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THE MANAGEMENT OF EXAMINATION MALPRACTICE USING BLOCKCHAIN TECHOLOGY

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Abstract— **Post examination malpractice has continued to show up in some of the marking centres at grade twelve (12) level, which is mostly the changing of grades already entered in an electronic system. This study was designed to investigate the current challenges that are poised by the current system in the entry and transmission of results from marking centres, through a mixed research study approach. To the challenges presented by the current system, a Blockchain technology approach was developed to address the challenges. The Blockchain system would use the cryptographic hash function known as SHA-256, to enable the system compute the correct input value given some output value. The function proposed because of it's collision resistance capability. The transactions between the marking centre and the examination council is a way of recording activities occurring in a digital form on the Electronic Results Management System (ERMS).**

Keywords— **Blockchain technology, SHA-256, Examiners, Malpractice,**

I. INTRODUCTION

Examination malpractice is a process by which a candidate has undue advantage in an exam through deliberate process to get a higher grade than anticipated, [1] Examination malpractice is any form of deliberate cheating on examinations which provides one or more candidates with an unfair advantage or disadvantage. There many forms of examination malpractice which can be termed as pre-examination, during examination malpractice and also post-examination malpractice. These forms of malpractice and determined by the circumstances that are prevailing at a particular time.

According to Jimoh and Basil Olatunbosun (2009) examination malpractice is viewed as a breakdown in cultural values, [2] As to what sustains examination malpractice in the country, the writer holds the opinion that societal apathy, which is summed up in the term "anomie" is what sustains examination malpractice in Nigeria.

This vice has again been defined by others scholars like Dr. Rita A. Ndifon et al (2014) who refers it to [3] an act of wrong doing carried out by a candidate or group of candidates or any other person with the intention to cheat and gain unfair advantage in an examination.

The management of this vice is of great concern to the country's effects on the production of ill-trained pupils. This paper proposes blockchain technology in combating post examination malpractice that results from the changing of grades at marking centres.

Blockchain technology provides a secure way of transmitting data from one point to another using a hashing mechanism, while making the data highly immutable. This proposal of Blockchain technology takes advantage of the current Examination Electronic Entry System that is provided by the council, which is already computerized but still ineffective due to the fact that it is prone to have grades that have been entered into the system changed at any time and any point.

A. Conceptual Framework

A conceptual framework links discrete concepts based on multiple theories and is seen as an impetus in the development of theory [4]. This study's conceptual framework outlines diagrammatically how the entire research process will be conducted from looking at all the related literature of the study to the development of a prototyping tool and consequently the validation of the tool which will be done in two folds; the process of tool testing as well as focus group discussion.

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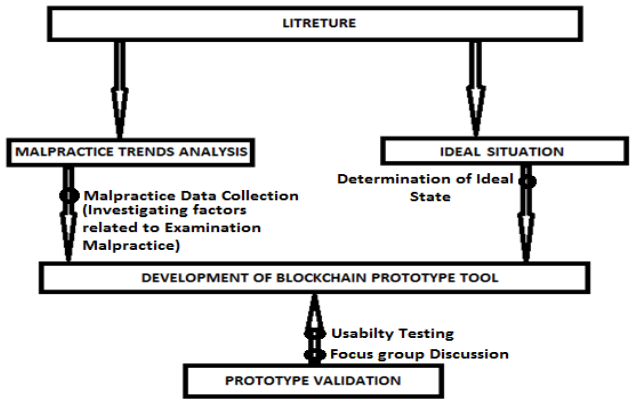

Fig. 1. Shows a conceptual framework for the research

B. Objectives and Questions

This research aims at assessing the challenges that are posed by the current trends in management of examination malpractice and develop a model & prototype to manage examination malpractice using blockchain technology. The two objectives were set as below:

i. Investigate the current challenges faced in management of examination malpractice from a marking centre to Examination Council of Zambia.
ii. Develop a model and prototype using blockchain technology.

The following were the questions that were obtained from the observed objectives of the research.

i. What are the challenges involved in the management of examination malpractice from the marking centre to examination council of Zambia?
ii. How can we develop a model and a prototype to manage examination malpractice?

II. LITERATURE REVIEW

This section will review various conference papers, journals, ministerial statements, books etc., on the subject of Blockchain technology its importance in managing post examination malpractice in education, Utaut model in technology advancement. A close look at EduRSS and EduCTX and their importance in the sharing of academic documents in institutions of learning.

A. Post Examination Malpractice

Post examination malpractice involves any form academic dishonest that is done or practiced at the completion of a terminal examination exercise. The following are some possible cases that were identified and termed as post examination malpractice including incidences that were recorded in online social media publications.

