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Toward a Framework for a Transportation Service Sharing Economy Platform with a Blockchain-based Service Review System

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Abstract

Several countries including Thailand currently face a phenomenon of population aging as a consequence of a combination of increasing life expectancy and a low birthrate. As people age, they may require doctor appointments more often to treat illness or for regular health check-up. This is challenging for some families since caregivers need to work and do not have time to take their parents or senior relatives to go to a medical center. In this research, a framework of a sharing economy platform for a senior transportation service, particularly focusing on the service to a medical center, is proposed and evaluated through the prototype system as a proof-of-concept. Decentralized technology in the form of blockchain, smart contract, and interplanetary file system (IPFS) are integrated with the proposed platform to tackle the challenges of transparency and trust with reviews of the provided service. The study results indicate that a hybrid architecture between a centralized and decentralized system is feasible for the proposed sharing economy platform and the emerging technology of decentralized technology has a great potential to drive the future development of a service review system.

Keywords: aging society, sharing economy, blockchain, service review system

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1. Introduction

Average life expectancy in developed countries and some developing countries has increased [1]. This results in a global phenomenon of aging of societies, including in Thailand which is rapidly aging. The percentage of elderly citizens increased from 5% in 1995 to 17.1% in 2017 [2]. According to a report into estimates and projections of the Thai population for the period 2010-2040, it is estimated that Thailand will become a superaged society in 2033 when the proportion of the population aged 60 years or older is predicted to reach 28% [3]. As people age, they may require doctor appointments more often for illness treatment or regular health check-up. It is common in several Asian countries including Thailand that family members have to take care of the elderly and there is a need for caregivers to take seniors to see doctors. However, this is challenging for some families since caregivers may also need to work and have little time available to take their senior relatives to medical centers. Recently, there has been an increase in the popularity of a sharing economy, an emerging concept for businesses to enable people to share their services or assets via online digital platforms [4]. In 2019, Airbnb, an accommodation-sharing economy platform startup, had a valuation of approximately US$31 billion, almost as much as the world's largest hotel chain Marriot, valued at US$44 billion [5]. In the same year, Uber, a transportation company with a ride-sharing application, was valued at (US$72 billion) which is higher than the market capitalization

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of General Motors, the United States' largest car company (US$56 billion). These high valuations show that sharing economy platform business models can capture large markets and have significant competitive advantages over traditional platform business models. In addition to economic aspects, because a sharing economy can facilitate people to share and reuse their resources, it could promote sustainability [6]. Many sharing economy service applications are primarily developed for younger people, yet little attention has been paid to a sharing economy platform to specifically provide transportation services for elderly groups [7]. Such services can support aging in place to enable seniors to live independently and more flexibly in order to reduce the burden on their caregivers. The main contribution of this research is to fill this gap by developing a framework of a sharing economy platform for senior transportation services. The platform can help caregivers who need to take their seniors to medical centers to find other elderly who need to visit the same center while sharing transportation costs or earning extra money. Hence, the proposed solution will also help promote sustainability by sharing transport and caregivers when visiting medical centers, while also contributing to social well-being and economic growth. Furthermore, current sharing economy platforms mostly rely on central servers in which administrators can fully control all data manipulation including by reviewing content. To address this issue, the proposed platform is implemented based on a hybrid architecture that combines elements of both centralization and decentralization. The main functions including the management of service request posts are developed based on centralized servers. The service review module which needs to be transparent and trustworthy is implemented based on decentralized technology.

The remainder of the paper is structured as follows. Section 2 provides background and related work on sharing economy and decentralized technology, namely, blockchain, smart contract, and IPFS. Section 3 describes the research methodology. Section 4 presents system design and implementation. Section 5 introduces a blockchain-based review system. Section 6 provides results and discussion and Section 7 presents the conclusion of the research.

2. Background and related work

This section provides a background and literature review related to the sharing economy and decentralized technology, namely, blockchain, smart contract, and IPFS.

