วารสารวิศวกรรมศาสตร์และนวัตกรรม
Journal of Engineering and Innovation

บทความวิจัย

# Preventive cheating guideline for game show voting system using an online blockchain platform

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Received 12 May 2021; Revised #1 18 June 2021; Revised #2 2 August 2021; Accepted 24 September 2021

**Abstract**

In a digital world, the information and transactions have been used in many activities in business worldwide however data security and reliability are important to the users. Blockchain technology can solve the problem of making transactions without intermediaries. Many organizations are more interested in various applications of blockchain technology. The game show program is one of the business applications that has a problem for cheating and duplicating the voting processes. The preventive cheating guideline has been presented for game show voting programs using an online blockchain platform presents to solve such a problem. The testing system allows voters to can submit their voting results with correction, transparent and immutable because of recording their votes in the blockchain. Furthermore, the average transaction times of proof of work (PoW) and Ganache were approximately at 30 seconds and 3 seconsds, respectively.

**Keywords**

guideline; preventive cheating; game show; blockchain; voting; Ethereum blockchain; proof of work (PoW), Ganache

## 1. Introduction

Thai social has been developing to the modern, adopting new technology and innovation that greatly make life more convenient. Most new technology and innovation are connected through the internet to the users. Most people receive information through televisions because they contain various news, dramas, game shows, etc. The programs may be domestically produced on licensed from abroad [1]. Compared with the past, the number of television stations in Thailand has increased and changed from analog to digital television. Consequently, the number of free television channels is increased while the number of audiences has not increased, in this circumstance, the proprietors need to adapt and compete to attract the audiences for their survival by producing high- quality programs that meet the demand of the audiences [2]. On average, a news analysis program is the most popular, next is a multi-episode drama, and game show or competition [3]. If the television channels want to reach more

audiences, they can add more special programs to attract particular target audiences.

Game shows are a form of the television program that entertained audiences. Furthermore the process of providing entertainment, there will also be additional knowledge content related to daily life. This makes most of the game shows very popular with the audience. In Thailand, the game show remains the popularity for a long time [4]. Presently, they try to change their styles to be more interesting by modifying their forms, contents, and elements to fulfill the audiences' demand and keep the most audiences with them. As it is one of the programs that make large income for the TV station and producers. Khattiya [5] explained that one of the interesting program from the audience is to receive the response by feedbacks or reflections after watching the program. This shows that the feedback response from the audience feature is the main principle for the development and creativity of the program producers. Based on the received responses, the feedback can be categorized into 2 types, positive feedback, and negative feedback [6]. Every producer wants its received responses to be positive feedback showing satisfaction and following.

Presently, the feedback responses are in the form of SMS. The market capitalization of the media category in game show programs has been reported for the worth as much as 1,019,163.62 (billion baht) in May 1, 2020 [7]. In 2019, if comparing ratings between news programs and game shows. It was found that game shows had higher ratings at 4.993, while news programs were at 1.943 due to their popularity among viewers [8]. However, the SMS format has weaknesses in the transparency of the voting system. This is because viewers doubt the transparency and reliability of this untraceable information. This led to a question of locking the results of the voting system. For this reason, the researcher is interested in applying blockchain technology to the game shows voting web applications. This research will study and focus on the transparency problem of the the game show program.

## 2. Literature Review and Related Research

### 2.1 Blockchain Technology

Blockchain concept was originated in 2008 by Nakamoto [9]. A blockchain is a form of information storage. The benefit is increasing the information's reliability because the recorded data cannot be changed or edited. All users will see the same recorded information [10]. It has three main properties as follows: 1) Immutability 2) Verifiability and 3) Distributed Consensus [11]. The concepts involve building a platform that can create security in the exchange of digital money called “Bitcoin”, using the theory of cryptography and distributed computing.

#### 2.1.1 Components of Blockchain

Blockchain consists of the following four components 1) Block: Block is the place where the data transaction/fact is kept. Each block is chained to the previous block using the value of Hash Function, thus making it difficult to be modified [12]. It can be divided into 2 pasts: block header and block data [10]. The structure of each block consists of block number and timestamp [13]. If there is a data change in the previous block, it will cause unequal Hash values of each block [14] 2) Chain: Chain memorizes every transaction of all users in the system and records the data together with copying the ledger which is distributed 3) Validation: the verification or validation depending on the design of data record in each block

and 4) Consensus: Consensus algorithm is a measure to confirm the reliability of the transaction process.

The consensus protocol ensures that every new block is added in the blockchain network to be guaranteed by every node [13]. Many research papers have been presented in the most popular consensus protocols e.g. Proof of Work (PoW) [15] [16], Proof of Stake (PoS) [17], and Proof of Authority (PoA) [18].

