“Blockchain-based Distributed Framework for Automotive Industry in a Smart City”

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Abstract

- Digitization and adoption of advanced technologies in the automotive industry not only transform the equipment manufacturer's operating mode but also change current business models.
- The increased adoption of autonomous cars is disrupt government regulations, manufacturing, insurance and maintenance services.
- To address these issues researcher propose Blockchain based distributed framework for automotive industry in smart city.
- This framework includes novel miner node selection algorithm for blockchain based distributed network architecture.
- Researcher simulate this model on Private Ethereum Blockchain plateform using litecoinpool.org captured dataset.

I. INTRODUCTION

- In today's world, automotive industry demands more personalized, integrated and on-demand services including shared, connected, autonomous environment, for example smart parking system, e-healthcare and so on.
- In the current business scenario, Blockchain technology are used in many applications.
- The main research contribution of this paper are summarized as follows:

1. They propose a distributed framework model for the automotive indistry using blockchain technology.
2. Then design an alogorithm for selecting miner nodes in the blockchain-based distributed network architecture.
3. Simulation is performed on Ethereum blockchain platform using captured dataset of mined block from litecoinpool.org.
4. Simulation result shows proof of concept, which can be used for smart applications in future.

II. PRELIMINARIES

A. Key requirement of Blockchain based framework for automotive industry:

- In the digital world, automotive industry is shifting to digitization, which is changing the entire business model. So, Blockchain based framework are used for automotive industry with following reason:

1. Supply Chain Management: apply blockchain technology for each phase with govt. rules.
2. Unparallel Security: provide different level security in automative industry with blockchain technology.
3. Evidence Integrity and Secure Storage:previously submitted evidence remains unchanged.
4. Mobility Solution: provide data resorce sharing, carpooling services in an autonomous system.
5. Ability to Audit Records: immutable nature of the information in the blocks.
6. Automated Maintenance Services: automate payment, insurance, maintenance services provided by Blockchain based automatic Framework.
7. Transparency: Due decentralized nature of blockchain, provide tranceparency in automotive industry.
8. Execution Speed and Cost Reduction

II. PRELIMINARIES *Continue*

B. Related Works

- Brousmiche et al. [5] presented a framework for automating the life cycle of vehicles using the consortium blockchain, they highlighted the initail phase of implementation and challenges in future.
- Supranee et al. [6] to isllustrate that the blockchain technology can help to improve the supply chain process of Thailand's automative industry.
- Daniel et al. [7] presented challenges and framework for knowledge exchange among organizations in the automotive industry.
- Pinheiro et al. [8] proposed a decision making process model in the multi-agent systems approach to the industry using blockchain.
- Abstract idea of the reward based smart vehicle data sharing framework is proposed by Singh et al. [9].

III. PROPOSED FRAMEWORK MODEL

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A. Blockchain based distributed framework model

