of whether their keys have been compromised or not) to update their private keys regularly by contacting the trusted authority. That this solution does not scale well – as the number of user's increases, the work on key updates becomes a bottleneck.

Decentralizing Attribute-Based Encryption, Multi Authority Attribute-Based Encryption (ABE) system. Any party can become an authority and there is no requirement for any global coordination other than the creation of an initial set of common reference parameters. A party can simply act as an ABE authority by creating a public key and issuing private keys to different users that react their attributes. A user can encrypt data in terms of any Boolean formula over attributes issued from any chosen set of authorities. Finally, our system does not require any central authority. In constructing our system .We create new techniques to tie key components together and prevent collusion attacks between users with different global identifiers.

User-Driven Access Control: Rethinking Permission Granting In Modern Operating Systems, Modern client platforms, such as iOS, Android, Windows Phone, Windows 8, and web browsers, run each application in an isolated environment with limited privileges. A pressing open problem in such systems is how to allow users to grant applications access to user-owned resources, e.g., to privacy- and cost-sensitive devices like the camera or to user data residing in other applications. A key challenge is to enable such access in a way that is non-disruptive to users while still maintaining least-privilege restrictions on applications To allow the system to precisely capture permission-granting intent in an application's context, we introduce access control gadgets (ACGs). Each user-owned resource exposes ACGs for applications to embed. The user's authentic UI interactions with an ACG grant the application permission to access the corresponding resource. Our prototyping and evaluation experience indicates that user driven access control enables in-context, non-disruptive, and least-privilege permission granting on modern client platforms.

Efficient And Provable Secure Cipher Text-Policy Attribute-Based Encryption Schemes, In CP-ABE scheme, the data is encrypted under an access policy defened by a user who encrypts the data and a user secret key is associated with a set of at- tributes which identify the user. A user can decrypt the ciphertext if and only if his attributes satisfy the access policy. In CP-ABE, the user enforces the access policy at the encryption phase, the policy moves with the encrypted data. It's important for data storage servers where data confidentiality must be preserved even if the server is compromised or un-trusted. The scheme is secure under Decision Bilinear Diffie Hellman assumption (DBDH). The expressivity of the scheme by including of (threshold) operator in addition to and operators. Comparison with existing CP-ABE schemes and show that our schemes are more efficient .The computational work done by the decryptor is reduced.

Selective Group Broadcast In Vehicular Networks Using Dynamic Abe ,CP-ABE) provides an encrypted access control mechanism for broadcasting messages. Basically, a sender encrypts a message with an access control policy tree which is logically composed of attributes; receivers are able to decrypt the message when their attributes satisfy the policy tree. A user's attributes stand for the properties that he current has. It is required for a user to keep his attributes up-to-date. It is difficult in CP-ABE because one attribute changes, the entire private key, which is based on all the attributes, must be changed .We introduce fading function, which renders attributes "dynamic" and allows us to update each one of them separately .Choosing fading rate for fading function affects the efficiency and security. We also compare our design with CP-ABE and find our scheme performs significantly better under certain circumstance.

3. RELATED WORK:

ABE comes in 2 flavors known as key-policy ABE (KP-ABE) and ciphertext-policy ABE (CP-ABE). In KP-ABE, the encryptor solely gets to label a ciphertext with a collection of attributes. However, the roles of the cipher texts and keys square measure reversed in CP -ABE. In CP-ABE, the ciphertext is encrypted with AN access policy chosen by AN encryptor, however a key's merely created with regard to an attributes set. CP-ABE is additional acceptable to DTNs than KP-ABE as a result of it allows en cipherors like a commander to settle on AN access policy on attributes and to encrypt confidential information below the access structure via encrypting with the corresponding public keys or attributes .

1).Attribute Revocation:

Bethencourt et al. [13] and Boldyreva et al. [16] 1st recommended key revocation mechanisms in CP-ABE and KP-ABE, severally. Their solutions area unit to append to every attribute Associate in Nursing expiration date (or time) and distribute a brand new set of keys to valid users once the expiration.The first drawback is that the security degradation in terms of the backward and forward secrecy it's a substantial scenario that users like troopers could amendment the attributes frequently, Then, a user World Health Organization freshly holds the attribute could be able to access the previous knowledge encrypted before he obtains the attribute till the info is re-encrypted with the freshly updated attribute keys by periodic rekeying (backward secrecy). as an example, assume that may be decrypted with a collection of attributes (embedded within the users keys) for users with . After time , say , a user freshly holds the attribute set . albeit the new user ought to be disallowed to decipher the ciphertext for the time instance , he will still decipher the previous ciphertext till it's re-encrypted with the freshly updated attribute keys. On the opposite hand, a revoked user would still be able to access the encrypted knowledge albeit he doesn't hold the attribute any further till successive expiration time (forward secrecy).

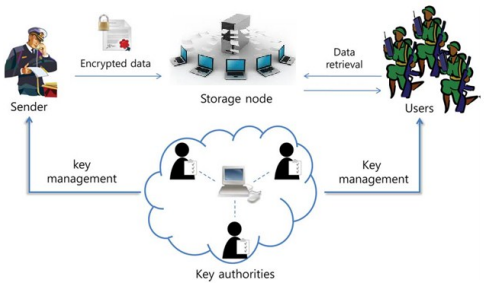
2). *Key Escrow:*

Most of the present ABE schemes square measure constructed on the design wherever one trusty authority has the ability to get the complete non-public keys of users with its master secret info[11], [13], [14], [21]–[23]. Thus, the key written agreement drawback is inherent specified the key authority will rewrite each ciphertext addressed to users within the system by generating their secret keys at anytime. Chase et al. [24] bestowed a distributed KP-ABE theme that solves the key written agreement drawback in an exceedingly multi authority system. During this approach, all (disjoint) attribute authorities square measure collaborating within the key generation protocol in an exceedingly distributed method specified they cannot pool their information and link multiple attribute sets happiness to a similar user. One disadvantage of this totally distributed approach is that the performance degradation. Since there's no centralized authority with master secret info, all attribute authorities ought to communicate with one another within the system to get a user's secret key. This ends up in communication overhead on the system setup and therefore the rekeying phases and needs every user to store further auxiliary key elements besides the attributes keys, wherever is that the variety of authorities within the system.

3. *) Decentralized ABE:*

Huang and Roy et al. [4] projected decentralized CP-ABE schemes within the multi authority network surroundings. They achieved a combined access policy over the attributes issued from completely different authorities by merely encrypting information multiple times. the most disadvantages of this approach area unit potency and quality of access policy. for instance, once a commander encrypts a secret mission to troopers beneath the policy it can not be expressed once every "Region" attribute is managed by completely different authorities, since merely multi encrypting approaches will by no means that specific any general . Therefore, they're somewhat restricted in terms of quality of the access policy and need computation and storage prices. Chase and Lewko et al. [10] projected multi authority KP-ABE and CP-ABE schemes, severally. However, their schemes additionally suffer from the key written agreement drawback just like the previous decentralized

4. NETWORK ARCHITECTURE



In this section, we describe the DTN architecture and define the security model

Fig. 1. Architecture of secure data retrieval in a disruption-tolerant military network *System Description and Assumptions.*

1) Key Authorities: they're key generation centers that generate public/secret parameters for CP-ABE. The key authorities comprises a central authority and multiple native authorities. we tend to assume that there are secure and reliable communication channels between a central authority and every bureau throughout the initial key setup and generation section. They grant differential access rights to individual users supported the users' attributes. The key authorities are assumed to be honest-but-curious. That is, they're going to honestly execute the allotted tasks within the system, but they might prefer to learn data of encrypted contents the maximum amount as potential.

2) Storage Node: this is often associate degree entity that stores knowledge from senders and supply corresponding access to users. it's going to be mo-bile or static [4], [5]. almost like the previous schemes, we tend to additionally assume the storage

node to be semi trusted , that's honest-but-curious.

3)Sender: This is often associate degree entity World Health Organization owns confidential messages or knowledge (e.g., a commander) and needs to store them into the external knowledge storage node for simple sharing or for reliable delivery to users within the extreme networking environments. A sender is chargeable for shaping (attribute-based) access policy and implementing it on its own

4) User: this is often a mobile node World Health Organization needs to access the info keep at the storage node (e.g., a soldier). If a user possesses a collection of attributes satisfying the access policy of the encrypted knowledge outlined by the sender, and isn't revoked in any of the attributes, then he are going to be ready to rewrite the cip her text and procure the info.

5. ANALYSIS

In this section, we have a tendency to first analyze and compare the efficiency of the projected theme to the previous multi authority CP-ABE schemes in theoretical aspects. Then, the potency of the projected theme is incontestable within the network simulation in terms of the communication value . we have a tendency to additionally discuss its potency once enforced with specific parameters and compare these results to those obtained by the opposite schemes.

A.Efficiency:

Logic expressiveness of access structure which will be outline dunderneath totally {different |completely different} disjoint sets of attributes (managed by different authorities), key escrow, and revocation roughness of every CP-ABE theme. within the projected theme, the logic are often terribly communicative as within the single authority system like BSW [13] specified the access policy are often expressed with any monotone access structure underneath attributes of any chosen set of authorities; whereas HV [9] and RC [4] schemes solelyenable the gate among the sets of attributes managed by completely different authorities. The revocation within the projected theme are often wiped out an on the spot method as against BSW. Therefore, attributes of users are often revoked at any time even before the expiration time that may be set summarizes the potency comparison results among CP-ABE schemes. within the comparison, rekeying message size represents the communication price that the key authority or the storage node has to send to update non-revoked users' keys for associate attribute. non-public key size represents the storage price required for every user to store attribute keys or KEKs. Public key size represents the scale of the system public parameters. during this comparison, the access tree is built with attributes of completely different authorities except in BSW of that total size is capable that of the one access tree in BSW. As shown in Table II, the projected theme desires rekeying message size of at the most to notice user-level access management for every attribute within the system .though RC doesn't got to send extra rekeying message for user revocations as against the opposite schemes, its cip her text size is linear to the quantity of revoked users within the system since the user revocation message is enclosed within the cip her text. The projected theme needs a user to store additional KEKs than BSW. However, it's a sway on reducing the rekeying message size. The projected theme is as economical because the basic BSW in terms of the cip her text size where as realizing safer immediate rekeying in multi-authority systems.

B. Simulation:

In this simulation, we have a tendency to take into account DTN applications victimisation the net protected by the attribute-based cryptography. Almeroth and Anmar [32] incontestable the cluster behavior within the Internet's multicast backbone network (MBone). They showed that the quantity of users change of integrity a bunch follows a Poisson distribution with rate , and therefore the membership length time follows Associate in Nursing exponential distribution with a mean length . Since every attribute cluster may be shown as Associate in Nursing freelance network multi cast cluster wherever the members of the cluster share a typical attribute, we have a tendency to show the simulation result following this probabilistic behavior distribution.

The amount of the key authorities is ten, and therefore the average variety of attributes related to a user's secret is ten. For a good comparison with relevancy the safety perspective, we have a tendency to set the rekeying periods in HV as min. to attain associate degree 80-bit security level, we set . isn't additional to the simulation result as a result of it's common altogether multi authority CP-ABE schemes. As shown in Fig. 3, the communication value in HV is a smaller amount than RC within the starting of the simulation time (until regarding thirty h). However, because the time elapses, it will increase prominently as a result of the amount of revoked users will increase accumulatively. The projected theme needs the smallest amount communication value within the network system since the rekeying message in is comparatively but the opposite multi authority schemes.

C. Implementation:

Next, we tend to analyze and live the computation price for encrypting (by a sender) and decrypting (by a user) an information. we tend to used a Type- A curve (in the pairing-based cryptography (PBC) library [33]) providing teams within which a additive map is outlined . Though such curves give smart computational efficiency (especially for pairing computation), an equivalent doesn't hold from the purpose of read of the area needed to represent cluster components .The implementation uses a 160-bit elliptic curve cluster supported the super singular curve over a 512 -bit finite field. The process price is analyzed in terms of the pairing, involution operations in and the relatively negligible hash, cruciform key, and multiplication operations within the cluster square measure unheeded within the time result. during this analysis, we tend to assume Computation prices in Table III represent the edge of every price. we are able to see that the overall computation time to encrypt knowledge by a sender within the planned theme is that the same as BSW, whereas coding time by a user needs exponentiations in a lot of.

6. SECURITY

In this section, we prove the security of our scheme with regard to the security requirements discussed.

A. Collusion Resistance:

In CP-ABE, the key sharing should be embedded into the cip her text instead to the non-public keys are irregular with personalized random values selected by the such they can't be combined within the projected scheme .This price are often blind out if and providing the user has the enough key parts to satisfy the key sharing theme embedded within the cip her text. Another collusion attack state of affairs is that the collusion between revoked users so as to obtain the valid attribute cluster keys for a few attributes that they're not licensed to possess (e.g., because of revocation). The at-tribute cluster key distribution protocol, that is complete sub-tree methodology within the projected theme, is secure in terms of the key identity [29]. Thus, the colluding revoked users will by no suggests that get any valid attribute cluster keys for at-tributes that they're not licensed to carry. Therefore, the colluding native authorities cannot derive the total set of secret keys of users.

B *Data Confidentiality:*

In our trust model, the multiple key authorities are not any longer absolutely trustworthy further because the storage node even though they're honest Data confidentiality on the keep knowledge against unauthorized users are often trivially warranted. If the set of attributes of a user cannot satisfy the access tree within the cip her text, he cannot recover the specified price throughout the secret writing method, wherever could be a random price unambiguously assigned to him. On the opposite hand, once a user is revoked from some attribute teams that satisfy the access policy, he cannot rewrite the cip her text either unless the remainder of the attributes of him satisfy the access policy. so as to rewrite a node for AN attribute , the user mustry from the cip her text and from its personal key. However, this cannot end in the worth , that is desired to get , since is blind by the updated attribute cluster key that the revoked user from the attribute cluster will by no suggests that get.

B. Backward and Forward Secrecy:

When a user involves hold a collection of attributes that satisfy the access policy within the cip hertext at your time instance, the corresponding attribute cluster keys are updated and delivered to the valid attribute cluster members firmly (including the user). Additionally, all of the element sencrypted with a secret key within the cip her text are re-encrypted by the storage node with a random ,and also the cip her text elements reminiscent of the attributes are re-encrypted with the updated attribute cluster keys. even though the user has keep the previous cip hertext ex-changed before he obtains the attribute keys and also the holding at-tributes satisfy the access policy, he cannot re-write the pervious cip her text. this can be as a result of, even though he will reach computing from the present cip her text, it'll not facilitate to re-cover the specified price for the previous cip her text since it's unsighted by a random .On the opposite hand, once a user involves drop a collection of at-tributes that satisfy the access policy at your time instance, the corresponding attribute cluster keys are updated and delivered to the valid attribute cluster members firmly (excluding the user). Then, all of the elements encrypted with a secret key within the cip her text are re encrypted by the storage node with a random , and also the cip hertext elements reminiscent of the attributes are re encrypted with the updated attribute cluster keys.

7. CONCLUSION

DTN technologies have become self-made solutions in military applications that permit wireless devices to speak with one another and access the counseling reliably by exploiting storage device nodes. CP-ABE could be a scalable science resolution to the access management and secure information retrieval problems .During this paper we tend to planned Associate in Nursing economical and secure information retrieval technique victimization CP-ABE for localized DTNs wherever multiple key authorities manage their attributes independently. The inherent key written agreement drawback is resolved specified the confidentiality of the hold on information is secure deven underneath the hostile atmosphere wherever key authorities could be com-promised or not totally trust worthy . Additionally, the fine -grained key revocation are often finished every attribute cluster. we tend to demonstrate the way to apply the planned mechanism to firmly and expeditiously manage the confidential information distributed within the disruption-tolerant military network.

REFERENCES

1. J. Burgess, B. Gallagher, D. Jensen, and B. N. Levine, “Maxprop: Routing for vehicle-based disruption tolerant networks,” in *Proc. IEEE INFOCOM*, 2006, pp. 1–11.

2. M. Chuah and P. Yang, “Node density-based adaptive routing scheme for disruption tolerant networks,” in *Proc. IEEE MILCOM*, 2006, pp. 1–6.

3. M. M. B. Tariq, M. Ammar, and E. Zequra, “Mesage ferry route de-sign for sparse ad hoc networks with mobile nodes,” in *Proc. ACM MobiHoc*, 2006, pp. 37–48.

4. S. Roy and M. Chuah, “Secure data retrieval based on ciphertext policy attribute-based encryption (CP-ABE) system for the DTNs,” Lehigh CSE Tech. Rep., 2009.

5. M. Chuah and P. Yang, “Performance evaluation of content-based information retrieval schemes for DTNs,” in *Proc. IEEE MILCOM*, 2007, pp. 1–7.

6. M. Kallahalla, E. Riedel, R. Swaminathan, Q. Wang, and K. Fu, “Plutus: Scalable secure file sharing on untrusted storage,” in *Proc. Conf. File Storage Technol.*, 2003, pp. 29–42.

7. L. Ibraimi, M. Petkovic, S. Nikova, P. Hartel, and W. Jonker, “Mediated ciphertext-policy

attribute-based encryption and its application," in *Proc. WISA*, 2009, LNCS 5932, pp. 309–323.

8. N. Chen, M. Gerla, D. Huang, and X. Hong, "Secure, selective group broadcast in vehicular networks using dynamic attribute based encryption," in *Proc. Ad Hoc Netw. Workshop*, 2010, pp. 1–8.

9. D. Huang and M. Verma, "ASPE: Attribute-based secure policy enforcement in vehicular ad hoc networks," *Ad Hoc Netw.*, vol. 7, no. 8,
    a. 1526–1535, 2009.
10. A. Lewko and B. Waters, "Decentralizing attribute-based encryption," Cryptology ePrint Archive: Rep. 2010/351, 2010.

11. A. Sahai and B. Waters, "Fuzzy identity-based encryption," in *Proc. Eurocrypt*, 2005, pp. 457–473.

12. V. Goyal, O. Pandey, A. Sahai, and B. Waters, "Attribute-based encryption for fine-grained access control of encrypted data," in *Proc. ACM Conf. Comput. Commun. Security*, 2006, pp. 89–98.

13. J. Bethencourt, A. Sahai, and B. Waters, "Ciphertext-policy attribute-based encryption," in *Proc. IEEE Symp. Security Privacy*, 2007, pp. 321–334.

14. R. Ostrovsky, A. Sahai, and B. Waters, "Attribute-based encryption with non-monotonic access structures," in *Proc. ACM Conf. Comput. Commun. Security*, 2007, pp. 195–203.

15. S. Yu, C. Wang, K. Ren, and W. Lou, "Attribute based data sharing with attribute revocation," in *Proc. ASIACCS*, 2010, pp. 261–270.

16. A. Boldyreva, V. Goyal, and V. Kumar, "Identity-based encryption with efficient revocation," in *Proc. ACM Conf. Comput. Commun. Security*, 2008, pp. 417–426.

17. M. Pirretti, P. Traynor, P. McDaniel, and B. Waters, "Secure attribute-based systems," in *Proc. ACM Conf. Comput. Commun. Security*, 2006,

18. 28 M.Belenkiy, J. Camenisch, M. Chase, M. Kohlweiss,A.Hysyanskaya, and H. Shacham, "Randomizable proofs and delegatable anonymous credentials," in *Proc. Crypto*, LNCS 5677, pp. 108–125.

19. 29D. Naor, M. Naor, and J. Lotspiech, "Revocation and tracing schemes for stateless receivers," in *Proc. CRYPTO*, 2001, LNCS 2139, pp.41–62.

20. 30C. K.Wong,M. Gouda, and S. S. Lam, "Secure group communications using key graphs," in *Proc. ACM SIGCOMM*, 1998, pp. 68–79.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 371 - 373, 2015, ISSN:- 2319–8656

Data Mining using Improved Association Rule

Arpit Tripathi
Thakur College of Engineering and Technology
Mumbai, India

Shefali Singh
Thakur College of Engineering and Technology
Mumbai,India

Devika Prasad
Thakur College of Engineering and Technology
Mumbai,India

Abstract: Data Mining plays an important role in extracting patterns and other information from data. The Apriori Algorithm has been the most popular techniques infinding frequent patterns. However, Apriori Algorithm scans the database many times leading to large I/O. This paper is proposed to overcome the limitaions of Apriori Algorithm while improving the overall speed of execution for all variations in 'minimum support'. It is aimed to reduce the number of scans required to find frequent patters.
Keywords: Aprior, association, candidate sets, data mining

1. INTRODUCTION

Data Mining has become a great field of interest in this era of online shopping and web malls. Although most data mining systems work with data stored in flat files, it is beneficial to implement data mining algorithms using SQL in DBMS that allow us to discover patterns in data. Association rules have been used to find realtionships between itemsets in large datasets. In this paper we discuss a method to find frequent itemsets in datasets faster than traditional algorithms, per se Apriori Algorithm. This algorithm reduces the number of scans done to find frequent patterns in large datasets. Apriori Algorithm creates large candidate itemsets for smaller 'minimum supports'. The main goal of the system is to reduce the execution time for finding frequent patterns.

2. RELATED WORK

Several attempts were made by researchers to improve the efficiency:

1. Krishna Balan, Karthiga, Sakthi Priya suggested using Hash table and finding frequent itemsets in dataset. They proposed a algorithm that does a three stage process where the first process is a hash based step is used to reduce the candidate itemsets generated in the first phase, create a 2-itemset combination of itemsets in a transaction and include it in Hashtable. Finally, removing the itemsets with support less than minimum support.[0]

2. Mahesh Balaji and G Subrahmanya VRK Rao et al in their paper for IEEE proposed Adaptive Implementation Of Apriori Algorithm for Retail Scenario in Cloud Environment which solves the time consuming problem for retail transactional databases. It aims to reduce the response time significantly by using the approach of mining the frequent itemsets.

3. ALGORITHM

4. Apriori Algorithm

R. Agrawal and R. Srikant in 1994 presented the apriori algorithm for mining frequent itemsets which is based on the generation of candidate itemset.One of the first algorithms to evolve for frequent itemset and Association rule mining was Apriori. Two major steps of the Apriori algorithm are the join and prune steps. The join step is used to construct new candidate sets. A candidate itemset is basically an item set that could be either Frequent or infrequent with respect to the support threshold. Higher level candidate itemsets (Ci) are generated by joining previous level frequent itemsets are Li-1 with it. The prune step helps in filtering out candidate item-sets whose subsets (prior level) are not frequent. This is based on the anti-monotonic property as a result of which every subset of a frequent item set is also frequent.Thus a candidate item set which is composed of one or more infrequent item sets of a prior level is filtered(pruned) from the process of frequent itemset and association mining.

Algorithm: The Apriori Algorithm

Input:

T//Transaction Dataset

m //Minimum support

Output:

Frequent Itemsets

Steps:

1.Ck: Candidate itemset of size k

2.Lk : frequent itemset of size k

3.L1 = {frequent items};

4.for (k = 1; Lk != □; k++) do begin

Ck+1 = candidates generated from Lk;

5.for each transaction t in database do

increment the count of all candidates in Ck+1 that are contained in t

Lk+1 = candidates in Ck+1 with min_support

6.end

7.return □k Lk

Apriori is an algorithm for frequent item set mining and association rule learning over transactional databases. It proceeds by identifying the frequent individual items in the database and extending them to larger and larger item sets as long as those item sets appear sufficiently often in the database. The frequent item sets determined by Apriori can be used to determine association rules which highlight general trends in the database: this has applications in domains such as market basket analysis. Apriori is designed to operate on databases containing transactions. Other algorithms are

designed for finding association rules in data having no transactions, or having no timestamps. Each transaction is seen as a set of items (an itemset). Given a threshold , the

Apriori algorithm identifies the item sets which are subsets of at least transactions in the database.

Apriori uses a "bottom up" approach, where frequent subsets are extended one item at a time (a step known as candidate generation), and groups of candidates are tested against the source dataset.

