



IMAGE PROCESSING BASED TOLL AUTOMATION USING ANPR

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Abstract: This paper presents a review of Automatic Number Plate Recognition (ANPR) algorithm using image processing in toll booths. On any toll booth the vehicle has to stop for paying the toll. We are trying to develop a system that would pay the toll automatically and reduce the queue at the toll booths. In this system camera is used for capturing the image of the vehicle number plate. The captured image would be converted into text using ANPR algorithm. Toll booth passes the vehicle plate number to the central server which holds the information about registered users. Server then uses this vehicle number to verify whether the user is registered account holder or not. If the user is registered account holder then server transmits the information about vehicle type, account balance to the toll booth. Based on the vehicle type, toll is deducted from the customer's account and then the toll gate is opened. Central server is updated with user's account balance using internet protocols by the toll booth the vehicle passes through. The user is updated about his account status via SMS.

Keywords: Automatic Number Plate Recognition, Optical Character Recognition, SMS, Image processing, Server.

I. Introduction

Toll gates are usually considered as an inconvenience by travelers not only for the cost of toll, also for the delay at toll booths. In order to ensure a steady flow of traffic, both staff and drivers require easy access to an efficient communication system covering the specific requirements of toll gates.

II. Related works

“Automatised Toll Gate System Using Passive RFID and GSM Technology”[1]. This paper proposes a system using RFID wherein the reader is placed in a strip which is laid beneath the lane, and the tag is placed in the front side of the number plate. The object detection sensor which is placed on the side of the road detects the approach of the incoming vehicle and intimates the stepper motor to raise the strip. Thus the reader rises to ground level and reads the information in the tag and the transaction takes place through a centralized database.

“Electronic Toll Collection System Using Barcode Laser Technology”[2]. This paper proposes a barcode laser system which uses tags (barcode) that are mounted on the number plate of vehicles, through which information embedded on the barcode are read by barcode readers. The drawback of this system is it requires direct line of sight and barcode scanner needs to be close to it.

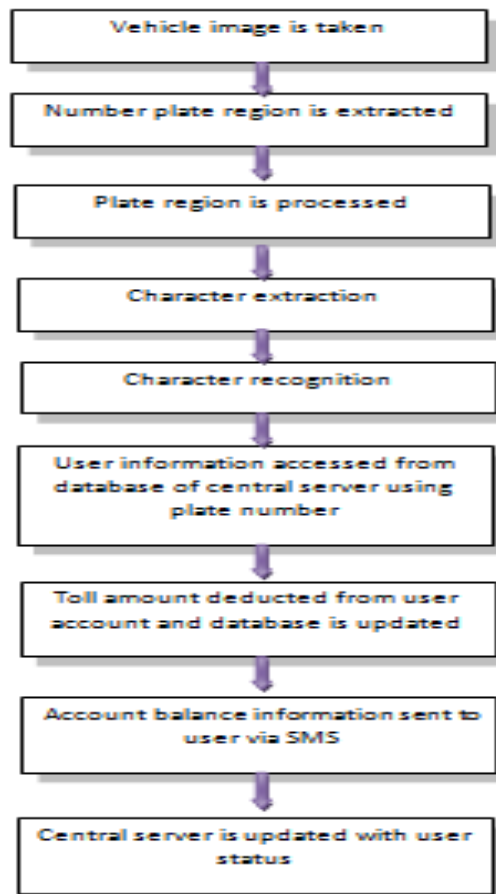
“Image Processing Based Automatic Toll Booth in Indian Conditions”[3]. For the identification of the stolen vehicles, the information of the vehicles is already stored on the central database. So captured number will be sent to the server received at the toll. In case it passes through any other toll a silent alarm would buzz which indicates the operator that the vehicle is stolen.

“Automatic Number Plate Recognition”[4] This paper presents two fastest algorithms used are edge finding method and window filtering method for the better development of the number plate detection system. In this method even after filtering is applied additional areas of high intensity appear beside number plate.

“Automatic License Plate Recognition (ALPR):A State-of-the-Art Review” [5] Presents a comprehensive review of the state of the art techniques for ANPR(Automatic number plate recognition).The algorithm proposed is designed to recognize license plate of vehicle automatically based on video. since it is video based it needs frame differencing or motion detection especially when the vehicles are at high speed.

This paper presents an automatic method of toll collection which overcomes the limitations of manual methods. Captured image of the vehicle's number plate is sent to a system with MATLAB software running in it, which pre-processes the image and extracts the vehicles plate number. Extracted number is then sent to central server to access the user information. Based on the type of vehicle toll amount is deducted from the user's account. Central server is updated about the users account every time a vehicle passes through a toll and the information is accessed by the next toll booths later.TCP/IP protocols are used to accomplish the same. User is informed about his account status through a SMS.

