Implementation of Smart Card for Vehicular Information

Kunal Gupta, Sushil Kumar, Malya Ranjan Tripathy

Abstract—Smart Cards have been used as portable, integrated devices that are capable of storing crucial information and have certain data processing capabilities. In almost all sectors, these cards have been used extensively for many years now, giving rise to new possibilities every day. The ability of these cards to enable easy, efficient and fast data access has led to their popularity and widespread usage in the transportation sector. In this research, a smart card solution to store all vehicle related information is proposed. The proposed system will link important vehicle data such as the vehicle's registration certificate (RC), vehicle owner's driving license (DL) up to five users' in family, vehicle's insurance and pollution details and vehicle owner's Challan (fine) details. This integrated vehicular card can also be recharged and the Challan (fine) amount can be deducted from the card itself as well from connecting Bank Account. Each vehicle owner's card would be identified with a unique serial number. The traffic management authorities, i.e. traffic policemen can access all this information through the mobile RFID readers provided to them. Linking all this crucial vehicle-related information onto one single card would eliminate the need for multiple cards & documents that vehicle owners need to carry otherwise. Traffic Police team can fetch Individual Vehicle data less than a minute depends upon Internet Speed & Central Server Processing time. This would, in turn, support Indian government's smart city mission.

Index Terms—Smart cards, IoT, RFID, Arduino UNO, GSM SIM900A, RFID reader

I. INTRODUCTION

With the rapid advancement in technology, we are heading for a world in which everyone and everything will be able to communicate and be connected. Such technology that provides communication among anyone and at any place or any time is the Internet of Things (IoT) [3]. The IoT may be termed as the Internet of the future that will enable machine-to- machine (M2M) learning. The main idea behind IoT is to have independent, self-governing connection that is secure and allows exchanging of data between real world physical devices and real applications [3]. The Internet of Things is a popular research area for industry, academia and government as well.

Many international organizations in Europe and America are actively participating and contributing to the design and devel- opment of IoT in order to gain various beneficial and robust automated services [4]. The services built using IoT also have to undergo and surpass many security-related challenges. Smart Card may be recognized as a plastic card that consists of a microprocessor that has the capability to perform calculations. The chip embedded on the card is usually an integrated circuit (IC). The information in a smart card is preserved electronically and it can control the access and modifications to that information. The IC is responsible to store the information in a way that it makes easy and secure for the authorized user to access this information by using a "reader" (data acquiring and processing equipment). The smart cards can be majorly categorized in two types: a memory card and a microcomputer integrated circuit. The former, i.e. the memory card can only store the information or certain values. Examples can be a simple toll card or a phone card. The latter, i.e. microcomputer integrated circuit not only stores the information, but also allows different ways to access that information. The IC consists of a Central Processing Unit (CPU) which is able to store the information and keep it secure Smart card have two different type of interfaces: contact and contact less. Contact smart cards are inserted into a smart card reader, making physical contact with the reader. However, contact less smart cards have an antenna embedded inside the card that enables communication with the reader without physical contact. [27]The standard for contact less smart card communications is ISO/IEC 14443 and allows for communications up to 10 cm (3.9 in)

Smart cards commonly use the ISO/IEC 7810 ID-1 format their standard size is 85.6 X 53.98 mm (3 3/ 8 in 2 1/ 8 in) and rounded corners with a radius of 2.88–3.48 mm. Smart cards provide ways to securely **identify** and **authenticate** the holder and third parties who want to gain access to the card. A PIN code or bio metric data can be used for authenticcation. Smart card technology is capable of storing the information present in possibly all the cards that we majorly use these days, like credit cards, toll cards, driver license, birth certificate records, phone cards and many more. If all of this information is securely stored in one card, it will prove to be highly beneficial to both, the users and the issuing agencies.

Implementation of Smart Card for Vehicular   Information

A. Smart Cards for Traffic Management

In today's scenario, one of the major concerns in metropoli- tan regions is the traffic on the road. As per the report of World Health Organization, more than 1.25 million people die due to road traffic injuries every year.