5. Improved Algorithm

In this algorithm, the first step is finding the support of all itemset is same as Apriori algorithm. Any items that have support less than minimum support is less are discarded. For next step, 2-itemsets combination for items in each transaction is created. Count for 2-itemset is found and itemsets with count less than minimum support are deleted. The database is reduced only using these distinct itemsets, this is called 'Transaction Reduction'. Support for all items is found and frrequent itemset are found.

Algorithm:

1 Take inputs from user for minimum support.

2. Find count for all itemsets in the database.

3. Delete itemsets from Databse having support less than minimum support .

4. Create all possible 2-itemset candidate itemset for each transaction.

5. Modify the transaction database to include only these candidate pairs

6. Then the candidate itemsets which has less frequent are then removed from the transaction database.

7. The database is scanned for minimum support threshold, frequent items are selected and sorted..

6. Example.

TID	Items
T1	I1,I3,I7
T2	I2,I3,I7
T3	I2,I3,I1
T4	I2,I3
T5	I2,I3,I4,I5
T6	I2,I3
T7	I1,I2,I3,I4,I6
T8	I2,I3,I4,I6
T9	I1
T10	I1,I3

Reducing the Database:

TID	Items
T1	I1,I3
T2	I2,I3
T3	I2,I3,I1
T4	I2,I3
T5	I2,I3,I4
T6	I2,I3
T7	I1,I2,I3,I4
T8	I2,I3,I4
T9	I1
T10	I1,I3

Hash Table-

TID	Items
T1	I1I3
T2	I2I3
T3	I1I2,I2I3,I1I3
T4	I2I3
T5	I2I3,I4I3,I2I4
T6	I2I3
T7	I1I2,I2I3,I3I4,I1I3,I2I4,I1I4
T8	I2I3,I3I4,I2I4
T9	I1
T10	I1I3

HASH COUNT:
{I1I3}=4,{I2I3}=7, {I1I2}=2,{I1I3}=3,
{I2I4}=3,{I3I4}=3,,{I1I4}=1

Reducing the Database:

TID	Items
T1	I1,I3
T2	I2,I3
T3	I2,I3,I1
T4	I2,I3
T5	I2,I3,I4
T6	I2,I3
T7	I1,I2,I3,I4
T8	I2,I3,I4
T9	I1
T10	I1,I3

Item Count-

Items	Count
I1	**5**
I2	**7**
I3	**8**
I4	**3**

7. Experimental Results

The data sets given to the Apriori and the improved algorithm are same. The results of the experiment are listed in table 1.

In this section we have taken the market basket analysis and compare the efficiency of the proposed method to the existing algorithms which is mentioned above. Both algorithms are coded using Visual Studio that uses Visual Basic and SQL programming language. The data sets have been generated for testing these algorithms. Two case studies have been done in analyzing the algorithm i) the execution time of the algorithm is tested to the number of transactions, ii) The execution time is executed to the number of the support.

Case i:

In this case where we are comparing the execution time of the transaction where any transaction may a contain more than one frequent itemsets. Here the minimum support is made constant.

Transaction	Apriori (mm:ss:ms)	Improved Algorithm
1000	00:15:82	00:14:10
2000	00:26:00	00:24:56
3000	00:36:77	00:35:58
4000	00:45:80	00:43:77
5000	00:50:07	00:46:23

Case ii:

Now the execution time of different algorithms is compared by varying the minimum support.

Support	Apriori (mm:ss:ms)	Improvised Algorithm
30	01:32:37	01:21:03
40	01:22:70	01:18:44
50	01:23:06	01:20:16
10	14:27:64	02:21:65

8. Conclusion

This new algorithm proposed for association rule mining is for finding the frequent itemsets. The present apriori algorithm has some bottlenecks we need to optimize and the proposed algorithm will give a new way for association rule where it reduces the candidate item sets. And we have also done some case studies about the existing algorithm above and we also listed the demerits of the existing systems and our proposed work is assured to overcome these bottlenecks we mainly concentrated to reduce the candidate itemset generation and also to increase the execution time of the process.

This algorithm works really efficiently against Apriori where support is low. Since it scans the database fewer times, I/O cycles are reduced and thereby decreasing the time of execution.

On another hand, it uses lesser memory than Apriori, saving crucial storage space. The increase in performance for small support (more transactions) is very good compared to Apriori, the runtime is reduced by 6 times.

The major limitation of the algorithm is that it has very slight increase in performance when the support is 30% or above.

9. REFERENCES

[1] Krishna Balan, Karthiga, Sakti Priya. An improvised tree algorithm for association rule mining using transaction reduction. International Journal of Computer Applications Technology and Research Volume 2– Issue 2, 166 - 169, 2013, ISSN: 2319–8656. .

[2] Feng WANG. School of Computer Science and Technology, Wuhan University of Technology Wuhan, China. 2008 International Seminar on Future BioMedical Information Engineering.

[3] Agrawal R, Imielinski T, Swami A. Mining association rules between sets of items in large databases. In: Proc. of the l993ACM on Management of Data, Washington, D.C, May 1993. 207-216

[4] Chen Wenwei. Data warehouse and data mining tutorial [M]. Beijing: Tsinghua University Press. 2006.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 377 - 379, 2015, ISSN:- 2319–8656

A Survey on Different Modes of Wormhole Attack and it's Countermeasures in MANET

Shahapur Farhat Kauser Iqbal
Dept of CSE
SECAB Engineering College
Bijapur, India

Syeda Sheema
Dept of CSE
SECAB Engineering College
Bijapur, India

Asha Guddadavar
Dept of CSE
SECAB Engineering College
Bijapur, India

Abstract: One of the most popular areas of research is wireless communication. Mobile Ad Hoc network (MANET) is a network with wireless mobile nodes, infrastructure less and self organizing. With its wireless and distributed nature it is exposed to several security threats. One of the threats in MANET is the wormhole attack. In this attack a pair of attacker forms a virtual link thereby recording and replaying the wireless transmission. This paper presents types of wormhole attack and also includes different technique for detecting wormhole attack in MANET..

Keywords: Mobile Ad Hoc Network; Packet encapsulation; Out of Band; Security; Wormhole

1. INTRODUCTION

Mobile devices for example laptops mobile, PDA's and many other are increasingly becoming common, making wireless technology popular. With the wireless technology users are provided with the ease to move freely while they are connected to a network. Wireless network can be classified as infrastructure based and Ad Hoc network. Infrastructure based requires a central access point or base station for communication. Ad Hoc in Latin means "for this" or "for this purpose only". This Ad Hoc network can be set up without the need for any external infrastructure (like central access point or a base station

Since the devices are mobile that's why the term "Mobile Ad Hoc network MANET)". Mobile Ah Hoc network consist of independent mobile nodes and communication between them is done via radio waves [1]. If the nodes are within the radio range of each other then they communicate directly else need intermediate node for routing the packets. Hence it is also called multihop network. Here Figure1 shows example of MANET where there is no central access point or base station is required for communication. Each node can communicate directly with the node which lies within its radio range.

There are many application of MANET. Some of the applications of MANET include disaster relief operations, military or police operations, business meetings, site operations (such as mines), Robot data acquisition.

Few characteristic of MANET can be summarized as follows:

- Communication is done via wireless means.
- Nodes act as both host as well as routers.
- No centralized access point or base station is needed.
- Network topology is dynamic and multihop.
- Set up can be done anywhere
- Limited security.
- No infrastructure required.

Due to the open and dynamically changing network topology, MANET is much more susceptible to attack then wired network.

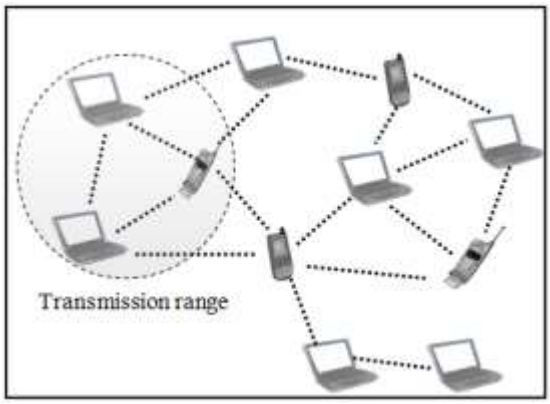


Figure 1. Example of MANET consisting of mobile nodes

2. WORMHOLE ATTACK

Wormhole attack is one of the severe attacks on MANET. In wormhole attack wormhole nodes are introduced which form a virtual link and make other nodes belief that there is a route between them and make all communication to go through this link. In the first phase the wormhole node will broadcast about the false route. In the second phase the attacker can do whatever they want to with the data passing through this link [2], [3].

3. DIFFERENT MODES OF WORMHOLE ATTACK

Wormhole attack is particularly severe against routing protocol such as DSR [11] and AODV [12]. In such routing protocol if a node, say S needs to discover route to destination, say D, then S floods the network with rote request

message. The node that receives the request packet processes the packet, adds its own identity and rebroadcast it. In order to limit the amount of flooding each node only broadcast the first packet it receives and drops further copies of same request. When destination node D receives the request it generates a route reply and sends back to S. The sender node then selects the best route from all the route reply it has received. Best route is selected on basis of shortest route. In case of wormhole attack the node at one end hears the route request and tunnels it to the wormhole node at the other end of tunnel. The wormhole nodes give false illusion that the route passing through them is the shortest, even though they are not.

Wormhole can be classified into four modes-packet encapsulation, packet relay, high power transmission and out-of-B-band [13].

3.1 Packet Encapsulation

In packet encapsulation the wormhole node on one end encapsulates the packet to prevent nodes on the way from incrementing node count. When the wormhole node at the other end receives this packet it will bring the packet to its original form. Figure 2 below shows an example of packet encapsulation where node C and node J are wormhole nodes.

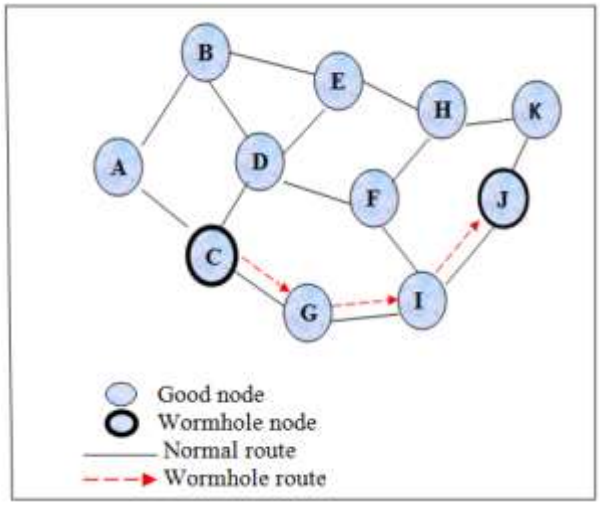


Figure 2. Example of packet encapsulation in wormhole attack

3.2 Packet Relay

In this type of attack two malicious nodes relay the packets between them which are far apar but make illution of being neighbor.

3.3 High Power Transmission

In this kind of attack there exist only one malicious node which has high transmission power used to attract packets to pass through it.

3.4 Out Of Band

In Out-of-band wormhole attack the attacked node form an external link between the two nodes to form a tunnel. The wormhole node then advertises about the shortest path and makes all the communication pass through it. This can be further classified as High power transmission. In high power transmission the attacked node has much higher capability that lures other nodes to send packets to go through this path.

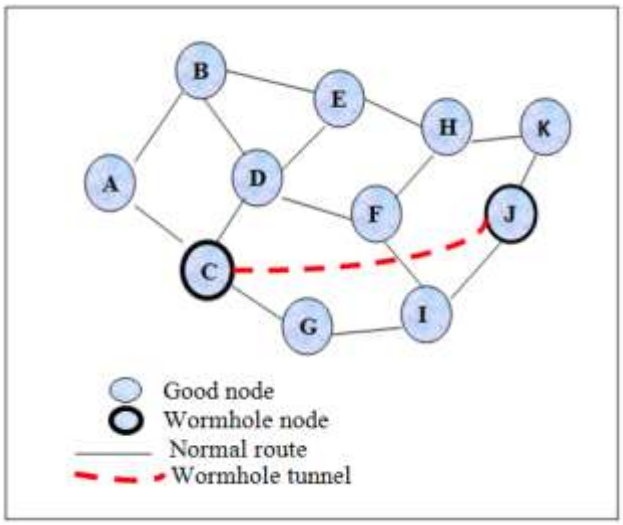


Figure 3. Out-Of-Band Wormhole Attack

Here figure 3 shows Out-Of-Band wormhole attack in which node C and node J forms an external link or in other words a tunnel through which all communication can be captured. The wormhole node will advertise that there is a shortest path between node C and node J and make all communication go through this link.

4. DIFFERENT DETECTION METHODS

Several researchers have worked on detection of wormhole attack in MANET. Some of the detection methods discussed in next section.

4.1 Hop Count Analysis Method

Shang, Laih and Kau[4] introduced a method called hop count analysis for detection of wormhole. This method does not really identify the wormhole but simply avoids the route that is suspected to have wormhole and selects a different route. The author introduced a multipath routing protocol that is based on hop count analysis method. The idea is to use split multipath route and so the data is also split. With this the attacker cannot completely seize the data.

4.2 Location Based Approach

Location based approach is useful where the location of neighboring nodes and transmission range are known. In this technique the nodes share their location information with each other. Author of [5] proposed a special method called the geographical leash to detect wormhole. A leash is some information which is attached to a packet designed to control the maximum allowed transmission distance. This geographic leash ensures that the receiver of the packet is within the range of sender. Initially all nodes know their own location. The node while sending a packet includes time when the packet was sent, time when packet was received and its

location. The recipient node now compares this information with its own location and time when the packet was received.

In location based approach special hardware is used. Location based is equipped with either GPS or some positioning technology. This technology fails in the absence of GPS system.

4.3 Time Based Approach

Time pased approach proposed by Hu et al [5][6] is based on accurate time measurement. This technique requires the nodes to maintain tightly synchonized clock. The author has proposed a technique called temporal leash. In this method extremly accurate clock synchonization is needed to bound propogation time of packet. In [7], the author has proposed a methode called transmission time based mechanism(TTM). Thia method detects wormhole during early stage of route set up by calculating the time of transmission between two successive nodes. If the transmission time betweenn two nodes is high then wormhole is detected. It doesa not require any special harware like GPS system.

4.4 Digital Signature Based Approach

In **[**8**]** author has proposed a method using digital signature. All nodes in network contains digital signature of every other nodes in the same network. A trusted path is created between the sender and the receiver using digital signature. If a node does not have legal digital signature, it is identified a malicious node.

4.4 Neighbor Node Monitoring

Author of [9] has proposed a method based on a response time of reply message. This response time is used for authentication purpose. All nodes maintain table for storing the reply time. If the reply time is not accurate then there is a malicious node in the network. Comparison is done on response time and repeated until destination is reached.

4.5 Round Trip Time Based Approach

The Round Trip Time (RTT) based approach proposed by Zaw Tun and Thein [10] considers the round trip time (RTT) between two successive nodes. Based on transmission time between two nodes wormhole is detected. Here the transmission time between two false nodes is considered to be higher than others. This technique does not require any kind of special hardware for its detection process.

5. CONCLUSION

Due to the open nature and dynamic network topology of MANET, it is much more vulnerable to attacks. This paper discusses a particularly severe attack that is the wormhole attack and its different types in detail. Wormhole attack has different modes through which it can capture and disrupt the packets. It can either hide the route information by packet encapsulation or form a tunnel between the attacked nodes to pass all packets through this tunnel. Various countermeasures are also discussed here which are used to detect the wormhole attack in MANET.

6. REFERENCES

[1] C. Siva Ram Murthy and B.S.Manoj, “Ad hoc Wireless Networks” (Chapter 7), 2014.

[2] Jyoti Thalor, Ms. Monika “Wormhole Attack Detection and Prevention Technique in Mobile Ad Hoc Networks: A Review”, International Journal of Advanced Research in Computer Science and Software Engineering - Volume 3, Issue 2, February 2013.

[3] Reshmi Maulik and Nanbendu Chaki: “A Study on Wormhole Attacks in MANET” International Journal of Computer Information System and Industrial Management Applications (IJCISIM),Vol.3 (2011), pp. 271-279.

[4] Jen S.-M.; Laih C.-S.; Kuo W.-C. A Hop-Count Analysis Scheme for Avoiding Wormhole Attacks in MANET. *Sensors*. 2009.

[5] Yih-Chun Hu, Adrian Perig, David B. Johnson: “Wormhole Attack on Wireless Network” IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, Vol. 24- No 2, 2006.

[6] Y.C.Hu, A.Perrig and D.Johnson: “Packet leashes: a defense against wormhole attacks in wireless networks,” in INFOCOM, 2003.

[7] Phuong Van Tran, Le Xuan Hung, Young-Koo Lee, Sungyoung Lee and Heejo Lee: “TTM: An Efficient Mechanism to Detect Wormhole Attacks in Wireless Ad-hoc Networks” IEEE CCNC, 2007.

[8] Pallavi Sharma, Prof. Aditya Trivedi, "An Approach to Defend Against Wormhole Attack in Ad Hoc Network Using Digital Signature”, *IEEE*, 2011.

[9] sweety goyai, harish rohil, “Securing MANET against Wormhole Attacl using Neighbour Node Analysis” *IJCA* volume 81,November 2013.

[10] Zaw Tun and Ni Lar Thein “Round Trip Time Based Wormhole Attack Detection” ICCA 2009

[11] D. Johnson, D. Maltz, and J. Broch, The Dynamic Source Routing Protocol for Multihop Wireless Ad Hoc Networks, in Ad Hoc Networking, Addison-Wesley, 2001.

[12] C. E. Perkins and E. M. Royer, Ad-Hoc On-Demand Distance Vector Routing, in Proceedings of the Second IEEE Workshop on Mobile Computing Systems and Applications (WMCSA’99), pp. 90-100, February 1990.

[13] Himanshu Prajapati “Techniques for Detection & Avoidance of Wormhole Attack in Wireless Ad Hoc Networks” Vol. 3 Issue 3, March-2014, pp: (21-27)

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 380 - 385, 2015, ISSN:- 2319–8656

A Survey on Selective Jamming Attacks in WMNs

Syeda Arshiya Sultana
Dept of CSE,
S.I.E.T, Vijayapur,
Karnataka, India

Samreen Banu kazi
Dept of CSE,
S.I.E.T, Vijayapur,
Karnataka, India

Parveen Maniyar
Dept of CSE,
S.I.E.T, Vijayapur,
Karnataka, India

M. Azharuddin
Dept of CSE
S.I.E.T, Vijayapur
Karnataka, India

Abstract—Wireless mesh networks (WMNs) assure to expand high-speed wireless connectivity beyond what is possible with the current Wi-Fi based infrastructure. Due to their unique architectural features leave them particularly vulnerable to security threats. In this paper, various forms of sophisticated attacks launched from adversaries with internal access to the WMN are described. We also identify possible detection and mitigation mechanisms.

Keywords—Security, wireless mesh networks, jamming, misbehaviour, insider attacks, packet drop

1. INTRODUCTION

Wireless mesh networks (WMNs) are continuously receiving significant interest as a possible means of providing seamless data connectivity, especially in urban environments [1]. Such networks evolved from classic mobile ad hoc networks, targeting long-range transmissions with importance on network throughput and connectivity. WMN applications include stationary deployments e.g., community networks, hierarchal sensor networks as well as mobile ones e.g., intelligent transportation systems, tactical military networks.

WMNs follow two-tier network architecture [2]. The first tier consists of the end users, also referred to as stations (STAs), and directly connected to mesh nodes referred to as Mesh Access Points (MAPs). The second tier consists of a peer-to-peer network of the MAPs. Connectivity in the second tier is assisted by intermediate routers known as Mesh Points (MPs) which interconnect MAPs (MPs do not accept connections from end users). The network of MAPs and MPs is often static and uses separate frequency bands to communicate data and control information (MAPs are typically equipped with multiple transceivers). Finally, Mesh Gateways (MGs) provide connectivity to the wired infrastructure. An example of a WMN is shown in Fig. 1.

WMNs are always vulnerable to "external" and "internal" attacks. External attacks take the forms of random channel jamming, packet replay, and packet fabrication, and are launched by "foreign" devices that are unaware of the network secrets e.g., cryptographic credentials and pseudo-random spreading codes. They are relatively easier to counter through a combination of Cryptography based and robust communication techniques. Internal attacks, which are launched from compromised nodes, are much more difficult in nature.

These attacks use knowledge of network secrets and protocol semantics to selectively and adaptively target critical network functions. By overhearing the first few bits of a packet, or classification transmissions based on protocol semantics, attack selectivity can be achieved. Internal attacks, hereafter referred to as insider attacks, cannot be mitigated using only proactive methods which rely on network secrets, because the attacker already has access to such secrets.

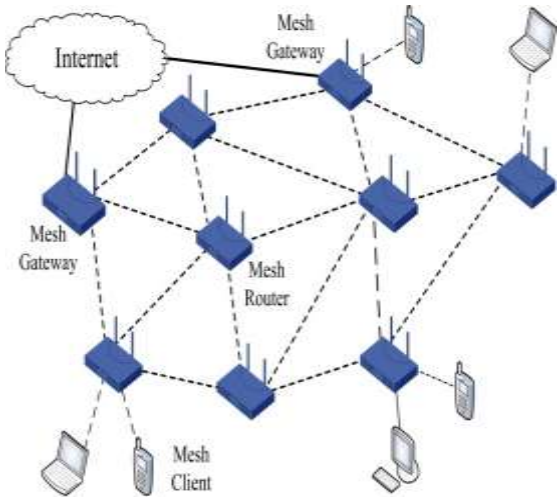


Fig.1 Architecture of WMN

They additionally require protocols with built-in security measures, through which the attacker can be detected and its selective nature can be neutralized.

1.1 ***Vulnerabilities of WMNs:*** While all types of wireless networks are vulnerable to insider attacks, for a number of reasons WMNs are mainly susceptible. First, MPs and MAPs are relatively cheap devices with poor physical security, which makes them potential targets for node capture and compromise. Second, given their relatively advanced hardware e.g., multiple transceivers per MP and MAP, WMNs frequently adopt a multi-channel design, with one or more channels dedicated for control or broadcast purposes. Such static design makes it easier for an attacker to selectively target control or broadcast information. Third, the reliance on multihop routes further accentuates the WMN vulnerability to compromised relays which can drop control messages, in order to enforce a certain routing behaviour e.g., force packets to follow long or inconsistent routes.

2. SELECTIVE JAMMING ATTACKS

The open nature of the wireless medium makes it susceptible to jamming attacks. Jamming is a severe form of DoS (Denial of Service) attack. In wireless networks jamming has been primarily analyzed under an external adversarial model. Existing anti-jamming

strategies employ some form of spread spectrum (SS) communication, in which the signal is spread across a large bandwidth according to a pseudo-noise (PN) code. Though, SS can protect wireless exchanges only to the extent that the PN codes remain secret. The intermediate nodes with knowledge of the commonly shared PN codes can still launch jamming attacks. By using the information the attackers can selectively target particular channels/layers/protocols/packets. We describe two types of selective jamming attacks against WMNs, which employ channel and data selectivity.

2.1 Channel-Selective Jamming

In a typical WMN, one or more channels are engaged for broadcasting control information. These channels, known as control channels, facilitate operations such as network discovery, time synchronization, and coordination of shared medium access, routing path discovery and others, without interfering with the communications of STAs with MAPs. An adversary who selectively targets the control channels can efficiently launch a DoS attack with limited amount of resources (control traffic is low-rate compared to data traffic). To launch a selective jamming attack, the adversary must be aware of the location of the targeted channel, whether defined by a separate frequency band, time slot, or PN code. Control channels are intrinsically broadcast and hence, every deliberate receiver must be aware of the secrets that used to protect the programme of control packets. The cooperation of a single receiver, be it a MAP or an MP, discloses those secrets to the adversary.