The case of stolen already written examination paper from a strong room that were earmarked for transportation to the council headquarters, "Eastern Province commissioner of police, Luckson Sakala, said the thieves drilled a hole from one of the classrooms into the deputy head teacher's office strong room where the papers were kept. Sakala said the incident occurred between November 23, 2018 at 17:00 hours and November 25, 2018 at 07:30 hours at Ncheka Primary School. He said the thieves went away with all the written grade nine examination papers, including maths and answer sheets, which were written on Friday, November 23, 2018"[1]

In some cases Data entry officers are able to change grades of particular candidates in order to give undue advantage, as seen in certain instances, "Some data entry operators change the correct figures as presented by the team leaders. This occurs mostly after the counter checking sheet has already been produced and given to the team leader"[2]. This includes some team leaders who are highly compromised that are responsible for coordinating belt marking in their subject panels as observed here, "Some team leaders do not only total up the marks after marking but also carry the marked papers to the data entry opera-tors. Therefore, some of these people deliberately enter in-flated marks for some papers, and data entry operators just enter the marks that they see on the mark sheet"[3]

The changing of results on the storage systems as observed by Dr. Gbenga Adewale is also one of the most persistant problems of post examination malpractice in modern times. This problem has not gone unnoticed by the examination council as observed through [5]"identified post examination malpractices that are traceable to the staff of the public examination boards and the examiners who mark the candidate's scripts."

Some other cases involve candidates paying some examiners money in order for them to mark their scripts and ward marks unnecessary, [6] post-examination malpractice could take the form of lobbying the examiners by begging and sending dose

[1] https://zambiareports.com/2018/11/28/thieves-steal-writtengrade-nine-exampapersanswer-sheets/
[2] https://www.zambiawatchdog.com/how-examinationmalpractices-are-carried-outinzambia/
[3] https://www.zambiawatchdog.com/how-examinationmalpractices-are-carried-outinzambia/

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friends and senior colleagues to the examiner to be lenient while marking.

Certain writers have done researches that dwell on the examiners having some inherent behaviors of malpractices, this has been observed through an article written by J. O. Adeleke, Ph.D and G. K. Oluwatayo (2011) where they submit the following [7] It was however found that, only Examiners' attitude to marking (β=.230; t=5.391; P<0.05) and Years of Marking with WAEC (β=.155; t=2.042; P<0.05) were significant factors that positively influenced examiners' disposition to reporting cases of examination malpractice. This is a huge risk towards the outcome of results in schools.

B. Unified theory of acceptance and use of technology model (UTAUT)

The unified theory of acceptance and use of technology (UTAUT) lies on the premise that an assessment on the need for a user is required for the quick establishment of the intention by the user of a system and the ultimate usage behavior. The four main determinates performance expectancy, effort expectancy, social influence and facilitating. Facilitating conditions this is the support that is made available to user so that the outcome is useful, [8] refer to consumers' perceptions of the resources and support available to perform a behaviour Venkatesh et al. (2011).

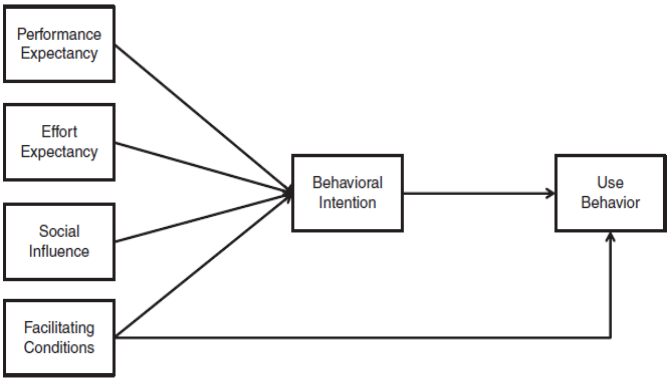

Fig. 2. The Unified Theory of Acceptance and Use of Technology (UTAUT) Model[4]

C. Blockchain Technology

Blockchain technology is the form of technology that uses distributed databases that makes use of a digital ledger to record their transactions, [9] Blockchain is a distributed public ledger that contains all the transactions that ever executed in the system. There are various types of platforms that could be used to develop smart and secure contracts i.e. Eth, Ark, Eos etc. The block chain technology comes as result of the technological advancement from bitcoin technology, which is meant to maintain trust in a system and not in a person that is accessing the system.

Block chain technology is applied in so many fields such as insurance companies, health institutions, schools etc. this technology helps in securing data by on premise users as well as remote access users because of its decentralized form, [10] blockchain is a decentralized technology that ensures the security of data, and no one can manipulate transaction data because of its many replicas in different servers.