From India's perspective, over 1,37,000 people lost their lives in road accidents in the year 2013 alone, accounting to larger numbers of deaths than that of all the wars put together.

Several Smart Cards have been made in order to regulate the traffic on the road. Smart Cards for Automated Parking to ad-

Fig. 1. Smart Card working& final sample

dress the road calamities due to parking space issues have been made. Smart Cards to avoid long queues at the toll booths, which previously led to slowing traffic on highways and hence, accidents, have been made to automate toll collection. The government has also initiated some projects where the information regarding the driver's license and the registration certificate (RC) of the vehicle has been embedded in a same card, eliminating the need for different documents. This has also helped in identifying fake driver licenses and registration certificates. Stolen vehicles could also be easily traced. In this paper, a system has been proposed consisting of a smart card that will be able to store the crucial vehicle information like the vehicle registration details, vehicle type, vehicle owner's license details, vehicle pollution details, vehicle Challan details and vehicle insurance details on a single card. This information will be stored in a central repository/database which will fetch the desired data at the front-end application. The aim is to reduce the manual intervention and to save the paper at the same time.

The underlying concept of the smart card would be the Internet of Things (IoT). The prototype proposed in this paper makes use of RFID technology because the cards developed using RFID cannot be cloned, minimizing the chances of vehicles being stolen. In the last few years since the IoT has gained popularity, smart cards have extensively used to develop various auto- mated systems. Smart Cards have lately been used in many different sectors such as transportation, healthcare, education, telecommunication, financial sector etc. Some of the notable efforts where these cards have been used to provide useful applications have been discussed in the next section of the report. In this paper, we have embedded all individual services example, like Vehicle Registration Copy, Driving License, Vehicle Insurance & Vehicle Pollution details into a single card by using IOT services. This novel work can help the Traffic

Department by retrieving information less than a minute.

The rest of the paper is divided into following section's Section 2 describes Literature Review. Section 3 describes Project Design and Implementation. Section 4 contains Results and Section 5 contains Conclusions. Section 6 of the paper comprises the Future Prospects that can be incorporated in this system to make it more robust and even more efficient. Lastly, the paper contains a list of all the references that have been used in this paper.

II.   LITERATURE REVIEW

In certain studies, an algorithm to treat real-time parking has been proposed by the authors. An algorithm for scheduling the system of parking from online to offline was used, and then a mathematical model to describe the offline problem based on a linear problem was set up. Lastly, an algorithm was developed in order to compute the linear problem. The algorithm proposed was then evaluated with the help of some simulations of the final system. Gayathri G, et al., in their paper proposed an On-road Card for automating the parking and toll collection systems. The paper highlighted the need to have such a card and then by the use of IR sensors, RFID Tag, RFID reader, proposed a system to automate parking and toll collection. The authors addressed the issue of unnecessary traffic on roads due to people in search of a parking spot and long queues at toll booths on highways which in turn slows down the traffic, leading to accidents. Both of these issues are resolved by this on-road card where the user can prebook and cancel the parking slot by using the application.

Also, The card is able to automatically pay for the tolls at toll booths as and when the vehicle installed with RFID tag crosses the booth [15].

A lot of efforts have been taken to develop Smart Cards to automate various processes in the healthcare industry. Some of the notable efforts are mentioned below: Geylani Kardas and E. Turhan Tunali, in their paper "Design and implementation of a smart card based healthcare information system", have proposed a system that intends to store patient's personal information and transfer health-related data [16].

The system works on two smart card modules- one for the patient, which saves his general health information and other one of the health care providers through which they can access the patient information. For secure and authenticated communication, the cards are protected by digital signatures and encryption keys.

India is a developing nation, is continuously working towards building a robust ICT infrastructure and the government is coming up with initiatives such as "Digital India" and "Skill India" to join hands with the developed nations on the paths of digitization. In a past few years, various projects have been deployed involving the smart card technology. Some of these notable initiatives are discussed below [22]:

• Resident Identity Card Project: The Government of India made it compulsory for all the citizens and non-citizens to get registered. In this scheme, each citizen will be allocated a smart card that will hold his identification information. This card is further linked to the Aadhar Card of the citizen.