III. Proposed System



A. Automatic Number Plate Recognition

ANPR can be used to store the images captured by the cameras as well as the text from the license plate. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. ANPR technology tends to be region-specific, owing to plate variation from place to place. ANPR uses optical character recognition (OCR) on images taken by cameras. Some license plate arrangements use variations in font sizes and positioning ANPR systems must be able to cope with such differences in order to be truly effective. More complicated systems can cope with international variants, though many programs are individually tailored to each country. Some systems use infrared cameras to take a clearer image of the plates. There are four primary algorithms that the software requires for identifying a license plate:

1. Plate localization – responsible for finding and isolating the plate on the picture.
2. Preprocessing – adjusts the brightness and contrast of the image.
3. Character segmentation – finds the individual characters on the plates.
4. Optical character recognition – The segmented characters are recognized by template matching.

B. Plate Localization

Captured image is converted to grey scale and smoothened to remove noise using median filter. Adaptive histogramming is performed to enhance contrast of the image. Discrete wavelet transform is performed using Haar filter to enhance the vertical edges. The intensity values are summed row by row and the row with the maximum value is identified. The neighbouring rows above and below the row with maximum intensity within an approximated number is extracted.

Figure 1 Cropped Image



C. Preprocessing

Cropped plate region is subjected to noise filtering and is further processed using structural element for morphological operations to enhance contrast of the image. Edges are brightened using convolution function.. The image still has horizontal lines that are borders of name plate which is unwanted this can be removed by

using structuring element 'line' with angle 0^0 to eliminate all horizontal lines in the image using imopen function. Image thinning is used to remove very fine and small noises.

Figure 2 Preprocessed Image



D. Character Segmentation

In this step, the characters & digits of the plate are segmented and each is saved as a different image. The pre-processed image is given as input to segmentation function. The objects in the image are identified by labeling and plotting bounding boxes around them. Each object identified is taken and only those objects with number of rows and columns within the predefined number range are considered and the corresponding characters are extracted which gives the number plate.

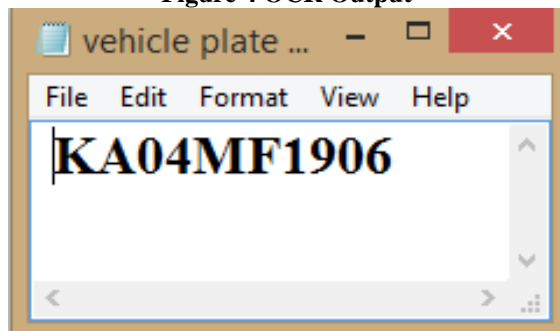
Figure 3 Segmented Image



E. Optical Character Recognition

OCR is done using template matching. Images from A to Z and numbers from 1 to 9 are taken into different variables and are pre-processed. All these variables are stored in the form of a cell in which each sub matrix represents a letter. The same process is done for printed upper case, printed lower case, and printed numbers, hand written upper case, hand written lower case and hand written numbers. All the model inputs are saved under the same variable name. Every character extracted from the number plates are compared with every template using correlation function, matching index is calculated and the one with maximum index value is found. The letter corresponding to that value is taken as the number or alphabet, which is repeated for every character obtaining entire registered number for further processing.

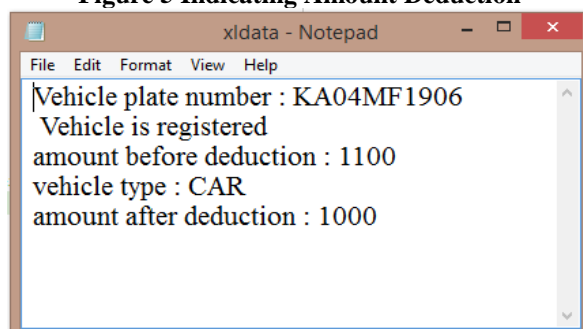
Figure 4 OCR Output



F. Database

The central database is the heart of the whole database system. This central database will be managed by a central administrator. The customer has to be registered for this account to use this system. Database includes all registered vehicles with details about owner, vehicle number and account balance. When the registered customer passes through a specified toll booth then automatically the toll fee will be deducted from customer's account. Central database is updated with this information at a same time, the customer will receive the information through SMS to his mobile using GSM modem.

Figure 5 Indicating Amount Deduction



IV. Conclusion

Our system is a user friendly toll fee method which can save time and reduce traffic congestion at toll gates and provide solution for users to reach their destination without wastage of time. 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 requires best quality camera and fixed font number plate. The main drawback of our paper is oriented number plates and false detection of objects in segmentation step. The future research of ANPR should concentrate on multi style plate recognition, oriented plates, high definition plate image processing, ambiguous-character recognition.

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