Journal of Statistics & Management Systems
ISSN 0972-0510 (Print), ISSN 2169-0014 (Online)
Vol. 28 (2025), No. 3, pp. 535–544
DOI : 10.47974/JSMS-1382

Blockchain technology for vehicle registration : A framework for VAHAN citizen services portal in India

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Abstract

This paper proposes a framework for using blockchain to improve the vehicle registration processes at the regional transport offices in India through VAHAN Citizen Services Portal. The proposed framework has been outlined on the basis of brainstorming sessions with the industry experts and can be implemented using hyperledger fabric. This can help in overcoming the existing loopholes in the vehicle registration processes and streamline the same. The paper also proposes the blockchain technology-based procedure for new vehicle registration, and the functional and solution architecture for the proposed solution, and the responsibilities and permissions for the various stakeholders in the business process. The study also delves into the use of smart contracts and the concerns related to data privacy and security in the registration process of new vehicles and transfer cases. The implications for the managers have also been outlined.

Subject Classification: *Primary 93A30, Secondary 49K15.*

Keywords: *Blockchain, Vehicle registration, Transportation, Information security.*

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1. Introduction

Registration of vehicles in the transportation sector is an avenue where the blockchain can help. Blockchain is one of the most revolutionary technologies in the twenty-first century. It has been proven to result in more reliable processes with lower chances of failure. Adoption of blockchain by many industries have led to the systems becoming- more fool-proof, less prone to safety threats, less prone to chances of information leakage, better cyber-security, more authenticity, better traceability and also higher scalability. Pharmaceutical supply chains and automotive supply chains with traceability requirements are one of the important beneficiaries of supply chains. E-governance initiatives from the government can also reap the benefits of blockchain. There are already some use cases where the e-governance initiatives became more strengthened with the adoption of this technology.

However, not much research has been done in this domain in the past. Therefore, this study proposes a framework for adoption of blockchain in registration processes in the context of India as a country. The reason for choosing India as a country lies in the size, diversity of the Indian road transportation sector.

This paper proposes framework for enhancing and improving the existing VAHAN Application Portal. The proposed framework advocates decentralizing the system for high availability & scalability to ensure better performance; enforcing the guidelines, regulations and compliance standards set by Regional Transport Authorities & Ministry of Road Transport & Highways (MoRTH), from time to time, and creating the ability to onboard and govern the third parties for better serviceability and collaboration.

2. Literature Review

There have been some studies on blockchain adoption in services operations also. Smart contracts can play an important role in making the transactions more foolproof, authentic and transparent [1][2]. But caution needs to be maintained during the design of such contracts to address the possible vulnerabilities[3]. Pharmaceutical industry has been one of the earliest beneficiary of blockchain implementation[4].

Several research studies proposed hyperledger fabric as a permissioned blockchain [5]. Applications can be built on blockchain technology to detect the frauds and ensure transparent and immutable

audits [6]. Blockchain implementation brings with it opportunities and challenges that need to be addressed [7]. One of the studies also proposed a used case for car registrations [8].

A few research studies also advocated the role of blockchain-based cryptography in enhancing the privacy for smart contracts [9]. A study has also proposed the utility of facial recognision in naking online payments more secure [10]. A research study proposed the use of computer vision and blockchain technologies for user authentication [11]. The other researcher suggested that healthcare industry can also benefit from blockchain technology in protecting biomedical databases [12]. Food industry is already using blockchain to enhance the traceability of food items, which helps in enhancing the food safety [13].

Many of the researchers in their latest study also proposed the use of blockchain technology to create a vehicle registration mechanism that is forgery-proof [14]. A study advocated the concept of intelligent transportation and automated license late recognition through the use of wireless sensor networks and blockchain [15]. One of the researchers advocated that the privacy of the information can be preserved if the vehicle insurance or accident registration is preserved [16]. The latest study proposed the framework for blockchain-based smart bus transportation that reduces the chances of data misrepresentation and enhances the accuracy of records, and can handle security threats [17]. The information security can be enhanced substantially through the use of blockchain [18]. The other study proposed a procedure to measure the functional stability of smart contracts that can benefit all the stakeholders including the developers themselves[19].

