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A Proposed Model For Decentralized Governance Using Blockchain Technology

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ABSTRACT

National governments are making efforts in de-globalizing various aspects of governance. There is need for a polycentric governance model utilizing blockchain potentials to establish a voluntary and consensual “global social contract” where every participating public or private member would abide by an agreed-upon set of rules. Blockchain Technology can be utilized to build a resilient and trustworthy international governance system through the distributed infrastructure in order for multiplicity of stakeholders to collaborate to solve most prevalent global challenges. In this paper, we proposed a smart contract model using blockchain technology for easy implementation, coordination and handling challenges in governance without a central control. This will help to increase public confidence and trust.

Keywords: Blockchain Technology, Governance, Decentralized, E-government, EVM

I. INTRODUCTION.

Blockchain technology has the potential to revolutionize governments, businesses and citizens' interactions in an unimaginable manner. The technology can revamp existing processes to unlock new potentials of efficiency and value. The capability of implementing the distributed ledgers for recording transactions offers numerous opportunities for government in achieving strategic goals such as masses satisfaction, efficient service and cost optimization [1]. Blockchains provide a common reference point for different level of government to host publicly government registers of data. Regulatory bodies globally are leveraging this technology for reliable integration across government services, business consistency across states, enhanced regulatory and improved mobility. This consequently increased delivery productivity, efficiency and security. The major role of government is trusted information about organizations, assets and individuals. Blockchain technology has been explored in diverse fields by e-government for transparency, public administration and secure public services to the citizens.

Consequently, the decentralized approach was adopted to eliminate the need for central authority in business transactions with government authorities', decentralized data collection, storage and processing of data for achieving data integrity and immutability [1]. The distributed technology provides opportunity for individuals and communities to redesign their political interactions, business and society as a whole, without any central control [2]. Many enthusiasts promote the distributed ledger as a decentralized and consensus-driven public repository with numerous applications to make citizens independent on governments, especially within a society founded on the state authority. International governance system lacks the potentials to provide coordinated response to global crisis along with the adoption of ad-hoc national policies. The ineffectiveness or exclusively restrictiveness has resulted in progression erosion of public trust both at national and international level [3].

The distributed ledger technology (blockchain) has the capacity to restore trust in governance processes; supply chain, health, e-voting, corporate governance etc. have demonstrated its ability to record data in secure, distributed and immutable manner as well as to automate and certify applications with self-enforcing smart contracts. As a result, the technology increases the confidence between agreed parties without any risks, privacy and security. This study intends to help citizens and business organizations understand the distributed ledger (blockchain) environment and the possibility of implementing e-governance without the trusted third party in focus. We investigated a blockchain-based e-governance system, existing e-governance public service model and highlighted the benefits of implementing public services using blockchain technology. Finally, we presented conclusions and provide suggestions for future research.

2. RELATED WORKS.

Terzi et al [11] presented the use of the blockchain 3.0 and artificial intelligent to enhance robust, scalable and authentic solutions to various industries. Two-validation scenarios were discussed utilizing smart contract and artificial agents energy and health support electronic government services. Although their research focused on governments and citizens but further research was proposed by the authors for public administrations and civil servants.

Alexopoulos et al [12] conducted a study on the use of blockchain in public sectors. The authors demonstrated that blockchain technology can be used as an enabling array of decentralized technologies to provide support for the openness and transparency of services in the public sectors. However, this paper concluded on the following issues: (a) lack of standard implementation of the distributed ledger technology in the public sector; (b) Private blockchain is preferable for e-governments, since it prevents scalability issues and offers better control and (c) recent use cases of this technology in the public domain represents transactional and registry functionality.

Svein and Jansen [13] presented a distributed ledger support for e-government using blockchain technology. This paper stated that blockchain technology has gained more attention in governmental tasks such as digital identity management and document handling than a mere crypto-currency application platform. The paper further discussed the application of the distributed ledger network in e-government and for authenticating many types of electronic certificates and documents. AIMendah et al [17] carried out a comprehensive survey on the adoption of blockchain on e-governance using Saudi Arabia as a case study. The study discussed how to achieve a smart environment by integrating e-governance with smart contract applications. The authors further described e-governance as a means whereby Information Technologies are utilized by the government to integrate public services for her citizens.