**2.1.2 Types of Blockchain**

Blockchain technology can be divided into 3 types. They are suitable for different applications; 1) Public Blockchain allows everyone to record their data without disclosing it. The advantage of a public blockchain is that the recorded data will be copied and distributed worldwide so that everyone in the network can verify them. The disadvantage is the recorded data will be disclosed worldwide, and the speed of data processing is slow [19]. 2) Private Blockchain is created to limit the number of users only within the organization. The advantage is that the system owner can set the rules of working within the network as they like and decrease the disclosing of data. 3) Consortium Blockchain is the hybrid. It is being popular nowadays [20].

**2.1.3 Principle of Blockchain Technology Operation**

Blockchain operates by keeping data using Distributed Ledger Technology (DLT). The important parts are called Nodes that many of them are connected within the network [8]. There are no central or host computers. Each node will contain the anonymous ledgers of all users within the network thus enabling every user to see other's ongoing financial accounts.

The data are recorded in a block. Hash functions identify each block by referring to its previous block Hash function. Then the link between each block is built by creating a chain of the block called "Blockchain" [21]. The data will be distributed to every node in the network to notify everyone about the new transaction. If a node is damaged it is still possible to restore the transaction from another node and confirm that it is the original transaction using the mining process.

In general, each user in the blockchain is eligible to perform a transaction through his or her node. These nodes will create a Peer-to-Peer network. The users can communicate with blockchain using his or her private key and public key. Therefore, other users in the same blockchain will notify every permitted transaction. Eventually, the transaction will be distributed all over the network. Each node will check if there are any new transactions. If new transactions occur, they will be kept in the blocks using a mathematical equation transforming into a digital signature called "Hash" for increased security. Hash is equivalent to a letter sent, if one character in a block is changed, every hash will be changed to confirm that there are the latest transactions. The correctives of subsequent transactions are also confirmed [22].

**2.1.4 Nodes, Testing and Ganache**

In the general blockchain, the data transactions are distributed to all the nodes connecting the peer-to-peer network and are verified by these nodes [23]. The nodes can be classified into 2 types i.e. (1) full nodes verify all the transactions in the network operating a complete copy of the blockchain [23] [24] and (2) SPV (Simplified Payment Verification) or lightweight nodes [23] do not process the complete blockchain but they connect to full nodes which only forward the transactions from their request [24].

Blockchain should implement to ensure testing quality e.g. security, privacy, throughput, size and

bandwidth, performance, usability, data integrity, and scalability, etc., but these quality attributes set up a lot of challenges that need to be addressed [24]. However, there is a comfortable tool to help and implement the blockchain development called "Ganache" which is a personal Ethereum blockchain allowing them to test and deploy the smart contracts without needing to connect to a real blockchain or set up their blockchain (private blockchain) using an Ethereum client like Geth [25].

**2.2 Game Show Program**

Initially, game show programs were radio quiz programs and then developed into TV programs called television quiz in the form of question-answer. Subsequently, they were further developed to be a game that rewarded the winning candidate in the competition. The contents of the programs included knowledge and entertainment. Until the advance of technology and art, they have been improved to be game show programs [26]. In Thailand, there are many games shows more increasing. The format of the program in the game show consists of many game players to win the prizes. The contents of the game show are both educational, entertaining to the audience and the participants.

At present, the vote of the participant's race through a game show in the form of voting via Short Message Service Voting (SMS). SMS Voting is a mobile service for sending a short message. It was known as SMS- C, a technology for sending and receiving information through via mobile device with a limit of 160 characters for forwarding messages [27].

**2. 2. 1 Voting Applications using Blockchain Technology**

Blockchain has become an important technology in a short time [28]. Voting by using blockchain technology has the potential for the elimination of unfair votes. Blockchain protocol in the way of recording data and the verification for transparency among users. Traditionally, the recording of votes, counting, and verifying are performed by the center of the election [29]. Blockchain technology has been applied to other businesses such as the medical, automotive industries. Case studies of consumer utilities, professionals and SMEs including their application in the electoral voting system [30]. The results of the study showed that It is improved the credibility of the electorate as it is implemented by blockchain outcomes fault prevention technology [31]. Kazeem [32] study adopted the blockchain system to improve digital electoral transparency.

Estonia has adopted blockchain technology in a voting system that is known as i-vote. The ballot will be checked for accuracy and time-stamped. Voting data is stored in the blockchain to prove its existence [10]. Switzerland is another country that adopts electronic voting [33]. In 2011 A.D. Norway used an electronic televoting system for national parliamentary elections. The system was developed by Scytl, an e-vote seller, which was similar to that of Estonia. However, in 2014 i-voting was stopped due to the security problem [34] [35].

