Advanced Automatic Car Parking System Using IoT

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***Abstract*: This issue causes traffic, waste of time and money. IOT techniques are now widely used in designing the automatic car parking system. Everything in the modern world is going automatic, we have built the automatic car parking system consists of sensors, Microcontroller, LCD and motors. LCD displays the free parking slot available in the parking area. Motors are used to open/close the gate. Motor gate opens only there is free parking slot available in parking area. The free slot detection is identified by the IR sensors installed in each parking slot of parking area. Then, the sensors send signal to the Arduino. Arduino transfers the received signal to the motor in entry gate and LCD. The existing system displays all the free parking slot available in the parking area. But in our proposed system we have used shortest path technique i.e., If there is more than one free parking slot available in parking area, LCD displays the free parking slot nearest to the entrance gate. This system reduces the man power. It shows the good performance. The proposed system is less expensive.**

***Keywords*: Slot detection, IR sensors, Microcontroller, Shortest path technique.**

1. Introduction

With an Advent of IoT, building a parking scheme is now become feasible. Most of the cities facing the major problem is the management of traffic control and there are no comfortable facilities for parking. It is getting harder for many of the drivers to park their vehicle in appropriate parking. Because of this parking issue in major cities, cars grow quickly it may lead to air pollution and also traffic congestion. So, maintaining an adequate car parking management will reduce the waste of time. Finding a parking space in larger town is not an easy task, it gets harder for drivers. Mostly this parking issue occurs in shopping malls, theatres.

Recently the IoT becomes the emerging technology, automatic car parking system is designed to avoid unnecessary travelling. It also avoids the harassment in searching for an appropriate parking area. There is many chaos occurring between drivers while parking their vehicle. To overcome this problem, automatic car parking applications have been introduced to satisfy the driver needs. The driver searching around the parking area not only increases the fuel consumption it also causes traffic jam and air pollution among the cities. It has been estimated that air pollution is the major cause for more

heart disease death. IR sensor plays a major role in decreasing the energy consumption. In addition, IR sensor is very efficient in detecting the vehicles. Arduino is one of the key learning platforms in IoT. It easily connects all the hardware components. It allows all the interface service through input/output pins.

2. Literature Survey

A. Design of Car Parking System using Microcontroller

The automated car parking system using microcontroller is designed in this system. At the entrance of parking space gate has been provided to open during the arrival or departure of a car. Number of car parking space available in parking area is shown in display section at any point of time [21]. The entry gate is closed after the maximum number of cars have been entered in parking area. In this paper, microcontroller AT tiny 26 is used. Stepped motor is used for opening the gate. A Stepped motor is an electromechanical device which converts electrical pulse into discrete mechanical movements. The motor rotates in one direction while opening the gate. The motor rotates in another direction while closing the gate.

B. Intelligent Parking Management System based on Image Processing

Cameras are used for image processing technique. It can capture the parking area image at once. For video processing one or more cameras are used. Firstly, the image of car park could be taken when there are no cars in the car park [18]. A camera is placed in parking area and captures all the images of parking area. The firstly taken image and the image capturing at the moment is compared using software. Then, can find the free parking space in parking area. But more cameras are needed for this process. It is very expensive.

C. Smart Automatic Parking System

The traffic jam that occurs in the urban areas are mainly caused by vehicle searching for parking area. The free parking slot is detected by using ultrasonic sensors. Ultrasonic sensor detects the free parking slot and sends signal to the microcontroller. One sensor is placed beside the main entrance gate. The sensor gets the presence of car in front of the entrance

[15]. One sensor is placed beside the exit gate. Arduino chip knowledge's that there is free parking slot available and then it will send signal to the dc servo motor. On other hand if Arduino chip encounter no empty slot at the time of a car trying to make entrance, the motor will not open the gate.

D. Wireless Sensor Network and RFID for Smart Parking System

RFID is a Radio Frequency Identification that helps to identify the object through radio waves. It is installed at the entrance and exit for detecting the presence of vehicle [26]. Monitoring nodes are installed in every side of parking space. The ultrasonic sensor is installed in parking slots to detect the free parking slot in parking area. The sensor nodes in parking slot sends information to the sink node. Sink node is installed in monitoring room. It collects all the information from the parking space and sends to management center. The LED screen is also installed in parking area. If there is parking space available, LED turns on. If there is no free parking space LED turns off.

E. Automatic Parking Management and Parking Fee Collection based on Number Plate Recognition

Automatic parking system and electronic parking fee collection based on vehicle number recognition is also designed in this system. Six primary algorithms are used for license plate recognition system. Firstly, the image is captured and the system should extract the number plate of the car for segmentation purpose [16]. The system is divided into subsystems which are "FULL "display, image acquisition and plate number recognition. Firstly, data is acquired from sensors of each parking space to count the number of free parking space available. Then, the image of the car in entrance to be analyzed. Secondly, the image of the car captured by camera is analyzed. Then, the exact free parking slot available is displayed in LCD.

