Research Article / Review Article FUPRE JOURNAL 7(4): 18-28(2023)

FUPRE Journal

of

Scientific and Industrial Research

ISSN: 2579-1184(Print) ISSN: 2578-1129 (Online)

http://fupre.edu.ng/journal

Design and Implementation of a Whiteboard Web-Application Using Block Chain Technology

***UDO, E. U.*[1,*], *ILO, S. F.*[2], *NNOCHIRI, I. U.*[3] *AKUMA, I. U.*[4]**

[1]*Department of Electrical/Electronic Engineering, Michael Okpara University of Agriculture, Umudike, Abia State*

[2,3,4] *Department of Computer Engineering, Michael Okpara University of Agriculture, Umudike, Abia State*

ARTICLE INFO

Received: 25/05/2023
Accepted: 01/07/2023

Keywords

Block chain technology, Decentralized white board, eLearning, Web application

ABSTRACT

The decentralized whiteboard application using New Kind of Network (NKN) is a real time collaborative application. Decentralized whiteboard uses NKN as a peer-to-peer network layer which is optimized to manage network resources. Decentralized applications create an innovative open-source software ecosystem which is both secure and resilient. Presently, when majority of researchers want to access information on the network, they often face the risk of learning online and some of the challenges they encountered are high bandwidth usage, high CPU usage, physical connectivity issues, malfunctioning devices, domain name server (DNS) issues and interference in the wireless network. The method adopted involves the breaking down of its compositional sub-system in a reverse engineering fashion. The top-down model helps researchers to write the main procedure that names all the major function needed in developing the decentralized whiteboard web-application. The results obtained shows that decentralized whiteboard has given software developers ability to reuse code in various program fragments and also provided better connectivity for their users. In conclusion, it is recommended that institution of higher learning can adapt this as a learning tool to aid a better learning experience in their institutions of higher learning.

1. INTRODUCTION

In education, Information and Communication Technology (ICT) plays a critical role, particularly in the learning process. ICT solutions have been shown to be beneficial in improving the quality of education and learning services. Online learning, often known as electronic learning, is one of the most widely used ICT solutions today (e-learning). Learners can customize their experiences to match their specific learning objectives using e-learning tools, which provide them control over material, learning sequence, learning speed, time and media. Because of its flexibility and adaptability, the online learning paradigm is

*Corresponding author, e-mail:*thought.umoren@gmail.com*
DIO

frequently used in educational institutions. Even if instructors and learners are in different locations, the learning process can be done directly and concurrently (Hwang, 2014).

Online learning is able to overcome a variety of issues, including distance, time, cost and lack of educator resources (Al-Saqafa and Seidlerb, 2017).

However, there are certain specific concerns that need to be addressed, one of which being the limitations of the learning medium.

Real-time visual information exchange is still challenging to achieve in online learning. Material explanations are more difficult to comprehend as a result of this condition, especially when it comes to pictures, sketching and modeling. As a result, in the virtual classroom, a more flexible and collaborative learning media solution is required (Hori et al., 2016).

Owing to the rapid development of Internet technology, online education has entered a stage of rapid growth. Online education is a web-based teaching method for content dissemination and fast learning using information technology and Internet technology.

With the Internet as the medium, online teaching transcends the limits on venue, environment, time teachers and offers students quality teaching activities at the expected time (Sun et al., 2019).

The various types of online education can be divided into vocational training, examination and certification training, personal skills improvement, language education, early childhood education and Kindergarten to 12 grades.

In China, online education platforms are springing up by players like traditional Internet giants (e.g. NetEase and Tencent) and traditional education companies (e.g. New Oriental, Xueersi and Hujiang), universities as well as primary and secondary schools. In recent years, massive open online courses (MOOCs) have been brought to public attention. Originated in the US, MOOCs are developed by leading content providers like Coursera, Udacity and edX.

Since 2012, top American universities have been setting up online learning platforms and offering free online courses. Targeting higher education, MOOCs are featured by quality teaching programs and independent management systems. Despite the immense popularity, the current forms and systems of online education have many defects in the face of an increasingly open and digital Internet (Ma, 2018).

