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Survey on Blockchain -Future of Security for Cryptocurrency- Bitcoin and Ethereum

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Abstract: As the use of online transaction is increasing day by day, security measure parameter is difficult to manage. In that case Blockchain enables peer-to-peer transfer of digital assets without any intermediaries in a secure manner with use of verification and validation operation by different miner nodes of decentralized network. Blockchain technology also supports the cryptocurrencies like bitcoin and ethereum for amount transfer digitally with secure communication.

Keyword: Blockchain, Block, Transaction, Bitcoin, Ethereum.

1. INTRODUCTION

Unlike traditional methods, blockchain enables peer-to-peer transfer of digital assets without any intermediaries [1]. Blockchain is a chain of sequential blocks, these blocks store all transactions of public ledger. The chain of Blocks extending continuously whenever new block append on it. Blockchain works in a decentralized network with the use of cryptographic hash functions, digital signatures and distributed consensus algorithms. All the transactions occur in a decentralized manner that eliminates the requirement for any intermediaries to validate and verify the transactions [3]. Blockchain has some key characteristics, such as decentralization, transparency, immutability, and auditability [3]. A Blockchain transactions are the a tasks that are stored in public records. These records referred as Block. As mentioned earlier blocks are executed, implemented and stored in blockchain for validation by all miners of the blockchain network. Each previous transaction can be reviewed at any time but it cannot be updated by miners [6].

2. BLOCKCHAIN ARCHITECTURE

A node initiates a transaction in a decentralized blockchain network with digital signature using private key cryptography. A transaction can be considered as a data structure which, represents transmission of digital assets between peers on the blockchain network. All the transactions are stored in an unconfirmed transaction pool and propagated in the network by using a flooding protocol known as Gossip protocol [3].In the case of transactions, it is the responsibility of the peers to select and validate these transactions based on preset criteria. After the verification and validation of transaction based on preset criteria by the miners, who use their computational power for the verification and validation of the blocks of their peers to know whether their peers have sufficient balance for the transaction or not. Once the verification and validation is completed, transaction is included in a block. Miner nodes need to solve a computational puzzle and spent a sufficient amount of their computing resources to publish a block [3]. The miner node who solves the puzzle first will become a winner node and it grabs the chance to create a new block. A small amount of incentive is given to the winner node on the successful creation of a new block. All the peers in the network, verify the newly created block using a consensus mechanism, which is a technique that assist a decentralized network to come on some agreement for certain matters. Once it is completed, the newly generated block will be added to the existing chain and the local copy of each peer's immutable ledger. At this point of time, the transaction is confirmed. The next block links itself with the newly created block with the use of cryptographic hash pointer. Now the block obtains its

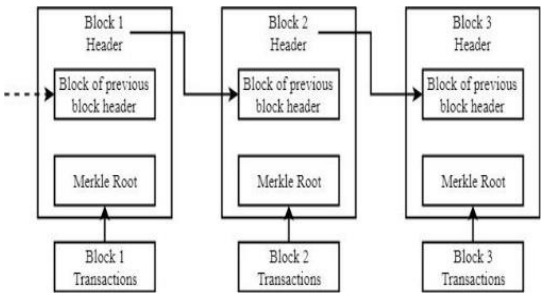

Fig.1 The structure of the Blockchain [4]

first confirmation while the transaction obtains the second confirmation [3]. Whenever a new block is appended to the existing chain, the transaction will be reconfirmed. In general, a transaction needs six confirmations in the network to be considered final [2].

Blockchain Structure has two parts block header and block body. The block is a collection of related information and record data. The data structure of the blockchain is composed of a block header and a block body. Block header contains metadata, which

are of size 80 bytes. Block header contains the hash value of the previous block, to connect the previous block for integrity ensurance of the blockchain. Block body contains business data of variable size. Markle tree is a hash of binary tree which is used for validation of the integrity of the data structure. It is mandatory that a hash node pair as a leaf node, for making node pair hash and inserting a new hash node in a hash binary tree. The hash process generates a unique Markle root, which is used for business record[5].

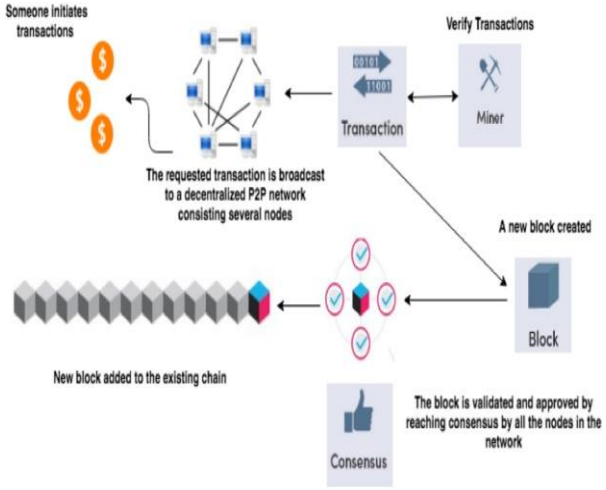

Fig.2 Functional Diagram of Blockchain [3]

3. BLOCKCHAIN TRANSCATION PROCESS

The first step of the blockchain transaction process is the identity verification of the sender, to know that the transaction is requested by the authorized sender and not by anyone else. For this verification, Blockchain uses digital signatures (public and private keys).

Transaction validation is done independently by all miners based on differ- ent criteria. Elliptic curve digital signature algorithm (ECDSA) is used by blockchain [3]. It ensures that the funds can only be spent by their true possessors. The signature in each transaction contains 256 bits.

After completion of validation by miners, new block is generated and ap- pended to blockchain with use of consensus mechanism.

4. BITCOIN

According to the original Bitcoin whitepaper, the main purpose of this digital cryptocurrency was to allow a decentralized electronic cash payment system between different parties by eliminating central intermediaries [3].A Bitcoin transaction refer to transfer the ownership of some bitcoin amount to another bitcoin address(Receiver bitcoin address). For the transaction initiation which is done by bitcoin wallet of a client and later it broadcasts to the network. The nodes on the network will further rebroadcast the transaction and include that transac- tion in the block ,nodes are mining only when if the transaction is valid. It takes approximately 10 minutes to include the transaction along with other transactions in a block [3]. The receiver should see the amount of transaction in their wallet after validation. The major element of structure of a bitcoin is unspent transaction output (UTXO), it refers to the output amount of a transaction, which is received by a user and it also refers to the the capability of spending in the future. All the received amount in a Bitcoin wallet maintained as a separate entity.

$$Inputsoutputs = Transactionfees \quad (1)$$

Miners include their individual coinbase transaction with the transaction data, which miners are trying to verify and validate during block mining. A coinbase transaction is a unique type of bitcoin transaction which can created by only miner. This type of transaction has outputs. The coinbase transaction will send the block reward and the sum of the transaction fees to the miner on given address. It shows that a miner has to assign his reward only when it is creating a block. It can be defined as equation (2).

$$sum(BlockOutputs)sum(BlockInputs) + BlockReward \quad (2)$$

5. ETHEREUM

Ethereum introduced a new concept of an account as a part of the protocol which is the initiator and target of a transaction.Here transactions directly updated to the account balances rather than maintaining the state information. Ethereum has two types of account, Externally Owned Account (EOA) and Contract Ac- count (CA).Externally Owned Account is owned using private keys, where in the case of Contract Account,it is controlled by the code and activated by an EOA only. Externally Owned Account is needed to participate in the Ethereum network , it interacts with the blockchain with the use of transactions. Con- tract Account represents a smart contract, which is piece of code deployed in the blockchains node. It adds a logic and computation to the trust infrastruc- ture [3]. Execution of an smart contract is initiated by a message, which is em- bedded in the transactions. In Ethreum transaction amount is refered as ether. An Ethereum transaction has fields for ether and messages to trigger smart con- tracts. For any action in Ethereum , crypto fuel or gas is required.Where Gas is used as a fees instead . Gas is a cryptocurrency independent of valuation for the transaction fee and computation fee [3].

6. CONCLUSION

Today Blockchain technology is rapidly growing because of its security con- straints. This paper provides information about the blockchain technology, its characteristics, block structure and cryptocurrencies like Bitcoin and Ethereum. For security constraints, it uses cryptographic hash functions and consensus al- gorithms like proof of work.

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Applicability of Naïve Bayes Model for Automatic Resume Classification

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Abstract: Resume selection and classification is a very important function of Human Resource Department of every institution. Due to increased use of technology and online job application, this department receives large volumes of resumes which has made resume selection and classification a complex process in terms of information processing, time taken and transparency in the selection process. In this research, a machine learning model is proposed to assist resume selection and classification. Naïve Bayes model was developed to select and classify resumes. The predictive accuracy attained will be recorded and compared to predictive accuracy of homogeneous Ensemble classifier model developed by using different data sets. Naïve Bayes classifier models obtained from different data sets was used as base classifiers to develop Ensemble Naïve Bayes Classifier. It was observed that the new model produced a better predictive accuracy compared to the original Naïve Bayes Classifier model. The original Naïve Bayes classifier model gave an average predictive accuracy of 89.8148% while Ensemble Naïve Bayes Classifier model attained an overall accuracy of 94.4444%.

Keywords: classification; machine learning; naïve Bayes; selection process; predictive accuracy

1. INTRODUCTION

Human resource department is very important in both public and private institutions. Bringing the right employees on board is a challenging task in all institutions. Employing people with good talent in their areas of specialization is a challenge and therefore the first important stage of getting the right employee is resume selection and classification. Recruitment process is a product of resume selection. Recruitment process is the process of identifying job vacancies, analyzing job requirements, reviewing applications, screening, shortlisting and selecting the right candidates. The purpose of this research is to use machine learning to automate the process so that we can achieve efficiency in resume selection and classification process in the human resource department. Research has been done to investigate the effectiveness of online recruitment and selection process in terms of use of the internet. In this research it was found that online recruitment is effective in reducing the cost and time of recruitment and selection [1]. Machine learning has been used to show that recruiting asymptomatic individuals in clinical trials can obtimize the cost of clinical trials. In the research which was done proposed the method of recruiting asymptomatic Amyloid positive individuals in clinical trials where by two step process was employed to select subset individuals more likely to be amyloid positive based on automatic analysis of data acquired in a routine clinical practice [2]. Technology has greatly impacted how information is being accessed in everyday life. It has changed the way people communicate in daily bassis. In this modern days, we cannot imagine how life could be without the World Wide Web. Every one uses the internet for different purposes such as looking for information or posting information in the internet. The information can be easily posted by people in form of blogs, forums, social networks, feedbacks can be given in particular web pages. Today, there are many sites that provide business and product review such as Amazon is an e-shop where customers can publish feedback about various products. This gives rise to opinions from various customers and therefore necessitating creation of automated system for seaching and classifying opinions[3]. Due to improvements in technology and use of internet, government and private institutions use websites to share information of job adverntisement and recruitment of new workers. This information overflows in various sites with various attributes and criteria making the selection process to be complex due to limited time. To simplify the process, reseach has been done to construct and collaborate web scrapping technique and classification using Naïve Bayes on search engine and it resulted in effective and efficient application for users to seek pontetial jobs that fits their interests [4].Soft skills are impotant factor to consider for a certain set of jobs. To get soft skills from job applicants is not an easy task, to do this, Bayesian network has been employed in some research to assist inidentification of soft skills becauseBayesian is suitablle for reasoning and making decisions under uncertainity. In the research, the Bayesian was trained using a dataset collected through extracting information from advertisements and also through interviews with few selected experts[5]. The most popular challege in data management is to support the construction and maitenance of machine learning models over large data which is multi-dimensional and evolving. Bayesian network can be employed to support the task of managing large volumes of data in terms of processing and classification [6]. Bayesian network classifier have demostrated good classification accuracy in variours applications however it is error prone in high confidence labels. To address the problem, the label-driven learning framework was proposed which incorporated instance based learning and ensemble learning[7]. From these various applications of machine learning techniques, it has been shown that machine learning methods can be applied to solve realy world problems such as online job application, job recommender systems, sentment analysis and spam filter sytems for identifying and filtering spam emails.

