Efficient Decentralized Sharing Economy Model Based on Blockchain Technology: A Case Study of Najm for Insurance Services Company

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Abstract
Blockchain is an emerging technology that is used to address ownership, centrality, and security issues in different fields. The blockchain technology has converted centralized applications into decentralized and distributed ones. In existing sharing economy applications, there are issues related to low efficiency and high complexity of services. However, blockchain technology can be adopted to overcome these issues by effectively opening up secure information channels of the sharing economy industry and other related parties, encouraging industry integration and improving the ability of sharing economy organizations to readily gain required information. This paper discusses blockchain technology to enhance the development of insurance services by proposing a five-layer decentralized model. The Najm for Insurance Services Company in Saudi Arabia was employed in a case study for applying the proposed model to effectively solve the issue of online underwriting, and to securely and efficiently enhance the verification and validation of transactions. The paper concludes with a review of the lessons learned and provides suggestions for blockchain application development process.

Keywords
Blockchain, Decentralized, Ethereum, Multichain, Najm, Sharing Economy

1. Introduction

Blockchain is a new technology that is defined as "a distributed database, which sequentially stores a chain of data packaged into locked blocks in a safe and unchanging way" [1]. Traditionally, most of the electronic service providers are centralized entities that are required to be validated and verified, and they need to be trusted by their stakeholders. By utilizing the concept of platform cooperation with peer-to-peer (P2P) rather than centralized services, blockchain technology offers the infrastructure for decentralized security, verifiability, and trust [2]. However, several blockchain designs and implementations resulted in principally different governance structures, such as hierarchy over meritocracy, necessitating comprehensive communication among all involved stakeholders [3]. To ensure a balance in sharing economy settings, a trusted platform in centralised architectures should be replaced with blockchain technology and associated protocols to ensure trust, security, and privacy [4]. The design of such decentralized platforms based on blockchain technology and its practical implications regarding security, privacy, and trust is extremely reliant on the type of blockchain technology used [5].

Along with the advancement of blockchain technology, sharing economy is another IT-mediated development that is growing rapidly. Sharing economy can be defined as: "the sharing activity of underutilized assets with the help of IT-based technology" [6]. It is an umbrella term related to activities of sharing goods and services such as exchanging or renting them via IT, without the need to change their ownership. It enhances efficiency and effectiveness by minimizing the cost of transactions and raises the utilization and exchange of goods and services. It also enhances competition between competitors within a marketplace and minimizes the complacency of suppliers [7], [8]. Integrating blockchain into sharing economy would improve the sharing economy in terms of security and privacy, and it might increase the distribution of P2P businesses due to the provision of a high level of data integrity and nonexistence of third parties; consequently, data security would be ensured.

Therefore, in this study, a new model for integration of blockchain and sharing economy was proposed as a five-layer decentralized model and it was applied to the Najm for Insurance Services Company as a case study. The main contributions of this study are the following:

- A model for car accident report application was designed for the Najm for Insurance Services Company using a blockchain platform.
- The proposed model was developed.

The remainder of this paper is organized as follows: Section 2 discusses related works; Section 3 details existing car insurance services; Section 4 discusses the design of the proposed car insurance application based on blockchain; Section 5 covers the implementation of the proposed model; and Section 6 presents the conclusions and discusses directions for future work.

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2. Related Work

2.1. Blockchain Concept

Blockchain is a new technology that is operated without the need for third parties to exchange their transaction data. Blockchain can also be defined as "an appending only, ever-growing chain of blocks, which are linked sequentially using the hash pointers as a linear linked list" [9]. Specifically, as shown in Figure1 the block header contains a hash pointer that is linked directly to the previous block, called the parent block, and this linkage extends all the way back to the first block, called the genesis block. Further, all transactions are ordered based on Merkle trees. As a result, data on the blockchain cannot be changed unless all the subsequent blocks are altered.