• Smart Card Based Driving License and Registration Certificate: The Government of India in the year 2010 introduced a scheme where every vehicle owner's driving license (DL) and his vehicle's registration certificate (RC) must be stored electronically on a smart card. The card also stores the personal identification of the owner, his digital signatures and fingerprint. The card works on the WORM (Write-Once-Read-Many) memory chip and has a microprocessor of 64 KB capacity embedded in it. The aim to implement this card was to detect fraud licensees and track the vehicles that have been stolen.

• Biometric Electronic Passports Project: The Government of India had started a project to switch the passports of Indian citizens to electronic, bio metrically operated smart passports. This smart passport is a contactless smart card that works on radio-frequency based chip (IC). It contains information regarding the passport holder's name, photograph, age and gender. The bio metric details such as fingerprints and facial patterns, etc. are also stored on the card. These projects initiated by the government ensure the future of e-governance and digitization in India. Many such projects are still under progress. Therefore, after an exhaustive review of the work done and the work being done in different sectors involving Smart Card technology, we can say that the concept of smart cards is not new. But a lot has still been left to harness its potential completely. After

surveying an extensive amount, no such Smart Card that stores all vehicle-related information such as driver's license details, vehicle registration details, vehicle pollution details, vehicle owner's Challan (fine) details, his previous offenses, vehicle insurance details etc. have been made yet. Therefore, to automate the entire vehicle-related processes, in my paper, a system has been proposed

III. PROJECT DESIGN AND IMPLEMENTATION

The proposed system will be implemented in vehicle management and control organizations. The prototype designed here intends to illustrate the functions and operations of such a system and the way it interacts with its users, i.e. the vehicle owners and the traffic management authorities (traffic policemen). The system is developed to gather the information about the environment that this card will be used in, here environment being trafficked management in mega cities. Designing a smart card to store vehicular information requires the design of the card, i.e. what type of the card to use, security features to be added to the card, functionalities of the card and what type of data it stores.

The proposed system has two major users- the vehicle owners and the traffic policemen. Both the users interact with different aspects of the system. The price of a smart card depends upon its capacity.

A. Hardware Configuration of the Proposed System

1) Approach: The system proposed in this paper "Integrated Smart Card for Vehicular Information" may be implemented using different programming and embedded languages based on the requirements. The prototype developed in this project can be used to illustrate various possible applications and features of smart cards to store vehicle related information. In order to design a smart card system for storing vehicle information, the designing of the smart card in itself is crucial. Various aspects such as what type of the card is to be used, what all applications, it can work on and what data has to be stored on the card etc. need to be decided beforehand.

2) Security Aspects: When working with smart cards, security is a key concern as these cards can be used maliciously for committing frauds. The risk becomes greater when the card is also being used to store some monetary amount. It is of utmost importance to provide the access to facilities to authorized smart card holders. Therefore, these resources need to be protected from unauthorized access by providing robust Access control and user authentication in a distributed envi- ronment [17]. The security features on the cards are different for different cards such as encryption of crucial information, inclusion of codes like PIN, passwords etc

3) System Features: This section of this paper will elaborate all the features and applications of this proposed smart card system for vehicular information.

The features are in- cluded such that the vehicle owner need not carry multiple cards like registration certificate of the vehicle, his driving license, his vehicle pollution papers, his vehicle insurance documents and even money to pay Challan or fine in case   a policeman stops him to charge a fine on him due to any traffic violations.

4)   Registration Certificate: The registration certificate number of the vehicle will be stored on the smart card so that the need to carry a separate RC card is eradicated. The policeman can view this RC number of the vehicle by flashing the vehicle owner's RFID smart card on the RFID reader attached to his device. As soon as the policeman scans the smart card on the reader, the details stored on the card such   as the RC number will flash on the 20*4 LCD display screen present on the policeman's device

5) Driving License: The Driving Licence (DL) of the vehicle owner is embedded on the smart card. This will allow the vehicle owner to carry just a single smart card and there is no more the need to carry the driving license separately. The policeman can view the driving license number of the vehicle owner/driver by flashing this smart vehicle card on the RFID reader attached to his device. As soon as the policeman scans the smart card on the reader, the details related to the DL can be viewed from the 20*4 LCD display screen present on his device work flow in figure 4.