**2. 2. 2 Comparisons of SMS Voting and Blockchain for Voting**

From Table 1, it can be seen that the use of blockchain technology in elections can resolve many problems, such as the elimination of the middle party involving with the voting results, i.e., the collectors of votes and related personnel. The voters can use the real-time results with confidence of the votes shown. Blockchain can increase efficiency in processing and manage the votes systematically [36]. The results are

transparent and reliable, accepted by everyone as compared to SMS voting.

**Table 1** Comparison of SMS Voting and Blockchain for voting.

| Topic of comparison | SMS Voting | Blockchain Voting |
|---|---|---|
| Creation of different formats of voting | ✓ | ✓ |
| Real Time votes summary | ✖ | ✓ |
| Management of votes systematically | ✖ | ✓ |
| Security of data | ✖ | ✓ |
| Validity of data | ✖ | ✓ |
| Able to check information data | ✖ | ✓ |

### 2.2.3 Comparisons of Various Voting Systems Using Ethereum Blockchain

From Table 2 , it shows that blockchain technology has gained the most popularity in election applications. The methodology schemes in the previous research study is a study in the concept and testing phase by doing multiple voting to increase the safety of voting only. There was no research using studies from the concept and testing phase to get further study in the practice phase due to the process of applying blockchain technology. It should be studied in the practice phase to understand the principles of applying the whole process. Also, blockchain technology was found to be applied to boardroom (self-tallying voting) application, a concept and testing phase that is studied by single voting. However, there was no research has been done on applying blockchain technology to the game show voting system. Therefore, it is the original research in the application of the SMS voting system in the game show. The methodology schemes of this study will be studied by the concept, testing and practice phase with both single voting and multiple voting tests.

**Table 2** Comparisons of Various Voting Systems Using Ethereum Blockchain.

| | | Methodology schemes | | | If applicable for | |
|---|---|---|---|---|---|---|
| **Applications** | **References** | Concept | Testing | Practice | Multiple voting | Single voting |
| Election | Hjálmarsson, Hreiðarsson [ 11] , Dagher, Marella [37], Chaieb, Yousfi [38], Yavuz, Koç [39], Hardwick, Gioulis [40] | ✓ | ✓ | ✖ | ✓ | ✖ |
| | Khan, Arshad [41] , Shukla, Thasmiya [42], Bulut, Kantarcı [43] | ✓ | ✖ | ✖ | ✓ | ✖ |
| Boardroom | McCorry, Shahandashti [33] | ✓ | ✓ | ✖ | ✖ | ✓ |
| **Game show program** | **This paper** | ✓ | ✓ | ✓ | ✓ | ✓ |

## 3. Research Methodology

This research is an R&D ( Research and Development) to assess the efficiency of the game show voting system using an online blockchain platform.

### 3.1 Participants

The samples are collected by random of 50 general people within the Bangkok area and suburban.

### 3.2 Research Tools

The researcher has developed a web application to assess the efficiency and to test the transparency

of the platform for resolving the problem from the voting via SMS.

Each voting session is stored on the blockchain and replicated in multiple nodes. Voters will vote using their account address to confirm their voting, and once the candidate has been successfully voted on, the wallet will be reduced. (If voters have a lot of wallets, they can vote for any favorite number of candidates within the specified time of the game show). This made the voting in a game show the difference from for an election that could only be voted on once. For SMS voting, voters cannot check real-time information and votes.

For this research, a game show program was arranged by allowing participants to vote on their favorite singer within the time limit. The transactions will be reviewed when re-voting that occurs at the same time. Redundant Spending is a fault in which cryptocurrency may be misused. Therefore, a miner on the blockchain must act as a validator for duplicate transactions. The 2nd transaction will be ignored as it is considered invalid. Design and develop the web application by layout program name, picture, and name of singers, clicking pushbutton for singer selection and clicking pushbutton for voting as shown in Figure 1.


