Web Server for Analysis and Visualization of Bitcoin Data

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***Abstract*— Most of the existing platform for Bitcoin data analysis or visualization, they perform data collection from one node in the main-net. Thus we can notice some differences in their provided data. In this research, and in order to provide global data visualization, we collect both the historical and real-time Bitcoin data. Our monitoring system is comprised of three main components; multiple full Bitcoin nodes were used to collect data, the analysis of data was done by the Analytic Engine, while the webserver was used to visualize both row-data and analyzed data.**

Keywords*— *Bitcoin, monitoring system, Ledger Analysis, Bitcoin data visualization

I. INTRODUCTION

Bitcoin was released late 2008 by the pseudonymous (Satoshi Nakamoto) under a paper named 'Bitcoin: A peer-to-peer Electronic Cash System' [1]. In the proposed system, anyone can participate freely, and without restriction in the Bitcoin network, participants (node and peer) are all logged in the blocks chain (ledger) to share information. In the last decade, Bitcoin was adopted globally, and it's ledger grows dramatically, making the trace of transactions a quite challenging to regular users, therefore, many researchers try to develop monitoring systems allowing regular users to easy trace transaction and get an in-depth insight into the data circulating among the network (nodes information, blocks information, etc.). Table 1 provides a list of well-known Bitcoin blockchain analysis services, which are based on data collected from Bitcoin main-net.

The above websites use only one node to collect data for their provided analysis information. Although this information enables a simple understanding of bitcoin, it is not possible to conduct various in-depth analyses and studies, such as monitoring abnormal participants or checking for abnormal transactions.

To provide services that improve performance or derive the required functions, data should be collected from multiple nodes, and visualize more comprehensive data [2] such as system information and network information on the nodes.

This paper presents a method of establishing a monitoring system to collect data from several nodes and visualize analyzed bitcoin data. Row data and analysis results collected by the method proposed in this paper are used as evidence to improve the performance of bitcoin platforms and maybe the beginning of a discussion on new features that should be added to bitcoin platforms in the future.

TABLE I. TOP5 BITCOIN ANALYSIS WEBSITE

	①	②	③	④	⑤
Nodes(peers)	X	O	X	X	X
P2P Messages	X	O	X	X	X
Block data	O	X	X	X	X
Block details	O	O	O	O	O
Block Size	O	O	O	O	O
Tx Data	O	O	X	X	X
Tx Detail	O	X	X	X	X
Tx/Fee	O	O	X	X	X
Mempool Size	O	O	X	X	X
Difficulty	O	O	O	X	X
Mining Information	X	O	O	X	O

① blockchain.com , ② statoshi.info , ③ btc.com
④ blockexplorer.com, ⑤ tradeblock.com

II. RELATED WORK

Bitcoin platforms contain various data, including blocks data, transaction data, wallets data, and data on passwords that certify the validity of transactions. Through analysis using this data, more information can be processed. Indeed, there are cases in which such data can be used to detect transactions used in the dark market, or been used to prevent attacks such as DDOS attacks. To better understand the Bitcoin data, studies have been conducted on bitcoin monitoring systems that perform various analyses, including statistical analysis.

Gogyeongchan et al. [3] presented an approach for detecting illegal trading by analyzing the direction of the Bitcoin monitoring systems. The proposed monitoring system allows users to visualize Bitcoin ledger data.

H. Kazuno et al. [4] they have introduced a blockchain monitoring method for visualizing, tracking and analyzing illegal transactions in real-time by clustering of known addresses.

TABLE II. METHOD OF DEVELOPMENT BY BLOCKCHAIN MONITORING SYSTEM SERVICE

name	Visualization Method		
	Approach	*Visualization*	*Programming / Library*
Bit bonkers	*The network structure is not clearly visible*	*Cube → Last block from the blockchain. The size in kilobytes → The size of the block its.*	*Three.js, Oimo.js*
Bitcoin City	*Distribution of nodes around the globe*	*Bitcoin node*	*Python*
Binodes	*City as Bitcoin transaction*	*City as a transaction, road as blockchain*	*Isomer.js*
Block seer	*Node as a link to the transaction*	*Detailed tree diagram*	-
Daily blockchain	*The network of Blockchain, Realtime transaction, evolving hubs.*	*Evolving Hub*	*Vivagraph.js*
Elliptic	*History of Blockchain since the beginning of creation*	*Node → transaction*	-
Interact	*Live Bitcoin transaction*	*Size of the node → Volume of transaction Node → Link to the transaction*	-
Live globe	*Transaction and the latest discovery*	*Latest discovered Blockchain blocks*	*WebGL*