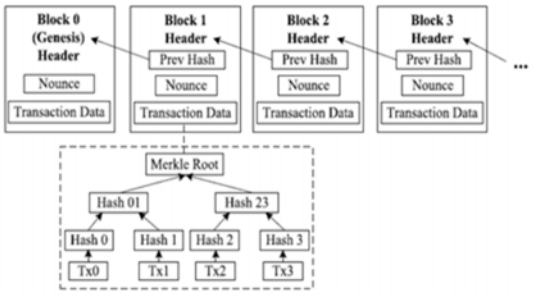

Fig. 1: Structure of blockchain

Blockchain can be one of three types: public blockchain, private blockchain, and consortium blockchain. The core components of the blockchain architecture are described below [10]:

- Node: the blockchain transaction that represents a user or a computer. It is the smallest construction unit of any blockchain system.
- Block: a data structure utilized to control a sequence of transactions disseminated to other network nodes.
- Chain: a series of blocks in a specific order.
- Miners: a collection of rules and agreements to conduct blockchain operations; these are unique nodes that conduct block verification processes.
- Consensus mechanism: it is called the consensus protocol and is the core of blockchain platforms. Its algorithm is used to validate the blocks, order them, and ensure agreement between nodes across the distributed P2P network. There are two main types of consensus mechanisms: proof-of-work (PoW), which is trusted and has a strong history, and proof-of-stake (PoS), which requires relatively fewer computations, less energy-consumption, and is more reliable and scalable.

The main driving features of the blockchain technology include: decentralization, transparency, security, immutability, and privacy. These are explored below [11]:

- Decentralization refers to governing the transactions to be updated from the ledger through transmission of the responsibilities to regional nodes that independently verify the transactions and then transmit them for computation with high throughput such as by employing the longest chain rule. Under decentralized consensus, no central authority or integration point is needed to receive the transactions and verify set rules. Further, no failure or trust is possible at a single point.
- Transparency refers to auditing of records by a predefined set of participants that can either be less or more open. These records are traceable and transparent, and the participants have the choice to combine their individual weighted rights.
- Security is a blockchain feature that takes the form of irreversible records stored in shared, replicated, and tamperproof ledgers. Additionally, the records cannot be forged because of the use of one-way cryptographic hash-functions. Blockchains are secure to some extent; however, security is a relative feature and having a private key allows data to be transferred throughout a blockchain.
- Immutability refers to the features of non-repudiation and irreversibility of records that control blockchain function. The data recorded in the ledger, which is tamper-resistant, cannot be secretly altered unless the alteration is done with the knowledge of the network, thereby making blockchains immutable.

Blockchain infrastructure is defined and implemented using interconnected devices in the hardware layer. The infrastructures of two major blockchain platforms are discussed below [12]:

'Ethereum' blockchain is a decentralized, open-source, generic and public blockchain network in which the transactions are validated through the PoS consensus. Its business model is used for business-to-consumer (B2C) activities. Every node has equity and can participate in creating new blocks. In contrast, the 'Hyperledger Fabric' blockchain is a decentralized, open-source, modular and private blockchain network in which the transactions are validated by different types of consensuses. Its business model is used for business-to-business (B2B) activities. Further, each node in this blockchain does not have equity and thus, it cannot participate in creating new blocks.

2.2. Blockchain-related Application

Blockchains may be used in different fields. The following are some examples where blockchain is used to enhance different functionalities [13]:

Gem is a Central Disease Control system that uses blockchain to provide effective disaster relief by inputting outbreak information onto a blockchain having an immutable ledger to help researchers collect and analyze data, and make the circumstances of the disease spread evident. The Ethereum platform has been used in Gem [14].

Abra is a cryptocurrency wallet that employs the Bitcoin blockchain network to control balances saved in different regions. It operates an interest-earning service for stable coins and cryptocurrencies, a trading service for buying and selling cryptocurrencies, and lending services. The Ethereum platform has been used in Abra [15].

Augur is a market prediction system that uses blockchain technology for financial services and it is based on a decentralized ecosystem. The main purpose of creating the Augur platform was to serve as a warning system in all matters. It also allows people to invest and profit through their expectations and opinions, which enables Augur to provide more accurate forecasting of upcoming events. The Ethereum platform has been used in Augur [16].

