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Designing of an Automatic Car Parking System

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Abstract: In view of the daily problems faced by car owners, the present system acts as a relief for this. Every day people face a lot of difficulties to find a place of comfortable and easily accessible place to park their cars and if they fail, they are bound to park the cars on the streets in exchange of penalty.

To remove traffic congestions and other problems related to parking we have designed an user friendly, automatic parking system that can provide proper information about free parking slots. In this project we have used a microcontroller which is the control unit along with other components like sensors, LCD display to design the innovative project. To reduce labor cost as also the time for finding parking slots is the main objective of the project.

Keywords: Car Parking, Arduino UNO, IR Sensors, Ultrasonic Sensors, Servo motor, RFID.

I. INTRODUCTION

Now a day the traditional parking systems like multilevel or multi-store car, robot car parking systems have been implemented in large scale. But these systems have many drawbacks such as it occupies a large amount of space, labor cost increases, more time consumption occurs etc.

The above problems can be easily solved by setting up an automatic car parking system. Numerous researches have been done in automatic car parking system using microcontroller with different ideas like Smart parking service based on wireless sensor networks written by J. Yang, J. Portilla, A fairness-aware smart parking scheme by C. Jin, L. Wang, L. Shu, Y. Feng, Applying Arduino for Controlling Car Parking System by Cihan University of Sulaimaniya using Arduino, Automatic Smart Car Parking system by Nutan Maharashtra Institute of engineering & technology using IOT etc.

In an automatic car parking system the total parking procedure of the car starting from the entry gate to the ending at the exit gate is controlled by the use of mechanical structure.

Our proposed model displays an automatic model that controls the number of cars which can be parked at a specified space at any time depending upon the availability of free slots. When a car comes at the entrance it will be stopped and the system then checks for vacant slots.

If vacant slots are available then the user is instructed to park his/her car at that particular slot. This instruction is provided by the use of open source hardware, programmable sensors and the use of computers. In this way it helps the driver to understand the digital output produced. The system is faster, flexible and reliable as well.

A. Parking Lot Problems

- 1) Finding a vacant parking area at the outside of a multiplex building is very difficult especially on weekends or during any public holidays. Searching for parking spaces during that period can take enough time for almost majority of the visitors. Stadiums, shopping malls become very crowded during peak hours and people face a lot of hardships to find parking slots outside those areas. As a result traffic congestion occurs and the driver also gets frustrated.
- 2) If a car is not parked abiding the rules and regulations of parking then it can occupy two parking slots rather than one leading to improper parking. This happens when a driver is not worried about other driver's right. Such type of problems can be solved by automatic car parking system.

B. Project Aim

- 1) To develop an intelligent and user friendly automatic car parking system in order to reduce manpower and traffic congestion.
- 2) To offer safe and secure parking slots within a specified area consuming less time compared to traditional parking system.

II. NECESSARY HARDWARE COMPONENTS:

The parking system comprises of a 1) Microcontroller (Arduino UNO), 2) IR sensors, 3) Ultrasonic sensors, 4) Servo motors, 5) LCD Display, 6) Radio frequency identification (RFID).

1) *Arduino UNO*: It is a type of microcontroller that can do both software and hardware jobs. Arduino board basically contains Atmel 8, 16 or 32 bit AVR microcontroller with complementary components that makes it a good programmable device and can be implemented on different circuits. The great aspect of arduino is its standard connectors that lead the user to connect the CPU with various interchangeable add on modules modules called as shields. Different types of processors have been used by arduino compatibles. Most boards comprises of a 5V linear regulator and a 16MHZ crystal oscillator. The microcontroller of Arduino is pre programmed with a boot loader that eases uploading of programs to the on-chip flash memory compared to other devices which require an external programmer. This architecture makes the Arduino more user friendly since an ordinary computer can be used as its programmer. Optiboot boot loader is the default boot loader that is installed in Arduino Uno.



