

IOT Based Vehicle Parking and Toll-Fee Management System Using Raspberry Pi 3

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Abstract:- The basic desideratum of the vehicle parking and toll-fee management system is to reduce the waiting time of the vehicles. There are huge amount of vehicles passing through Toll Gate Stations and using parking places every day. This IOT based management system collects vehicle toll fee or parking fee automatically. In this system camera is used for capturing the image of the vehicles number plate. The captured image would be converted into the text using Python based OCR (optical character recognition) and the toll would be cut from the user's account and then the gate is opened. The system is divided into the design of three modules, Vehicle Module and the Database Module, Tollgate station. The three modules communicate via GSM modem connected to each module, stolen vehicle are also identified and alarm would be buzzed. For the Identification of the vehicles, the information of the vehicles is already stored on the database. Stored information is also easily exchanged between the motorists and toll or parking authorities, thereby enabling a more efficient toll or parking fee collection by reducing waiting time and traffic.

Keywords: IOT, Raspberry Pi, Global Synchronous Mobile, Mobile App.

I. INTRODUCTION

The Internet of Things (IOT) refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. IoT extends internet connectivity beyond traditional devices like desktop and laptop computers, smart phones and tablets to a diverse range of devices and everyday things that utilize embedded technology to communicate and interact with the external environment, all via the Internet.

Vehicle parking and toll-fee management system useful in our daily life because of the unlimited increase of vehicles and transportation systems. Presently, parking and toll-fee collection fully managed and monitored by humans with manual operation. The aim of this designed system is to automatically identifying the approached vehicles and recording vehicles number, time and this is system can solve the problems of the car parking and problems in toll-fee management and also reduces waiting time and

traffic.

It is aimed at making toll taxation more efficient, reliable, and safe and environment friendly. In the past, customer would have to wait at the toll booth to pay the money to collector, creating traffic Congestion, pollution, consumption of fuel and ofcourse of a lot of frustration. Today Automatic toll collection successfully removes unnecessary traffic delays; keep track of on any car that might not be correctly registered and also find the stolen vehicle.

The researchers have come out with new techniques in solving several issues in vehicle plate recognition system. Siam [1] has constructed a practical prototype system to detect the vehicle license plate number at the entrance of the car park using the image processing technique of capture image, template matching, Internet Protocol (IP), camera and motion detector. The GUI was developed to display the detected vehicle plate number and the result of the template matching based on the number plate. The drawbacks of the research are the information of the vehicle's owner is not available, and the hardware part is implemented using Internet and not tested for any light condition. Meanwhile, Dhruw et al. [2] have applied the Otsu's algorithm to recognize the non-standard Indian number plates. However, the research focuses merely on the offline analysis of the captured image. N. Sulaiman et al. [3] used MATLAB Image processing tool box for recognizing the number plates and they developed a GUI to display the detected vehicle plate number and the result of the template matching based on the number plate.

The upcoming sophisticated technology related to Internet of things has been emerging the automation to avoid the human errors and also save the time. The most obvious advantage of this technology is the opportunity to eliminate traffic congestion at toll gates and paid parking places. Other than this obvious advantage, applying automatic toll booth or parking fee points could also benefit the toll or parking booths operators. This automatic system used the technology of Python based OCR (optical character recognition). Hence this system works very fast with the best results.

II. MATERIALS AND METHODS

IOT Based Vehicle Parking and Toll-Fee Management System all components centralized with Roseberry Pi3 Model. Raspberry pi 3 model B connected to the camera, IR

sensor, Monitor display, LCD display, GSM Module and it is connected to bank and the mobile via wireless as shown in the block diagram figure 1. The Python based OCR (optical character recognition) recognizes the Vehicle number and identifies the user details. The database management system collects process the vehicle number,

identifies the account number of owner, and deducts the required fee amount and creating the Smart environment between the vehicle and the toll or parking booths or operators.