The aim is to supply citizens with accurate and perceived services in achieving diverse goals with high and effective performances.

3. ORGANIZATION OF GOVERNANCE

This describes how roles are distributed within the blockchain network. The Four major forms of governance include; centralized, hybrid, polycentric, and decentralized. Centralized governance involves off-chain decision making process where decisions are made by selected group of people or organizations. Hybrid governance refers to a form of governance where centralized board of directors makes decisions on behalf of the government. For example, on-chain voting procedure can be carried to decide the network of users or platform functions as decision makers [6]. Similarly, users vote differs when implementing decisions. For instance, the decisions taken by the board of directors can be initiated by the majority of users or different options utilized during the voting process. In polycentric method of governance, diverse roles and responsibilities are occupied by clusters of actors in blockchain governance such as miners, developers and participating nodes, taking into consideration what the others are doing [7].

However, in a decentralized form of governance, decisions are made by participating users who are involved in activities such as coordinated mining and on-chain voting process whereby the processes are not dominated by a single or a group of actor(s). In this case, the architecture of the voting processes and the openness of propositions to the public is influenced by the decentralized nature of the governance structure. Additionally, open-source systems, improvement proposals and DApps are initiated by the network users without the intermediation of the developers.

4. BLOCKCHAIN TECHNOLOGY

Blockchain exists to provide a new paradigm trust based distributed ledger platform. In 2008, the bitcoin white paper released by Satoshi Nakamoto [4] argued that the traditional trust-based payment structure with limitations of reversal, central control, high cost be replaced with decentralized cash payment system called the Bitcoin. It was also proposed [4] that trust can be introduced cryptographically without a trusted third party. Blockchain is broadly defined as an e-infrastructure that create trust in a network through verifiability, consensus protocol and auditability. Blockchain is a database that groups records of transactions into a block in a ledger. Every existing block on the network contains the hash of the previous block (See figure 1) chained together to form the word 'Blockchain' [1].

Each device that runs blockchain software is called a node and can interact with other network of node. Blockchain is described as a disruptive technology for various applications and industries. The technology started with bitcoin which was mainly for automating financial payments and is referred to as blockchain 1.0. As technology began to advance, research in blockchain kept evolving. The need for a programmable technology aroused and was developed a smart contracts which is called Ethereum or Blockchain 2.0. Smart contracts are program codes written by solidity developer to run on a blockchain once contractual agreements are fulfilled. The distributed technology reshaped supply chain by enabling on-chain actions such as assets tracking for transparency and Efficiency. Blockchain is now been used in industries such as education, government, healthcare, real estate and insurances. This is referred to a Blockchain 3.0 as it extends its benefits and solutions beyond financial transactions and assets transfer [11]. Three categories of blockchain exist: public, private and consortium.