Skuchain is a control goods and services system based on blockchain that is used to track the services provided through a supply chain. It assists businesses in overcoming the difficulties and expenses associated with their inventory and helps to advance the concept of "collaborative commerce." The Hyperledger platform has been used in Skuchain [17].

OpenBazaar was a blockchain-based decentralized trading market where no middlemen were needed to trade goods and services. It also utilized Bitcoin, which is a censorship-resistant, decentralized, and inexpensive digital currency. The Ethereum platform has been used in OpenBazaar [18].

Blockchain is used to enhance the functionality of car reporting systems in different ways. For instance, the blockchain-based reporting system proposed in [19] provides a new mechanism to provide indisputable accident forensics by guaranteeing verifiability and trustworthiness of information. The proposed mechanism is used to verify and validate a new block of event data in a trusted manner without any central ownership. In addition, the model proposed in [20], called (IV-TP), is used to communicate between intelligent vehicles using blockchain technology. The data shared between the intelligent vehicles are secure and reliable. The (IV-TP) model provides trustworthiness for vehicles' histories (i.e., behaviour) and their actions (legal or illegal). Blockchain is used to store all the details of each vehicle.

The present paper proposes an architecture of a car accident reporting application for the Najm for Insurance Services Company using the blockchain platform. Najm is a Saudi company started in 2007 to implement an effective platform for facilitating, overcoming, and resolving accident-related transactions and formalities [21]. This organization has obliged itself to offer hassle-free and smooth processing among insurance companies. Najm initially had only 13 insurance agencies as its core shareholders but now, it works with more than 26 Saudi insurance companies.

3. Existing Car Insurance Services

This section demonstrates the existing accident reporting systems for the Najm for Insurance Services Company [21].

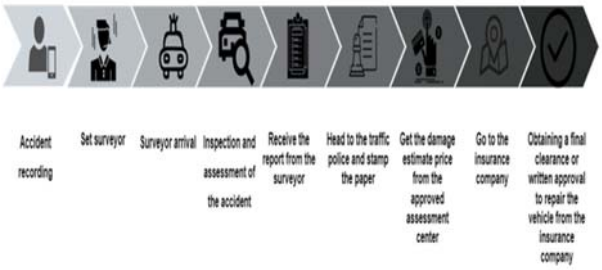

Fig. 2: Existing accident procedure in the Najm for Insurance Services Company

As shown in Figure 2, the process begins when the insured party first records the accident on an application or contacts the car accident reporting company. Second, the company appoints a surveyor located close to the accident spot. Third, the surveyor arrives at the accident spot. Fourth, the surveyor examines and evaluates the accident. Fifth, the insured party receives a report from the surveyor. Sixth, the insured party goes to the traffic police to get a repair paper in the report stamped. Seventh, the insured party gets the estimated damage cost from the authorized assessment Center. Eighth, the insured party goes to the insurance company. Finally, the insured party obtains a final clearance or written approval from the insurance company to get the vehicle repaired.

Therefore, the existing accident reporting systems such as that of the Najm for Insurance Services Company, are suffering from various challenges, including the need to enhance user security, increase service availability, and provide service flexibility at the lowest cost. Moreover, the accident report data must not be changed after they are

inputted into the database. Further, accident reports should be shared and distributed among different stakeholders such as the insured party, reporting company, surveyor, traffic police, assessment centers, and insurance company in a consistent and secure manner. These issues should be addressed to provide a trusted accident reporting system.

4. Design of the Proposed Car Insurance Application Based on Blockchain

After conducting a thorough synthetic analysis about the use of blockchain technology in sharing economy applications, this study combined the blockchain technology with sharing economy applications to create a decentralized P2P sharing economy model for a car accident reporting application. In general, the sharing economy for businesses connects service providers and consumers, and enables people to offer services through online platforms in a private and secure manner. As mentioned hereinabove, the blockchain technology facilitates decentralization of data storage and communication. The decentralized processes can be automated when deploying 'smart contracts' that are a part of the blockchain technology.

