Smart Ticketing and Payment System for Safer Highways in India

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***Abstract*— In India the growing accident rates on national highways are becoming a huge concern. As per the Ministry of Road Transport and Highways, in 2018, 64.4% of 1, 51,417 fatalities in road accidents were attributed to over-speeding. The tendency to over-speed can be curtailed by effective implementation of traffic laws against over-speeding and effective ticketing to punish the offenders. Hence, a reliable system for speed violation detection and effective ticketing is required. The current system of speed-sensing and ticketing relies on manual processes and manual interventions. This results in a lower effectiveness of the same. The objective of this paper is to propose a system that will use the RFID FasTag mandated by the government of India for all registered vehicles, to detect over-speeding vehicles and issue the ticket by scanning the RFID tag of the violating vehicle. This paper proposes the architecture of this system and also assesses the limitations which can pave the further way of research. The proposed system also suggests the use of Blockchain to store the speed violator's data so that it can be used to initiate the transaction even after the vehicle is not in range and take necessary action against repeat offenders.**

Keywords—RFID, FasTag, Speed Radar, Accident prevention, National Electronic Toll Payment (NETC)

I. INTRODUCTION

Road fatalities becoming a huge concern in India. Ministry of Road Transport and Highways [1], released the report on road accidents (for the year 2018). According to this report in 2018 near about 4, 67,044 accidents have been reported claiming 1, 51,417 in which over-speeding accounted for 64.4% for the total persons killed. Hence, an effective system is required for controlling the over-speeding vehicle to mitigate the accident rates on the highways of India. In Present, there is no effective system is in place to detect the over-speeding vehicle on National Highways of India and issuing the ticket to the over-speeding vehicle to control the over-speeding vehicles. Also, along with issuing the ticket, an effective system is required for collecting the payment of those tickets. According to the figure provided by the Maharashtra state police, after implementing the e-challan system in the state of Maharashtra the total unpaid amount of e-challans is of Rs. 168 crores till the month of September 2019. This paper proposes a system for detection of the over-speeding vehicle through speed sensor and issuing the ticket to the offender by scanning the RFID FasTag affix on the windscreen of the vehicle through RFID (Radio Frequency Identification) reader and payment of those tickets through FasTag.

II. LITERATURE SURVEY

The over-speeding controlling system became the necessity of the present world. Not just in India but in many cities, over-speeding is the major cause of the accident. In India, there is no effective system in place to control the speed of the vehicle on expressways and highways. The work in [2] proposes an android based traffic rule violation detection system by using sensors, RFID reader and RFID tags. This system is based on the RFID tag and the reader. When the sensors detect a violating vehicle the RFID reader sends a signal to the RFID tag of the violating vehicle and fetches data from the tag. Later the data is sent to the database and a request for a fine amount is initiated from the bank associated with RFID tag and the message is being sent to the owner of the RFID tag. The work in [3] proposes a smart prepaid traffic system based on RFID, IoT and mobile application for Iraq. The RFID reader is connected to the local processing unit (i.e. Arduino UNO micro-controller) which is connected to Wi-Fi enabled micro-controller (i.e. ESP8266) for communication with the main server. In the proposed system there is seven RFID reader which are used to detect the traffic violation and scanning the RFID tag of the vehicle. RFID tag used here is a wallet-based RFID reader so the fine amount can also be deducted instantly. The mobile application is also developed for both authorities and vehicle user for tracking the data. The work in [4] proposes an RFID based speed violation detection system. Under this work, the author uses multiple RFID readers for measuring the speed of the vehicle. In this system when a vehicle crosses an RFID reader R1 the RFID tag is being scanned and the information regarding vehicle stored in the RFID tag is stored in the database along with the information of the vehicle the time of scanning the tag is also stored. Now, when the vehicle again crosses another RFID reader R2 the information and time of scanning are again stored into the database. After this the system calculates the speed by calculating the time taken by vehicle to travel from R1 to R2, the distance between the two readers is predefined. If the vehicle is over-speeding the fine is issued according to the type of vehicle. The work in [5],[6],[7] proposes research on the Vehicle Detection system and suitability of RFID based vehicle detection system. The authors have also proposed the structure and application of RFID based vehicle detection system. The authors in [8],[9] proposes work on traffic violation detection based on RFID reader and computer vision. With the help of sensors and object detection algorithms, the violation is being deducted

and by scanning the RFID tag the vehicle information is fetched and stored with the help IoT devices and RFID reader.