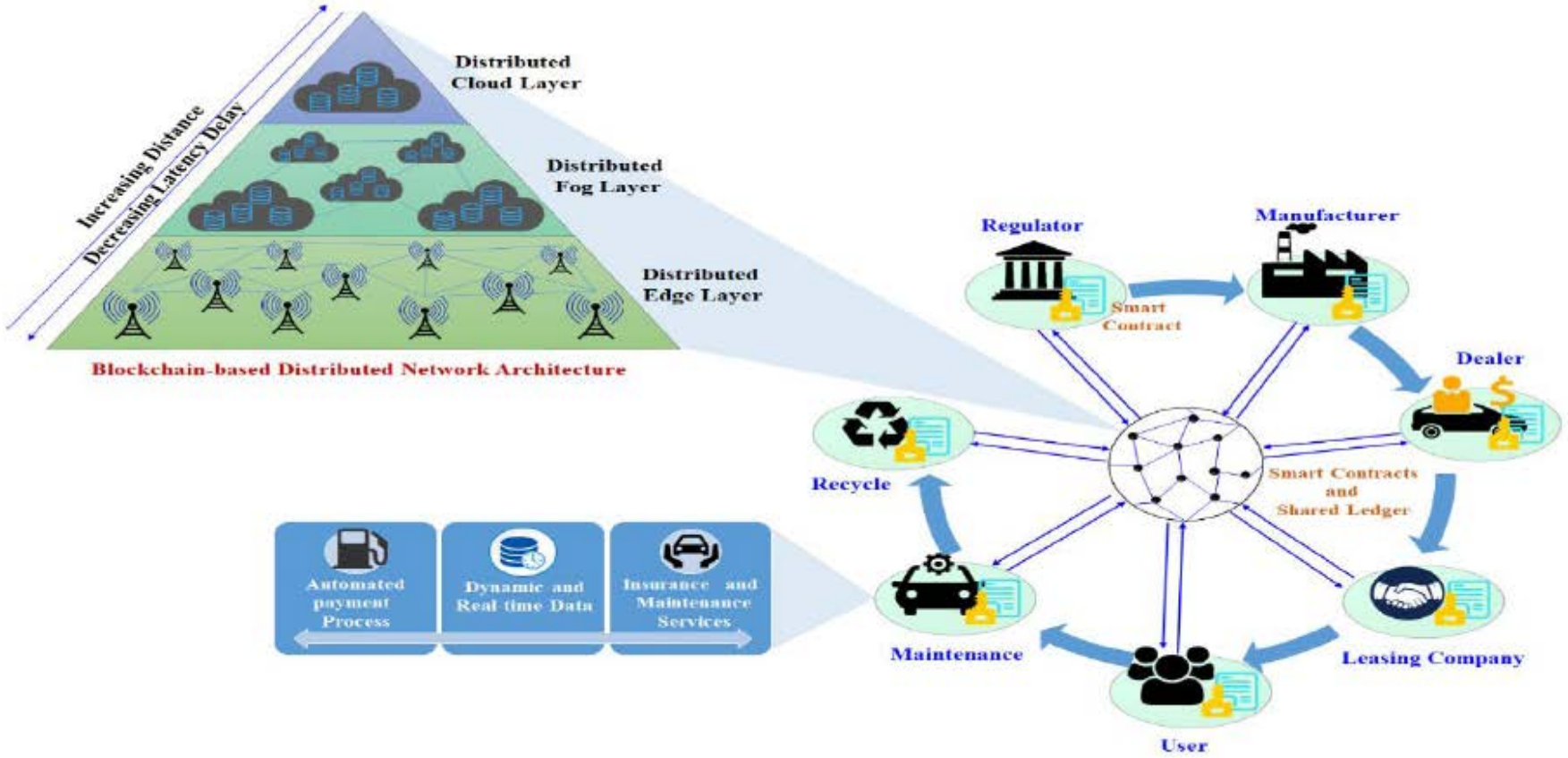


Fig. 1 Blockchain-based distributed framework for automotive industry in the smart city

Figure-1 provide complete life cycle of Automotive Industry Framework in a Smart City using Blockchain based distributed network. It has seven phases:

1. **Regulator Phase:** responsible for creating new vehicle registration based on govt. regulations and loading it into shared ledger on network and also create certified ownership(consensus) between regulator and manufacturer phase.

2. **Manufacturer Phase:** makes vehicle ID, vehicle model and template which is available in the network for relevant parties with permissions using Smart contract.

3,4. **Dealer and leading company Phase:** By execution of Smart Contract in supply chain vehicle transferred to the dealer and leasing company.

5. **User Phase:** Finally vehicle is released to the user subsequently passing through maintenance and recycle phase.

6. **Maintenance Phase:** provide services such as automated payment, insurance, dynamic and real time data for smart contract.

7. **Recycle Phase:** The Scrap merchant is allowed to scrap vehicle at the end of its life by executing Smart Contract.

