IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 09, Issue 5 (May. 2019), ||S (X) || PP 48-54

Design and Development of Automatic Toll Collection System

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Abstract: *A automatic toll collection systems have really helped a lot in reducing the heavy congestion caused in the metropolitan cities of today. It is one of the easiest methods used to organize the heavy flow of traffic. The system thus installed is quite expedient reducing the time and cost of the travelers. An automatic toll collection system is an advanced system. Toll collection is considered as a hectic task. The collection of the toll is a tedious as well as a big task to do. The toll amount is to be paid by users manually. The main objective behind implementing this project is to provide ease to the people visiting toll sation and reduce the traffic issues. It is based on IOT and is fully automated. The system will use a raspberry pi board to control the hardware. To do it in an easy way the automatic toll collection system is introduced . This system will make the task of toll collection easy. The payment of toll will be done online with the ease of users. And when the vehicle will approach the toll center the camera will capture license plate and the amount will be deducted directly from the user's account. The user will be updated about the transactions and provide a ease via e-payment. Through this approach, the system will be fully automated.*

Keywords: *ATCS, Automatic toll collection, Image processing, Toll Authorities, Prepaid Account, Toll collection.*

I. Introduction

Automated Toll System has been implemented in some countries where the toll amount is deducted from the vehicle owner's bank account. Generally, the congestion near the toll centers is due to the people are required to pay toll amount in the form of physical cash. Also, there is a system of the smart card in current toll centers this system will also benefit to smart card holders.. The vehicles numberplate will be detected using a camera that will be placed at the toll checkpoint, with the help of which a imageprocessing technique will be implemented to extract the registration number of the car from the number plate,with the help of this extraction the details of the vehicles owner will be extracted from the database and therespective amount will be deducted, if the vehicle owner acquires a smart card, even that information will beextracted from the database because that person has already paid the toll amount in advance for a respectiveduration and the toll amount won't be collected from him/her.Automated Toll Collection in India is beneficial because it can provide a means with the help of which we can reduce the congestion near the toll collection areas and also help in reducing corruption at the toll checkpoints. Automated Toll Collection will also be beneficial for smart card holders. Vehicle owners opt for a smart card facility to reduce the cost overheads for frequent visits in the same locality. The main task is to capture the vehicles number plate in the database for which the user has register him/herself..Image processing is the first and foremost step in the project discussed in the paper.

Image Processing(OCR):Number plate recognition is a form of automatic vehicle identification. A number plate is the unique identification of vehicle. The user is also identified by the vehicle number plate for which he/she register on the application or in the RTO database. It is an image processing technology used to identify vehicles by their own number plates. Real time number plate recognition plays an important role in maintaining law enforcement and maintaining traffic rules. This technology is used for many countries in order to apply proper law enforcement on the citizen.It has wide applications areas such as toll plaza, parking area, highly security areas ,boarder's areas etc. The process starts with detection of the image captured via a high resolution camera. Number plate recognition is designed to identify the number plate and then recognize the vehicle number plate from a moving vehicle automatically. Automatic number plate recognition has three major parts: vehicle number plate extraction, character segmentation and Optical Character Recognition(OCR). Number plate extraction is that stage

where vehicle number plate is detected. The pre-processing is done on the detected number plate of user to remove the noise and then the result is passed to the segmentation part to segment the individually characters from the extracted number plate. The segmented characters are normalized and passed to an OCR algorithm. At last the optical character information will be converted into encoded text. The input can also be converted into the hash value by applying encryption algorithm to maintain the security purpose.The final output must be in the form of string.

II. Related Work

Electronic toll collection was first implemented in 1986. After that many electronic toll collection systems are implemented with different techniques. Some of them are as follows

Automated Toll Collection System Using RFID:Considering the present toll collection system where each vehicle has to stop and pay taxes. Suppose the manual toll collection system is very efficient then for one vehicle to stop and pay taxes total time taken is 60 seconds. And suppose 100 vehicles cross the toll plaza. So they used RFID card to implement an automated toll collection system. This paper gives the average estimation of the time spend on the toll collection by the people. In this system the identification is done with the help of radio frequency. A vehicle will hold an RFID tag. This tag is nothing but unique identification number assigned. This will be assigned by RTO or traffic governing authority. In accordance with this number all basic information as well as the amount he has paid in advance for the TOLL collection is stored. [1]