2. RELATED WORK

2.1 Artificial intelligence

Artificial intelligence is relevant for the recruitment process due to many human challenges faced by human resource professionals in the recruitment process. Someof the

challenges include large volumes of reumes received, time constraits and lack of transparency in the resume selection process. Despite this, limitted research has been done on this topic. One of the research which has been done used and repricated data from the Boston consulting Group, CV Library, Linkedln, MIT Sloan Management Review, Software Advice, Statista and Tractica[8]. In the research, analysis was performed and estmates were made regarding utilization of artificial intelligence and automation in interviewing and assessment of candidates. Approaches to building artificial intelligence related skills and effect of it on human resource. The artificial intelligence (AI) has started managing the recruitment process in the human resource department. Providing the right human resource duringrecruitment process is one of the important function of human resource management[9].

2.2 Email Spam Filtering

Due to 5G era, the email application has become more extensive and spam messages have caused serious problems. There are various spam filtering methods. Probability based bayesian classification algorithm has been employed in the past as a simple and efficient method to filter spam messages to avoid serious problems caused by spam messages[10]. The accuracy so far attained by bayesian email spam filtering was 90%. The research bayesian model based on naïve bayesian classification model included advantages and disadvantages of the effectiveness of the model.

2.3 Predicting Diseases

Naïve bayes has been used as a classification method for predicting diseases in haemoglobin protein sequence. In the research which was done it was shown that the technique can be successively applied to unveil the structures, functions and evolutionally relationship in protein sequences and predict diseases based on their sequence information[11]. The use of data mining method in protein analysis provided efficient way of examing the proteins to identify their characteristics and provided away for designing better drugs. In the research Naïve Bayes attained an Accuracy of 85%.

It has also been demostrated that machine learning algorithms can be used in medical sector. Heart disease prediction using classification technique such as Naïve Bayes have been employed in the past. A research was done presentig six classification models where indipendent features were used to build the model[12]. The classification models which were used included K-nearest neighbors(KNN), support vector machine(SVN), and Naïve Bayes. The feature selection was applied to improve prediction accuracy. In the same study, Naïve Bayes produced an accuracy of 88.16%. Health care is a task to be done in human beings. Effective decissions about human disease can be handled by applying data mining techniques. Different tests can be done to detect cardiovascular diiseases in patients. Naïve bayes is one of data mining technique which can be employed to serve as diagnosis of heart disease in patients. Paramenters were analyzed and predictions made on heart disease and therefore heart disease prediction system was proposed[13]. Using the same approach, machine learning algorithms can be applied in resume selection and classification process to make it easy, simple and straight forward. It has been shown that machine learning applications in realy world task eliminates time wastage and makes processes efficient in terms of time taken to complete some human task. Naïve Bayes classifier has also been used in predicting the risk of heart disease in diabetic patients. The clinical analysis on datasets was done to detect diseases and diagnosis based on data and attributes and a predictive accuracy of 89.41% was attained in the prediction of risk of heart disease in diabetic patients[14]. This is a human task just like resume selection and classification. And therefore Naïve Bayes algorithm is intended to be used to perform the task of resume selection and classification from job applicants.

2.4 Customer Churn Analysis

In customer Churn Analysis and Prediction, customer past behaviour are analyzed to find the cause of churn and predicting whether the churn will happen in the future. The aim of the study was to use machine learning Predictionto predict, retain and avoid customer churns. Company growth entiry depends on customers. Customers play an important role and therefore companies should understand their customers in terms of their behaviour and requirements. Various machine learning algorithms such as Naïve Bayes, decision trees, random forest have been applied in feature selection for use in Customer Churn Analysis and[15]. Therefore machine learning techniques has become very important tool of making good predictions with highest accuracy in getting correct information in most of human task in the modern technology. Equaly machine learning can be applied in resume selection and classification process and this is the main purpose of this research work.

2.5 Naïve Bayes

Naïve Bayes Classifier is a supervised machine learning algorithm making use of the Bayes' Theorem where features are statistically indipendent. A research was done where simple machine learning model was developed from a set of attributes(training examples) in relation to response variables[15]. The Bayesian principle states that the probability of something happening in future can be estimated by calculating how often it has happened[10]. In spam filtering study, Bayesian algorithm was utilized to filter spam from asample size of 5574 and cross validation was used.

The essence of Bayes theorem is the conditonal probability where conditional probability is given as the probability of a given event happening given that some other events have already occurred. By using conditional probability, probability that a given event will occur given the knowledge of previous event can given by equation (1) below

$$P(A/B) = \frac{P(B/\ B)P(A)}{P(B)} \quad (1)$$

Where

P(A/B)=Posterior probability, Probability of event A happening given the value of B.

P(B/A)= Likelyhood of B given A is true

P(A)= Prior Probability, Probability of event A

P(B)= Marginal Probability, Probability of event B

The Naïve Bayes Classifier formula using Bayes theorem isgiven as equation (2) below.

$$P(y/x_1, \dots x_j) = \frac{P(x_1, \dots x_j/P(y)}{P(x_1, \dots x_j)} \quad (2)$$

$P(y/x_1, \dots x_j)$ = Posterior probability, probability of the data included in the class of y given their features $x_1\ up\ to\ x_j$

$P(x_1, \dots x_j/P(y)$= Likelyhood of features value given that their class is y.

$P(y)$= Prior probability.

$P(x_1, \ldots x_j)$= Marginal probability.

Naïve Bayes Model is easy to develop which makes it useful for large datasets. Despite its simplisity, it performs well than other sophisticated machine learning methods[16].

3. METHODS AND EXPERIMENTS

This section describes data pre-processing, experimental setup, application of Naïve Bayes Classifier in resume classification and accuracy improvement through homogeneous Bayesian ensemble classifier.

3.1 Data preprocessing

Data preprocessing is the process of transforming raw data into understandable format to increase the validity of the data.Therefore, before clasification, the datasets must be prepared to optimize the data[17].A dataset contains and providents concise and unumbiguos definition of items related to the phenomenon under study [13].The data set used in this research was obtained from resumes of job applicants and most of it was obtained from linkedln. There were a total of 250 resumes which were used and experiments were used as the main researchmethodology for this study. During classification, three major classes were considered as follows: employable resumes(ER), waiting resumes(WR) and not employable resumes(NER). Employable resumes are those resumes with all the required attributes which meets the recruitment criteria. Waiting resumes are those resumes which meet the minimum requirement for recruitment but lacked some important attributes for the recruitment, while not employable are those resumes which did not meet the minimum recruitment criteria.

3.2 Data and Input Attributes

There are two major terminologies associated with data sets. The first term is an Instance, an instance is an example in the training set. In this research an instance is a particular resume in a group of resumes. The second terminology is an attribute which refers to a feature of a group of characteristics which makes up one instance in a dataset. Therefore attributes are called features in machine learning. A class is a label given to an instance of a class. In this research, there are three classes namely: Employable, waiting and not employable. The following attributes were taken into consideration during resume classification process:

1. Level of education
2. Course (area of specialization)
3. Work experience
4. Skill (special skills)
5. Year of graduation
6. Length of stay after gradution
7. Quaality of the certificate(e.g. first class)

Some attributes were combined due to close relationship to each other. For example year of graduation and length of stay after graduation were combined to give one attribute.

The dataset was divided into five subsets. This was done because the dataset was small and the major objective of this research was to improve predictive accuracy of Naïve Bayes classifier by combning four homogeneours Naïve Bayes models deveoped from the four data subsets. The fifty data subset was used as testing dataset while the other four datasets were used to develop four base classifiers for use in developing ensemble classifier.

3.3 Experimental setup

The experimental data was organized into a feature vector representing the recruitment data with various attributes. The recruitment data was obtained from job applicant resumes. Matlb 2016a was used to conduct experiments to design four Bayesian Classification models from the four data subsets. Supervised machine learning algorithm(Naïve Bayes) was used for the classification. The total number of resumes for each class was organized into a vector of instances as follows:

$$\text{Employable Resumes (ER)} = \begin{bmatrix} ER_1 \\ ER_2 \\ ER_3 \\ \cdot \\ \cdot \\ \cdot \\ ER_n \end{bmatrix}$$

$$\text{Waiting Resumes (WR)} = \begin{bmatrix} WR_1 \\ WR_2 \\ WR_3 \\ \cdot \\ \cdot \\ \cdot \\ WR_n \end{bmatrix}$$

$$\text{Not Emplyable Resumes (NER)} = \begin{bmatrix} NER_1 \\ NER_2 \\ NER_3 \\ \cdot \\ \cdot \\ \cdot \\ NER_n \end{bmatrix}$$

Employable resumes consitituted 32.4%, waiting resumes 40.8% and not employable resumes 26.8%of the overal recruitment data. Each resume also contained a vector of features called attributes. Each attribute was assigned different weights depeding on the importance contributed to the overal recruitment criteria. Some features in the recruitment process are more import and therefore they are assigned more weight compared to others.All 250 resumes contained equal number of vector features. Therefore organizing the resumes against there individual features, they form a rectangular matrix of the order 250 X 4. This means that each resumes contais four recruitment attributes which contributes to the overal score of eachresume.The 75% of the total resumes with seven features were given to the original Bayesian classifier as input for training the model while 25% of the total resumes were used for testing the Naïve Bayes model. Table (2) below shows percentage datasets for the three classes.

Table 2. Percentage datasets

Class	Number	Percentage
Employable	81	32.4%
Waiting	102	40.8%
Not Employable	67	26.8%
Total	250	100%

3.4 Naïve Bayes Classification

Classification is a supervised machine learning technique used to predict the class of a given data points. Classification is best used when the outputs or targets are known. In this research a nonlinear model naïve bayes algorithm is used to classify job applicant resumes into three classes namely: employable, waiting and not employable.

The naïve classifier was designed as follows:

1. Let T be a training set of rsumes and there associated classes employable(CE), waiting(CW) and not employable(CN). Each resume(record)contains various attributes forming a vector Y=(y_1,y_2,..y_{n-1},y_n)
2. Let k be a number of classes for prediction, C_1,C_2,…C_K. Given the record Y, the naïve bayes classifier will predict Y belong to the class which have the highest posterior probability. i.e.

$$P(Ci/Y) > P(Cj/Y) \ \ for\ 1 \leq k\ and\ j \neq i \qquad (3)$$

Therefore maximizing$P(Ci/Y)$, the bayes theorem becomes

$$P(Ci/Y) = \frac{P(Y/Ci)P(Ci)}{P(Y)} \qquad (4)$$

3. To predict the class label for Y, $P(Y/Ci)P(Ci)$ was evaluated for each class Ci where the naïve bayes classifier predicted that the class label for Y was the class Ci if and only if

$$P(Y/Ci)P(Ci) > P(Y/Cj)P(Ci)\ for\ 1 \leq k, j \neq i \qquad (5)$$

This was to say that, the predicted clsss label was the class Ci in which the $P(Y/Ci)P(Ci)$ was maximum. In this study the datasets were preprocessed and then subdivided into two datasets namely training dataset and testing datasets. The overal dataset was normalized. The training dataset was preprocessed and the correct class labels were given for the purpose of conducting supervised machine learning classification. Nonlinear naïve bayes classification was done by developing a classification model based on Bayes rule.

