Smart parking system using IoT

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1. INTRODUCTION

IoT applications utilize the advanced communication technologies for giving better services to the citizens who live in smart cities. Nowadays, as the population in the cities is increasing rapidly, a large number of people are buying vehicles for personnel use and the land in these cities is limited, therefore the need for optimized parking has increased significantly and management of such spaces is becoming difficult by using old practices of management.

The increase in city traffic is one of the major effects of population growth especially in urban areas. Due to this searching for a vacant parking area during peak hours is not only time-consuming but also results in wastage of fuel. The drivers keep searching for suitable parking lot which leads to increase in traffic. Increasing volume of vehicular exhaust creates a negative impact on the environment. Hence smart parking has become the need of the day.

This Project focuses on implementation of vehicle parking place detection using internet of things. The system benefit of smart parking goes well beyond avoiding time wasting and minimizes the costs of moving to the parking space. Developing smart parking solutions within a city also solves the pollution problem.

The following Technologies will be used in this project:

1. Database Management

PhpMydmin is a free and open source administration tool used for MySQL. It is used to perform web hosting services. We can create, modify, edit and even delete tables using SQL queries.

2. OpenCV in Image Processing

OpenCV is a free open source library used in real time image processing. In OpenCV, images are converted to multidimensional arrays which greatly simplify their manipulation. It is also used in Optical Character Recognition.

3. Raspberry Pi 4 (2GB)

Raspberry Pi is a desktop board which acts as a computer. It helps in various tasks like integration of sensors for reading/writing data, in running and developing software and also in creating a local host database in it.

4. Web Application

Web application is a software which runs on a web browser with active internet connection unlike the computer applications which run locally using operating system. It performs task over the internet.

2. BLOCK DIAGRAM

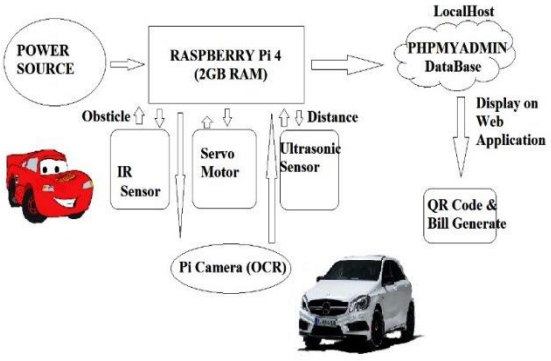

Fig.2 Block Diagram Representation

The Fig.2 explains the interconnection of different sensors with one another. There are mainly four sensors which we are using in this project and they are:

2.1 Ultrasonic Sensor

An ultrasonic sensor is an electronic device the measures the distance of a target object by emitting ultrasonic

sound wave and converting the reflected sound to electrical signal. To calculate the distance of the object the equation which is used is as follows:

D = (Time Taken*Speed of Sound)/2 (1)

Fig.3 Ultrasonic Sensor

2.2 IR Sensor

IR Sensor is an electronic device, which emits the light in order to sense an obstacle in front of it. It can measure the heat of an object as well as can detect motion of that object.

Fig.4 IR Sensor

2.3 Servo Motor

A servomotor is a device that allows angular rotation. It is a rotary actuator. It consists of a suitable motor coupled to a sensor for position feedback.

Fig.5 Servomotor SG90

2.4 Pi Camera V2 (8MP)

The Raspberry Pi Camera Module v2 has a Sony IMX219 8-megapixel sensor. The Camera Module can be used to take high-definition video, as well as stills photographs.