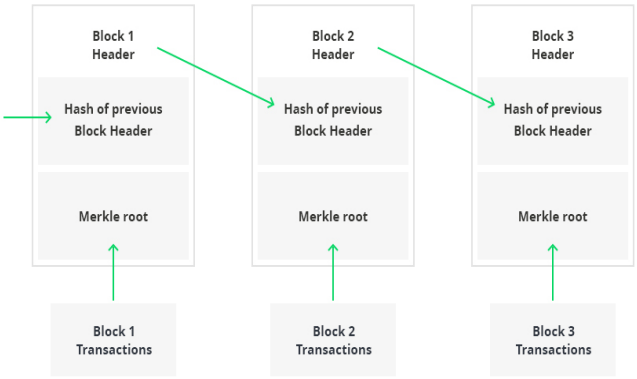

Fig. 3. Blockchain Structure[5]

D. Smart Contracts

Smart contracts are completely digital and in actual sense they represent the same legally signed documents that show agreements of parties involved and provide for a secure platform with digitally programmed functions and rightful procedures during execution, [11]"The security and reliability of smart contracts include two dimensions. One is to regard smart contract as a static program that has not been put into use. The correctness of the program is a prerequisite for ensuring the security and reliability of the contract. The other one is the security issues that may arise during the execution of the contract". The transaction are fundamentally sent from the wallets that are held by a blockchain and are also automated, [12]"Smart contracts can facilitate safe and trusted business activities by providing automated transactions without the supervision of an external financial system such as banks, courts, or notaries. These transactions are traceable, transparent, and irreversible". The wallets are endpoint clients that are used to interact with the smart contracts in form of transactions.

[4] https://www.researchgate.net/figure/The-Unified-Theory-of-Acceptance-and-Use-of-Technology-UTAUT-Model_fig1_325479498

[5] https://mlsdev.com/blog/156-how-to-build-your-own-blockchain-architecture

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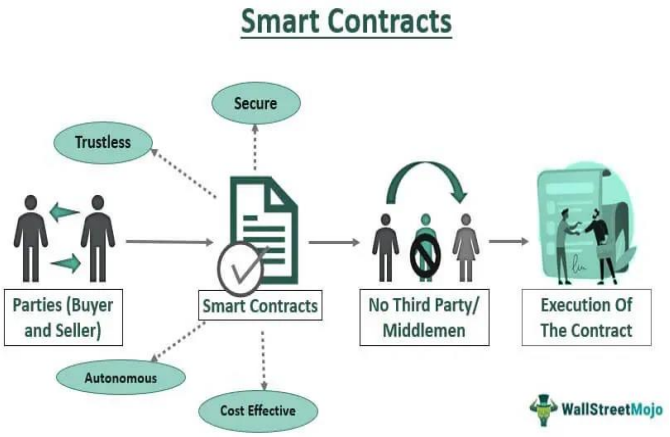

Fig. 4. Smart contracts[6]

E. Consensus Algorithms

Consensus algorithm is an integral part of blockcahin technology and could be applied to many forms distributed systems; they play a very big role in trying to make sure that the nodes that are attached to a blockchain have the same data items and format as can be observed in [13]. There are a lot of consensus algorithms that are used depending on the requirements of the results that need to be attained in a particular instance; the following are some of the examples of consensus algorithms that are used in a distributed system, Leader free byzantine consensus algorithm, Blockchain Consensus: An analysis of Proof-of-Work (PoW) and its applications, Implicit Consensus: Blockchain with Unbounded Through- put etc. The block before being added to a blobkchain, some amount of computation has to be done to determine which node can add that particular block to the blockchain.

F. EduCTX: A Blockchain based higher education credit platform

Many High Education Institutions (HEI) which use Peer-to-Peer network technology have based their technology advancement on the credit transfer which is meant to control third party interference [14]–[17], this is a big achievement that has been demonstrated through the management of educational records using block chain technology.

G. Key features and security of EduCTX: A Blockchain based higher education credit platform

The enrolment system for the students was done at the same time just after enrolment to the HEI, then a student obtains an ID and the private & public key are generated and verification is to be done by a course instructor at the completion of the exam by the student. The organizations that are wishing to look at a student's 'records can obtain them upon submission of the students 'address to the HEI [18].

