Blockchain Technology Implementation In Raspberry Pi For Private Network

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***Abstract*— This research tries to prove low-cost computer devices such as mini-computers can be used in the development of blockchain technology. Mini-computer technology is used because of many problems that occur due to the use of hardware resources that are discussed large, specifically in the pharmaceutical industry in the process drug makers, packing drugs (drug packaging identities), checking drugs, installations (printing drug identities), and this use to label drug to read posts on drug strips, to make the products used by customers better. This study uses an experimental design. Experiments were carried out with devices to use and blockchain technology. The device used is a Raspberry Pi mini-computer, and blockchain technology is the Ethereum platform. The results of this study indicate the installation process until the blockchain system can run. The results show that the raspberry pi device can be implemented with Ethereum blockchain technology correctly and adequately.**

Keywords; Blockchain; Mini pc; Ethereum; Raspberry Pi

I. INTRODUCTION

Current, technology developments provide very rapid development on computers so that today can produce a variety of computer devices of various sizes [1], [2]. At present many mini computer devices have been developed, one of which is the Raspberry Pi device. The Raspberry Pi is a mini-computer device that is the size of an identification card or credit card. Where this device is supported by various components such as processors with speeds up to 1 GHz, RAM up to 1 GHz is supported by media and other ports [3], [4]. This device also does not use a built-in hard disk or solid-state drive but uses an SD card for booting and long-term storage [5]. In addition to these devices also need an Ubuntu-based operating system that will be embedded in it. This device very well used as a support for other activities instead of computers in general[5]. This device is also currently widely used in various fields of example in the world of education to support educational activities to the use of server devices, including cloud servers, web servers, and others[5]. The device gives hope, and interest in the Raspberry Pi device is very extraordinary so that the Raspberry Pi can be implemented in various technologies, one of which is so that the trend is Blockchain.

The Blockchain concept has first disclosed by someone named Satoshi Nakamoto in 2008 [6]. Blockchain, according to Santoshi Nakamoto, is a list of records that always keep increasing, shaped in blocks and connected Theon the network. Block created is a transaction that has been agreed with a group of people and is protected by cryptographic algorithms [7]. The first concept was known when Santoshi Nakamoto was a Bitcoin or known as cryptocurrency. The emergence of the blockchain provides new hope and revolution for all system performance [6] because the blockchain's performance focuses on peer-to-peer networks, and collaboration between several parties and service systems are analyzed and agreed upon by those who contribute to the network [8]. The application of this technology is related to the internet, which gives a concentration on security on shared networks[9], [10]. So that requires new technology that can provide better security. At present, with the emergence of smart contracts, it can be used in all fields, namely economics, education, social and especially in the world of enterprise systems, namely CRM, SCM, ERP[11]. Thus, blockchain technology in the future will be used by various organizations, industries, and the business world. One example is in the pharmaceutical industry which can be used to help all its activities, for example, drug makers, packing drugs (drug packaging identities), checking drugs, this use to label drug installations (printing drug identities), and to read posts on drug strips, to make the products used by customers better. In the process, the use of technological developments such as IoT and mini devices is useful for reducing the use of resources.

Rapid development, resources are significant for the implementation process. One of the resources needed is a computer device. Many developments require enormous resources, so this research will offer another alternative in the development of new systems today, namely blockchain technology using mini-computer devices. Raspberry Pi is the server node used to process transactions so that the Raspberry function is the same as a web server or cloud server that provides services to other nodes. This research aims to provide new solutions to the implementation of blockchain technology so that it can be used in various processes in the pharmaceutical industry. Theory

A. Blockchain

Blockchain technology is the first new technological concept in 2008 and presented by Satoshi Nakamoto[6]. The beginning of the emergence of this technology only was used in the process of financial transactions that are familiar with Bitcoin or cryptocurrency[6], [12], [13]. Blockchain is a

technology that implements ledger as a place of recording and in the form of blocks within specific networks. Blocks always connected to each block and if a transaction block if want to connect with other blocks in the network must be consensus and cryptography carried out in each block [7]. Blockchain concept generally has consensus, distributed ledger, Markle tree to handle many transactions in the same timestamp, hashing method to handle security in protecting each transaction. With time this technology has experienced such rapid development that it can make changes to a process of performance in an existing system [8]. This technology is expected to contribute to existing business systems such as SCM, ERP, SCM, or others[11]. That the chosen service system makes a potential contribution quickly[8].