B. Methodology approach of the proposed framework

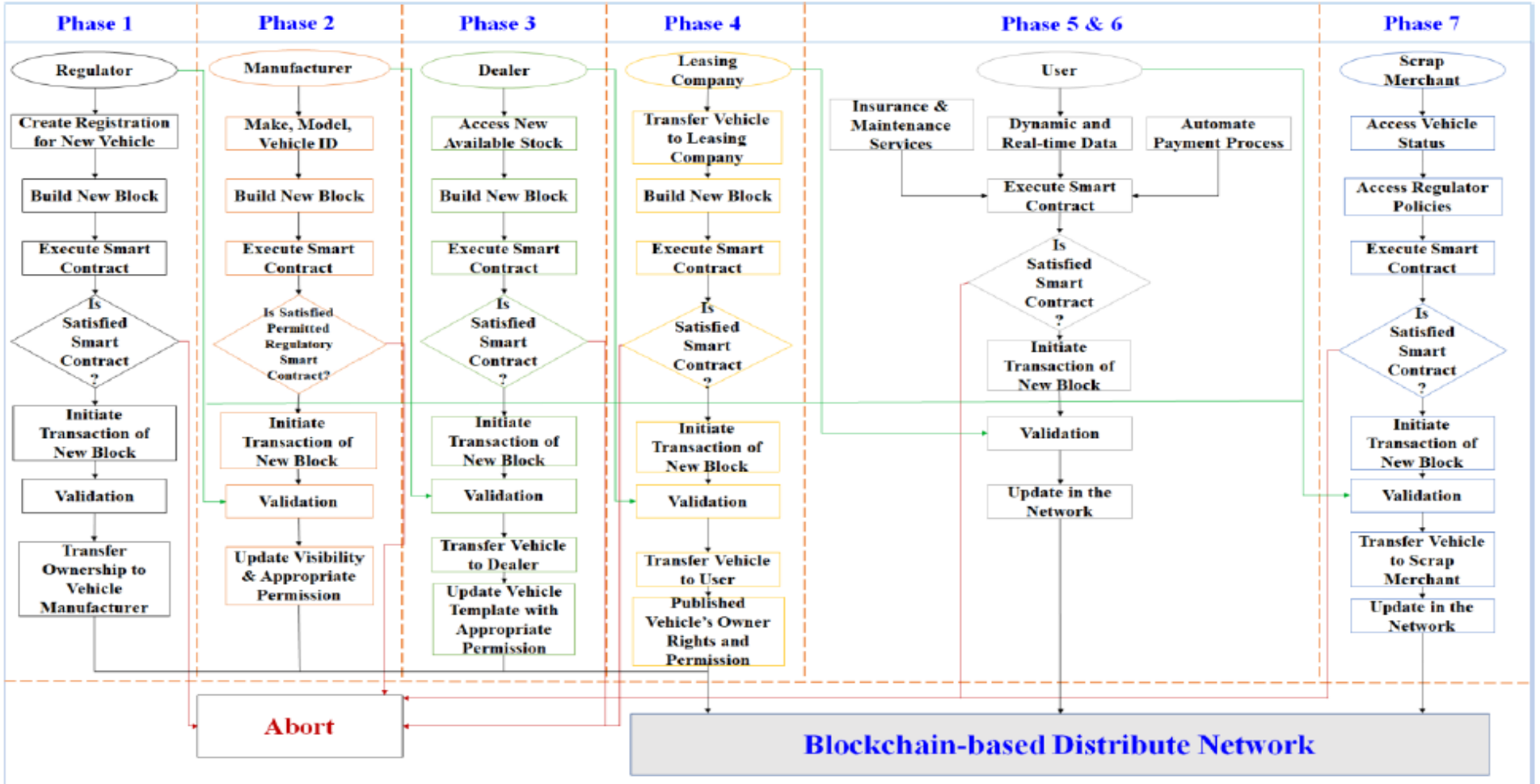
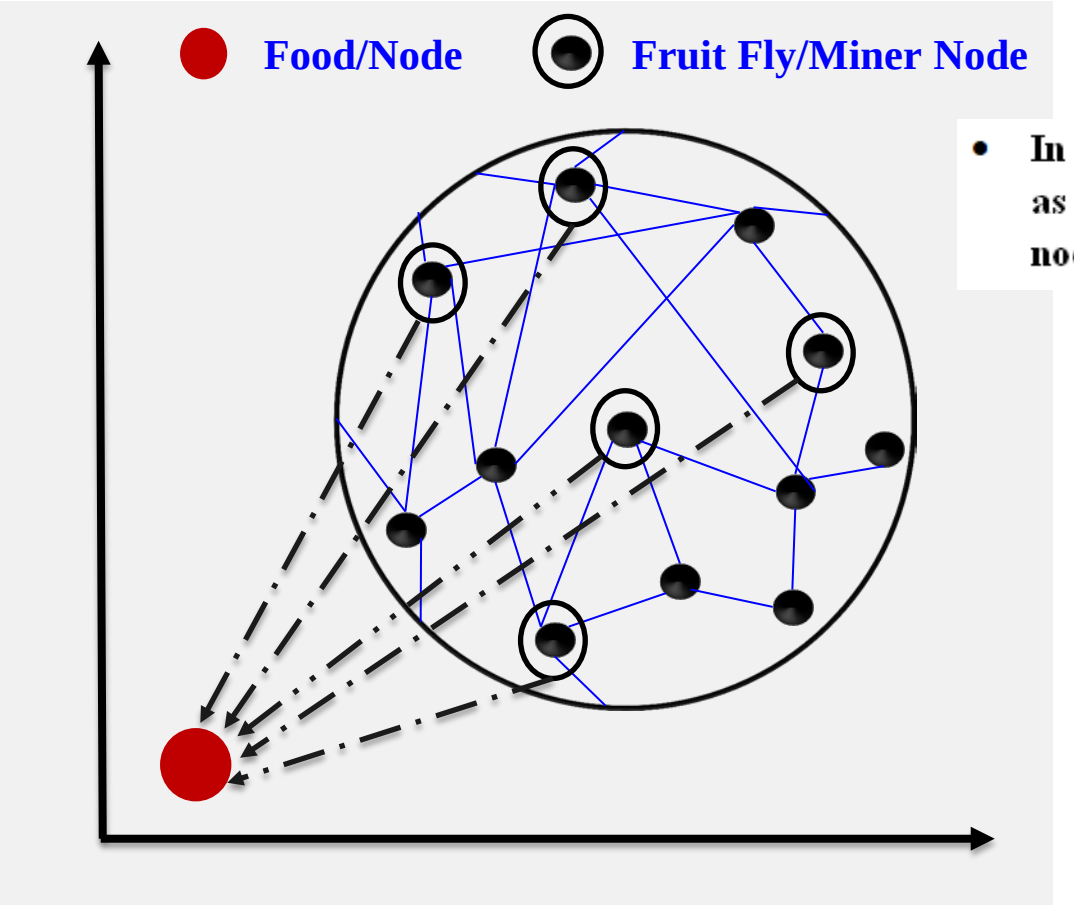