6)   Vehicle Insurance Details: For a vehicle owner, it is mandatory to get the vehicle insured. If not, fine is charged upon the owner. Therefore, the vehicle owners need to carry the insurance related documents while traveling Anywhere. These documents can be checked by the traffic authorities or traffic policemen anytime and anywhere. To eradicate the need to carry these insurance documents, the insurance due date
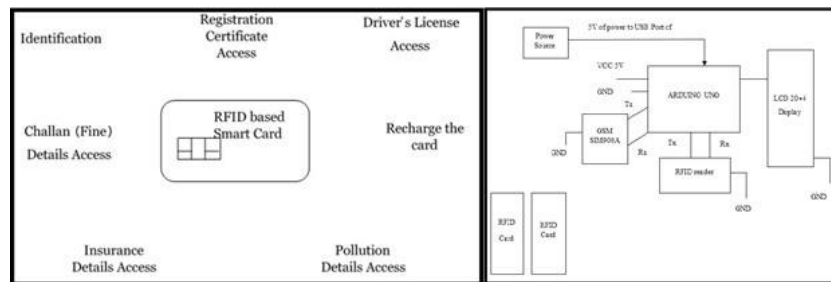

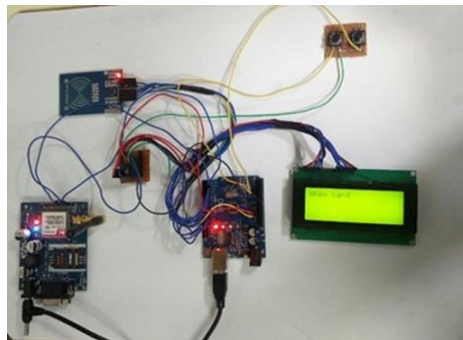Fig. 2. Overview of theIntegrated Smart Card for Vehicular Information System & Connections among Hardware Components

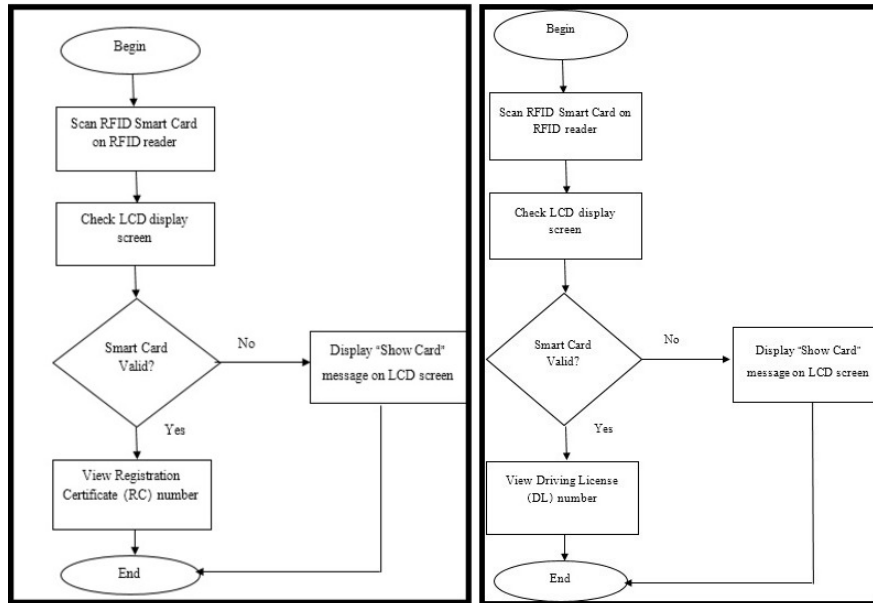**Fig. 3. Connections amongHardware Components of the Proposed System**