2.1 Sharing economy

According to Hamari et al. [8] the sharing economy is described as "the peer-to-peer-based activity of obtaining, giving, or sharing access to goods and services, coordinated through community-based online services." A report published by the Australian Competition and Consumer Commission [9] considered a sharing economy platform as a business operating an online platform facilitating peer-to-peer transactions to connect consumers and sellers in the sharing economy and utilizing review mechanisms as a means of regulating quality. According to a PricewaterhouseCoopers report [10], it is estimated that the sharing economy will grow to US$335 billion by 2025. In [11], the author mentioned that younger people utilize sharing economy platforms more than older people because of the generational and educational gap. As age increases, the use of digital platforms decreases. Therefore, most sharing economy platforms are developed to serve younger people. However, society ages in part as a consequence of increasing lifespans; there is a demand for sharing economy service platforms that focus on elderly people.

In Thailand, the Grab application is one example of the popular sharing economy platforms operating in the country. It connects peer-to-peer users to provide a range of on-demand transport services which include

private cars, taxis, and motorcycles to deliver food, transportation, and packages [12]. Besides Grab, there are other service providers providing services to pick up elderly people to see doctors at hospitals. However, these services are not based on the sharing economy concept and instead operate as a normal business to take care of individual elderly people to see a doctor at medical centers. Furthermore, the advertisements of such services are dispersed across various websites and social media rather than compiled in one place for users to easily find information. Even though sharing economy platforms are gaining broad popularity, there is a crucial barrier in the lack of transparency and trust in the online review system [13]. Therefore, there is a need for the study to tackle this challenge in order to develop transparency and trust towards the online review system in sharing economy platforms.

2.2 Blockchain, smart contract, and IPFS

A blockchain is a specific type of distributed ledger technology (DLT) comprised of a chain of interlinked blocks, with each block having a distinct hash value that serves to identify it uniquely. Each block is interconnected by containing the hash value of each block which is linked to the hash value of its preceding block, forming a continuous chain that constitutes a distributed digital ledger. [14]. A smart contract is a computer program in which the code and state persist as data deployed on a blockchain [15]. It can proactively respond to received or executed transactions according to predefined rules. Solidity is the most popular language for creating Ethereum smart contracts. When a smart contract is deployed, it will be running on an Ethereum Virtual Machine (EVM) and is stored on the blockchain network and it can be executed automatically with high security and speed without intermediation costs. IPFS is a peer-to-peer, open-source, content-addressable, globally distributed file system that enables high throughput storage and shares large volumes of data [16]. It is based on distributed hash table technology (DHT). Data is fragmented into several small parts and each part is identified with its hash address which is called CID and is distributed among other nodes. IPFS is widely used as an off-chain decentralized storage solution for blockchain-based applications because it can help to store decentralized and immutable data.

The sharing economy and blockchain are emerging concepts and fast-moving phenomena. Some works have been carried out on the sharing economy and blockchain technology. Nevertheless, only a relatively small number of research has been undertaken on the combination of these two fields to develop a sharing economy platform [17]. Mehrwald, et. al. [18] proposed the conceptual model of blockchain-based transparency and trust of online peer-to-peer transactions in the sharing economy. They mentioned that blockchain technology can enable trust at various stages and it has the potential to facilitate disintermediation and solve trust issues in the sharing economy. In [19], the authors presented a blockchain-based circular economy credit rating system to address the challenges of traditional credit checking process that relies on information from another party's credit status, which is time-consuming and results in higher transactional costs.

According to the literature review, numerous studies have focused on developing sharing economy platforms for various purposes, while some attempts have been made to integrate blockchain-based technology into their platforms. Nevertheless, to the best of our knowledge, there have been no studies that combine these two fields to develop a hybrid system architecture of a sharing economy platform providing a transportation service for elderly people to go to medical centers.

3. Research methodology

In this research, the design science research methodology was chosen. According to [20], design science research is a research paradigm

that addresses human problems by building innovative artifacts and contributing new knowledge to the body of scientific evidence. Design science research addresses the design, creation, and evaluation of applicable artifacts, for example, methods, applications, and systems, that could potentially enhance the efficacy of information systems in organizations [21]. In this study, a design science research methodology is applied to develop and evaluate the proposed framework as it provides guidelines and principles to solve problems through the creation of innovative information technology artifacts. Six activities are implemented according to the guidelines of design science research methodology of Peffers et al. [21] as follows.

