Automatic Toll collection System Using ALPR and Biometrics system

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Abstract - *Nowadays generally all highways toll system are manually operated, where an employee collects cash from the driver and provides a receipt. This procedure can be slow, and that encounter traffic jams at the toll plazas on busy highways. Automatic process of toll payment will save time, effort, and man power by efficient technique called Electronic Toll payment using Biometrics System that are automatically collects the toll from moving vehicles when they cross the toll. Automatic license plate recognition (ALPR) is the process of capturing and extracting vehicles plate information from vehicle number plate images or videos. The extracted information is necessary for several everyday applications, ranging from automated payment services just like as parking and toll roads payment collection to more critical applications, like border crossing security and traffic surveillance systems. We also assume that an each owner maintains a bank account, so that toll tax is deducted automatically from that account at toll plaza. If the balance in the owners account is low or if the vehicle is not equipped with an RF system, the toll gate remains close.*

***Key Words*: Automatic License plate recognition ALPR, Radio Frequency Identification (RFID), Image Processing, Electronic payment transaction, Electronic Toll payment**

1. INTRODUCTION

Nowadays generally all highways toll system are manually operated, where an employee/ worker collects cash from the driver and provides a receipt. This procedure can be slow, and encounter traffic jams at the toll plazas on busy highways. Our system will save time, effort, and man power because we are avoiding the manual task of collecting cash. In this work propose a low cost and efficient technique called Electronic Toll Collection using RFID modules that automatically collects the toll from moving vehicles when they cross the toll. We also assume that an owner maintains a bank account, so that toll tax is deducted automatically from that account at toll plaza. If the account balance is low or if the vehicle is not supplied with an RF system, the toll gate restrict to vehicle. In such a case vehicle owner will have to pay the toll tax in cash and collect the receipt.

2. LITURATURE SURVEY

2.1 Automatic License Plate Recognition

A Comparative Study Automobiles are an necessary part of our present life. Generally, license plates are used for identication of every vehicle. Automatic License Plate Recognition (ALPR) is the process of automatically Capturing number plate and extracting license plate information.

Access control systems, Parking entrance control, toll road payment collection, and border crossing security are some of the many applications in this area where, ALPR can be effectively utilized. However, perfect detection and reading of license plate contents are vital in making ALPR successful in any of these applications. The perfect reading of vehicle number plate information from an image is a challenging task due to following reasons. Depending on the acquisition time, environment, and climate changes, the background of the vehicle and lighting conditions may changes. The angle between the vehicle and the camera can also change and can have a signicant impact on accurate getting of plate contents. In addition, different types of fonts, colors, use of background images and plate standards make the task of automatic license plate recognition quite challenging task.

2. 2 Automatic toll e-ticketing system for transportation systems

The automatic toll e-ticketing system is the approach used for the vehicle when it reaches the toll plaza, this is detected by using Infrared Proximity Sensor. RFID tags are used to read each vehicle with the help of RFID reader. An IR receiver is used to receive these pulses and sends it to a controller (MSP 430 Launch pad), which then transmits the vehicle number through the RF transmitter located in vehicle. We assume that vehicles have 16-bit identification numbers. The RFID tags to readers read the signal and information about vehicles owners. These RF signals are received by an RF receiver at the toll plaza, which send data to a computers parallel port. A software program running on the computer retrieves vehicle details from its vehicle database.

2.3 Development of a GPS-based highway toll collection system

The necessity for vehicles to stop or slow down for toll fee payment results in traffic congestion and reduces fuel efficiency. Hence, a system that enables road users to pay the toll fees without stopping or slowing down was proposed and developed. Hardware and software designs were carried out to develop a Global Positioning System (GPS)-based highway toll collection system. This system was developed using a Raspberry Pi 2 microcontroller.

Different modules such as GPS module, Liquid Crystal Display (LCD) module, speaker, wireless Wi-Fi router modem and wireless Wi-Fi adapter were incorporated and integrated with the microcontroller to perform a few specific functions. In general, the system utilized GPS coordinates to detect whether a vehicle passed through predefined locations in the database and the travel details were

recorded. The Raspberry Pi 2 microcontroller was configured as a personal cloud server to allow online access of travel logs. This developed system presents a different approach for highway toll collection which eliminates travel delays and construction of expensive gantries or toll booths.

