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Automatic Toll Collection System (ATCS)

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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. It is based on IOT and is fully automated. The system will use a raspberry pi board to control the hardware. Toll collection is considered as a hectic task. The collection of toll is a tedious as well as big task to do. The toll amount is to be paid by users manually. To do it in an easy way 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 direct from user's account. 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.

Automated toll collection implementation in India can provide us benefits in many ways like it can reduce fraudulent behavior and can also reduce the long generation of queue near toll centers. 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 smart card in current toll centers this system will also benefit to smart card holders.

Automated toll collection system is already implemented in many countries through various techniques and these technologies are most advanced only in India this system is not implemented, through this system implementation we can lead to digitalization.

II. RELATED WORK

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. Then, time taken by 1 vehicle with 60 second average stop in a month is: 60x30= 1800 seconds Yearly total time taken = 1800x12 = 216200seconds= 6.0 hours, so they used RFID card to implement an automated toll collection system. 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]

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 and OBU unit placed inside the vehicle. As the vehicle passes through the centers the amount is automatically deducted.

Improvement in transportation systems result into the good 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. Increasing number of vehicles on the road, result into number of problems such as congestion, accident rate, air pollution and many other. [2]

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. Various steps are involved in OCR. These are acquisition, conversion, dilating, horizontal and vertical edge

processing, passing these edges through low pass filters, segmentation, extraction, recognizing characters. [3]

Raspberry pi board is an innovative small computer with a os. 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 basic 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]

This paper focuses on an electronic toll collection (ETC) system using radio frequency identification (RFID) technology. Research on ETC has been around since 1992, during which RFID tags began to be widely used in vehicles to automate toll processes. The proposed RFID system uses tags that are mounted on the windshields of vehicles, through which information embedded on the tags are read by RFID readers, The proposed system eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. Data information are also easily exchanged between the motorists and and toll authorities, thereby enabling a more efficient toll collection by reducing traffic and eliminating possible human errors. [5]

Hence the automatic toll collection system is used worldwide in collaboration with different types of technologies and hardware.

III. PROBLEM STATEMENT

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. PROPOSED PLAN

In order to overcome the existing problems the conventional system is proposed. In the proposed system the registration number will be encrypted and put on vehicle a camera will capture this image and processing will be done on this image which will give an output. This output is license number of vehicle. This will be used for transaction. A web application is also developed to let users keep track of their transactions and to keep the overall application transparent. The user can check history of the transactions. Also admin can check if any fraudulent behavior is going on or not.

*LOGIN/SIGN-UP MODULE***:**
This module will register a new user. A user must be registered with the license number of their vehicle to be able to make use of the system this module will help in that. Also user would like to see their history so they can simply login where they can see the history or can update the balance for the uninterrupted use.

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.

Following are the steps of OCR algorithm,
A. *Image Acquisition:* It is the first stage of image processing. In this step the main task is to capture the image through a high resolution camera perfectly so that it can be passed on for further processing.

B. *Conversion of Image into Gray Image:* Here original image is converted to gray scale image because to obtain the characters from license plate important edges should be considered, due to RGB that important edges can be lost. Sometimes RGB also becomes as noise.

C. *Dilating The Captured Image:* In this stage the image is dilated. Dilation is the process of filling holes in the image and removing unwanted noise from the image. It also sharpens the edges and lines in the image to recognize characters perfectly.

D. *Horizontal Edge and Vertical Edge Processing:* There are two types of histograms in a image horizontal and vertical histograms. These two are responsible for row wise and column wise sum of difference of gray scale values among the neighboring pixels. Horizontal histograms can be calculated by traversing column wise and vertical histogram can be calculated by traversing row wise.

E. *Passing the Vertical and Horizontal Histograms through low pass filters:* The values of horizontal and vertical histograms changes frequently and drastically, so these values are passed through low pass filters which minimize the loss of information and smoothens the changes. In this step the values of histograms are

averaged and filtering removes all unwanted regions in image.

