

# Assimilation of Blockchain for Augmenting the Security and Coziness in IoT Based Smart Home



Rincy Merlin Mathew, R. Suguna, M. Shyamala Devi

**Abstract:** The technology advancement in Internet of things has benefitted many real time scenario to emerge as a smart applications. The block chain technology is the recent advancement in the current world which facilitates on time operation upgradation to all the nodes. This prohibits the private process execution that leads harm to the application. It also enhances the authorization of work done by any individual and everyone in the network are aware of the job done by others. It is facilitated by the maintenance of the distributed ledger in the block chain system. The consensus and smart contract software is constantly processed by the block chain to prevent the entry of illegal users into the network. Due to cast advantage of blockchain and internet of things towards security and privacy, it is mainly focused to adapt these technologies in the banking, credit card transaction, trading and online applications. With this exploratory study, we focus to integrate the blockchain and internet of things to provide security and privacy to a greater extent. This paper attempts to design a Blockchain Integrated IOT Based Smart Home that effectively monitors the home and arrest the entry of harmful users. The famous private Blockchain software Ethereum blockchain is utilized to implement the smart home architecture and the obtained results are also for implementation and the results are also conferred.

**Index Terms:** Blockchain, IoT, Distributed Ledger, Consensus and Ethereum.

## I. INTRODUCTION

The technology advancement has never left any field. One of the major fields that grows due to the enhancement in the technology is the network field. The client server technology changes to peer to peer network. With the processing advancement, it evolves to local area network. Then it is further enhanced to wide area network. Due to increase in the network portability, the network emerges to World Wide Web. With additional need in the parallel processing, the network further raised to the evolution of centralized area network, distributed area network and Decentralized network. With increasing need of security and privacy, the evolution of

block chain network comes into picture. Any user can enter into blockchain. But all the users' activities are done in open forum where the transactions are updated to all block chain.

The history of the block chain is shown in Fig. 1. The details of the development of the block chain are portrayed from the year 1990 to till now.

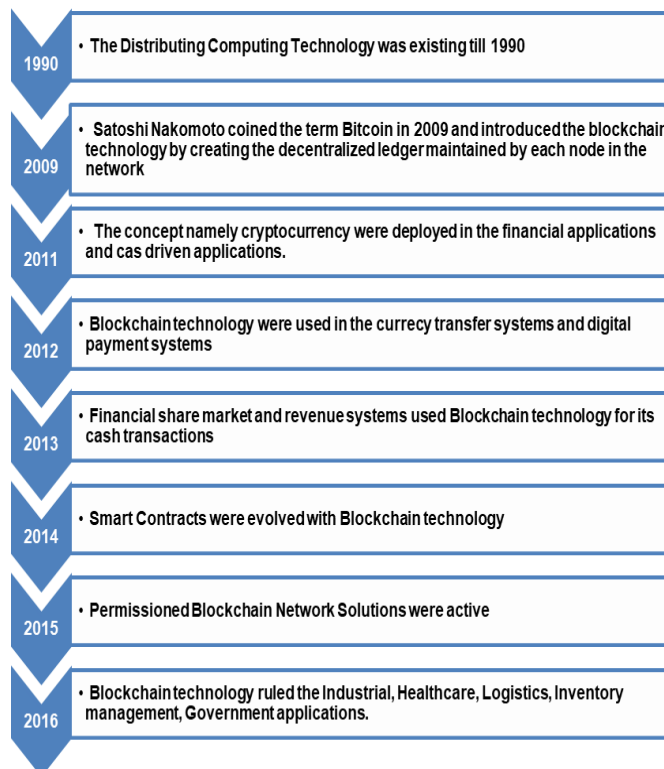


Fig. 1. History of Block chain Technology

The E-commerce, finance, banking and all the online business application can make use of the advantages of the blockchain technology for improving the operational efficiency [1]. The blockchain can be public block chain network or private block chain network. Any unknown user or client can participate and register themselves inside the block chain network and they can involve in the transaction processing. The execution of any process that is done by any client is transparent to all the block chain nodes and the clients enrolled in the block chain network [2]. This scenario is falling under public block chain network. In the private block chain network, only the authorized users are allowed to perform the login inside the block chain network. The process or the tasks executed by the authorized users are acknowledged, verified, validated and are securely stored in the database namely distributed ledger [3].