3.5 Improving Accuracy of Naïve Bayes

There are many ways of improving Naïve Bayes prediction accuracy such as data preprocessing, feature selection, ensemble method and the fisher method. In this study data preprocessing, feature selection and homogeneous ensemble method was employed to improve predictive accuracy of Naïve Bayes Classifier. During data preprocessing, the data was converted into a form which can be accepted by the machine learning algorithm used. The input data was prepared with respect to the output expected. Feature selection was done where only those attributes which contributed to the overal classification accuracy were considered in the development of the classifier. Then, lastly ensemble method was employed where the overal dataset was divided into four datasubsets. The four datasubsets were used to develop four Naïve Bayes Classifier models which formed base classifiers. The base classifiers were then combined to develop Ensemble Naïve Bayes Classifier(ENBC). Both the original Naïve Bayes and Ensemble Naïve Bayes Classifier were used to classify resume data and their accurancies were recorded and compared. It was noted that the predictive accuracy of Ensemble Naïve Bayes Classifier was better than the original Naïve Bayes Classifier.

3.6 Confusion Matrix

A confusion matrix is a table used to describe the performance of a classification model on a set of data in which the true values are known[18]. It gives the summary results of the classification model and it is used for model evaluation in terms of accuracy, precision and recall.

Table 3. Confusion Matrix

	Predicted NO	**Predicted YES**	**Total**
Actual NO	TN	FP	TN+FP
Actual YES	FN	TP	FN+TP
Total	TN+FN	FP+TP	TN+FN+FP+TP

$$Accuracy = \frac{TN + TP}{TN + FN + FP + TP} \qquad (6)$$

$$Precision = \frac{TP}{FP + TP} \qquad (7)$$

$$Recall = \frac{TP}{FN + TP} \qquad (8)$$

Where
TN = True Negative
FP = False Positive
FN = False Negative
TP = True Positive

4. RESULTS AND DISCUSSION

This section presents the experimental results and discussions. Both results are represented in the form of tables. The first part represents results in the form of confusion matrix for model evaluation and the second gives the experimental results summary.

4.1 Confusion Matrix Results

This were the results based on the confusion matrix which showed correctly classified resumes and those which were miss classified by the models as shown in the tables below.

Table 4. Confusion Matrix Dataset_1

	Predicted			Total
Actual	15	2	0	**17**
	1	21	0	**22**
	0	3	12	**15**
Total	**16**	**26**	**12**	**54**

Table 5. Confusion Matrix Dataset_2

	Predicted			Total
Actual	17	0	0	**17**
	5	17	0	**22**
	0	2	13	**15**
Total	**22**	**19**	**13**	**54**

Table 6. Confusion Matrix Dataset_3

	Predicted			Total
Actual	16	1	0	**17**
	2	20	0	**22**
	0	1	14	**15**
Total	**18**	**22**	**14**	**54**

Table 7. Confusion Matrix Dataset_4

	Predicted			Total
Actual	14	3	0	**17**
	1	21	0	**22**
	0	1	14	**15**
Total	**15**	**25**	**14**	**54**

Table 8. Ensemble Confusion Matrix

	Predicted			Total
Actual	16	1	0	**17**
	1	21	0	**22**
	0	1	14	**15**
Total	**17**	**23**	**14**	**54**

4.2 Experimental Results summary

The experimental results are subdivided into three. The first result was obtained when the original Naïve Bayes Classifier (NBC)was used to classify the job applicant resume data and it attained an accuracy of 89.8148%.The second results was obtained from the four base classifiers i.e. Naïve Bayes Classifier-1(NBC-1), Naïve Bayes Classifier-2, Naïve Bayes Classifier-3(NBC-3) and Naïve Bayes Classifier-4(NBC-4). The results was recorded in tables (9) given below. The third result was obtained when the ensemble Naïve Bayes Classifier(ENBC) was used to classify the same dataset and the results were recorded in table (10) as shown below.

Table 9. Models Performance Measures

Model	Accuracy	Precision	Recall
NBC-1	88.8889%	0.9375	0.8824
NBC-2	87.0370%	0.7727	1.0000
NBC-3	92.5926%	0.8889	0.9412
NBC-4	90.7407%	0.9333	0.8235

Table 10. Ensemble Performance Measures

Model	Accuracy	Precision	Recall
ENBC	94.4444%	0.9412	0.9412

4.3 Result Discussion

The overall dataset was divided into five datasets. The first four were used to develop four naïve bayes models for resume classification. The fifty dataset was used for testing the models. Dataset 1 was used to train NBC-1 model which was later tested by dataset 5 and it classified 15 resumes correctly as employable while it misclassified 2 resumes as waiting but they were actually in the class employable. The model also classified 21 resumes correctly as waiting resumes while it misclassified 1 resume as employable. Lastly it classified 12 resumes correctly as not employable and 3 resumes were misclssified as waiting. These results are given in table (4) above.NBC-1 model attained a predictive accuracy of 88.8889% as shown in table (9) above.

When NBC-2 model was used, it classified a total of 47 resumes correctly. A total of 7 resumes were missclassified where 5 were missclassified to belong to the class employable while they were actually in the class of waiting. Another 2

resumes were also missclassified as waiting when they were actually in the class of not employable. The result of this model is given in table (5) above. The model attained a predictive accuracy of 87.0370% as indicated in table (9) above.

NBC-3 model classified 50 resumes correctly to belong to their actual classes and only 4 resumes were misclassified. 2 of misclassified belonged to the class of waiting resumes but they were classified as employable resumes. The other 2 resumes were misclassified as waiting and not employable respectively as shown in table (6) above. The model attained an accuracy of 92.5926% as indicated in table (9) above.

The fourth model was NBC-4 which classified an overall of 49 resumes correctly while misclassified 5 resumes. 3 resumes were misclassified as waiting but they were actually employable resumes. Another 1 resume was placed in employable resumes but it was actually in the class of waiting resumes. Lastly 1 resume was also misclassified as waiting but its actual class was not employable. The overall classification for this model is given in table (7) above. The predictive accuracy for this model was 90.7407% as given in table (9) above.

Ensemble Naïve Bayes Classifier (ENBC) classified 51 resumes correctly while it misclassified only three resumes as shown in table (8) above. The overall predictive accuracy of ENBC was 94.4444% as indicated in table (10) above.

5. CONCLUSSION

During resume selection process, there are many factors which influence resume selection for consideration for the job opening. The factors can be considered during selection process to ensure that job applicants are selected to take over the jobs that best fit their qualification and skills they possess. It has been noted in many occasions that selecting the best resume for a job opening is the main factor in the recruitment of new employees. Selecting a wrong resume for a job opening can misslead the process. Therefore it is vital to automate the process of resume selection inorder to save time, cost and make the resume selection process transparent hence eliminating personal interrest in the selection process. The anlysis of the five models showed that the individual naïve bayes classifier models gave different results and different predictive accuracies when used to classify the same recruitment data. It was also observed that when the four models were combined to form ensemble naïve bayes classifier, model stability improved together with predictive accuracy. Future work will involve using heterogeneous base classifiers to investigate the overal effects on the predictive accuracy of the model.

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Inter-Schools Collaboration and Information Management System: A Case of KISII County Secondary Schools, Kenya

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Abstract: Inter-Schools Collaboration and Information Management System are technologies that support Knowledge Management (KM) in organizations, specifically - knowledge generation, codification, and transfer. The use of KM in organizations is now widely recognized and expected to be an important part of organizational practices. The study focused on establishing an Inter-Schools Collaboration and Information Management System that captures various aspects of school operations for Kisii County secondary schools. A KM system was designed, tested and implemented. The key areas of the Inter-Schools Collaboration and Information Management System that arose from the analysis done include; academics, student admissions, accounts, examinations and sports that encompass the bulk of the information critical for Inter-Schools Collaboration and Information Management System for school management. The researcher employed UML (unified Modeling language) in presenting the Inter-Schools Collaboration and Information Management System at the design stage. The results of the design phase were translated into program Codes using PHP, javascript, HTML, MySql and the wamp server as the implementation environment. The study provided platform that has made it easier, faster, and cheaper to access schools data from the same access point for many secondary schools in Kisii County.

Keywords: Knowledge Management, Collaboration, Information Management System, Inter-Schools

1. INTRODUCTION

Inter-Schools Collaboration and Information Management System (ISCIMS) support Knowledge Management (KM) in organizations in generating, codifying, and transferring the available data into information [1]. Information practices and learning strategies are gaining acceptance in the field of education. At the most basic level, knowledge management helps to improve the use and sharing of data and information in decision-making [2]. In addition [3] noted that professionals are always in situations where they have to think fast and process an array of information results in order to make decisions. This implies that knowledge management holds key to proper decision making in complicated situations. Educators have been using information management tools for years to improve the efficiency of administrative services and the effectiveness of academic programs. Historically, the practice of information management within education has focused primarily on the technical systems that are implemented to collect, organize and disseminate the organization's expanse of quantitative data in areas of management [2]. This research aimed at developing an information system that manages school information for secondary schools in Kisii County. In Kenya, most existing systems are either manual or semi-automated targeting individual schools or automated systems not targeting secondary schools and thus most of the data required about secondary schools can only be accessed manually or through individualized documentations or a school web site. The knowledge users include administrators, teachers, parents, donors, sponsors, students and various stakeholders.

2. LITERATURE REVIEW

2.1 Knowledge Management Concept

[4] define knowledge as understanding gained through experience or study. It is know-how or a familiarity with how to do something that enables a person to perform a specialized task. Further, [5] define knowledge as a "fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information". In organizations, knowledge management is entrenched in organizational routines, processes, practices, documents and norms. [6] says that there are three types of knowledge: tacit, explicit and implicit knowledge. Tacit knowledge exists in people's minds. It is difficult to articulate in writing and is acquired through personal experience [6]. Tacit knowledge according to [5] is present inside the human intricacy and volatile. [7] defines explicit knowledge as knowledge, which is "articulate, capture and distribute in different formats, since it is formal and systematic". Explicit knowledge is codified, recorded and available, and is held in books, journal articles, databases, in corporate intranets and intellectual property portfolios. Implicit knowledge is the middle ground of tacit and explicit knowledge. [8] points out that some knowledge believed to be tacit can be transformed into explicit knowledge. This body of knowledge is referred to as the organization's implicit knowledge. Organizational needs are driven from KMS by looking at the processes supporting KM in organizations [1]. These processes imply required functionalities that a KMS should provide to enable effective KM use.

Knowledge management is a discipline that promotes an integrated approach to identifying, managing and sharing of all of an enterprise's information assets [9]. The information in the database includes the documents like policies, procedures, expertise and individual experiences. Knowledge management issues include developing, implementing and maintaining the approximate technological and organizational infrastructure to enable knowledge sharing. Knowledge management solutions are now key to strategic technologies for large companies to achieving their strategic goals over years to come.

There are three main KM activities in organizations; knowledge generation, knowledge sharing, and knowledge codification [5].

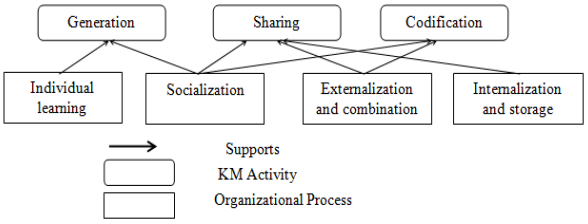

Figure 1: KM activities and supporting processes

[6] explains these activities in an organizational knowledge creation based on interactions between tacit (highly personal) and explicit (formalized) knowledge. He say that the process begins with the enhancement of an individual's tacit knowledge through hands-on experience, supporting the generation of knowledge. Socialization then follows, involving the transfer and sharing of tacit knowledge between individuals. The process for making tacit knowledge explicit is externalization. Dialogues allow the conceptualization of the tacit knowledge and trigger externalization, the transformation of knowledge from tacit to explicit. Then knowledge is combined with existing knowledge and internalized (codified). Once knowledge is explicit, it can be transferred as explicit knowledge through a combination process. This is the area where information technology is most helpful, because explicit knowledge can be conveyed in documents, email, data bases, as well as through meetings and briefings.