**Figure 1** User interface for web application used in the voting for Game Show.

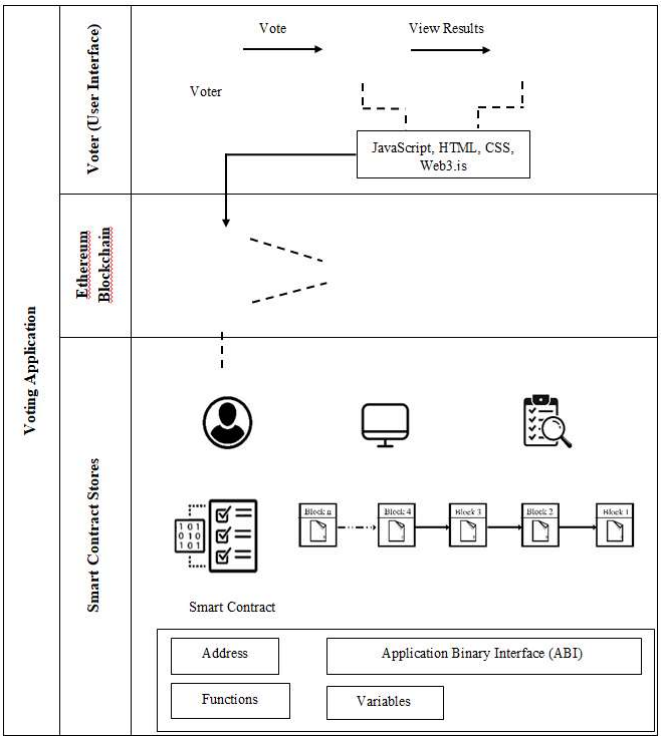


**Figure 2** Overview of Voting step using Blockchain

Web applications are developed with JavaScript, HTML and CSS. Voting information is stored in a variable. The web application is developed to test and simulate game shows' voting system using blockchain technology and smart contracts. It runs on a distributed network such as the ethereum blockchain. The determination voting rules are written with smart contracts by using ethereum's solid language, as shown in Figure 2.

Ethereum Web3 Framework will make it easier for voters to communicate with the ethereum blockchain, as there is no need to download a full or part ethereum. Voters receive their mobile nodes and synchronize them with a secure blockchain and verifiable, as shown in Figure 3.

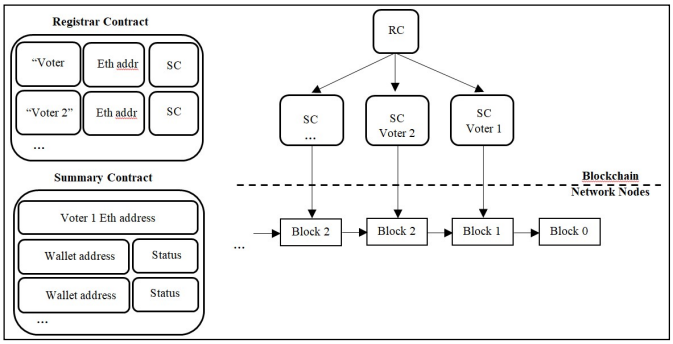


**Figure 3** Principle of Operation of a smart contract of voting game show program (1 block = 1 transaction).

The stage of the smart contract, with the Vote() and getWinning() functions included at every step to retrieve the database that is saved in the ethereum blockchain. In the last step, it is returned the highest score with the getWinning() function, as shown in Figure 4.

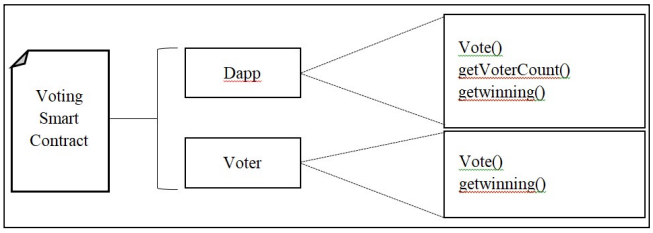


**Figure 4** The content of the proposed voting smart contract.

From Figure 4, it can be described as follows: (1) Vote: Voters can vote for his or her favourite singer using account address. When the voter votes, variable Voter() will receive the data and send eth. calls to voting contract for examination of vote' s account address. If the vote is confirmed it will send eth.calls to voting contract for validation of the vote permission. (2) getVotesCount is the Function to retrieve the data from the finished voting whilst getVotesCount will submit all current votes in the platform based on types of the time limit. The voter can check the results on time. Voting scurs for new voting of every choice will be sent as transaction array to voting contract. (3) getwinningChoice(): Function to return the winner in the voting. (4) Test implement the system on a private network to collect the data about the expense of GAS and time duration in the vote since it can be translated to the efficiency data and 5) Test of the developed web application.

The researcher has tested the operation of nodes by comparing the time spent in 1 node, 3 nodes, 5 nodes, 8 nodes and 10 nodes using Windows 10 Pro. Then, to tested comparing Proof of Work (Pow) and Ganache to assess the efficiency of both systems 50 times to obtain the average value on the time duration and efficiency.