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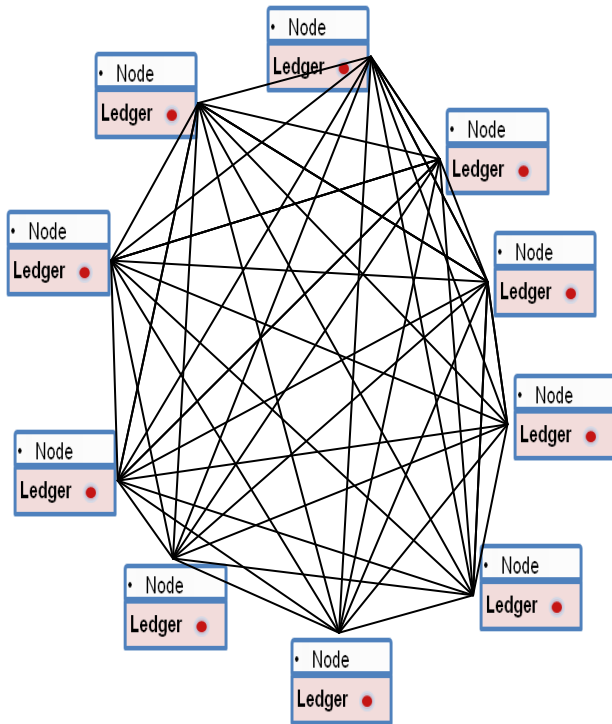
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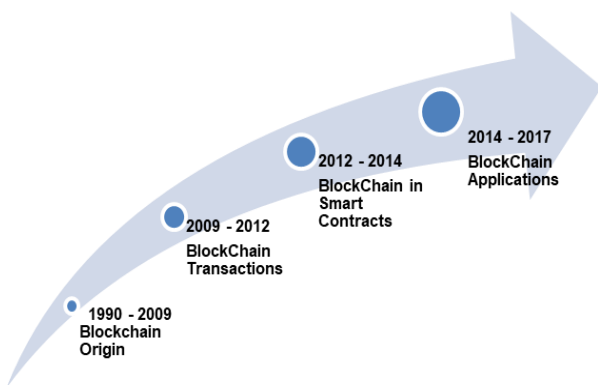
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The distributed ledger keeps track of all the process executed by the users involved in the block chain for a particular period of time [4]. Then it publishes the current distributed ledger to all the block chain nodes. The updation of distributed ledger [5] to all the block chain happens in continuously in a regular block interval. The architecture of the block chain technology is shown in fig. 2 and the evolution of the block chain technology is shown in fig. 3.



**Fig. 2. Blockchain Technology**



**Fig. 3. Evolution of Block chain Technology**

## II. PRELIMINARIES

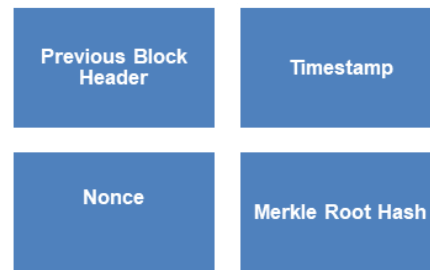
### A. Block Chain

The elements of the block chain [6] are as follows and are shown in Fig. 4.

- Merkle Root Hash
- Nonce
- Previous Block Header
- Timestamp

As the block chain technology executes the smart contract [7] code continuously for each process, the illegal users are not able to enter into the block chain network. It is very difficult task for the attackers to cross over the smart contract code to process the transactions in the block chain network [8]. The block chain network also executes consensus algorithm to enter into final prediction. The result of the consensus protocol [9] that is executed by the block chain network can be fall into anyone of the following categories.

- Termination
- Validity
- Integrity
- Agreement



**Fig. 4. Block chain Data Structure**

### B. Block chain Process

The process and the execution steps of the blockchain technology is shown in Fig. 5. The paper is organized in such a way that preliminaries of the block chain network is discussed in Section 2. Section 3 deals with the Proposed work namely Block chain Integrated IoT based Smart Home followed by the implementation details and result discussion is dealt with Section 4. The paper is concluded in Section 5.

## III. PROPOSED WORK – BLOCK CHAIN INTEGRATED IOT BASED SMART HOME

In this paper, we attempt to design a architecture for Internet of Things based blockchain for implementing the Smart Home. To implement this work, we identify the features that can be monitored by the sensors and it get the notification from the respective features. These features in the smart home are considered as the block chain nodes in the block chain network. The design architecture for Block chain Integrated IoT based Smart Home is shown in Fig. 6. The features or the components that are selected for monitoring the smart home in the Block chain Integrated IoT based Smart Home are as follows and is shown in Fig. 7.