2.2 Conceptual Framework

Based on literature the researcher proposes four design aspects to support the KMS functionalities. In the study, the researcher uses a conceptual framework that is based on a synergy of Nonaka's system and Bohjaraju knowledge management systems to come up with a conceptual system for his research:

i. The network design to support sharing
ii. An ontological base to provide a shared language
iii. Meta-knowledge to support organizational memory , and
iv. People or employees or users.

These aspects are described in the framework shown in figure 2.

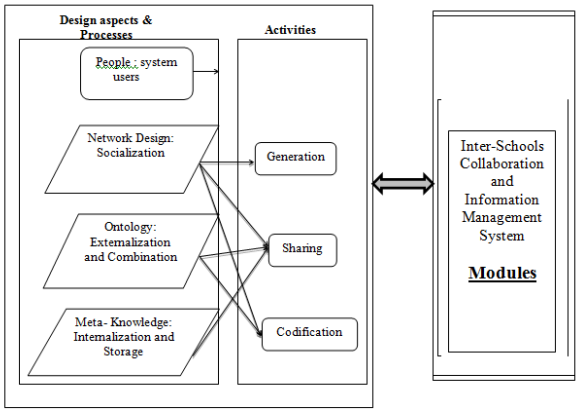

Figure 2: ISCIMS conceptual framework

3. METHODOLOGY

In order to identify the most crucial areas for automation, a sample size of 169 schools (out of Out of the 306 secondary schools in Kisii County) was chosen. This gives a 5.0% margin of error and 95% confidence. Questionnaires were used to gather information regarding the intended use of a Knowledge management system, what type of data will be processed, how the software should handle the data, and how the data can be accessed once in the system. The researcher adopted open ended, dichotomous, multiple choice and declarative questions. The respondents were given between zero (0) and three (3) days to answer the questions on the questionnaires before handing them back. After three days, the researcher collected back the questionnaires for reading and collating the responses.

Since the researcher intended to develop a system, Software Development Life Cycle (SDLC) approach was used. Gerald D. Everett stated that software development life cycle is a way of describing, developing and deploying a software system (Gerald D. Everett, 2007). A variety of life cycle systems for software development exist, but they all include the same constituent parts. All life cycle systems take a project through several primary phases i.e.: Communication, Requirement gathering, Feasibility study, System analysis, Software design, Coding, Testing, Integration, Implementation, Operation & Maintenance and Disposition.

The researcher opted to implement the Waterfall SDLC system as it is a simple software development paradigm. All the phases of SDLC function one after another in linear manner thus the outcome of one phase acts as the input for the next phase sequentially. When the first phase is finished then is only when the second phase will start and so on. The approach assumes that everything is carried out and taken place perfectly as planned in the previous stage and there is no need to think about the past issues that may arise in the next phase. The researcher consulted widely to ensure that all necessary data was captured and no issues left at the previous step.

Figure 3 provides an illustration of the general software development life cycle system.

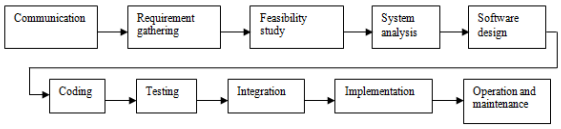

Figure 3: Software development life cycle system (Source: SDLC)

4. RESULTS AND DISCUSSION

4.1 Critical Areas Suggested For Automation

Many of the respondents indicated in their responses that so much information was available for use but the problem was how to access that information. When asked about centralizing that information, many suggested that if their information is centrally placed, they will likely do better as with the availability of information, competition with other schools will increase, enable easy and quick benchmarking, sharing of information among others. They indicated many areas that can be automated to assist in the operations and management with school information.

The most critical areas that were suggested for automation among others included: Academics (Teacher notes, e-books, performances), Admissions (Student admissions, list of student population, instant messaging, inquiries), Accounts(Statements, sponsorships, scholarships, sources of income), Examinations(Examination results, past papers, answer booklets), Sports(Games available, performances, sports infrastructure, requirements, sponsors), Administration (Current projects, completed projects, financing, donations) and Contacts (Post office box, email contact, websites, short massage services, social media contacts, phone numbers).

4.2 System Design

The researcher employed UML (unified Modeling language) in presenting the Inter-Schools Collaboration and Information Management System in a pictorial form. He used the UML standard because the standard specifies, visualizes and

documents artifacts of software systems during software development. The researcher deployed various system diagrams as explained in the following subheadings.

4.2.1 Inter-Schools Collaboration and Information Management System state machine notation

The researcher employed the state machine notation to describe the different states of a component in its life cycle.

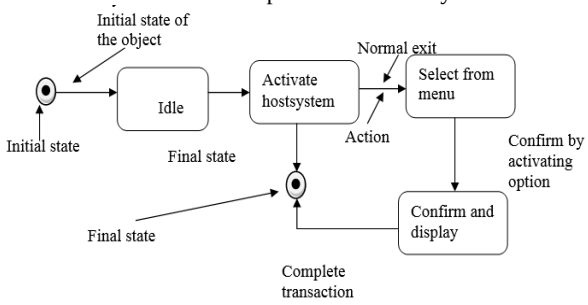

Figure 4: KMS state machine

The state of an activity can be active or idle. Active when the user is executing a given event and idle when such activity is not taking place.

4.2.2 Class Diagram

A class diagram is a graphical representation of the static view of the system and represents different aspects of the application while describing the functions performed by the system. The researcher used class diagram to analyze and design the static view of his system and describe responsibilities of the system. Here are a few of those views.

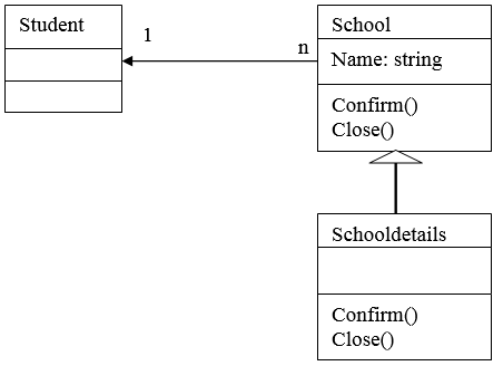

Figure 5: Student class diagram

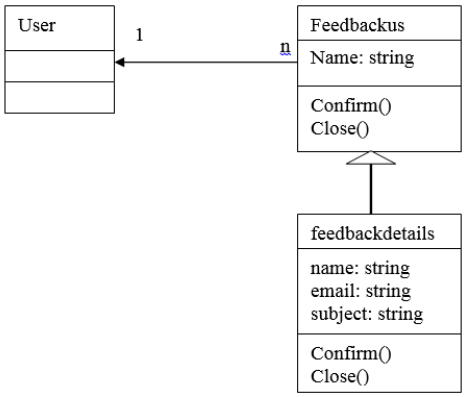

Figure 6: User class diagram

4.2.3 Component Diagram

The researcher applied the component diagram to bring out the physical aspects/ artifacts of the KMS system. These are the elements like those the researcher employed including the executable files and documents that reside in the nodes. The main purpose for the component diagrams was to describe the components used to make functionalities without describing their functionalities.

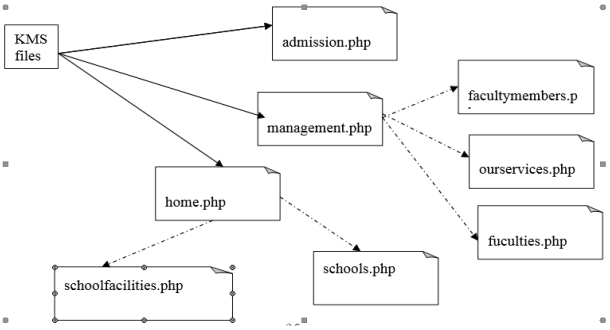

Figure 7: Component diagram

4.2.4 Deployment Diagram

The researcher used the deployment diagram to visualize the topology of the physical components of the system where the software components are deployed.

They describe the static deployment view of the system. Some nodes and their relationships are shown. They describe the hardware components where software components are deployed.

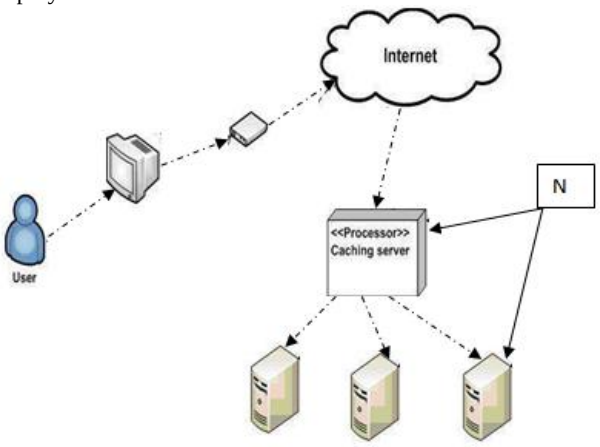

Figure 8: Deployment diagram

4.2.5 Use case Diagram

The researcher used the use case diagrams to capture the dynamic behavior of the system i.e. the behavior of the system when it is running / operating. The researcher implemented the use case diagram in showing the actors, use case and their relationships.

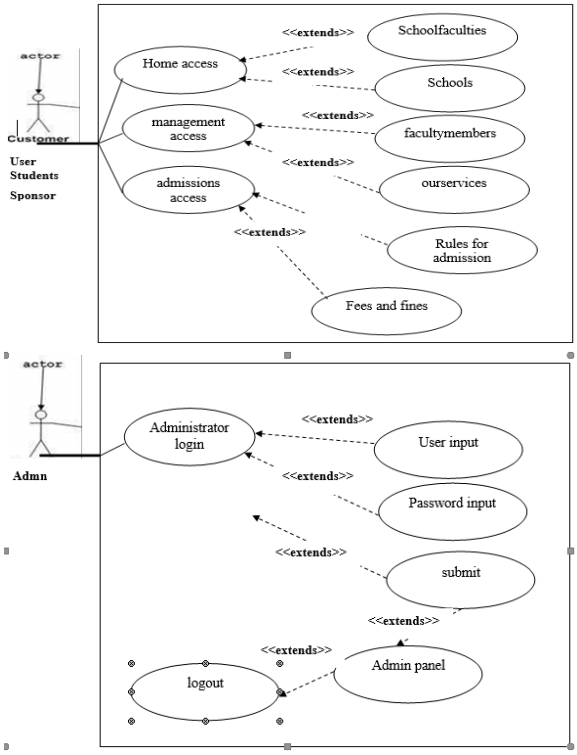

Figure 9: Use case diagrams

4.2.6 Interaction Diagram

The researcher used the interaction diagram to describe an overview of the interaction among different elements in his system. He employed the sequence and collaboration diagrams. The sequence diagrams were used to emphasize on time sequence of messages while he used collaboration diagram to emphasize on the structural organization of the objects that send and receive messages in the system.

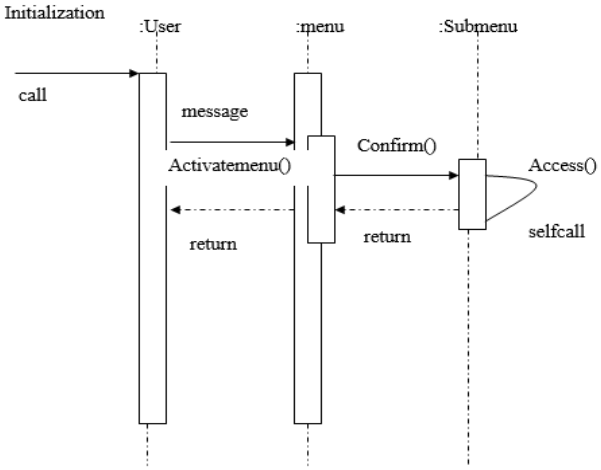

Figure 10: Sequence diagram

The collaboration diagram shows the object organization in the KMS. It indicates how the methods are called one after the other during execution.