Fig. 1: Arduino Uno

2) *IR Modules*: There are two infrared modules used in the project. Each of the modules contains one IR transmitter and an IR receiver. Before the gate the transmitter is placed on one side of the gate and the receiver is placed directly opposite to the transmitter on the other side. The IR transmitter will emit IR waves and the receiver will continuously absorb the IR waves. IR LEDs will be there with the sensor.



Fig. 2: Infrared Sensors

3) *Ultrasonic Sensors*: Ultrasonic sensors are used to calculate the distances of an object. It works by sending an ultrasonic pulse of around 40 KHz and then waits for the pulse that comes back as an echo after striking the distance object. It then calculates the time taken by the pulse to cover the entire journey in microseconds ($1\text{microseconds}=10^{-6}$). This sensor can detect the presence of an object situated up to 3 meters away and as near as 3 cm. In our project it will check the presence of an empty slot and will immediately inform the microcontroller about it.



Fig. 3: Ultrasonic Sensor

- 4) *RFID (Radio Frequency Identification)*: The RFID contains a reader and a tag. At the entry gate when the customer tries to enter the parking lot he/she will be provided with a card/tag. The card contains the information where the customer has to park his/her car and also a code number that is used later to identify that customer at the time of exit. This helps in quick identification and also saves time in searching for free slots thus preventing traffic congestion.



Fig. 4: Radio Frequency Module

- 5) *Servo Motor*: The servo motor is used to open and close the gate of the system as it is previously instructed in the program. It is connected with the microcontroller and takes command from it to rotate the doors specifically at certain angles.



Fig. 5: Servo motor

- 6) *LCD Display*: The use of LCD makes the project more user friendly by displaying each and every details of the parking lot on its screen. It is an intelligent LCD module since it has an inbuilt controller that converts the alphabets and digits into its ASCII code and then shows on its display. The LCD in the project will show total number of cars already parked, the number of vacant slots that are available for parking and the total parking time.



Fig. 6: Liquid Crystal Display

III. WORKING PRINCIPLE

An automatic car parking system can be made using various methods. After studying those systems we have found that this requires a little manpower compared to the existing parking system. In our project we have used Arduino which is the backbone of the system along with two types of sensors, RFID technology, servo motors and a LCD Display.

At first when a car appears at the parking lot the IR sensors send instructions to the microcontroller and it then checks for the availability of parking slots using ultrasonic sensors. The number of vacant slots is displayed on the LCD screen. If any slot is found free for parking that information is sent to the microcontroller and then the driver will be provided with a RFID card that is encrypted with a particular slot otherwise the LCD will show "NO VACANT SLOTS AVAILABLE". When vacant slot is detected the IR sensors instructs the microcontroller by sending signal to open the gate using servo motors thereby allowing the car to get inside the parking area. As soon as the car enters a timer starts counting the time of parking. The value of empty slots gets reduced by one and the gate is closed thereafter. The RFID details are saved in the system against a slot number.

