

SPARKS: Smart Parking System

Prajakta B. Kulkarni¹, Ankita A. Joshi²

Students, Department of Computer Science and Engineering,

D. Y. Patil College of Engineering and Technology, Kasaba Bawada, Kolhapur, Maharashtra, India.

Abstract:- Parking problems have become ubiquitous and are growing at an alarming rate in every major city. It causes parking problems which leads to traffic congestion, driver's frustration, and air pollution. When we visit various public places like shopping malls, multiplex cinema hall & hotels during festivals or weekends, it creates more parking problem. The searching for a parking space lead to 30% to 40% of traffic congestion. Because of this, car parking in turn causes the traffic issue. There are some problems related to car parking like: How to control the number of the car in the parking lot, monitoring the movement of car in/out side of the parking lot, check whether there is a place inside for more cars or not and the safety to park. This paper proposes a solution for these problems using the concept of Internet of Things. SPARKS is a fully automated system which senses the entry and exit of a car, displays the total number of cars parked in the parking lot on screen and how many free spaces are available in parking area.

Keywords:- Internet of Things, Sensing Unit, Arduino UNO Microcontroller, Image Processing, ANPR-Automatic Number Plate Recognition.

I. INTRODUCTION

Traditionally, many problems arrive in a manual car parking system like traffic control, time consumption and fuel wastage. The existing parking system doesn't provide an efficient way to predict and spot the vehicle occupancy in real time. Whenever we have to park a car in the parking structure, we have to manually search for a parking slot. This problem multiplies when the parking structure is full or multi-storied. This causes traffic management problems and unnecessary time consumption in rush hours. Hence, existing system doesn't enable better real time monitoring and management of available spaces in the parking area. All this causes inconvenience for the people. We face various problems related to car parking like: How to control the number of the car in the parking lot, monitoring the movement of car in/out side of the parking lot, check whether there is a place inside for more cars or not and the safety to park. [1] We have implemented a smart system by using various technologies and advanced researches. The smart parking system is implemented in many environments with various features, which solves the problems faced in the day to day activities. The main idea behind the Smart Car Parking System is to help the user to find areas where parking is available and the number of slots free in that area.

Our proposed system reduces the time taken to check space for the vehicle. It also helps in reducing the fuel consumption. [4] Our proposed system uses ultrasonic sensors to sense the car. [1] There are three tiered functionalities, the lowest level comprising the sensing functionality, a middle tier dealing with data forwarding, and the upper tier handling data storage, processing and client interfaces. Our proposed system uses image processing using ANPR technique to detect the number plate of the car. [5][6][7] We have also added the functionality to calculate the wages automatically. The use of android technology combined with the recent advances in wireless applications is the key to solve emerging parking problems. [3]

II. Related Work

The following are some papers that were referenced for the project:

“Automatic Multilevel Car Parking System” in International Journal of Electrical and Electronics Research, ISSN 2348-6988 Vol. 3, issue 2, pp: (438-441), Month: April-June 2015 by Ankit Gupta, Ankit Jaiswar, Harsh Agarwal, Chandra Shankar [1]. In this paper, the authors have introduced and described the concept of “automatic car parking system”, which can automatically sense the entry and exit of the cars, number of cars displayed on the LCD. This automated car parking system reduces the time taken to check the space for the vehicles. Here, authors have suggested the use of sensors to sense the presence of the car.

“Smart Parking System with Image Processing Facility”, I.J. Intelligent Systems, Applications, 2012,3, 41-47 published online April 2012 in MECS by M.O. Reza, M.F. Ismail, A. A. Rokoni, M.A.R Sarkar [2] [5] [6] [7]. This paper has shown the Smart Parking Systems which obtain information about available parking spaces, process it and then place the car at a certain position. Also, the authors have introduced a concept of an optical character recognition technique, i.e. “ANPR-Automatic Number Plate Recognition” for number plate recognition of cars.