To make the learning process and results trustable, it is necessary to develop a distributed and trustable data storage method to record the students' learning process, disclose all learning data to the public and ensure the security and non-tamper ability of data. Block chain technology is a desirable tool to solve the problems of online education, namely poor certification, lack of recognition and data insecurity. Currently, this technology is mainly applied in such fields as finance, the internet and Internet of Things (IoT) (Gopane, 2019).

The block chain technology enables devices to communicate autonomously and identify errors. This technology has also been

applied preliminarily in the field of education. For instance, Mike Sharple proposed that the block chain can be employed to realize distributed storage of education data, forming the so-called knowledge currency. Some scholars suggested applying block chain in credit card authentication, secure data encryption and distributed data storage (Zhong et al., 2018)

The MIT Media Lab built a digital learning certificate system using block chain technology and Mozilla's open badge. Block chain technology has been adopted for product design in the industrial field. Sony Global Education, a block chain technology infrastructure platform under Sony Corporation of Japan can openly and securely share learning courses and record data without disclosing this information to the education management authority, thus realizing the fairness and digitization of education. University College London uses block chain technology to help postgraduates of financial risk management verify the authenticity of their academic qualifications (Coleman, 2016).

This paper proposes the design and implementation of a whiteboard web Application using NKN to aid in the improvement of electronic learning services over a decentralized system. This capability, similar to a whiteboard in the classroom, allows educators to write text, draw diagrams and models interactively that can be shared with all distance education participants. This technique is capable of addressing some of the problems present in communication. The introduction of an interactive online whiteboard has numerous effects on learning, including increased student participation in the classroom, motivation and passion for learning.

1.1 Analysis of the Proposed System

This research focused on the use of block chain technology in a very specific area of peer-to-peer eLearning. This research discussed the understandings of this technology and how it works, identified and analyzed the past and current research of using block chain technology in peer-to-peer eLearning to find the gaps and explored the opportunities the block chain technology has in this specific area (Sharples and Domingue, 2016).

The decentralized web-application using New Kind of Network rests on the foundation of block chain. It proposes the effective use of computers to communicate on a decentralized internet despite the bandwidth. It offers a more effective and efficient medium for students to communicate appropriately with lecturers through audio, illustrations of text, shapes and many more. Block chain can provide several advantages and can overcome some of the limitations of traditional eLearning systems (Al-saqafa and Seidlerb, 2017).

In a centralized system or network, if the centralized server or database fails, the whole system fails whereas in the block chain network each node or computer communicates with other nodes and has the same power and there is no centralized or controlling node, so failing of any node in the network does not affect the performance of other nodes. Block chain technology can provide this benefit of a decentralized

system for peer-to-peer eLearning (Campell, 2016).

Unlike the centralized system, in the block chain network the total number of users does not depend on the capacity of a single centralized server, so it can accommodate a growing number of users easily. So, peer-to-peer eLearning using block chain should be able to accommodate a greater number of users.

In a centralized system, the performance is limited and depends on the capacity of the centralized server. In the block chain network, the performance does not depend on any single node or server. So, the overall performance in peer-to-peer eLearning using block chain will not depend on any single centralized server (Kosba et al., 2016).

The traditional eLearning system has a high cost and sometimes the cost is beyond the capability of independent learners and sometimes can be available only through an institution or organization. Also, it can be available for one-way teaching/learning when students learn from a teacher/tutor and cannot be available for peer-to-peer eLearning. Peer-to-peer eLearning can provide anyone the benefit to learn or teach. This can be free of cost or sometimes with a very minimal cost that can be beneficial for students who cannot afford high tuition costs.

Sharples & Domingue (2016) proposed block chain technology for the distributed storage of education data and also form knowledge currency. MIT media labs used block chain technology to issue academic certificates (Coleman, 2016). Other institutions such as Holberton school in San Francisco and Ngee Ann Polytechnic in Singapore also use block chain technology to have their students record their academic credentials, manage them as their learning outcomes and use them for job-searching.

Zhong et al., (2018) proposed an application using block chain technology to improve engagement by rewarding virtual currencies to the top ranked learners based on predefined policies deployed on the block chain network. Gopane, (2019) studied the possibility of using block chain technology in education especially in the context of self-directed, motivated, adaptive, resource enriched and technology embedded university environment (Hwang, 2014) and proposed several areas where block chain technology can be of great use but the study does not cover anything specific to the peer-to-peer eLearning area.