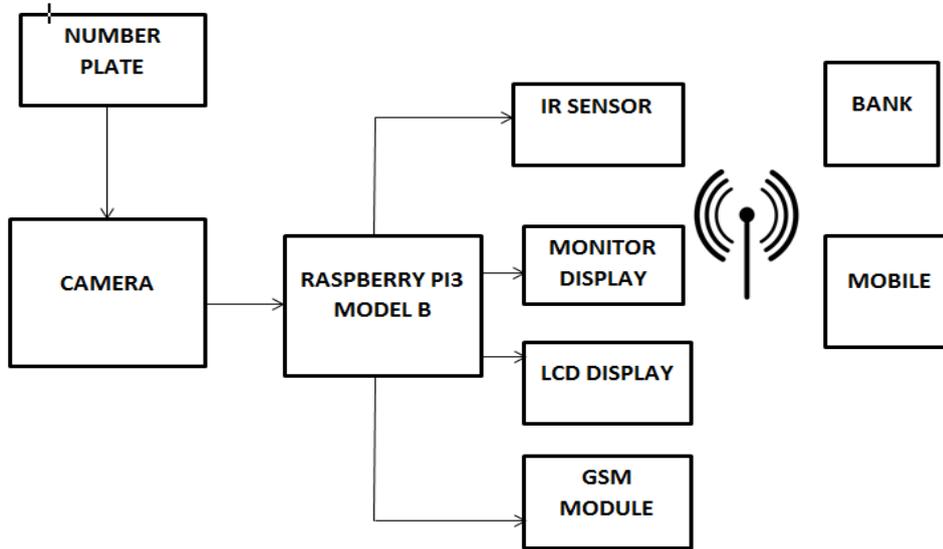


Figure 1: Block diagram of the connection of the materials

A. Materials: Hardware Details

The Raspberry Pi 3 (read R-pi3) as shown in the figure 2, is a series of low-cost, creditCard-sized single-board computers. It is just like any other computer and features built in Wi-Fi, Bluetooth and 1GB RAM. We connect a keyboard, mouse through USB or Bluetooth and a display monitor through HDMI cable and start using it just like a normal computer. But the real power of R- pi3 is realized in embedded systems. The R-Pi3 has the ability to interact with the outside world.

Hence it is well suited for the IOT technology and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras. It has 40 GPIO Pins. Out of 40 pins, 26 pins are Input and Output pins, 8 pins are ground, 2 pins are 5V, 2 pins are 3.3V and 2 pins are ID_SD and ID_SC used in I2C communication. The Product information can be accessed though Roseberry website [4].

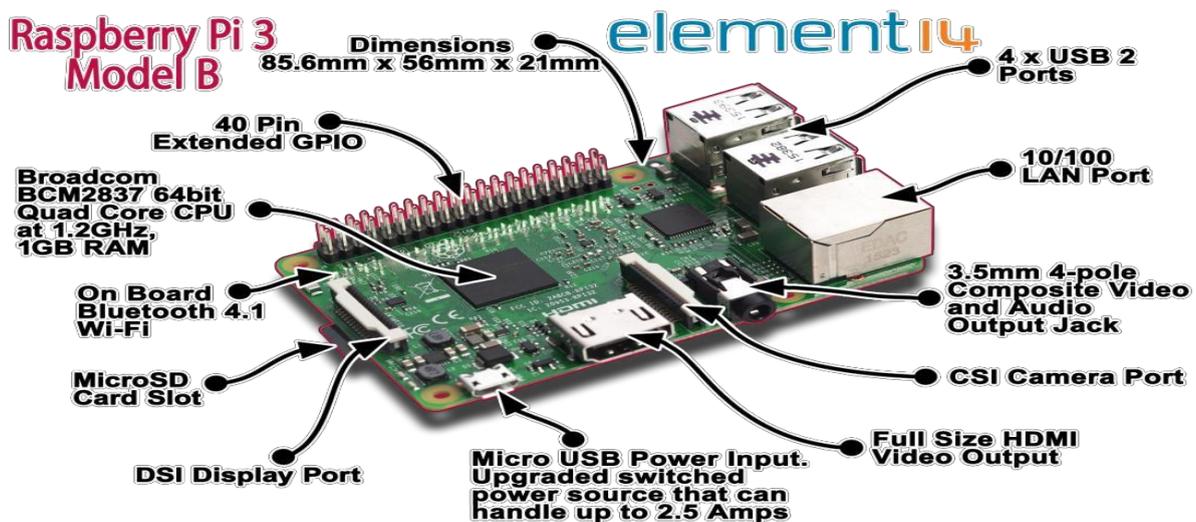


Figure.2: Raspberry pi 3 model B

The web camera connected to the Raspberry Pi3 Model B will capture the image when there is any interruption of the rays in the IR sensor. An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. when the vehicle comes near the sensor the infrared rays that are passing through the transmitter and the receiver breaks and the image will be captured.