“Android based Smart Parking System” in International Journal of Innovative Research in Computer Engineering Vol. 3, May 2015 by Pallavi Mane, Radha Deoghare, Samiksha Nagmote, Shubhangi Musle, Shraddha Sarwade [3]. In this paper, the authors have proposed a design of “Android based smart Parking System” that regulates the number of cars to be parked in designated parking area. This

is done by automating the Parking and unpacking of the car with the help of an Android Application. An Android application will help the user to find out the exact parking slot allocated to him in the parking area. Data will be accessed locally. Directions to the allocated parking slot will be shown to the user [3].

“Automatic Smart Parking System using Internet of Things (IOT)” in International Journal of Scientific and Research Publications, Volume 5, Issue 12, December 2015 629 ISSN 2250-3153 by Mr. Basavaraju S. R [4]. In this paper, the author has introduced a concept of Internet of Things (IOT) which plays a vital role in connecting the surrounding environmental things to the network. The Author has suggested a use of categories of IOT like sensing, processing and connectivity of data. Also, the author introduced a design of a Smart Parking System by making use of IOT supportable hardware such as Arduino UNO microcontroller which consumes less power.

III. IMPLEMENTATION DETAILS

A. System Overview

The system architecture shows the schematic of the smart parking system. At the entry point, when the car enters into the parking lot, web camera captures the image of number plates and the image processing unit is used to convert it into text format and it is used to allocate a parking slot which is then stored into database. [4] When the car is parked in the allocated parking slot, then sensing unit senses the presence of a car in the parking slot. The Arduino unit then processes this raw data and store it into a database through the internet via Ethernet Connectivity. [4]

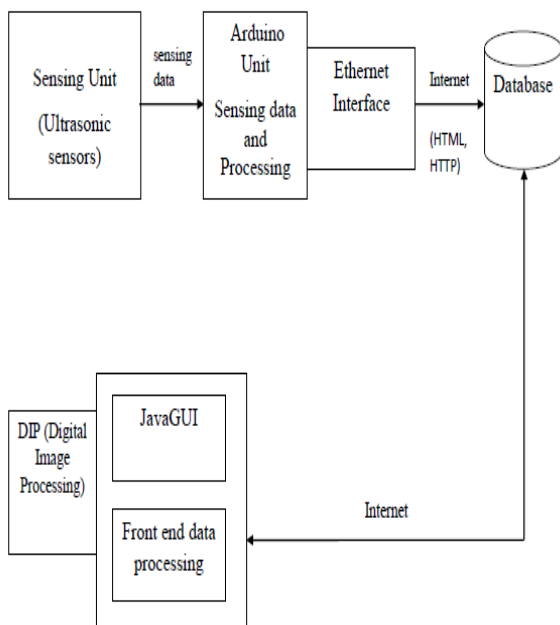


Fig 1. System Architecture of Proposed Car Parking System

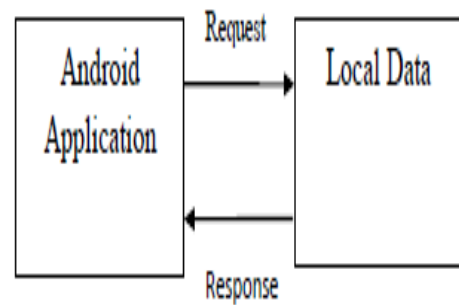


Fig 2. Android Application

The android application provides the exact route of the allocated parking slot to the user. The application then takes the allocated parking slot number as an input and displays the route that the user needs to follow to reach the parking slot. [3] The data is accessed locally.