Automated Toll Cash Collection System for Road Transportation. Ms. Galande S.D. UG Student, S.B. Patil College of Engineering, Indapur:This system uses the GPS technology to implement an automated toll collection center. The amount of toll to be deducted and the information is obtained with the help of GPS placed inside the vehicle. As the vehicle passes through the centers the amount is automatically deducted. Improvement in transportation systems result into the improved lifestyle in which we achieve extraordinary freedom for movement, immense trade in manufactured goods and services, as well as higher rate of employment levels and social mobility. In fact, the economic condition of a nation has been closely related to efficient ways of transportation if not managed result into number of problems such as congestion, accident rate, air pollution and many other. [2]

Design of an Optical Character Recognition System for Camera based Handheld Devices: The paper gives us information about the OCR technique of image processing. Image processing is done on captured images to extract the characters present in an image. First text regions are extracted and skew corrected. Then these lines are binarized and skew corrected.The various techniques and processes are discussed and explained in this paper. Steps involved in OCR are acquisition, conversion, dilating, horizontal and vertical edge processing, passing these edges through low pass filters, segmentation, extraction, recognizing characters. [3]

Raspberry Pi Technology: A Review Harshada Chaudhari:Raspberry pi board is an innovative small computer with aos. The raspberry pi support the different OS for the execution of the raspberry pian OS along with various programming languages. Obviously we cannot install windows on it but definitely some of linux versions can be installed. This is a very helpful thing. We can perform a lot of operations through it as it supports many programming languages like C, C++, JAVA, Python, C#. In this project to control the hardware Raspberry pi board will be used. It has many applications it supports high quality video and audio playback also. [4]

III. Problem Statement and Objectives

The toll amount is to be paid by vehicle owners whenever they cross any toll center. It takes a lot of time to collect toll as the driver pays the toll amount in form of physical cash, this leads to congestion near toll center area and as well as is one of the big reason of corruption.

IV. Objectives

- Avoid financial loss.
- Provide traveller ease of toll payment.
- Avoid fuel loss.
- Reduce illegal toll gate entry.
- Avoid Corruption.
- Avoid congestion near toll centre.

V. Methodology

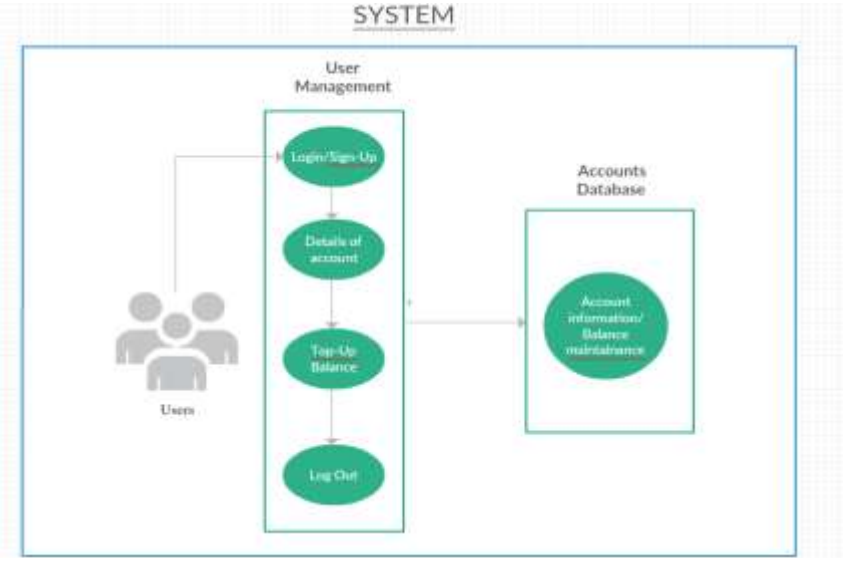

Fig 1. The Basic Architecture

The system consists of the different modules as follows:

In order to overcome the existing problems, the conventional system is proposed. The fully automated system is developed by followings the steps from image processing to online payment via web app.T he registration number will be encrypted and put on a vehicle a camera will capture this image and processing will be done on this image which will give an output. This output is the license number of the vehicle. This will be used for the transaction. A web application is developed to let users keep track of their transactions and to keep the overall application transparent. The user can check the history of the transactions. Also, admin can check if any fraudulent behaviour is going on or not.