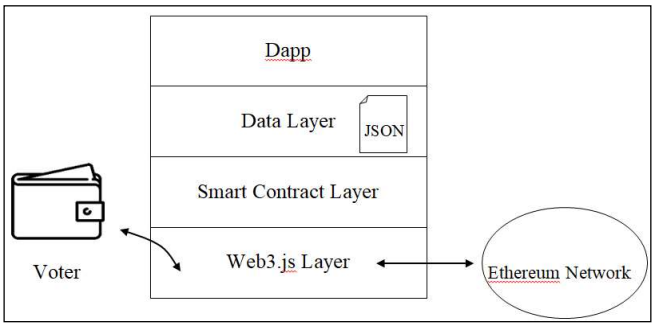


**Figure 5** The proposed structure of decentralized application.

Figure 5 is shown an application structure consisting of layer 1: Dapp interface for user interface, layer 2: Data layer converting first layer's input data into string JSON data, layer 3: Smart Contract is a layer consisting of the voting smart contract. Web3.js is the last layer using a connection of the Ethereum blockchain with voters.

### 3.3 Measurement Instrument

The researcher has created the questionnaire to ask for the opinion of the sample group after using the web application. The questionnaire was divided into 2 parts: Part 1, closed-ended questionnaire is the assessment that the answers are given for the sample

group to choose the true one using the scale of 5 satisfaction levels. Part 2, Open-ended questions is the assessment that no answers are given, the sample group is tree to answer to their opinions. Data were collected by administering an online questionnaire on Google Form.

The data collection has the following steps; 1) the researcher explains the objective and how to use the web application to the sample groups 2) the sample groups vote through the web application 3) the researcher and sample groups examine the correctness of data to show the transparency of voting scores 4) the sample groups answer the satisfaction questionnaire on using the web application and 5) get the collected data of satisfaction for further statistical analysis.

### 3.4 Data Analysis

Qualitative analysis of the result using the web application by sample groups is done by seeing the stored data in the blockchain about the time duration (from the beginning of the vote to the instant of score show).

Quantitative analysis of the data collected from the satisfaction questionnaire, part 1 and part 2 is done by finding the percentage, mean and standard deviation.

### 3.5 Statistics used in the Data Analysis

#### 3.5.1 Blockchain statistics

1) The average time to find a block

time = difficulty * / 32**2hashrate

2) Target is a 256bit number (SHA256)

**Target =**

$$\frac{0x00000000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF}{difficulty}$$

#### 3.5.2 Basic statistics

1) Percentage

$$\text{Percentage} = \frac{\text{Obtained scores}}{\text{Full scores}} \times 100$$

2) Means $\bar{x}$

$$\bar{x} = \frac{\sum x_i}{N}$$

Where $\bar{x}$ represents the mean

$N$ represents numbers of data

3) Standard Deviation (S.D.)

$$\text{S.D.} = \sqrt{\frac{\sum x_i^2}{N} - \left(\frac{\sum x_i^2}{N}\right)^2}$$

Where $x_i$ represents each data

$N$ represents numbers of data

## 4. Research Results

This research using online blockchain voting system consists of data collection from a sample group of 50 people on using the web application and seeing the stores data in the blockchain. Descriptive statistics are used in the data analysis to obtain qualitative information. The basic statistics are used in the analysis of satisfaction questionnaire responses to obtain quantitative information.

### 4.1 The Result of Data Analysis for Sample Groups

From the voting system (Web application) used to collect data with a sample the results of the data analysis are as follows:

#### 4. 1. 1 The result of data analysis on the number of responses of satisfaction questionnaire about using the web application

From Table 3, general information of 50 samples were males of 46.00% and females of 54.00%, aged between 18 - 25 years old of 22.00%, 26-33 years old

of 48.00%, 34- 41 years old of 18.00%, and 42 years old and over of 12.00%.

**Table 3** Classification and percentage of the sample group.

| Variable | Amount (N 50) | Percentage |
|---|---|---|
| **1. Gender** | | |
| Male | 23 | 46.00 |
| Female | 27 | 54.00 |
| **2. Age** | | |
| 25-18 | 11 | 22.00 |
| 33-26 | 24 | 48.00 |
| 41-34 | 9 | 18.00 |
| 42and over | 6 | 12.00 |

### 4.1.2 The results of the data analysis from the satisfaction questionnaire

The data from the satisfaction questionnaire about using the web application of the sample groups can be divided into 2 aspects: 1) data and their transparency and 2) web application usage is as following:

From Table 4, the overall opinion of the sample group on using the web application about the data and their transparency is a very satisfactory level (Mean = 4.69, S.D. = 0.48). In details, the correctness of data gets the highest average (Mean = 4.72, S.D. = 0.45) of 94.40%. Next is the open of data (Mean = 4.7, S.D. = 0.51) of 94.00%. The data can be examined gets the lowest average (Mean = 4.66, S.D. = 0.48) of 93.20%. No additional comments about the data and their transparency. The overall opinion of the sample group on the property of web applications is a very satisfactory level (Mean = 4.72, S.D. = 0.45). In detail, transaction speed gets the highest average (Mean = 4.74, S.D. = 0.44) of 94.80%. Ease of use gets the lowest average (Mean = 4.7, S.D. = 0.46) 94.00%. There is a suggestion that the properties should be more than this since it is a private network.

