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Smart Parking System Based on RFID & GSM Technology

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ABSTRACT

In the modern world with about a billion vehicles present around the globe, and being in a densely populated country like India creates the need for an efficient parking system and with world advancing towards automation, there is also a need for an automated parking system. Mainly the problem of parking arises in big cities and this causes problems like traffic congestion, driver frustration & air pollution, etc. The issue mainly arises from not knowing whether the parking spaces is available at any given point of time. Even if known, many vehicles may be competing for limited parking spaces causing severe traffic congestions. Even there are problems that can be caused with regards to the parking management. It may be difficult for the parking management to organise the parking of the vehicles in an orderly manner.

Thus we are trying to resolve the problems stated by developing an RFID based smart parking system that monitors the availability of idle parking slots and guides the vehicle to the nearest such slot by sending a message to the mobile number registered in the vehicle's RFID. The proposed system uses infrared transmitter-receiver pairs that remotely communicate the status of parking occupancy to the Arduino UNO microcontroller 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-- Parking System, RFID, Arduino UNO

I. INTRODUCTION

Nowadays in many public places such as shopping-malls, Cinema multiplex, hospitals, market areas there is a crucial problem of car parking. The car-parking area has many lanes/slots for car parking. In order to park a car, one has to look for all the slots from the start till the end. Moreover, a Conventional parking system do not have any monitoring system and the parking lots are monitored by security guards. this involves a lot of manual labour and investment, and a lot of time is wasted in searching vacant slot for parking. So, there is a need to develop an automated parking system that indicates directly the availability of vacant parking slots

RFID based Car Parking System is a project that offers an efficient car parking management system using Arduino and RFID technology. As in the modern world everything is going automatic, we have built a system which will automatically sense the entry and exit of cars through the gate and then display the number of cars in the parking lot. The check-in and check-out of the vehicle will be handled by placing RFID reader at the entrance and IR sensors at exit of the parking lot.

The availability of land has grown decreased in cities, so it the parking have become storeyed to accommodate more number of vehicles in a limited land space. This makes it difficult for the driver to identify if there is a parking space available or not. There may be a parking slot available but there may not be a way for the driver to find out that there is a slot available. This may lead to think that the parking is full, and makes him exit the parking, and if there are no other parking available then it makes the driver park the vehicle on the sides of the road which may lead to many traffic problems. Therefore, by this project we develop a parking system for an organization to have automated parking system for making best use of space

II. PROPOSED SYSTEM

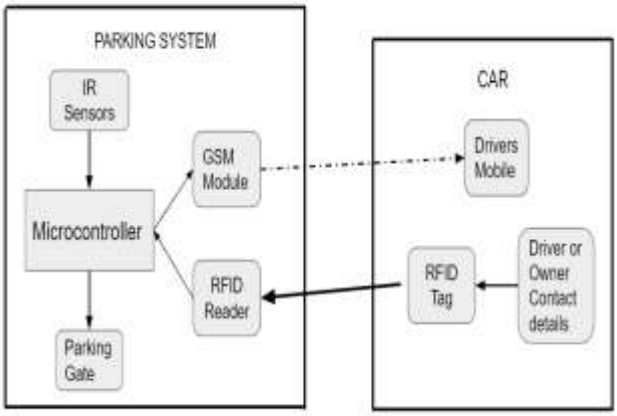

Figure 1

In the proposed system IR sensors are placed at each parking slot in the system, in order to check if the slot is available for parking. The figure (fig.1) shows in working model if the proposed system in the form of blocks. There is a screen placed at the entrance to display the number of slots available. In order for the system to work an RFID card or tag has to be in the vehicle which has the contact detail of the driver or owner, as per the convenience of the people. A RFID reader is placed in the entrance to read the RFID card of the vehicle. Once the vehicle enters the parking the reader receives signal and checks for the contact details in the system. Then the system send the information about the nearest available slot from the gate of the parking to the mobile number registered with the RFID card present on the vehicle through the GSM module. The is an IR sensor present at the exit gate to check for any vehicle leaving the parking slot.

If the parking spaces are full and there is no slot available then the gate remains closed and the user also receives through message that there is no available slot in the parking.

There are some systems that only display the no of slots available at the entrance of the parking[1], but the driver will not known where a parking slot is available at the nearest from the entrance.

