International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 17 (2017) pp. 6559-6563

RFID Based Smart Car Parking System

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Abstract

The main objective is to avoid the cramming in the car parking area by implementing an efficient car parking system along with a user-friendly application for an ease of use. Normally at public places such as multiplex theatres, market areas, hospitals, function-halls, offices and shopping malls, one experiences the discomfort in looking out for a vacant parking slot, though it's a paid facility with an attendant/ security guard. The parking management system is proposed to demonstrate hazel free parking. The proposed system uses infrared transmitter-receiver pairs that remotely communicate the status of parking occupancy to the raspberry pi and displays the vacant slots on the display at the entrance of the parking so that the user gets to know the availability /unavailability of parking space prior to his/her entry into the parking place. Implementation involves minimal human interaction and provides a seamless parking experience thereby reducing a lot of time wasted by the user in parking his/her vehicle.

Keywords: RFID, Sensors, pi, slots.

INTRODUCTION

Nowadays in many public places such as malls, multiplex systems, hospitals, offices, market areas there is a crucial problem of car parking. The car-parking [1-3] area has many lanes/slots for car parking. So to park a car one has to look for all the lanes. Moreover, this involves a lot of manual labor and investment. So, there is a need to develop an automated parking system that indicates directly the availability of vacant parking slots in any lane right at the entrance. It involves a system including infrared transmitter- receiver pair in each lane and a display outside the car parking gate. So the person desirous to park his vehicle is well informed about the status of availability of parking slot. Conventional parking systems do not have any intelligent monitoring system and the parking lots are monitored by security guards.

A lot of time is wasted in searching vacant slot for parking and many a times it creates jams. Conditions become worse when there are multiple parking lanes and each lane with multiple parking slots. Use of parking management system would reduce the human efforts and time with additional comfort. In the proposed system, the display unit displays a visual representation of the parking and it shows the empty and occupied slots which help the user to decide where to park their car. The system would not only save time but the software and hardware would also manage the Check-in and check-outs of the cars under the control of RFID readers/ tags with additional features of automatic billing, Entry exit data logging.

The users go through a onetime registration process where there are asked to fill in their personal details and an account is created for them, this account has information about them and also has money in it which they can recharge at kiosks present in the vicinity. In this system, the users are guided to the vacant slot for parking using Video Displays at the entrance of the parking floor, these displays show a visual representation of the parking lot with empty and occupied slots which are green and red respectively. The user is provided with a tag which he receives on registration, this tag is linked with his prepaid account and includes his personal information, and this tag uses Radio Frequency identification (RFID) technology and is placed on the top of the user's windshield. The parking charges are automatically deducted from the user's account based on the time spent inside the parking area.

OBJECTIVE

Now days in many public places such as malls, multiplex systems, hospitals, offices, market areas there is a crucial problem of car parking. The car-parking area has many lanes/slots for car parking. So to park a car one has to look for all the lanes. Moreover, this involves a lot of manual labor and investment. So, there is a need to develop an automated

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BACKGROUND

Due to the large amount of time people spend on parking their car, there is a need for a better system which reduces the time taken to park vehicles, the current system which exists involves the client(user) to wait in a queue where each car has to wait for a token to be generated, this token is kept by the client till he is done with his work and on the time of exit has to return the token, which then calculates the time spent and the bill is generated. But the problem with this current system is the queue, each person is unique in their own way, so it depends from person to person, some people might quickly take the token and park their car, while some might take a longer time, leading to delay. The other problem with the current system is that there is no automatic way in which the user knows where there is parking space; he relies on another person (security guard) for the parking. To overcome these problems, we use RFID and IR sensors. RFID is used instead of generating a token again and again, each user goes through a onetime registration process where a RFID tag is attached to his vehicle, This RFID tag has information about him, which is unique to him (like Aadhar number) so there is no queue as such, users just pass through the gate seamlessly and park their vehicle. Once they pass through the entry gate they can see a huge display which has the live parking slots available, once a car is parked the IR sensor updates the database. On exiting the tag is detected again and the amount is calculated and automatically deducted from the users account.

