INTEGRATING BLOCKCHAIN TECHNOLOGY WITH INTERNET OF THINGS TO EFFICIENCY

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Abstract

The research study focused on integrating blockchain technology with the internet of things. The study is necessitated by the need to come up with practical and feasible means to improve the accuracy, accountability and trust among various parties involved in blockchain transactions. The research recognizes the fact that there has been an increasing using of the cryptocurrency in the global market. This has lead to the emergence of blockchain, which is one of the disruptive technologies in the information and technology sector. The research study indicates that there is a need to improve on the architecture of blockchain and the IoT system. It shows that there is a need to develop a new model to improve its efficiency and accuracy. This research paper recommends the use of decentralized model to enhance the efficiency of the integration of the blockchain technology and IoT.

Keywords: Blockchain Technology, Internet of things, IoT Efficiency

Introduction

Internet of things IoT has emerged as one of the popular technologies with the aim of connecting various applications and devices to the internet. Currently, the convergence of the wireless communication, sensors and Radio Frequency Identification has led to the evolution of Internet of Things devices [1]. The use of smart features together with IoT platforms has proved useful in providing the smart services, electro-mechanical system, and controllers to establish integration between the physical world and cyber space. There are typically various types of IoT protocols that include Message Queuing Telemetry Transport (MQTT), Blur Low Energy and Constrained Application Protocol (Co-AP) [2]. As a result of the heterogeneity of the IoT protocols, the standards of the protocols and the IoT devices, there are several challenges and problems that have emerged such as scalability, flexibility and lack of interoperability. Besides, there are several IoT systems designs, architectural patterns that have been adopted and include microservices architecture and services-oriented architectures (SOA), which plays important roles in services-oriented solutions. The solutions provide by the IoT designs these solutions use communication protocol and the IoT devices to provide service to other applications and devices

[43]. The service offered is known as an availability of business functionality via a service contract. On the other hand, the service contracts incorporates various documentations, QoS, service policies, and a service interface that are useful in monitoring and ensuring enhanced performance of QoS and IoT transactions [3].

The architecture of the emerging IoT technology is primarily adopted by many companies across different industry, which leads to new sources of incomes for the various industries. Over the past years, the application of IoT solutions in the industrial sector has experienced a rapid growth. Cyptocurrency has led to invention of the Blockchain, a technology which is regarded as the most innovative transaction system [4]. The Blockchain technology enables the collection of transaction data between different individuals and business entities. The data from the regular transactions done by huge number of devices and users is normally stored in the decentralized applications. The decentralized applications arise from the cryptocurrency. The IoT is able to comprehend various networks of communications by allowing the devices to interact with each other via internet.

Blockchain has been branded as the most disruptive technology of all the times. The blockchain technology has been applied in different sectors and industries that include finance, utilities, healthcare, agriculture, supply chain management and real estate [38]. The use of blockchain technology across different sectors is due to trusted intermediaries serving as the gatekeepers for some applications can be eliminated and the same applications can be run in decentralized manner without using the centralized authority [5]. This can be done efficiently and effectively without compromising the security which was a not possible in the past times.

The emergence and implementation of the blockchain technology have led to the establishment of the peer-to-peer networks that allows users on the network to share data and perform certain transactions without the need to trust each party. According to [6], third party trusted intermediaries have been known to cause certain delays during transactions across several industries. In essence, the absence of the intermediaries can imply that there is fast transaction and reconciliation between different parties and participants involved.

Blockchain technology operate with a significant reliance on cryptographic system and scheme and mixed up function which attempt to bring high level authoritativeness and security to transactions, and interactions within the network system. Over the past years, blockchains in were merely viewed as distributed databases or ledgers [7]. However, blockchain have now been empowered using smart contracts. Smart contracts refer to the independent and self-executing scripts that normally reside on blockchains and help it achieve high level of autonomy combining all the important features to provide a favorable distributed platform [39]. As a result, it has earned and attracted the attention of many developers and industry players in the Internet of Things (IoT) domain.