III. PROPOSED SYSTEM

The paper proposes system based on the speed sensor, RFID FasTag, camera and RFID reader for detecting over-speeding vehicle and issuing the ticket to the offender. Under the proposed work each spot will contain one speed Radar and one RFID reader for each dedicated lane. When an over-speeding vehicle gets detected by the speed radar of a particular lane the NETC (National Electronic Toll Collection) RFID reader of dedicated lane will get activated and scan the RFID FasTag of the vehicle and determined fine amount will get deducted directly to the FasTag account of the offending vehicle and footage will be taken from camera as a proof.

In the proposed system RFID reader will fetch the tag id and vehicle registration number. Camera will capture the footage of the vehicle along with location and stores it in the blockchain so that transaction can be done even after the vehicle is not in the range of the RFID reader and further referred to validate the data stored in the database. When transaction gets done successfully the data will be further sent to the centralized server for storing the data. After deduction of the fine a message will be sent to the registered mobile number of the FasTag owner and a link of the footage will also be sent along with the message. If a vehicle violates the speed limit multiple times in a day then information regarding vehicle will be sent to the nearby traffic authorities.

IV. ARCHITECTURE

In this System, we are using Hardware components as well as software. The hardware components are Speed Radar, RFID reader for each dedicated lane and camera as shown in the following figure 4.1.

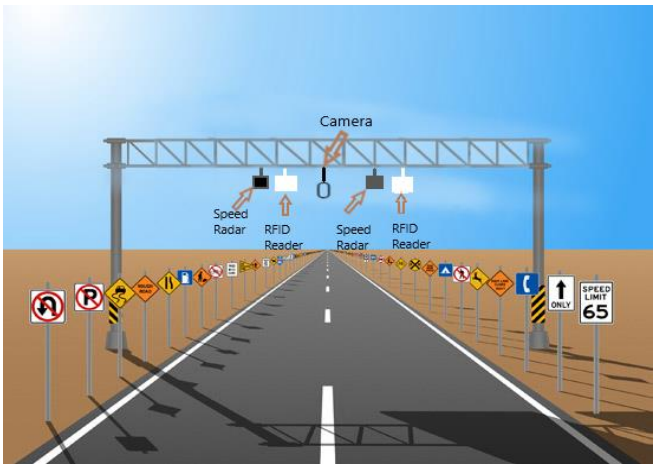

Fig: 4.1 Deployment diagram of the proposed system

When a vehicle comes into the range of the speed radar, speed radar will check the speed of the vehicle. If the vehicle speed is above the speed limit the dedicated NETC RFID reader will scan the RFID FasTag of the vehicle for fetching the details of the FasTag. The information further will be delivered to the Permissioned blockchain for temporary storing tag id so that the transaction can be done even after the vehicle is no longer in the range of the system further the data from blockchain are transferred to a centralized system where data of the offender will be maintained. Permissioned Blockchain here will work here as a secondary database for bringing transparency and making data tamper proof. It is also used for further for verification the data.

V. DESIGN CONSIDERATION

The Flow of the proposed system are shown in fig, 5.1.