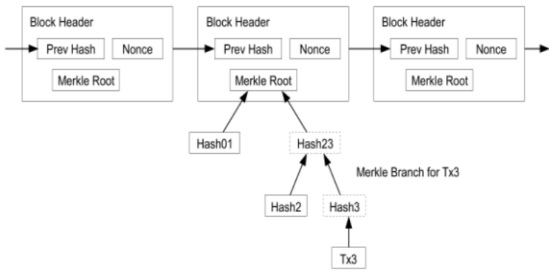

Fig. 1. Scheme Blockchain Platform

B. *Ethereum*

Ethereum is a platform that creates an alternative protocol that is used to build decentralized applications[14], [15]. Ethereum is built based on abstract foundation layers that can be used in application development by anyone by using a smart contract that is by the rules or format required[16]–[18]. Smart contracts or also can be called "boxes" cryptographic that contain values and only open them if specific requirements can be fulfilled [19]–[21]. Also, it aims to give developers the end of a tightly integrated end-to-end system to build software in the computational paradigm that has not to explore in the mainstream of a trusted computing framework [14].

C. *Raspberry Pi*

Raspberry Pi is a capable small computer that has the size of an ATM card [3], [4]. This device can be used for electronic projects because it has input, output, digital ports and can do many things like desktop PC or computer. Raspberry Pi can connect them to a TV or computer screen and keyboard. The Raspberry Pi is made in England by the Raspberry Pi Foundation. Initially, the Raspberry Pi showed for computer science learning modules used in schools. Some of the existing raspberry pi models include the Raspberry Pi 3 Model B, Pi 2 models B, Pi Zero, Pi Zero W, and Pi 1 Model B + and Model A +. In this study, using the Raspberry Pi 3 Model B[5].

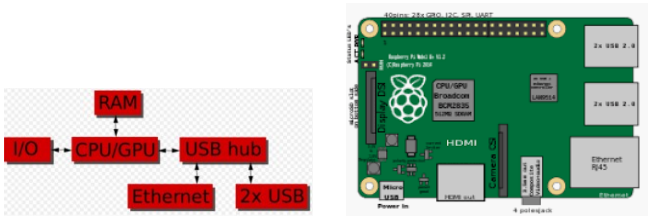

Fig. 2. Block Diagram and Board Raspberry Pi

II. Designed Architecture of the Proposed Blockchain Platform with Raspberry Pi

This research describes a conceptual scenario for a blockchain technology platform with a raspberry pi device, a provider of data storage in the form of hard drives and devices used by clients to connect with the blockchain. Blockchain with a peer-to-peer network system can relate directly to the client on the blockchain network. The hard disk used as a place for data storage media needed on the system to provide sufficient space on the operating system to work. While the client can connect with networks with a variety of devices such as smartphones, laptops, PCs, and other devices. Where the client functions as the last user, who can only read or write transaction data into the blockchain network. The connection of server devices built with Raspberry Pi, which can directly use Web services as the application programming interface to transfer status representational transfer status (REST APIs). So that communication links use wireless with the client. While the interface that can be used by clients can be web-based or mobile-based can be adjusted with the device. Design architecture can see in the following figure.

