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Smart Car Parking Indicator System

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Abstract : *This paper is part of a summer training program undertaken by the above mentioned students. We chose the Smart Car Parking Indicator System because we feel that parking is a growing problem of urbanization. There is an urgent need to address this menace. At present, most car parking systems do not have any intelligent monitoring system or are monitored by human beings.The Smart Car Parking system indicates the total no of empty and filled parking slots at the entry gate as well as at each crossing inside the parking area. A magnetic sensor is used to sense the entry of a car into the parking system. The boom barrier at the entrance opens only if a parking slot is available. Empty slots are indicated by IR sensors and LEDs. An ultrasonic sensor assists in parking of the vehicle. The entry time, exit time and, photo of each car is recorded to address security concerns.The status of the parking system can also be accessed through a website by the user in the course of the journey.*

The smart car parking system can be easily adopted by housing societies, malls, theatres etc any paid or unpaid parking facility with ease and less cost. The smart car parking system uses the Raspberry Pi Board. This paper describes the details of the technology and software used in the development of the product.

Keywords: *smart car parking, Raspberry Pi, sensors, Python*

1. INTRODUCTION

Car parking is a growing menace in urbanized nations. Conventionally, car parking systems do not have any intelligent monitoring system. Parking lots are monitored by human beings. All vehicles enter into the parking area and waste time for searching a parking slot. Sometimes it creates blockage. Conditions become worse when there are multiple parking lanes and each lane has multiple parking slots. To locate a vacant spot one has to look in all in lanes. The need is to develop an automated car parking system that directly indicates a vacant spot in any lane**.**

1.1 REQUIREMENT ANALYSIS

A parking facility is required to fulfill the following requirements:

(a) The location of the car park should be easy to find in the street network.

(b) The entrance of the car park should be easy to locate.

(c) Should be safe.

An intelligent car parking system should also address the following requirements:

(a) The system should provide informative instructions to help drivers to find an available parking slot

(b) The system should provide effective security measures.

(c) The system should provide suitable auto toll methods to drivers.

(d) The system should provide powerful functions to facilitate administrators and managers to manage a car park.

The aim of our smart car parking system is to meet the above requirements.

2. THE HARDWARE

2.1 RASPBERRY PI

Fig. 1. The Raspberry Pi

The Smart Car Parking System is developed using a Raspberry Pi and Raspbian OS. Python is used as the programming language as it is highly compatible with the

Raspberry Pi. The Raspberry Pi has 22 GPIO pins which have been used to attach various sensors, chips, LED lights and buzzers. It also has ports to attach the HDMI cable, camera, keyboard and mouse. However, it can use only those sensors which provide digital input [1]. Since all the sensors used are of the above category the Raspberry Pi is a cost- effective choice.

2.2 MAGNETIC SENSORS

Magnetic sensors (Hall effect sensors) present at the entry detect the entry of the car inside the system and decrements the no. of available slots by 1. Similarly the magnetic sensor at the exit detects the exit of the car and increments the available parking slots.

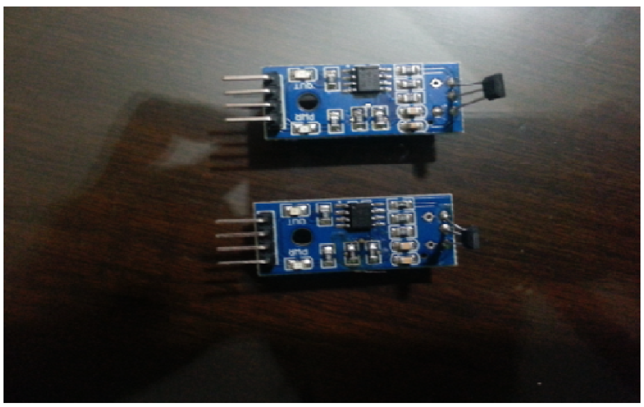

Fig. 2. Hall Effect (magnetic sensors)

2.3 INFRARED SENSORS

Infrared sensors in every parking slot and a LED indicate the current status of the slot. The IR sensor is programmed such that its output is fed to a LED. If there is no obstacle the LED lights up. If it detects an obstacle, the LED lights off. These IR sensors are also used to indicate the number of empty parking slots in the left and right directions of each diversion, by means of a LCD. So the person entering the parking area can view the LCD display and can decide which lane to enter to park the car.