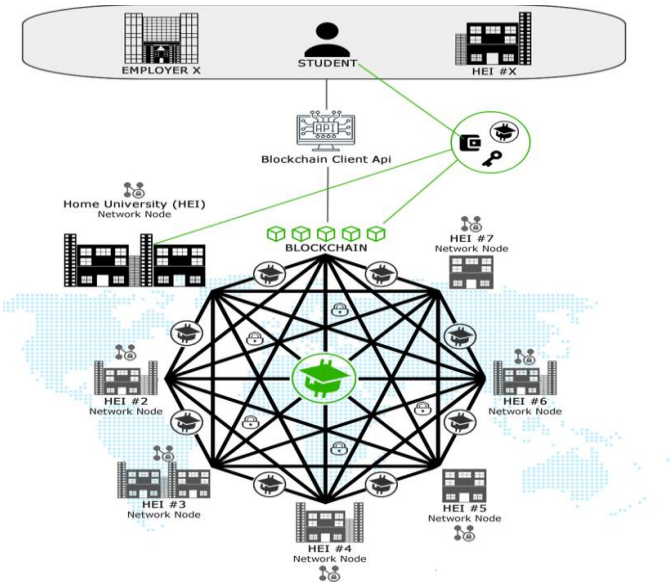

Fig. 5. A high-level depiction of proposed EduCTX platform [18]

H. EduRSS: A Blockchain-Based Educational Record Secure Storage and Sharing Scheme

The EduRSS was built with different mechanism that would enable the most secure way of doing transaction in a P2P network. It ensures that there is consensus in the way these transactions are done using a consensus algorithm. It also provides for cyber security which is on the increase as observed from situations like these contained in the article [19]. The Educational Records Secure Storage (EduRSS) had features that were meant for the performance of the system; First step is to take care of the individual enrolment of institutions as they join a HEI through the steps as proposed system is to have a three phase system to enable the establishment of a link i.e. the request phase, the vote to join phase and the set up member to join. This process involves the use of a certificate to enable the smooth running of the transactions and establishing what is called the (x) for each institution.

[6] https://www.wallstreetmojo.com/smart-contracts/

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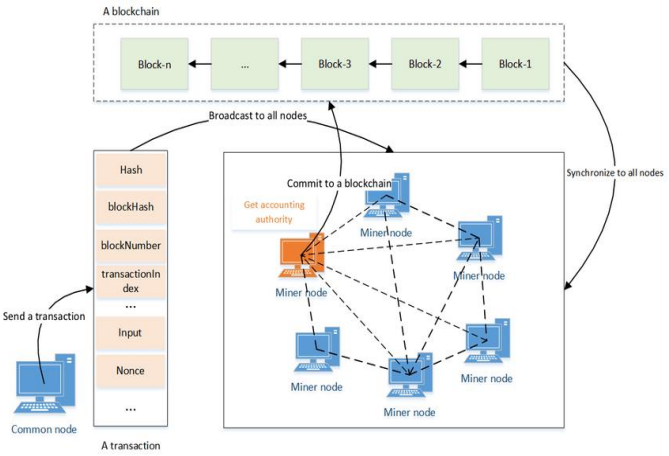

Fig. 6. The detailed logical flow for processing a transaction[20]

I. Key features of EduRSS: A Blockchain-Based Educational Record Secure Storage and Sharing Scheme

A smart contract with its primary objective of trying to make secure the storage and transmission of academic records the EduRSS was developed. These Smart contracts were designed with IISC which they employed in the process of joining smart contracts that are compiled and deployed on the blockchain to control the behaviors of nodes. According to the parameters that IISC smart contracts it needed to apply were mapping of the key storage value as well as the relationships the keys generated for the insitutions [20], the interfaces of the IISC would enable the smooth transfer of information on a blockchain as observed in the below with the two algorithms.

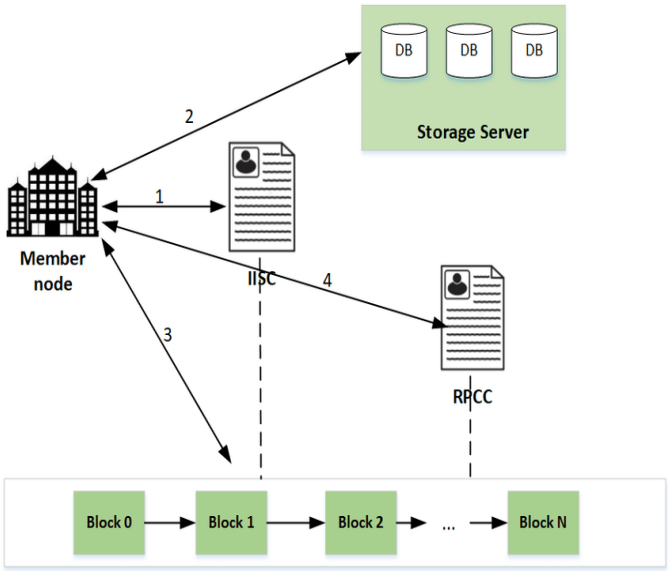

Fig. 7. The illustration of the storage process.[20]

III. METHODOLOGY

The section is structured around baseline study which includes: mixed methods research methodology. The purpose of the study was to find out what challenges that the council is facing in the regard to examination malpractice in the transfer of results from a marking centre. This is followed by system automation, which focused on the current and proposed business processes. The various system design are then presented.

