An Efficient Distributed Framework Model for Automotive Industry in SmartCity Using Ethereum Blockchain

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***Abstract*— The digitalization and advanced technologies in the automotive industry change the current business models. The increased adoption of autonomous cars is disrupted government regulations, manufacturing, and other activities. Because we provide an integrated, very personalized, and on-demand services have shared, connected, and autonomous cars in the smart city for a sustainable ecosystem. To address these issues propose a blockchain-based distributed framework for the automotive industry in the smart city. The proposed framework includes a validation algorithm Proof-of-Authority (PoA). To evaluate the feasibility of the proposed framework, simulate the proposed model on a private Ethereum blockchain platform. The final results show the proof-of-concept of the proposed model which can be used for future smart applications.**

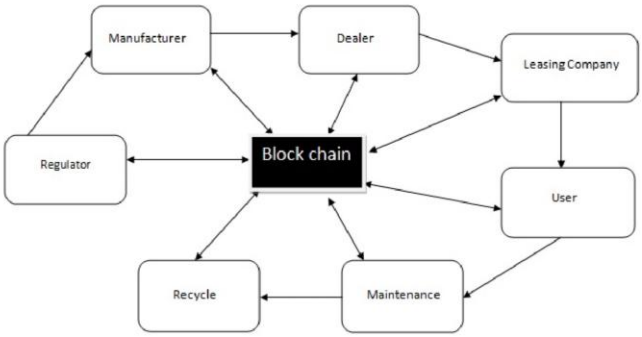
Keywords- Smart City, Blockchain, Automotive Industry, Supply Chain Management

I. INTRODUCTION

Blockchain technology becomes a revolution and attracts the attention of many share-holders who recognize the benefits of this disruptive technology, influencing the financial industry as well as other sectors. It has an impression on all sectors of the industry, and it's not surprising that the automotive industry has also been influenced by this revolution. In the current business scenario, many intermediaries needed such as banks, notaries, administrations, associations, etc. The automotive industry is linked to new technologies. Autonomous cars are a notable revolution in the automotive industry. A recent study predicts that around 250 million connected cars each of them carrying more than 200 sensors to collect information will be on roads worldwide by 2020. The huge adoption of autonomous cars in the automotive industry is seen to disrupt government regulations, manufacturing, insurance, maintenance services, etc. The integration of innovations in cars is a time-consuming process in terms of investment, development, and validation.

II. BLOCKCHAIN-BASED DISTRIBUTED FRAMEWORK MODEL

As a competitive need, digitalization is widely considered. In recent years, the growth of IoT has been explosive; it continues to grow in both value and adaptation at a rapid pace,leading to smart ecosystems. In the automotive industry of smart cities, trusted suppliers in the supply chain lifecycle are carefully selected, managed, audited, and certified to deliver reliable, consistent, quality services. Here propose how the blockchain structure model allows the development of secure digital product memory records, from raw material sources and manufacturing up to their maintenance and recycling phase in the supplychain lifecycle.



Proposed System Diagram

It demonstrates the complete life cycle of the automotive industry framework model in a smart city using the distributed blockchain-based scalable network. In the proposed framework model, the entire life cycle is categorized into seven phases.

1. Regulator
2. manufacturer
3. Dealer
4. Leasing company
5. User
6. Maintenance
7. Recycle

In the first phase, the regulator in the proposed framework model is responsible for creating the new vehicle registration based on government regulations and loading it into the shared ledger in the network. A smart contract ensures that only the regulator has the right to do so. In the second phase, the manufacturer receives the certified created ownership issued by the regulator, which is called a consensus between the manufacturer and the regulator. Upon receiving ownership, the manufacturer makes the vehicle model, ID, and template available in the network for all relevant parties with appropriate permission using smart contracts. In the third and fourth phases, the vehicle are transferred to the dealer and leasing companies with the execution of smart contracts in the supply chain.After the vehicle transfer to the leasing company, the car

is finally released to the user, subsequently passing through the maintenance and recycle phases in the fifth, sixth, and seventh phases in the supply chain life cycle. In the maintenance phase, the proposed framework model provides services such as automated payment process, insurance and maintenance services, and dynamic and real-time data for the smart transportation system and personalized, on- demand, and automated services to meet user demands. In the recycle phase, the scrap merchant is allowed to scrap the car at the end of its life by executing a smart contract. The synchronization process continues throughout the supply chain of the car through the end user, maintenance, and scrap merchant.