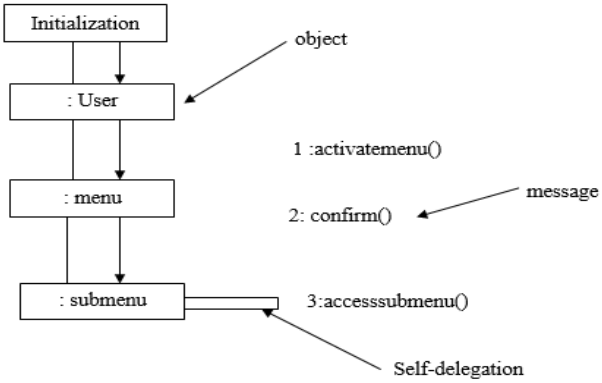

Figure 11: Collaboration diagram

4.2.7 Statechart Diagram

The researcher used the statechart diagram to describe the different states of a component when the system is running. This is because the states are specific to an object or component of the researcher's system. The researcher wanted to clearly show the object, state and even therein.

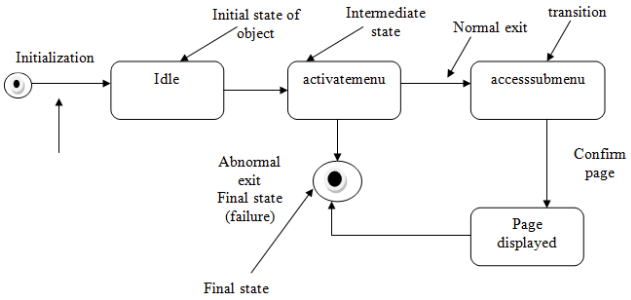

Figure 12: Statechart diagram

4.3 Implementation

The results of the design phase were translated into program Codes. During this Phase the researcher made it his central goal to fulfill the requirements of the Knowledge management system and to meet the design outlined in the design phase. The classes and class interactions developed in the design phase are very explicit. They translate directly into the code generated in the implementation phase. The researcher developed an Inter-Schools Collaboration and Information Management System using PHP, javascript, HTML, MySql and the wamp server.

4.4 Integration

Many components of the knowledge management system are new and needed no integration with other existing software or applications.

4.5 Testing and Validation

In the testing phase, the results of the implementation phase were run through a series of tests to verify that the system meet the goals of the requirements phase. A testing plan was created to allow for unit tests and system tests that were be performed. Unit testing was performed on individual software components. The process of integration brought together all the software components to create a complete Inter-Schools Collaboration and Information Management System to perform system testing in the software system as a whole. Some of the test results are discussed below.

4.5.1 The new system

The researcher was able to develop a system with a knowledge source. When a user wants to access information of a particular school, he / she access the county network and then Kisii County ISCIMS system that shows a screen shown in Figure 13.

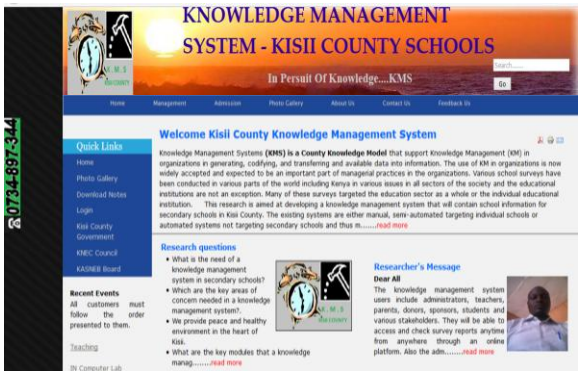

Figure 13: ISCIMS home page

The user can then select an option menu to access some information from any access point.

4.5.1 The system menus

The new knowledge system has many menu options as briefly explained below:

4.5.1.1 Home page

The home page has got seven key components: home, management, admissions, photo gallery, about us, contacts, and feedback us.

4.5.1.2 Home option

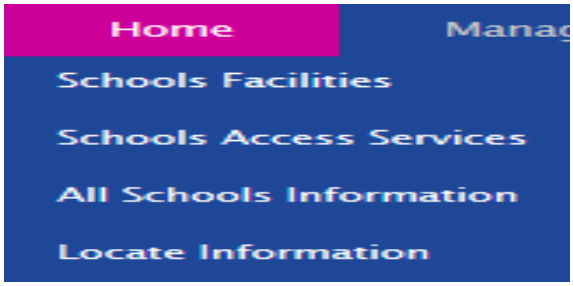

Figure 14: Home options

The home menu option consists of the following list content: school facilities, school access services, school information and locate information options. There is an overall welcome message to the user when he/ she visits the system.

Figure 15: Welcome message

4.5.1.3 Management option

This menu option contain the following options: Kisii county secondary schools, from director of education, principal's message, faculty members in a school, services in a schools and future faculties that can be joined and school performance option. The screen in the next page depicts that.

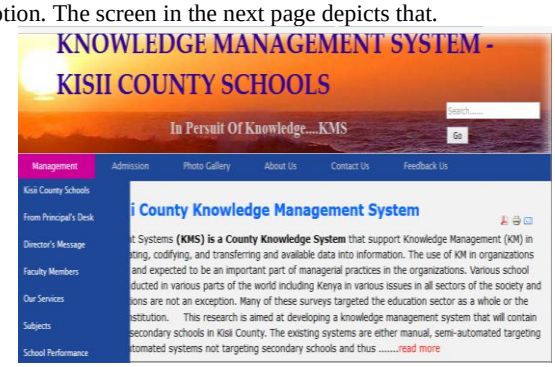

Figure 16: Management option

4.5.1.4 Admissions option

This menu contain three options for rules of admission to various schools, fees and fines by those schools and candidate performance in various schools.

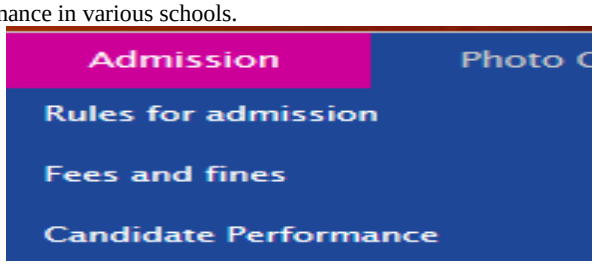

Figure 17: Admission option

4.5.1.5 Photo Gallery

Various schools can display activities of interest in their schools like athletics, science, balls, debates etc

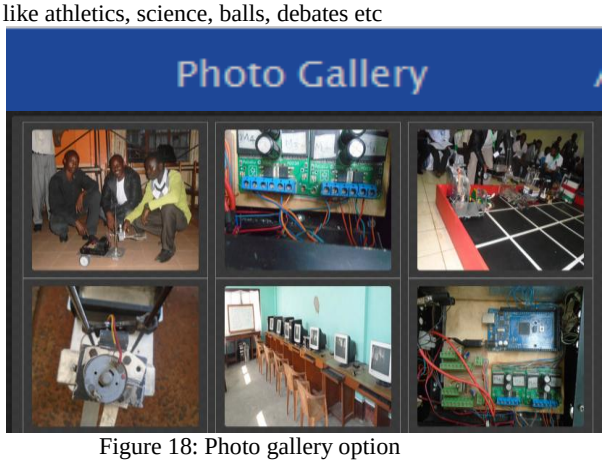

Figure 18: Photo gallery option

4.5.1.6 Contact us

With this option, the developers and school administrations and be contacted for any reason.

Figure 19: Contact us option

4.5.1.7 Feedback us

The feedback us option is used for communication for urgent help when browsing the knowledge system.

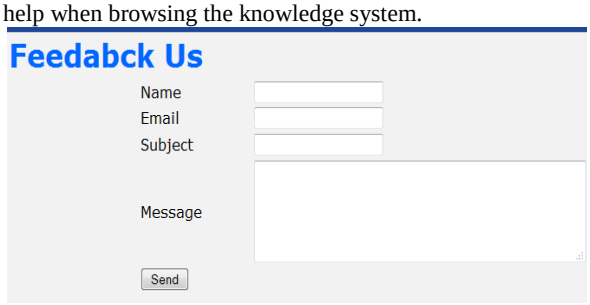

Figure 20: Feedback us option

4.5.1.8 Downloads

Various schools can post important materials that can be accessed and downloaded by users.

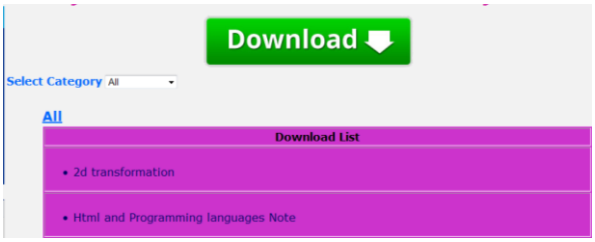

Figure 21: Downloads

5. CONCLUSION

In completion of the study, a new system was developed to incorporate the research findings as discussed above. This study involved two aspects namely: a field study and development of the system and subsequent implementation. The findings showed that the following information is needed by the users: School performance, School fees, Admissions, Accounts, Examinations and sports. All included in the new system.

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Providing a Model for Creating Trust and Guaranteeing the Originality of Goods in the Machine Woven Carpet Supply Chain Based on Blockchain

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Abstract: For the past few years, globalization of collaborate industries and consumers has become an outstanding issue in the world. Collaboration between networks of all people/organizations, from creation to product sale as supply chain, is a hot challengingtopic. Planning and risk management, cost control, transparency and traceability are the challenges of supply chain. These challenges are very important topics as they are directly related to security and trust between members is doomed to failure.
The same problem appears in carpet industry supply chain. Lack of trust among network members and high potential of cheating in raw material and production process are serious problems in carpet supply chain. We suggest an infrastructure for carpet supply chain based on blockchain. Blockchain can provide security and reliability.Blockchain technology can be used as a decentralized information system which provide an information platform for all supply chain parts. Our proposed system can provide the traceability with trusted information in the entire carpet supply chain, whichwould effectively guarantee the carpet originality, by gathering, transferring and sharing theauthentic data of carpet in production, processing, warehousing, distribution, and selling. Our proposed model remove concerns and make a better commercial carpet market.

Keywords: Blockchain, Trust, Carpet Industry, SupplyChain,Traceability

1. INTRODUCTION

Machine carpet industry is one of the leading industries in Iran that has been able to incorporate traditional handmade carpets with state of the art technology. Carpet production involves a wide range of industries and suppliers. Paying attention to the quality of materials used, the basic characteristics and the need for transparency of information for those involved in this supply chain, need more attention in carpet supply chain management. Supply chain management can be considered as a process of planning, implementing and controlling related operations [1]. Supply chain is important in terms of production, storage and delivery [2].

The main goal of supply chain management is to reduce risks. Among the various risks that organizations face,communication risks such as participation of business colleagues in information distortion and fraud are very important [3,4]. The possibility of this business cooperation in distorting the information also is a very high risk in the industry. The consumers should be able to confirm the authenticity and originality of the materials used during the production of a particular product. Lack of transparency in supply chain process may lead to consumer dissatisfaction. [5-9]. In some supply chains such as food, RFID is used to build a supply chain tracking system [10].

In recent years, blockchain technology has received tremendous attention to serve as a secure transparent framework for supply chain management.Blockchainhas the potential to be integrated with other IoT technologies to ensure food safety [11]. Blockchain can have a significant impact on supply chain management. Some features of blockchain technology such as consistency and transparency for data storage; and intercept block's transactions for network members are very useful for supply chain [12]. One of the interesting benefits of using Blockchainin supply chain is to confirm the authenticity of manufactured goods. Blockchain helps to maintain a healthy supply chain and reduce the risk of unhealthy and counterfeit goods [13]. Blockchain also allows irreversible transaction in the supply chain, and let the supply chain partners have access to transaction history [14, 15] and allows customers to track the source and follow product changes. This way, it potentially reduces the risk of activities [16]. This technology can play a determinant role in clarifying supply chain transactions [17].