A. Study Setting

The target population involved twelve (12) marking centers countrywide out of twelve (12) which is the usual number of marking centers that are used in the marking process at grade (12). The target were four (4) rural centers, four (4) peri-urban and four (4) urban areas and twelve (12) systems administrators for the centers, twenty two (22) data entry officers, forty two (42) chief examiners for the panels, two hundred and thirty-two (232) examiners from different panels and two (2) IT personnel in charge with the publication of results at the council.

B. Data Processing and Analysis

This process involved organizing the data collected in manner which was clearly understood. The quantitative data was analyzed and interpreted using Statistical Package for Social Science (SPSS) software while the descriptive statistics were applied to show the frequency distributions from the various responses that were obtained.

C. Proposed System Automation

The process of results verification from various marking centres was a setup previously done in the manual by the officers from ECZ who go through the hard copies and confirmed the results of each candidate and their respective centres, and due to the high volume of results involved in the process, much of the process is not completely exhausted and go straight to the softcopies in order to publish the results quickly. The new approach will provide for the quick confirmation of the results by the examiner within the panel and not from a typing pool using the web application, after the confirmation, the results will be hash by the application and upload on the Blockchain for further verification process before they are distributed to the candidates.

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D. Proposed Web Based System

Fig. 8. Web based blockchain system interface[7]

E. Digital Signature Phase

The digital signature is meant to detect the unauthorized tempering of grades. This part of the examination process confirms who the original source of the signer of that specific document sheet of the grades. At this point since there are a number of examiners that are involved in the process of confirmation for transferred grades. The process of signing on the document is done using a group signature.

F. Group Signature

This form of signature ensures that only members of a specific group can sign on a document, it also makes the receiver to be able to verify if the message is valid or not but cannot immediately discover which member sent it and can be revealed after opening the message and seeing the content of it, "the group is initialized by having the group manager generate master public and secret keys; upon admission to the group, a user is given a personal secret key that is derived from the master secret key by the manager"[21].

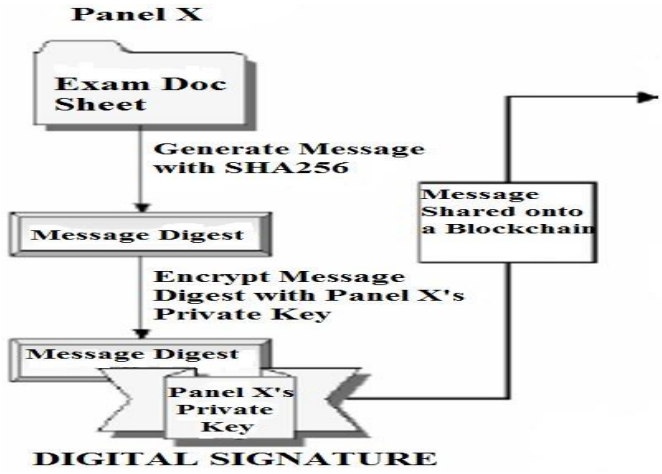

Fig. 9. Digital signing process [**Adopted Image**][22]

The process of signing on a message is done using an algorithm as seen in the figure below. The generators of the key $g_1 and\ g_2 \in G_q$. The secret key P_i is $(x_{i1}, x_{i2}) \in Z_q^2$ for every $i = 1, 2$ and its public key is given by $h_i = g_1^{x_{i1}} g_2^{x_{i2}}$, it must be noted that no two persons from the same marking panel will have the same public key, therefore it shows that $h_1 \neq h_2$.