B. Modules

The proposed system is divided into following five modules:

a). Sensing Unit

The Ultrasonic Sensors are used to sense the presence of the car. Ultrasonic sensors are proximity sensors. These sensors sense the presence of the physical object without coming in contact with that object, so the lifespan of these sensors is more. In this proposed system, we use HC-Sr04 ultrasonic distance measuring sensor which is able to sense an object at distance ranged from 2cm to 51cm. Ultrasonic sensor consists of transmitter, receiver and control unit with trigger, echo and I/O pins. The data measured by the sensors is collected.

b). Arduino Unit

It is the Microcontroller Unit, which processes the data collected by sensors and updates the database. [1] The corresponding changes are reflected in the database and displayed on the front end. The Arduino unit processes the data sent from the sensors and sends it to the database using Ethernet Shield using the internet. The data sent by the sensors is analog data. [4] The Arduino unit converts that raw analog data into digital format. The digital data is used and a default range for car parking is set. A predefined range is compared with the range measured by the sensors. Depending on this status of a parking lot is determined.

c). Ethernet Connectivity

For connecting microcontroller to the database, Arduino Ethernet Shield is used. The Arduino Ethernet Shield connects our Arduino Unit to internet in a few minutes. [4] An Ethernet Shield is mounted on the Arduino board which

facilitates connectivity to the internet over the Ethernet. The Ethernet Shield acts as a gateway for the system which is helpful to access online repositories. We have used standard Ethernet libraries provided by the Arduino unit to read and write the data. The Arduino unit is connected to the database using the internet. [4]

d). Image Processing

We have used a technique called “ANPR-Automatic Number Plate Recognition” in our proposed system. ANPR is a technology that uses optical character recognition on images to read vehicle registration plates. [5][6][7] With the help of web camera, we capture a picture of the number plate of the car and we have designed a code which converts it into text format which is further stored in the database automatically. The javaanpr.jar file is used for image processing. This file includes various inbuilt libraries which are used for comparing and processing the image [2][5][6][7]. The ANPR technique consists of following steps:

- i. Number plate area detection
- ii. Plate fragmentation
- iii. Feature extraction and normalization of characters
- iv. Recognition of characters

e). Android Application

An Android application is created using Eclipse. The android application helps the user to find out the exact parking slot allocated to him in the parking area. Data is accessed locally. Directions to the allocated parking slot are shown to the user [3].

C. Algorithm

There are seven primary algorithms that the software requires for identifying a license plate:

- Plate localization – This technique is responsible for finding and isolating the plate on the picture.
- Plate orientation and sizing – This technique compensates for the skew of the plate and adjusts the dimensions to the required size.
- Normalization –This technique adjusts the brightness, contrast of the image.
- Character segmentation –This technique is used to find individual characters on the plates of car.
- Optical character recognition.
- Syntactical/Geometrical analysis – This technique is used check characters and positions against country-specific rules.
- The averaging of the recognized value over multiple fields/images is done to produce a more reliable and confident result. Especially in the case of any single image may contain a reflected light flare, be partially obscured or other temporary effect.

D. Experimental Setup

The following are the hardware and software requirements for the proposed system:

a). Hardware Requirements

- Arduino Microcontroller-ATmega328
- HC-SR04 Ultrasonic Sensors
- Ethernet Shield- Wiznet W5100 Ethernet Chip
- REES52 Premium USB AB Cable
- RI193 Jumper Wires
- Web Camera QHMPL PC Camera: QHM495LM

b). Software Requirements

- Arduino IDE
- JDK- Eclipse
- Database- MySQL

IV. Dataset

The values from the ultrasonic sensors are a part of the dataset. The maximum range of the sensors is 51 cm. The blind spot for the sensors is 2cm. The database has entries for the time at which the car was parked, the parking slot number and status. The status of a parking slot can be empty (0), booked (1), parked (2). The input for the web camera is an image of the number plate.