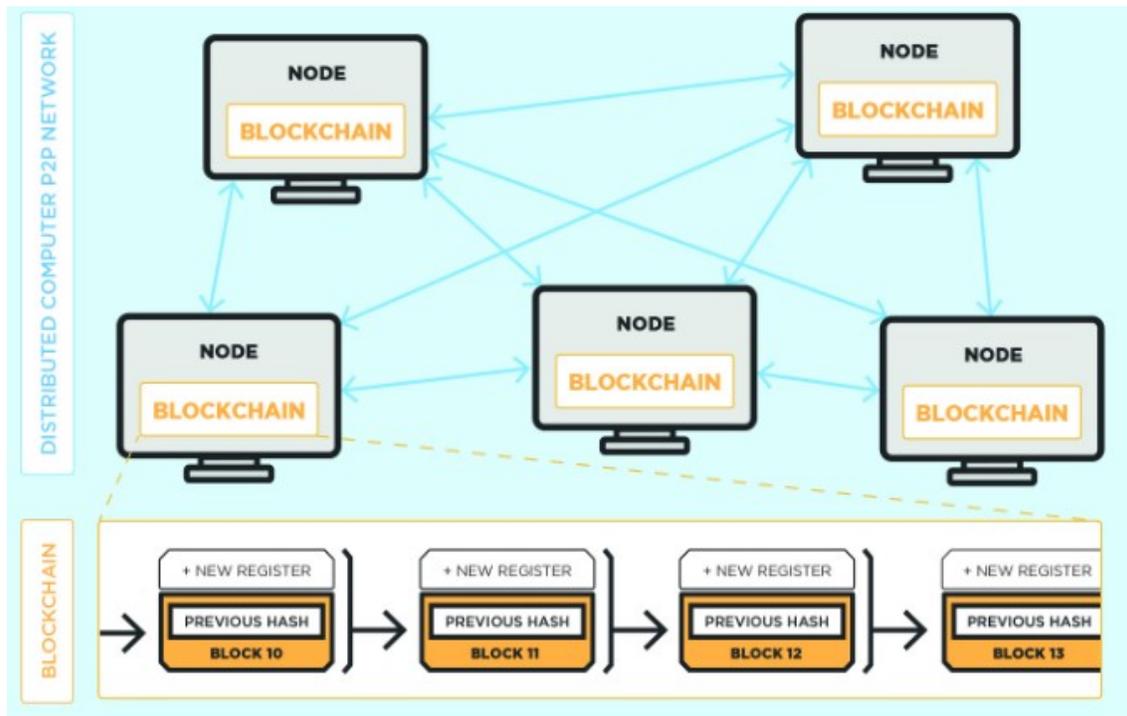


Figure 1: A blockchain Architecture [8].

5. BLOCKCHAIN-BASED GOVERNANCE

The centralized systems of government are costly, flooded with insecurity, and inefficient. Recently, governments have made efforts to offer cost effective public services by placing disciplined and relevant personnel in diverse sectors of the economy, but such has consequently failed as individuals integrity cannot be relied upon in promoting trust and financial discipline in all sectors. With blockchain technology, government can manage trusted information, ensure integrity of online data and protect information from unauthorized access.

The decentralized model contributes greatly to government by affording the following outlined attributes [9]:

1. Eliminating middle-man party in e-government services in fighting corruption. The technology provides real-time smart contract functionality, transparency and auditability to inculcate decentralized approach where appropriate and tamper proof record keeping is guaranteed.
2. Governments are faced with insecurity, cybercrimes and data breaches. Blockchain technology can be utilized to protect citizen's identities and sensitive data.
3. Blockchain consensus algorithms is cost effective and efficient by providing a platform for government to track and reconcile transactions. The digitized accounting system using the distributed ledger will provide support for an auditable and faster database reconciliation system.

4. Many governments disburse millions of dollars yearly which are opaque, convoluted and inefficient. The third parties in charge of such disbursement divulge such funds for their personal interest. Blockchain technology has the potentials to eliminate corruption and build trust by reducing or eliminating third parties involvement in grant management and disbursements.
5. Blockchain provides an essential voting solution for democratic processes. The distributed network facilitated a decentralized, transparent, immutable and encrypted e-voting model to combat election tampering and sustain electoral integrity.

Public information shared through blockchain is comprehensible, interoperable, readily accessible and open to anyone by default. Blockchain technology facilitates the security of citizens engagement and promote efficiency. Figure 2 reveals other sector of blockchain use cases in e-government.