USER DASHBOARD:

Through this module the user will be able to see the whole history of their usage. They can use it to see the transaction, expenditure and every detail of transactions. They can update, check their account balance. They can view the overall statistics. They can manage their profile.

ONLINE PAYMENT MODULE:

This module will be used to prepay the amount of tolls. The user will update the balance in their account through bank account with the help of this module.

RASPBERRY PI BOARD:

This is the board to which the hardware will be connected and will be configured. This will be responsible for opening the barricade to let user pass by once the transaction is successful.

IMAGE PROCESSING:

The algorithm used here is OCR, which has many steps from image acquisition to recognizing characters. This is the algorithm to which the captured image will be sent for processing. It is the backbone of the project and will give the output i.e. a license number which will be used for the transaction. The reason behind using this technique is that this is the most precise and easy and less complex algorithm and can be used easily. This algorithm is mainly built to recognize a stream of characters in our case it is a stream of alphanumeric stream which we want altogether not segregated.

VI. Implementation

We created an web application using Node.js technology as a platform through which user can pay their toll amount online. The implementation consist of the following steps as shown below:

Step 1: Registration and Login in of user:Every unique user must register their vehicle number in order to use the application.Once registered, user will be redirected to his personal dashboard.

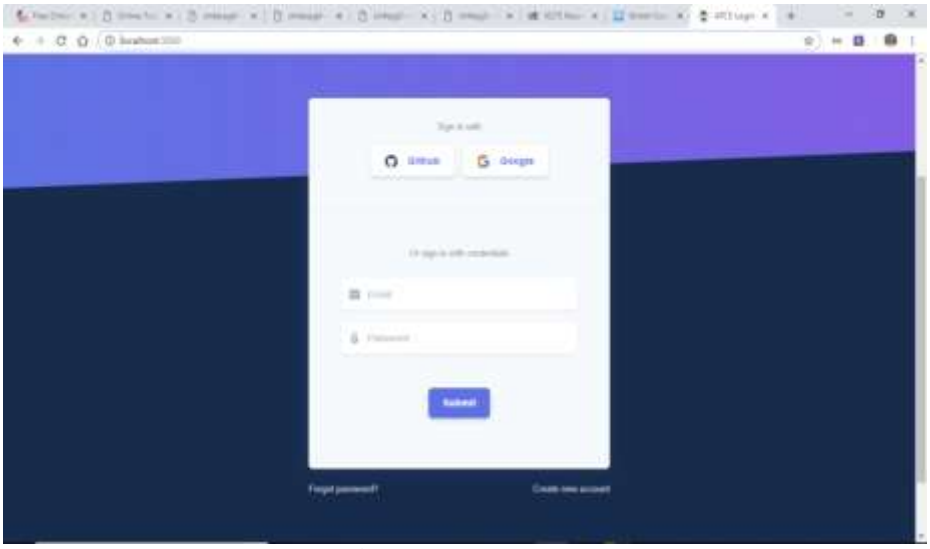

Fig 4.1 Login/Sign up

Step 2: The personal dashboard contains all information of the transactions along with parameters based upon the previous and upcoming transactions.

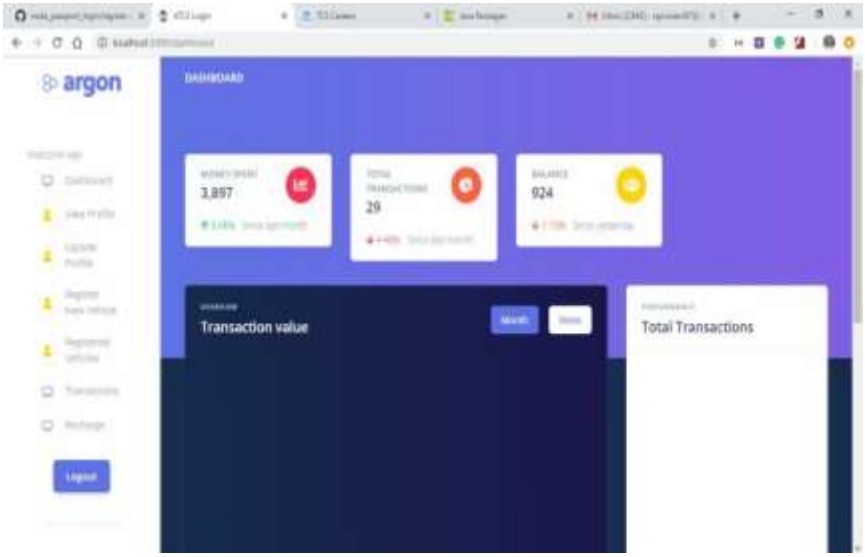

Fig 4.2 User Dashboard

Step 3:Hardware implementation:

