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Original Article

A Mutually Exclusive Block-Chain Technology Cluster Approach to Electronic Voting as a Measure to Cob Covid-19 Pandemic Transmission in Developing Nations

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Abstract **-** *In nations of the world, democracy has become the mode of appointing new leaders. This ranges from the executive position to the community development level. This is an exercise that requires a large population, and the gathering of humans is inevitable. In the era of the second wave of COVID-19 Pandemic, the rate of transmission is higher than the first wave. COVID-19 is an invisible disease that is highly infectious. Presently, there is no known cure for the disease, yet it is infecting and killing people globally. Public gatherings such as the polling booth system of elections operated in many nations of the world are avenues where people can contact this disease quickly, leading to community transmission. Meanwhile, without voting or elections, there could be constitutional destruction and anarchy in a democratic nation. This paper presents a technological system of voting that will prevent COVID-19 community transmission. This system uses a mutually exclusive cluster of present technologies to eliminate congestions at physical polls. The Mutually Exclusive Block-chained Technological Cluster (MEBTC) comprises of five (5) technological systems, namely Telephone call (with Voice in all Ethnics), Phone application, Unstructured Supplementary Service Data (USSD), web-based computer application, and Direct Recording Electronic voting machine which are mutually exclusive with a centralized database and interface where voters can check results update at every instance. Programming tools, specified machines with specific requirements are configured for the proper implementation of the secure model. Each voter (user) adopts the preferred option to use, and the centralized database checks the voter's space as used. The result is a well-regulated voting exercise that is void of physical congestion.*

Keywords **-** *COVID-19 Pandemic, USSD, Mobile devices, Internet, Blockchain, Voting system.*

I. INTRODUCTION

Conducting elections is a key issue in most countries of the world. There have been several challenges militating against the conduct of free and fair elections. Some of these challenges include the need for a large amount of money, the need for large security personnel, the need for a large number of election officials, transportation challenges, requests for a large volume of materials, and lots more. All of these challenges often lead to imperfect elections, and when the elections are not credible, the success is uncertain. Recently, with the break-out of the COVID-19 Pandemic, there is the easy spread of diseases, which can keep voters away from participating in elections. Coronavirus disease 2019 (COVID-19) is a very infectious disease that can be contracted easily during public gatherings such as election polls. Meanwhile, elections are important, and the full participation of all concerned without fear of contracting diseases or death has become essential. In a bit to solving some of these challenges militating the conduct of elections, several technologies have evolved. However, subsequent sections contain discussion on the novel COVID19 and a well-researched concept of electronic voting.

A. The Break-out of COVID-19 Pandemic

Until the year 2019, there has not existed such occurrence in this century, causing a total lockdown of economies, airports, and sit-at-home for people. It started in China, but within few months, it grew from a local disease to an epidemic and presently a pandemic. Almost every nation of the world is suffering severe consequences from the outbreak of this pandemic. World Health Organisation (WHO) (2020) said COVID-19 is an acronym for coronavirus 2019. It reported that COVID-19 is an infectious disease that was first discovered in China in 2019 (Fauci, Lane & Redfield, 2020; Thirumalaisamy & Meyer, 2020). According to Rothan & Byrareddy (2020), COVID-19 is a fatal disease. Since there are no vaccines or cures for the disease yet, prevention has been the recommended means of escape. WHO (2020) recommended the following preventive measures:

Washing of hands regularly with soap and water, or cleaning them with alcohol-based hand rub; Maintaining at least 1-meter distance from people coughing or sneezing; Avoiding to touch the face; Covering of mouth and nose when coughing or sneezing; Staying at home if unwell; Refraining from smoking and other activities that weaken the lungs; Practicing physical distancing by avoiding unnecessary travel and staying away from large groups of people. Since all these preventions are contravened during electioneering campaigns and elections proper at polling booths, it became pertinent to adopt a way of conducting elections without contravening these measures. Conducting elections at Polling booths in the manner in which they used to be conducted can lead to community transmission of the pandemic.