Example: The impact of channel selective jamming on CSMA/CA-based medium access control (MAC) protocols for multi-channel WMNs. A multi-channel MAC (MMAC) protocol is engaged to coordinate access of multiple nodes residing in the same collision domain to the common set of channels. A class of MMAC protocols proposed for adhoc networks such as WMNs follows a split-phase design (e.g., [5]). In this design, time is split into alternating control and data transmission phases. During the control phase, every node converges to a default channel to negotiate the channel assignment. In the data transmission phase, devices switch to the agreed on channels to perform data transmissions. The alternating phases of a split-phase MMAC are shown in Fig. 2.

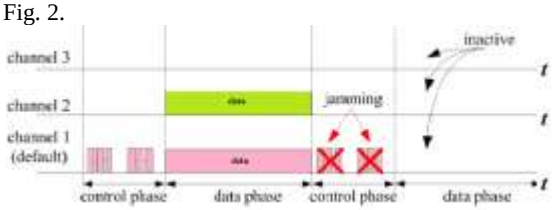


Fig. 2: A MMAC protocol that uses a split-phase design. Channel selective jamming of the default channel during the control phase prevents the use of all channels during the data transmission phase.

By using a channel-selective strategy, an inside adversary can jam only the evasion channel and only during the control phase. Any node that is unable to access the default channel during the control phase must postpone the channel negotiation process to the next control phase, thus remaining stationary during the following data transmission phase. This attack is demonstrated in Fig. 2. We can see that the impact of this channel-selective jamming attack circulated to all frequency bands at a low energy overhead, as only a single channel is targeted and only for a fraction of time.

2.2 Countering Channel-Selective Attacks

Some of the anti-jamming methods have been proposed to concentrate on channel-selective attacks from insider nodes. The entire methods deal communication efficiency for stronger resilience to jamming. We present a short description of such anti-jamming approaches.

2.2.1 Replication of control information: An instinctive approach to counter channel-selective jamming is to repeat control information on multiple broadcast channels [6]. In this case, an insider with incomplete hardware resources cannot jam all broadcasts simultaneously. Furthermore, if each node has only partial knowledge of the locations of the broadcast channels, an insider can mark only the subset of channels identified by him. Because of the limited number of available channels, the scheme provides protection against a small number of colluding attackers.

2.2.2 Assignment of unique PN codes: Different method for neutralizing channel-selective attacks is to dynamically vary the location of the broadcast channel, based on the physical location of the communicating nodes [7]. The main incentive for this architecture is that any broadcast is inherently limited to the communication range of the broadcaster. So for broadcasts intended for receivers in unlike collision domains, there is no particular advantage in using the same broadcast channel, other than the design simplicity. The assignment of unlike broadcast channels to different network regions leads to an inherent partitioning of the network into clusters. Information about the location of the control channel in one cluster cannot be subjugated at another. Moreover, broadcast communication can be restored locally should a jammer appear, without the need for re-establishing a global broadcast channel.

To care for the control channel within each cluster, following cluster formation, one mesh node is chosen as the Cluster Head (CH). The CH assigns its cluster members unique PN hopping sequences, that have significant overlap. The common locations among these PN sequences implement a broadcast channel. If an insider uses his PN sequence to jam this broadcast channel, it becomes exclusively identifiable by the CH. Once identified, the CH informs all nodes of the cluster with new PN sequences, except to the identified attacker.

The idea of assigning unique PN codes to various nodes in the network was also subjugated in [8]. In this work, nodes of a cluster are represented by the leaves of a binary tree. Each node of the tree is assigned a unique key, corresponding to a seed for the generation of a unique PN code. Every node knows all the keys along the path from the corresponding leaf to the root. In the dearth of jamming, the PN code known to all receivers (generated by the root key) is used. If jamming is detected, transmitting nodes switch to a PN code known only to a subset of nodes. The compromised node is uniquely identified in a number of steps that is logarithmic to the number of nodes within the cluster.

2.2.3 Elimination of secrets: Selective insider jamming attacks can be rebel by avoiding secrets in the first place. In the design proposed in [9], a transmitter randomly

selects a PN code from a public codebook. To recover a transmitted packet, receivers must record the transmitted signal and attempt decoding it using every PN code in the codebook. Because the PN code used to spread each packet is not known a priori, an inside adversary can only attempt to guess it, with a limited probability of success. Special care needs to be given to the management between the communicating parties (knowing the PN code is essential for discovering and "Locking onto" the transmitted signal).

2.3 Data-Selective Jamming

Further to progress the energy efficiency of selective jamming and reduce the risk of detection, an inside attacker can use a greater degree of selectivity by targeting specific packets of high importance. One way of launching a data-selective jamming attack, is by classifying packets before their transmission is completed. An example of this

Fig. 3(a) A data-selective jamming attack

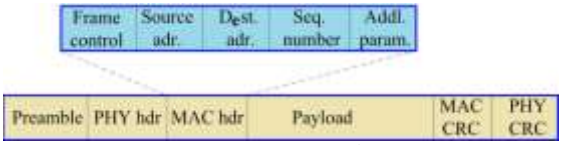


Fig. 3(b) generic packet format

attack is shown in Fig. 3(a). MP_A transmits a packet to MP_B. Inside attacker MAP_J classifies the transmitted packet after overhearing its first few bytes. MAP_J then interferes with the reception of the rest of the packet at MP_B. Referring to the generic packet format in Fig. 3(b), a packet can be classified based on the headers of various layers.

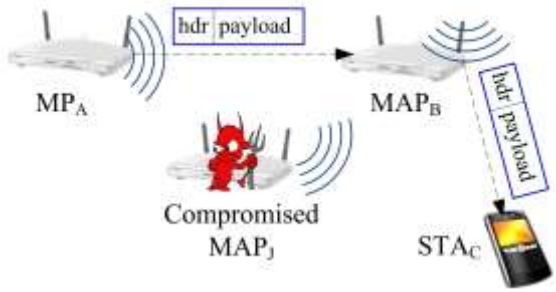


Fig. 3(c) inference of a RREP transmission on link MAPB-STAC

For example, the MAC header typically contains information about the next hop and the packet type. The TCP header reveals the end-to-end source and destination nodes, the transport-layer packet type (SYN, ACK, DATA, etc.), and other TCP parameters. Another method for packet classification is to anticipate a transmission based on protocol semantics. As an example, consider the routing function in WNMs, described in the IEEE 802.11s standard [2]. Routing is performed at the MAC layer according to the Hybrid Wireless Mesh Protocol (HWMP). The latter is a combination of tree-based routing, and on-demand routing based on AODV. Tree-based routing provides fixed path routes from the mesh nodes to the MGs. On demand routing is employed to discover routes to mobile STAs who associate with multiple MAPs due to their mobility. Consider the route discovery process depicted in Fig. 3(c). MP_A transmits a route reply (RREP) to MAPB, which is listening in by MAP_J. MAP_J can conjecture that MAP_B will forward the RREP to STA_C, and hence, jam this RREP while it is in transit to STA_C.

Packet classification can also be achieved by observing implicit packet identifiers such as packet length, or precise protocol timing information [4]. For example, control packets are usually much smaller than data packets. The packet length of an eminent transmission can be inferred by decoding the network allocation vector field (NAV) of request-to-send (RTS) and clear-to-send (CTS) messages, used for reserving the wireless medium.

2.4 Countering Data-Selective Jamming Attacks

An instinctive solution for preventing packet classification is to encrypt transmitted packets with a secret key. In this case, the entire packets, including its headers, have to be encrypted. While a shared key be sufficient to protect point-to-point-communications, for broadcast packets, this key must be shared by all intended receivers. Therefore, this key is also known to an inside jammer. In symmetric encryption schemes based on block encryption, reception of one cipher text block is sufficient to obtain the corresponding plaintext block, if the decryption key is known. Thus, encryption alone does not prevent insiders from classifying broadcasted packets.

To avert classification, a packet must remain hidden until it is transmitted in its entirety. One possible way for temporarily hiding the transmitted packet is to employ commitment schemes. In a commitment scheme, the transmitting node hides the packet by broadcasting a committed version of it. The contents of the packet cannot be inferred by receiving the commitment (hiding property). After the transmission is completed, the node releases a de-commitment value, which reveals the original packet. The commitment scheme must be carefully designed to prevent the classification of the original packet based on the partial release of the de-commitment value. Another approach is to use public hiding transformations that do not rely on secrets. An example of them is all-or-nothing transformations (AONTs), which were originally proposed to slow down brute force search attacks against encryption schemes. An AONT serves as a publicly known and completely invertible pre-processing step for a plaintext, before it is passed to an encryption algorithm. The defining property of an AONT is that the entire output of the transformation must be known before any part of the input can be computed. In our context, an AONT prevents packet classification when the AONT of a packet is transmitted over the wireless medium.

3. SELECTIVE DROPPING ATTACKS

If selective jamming is not successful due to anti-jamming measures, an insider can selectively drop packets post-reception. Once a packet has been received, the cooperated node can inspect that the packet headers, classify the packet, and decide whether to forward it or not. Such an action is often termed as misbehaviour [10]–[13]. Post-reception dropping is less flexible than selective jamming because the adversary is restricted to dropping only the packets routed through it. Nonetheless, the impact on the WMN performance can be significant.

Examples: Consider a compromised MP targeting the routing functionality in WMNs. By selectively dropping route request and route reply packets employed by the routing protocol, as defined in the of the 802.11s standard [2], the compromised MP can prevent the discovery of any route that passes through it, delay the route discovery process, and force alternative, possibly inefficient paths.

Alternatively, the compromised MP can allow the establishment of a route via itself, but throttle the rate of the end-to-end connection at the transport layer. This attack can be actualized by selective dropping of critical control packets that regulate the end-to-end transmission rate and effective throughput. For example, the dropping of cumulative TCP acknowledgments results in the end-to- end retransmission of the entire batch of pending data packets (see Fig. 4). In addition, packet loss is interpreted as congestion, resulting in the throttling of the sender's transmission rate. In another selective strategy known as the Jellyfish attack, a compromised mesh node that periodically drops a small fraction of consecutive packets can effectively reduce the throughput of a TCP flow to near zero [14]. This attack can be achieved even by inducing random delays to TCP packets, without dropping them, while remaining protocol compliant [14]. Similar selective dropping attacks can be constructed for other network functions such as the association/de-association of STAs, and topology management, to name a few.

Fig. 4. An insider selectively drops cumulative TCP acknowledgments and forces end-to-end data retransmissions.

3.1 Mitigation of Selective Dropping

Selective dropping attacks can be mitigated by employing fault-tolerant mechanisms at various layers of the protocol stack. At the routing layer, multi-path routing provides robust multi-hop communication in the presence of network faults, by utilizing more than one path from a source to a destination. Tree-based routing in HWMP already provisions for back-up paths to the MG [2]. At the transport layer, variants of the standardized TCP protocol have been specifically developed for dealing with the imperfections of the wireless medium [15]. These protocols differentiate between congestion and wireless transmission losses. A selective dropper can always attribute his losses to congestion, in order to avoid detection as a malicious node. In this case, identification mechanisms employing long-term statistics, can accurately pinpoint selective droppers.

3.1.1 Identification of Selective Droppers

Current methods for detecting misbehaviour in self organizing systems such as WMNs, can be classified into reputation systems [12], credit-based systems [13], and acknowledgment systems [10].

Reputation Systems: Reputation systems identify misbehaving nodes based on per-node reputation metrics, computed based on interactions of each node with its peers. These systems typically incorporate two critical operations: (a) the collection of accurate observations of nodes' behaviour and, (b) the computation of the reputation metric. Behavioral information is collected based on first-hand observations provided by neighboring nodes and second hand information provided by other interacting peers [12]. First-hand observations are collected by monitoring nodes which operate in promiscuous mode in order to confirm the correct forwarding of transmitted packets. Overhearing becomes problematic in the case of multichannel WMNs, because MPs and MAPs are scheduled to communicate in parallel over orthogonal frequency bands, and hence, they might not be available to monitor the behavior of other nodes. Several schemes have been proposed for managing second-hand information. A node may flood warnings to the entire network, if it detects a misbehaving node. Then again, information can be provided on-demand, after a request from a particular node has been received. In the latter scenario, flooding of the request is necessary to discover nodes that possess second-hand information. Both methods consume considerable bandwidth resources due to the underlying flooding operations for the dissemination and collection of second-hand information. Robust computation of reputation metrics is equally important for the identification of packet droppers. Simple aggregate metrics have been shown to be vulnerable to false accusations from colluding malicious nodes, and suddenly changing behavioral patterns. For instance, a misbehaving node can exhibit a long history of good behavior in order to build a high reputation metric, before it starts to misbehave. Such instances are dealt by assigning larger weights to recent behavioral observations and/or adopting additive increase-multiplicative decrease type of algorithms for updating the reputation metrics [12].

A critical challenge for any metric computation algorithm is the selective nature of packet droppers. When a very small fraction of packets is dropped, metrics that do not take into account the packet type are bound to have high rates of misdetection. Dropping selectivity can be detected with the use of storage-efficient reports (e.g., based on Bloom filters) of the per-packet behavior of nodes [11]. Based on these reports, it is possible to conduct multiple tests to identify malicious selective dropping patterns. These patterns are likely to have some deterministic structure compared to packet losses due to congestion or poor channel quality. ACK-based systems: ACK-based schemes differ from overhearing techniques in the method of collecting first-hand behavioral observations. Downstream nodes (more than a single hop

away) are responsible for acknowledging the reception of messages to nodes several hops upstream [10]. These systems are suitable for monitoring the faithful relay of unicast traffic, at the expense of communication overhead for relaying an additional set of ACKs. However, ACK-based schemes cannot be used to identify insiders that selectively drop broadcast packets. Such packets remain, in general, unacknowledged in wireless networks, to avoid an ACK implosion situation. Moreover, a small set of colluding nodes can still provide authentic ACKs to upstream nodes while dropping packets.

Credit-based systems: Credit-based systems lessen selfish behavior by incentivising nodes to forward packets [13]. Nodes that relay traffic receive credit in return, which can be later spent to forward their own traffic. However, in the context of WNMs, MPs do not generate any traffic of their own, but act as dedicated relays. Hence, compromised MPs have no incentive for collecting credit. Moreover, in the case of selective dropping attacks, misbehaving nodes can still collect sufficient credit by forwarding packets of low importance, while dropping a few packets of "high value." In addition, the credit collected by a particular node depends on the topology of the network. A highly connected node is expected to collect more credit due to the increased volumes of traffic routed through it. An adversary cooperating such a node is likely able to implement a selective dropping strategy without running out of credit. Finally, credit-based systems lack a mechanism for identifying the misbehaving node(s), allowing them to remain within the network indefinitely.

4. DISCUSSION AND CONCLUSIONS

WMNs are exposed to various external and internal security threats. While most external attacks can be alleviated with a combination of cryptographic mechanisms and robust communication techniques, internal attacks are much harder to counter because the adversary is aware of the network secrets and its protocols. Jamming resistant broadcast communications in the presence of inside jammers leftovers a challenging problem. Present solutions attempt to eliminate the use of common secrets for protecting broadcast communications. Such secrets can be easily exposed in the event of node compromise. Nevertheless, the heightened level of security comes at the expense of performance, because broadcasted messages have to be transmitted multiple times and on multiple frequency bands to guarantee robust reception.

Furthermore, even if packet reception of critical messages is ensured, inside adversaries are in complete control of the traffic routed through them. A large body of literature addresses the problem of misbehavior in the form of packet dropping by developing reputation systems, credit-based systems, and communication-intensive acknowledgment schemes. Despite the relative wealth of literature on this problem, significant challenges are yet to be addressed. Most existing methods assume a continuously active adversary that systematically drops packets. These adversaries are detected by aggregate behavioral metrics such as per-packet reputation and credit.

However, these metrics cannot detect attacks of selective nature, where only a small fraction of "high value" packets is targeted. Furthermore, when the adversary drops only a few packet, his behavior can be indistinguishable from dropping patterns due to congestion or poor wireless conditions. Further challenges include efficient behavioral monitoring mechanisms not relying on continuous overhearing and efficient maintenance and dissemination of reputation metrics.

5. ACKNOWLEDGEMENT

Firstly we thanks to Almighty for his mercy on us. We sincerely thank our Principal Dr. Syed Zakir Ali for his support and guidance. We thank to Prof. Aslam Karjagi for his support and we also thanks to Prof. Mohammed Azharuddin for his guidance and continuous encouragement. We thank our parents for their moral support and also thanks to others who have supported us.

6. REFERENCES

[1] I.F.Akyildiz, X. Wang, and W. Wang. Wireless mesh networks:a survey. Computer Networks, 47(4):445–487, 2005.

[2] IEEE P802.11s/D1.01 standard. At https://mentor.ieee.org/802.11/dcn/07/11-07-0335-00-000s-tgs-redline-between-draft-d1-00-and-d1-01.pdf, 2007.

[3] Alejandro, Proano and Loukas Lazos. Selective jamming attacks in wireless networks. In proceedings of the IEEE International Conference on Communications (ICC), 2010.

[4] T.X.Brown, J.E. James, and A. Sethi. Jamming and sensing of encrypted wireless ad hoc networks. In Proceedings of the 7th ACM International Symposium on Mobile ad hoc networking and computing, 2006.

[5] J. So and N.H. Vaidya. Multi-channel MAC for ad hoc networks: handling multi-channel hidden terminals using a single transceiver. In Proceedings of the ACM MobiHoc Conference, pages 222–233, 2004.

[6] P.Tague, M. Li, and R. Poovendran. Probabilistic mitigation of control channel jamming via random key distribution. In Proceedings of the International Symposium in Personal, Indoor and Mobile Radio Communications (PIMRC), pages 1–5, 2007.

[7] L. Lazos, S. Liu, and M. Krunz. Mitigating control-channel jamming attacks in multi-channel ad hoc networks. In Proceedings of the Second ACM Conference on Wireless Network Security (WiSec), pages 169–180, 2009.

[8] Jerry Chiang and Yih-Chun Hu. Cross-layer jamming detection and mitigation in wireless broadcast networks. In Proceedings of the ACM MobiCom Conference, pages 346–349, 2007.

[9] Christina P´opper, Mario Strasser, and Srdjan Capkun. Jamming resistant broadcast communication without shared keys. In Proceedings of the USENIX Security Symposium, 2009.

[10] K. Liu, J. Deng, P.K. Varshney, and K. Balakrishnan. An acknowledgment-based approach for the detection of routing misbehavior in MANETs. IEEE Transactions on Mobile Computing,6(5):536–550, 2007.

[11] W. Kozma and L. Lazos. Dealing with liars: Misbehavior identification via R´enyi-Ulam games. In Security and Privacy in Communication Networks, pages 207–227, 2009.

[12] Han Yu, Zhiqi Shen, Chunyan Miao, C. Leung, and D. Niyato. A survey of trust and reputation management systems in wireless

communications. Proceedings of the IEEE, 98(10):1755–1772, 2010.
[13] Y. Zhang, W. Lou, W. Liu, and Y. Fang. A secure incentive protocol for mobile ad hoc networks. Wireless Networks, 13(5):569–582, 2007.
[14] Imad Aad, Jean-Pierre Hubaux, and Edward W. Knightly. Impact of denial of service attacks on ad hoc networks. IEEE/ACM Transactions on Networking, 16(4):791–802, 2008.
[15] J. Liu and S. Singh. ATCP: TCP for mobile ad hoc networks.IEEE Journal on Selected Areas in Communications,19(7):1300–1315, 2002.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 386 - 389, 2015, ISSN:- 2319–8656

Hand Gesture Recognition using Colour Based Segmentation and Hidden Markov Model

Kshitish Milind Deo
Computer Engineering Department, Pune Institute of Computer Technology, Pune, India.

Avanti Yashwant Kulkarni
Computer Engineering Department, Pune Institute of Computer Technology, Pune, India.

Tirtha Suresh Girolkar
Computer Engineering Department, Pune Institute of Computer Technology, Pune, India.

Abstract: Automatic gesture recognition is a key technology used in Human Computer Interaction. In this paper we introduce a hand gesture recognition system which consists of 4 modules, image segmentation, feature extraction, HMM training and gesture recognition. Image or video is divided into multiple frames and segmentation process which uses colour based detection of the path of the object is applied to each frame. Feature extraction process mainly considers the orientation of the state tracked. This is done using HSV[hue-saturation value] image and contour mapping of the image. The training part of the HMM model works on basis of LRB(Left-Right-Banded)topology and uses the BW (Baum Welch) algorithm. We have used Viterbi algorithm for mapping the state to a symbol i.e. recognition. HMM is used to predict the gesture and increase the tolerance of the system to incorporate human errors.

Keywords: Hidden Markov Model (HMM), Forward Backward Algorithm, Baum Welch Algorithm, Viterbi Algorithm, Colour Segmentation.

1. INTRODUCTION

The goal of gesture interpretation is to enhance the advanced human machine communication so as to make it more close to human-human interaction. Few of the models used for this purpose are Neural Networks, Fuzzy logic and HMMs. We are going to propose a system which is based on HMM model.

In this paper, HMM model is used for dynamic hand gesture recognition. HMMs can be successfully used for both speech and two-dimensional signs, because their state based nature enables them to capture variations in duration of signs, by remaining in same state for several time frames. Gesture recognition is a step by step process which has input as sequence of image frames and output as a symbol.

Here, a system is developed to recognize geometric shapes drawn with a blue coloured object. Colour is detected and pattern of hand movement is analyzed. This gesture is divided into multiple states. Output symbols are extracted from the gesture. These form parameters for the Hidden Markov Model (HMM).Colour detection technique has been used in our proposed system so as to track the path of the object using which the desired shape is being drawn. After the detection part the main issue is how to make the computer understand the gesture. Recent works can be said to use two methods: Data-glove based methods and vision based methods. The Data Glove method uses sensor devices for digitizing hand and finger motions for multi-parametric data. For Vision-based method, the only required equipment is a camera.

Challenges in vision based system are, it needs to be background invariant and lighting insensitive.

In the upcoming sections we will see how the segmentation part is being done using colour filtering. We will briefly talk about the process of feature extraction which requires contour detection and calculation of centroid of each contour in each frame. Section 3.3 will be encompassing the explanation of how HMM training and recognition works for our system.

2. HISTORY AND LITERATURE SURVEY

There exist many reported research projects related to learning and recognizing visual behaviour. However due to its recent introduction to the vision community, only a small number have been reported which use Hidden Markov Models. HMM has been traditionally used as tool for speech recognition tool, recent researches have begun relating the speech variations to visual gestures. Moni M. A. et al in their review paper [6] have analysed various techniques and approaches in gesture recognition for sign language recognition using HMM. They have provided an overview of HMM and its use in vision based applications, working in two stages that of image capturing and processing using cameras, and the second stage for identifying and learning models has eliminated the need of previously used sensor embedded equipment such as gloves for tracking of a gesture. T. E. Stanner have employed HMM in 1995 in identifying the American Sign language. On similar grounds authors Gaus Y. F. A. et al have successfully recognized the Malaysian Sign Language[5], skin segmentation procedure throughout frames and feature extraction by centroids, hand distances and orientation has been used, gesture paths define the hand trajectory. Kalaman filters have been used by researchers to identify overlaping hand-head and hand-hand regions. In [1] Elmezain M, Al-Hamadi A, MichaelisB,have quantized features form spatio-temporal trajectories into codewords. They have used a novel method of tracking the gesture by using 3D depth map along with colour information, this helps at separating the same colour at different surfaces in a complex background. In order to separate continuous gestures a special zero codeword is defined, using the start and end points of meaningful gestures the viterbi algorithm is employed or recognition. In [2] the authors have used the LRB topology along with forward algorithm to achieve the best performance. With a recognition rate of 95.87% arabic numbers have been identified. Shrivastav R[3] use OpenCV image processing library to perform the isolation of gesture frames, the entire process form per-processing to testing. In coordination with this processing, Baum-Welch algorithm and LRB topology with forward algorithm is applied for recognition.

3. DESIGNAND ANALYSIS OF SYSTEM

3.1 Segmentation:

We use in our implementation, a colour based segmentation approach to extract the object used. Gesture video is captured using a generic web cam. For each frame in the video, contour of object (blue colour) is tracked. Minimum threshold area is given so as to put a constraint on the size of the object to be tracked, this avoids the tracking of the accidental blue colour that appears in the background. After identifying this contour we calculate the centroid of the area.