A similar approach has been taken by Somfy RFID based parking solution, who provide their service to residential areas, societies, factories and industrial areas. Another solution is provided by FASTag which uses RFID tags for automatic deduction of toll charges and lets you pass the toll gate without having to stop.

Motivation

The main motivation for making Car Parking System is because of the huge amount of time people have to take in order to park their cars in malls, multiplex systems, hospitals, offices and super markets. In the existing system, one has to spend ample time before they find out an empty parking spot and also the conventional payment method requires the user to spend a lot of time to complete their transaction. Creating an automated system which not only helps users to make parking much more efficient and faster but also automates the payment gateway using RFID thus saving the user a lot of time.

Description

It proposes a prototype of Car Parking System [4] with various personalized features. The sensor used in this project is an infrared sensor which determines whether the slot is occupied or unoccupied. These sensors are connected to the raspberry pi. The output of these sensors is sent to the database through the raspberry pi. Once the database is updated the result is displayed on the video monitor at the entrances of the parking level. This result is displayed using the website URL which is updated every 5 seconds. The other module of CPMS is the payment gateway using RFID. There will be an RFID Tag attached to every vehicle.

As soon as the vehicle passes through the entry gate the RFID Reader reads the tag and gets the Unique ID and then logs an entry into the database and upon exit another RFID Reader reads the tag and deducts money from the users account based on the time spent in the parking lot and hence completes the transaction.

The hardware comprises of IR Sensors, Raspberry pi [6] and RFID Sensors which communicates with the Google App Engine and is rendered on various Applications such as the Website, Twitter bot and the Mobile Application

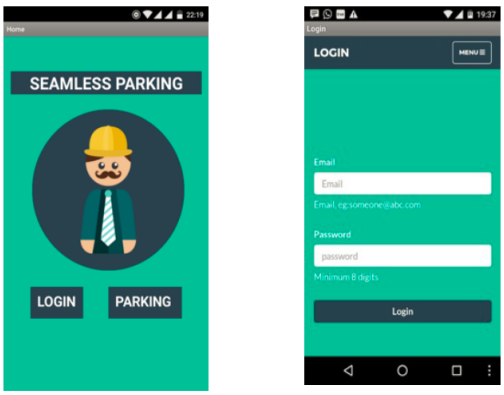

Figure 1: Software Design

HTML 5.0, CSS and Bootstrap were used to design the software aspect of this project. This involved designing a registration page, a login page, a page where users can view his previous transactions and balance and also an interface for the users to check the available slots in the parking lot. The data is read from the database using a python file and these data are read as a list and sent to the HTML files using jinja templates. Similarly, the app is designed using the MIT App inventor studio where we can use the website links using the Web Viewer component provided by App engine.

The smartphone application provides the user with an interface to interact with the device. The application provides the user real time reading of the available slots. The user also has the option of logging in and viewing all his previous transactions. 802.11n was designed to improve on 802.11g in the amount of bandwidth supported by utilizing multiple wireless signals and antennas (called MIMO technology) instead of one. Industry standards groups ratified 802.11n in 2009 with specifications providing for up to 300 Mbps of network bandwidth. 802.11n also offers somewhat better range over earlier Wi-Fi standards due to its increased signal intensity, and it is backward-compatible with 802.11b/g gear.

The hardware consists of two Raspberry Pi, 6 IR Sensors, one RFID Reader, Jumper wires and RFID Tags. The IR Sensor is primarily responsible for detecting any object within its range. The RFID Reader is used to read data from the RFID Tags. The Raspberry Pi acts as an interface between the hardware and the software.

METHODOLOGY

Overall Design

The Overall Engineering Design is described in the figure 2. The hardware comprises of IR Sensors, Raspberry pi and RFID Sensors which communicates with the Google App Engine and is rendered on various Applications such as the Website, Twitter bot and the Mobile Application. This detailed architecture explains about the entire working system of the efficient car parking model with various personalized features. The sensor used in this project is an infrared sensor which determines whether the slot is occupied or unoccupied. These sensors are connected to the raspberry pi. The output of these sensors is sent to the database through the raspberry pi .