Community transmission is simply a stage of the infectious disease in which a person is infected but can no longer trace or identify the direct source of contracting it. It is therefore not farfetched that public gatherings such as the polling booth system of elections operated in many nations of the world are avenues where people can contract this disease quickly, leading to community transmission. Meanwhile, without voting or elections, there could be constitutional aberrations and anarchy in a democratic state or nation. According to WHO (2020), there are over twelve million confirmed cases of the virus and over five hundred thousand confirmed deaths in two hundred and sixteen countries of the world as of July 11, 2020.

B. Traditional Voting System

The traditional voting system involves visiting the polling booth compulsorily at a specified range of time which must have been pre-announced to the public. The stages involve registration, validation, voting, collation, and counting of votes. Cranor and Cytron (1995) said that the traditional voting system is not reliable in the sense that some trusted personnel can induce voters as well votes, thereby resulting in unfairness. This process of inducing voters and votes leads to a complete breakage of COVID19 control measures. This is because these inducements are commonly practiced in close ranges, that is, partially secret means. In addition, this method of voting, called the traditional voting system, relies on a large use number of physical personnel for the election to be successful. For instance, everyone marches out to vote. Hence, the need for the presence of many security personnel, observers, and representatives of various political parties makes it impossible to curtail the possibilities of violations of preventive measures against COVID-19. Consequently, when this is not ensured, the spread of the dreaded coronavirus disease becomes inevitable during elections. Should democracy now become the bait and medium for contracting the disease?

C. Electronic Voting

The application of technology to aid the process of voting is referred to as electronic voting, otherwise referred to as e-voting. This may involve the use of machines or other means simply for the purpose of automating part of the voting process. E-voting has several types or kinds. Each is intended to implement a particular design protocol. According to International Institute for Democracy and Electoral Assistance (IIDEA) (2011), the various types include: Direct Recording Electronic Voting System, often referred to as the DRE; Paper-Based Direct Recording Electronic Voting System (PBDRE), Electronic Ballot Printers (EBPs) and the Internet Voting System. It is obvious that three-quarter of this electronic voting system requires physical convergence of the electorate. The fourth type is internet-based and, as such, remains the major means through which elections can be conducted to avoid community transmission. The model of this paper tends to explore every possible means of using the internet to exercise electoral rights, thereby discouraging convergence in the ballot polls. In addition, electronic machines that allow electoral officials to send results through a transmission means are also recommended for this design. According to Zetter (2007), there are some electronic voting machines that have modems that allow poll workers to send results through the phone line to a collation center.

D. Blockchain

The greatest challenge that people have towards electronic voting is the issue of trust. People cannot trust the machines since they don't trust the developers; people cannot trust the computer and software since they are not the developers. Hence, people have the seemingly undependable notion about the concept of e-voting. Meanwhile, the outbreak of this pandemic, COVID-19, has increased the belief of people and their patronage of cryptocurrency, which specifically uses blockchain technology. So block chain tends to solve the issue of trust. Crosby et al. (2016) defined the blockchain as a distributed database of records or public ledger of all transactions or digital events that have been executed and shared among participating parties.

II. RELATED WORKS

Ayed (2017) proposed a block chained based electronic voting system which focused on blockchain technology as a secure, reliable, and anonymous e-voting tool. The necessity of the clusters of devices to avoid COVID-19 was not emphasized. Joaquim, Zúquete, and Ferreira (2003) designed a robust electronic voting system (REVS) which dealt with failures in real-world scenarios, such as machine or communication failures that can lead to protocol interruptions through the security and trust issues associated with the electronic voting system was still a threshold for improvement.