3.2 Extraction.

Selecting good features to recognize the hand gesture path play significant role in system performance. There are three basic features; location, orientation and velocity. The previous research showed that the orientation feature is the best in terms of accuracy results. Therefore, we will rely upon it as a main feature in our system. We will use the calculated centroid co-ordinates of each frame as a measure to deduce the orientation feature. Orientation is defined as the angel of the vector made by the centroid of two consecutive frames (refer Figure 1). As observation symbols for HMM this orientation is normalized. For normalization purpose we divide the 360 degree angles into 18 parts, 20 degrees each. Codewords are calculated after this normalization, to be further used(refer Figure 2.).

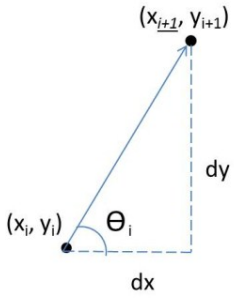


Figure 1. Orientation Calculation

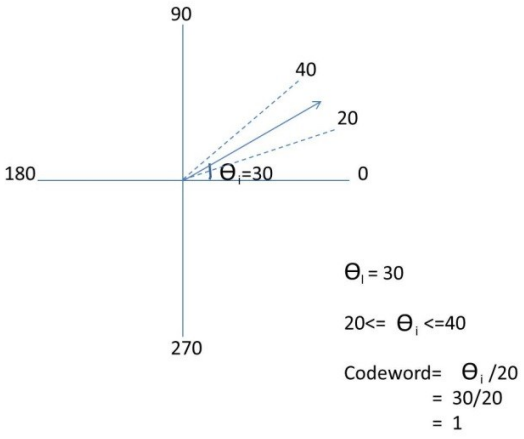


Figure 2.Codeword calculation

3.3 Recognition

HMM is a mathematical model of stochastic process. Evaluation, Decoding and Training are the main problems of HMM and they can be solved by using Forward-Backward, Viterbi and BW algorithms respectively. Also, HMM has three topologies; Fully Connected (i.e. Ergodic model) where any state can be reached from other states, LR model such that each state can go back to itself or to the following states and LRB model in which each state can go back to itself or the next state only.

3.3.1 Hidden Markov Model:

HMM = (π;*A*;*B*) where π represents initial vector, *A* is the transition probability matrix and *B* refers to emission probability matrix.

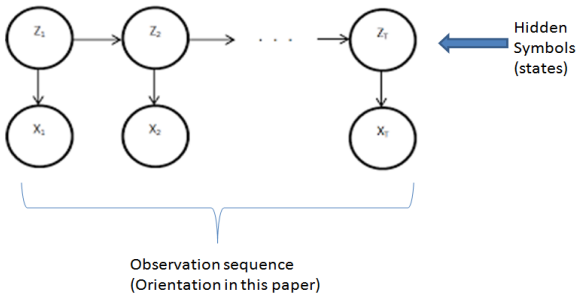


Figure 3. Trellis Diagram

In above trellis diagram, z is the hidden states and the x is the observation symbol. There is transition from z_1 to z_2 and so on to z_n. z_1 gives the observation symbol x_1, z_2 gives x_2 and so on. We can find the transition probability and the emission probability from the given trellis diagram. Transition matrix is the matrix of probabilities of the transitions of states to other states and the emission matrix is the matrix of the probability of states to emit observation symbols.

We can write the equation of HMM as

$$P(x_1,x_2,.....x_n,z_1,z_2,.....,z_n) = P(z_1)\ P(x_1 \mid z_1) \prod_{k=2}^{n} P(z_k \mid z_{k-1}) . P(x_k \mid z_k)$$

Let us write $P(x_1,x_2,.....x_n,z_1,z_2,.....,z_n)$ as P(X,Z).

Where,

$P(z_1)$ $P(x_1 \mid z_1)$ is the probability of x_1 given z_1. It is the initial state(π). We have added it as it doesnot have any previous state.

$P(z_K \mid z_{k-1})$ is the probability of z_K given z_{k-1} .This represents the transition state. Let us denote it as A.

$P(x_K \mid z_K)$ is probability of x_K given z_k .This represents the emission state. Let us denote it as B.

So the HMM equation is

$$P(X,Z)=\pi(i).B_{z1}(x_i)\prod_{k=2}^{n} A(z_{k-1}, z_k) . B_{zk}(x_k)$$

With Hidden Markov Model, we can solve following problems

1. Match most likely system to sequence of observation(using forward algorithm)
2. Determine hidden sequence generated by sequence of observations(using Viterbi algorithm)
3. To model parameters which might have generated sequence of observations(Using forward backward algorithm)

In the paper we have used, Viterbi algorithm for recognition and Baum Welch (BW) algorithm for training purpose. Forward backward algorithm is used for evaluation purpose. In forward backward algorithm, probability of z_k given x is found ie. $P(z_k|x)$.

Assumption is that HMM parameters π(initial state), transition probability and the emission probability is known. For this purpose we use forward algorithm and backward algorithm.
In forward algorithm we calculate probability of z_k given $x_{1:k}$ ie. $P(z_k|x_{1:k})$. Note that when we write $x_{1:k}$ it means $x_1,x_2\ldots\ldots,x_k$.

In backward algorithm we calculate probability of $x_{k+1:n}$ given x_k ie $P(x_{k+1:n}|x_k)$.
Thus the forward backward algorithm is the multiplication of the two probabilities generated from the forward algorithm and backward algorithm.
$P(z_k,x)=P(x_{k+1:n}|z_k,x_{1:k}).P(z_k,x_{1:k})$
In Viterbi algorithm, we find the maximum likelihood of the given sequence to the trained model. Thus the goal is to find $Z^*=argmaxP(z|x)$.

4. EXPERIMENTATION ANALYSIS

4.1 Segmentation

Our experiment consists of detecting the motion of blue coloured object. Now one issue is that different shades of blue from the background can get detected and create disturbance. To avoid this we have specified a particular range of blue intensity that is to be considered for detection. Range values used in our code are min[95,50,70,0] and max[145,255,255,0].
Another issue which we deal with is the size of blue object. To avoid detection of unnecessary blue objects we have put a constraint of area of the object to be detected i.e. the area should be greater than 1000{units}. Each frame is then passed to a filter where contours of the object are drawn.

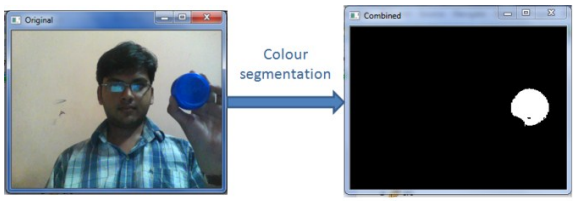


Figure 4. Image Segmentation

4.2 Feature Extraction

Here, we used the Orientation feature for extraction. We first calculated centroids of contour of each frame. Thus we got the position of the blue spot in each frame. Using position of blue spot in consecutive frames we calculated angle of orientation.
For convenience we have normalised the angle by forming groups of 20 degrees each as follows.

```
angle =  atan2(y2 - y1, x2 - x1));
                angle -=180;
            if(angle < 0){
                    angle += 360;

                }
                    Where x1,x2,y1,y2 are the coordinates of the centroid.
```

Figure 5.Code snippet for angle calculation

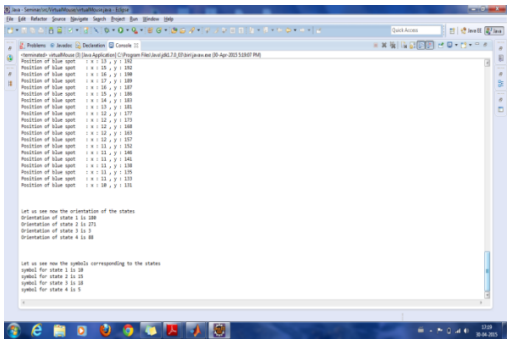


Figure 6. Centroid co-ordinates of each frame and output states and observation symbols

After normalising the orientation angles we get an associated code word for each state as follows.

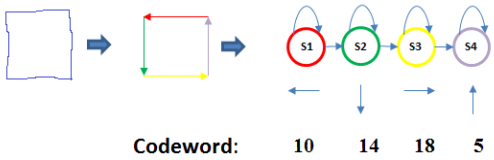


Figure 7. State Symbol Mapping for Anticlockwise square.

In above figure, s1 is first state with horizontal line from right to left. The approximate angle is 180°. After normalization we get symbol as 10. Similarly for s2 we get symbol as 14, for s3 we get 18 and for s4 we get 5.

4.3 Hidden Markov model analysis and recognition

We have got hidden states and observation symbols for analysis of HMM. From previously trained samples we have emission and transition probability matrix. This sequence of symbols is given to the viterbi algorithm for checking the likelihood of the model with the trained model. The threshold is fixed to 80% likelihood. Thus if the model matches with the given trained model, then the emission and transition matrices are modified accordingly.
However if there is no match with the given model, then next model is taken for matching.

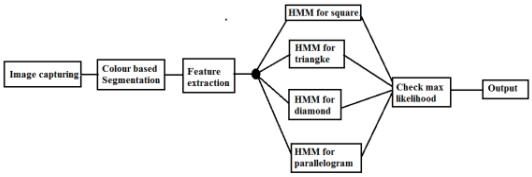


Figure 8. HMM flow diagram

4.4 RESULTS:

In this paper we analysed the algorithm for four shapes which are square, rhombus, parallelogram and triangle. The analysis includes test cases from four different users represented in the Figure 9.

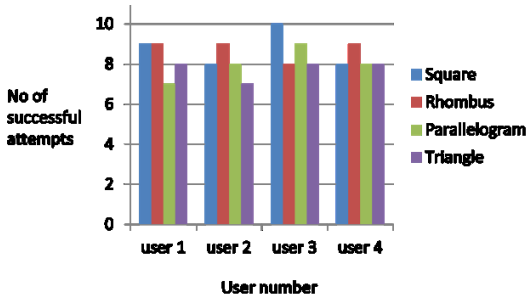


Figure 9. Analysis of Test Cases

The results obtained in the various test cases are summarized in the form of percentage accuracy for each shape in the following table 1.

Table 1. Percentage Accuracy

	Square	Rhombus	Parallelogram	Triangle
% accuracy	80	87.5	80	77.5

5. FUTURE SCOPE

The proposed system can be further developed to include different sign language gestures. This will become an interactive aid for people unable to speak. Thus they'll be able to communicate with other human beings, who are unaware of the sign language, as if they themselves were speaking. Hence our system will act as an interface between the sign language gestures and English words.

6. CONCLUSION

This paper proposes an automatic recognition system that can recognise geometric figures. The proposed system uses HMM for recognising the gestures. Further experiments would focus on larger array of geometric shapes, number and alphabets.

7. ACKNOWLEDGEMENT

We would like to acknowledge Mrs. Archana Ghotkar, Professor Pune Institute of Computer Technology, Pune for providing us this idea to work upon.

8. REFERENCE:

[1] Elmezain, M. ; Al-Hamadi, A. ; Michaelis, B, *Hand trajectory-based gesture spotting and recognition using HMM*, Image Processing (ICIP), 2009 16th IEEE International Conference on

[2] Elmezain, M. ; Al-Hamadi, A. ; Michaelis, B *,A Hidden Markov Model-based continuous gesture recognition system for hand motion trajectory,* Pattern Recognition, 2008. ICPR 2008. 19th International Conference on

[3] Shrivastava, R. ; Dept. of Electron. & Commun. Eng., Maulana Azad Nat. Inst. of Technology.,Bhopal, India, *A hidden Markov model based dynamic hand gesture recognition system using OpenCV,* Advance Computing Conference (IACC), 2013 IEEE 3rd International

[4] Gaus, Y.F.A. ; Sch. of Eng. & Inf. Technol., Univ. Malaysia Sabah, Kota Kinabalu, Malaysia; Wong, F., *Hidden Markov Model-Based Gesture Recognition with Overlapping Hand-Head/Hand-Hand Estimated Using Kalman Filter*, Intelligent Systems, Modelling and Simulation (ISMS), 2012 Third International Conference on

[5] Moni, M.A. ; Dept. of Comput. Sci. & Eng., Jatiya Kabi Kazi Nazrul Islam Univ.,Bangladesh ; Ali, A.B.M.S., *HMM based hand gesture recognition: A review on techniques andapproaches,* Computer Science and Information Technology, 2009. ICCSIT 2009. 2nd IEEE International Conference on

[6] M Elmezain, A Al-Hamadi, B Michaelis,*Hand gesture recognition based on combined feature extraction ,* Int. J. Inf. Math. Sci, 2010 [7]. TE Starner ,*Visual Recognition of American Sign Language Using Hidden Markov Models,* DTIC Document-1995

[7] R Shrivastava, *A hidden Markov model based dynamic hand gesture recognition system using OpenCV*, Advance Computing Conference (IACC), 2013 IEEE 3rd International Conference on

[8] J Yamato, J Ohya, K Ishii*, Recognizing human action in time-sequential images using hidden markov model*, Computer Vision and Pattern Recognition, 1992. Proceedings CVPR '92., 1992 IEEE Computer Society Conference on

[9] Bregler, C. ; Div. of Comput. Sci., California Univ., Berkeley, CA, USA,*Learning and recognizing human dynamics in video sequences*, Computer Vision and Pattern Recognition, 1997. Proceedings., 1997 IEEE Computer Society Conference on

[10] AD Wilson, AF Bobick*, Hidden Markov models for modeling and recognizing gesture under variation*, International Journal of Pattern Recognition and Artificial Intelligence,Volume 15, Issue 01, February 2001

[11] Wilson, A.D. ; Media Lab., MIT, Cambridge, MA, USA ; Bobick, A.F.,*Parametric hidden Markov models for gesture recognition*, Pattern Analysis and Machine Intelligence, IEEE Transactions on (Volume:21 , Issue: 9)

[12] Eickeler, S. ; Fac. of Electr. Eng., Gerhard-Mercator-Univ. Duisburg, Germany ; Kosmala,A. ; Rigoll, G.,*Hidden Markov model based continuous online gesture recognition,* Pattern Recognition, 1998. Proceedings. Fourteenth International Conference on (Volume:2)

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 390 - 394, 2015, ISSN:- 2319–8656

Skip Graph in Distributed Environments: A Review

Upinder Kaur
Department of Computer Science and Application
Kurukshetra University
Kurukshetra, India

Pushpa Rani Suri
Department of Computer Science and Application
Kurukshetra University
Kurukshetra, India

Abstract: As we see that the world has become closer and faster and with the enormous growth of distributed networks like p2p, social networks, overlay networks, cloud computing etc. Theses Distributed networks are represented as graphs and the fundamental component of distributed network is the relationship defined by linkages among units or nodes in the network. Major concern for computer experts is how to store such enormous amount of data especially in form of graphs. There is a need for efficient data structure used for storage of such type of data should provide efficient format for fast retrieval of data as and when required, in this types of networks. Although adjacency matrix is an effective technique to represent a graph having few or large number of nodes and vertices but when it comes to analysis of huge amount of data from site likes like face book or twitter, adjacency matrix cannot do this. In this paper, we study the existing application of a special kind of data structure, skip graph with its various versions which can be efficiently used for storing such type of data resulting in optimal storage, space utilization retrieval and concurrency.

Keywords: Skip List, Skip Graph, and Distributed Networks, Efficient and fast search

1 INTRODUCTION

1.1 SKIPLIST

A skip list [3] is an ordered data structure based on a succession of linked lists with geometrically decreasing numbers of items. The deterministic versions of skip list have guaranteed properties whereas randomized skip lists only offer high probability performance. This height (Hn) is the maximum length of a search path for any key from the top of the skip list. Devroye has proved that this height Hn is of order log n [10].

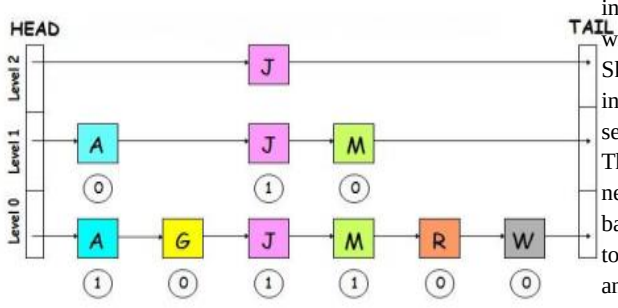


Figure 1 - Example of Skip List [13]

1.2 SKIP GRAPH

The skip graph, introduced by Aspnes and Shah in [2, 4], is a variant of the skip list, designed to perform better in a distributed environment. In a skip graph, the whole data structure can be distributed among a large number of nodes, and the structure provides good load balancing and fault tolerance properties.

As defined by author in [6] Skip graphs are data structures with similar functionality to binary trees or skip lists, permitting efficient insertion, removal and searches among elements, but they are best suitable for P2P distributed environments. Skip Graphs are composed of tower of increasingly refined linked lists in various levels, each one with no head and doubly linked. shown in fig from [6]. Skip graphs provide the full functionality of a balanced tree in a distributed system where elements are stored in separate nodes that may fall at any time as described in [3]. They are designed for use in searching peer-to-peer networks, and by providing the ability to perform queries based on key ordering, they improve on existing search tools that provide only hash table functionality. As per analysis done by James and Shah in [2, 3] on skip lists or other tree data structures, skip graphs are highly resilient, tolerating a large fraction of failed nodes without losing connectivity. In addition, constructing, inserting new elements into, searching a skip graph and detecting and repairing errors in the data structure introduced by node failures can be done using simple and straightforward algorithms. During past years interesting variants of skip

graphs have been studied, like skip nets [7], skip webs [1] or rainbow skip graphs [6].

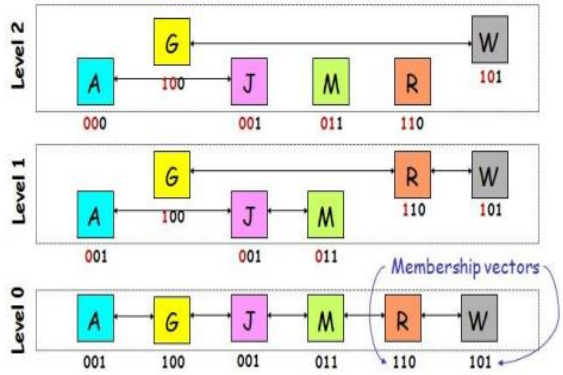


Figure 2 - Example of Skip Graph [13]

2. MODELS AND NOTATIONS

In a skip graph, each node represents a resource to be searched where node x holds two fields: the first is a key, which is arbitrary and may be the resource name. Nodes are ordered according to their keys. For notational convenience the keys are the considered to be integers 1 , 2, . . . , n. Since the keys have no function in the construction other than to provide an ordering and a target for searches there is no loss of generality. The second field is a membership vector m(x) which is for convenience treated as an infinite string of random bits chosen independently by each node. In practice, it is enough to generate an O(log n)-bit prefix of this string with overwhelming probability. The nodes are ordered lexicographically by their keys in a circular doubly-linked list

The insert operation
A new node ‘u’ knows some introducing node ‘v’ in the network that will help it to join the network. Node ‘u’ inserts itself in one linked list at each level till it finds itself in a singleton list at the topmost level. The insert operation consists of two stages: (1) Node ‘u’ starts a search for itself from ‘v’ to find its neighbours at level 0, and links to them. (2) Node ‘u’ finds the closest nodes ‘s’ and ‘y’ at each level W _ 0, s < u < y, such that m(u) _ (W + 1) = m(s) & (W + 1) = m(y) _ (W + 1), if they exist, and links to them at level W + 1. Because each existing node ‘v’ does not require m(v)(W+1) unless there exists another node ‘u’ such that m(v) _ (W + 1) = m(u) _ (W + 1), it can delay determining its value until a new node arrives asking for its value; thus at any given time only a finite prefix of the membership vector of any node needs to be generated.

The delete operation When node ‘u’ wants to leave the network, it deletes itself in parallel from all lists above level 0 and then deletes itself from level 0.

3. SKIP GRAPH IN DIFFERENT AREAS:

Skip index [15]: It is a distributed high-dimensional index structure based on peer-to-peer overlay routing. A new routing scheme is used to lookup data keys in the distributed index, which guarantees logarithmic lookup and maintenance cost, even in the face of skewed datasets.efficient performance in dynamic load balancing and handling complex queries.
Skip Webs [1]: Skip webs a framework for designing randomized distributed data structure that improves previous skip-graph/SkipNet approaches and extends their area of applicability to multi-dimensional data sets. The queries allowed include one-dimensional nearest neighbor queries, string searching over fixed alphabets, and multi-dimensional searching and point location. Our structure, which we call skip-webs, matches the O(log n/ log log n) expected query time of NoN skip-graphs [13, 14] for one-dimensional data, while maintaining the O(log n) memory size and expected query cost of traditional skip graphs [3] and SkipNet [10]. We also introduce a bucketed version of our skip-web structure, which improves the overall space bounds of our structure, while also significantly improving the expected query and update times.
Rainbow Skip Graph [8]: this is the first peer-to-peer data structure that simultaneously achieves high fault-tolerance, constant-sized nodes, and fast update and query times for ordered data. It supports successor queries on a set of n items using O(log n) messages with high probability, an improvement over the expected O(log n) messages of the family tree. The structure should be able to adjust to the failure of some nodes, repairing the structure at small cost in such casesThe structure should support fast queries and insertions/deletions, in terms of the number of rounds of communication and number of messages that must be exchanged in order to complete requested operationsThe structure should support queries that are based on an ordering of the data, such as nearest-neighbor searches and range queries.
Inverted skip graph [16] : Inverted skip graphs are capable of processing mobile node updates within the skip graph with fewer skip graph messages. In a 10,000 node network, inverted skip graphs process a mobile node's position update using a fourth of the messages (on average)

a standard skip graph requires for the same task. When a node changes geographical locations in the context of a standard skip graph, a query is required to re-assign the node in the proper position in the base list in Lo. inverted skip graph outperforms the standard skip graph, mobility performance and query execution,
SkipNet [12]: SkipNet also employs a background stabilization mechanism that gradually updates all necessary routing table entries when a node fails. Any query to a live, reachable node will still succeed during this time; the stabilization mechanism simply restores optimal routing Performing range queries in SkipNet is therefore equivalent to routing along the corresponding ring segment. Because our current focus is on SkipNet's architecture and locality properties, we do not discuss the use of range queries for implementing various higher-level data query operator
Skip Graphs++ [17] : Skip Graphs++ takes the heterogeneity of P2P networks into account. It treats the nodes differently and in Skip Graphs++ loads of nodes are proportional to capacities of nodes. Powerful nodes afford more loads and weak nodes afford fewer loads. Skip Graphs++ may be a good tradeoff. The node starts the search from its own search table, which will avoid the problem of single point failure. The total number of the node's pointers is proportional to the capacity of the node. It will be easier to achieve better load balance
SkipStream [14]: SkipStream, a skip graph based Peer-to-Peer (P2P) on-demand streaming scheme with VCR support to on-demand streaming services with VCR functionality over ubiquitous environments address the above challenges. In the design of SkipStream, we first group users into a set of disjoint clusters in accordance with their playback offset and further organize the resulted clusters into a skip graph based overlay network.. It is a distributed on-demand streaming scheduling mechanism to minimize the impact of VCR operations and balance system load among nodes adaptively. The average search latency of SkipStream is O (log (N)) where N is the number of disjoint clusters. We also evaluate the performance of SkipStream via extensive simulations. Experimental results show that SkipStream outperforms early skip list based scheme DSL by reducing the search latency 20%-60% in average case and over 50% in worst case.
Skip mard [18]: A new multi-attribute P2P resource discovery approach (SkipMard) that extends Skip Graph structure to support multi-attribute queries. SkipMard provides a prefix matching resource routing algorithm to resolve multi-attribute queries, and introduces the concepts of "layer" and "crossing layer nearest neighbor" into the data structure. To decrease message passing numbers, an approximate closest-point method is addressed that can help routing a searching key to a node with a key value that has the minimum distance between two keys. Each node has O(m*l) neighbors for total m layers and l levels in SkipMard. The expected time for a multi-attribute query is O(log N) and the message passing number is O(log N)+O(k)

Table 1. Table showing the various Skip Graph Applications.