3.1 Activity 1: Problem identification and motivation

In this activity, an extensive literature review is conducted on the topics related to problems in aging and aged society, particularly focusing on the challenges of getting seniors to their doctor appointments in Thailand's context and existing sharing economy platforms. The analysis of the existing literature helps to identify research gaps and open research issues. A comprehensive study has revealed that there is a lack of a sharing economy platform to provide service for seniors to their doctor appointments in which some resources such as transportation or carers can be shared. In addition, because transparency and trust in the quality of service providers are important, particularly in the peer-to-peer sharing economy platform, the proposed platform should be integrated with an effective mechanism to provide transparency and trust with a service review system.

3.2 Activity 2: Objectives of the solution

According to the problem identification and motivation previously identified in Activity 1, in this step, the primary objective of this research is defined. It seeks to develop a framework for a sharing economy platform for senior transportation services to medical centers. The research objective can be segmented into the following sub-objectives:

Sub-objective 1: To develop a system architecture of a sharing economy platform focusing on senior transportation services to medical centers.

Sub-objective 2: To develop an approach to provide transparency and trust through service reviews.

Sub-objective 3: To develop and evaluate a system prototype as a proof-of-concept experiment of the proposed framework.

3.3 Activity 3: Design of the solution

To address the abovementioned problems in Activity 1, the objective of the proposed solution is transformed into the software artifact's functionality and its system architecture. The proposed sharing economy platform framework for senior transportation services to medical centers (hereinafter referred to as GoMed) is designed as a hybrid system between a centralized and decentralized architecture. The main function of the platform which is a host for service providers and clients to meet and match the service relies on a centralized architecture. However, since a user review of the service quality is vulnerable to data manipulation by the host, the service review module is designed based on a decentralized architecture. The detail of the design activity is described in Section 4.

3.4 Activity 4: Development of the solution

Once the software solution was designed in the previous activity, in this step, a proof-of-concept system prototype is developed. As previously mentioned, the GoMed platform does not just rely on a centralized software solution, but also integrates both centralized and decentralized technologies. The main function of the platform to be a host for service providers and client to meet relies on a centralized technology. However, a service review module is built upon a decentralized technology, specifically blockchain and smart contract, to handle system's state and logic. Furthermore, in this research, IPFS is also used to store user service review content. More

details of the development activity are described in Section 5.

3.5 Activity 5: Evaluation

Once the system prototype is implemented as a proof-of-concept experiment, it is used to evaluate technological feasibility and functionality of the proposed sharing economy platform and to enable trust and transparency in reviewing the service. The developed software artifacts' functionality is compared with the solution objectives. The proposed solution is evaluated in accordance with a framework for evaluation in design science research addressed by Veneble et al. [22]. The simulation technique, which is considered an artificial evaluation approach by executing a prototype with artificial data, would be used to evaluate the system prototype. The detail of the evaluation activity is described in Section 6.

3.6 Activity 6: Research communication

This activity involves the dissemination of the research objective, methodology, and research findings to relevant audiences such as the academic community through this publication.

4. GoMed: A sharing economy platform for senior transportation services to medical centers

In this section, the system analysis of the proposed platform is discussed, followed by the system design and implementation.

4.1. System analysis

In this study, a use case diagram was chosen to explain and document the interaction required between the users and the system to accomplish the user's task as well as to provide the functionalities of the proposed platform as shown in Figure 1. There are five types of actors as follows.

1) User – This actor is kind of an actor generalization to represent the inheritance relationship meaning that the descendant actor can have all the use cases that have been defined for its ancestor. For instance, a general user and a client have some common behaviors, namely, "Browse post" and "View service review"; therefore, an actor type "User" is used to capture those common functionalities and then the descendant actors which are "General user" and "Client" can be specialized to identify the individual needs of each actor.

2) General user – This actor can browse posts regarding service offerings and service requests and view service reviews. Then if he wants to post his available service on the platform, he has to register to the platform.

3) Client – When the general user successfully registers to the platform, his role will be changed to be a client. He can then manage his post by adding, updating, or deleting the post to request a transportation service to take a senior to the doctor for a scheduled appointment. In addition, this actor can view service reviews of a specific service provider written by previous clients to make a service purchase decision. He can also add a service review after the job has been completed. In addition, he can view service request reports and manage his user profile.