To build a decentralized sharing economy using the blockchain technology, several design elements should be considered, including the features of blockchain and its main components, as well as decentralized infrastructures and platforms. As previously stated, the blockchain architecture presents benefits for businesses in gaining several features such as improved security and privacy.

The proposed model is adapted from the 'Blockchain Market Engineering Framework' [22]. The Ethereum platform was selected for implementation in the proposed model because it is an open-source, public, and generic blockchain architecture in which the transactions are validated by the PoS consensus. The proposed blockchain architecture is independent of any specific platforms and it consists of five main layers, as shown in Figure 3.

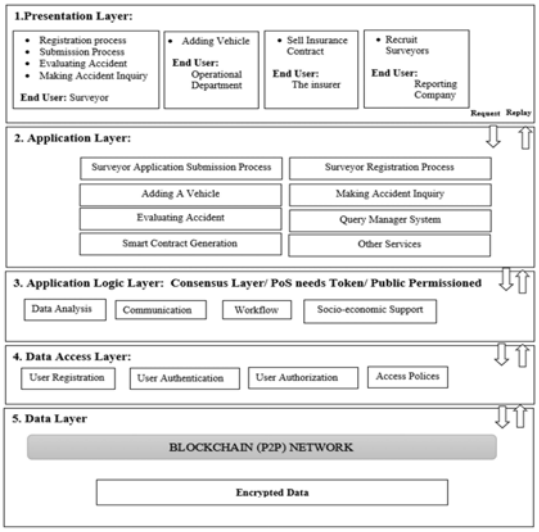

Fig. 3: Five-layer architecture of the proposed model

The blockchain platform (BaaS) provider manages the setup, maintenance, and support of the blockchain infrastructure. A node is any electronic equipment that is linked to the internet and has an IP address, such as a computer, mobile phone, or printer. The node can copy the blockchain and process transactions.

The data layer manages encrypted data that are maintained in a standard form to ensure compatibility and inter-sectoral communication requirements.

The data access layer integrates the data generated from various sources to enable user registration, user authentication, user authorization and accessing of policies. Effective access control is required to ensure that only the involved actors (i.e., legal users) have access to the relevant transaction data. The implementation of a role concept is critical in this context. Furthermore, a precisely designed role concept combined with effective access control makes illegal data alteration more difficult. Furthermore, the integration of related organizational parties and relevant metadata is supported by a metadata repository.

The application logic layer manages data analysis, communication, socioeconomic support, and workflow of the integrated applications and systems. Therefore, the processed and retained data are available for all purposes. This predominantly concerns research trends and allows to conduct statistical assessments.

The application layer represents the platform features, business services and user-controlled services that are given to the users of sharing economy organizations, such as the surveyor application submission process, surveyor registration process, addition of a vehicle, making an accident inquiry, evaluation of an accident, querying the manager system, smart contract generation, and other services.

Lastly, the presentation layer enables the services provided by the system to be displayed to stakeholders such as the surveyor, insurer, reporting company and operational department. The functions and features provided to each user differ depending on their role and permission. For instance, the registration process, submission process, accident evaluation, and making an accident inquiry are available for the surveyor; addition of vehicles is available to the operational department; selling of insurance contracts is available to the insurers; and recruitment of surveyors is available to the reporting company. Note that it is vital to ensure responsiveness in the proposed model by allowing access through web or desktop applications supported by various operating systems. Also, the model can be further extended by applying security mechanisms in smartphones, such as fingerprint and iris scanning.

To demonstrate the effectiveness of the proposed model, it was adapted in the Najm for Insurance Services Company [21].

5. Implementation of the Proposed Application

To implement the prototype, the following steps were undertaken:

1- Creating a blockchain for data storing: A multichain platform was used with the Windows 10 OS; the chain consisted of only one computer and all data about stakeholders were saved in the chain as bytecode that was then converted to the JSON format to be read. Further, any stakeholder computer could be added, and the command prompt (CMD) scripts were used to create the chain.