Fig. 4. Flowchart for viewing Registration Certificate (RC) & Driving License(DL)

is embedded into this smart card so that the policeman can directly check whether the due date is expired or not. As soon as the policeman scans the RFID smart card on the RFID reader, the insurance due date is displayed on the LCD display screen on his device. Accordingly, if the insurance due date is expired, fines will be deducted from the vehicle owner's smart card if it has enough balance. If the card is not recharged, then the vehicle owner can pay the Challan amount (fine) in cash. To deduct the Challan amount (fine), the policeman will press a button on his device. As soon as this button is pressed, 100

INR (in this prototype) will be deducted from the owner's smart card and a message will be sent to his registered mobile number regarding the same stating the reason as "Due Date Expired"

The flowchart given in figure 5 depicts the steps needed to check the vehicle insurance due date by the traffic policeman and charging a challan or fine if the due date is expired.

7) Vehicle Pollution Details: It is mandatory for a vehicle owner to get the pollution of the vehicle checked at regular intervals. If not, fine is charged upon the owner. Hence, the
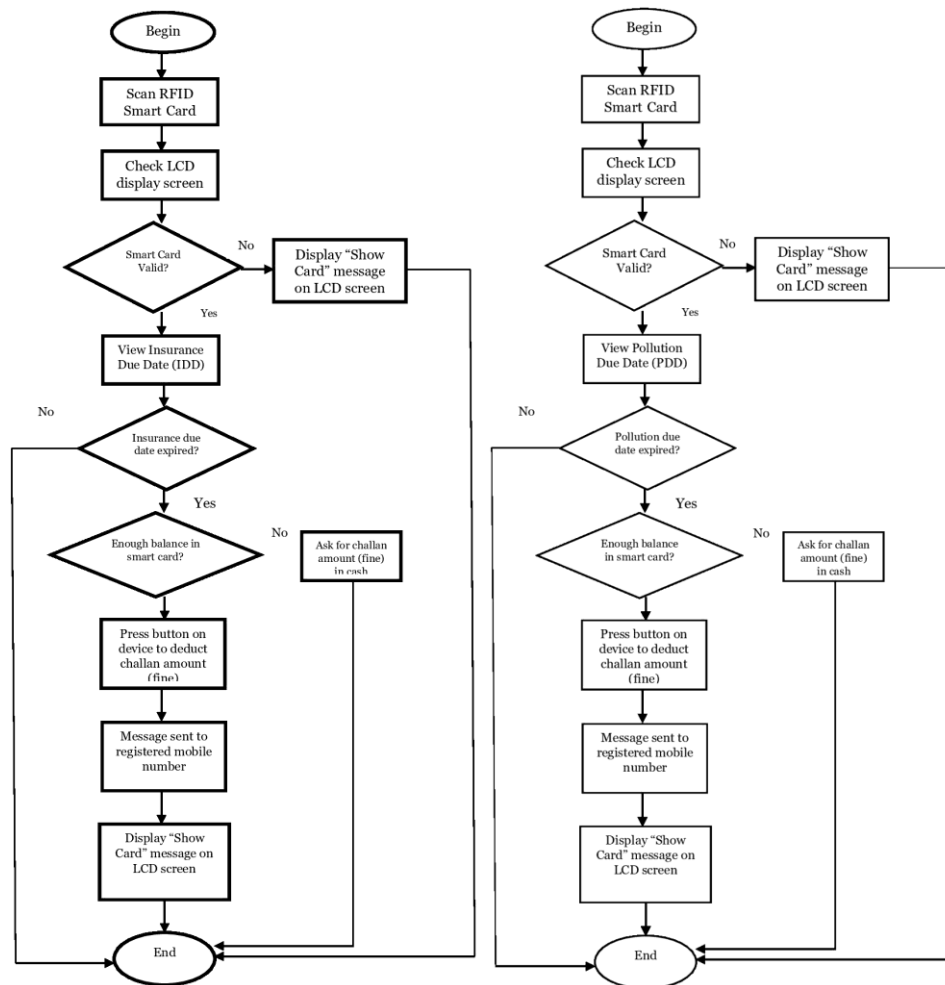
Fig. 5. Flowchart for viewing Vehicle Insurance Details & Vehicle Pollution Details