4) Service provider – This actor needs to register to the platform. He can manage his posts to offer a transportation service for seniors to go to medical appointments. He can view service reviews and service-related reports as well as manage his profile.

5) Administrator – This actor has rights over several services including managing the system configuration, managing user profiles, and viewing service-related reports.

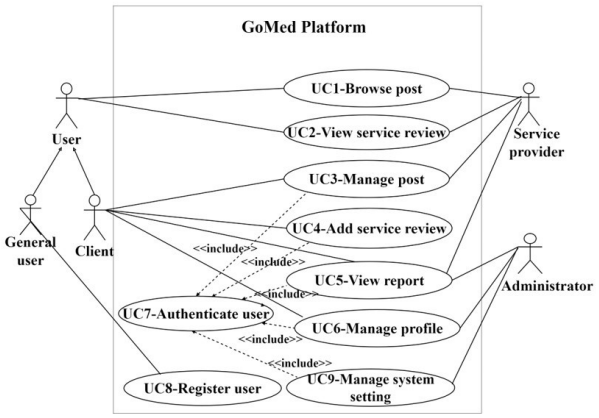

Figure 1. A use case diagram

Table 1 presents available use cases and their functionalities for the proposed platform.

Table 1. Detail of GoMed platform use cases

Use case #	Use case name	Use case functionalities
UC1	Browse post	To allow users to browse service posts
UC2	View service review	To allow users to view service reviews
UC3	Manage post	To allow service providers and clients to add/update/delete their posts
UC4	Add service review	To allow clients to add service reviews regarding the quality of service received
UC5	View report	To allow authorized users to view service post reports
UC6	Manage profile	To allow authorized users to manage their profiles
UC7	Authenticat e user	To authenticate user identity
UC8	Register user	To allow general users to register to the GoMed platform

4.2 System design

The GoMed platform is designed as a hybrid system between a centralized and decentralized architecture as depicted in Figure 2. The system architecture can be divided into three layers. The first layer is a user interface layer interacting with a user by sending a user request to the next adjacent layer, receiving a response and displaying a result to the user. The second layer is a business logic layer, an intermediate tier between a user interface layer and a data layer. It is responsible for logical processes and calculations. A request is also processed based on predefined logic in the application to yield meaningful information for communicating to the data layer which is the third layer. The main function of the platform which is a host for service providers and clients to make service-related posts to share transportation services for medical appointments relies on a centralized manner. However, the review of the quality of the service received is based on decentralized technologies, namely, blockchain and smart contract used to provide decentralized management of the logic and state of the system. In addition, IPFS is used to store service review content to enable off-chain decentralized file storage and provide immutable permanent links which use content addressing in a blockchain.

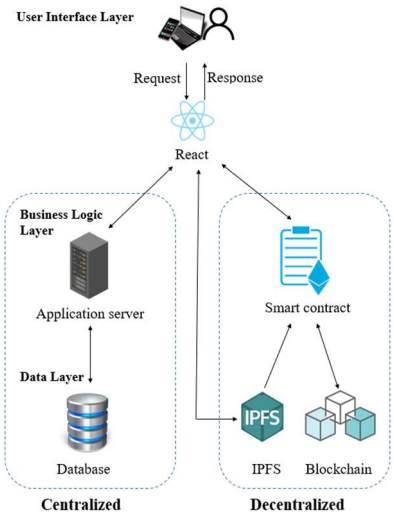

Figure 2. Overview of the GoMed architecture.

4.3 Prototype implementation

The GoMed prototype is implemented as a proof-of-concept based on the following criteria.

4.3.1) Authentication

Even though general users can access and view public posts, they cannot make a new post or modify or delete a post. Only registered

users, i.e., clients, service providers, and administrators can log in and do those operations.

4.3.2) Transparency and trust of review content

In the sharing economy platform, consumers are likely to make their purchase decisions based on previous service quality reviews. Therefore, with the centralized system, reviews are subject to compromise or tampering by the administrator in order to manipulate consumer purchase decisions. Concerning the transparency and trust of service review content, blockchain technology, smart contract, and IPFS are utilized in the proposed platform. As a consequence, reviews can be verified that they are genuine, historically consistent, as well as untampered.