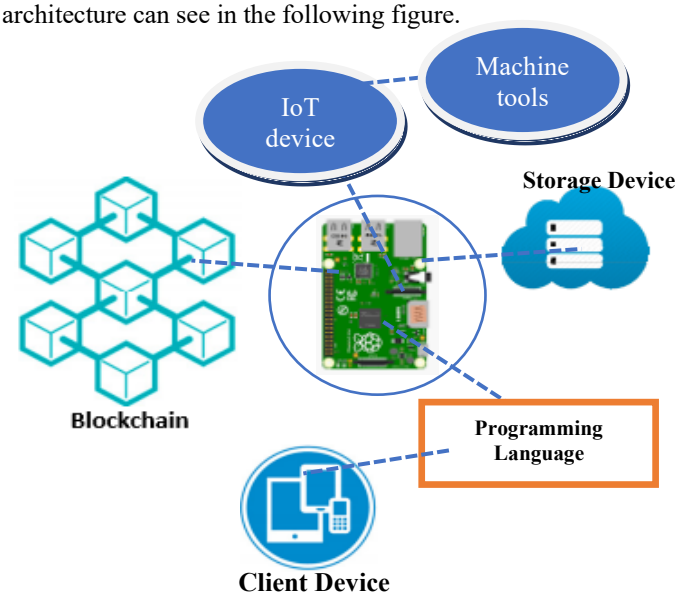

Fig. 3. Implementation of the Proposed Blockchain Platform

III. Implementation of the Proposed Blockchain Platform

A. *Development Environment*

The platform proposed to implement the network blockchain described, as shown in Table 1. The operating system is Ubuntu Linux 18.04 LTS with the Model B

Raspberry Pi3 Hardware and 1 GB of memory. Using the Ethereum blockchain platform, which is an open-source blockchain framework. The Composer (CLI) command-line interface allows developers and administrators to use and manage smart contract definitions. The REST API is generated by the REST server, which exposes the blockchain logic to a web or cellular application.

TABLE I. DEVELOPMENT ENVIRONMENT FOR THE BLOCKCHAIN NETWORK

Component	Description
Hardware	Raspberry Pi3 Model B
Memory	1 GB
Operating Systems	Ubuntu Linux 18.04.1 LTS
Blockchain Platform	Ethereum
Programming Language	Node.js, android and PHP

B. Implementasi Development Environment

The implementation process does by installing the Linux operating system into Raspberry Pi, followed by installing a blockchain platform where this research uses Ethereum as a trial. Ethereum originally was created by Wood and Buterin in 2015 [15]. At that time, it was built based on the use of Bitcoin. In its development, Ethereum can use in various applications based on smart contracts. In the process of implementation, it can be seen the stages carried out as follows:

1) Installation process Ethereum

Ethereum installation can be done directly through online or downloaded first at https://github.com/ethereum

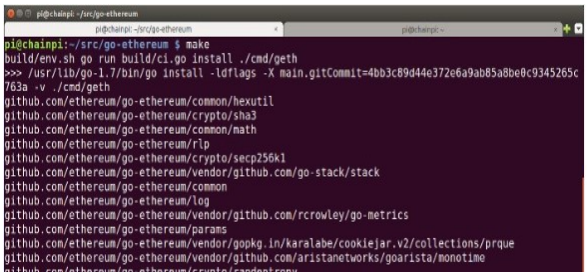

Fig. 4. Installation process Ethereum

2) Start the Node

In starting something in the blockchain, we have to create a node in the blockchain command that use is :

$ geth - , light - cache 64 - max. 12

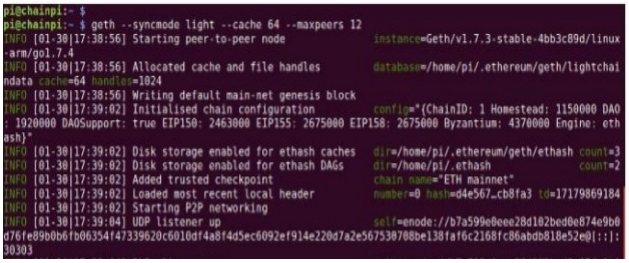

Fig. 5. Start the Node

3) Setting the blockchain network

Setting the blockchain network so as not to synchronize data from all the blockchain in the Ethereum network. So that it only takes the header block when they appear and other parts adjust to the request. The process does by making a file service on Ethereum with the command:

$ Model vi /etc/systemd/system/ geth@. service

```
[Unit]
Description=Ethereum daemon
Requires=network.target

[Service]
Type=simple
User=%I
ExecStart=/usr/local/bin/geth --syncmode light --cache 64 --maxpeers 12
Restart=on-failure

[Install]
WantedBy=multi-user.target
```