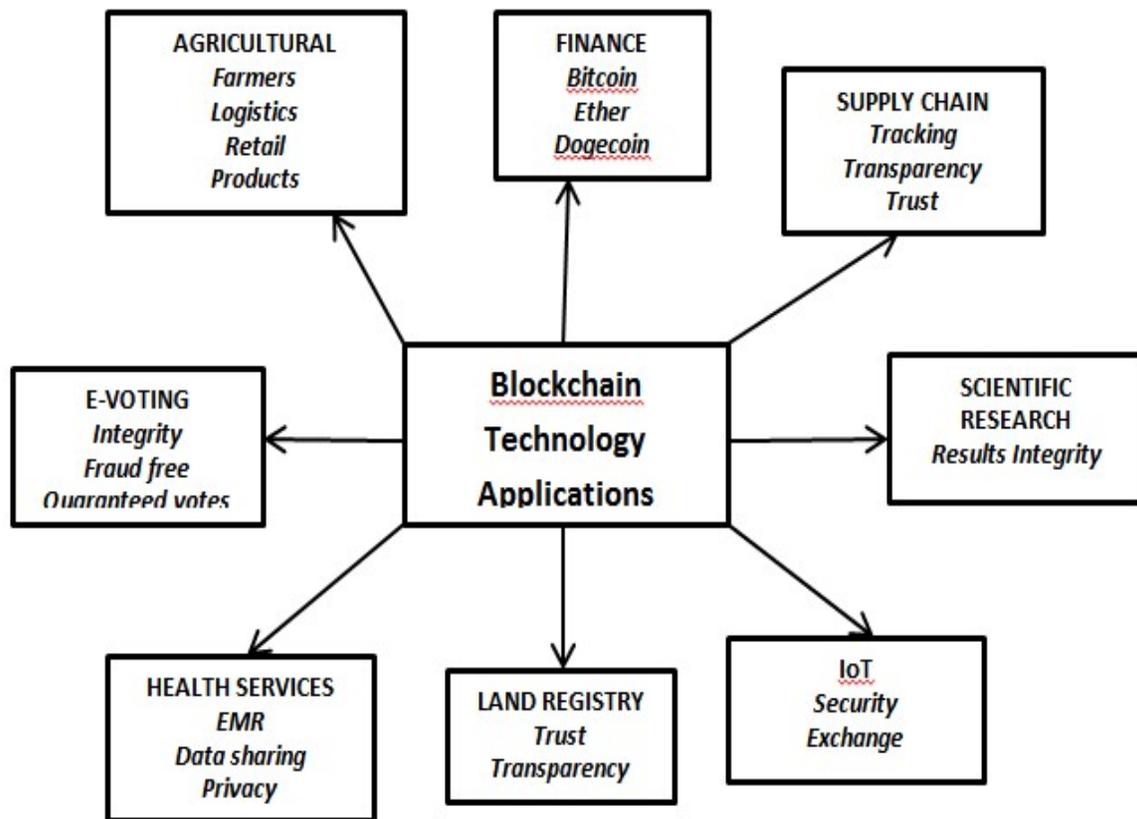


Figure 2: Some Blockchain Use cases in e-government.

6. THE EXISTING E-GOVERNANCE PUBLIC SERVICE SYSTEM

E-governance, otherwise called electronic governance utilizes Information and Communication Technology (ICT) tools to make administration efficient and easy [14]. E-Government involves the use of information and communication technologies by the government to provide and receive quality public services [15]. E-governance enables direct communications from the government to the people, providing high level of transparency and accuracy. Even though experts and government have well-structured e-governance projects plans, which generally provides efficient, transparent, adoptable and updateable technologies, accountability, efficiency and effectiveness in public and private sectors, certain issues plague existing e-government system [15].

Low data security, privacy threats and other security vulnerabilities affects the functional implementation of the present e-governance structure. For instance, [18] ascribed disparities in e-governance implementation to the differences in government structures, technological and infrastructural domain. Furthermore, effective implementation of e-governance requires quality of the human capital in terms of education, skill set, communication, network infrastructure and attitudinal matters. The challenges of electronic governance are in varying magnitude [16] which cannot be under-estimated (see figure 3). Blockchain emerged as a distributed ledger platform to handle the various challenges of implementing e-governance utilizing ICT tool. The distributed platform provides secure and efficient methods for data collection which is cryptographically encrypted against security threats.