4.3.3) Human-computer interaction

The main functions of the GoMed platform prototyping to allow clients and service providers to manage their posts and to communicate to each other are developed with a combination of various technologies, namely, HTML5, CSS, JavaScript, Bootstrap, and React JavaScript library. The design of the interface follows the principles of being simple and easy to use so a new user can learn to use the platform easily.

5. Toward a blockchain-based service review system

The current state-of-the-art online review system of sharing economy platforms is inefficient as they lack transparency and trust in review content. This is because those platforms rely on central servers with full control of the platforms' authorities such as administrators. Therefore, all service review content is prone to be modified, removed, or manipulated by the central authorities. In this paper, a novel blockchain-based review system approach is presented to solve the abovementioned issues in sharing economy platforms. A blockchain is selected to be an underlying infrastructure to provide transparency and trust in service review content. Smart contract which is a deterministic program that runs on a blockchain is also used to automatically execute when it is triggered by an on-chain transaction without human intervention. The platform also uses IPFS as off-chain storage to solve the scalability problem that arises due to the increasing number of transactions and nodes on the blockchain by carrying out transactions outside of the blockchain. IPFS is widely used as an off-chain decentralized storage solution for blockchain-based applications because it can help to store decentralized and immutable data. A workflow of the blockchain-based service review module in the GoMed platform is presented in Figure 3.

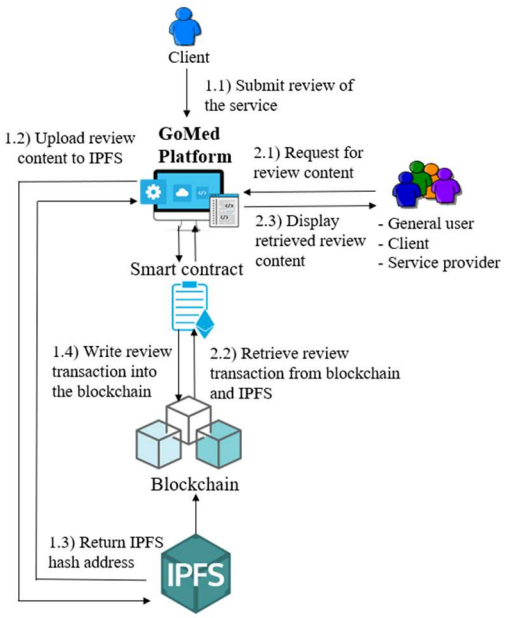

Figure 3. A workflow of the service review module

As shown in Figure 3, the blockchain-based service review module consists of three main components, namely, blockchain, smart contract, and IPFS. During the development phase, the smart contract written in Solidity programming language is compiled and executed on a development network. Then it is deployed to the Sepolia blockchain which is a testing network for Ethereum blockchain. The transaction is time-stamped depending on the block that it is accepted and cannot be altered or removed later. When a user submits a review regarding the quality of a service previously received, the review content is uploaded to the IPFS network which is used to store service review content in an open distributed storage system. Therefore, although the host node is disconnected, there will be other nodes in the IPFS network that have a cache and can provide the requested review content. Once the review is uploaded, the IPFS hash address which is a unique identifier of the document is returned to the platform. Next, the GoMed platform submits the service review information and IPFS hash address of review content to the Sepolia blockchain network by interacting with a smart contract through Web3.js, the JavaScript Application Programming Interface library to connect the web application to a blockchain.

In case a user would like to view the review content of a particular service provider to make a service purchase decision, they can make a request to receive review content through the GoMed Platform. The smart contract function to get service review information is activated. It retrieves the review information stored on the blockchain as well as the real review content from the IPFS. The review information is sent to be displayed to the user. After the client received the service from the provider, they are eligible to review the quality of the service. Once, the client submits the review, the review content is uploaded to the IPFS network and then a hash address linked to the uploaded review content is returned. Service review information along with the IPFS hash address is subsequently saved within the blockchain by the smart contract.

Some key variables used in the implementation of the service review smart contract are shown in Table 2 and an algorithm of the process of service review submission to the blockchain is described in Algorithm 1.

Table 2. Some key variables used in the implementation of the smart contract.