GSM/GPRS module is used to establish communication between a computer and a GSM- GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. The GSM sends the message after the required toll is deducted from the vehicle owners account and the

balance in his account is sent.

B. Software Detail

Python is a simple programming tool available for Raspberry Pi. Python is a widely used high-level programming language for general-purpose programming, created by Guido van Resume and first released in 1991. An interpreted language, Python has a design philosophy which emphasizes code readability and a syntax which allows programmers to express concepts in fewer lines of code compared to other languages.

The database is defined as the collection of the interrelated data that is maintained and managed by the software here by the MYSQL server, which is used to maintain the details of the registered vehicles in the database and if the details are valid the further process is done such as deducting the amount from his account and the details are updated in the database.

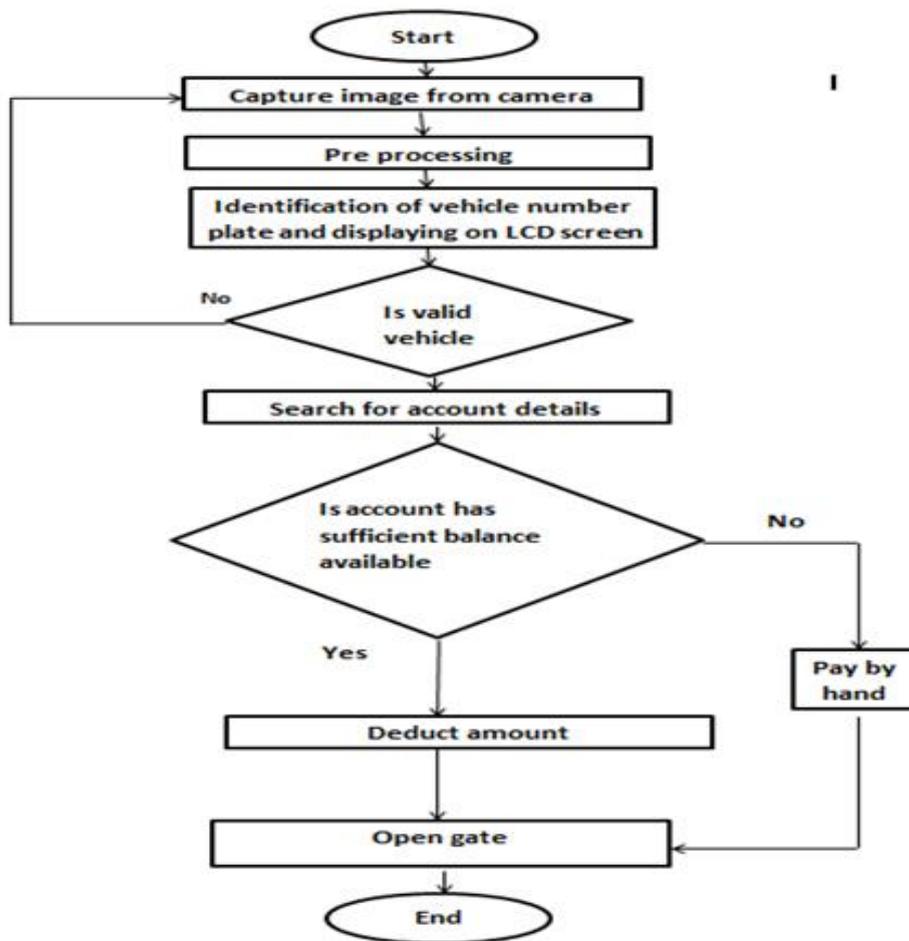


Figure 3: The software process of the methodology

C. Methodology

The process describe by the flow chart as shown in the figure 3, starts when the vehicle comes near the IR sensor placed before the toll or packing booth the infrared rays get interrupted and then the image will be captured by the camera. The captured vehicle number image will be processed in Raspberry pi 3 model B, recognized by python number plate recognition tool and the number is displayed on LCD/Monitor display, the details of vehicle will be verified in the database whether it is a valid vehicle, search for the account details if the sufficient balance is present in their account , required toll fee deducted from the vehicle owner account and the relevant messages will be delivered to the vehicle owner, if is not the case the vehicle is not valid and the user should pay the toll by hand or they can register. The vehicle details are continuously updated according to the time in the database.

