

SMART PARKING SYSTEM USING IOT

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ABSTRACT

Due to the rapid production of number of vehicles, traffic problems are bound to exist. The number of vehicles has been increasing on a daily basis, which adds to the parking constraints at public places. The proposed system, "Smart Parking System" is designed to alleviate the current problems. With the implementation of the smart parking system, user can easily locate and reserve a vacant parking space at any car parking area which is convenient to them. Checking in and checking out of vehicles is also made easier and more convenient to the drivers with the help of Node MCU (ESP8266) and Ultrasonic sensor. In today's world, smart cities have become very popular. The evolution of Internet of Things has made it possible to achieve smart parking system. Problems such as, traffic congestion, limited car parking facilities and road safety are being addressed by IoT. In case the parking is not available in the desired location, the proposed system also allows the user to search for nearby available parking area. Using Naïve Bayes Classifier algorithm the user can also search for the availability status of a parking area for any particular day.

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KEYWORDS: *Node MCU (ESP8266), Ultrasonic Sensor, Naïve Bayes Classifier Algorithm*

Article History

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INTRODUCTION

[1] In the year 2001, the total registered vehicle population in India was 55 million. In the year 2015, the total number of registered vehicles in India was 210 million. There were more than 7 states in India having more than 10000000 registered vehicles, which makes it a rough estimate of 281.81% increase of registered vehicles in a span of 14 years. This

tremendous increase in the number of vehicles on the road has led to traffic congestion.

Parking has become one of the major problems in today's world. As the population increases, the numbers of vehicles are also increasing day by day. This causes traffic congestion during peak hours. In today's ever busy working environment, drivers do not have much time to search parking spot for their vehicle. In many public places, like shopping malls, universities, city centres, and many other busy working places, finding parking has become time consuming for individuals who drive. Searching for parking in such places can cause stress and irritation for the drivers. Hence people usually park their vehicles on the road in a much disorganized manner. This leads to inconvenience for other drivers to move their vehicle on the road. The aim of our system is to search and book parking for drivers for their vehicles before they arrive to their destination. In this manner, drivers do not have to waste their time in searching places to park their vehicle.

System Design

This diagram shows how the entire system works. The given flow diagram shows how the user interacts with the smart parking system. With this diagram we can come to know the proper flow and the way the smart parking system actually works. The user login into the website and selects a parking spot. After the payment is successful he is given a unique code which will be verified at the destination. Once the user reaches the destination and the code is verified, a map showing the user of the available slots will be provided. After the user parks the car the sensor will update the corresponding changes to the database which will be shown on the website.

Proposed System

The proposed Smart Parking system, allows the user to search for nearby available parking area. Finding a desirable parking place has become a huge problem in today's world, and that is where the motivation for this project came up from. Smart Parking System will help drivers search an appropriate place to park their vehicles. In this way, drivers do not have to burn their fuels and search for places to park their vehicles. The amount of fuel burnt while searching for parking will also be reduced. Once the user finds the appropriate parking area, he can reserve it for a particular time period and the count of availability will be decremented on the website. If the user has booked the slot online the unique code is generated for the user, thus when he'll reach the parking counter, he has to just verify the code. Once the code is verified, it will show the available and unavailable parking slots for him and he can park his car in the available space.

Initially, the free slots are green (available state). Once the car is parked the sensor will detect the vehicle and it will change the color of the slot on the website to blue (waiting state). The timer begins and waits for a certain period of time. One's timeout occur, it again senses the presence of the vehicle and changes the color of the slot to red (unavailable state).

The Smart Parking System Project aims at giving a smart and smooth user-friendly system for the user to book their slots for parking. In order to do that we provide the probability of parking space available in that parking area with respect to days and hours. To do that, we use the Naïve Bayes Classifier algorithm. With the available data set, we'll show the probability of the vacant slot at a particular time for that parking area.

Ultrasonic Sensor [2]

In this proposed technique we are using an ultrasonic sensor to detect the presence of the vehicle. Other sensors like proximity sensor, pressure sensor, IR sensor, capacitive sensors, and many other sensors can be used but due to the cost, response time, accuracy and the lifetime of the ultrasonic sensors were better than the other sensor.