Fig. 2 Illustrates the methodological approach of blockchain-based distributed framework model for automotive industry



- In proposed algorithm, they consider Fruit Flies as a miner nodes and Food as a transaction initiator node to create a new block.

Fig. 3 Node finding behavior of fruit flies/miner nodes during mining process

C. Miner node selection algorithm

Algorithm 1: Miner node selection algorithm

Input: $N \leftarrow$ *Is the list of total miner nodes in the network*
M ← Is the list of newly added miner nodes (or didn't pa
process for long time)
K ← Is the list of active miners
$MaxGen \leftarrow$ *Maximum generation*
$gen \leftarrow 0$
$index \leftarrow 0$
$FruitFlyList \leftarrow NULL$
$FruitFlySmell \leftarrow NULL$
$IsActive \leftarrow NULL$
$BestSmell \leftarrow NULL$

Output: List of selected miners to send transaction requ

Begin
For Each K Active Miner Nodes
Calculate SD_i, LT_i, TL_i;
Calculate $Weight_i \leftarrow SD_i + {}^{1}/_{LT_i} + {}^{1}/_{TL_i}$;
Calculate $Dist_i \leftarrow Weight_i$;
Calculate $S_i \leftarrow {}^{1}/_{Dist_i}$;
Calculate $Smell_i \leftarrow Function(S_i)$;
$FruitFlyList[index] \leftarrow Add(K_i)$;
$FruitFlySmell[index] \leftarrow Add(Smell_i)$;
$IsActive[index++] \leftarrow True$;
End For
For Each M Miner Nodes
$FruitFlyList[index] \leftarrow Add(M_i)$;
$FruitFlySmell[index] \leftarrow NULL$;
$IsActive[index++] \leftarrow False$;
End For
While $(True)$

While $(True)$
$index \leftarrow 0$;
$BestSmell \leftarrow FindBestSmellConcentration\ (FruitFlyList, FruitFlySmell)$;
For Each N Miner Nodes Searching for the Food Source
If $(IsActive[index])$
Set $Weight_i \leftarrow BestSmell + RandomValue$;
Calculate $Dist_i \leftarrow Weight_i$;
Calculate $S_i \leftarrow {}^{1}/_{Dist_i}$;
Calculate $Smell_i \leftarrow Function(S_i)$;
$FruitFlySmell[index] \leftarrow Update(S_i)$
End If
$index++$;
End For
$gen++$;
If$(gen > MaxGen)$
$FruitFlyList \leftarrow SortIncreasingOrderSmell\ ((FruitFlyList, FruitFlySmell))$
Return *Select Top L Miner Nodes with High Concentration Smell*
End If
End While
End

1. To avoid the mining process during the block generation by unique miner pool, they propose an efficient algorithm for selecting miner nodes.

2. In this algorithm, they used the fruit fly optimization algorithm to select the list of the best possible miner nodes to compute the mining process.