Bdiwi et al., (2017) proposed a block chain based architecture for ubiquitous learning environment (ULE) that preserves the benefits of security and privacy. The architecture allows the design of a decentralized topology based on secure learning system.

2. MATERIALS AND METHOD

The paper makes use of software tools which includes React JS, Chakra UI, NKN JS SDK, Visual Studio Code and Google Chrome. The system is composed of more than one sub-system and it also contains a large number of components. These subsystems and components have their own set of subsystem and components that can create hierarchical structure in the system. This is because of its capabilities in areas such as object usages, data abstraction and

encapsulation. The communication that exists between objects, routines and sub-menus are usually basic because of the graphic effects it possesses and its relationship with html.

The method employed top-down design that takes the whole software system as one entity and then decomposes it to achieve more than one subsystem based on some characteristics. Each sub-system or component is then treated as a system and decomposed further. This process keeps on running until the lowest level of the system in the top down hierarchy was achieved. Top-down design starts with a generalized model of the system and keeps on defining the more specific part of it. When all the components are composed, the whole system comes into existence. Top down design breaks programming languages into smaller subsections that are further polished until they are readable.

Through top down design, the modules can be updated regularly in line with the programmer's needs.

During system design, a new program and database are specified. The required equipment that implemented the program and database in the decentralized system was specified. The decentralized whiteboard also shows how system tends to achieve its objectives and overcome the identified short falls of the existing system by specifying the required hardware.

The designed system consists of the following sections, namely interface for modern interactive systems that make use of various terminals and work stations, input/output roles, database, procedures and programs which unify the processes involved to produce the required output.

A decentralized whiteboard using NKN is an online web-based system that takes advantage of block chain technology which allows users to connect, use and share resources on the learning platform which makes the learning process seamless for both teachers and students (host and participant). It collaborate using whiteboard tools for learning in both ways rather than having learning as a one way traffic.

One can access the web page of the learning platform and select any icon. The home icon leads to the home page. The home page offered two reporting options like the sign in portal that allows a new user to create a profile on the online learning system and the sign up portal that allows an existing user to use the online learning system. Figure 1 shows the flowchart of a decentralized white board web application.

2.1 Use Case Diagram

The use case diagrams are used to summarize the details of the user's system and their interactions with the system. A proper use case diagram depicts a high-level overview of the relationship between use cases, actors and systems. The prototype of the use case diagram is shown in figure 2.

3. RESULTS AND DISCUSSION

3.1 Input Specification

Inputs are raw materials that are fed into the computer for processing. The system accepts input through the mouse and the keyboard. The registration of the data was done via the mouse and keyboard. The mouse plays an important role in closing windows and

validating passwords. The keyboard was used to enter text and values into the boxes.

3.2 Output Design

An output is result obtained from processing data which has been fed into the computer. In this paper, the output was the input of the host to the participant and vice versa.

The host (teacher) connected to the decentralized whiteboard network was able to use the tools provided by the whiteboard which can be seen in real time by the participants (students). The participants can make use of the tools and the input from the participant's end was seen as an output on the host's end in real time.