Name	Type	Description
Reviewer-Address	address	The address of a reviewer who submits a review regarding service quality
Service-ProviderID	string	The identification of a service provider
serviceID	string	The identification of a service received
reviewTime-Stamp	uint	Timestamp of the review submission
rating	uint	The rating score of the service quality received
IPFSReview-Content	string	The hash address of review contents in IPFS network
Service-Reviews	mapping	A mapping type that stores a mapping relationship between the service provider and information on the review content
totalReview	uint	The number of total service reviews for a service provider

Algorithm 1. A process of service review submission to the blockchain

```
Input: serviceProviderID, serviceID, rating,
       IPFSReviewContent, reviewerAddress
If the rating is between 1 and 5 and the
IPFSReviewContent is not empty
   Add review information (i.e., reviewerAddress,
   serviceProviderID, serviceID, reviewTimeStamp,
   rating and IPFSReviewContent to the blockchain
   Trigger event ReviewAddedEvent
   Notify with a message "Submit review
   successfully"
Else
   Revert the smart contract state and display an
   error message
end if
```

6. Result and discussion

In this section, the system prototype is used as a proof-of-concept experiment to evaluate the technical feasibility and functionality of the proposed platform framework. Therefore, in this study, the developed system prototype is

evaluated in terms of functional testing against the identified objectives in Section 3.2. The evaluation is carried out in accordance with a framework for evaluation in design science research addressed by Veneble et al. [22]. It is to be noted that the artificial evaluation technique is chosen to evaluate the platform because of its benefits of having stronger scientific reliability in regard to repeatability and falsifiability as well as the possibility to control potential confounding variables more carefully [22].

6.1 Experiment Setup

The proof-of-concept system prototype of the GoMed platform was developed to demonstrate some use cases and evaluate its performance. The proposed smart contract was developed in the remix IDE using Solidity programming language and deployed to the Sepolia blockchain network which allows for development testing and verifying before deployment on the main network. In this research, the black box testing technique was selected, which is a design science evaluation method to evaluate functional testing by executing artifact interfaces to uncover failures and detect defects [20]. The following use case scenarios are simulated examples for the experiment to evaluate the technological feasibility and functionality of the proposed platform. Details of these use case scenarios are as follows.

Use case scenario 1: A client is looking for a service provider

In the experiment, we assume that Alice has the go med username in the platform. Alice, a bank teller with a sixty-year-old father, would like to find someone to take her father to the medical center for an annual health check-up. She logged in to the GoMed platform and browsed for available services. Unfortunately, there was no service offered on that day. Therefore, Alice created a new post to request a service on the GoMed platform. In the post, there was information, namely, the original address to pick up her father, their name, address, and map of the medical center, the date and time of the requested service, the service fee offered, as well as additional details in case that Alice would like to communicate with the service provider. Alice confirmed that the above information was correct and then this information was uploaded to the GoMed platform as shown in Figure 4. We also assume that Bob, a man who is a registered service provider of the GoMed platform, was going to take his father to see a doctor at the same medical center as Alice's father on that day. He would like to have someone to go with him in order to share the transportation expenses as well as to earn extra money. He thus visited the GoMed platform and browsed through the available service request posts. He found Alice's post and wanted to accept the job. He could send a direct message to Alice in case he had any questions according to the service. Once he decided to accept the job, the platform updated the post's status as accepted and the confirmation message was sent to Alice.