Table 1. Notations of mine node selection algorithm

Notation	Description
N	List of all miner nodes in the blockchain-based distributed network.
K	List of all miner nodes those are actively participating in the mining process.
M	List of all miner nodes those are newly added or did not participated in the mining process for a longer time.
$FruitFlyList[]$	Array list to store the active and newly added miner nodes.
$FruitFlySmell[]$	Array list to store the smell of active and newly added miner nodes.
$IsActive$	Flag indicates that the node is active or not.
$BestSmell$	Indicates the miner node with best smell.
$MaxGen$	Maximum number of generation while searching for food.
SD	Standard deviation of the generation time of block by each miner node.
LT	It represents the time at which the last block created by a miner node.
TL	It represents the trust level of the miner nodes. The value of trust level increases as it successfully create new block. The trust level of newly added miner node or that did not participated in the mining process for longer time is set to zero.
$Weight$	Weight of the miner node which can be defined as $Weight \leftarrow SD + {}^{1}/_{LT} + {}^{1}/_{TL}$, When LT>0 and TL>0. In case of LT or TL value zero, we are omitting it from the calculation of the weight of miner node.
$Dist$	The distance is equivalent to weight of miner node.
$Smell$	The smell concentration of each miner node is inversely proportional to the distance of miner node.
$FindBestSmellConcentration$	It returns the smell value of miner node that has a high concentration.
L	It is the number of selected miner nodes to send transaction request.

$$SD_i = \sqrt{\frac{1}{N}\sum_{j=1}^{N}\left(M_j(t) - \mu\right)^2}$$

Where N is the number of miner nodes in the blockchain-based distributed network, $M_j(t)$ is the capture time taken by i miner node to generate the last block, and $\mu = \frac{1}{N}\sum_{j=1}^{N} M_j(t)$ is the mean; we assume that each miner has equal probability.

In FOA algorithm, miner node(N) classified into two groups:

1. Group of active miner node (K)
2. Group of newly added miner node(did not participate in mining process for long time) (M)

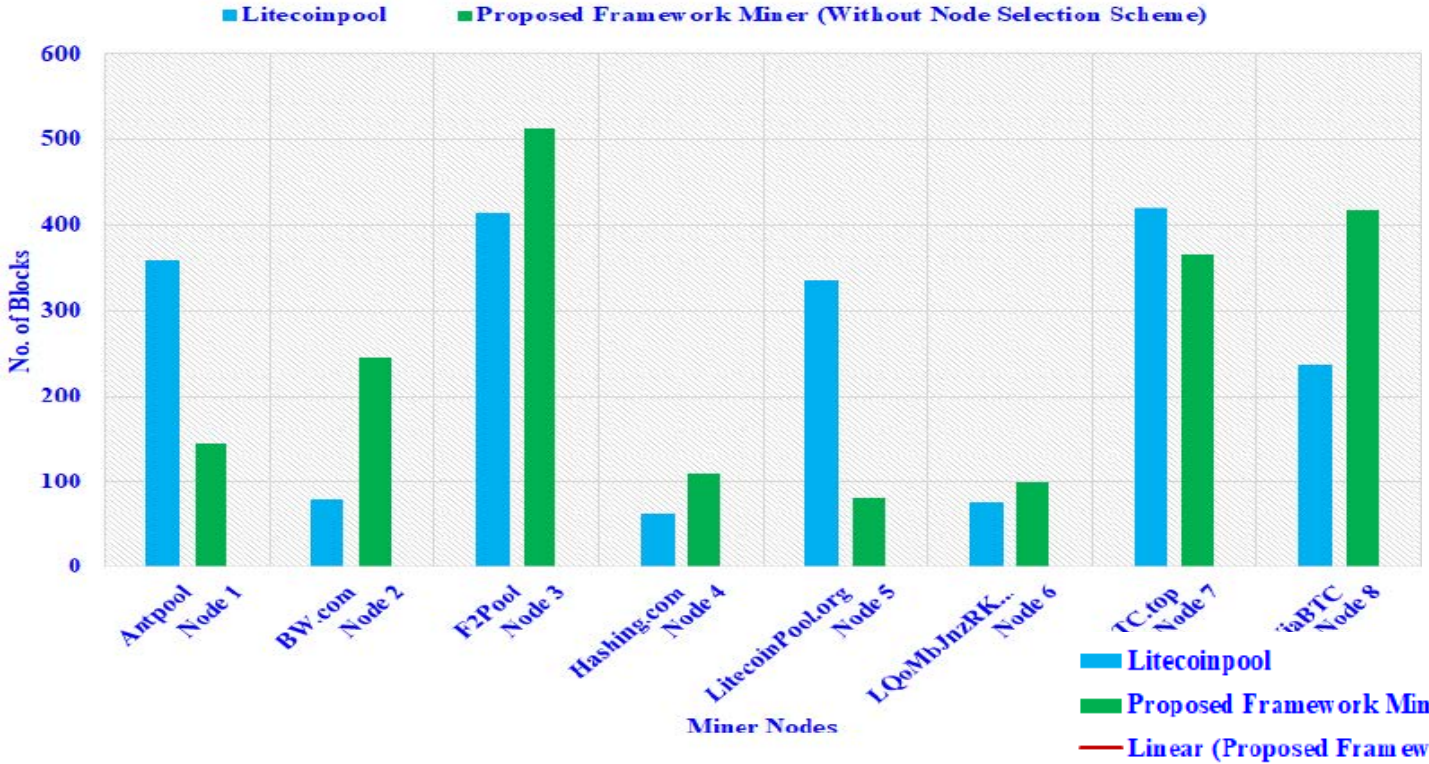
List of all miner node as a Input and provide a list of best possible miner node.