Theoretical Framework

The research is based on the theoretical framework that focuses on general framework architecture. The general framework architecture is designed to help in monitoring and surveillance of activities to address the issue of trust among the parties transacting via blockchain. The general framework was developed by [8] to reduce the threats and vulnerabilities regarding the internet of things. The research paper will meet most of the requirements of IoT systems and block technology by design appropriate architecture that combines the IoT and the block chain [37]. The main layers of the system architecture include devices, data, applications, security, integrity, IoT, SQL and program interface [9]. The framework developed for this research study follows the nomenclature of the International Electro-technical Commissions or the System Committee Acted Assisted Learning [10].

Operational Definitions

- IoT is used to refer to the Internet of Things
- Blockchain implies the technology used to perform transactions in cyptocurrency market
- MQTT is used to refer to the Message Queuing Telemetry Transport
- Co-AP refers to the Constrained Application Protocol
- SOA means services-oriented architectures

Industry description

Blockchain is emerging as a powerful industry that supports the operation of many firms and businesses across different sectors. The emergence of blockchain as an innovative and disruptive technology has evidently helped revolutionize the information, communication and transactions [36]. Currently, there are several attempts and research studies aimed at integrating blockchain technology with IoT [9]. The research thus considers various models that have been used to align the blockchain technology with the past and recommend the best model that can help improve the accuracy and accountability of the blockchain technology.

Literature Review

The idea of rapid expansion IoT device to convey it towards a decentralized architecture was advanced by [10] so that it maintains its suitability and sustainability. Based on the customer's point of view, to address some of the privacy and trust issues, it is necessary to improve the information and technology infrastructure to solve the problems [32]. In maintaining the current centralized model, majority of businesses and manufacturer have spent huge amount on measures to help in the maintenance and improvement [11]. In essence, the blockchain has been used to successfully address the issue since it operates and works on a scalable peer-to-peer network, which functions accurately and transparently as well as spread data securely. The goals of blockchain and IoT integration range from decentralization framework to scalability [12]. The decentralization framework is an approach that is similar in Internet of Things and blockchain. It has led to the elimination centralized system thus provides platform that supports decentralized network system [13]. In addition, the developed architecture is important as it can enhance the security of the system. In blockchain the system will ensure that the transactions within the node are secured. It is a useful communication strategy that enables the users to effectively and securely interact and performs various transactions. In the IoT frameworks, all the connected devices and system are identified with a unique identification [14]. In addition, each block in the blockchain is also uniquely identified. This implies that the designed blockchain becomes trusted technology that can provide uniquely identified data that is stored in the public ledger. The connected blockchain and IoT will also be fitted with the feature that ensures reliability of data and information for the users. The IoT nodes in the blackchain typically have the capabilities to authentic certain information passed within the network [35]. The contained data passed on the IoT infrastructure is reliable since it is verified by the miners before it enters in the blockchain. In essence, only the verified blocks are allowed to enter in the blockchain network system. The autonomous is another important features that blockchain and IoT framework [15]. It implies that all the nodes included in the infrastructure are free to communicate with any of the nodes in the network system without the need for the centralized system [30]. Lastly, the scalability is important feature in the blockchain and IoT device, which plays an important role in communication within a highly available distributed and intelligent network connecting with destination devices to exchange information in real-time [31].

Problem statement & Research Gap & Research Contribution

Several research studies have focused on the integration of the blockchain technology with IoT devices [16.] Many of these research studies have focused in specific areas such as health [17], finance [18] and agriculture [19] among others. Although there have been successful integration of blockchain with IoT, the adoption of this new technology has faced various challenges that compromises its effective operation in the market [29]. As a result, there is a need for the current research studies to address these challenges and identify the opportunity for improvements. The current research study attempts to identify the challenges and opportunities to come up with the best architecture that can help improve their accuracy and accountability.

Research MODEL & Hypotheses

The research model considers in the study is analytical approach. In the analytical research approach various architecture used to integrate the IoT and the blockchain technology are analyzed based on different factors that include the scalability [28], accuracy, trust and efficiency. In addition, it will also assesses and analyze the challenges and opportunities that impact on the IoT technology. This proves vital in developing an appropriate model that can improve the accuracy of transactions in blockchain.