- Gate Entry monitor Node
- Light Control Node
- Sound Control Node
- Motion Control Node
- Temperature Pressure Control Node
- Glass Wall Breakage Control Node
- Moisture Water Control Node
- Smoke, Fire and Gas Leakage Control Node
- Remote Appliances Node



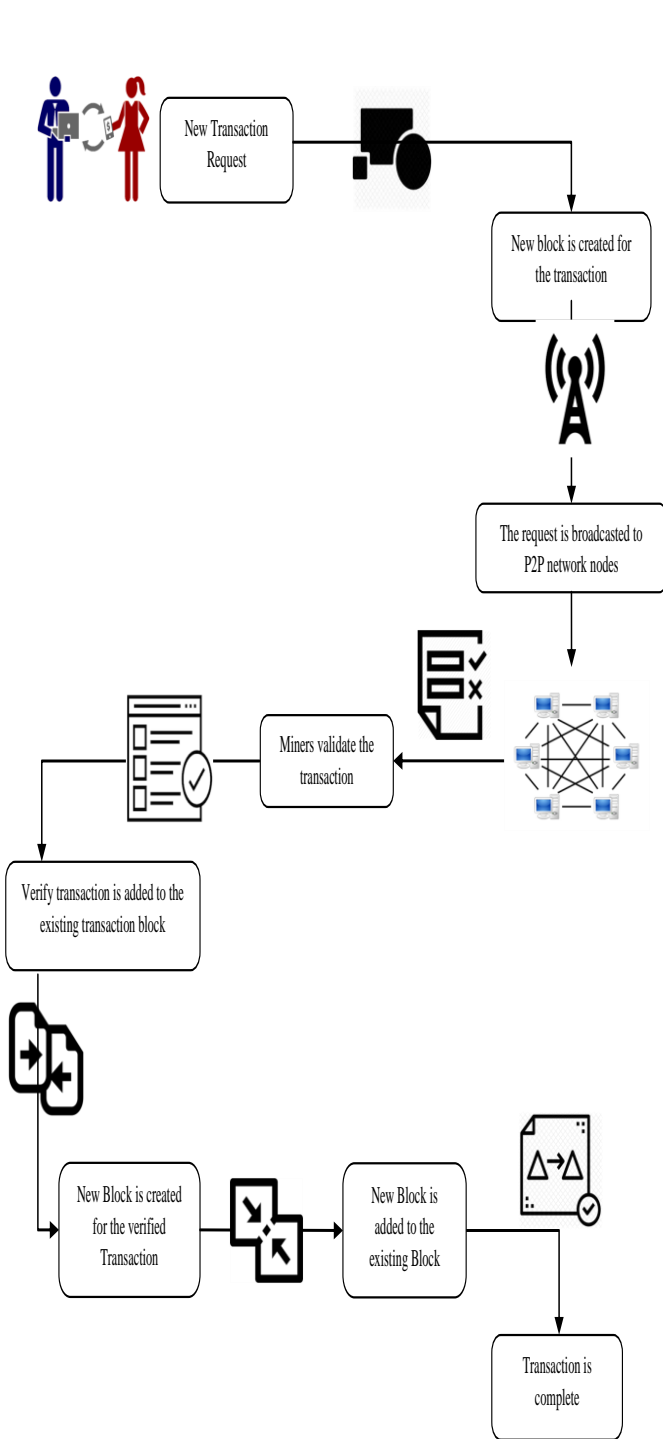


Fig. 5. Blockchain Process

**A. Moisture Water Control Node**

The mining process occurs in the block chain network and it involves the participation of each block chain node in the block chain network. The nodes in the Block chain Integrated IoT based Smart Home networks receives the task and data from the sensors installed in the respective nodes. Now let us take a single node namely Moisture Water Control Node. The Operations of the Moisture Water Control Node are as follows and the use case diagram of Access Moisture Water Details Transaction in Block chain Integrated IoT based Smart Home is shown in Fig. 8.