Step1: Calculate SD (Standard Deviation of each miner node, LT (time for last block creation by miner node) and TL (Trust level of miner node). Then compute smell of each miner node.

Step2: Select a miner node with best smell using FindBestSmellConcentration Function. While all miner node search for Food source, check miner node is active or not.

If miner node is active then set weight by best smell and random value and compute smell concentration by smell function.

Step3: If number of iterations reaches the maximum generation then sort the list of all miner nodes based on their smell concentration.



(a) Without node selection scheme

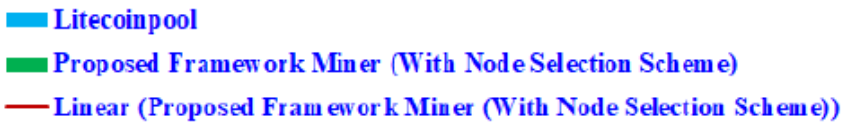
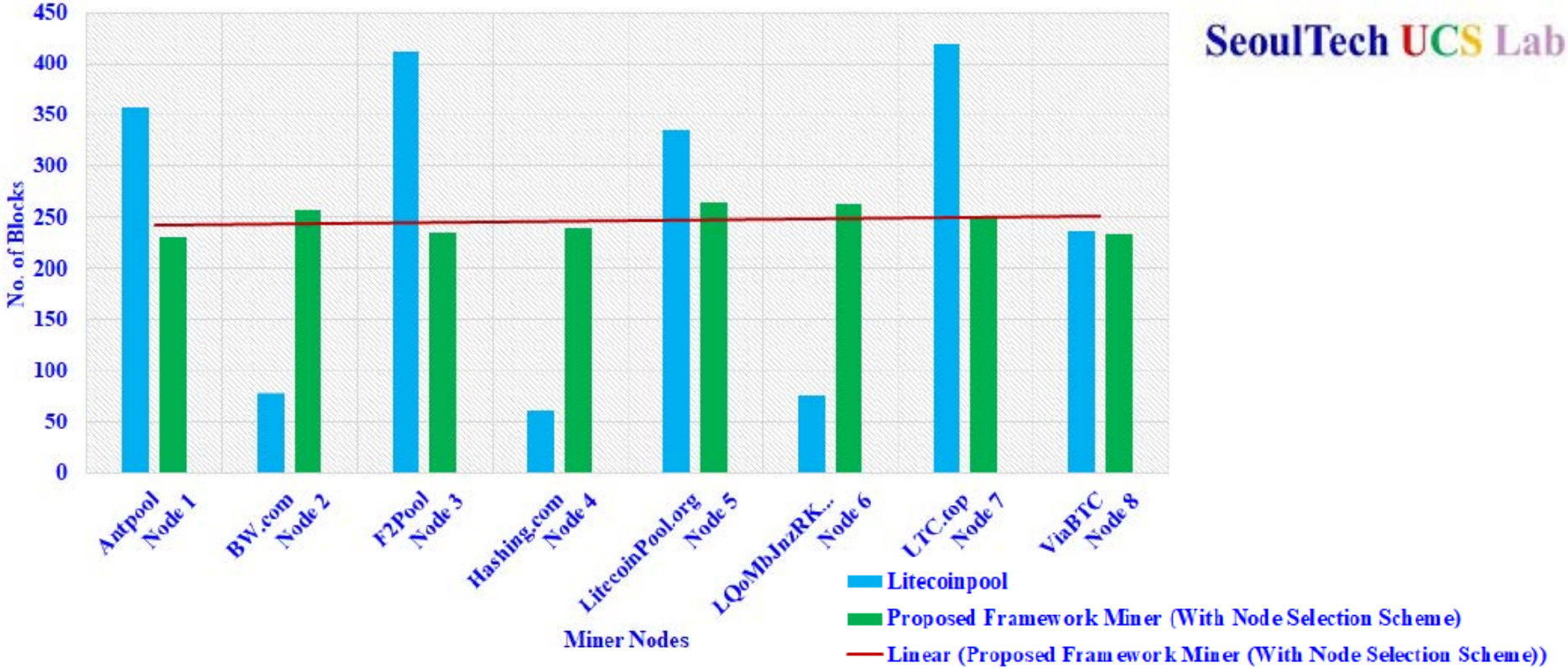