vehicle owners need to carry pollution related documents whenever they are on the road. These pollutants related docu- ments can be asked for and checked at any point of time by the traffic authorities or traffic policemen. The need to carry this pollution related documents is curbed as the vehicle pollution due date details are stored on the proposed smart vehicle card. The policeman can directly check whether the pollution due date is expired or not by flashing the smart card to the RFID reader on his device. As soon as the policeman scans the RFID smart card on the RFID reader, the pollution due date   is displayed on the LCD display screen on his device. If the vehicle pollution due date is expired, fines will be deducted from the vehicle owner's smart card if it has enough balance. If the card is not recharged, then the vehicle owner can pay the Challan amount (fine) in cash. To deduct the Challan amount (fine), the policeman will press a button on his device. As soon as this button is pressed, 100 INR (in this prototype) will be deducted from the owner's smart card and a message will be sent to his registered mobile number regarding the same stating the reason as "Due Date Expired".

The flowchart given in figure 5 depicts the steps needed to check the vehicle pollution due date by the traffic policeman and charging a challan or fine if the due date is expired

8) Deduct Challan for Transport Rule Violation: The RFID based smart cards in this prototype are   initially recharged with a fixed amount of 500 INR. If the vehicle owner/driver commits any traffic rule violation such as jumping the red signal light, drinking and driving, over speeding etc., the policeman can directly deduct the challan amount (fine) from the former's smart card. This will promote the concept of "Smart Living" as money is stored in the form of plastic money and there is no need to carry cash. As soon as the policeman scans the RFID smart card on the RFID reader, the balance present in the card is flashed on LCD display screen on policeman's device. If the card has enough balance for the challan amount (fine) to be deducted, the policeman will press the button present on the device in order to deduct the amount. If the challan amount (fine) is deducted successfully, a message will be sent to the vehicle owner' /driver's registered mobile number with the reason   stated as "Others".
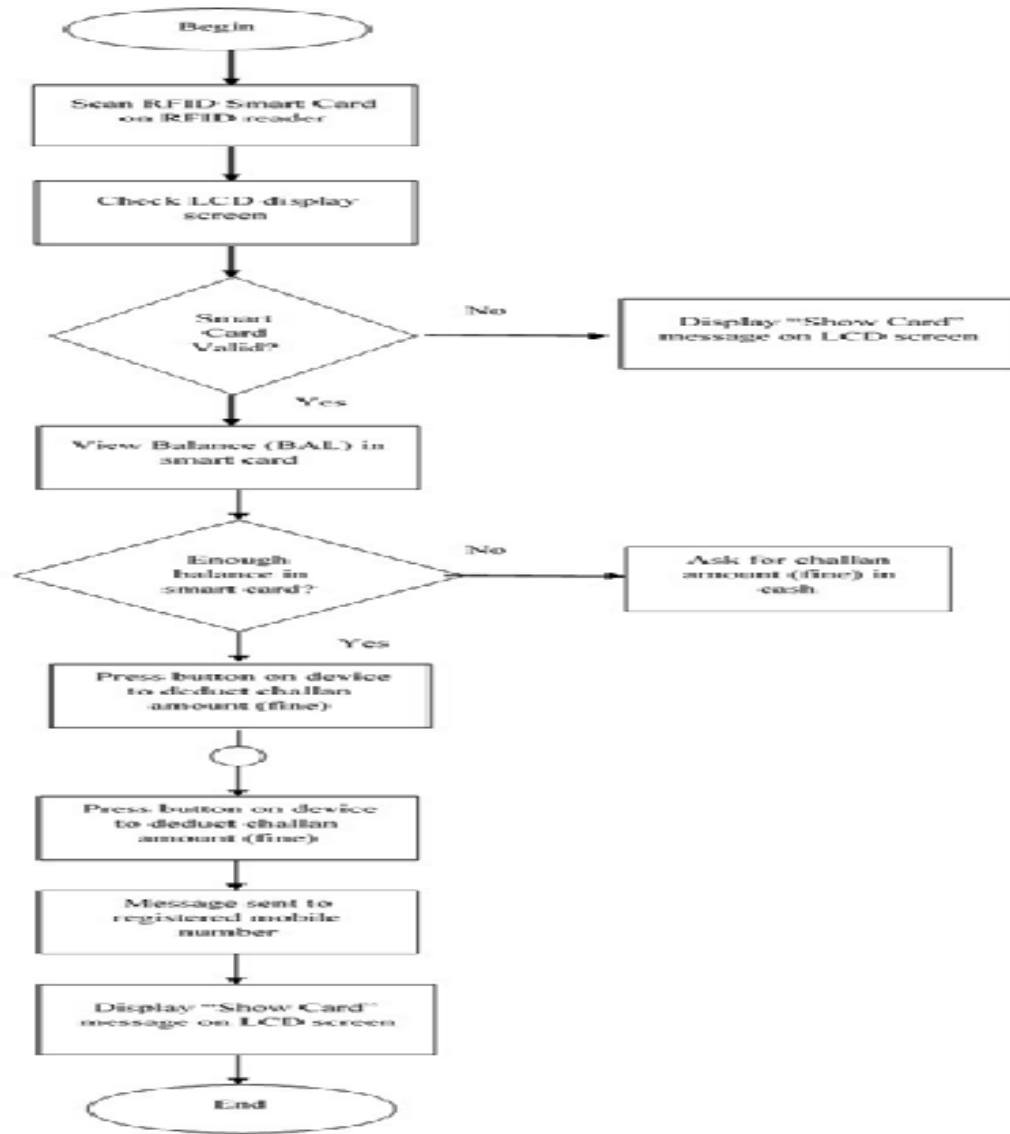
Fig. 6. Flowchart for Generation of challan & Amount (fine) for traffic rules violations

