

Smart Parking System Using the Raspberry Pi and Android

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Abstract: The aim of this paper is to propose a design of an Automated Car Parking System commanded by an Android application that regulates the number of cars to be parked on designated parking area by automating the Parking and Un-parking of the car with the help of Commands of an Android Application. The study of some existing systems shows that the level of automation in them is limited only to features like Number plate extraction, Comparison based on Snapshots of parking spaces, processing of images or Mechanical lifts in case of multilevel parking. Our system aims to reduce the human intervention to the minimal by automating the process of car parking. This in turn would prove to be useful in reducing the time required for search of free parking space by manually driving through multiple slots. The automation in the car is achieved by means of feature of Path Tracing using Sensors. We, hereby, also present a mathematical representation of our system. We also hereby present the results obtained and finally, focus on the future advancements for the project.

Keywords: Automated Parking System, Android Application.

I. INTRODUCTION

Variety of occasions turn up when we visit various public places like Shopping malls, 5-star and 7-star hotels, multiplex cinema halls, etc. The difficulty we encounter at these places is finding the availability of parking space. Most of the times we need to traverse through multiple parking slots to find a free space for parking. The problem becomes more tedious if the parking are multi-stored. Thus the problem is time-consuming. This situation calls for the need for an automated parking system that not only regulates parking in a given area but also keeps the manual intervention to a minimum. Our proposed system presents an Autonomous car parking that regulates the number of cars that can be parked in a given space at any given time based on the parking space availability. When a car arrives at the entrance, it will be stopped at the main gate and the driver de-boards the car. Using the Android application on his Android device, the user commands the Parking Control Unit to check the Status of available Parking slots, through an SMS. On receiving this command, a search for free slot is carried out and corresponding information is provided to the user, by means of SMS. If the availability of Parking space is confirmed, the user commands the car to get parked to the designated slot. The car traces its path to the entrance of the parking area. Here, it waits and the details required for parking of car at the proper slot are communicated to the Car Control Unit. On receiving the information, the car will further trace its path to free parking spot. On successful parking, the data on the LCD will be updated automatically. For retrieval purpose, the user commands "Un-park", through the Android Application. On reception of this SMS, the car begins to trace back the path to the entrance, where the car driver is waiting. Thus this system proves to be useful for the purpose of the car parking automation and thereby helps reduce the car driver's time, as the searching of the free parking space is handled by the Parking Control Unit. There is a lot of fuel and time wasted by countless commuters to find for a place for parking. This became our main motivation to develop a system where commuters can get parking information on finger tips, because time saved is time earned.

II. LITERATURE SURVEY

Various methods are prevalent for development of autonomous or intelligent parking systems. Study of these systems shows that these require a little or more human intervention for the functioning. One of the intelligent systems for car parking has been proposed by making use of Image processing [1]. In this system, a brown rounded image on the parking slot is captured and processed to detect the free parking slot. The information about the currently available parking slots is displayed on the 7-segment display. Initially, the image of parking slots with brown-rounded image is taken. The image is segmented to create binary images. The noise is removed from this image and the object boundaries are traced. The image detection module determines which objects are round, by estimating each object's area and perimeter. Accordingly, the free parking space is allocated.

A vision based car parking system [2] is developed which uses two types of images (positive and negative) to detect free parking slot. In this method, the object classifier detects the required object within the input. Positive images contain the images of cars from various angles. Negative images do not contain any cars in them. The co-ordinates of parking lots specified are used as input to detect the presence of cars in the region. Haar-like features are used for feature detection. However, limitations may occur with this system with respect to the type of camera used. Also, the co-ordinate system used selects specific parking locations and thus camera has to be at a fixed location. Limited set of positive and negative images may impose limitations on the system.

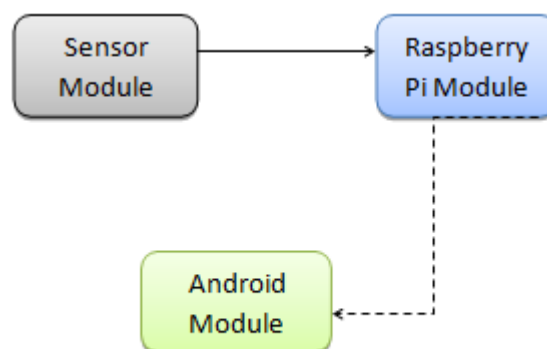
Number Plate Recognition technique [3] for developing autonomous car parking system uses image processing basis to process the number plates of the vehicles. In this system, the image of the license number plate of the vehicle is acquired. It is further segmented to obtain individual characters in the number plate. Ultrasonic sensors are used to detect free-parking slots. Then the images of number plate are taken and analysed. Simultaneously, the current timing is noted so as to calculate the parking fees. The LCD displays 'FULL' sign to indicate that a parking lot is not available. However some limitations with the system include background colour being compulsorily black and character colour white. Also, analysis is limited to number plates with just one row.

Smart Parking system [4] designed proposed a mechanical model with an image processing facility. The car would be parked with the use of lift at multiple levels. Also, image processing is used to capture the number plate and store in database for comparison to avoid illegal car entry.

Thus, we aim to propose a car parking system that represents a fully automated model with minimum human intervention and overcome the limitations of existing systems.