IV. BLOCK DIAGRAM

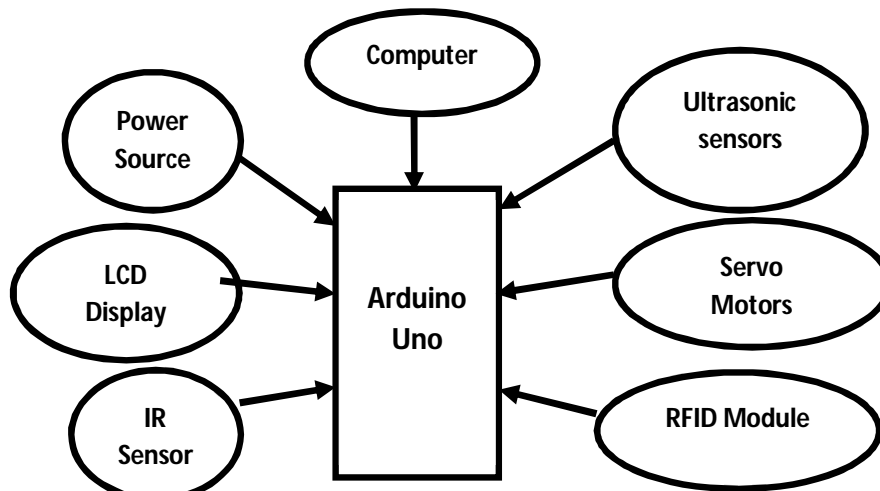


Fig. 7: Block Diagram of the System

V. CIRCUIT DIAGRAM

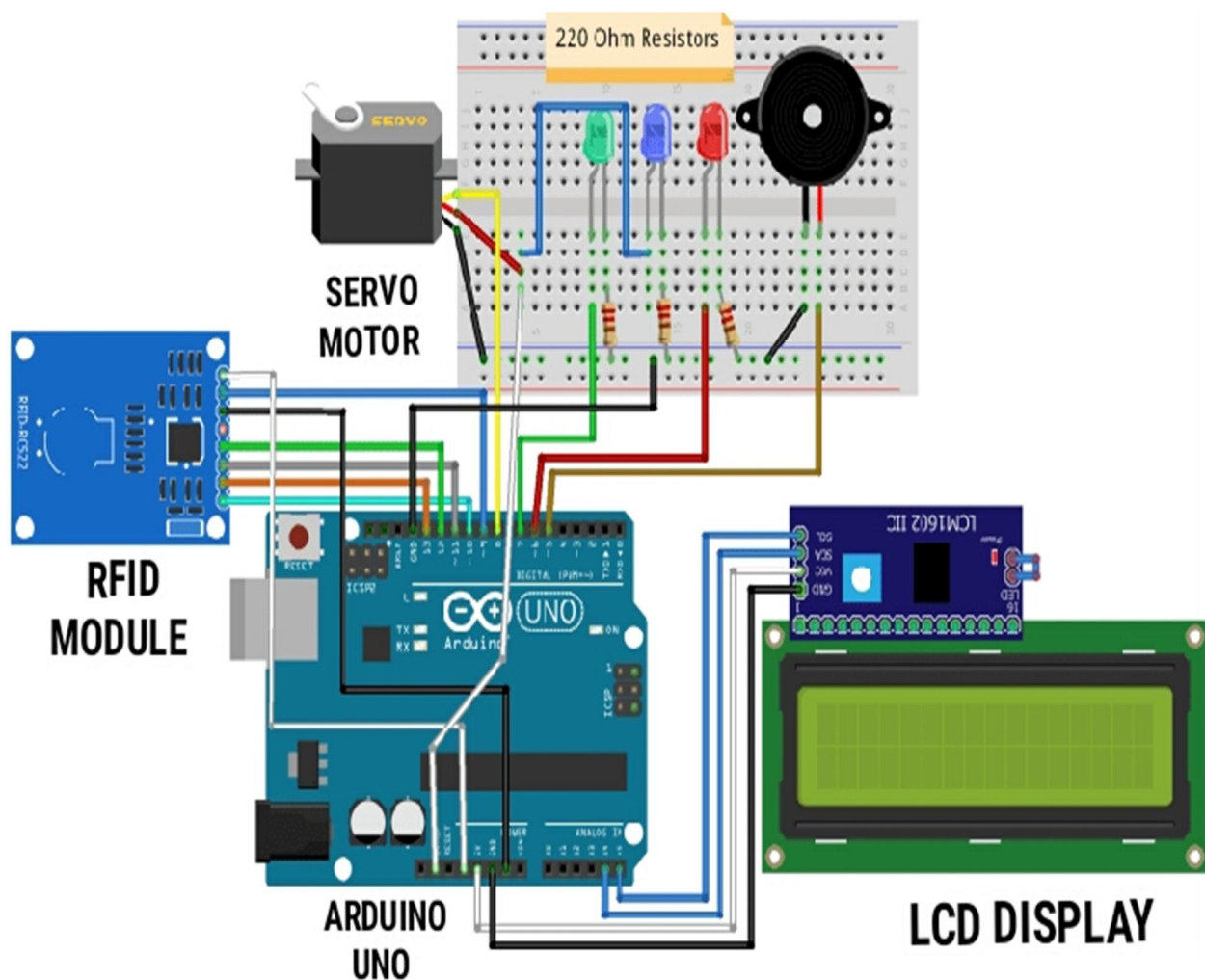


Fig. 8: Circuit Diagram of the model

The flowchart of the Entrance gate is depicted in the fig below

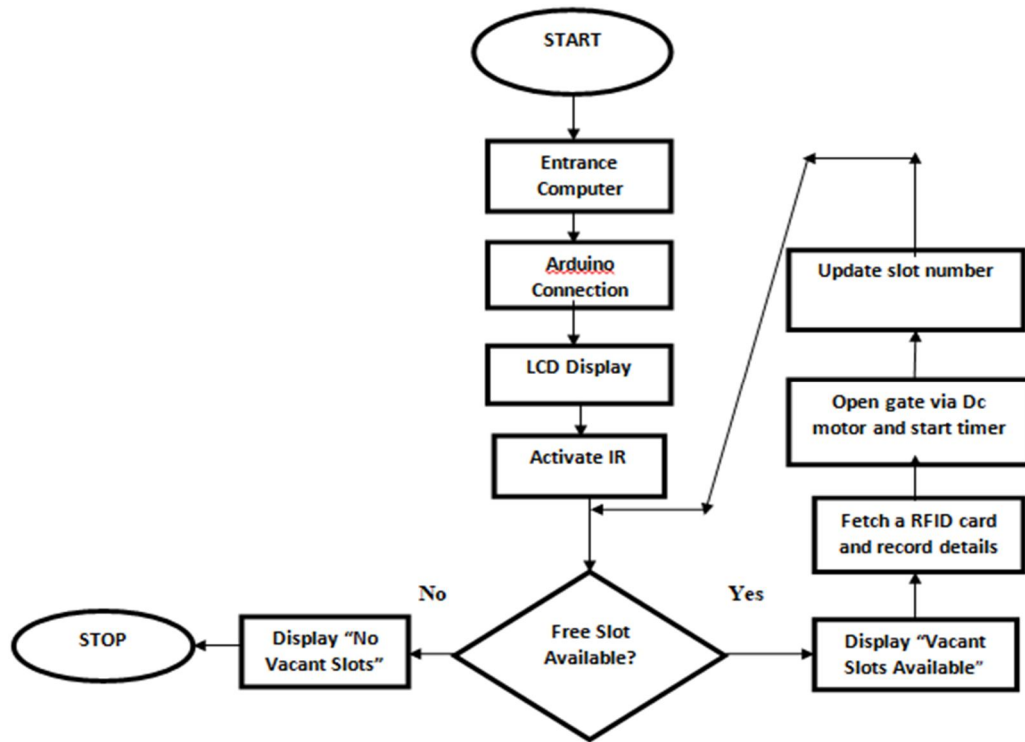


Fig. 9: Entrance Gate Flowchart

Now during the exit time, the driver has to submit the card in the counter machine and the parking fees is calculated according to the total time displayed in the timer. The driver has to pay the requisite amount or else the exit gate will not open. After successful payment the gate gets opened and the car is allowed to leave. At the same time the total number of empty slots gets incremented by one.