IV.   RESULT

A. Welcome Screen

As soon as the system is turned on, a message as depicted in the figure below is shown on LCD 20*4 display screen. Once the welcome message disappears after 5 seconds, a message saying "Show Card" is displayed on the LCD display screen asking the traffic policeman to scan the RFID smart card on the RFID reader attached to his device.

B. Scan RFID Smart Card on RFID reader

When the "Show Card" message appears on the LCD, the policeman scans the RFID Smart Card on the RFID reader attached to his device. As soon as the RFID smart card is scanned to the reader, all the details regarding the card owner's vehicle appear on the LCD display screen.

1) Driver' s License & Registration Details on screen:
When the RFID Smart Card is scanned on the RFID reader, the policeman can view the Driver's License number (DL) & Registration Certificate (RC) number of the user

2) Vehicle Insurance Due Date (IDD) & Vehicle Pollution Due Date (PDD) on screen: When the RFID Smart Card is scanned, the policeman can look at the Vehicle's Insurance due date & Pollution Due Date on the LCD screen. If the due date is expired, a challan or fine will be deducted by him.

Here, as the vehicle's pollution due date (PDD) is expired, as it is 20/04/2019, a challan or fine will be charged on the vehicle owner

3) Deduct Challan or fine from RFID Smart Card: If the vehicle's pollution or insurance due date is expired, the policeman will press a button on his device to charge the challan or fine on the vehicle owner. If the owner's smart card has enough balance, challan (fine) amount will be deducted from it, otherwise, he can pay the challan or fine amount in cash.

As soon as the policeman presses the challan or fine deduction button on his device, the RFID Smart Card shows updated balance on the LCD display screen as illustrated in the figure below.

Once, the amount is deducted, the owner will receive a message regarding the same on his registered mobile number.

