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Online Toll Payment System Using Image Processing

Bhakti Dhurat[1]*, Mayuri Ranmale[2], Dipak Mahajan[3], Rushikesh Kondke[4], Dr. S. R. Todmal[5]

[1,2,3,4] Final Year Graduate students of Comp. Engg. Dept., JSPM, ICOER, Pune

[5]Comp. Dept., JSPM ICOER

Abstract – In this 21st century, India is a developing country. To make India a developed country DIGITALIZATION can play vital role. India is currently going through the process of digitalization. Various fields are being digitalized by our Government. But at many places still traditional methods are being used. One such place is the Toll Plaza encountered on various highways. Traditional methods are very time consuming and also not secure. There is no platform till date to pay the toll fees digitally. And this causes very high rush on toll booths. This project will provide an Android App, which will help to pay toll fees through Mobile by using Credit/Debit card .This approach will go eco-friendly because of paperless transaction. Project uses the GPS technology to track the location of the vehicle. When the location of mobile enters in range of 2 km from toll booth, a notification will be sent on user mobile with details of toll and charges. The user pays toll charges without having to stop at the upcoming toll booth.

Keywords— Image Processing, GPS coordinates, Digitization, Image Capture and Mobile wallet

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1. INTRODUCTION

There is always a queue at various toll booths on highways across the country. Increased traffic and poor process of toll collection at toll booth delay the travel time. Furthermore payments are made by cash which increases transaction time. Travellers on the road are not aware of how many and when the toll booths will arrive during travelling.

To solve the problem of traffic congestion at Toll Plaza we are developing an Android Application for online toll payment. The major modification that we are planning is to provide voice notification to user. Also in the future we are looking to add feature that will allow the government cars to pass through without collecting their tax.

2. RELATED WORK

We have studied many papers, researches about automation in toll collection system at highways. At many toll plazas there is manual toll payment system which creates lots of problems. But this manual toll collection system at toll plazas is unreliable, time consuming and it creates traffic congestion. Also it leads to wastage of fuel. Many researchers have used RFID for toll collection which reduces manual labor and also leads to secured transaction process.

Also at many places, image processing is used for toll collection. Number plate of vehicle is captured using camera and then amount of toll is collected from the account number which is linked to the vehicle owner of that number plate. We have seen RFID card punch system in hostels, medical centers and offices to restrict the entry of general people. We aimed to combine those ideas and introduce something new which can be implemented at the highways and bridges to ensure security.

In some cases, vehicles are equipped with GPS tracking device which helps to get the co-ordinates of vehicle.With help of these co-ordinates vehicle will be tracked and notification about nearest toll plaza will be send to owner. Then online payment will be done by owner. For an effective and fast collection of toll, another system was developed using QR code. QR code id mounted on vehicle and that code will be read by QR code reader. Whenever vehicle arrives at toll plaza, camera captures image and send it to QR code reader for decoding process. It will retrieve vehicle database.

We are combining GPS and Image processing systems from above and trying to develop more efficient system for toll payment at highways.