3.1 BENEFITS OF SKIP GRAPHS IN DIFFERENT APPLICATIONS

- ***Correctness under concurrency***
  As discussed in section 2, both insertion and deletion can be comfortably done on skip graph and search operations eventually find their target node or correctly report that it is not present in the skip graph. So any search operation can be linearized with respect to insertion and deletion. In effect, the skip graph inherits the atomicity properties of its bottom layer, with upper layers serving only to provide increased efficiency. Concurrency is not handled properly in various applications.

- ***Fault Tolerance***

  Rainbow skip graph provides fault tolerance properties of a skip graph [4]. Fault tolerance of related data structures, such as augmented versions of linked lists and binary trees, has been well-studied by Munro and Poblete [11]. The main question is how many nodes can be separated from the primary component by the failure of other nodes, as this determines the size of the surviving skip graph after the repair mechanism finishes. It has been clearly proved that even a worst-case choice of failures by an adversary can do only limited damage to the structure of the skip graph. With high probability, a skip graph with n nodes has an tQ(1/logn) expansion ratio, implying that at most *O(f*log n) nodes can be separated .

- **Random failures**
  Rainbow skip graph, skipmards, skip webs and skip nets efficiently handles random failures, the situation appears even more promising, experimental results presented in [4,7,9] show that for a reasonably large skip graph nearly all nodes remain in the primary component until about two-thirds of the nodes fail, and that it is possible to make searches highly resilient to failure even without using the repair mechanism by use of redundant links.

- **Fast Search and Fault Tolerance**
  All the application of skip graph effienclty works for fast searching and fault tolerance. The average search in skip graph involves only O(logn) nodes that most searches succeed as long as the proportion of failed nodes is substantially less than O(logn) [1,8,9] . By detecting failures locally and using additional redundant edges, one can make searches highly tolerant to small numbers of random faults. In general, results cannot make as strong guarantees as those provided by data structures based on explicit use of expanders [6,7], but this is compensated for by the simplicity of skip graphs and the existence of good distributed mechanisms for constructing and repairing them

- **Load balancing**
  skip index, skip graph++, inverted skip graphs are best suitable application for load balancing in didtributed networks like p2p. In addition to fault-tolerance, a skip graph provides a limited form of load balancing, by smoothing out hot spots caused by popular search targets. The guarantees that a skip graph makes in this case are similar to the guarantees made for survivability. Just as an element stored at a particular node will not survive the loss of that node or its neighbours in the graph, many searches directed at a particular element will lead to high load on the node that stores it and on nodes likely to be on a search path. However, James has shown that this effect drops off rapidly with distance elements that are far away from a popular target in the bottom-level list produce little additional load on average [4]. Further author has provided two characterizations of this result. The first shows that the probability that a particular search uses a node between the source and target drops off inversely with the distance from the node to the target. This fact is not necessarily reassuring to heavily-loaded nodes. Since the probability averages over all choices of membership vectors, it may be that some particularly unlucky node finds itself with a membership vector that puts it on nearly every search path to some very popular target. Second characterization addresses load balancing issue by showing that most of the load-spreading effects are the result of assuming a random membership vector for the source of the search.

- ***Low hitting times***
  skip streams provides Random walks on expanders done in [7] have the property of hitting a large set of nodes fast and with high probability. This can be used for a variety of applications such as load balancing, gathering statistics on the nodes of the skip graph and for finding highly replicated.

- ***High dimensional searching and range queries***

  Skip index, rainbow skip graph, skip streams, all provides a distributed high-dimensional index structure based on peer-to-peer overlay routing. A new routing scheme is used to lookup data keys in the distributed index, which guarantees logarithmic lookup and maintenance cost, even in the face of skewed datasets.efficient performance in dynamic load balancing and handling complex and range queries.

4. CONCLUSIONS AND FUTURE SCOPE

A short survey of skip graph with various application areas provided in this paper, clearly indicate the usage and advantages of using skip graphs in various distributed and graph based applications. Since skip graphs provide the full functionality of a balanced tree in a distributed system they can be designed for use in searching peer-to-peer networks, and by providing the ability to perform queries based on

key ordering, they improve on existing search tools that provide only hash table functionality. There are still many unexplored areas where skip graphs can fine many useful applications and one such application concurrent execution of skip graph in distributed networks. Skip graphs can be used to store the data in graphs and cluster the data and above all retrieval will be very efficient and fast.

5. REFERENCES

[1] L. Arge, D. Eppstein, and M.T. Goodrich. Skip-webs: efficient distributed data structures for multi-dimensional data sets. Proceedings of the annual ACM SIGACT-SIGOPS symposium on Principles of distributed computing, pages 69–76, 2009.

[2] J. Aspnes and G. Shah. Skip graphs. Proceedings of the fourteenth annual ACM-SIAM symposium on Discrete algorithms, pages 384– 393, 2003.

[3] James Aspnes and Gauri Shah. Skip graphs. ACM Transactions on Algorithms, 3(4):37, November 2007.

[4] James Aspnes and Udi Wieder. The expansion and mixing time of skip graphs with applications. In SPAA '05: Proceedings of the seventeenth annual ACM symposium on Parallelism in algorithms and architectures, pages 126–134, New York, NY, USA, 2005. ACM.

[5] Thomas Clouser, Mikhail Nesterenko, Christian Scheideler : Tiara: A self-stabilizing deterministic skip list and skip graph . 2012 Elsevier

[6] Hammurabi Mendes , Cristina G. Fernandes - A Concurrent Implementation of Skip graphs . Electronic Notes in Discrete Mathematics 35 (2009) page no .-263-268 .

[7] James Aspnes , Udi Wieder -The expansion and mixing time of skip graphs with applications. page no 385-394 , Springer-Verlag 2008

[8] Michael T. Goodrich, Michael J. Nelson , Jonathan Z. Sun –The Rainbow Skip Graph: A Fault-Tolerant Constant-Degree P2P Relay Structure . ArXiv - 2009

[9] Fuminori Makikawa, Tatsuhiro Tsuchiya, Tohru Kikuno – Balance and Proximity-Aware Skip Graph Construction. 2010 First International Conference on Networking and Computing .

10] Shabeera T P, Priya Chandran, Madhu Kumar S D - Authenticated and Persistent Skip Graph: A Data Structure for Cloud Based Data-Centric Applications . CHENNAI, India , 2012 , ACM

[11] Ian Munro and Patricio V. Poblete. Fault tolerance and storage reduction in binary search trees. Information and Control, 62(2/3):210-218, August 1984.

[12] Jianjun Yu, Hao Su, Gang Zhou, Ke Xu - SNet: Skip Graph based Semantic Web Services Discovery . Seoul, Korea. 2007 ACM

[13] James Aspnes, Guari Shah, ppt in SODA 2003." http://www.cs.yale.edu/homes/aspnes/papers/skip-graphs-soda03.ppt"

[14] Qifeng Yu, Tianyin Xu, Baoliu Ye, Sanglu Lu and Daoxu Chen. SkipStream: A Clustered Skip Graph Based On-demand Streaming Scheme over Ubiquitous Environments. Proceedings of IC-BNMT2009, IEEE

[15] Chi Zhang Arvind Krishnamurthy Randolph Y. Wang, SkipIndex: Towards a Scalable Peer-to-Peer Index Service for High Dimensional Data. Vol ol. TR-703-04 (May 2004)

[16] Gregory J. Brault', Christopher J. Augeri2, Barry E. Mullins2, Christopher B. Mayer2, Rusty 0. Baldwin,. Assessing Standard and Inverted Skip Graphs Using Multi-Dimensional Range Queries and Mobile Nodes, MobiQuitous 2007. Fourth Annual International Conference on 6-10 Aug. 2007

[17] Wu Hengkui, Lin Fuhong, Zhang Hongke. reducing maintenance overhead via heterogeneity in skip graphs proceedings of ic-bnmt2009 ,2009 ieee

[18] Jun Ni ; Segre, A.M. ; Shaowen Wang. SkipMard: a multi-attribute peer-to-peer resource discovery approach. IMSCCS '07 Proceedings of the Second International Multi-Symposiums on Computer and Computational Sciences. 2007. IEEE

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 395 - 404, 2015, ISSN:- 2319–8656

Human Iris Recognition Using Linear Discriminant Analysis Algorithm

Gafar Zen Alabdeen Salh
Department of IT
Faculty of Computers and IT
University of Jeddah, Khulais
Jeddah, Saudi Arabia

Abdelmajid Hassan Mansour
Department of IT
Faculty of Computers and IT
University of Jeddah, Khulais
Jeddah, Saudi Arabia

Elnazier Abdallah Mohammed
Department of CS
Faculty of CS and IT
Kassala University
Kassala, Sudan

Abstract: The paper holding a presentation of a system, which is recognizing peoples through their iris print and that by using Linear Discriminant Analysis method. Which is characterized by the classification of a set of things in groups, these groups are observing a group the features that describe the thing, and is characterized by finding a relationship which give rise to differences in the dimensions of the iris image data from different varieties, and differences between the images in the same class and are less. This Prototype proves a high efficiency on the process of classifying the patterns, the algorithms was applied and tested on MMU database, and it gives good results with a ratio reaching up to 74%.

Keywords: linear discriminant analysis, iris recognition, Biometrics, False Rejection Rate, False Acceptance Rate

1. INTRODUCTION

Biometrics refers to the identification of human identity via special physiological traits. So scientists have been trying to find solution for designing technologies that can analysis those traits and ultimately distinguish between different people. Some of popular Biometric characteristic are features in fingerprint, speech, DNA, face and different part of it and hand gesture. Among those method face recognition and speaker recognition have been considered more than other during last 2 decades [1].

Iris recognition is one of the most promising approach due to its high reliability for personal identification. The human iris, which is the annular part between the pupil and the white sclera, has a complex pattern. The iris pattern is unique to each person and to each eye and is essentially stable over a lifetime. Also iris pattern of left and right eye is different. Uniqueness, stability makes iris recognition a particularly promising solution to security [3].

The iris is a thin diaphragm, which lies between the cornea and the lens of the human eye. A front on view of iris is shown in fig.1. The iris is perforated close to its centre by a circular aperture known as pupil. The function of the iris is to control the amount of light entering through the pupil. The average diameter of the iris is 12mm and the pupil size can vary from 10% to 80% of the iris diameter [2].

Iris patterns become interesting as an alternative approach to reliable visual recognition of persons when imaging can be done at distances of less than a meter, and especially when there is a need to search very large databases without incurring any false matches despite a huge number of possibilities. Although small (11 mm) and sometimes problematic to image, the iris has the great mathematical advantage that its pattern variability among different persons is enormous. In addition, as an internal (yet externally visible) organ of the eye, the iris is well protected from the environment and stable over time. As a planar object its image is relatively insensitive to angle of illumination, and changes in viewing angle cause only affine transformations; even the nonaffine pattern distortion caused by pupillary dilation is readily reversible. Finally, the ease of localizing eyes in faces, and the distinctive annular shape of the iris, facilitate reliable and precise isolation of this feature and the creation of a size-invariant representation [7].

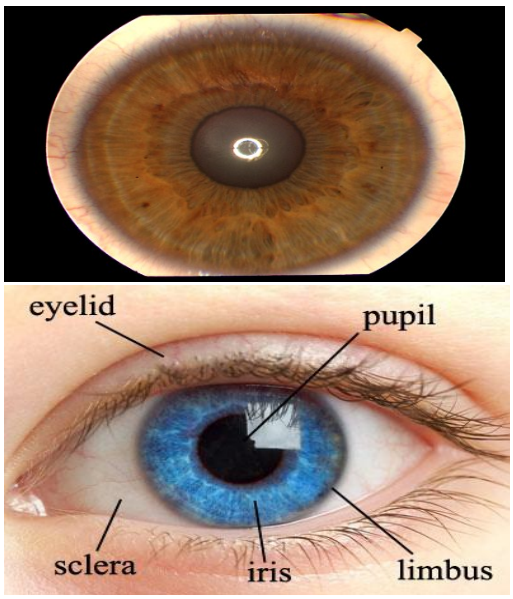


Fig 1: The Human Iris. [12]

In view of iris recognition issue, domestic and overseas scholars have done a lot of in-depth researches, and put forward many effective iris recognition methods. Iris image has high dimensionality, and its feature dimensions often exceed the number of samples, so that the iris image is sparse in high-dimensional spatial distribution. If the original features of iris image are directly entered into the classifier for

learning, in which the useless and redundant features adversely affect the iris image' recognition rate, resulting in low identify efficiency [4], [5]. In order to solve the "curse of dimensionality" and small sample size issues incurred by iris's high-dimensional feature and improve the iris recognition rate and efficiency, some scholars have proposed the sub-mode-based iris recognition algorithm [4], [6]. Sub-mode-based iris recognition algorithm refers to project the high-dimensional iris image onto the low-dimensional subspace by adopting certain dimensionality reduction methods, eliminate the useless and redundant features, and extract the iris features in low-dimensional spaces. Currentiris feature dimensionality reduction techniques consists of the Principal Component Analysis (PCA), Independent Component Analysis (ICA), Linear Discriminant Analysis (LDA), Isometric Feature Mapping (ISOMAP), Locally Linear Embedding algorithm (LLE), Laplacian Eigenmap algorithm (LE), Locality Preserving Projection (LPP) and so on. PCA, ICA, LDA are a class of linear dimension reduction method, which can only extract the global low-dimensional features. It is difficult to find the nonlinear manifold [4].

2. Overview of Linear Discriminant Analysis (LDA) :

Linear Discriminant Analysis is a well-known scheme for feature extraction and dimension reduction. It has been used widely in many applications such as face recognition, image retrieval, microarray data classification, etc. Classical LDA projects the data onto a lower-dimensional vector space such that the ratio of the between-class distance to the within-class distance is maximized, thus achieving maximum discrimination. The optimal projection (transformation) can be readily computed by applying the Eigen decomposition on the scatter matrices. An intrinsic limitation of classical LDA is that its objective function requires the nonsingularity of one of the scatter matrices. For many applications, such as face recognition, all scatter matrices in question can be singular since the data is from a very high-dimensional space, and in general, the dimension exceeds the number of data points.

Given a data matrix $A \in \mathrm{IR}^{N\times n}$, classical LDA aims to find a transformation [redacted] that maps each column a_i of A, for $1 \le i \le n$, in the N-dimensional space to a vector b_i in the -dimensional space. That is [redacted]. Equivalently, classical LDA aims to find a vector space G spanned by [redacted], such that each ai is projected onto [redacted].

Assume that the original data in A is partitioned into k classes as A = {Π1,⋯,Πk}, where

Πi contains ni data points from the ith class, and [redacted]. Classical LDA aims to find the optimal transformation G such that the class structure of the original high-dimensional space is preserved in the low-dimensional space.

In general, if each class is tightly grouped, but well separated from the other classes, the quality of the cluster is considered to be high. In discriminant analysis, two scatter matrices, called within-class (Sw) and between-class (Sb) matrices, are defined to quantify the quality of the cluster, as follows [4]:

[redacted], and

[redacted], where

[redacted] is the mean of the ith class,

And [redacted] is the global mean.

It is easy to verify that trace(Sw) measures the closeness of the vectors within the classes, while trace(Sb) measures the separation between classes. In the low-dimensional space resulting from the linear transformation G (or the linear projection onto the vector space G), the within-class and between-class matrices become SbL = GTSbG, and SwL = GTSwG.

An optimal transformation G would maximize trace(SbL) and minimize trace(SwL). Common optimizations in classical discriminant analysis:

[redacted] and [redacted] trace [redacted].

(1)

The optimization problems in Eq. (1) are equivalent to the following generalized eigenvalue problem:

[redacted]. The solution can be obtained by applying an Eigen decomposition to the matrix $S_w^{-1}S_b$, if Sw is nonsingular, or $S_b^{-1}S_w$, if S_b is nonsingular. There are at most k − 1 eigenvectors corresponding to nonzero eigenvalues, since the rank of the matrix Sb is bounded from above by k − 1. Therefore, the reduced dimension by classical LDA is at most k − 1. A stable way to compute the eigen-decomposition is to apply SVD on the scatter matrices. Details can be found in [14].

3. RELATED WORK

John Daugman [10] presents the statistical variability that is the basis of iris recognition is analyzed, using new large databases. The principle underlying the recognition algorithm is the failure of a test of statistical independence on iris phase structure encoded by multi-scale quadrature wavelets. Combinatorial complexity of this phase information across deferent persons spans about 249 degrees-of-freedom and generates a discrimination entropy of about 3:2 bits=mm2 over the iris, enabling real-time identi/cation decisions with great enough accuracy to support exhaustive searches through very large databases. This paper presents the results of 9.1 million comparisons among several thousand eye images acquired in trials in Britain, the USA, Japan and Korea.? 2002 Pattern Recognition Society. Published by Elsevier Science Ltd. All rights reserved. Shideh Homayon , [1] proposes

special type of neural network is used for iris recognition , say LAMSTAR , The LAMSTAR and modified LAMSTAR are applied on CASIA interval database. Both of them are really fast. For instant required time for training was 66.1584s and for testing 2.5939 seconds while the accuracy was 99.39% for regular LAMSTAR and 99.57% for modified LAMSTAR . Jaydeep N. Kale, Nilesh G. Pardeshi, Vikas N. Nirgude [3] , presents efficient algorithm for iris recognition using Two dimensional (2D) Discrete Fourier Transform (DFT), Algorithm is evaluated with CASIA iris image databases (version 1.0) . M. Z. Rashad1, M. Y. Shams2, O. Nomir2, and R. M. El-Awady3 [8] : proposes an algorithm for iris recognition and classification using a system based on Local Binary Pattern and histogram properties as a statistical approaches for feature extraction , and Combined Learning Vector Quantization Classifier as Neural Network approach for classification, in order to build a hybrid model depends on both features. The localization and segmentation techniques are presented using both Canny edge detection and Hough Circular Transform in order to isolate an iris from the whole eye image and for noise detection .Feature vectors results from LBP is applied to a Combined LVQ classifier with different classes to determine the minimum acceptable performance, and the result is based on majority voting among several LVQ classifier. Different iris datasets CASIA, MMU1, MMU2, and LEI with different extensions and size are presented. Since LBP is working on a grayscale level so colored iris images should be transformed into a grayscale level. The proposed system gives a high recognition rate 99.87 % on different iris datasets compared with other methods. Shibli Nisar, Mushtaq Ali Khan [9]: proposes Iris feature extraction using Mel Frequency Cepstral Coefficient (MFCC). MFCC is originally used for speech and speaker recognition. The MFCC is applied in Iris recognition and the results obtained are very accurate and satisfactory. The system first takes the eye pattern of a person and after converting to 1D signal the MFCC is applied which extracts Iris features. The features are then compared with the features obtained in Enrollment phase, and decision is made after taking Euclidean distance. Ujwalla Gawande, Mukesh Zaveri ,Avichal Kapur [11] , proposes Improving Iris Recognition Accuracy by Score Based Fusion Method Iris recognition technology, used to identify individuals by photographing the iris of their eye, The proposed method combines the zero-crossing 1 D wavelet Euler No., and genetic algorithm based for feature extraction. The output from these three algorithms is normalized and their score are fused to decide whether the user is genuine or imposter.

4. PROPOSED SCHEME

The proposed work uses the Linear Discriminant Analysis algorithm (LDA) for the purpose of human iris recognition, this system was trained by using MMU1 database it is standard database of iris, on a group of data containing 200 iris image for 20 persons (10 different samples for every person) The system is trained and classified by using the algorithm of LDA, they divided the process of this system into four phases, as shown in Figure2.

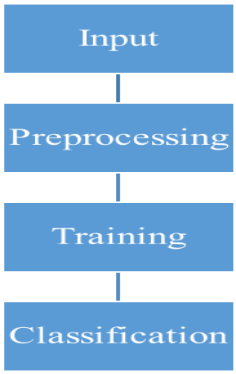


Fig 2. General structure of the system

A. input

It's the system inputs, and act as the required pattern to train or classification on it, they entered in png or bmp format.

B. Pre-processing

This phase related to samples configuring of the iris, the image will formatted and optimized, in order to take the optimal shape for training or classifying, they include (Formatting, Cropping, Resizing, Gray scaling, Filtering).

D. Training:

The system were trained on 200 image of the iris for 20 person, these image making 20 class, and each class contain 10 left iris image and 10 right iris image , as shown in the Table 1.

TABLE 1: IMAGE USED IN TRAINING PHASE

Class(1)	Iris right (1)	Class(1)	Iris left (1)
Class(2)	Iris right (2)	Class(2)	Iris left (2)
Class(3)	Iris right (3)	Class(3)	Iris left (3)
Class(4)	Iris right (4)	Class(4)	Iris left (4)
Class(5)	Iris right (5)	Class(5)	Iris left (5)
Class(6)	Iris right (6)	Class(6)	Iris left (6)
Class(7)	Iris right (7)	Class(7)	Iris left (7)
Class(8)	Iris right (8)	Class(8)	Iris left (8)
Class(9)	Iris right (9)	Class(9)	Iris left (9)
Class(10)	Iris right (10)	Class(10)	Iris left (10)
Class(11)	Iris right (11)	Class(11)	Iris left (11)
Class(12)	Iris right (12)	Class(12)	Iris left (12)
Class(13)	Iris right (13)	Class(13)	Iris left (13)
Class(14)	Iris right (14)	Class(14)	Iris left (14)
Class(15)	Iris right (15)	Class(15)	Iris left (15)
Class(16)	Iris right (16)	Class(16)	Iris left (16)
Class(17)	Iris right (17)	Class(17)	Iris left (17)
Class(18)	Iris right (18)	Class(18)	Iris left (18)
Class(19)	Iris right (19)	Class(19)	Iris left (19)
Class(20)	Iris right (20)	Class(20)	Iris left (20)

E. Classification

On this phase they taken a decision, where the recognition is done, and identification of the entered image to which specific class it belong, by using the data resulted from the training process. Then entered pattern will be compared with features of the 20 class that exist on the system by using the Linear Discriminant Analysis algorithm (LDA).

V. RESULTS OF TESTING THE SYSTEM ON MMU1 DATABASE OF IRIS

The Multimedia University has developed a small data set of 450 iris images (MMU). They was captured through one of the most common iris recognition cameras presently functioning (LG Iris Access 2200). This is a semi-automated camera that operates at the range of 7-25 cm. Further, a new data set (MMU2) comprised of 995 iris images has been released and another common iris recognition camera (Panasonic BM-ET100US Authenticam) was used. The iris images are from 100 volunteers with different ages and nationalities. They come from Asia, Middle East, Africa and Europe and each of them contributed with five iris images from each eye. [15]

The test was over twenty people and each person has ten iris images under different illuminations and distances from the camera.

I. Recognition of group 1

After testing the image of the group number 1, the system was recognized to 8 sample out of 10, as shown in the Table 2 and Fig 3.

Table 2: RECOGNITION OFGROUP 1

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

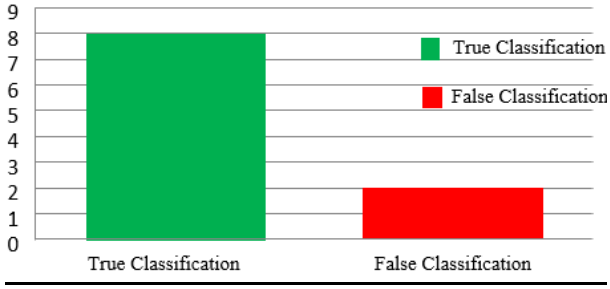


Fig 3. Recognition of group 1

II. Recognition of group 2

After testing the image of the group number 2, the system was recognized to 8 sample out of 10, as shown in the Table 3 and Fig 4.