If the message is sent successfully, the LCD screen will again display the "Show Card" message as below. Once the "Show Card" message appears on LCD, it depicts that the SMS regarding challan or fine deduction has been successfully sent on the user's registered mobile number. The SMS screenshot is given below

V. CONCLUSION

This paper proposes an "Integrated Smart Card for Vehicluar Information" system that is intended to store all vehicle related crucial information. The RFID based smart card developed in this project will eliminate the need to carry multiple cards like Driver's License (DL), Registration Certificate (RC) of the vehicle, vehicle's insurance and pollution documents, etc. This system will allow the traffic authorities to easily detect frauds and duplication of DL and RC numbers. The policeman can view the information stored in the smart card by scanning it to the RFID reader. Also, the vehicle owner can pay his Challan/fine through this card by simply scanning it to the RFID reader attached to the policeman's device. This will eliminate the need to always carry cash while traveling to pay a Challan / fine, if need be. The Arduino board embedded in the policeman's device will ensure the connection with the LCD display screen and the GSM SIM900A. The GSM will send the SMS to the user's registered mobile number when the challan/fine amount is deducted from his smart card stating the reason for the deduction. This project is developed keeping in mind the Indian government's smart city mission. Such a card will promote the concept of smart living amongst the people of India.

FUTURE PROSPECTS

The Integrated Smart Card for Vehicle Management system proposed in this paper is a prototype of the system that can be enhanced and upgraded further to incorporate numerous features that will ease the process of vehicle management in mega cities and smart cities. Presently, this prototype is made statically for a limited number of users. This can be made into a nationwide system in which a database can be maintained on the backend to store the details of millions of vehicle owners who register themselves with the system. The database can be made to store crucial vehicle related information such as driver's license number (DL), registration certificate (RC) of the vehicle, vehicle insurance and pollution details dynamically.

Currently, in this prototype, the cards are initially credited with a fixed balance of 500 INR. In the enhancement of this system, the facility to recharge the card with any amount dynamically can be added.

Also, in the proposed smart card system, RFID based smart cards are used which cannot be cloned. This ensures user safety and protection against malicious attackers. But these cards can be anytime stolen and misused. Therefore, a feature to encrypt the data saved in the card such as a key encryption (cryptography), bio metric or any other robust algorithm can be used in the future. This system can also be used to add more functionality to it pertaining to vehicle related information to ease the process of vehicle management even further. The bank account of the vehicle owner can also be linked to the smart card so as the need to recharge the card is eradicated and the owner can directly pay Challan or fines from his bank account. These are some of the possible features that can be added to this prototype to make it highly beneficial in the vehicle management process. This will reduce the work of traffic management authorities or traffic policemen also. On the other hand, the vehicle owners will not need to carry multiple cards while traveling. The system is intended to promote the concept of Smart Cities and Smart Living
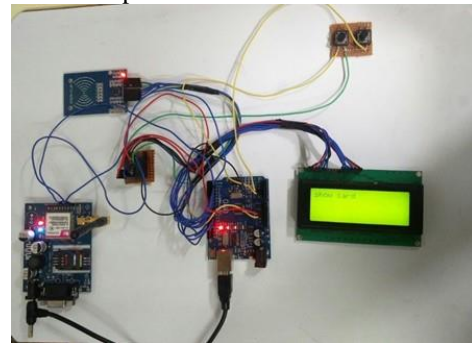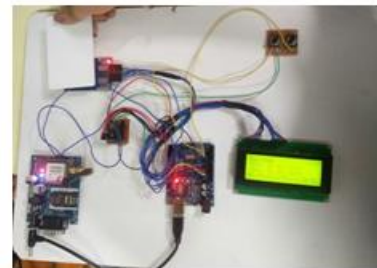

Fig. 7. The Show Card Screen

Fig. 8. Scanning the RFID Smart Card on RFID reader

Fig. 9. DL-1C-1278 Registration(RC)Details on LCD &12678 User's Driver's License Number (DL) on LCD

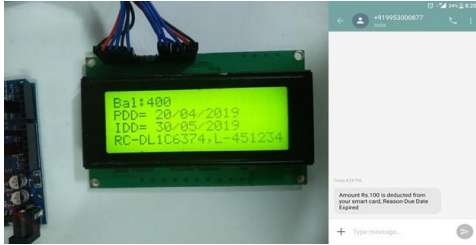Fig. 10. Vehicle's Insurance Due Date (IDD) & Pollution DueDate(PDD) on LCD

Fig. 11. SMS On Registered Mobile Number

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