Vehicle Security Using RFID and QR Code Authentication System

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***Abstract*- Now a days most of the toll collection systems are automated, they don't let you wait for long time in queue to pass the vehicle and to collect the toll amount.This automatic toll collection is done through RFID system, where an RFID tag is scanned by the RFID reader and it automatically reduces the toll amount from the user's provided account. Such a system is very helpful as it eliminates the waiting time, but they don't provide any security related to vehicle theft.Their main objective is to identify the object on the basis of combination of tags and readers. But this type of technology comes with many security challenges. To overcome all these limitations related to vehicle security and RFID system, in this paper we proposed a new technique related to vehicle security and by double authenticating the vehicle when it passes through the automatic toll collection system with the help of RFID based authentication system. The experimental results show that with the help of this system we can authenticate only authorized vehicle to pass through the toll and we can also track if the vehicle is stolen.**

***Index Terms*- RFID, Card, Reader, Arduino, ESP8266, QR tags.**

I. INTRODUCTION

Transportation plays an important role in the economy of a developing country. Development in transportation system can result in many factors like it reduces transportation time, which can be used to accomplish better lifestyle, increase in production and services, employment etc. Because of all these reasons we can say that the economic growth of any developing country mostly depends on the transportation system of that country. But for the better transportation, increase in the number of vehicles on road, leads to the increase in the number of problems also. All these problems related to the transportation are handled on different levels to reduce factors such as pollution, transportation time etc.

One of those techniques to improve the transportation system and to reduce the transportation time is, Automatic Toll Collection System (ATCS) [11], [14], [15]. Such systems work on the basis of an RFID system. The main objective of an RFID system is to identify the object on the basis of combination of tags and readers. ATCS is capable of automatically verifying the vehicle and if the vehicle is registered with the system then toll price is deducted from the user provided account. The main advantage of this system is that, they don't let the user wait for long time in queue to pass the vehicle and to collect the toll amount which reduces the congestion in toll plaza, reduces fuel consumption, reduces engine acceleration and air pollution especially for the days when the traffic is higher than normal.

Beside all these advantages, most of the existing ATCS work is to collect the toll from the vehicle passing through toll plaza; they don't provide any security related provision to track the stolen vehicle or to catch the unauthorized . Also RFID based systems come with many security challenges. Generally RFID tags contain user related data which are scanned by RFID readers and then processed with the help of database systems. RFID systems suffer from many securities related problems such as tag imitation, server imitation, reader imitation, response hack [13]. To improve the security related to RFID tags many techniques are proposed such as cryptographic technique [8], elliptical curve technique [12], hash function [2], [4] and many more illustrated in literature survey section.

In this paper we investigate the problems related to RFID based systems in the view of security and also we are studying different ATCS which only work for toll collection and don't give any provision related to vehicle security. To mitigate all the disadvantages of the existing systems we propose a novel approach for vehicle security called Vehicle Security Using RFID

Authentication System. In this approach we provide double authentication to the vehicle passing though toll plaza, first with help of RFID tag and after that we match the user provided data with the database stored data with the help of QR code. If the information given by the user while authenticating the vehicle matches exactly with the stored information then the vehicle is authorized to pass through that toll plaza otherwise a message will be sent to the owner with the vehicle location, so that the vehicle can be tracked.

II. RELATED WORK.

Automatic toll collection system really helps to reduce the traffic congestion caused due to the increase in the number of vehicles. An automatic toll plaza scans the RFID tags mounted on the vehicle and if the details match with the central system then it deducts the amount from the user's account [11], [14]. A similar concept is also given in [15] where they use RFID tags for the toll collection and GSM model to inform the user about the deducted amount by toll plaza. As most of the existing works are done only for toll collection, none provides a technique to detect vehicle theft. In [11] for the vehicle security, to track vehicle theft they come with one technique in which user has to register a complaint for the missing vehicle and if that vehicle passes through any toll plaza then that vehicle will get tracked. The main drawback of this system is that, the user has to register a complaint. Rather than toll collection RFID is also used in many different applications. One of such fields is heath care [9] where RFID tags are used to monitor or to get the patients data for the treatment.

