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Multi Container on Docker as a Support for IoT-Based Blockchain Electronic Transaction Systems

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Abstract. *The use of blockchain as a supporting element in securing transactions is growing, as the presence of the blockchain system ensures enhanced security in the data transaction process. However, it should be noted that blockchain requires a more complex system for data verification. This complexity is not a concern when using paid blockchain services. However, when users aim to implement it privately, multiple nodes are needed for transaction verification. We present a proposed scheme for the use of multiple nodes utilizing Docker for transaction verification. This approach makes the costs more affordable and the maintenance easier.*

Keywords: *IoT, Blockchain, Docker*

Abstrak. Penggunaan blockchain sebagai elemen pendukung dalam mengamankan transaksi semakin berkembang, karena kehadiran sistem blockchain memastikan keamanan yang lebih baik dalam proses transaksi data. Namun, perlu dicatat bahwa blockchain memerlukan sistem verifikasi data yang lebih kompleks. Kompleksitas ini bukanlah masalah saat menggunakan layanan blockchain berbayar. Namun, ketika pengguna ingin menerapkannya secara pribadi, multiple node diperlukan untuk verifikasi transaksi. Kami menyajikan skema yang diusulkan untuk penggunaan multiple node yang memanfaatkan Docker untuk verifikasi transaksi. Pendekatan ini membuat biaya lebih terjangkau dan pemeliharaan lebih mudah.

Kata kunci: *IoT, Blockchain, Docker*

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INTRODUCTION

The current development of IoT is considered significant, as it has greatly assisted humanity in various activities directly connected to the internet. One widely implemented application is the integration of IoT devices in payment methods[1] , [2], [3]. To support trust in the use of IoT-based payment technology, the application of blockchain technology has become a key factor [4]. Currently, blockchain technology has been widely applied in various sectors, including government [5] and the healthcare sector[6]. Blockchain technology has proven effective in implementation across various fields. However, a common challenge when combining blockchain technology and IoT devices is related to the infrastructure in handling data. As we know, blockchain technology requires validation of each transaction block to generate valid transactions. In a paid or open blockchain system, there are various options for transaction validation, but these may not be cost-efficient when applied on a small and private scale. Therefore, we propose a solution to this issue, where implementation can be carried out with low associated costs. By utilizing multi docker containers, a cluster can be created for verification at a lower cost..

RESEARCH METHODS

This research utilizes the waterfall method [7]because this method is highly suitable for development and implementation. The process is elaborated as follows:

1. Requirement Analysis

   In this phase, an analysis of the system's requirements is conducted.
2. Design

   Once the requirements are identified, the design process follows.
3. Implementation

   After completing the design phase, the system is implemented.
4. Testing

   Testing is carried out to assess the outcomes against the expected system behavior.
5. Deployment

   When the system successfully passes testing, it can be deployed for general use.
6. Maintenance

   The final stage involves ongoing maintenance of the system over time.

RESULTS AND DISCUSSION

In this section, we will elaborate on the development of our system. This section consists of several main parts, namely:

1. The process of data transmission originating from the payment device.

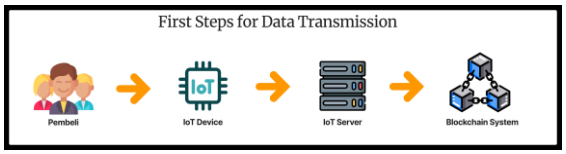


Figure 1. Data transmission originating from merchant

As shown in Figure 1, it illustrates the occurrence of the data transmission process, where the initial transaction process takes place in the data. This involves the input of data by the buyer using the payment device.

2. The process of data processing by blockchain.

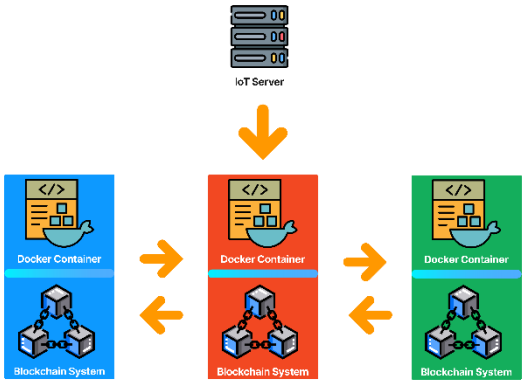


Figure 2. IoT Server Forward Data to Blockchain Environment

Figure 2 illustrates how multi-node containers in the blockchain system can operate. The sequence of events is as follows: When data enters through the IoT server, the next step is to send the data to the Docker cluster that has a well-functioning blockchain system, as indicated by different colors, namely blue, red, and green. Each system represents a cluster on a different Docker with distinct locations.

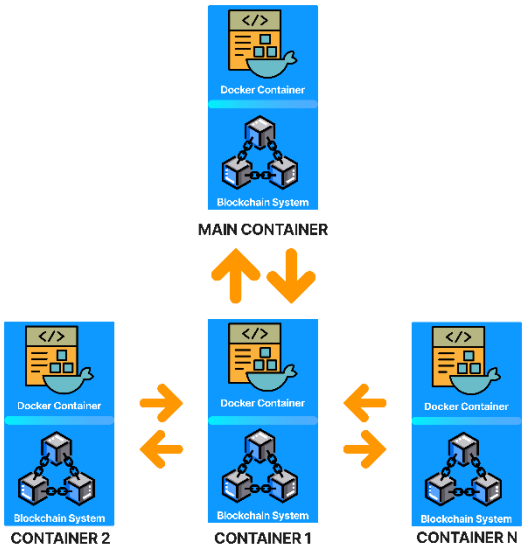


Figure 3. Main Container Distribution Data

An example of a unit is in the container with the blue color designation. In this container, there is a main container responsible for distributing the workload or processes of the existing blockchain system. This enhances efficiency and establishes a multi-node system, ensuring that if a particular node fails, the process will be taken over by other nodes.