**Table 4** Mean, percentage and standard deviation for sample group's response on using web application about the data and their transparency.

| No | Description | Level of Satisfaction | | | | | Average | S.D. |
|---|---|---|---|---|---|---|---|---|
| | | Most satisfied (5) | Very Satisfied (4) | Moderately satisfied | Dissatisfied (2) | Very Dissatisfied (1) | | |
| **1) Data and their transparency** | | | | | | | | |
| 1.1 | The data are open | 36 | 13 | 1 | 0 | 0 | 4.7 | 0.51 |
| 1.2 | The data can be examined | 33 | 17 | 0 | 0 | 0 | 4.66 | 0.48 |
| 1.3 | The data are correct | 36 | 14 | 0 | 0 | 0 | 4.72 | 0.45 |
| **Total** | | | | | | | **4.69** | **0.48** |
| **2) Web application usage** | | | | | | | | |
| 2.1 | Transaction speed | 37 | 13 | 0 | 0 | 0 | 4.74 | 0.44 |
| 2.1 | Ease of use | 35 | 15 | 0 | 0 | 0 | 4.70 | 0.46 |
| **Total** | | | | | | | **4.72** | **0.45** |

## 4.2 System Analysis

### 4.2.1 The result of data analysis on recorded scores and the time spent in the voting

This research is a web application development for voting in game shows using blockchain technology. The results of data analysis of recorded data and the voting time for the sample group of 50 people, as following:

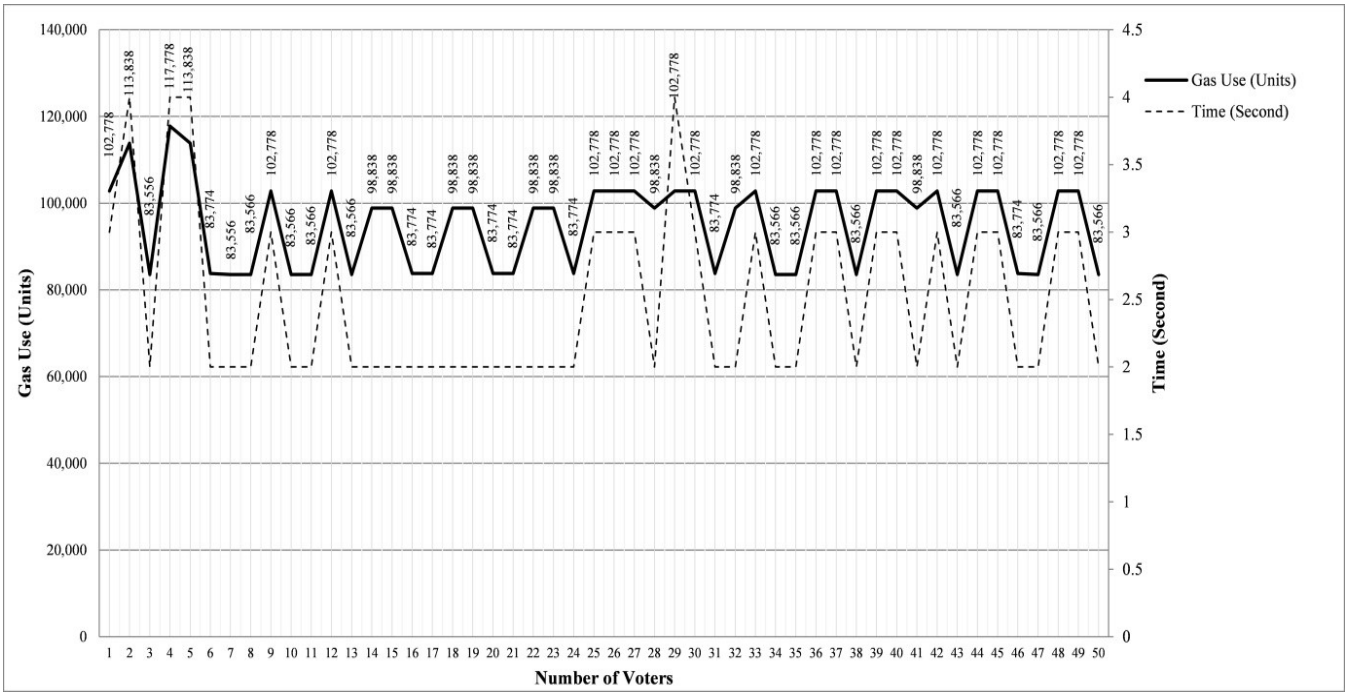


**Figure 6** The data results of Gas Use and Voting Time at Gas Price= 10 Gwei.

Figure 6 shows the results of data analysis of recorded data and the voting time for the sample group of 50 people was found that the voted Gas Use had the mean of 95395. 88, and Gas Use of each sample was similar each other. For time for voting, its mean was 2.51 seconds using Ganache.