3. Existing System

At present system, user gain the information about the parking spaces via internet, but it won't give the exact parking slot available. LCD displays the free parking slot available. But it won't display the shortest path free parking slot available in parking area. Using of cameras to detect the free parking slot in parking area is not possible for medium scale shopping malls, theatres., It is very expensive. Hence need a smart and efficient method to find the free parking slots available in parking area.

4. Proposed System

Arduino is the brain for the whole system. It controls and watches over all components. In our system we have used Arduino because it is an open- source electronics based on easy-to-use hardware and software. Arduino boards are able to read inputs. We use Arduino to get input signal from sensors and gives output signal to motor and LCD. IR sensor is placed in each parking slot. It will encounter the presence of car inside the parking slots. If there is an empty slot available, sensors in parking slot will send signal to the Arduino. Arduino send the signal to the entry gate motor to open the gate. If there is an empty slot available, the motor gate will open otherwise the motor gate will not open. The LCD display shows the information of free parking slot. If there is more than one free parking slot available, LCD display displays the parking slot nearest to the gate. To display the nearest free parking slot in LCD, we have used shortest path technique. We have used sorting algorithm for shortest path technique. If parking slot 1 and parking slot is 4 available in parking area. LCD display displays the parking slot 1 because slot 1 is closest to the gate. Complexity of sorting algorithm O(n^2). It is very efficient. If there is no free parking slot available in parking area, LCD displays PARKING FULL.

One IR sensor will be placed in the main entrance of the parking lot. And the motor also placed in the entrance for the purpose of gate opening. As soon as the sensor get the presence of car in front of entrance, sensors will send input signal to the Arduino to check if there is free slot inside the parking lot. When Arduino chip acknowledges that there is a free slot available in parking lot, it will be displayed in LCD and sends signal to the motor which will open the main entrance gate. And the car will be parked in respective slot. On other hand, if Arduino chip encounter no free slot at the time of car trying to make entrance, LCD display parking full and the gate will not open. We use automatic gate opening in our project, it will reduce the time of the user.

One IR sensor and motor are placed in exit gate. If car leaves out of the parking lot, sensor detects the presence of car. It sends signal to the motor. And the motor opens the exit gate. If the drivers park the car mistakenly in wrong slot i.e., Another slot instead of the slot displays in LCD. We have used the error detection algorithm in the program the mistake will get update.
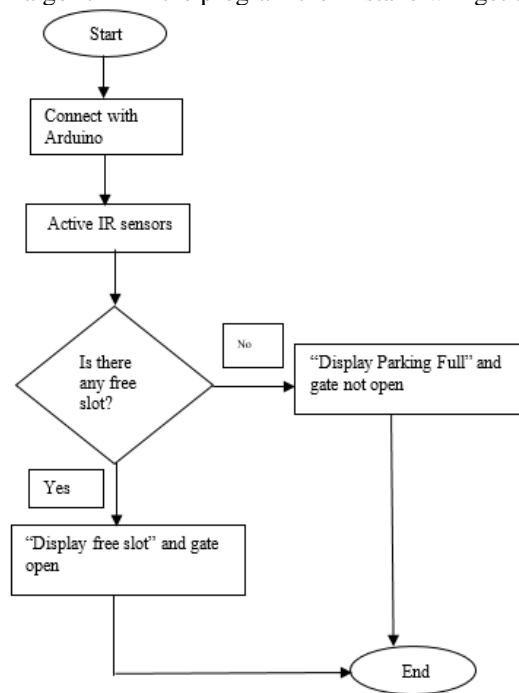

Fig. 1. Flow diagram of automatic car parking system

5. Module Description

A. Checking the availability of Parking Space

IR Sensor is installed in each parking slot of parking area.

The sensors in parking slot are used to detect the presence of cars in parking slots. If there is presence of car, sensor sends signal to the Arduino that parking slot is full. If there is no presence of car, sensor sends signal to the Arduino that parking slot is free.

B. Displaying the Information

After the sensor detecting the parking slots in parking area, it sends signals to the Arduino. Arduino sends information to the LCD display. The free slot available is displayed in the LCD. If there is more than one free parking slot available, LCD displays the slot closest to the main entrance gate. If there is no free parking slot available, LCD displays the parking is full.

C. Entry/Exit gate Information

IR sensor and motors are placed in the entry and exit gate. If the sensor gets the presence of car in front of the entry gate, it sends signal to the Arduino to check whether there is a free parking slot available in parking area. If there is free parking slot available, Arduino sends signal to the motor and information to the LCD display. If there is free parking slot available, the entry gate will open. If there is no free parking slot available, the entry gate will not open.

D. Error detection in Parking Area

The LCD displays the slot 2 for parking the car. But the driver parks the vehicle in slot 3 mistakenly. In the program, it will get updated that the driver parks the vehicle in slot3. It is simply, the driver parks in another slot instead of the slot displayed in the LCD. The error will be updated in the program.

6. Hardware Components

A. Arduino

Arduino Uno is a microcontroller board based on ATmega328P(datasheet). IT has 14 digital input/output pins (of which can be used as PWM outputs), 6 analog inputs, a 16Mhz ceramic resonator, a USB connection, a power jack, an ICSP header, a reset button. We can connect it to a computer with USB cable or power it with an AC to DC adapter or battery to get started. It is the brain for the whole system. The UNO board is the first in a series of USB Arduino boards, reference model for the Arduino platform.