2.4 Smart toll collection system using embedded Linux environment

Electronic Toll Collection system developed in India to save the time by collecting the toll electronically instead of manually. In order to provide zero delay toll collection system, so many modern toll collection systems are used like RF Tags based toll collection system, Barcode Scanner based toll collection system, and number plate recognition based toll collection system. As all the aforesaid systems are reliable, but still it's not defined as system without human interaction. The paper presents smart toll collection system using embedded Linux environment. The whole system is balanced and focused to design and develop an entirely automated license plate recognition system which will be an excellent low-cost alternative to all other systems. The entire system is design using embedded Linux development board such as Raspberry Pi. The board is most suitable for Implementing Image processing algorithm. In the suggested system one webcam is interfaced with Raspberry Pi Board which is used to capture the image of vehicle's license plate which will pass through the toll booth. These images of license plates are processed through Optical Character Recognition (OCR) engine such that image of license plate will be converted into equivalent ASCII characters. This extracted information will further send to the RTO server to identify the type of vehicle and owner of the vehicle. The retrieval information will once again send to the system through GSM module interfaced with raspberry pi. According to the type of the vehicle the nominal toll will be deducted from owner's account. After receiving the notification message on registered mobile number of the owner about the deducted amount from owner's registered account, the barrier will open and vehicle is allowed to leave the toll booth.

3. METHODOLOGY

The proposed system provides a base for implementing automatic number plate detection using image processing for toll collection at toll checkpoints. This system will help in saving time as well as help in reducing congestion at toll checkpoints. This system will also help in monitoring any fraudulent behaviour that takes place at the toll checkpoints. The proposed system will capture an image placed at the toll checkpoint and will perform certain processes to detect the number plate of a vehicle. Following are the steps that needs to followed to detect a number plate.

A. Image Acquisition
B. Image Pre-processing
C. Licence Plate Localization
D. Character Segmentation
E. Character Recognition

3.1 Image Acquisition

The first step is to acquire the image from the camera. The image can be captured using a high resolution camera.

3.2. Image Pre-processing

After acquisition of an image we need to perform certain pre-processing techniques like gray scale conversion, noise reduction, contrast enhancement to remove noises, low contrast, and unwanted background.

License Plate localization: License plate region are localized based on the features of the license plates. Localization can be performed using the following steps.

I. Opening and Closing of Image
II. Image Binarization
III. Elimination of unwanted region
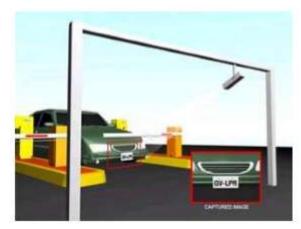IV. Mapping of co-ordinates

Figure 1: Number Plate detection using image processing

3.3 Character Segmentation

Unwanted objects like dots or some noise needs to be removed. After removing unwanted objects, dilation is performed.

3.4 Character Recognition

Character Recognition is the final step in License Plate Recognition. Two main components of License Plate Recognition are Feature Extractor and Classifier.

3.4.1 Feature Extractor: Given a character image, the feature extractor derives the features that the character possesses. The derived features are then used as an input to the character classifier.

3.4.2 Character Classifier: Classification is performed by comparing an input character image with a set of templates from each character class. Each
Comparison results in similarity measure between the input character and the template.

3.5 RFID

Radio-frequency identification (RFID) is a technology that uses radio waves to transfer data from an electronic tag, called RFID tag or label, attached to an object, through a reader for the purpose of identifying and tracking the object. Some RFID tags can be read from several meters away and beyond the line of sight of the reader.

The application of bulk reading enables an almost-parallel reading of tags. RFID tags can be either passive, active or battery assisted passive. Passive RFID does not use a battery, while an active has an on-board battery that always broadcasts or beacons its signal. A battery assisted passive (BAP) has a small battery on board that is activated when in the presence of a RFID reader. Most RFID tags contain at least two parts: one is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, and other specialized functions; the other is an antenna for receiving and transmitting the signal.

3.6 Biometric

Fingerprint Scanners is a fingerprint recognition device's for computer security equipped with the fingerprint recognition module featuring with its superior performance, accuracy, durability based on unique fingerprint biometric technology.

4. CONCLUSION

In this research paper, we have discussed the image processing technique to implement the automated toll collection in order to reduce congestion and fraudulent behaviour at the toll checkpoints. Further we have discussed the working of the proposed system including the smart card implementation and the automated deduction of the toll from the vehicle owner's bank account. The proposed system will help in reduce the human intervention at the toll collection areas. The purpose of this research paper was to improvise the toll collection as well as implement a system for smart card users as smart cards is being used by many people in order to avoid physical cash.

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