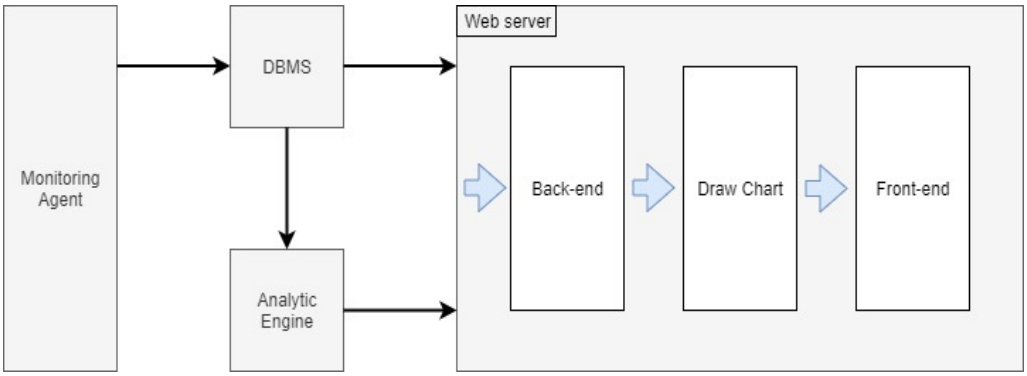

Fig 1. Blockchain monitoring system Architecture

The suggested method discovers the relationship and path among addresses, and it also provides a graph analysis of transactions. As a result of the analysis, the usefulness of the system was verified by applying it to the Bitcoin market, and three criminal cases were detected through illegally robbed Ransomware and DDoS attacks.

Ideva et al. [5] presented the results of a systematic review, evaluation and visualization of several blockchain transactions. The monitoring systems reviewed and analyzed in [5] are (1) Bit bonkers, (2) Bitcoin City, (3) Binodes, (4) Block seer, (5) Daily blockchain, (6) Elliptic, (7) Interact, and (8) Live globe, Table 2 provides more data concerning the conducted visualization methods.

With a study related to Bitcoin network analysis, Tri A et al. [6] used graph mining algorithms to describe network analysis and statistics, based on graphs created from the latest data of bitcoin transactions, the data in bitcoin and the status of the current network were shown in tables and graphs. Based on the gotten result of data analysis, they also explained the phenomena that occur in blockchain according to the trend of data.

Through the various studies introduced above, various results can be obtained based on blockchain data analyzed through bitcoin monitoring, and the resulting problems can be identified to build a more reliable blockchain system by contributing to operation, maintenance, and network resource management as well as the construction and development of bitcoin system. Therefore, this study presents a plan to design and implement a blockchain monitoring system for data analysis and visualization of bitcoin, based on the use of multi-nodes to collect data and use more accurate algorithms to analyses the data.

III. SYSTEM DESIGN

The monitoring system for analysis and visualization of bitcoin data is shown in Fig. 1 . The real-time data collection is performed by the monitoring agent, which is a set of bitcoin full nodes. The collected data is stored in the DBMS. The analyzed data by Analytic Engine is displayed on the webserver. The Web server processes data from the Back-end. The Back-end requests the database is the case on querying raw data or form Analytic Engine to retrieve the analyzed data. The Front-end server is used for displaying data into graph or table forms. The chart requests data in the RESTful API [7] format and receives the result values to represent the data as a chart. The Front-end supports visualization for user convenience and displays the desired data. The user can filter the displayed data based on time periods, and the display data is updated every 5 min when the newly collected data is analyzed.

IV. SYSTEM IMPLEMENTATION

The system designed in this study implemented each module in a micro-service architecture using a docker container to enhance portability, shorter development time and greater ease of management.

