Automatic Toll Collection System based on Embedded system

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ABSTRACT: Many highway toll collection systems have already been developed and are widely used in India. Some of these include Manual toll collection, RF tags, Barcodes, Number plate recognition. All these systems have disadvantages that lead to some errors in the corresponding system.

KEYWORDS: EMBEDDED LINUX

I. INTRODUCTION

In India, most highway projects are developed by private sectors on PPP (Public Private Partnership) basis. This private organization retains construction capitals and reasonable profit from people. After construction of roads, for some permissible period tax is collected by the companies. This tax is called toll tax. There are many different toll collection system practiced by various organizations at different toll plazas. However this toll plaza wastes the time and increases traffic on the highways. Initially, there was a manual toll collection system in India. This method is insufficient for toll collection because the vehicle owner pays the toll in the form of physical cash.   Here we introducing Electronic toll collection system using embedded   which will be an automatic system, will not stop the vehicles as well as this system will help to reduce the traffic jam. Here, the payment will be taken from the bank account of the vehicle owner and he will receive a message from the server that the toll payment has been taken. In addition, our system will also help to solve the traffic severe crashes .This was causing congestion of traffic. Automated Toll Collection is beneficial because with the help of this system congestion of traffic at the toll collection areas can reduce and also help in reducing corruption at the toll booth. Some of the existing toll collection systems are discussed as follows:

II. LITERATURE REVIEW

There are following toll collection systems presently used:
 A. Manual toll collection
 This technique is not a technical method. It requires a toll collector or attendant. The toll collector himself classifies the vehicle, collects the toll, dispense the change, provide receipt to the vehicle owner. All this process is time consuming due to manual intervention. Sometimes, when vehicle comes to booth, toll is charged manually by simply providing just receipt in which no description about vehicle is given, only toll tax amount is present. In this case, what happens, if a heavy vehicle comes to toll booth, Operator charges some amount greater than toll amount of light vehicle but receipt is provided for light vehicle. Thus manual collection can provide loss to the owner of booth.

B. RF Tags
 In this system, The vehicles are identified with the help of Radio frequencies. RFID stands for Radio Frequency Identification. RFID is a technology which is used to identify, track and store the information contained in the tag. A RF reader scans the tag for data and sends the information to a database contained on the tag. RFID system consists of two main technology components namely tag and reader. RFID Tag: An RFID tag, or transponder, consists of a chip and an antenna. A chip can store a unique serial number or other information based on the tag's type of memory, which can be read-only, read-write, or write once readmany (WORM). The antenna, which is attached to the microchip,

transmits information from the chip to the reader. Typically, a larger antenna indicates a longer read range. RFID Reader: In order for an RFID system to function, it needs a reader, or scanning device, that is capable of reliably reading the tags and communicating the results to a database. A reader uses its own antenna to communicate with the tag. When a reader broadcasts radio waves, all tags designated to respond to that frequency and within range will respond. A reader also has the capability to communicate with the tag without a direct line of sight, depending on the radio frequency and the type of tag (active, passive, or semi passive) used. Readers can process multiple items at once, allowing for increased read processing times.

C. Barcodes

This method brings our attention to a new technology for an electronic toll collection. In this system, barcodes are mounted on the number plate of vehicles. The information related to that vehicle is embedded on the barcode. Barcodes are read by the barcode scanners present at toll booths. Thus this method reduces the efforts of human authority. Data information are also easily exchanged between toll authority and vehicle owner, hence providing a more efficient toll collection by less traffic and less possible human errors. But Optical systems at toll booth proved to have poor reading reliability especially when faced with inclement weather and dirty vehicles.

D. Automatic Number Plate Recognition

Automatic number plate recognition is a mass surveillance method that uses optical character recognition on images to read vehicle registration plates. They can use existing closed circuit television or road-rule enforcement cameras, or ones specifically designed for the task. They are used by various police forces as a method of ETC system on pay-per-use roads and to catalog the movements of traffic or individuals.

III.A SURVEY ON EXISTING METHODS

The system we present is designed and implemented using an Embedded Linux board called Raspberry pi which is having OpenCV library, Apache server and other necessary software installed on it. Basically the system is based on vehicle detection using Image Processing. In this system, a camera captures images of vehicles passing through toll booth thus a vehicle is detected through camera. Depending on the area occupied by the vehicle, classification of vehicles as Light and heavy is done. Further this information is passed to the Raspberry pi which is having web server set up on it. When raspberry pi comes to know the vehicle, then it access the web server information and according to the type of the vehicle, appropriate toll is charged.