III. RESULTS AND DISCUSSION

During the testing process of the designed system at indoor, the printed image of the vehicle plate was captured by web camera inside the laboratory. Then, the system is implemented by capturing a few images of vehicle plates. The system is tested either it is successful to capture the good image and to recognize the image successfully. 25 samples of image were captured during this testing session. The detection accuracy obtained at the indoor is 100%. Interruption of IR

detector used for initiating the activation process of Raspberry Pi and camera. After the camera can capture the image of the number plate, send the data of the image to computer for next process.

During the testing of the designed at outdoor, system captures the real image of number plate and then process the image simultaneously to recognize the number plate. Outdoor testing of the system done by placing the web camera between the vehicle and computer. Here, there are several things need to be considered during the setup of the experiment. Firstly, the distance between camera and number plate must be approximately 1meter. Next, another vital factor is the position of the camera to capture the image of number plate. It must be aligned or perpendicular with the position of the number plate of the vehicle. Otherwise, it will affect the resolution of the captured image and disturb the processing of the image in computer. The detection accuracy is at the outdoor condition comparable to the indoor condition.

These results explain the limitation of the web camera where the image accuracy and resolution can be affected by the light condition.

Using IOT, Developed a mobile app to know the recent vehicles that have passed the toll gate as displayed on the figure 4 and the toll operators or authorities can check this anywhere from this app.

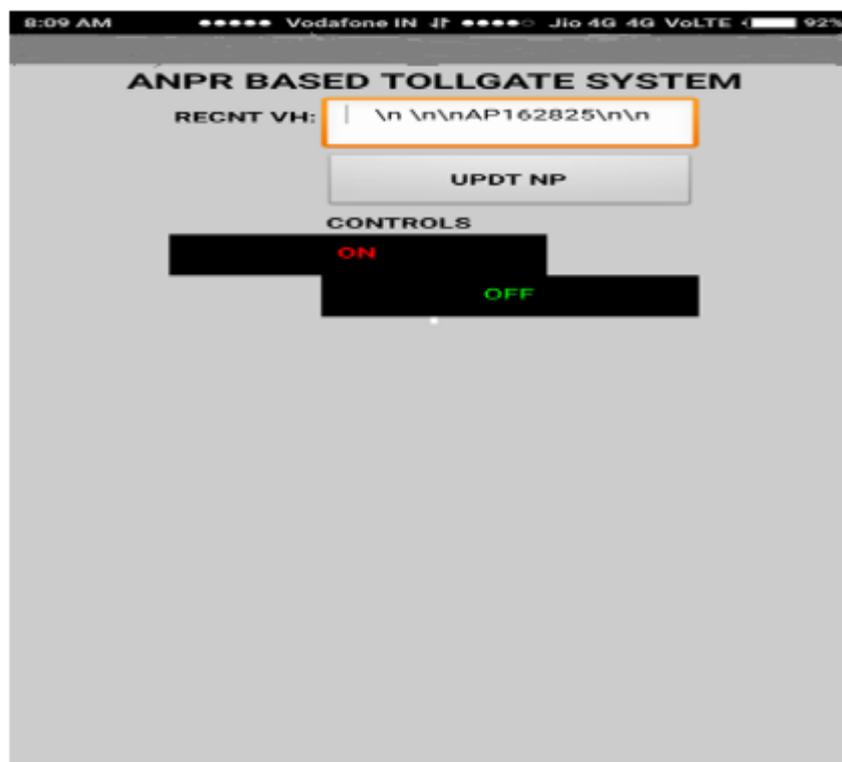
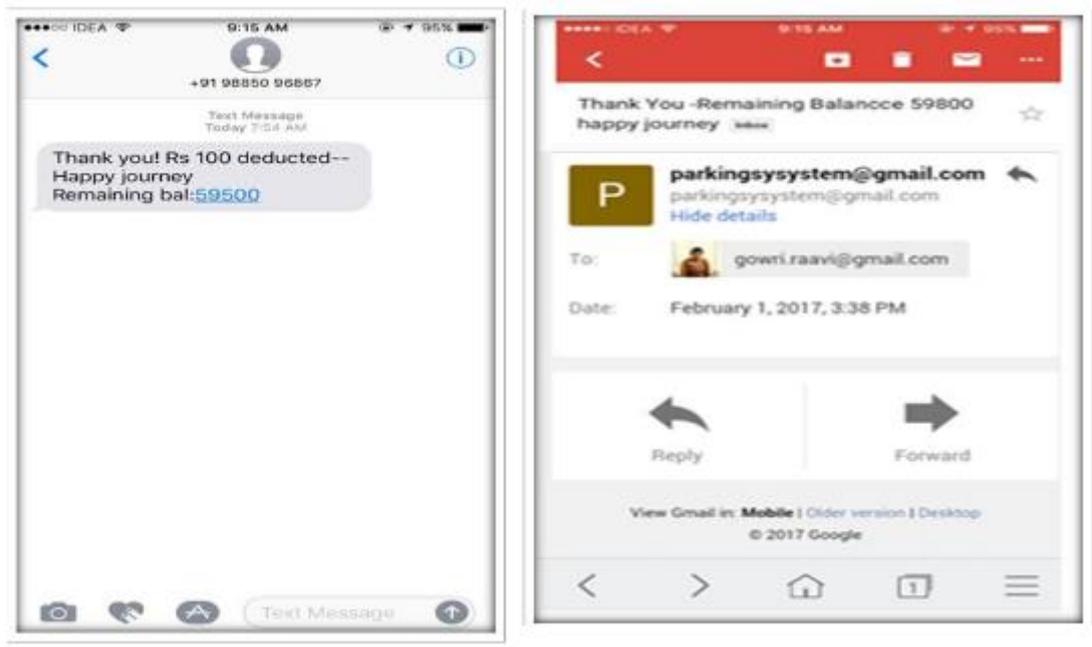