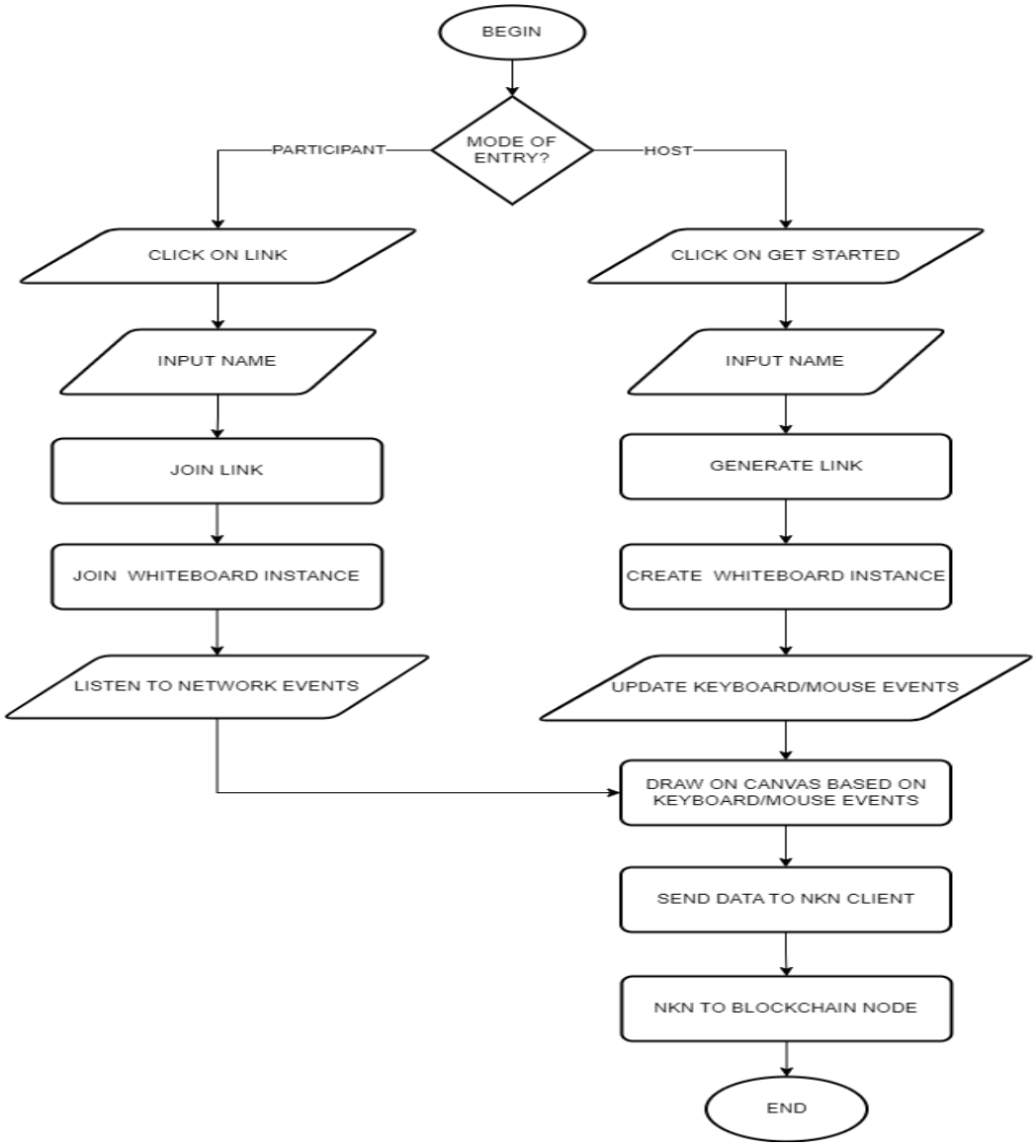

Figure 1: Flowchart of a decentralized white board web application

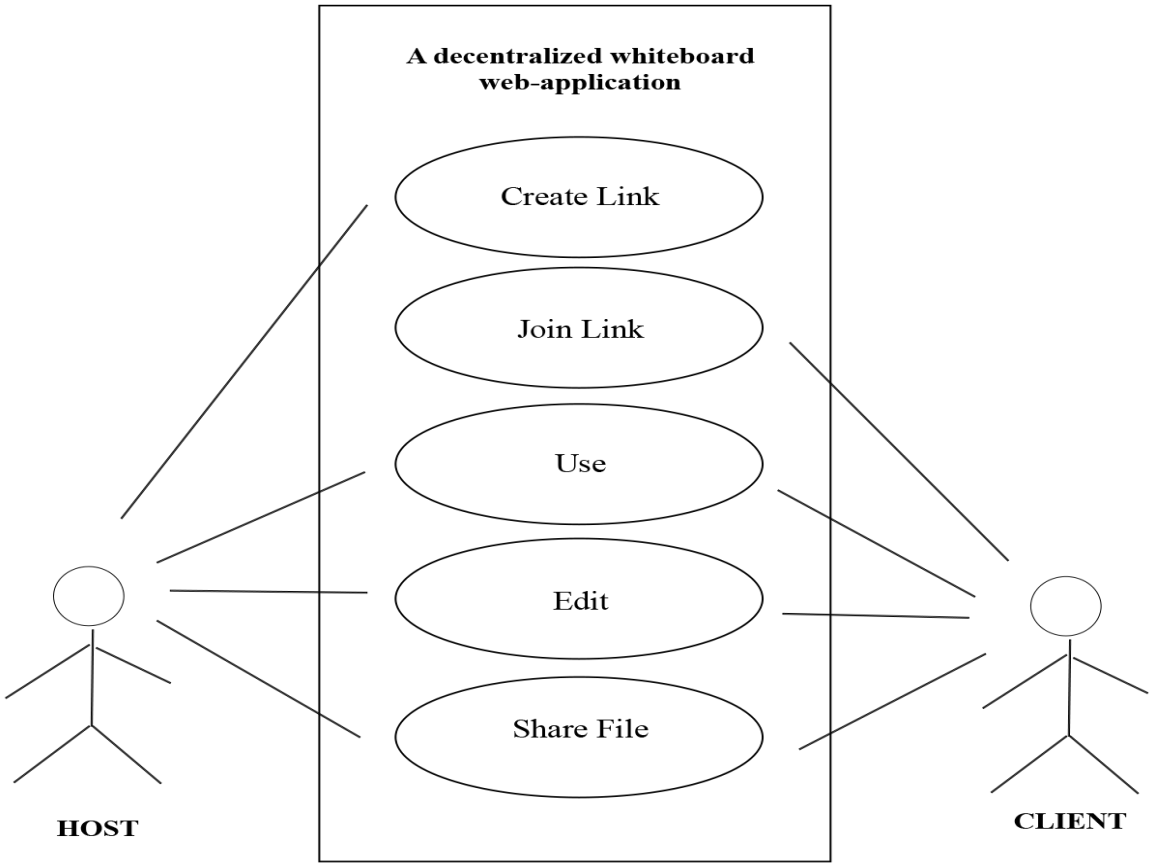

Figure 2: Use case diagram of the decentralized whiteboard web application

Figure 3: Home Page

3.2.1. Home Page

Once the software is run, the home page appears and to access other features of the software such as hosting or joining link, the user's name must be inputted before the process will allow someone to use or go to the white board as shown in figure 3.

3.2.2. Name Input

However, in order to use the NKN whiteboard, the user must input his/her name and this is a condition which the user can only be allowed to proceed. If the user does not provide his/her name the submit button will not become active. After the input is made, the submit button becomes active and is clickable as shown in figure 4.