The RFID technology provides authentication very accurately without any requirement of line of side matching and because of this it is used in most of the applications for the authentication purpose [2]. However this technology has numerous advantages but it suffers from several problems related to security and data privacy [4], [5], [7], [8], [10]. So much is done to provide data security and privacy in RFID techniques. A hash based mutual authentication protocol is given in [4] to provide data security in RFID tags. In this a unique value generated by the tag is encoded with a secret key and this is embedded to the series of messages generated to securely transfer the data to the server. An another method [7] proposed a Random Flipping Random Jamming protocol, uses physical layer of the network to form a secure communication in distributed RFID system. To provide more security [10] a new architecture for passive RFID tags are designed to encrypt the data. They used AES-128 with Elliptical Curve digital algorithm to securely pass the data from tag to the reader. [13] Studied various security related problems during product authentication and proposed a hash chain of a one-way cryptographic hash function based on QR code technique to authenticate the product.

Rather than improvement of RFID tags [1] works for the security and proper authentication for which they contribute to derive the general chain of trust as well as security requirements of RFID-based product authentication. A self validating and visualization system by using RFID and EPC concept to protect the product from an unauthorized person by means of mobile platform is given in [5].

III. METHODOLOGY

1. Arduino UNO:

arduino is an open source software, hardware project and a user community that designs user based manufucturing micro-controller system. It can design a digital device and controls objects in the world.

Fig. 1. Ardunio unio.It controls the RFID detection tag to sensor and sends information into the server.

Basic pin information on Ardunio.

Pin	Info
SDA	Digital 10
SCK	Digital 13
MOSI	Digital 11
MISO	Digital 12
GND	GND
RST	Digital 9
3.3 V	Only 3.3v not greater than

Table 1. Ardunio pin.

2. RFID Tag:

It's a Radio Frequency Identification tag which works on the frequency for tracking purpose. It has its own tag, data collection, transmission and processing with read write functionality. In a tag one end is a receiver which receives a signal and one is transmitter which transfers a unique signal. Both tags are in range then detect signals through radio frequency. These passing signals are controlled by an ardunio.

IV. PROPOSED SYSTEM

In this section we present our proposed system architecture with description about the system.

A. System Architecture

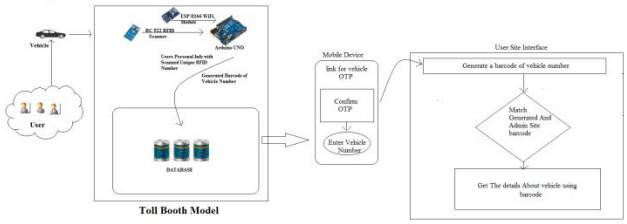

Fig.1 System Architecture

The above fig 1 shows the system architecture of our proposed system, which consists of combination of hardware and software parts. Whenever a user vehicle, which is RFID enabled passes though any toll plaza, then that RFID tag is scanned by the RFID scanner mounted on that toll plaza. After scanning the RFID tag it gives a unique ID. This ID is then used to get vehicle information and its related owner details from the database. For the vehicle authentication it sends a verification link on the owner's registered mobile number. In response to this link it opens a page on owner's mobile where the owner has to enter his vehicle number. After entering the vehicle number this user provided vehicle number and the database stored vehicle number is matched to investigate if the vehicle is authorized and if that code doesn't match or in a given time constraint if the owner doesn't respond to that link then the vehicle information with its GPS location is sent to the owner. If that vehicle is stolen or taken by any unauthorized person then it generates a response message from the system that the vehicle is tracked within a small period of time. In this way we can achieve the security for the vehicle while passing through the toll plaza.

Hardware: The hardware used in this section contains arduino Uno, RC522 RFID scanner, ESP8266 WIFI module and passive RFID tags. In this system RC522 and ESP8266 modules are connected to arduino Uno. ESP8266 is used to connect the hardware section to the server to send the data scanned by RFID scanner for the further processing.

QR Code: QR Code (Quick Response Code) is developed by Denso Corporation in 1994, as shown in Fig. 2. There are 40 versions in QR Code, four levels of error correction, and the maximum symbol size (the highest version) can encoding 7089 numeric data or 4296 alphanumeric data. The highest level of error correction allows recovery of 30% of the symbol code words. The QR algorithm consists of two separate stages. First, by means of a similarity transformation, the original matrix is transformed in a finite number of steps to Hessenberg form or – in the Hermitian/symmetric case – to real tridiagonal form. This first stage of the algorithm prepares its second stage, the actual QR iterations that are applied to the Hessenberg or tridiagonal matrix. Here in this project we use QR code to match the user provided vehicle number with the database stored vehicle number for the security and uniqueness purpose.