2- Connecting with the chain: To connect with the chain and cover its complexity, an API was created using the Python programming language. The created API offers data storage and retrieval from the chain. Further, the Flask web server was used to allow a client to connect to the chain.

3- The application: To create a GUI app for users, an android app was used to connect with the API.

5.1. Code and Functions for Computer Program

The system consists of a mobile application and a computer program. The computer program consists of two elements: one is responsible for the blockchain and the other is responsible for the web server. The blockchain and web server functions are listed in Tables 1 and 2, respectively.

Table 1: Blockchain functions

Functions	Description
Create	It is used to create a new blockchain.
Start	It is used to start a blockchain activity.
Storage	It is used to create a stream on blockchain to start writing on it and give permission for commuters who are connected to the blockchain to write on it.
add_data	It is used to take (chain, stream, path) of blockchain to write on it and publish.
converter	It is used to take the existing data and convert it to hexadecimal.
find_data	It is used to find data inside a blockchain.
distance	It is used to calculate the distance between the surveyor and the insured party.
find_ac	It is used to store all the data in the JSON file and search for the existing data.

Table 2: Web server functions

Functions	Description
app.route(users)	It is used to add a new user to the company.
app.route(acid)	It is used to report an accident.
app.route(Log)	It is used to log in to the user account and locate the nearest accident.
app.route(Select)	It is used to the nearest accident for serving.

5.2. Proposed Mobile Application

The proposed application contains different screens for executing different functionalities. Figure 4 represents the pre-step of using the system. The user needs to enter their IP address to link the application to the blockchain and then, select one of three options: ‘Create New User’, ‘Login’, or ‘Report an Accident’.

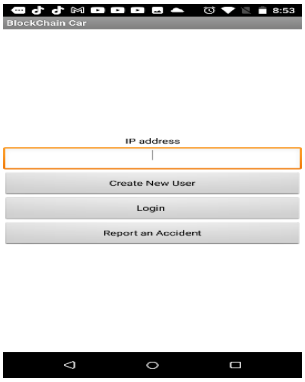

Fig. 4: Initial registration

The surveyor is provided two options: 'Create New User' and 'Login'.

Create New User: When the surveyor chooses to create an account, the screen contains fields to receive information about the user. The surveyor should enter their name, email, password, form number, car plate, identification number and mobile number and then, click on the 'Create User' icon, as shown in Figure 5.

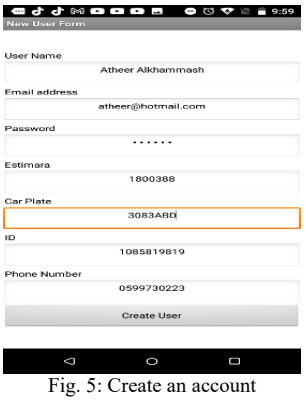

Fig. 5: Create an account

After the surveyor account creation process is completed, the screen shown in Figure 6 is presented to the surveyor, which contains the message 'Your Req Has been sent, wait for a phone call'.

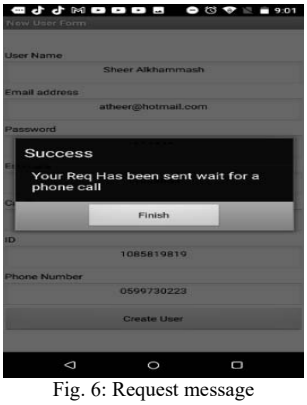

Fig. 6: Request message

Login: When the surveyor selects the 'Login' option, they will be allowed to login. This screen contains two fields: email and password. After providing this information, the surveyor is logged into the application, as shown in Figure 7.

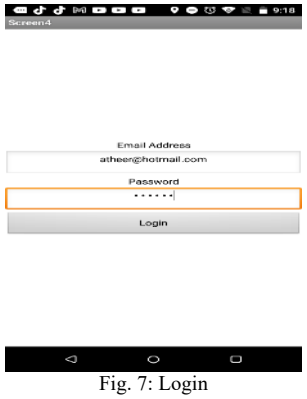

Fig. 7: Login

After the surveyor login process is successfully executed, the screen shown in Figure 8 appears, which contains longitude and latitude coordinates of the nearest accidents.