The ultrasonic sensor transmits the ultrasonic waves towards the obstacle which is to be sensed. The receiver receives the echo from the obstacle and determines its distance. The advantage of using ultrasonic sensor is that it's not affected by the moisture, dust, rain, snow, etc. It has a higher sensing distance (in centimeters and inches) compare to inductive proximity sensor or capacitive proximity sensor. The vehicle height is varying so the need for higher sensing distance is important.

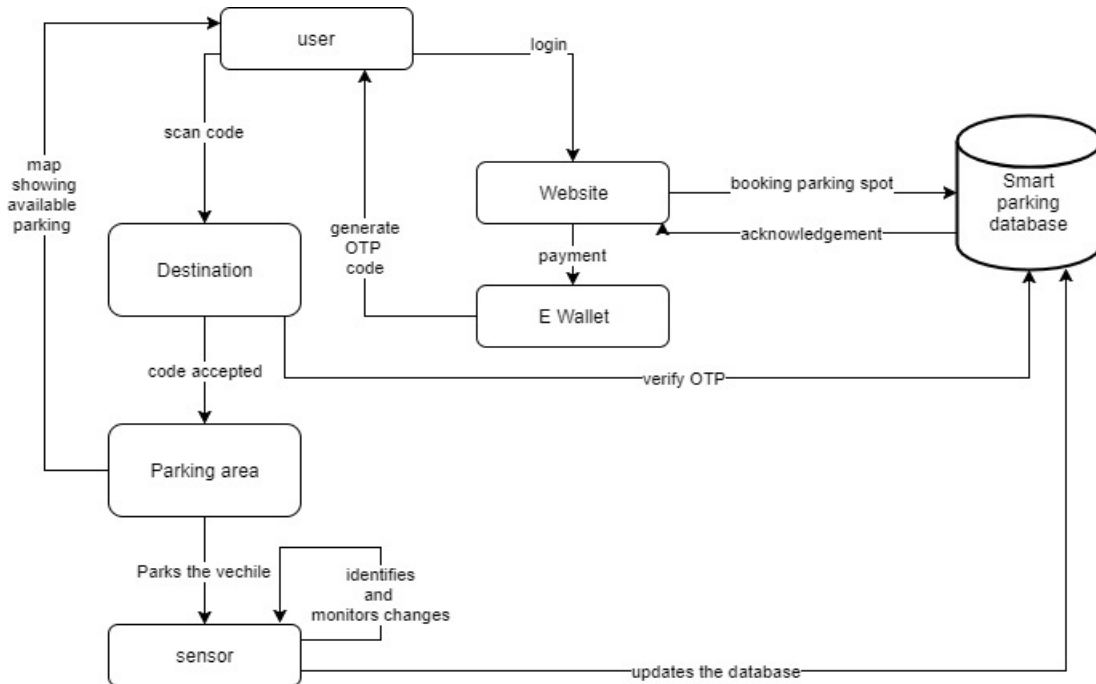


Figure 1: Flow Diagram of the Proposed System.

Node MCU (ESP8266) [3]

ESP8266 is used to integrate the website and the sensors. The advantage of using ESp8266 over raspberry pi and Arduino is that it has an inbuilt wifi module and does not require an external wifi module to power the software. The wifi module is required to send the sensor details to the database on the server. These details will modify the website according. The ESP8266 can connect to web server to send and receive data. It has low energy consumption and low cost. There are three indications to determine the availability of the parking spot by the user to while checking for parking slot on the interface:

Green Indication (Available): This indicates that the parking spot is empty (available) and vehicles are allowed to park in that particular parking spot.

Blue Indication (waiting): This indicates that it has detected the presence of the vehicle and it waits for a particular time period. The time varies from location to location. If the number of users increases in a particular location then the waiting time will be reduced and if the number of users decreased in a particular location then the waiting time will be increased. The Default average waiting time period is 5 minutes. After a timeout, if the sensor senses the vehicles it changes from blue to green else from blue to red.

Red Indication (Unavailable): This indicates that the parking spot is not empty (not available) and vehicles are not allowed to park in that particular parking spot.