3. METHODOLOGY

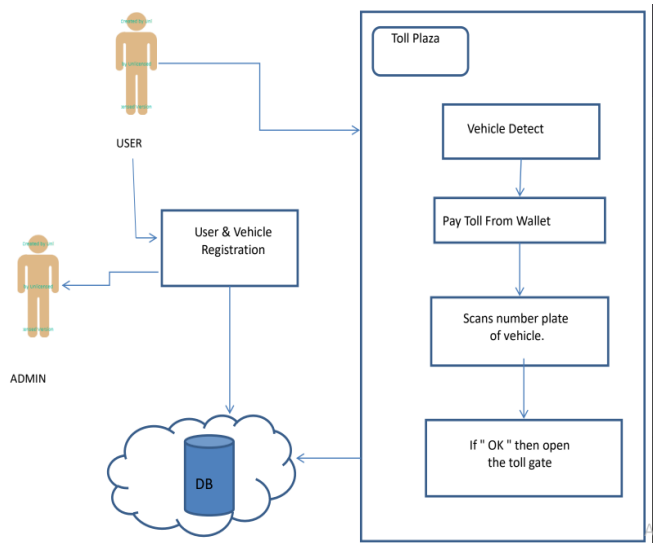


Figure 1 : Block Diagram of System

4. LITERATURE SURVEY

A. The Survey on Automated Toll System for Number Plate Detection and Collection.

Rama Takbhate, Prof. S. D. Chavan, Volume 1, Issue 3, IJIRCCE, July 2014.

In the journal the technique is to collect the toll tax with the help RFID base system to collect the toll tax automatically.

B. NUMBER PLATE DETECTION WITH APPLICATION TO ELECTRONIC TOLL COLLECTION SYSTEM :

Kannan Subramanian, Volume 1, Issue 1, IJIRCCE, March 2013.

The detection of the number plate is the part of the image processing domain, the detection of the number plate in the above journal is done with the help of the camera and then process by using the OCR image processing algorithm and the collection of the toll is with the help of RFID system is done here.

C. AUTOMATED TOLL BOOTHS AND TRACKING SYSTEM FOR THEFT VEHICLE:

S. R. Jog, S. D. Chavan, Rama Takbhate, Volume 1, Issue 2, Nov. 2013.

The major problem of the country is the stolen vehicles. The proposed work make the tracking system like that it will capture the stolen or the theft vehicle easily and collect the toll tax.

D. AUTOMATED TOLL SYSTEM FOR NUMBER PLATE DETECTION AND COLLECTION:

Ankita Bhore, Bhawana Nimbhorkar, Punam Pure, Priya Thombre, Volume 5, Issue 9, October 2016.

The work suggests to overcome the drawback of vehicle congestion, money corruption, time consumption and stolen vehicle. It uses the technique called image processing to detect the number plate and input the video and having the collection of number plates in the video.

E. AUTOMATED TOLL GATE SYSTEM USING ADVANCED RFID AND GSM TECHNOLOGY:

S. Nandini, P. Premkumar, IJAREEIE, June 2015.

The system is implemented for the toll tax collection automatically and eliminates the possible human efforts and sends the sms to the owner of vehicle by the GSM modem.

5. SYSTEM OVERVIEW

The process starts when a sensor detects the presence of a vehicle and signals the system camera to record an image of the passing vehicle. The image is passed on to a computer where software running, on the computer extracts the license plate number from the image.

LPN (License plate number) can then be verified in a central database. If number is valid for this system then LPN recorded in a database with other information such as vehicle number, time, balance, personal details. License plate numbers can also be further processed and used to control other systems such as raising a gate. These toll systems are generally composed of four main components: Sensor used for vehicle identification, LPR Camera for capturing images, Computer with TOLL, Image processing software and Gate controlled system.

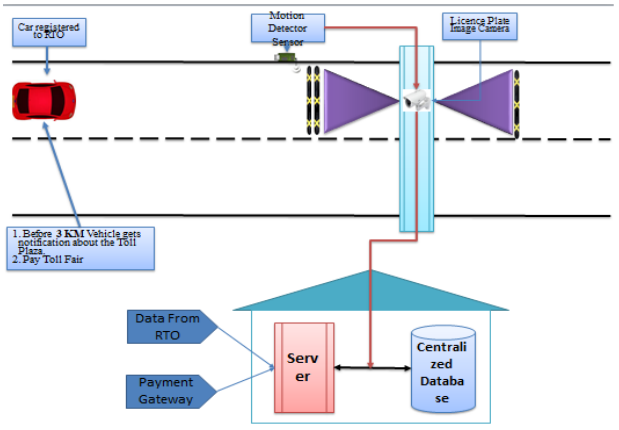


Figure 2: System Architecture

6. DESIGN COMPONENTS

1. User Registration:

Initially, user has to register himself in proposed app. Information will be stored in User Database.