V. Result Set

The following are the snapshots for the Smart Parking System:

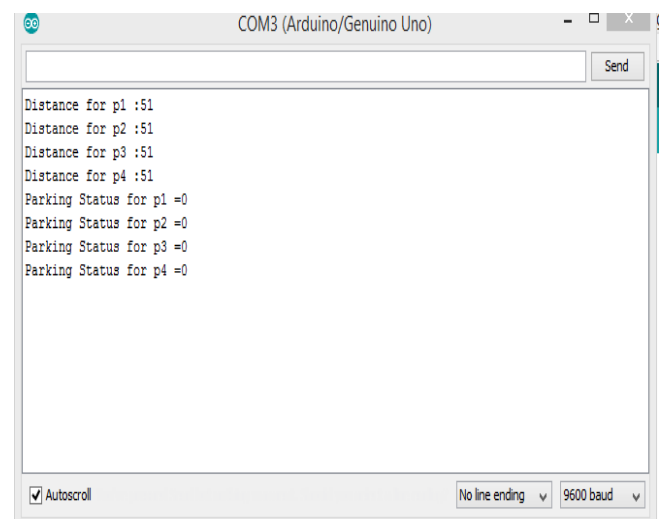


Fig.3

The above screenshot shows serial monitor screen used in Arduino tool. When car is parked in allocated parking slot, serial monitor displays maximum distance of car from ultrasonic sensors. The screenshot shows maximum distance that ultrasonic sensors can sense is 51 cm for parking slot p1, p2, p3 and p4.

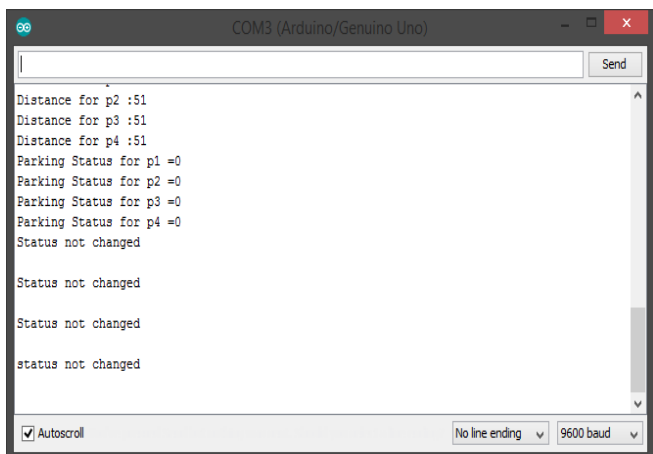


Fig. 4 This Screenshot Shows Parking Status for Parking Slot P1, P2, P3 And P4 Depending Upon Whether Car is Parked or Not.

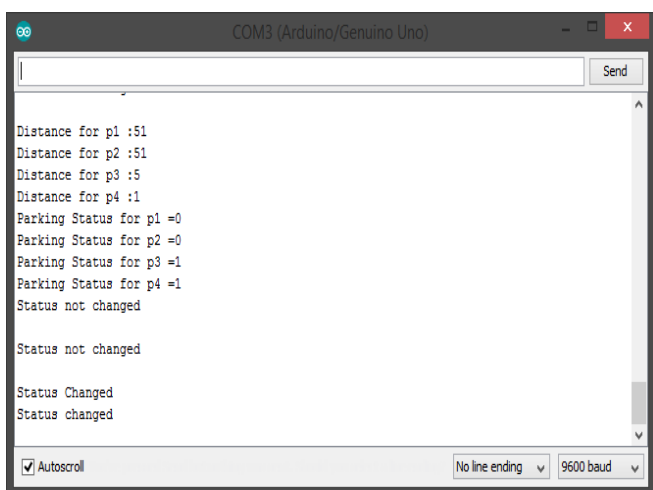


Fig.5 This Screenshot Shows Distance of Cars From Sensors When Car is Parked In Parking Slot P3 And P4. Accordingly, It Shows Parking Status=1 For Parking Slot P3 And P4. Since, No Cars Are Parked In Slot P1 And P2, Their Status Remains Unchanged.



Fig. 6 This Screenshot Shows Admin Login Form.



Fig.7 The Above Screenshot Shows An Empty Parking Lot In The Android Application.