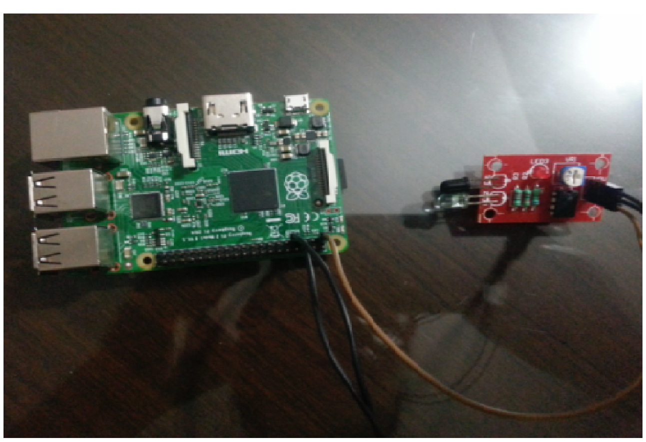

Fig. 3. An IR sensor

2.4 ULTRASONIC SENSORS

Ultrasonic sensors are installed in each parking slot. These provide a cost effective means to aid the users in parking [3]. It uses a target and echo mechanism to determine the distance of an obstacle from it. An ultrasonic sensor sends out a target wave and receives that wave after reflection from an obstacle. The time taken for the wave to return gives an estimate of the distance of the obstacle from the sensor. The output of the ultrasonic sensor is constantly fed to a buzzer which rings whenever the ultrasonic sensor detects an object which is at a distance. This value can be selected by choice.

Fig. 4. Ultrasonic sensor

2.5 PI CAMERA

A Pi Camera at the entrance captures a photo of the car as it enters the system [6]. This photo along with the entry and exit time of the car is stored on an online database for security purposes. Internet access is provided using a TP-LINK Wifi module.

Fig. 5. Picamera attached to Raspberry Pi

2.6 MOTOR

A motor along with a L293D chip is used to facilitate the opening and closing of a boom barrier placed at the entrance of the parking area [2]. The speed of the boom barrier and its direction of movement (clockwise or anticlockwise) can be controlled by coding it in Python. Also, the boom barrier opens only when empty parking slots are available in the system and the magnetic sensor detects a vehicle.

2.7 TP-LINK Wifi module

TP-LINK Wifi module is used to provide internet access to the system [4]. This is used to update the number of empty parking slots in the parking area on a website using Ajax. Before leaving for the destination, the users can also check the status of parking in the parking system.

3. THE EXECUTION

3.1 SOFTWARE

The developing tool for programming the board is the high level Python language. The empty slots are displayed on the LCD screen using a graphical user interface (GUI). The software used for building the GUI is Tkinter for Python.

The software code is stored in the memory of the main controller chip which handles all the communication between the controller, the ultrasonic sensor, the buzzer, the IR sensor, the Hall Effect sensor, the monitor and the motor to operate the hardware structure. The software code is written in Python language on the Leafpad Text editor. This code is compiled by a Python compiler. The compiler converts the high level C language to low level assembly language which is understood by the controller. The compiled code is debugged for any errors.

3.2 USER INTERFACE AT ENTRY AND EXIT POINTS

As the user approaches the parking area, the number of vacant parking slots is displayed on the LCD. The boom barrier lifts and the car enters the parking systems the car approaches the first diversion, the LCD's placed at the diversion display that no empty slots are available, both to the left and the right. The car moves ahead to the second diversion.

The LCD displays two empty slots to the left and five to the right. (The numbers are arbitrary). The user turns to the right. On the way, at the empty parking slots the LED is lit. The user begins to park the car in one of the empty slots. The LED shuts off. During parking, as the car nears too close to the wall, a buzzer starts to beep. The user parks the car at a safe distance from the wall and leaves the parking area.

As the car exits from the parking slot, the LED switches on. The car leaves the parking area through the exit.