Figure4: Mobile App to know the recent vehicles that have passed the toll gate

The message is sent via the GSM module to the vehicle owner phone number and email after the required fee is deducted from the vehicle owner’s account and shows

updated balance as represented in the figure5 a & b and 6. If he is having the insufficient balance, also the message will be send like “insufficient balance in the account”.



(a)

(b)

Figure 5: a) Sample Text Message send to the vehicle owner and b) Sample Gmail Message send to the vehicle owner

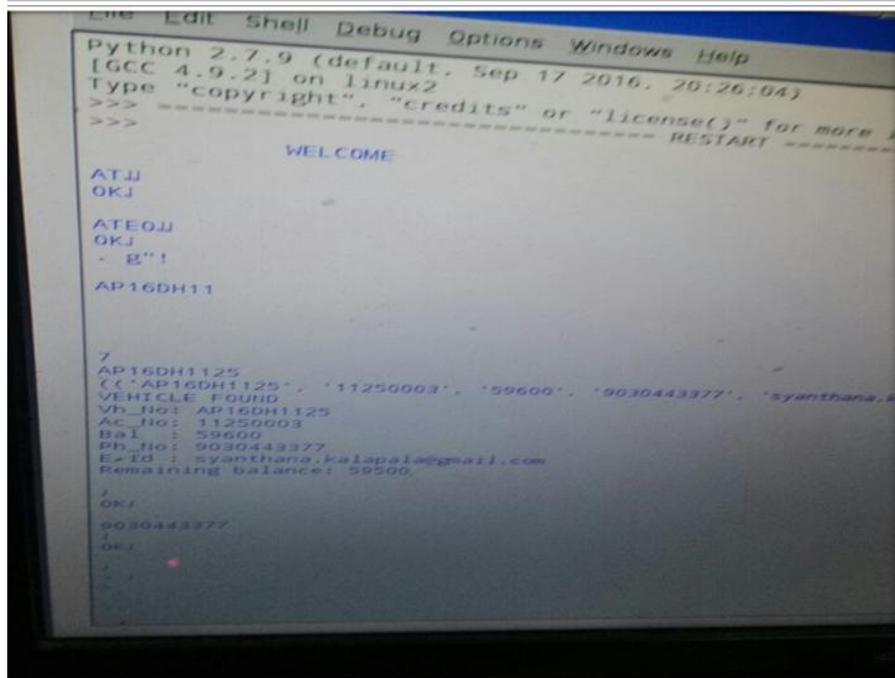


Figure 6: display of the output on monitor screen

IV. CONCLUSION

The well designed IOT based Vehicle parking and toll-fee Management system is an efficient system using python based OCR. This system is highly reliable and also achieves high security. This system succeeded with

displaying the vehicle number, the details of vehicle owner. And this system can remove the traffic congestion by eliminating the manual operations and reduces the waiting time at traffic areas. A standalone system to be designed with best quality camera to capture the image of the moving vehicle plate regardless of the lighting conditions.

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