Table 3: RECOGNITION OFGROUP 2

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

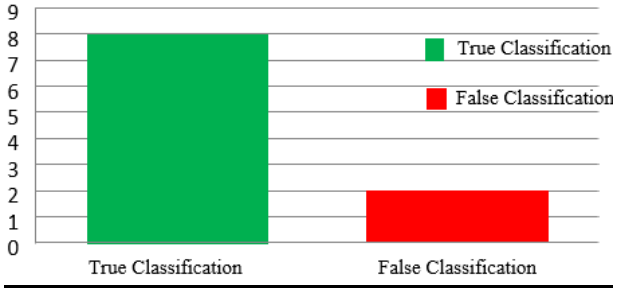


Fig4. Recognition of group 2

III. Recognition of group 3

After testing the image of the group number 3, the system was recognized to 9 sample out of 10, as shown in the Table 4 and Fig 5.

Table 4: RECOGNITION OFGROUP 3

		Frequency	Percent	Valid Percent
Valid	false Classification	1	10.0	10.0
	True Classification	9	90.0	90.0
	Total	10	100.0	100.0

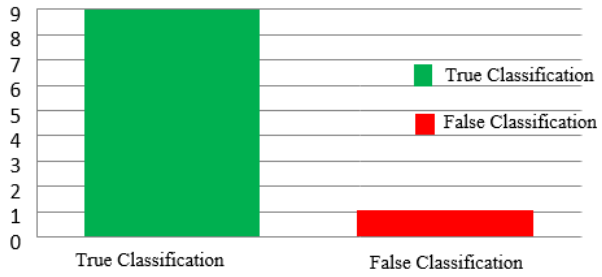


Fig 5. Recognition of group 3

IV. A. Recognition of group 4

After testing the image of the group number 4, the system was recognized to 8 sample out of 10, as shown in the Table 5 and Fig 6.

Table 5: RECOGNITION OFGROUP 4

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

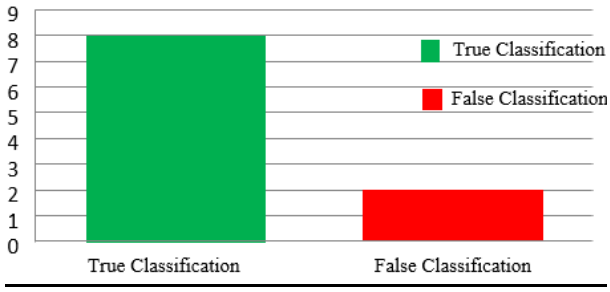


Fig 6. Recognition of group 4

V. A. Recognition of group 5

After testing the image of the group number 5, the system was recognized to 8 sample out of 10, as shown in the Table 6 and Fig 7.

Table 6: RECOGNITION OFGROUP 5

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

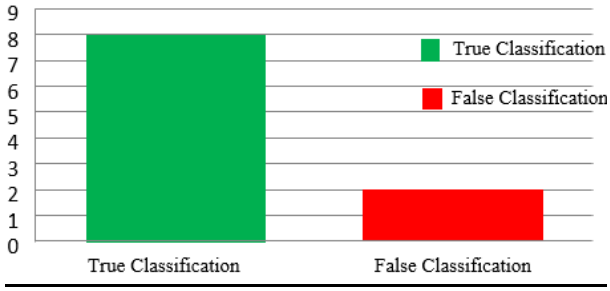


Fig 7. Recognition of group 5

VI. Recognition of group 6

After testing the image of the group number 6, the system was recognized to 6 sample out of 10, as shown in the Table 7 and Fig 8.

Table 7: RECOGNITION OF GROUP 6

		Frequency	Percent	Valid Percent
Valid	false Classification	4	40.0	40.0
	True Classification	6	60.0	60.0
	Total	10	100.0	100.0

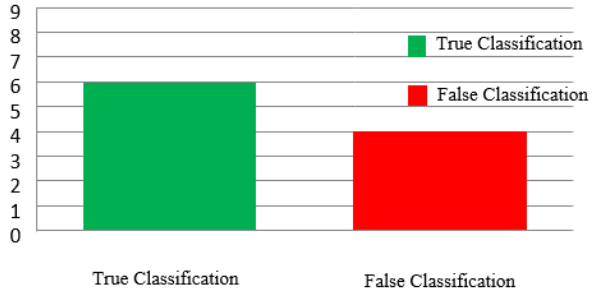


Fig 8. Recognition of group 6

VII. Recognition of group 7

After testing the image of the group number 7, the system was recognized to 7 sample out of 10, as shown in the Table 8 and Fig 9.

Table 8: RECOGNITION OFGROUP 7

		Frequency	Percent	Valid Percent
Valid	false Classification	3	30.0	30.0
	True Classification	7	70.0	70.0
	Total	10	100.0	100.0

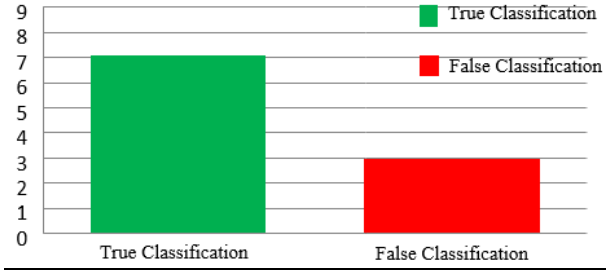


Fig 9. Recognition of group 7

VIII. Recognition of group 8

After testing the image of the group number 8, the system was recognized to 8 sample out of 10, as shown in the Table 9 and Fig 10.

Table 9: RECOGNITION OFGROUP 8

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

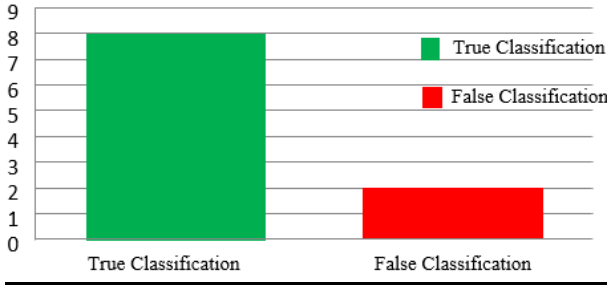


Fig 10. Recognition of group 8

IX. Recognition of group 9

After testing the image of the group number 9, the system was recognized to 8 sample out of 10, as shown in the Table 10 and Fig 11.

Table 10: RECOGNITION OFGROUP 9

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

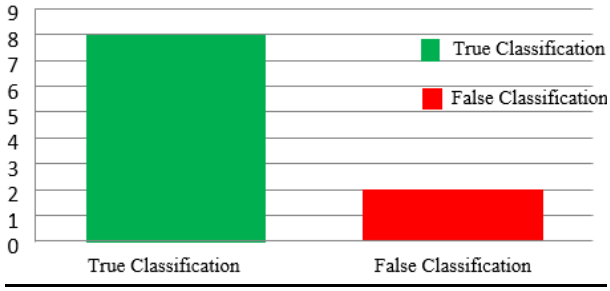


Fig 11. Recognition of group 9

X. Recognition of group 10

After testing the image of the group number 10, the system was recognized to 8 sample out of 10, as shown in the Table 11 and Fig 12.

Table 11: RECOGNITION OFGROUP 10

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

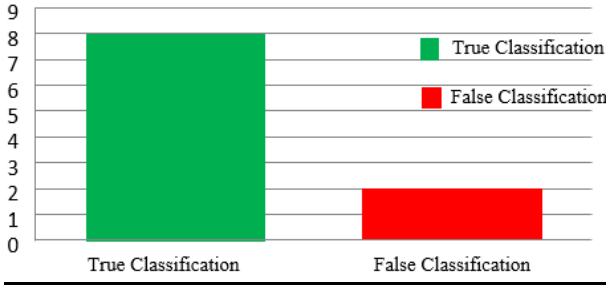


Fig 12. Recognition of group 10

XI. Recognition of group 11

After testing the image of the group number 11, the system was recognized to 7 sample out of 10, as shown in the Table 12 and Fig 13.

Table 12: RECOGNITION OFGROUP 11

		Frequency	Percent	Valid Percent
Valid	false Classification	3	30.0	30.0
	True Classification	7	70.0	70.0
	Total	10	100.0	100.0

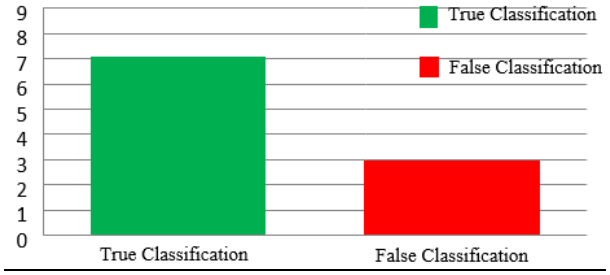


Fig 13. Recognition of group 11

XII. Recognition of group 12

After testing the image of the group number 8, the system was recognized to 7 sample out of 10, as shown in the Table 13 and Fig 14.

Table 13: RECOGNITION OFGROUP 12

		Frequency	Percent	Valid Percent
Valid	false Classification	3	30.0	30.0
	True Classification	7	70.0	70.0
	Total	10	100.0	100.0

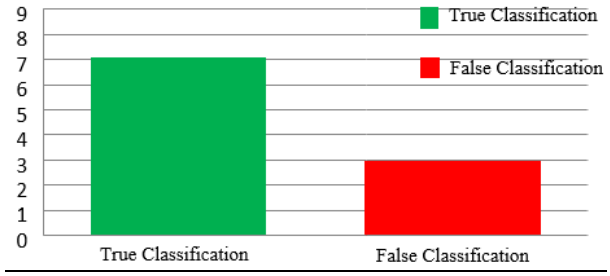


Fig 14. Recognition of group 12

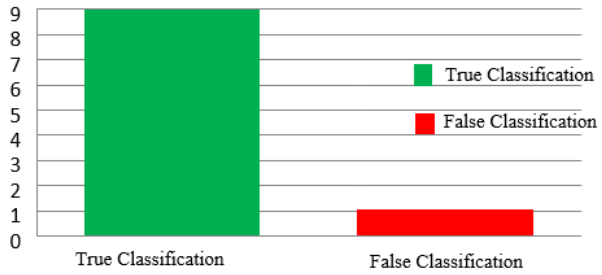


Fig 16. Recognition of group 14

XIII. Recognition of group 13

After testing the image of the group number 13, the system was recognized to 7 sample out of 10, as shown in the Table 14 and Fig 15.

Table 14: RECOGNITION OFGROUP 13

		Frequency	Percent	Valid Percent
Valid	false Classification	3	30.0	30.0
	True Classification	7	70.0	70.0
	Total	10	100.0	100.0

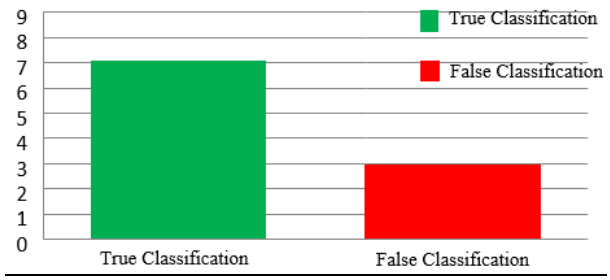


Fig 15. Recognition of group 13

XIV. Recognition of group 14

After testing the image of the group number 14, the system was recognized to 9 sample out of 10, as shown in the Table 15 and Fig 16.

Table 15: RECOGNITION OFGROUP 14

		Frequency	Percent	Valid Percent
Valid	false Classification	1	10.0	10.0
	True Classification	9	90.0	90.0
	Total	10	100.0	100.0

XV. Recognition of group 15

After testing the image of the group number 15, the system was recognized to 7 sample out of 10, as shown in the Table 16 and Fig 17.

Table 16: RECOGNITION OFGROUP 15

		Frequency	Percent	Valid Percent
Valid	false Classification	3	30.0	30.0
	True Classification	7	70.0	70.0
	Total	10	100.0	100.0

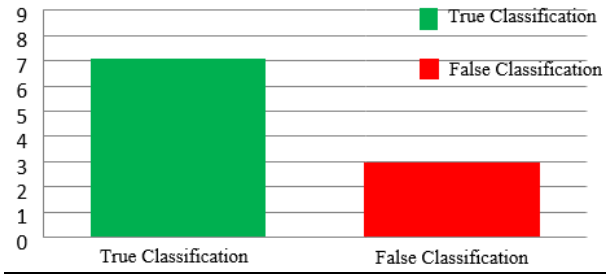


Fig 17. Recognition of group 15

XVI. Recognition of group 16

After testing the image of the group number 16, the system was recognized to 7 sample out of 10, as shown in the Table 17 and Fig 18.

Table 17: RECOGNITION OFGROUP 16

		Frequency	Percent	Valid Percent
Valid	false Classification	3	30.0	30.0
	True Classification	7	70.0	70.0
	Total	10	100.0	100.0

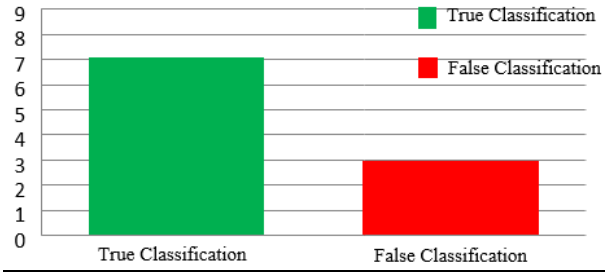


Fig 18. Recognition of group 16

XVII. Recognition of group 17

After testing the image of the group number 17, the system was recognized to 8 sample out of 10, as shown in the Table 18 and Fig 19.

Table18: RECOGNITION OFGROUP 17

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

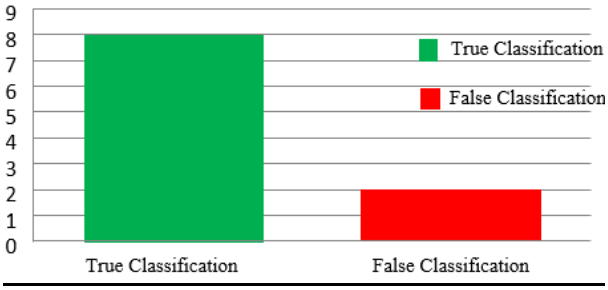


Fig 19. Recognition of group 17

XVIII. A. Recognition of group 18

After testing the image of the group number 18, the system was recognized to 8 sample out of 10, as shown in the Table 19 and Fig 20.

Table 19: RECOGNITION OFGROUP 18

		Frequency	Percent	Valid Percent
Valid	false Classification	2	20.0	20.0
	True Classification	8	80.0	80.0
	Total	10	100.0	100.0

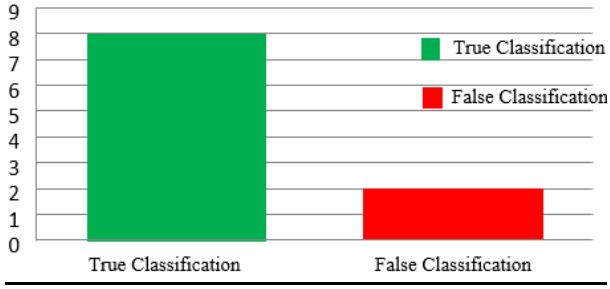


Fig 20. Recognition of group 18

XIX. Recognition of group 19

After testing the image of the group number 19, the system was recognized to 9 sample out of 10, as shown in the Table 20 and Fig 21.

Table 20: RECOGNITION OFGROUP 8

		Frequency	Percent	Valid Percent
Valid	false Classification	1	10.0	10.0
	True Classification	9	90.0	90.0
	Total	10	100.0	100.0

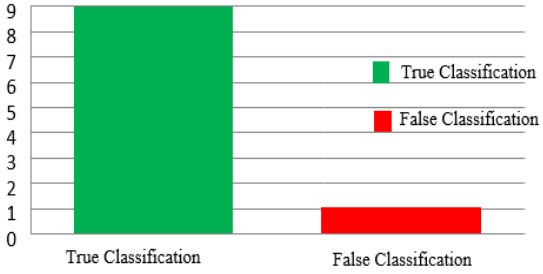


Fig 21. Recognition of group 21

XX. Recognition of group 20

After testing the image of the group number 20, the system was recognized to 7 sample out of 10, as shown in the Table 21 and Fig 22.

Table 21: RECOGNITION OFGROUP 20

		Frequency	Percent	Valid Percent
Valid	false Classification	3	30.0	30.0
	True Classification	7	70.0	70.0
	Total	10	100.0	100.0

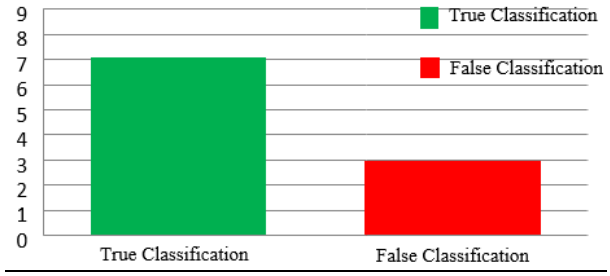


Fig 22. Recognition of group 20

XXI. Recognition of all groups

After testing the image of all groups, the system was recognized to 148 sample out of 200, as shown in the Table 22 and Fig 23.

Table 22: RECOGNITION OF ALL GROUPS

		Frequency	Percent	Valid Percent
Valid	false Classification	52	26.0	26.0
	True Classification	148	74.0	74.0
	total	10	100.0	100.0

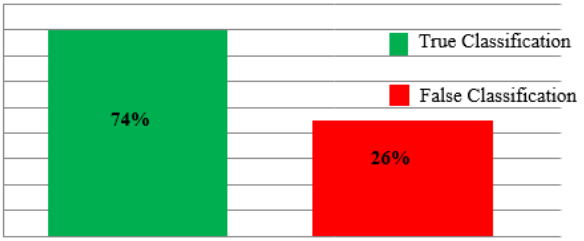


Fig 23. Recognition of all groups

40 samples were selected to measure the performance of iris recognition system .20 iris to test iris False Acceptance Rate (FAR) and 20 to test the False Rejection Rate FRR, and the results were as follows:

Table 23: CALCULATION OF FALSE ACCEPTANCE & FALSE REJECTION RATE

	False Rejection	False Acceptance
1	T	T
2	T	T
3	T	F
4	T	T
5	T	F
6	F	T
7	T	T
8	T	T
9	T	T
10	T	T
11	T	T
12	T	T
13	T	T
14	T	T
15	T	F
16	T	T
17	T	T
18	T	T
19	T	T
20	T	T

The False Acceptance Rate (FAR) = 1 /20 * 100 = 5%, as shown in Table 24 .and Fig 24.

Table 24: FALSE ACCEPTANCE RATE

		Frequency	Percent	Valid Percent
Valid	invalid	1	5.0	5.0
	valid	19	95.0	94.0
	total	20	100.0	100.0

The False Rejection Rate (FRR) = 3/20*100= 15%, as shown in Table 25 and Fig 24.

Table 25: False Rejection Rate FRR

		Frequency	Percent	Valid Percent
Valid	invalid	3	15.0	5.01
	valid	17	85.0	84.0
	total	20	100.0	100.0

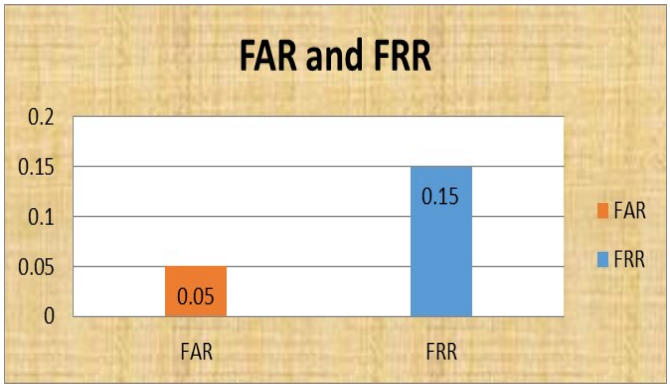


Fig 24. Result of False Acceptance & False Rejection Rate

5. CONCULSION

The paper aim to increase efficiently of iris recognition process , which was reached recognition rate amounted to 74% , the samples are trained and tested on standard database of iris (MMU), as we have acquired False Acceptance Rate, FAR) is 5 %, a ratio less than the False Rejection Rate (FRR) , which amounted to (15%)therefore, we can say that the linear discriminate analysis algorithm (LDA) highly efficient in identifying the iris recognition .

6. References

[1] Shideh Homayon, IRIS RECOGNITION FOR PERSONAL IDENTIFICATION USING LAMSTAR NEURALNETWORK , International Journal of Computer Science & Information Technology (IJCSIT) Vol 7, No 1, February 2015. DOI:10.5121/ijcsit.2015.7101.

[2] Ms. Aparna G. Gale, DR. S. S. Salankar , A Review On Advance Methods Of Feature Extraction In Iris Recognition System, IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676, p-ISSN: 2320-3331 PP 65-70 www.iosrjournals.org , International Conference on Advances in Engineering & Technology – 2014 (ICAET-2014) 65 | Page

[3] Jaydeep N. Kale, Nilesh G. Pardeshi, Vikas N. Nirgude , Improved Iris Recognition using Discrete Fourier Transform, International Journal of Computer Applications (0975 – 8887) International Conference on Recent Trends in engineering & Technology - 2013(ICRTET'2013)

[4] Yongqiang LI, Iris Recognition Algorithm based on MMC-SPP ,International Journal of Signal Processing, Image Processing and Pattern Recognition Vol. 8, No. 2 (2015),pp.1-10 http://dx.doi.org/10.14257/ijsip.2015.8.2.01

[5] Z. N. Sun and T. N.Tan,"Ordinal Measures for Iris Recognition",IEEE Trans. Pattern Analysis and Machine Intelligence ,vol. 31, no. 12, (2009), pp.2211-2226.

[6] Z. HeandL. Lv, "Iris feature extraction and recognition based on ICA-MJE and SVM",Computer Applications, vol.27, no. 6, (2007), pp.1505-1507.

[7] John Daugman, How Iris Recognition Works, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 14, NO. 1, JANUARY 2004 .pp 21-30.

[8] M. Z. Rashad1, M. Y. Shams2, O. Nomir2, and R. M. El-Awady3 ,IRIS RECOGNITION BASED ON LBP AND COMBINED LVQ CLASSIFIER , International Journal of Computer Science & Information Technology (IJCSIT) Vol 3, No 5, Oct 2011, DOI : 10.5121/ijcsit.2011.3506

[9] Shibli Nisar, Mushtaq Ali Khan, Muhammad Usman , Iris Recognition using Mel Fequency Cepstral Coefficient , International Journal of Engineering Research (ISSN:2319-6890)(online),2347-5013(print) Volume No.3, Issue No.2, pp : 100-103

[10] J. Daugman, "The importance of being random: statistical principles of iris recognition", Pattern Recognition Society, Vol. 36, pp. 279-291, 2003.

[11] Ujwalla Gawande, Mukesh Zaveri ,Avichal Kapur , Improving Iris Recognition Accuracy by Score Based Fusion Method , International Journal of Advancements in Technology (IJoAT) http://ijict.org/ ISSN 0976-4860 , Vol 1, No 1 (June 2010) ©IJoAT .

[12] Sangini Shah, Ankita Mandowara, Mitesh Patel , IRIS SEGMENTATION AND RECOGNITION FOR HUMAN IDENTIFICATION, INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY, © 2014 IJIRT | Volume 1 Issue 7 | ISSN: 2349-6002

[13] VO Dinh Minh Nhat and SungYoung Lee (2007). Image-based Subspace Analysis for Face Recognition, Face Recognition, Kresimir Delac and Mislav Grgic (Ed.), ISBN: 978-3-902613-03-5, InTech, Available from:http://www.intechopen.com/books/face_recognition/image-based_subspace_analysis_for_face_recognition

[14] J. Ye, R. Janardan, and Q. Li, "Two-dimensional linear discriminant analysis," Advances in Neural Information Processing Systems (NIPS2004), 17:1569-1576, 2004.