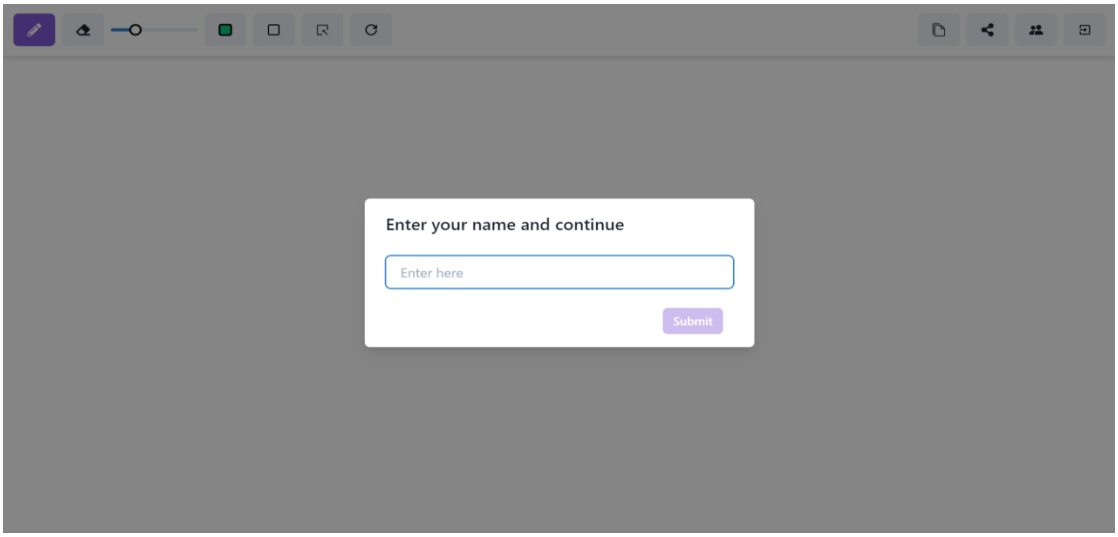

Figure 4: Name Input

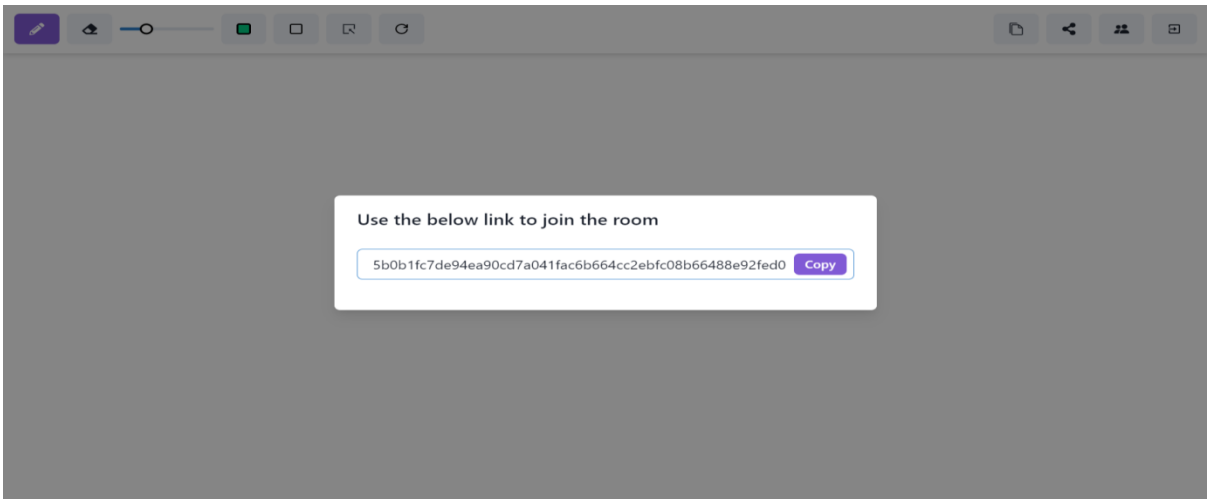

Figure 5: Link Generation Module

3.3 Link Generation Module

After the submit button was clicked, a link to the NKN whiteboard is automatically generated. This link can be copied and shared with participants when the link are required to input name and submit before he can be allowed into the NKN whiteboard environment and the link generation module is shown in figure 5.

3.4. NKN Whiteboard Interface

This interface allows users to interact with the whiteboard. The whiteboard interaction is real time and peer to peer. When joining the link both host and participant have equal access and no special privilege to host. The NKN whiteboard interface allows the use of shapes, text and eraser tools. A unique characteristic of this peer to peer network is that once a participant who is not the initiator of the link joins the network he/she can share the link and allow others to join the link.