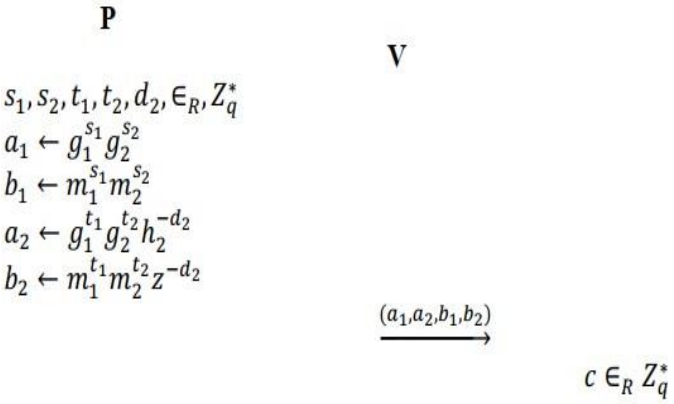

Fig. 10. Proving that z is constructed by correctly with respect to h_2[23]

[7] https://www.digisigner.com/free-electronic-signature/signdocument-online

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G. Verification Phase

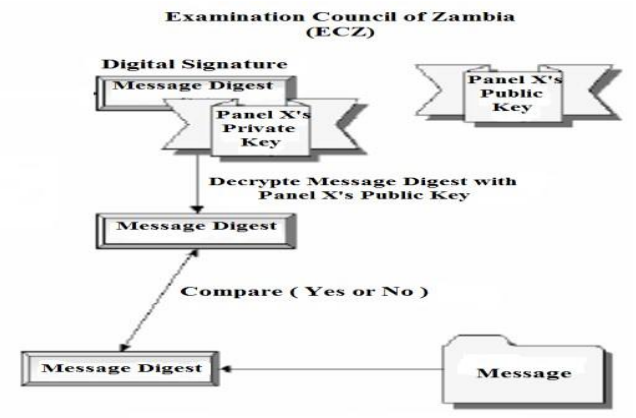

Fig. 11. Verification process of the document [**Adopted Image**][22]

H. Use Case Diagram on Signing and Verification

The diagram below shows the two types of signing a digital document that are used on the Examination Results Management System (ERMS).

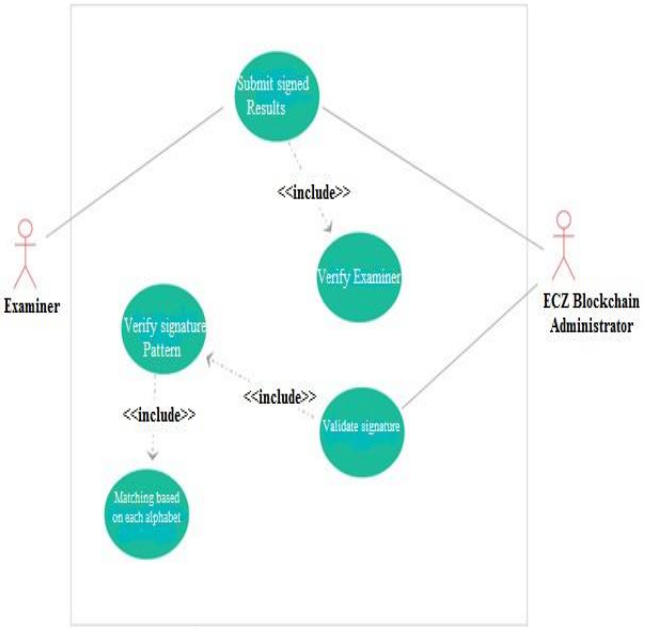

Fig. 12. Use case diagram on the signing and verification of a digital signature [**Adopted Image**][8]

[8]https://www.google.com/search?q=use+case+diagram&tbm=isch&hl=en-GB&tbs=rimg:CTsFjQpkBFNAYTtOUYjWDzrM&client=firefox-b-d&sa=X&ved=2ahUKEwj355vv2MP2AhXZwYUKHYX_DoAQuIIBegQIABAp&biw=1124&bih=529#imgrc=7AMu5Jk0CKdSdM

I. The Sequence Diagrams

The next part deals with the Sequence diagrams which help with showing the kind of interactions that are defined among different system classes. These instances help in the process of visualizing as well as validating the different runtime scenarios. As can be described below between the actors and main system.

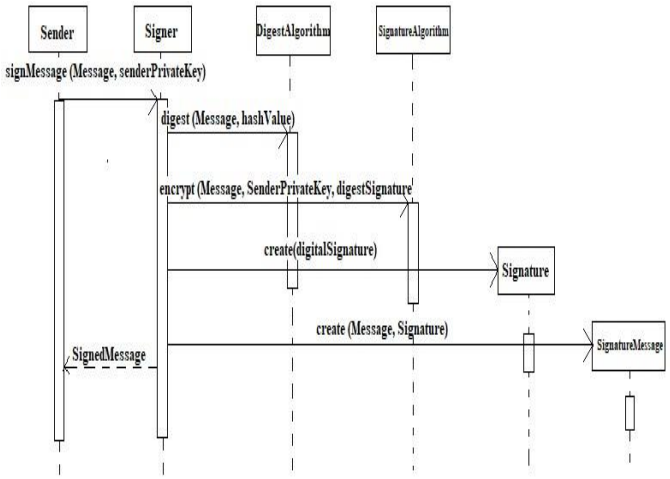

Fig. 13. The sequence diagram for signing a digital signature[24]