3.3 FLOW OF CONTROL FOR GUI

a) Display of Total Number of empty slots/ Lifting of Barrier – at entry & exit

1. Hall effect sensor detects car, sends message to processor
2. Processor sends message to lift the boom barrier, only if empty slots are available.
3. Car enters system.
4. Processor decrements total number of available slots by 1, shows on LCD
5. Photo of the car is captured and saved along with entry time.
6. No of empty parking slots is updated on the website.
7. Car exits system
8. Hall effect sensor at exit detects car has exited, sends message to processor
9. Processor increments the total number of available empty slots by 1, displays on GUI
10. No of empty parking slots is updated on the website.

b) Display of direction where empty slots are present – at the diversion points

1. IR sensors on the left of diversion check whether slot occupied or vacant, send message to processor
2. IR sensors on the right of the diversion check whether slot occupied or vacant, send message to processor
3. Processor computes total number of available slots on left and total number of available slots on the right, displays on the GUI.

3.4 FLOW OF CONTROL AT THE PARKING SLOT

1. Car enters parking slot
2. IR detects car entered, sends message to processor
3. LED switches off
4. User begins parking the car, ultrasonic sensor attached to the opposite wall measures distance of car from wall
5. Car nears wall, ultrasonic sensor detects the distance from the wall. If the distance is less than the minimum specified (can be defined, say 5cms), it sends message to the processor
6. Processor instructs buzzer to start beeping, helping the user park the car

4. RESULT OF ANALYSIS

4.1 RESPONSE TIME OF SYSTEM

TABLE 1: Show the response of the system according to the high signal sent by each of the sensors.

Data	Component Control	System Response	Response Time Hall effect sensor	Response Time IR sensor	Response Time Ultrasonic sensor
1	DC Motor	DC motor simulated to ON position	1.1s	NIL	NIL
2	Camera activated	Camera clicks a photo	1.2s	NIL	NIL
3	LED	LED is switched off	NIL	0.51s	NIL
4	Buzzer	Buzzer is activated	NIL	NIL	0.66s

Inferences from Table 1

1. The boom barrier lifts 1.10 seconds after the hall effect sensor senses the car entry.
2. The photo of the car is clicked 1.20 seconds after the hall effect sensor senses the car entry.
3. The LED switches off 0.51 seconds after the IR sensor detects a car in the parking lot
4. The buzzer starts 0.66 seconds after the ultrasonic sensor detects the car to be too near the wall.

4.2 RESPONSE BASED ON CAR ARRIVAL

TABLE 2: Shows the response of the system when a car arrives.

Data	Car arrival spot	Response
1	Car at entrance	DC motor and Camera is activated, Entry time is noted. No. of empty parking slots is decremented by 1.
2	Car at diversion	Car turn left or right depending on the availability of slots
3	Car at parking slot	LED switches off and buzzer is activated if the user parks the car at a distance less than 5cm. No. of parking slots at diversion is updated.
4	Car at exit	Number of available parking slots incremented by one at entry

Inferences from Table 2

1. When the car enters the system, the total number of vacant parking slots is decremented by one. The boom barrier lifts and a photo of the car is taken.
2. At the diversion, the car turns, depending on the availability of empty parking slots.
3. At the parking slot, the LED switches off or on depending if the slot is occupied or empty.
4. When the car exits the system, the total available parking slot is incremented by one.

4.3 DATABASE

A database is maintained for security use containing information about each car, that is its entry time, exit time and the picture of its number plate as well. This is uploaded online.

This information can be used for maintaining security.

5. ADDITIONS IN FUTURE – WORK IN PROGRESS

- The system can be expanded with the following ideas:
- A system can be developed where users can book a parking slot in the system using the website. This will

require techniques like image processing and time co-ordination

- Parking for multiple types of vehicles can be provided. The user can be guided to a suitable available slot on the basis of the vehicle.
- Toll Collection can be automated by registering the exit time of the car, together with the entry time and photo of the car and by using Image Processing.

6. CONCLUSIONS

This work was taken up with an objective to provide a smart and efficient parking system which can be used as part of the Smart Cities Initiative. We developed a prototype which has an improved performance with respect to cost, range, real time monitoring, data rate etc. and shall work optimally in many different applications. The smart car parking system is well suited for malls, theatres, paid or unpaid parking facility, housing societies etc. The system can be implemented with ease and costs less.

Following are the contributions of this system towards the existing remote monitoring and control systems:

- The system is intelligent enough to provide a hassle-free parking facility to the user.
- The system is scalable and allows any number of different devices to be added with no major changes in its core.
- The limitations are as follows:
- The system requires continuous electrical supply.
- The prototype has not been tested for a multi-floored car parking. But it can be extended to cater for such requirements.

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