Most of such available systems [2-5]as RFID based parking that can only be used in a private sector, and also integrated with some application which the common may find some difficulty in its usage. Therefore, in order to remove all the constrains stated in these systems. We have used GSM module[8] to transmit the information through a SMS to the registered Mobile.

For this system we have used have used Arduino IDE software [7] for programming the Arduino UNO board.

III. COMPONENTS USED

1. GSM Module

- It stands for Global system for mobile communication, it is designed for wireless radiation monitoring thorough short messaging service (SMS)
- It is also used to transmit mobile data as well as voice services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.
- The digital system has the ability to carry 64kbps to 120Mbps of data rates.
- Global System for Mobile Communications (GSM) uses a combination of Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA).
- Frequency Division Multiple Access: It involves dividing a frequency band into multiple bands such that each sub-divided frequency band is allotted to a single subscriber. FDMA in GSM divides the 25MHz bandwidth into 124 carrier frequencies each spaced 200 KHz apart. Each base station is allotted one or more carrier frequencies.
- Time Division Multiple Access: It involves allotting same frequency channel to different subscribers by dividing the frequency band into multiple time slots. Each user gets his/her own timeslot, allowing multiple stations to share same transmission space.

Figure 2

2. Arduino Uno[6]

- It is an open-source microcontroller based on the Microchip ATmega328P microcontroller.
- It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs. It is simply connected to a computer with a USB cable or power it with a AC to DC adapter or battery to get started.

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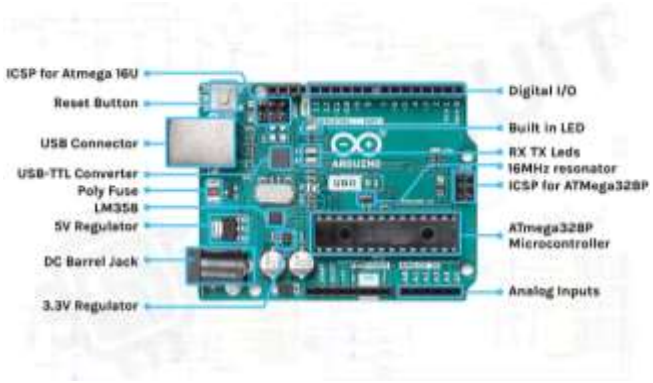

Figure 3

Features of the Arduino UNO

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

3. RFID and RFID Reader

- Radio frequency identification or RFID is a special type of radio technology that use radio waves to identify tag which is attached to an object and thus identify then object. RFID is a essential technology used in logistical applications and is being used to optimise supply chains and production processes across different industries.
- RFID tag is attached to assets to transmit stored data to the antenna. It receives stored data from the tag and send it to the RFID reader.

Figure 4

EM-18 RFID Reader Module

The EM 18 RFID Reader module operating at 125kHz is an inexpensive solution for your RFID based application. The Reader module comes with an on-chip antenna and can be powered up with a 5V power supply. Power-up the module and connect the transmit pin of the module to receive pin of your Microcontroller. Show your card within the reading distance and the card number is thrown at the output. This is a great little RFID Reader Module from Innovations, similar to the ID models. If you need an inexpensive way to get started with RFID, this is a great little module. Just power the module, and it will read any RFID card within range. It will output the cards ID in a serial string, which can easily be read by any Microcontroller. The spacing on the pins is 2.54 mm, which means the module will directly fit on a breadboard. This is EM4001 64-bit RFID tag compatible, has Magnetic stripe emulation output.

Specification

- Operating Voltage: 4.5 V to 5.5 V
- Current Consumption: Less than 50 mA
- Operating Temperature: 0 ºC to +80 ºC
- Operating Frequency: 125 KHz
- Communication Parameter: 9600 bps
- Reading Distance: 10 cm, depending on TAG

Features

- The module radiates 125KHz through its coils.
- Pitch of output pins are 2.54mm.
- EM-18 RFID reader is one of the commonly used RFID reader.
- It provides both UART and Wiegand26 output formats.
- It can be directly interfaced with microcontrollers using UART and with PC using an RS232.

Figure 5

4. IR Sensor

- Infra-Red sensor is an electronic device it measures and detect infrared radiation from its surroundings, and also to detect if any object is present at proximity of the sensor.
- IR is invisible to the human eye and it has a wavelength longer than that of the visible light

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- There are two types of infrared sensors: active and passive. Active infrared sensors both emit and detect infrared radiation, whereas a passive sensor only senses the Infrared radiation.
- Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver.
- Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems, and this type of sensor is used in this system.