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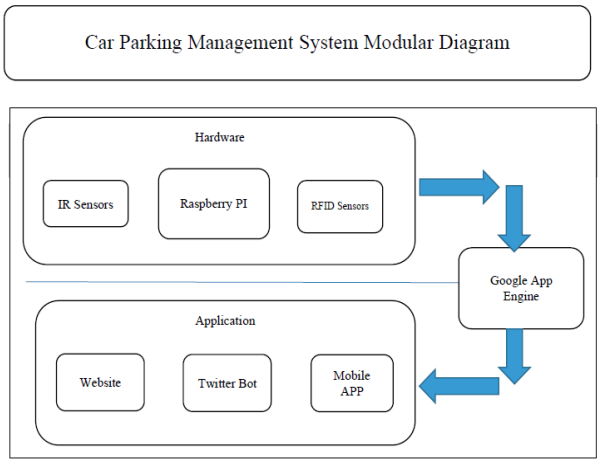

Figure 2: Architecture

Hardware Design

The IR sensors and the RFID readers sends values to the Raspberry Pi which then is sent to the Google App engine where the database gets updated and these values are later interpreted by the App and the website which can be viewed by the end user.

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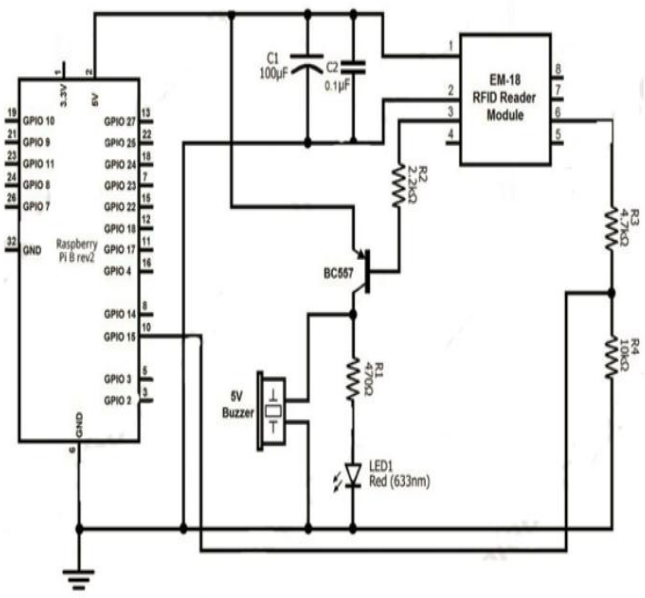

Figure 3: Hardware Design

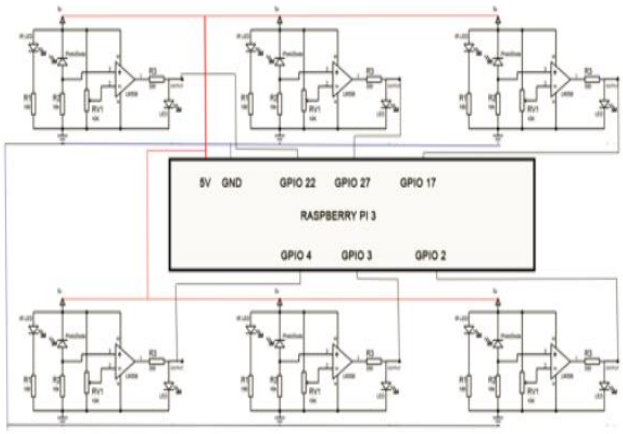

Figure 4: Slot availability circuit

When the IR Sensors detect any vehicles in the parking slots , the IR Sensor sends a signal to the Raspberry Pi . According to the output from the IR Sensor the Pi runs a particular link to update the database. For example , if the status of slot 5.

changes from occupied to unoccupied the IR Sensor detects no object in front of it and hence sends a signal to the Pi and the Pi runs the website link "Seamless-parking.appspot.com/slot/5/1" Where 5 indicates the slot number and 1 indicates the availability of the slot.