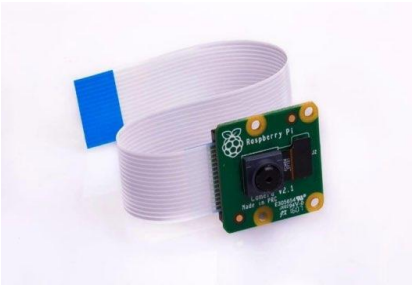

Fig.6 Pi Camera

3. PROJECT EXECUTION PLAN

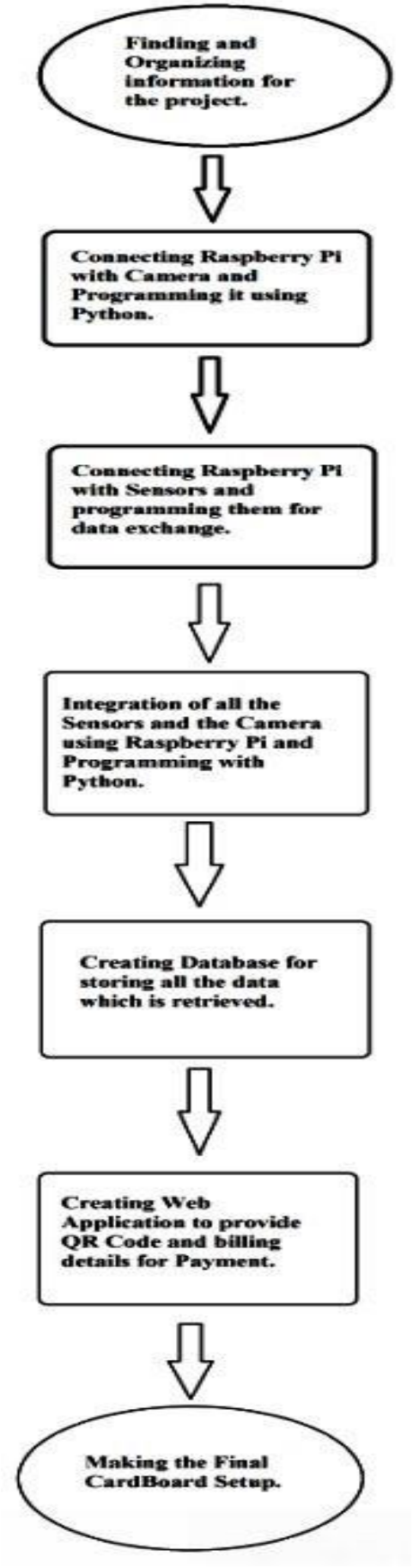

Fig.2 Project Execution Plan Diagram

Initially, we gathered all the information and went through various research papers which were available on the internet related to smart parking. Then we had to choose the latest trend and technologies which can be used to implement our project in a cost effective manner. There were many technologies available on the internet but the most cost effective trends were considered by our team.

We then used raspberry pi as it already has a port for camera and it can also connect different sensors which are necessary for the project. After we finalized the board we connected our board to pi camera and learned to program the camera using python. We installed a lot of libraries in the process and finally made a program which can capture real time image of vehicle and then using optical character recognition we were able to extract the vehicle number plate in text form.

After the installation of the camera we started our work with different sensors which were used to read the objects in nearby surrounding. We used ultrasonic sensors and infrared sensors for the same purpose. We programmed them in such a way that they became the deciding factor for taking the picture using camera and also we used servomotor whose function was also decided with the help of the sensors. We then integrated all the small programs which were generated in the process into one big program using functions.

Now after collecting all the data, we needed a place to store all the information so that we may access that information in later stage. For this purpose we used phpmyadmin database to create tables with various columns i.e., vehicle number plate, entry time, exit time, slot number allotted.

To retrieve all the data from the database and to display it to the user we created a web application with the help of website templates which were available on the internet. Through the web application we were able to provide all the billing details as well as we used python programming to generate a qr code of the amount payable which can be paid after scanning the code.

Finally after completing all the required steps we optimized our model and made it in a more presentable state by creating a cardboard setup. We had to hide all the wiring and also we had to paint it to make it more attractive. With the help of breadboard we were able to use less number of GPIO pins because one of the issues we faced were the limited number of GPIO pins on the raspberry pi.

4. CIRCUIT DIAGRAM

Fig.3 Circuit Diagram Representation

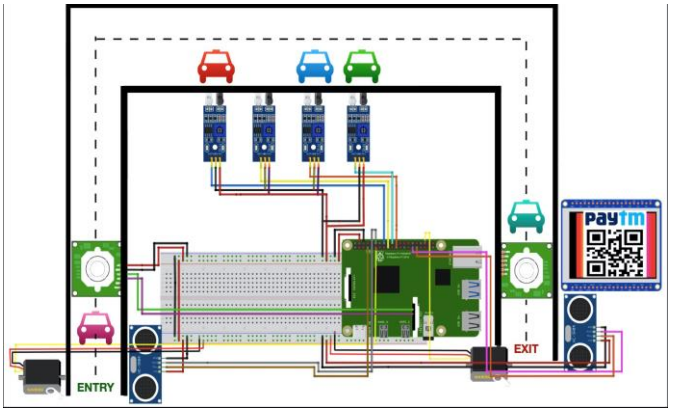

Fig.3 represents the circuit diagram which is created during the project. As there are limited GPIO pins on the raspberry pi we took the 5V vcc and GND pin common on the breadboard. The pin 2 of GPIO is taken as 5V and pin 6 as GND.

We have connected all the vcc and GND of all the different sensors to the breadboard with common GPIO pins for power. All the reading/writing connections of different sensors are connected individually to the GPIO pins.

We used two ultrasonic sensors for entry and exit points in the parking space and we have used servomotor at both the gates.

In this project we have used four IR sensors which will be placed in front of parking slots to assign name to each slot and also to check the availability of parking space.

Only depending upon the available parking space the gate will be triggered otherwise if all the IR sensors are blocked then the gate will remain closed i.e. the servomotor will not rotate.

We have connected the Pi camera for taking the real time images when the gate opens and when ultrasonic sensor detects the vehicle. The image taken will be used in figuring out the number plate of the vehicle and therefore we will be able to recognize the in time and out time of that particular vehicle to generate a bill and QR code for payment of our services.

We have used BOARD configuration to program our project using Python. The IR sensors OUT pins are connected to Pin 13,15,16,18 of the Raspberry pi GPIO set. The servomotor pin is connected to 11 pin of GPIO set. Ultrasonic sensor one and two has trig and echo pins respectively and they are connected to 12, 7, 29, 31 GPIO pins. We are also using resistors to provide stable connection to ultrasonic sensors.

5. CONCLUSION

The purpose of parking management system for smart cities is to reduce traffic, pollution and time taken for searching the right parking spot. This project also helps in providing security to the vehicles parked.

In this project, the issues related to parking are presented and solution is given by using IoT technology which is integrated with web application and database management. This project provides real time information regarding availability of parking slots in a particular parking area and it also helps in optimizing the limited parking space available in cities.

This project will enhance the performance of locating available spaces, storing information in database, providing billing details, improving security and finally automating the system.

The application of our project is not limited to metro station parking lots, bus depots, shopping centers, colleges, schools and hospitals but can also be implemented in various other regions.

6. FUTURE SCOPE

This Project can be integrated with machine learning, artificial intelligence and it can also use upcoming autonomous vehicle technologies and can be a very good business model which uses automation to create a hassle-free environment in the smart cities.