Fig. 8: Nearest accidents

On the other hand, the insurer has one option:

Report an Accident: When the insurer chooses the third option, a screen appears containing information about the

accident, mobile number of the insured party, car plate number, user name, and accident degree. There are three different accident degrees: ‘small no injury’, ‘medium no injury’, and ‘With injury’, as shown in Figures 9 and 10.

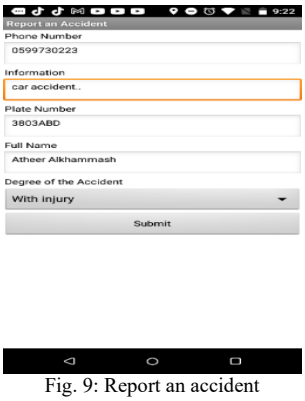

Fig. 9: Report an accident

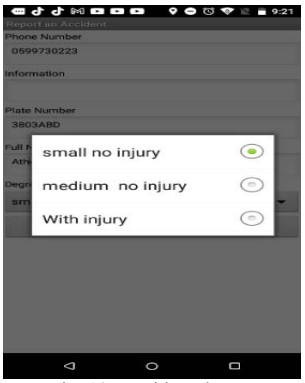

Fig. 10: Accident degree

After determining the accident degree, the insurer presses submit and the screen shown in Figure 11 appears for the insurer, which contains the message ‘Accident Data Has been Received’.

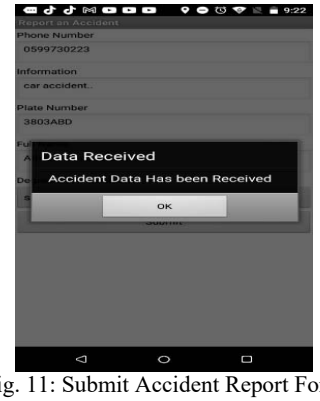

Fig. 11: Submit Accident Report Form

CMD scripts are used for interacting with blockchain. Figure 12 shows how the user information is saved in blockchain. Figure 13 shows how the accident report is stored in blockchain.

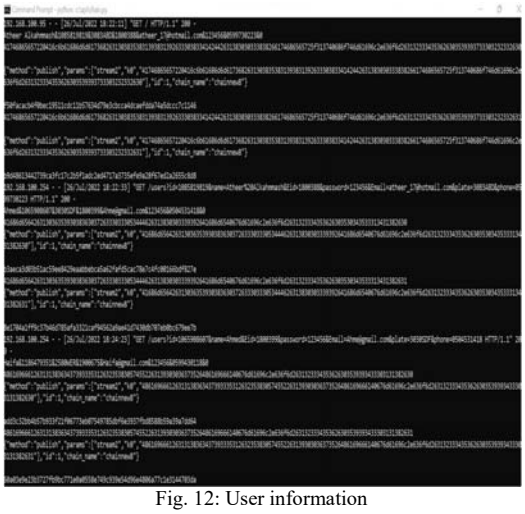

Fig. 12: User information

Fig. 13: Accident reporting information

6. Conclusion and Future work

Blockchain plays an important role in increasing data security and integrity in sharing economy applications. Therefore, proposing a blockchain-based framework to enhance sharing economy application is important to solve the issues related to existing accident reporting systems, including the need for significant data harvesting, providing secure storage, and enabling frequently updated transactions. Moreover, the old reporting data must not be changed after inputting it into the database. Also, accident reports should be shared and distributed among different stakeholders in a consistent and secure manner. These issues should be addressed to provide a trusted accident reporting system. In this paper, a new business method is proposed for sharing economy using the blockchain architecture. The proposed model features a software architecture that was used to develop the sharing economy application based on blockchain and the identified business pattern and architectural model of a car accident reporting application was adopted as a prototype of the proposed blockchain platform and subsequently implemented for the

Najm for Insurance Services Company in Saudi. With regards to future work, we need to add new functions and evaluate the adaptation of the architecture and business pattern identified through the case study.

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