III. Methodological approach of the proposed framework

The government regulator in the first phase of the supply chain lifecycle creates a registration for the new vehicle based on the government rules and policies and building a new block. With the help of the smart contract, we execute the block and ensure that it satisfies the smart contract terms and conditions and initiates the transaction of the new block. Once the transaction gets validated, the consensus and transfer ownership to the vehicle manufacturer are published in the blockchain based distributed network. After transferring ownership to the vehicle manufacturer, the manufacturer begins to fabricate the vehicle model, identification, and model and build a new block, and execute a smart contract. If the newly created block satisfies the permitted regulatory smart contract, initiate the transaction of a new block and get validated by miner nodes in the network. Here, transactions are verified and validated by the regulator as well. Once the transaction is validated, the manufacturer publishes the vehicle template with updated visibility and appropriate permission for all the relevant parties in the network.

After publishing the updated templates into the network, the dealer can access information on stock availability from the network and execute their smart contract to initiate the transaction of the new block and transfer the vehicle to the dealer. Here, the manufacturer and regulatory participate in the validation process. In the end, the dealer publishes the vehicle template in the network for all members with appropriate permission to see. In this phase, the dealer can also issue loyalty points that can be used and exchanged as currency in the network. The dealer could complete the purchase of parts with loyalty points redeemed by the customer at a discounted price. Once the loyalty points have been redeemed, the dealer account will be updated so that participants in the network can see with appropriate permission. The leasing company accesses the updated vehicle template from the network, transfers the vehicle from the dealer, and builds a new block and initiates a new transaction if the created block satisfies the smart contract. Once the transaction is verified and validated by the regulator, manufacturer, and dealer, they transfer the vehicle to the end-user and publish the vehicles ownership, rights and permission into the network.

The proposed framework model connects the entities involved when leasing a vehicle to a customer in a secure manner to perform Know Your Customer (KYC) customer checks such as credit check, ID, and license before leasing the vehicle and storage of leasing contract in the blockchain network. During phases 5 and 6, there are different personalized, on-demand, and real-time services offered for the user such as insurance contract, periodic maintenance contract, and automated fuel payment contract. In this phase, the proposed model allows insurance companies to create customized vehicle insurance contracts based on actual driving behavior and automate the payment of insurance and financial settlement following a claim. Driving behaviors and safety events sucas mileage, speed, damaged parts, and collisions of a vehicle owner could be stored in the blockchain network, shared, and used to calculate insurance premiums and payments.Since the record is tied to the owner, the history of the vehicle owner remains available to the insurance company for future insurance quotes even after the sale of the car.

In case of on-demand mobility, fuel payment, and ride-sharing services, our proposed blockchain-based framework model records and executes agreements and monetary transactions to allow vehicle owners to monetize trips, pay at fuelling service stations, and exchange data in a seamless, secure, and reliable manner. At the end of the lifecycle, scrap merchant access vehicle status information, regulatory rules, and policies and execute a smart contract and check if the newly created block satisfies the smart contract, and then initiate the transaction of the new block, with the process validated and verified. In the validation process, all the relevant parties in the supply chain will participate in the process. Once the transaction gets validated, the vehicle will be transferred to the scrap merchant with appropriate permission to dispose of the vehicle at the end of the lifecycle and make the corresponding update in the network.

IV. Analysis Review On Recent Methodologies

To conduct a review analysis and comparative study on “Efficient Distributed Framework Model for Automotive Industry in SmartCity Using Ethereum Blockchain”. We have considered several recent studies on this topic.

Kei Leo Brousmiche, et. al. in Digitizing, Securing and Sharing Vehicles Life-cycle Over a Consortium Blockchain[1].