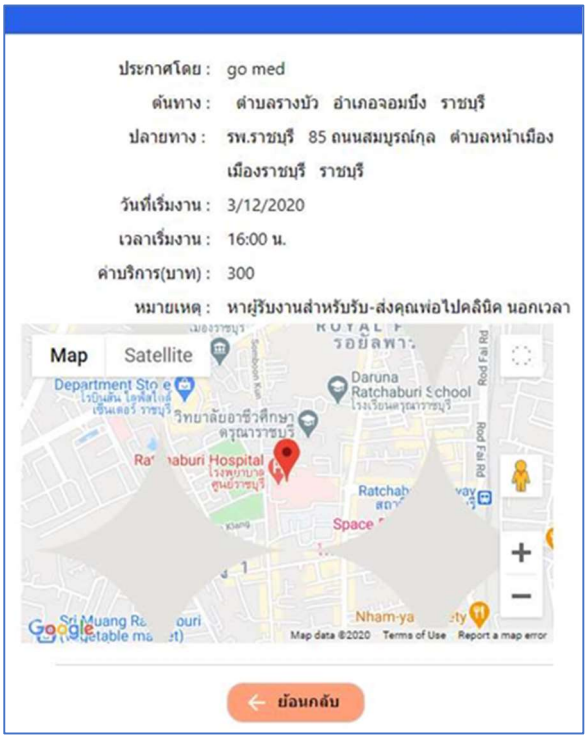

Figure 4. A screenshot of the requested service post

Use case scenario 2: The service has been completed and the client submits the review.

When Bob completed his job and changed the status of the provided service as completed, the GoMed platform allowed Alice to write a review regarding the quality of Bob's service. Alice could submit the review regarding the quality of service provided by Bob through the GoMed platform. There is also a frontend validation for input fields of the service review form to ensure properly formed data is provided (e.g., missing content or incorrect format). The valid service review content was uploaded to

the IPFS network, which then returned the hash address of the uploaded review content to the GoMed platform. The platform would then submit service review information and the hash address of the review content to the smart contract. The smart contract then created a transaction with all the information and submitted it to the blockchain. Figure 5 represents a sequence diagram of submitting a service review process by a client.

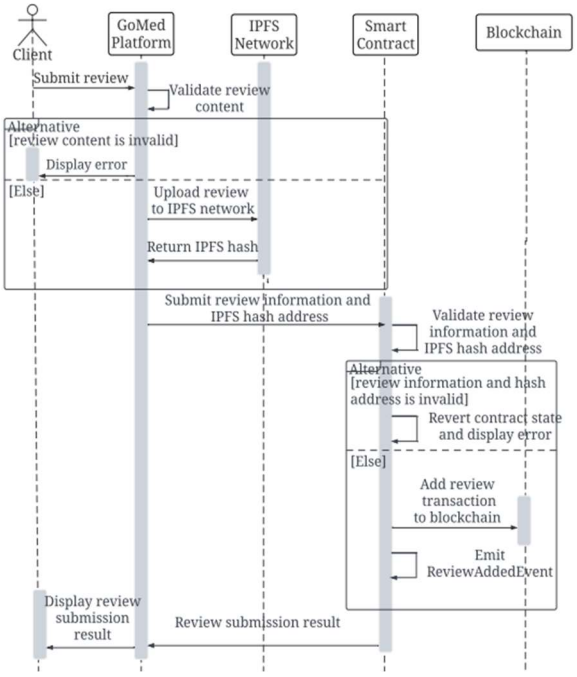

Figure 5. A sequence diagram of review submission

6.2 Result and discussion

According to the design science research, once the proposed solution is developed, it will be evaluated. In this study, the functionality of the proposed system is evaluated through the system prototype by using a black box testing technique. The purpose is to determine whether all functionality of the GoMed platform operates properly according to the use cases that have been analyzed. The result of the evaluation might be either 'Pass' for success or 'Fail' for failure. The result of the black box testing has shown that all system functionality performed as expected. Specifically, in order to evaluate the blockchain-based review module, a transaction cost is calculated and used to measure the performance of the prototype as a technical-based evaluation. The service review module is implemented on the Ethereum blockchain; therefore, a transaction fee called 'gas' has to be paid for each data manipulation transaction. On the Ethereum network, the gas or transaction fee is paid in Ethereum's native currency called Ether (ETH). The total cost of fees which is in Ether unit can be calculated by multiplying gas used with gas price [23] as shown in the equation (1).

Total cost (Ether) = Gas used * Gas Price (Gwei) (1)

Each operation consumes the number of gas used and can be calculated to the amount of transaction cost in Ether as presented in Table 3.