B. IR Sensors

Infrared radiation is the portion of electromagnetic spectrum having the wavelength longer tan visible light wavelengths, but smaller than microwaves. The wavelength region of 0.75 micrometer to 3 micrometers is called near infrared, the region from 3 micrometer to 6 micrometers is called mid infrared and the region higher than 6 micrometers is called far infrared. These IR sensors is used to the detect the presence of car in our system.

C. DC Motor

A DC motor is a rotary electrical machine that converts direct current electrical energy into mechanical energy. DC motors are widely used in tools, toys and propulsion of electric vehicles, elevator and hoists, or in drive for steel rolling mills. DC motor

is used to open and close the gate.

D. LCD

Liquid crystal display known as LCD is a flat-panel display or electronically modulated optical device that uses the light modulating properties of liquid crystals, liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary or fixed images with low information content, which can be displayed, such as pre-set words, digit and 7-segment displays. LCD displays available in various sizes 8×1, 16×1, 16×2, 16×4, 20 Char x 4 Lines. We mainly focus on 16×2 display.

Table 1
Evaluation metrics

S. No.	Existing System 1	Existing System 2	Proposed System
1. Object Detection Time	20-30seconds	15-20 seconds	5-10seconds
2. Types of Sensor Used	RFID	Ultrasonic Sensor	Infrared Sensor
3. Frequency of sensors	3– 30 MHz	2Hz– 20KHz	300GHz– 400THz
4. Range of sensor	16m	20– 400cm	300 – 500cm

7. Result and Discussion

In this project, LCD displays the shortest path free parking slot available in parking area. If there is no free parking slot available LCD displays PARKING FULL. Sensors in the parking slot will detect the presence of car. Entrance gate will open only if the free parking slot available in parking area. Otherwise, gate will not open. The gate opening depends on the free parking slot available in the parking area.
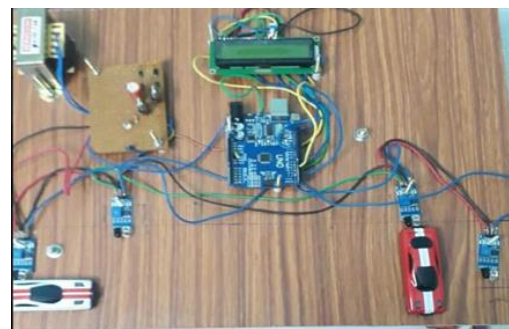
8. Result and Discussion

Fig. 2. Prototype of advanced automatic car parking system

The figure 2 represents the prototype of our system. This figure includes the hardware Arduino, sensors and LCD display.

The figure 3 represents the LCD display of free parking slot. We have kept 4 parking slot in our project. LCD display displays the free parking slot closest to the gate. Parking 1 is full. Parking 2,3,4 are free. So, LCD displays that Parking 2 is free.

The figure 4 represents the LCD display. The LCD display shows the Parking is Full. Because all the 4 Parking has occupied. If all 4 parking had occupied gate will not open and LCD shows parking full.
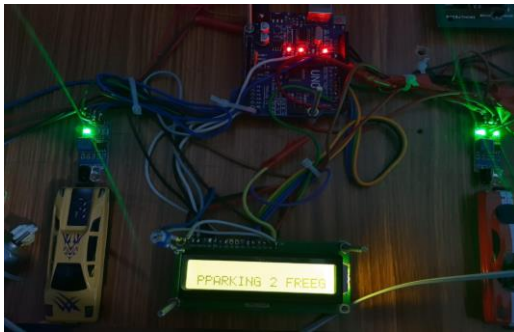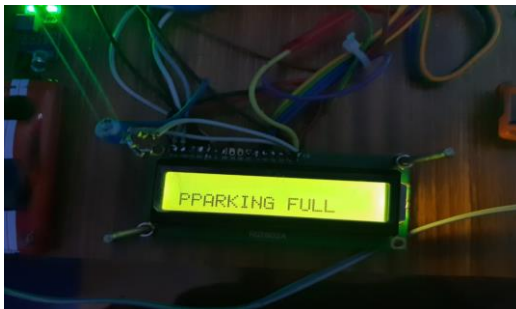
Fig. 3. Display of free parking slot

Fig. 4. LCD display (Parking Full)

9. Conclusion

By the use of our system, the car can park in appropriate parking slot in a comfortable manner. The main benefits of the system are time saving and fuel saving. Our system helps to park the vehicle in the respective slots with the help of microcontroller, sensors, motors and LCD display. It reduces the chaos among the drivers and hassle in parking area. It will also encourage Automation engineering in our country that will make advancement in increasing usage of technology. Our system reduces the congestion in finding the free parking slots for parking the car.

10. Future Work

- Implementing the system using cloud to store all the data collected with the help of hardware components.
- Develop an android application which is convenient for the users to book the parking slot for parking the car via Internet.

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