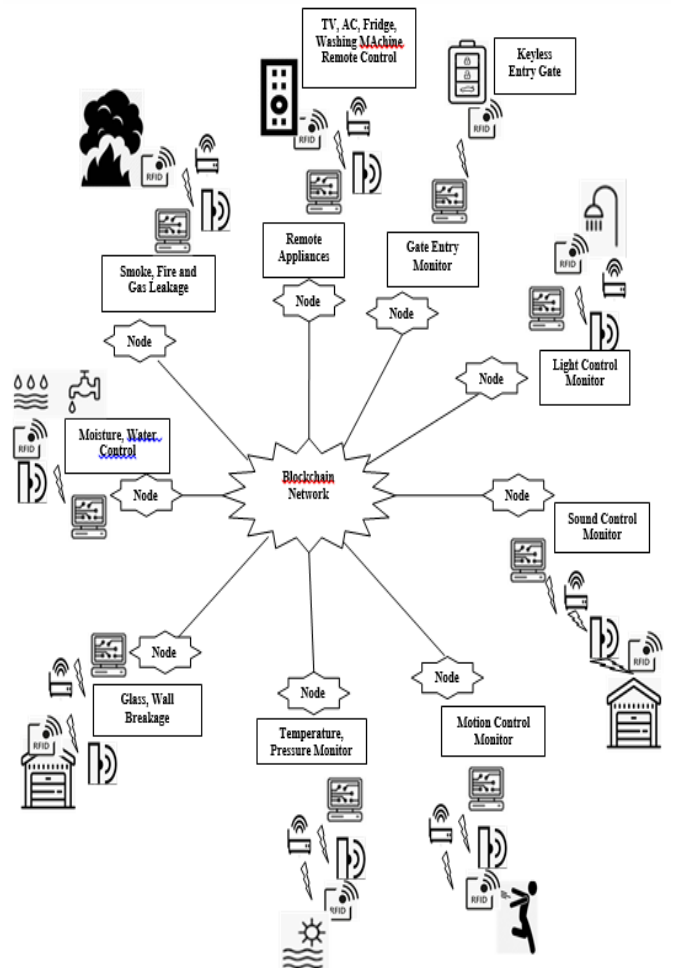


Fig. 6. Block chain Integrated IoT based Smart Home



Fig. 7. Nodes in Block chain Integrated IoT Based Smart Home

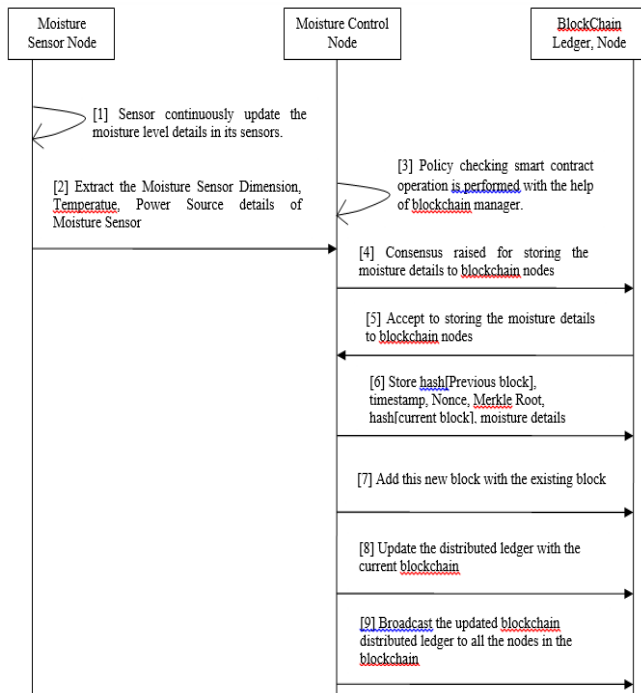


Fig. 8 Access Moisture Water Details Use Case Diagram

The Algorithm for all the Transactions in Block chain Integrated IoT based Smart Home are shown below,

### ALGORITHM 1: Moisture Process

- (1) Prepare the process of Remote Switch on of SmartSense Moisture Sensor that is installed near AC, Fridge, Water pipes, Kitchen, Bathrooms
- (2) Sensor continuously update the moisture level details in its sensors
- (3) Extraction of following attribute is performed.
  - Moisture Sensor Dimension
  - Temperature details of Moisture Sensor.
  - Power Source details of Moisture Sensor.
- (4) Receiving the Moisture details from the SmartSense Moisture Sensor by means of accessing through internet gateways.
- (5) Moisture processed data is retrieved by the Moisture Control Node.
- (6) End the process of controlling the Moisture Process

The operations of the Moisture Water Control Node that are considered for the Block chain Integrated IoT based Smart Home are as follows,

1. Store Moisture Details Transaction
2. Access the Moisture details Transaction
3. Monitor the Moisture scenario Transaction

### ALGORITHM 2: Store Moisture Details Transaction

- (1) Extraction and accessing of pre-installed devices from the Block chain Integrated IoT based Smart Home
- (2) For the purpose of block chain updation, policy verification and validation, the smart contract software is executed
- (3) All the block chain nodes in the Block chain Integrated IoT based Smart Home are regulated for consensus protocol for performing agreement for the moisture details to be updated in the blockchain.