Table 3. The transaction cost of operation in Ether for the developed smart contract

Operation	Gas used (Units)	Gas Price (Gwei)	Total cost (Ether)
contract deployment	1,252,038	2.500000012	0.00313009501
addReview function	366,315	2.500000012	0.00091578750

According to the gas cost evaluation result shown in Table 3, it is seen that the blockchain-based service review system has some costs, but it is rather small and acceptable when compared with the advantage of transparency and trust achieved. It is to be noted that because the proposed system is implemented by using IPFS as a low-cost off-chain storage for the review content, only hash addresses returned from IPFS are stored on the blockchain. The IPFS address is a fixed-size bitstream. As a consequence, the gas cost for processing the hash address data is rather steady no matter the size of the service review content. The experimental result has shown that the integration of decentralized technology, namely, blockchain, smart contract, and IPFS in the GoMed platform can tackle the challenges of transparency and trust in review content which greatly enhances the confidence of users.

In this study, besides the technical-based evaluation to measure the performance of the proposed solution, the comparison of the developed system prototype to existing solutions is also presented. Table 4 provides a

comparison of the conventional review system in existing sharing economy platforms (i.e. Airbnb, Uber, Grab) which do not use blockchain technology, and the proposed blockchain-based review system presented in this study. The comparison result has shown that the integration of blockchain-based technology in the service review process of the GoMed platform can tackle the challenges of transparency and trust in the review process which greatly enhances the confidence of the GoMed platform users.

Table 4. Comparison between conventional review systems and the proposed review system

Characteristics	Conventional review systems	Proposed review system
Architecture	Centralized	Decentralized
Authority	Central authority	No central authority
Single point of failure	Yes. If the central server fails, it may cause the entire system to stop operating.	No. Each node in a blockchain network has a duplicate of the ledger.
Data integrity	Review content can be manipulated.	Review content is immutable.
Data security	Review content is prone to data leaks.	Review content is secure because it is encrypted.
Data manipulation	Support creating, reading, updating, and deleting data operations	Only support reading and writing data operations
Reliability	Less reliable because review content can be deleted or modified	More reliable because review content cannot be deleted or modified
Maintenance	Easy to maintain	Difficult to maintain
Fault tolerant	No	Yes
Anonymity	No	Yes
Transparency	Not transparent	Highly transparent and auditable

7. Conclusion

In this paper, a framework of a sharing economy platform has been proposed and it captures the main operations required for a peer-to-peer-based activity of providing or sharing senior transportation services to medical centers. Furthermore, a proof-of-concept prototype of the proposed framework is implemented based on a hybrid architecture between a centralized and decentralized system in order to leverage the advantages of both architectures. For instance, the majority of operations such as managing a service post or managing user profiles are designed to operate on a centralized host and traditional database solution because of a need for data modification, cost-effectiveness, and easy maintenance. However, the module for reviewing the quality of service is implemented based on decentralized technology, namely, blockchain, smart contract, and IPFS to provide transparency and trust in the consumer review content to ensure reviews are transparent in the proposed platform since review data is always available at any time to all users. In addition, this service review content can be trusted because it is stored on the distributed file storage platform, namely, IPFS and blockchain in which stored data is immutable.

Overall, the main contributions of this work can be concluded as follows:

1. The development of a framework of sharing economy platform for senior transportation services, particularly focusing on the service to medical centers.
2. A blockchain-based service review approach to provide transparency and trust in consumer review content.
3. A hybrid architecture between centralized and decentralized systems to tackle interoperability challenges according to transparency and trust of consumer reviews within the proposed sharing economy platform.

In spite of a good result from the experiment from a proof-of-concept prototype, this work still has a limitation. It lacks an incentive mechanism to encourage a user to provide a service review previously received. Therefore, in future work, the proposed platform could be enhanced with a business model equipped with an algorithm to incentivize consumers of the platform to provide their service review through a blockchain-powered incentive mechanism

such as loyalty rewards with cryptocurrency tokens. The emerging technology of decentralized technology has great potential to drive the future development of review systems which can influence consumer purchasing decisions for products or services as well as revolutionize the future of sharing economy platforms. When the proposed GoMed platform is deployed for real use, it can facilitate caregivers accompanying their elderly relatives to medical centers. The platform achieves this by connecting caregivers with other seniors who have medical appointments at the same location. This connection enables cost-sharing for transportation or allows caregivers to earn additional income during their visits to the medical center. Consequently, this proposed solution promotes sustainability by fostering the sharing of transportation resources and caregivers during medical appointments. It can play an important role in enhancing social well-being and contributing to economic growth.

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