The flowchart of the exit gate is shown below

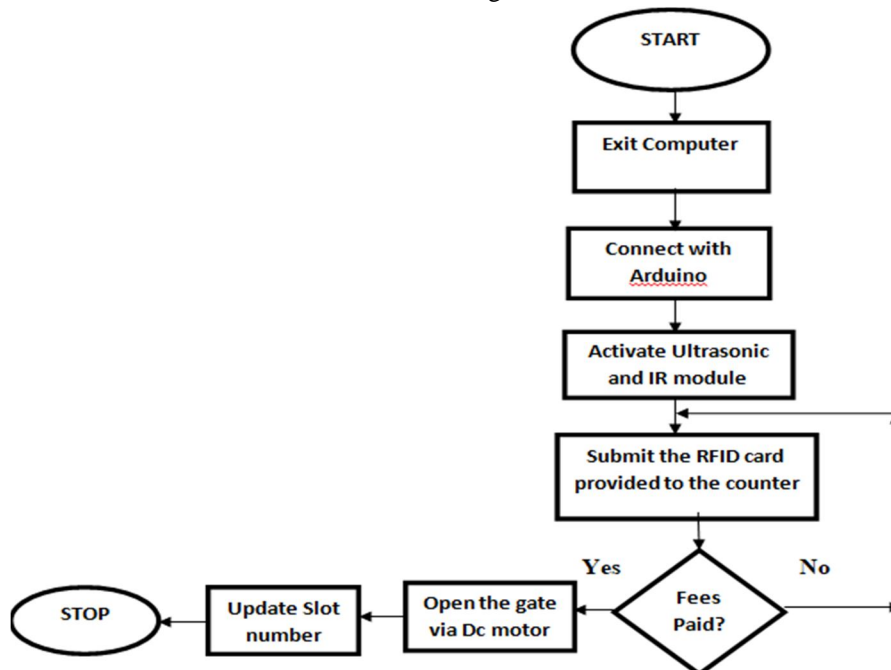


Fig. 10: Exit Gate Flowchart

At the beginning of the program the variable count (count=total number of cars) is set to zero and a loop is applied which will check the value of count. If count=50(assumption) then parking slot is considered to be full and a message “SLOTS ARE FULL” will be displayed on the screen. If count<=50 then it is assumed that parking space is there and a message “SLOTS REMAINING” will be shown. The program then checks the ENTRY switch and the count value is incremented by one when a car enters into the parking area. Likewise, the value of count will be decremented by one when a car leaves. The lock mechanism is activated when the parking lot contains the maximum number of cars. The lock mechanism will stop the ENTRY barrier to open even if a car tries to enter through the gate during that time. The lock mechanism will remain deactivated as long as free spaces are there for parking.

VI. EXPERIMENTAL RESULTS

The automatic car parking system model has been tested and it gave the results as expected. The model has been successfully able to search for the empty slots and instruct the car accordingly. To check accuracy of the project we have compared the data of normal car parking system with automatic car parking system by the help of following parameters.

However it has been noticed that with the increase in the number of cars in the parking area the detection accuracy got decreased. This happened due to the use of one ultrasonic sensor for 3-4 parking slots. So to make the accuracy better it is recommended to use one ultrasonic sensor for each parking slots. The results are shown in the following table (Table 1).

Table 1: Comparison Between Ordinary and Automatic Car Parking System

Parameters to be Compared	Ordinary Parking System	Automatic Parking System
Space required per slot	15/8	15/8
Maintenance Cost(\month)	1000/-	450/-
Total Labours required	10	3
Detection of Empty slot	Need to search manually	Using Ultrasonic and IR sensors
Parking method	Manual Searching	Path Tracking
Average distance travelled to park the car	40m	25m
Average time taken for parking	8 mins	2 mins
Average Time taken to wait in queue	7-8 mins	3 mins

VII. CONCLUSION

The above project can be used in different areas like Multiplex, Shopping malls, industries, domestic etc. It is helpful as the technology benefits all kinds of people even if they have less knowledge of hardware since simplified circuits and technology have been used to develop it.

This automatic parking system provides parking of vehicles quite easily and thereby reduces the time taken to check for vacant slot which is shown on an LCD display at the Entrance of the parking lot and also minimizes traffic congestions.

VIII. FUTURE ENHANCEMENT

The project can be modified in the future by adding other applications like booking online using GSM. By this method the driver will be able to book the parking lot from home or on the way to shopping mall, multiplex etc. This would save the waiting time of the driver that is elapsed in searching for the empty slot while entering the parking area.

The model can also be modified by including image processing into the system so that the cars can be recognized by their number plates. Use of more advanced technologies would also help the customers to directly pay the parking fees using their mobile phones.



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