F. *Segmentation:* In this stage the various areas of image are segmented. These segments are divided on the probability of characters in that region. When a character is found in any part of image it is segmented.

G. *Extraction:* From the segmented image and the values of highest horizontal and vertical histogram the region of highest probability is taken out, from this region extraction is done.

H. *Recognition of characters from Extracted Image:* Now in the final stage when extraction is performed the recognition of each character is done. Each character is recognized particularly and is given as output.

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.

ENCRYPTION MODULE:
This module will encrypt the vehicle registration number and store it in the database. This encrypted string will be printed in a particular font and put on the vehicle.

V. METHODOLOGY/FLOW DIAGRAM

When the vehicle will enter toll center, a camera will capture the image and through image processing technique (OCR Algorithm) the license plate number will be extracted. After this a search operation will be performed on database and after finding the correct match the amount will be directly deducted from account and user will be allowed to pass by.

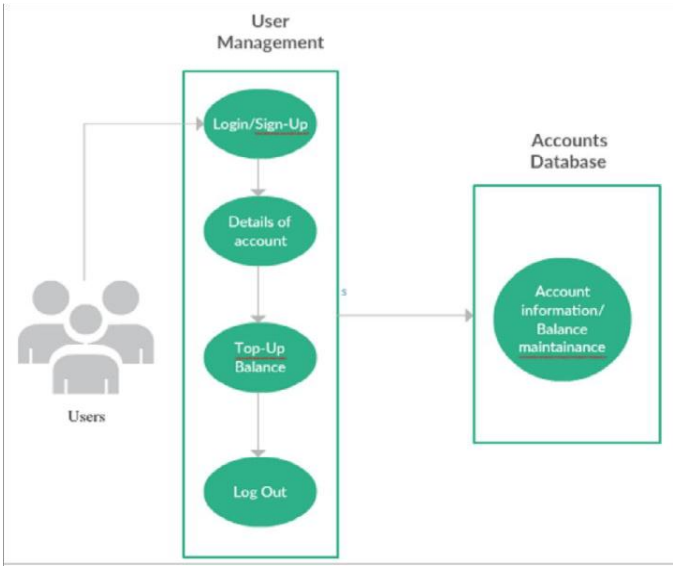

Fig 1: Use Case diagram

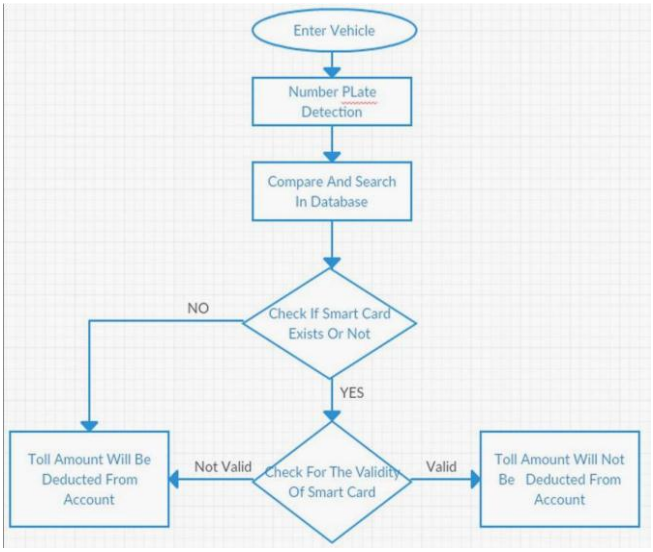

Fig 2: Data flow diagram

VI. CONCLUSION

As the system is a web application it is an online 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. It will also reduce air pollution as loss of fuel is avoided. Overall system would be transparent letting users to keep track of their transactions and avoiding any fraudulent behaviour with the users.

FUTURE ENHANCEMENTS
Here we are using an automated system to collect toll using camera and image processing. In future we can develop high tech license plates so that there is no need of camera.

Also we can make use of GPS. Also special sensors can be used and functioning like theft detection and collision detection can be added.

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