Fig. 5 Number of blocks mined with and without proposed miner node selection approach



(b) With node selection scheme

Fig. 5 Number of blocks mined with and without proposed miner node selection approach

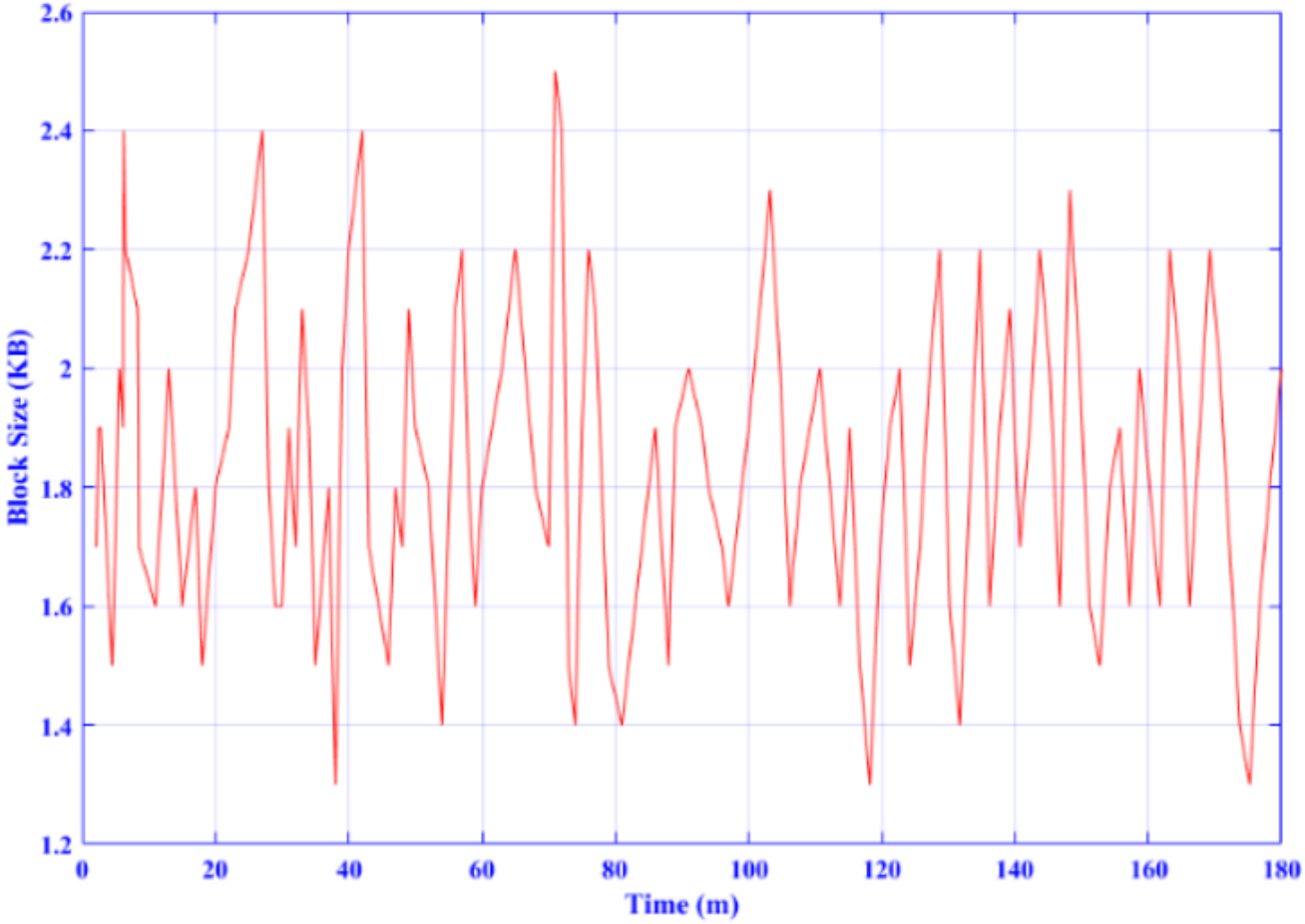


Fig. 6 Result of block size per KB

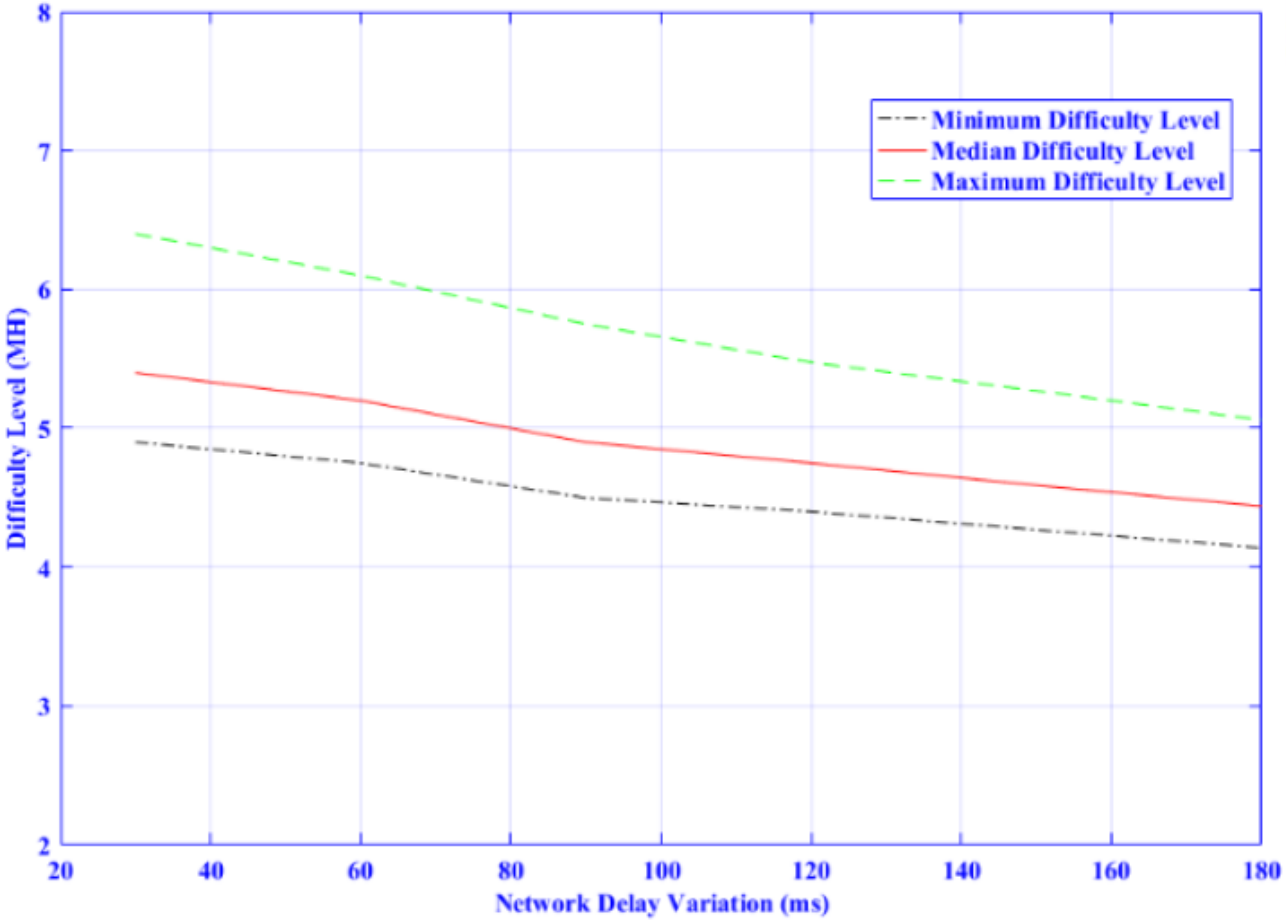


Fig. 7 Difficulty levels with various network delays

V.CONCLUSIONS

- In this paper, they proposed a distributed framework model for life cycle phases of the automotive industry using Blockchain technology.
- Elaborate workflow of the proposed framework model in detail.
- Tested proposed miner node selection algorithm using real time captured dataset.
- Experimental results show the effectiveness of proposed approach and feasibility of sustainable automotive ecosystem.

Reference

[1] Sharma, P. K., Kumar, N., & Park, J. H. (2018). Blockchain-based distributed framework for automotive industry in a smart city. *IEEE Transactions on Industrial Informatics*.

Opinion and Suggestions

I have two opinion for this paper

1. We can propose Blockchain based distributed framework in other applications such Video streaming system, Modern Power System, Waste water management, traffic management, lighting management, and so on in Smart City .

2. We can propose Blockchain based distributed framework with AI (Dueling Deep Q-Learning) in Smart city applications.

Thanks

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