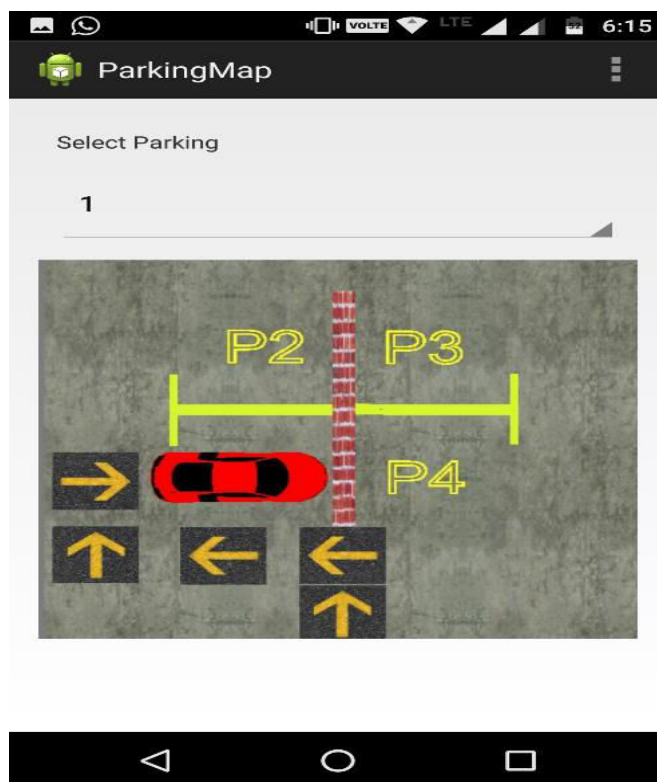


Fig.8 This Screenshot Shows The Parking Directions For Parking Slot 1.

VI. CONCLUSION

Now-a-days, the problem of parking is tremendous as there is no proper plan in place. The existing car parking system is inefficient. To overcome this problem, we have created a Smart Parking System (SPARKS) which enables the parking of vehicles and thus reduces the time taken to check the space to be used by displaying the spot where the space for parking is available. In this paper, an efficient car parking system is proposed which majorly reduces the parking problems. This paper shows how the parking problem at crowded places can be handled with a well-thought plan. It helps the clients to find out the availability of a parking slot in parking area, get the availability confirmed, and reach to the allocated parking slot within parking area. It helps to make the management easier on administrator side. It also saves the time of the clients required for searching a parking slot. Thus, the designed smart parking system is simple, economical, and more efficient as compared to existing systems and provides better customer service.

VII. FURTHER SCOPE

The smart parking solutions now-a-days are still in the infancy state. As these solutions mature, additional features will be offered that will make parking easier for customers. The following are features that will also be implemented in Smart Parking System:

- *Payment Modes:* Both on-street and off-street parking spaces charge for parking. This transaction can be easily done from the mobile phone. Also specific parking lots have a time limit, usually on-street parking. If in case a car over-stays the amount of time it is parked, then an alert can be sent out to the towing company / police in order to take the car to the impound lot in parking area.
- *Parking Reservation:* Customers will be able to reserve parking from their home, even before leaving instead of driving to the parking lot and then getting directions. For this, the server will have to be connected to the Internet, and must recognize the appropriate customer.
- *Connected Lighting:* Parking lots are kept illuminated throughout the day. Basically, this technique will help in keeping the track of which parking spaces are occupied and which are not. The sectors/parking slots with no occupancies will be dimmed out immediately. Similarly, office parking lots can be dimmed during work hours. As every new car entering will be detected, appropriate sectors can be illuminated, and others kept at diffused setting.
- *On-Street Parking:* On-street parking will be the next sector that will be targeted once off-street parking has reached a better state. Already pilot projects are being implemented in the cities of Los Angeles and San Francisco.
- *GPS Based Directions:* For both on-street and off-street directions, GPS based systems will no doubt be the best possible solution. The user will be able to get real time directions that will guide to the parking space. It will not be just a route drawn on a map, but the arrows pointing towards the possible destinations are shown to

user. However, now-a-days, getting a GPS connection inside parking lots is difficult task. It will take lots of innovation and technological wizardry to achieve.

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