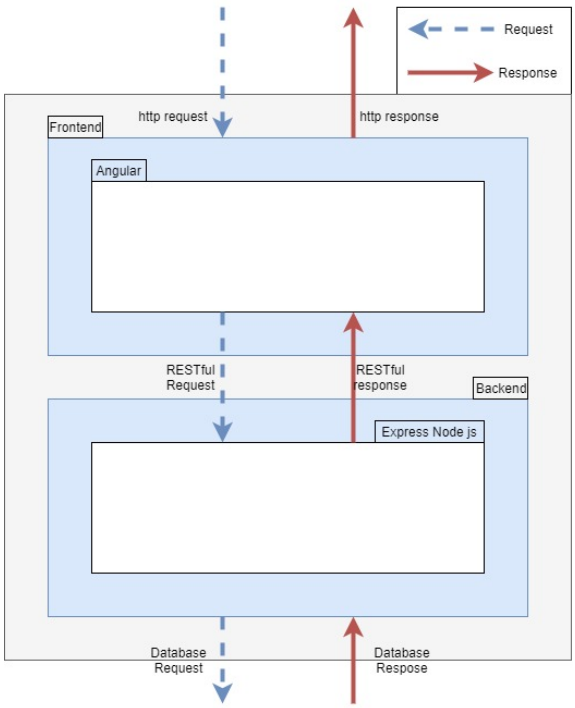

Fig 2. Blockchain Monitoring Data Visualization System Architecture

The agent module for collecting bitcoin data is transformed into a format that receives data collected from a pool node and can be stored in the database through the pre-defined format. The database was implemented using MongoDB. In the analysis module, the data of the Bitcoin is organized by date and outputted as a graph. The web module for data visualization is shown in Fig. 2. The back-end of this system is configured using Express Node JS[8].

By the use of Restful API, the client can request Bitcoin data separately, the client can process the row-data by requesting it from the back-end database and display it as tables, or the client can request analyzed data from the back-end Analytic Engine and display it as graphs.

The Front-end server draws the tables and the graphs. For the web and mobile app, a variety of graphs, maps, as well as dashboard are generated using Angular[9] and FusionCharts [10] to visualize Bitcoin data. The visualized data can be specified by users, and they can filter data based on time(days, months, years).

The implemented system is shown in Fig. 3. Clicking on the menu named Data in the top bar brings up a list of Bitcoin analyzed, a graph is drawn when selecting a time period. The data on the graph is updated by default every five minutes. Graphs have functions such as zooming, shrinking, and moving. Besides, only data in the selected period can be monitored using zooming and shrinking functions. The graph in Fig. 3 shows the average daily block size output.

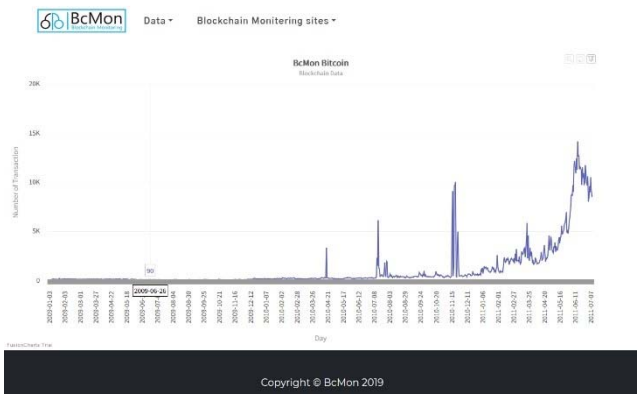

Fig 3. Blockchain monitoring system web chart representation

V. Conclusion

In this paper, the monitoring agent saves the data extracted from the full node of bitcoin in the database, analyzes the stored data in real-time, visualizes the results, and then presents the Web server design and implementation method of bitcoin real-time analysis system that can be monitored through the web.

In this paper, we studied data collection, analysis and visualization of bitcoin, but we will expand it into a system that applies to various blockchain platforms such as Ethereum, Hyperledger, etc. The system developed through this study is expected to be able to be used to improve performance through blockchain network monitoring, develop blockchain services, analyze and track abnormal use or security problems.

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