III. METHODOLOGY

Block Schematic Diagram



The system will be implemented in 3 modules

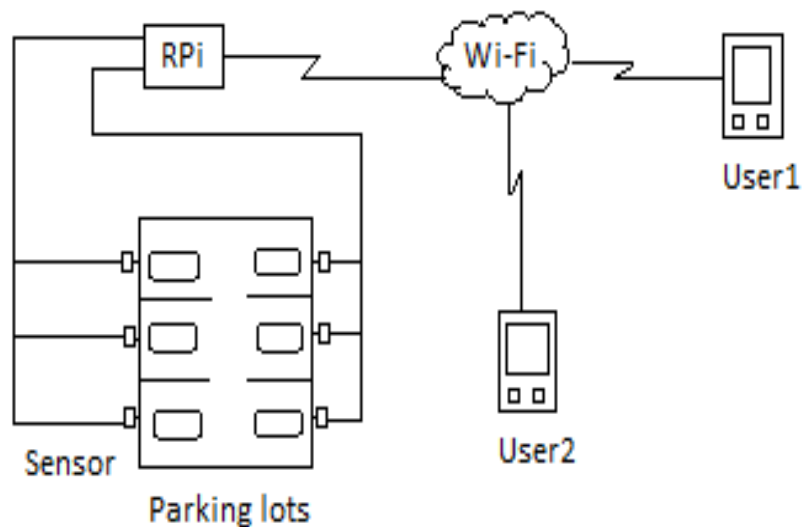
Sensor Module: This module will be installed in the parking place, there will be a sensor node for each parking space. The sensors which will be used are IR- sensors.

Raspberry Pi Module: This module will be connected to the internet and will have connections from all sensor nodes.

Android Module: This module will be installed as an Android app in the users phones. And will display the parking lot status.

The system will require a Raspberry Pi with various IR sensors attached to it. The IR sensors will determine the parking status. The operating system of the raspberry Pi is Raspbian and to see the status of the parking in the parking lot we use the Android App. The parking lot setup (Raspberry Pi and IR sensor) will be accessible to the Android app over Wi-Fi network. The Android application will be used by users to check the parking status on their cell phones, and hence it will be the User interface of our project. The Raspberry Pi is interfaced with the IR sensors to determine the parking status will be the hardware setup of the project. Hence the raspberry pi becomes the hardware module of the system.

System Architecture:



The system architecture has been divided into following **3 modules:**

- 1) Raspberry Pi module
- 2) Sensors module
- 3) Android module

The Hardware module is Raspberry Pi and Sensors. The Raspberry Pi will have connections from all sensor nodes. It serves the communication module with latest Database status whenever required by Users. The Raspberry Pi is a credit-card size computer. This is similar to normal computer. The operating system of the Raspberry Pi is Raspbian which is Linux based operating system. It is programmed by using Python Language. The Raspberry Pi is connected to the users through Wi-Fi by using PHP language. To access the Wi-Fi we should connect dongle to the Raspberry Pi.

Sensor module will be placed in the parking space there will be a sensor node for a each parking space. The sensors which will be used are IR-sensors. An Infrared Sensor is an electronic device which is used to sense light wavelength of its surroundings by either emitting or detecting infrared spectrum. Green LED will be glow if no object is detected and Red LED will be glow if object is detected. Using the IR sensors in each parking slot, it detects the presence or absence of a vehicle, and sends messages to user. It will always keep track of cars parked in parking lots using IR Sensors.

Android module will display the parking status to the user in real time. An Android application is created using Android studio. The Android applications are developed using the JAVA code. Using the JAVA compiler the source files are converted to JAVA class files. The Parking status is commanded by the Android device having the Android application, installed. Then checks for the parking slot for availability. If it is available then it shows green signals or if not available then shows Red signals

The communication between the user and the Raspberry Pi is responsible for the overall movement of the car as per data received from the Parking lots. Designing, developing and producing a leading edge parking technology is called as Smart parking. It is a vehicle parking system that helps drivers find a vacant spot. Smart Parking system is proven as an exact, robust and cost efficient way to ensure that users know exactly where unoccupied car parking spaces .

Algorithm:

Sensor and Raspberry Pi Module:

- Step 1: Initialize the System (IR Sensors and raspberry Pi)
- Step 2: Read sensor status and store in the Database
- Step3: Send Sensor Status to Android Application when requested
- Step 4: Continue through Step 3
- Step 5: Stop

Android Application Module:

- Step 1: Start Android App
- Step 2: Check connectivity with Server (Raspberry Pi)
- Step 3: Request Sensor Status after every time interval
- Step4: Continue through Step 3
- Step 5: Stop

Application:

The system after development can be used by big Shopping or Multiplex malls or Industries to automate the parking status intimation system.

Advantages:

- Save the time for searching the parking spaces.
- Reduces the fuel consumption and traffic congestion
- Avoids air pollution & global warming.
- Scalable, robust and reliable.
- Reduces the driver stress and improves the urban area.
- Provides the accurate information.
- More efficiency.

Disadvantages:

The users must have Android cell phone to see the parking status.

IV. CONCLUSION AND FUTURE SCOPE

In this paper, the implementation of an Automated Car Parking system commanded by Android Application is successfully discussed. The components used for the implementation of the system provide efficient output at various stages of implementation. The interfaces established between various components provide an effective communication across the overall working of the system. Thus, the system functioning is efficient and is recommended for commercial implementation.

In future, certain changes can be incorporated as per the requirements of the organizations implementing the system. They are:- Search of free parking slots can be improved using Binary or Hash Search. System can be extended to multi-level and multiple parking areas by making potential changes in the hardware setup. SMS sent through Android Application can be made secure by applying encryption algorithms. Also, for security purpose, Login facility can be provided to the users.

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