2. Vehicle Detection:

Location of the vehicle will be detected by GPS System. Here, we will be using ***Haversine Algorithm.***

3. Image Processing:

Number plate of vehicle will be scanned by a wall mounted camera at Toll Plaza.

7. IMAGE PROCESSING

1. Principles of number plate area detection:-

The first step in a process of automatic number plate recognition is a detection of a number plate area. This problematic includes algorithms that are able to detect a rectangular area of the number plate in an original image. Humans define a number plate in a natural language as a "small plastic or metal plate attached to a vehicle for official identification purposes", but machines do not understand this definition as well as they do not understand what "vehicle" ,"road", or whatever else is. Because of this, there is a need to find an alternative definition of a number plate based on descriptors that will be comprehensible for machines. Let us define the number plate as a "rectangular area with increased occurrence of horizontal and vertical edges". The high density of horizontal and vertical edges on a small area is in many cases caused by contrast characters of a number plate, but not in every case. This process can sometimes detect a wrong area that does not correspond to a number plate. Because of this, we often detect several candidates for the plate by this algorithm, and then we choose the best one by a further heuristic analysis.

2. Principles of plate segmentation:-

The next step after the detection of the number plate area is a segmentation of the plate. The segmentation is one of the most important processes in the automatic number plate recognition, because all further steps rely on it. If the segmentation fails, a character can be improperly divided into two pieces, or two characters can be improperly merged together. We can use a horizontal projection of a number plate for the segmentation, or one of the more sophisticated methods, such as segmentation using the neural networks. If we assume only one-row plates, the segmentation is a process of finding horizontal boundaries between characters. The second phase of the segmentation is an enhancement of segments. The segment of a plate contains besides the character also undesirable elements such as dots and stretches as well as redundant space on the sides of character. There is a need to eliminate these elements and extract only the character.

3. Feature extraction and normalization of characters:-

To recognize a character from a bitmap representation, there is a need to extract feature descriptors of such bitmap. As an extraction method significantly affects the quality of whole OCR process, it is very important to extract features, which will be invariant towards the various light conditions, used font type and deformations of characters caused by a skew of the image. The first step is a normalization of a brightness and contrast of processed image segments. The characters contained in the image segments must be then resized to uniform dimensions (second step). After that, the feature extraction algorithm extracts appropriate descriptors from the normalized characters (third step). This chapter deals with various methods used in the process of normalization.

4. Syntactical analysis of recognized plate:-

In some situations when the recognition mechanism fails, there is a possibility to detect a failure by a syntactical analysis of the recognized plate. If we have country-specific rules for the plate, we can evaluate the validity of that plate towards these rules. Automatic syntax-based correction of plate numbers can increase recognition abilities of the whole system. For example, if the recognition software is confused between characters „8" and „B", the final decision can be made according to the syntactical pattern. If the pattern allows only digits for that position, the character "8" will be used rather than the character "B".

Another good example is a decision between the digit "0" and the character "O". The very small difference between these characters makes their recognition extremely difficult, in many cases impossible.

8. OCR TECHNOLOGY

OCR stands for optical character recognition i.e. it is a method to help computers recognize different textures or Characters. OCR are sometimes used in signature recognition which is used in bank and other high security buildings. In addition, texture recognition could be used in fingerprint recognition. OCR's are known to be used in radar systems for reading speeders license plates and lot other things. The goal of Optical Character Recognition (OCR) is to classify optical patterns (often contained a digital image) corresponding to alphanumeric or other characters.

The process of OCR involves several steps including segmentation, feature extraction, and classification. Each of these steps is a field unto itself, and is described briefly here implementation of OCR. One example of OCR is shown below. A portion of a scanned image of text, borrowed from the web, is shown along with the corresponding (human recognized) characters from that text. An OCR algorithm will be use in the system to detect the number plates of the vehicle using gray scale image representation.