However, when it comes to public services such as vehicle registration in the transportation sector, there are no such studies in the existing literature. That is why this study has been undertaken to propose a solution framework for adoption of this technology in vehicle registration processes.

3. About VAHAN Application (www.parivahan.gov.in) and Existing Process of VAHAN

The Ministry of Road Transport & Highways (MoRTH) has been facilitating the computerization of Transport Offices (RTOs) across India through Vahan application portal. Based on the analysis of VAHAN's current system, a citizen can interact with the System in two different ways. In the Online option, the citizen first interacts with the system by

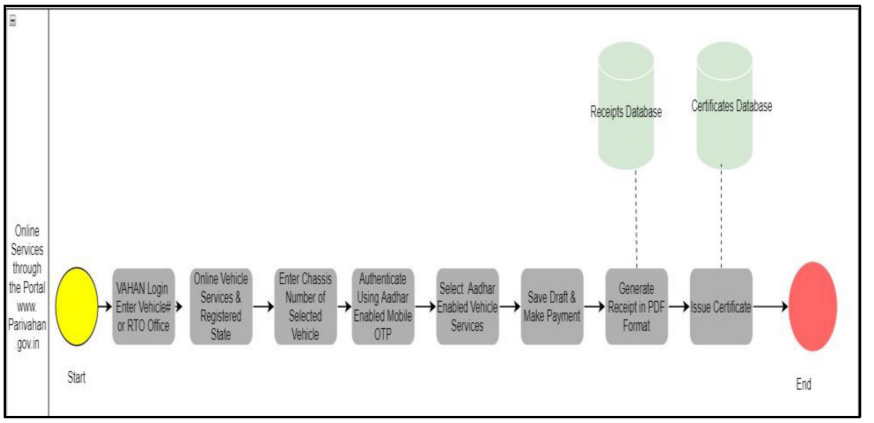

Figure 1

Business Process for online registration of vehicles

selecting the State in which his vehicle is registered and then can avail of Vehicle-related services using his registered Vehicle number or Selecting the Regional Transport Office (RTO) where his vehicle is registered.

Figure 1 illustrates the business process of availing Online Vehicle Services. To begin with, the citizen selects State of Vehicle registration, Registered vehicle number. After service selection, the Chassis number & Engine number of his registered vehicle. His/her credentials are authenticated using Aadhar enabled mobile OTP. Citizen's registered mobile number was already obtained at the time of Registration of the vehicle. The particular Vehicle Online service is selected post this. The draft of the service is saved and the payment is done online mode. Receipt gets generated in a PDF format, a copy of which is stored in the receipts database. A certificate is issued to the customer of the vehicle, a copy of which gets stored in the certificates database.

Figure 2 depicts the Business process of availing Vehicle Services, by visiting physically. The RTO employee upon receiving the form will query the VAHAN application for the fulfilment of the citizen's request. For the vehicle Services type selection requested by the citizen, a Role & allotted action is selected, say the Role is Application Inward and allotted action is New Registration application. Seat Work is then initiated for the selected Role & allotted action, say, details would have to be filled in of the Owner, Vehicle & Hypothecation information, if any. The next step is collection of payment of relevant fees & vehicle tax. Also, a new Seat work is initiated for the Role & corresponding allotted action. Receipt is generated & stored