The camera will capture the image of the vehicle number plate of the user .The query is fired to find out the registered user in the database. User Management– Here users will be redirected after login.They can view their status of balance and transactions.The detailed view of every transactionswill be shown here.The toll amount will be detected as per the type of the user A,B,C.

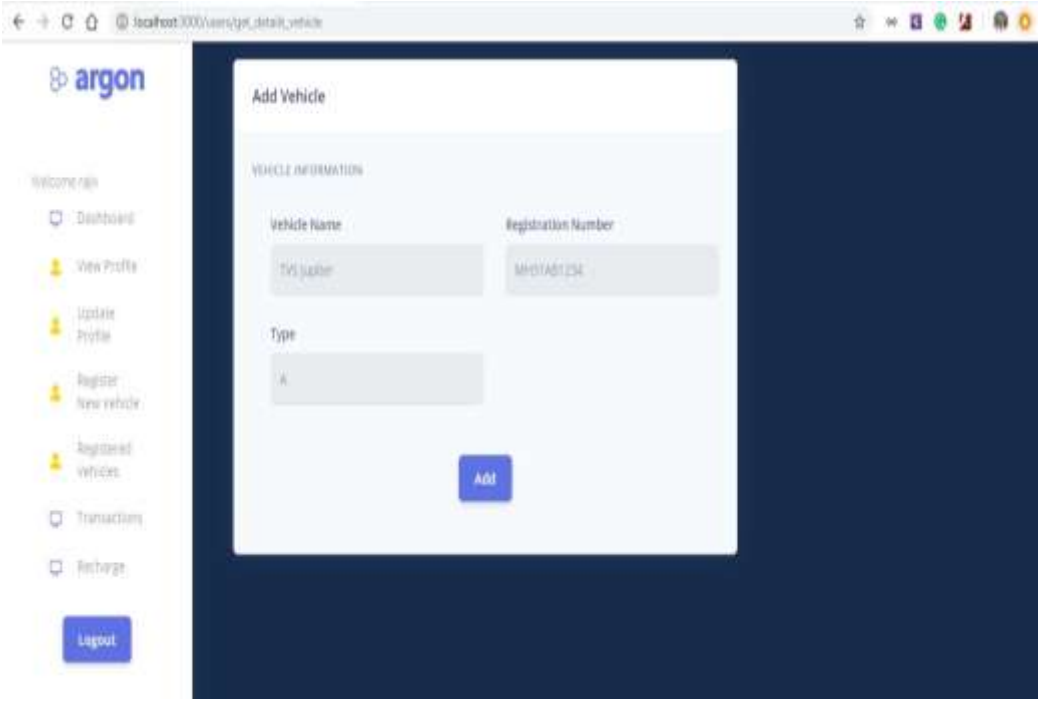

Fig 4.3 Registration of vehicle with type.