1. License Plate Localization

2. License Plate Sizing and Orientation

Figure 3 : Number Plate Recognition

9. HAVERSINE ALGORITHM

The **haversine formula** determines the great-circle distance between two points on a sphere given their longitudes and latitudes .Important in navigation, it is a special case of a more general formula in spherical trigonometry, the **law of haversines**, that relates the sides and angles of spherical triangles.

For any two points on a sphere, the haversine of the central angle between them is given by

$$\operatorname{hav}\left(\frac{d}{r}\right) = \operatorname{hav}(\varphi_2 - \varphi_1) + \cos(\varphi_1)$$

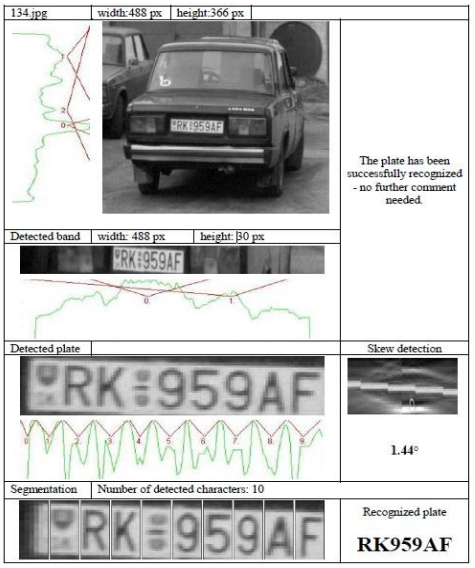
Where,

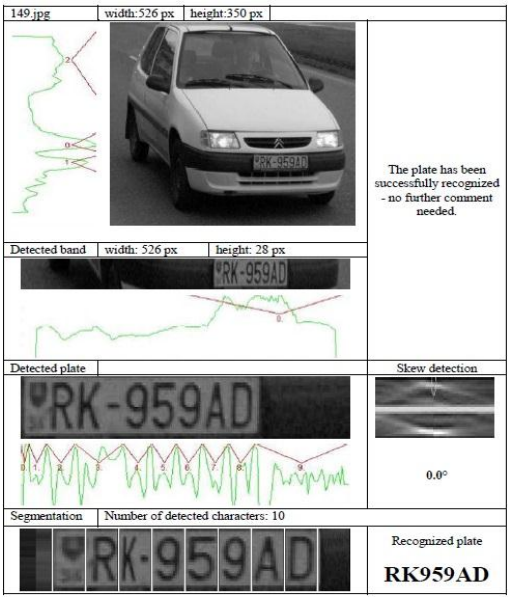
- *hav* is the haversine function:

d is the distance between the two points (along a great circle of the sphere; see spherical distance),

- *r* is the radius of the sphere,
- φ_1, φ_2: latitude of point 1 and latitude of point 2, in radians
- λ_1, λ_2: longitude of point 1 and longitude of point 2, in radians

10. SNAPSHOTS OF NUMBER PLATE RECOGNISATION





When Number plate recognition system is execute then it takes images of vehicles which are passing though Toll Booth. Above Snapshot shows example of character recognization of number plate.

11. CONCLUSION

Thus a system used as an Automated Toll collection booth, based on image processing saves the time at toll booth, minimizes the fuel consumption of vehicle. In turn we can save the environment from emission of extra carbon monoxide (CO2). Hence we can reduce the pollution. Also it serves in providing the tracking system for theft vehicle which is secured and highly reliable can be obtained. It can be used to remove all drawbacks with the current system such as time and human effort and it also doesn't require any tag only required best quality camera and fixed font number plate on each vehicle.

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Corresponding Author

Bhakti Dhurat*

Final Year Graduate students of Comp. Engg. Dept., JSPM, ICOER, Pune