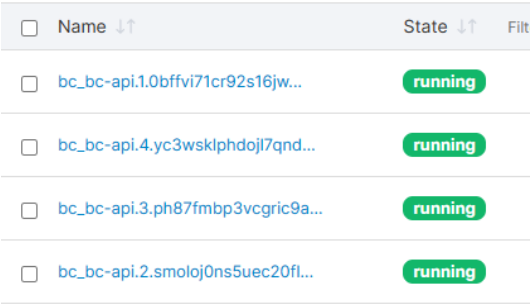
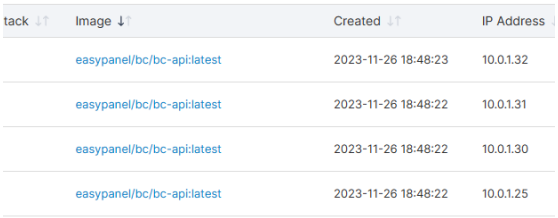


Figure 4. Nodes On Same Systems That Consist 4 Container

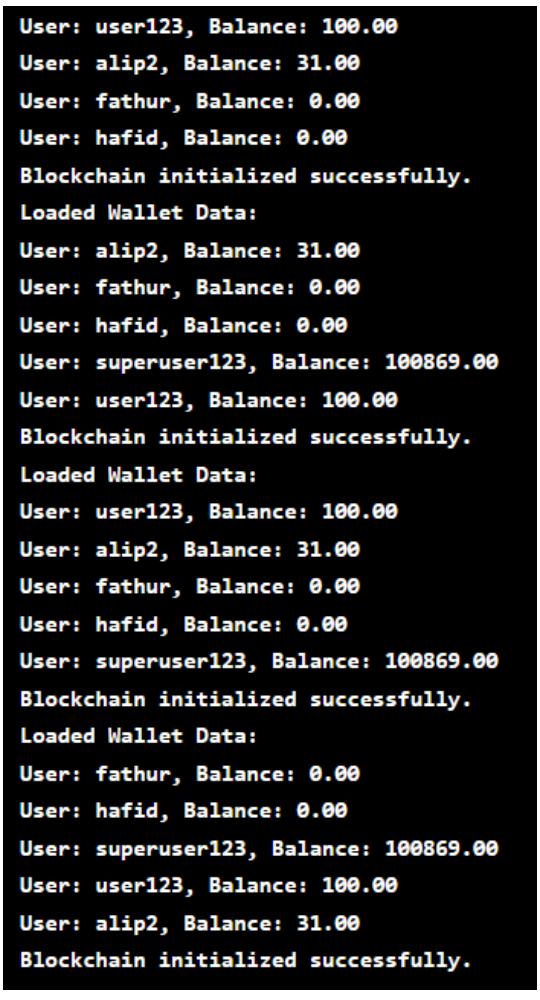
In Figure 4, it is shown that there are four concurrently running nodes in Docker, and the blockchain system operates simultaneously, waiting for processes.



tack	Image	Created	IP Address
	easypanel/bc/bc-api:latest	2023-11-26 18:48:23	10.0.1.32
	easypanel/bc/bc-api:latest	2023-11-26 18:48:22	10.0.1.31
	easypanel/bc/bc-api:latest	2023-11-26 18:48:22	10.0.1.30
	easypanel/bc/bc-api:latest	2023-11-26 18:48:22	10.0.1.25

Figure 5. IP Address for Each Container

In Figure 5, by using the same images with different IP addresses, the system can integrate seamlessly. Therefore, even with different IP addresses, the system can operate effectively.



```
User: user123, Balance: 100.00
User: alip2, Balance: 31.00
User: fathur, Balance: 0.00
User: hafid, Balance: 0.00
Blockchain initialized successfully.
Loaded Wallet Data:
User: alip2, Balance: 31.00
User: fathur, Balance: 0.00
User: hafid, Balance: 0.00
User: superuser123, Balance: 100869.00
User: user123, Balance: 100.00
Blockchain initialized successfully.
Loaded Wallet Data:
User: user123, Balance: 100.00
User: alip2, Balance: 31.00
User: fathur, Balance: 0.00
User: hafid, Balance: 0.00
User: superuser123, Balance: 100869.00
Blockchain initialized successfully.
Loaded Wallet Data:
User: fathur, Balance: 0.00
User: hafid, Balance: 0.00
User: superuser123, Balance: 100869.00
User: user123, Balance: 100.00
User: alip2, Balance: 31.00
Blockchain initialized successfully.
```

Figure 6. Blockchain Initialization on 4 Nodes

In Figure 6, the initialization process of the blockchain is depicted in each container, following the description in Figure 3. The process can run simultaneously without any

issues, as indicated by the display "blockchain initialized successfully." This ensures that the system can exchange information seamlessly and collaborate effectively.

CONCLUSION

In conclusion, multi-docker can operate effectively even when processing different sets of data and can synchronize data quickly. The next step is the development of a more extensive and sophisticated multi-docker system with the support of artificial intelligence to map existing nodes.

ACKNOWLEDGEMENT

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