The whole system composes as follows:

A. Embedded Linux

Numbers of commercial OSs are available, but using Embedded Linux is more beneficial as it is open source, stable and reliable, with broad hardware support and moderate requirement of resources. It also has excellent development tools, community supports. Linux is getting tremendous popularity because its open source and some other features like security, scalability, cost, robustness, rate of development. These features can be used in embedded application to make good quality and low cost product. There are lots of development boards available out there in embedded market. Raspberry Pi is one of the popular embedded Linux based development boards.

B. Raspberry pi

The Raspberry Pi is a credit card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. It is the core of the whole system. The job of Raspberry pi in this system is processing large quantities of data and also it will keep detailed log of vehicles which are in the system.The Raspberry Pi is a good choice for a webserver that will not receive too much traffic and only uses around 5 Watts of power.

IV.THE PROPOSED METHOD

The whole system is implemented on the embedded Linux Environment using Raspberry Pi board [4]. The proposed block diagram of the system is shown in the Fig. 3. Proposed Block Diagram The system contains Raspberry Pi board as the main processor. The SD card is used to contain the dedicated operating system which is compatible with the raspberry pi board. The License plate of vehicle is captured by the Webcam which is directly interfaced with the Raspberry Pi board. The 16 * 2 LCD is used to display the validation message. To make the validation process more sophisticated, the Speaker can also interfaced with the raspberry pi board. GSM module can be directly interfaced with the pi board using serial communication protocol. GSM module is used to retrieve the database of the respective vehicle from R.T.O., which is available at toll booth. and also used to send the notification message of the deducted amount from vehicle's owner account on owner's registered mobile number. Here Stepper Motor is used to indicate the status of Barrier, weather it is open or close according to the specific cases. The whole system will work as follows: Webcam captures the image of vehicle's license plate passing through the toll booth. OCR (Optical Character Recognition) Engine converts captured image of Vehicle's license plate into character codes in ASCII form. The text version of vehicle's license plate then sends to the R.T.O. server in form of message through GSM module. The vehicle number is compared with the R.T.O database, based upon which the vehicle category is known. The nominal amount is deducted from user's account. Information of User's account is also registered in R.T.O. Database. Notification of successfully deducted amount will be delivered to the owner in the form of SMS through GSM module. As toll amount is successfully deducted from user's account barrier will open and the vehicle is allowed to go.

V. MODULE DESCRIPTION

To implement the Automatic Toll Collection System based on embedded system ,we have use 6 important modules. The modules are , Raspberry pi , Monitor , LCD , GSM , DC motor, IC Driver (L293D)

A. Raspberry pi
Raspberry pi is a small credit card sized computer that includes ports such as HDMI, Ethernet, 2 USB's version 2.0, Audio, and RCA Video. In addition, Raspberry Pi includes a SanDisk card slot which is used as the Pi's storage and GPIO (general purpose input output) pins which can be programmed using python. There are two models of the Pi that is available to purchase in different electronic sites. Model A comes with a256MB RAM and costs $25 and Model B comes with 512MB RAM and costs $35.
There are several, Linux based operating systems available for the Pi that can be downloaded online and written on the SanDisk card. Each operating system has its pros and cons. The Pi operates at 700MHz by default, but can be over clock to 900MHz.furthermore, the Pi is powerful enough to support high definition videos. Writing one of the operating systems to the raspberry pi is nothing but placing the SanDisk in the Pi's slot, one is ready to utilize the Pi. The Pi can be accessed by attaching a HDMI cable from the Pito the TV and a keyboard. However if those items are unavailable to a person. Raspberry pi has special operating system known as Raspbian. Raspbian operating system, described as an OS specifically optimized for the Pi computer's hardware specs. That means the Raspberry Pi now has a recommended operating system for making the device work.

Fig. 1. Raspberry Pi Model B

B. Camera

In this project we have to use high image capturing digital camera to get the clear images of vehicles. For practical purpose, we have used following camera just for demonstration. '

C. Monitor

Raspberry pi has one HDMI port so that we can connect it to the monitor which is having HDMI cable. It is used to display Graphical User Interface(GUI) of raspberry pi. Also it is used to check the information list of toll collected vehicles. It will help administrator to check whether toll tax is entered correctly or not.

D. LCD Display

The LCD that we use here is a 16 pin LCD that would work on 5v.It is called 16*2alphanumeric LCD.LCD is used to display the amount that is to be Payed by the driver. The LCD will display the amount to be payed and the balance after deducting that money from user account

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