Kohno, Stubblefield, Rubin, and Wallach (2004) presented a security analysis of the source code to one electronic voting machine and identified several problems, including unauthorized privilege escalation, incorrect use of cryptography, vulnerabilities to network threats, and poor software development processes in it. Their analysis showed that the voting system was far below even the most minimal security standards applicable in other contexts. Moura and Gomes (2017) expatiated the possibility of using the blockchain as a means of boosting

voter confidence in electronic voting. Hjálmarsson and Hreiðarsson (2018) proposed a blockchain-based electronic voting system that offers blockchain as a service to increase security and offer a less expensive means of hosting elections. Their focus was on the dual purposes, thereby improving on some challenges of previous models.

III. METHODOLOGY

In this section, the procedures required for a mutually exclusive blockchain technology cluster are discussed and their application to the electronic voting system. The electoral process involves:

A. Party's Pre-Primary Election Campaign

These are the activities that characterize the political period prior to the primary election that each political party conducts to determine its candidate. These activities are assumed to take place via social media, mass media, and every other means that curtail physical convergence in a location. Zoom meetings with party leaders are expected to achieve whatsoever goal is required of this stage, thereby minimizing physical rallies. Rallies can take place via telegram and other means earlier mentioned.

B. Party's Primary elections

Party's Pre-election campaign is expected to have taken place through televisions, radios, the internet, mass media, and social media without any massive convergence of people in stadiums and centers. The Primary election can take place through the developed cluster of technological platforms, thus making an electronic voting system. The centralized interface of the platform gives room for easy collation of results.

C. Pre-General elections campaign

A pre-General election campaign is expected to also take place through televisions, radios, Internets, mass media, and social media without any massive convergence of people in stadiums and physical centers where physical contacts and eventual contagion are inevitable.

D. Registration

This is an essential activity that precedes election, and it involves data capturing of eligible voters. There are already existing databases that only need updating with newly qualified voters. So this design is based on the already captured data. Meanwhile, a routine registration pattern could be scheduled for yet-to-be registered voters. However, registration could be collected through indirect data collection from other sources where such persons have been earlier registered, such as national identity information.

National Databases contain information on birth and mortality so, through that, the registration criteria and eligible voters can be migrated into the database of eligible voters. Meanwhile, an application could be launched for processed records to be authenticated by such persons within the specified period.