**Figure 7** The results of voting transparency and verification.

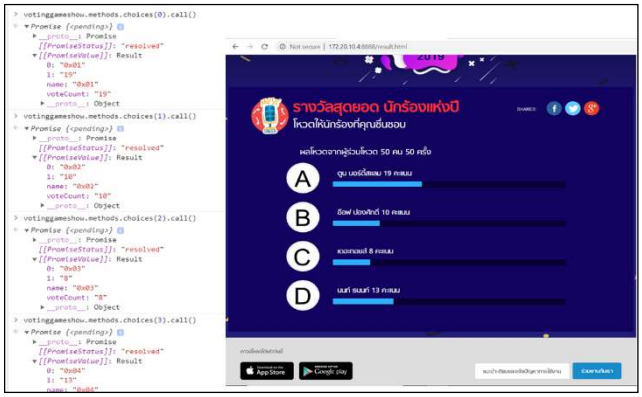

**Figure 8** The final results of voting transparency and verification.

Figure 7 and 8 show the address data and the recorded voting data. The data can be retrieved for examination of the correctness, and transparency in the voting. The result found that the voting data of the sample group of 50 people are the same as those recorded in the blockchain. The voting scores summary of the sample group and on the monitor display the same.

**4. 2. 2 The results of data analysis by the comparisons of the time speed using PoW**

The results of data analysis by comparing the time speed for verifying and operating transactions between full nodes and lightweight nodes in the blockchain network for the cases of conditions e.g. 1 node, 3 nodes, 5 nodes, 8 nodes and 10 nodes. From the results in Table 5, if the nodes have increased, then the time speed for operating transactions will also increase. These results show that the blockchain network will spent more time of transactions depending on all the nodes in the network.

The result of data analysis by the comparison of the speed of node operation time ( 1 node, 3 nodes, 5 nodes, 8 nodes and 10 nodes) by testing the working time for 5 times and testing on Windows 10 Pro, was found that working with 1 node was faster than 3 nodes, 5 nodes, 8 nodes and 10 nodes, with an average of 31. 8 seconds, with Hashrate is 30. 2 GH/ s, and Difficulty is 13192. When working with a 3 nodes connection, the average was 36 seconds, Hashrate is 31. 8 GH/ s, and Difficulty is 15938. While working with a 5 nodes connection had an average of 38 seconds, Hashrate is 32. 5 GH/ s, and Difficulty is 17496. Working with an 8 nodes connection had an average of 41. 8 seconds, Hashrate is 32. 9 GH/ s, and Difficulty is 19312, and working with a 10 nodes connection had an average of 53 seconds, with Hashrate is 37 GH/s, and Difficulty is 27989.

Table 5 shows as Hashrate and Difficulty data was found that higher hashrate mining, the difficulty will automatically increase effect to more time which corresponds to the equation time = difficulty * 2**32 / hashrate.

**Table 5** Voting time for connection.

| No | Time (Seconds) | Hashrate | Difficulty |
|---|---|---|---|
| **Voting time for connection with one node** | | | |
| 1 | 27 | 30.2 GH/s | 13192 |
| 2 | 38 | | |
| 3 | 43 | | |
| 4 | 22 | | |
| 5 | 29 | | |
| **Average** | **31.8** | | |
| **Voting time for connection with 3 nodes** | | | |
| 1 | 40 | 31.8 GH/s | 15938 |
| 2 | 42 | | |
| 3 | 28 | | |
| 4 | 39 | | |
| 5 | 31 | | |
| **Average** | **36** | | |
| **Voting time for connection with 5 nodes** | | | |
| 1 | 32 | 32.5 GH/s | 17496 |
| 2 | 46 | | |
| 3 | 33 | | |
| 4 | 31 | | |
| 5 | 48 | | |
| **Average** | **38** | | |
| **Voting time for connection with 8 nodes** | | | |
| 1 | 34 | 32.9 GH/s | 19312 |
| 2 | 36 | | |
| 3 | 49 | | |
| 4 | 38 | | |
| 5 | 52 | | |
| **Average** | **41.8** | | |
| **Voting time for connection with 10 nodes** | | | |
| 1 | 58 | 37 GH/s | 27989 |
| 2 | 41 | | |
| 3 | 57 | | |
| 4 | 55 | | |
| 5 | 54 | | |
| **Average** | **53** | | |