OTP Generation Algorithm

A one-time password (OTP), is a password that is valid for only one login session or transaction. It is a secure way to provide access to an application. OTP works through randomness algorithms that generate a new and random password each time they are used. For the payment verification and authentication, OTP plays a good role. Thus there will be the generation of OTP using an algorithm.

Naïve Bayes Classifier Algorithm [4]

The Naïve Bayes Classifier algorithm is used to tell the user about the status of the parking area for any particular day. It gives the user the probability if the parking will be available for him parking space for him. Accordingly, the user can decide the parking area and book in that particular area. The K- Means is efficient for large data collection set, ease of implementation and high performance.

Algorithm

Step 1: Determine the class (target) and predictor (attribute) from the given data set. From our dataset class (target) element is Availability, as we are finding the probability of the available slot.

Step 2: Construct a frequency table for each attribute against the target. From our dataset we have to construct the frequency table for each attribute against the target i.e. the attributes are Day, Day-type (holiday/no holiday), Time (hours).

Step 3: Transform the frequency tables to likelihood tables. Now convert the frequency tables to the likelihood table and proceed with the further calculation

Step 4: Finally use the Naive Bayesian equation to calculate the posterior probability for each class.

We want to find the probability of availability i.e. $Y = \{YES, NO\}$ and X will be $X = \{Day, Day-type, Time\}$

$$P(Y|X) = P(Y) \prod P(x_i|Y)$$

SCOPE

Parking for Private Areas

The user selects a location on the website. All the nearby places will be shown to the user in case if the place the user wants to park is full. Once the user selects the parking spot and the payment is done, a unique code will be generated to the user. This unique code will be verified at the location. All the available parking spots will be shown to the user. When the user parks the car the sensor will detect the car and update the software.

Autonomous Car Integrated with our Project

The autonomous car communicates with our software, which detects the available spaces in the nearby places where the user wants to visit. The user selects the location he wants to visit. The unique code is generated which will be verified at the parking location. The autonomous car will park in the parking slot selected by the user.

Parking for Residential Areas

Each resident will be provided by an RFID sticker per car. Once the user enters the residency, the RFID sensor will scan the RFID sticker on the car. Each car has a unique RFID sticker. The smart parking system will detect if the car is present in the given slot and will verify if the given RFID matches (to check if the car has entered the building or not). Integrating with our software the owner will know if someone else has parked in his parking spot.

CONCLUSIONS

The traditional system uses image processing to detect the car and update the changes. The traditional system only shows the count of the cars present at the parking place. It does not show the exact location of the available parking spots.

The proposed system uses sensors to detect the car and update the changes to the website. The website is user-friendly. The website shows the user the available, unavailable and waiting places. The prediction tells the user about the availability of parking places for a particular day.

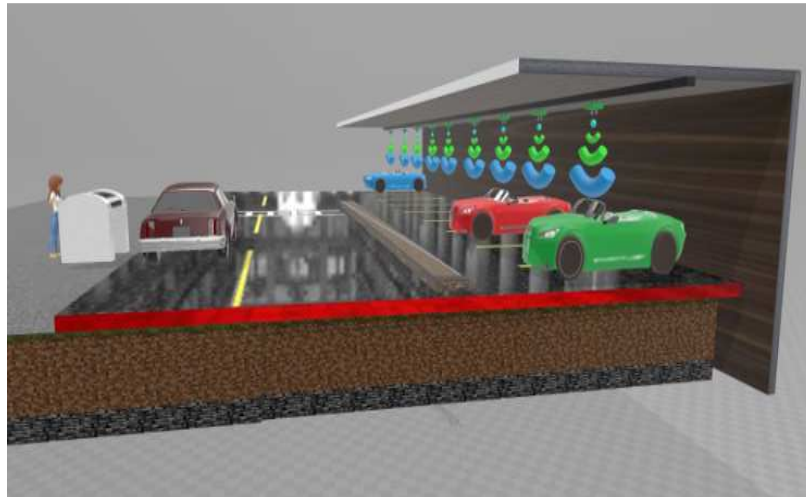


Figure 2: Car Arriving at the Parking Area and Verifying the Scan Code.



Figure 3: After the User Verifies the Scan Code, the User Gets an Overview Map of that Parking Area According to which the User Parks His Car in the Desired Parking Slot. Once the Car is Parked, this Data is Updates in the Database.

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