- (4) The consensus agreed and validated moisture details are updated to all the block chain.
- (5) The moisture details are updated along with the following features
  - Blockhash[Previous block value]
  - Value\_timestamp
  - Computed\_Nonce
  - Value\_Merkle Root
  - Blockhash[current block value],
  - Moisture details.
- (6) Attachment of the new block chain in the existing network.
- (7) Reconfiguration of the distributed ledger of smart home block chain network.
- (8) Revealing and publicizing the new distributed ledger to each and every node in the blockchain network.
- (9) End the Store Moisture Details Transaction

### ALGORITHM 3: Access Moisture Details Transaction

- (1) Acquiring of the moisture details of the smart home from the Moisture control Sensor node
- (2) Mining of the moisture details for the represented items below.
  - Moisture Sensor Dimensions
  - Moisture Temperature
  - Power Source
- (3) For the purpose of block chain updation, policy verification and validation, the smart contract software is executed
- (4) All the block chain nodes in the Block chain Integrated IoT based Smart Home are regulated for consensus protocol for performing agreement for the moisture details to be updated in the blockchain.
- (5) The consensus agreed and validated moisture details are updated to all the block chain.
- (6) The moisture details are updated along with the following features
  - Blockhash[Previous block value]
  - Value\_timestamp
  - Computed\_Nonce
  - Value\_Merkle Root
  - Blockhash[current block value],
  - Moisture details.
- (7) Attachment of the new block chain in the existing network.
- (8) Reconfiguration of the distributed ledger of smart home block chain network.
- (9) Revealing and publicizing the new distributed ledger to each and every node in the blockchain network.
- (10) End the Store Moisture Details Transaction

### ALGORITHM 4: Monitor Moisture scenario Transaction

- (1) Continuous and repeated monitoring of the moisture control sensor node in the smart home.
- (2) Mining of the moisture details frequently with predefined interval with respect to the policy updation of the smart contract code.

- (3) For the purpose of moisture details updation, policy verification and validation, the smart contract software is executed
- (4) Once arriving to the termination of the required time interval, retrieve the new moistures details from the moisture control sensor node.
- (5) All the block chain nodes in the Block chain Integrated IoT based Smart Home are regulated for consensus protocol for performing agreement for the moisture details to be updated in the blockchain.
- (10) The consensus agreed and validated moisture details are updated to all the block chain.
- (11) The moisture details are updated along with the following features
  - Blockhash[Previous block value]
  - Value\_timestamp
  - Computed\_Nonce
  - Value\_Merkle Root
  - Blockhash[current block value],
  - Moisture details.
- (12) Attachment of the new block chain in the existing network.
- (13) Reconfiguration of the distributed ledger of smart home block chain network.
- (14) Revealing and publicizing the new distributed ledger to each and every node in the blockchain network.
- (15) End the Monitor Moisture Details Transaction

#### IV. IMPLEMENTATION AND PERFORMANCE EVALUATION

##### A. Implementation Setup

Ethereum is used for implementing the private block chain network of the Block chain Integrated IoT based Smart Home. The following block chain nodes are facilitated to perform the actions.

1. Smart Home Representative account node
2. Smart Home contract node

The implantation setup is depicted in Fig. 9. The policy further executed when the diamond contract node retrieves anew information from the sensor node involved in the IoT Blockchain based Diamond International Trade blockchain. LibCoAP Library is used for setting up the benchmark library for the IoT smart home devices and the sensors in the block chain nodes of the Block chain Integrated IoT based Smart Home. The block chain nodes are subjected by writing the macro codes in C language. CoAPBench bench mark tool is used for analyzing and comparing the obtained results with the ideal results. The obtained throughput, total number of work time, delay in executing the task of the smart home blockchain network is shown in Fig. 10 and Fig. 11.