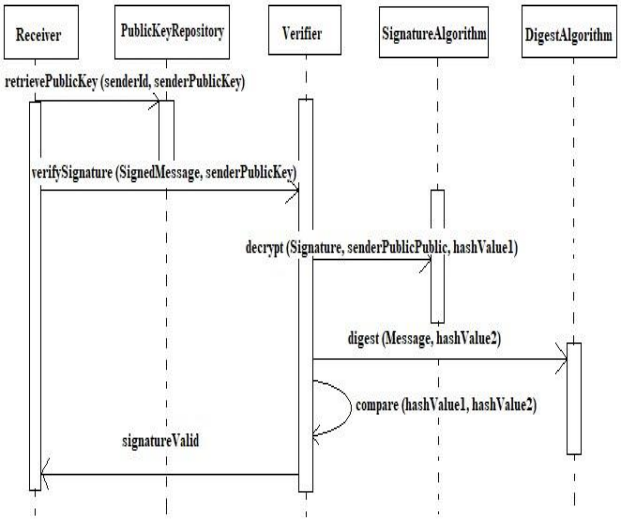

Fig. 14. The sequence diagram for verifying a digital signature[24]

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IV. FINDINGS AND DISCUSSION

A. Results Obtained from the Interviews Conducted

Using the Likert Scale the researcher looked at the variables which were considered in the study "Likert scale is applied as one of the most fundamental and frequently used psychometric tools in educational and social sciences research"[10] to determine their results and how useful the model used towards finding out how important this survey was. These variables included performance attribute, effort expectancy, influence of people from various spheres, facilitating attribute of the Blockchain, behavioral factor on blockchain, as well as other factors such as the functionality of the current system.

Table 4. 0 Statistical results for the parameters of the utaut model

	Performance Performance	Expectancy Effort	Social Influence	Facilitating Conditions	Behavioral Intention	Functionality of Current Sys	System Control
N Valid	92	92	92	92	92	92	92
Missing	0	0	0	0	0	0	0
Mean	4.0217	3.6033	3.2609	3.6587	2.8457	3.0938	2.0978
Median	4.2500	3.7500	3.0000	3.8000	2.8000	3.0000	1.7500
Mode	5.00	4.00[a]	3.00	3.60	2.20	4.75	1.00
Std. Deviation	1.08793	1.01983	1.15053	.95873	1.09468	1.01036	1.13568

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B. Code that was generated to give the SHA 256 Algorithm

The results of the platform that was developed were obtained through the use of Java programing on NetBeans. This a development platform that was developed by Oracle.

```
124
125     private void SignActionPerformed(java.awt.event.ActionEvent evt) {
126         // TODO add your handling code here:
127         File file =new File (Input.getText());
128
129
130         try {
131
132             //Use SHA-1 algorithm
133             shaDigest = MessageDigest.getInstance("SHA-256");
134         } catch (NoSuchAlgorithmException ex) {
135             Logger.getLogger(Upload.class.getName()).log(Level.SEVERE, null, ex);
136         }
137
138
139         try {
140
141             //SHA-1 checksum
142             String shaChecksum = getFileChecksum(shaDigest, file);
143             //see checksum
144
145             Output.setText(shaChecksum);
146         } catch (IOException ex) {
147             Logger.getLogger(Upload.class.getName()).log(Level.SEVERE, null, ex);
148         }
149
150
151     }
152
153     private void InputActionPerformed(java.awt.event.ActionEvent evt) {
```

Fig. 15. Shows the output obtained from the digital signature created using SHA256.

C. Sign up page for the Blockchain System that was developed

The signup page gives an opportunity for the user of the online transmission of the results using a blockchain to create a persoanl account that the user will be able to gain access to the blockchain system and be able to do transactions as prescribed by the roles given to him/her by the super user of the system. The diagram below shows the signup page:

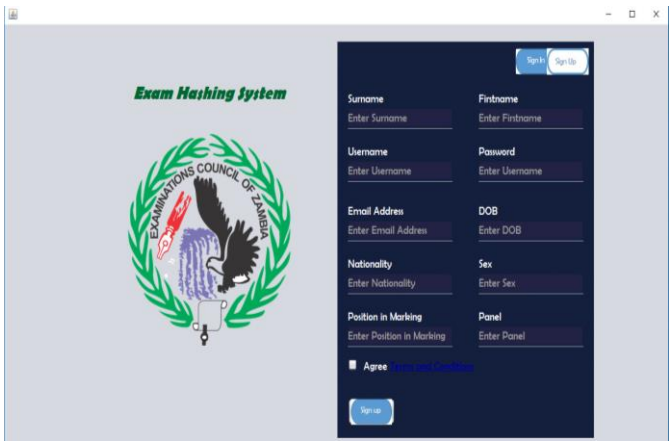

Fig. 16. The sign-up page

The Examiners use this signup page to create an account for use during the time when examination-marking process is in session at a marking center for the examiners who will be responsible for the process of entering results into the blockchain system.