Methodology & Research Design

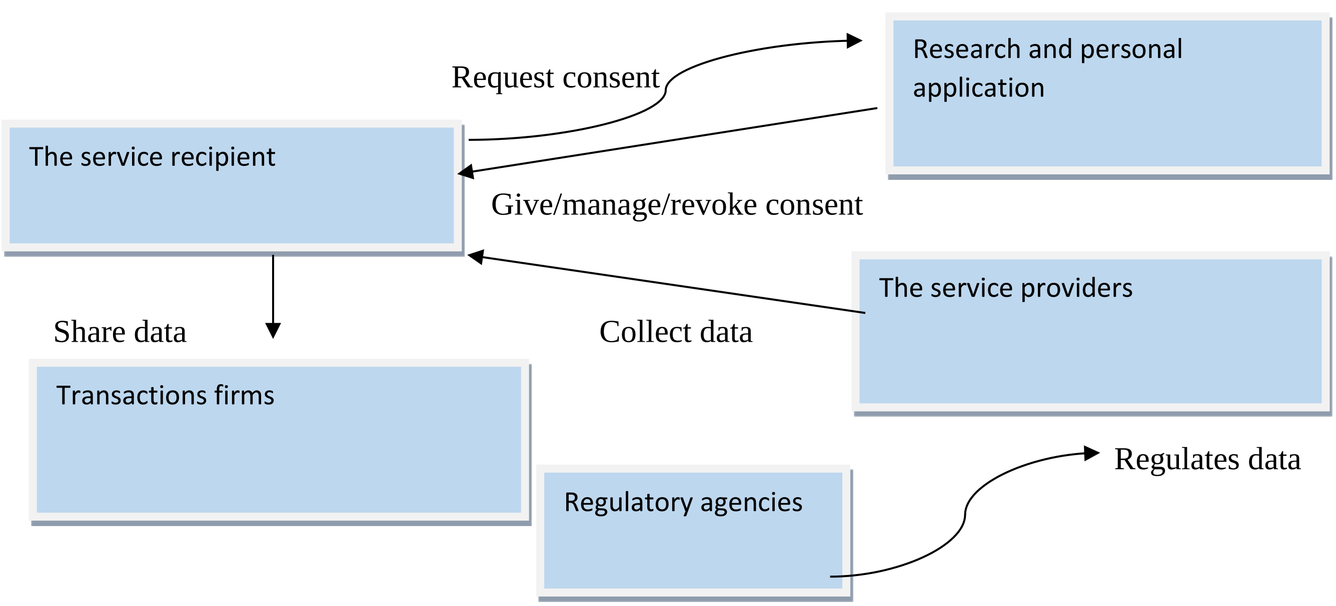
The research study to adopt IoT in blockchain considered the exploratory research design. It investigates different versions of integrating IoT in blockchain companies. It starts by assessing the literature review on IoT so as to identify the challenges and opportunities as indicated in [42]. The study uses the challenges and opportunities to develop a new model that can help improve the effectiveness of integrating IoT Ain blockchain. The primary focus of the study willto improves the effectiveness and efficiency of the IoT.

The main method used in the study design is mapping of trust issues. [20] Identified the general methodology used to identify trust of relations among parties connected through an integrated blockchain and Internet of Things devices [26]. The approach mainly involves various sequential steps relevant to this research study [27]. The sequential procedure followed to accomplish this research study is as shown below.

1. Identification of the participants involved and the relations between them. If the identified relations fail to meet the required standard or level of trust that is necessary to accomplish the desired objectives of the relationship, then it noted and marked s a trust issue.
2. Designing the minimal and standard blockchain internet system that can help solve and address the trust issue
3. Migrate all the other existing features in the system to the newly developed blockchain network.

The current research study followed this methodology used to model the consent management process for certain data and information contained in the network system.