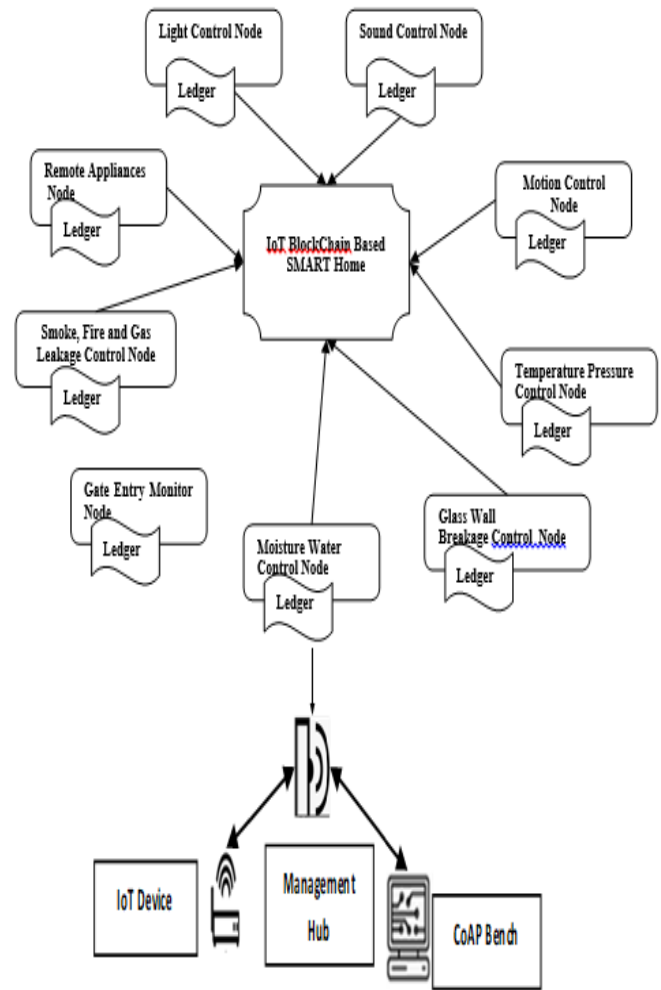


Fig. 9. Implementation Domain in Blockchain Integrated IoT Based Smart Home

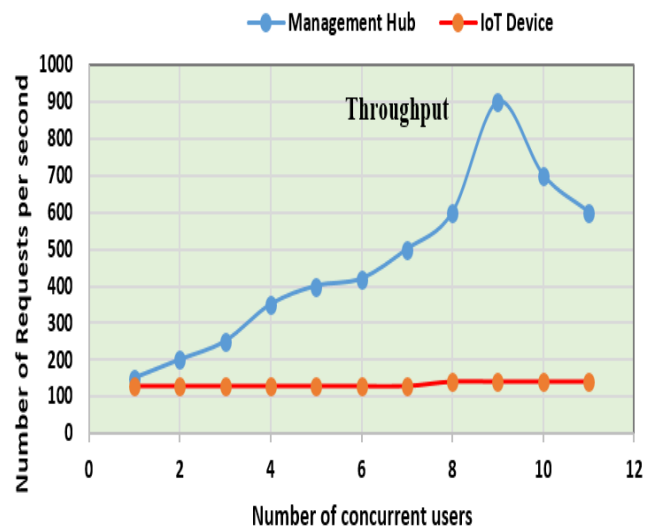


Fig. 10. Throughput of Moisture Control node

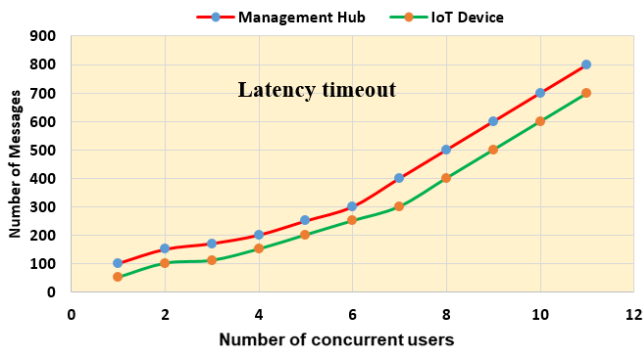


Fig. 11. Timeout Delay of Moisture Control Node

## V. CONCLUSION

The system prototype for the Block chain Integrated IoT based Smart Home is designed in this paper. It ensembles the reflection of high security and efficiency in controlling process of all the sensors in the block chain network. The Ethereum Private Blockchain network are facilitated with the implementation setup and the performance analysis is done with CoAPBench benchmark tool and the results are also deliberated. The future directions of this work is to enhance the sensor and its predictions towards sustainable and infrastructural development of the smart home.

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