Fig 2 QR Image

Algorithm: QR Algorithm
Input: Vehicle No as string Vn
Output: Generate QR Code
1. Compute eigen values with real matrix T.
2 for k=0 to Vn.length
3. Compute QR factorization f(qr)
f(qr)=QkRk
4. update matrix T
T=T*f(QR)
5. Ends

V. RESULTS

This section shows the experimental results of the overall system.

As shown in our system architecture, at the toll plaza section, whenever a vehicle passes through the toll plaza area, RFID tag which is mounted on the vehicle is scanned by the toll plaza RFID scanner. After the tag gets scanned, scanner gets the unique number stored in that RFID, which is then sent to the server by the scanner. At the server side, data associated to that unique number is retrieved from the server. After getting the owner information from that unique number, a verification link has been sent over owner registered email address as shown in below fig.

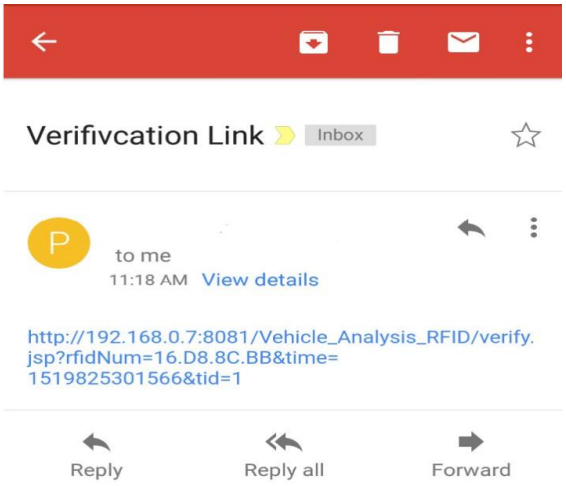

Fig 3 Verification Link

In response to this link, it redirects the owner to a verification page where the owner has to enter his vehicle number. If the owner entered vehicle number is matched with the system present vehicle number then it shows a verification successful message.

Fig.4. Verification Page

Thank You For Verification.
Vehicle Verified Successfully.....

Fig.5 Verification Successful

For the vehicle verification in our system we have given a time limit within which the owner has to respond to the given link. If the owner doesn't respond to the sent link within the specified time then the system shows a link expiry message to the owner and the system sends an email containing vehicle number and toll plaza address for which it has not responded as shown in fig 6 and 7.

Link Expired....
Contact on help line number 123456789....

Fig.6 Link Expire

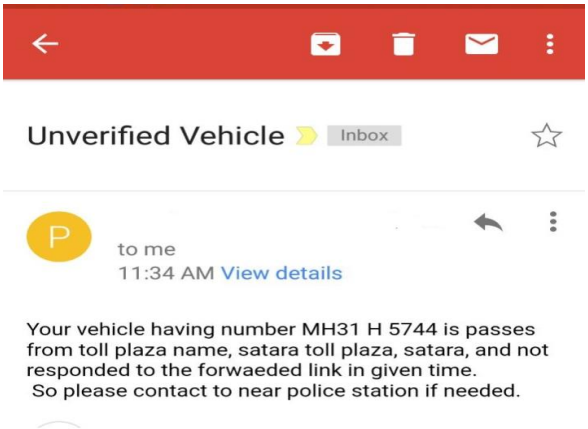

Fig.7 Unverified Vehicle

VI. CONCLUSION

In this we have discussed the use of RFID techniques in various fields and its use in Automatic Toll Collection System. We have also mentioned the limitations of most of the existing ATCS related to

vehicle security. To overcome the security related problems we have given the solution by double authenticating the vehicle while passing through the toll plaza to track the stolen vehicle or to prevent the unauthorized person to drive the vehicle without the permission of the owner. Further we have also mentioned some problems related to RFID tags regarding the security and data privacy. For this we used QR code to securely store the vehicle no in the database. The experimental results show that our system effectively authenticates the user and also is efficient to track the stolen vehicle.

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