In this article, for the first time, the machine woven carpet supply chain is discussed and some solutions are provided to solve the problem of product originality andthe trust between the manufacturer and the consumer.

With the introduction of industrial machinery into the art of handmade carpets, a lot of changes were made in it, and the prerequisite of carpet production also moved toward industrialization. Creation of different carpets with a vast diversity of color, reed and density provides a wide range for manufacturers and users of carpet machines. Today, carpet industry is one of the important pillars of the Iranian economy and should be seriously considered. This industry creates a variety of jobs ranging from designing pattern to providing yarn and selling carpet. But given the lack of transparency in the production process and the problems such as cheating on the yarn, fraud in the presentation of the actual density and reeds of the carpet, have led to uncertainty about the originality of the product.

The presence of broker in the sale of carpet causes a significant difference in the price of carpet for the buyer than for the producer. This factor is at the expense of the domestic manufacturer, i.e. low profits for manufacturer and high prices for consumer. The issue of uncertainty is a big problem in the carpet industry and supply chain. Therefore, the main issue is to create trust about the originality and the price of the goods.

Using blockchain in the supply chain, we want to solve the problem of trust and fraud, and propose a model based on Blockchain.

Therefore, no one can change the data recorded in Blockchain. Due to its high security and reliability, Blockchain has recently been widely studied and applied. As shown in Fig. 1, blockchain is a sequence of blocks. Each block holds a number of transactions. Transactions are created by the parties of a transaction and broadcast on the network. Each block is chained to its previous block by the hash of the previous block values. Therefore, any change in a particular block will result in the loss of integrity in the blockchain and will be identified and deleted by other members of the network. Additionally, given the nonce positioned in the block and solving the complex mathematical puzzles by the miner, the mined block is being broadcasted by the miner on the network.

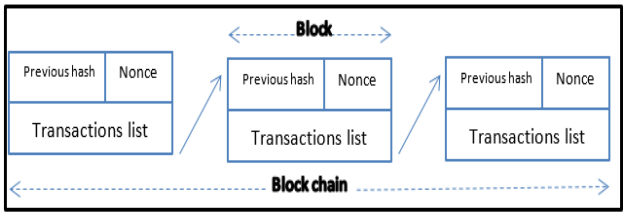

Figure 1-blockchain structure

Several methods have been proposed to choose a Miner for formation of block on Blockchain network. The most famous ones are proof of work, proof of stake, and proof of capacity [19], given the computational power, capital and storage capacity, which increases the chance of winning miners. Therefore, Blockchain provides a practical way to maintain data security, compatibility and reliability in the network.

The rest of the paper is organized as follow: In section 2 we explain the required material to proposing our Model. We will discuss the proposed model in section 3. It presents an infrastructure for carpet supply chain based on blockchain technology. With attention to this model, we have a tracking system for members. This kind of system reduce risks for untrusted transaction between members. Due to using input-output transaction method, validation becomes easier and information transparency increases in the carpet supply chain. Evaluation ofthe proposed model is discussed in Section 4 while Section 5 provide conclusion and future work.

2. BACKGROUND

General issues in supply chain is followed by discussion on blockchain-based supply chain. First, we describe general issue and then we discuss supply chain, blockchain. Finally, we mention the blockchain usability for the traceability program of carpet supply chain.

With the fast growth of IoT, many researchers have focused on traceability of supply chain. Some of them pointed to the efficiency of traceability system by track ability of each product. In this case users can monitor anything from primary production to final disposal by consumer [20]. Some studies suggest a RFID based framework for food supply chain [21]. Using RFID for identification of product and biometric identifiers for the animal's identity in food supply chain, this system proposes traceability records.

Today, blockchain brings new approaches in many domains. Some of the research papers discussblockchain'spotential in manufacturing supply chain [22]. So it offers a good platform for distribution and transparent mechanism to be used in business and industry. Because of the lack of trust in business processes, some researchers offer blockchain for emerging distributed technology with data sharing for untrusted participants [23].

2.1. Supply chain

In manufacturing and business, supply chain is a management system of people, resources and activities involved from supplier stage to the consumer. And supply chain management is the management of product flowfrom beginning to the end. It involves business activity to maximize customer value and gain the advantage in market for producer. Supply chain management has two sub tasks [24]:

1) Activity planning, implementing and controlling to create a value for final consumer.

2) Integration and cooperation between companies for business process.

The important issue in the supply chain management is information and communication technology [25, 26]. Technology represents a good tool for supply chain innovation [27].

Table 1- Supply chain applications across industries[28].

Industry	Count
Food products	9 (31%)
Container shipping	7 (24%)
Discrete manufacturing	4 (14%)
Pharmaceuticals	3 (10%)
Mining industry	2 (7%)
Other/not specified	4 (14%)

2.2. Blockchain

Blockchain is used as a platform in decentralized networks to maintain consistent databases and build security and trust among all network members. Its first application was by Satoshi Nakamoto in creating Bitcoin as a cryptocurrency [18]. The difference between networks based on blockchain with centralized networks is in the absence of a central node.

All network members in Blockchain have equal positions, and they all keep a copy of the database (i.e., Ledger). So blockchain is a distributed ledger that is shared between peer-to-peer (P2P) network's node [29, 30].

Research studies about blockchain application in supply chain focus on construction and integration supply chain through the blockchain [37, 38]. Using blockchain is very useful in transparency and traceability [31, 36]. It enables supply chain for significant research advances [34] and helps for supply chain provenance and knowledge of product provenance [33, 35]. Also blockchain can be used for digital advertisingsupply

chain, increasing resilience uncertainty and etc. [32]. In carpet supply chain, no study has focusedon this issue, so this work is novel and the first in this area.

3. PROPOSED MODEL.

3.1. Main idea

In this study, we are looking to build trust in the carpet machinery supply chain. In this industry, in addition to carpet manufacturers, raw material manufacturers, including yarn manufacturers, knitting manufacturers, and also manufacturers of accessories such as resin, leather, starch, and carpet packing covers are present in this supply chain to complete carpet production.

In Fig. 2, the supply chain diagram can be seen. This supply chain can include the following general steps:

1- Supply of raw materials

2- Production

3- Processing

4- Warehouse

5- Sales.

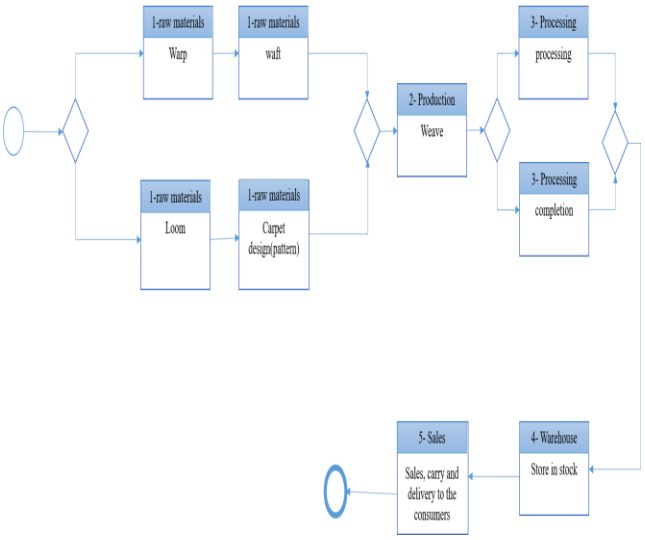

Figure 2: diagram of machine carpet

In the material supply phase, according to the characteristics of the carpet, the appropriate pile yarn, warp yarn and weft yarn should be provided. One of the most important concerns of end users is the authenticity of the warp yarn and weft yarn. At raw materials stage, the production transparency is achieved by registering all the characteristics of material, including the location of production and destination, productiontime and sales date, and qualities of yarn in a block in Blockchain. Based on yarn barcode information that exists on the block, every carpet producer can check yarn quality with this information,if raw material and block information match, then producer proves the block validity by referring block number on his own block.

In the production stage, the device and the carpet pattern information, including the type of pattern, layout and general information, the carpet texture information such as density, reeds, height of pile yarn, and carpet size can be fully recorded in a block for daily products. As the previous step, next chain player will check for authorization of the product. At the processing and completion stage, there is also the possibility of cheating on materials used, including resin, starch, type of leather and root type used.

At the processing and completion stage, there is also the possibility of cheating on materials used by manufacturer, including resin, starch, and leather and fringe type used. By registering the specification and percentage of material for each carpet in Blockchain, any fraud in the processing will be prevented. The production information of carpets, that is available on the network, is collected and placed in the blocks by the miners. The miners store new block in the blockchain following a consensus algorithm which ensures blockchain security(Please see Fig.3).

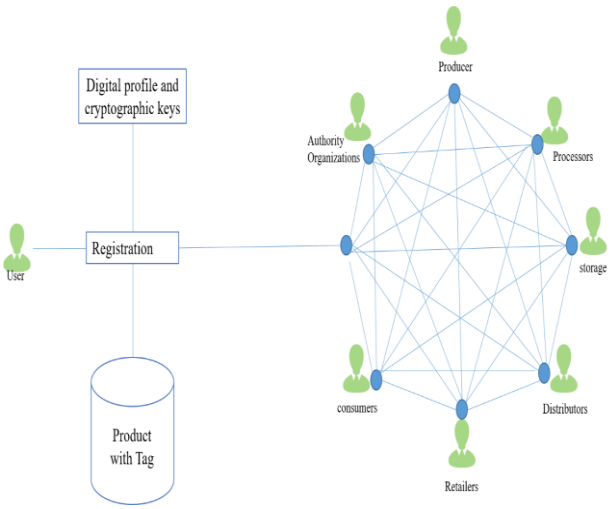

Figure 3- The Conceptual Framework of the proposed model and the nodes of the Blockchain Network

In the warehouse, the block address, which includes the transaction containing the carpet profile, is attached to the product as a barcode tag which will be visible to the buyers and thus insures transparency in supply chain. The fifth stage, the distribution and sale stage, can be done in two different ways; sell by retailers or direct sales from the factory.

3.2. Proposed Blockchain Structure

In the proposed blockchain-based system, transactions contain input-output, where the input is data of material block and output is production information.In each stage the producer

generates a transaction, as shown in Figure 4, and broadcasts to the network.

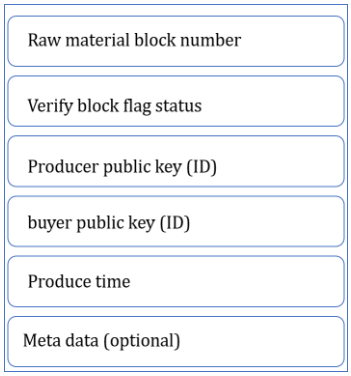

Figure 4-Transaction format.

In this way, the interests of the manufacturer and the buyer are directly supported. By providing a store on the blockchain platform, the manufacturer can directly sell the product without the presence of broker, and consumers can also buy the product at the best price. With this method, using smart contracts.

Each member of supply chainstorestheir product information in the transaction. This information contains raw materials, production time, producer name (public key), buyer name (public key) and metadatawhere applicable. In this method each member of supply chain must verifymaterial or product and mention their agreements on their transaction. The transactions are verified and stored in the blockchain by miners. Each node, focusing on their stack, can work as a miner and try to generate a block for exiting transactions. The stack definesthe trust value of the node in network. Each node can generate a trustable block and get 51% of network's nodes agreement, then the block linked to the main chain and miner's stack will be raised.

Each candidate miner must put a specified stake for his process, if the generated block is accepted by the network, they can get reward stake; otherwise they lose those amount of stake. However the miner incentive for participation in this competition is priority of higher stake owner to their generated transaction in the network by other miners.