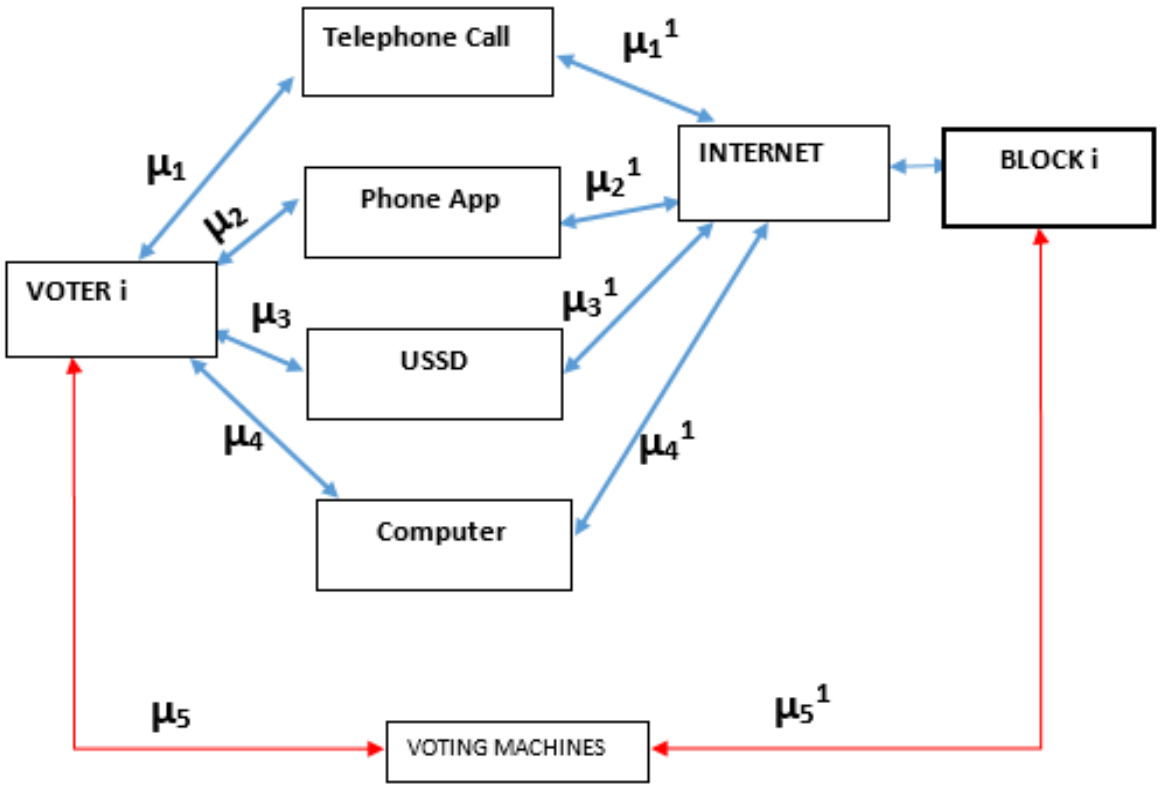

Fig. 1 Individual voting clusters

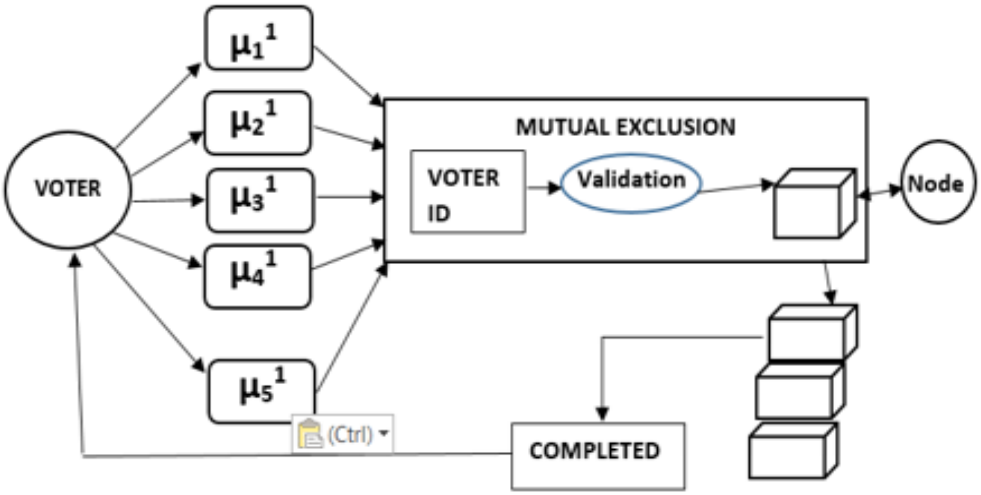

Fig. 2 Blockchain model

E. General Elections using Mutually Exclusive Block-chained Technological Cluster

As presented in Figure 1, the arrows show different pathways through which the vote of a voter can be cast. This model de-emphasizes the bottom arrow and therefore marked it as red being a route that may entail that persons are physically present in a location to cast their votes. This model uses the two basic forms of electronic voting to decongest polling booths. The two types, namely internet voting and the use of machines, were used with greater emphasis on internet voting. The various internet voting mechanisms are utilized in this model in a bit to deemphasizing the need for convergence in a physical location. $\boldsymbol{\mu}_i$ indicates the various clusters, where $\boldsymbol{\mu}_1$ means the telephone call cluster. This means that voters can cast their vote through a unique phone number that would be dialed, using the following algorithm:

- Unique call to the electoral line
- Choice of language
- Announcement of the office to be elected
- Announcement of contestants by Political Party or/and Candidate
- Selection/Voting
- Confirmation of vote
- Success or failed
- if failed, go to step iii else go to step ix
- exit or proceed to another office election
- if 'proceed to another office,' continues with step iii – step ix appropriately.