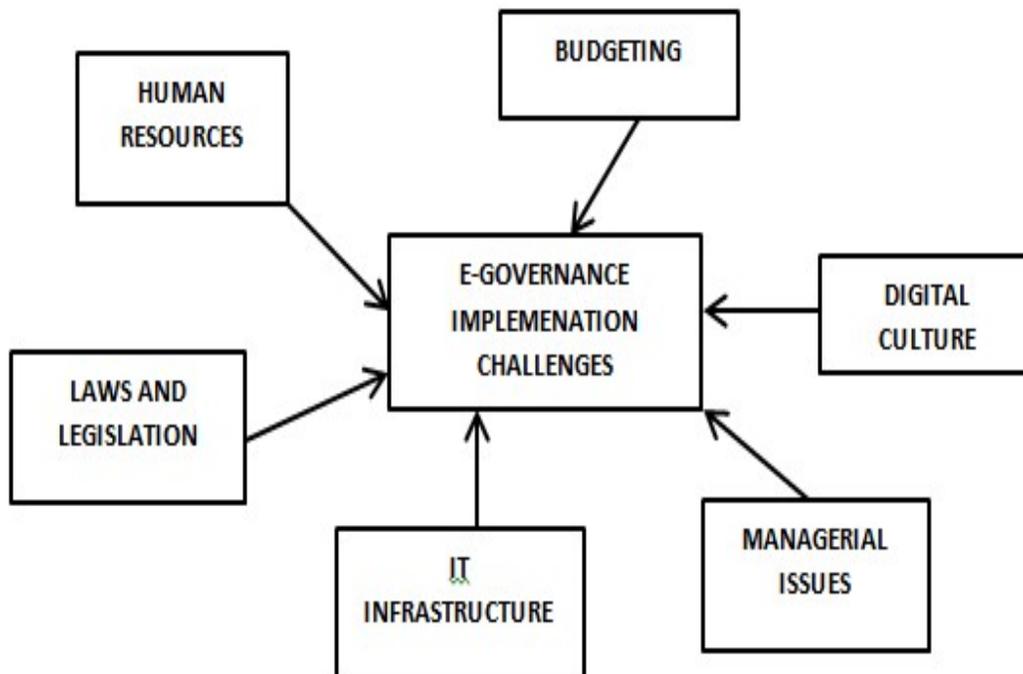


Figure 3: Challenges of present E-governance.

7. THE PROPOSED MODEL

In this paper, we demonstrated how a smart contract model can be developed for implementing decentralized governance. The proposed model consists of components such as Users, Public services, Dapps, Digital ID and On-chain platform, which cannot be found in existing or centralized governance architectural models. In building this model, we must ensure that the components are well-structured, organized and incorporated, depicting their functional requirements.

The proposed model components and their basic functionalities are analyzed, thus:

- a. Users: This comprises the citizens, organizations or anyone who benefits from the public services.
- b. Public services: refers to governmental activities for providing services decentralized applications (DApps) and from where the private user data and the open data is delivered.
- c. Digital ID: Identifies the end users' access with the system. The "Digital ID" grants users access for any personalized interaction with the system.
- d. Dapps: This consists of solidity smart contracts for implementing governance public services on the blockchain. The smart contract codes must be verified to detect any vulnerability before deploying on the EVM platform.
- e. On-chain Platform: This is the blockchain platform which consists of sub-sections such as EVM, tokens, Open data and Smart contract validation. EVM is the ethereum virtual machine where the smart contract is deployed. The smart contract solidity codes are converted to EVM byte codes to be executed on the blockchain. Ether tokens are required for executing decentralized applications on Ethereum Virtual Machine (EVM). Tokens are measured in the form of Gas. Open Data involves public records such as urban data, environmental data etc., or any accessible information in the system. However, smart contract validation using etherscan tool helps to ensure that the deployed contract meets functional requirements and achieved the desired goal.

In general, the user is required to create a blockchain account and a digital wallet address. A user interface is created and the user interacts with the system using his digital ID, which is his unique identity on the distributed platform. The "user interfaces" offers the citizens interaction with the applications and information system, with a variety of technology platform preferences, such as mobile and personal computer. We proposed a smart contract model on a blockchain platform for public services by structuring these components (see figure 4).