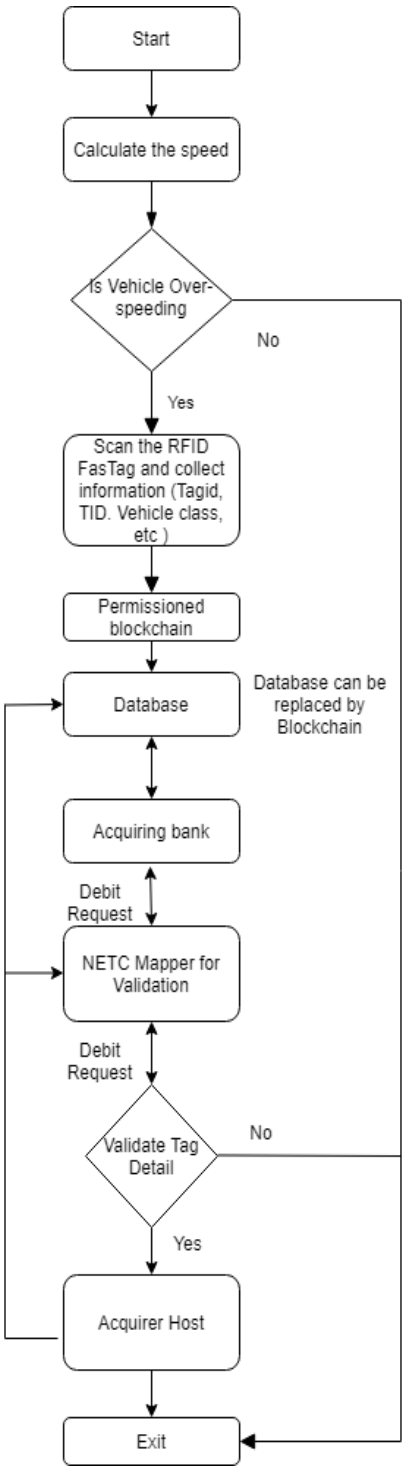

Fig: 5.1 Design flow of proposed system

The flow of the proposed system is designed with respect to existence toll payment system of NETC [6]. The design of the proposed system consists of 10 layers.

Step 1: Detect the speed of the vehicle with speed radar.

Step 2: Check whether the vehicle is over-speeding.

Step 3: If yes then
Jump to step 4
Else
Exit

Step 4: Activate the NETC RFID reader of the dedicated lane and scan the RFID FasTag.

Step 5: The tag Id will be stored in the blockchain and send it to the acquiring bank and later send it to the database for data keeping for future reference. The database in here can be replaced by blockchain. By switching the whole NETC data storage system on blockchain for bringing more transparency.

Step 6: The Acquiring bank will send request to the NETC Mapper for validation of the tag.

Step 7: If the FasTag is a valid tag then
Send information of the FasTag to the Acquirer Host
Else
Exit

Step 8: The Acquirer Host will send debit request to the NETC mapper and supply data to the database along with the camera footage.

Step 9: The NETC mapper will send the debit request to the acquiring bank and fine amount will be deducted from the over-speeding vehicle owner's FasTag account.

Step 10: The bank will send message to the owner's registered mobile number.

Step 11: Exit

VI. LIMITATION

The proposed system has some limitations which can be overcome by doing some modifications in the existent system. At present, the minimal balance of FasTag is just Rs. 150 only. If the minimum balance is not maintained then the FasTag gets blacklisted and NETC mapper invalidates the FasTag. When the FasTag gets Invalidated the transaction does not gets completed. To overcome this problem the minimum tag balance should increase and even though the tag is blacklisted the NETC mapper should fetch the details of the FasTag so that details can be stored in the database with status of the transaction (paid, unpaid) and FasTag (active, inactive) so that the necessary actions can be taken on the offenders. The details of the blacklisted FasTag owners along with the fine amount should be shared with nearby toll plaza so along with the toll tax the fine amount can also be levied from the offenders. The current FasTag system is database based we suggest to switch the whole system as a blockchain based system so that the data can be more secured and making system more transparent.

VII. CONCLUSION AND FUTURE WORK

This paper proposes an effective system for highways of India for issuing the traffic violation ticket to those who drives their vehicle above the speed limit and become vulnerable for other vehicles. Every year the accidents rate is increasing and fatalities in road accident are also increasing in India. The main objective of this system is to make Indian highways safer. In this system, each lane will have a dedicated speed sensor and RFID reader for detecting and issuing the ticket to the over-speeding vehicle and collecting the fine. Having dedicated sensors and readers will keep the system efficient in heavy traffic also.

This work can further be developed by adding more sensors and AI cameras for detecting the many other violations like rash driving, overtaking, solid line crossing, inappropriate lane change etc. Also, in FasTag mobile app fine management module can be developed so that user can manage the fines being issued to him/her.

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