To maintain the privacy of nodes, we suggest apermissioned blockchain. In the permissioned blockchainsall parties require permission to read the information on the blockchain, sowe can set who can transact and who can mine new blocks and add it into the chain. At the end, the information of final product issaved in RFID tag for reference to the block.

The first method is the traditional way of selling in stores and retailers, which is a common technique. The second approach, which we offer, is the use of smart contracts. This method can be seen in Fig. 5.

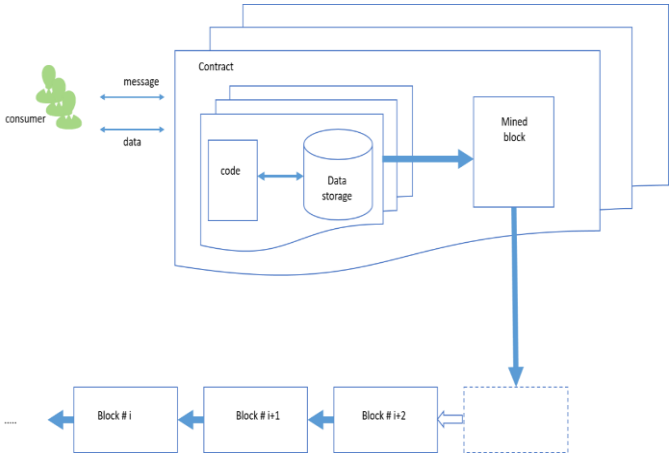

Figure 5-Sales Infrastructure with Block Chain Based on smart Contract.

the originality of the goods is guaranteed by the manufacturer and the payment of the price is also guaranteed by the consumer. All trading conditions are recorded in the smart contract. The cost is blocked from the buyer's account but will not be paid to the seller until the delivery of the goods. If the provisions are properly implemented, the transaction will be completed by the parties recorded in Block Chain. This will ensure full trust between the parties of this network. The blockchain process can be seen in Fig. 6.

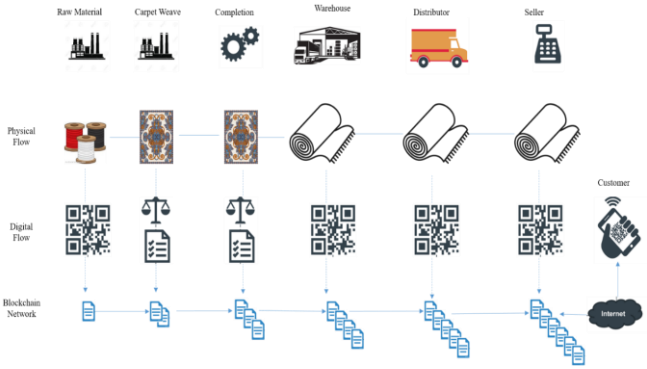

Figure 6- Machine carpet Supply chain based on blockchain

4. DISCUSSION

A blockchain platform enables tracking system in the supply chain. In this system, all transaction information can be used by a unique product ID. This ability is used for data collection in IoT (i.e., digital Flow). Blockchain has the same benefit for this system. Firstly blockchain's nature is distributed and compatible for distributed database in IoT layer. Secondly, transactions are accessible for every new node in our supply chain network. And finally due to using blockchain infrastructure, adding new nodes in supply chain is easy and ready for tracking system.

Transparency in supply chain creates trust, balances the information between suppliers and makes incentive to have good behavior on system. Besides, it makesconsumers sure

that they have bought the original product and it's like a guarantee for every product.

Another benefit of this system is identification of malicious agents in the supply chain. The previous block is checked for using raw material to produce new product, and the stake of miners is checked to generate trustable block. This encourages the blockchain nodes to select the best way and have good behavior. So, with this solution, a malicious node is identifiedvery fast and all nodes will choose the way without cheating in the products.

5. CONCLUSION

In this article, we addressed the problems of the carpet supply chain, and found out that the possibility of fraud in the production process as well as the sale of this product is very high. The problem of collusion of raw material suppliers with the supply of false materials to carpet completion and the supply of misinformation at the time of sale is one of the main problems of this supply chain, which issolved

Many consumers can block chain technology in this industry, and we can guarantee the authenticity of the product and information of each carpet. Implementing this method, trust will be created between the producer and the consumer and the possibility of fraud will be very low.

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Implementation of Web-based kWh (Kilowatt-hour) Meter System for Student Accommodation Room

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Abstract: Currently student accommodations are very common to be found around campus areas. Student accommodations generally utilize PLN (National Electricity Company) as their source of electricity. However, most student accommodations use single kWh meter system to accommodate all rooms in a unit. This results in difficulty in determining the appropriate billing for each room's energy consumption. This research aims to build a prototype of kWh meter for single use which enables the property owner to bill each room's electricity consumption appropriately. This prototype utilizes the web as the media to display the total energy consumption from each of the student's room. This research designed a prototype of kWh meter which can be used to measure electricity consumption of three rooms, upon which prepaid billing system is applied. This allows consumption of energy to not exceed the amount of money paid with billing system designed to meet with the standard of PLN. The kWh meter device installed in each room is equipped with LCD which displays information about consumption of electricity. This information is then uploaded to the website so that user can access the information easily. Student as the accommodation user or occupant can also purchase electricity token credit to the property owner through the website. The prototype of kWh meter system using token has already been tested to accommodate moderate electricity use (electricity consumption allocated for rice cooker and ironing machine). From the trial test, the average measurement error value obtained was 0,004 kWh for a 1 kWh usage load change. This system automatically cuts off current when the energy used has exceeded the credit limit purchased.

Keywords: Electricity energy, kWh meter, Token system, Current sensor, Student accommodation room

1. INTRODUCTION

kWh meter is a measurement unit used to measure the consumption of electricity energy used by electronic utilities during certain period of time [1] [2]. This measurement unit is commonly used by the National Electricity Company to measure the electricity consumption in each month [3] [4]. There are two types of kWh meter systems used by the National Electricity Company to measure their consumer's electricity consumption, namely the analogue kWh meter (the mechanical electricity consumption measurement unit) and the digital kWh meter (the electronic electricity consumption measurement unit) [5]. The digital kWh meter is also known as token-based kWh meter system where payment is made before usage (prepaid service). The benefit of this system is that it allows the consumer to consume electricity energy by the amount of money paid before use. The system has been implemented by the National Electricity Company, but many of their customers have not yet utilized this system. Specifically, there are many student accommodation units that are still using the postpaid service, paying their bills based on the energy consumption billing system as shown by the older version of kWh meter [6] [7]. The National Electricity Company has implemented a policy that requires each house to be equipped with a single kWh meter system. If a building is using more than one kWh meter systems, the billing will be determined based on the contract. This situation can cause problem for student accommodation owners or landlords because this means that they would have to make all occupants in their unit to pay equal amount of money per month. There are also other student accommodation owners who charge their accommodation user based on the types of electronic devices they use [6]. These approaches are still considered unfair because accommodation occupants are not given exact price for the amount of electricity they have used. It is assumed that although some users possess similar electronic devices, such as television, computer, laptop, rice cooker, and such, the frequency and duration of usage might differ from one occupant to another.

Apart from inability to ensure a fair billing system for every student accommodation occupant, the older version of kWh meter has another drawback; occupants are unable to control their electricity consumption, resulting in a huge end-of-month electricity bill. The difficulty in controlling energy consumption becomes a problem for student accommodation occupants because they do not have access to their electricity consumption and therefore some might gain profit while others might be at lost [8] [9] [10] [11].

Considering the problems above, a token-based kWh meter system is necessary, especially in a student accommodation unit, so that the occupant's bill can be adjusted to their consumption. In this research, a kWh meter system is designed to accommodate three student accommodation rooms. It is also able to display electricity

consumption information as well as the remaining credit left. Control of the kWh meter is carried out by an Arduino micro-controller which automatically cuts off the electric current flowing into the room when the number of available token credit is insufficient [12]. The reading of the kWh meter system is displayed in an LCD to allow easier monitoring [13]. The data is uploaded to the website so that occupants can monitor their energy consumption anywhere they wish. The website is also used as the media to do transaction for token credit payment between occupants and an administrator or the student accommodation owner. Using this system, it is expected that the electricity consumption can be curved by each occupant so that they can consume electricity wisely.

2. RELATED WORKS

A wireless kWh meter with network technology is designed to eliminate human intervention in power management. Customers must pay bills on time; otherwise, the power connection will be cut off automatically from a remote server. It displays billing information via the LCD and data sent to the server by ARM7 based hardware via the GSM Module [14] [15]. This system provides efficient meter reading, avoids billing errors, and reduces maintenance costs [16]

An electronic kWh is developed as a power load management system using ARM-7 and GPRS micro-controllers for communication. This system consists of a kWh electronic meter, an intelligent management terminal(IMT), and a management center. This system can complete remote meter reading and power load management via GPRS wireless communication network [16] [17]. The most important features of this system are increasing the level of automation in power load management and reducing energy consumption reading errors [14].

kWh meter with a smart card is used to calculate prepaid electricity usage [18] [19]. The hardware and application design developed to detect how much energy is used and stored as a basis for usage history will help users know whether their energy usage is efficient, normal, or wasteful. The information system is used as a validation which provides information about electricity usage and as a determinant for saving energy [20] [21] [22}.

3. SYSTEM DESIGN

3.1 Hardware Design

The block diagram below (Figure 1) shows the design of the system made. Figure 1 shows 3 kWh meter devices. Each kWh meter device is equipped with LCD display. In 1st Room, Arduino Uno board is used as the controlling system of all rooms. Apart from controlling the communication with the kWh meter devices in 2nd and 3rd Room which are controlled by Arduino Nano board, this board is also equipped with Ethernet shield, which communicates with server via router. The measurement reading of current moving into each room is not only displayed in the LCD as current load consumed, but also uploaded to the web which will then be measured and adjusted with the token credit paid. When the token credit has reached the limit, indicating that the electricity consumption has reached its limit, the processor within the board sends instruction to cut off the current flowing into the room.

The designing of the hardware for each room is explained in details as follow.

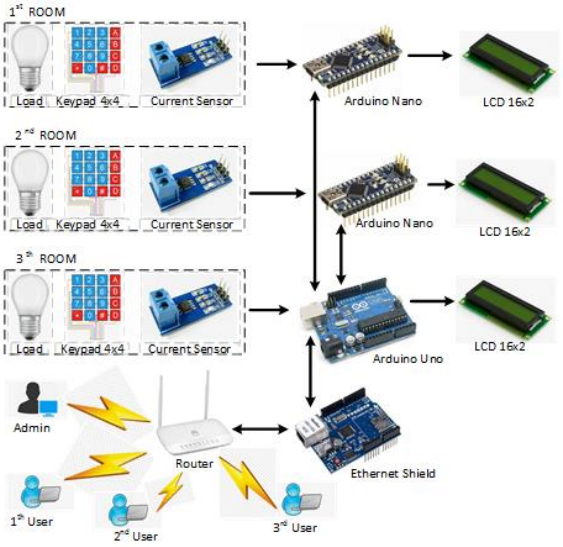

Figure 1. Block Diagram of Token-based kWh Meter System

a. The design of kWh meter hardware for 1st Room

For the 1st Room, the hardware is designed to be able to communicate with another hardware in the 2nd Room and can also upload the reading of electricity use to the web. Therefore, the hardware is equipped with Arduino Uno as the central control and Ethernet shield to communicate with the router in order to connect with server. Figure 2 shows the design of kWh meter device for the 1st Room.

