Smart Tolling for Highway Transportation System

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Abstract: Electronics Toll Collection system developed in India to save the timeby 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 as all the aforesaid systems are reliable, but still it's not defined as system without human Interaction. Electronic cognition based toll collection. The paper presents Fast toll collection system using Raspberry

Keywords: Raspberry Pi three, License plate Recognition.

1. Introduction

Nowadays generally all highways toll system is 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 Biometric 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 as like as parking and toll roads payment collection to more critical applications, like border crossing security and traffic surveillance systems. We also assume that 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 tollgate remains close.

In our busy life we don't have much time to monitor and to keep a watch on everything. From every family most of the members are working, or even in malls and hospital to monitor each and every space is not possible. It's 21st century and we need to think smartly to make our life better, easier and secure, so instead of sitting at once place for longer why not carry the security in our pocket

2. Literature survey

A. Automatic license plate recognition

A Comparative Study Automobiles are a necessary part of our present life. Generally, license plates are used for identification 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 change. The angle between the vehicle and the camera can also change and can have a significant 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.

B. 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.

C. 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

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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 an 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.

D. Smart toll collection system using embedded Linux environment

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.

- Image Acquisition

- Image Pre-processing
- Licence Plate Localization
- Character Segmentation
- Character Recognition

4. Implementation setup

A. Components required

- Raspberry pi three
- Raspberry pi camera module
- ALPR Module
- Block Diagram

B. Raspberry pi three

Raspberry pi [9] is the credit size low cost as well as low power computing device. Motivation for building such a tiny computer with HDMI out is to build the skills in the young generation in somewhat more interesting way. Some students (6 in numbers) of University of Cambridge, United Kingdom analyzed the data of student enrollment of past few years in two parameters, one was number of student applying computer science technology and the second parameter was computer skills. They evaluated the data and further concluded that number of applicants (students) for Computer Science are decreasing every year due to lack of skills in Computer Technology. By keeping this problem for the background of motivation, theses six students decided to build a small computer device which can do the physical computation. Physical computation means to make the personal computer capable for being interacted with the real world hardware such as sensors, web servers, robots, locks and much more. For this physical computation, Raspberry has provided the GPIO (General Purpose Input Output) pins. These pins are like those standard input output pins which were dedicated in your personal computer for standard devices like Mouse and Keyboard etc. This GPIO module has made Raspberry different from other computer devices. This inspiration of raspberry Pi is more than enough to drive the Internet of Things (IoT) concept into the reality.

Fig. 1. PI three

C. Raspberry pi camera module

A Camera Module can be used to take high-definition video, as well as stills photographs. It supports 1080p30, 720p60 and VGA90 video modes, as well as still capture. It attaches via a 15cm ribbon cable to the CSI port on Raspberry Pi. The camera works with all models of Raspberry Pi 1, 2, and 3.

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Fig. 2. Camera module

D. ALPR module

Automatic License Plate recognition (ALPR) is a picture handling innovation which utilizes effective calculations to recognize the vehicle number from constant pictures. The goal is to structure a productive Vehicle Number Recognition System and to actualize it for programmed toll fee collecting. The framework distinguishes the vehicle first and after that catches the picture of the front perspective of the vehicle. A framework is intended for grayscale pictures so it recognizes the number plate paying little respect to the shading. Layout coordinating system is utilized for character acknowledgment. The subsequent vehicle number is then contrasted and the accessible database of the considerable number of vehicles in order to concoct data about the vehicle type and to charge toll impose as needs be

Fig. 3. Colours of vehicles' LPs and traffic signs in China are similar. The left panel shows the LPs of vehicles in China, while the right panel shows the traffic signs
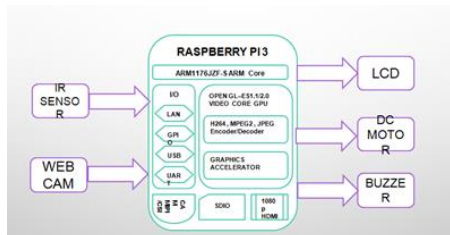
E. Block diagram

Fig. 4. Block diagram

1) DC Motor

It is an electrical machine that convert and directs current electrical power into mechanical power. DC motor is drives by motor driver which is responsible for opening and closing the gate. It required low power and low voltage.

2) IR Sensor

IR sensor means infrared sensor. IR is a device used to detect motion, speed and distance of a vehicle to decide whether the vehicles cross TOLL booth or not. The value is then passed to the application running on a client machine. According to this Traffic gate is opened and closed with help of micro-controller and DC motor and driver.
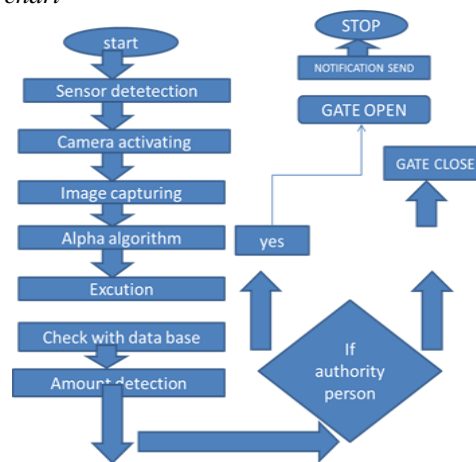
3) Flow chart

Fig. 5. Flow chart

F. Proposed system

The proposed system uses the Camera to identify the number plate of a vehicle and checking it against the database. The toll amount was automatically reduced from that vehicle owner's bank account which account stored in the database. There is no need to waiting at a toll plaza, reduced the manpower, time and fuel.

5. Conclusion

In this project, 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. The future of this system is very wide. In this the simple web camera, periodically, images can be taken and sent on the internet. E-mail sending is also possible easily on raspberry pi using the SMTP library function present already.

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