D. The Message Upload/Sign Page

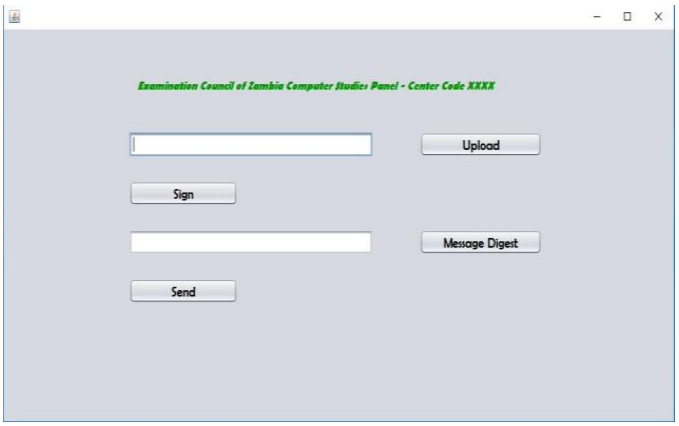

Fig. 17. The message upload/sign page

This part of the platform gives the system users to be able to upload the ducoments that earmarked for signing to be transformed into a message digest that would be used for transmission to the intended destination. This digest would be hashed using SHA 256 Algorithm.

E. Verification Page

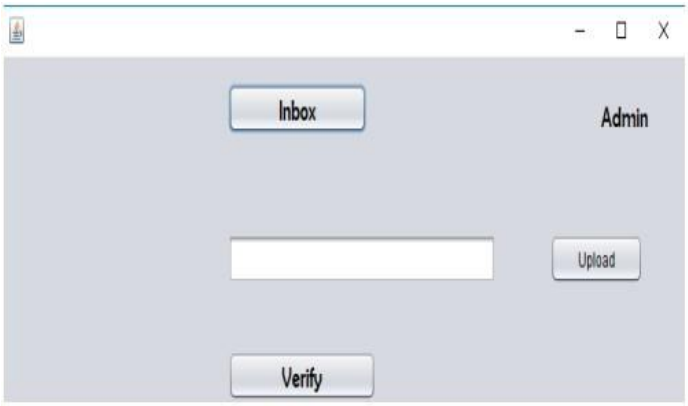

Fig. 18. The document verification page for the blockchain system

This part of the platform provided for the establishment of the authenticity of the document being transmitted on the block.

F. Encryption Mechanism

The encryption feature for the examination results managements system was meant to lock the transaction content to make it impossible for unauthorized users to gain access to the content of the message as observed in the article, [25]"The method of surrounding pixels generated by the SHA-256 hash value of the plaintext image is adopted, which can enhance the ability of the encryption system to resist chosen plaintext attacks".

G. Time Stamping

This feature of a blockchain will enable the transactions to be digitally recorded with the time at which they were performed is the time stamp. It enables the hash that is generated by the algorithm to be shared onto the blockchain so that any attempt to modify a particular transaction, a new hash is created as observed through "A hash is the identity of a block that is generated from the aforementioned properties. If any value in the transaction changes, the value of the Merkle tree also changes. As the Merkle tree value changes, the hash of the block also changes, as the hash is totally dependent on the value of each property. In this way, if any illegal changes occur, they can be detected very easily in the block-chain,"[24].

H. Immutability

It's a feature which provides for maximum resistance to any sort of modification of data that has been on a network. "As for immutability, the Blockchain technology itself guarantees integrity of data. If a user wants to modify some piece of information, his or her acts will be registered in the ledger, being very easy to detect. This makes this technology trustworthy."[26].

V. CONCLUSION

The challenges that were faced with the Examination Entry System which was a desktop application such as essay modification of results by a user viz vi deletion, addition etc. The web based results entry system with the use of blockchain technology used functionality such as encryption of the message using SHA 256, interface for the application developed using Java and the backend database was developed using MySQL as a relational database with connector using PHP. The prototype showed how the data could be centrally managed from a marking center to a central point at the Examination Council. The test used real data to test the use of the system and the validations that had been put in place.

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