The user has to register by entering various details such as Name, Phone Number, Email, Aadhar Number and Amount of

cash to be depo. Once the user has registered he is ready to use the seamless parking System. As you can see in, if we want to make this work in the real life we would require

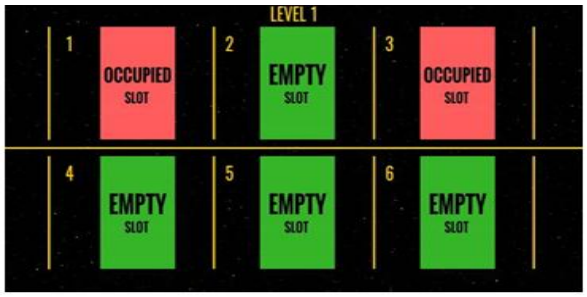

Figure 5: Slot availability module software design

Active RFIDs and high end ultra sonic sensors, as you can see from the pricing below, these sensors cost a lot, together they come for around 3535 $ which is close to 2.26 Lakhs they are expensive because of their range and accuracy, The Reader can detect objects as far as 400 m and these tags are active tags. For the demo we have used passive RFID tags which are really cheap compared to the active ones but they have a range of 5 cm only which isn't enough for this to work in real life.

Telegram Bot

Telegram is a Chat application used to send messages, a bot on that platform sends messages to the users who come to park their vehicle. This is done using the bot API of telegram. The bot is made using python which is why we have used Telepot library which is a python library for telegram.

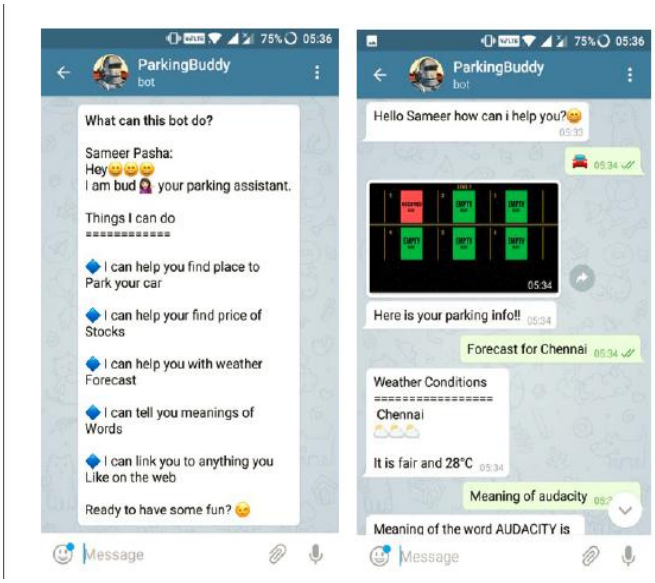

Figure. 6 Twitter Bot

Twitter is a social media platform where users send tweets, tweet is basically a small text (140 words max). In this platform, we can filter tweets out using "# ". We are using the Tweepy module, which is a twitter python library. So, users can get parking information from the bot by tweeting to it.

CONCLUSION

The main aim is to design an integrated system which involves two components namely Parking Allocation and Seamless Parking. The Parking Allocation component consists of sensors in front each slot and when a vehicle enters into the slot, the database is updated and the changes are reflected immediately on the nearby display. The Seamless parking component consists of a RFID Tag attached to the windshield of vehicle. When the car is passed through the entrance the RFID Scanner scans the tag stores the timestamp of the entry and at the exit the tag is read again and the total time is calculated and reflected in the users account, thus saving the hassle of human intervention and saving an ample amount of time. We have interfaced 6 IR Sensors and an RFID Reader module (EM-18) using a raspberry pi. The IR senses the presence of a vehicle in the parking slot and updates the database. The RFID is used for identification and transaction. We have made an android application, twitter bot, telegram bot, website to further simplify the process of getting data about the parking slot availability and effort less parking.

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