Figure 1: Conceptual Model



Population & Sample & Unit of Analysis

The population and sample unit of analysis was considered integral conducting the research study. The research identified ten firms that use integrated blockchain technology and IoT of things. The ten firms were assessed on various issues that include the opportunities and challenges they face. It identified the challenges that this firms face in the adoption of IoT platforms for the various block chain companies [25]. The measure used in the study is to determine the efficiency of the proposed approach in improving the rate of transactions in blockchain companies. The efficiency in this case is determined as a percentage of the security, trust and number of transactions and denominated as following.

Where security of transactions = s

Trust of the transactions = t

Number of transactions = n

Efficiency of transaction = s + t + n

The model also assumed that the three measurements have the same relative weight of 100 % in determining efficiency. Thus the sum of the three variables forms the average weight. In essence, the selected participants were required to show the rate of trust and efficiency for the new models, which was eventually converted to the relative weight.

Analyzing Data

The equation= s + n + t was used in the analysis of the data. Once the proposed model for the integrated blockchain and IoT is in place, it was subjected to a series of test to determining its accuracy in addressing the challenge faced by the previous block chain model.

The first test calculated the trust of transaction, which was mainly aimed at its ability of improving the customers trust in proposed blockchain model [24]. This was achieved by seeking the perception of the various users regarding its ability to meet their expectation. Since it was conducted online, it was easy to get the perception of the customer on time and analyzed the data.

The customer trust = (number of successful transaction (Yt) + Number of failed transaction (ft)) divide by number of total transactions (tt)

Trust of transactions (t) = (yt + ft)/tt

Security of transactions (S) = number of threats detected (td) – number of threats solved (ts) divide by total number of threats identified

S= (td – ts)/td

Number of transactions (n) = Days transaction (dt)/average daily transaction (adt)

N = 9dt/adt)

Discussion of the Results

The result of the research study was based on the three main measures which include the frequency of the transactions, trust of transactions, the security of transactions. The three measures were combined to determine the accuracy of the transaction as a percentage using the formula discussed in the analysis section.

Table 1: Comparison of the Models

Number	Model	Accuracy
1	Decentralized architecture	87 %
2	System architecture	82 %
3	General framework architecture	79 %
4	Centralized architecture	81 %

From the table, it is noted that the different architecture of integrated blockchain and IoT yields to different accuracy. It shows that the decentralized architecture has 87 % accuracy, system architecture has 82 %, General Framework architecture has 79 %, and centralized architecture has 81 %.

From the result, there is no model that is 100 percent. This is an indication that there is a need for future improvements to come up with appropriate algorithm that can help address the issue [22]. The result also demonstrates that each of the techniques used by company to integrate IoT with blockchain chain faces unique challenges and opportunities that they should attempt to address [23]. The challenges that are unique to each of the architectures are regarded as the main factor that contributes to the differences in the levels of accuracy [21]. As a result, it is appropriate that research studies on IoT and blockchain focus in addressing the loophole s that might compromise the functionality of blockchain and IoT devices and systems as suggested in [41].

The research also compared the proposed model with other model that has been in use by other firms. The comparison of the proposed model with the other models can help determine its appropriateness for use to improve the accuracy of the IoT and blockchain functionality [40]. The proposed model for this research study is the decentralized architecture, which is compared to the system architecture as shown in the table below.

Table 2: Comparison of the Proposed Model with another model

Number	Model	Accuracy

1	Decentralized architecture(proposed)	87 %
2	System architecture	82 %

Conclusion & Recommendations

The finding of the research study demonstrates that IoT plays a critical role in connecting various system and devices across different sectors in the economy. With the emergence of blockchain technology as one of the disruptive innovation, it is becoming important to improve it accuracy as the number of people using the blockchain as a means of transactions continue to rise. The increase in the number of transactions through a blockchain platform exposes it to certain challenges that can compromise its performance. The proposed model, decentralized architecture can help improve the accuracy of the blockchain online network as compared to the other alternatives. It recorded the highest level of accuracy at 87 %. Given that there is model that guarantees 100 % accuracy, it is recommended that future research studies should emphasize on improving the reliability of these standards models to ensure that there is trust and accountability between the parties involved in the transactions. Also, the future research study should focus on increasing the sample size to collect adequate data and information for analysis.

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