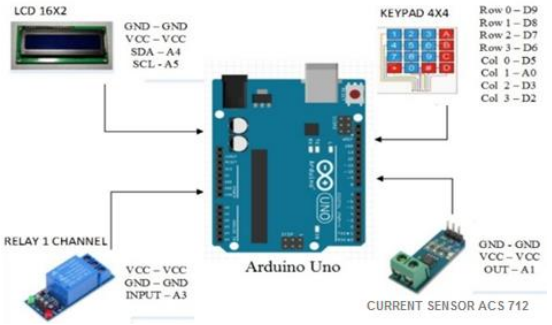

Figure 2. The Design of kWh Meter Device for the 1st Room

b. The design of kWh meter Hardware for the 2nd and 3rd Room

Unlike the device in the 1st Room, the devices for the 2nd and 3rd Room are equipped with Arduino Nano board which has easier tasks compared to the board in the 1st Room. Below is the design of kWh meter for the 2nd and 3rd Room.

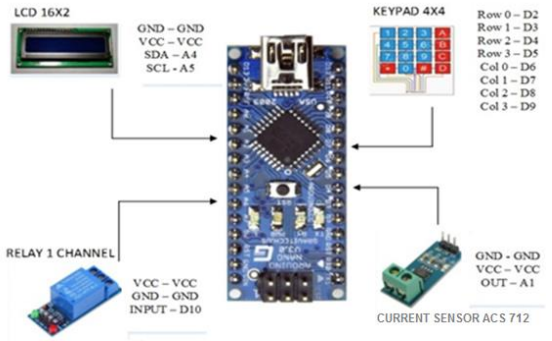

Figure 3. Design of kWh Meter for the 2nd and 3rd Room

c. The design of communication between Arduino boards

In order to make sure that all the three kWh meter devices can communicate, Figure 4 shows the connection between Arduino boards.

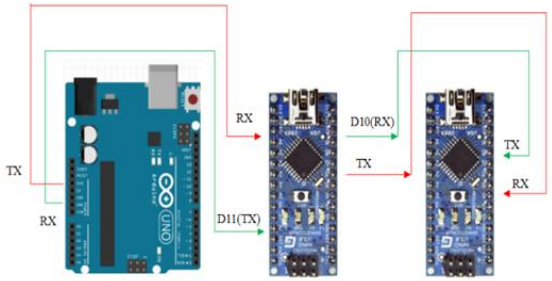

Figure 4. Communication between Arduino Boards

3.2 Software Designing

Data Flow Diagram (DFD) in Figure 5 explains the designing of the software.

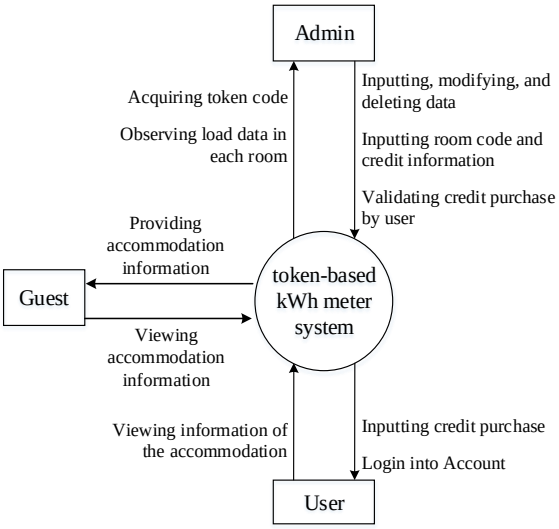

Figure 5. Data Flow Diagram Level 0

DFD Level 0 describes the process happening in the website dedicated for token-based kWh meter system. The design has three entities which include the administrator or the student accommodation owner, the user or the accommodation occupant, and the guests who are the visitors of the web.

Figure 6 shows the development of DFD Level 0. The Level 1 diagram contains the processing of data which involves the administrator (student accommodation owner), the user (the occupant), and the guest. The administrator can perform data monitoring on electricity consumption in each room and validate the purchase of the electricity token credit. The user can view the consumption of electricity in their room and can purchase electricity token credit which needs to be validated by the administrator in order to acquire the token code. The guest is allowed to visit the web in order to find information about the student accommodation.

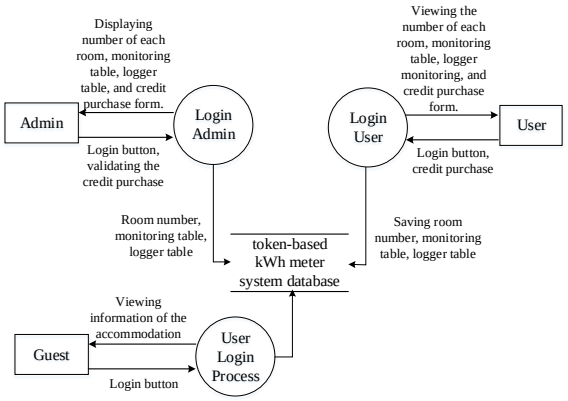

Figure 6. Data Flow Diagram Level 1

4. TESTING AND DISCUSSION

4.1 The Results of Implementing Token-based kWh Meter System

Figure 7 shows the three prototypes of kWh meter devices which have been successfully implemented in the 1th, 2nd, and 3rd Rooms.

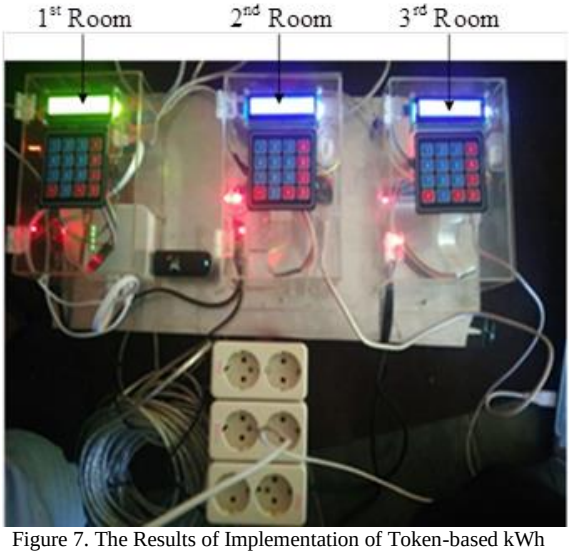

Figure 7. The Results of Implementation of Token-based kWh Meter System

4.2 Web Testing

Figure 8 shows the Menu page for Administrator. This page displays information on the accumulation of electricity power in each room and the credit purchase form including the pricing set by the accommodation owner. The validation button is used to acquire token code when the user (occupant) wishes to purchase token credit. Otherwise, users can also make purchase in the page for User.

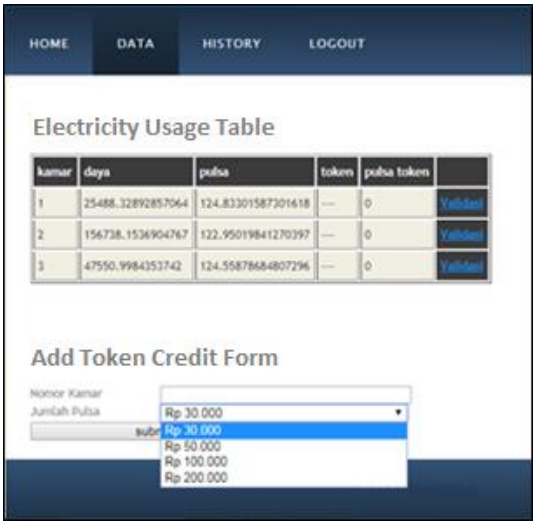

Figure 8. The Data Page in Administrator

Figure 9 shows History page which provides information on the history of electricity token purchases and information on the remaining token credit for each room, namely 1th Room, 2nd, and 3rd.

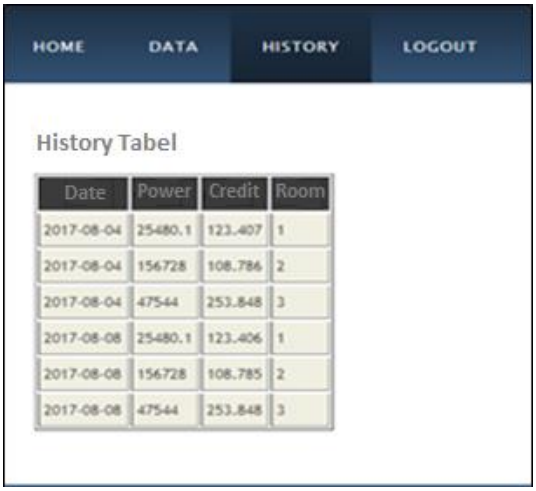

Figure 9. The History Page in Administrator

Figure 10 shows the User page, where users can preview the consumption of electricity and the remaining token credit available. The credit purchase form is also available here, but user needs to acquire a token code which needs to be validated by the administrator.

Figure 10. The Page in User

Figure 11 shows the history page for user. Occupants can view the history of electricity consumption and the remaining token credit.

Figure 11. The History Page in User

4.3 The Testing of Working System

The testing aims to find out whether the system designed can function and work properly and as planned. The testing involves the following steps.

a. Credit purchase testing

In order to conduct sensor testing, the first thing that needs to be done is to test credit purchase. Before testing, the device had 0 balance. The test was conducted in each room and each room was provided with IDR 200.000,00 token credit. Token code was obtained randomly and was recorded in the token database. The calculation of credit is based on the formula below.

Token credit = price of credit - 10% x price of credit / price of electricity per kWh
Where each kWh costs IDR 1.350
Therefore,
Token credit = 200.000 - 10% x 200.000/1.350
Token credit = 133.333

b. The Testing for Current Reader Sensor ACS712

This testing aims to test the sensor for current reader ACS712 in performing the reading of current load. The system was tested in all three rooms and was conducted using the same loads, which were ironing machine with ±380W power and rice cooker with ±300W power. The measurement of duration was conducted in order to find the changes in kWh value measured at 1 kWh. The table below shows the comparisons of the measurement results and the calculation.

Table 1. The results of consumed electricity power measurement at 1 kWh

Room	Loads	Measured Power	Time required to run out 1 kWh	Power used based on calculation
1	Ironing machine	387 W	2 hours 34 mins.	993,3 Watt hours
	Rice cooker	292 W	3 hours 25 mins.	997.7 Watt hours
2	Ironing machine	384 W	2 hours36 mins.	998.4 Watt hours
	Rice cooker	304 W	3 hours 16 mins.	993,1 Watt hours
3	Ironing machine	373W	2 hours 40 mins.	994,7 Watt hours
	Rice cooker	305 W	3 jam 16 mins	996,3 Watt hours

From the Table 1, it can be concluded that all the three token-based kWh meter systems showed reliable performance with measurement results which were relatively similar. For each power consumption increase at 1 kWh, the average error value obtained was 0,0044 kWh.

c. Token Credit Purchase Testing

From the testing of token credit transfer, it shows that the process of inputting token code worked as planned. The token code which was acquired from the web was entered to the kWh meter device instantly. The communication from token code transfer to credit transfer successfully added to balance took around 5 seconds.

d. Relay Testing

The testing aims to find out whether the relay is working properly in cutting off the current when the balance is IDR 0. The testing shows that token-based kWh meter system can be used as electricity measurement unit which is suitable for student accommodation rooms. By using this device, occupants can consume electricity wisely by purchasing credit in the amount needed. Another advantage of this system is that the consumption of electricity (kWh meter condition) and the remaining token credit can be monitored from the web.

5. CONCLUSIONS

Token-based kWh meter system had been tested and successfully implemented in three student accommodation rooms which used ironing machine and rice cooker. It was found that for an increase in electric power of 1 kWh, an average error value at 0,0044 kWh was obtained. The process of credit purchase and the transfer of token credit to each device were successfully conducted with ± 5 seconds of communication time before top up. During the testing, the ON/OFF relay against load current in each room worked smoothly. When the token credit shows 0 balance, the relay automatically cuts off the current.

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