[15] "MMU Iris Image Database: Multimedia University," http://pesona.mmu.edu.my/ccteo; 2004

Authors Profile

Dr. Gafar Zen Alabdeen Salh Hassan, Assistant Professor, Department of Computers and Information Technology, University of Jeddah, Faculty of Computers and Information Technology, Khulais, Jeddah, Saudi Arabia..
Permanent Address: Department of Information Technology, Faculty of computer Science and Information Technology, Alneelain University, Khartoum, Sudan.

Dr. Abdelmajid Hassan Mansour Emam, Assistant Professor, Department of Computers and Information Technology, University of Jeddah, Faculty of Computers and Information Technology, Khulais, Jeddah, Saudi Arabia.
Permanent Address: Department of Information Technology, Faculty of computer Science and Information Technology, Alneelain University, Khartoum, Sudan.

Elnazier Abdallah Mohammed Elhassan, Lecturer, Department of computer Science, Faculty of computer Science and Information Technology, Kassala University , Kassala, Sudan

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 405 - 408, 2015, ISSN:- 2319–8656

Evaluation of automated web testing tools

Mohamed Monier
Information System Department,
Faculty of Computers and Informatics, Zagazig University, Egypt.

Mahmoud Mohamed El-mahdy
Information System Department,
Faculty of Computers and Informatics, Zagazig University, Egypt.

Abstract: Software testing is a main part of Software Development Life Cycle and one of the important aspects of Software Engineering. There is a wide variety of testing tools which require or not the user experience in testing software products. According to the daily use, Mobile and Web applications take the first place in development and testing. Testing automation enables developers and testers to easily automate the entire process of testing in software development saving time and costs. This paper provide a feasibility study for commercial and open source web testing tools helping developers or users to pick the suitable tool based on their requirements.
Keywords: Black Box Testing; web testing tools; open source; Commercial;

1. INTRODUCTION

Software Testing aims to evaluating the software quality and to what degree the efficiency of that product. Testing Process including many aspects such as reliability, usability, integrity, maintainability and compatibility [1].

The Two main types of Software testing Black Box Testing and White Box [2].Black Box Testing concerned with the specification of the System component under test which not require intensive knowledge about the internal structure of the system. White box strategy otherwise require high experience of the internal system code for developing test suits suited the test cases.

Web and Mobile applications have become very complex and crucial, Most of researches focused attention to Web application design, development, analysis, and testing, by studying and proposing methodologies and tools [3].Mobile applications developed over more than platform which need more experience in the developing environment and structure of applications to be designed and developed.

Software Testing follow two ways manual or automation. Manual Testing has many drawbacks such as consuming time and cost, require experience, complex reusing, less efficiency and not provide scripting facility for code [4].Automation testing reveal all complex Obstacles attached with manual testing, this type of testing create a scenarios by recording the interaction with the system under design into test cases to be tested under many Configurations [5].

Automated testing tools exist widely in the market varying in the capabilities and features which make the user puzzled for which tool suitable for his testing purpose [6]. There are two types testing tools commercial and open source tools. Open source tools are free for users to use with open source code to be modified. On the other hand, Commercial tools take advantage in organizations and mentoring capabilities providing the user with facilities needed to accomplish tasks with extra controlled features and low efforts.

The Objective of this paper is to present feasibility study of automated web testing tools through comparing the tools features for helping users to select suitable tools according to their requirements based on a study of tool's major criteria. The paper divided into sections. Section I provide a brief overview of testing tools. Section II discuss the tools features and criteria used as input to the model. Section III discuss the related work. Section IV Methodology Section V finally provide the conclusion and future work.

2. RELATED WORK

Last researches interested in comparing the capabilities of the testing tools by practicing them or only based features each tool support. Harpreet Kaur, Gagan Gupta conduct a comparative study among selenium, Test Complete and QTP tools the study include many aspects but not drag the automation features of tools such as record and play-back, cross platform or browsers support features [7]. Abha Jain, Manish Jain, Sunil Dhankar[8] compare two commercial tools Ranorex vs. QTP including many features but the main concern on the cost of the total project and the study not include any open source software to compare against. Angmo, R and Sharma, M [9] compare the performance of selenium web driver against watir-web driver the two open source software, Study includes performance parameters such as execution speed which vary in the type of tested Controls. This research is efficient but require more than one tool to give the best judge to the user.

3. METHODOLOGY

There are a lot of web testing tools exist on the market commercial or open source. We select the tools that perform the automation testing using record scripts and then playback this scripts as an important feature in testing automation.

3.1 Automated Software testing tools

3.1.1 Selenium webdriver

Selenium IDE is a one of the most popular free open-source automated testing tool which provide a testing framework for testing web applications and supporting multiple kind of frameworks. It can be easily downloaded from internet as a plug-in for some browsers. It is basically used by the web development community to perform automated testing of web applications. We choose in our study Selenium web-driver because Selenium IDE not support record-playback feature and also it most supportive for web-application testing [10].

3.1.2 Sahi

Sahi is an open source provide a testing framework based on Ruby and java script supporting the most types of web browsers and platforms. Sahi provides powerful abilities for recording and replaying across browsers; different language drivers for writing test scripts (Java, Ruby) and support for AJAX and highly dynamic web application Sahi used by IBM developers for web applications testing automation [11].

3.1.3 Watir-web driver

Watir is an abbreviation for Watir application testing in Ruby. Is a powerful open source tool that requires programming skills in ruby language [12].We choose Watir web-driver for evaluation study in web automated testing as it support record-playback capability. It is available as RubyGems and capable of driving variety of browser including the major like Internet Explorer, Firefox etc. [13]. *Bret Pettichord and Paul* Rogers developed Watir. Watir project is composed of several other projects of which watir-classic, watershed and watir webdriver are important.

3.1.4 Quick Test Profession

Quick Test Profession is an automated testing tools based on graphical interface record playback capability [14]. It works by identifying the objects in the application user interface or web page and performing desired operations (such as mouse and keyboard events).QTP uses a VBScript scripting language to specify test procedures and manipulate activities. Automated testing tool QTP provides the industry's good solution for functional test and regression test automation – addressing every major software application and environment. Quick Test Professional also enables testing Java applets and applications, and multimedia objects on Applications as well as standard Windows applications, It works by identifying the objects in the application user interface or a web page and performing desired operations (such as mouse clicks or keyboard events); it can also capture objects properties [15].

3.1.5 Ranorex

Ranorex is a commercial and complete image-based detection tool used for programmed testing [16]. Ranorex perform testing based on Image detection and facility to record and playback. It does not necessitate to study a scripting language, since it is written in pure .net code using C#, VB.net and Iron Python. Ranorex recommended for expanded projects with new license for tools as it cost benefits but the support restricted only to companies.

3.1.6 Test Complete

TestComplete is a testing automation tool formulated as Smart Bear testing framework [17]. It makes available the testing of windows and web applications and is one of the primary functional testing tools in the world. TC is a graphical record-playback automation tool which supports various testing types and methodologies: unit testing, functional and GUI testing, regression testing, distributed testing.TC provide recording and capabilities of generation of test scripts.

3.1.7 Telerik

Telerik is a market-leading vendor of UI controls, end-to-end solutions for web and mobile applications development across all major development platforms [18]. Telerik empowers over one million developers to create compelling experiences across web and mobile applications taking the advantage of record and playback tested scripts to validate user interaction with the system. [18]Telerik Perform complex UI actions like Drag-n-drop and pure UI actions on web pages and provide comfort and speed web application testing against many browsers by only change browser type and settings.

3.1.8 Coded UI

Coded UI is an automated testing framework that used for analyzing and testing user interfaces. Developers create a coded UI test that can test the user interface for an application functions correctly [19]. Testing performs actions on the user interface controls for an application and verifies that the correct controls are displayed with the correct values. Developer create coded UI testing cases by recording the actions of user with applications or by writing test cases using visual studio platform and then playback this scripts for verification of user interactions.

3.2 Tools Features

The features below used for the evaluation process for distinguishing the capability of each tool versus the others [20]. Each parameter are listed with the up to date value based on intensive searching at tool's support website and last research papers. Table below list all evaluation parameters with the meaning of parameters.

Table 1: Evaluation Parameters

Features	Explanation
Cross platforms.	To what degree tool support operating system
Cross –Browsers.	How many browsers tools able to work with
Record-Playback.	The ability of tool to record scripts to be run under different conditions.
Script-language.	Programming language used to edit testing scripts or for the creation of testing scripts
Ease of Learning.	Working with GUI easy or not
Data-Driven Framework.	The ability of tool to reduce efforts.
Programming skills.	Require programming skills or based on predefined steps
Online-Support.	Provide support or not for sudden situations and troubleshooting
Training-Cost (USD).	The cost of tool training cost if exist
Debugging support.	Does the tool has the mechanism to handle error and provide debug or not
Report Generation.	Effective analysis for test script

4. EVALUATION STUDY

There are a number of open source and commercial windows, web and mobile application tools available in the software market [21]. Although the core functions of these tools are similar, they differ in functionality, features, usability. Keeping in view the previous mentioned aspects, we have selected the more usable web testing tools for comparison taking in consideration tools that support record-playback feature which are Selenium, Quick Test professional, Test Complete , Ranorex , Sahi ,Telerik and CodedUI. Our research work comprises of the analysis of different automated web testing tools based on the features each one support. For our comparative study we use the current version of each open source tool and the demo of commercial one. The table below constructed based on the features listed before providing the mainly features chained with each tool versus other tools. We drag commercial and open source tools for two reasons, first the main concern of each tester is how much the tool cost? And is it fulfill his needs? The open source tools take the advantage of it has low or no cost for use, maintain and distribute but the main disadvantage is it is not straight forward to use. In the other side, the commercial tools give the user the guide steps and full support to do his work under license agreement. The features not contain the experimental records for the tools but only the usability features which chained with the tools.

The evaluation study presented in a tabular form providing the evaluation study of the tools under study according to criteria mentioned before. The study give the user the basis view of how to select the suitable tools based on his/her requirement .the study list usability features of each tool against other tools and give the user near view of how to make a selection.

Table 2: Evaluation study of automated web testing tools.

Tools/criteria	Selenium-web driver	Sahi	Watir-web driver	QTP	Ranorex	Test Complete	Telerik	Coded UI
Pricing (USD)	Open source	Open Source	Open Source	8000	1855	1,069	2,999	999
Cross Platform	Windows Only	Windows –Mac	Windows-Mac-Linux	Windows Only	Windows Only except XP	Windows 7 and Higher	Windows Vista and Higher	Windows 7 and Higher
Browsers-support	Chrome-Firefox-IE-Opera	All Browsers	Chrome-Firefox-IE-Opera	IE-Firefox-Chrome	IE-Firefox-Chrome-Safari	IE-Firefox-Opera-Chrome	All Browsers	IE Only
Record-Playback	Support	Support	Support	Support	Support	Support	Support	Support
Script-Language	Ruby-java-python-php- java script	Java script -Ruby	Ruby based	VB Script	VB script	VBScript-C#-Jscript	VB.net-C#	VB.net-C#
Ease of Use	Experience needed	No experience	No experience	Easy to learn in a short time	Experience needed	Experience needed	Experience needed	Experience needed
Data-Driven Framework	Excel-CSV	CSV	XML- Excel files	Excel files-text files-XML-DB files	CSV-Excel-SQL	CSV-Excel-SQL	Excel files-text files-XML-DB files	CSV-Excel-SQL
Programming skills	Required	Partially	Partially	Partially	Partially	Required	Required	Required
Online-Support	Strong Support	Strong Support	Weak support	Licensed	Strong Support	Strong Support	Strong Support	Strong Support
Training-Cost (USD)	350	No training cost	No training cost	250	1087	449	349	1251
Debugging support	Strong	Partially	Partially	Strong	Strong	Strong	Strong	Strong
Report Generation	HTML	HTML	HTML,XML	HTML	HTML	HTML,XML	HTML, XLS , PDF, CSV	HTML

5. CONCLUSION AND FUTURE WORK

Our research work comprises of the analyzation of different automated web testing tools for not also commercial but also involve open source tools. This study helping in selecting the suitable tools based on multiple criteria. Selecting tools in this area, it is important to consider multiple parameters which vary among different requirements, many requests in the market make the cost the first target to be considered, in the other hand some open sources software didn't provide support for its user as it work under user experience .The study present each tools with features which in the same and different degree with other tools and how each tool behave against others tools' features .This comparative study can be the basis for developing a model facilitate selecting the most applicable tools based on the needed requirements.

Our future work will encounter more tools and more features also that will help in building a user based requirement model. This model also will help researches to select tools helping their research work.

6. REFERENCES

[1] Ms. Shikha maheshwari1 „A Comparative Analysis of Different types of Models in Software Development Life Cycle" International Journal of Advanced Research in Computer Science and Software Engineering Volume 2, Issue 5, May 2012.

[2] Boydens, Jeroen. Location transparency and transactions as first-class concepts in object-oriented programming languages. Diss. PhD thesis, KU Leuven, 2008.

[3] Bellettini, Carlo, Alessandro Marchetto, and Andrea Trentini. "TestUml: user-metrics driven web applications testing." Proceedings of the 2005 ACM symposium on applied computing. ACM, 2005.

[4] Prof. (Dr.) V. N. Maurya, Er. Rajender Kumar "Analytical Study on Manual vs. Automated Testing Using with Simplistic Cost Model",International Journal of Electronics and Electrical Engineering ISSN:2277-7040 Volume 2 Issue 1 (January 2012).

[5] Jomeiri, Alireza. "A SURVEY ON WINDOWS-BASED WEB TESTING TOOLS." International Journal of Academic Research 6.4 (2014).

[6] Binder, Robert. Testing object-oriented systems: models, patterns, and tools. Addison-Wesley Professional, 2000.

[7] Harpreet kaur et al Int. Journal of Engineering Research and Applications ISSN : 2248-9622, Vol. Issue 5, Sep-Oct 2013, pp.1739-1743

[8] Abha Jain, Manish Jain, Sunil Dhankar International Journal of Engineering, Management & Sciences (IJEMS)ISSN-2348 –3733, Volume-1, Issue-1, January 2014

[9] Angmo, Rigzin, and Monika Sharma. "Performance evaluation of web based automation testing tools." Confluence The Next Generation Information Technology Summit (Confluence), 2014 5th International Conference-. IEEE, 2014.

[10] Bruns, Andreas, Andreas Kornstadt, and Dennis Wichmann. "Web application tests with selenium." Software, IEEE 26.5 (2009): 88-91

[11] http://www.ibm.com/developerworks/library/wa-sahi

[12] "Watir Automated testing that doesn't hurt," [Online]. Available: http://watir.com//

[13] B. Marick, Everyday Scripting with Ruby: For Teams, Testers, and You, The Pragmatic Programmers, 2007, 2007.

[14] Dustin, Elfriede, Jeff Rashka, and John Paul. Automated software testing: introduction, management, and performance. Addison-Wesley Professional, 1999

[15] Nguyen, Hung Q. Testing applications on the Web: Test planning for Internet-based systems. John Wiley & Sons, 2001.

[16] Jain, Abha, Manish Jain, and Sunil Dhankar. "A Comparison of RANOREX and QTP Automated Testing Tools and their impact on Software Testing." IJEMS 1.1 (2014): 8-12.

[17] Dubey, Neha, and Mrs Savita Shiwani. "Studying and Comparing Automated Testing Tools; Ranorex and TestComplete." IJECS 3.5 (2014): 5916-23.

[18] http://www.telerik.com/teststudio

[19] Nagarani, P., and R. Venkata Ramana Chary. "A tool based approach for automation of GUI applications." Computing Communication & Networking Technologies (ICCCNT), 2012 Third International Conference on. IEEE, 2012.

[20] Mohd. Ehmer Khan, "Different Forms of Software Testing Techniques for Finding Errors,"IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 3,No 1, May 2010.

[21]http://www.softwareqatest.com/qatweb1.html

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 409 - 413, 2015, ISSN:- 2319–8656

A Scalable Two-Phase Top-Down Specialization Approach for Data Anonymization Using Map Reduce on Cloud

R.Thaayumaanavan
Bharath University
Chennai-600073

J.Balaguru
Bharath University
Chennai-600073

N.Priya
Bharath University
Chennai-600073

Abstract: : More number of users requires cloud services to transfer private data like electronic health records and financial transaction records. A cloud computing services offers several flavors of virtual machines to handle large scale datasets. But centralized approaches are difficult in handling of large datasets. Data anonymization is used for privacy preservation techniques. It is challenged to manage and process such large-scale data within a cloud application. A scalable two-phase top-down specialization (TDS) approach to anonymize large-scale data sets using the Map Reduce framework on cloud. It is used to investigate the scalability problem of large-scale data anonymization techniques. These approaches deliberately design a group of innovative Map Reduce jobs to concretely accomplish the specialization computation in a highly scalable way. The Top-Down Specialization process speeds up the specialization process because indexing structure avoids frequently scanning entire data sets and storing statistical results.

Keywords: map reduce,TDS approach,cloud computing,large scale data set anonymization,privacy preservation,scalable two-phase top-down specialization approach

1. INTRODUCTION

A cloud computing provides efficient computation power and storage capacity via utilizing a large numbers of computers together. On cloud health service, users from various distributed computers can send and share the data in it. Private data like electronic health records or financial transactions are extremely more sensitive if they are used by research centre /accounting entries. They are two conflicting goals that is maximizing data usage and minimizing privacy risk. While determining the best set of transformations has been the focus of extensive work in the database group, the vast majority of this work experienced one or both of the following major problems: scalability and privacy guarantee.

2. EXISTING SYSTEM:

In many cloud applications, data are corrupted in accordance with big data trend while transferring data from one part to another part. At present, we are used software tools like data anonymization via generalization to satisfy certain privacy requirements such as k-anonymity is a widely used category of privacy protecting procedures. Expansive scale datasets have incorporated with cloud applications to provide powerful computation capability. Data anonymization refers to hiding identity and/or sensitive data for owners of data records. Data anonymization approach is used TDS algorithms to handle large scale data sets. It is a challenge to achieve privacy preservation on privacy-sensitive large-scale data sets due to their insufficiency of scalability . Inadequacy inhandling large scale data sets in cloud application.It is failed to achieve high efficiency and File encryption is much difficult

3. PROPOSED SYSTEM:

Data anonymization is difficult in handling of large datasets in cloud applications. It is very challenged to achieve privacy preservation techniques and insufficiency of scalability. To this end, we propose a scalable two-phase top-down specialization (TDS) approach to anonymize large-scale data sets using the Map Reduce framework on cloud. It handles two phase, 1) data partition which describes large datasets are clustered function. 2) Anonymization Level merging which describes clustered tasks are merged into a large-scale dataset. Two- phase TDS combined with Map Reduce framework to reduce unsecured data and maintenance.

Advantages:

It is very easy to access large data set in cloud applications.
The combinations of two-phase TDS, data anonymization and encryption are used in efficient way to handle scalability.

Private data are secured in storage and send transaction forms.

4. SECTIONS
. MODULES:

Login Module:

Administration persons are securely login to our storage management by them via identification and authorization. Only authorized holders enter to view cloud storage information. If the patient wants to view their information or status, they are typing their hospitalization identity number. The users are seen their status when enter the identification number.

Administration Module:

Hospitalization authorities are stored new patient information into the datasets. If the patients are already come into this hospital, update their status via patient treatments. When authorities are want to view some patient information to analyze about health specialization, particular data is required to view full details for preservation of data in cloud applications.

Customer Module:

If other person wants to know particular patient information, patient identification number or hospitalization id must know to view full information. Third parties enter the correct identification number in the customer module. The identification number is validated by login module. If number is correct, patient full details are viewed by the third parties. Customer module is read only module. It does not change or update by patient or any other persons.

Data clustering Module:

Organization persons view all patient information in one selection of administration module. In this module, large datasets are separated by category/department wise. Heart patients are stored separately among all patient information. Likewise, other departments are stored in distinguishable way. The anonymization merge tables are viewed by Data clustering module. The two-phase top down specialization algorithm are applied into the data clustering module to classify each type of category like headache, heart patient, knee department etc. Data are split up into several parts by using first phase of TDS algorithms and data are merged into large datasets by using second type of TDS algorithms. Map is used to data specialization and Reduce framework is used to handle correct dataset organizations.

Privacy Module:

Privacy preservation Techniques are used to data storage applications. Administration authority's data are sometimes easily hacked by malicious users. Overcome of hacker's knowledge, privacy modules use the preservation techniques such as encryption and decryption formats. The special identification of patient is encrypted by authorities and it will store to database in encrypted data. It will decrypt for viewer to read identification is correctly encrypted or not. Two tables are merged to view full details of patient information. In that table, Encrypted identification number is stored replace of original number.

LITERATURE SURVEY:

In the database world, the enterprise data management world, "Big Data" problems arose when enterprises identified a need to create data warehouses to house their historical business data and to run large relational queries over that data for business analysis and reporting purposes. Storage and efficient analysis of such data on "database machines" that could be dedicated to such purposes. Early database machine recommendations involved a mix of novel hardware architectures and designs for prehistoric parallel query processing techniques. Within a few years it became clear that neither brute force scan-based parallelism nor proprietary hardware would become sensible substitutes for good software data structures and algorithms.