Each component of μ_n is mutually exclusive with the rest that is, if an election is successful through μ_i; $\mu_1$to μ_{i-1} andμ_{i+1} to μ_n becomes inactive for that voter for the successful vote cast. $\boldsymbol{\mu}_1$, $\boldsymbol{\mu}_2$, $\boldsymbol{\mu}_3$, $\boldsymbol{\mu}_4$, **and** $\boldsymbol{\mu}_5$ are mutually exclusive for a particular voter for one electoral office.
$\boldsymbol{\mu}_2$ and $\boldsymbol{\mu}_4$ are the votes through phone application cluster and computer-based applications, respectively, with both powered by the internet.

$\boldsymbol{\mu}_3$ is the vote through the Unstructured Supplementary Service Data, otherwise referred to as the USSD facility of the mobile phone. It is also referred to as the Quick codes or feature codes, which is the same way codes are used for the purpose of assessing bank loans, credit and debit transactions, checking of balance, the opening of bank accounts, performing general financial and telecommunication activities without physical presence at the banking or telecommunication offices, elections too can be conducted through this quick means. Persons with small mobile devices with simple dialing options will be able to follow the less cumbersome buy secured steps to cast their votes. This can be conducted through national telecommunication services. For instance, a "*111#" code can be selected for a presidential election such that once the user phone number is verified with the necessary conventional user password(s) and detailed question and answer, elections can be conducted.

A separate code is selected for the election into each office, or a general code is dialed through which several questions and answers generate into each of the offices, and then the voting is termed successful. The mobile applications cluster, $\boldsymbol{\mu}_2$, is supposed to be carried on through dedicated mobile phones compatible software that operates very easily on mobile phones. The applications are to be downloadable easily on the mobile play store or its equivalent for each operating system. Computer applications are simply software that is dedicated for easy use on computers through the Internet.

IV. DISCUSSION OF RESULTS

A. Block Chained Cluster

Only a cluster is allowed to vote for a particular electoral office, after which that office for that electorate is activated as a completed transaction and by such counted and disabled. A vote is initiated from any of the clusters. If more than one cluster tends to send a transaction (vote) at a time, one is picked while the other(s) is/are killed. A block representing that vote is created. The block populates every node, that is, reporting centers/servers, and the votes are

validated at the node for the purpose of decentralization. Then the block is added to the chain of blocks (referred to as blockchain). That is, the vote is added to the votes of the candidate contained in the vote. The update is then distributed across the network. Then, that particular vote is completed, and the electorate gets a successfully completed voting as feedback. Figure 2 depicts this model. Each of $\boldsymbol{\mu}_n^1$represents the successful electronically initiated technological cluster that a voter can use to cast their vote. The cubic symbol represents the block created, which is then added to the chain of blocks. Then the completed transaction is delivered to the voter.

B. Mutual Exclusion

Whenever the critical session of the vote cast algorithm is being assessed by a cluster, no other cluster with originating voter's identification and registration tag can gain access to the same session. This will prevent votes of the same electorate via different clusters concurrently.

V. CONCLUSION

It is concluded that a cluster of technological devices commonly available among voters is the new normal in terms of electioneering activities. This means that elections become more internet empowered with minimal use of direct recording electronic voting machines. Systems are to be developed with these devices in focus. Then the issue of trust, which is a common constraint with voters' acceptance of the electronic voting system, will be solved through the secure blockchain model, which is enacted with the chosen technology clusters. This system is adopted for local, state, and national elections, and then democracy can be sustained without the spread of the coronavirus during electioneering activities.

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