Propose an innovative Blockchain-backed Vehicles Data and Processes Ledger framework to digitize the vehicles life-cycle over a consortium Blockchain, that permits the aforementioned stakeholders to collaborate through the secure sharing of vehicles data and maintenance history. Our main objective is to permit the secure sharing of some parts of the vehicles data and processes between stakeholders, that own them. which will exploit them to provide value added services. This represents the essential framework which will enable all an ecosystem of services to grow round the proposed framework.

Blockchain-based Vehicles Data and Processes Ledger framework to streamline the management of vehicle’s life-cycle and data history, and hence to provide more transparency and collaborations between the involved stakeholders. The first example of a vehicle is its mileage, That is the very first information that will impact its current

value. In today's second-hand car market, the lack of trust is the main reason for devaluation. If a consumer wants to buy a vehicle from a private or professional entity, he/she may have serious doubts regarding the authenticity of the vehicle's maintenance history, is played mileage or actual value/state. This is because vehicle fraud (e.g. odometer frauds, wrecked or salvaged vehicles available, etc.) is currently becoming a growing problem internationally. Another example of vehicle fraud that is great economic and societal impacts concerns the rolling wrecks, i.e. vehicles that experienced severe damages which are declared as wrecks by an insurance expert, and hence that aren't any longer allowed to travel on the roads. Then, some wreck vehicles area unit swap onto the second-hand automotive market, with the help of corrupt professionals. These rolling wrecks are often the explanation for severe accidents, involving injured people, and costing insurance companies and consumers a great deal of cash . They propose an innovative Blockchain-backed Vehicle Data and Processes Ledger framework to digitize the vehicle's life-cycle over a consortium Blockchain, that enables the aforementioned stakeholders to collaborate through the secure sharing of vehicles data and maintenance history.

Iva Najdenova, et. al. in the Blockchain-Based Approach for Preserving Car Maintenance History[2].

To implement a blockchain solution that can be used to fight frauds in the automotive world. To be more specific, we apply the ByzCoin blockchain technology and build a service on top of it. For a correct implementation, the system requires at least 5 machines, with the assumption that at most one of them might be faulty or byzantine. This is deducted from the statement that ByzCoin tolerates faulty members among 3f + 2 nodes in the system. These conodes are envisioned to be distributed between the distrustful parties (car manufacturers and dealers, insurance companies, police...). Each machine maintains a local copy of the blockchain and users can interact with the nodes by using a desktop application. The prison either creates and send a new transaction, or get a proof of existence for the data stored on the blockchain.

System Discription

The main elements of the ByzCoin implementation are: instructions sent by the clients, contracts that define how the instructions are interpreted, a global state with instances which are tied to a contract and hold data, and DARC structures for access control.

The management of access rights is handled by DARC structures (Distributed Access Right Controls), which maintain a set of rules. Every rule consists of an action name and an expression that contains identities allowed to execute that action.

V. Comparative Analysis And Discussion

Table 1: Comparative analysis of existing techniques

Consensus	Pros	Cons
Proof-of-work	Less opportunity for 51% attack Better Security	Work is moderately difficult for the miners to perform.
Proof-of-stake	Energy efficient More decentralized	Monopoly Problem
Delegated proof-of-stake	Energy efficient Scalable Increased security	Seem to result in a semi centralized network, but its traded off for scalability.
Proof-of-capacity	Cheap Efficient Distributed	Possibility of malware affecting mining activities. The process creates a massive amount of redundant disk spaces.
Proof-of-weight	Customization Scalability	Incentivizing could be a big challenge for this consensus algorithm

VI. CONCLUSION

In the automotive industry, inheriting the features of blockchain technology enables increasing the trust among organizations across the supply chain for the reduction of business friction. Through the shared distributed record-keeping structure, communication and collaboration among participants in the supply chain life cycle can be greatly enhanced; thus realizing significant time and cost savings and enabling manufacturers and suppliers to protect their brands against counterfeit products. In this research, proposed a distributed framework model for the entire life cycle phases of the automotive industry using blockchain technology by using validation algorithm proof-of-authority(PoA).

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