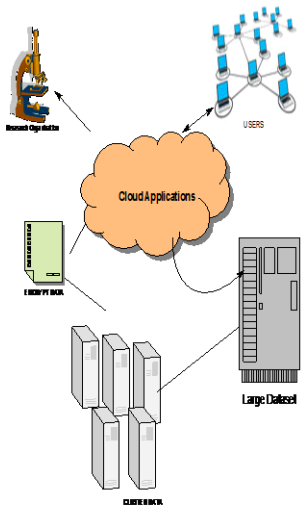
This realization led to the first generation of software-based parallel databases based on the architecture now commonly referred to as "shared-nothing". The architecture of a shared-nothing parallel database system, as the name implies, is based on the use of a networked cluster of Individual machines each with their own private processors, main memories, and disks. All inter-machine coordination and data communication is accomplished via message passing. These

systems exploited the declarative, set-oriented nature of relational query languages and pioneered the use of divide-and-conquer parallelism based on hashing in order to partition data for storage as well as relational operator execution for query processing. A *distributed anonymization protocol* that allows multiple data providers with horizontally partitioned databases to build a virtual anonymize database based on the integration (or union) of the data. As the output of the protocol, each database produces a local anonymize dataset and their union forms a virtual database that is guaranteed to be anonymous based on an anonymization guideline. The convention uses secure multi-party *computation* protocols for sub-operations such that information disclosure between individual databases is minimal during the virtual database construction. L*site-diversity*, to ensure anonymity of data providers in addition to that of data subjects for anonymize data. We present heuristics and adapt existing anonymization algorithms for $l - site - diversity$ so that anonymize data achieve better utility. There are some works focused on data anonymization of distributed databases. presented a two-party framework along with an application that generates *k*-anonymous data from two vertically partitioned sources without disclosing data from one site to the other. Proposed provably private solutions for *k*-anonymization in the distributed scenario by maintaining end-to-end privacy from the original customer data to the final *k*-anonymous results. designing SMC protocols for anonymization that builds virtual anonymize database and query processing that assembles question results. Our disseminated anonymization methodology uses existing secure SMC protocols for subroutines such as computing sum, the *k*-th element and set union. The protocol is carefully designed so that the intermediate information disclosure is minimal. Existing security management and information security life-cycle models significantly change when enterprises adopt distributed computing. Specifically, imparted administration can get to be a significant issue if not legitimately tended to. Regardless of the potential advantages of utilizing clouds, it might mean less coordination among different communities of interest within client organizations. Dependence on external entities can also raise fears about timely responses to security incidents and implementing systematic business continuity and disaster recovery plans. Similarly, risk and cost-benefit issues will need to involve external parties. Customers consequently need to consider newer risks introduced by a perimeter-less environment, such as data leakage within multi-tenant clouds and resiliency issues such as their provider's economic instability and local disasters. Similarly, the possibility of an insider threat is significantly extended when outsourcing data and processes to clouds. Within multi-tenant environments, one tenant could be a highly targeted attack victim, which could significantly affect the other tenants. Existing life-cycle

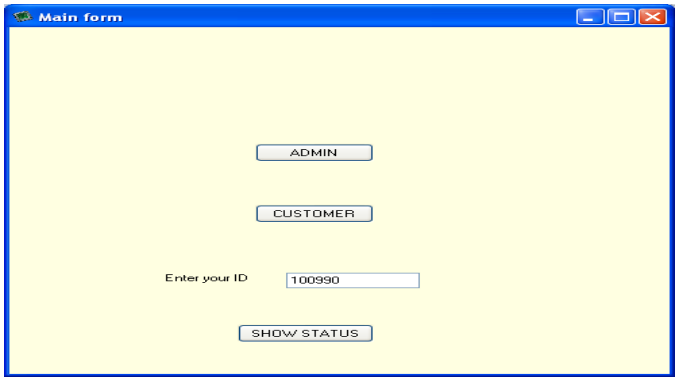
models, risk analysis and management processes, penetration testing, and service attestation must be reevaluated to ensure that clients can enjoy the potential benefits of clouds. The information security area has faced significant problems in establishing appropriate security metrics for consistent and realistic measurements that help risk assessment. We must reevaluate best practices and develop standards to ensure the deployment and adoption of secure clouds. These issues necessitate a well-structured cyber insurance industry, but the global nature of cloud computing makes this prospect extremely complex. Data in the cloud typically resides in a shared environment, but the data owner should have full control over who has the right to use the data and what they are allowed to do with it once they gain access. To provide this data control in the cloud, a standard based heterogeneous data-centric security approach is an essential element that shifts data protection from systems and applications. In this approach, documents must be self-describing and defending regardless of their environments. Cryptographic approaches and usage policy rules must be considered. When someone wants to access data, the system should check its policy rules and reveal it only if the policies are satisfied. Existing cryptographic techniques can be utilized for data security, but privacy protection and outsourced computation need significant attention—both are relatively new research directions.Data provenance issues have just begun to be addressed in the literature. In some cases, information related to a particular hardware component (storage, processing, or communication) must be associated with a piece of data. Although security and privacy services in the cloud can be fine-tuned and managed by experienced groups that can potentially provide efficient security management and threat assessment services, the issues we've discussed here show that existing security and privacy solutions must be critically reevaluated with regard to their appropriateness for clouds. Many enhancements in existing solutions as well as more mature and newer solutions are urgently needed to ensure that

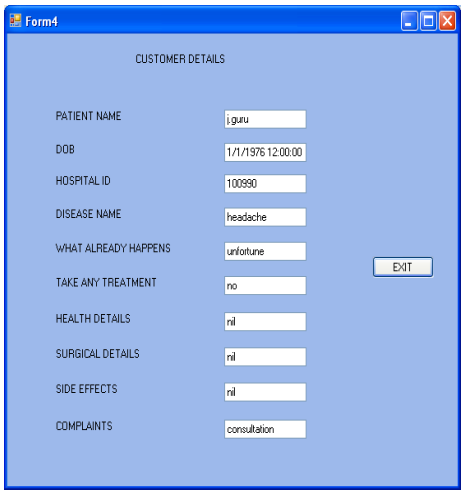
cloud computing benefits are fully realized as its adoption accelerates.

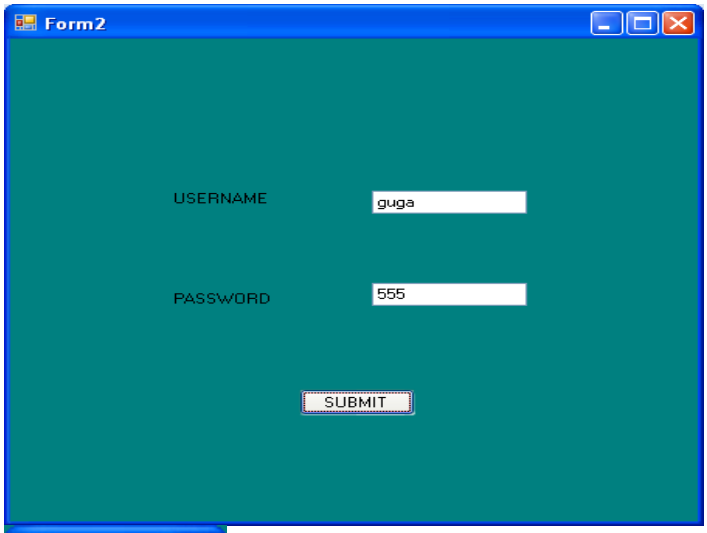
SYSTEM ARCHITECTURE



SCREEN SHOTS:







5. ACKNOWLEDGMENTS

Our thanks to the N.PRIYA(proj guide)&ms.ANURADHA(project coordinator) who have contributed towards development of the template.

6. REFERENCES

[1] S. Chaudhuri, &ldquo,What Next?: A Half-Dozen Data Management Research Goals for Big Data and the Cloud,&rdquo, *Proc. 31st Symp. Principles of Database Systems (PODS ',12),* pp. 1-4, 2012.

[2] M. Armbrust, A. Fox, R. Griffith, A.D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica and M. Zaharia, &ldquo,A View of Cloud Computing,&rdquo, *Comm. ACM,* vol. 53, no. 4, pp. 50-58, 2010.

[3] L. Wang, J. Zhan, W. Shi and Y. Liang, &ldquo,In Cloud, Can Scientific Communities Benefit from the Economies of Scale?,&rdquo, *IEEE Trans. Parallel and Distributed Systems,* vol. 23, no. 2, pp.296-303, Feb. 2012

[4] H. Takabi, J.B.D. Joshi and G. Ahn, &ldquo,Security and Privacy Challenges in Cloud Computing Environments,&rdquo, *IEEE Security and Privacy,* vol. 8, no. 6, pp. 24-31, Nov. 2010.

.

[5] D. Zissis and D. Lekkas, &ldquo,Addressing Cloud Computing Security Issues,&rdquo, *Future Generation Computer Systems,* vol. 28, no. 3, pp. 583-592, 2011

[6] X. Zhang, C. Liu, S. Nepal, S. Pandey and J. Chen, &ldquo,A Privacy Leakage Upper-Bound Constraint Based Approach for Cost-Effective Privacy Preserving of Intermediate Data Sets in Cloud,&rdquo, *IEEE Trans. Parallel and Distributed Systems,* to be published, 2012.

[7] L. Hsiao-Ying and W.G. Tzeng, &ldquo,A Secure Erasure Code-Based Cloud Storage System with Secure Data Forwarding,&rdquo, *IEEE Trans. Parallel and Distributed Systems,* vol. 23, no. 6, pp. 995-1003, 2012.

.

International Journal of Computer Applications Technology and Research
Volume 4– Issue 5, 414 - 418, 2015, ISSN:- 2319–8656

Review and Analysis of Various Image Enhancement Techniques

Sandaldeep Kaur
Dept of CSE
Guru Nanak Dev University Amritsar, India

Prabhpreet Kaur
Dept of CSE
Guru Nanak Dev University Amritsar
India

Abstract: Image enhancement plays an important role in vision applications. Recently a lot of work has been performed in the field of image enhancement. Many techniques have already been proposed till now for enhancing the digital images. This paper has presented a comparative analysis of various image enhancement techniques. This paper has shown that the fuzzy logic and histogram based techniques have quite effective results over the available techniques. This paper ends up with suitable future directions to enhance fuzzy based image enhancement technique further. In the proposed technique, an approach is made to enhance the images other than low-contrast images as well by balancing the stretching parameter (K) according to the color contrast. Proposed technique is designed to restore the degraded edges resulted due to contrast enhancement as well.

Keywords: Fuzzy Logic; image processing; color image enhancement; histogram equalization; edge restoration.

1. INTRODUCTION

An image is a two dimensional light intensity function f(x,y), where x and y denotes the spatial co-ordinates and the value of 'f' at any point is directly proportional to the brightness(gray level) of the image at that point [1]. Digital image processing is converting an image into its modified better version. In computer science, image processing is any form of signal processing for which the input is an image or frames of videos and output can be either an image or set of parameters related to the image [1]. Image processing is the process of improving image or its features to get maximum details and highlight the useful information. The area under applications of image processing has been increased tremendously. Basic applications of image processing are:

1. Improving the visual quality of images to the next level.

2. Preparing images for extraction of maximum possible features.

Image enhancement is basically improving the interpretability or perception of information in images for human viewers and providing `better' input for other automated image processing techniques. Main motive behind image enhancement is to modify the attributes of given image to make it suitable for the given task and observer. The modification process may vary according to the given task. Also, more than one attributes of the image can be modified as per the requirements. Various techniques exist for image enhancement and their selection may vary according to the observer-specific factors i.e. humans' visual system and their experience can add great deal of subjectivity to the selection procedure. For visual perception, color images provide more information than gray images. Color image enhancement plays an important role in Digital Image Processing [1]. In color images, poor illumination may result in dark or low contrast images. So such images require enhancement to extract maximum information. In the literature various enhancement techniques such as histogram equalization have been discussed. Contrast enhancement is the process of enhancing the apparent visual quality of that image as well as the specific image feature for further processing and analysis by a computer vision system [1].

2. VARIOUS IMAGE ENHANCEMENT TECHNIQUES:

The image enhancement process consists of various techniques that improve the visual appearance of the given image or convert the input image into better form for better analysis by machines as well as humans. Various enhancement techniques are as follows:

1. Spatial domain methods.
2. Frequency domain methods.
3. Fuzzy domain methods.

1. Spatial Domain Method (SDM):

Image processing techniques based on spatial methods operate directly on pixels. These methods modify the pixel values according to rules depending on original pixel value i.e. local or point process. Numerous methods exist to compare or combine the pixel values with their immediate or neighboring pixels.

Consider the original image f(x,y), transformation T can be applied to obtain the resultant or processed image g(x,y) as:

$$g(x,y)=T[f(x,y)]$$

Operator T is defined over neighborhood pixels of (x,y). Operator T is applied to each pixel (x,y) to obtain g output at that point. Various SDM based techniques are discussed below:

Histogram Equalization (HE):

It is one of the most popular techniques for contrast enhancement of image. HE is a technique based in spatial domain using histogram of the image [1]. A histogram plots the frequency of gray level, at each pixel of the image, varying from 0(black) to 255(white). Histogram is a discrete function given by:

$$h(rk)=(nk)/N$$

Where, rk and nk are intensity levels of the pixels,

N is the number of pixels in the image with intensity resp.

Histogram Equalization is a technique that transforms given histogram of the image by spreading the gray-level clusters over a dynamic range. It remaps the gray level frequency based on a probability distribution of input gray-levels of the original image to histogram with near-to uniform probability density function. This technique redistributes the intensity distribution. Histogram having peak and valleys will have peak and valleys even after equalization but these will be shifted [5]. Histogram Equalization can be classified into two principle categories- global and local histogram equalization. Global histogram equalization (GHE) uses entire input for transformation function of the input histogram. While, Local Histogram Equalization (LHE) uses a sliding window that slides through every pixel or block of pixels sequentially and gray-level mapping is performed on the center pixel of that block only. Another methods based on histograms are Histogram Specification that transforms histogram of one image into the histogram of another image, and Dynamic Histogram Specification works on critical points from the input histogram.

Global Histogram Equalization (GHE):

In this technique, each pixel of the image is assigned a new intensity value based on previous cumulative density function. To perform GHE, the original histogram of the grayscale image needs to be equalized. GHE accounts the global information. The resultant image of GHE is enhanced in contrast. But, it may have unnatural looks due to over-enhancement of brightness. Also, GHE technique is not adaptable to local light conditions.

Local Histogram Equalization (LHE):

This technique uses sub-blocks of the input image and use these blocks to retrieve their histograms. Histogram equalization is applied to the central pixel of that block by applying Cumulative Density function. The process is repeated for every pixel until the end-pixel is equalized. This technique results in over-enhanced portions. This technique is not adaptable with partial light information. Also, computational costs are high for this technique.

Histogram Specification (HS):

Under this approach, histogram of input image is transformed into the histogram of another image. This approach is used at the times when output is required to form a specific histogram by achieving highlighted gray-level ranges. This approach allows to obtain the desired output. Using this approach is bit complicated, since it's difficult to specify the output histogram as it varies for all the images.

Dynamic Histogram Specification (DHS):

In these techniques, some Critical Points (CPs) of the input image are selected. On the basis of CPs and some other variants, a specified histogram is created dynamically. This approach enhances the image, by preserving some of the characteristics of the input image's histogram. But, it does not enhance the overall contrast of the image.

Histogram equalization techniques suffer from mean-shift problem [4]. The mean intensity value of the image is shifted to the middle gray-level of the intensity range. Thus, HE based techniques are not useful in the cases where brightness preservation is required.

2.1 Frequency domain methods (FDT)

Frequency domain methods are based on Fourier transform. High-frequency contents in the Fourier transform are responsible for Edges and sharp transitions in an image. Smooth areas of image appear due to low frequency contents of Fourier transform. Enhancement of image f(x,y) is performed by applying frequency domain based on DFT.

2.2 Fuzzy domain

Various uncertainties and functions in image processing can be easily applied using fuzzy logic. Fuzzy based image processing is collection of various fuzzy approaches that understand, represent and process the image. Fuzzy approach has three main steps: fuzzification, modification of membership function values, and defuzzification. Some steps of fuzzy reasoning can be such as:

Fuzzification: Input values are compared with the membership function to obtain membership values for each part of image in case of image processing.

Modification of membership function values: The membership values are then combined with the defined fuzzy set operations to get weight of each fuzzy rule.

Defuzzification: The qualified output results are combined to obtain crisp output based on the defined methods.

Rules for Fuzzy Inferencing:

If x is A1 and y is B1, Then z is C1.

If x is A2 and y is B2, Then z is C2.

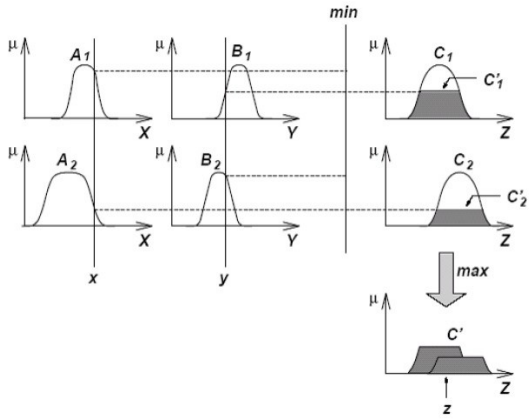


Figure.1 Rules of Fuzzy Reasoning [17]

The process of fuzzification and defuzzification are just the steps for encoding and decoding the image and hence the key point is the modification of membership value. Fuzzy based image processing depends on the fuzzy inference system being used and the input image to be processed.

3. LITERATURE SURVEY

Kannan P., Deepa S. and Ramakrishnan [2] presented two approaches for the enhancement of dark sports images. Low contrast images may occur because of poor lightning conditions or small dynamic range of imaging systems. The methods proposed here are fuzzy rule based method and then applying sigmoid functions for the dark and bright inputs. The approach used for enhancement is splitting the color images into RGB planes and applying membership functions to each of the plane. The RGB planes are then concatenated to obtain the resultant enhanced mage. Sigmoid approach is beneficial, since it is flexible; the contrast factors can be adjusted until a satisfactory result is obtained.

K. Hasikin, Ashidi M. I. [3] presented a parameter, named, contrast factor. This parameter provides information on difference among gray-level values in lo9cal neighborhood. It divides the degrade image into bright and dark regions. Gaussian membership function is applied to the respective dark and bright regions separately. For the dark images, sigmoid functions are used to enhance the image. While for colored images, HSV model is used to enhance them. This approach is best applicable for real time applications.

M. Hanmandlu, D. Jha [6] presented a gaussian membership function which fuzzifies the image in spatial domain in order to enhance the given colored image. A global contrast intensification operator (GINT) is introduced which comprises three different parameters namely, intensification parameter, fuzzifier and the crossover point. HSV model is implemented i this paper and the color component is left unmodified. This approach provided a visual improvement to the under-exposed images.

M. Hanmandlu and O.P. Verma [7] proposed a new approach for color image enhancement. An objective function, called exposure is defined to differentiate the underexposed and overexposed regions of image. The image is converted into HSV color space. The hue component (H) is left completely untouched in order to preserve the original colors. For the underexposed images, sigmoid function is used. To recover the lost information in over exposed regions a power law is applied.

O.P. Verma, P. Kumar, M.Hanmandlu [8], enhancement of images over a high range is presented using fuzzy logic and artificial ant colony system. The AACS is used to identify the underexposed, mixed and overexposed regions of an image. The HSV color model is implemented and gaussian factor is used for the fuzzification of over and under-exposed regions, while mixed-exposed regions are left untouched. Parametric sigmoid functions are used for the enhancement. Furthermore, AACS is used to optimize the visual factor of image and thus ascertaining the parametric required for enhancement. The visual appeal is preferred to make the resultant image human eye friendly. This approach is effective in recovering lost information from permanently degraded images.

Preethi S.J., K. Rajeswari [9] presented a membership function ramp used to enhance the visual appearance of the image so hat maximum possible information could be extracted. The membership function is modified for dark and bright regions, but is left unchanged for the middle regions. This approach can be used in medical images to make the diagnosis easy.

O.P. Verma, V.K. Madasu and Shantaram [10] proposed two new transformation functions for the enhancement of under and over-exposed regions of the same image. Rectangular hyperbolic function is used for the under-exposed regions, while for over-exposed regions, S-function is applied. The HSV color model is used for the enhancement purpose. The S-function allows more flexible control for the given regions. The proposed technique is efficient in terms of time required for getting best possible results.

Mahashwari T., Asthana A [11] presented a fuzzy based method for image enhancement. The pixels of image are classified into three classes: dark, bright and gray. On the basis of this classification membership functions are applied by following a global approach. The resultant image obtained is modified and clear.

Shrivastva D., Richhariya V. [12] presented a contrast enhancement technique based on fuzzy entropy principle and fuzzy set theory for low contrast gray scale images. The proposed algorithm is better in contrast enhancement as well as requires less computational time. It is able to overcome the

drawbacks of spatial domain methods of thresholding. It results in high contrast images.

Chamorro J., Sanchez D. [13] discussed various cardinalities of fuzzy sets and their uses in quantification. The study shows that scalar measures are not well suited for measuring cardinalities and fuzzy numbers suit this well. A new fuzzy based method has been proposed to evaluate the quantified sentences. Linguistic histograms have resulted in more appropriate approach to provide inputs to users. The concepts of color have been defined very well using fuzzy based approach which can be efficiently used in fuzzy image processing.

Raju G. and Madhu S. Nair [14] presented a fast and efficient fuzzy based color image enhancement method for enhancing low contrast color images. This method is based on two parameters M and K, where M is average intensity value of image and K is contrast intensification parameter. The image's RGB factor is converted into HSV color space. To enhance the image, V factor i.e. intensity is stretched under the control of M and K. The basic principle on which the technique is designed is transforming skewed histogram of input image into a uniform histogram. The proposed algorithm is compared with conventional techniques. Beside the visual results and computational time, Contrast Improvement Index (CII) and Tenengrad measure are two quantitative measures used for performance analysis. The tenengrad value is larger for high quality images which show that it enhances the structural information, and thus is the result obtained after applying this approach to images. The proposed method is computationally faster than the existing methods and well suits with the images having background with non-uniform distribution of brightness.

Chi-FarnChen , Hung-Yu Chang, Li-Yu Chang [15] presented fuzzy-based approach to enhance the contrast and brightness information on the image. The test results indicated that the proposed method provides better contrast image compared to the conventional enhancement methods in terms of visibility and image details. Two image quality indices have been used to evaluate the performance of the proposed enhancement technique. The comparison of proposed technique with conventional enhancement techniques showed that the proposed method can produce better measurements compared to the conventional techniques. The stretch method used to enhance each cluster is generated by way of a linear model with stretch parameters.

4. GAPS IN LITERATURE:

The existing contrast intensification parameter (K), has been taken 128 by most of the researchers, which is only feasible for very low contrast images' enhancement and hence over-contrast images when enhanced result in loss of information. The traditional methods even lay no attention to the regions or objects present in image and enhancement is performed by predefined rules thus resulting in color imbalance of the output image. Conventional techniques also result in images with degraded edges. Since, edges play a significant role in extracting information from images, proposed technique will concentrate on edge restoration as well.

5. Conclusion:

This paper has presented a study on various image enhancement techniques. The review has shown that there are still many improvements required in the available techniques to handle different kind of images. This paper has shown that no particular technique is effective for every kind of images or image data set. Although fuzzy logic and histogram based techniques have shown quite significant results but it still face many issues. To overcome the limitations of existing techniques a new technique will be proposed in near future which will evaluate K factor of fuzzy based enhancement automatically using the ant colony optimization to find the best similarity value among the given set of values which represents the image in more efficient manner.

6. REFERENCES:

[1] Gonzalez RC, Woods RE. 2002. Digital image processing. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall. ISBN: 0-201-18075-8.

[2] Kannan, P., S. Deepa, and R. Ramakrishnan. 2012. "Contrast enhancement of sports images using two comparative approaches." American Journal of Intelligent Systems 2.6: 141-147.

[3] Hasikin, Khairunnisa, and NorAshidi Mat Isa. 2013. "Adaptive fuzzy intensity measure enhancement technique for non-uniform illumination and low-contrast images." Signal, Image and Video Processing: 1-24.

[4] Kim, Yeong-Taeg. 1997. "Contrast enhancement using brightness preserving bi-histogram equalization." Consumer Electronics, IEEE Transactions on 43.1: 1-8.

[5] Arici, Tarik, SalihDikbas, and YucelAltunbasak. 2009. "A histogram modification framework and its application for image contrast enhancement." Image processing, IEEE Transactions on 18.9: 1921-1935.

[6] Hanmandlu, Madasu, and DevendraJha. 2006. "An optimal fuzzy system for color image enhancement." Image Processing, IEEE Transactions on 15.10 : 2956-2966.

[7] Hanmandlu, Madasu, et al. 2009. "A novel optimal fuzzy system for color image enhancement using bacterial foraging." Instrumentation and Measurement, IEEE Transactions on 58.8 : 2867-2879.

[8] Verma, Om Prakash, et al. 2012. "High dynamic range optimal fuzzy color image enhancement using artificial ant colony system." Applied Soft Computing 12.1 : 394-404.

[9] SJ, MrsPreethi, and Mrs K. Rajeswari. "Membership Function modification for Image Enhancement using fuzzy logic."

[10] Verma, Om Prakash, V. K. Madasu, and V. Shantaram. 2011. "High Dynamic Range Color Image Enhancement Using Fuzzy Logic and Bacterial Foraging." Defence Science Journal 61.5 : 462-472.

[11] Mahashwari, Tarun, and Amit Asthana. 2013. "Image enhancement using fuzzy technique." International Journal of Research in Engineering Science and Technology 2.2 : 1-4.

[12] Shrivastava, Diwakar, and VineetRichhariya, "Analytical Survey on various parameters."

[13] Chamorro-Martínez, J., et al. 2014. "A discussion on fuzzy cardinality and quantification. Some applications in image processing." Fuzzy Sets and Systems 257 : 85-101.

[14] Raju G., and Madhu S. Nair. 2014. "A fast and efficient color image enhancement method based on fuzzy-logic and histogram." AEU-International Journal of Electronics and Communications 68.3 : 237-243.

[15] Chen, Chi-Farn, Hung-Yu Chang, and Li-Yu Chang. 2008. "A Fuzzy-based method for remote sensing image contrast enhancement." The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences 37 :995-998.

[16] Zadeh, Lotfi A. 1975. "The concept of a linguistic variable and its application to approximate reasoning—II." Information sciences 8.4 : 301-357.

[17] Tizhoosh 1997. "Contrast Improvement based on Fuzzy If-Then rules.

[18] Tizhoosh, Hamid R. 1997. "Fuzzy image processing." Publisher: Springer-Verlag. Kartoniert (TB), Deutsch.