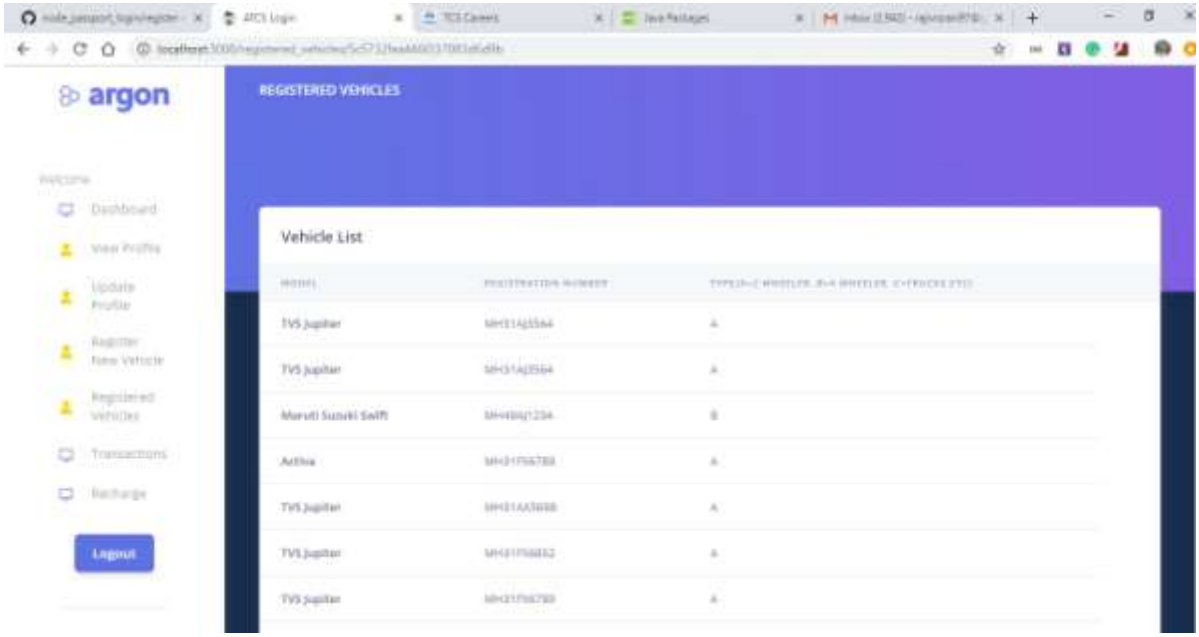

Fig 4.4 Vehicles list in database

Step 4.: The user will get the updated information of his/her profile along with the balance amount after the transaction is being processed.

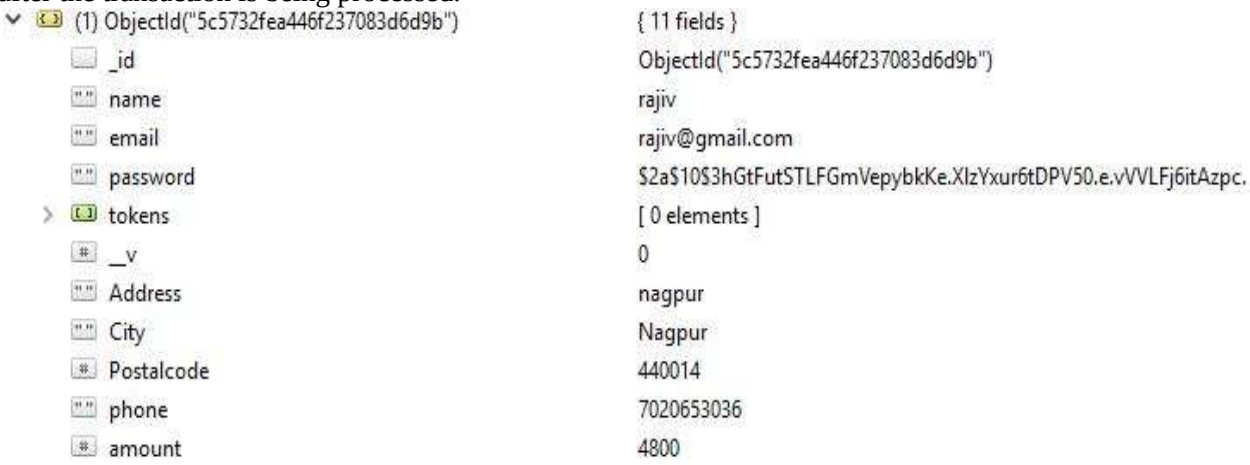

Fig 4.5 Updated account after transaction.

VII. Conclusion

In this paper , we are providing a online toll collection system so through this user's time will be saved. The toll center areas will have less congestion which will lead to less waiting time and avoid fuel consumption in aenvironmental friendly way. Overall system would be transparent letting users keep track of their transactions and behavior with the users. One of the most important impacts of technology is the development of sustainable solution that reduce the traffic conjunction and need of future generation to save energy and time. Our project mainly impact full in these aspects as shown it makes the toll collection payment easy by using automatic avoiding any fraudulent toll cash collection process.

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