Fig. 6. Setting the blockchain network

4) The next step is to run the service so that the network can be used, with the following command:

$ sudo systemctl enable geth@pi.service

$ sudo systemctl start geth@pi.service

Fig. 7. Run the service

5) The next step is to create a new account on the blockchain. The syntax command that can use is

$ geth - arrived at the. designpark account new

Fig. 8. Create a new account

6) The next step is to start the blockchain service process on the first node

$ get-identity raspberryPi -rpcport 8080 - rpccorsdomain "*".designpark -port 30302 - nodiscover -rpcapi "db, eth, net, web3" -networkid 555 console

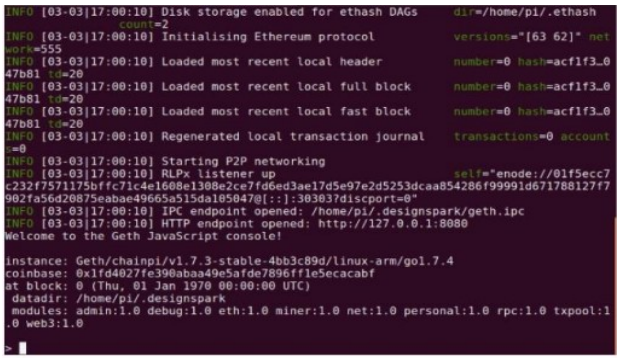

Fig. 9. Start the blockchain service

This step has .” so that the blockchain with the Ethereum platform can be used to create applications that are required to use smart contracts. So, blockchain is ready to be used for the development of various applications.

IV. Evaluation Performance

Evaluate the performance of the blockchain working system with the Ethereum platform with the recording process of each block carried out in the blockchain. The data obtained is analyzed for each transaction made, which can be shown in the figure. With this result, we can see the problems that occur in each transaction. In the picture, we can see that financial transactions carried out to make a block to the network can provide enough for transactions that many in the block can still be processed correctly. While in terms of the time of each transaction can still reveal all the activities carried out. This measurement can be the average block size (in kB or the average number of transactions per block, the size of the network on the blockchain, and the frequency per block).

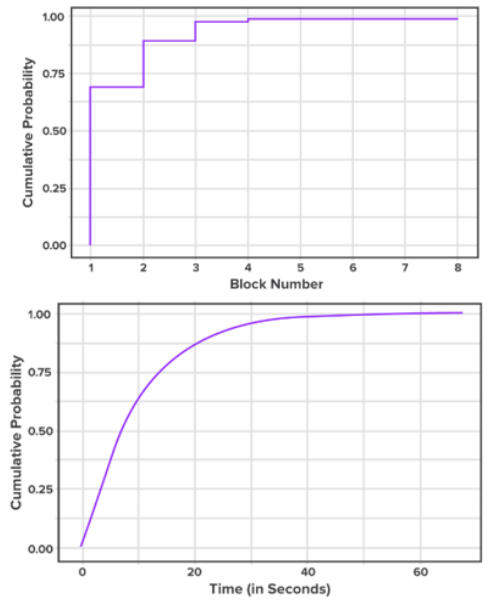

Fig. 10. Transaction Confirmation Probability

V. Conclusion

This research, the application of blockchain technology using mini computers or mini pc devices. The blockchain platform used is Ethereum. The implementation uses Ethereum because this platform is very commonly used today in developing blockchain-based applications. While the mini PC device used is the Raspberry Pi because it is a low-cost mini PC device and is very widely used in the development of embedded systems. The operating system used is Ubuntu version 18. The results prove that the Raspberry Pi device can be used as an alternative in the development of blockchain technology as one of the primary nodes in the blockchain network that can be used in the pharmaceutical industry. In further research, Thus, blockchain technology in the future will become, for various businesses and the business world. One example is in the pharmaceutical industry which can be used to help all its activities, for example, drug makers, packing drugs (drug packaging identities), checking drugs, and this use to label drug installations (printing drug identities), to read posts on drug strips, to make the products used by customers better. it can develop the use of Raspberry Pi devices with a clustering system using some Raspberry Pi to build supercomputers so that it can handle transaction processes more quickly, effectively, and efficiently.

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