**4. 2. 3 The results of data analysis by the comparison of Proof of Work ( PoW) and Ganache**

As mentioned earlier in section 2. 1. 4, Ganache is a personal ethereum blockchain consisting of self-

miner nodes or blockchain testing platform whilst PoW is tested by self-creation nodes and self-build blockchain network using command prompt setting from the website: https://github.com/ethereum/go-ethereum/. Table 6 shows performance comparisons of Proof of Work (Pow) and Ganache. The results show that the average transaction times of PoW and Ganache at one node were approximately at 30 seconds and 3 seconsds, respectively. Then, Ganache was more and more faster than PoW in transaction of sending speed in ten times

**Table 6** Performance comparisons of Proof of Work (Pow) and Ganache.

| Type of comparison | Average Transaction Speed (Time interval from voting to score shown instant) |
|---|---|
| Proof of Work (PoW) | 30s |
| Ganache | 3s |

### 4.3 Discussion

This study aimed to investigate on development of a voting system in the game show using blockchain technology. The results of the research indicated the sample's opinions toward the use of web applications with details were as follows:

#### 4.3.1 Data and their transparency

The results showed that the data accuracy was at the highest level after the disclosure was revealed from the vote-counting results. The score was corresponding to the voting and it was affected to provide transparency with the voting system of the game show. Shah [44] stated that the voting system must be stable and transparent, safe and verifiable without the loss of voter's privacy whilst Thonchai [45] discussed the ability of blockchain technology to transform a centralized system into a decentralized system or distributed data network then the results were safer and more transparent because the data was difficult to change or edit it. It can be verified to confirm the accuracy of previous data from the data stored in each node connected to each other in the data network.

For the disclosure of vote-counting results, voters shall have a password in the event of voting change. After voting by using blockchain, each voter would saw their vote-counting result. In addition, voters also would saw the progress of the election in real time when voting (followmyvote.com), which all voting data was stored at the blockchain at the highest level. Voting data for the whole country would be accessible immediately at any time after being synchronized, therefore, there was not any problem on display the vote-counting result of the election [42].

#### 4.3.2 Web application usage

The results found that most voters viewed the system as fast at the highest level, followed by the easy to use. When considering the opinions on the said issues, it was found that the fastness of the system affected the efficiency of the system which corresponded to Hanifatunnisa and Rahardjo [46] stated that all processes of recording an electronic voting system (e-voting) with the average time required for each node to create a block of 0.24 seconds. It also corresponded to the system proposed to use existing technology such as client server architecture with blockchain system to ensure transparency, safety and verifiability without the loss of voter's privacy, which was proposed by Shah [44].

The cost for creating a blockchain system was much lower than the cost of a vote-counting system with many social benefits from using this system, such as a faster and easier process, increasing the voter's number. This system can be installed in most countries because the internet was expanded worldwide.

### 4.4 Limitation

This study has some limitations; the first limitation is the computer specification for system development. Secondly, there were many transactions simultaneously while the time for transaction confirmation continues to increase, causing the system's delay. Finally, transparency efficiency.

## 5. Conclusion and Further Work

A Game Show in TV Program using online blockchain voting system can be concluded as follows:

### 5.1 Conclusion

The purpose of this research is to apply blockchain technology to the development of voting systems, game show programs via web applications, to assess the performance and transparency of the developed systems. The research results showed that voters could check their voting scores in real time and no more than 5 seconds of voting time.

The recorded data were tested by real-time data. The selected candidates can vote consistently for their results through the platform. The voting data cannot be edited or changed. The results of the data analysis from the satisfaction questionnaire on web application usage in both aspects were found that the sample group was satisfied with the web application using blockchain technology at a good level - very good. Ganache was more and more faster than PoW in transaction sending speed in ten times. The result of data analysis by the comparison of the speed of node operation time was found that working with 1 node was faster than 3 nodes, 5 nodes, 8 nodes and 10 nodes and higher hashrate mining, the difficulty will automatically increase effect to more time which corresponds to the equation.

### 5.2 Suggestions for Further Work

Firstly, Blockchain's operation may not reach its full potential. There should be an effort in blockchain technology research to improve its features and support the complex applications implemented within the blockchain network. Finally, the voting system should be utilized using blockchain technology in other fields to improve the efficiency.

## Acknowledgements

A preliminary version of this work has been published in ECTI-CON 2020 entitled " Development of The Voting System for Game Show Program Using Blockchain Technology" [47].

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