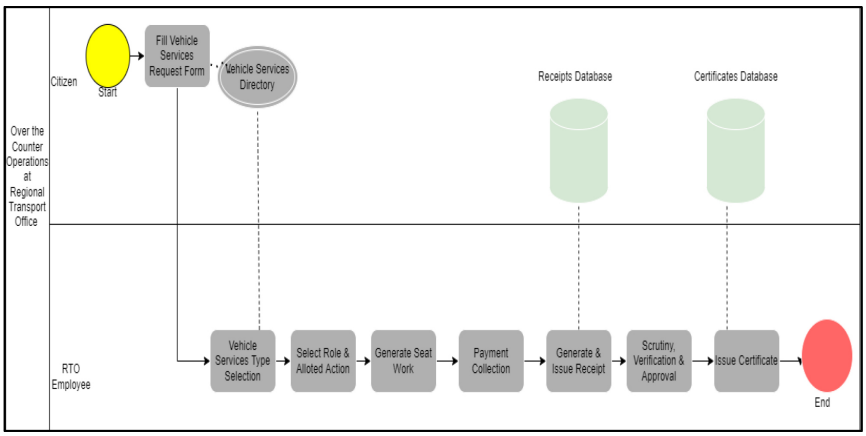

Figure 2

Business Process at Regional Transport Office

in the Receipts database. Seat work is now generated for Role of Fitness/ Inspection along with Role of New Inspection/Fitness. The completed request for Vehicle service is then scrutinized, verified & approved by the Regional Transport Officer & a certificate is issued. A copy of the certificate is also stored in the database.

4. Gaps in the existing process

Based on a brainstorming exercise, several gaps were identified in the existing process. First, the application is centralized & has a high probability of single point of failure. Second, due to closed system design and confidentiality, existing regulations and compliance monitoring cannot be extended to third parties. Third, in case of a requirement of outsourcing of services to third parties, it will not be possible to extend the governance. Fourth, the Data Management becomes tedious in case there is a requirement of extending the data to outside of the system. Fifth, presently the system is unable to integrate the services offered by partners in a secured manner.

5. Research Methodology

This study is essentially an action research where the brainstorming was done among a team of experts in multiple stages to arrive at the possible framework for blockchain adoption vehicle registration. First, the existing process was discussed with respect to the pain points in the same.

Then, the subsequent discussions were undertaken on how blockchain could be used to address those pain points. These discussions involved several sequential brainstorming sessions with the e-governance experts and with the executioners of the business processes.

6. Findings of the Research

Requirements of the Proposed System, as collected from the brainstorming exercise, are the following. The participants in the system should be registered users with a well-defined role in the system. All transactions should be closely monitored and controlled here also needs to be a well-defined pluggable application of business rules. The concerns related to data Data Privacy and security need to be addressed. There needs to be a well-established approval system. Data Sharing should be well controlled and managed.

7. Proposed Framework to reflect the insights generated from research findings

Currently, the underlying database i.e Postgre SQL has a centralized architecture and its biggest drawback is a lack of transparency & trust which is usually associated with databases that are centralized. To address this, an improvised process is proposed. As illustrated in the Figure 3, all the records pertaining to the vehicle are proposed to be stored in the Vehicle Blockchain database, initiation of which can be done by the Manufacturer of the Vehicle. The verified records stored in the blockchain database are immutable and cannot be deleted or altered (edited). Template of the record will have the details as per RTO Form Number 21 & Form Number 22.

The current process involves driving down the vehicle to be registered, to the RTO, from the premises of the Dealer/Manufacturer. Reduction in time required for registration is possible, by eliminating the process of physical verification of the vehicle at RTO premises and completing the Registration formalities at the dealer location itself. This is possible as the Vehicle Model & Make, Chassis number, Engine number and other details like the Emission norms, Vehicle's kerb Weight & Colour are stored on the blockchain database & these records are immutable. Registration authority can now entrust the dealer with the Registration process & the registration can proceed with the Motor Vehicle inspector doing a virtual inspection of the new Vehicle.