Figure 6: Whiteboard Interface

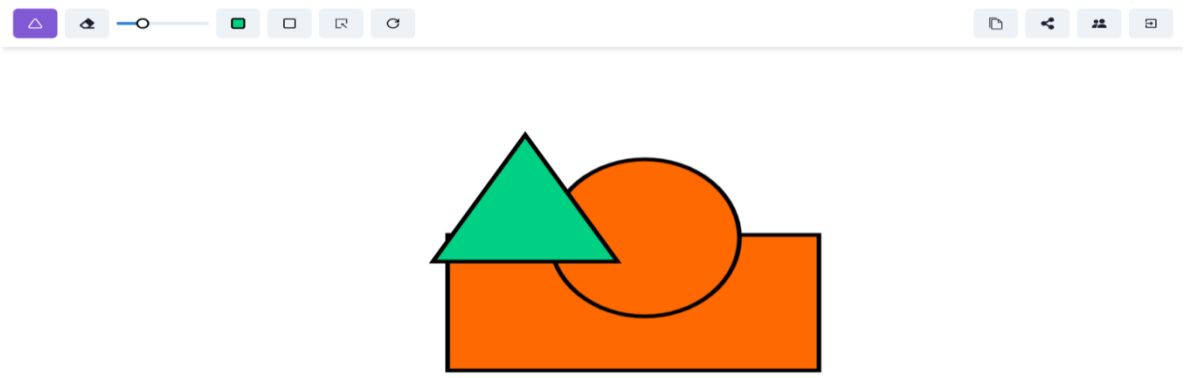

Figure 7: Update Keyboard and Mouse Events

3.5. Update Keyboard and Mouse Events

Keyboard and mouse event updates a user interaction with the keyboard and mouse. Each event describes a single interaction between the user and a key (or combination of a key with modifier keys) on the keyboard. The illustration is shown in figure 7.

4. CONCLUSION

Due to the weakness observed in manual whiteboards in the world, as well as almost a total absence in the e-learning sector. The implementation of a decentralized whiteboard system using NKN will go a long way in solving most of the difficulties encountered in manual whiteboard systems. This new system that is equipped with a variety of real time whiteboard facility will greatly improve the old system, thereby eradicating many limitations and introduce the benefits that will promote a new computerized system that will be able to meet easy tracking of progress of students by tutor as students have access and can express themselves better, easier decision making as well as easy correction, better involvement of parties using the system, less stress on the user and less time wastage and user friendly and many more.

References

Al-Saqafa, W., and Seidlerb, N., (2017). Blockchain technology for social impact: opportunities and challenges ahead. Journal of Cyber Policy. DOI: 10.1080/23738871.2017.1400084.

Bdiwi, R., Runz, C. de., Faiz, S., and Cherif, A. A., (2017). Towards a New Ubiquitous Learning Environment Based on Blockchain Technology. IEEE International Conference Advanced Learning Technologies (ICALT).

Campbell, R., (2016). Holberton School Begins Tracking Student Academic Credentials on the Bitcoin Blockchain. https://www.nasdaq.com/articles/holbertonschool-begins-tracking-

student-academiccredentials-on-the-bitcoin-blockchain. Last accessed on May 19, 2020.

Coleman, L., (2016). MIT Media Lab Uses the Bitcoin Blockchain to Issue Academic Certificates, Retrieved from https://www.ccn.com/mit-media-lab-usesthe-bitcoin-blockchain-to-issue-academiccertificates/. Last accessed on May 31, 2020.

Gopane, T. J., (2019), Blockchain Technology and Smart Universities. Proceedings of 4th International Conference on the Internet, Cyber Security and Information Systems, 12: 72-84.

Hori, M., Ono, S., Yamaji, K., Kobayashi, S., Kita, T., and Yamada, T., (2016). A Suitable m Learning System using e-Book for Developing Countries. International Conference on Computer Supported Education (CSEDU), 408–415.

Hwang, G. J., (2014). Definition, Framework and Research Issues of Smart Learning Environments: a context-ware Ubiquitous Learning Perspective. Smart Learning Environment, Springer Open. 1(4).

Kosba, A., Miller, A., Shi, E., Wen, Z., and Papamanthou, C., (2016). Hawk: The Blockchain Model of Cryptography and Privacy-Preserving Smart Contracts. Security & Privacy, 839-858.

Ma, S., (2018). Using blockchain to build decentralized access control in a peer-to-peer e-learning platform. Graduate dissertation, University of Saskatchewan.

Sharples, M., and Domingue, J., (2016). The Blockchain and Kudos: A Distributed System for Educational Record. Reputation and Reward. European Conference on Technology Enhanced Learning.

Sun, H., Wang, X., and Wang, X., (2018). Application of Blockchain Technology in Online Education. International Journal of Emerging Technologies in Learning, 13(10).

Zhong, J., Xie, H., Zou, D., and Chui, D. K., (2018). A Blockchain Model for Word-Learning Systems. In Proceedings of the 2018 5th International Conference on Behavioral, Economic, and Socio-Cultural Computing (BESC), Kaohsiung, Taiwan, 130–131.