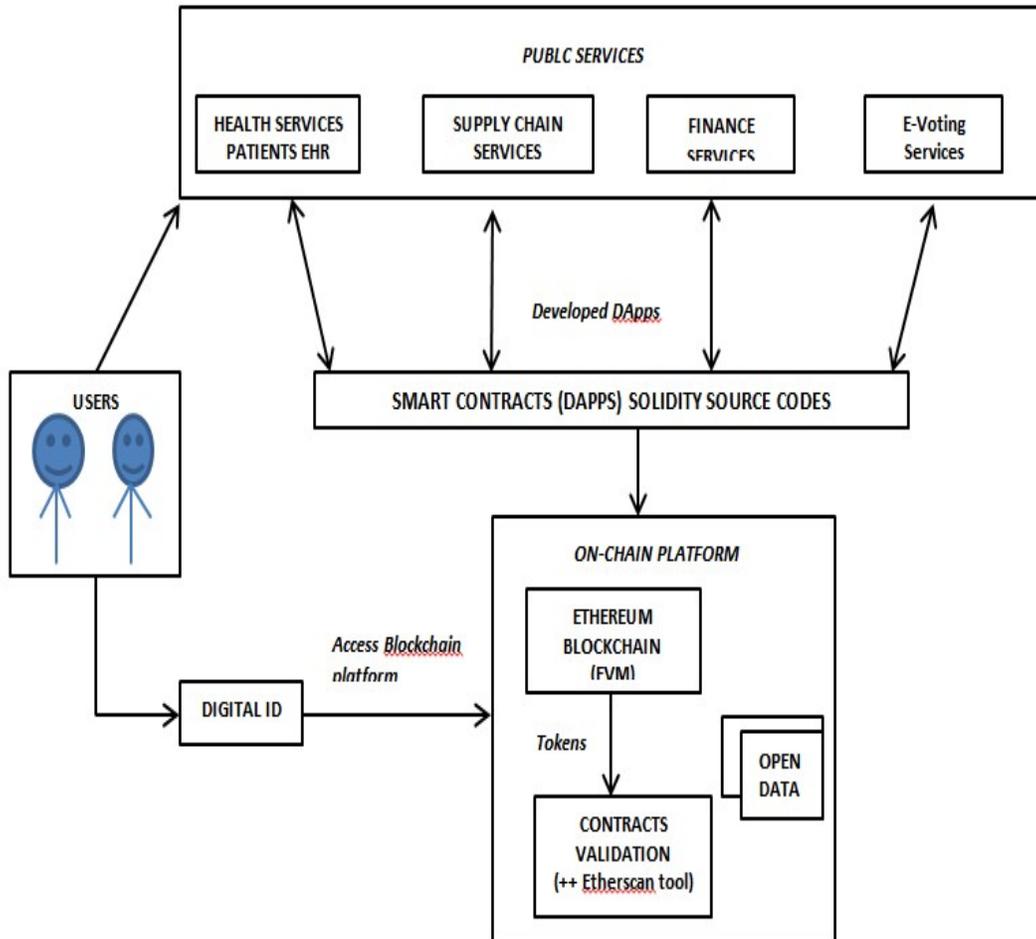


Figure 4: The System Architecture.

8. CONCLUSION.

The global pandemic (COVID-19) which occurred between 2019 to 2020, had created huge impacts on health care and economies, speeding up the adoption of distributed technology in executing transactions. Its unique attributes such as immutability, decentralization, and transparency have been explored in diverse business management practices and proposed by various researchers in rendering public services by the government. For example, blockchain can be useful in managing electronic medical records, distribution of government palliatives to troubled regions and implementing educational facilities in rural areas etc. Sadly, before and during the pandemic era, the norm was accessing these governmental benefits through delegated third parties intermediaries. However, lack of transparency, insecurity and inefficiency plague the present e-governance system. Blockchain is an innovative and disruptive technology that existed to replace centralized repository with distributed, democratized and transparent ledgers. This new technology paradigm has shown its potentials in resolving e-governance issues of trust, efficiency, availability and data security by providing a decentralized platform for its implementation.

9. FURTHER RESEARCH

Below are some of the recommended research activities that could facilitate the development and implementation of the proposed model for decentralized governance in providing public services:

1. further analysis and description of the various components of the model, interfaces and the functionality of each one of them is required.
2. real-life implementation of the proposed model is suggested using an Ethereum blockchain platform and the smart contract codes for public services can be developed using solidity programming language on Remix Integrated Development Environment.
3. evaluate the proposed model performances based on technical, legal, social and economic views.

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