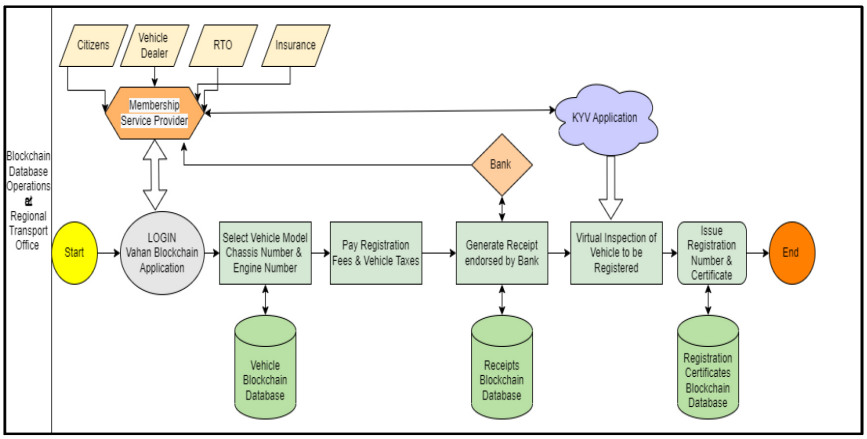

Figure 3

Proposed Blockchain-Based Registration Process for Vehicles

The following steps are proposed. First, the citizen places an order with the dealer for the vehicle model & colour and it is available in the inventory of the dealer. The vehicle record is available in the blockchain database as the details are already entered by the Manufacturer of the vehicle. Vehicle record will be in the format of Form 21. Second, the credentials of the Citizen, RTO, Vehicle dealer and Insurance Company have been verified by the Membership service provider and they can seamlessly login in the Vahan blockchain application. Post Login, the dealer selects the chassis number & Engine number of the vehicle model & make selected by the customer and submits an online application to the RTO for Registration. Format of the application is as per Form 20. A certificate of Road worthiness in the format of Form 22 is already a part of the Blockchain record. The Insurance Company has also provided the Insurance certificate. Format is as per Form 51 and it is also a part of the Blockchain record. Registration fees & Vehicle Taxes are paid into the Bank designated by the RTO, mostly State Bank of India & an endorsed receipt is received from the Bank. Bank is also endorsed by the Membership service provider.

A virtual inspection using the Know Your Vehicle Application is scheduled with the Motor Vehicle inspector. Know Your Vehicle application is initiated by the MV inspector on his device and he sends a link on the mobile phone of the Dealers representative. Upon joining the MV inspector takes the photographs of the vehicle, its Chassis number & Engine number using the mobile phone camera of the dealer's representative. The

recording of the session and photographs are also stored on the blockchain. After Scrutiny, a Temporary Registration certificate is issued in the format of Form 23B. After completion of all verifications, especially Vehicle Registration fees & Taxes, a Final Registration certificate as per Form 24 is issued, having necessary digital signatures of the MV Inspector & the Registering Authority. Record of the blockchain database is updated with the details of the Citizen & the Registration Mark of the Vehicle.

Managerial Implications

It is important to improve the quality of services delivery to the citizen and the quality of the work environment of the RTOs. It intends to automate all Vehicle Registration and Driving License related activities in transport authorities of India with the introduction of smart card technology to handle issues like inter-state transport vehicle movement and to create state and national level registers of vehicles/DL information. This would enable the provision of better services to Transport Department as well as the common citizens, a quicker implementation of Government policies from time to time. This would lso enhance the image of Government & Department, and provide Instant access of Vehicle/DL information to other government departments.Going forward, mobile-based applications should be developed and systems utilizing the Aadhar Based identification would also be integrated with the Unified RTO database for higher security and ease of operations.

Conclusion

The proposed framework in this research study has the potential to enhance the existing VAHAN application since the present system is a closed one & has very limited ability to onboard third-party services which are needed to offer more & better services to the Citizens of India. This study started with identifying the gaps with the existing business processes, online on www.parivahan.gov.in as well as the physical processes at RTO office, and worked out the solution which can be implemented to address those gaps & identified the technology/platform on which the solution can be hosted.

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Received August, 2024