Figure 6

5. Servo Motor

- Servo is a closed loop system uses the feedback signal to adjust the speed and direction of the motor to achieve the desired results.
- You can control the servo motor by sending a series of pulses to the signal line. A conventional analog servo motor expects to receive a pulse roughly every 20 milliseconds (i.e. signal should be 50Hz).
- The length of the pulse determines the position of the servo motor.
- If the pulse is high for 1ms, then the servo angle will be zero.
- If the pulse is high for 1.5ms, then the servo will be at its center position.If the pulse is high for 2ms, then the servo will at 180 degrees.Pulses ranging between 1ms and 2ms will move the servo shaft through the full 180 degrees of its travel.

Figure 7

IV. WORKING

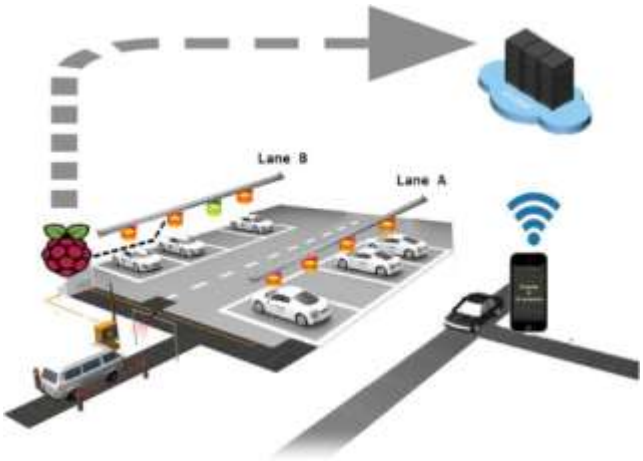

Figure 8

The figure (fig.8) represents the working model of the proposed system which is detailed in the following steps.

Step 1:

At first we have to get an RFID card for each of the vehicle and link it with the mobile number. The mobile number linked can be of the driver or owner of the vehicle based on the convenience of the user. Upon linking the RFID card is attached to the vehicle in a place such that it can be scanned.

Step 2:

In the at the entrance of the parking an RFID reader is placed. With the help of the reader the RFID card placed on the vehicle is scanned and then the linked mobile number is noted.

Step 3:

Infrared(IR) Sensors are placed at each of the parking slot to see that is the slot is available for parking or not. The total no of available slots are displayed in a screen that is placed at the entrance of the parking, so that the user can know the availability of parking space well in advance.

Step 4:

Once a vehicle enters a parking space the system checks if the slots that is available nearest to the entrance is available and if not checks the next slot. Then the information about the nearest slot is sent to the noted mobile number using the GSM module in the system, and the gate to the parking slot opens only is there is a parking space available. The driver can use this message to park the vehicle is a very short span of time without searching for any parking slot.

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Step 5:

During the time of exit when the vehicle gets near the gate the parking gate opens by sensing the vehicle using the IR sensor that is present in front of the exit of the parking.

V. SIMULATION MODEL

We have made a proteus model(Fig. 9) for simulating the working of our smart parking system based on RFID with four parking spaces for the parking. In order to simulate the RFID reading and GSM module we have used a terminal window in this simulation model.

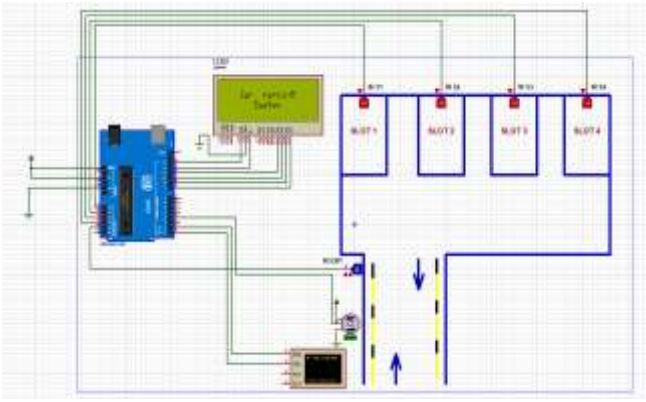

Figure 9

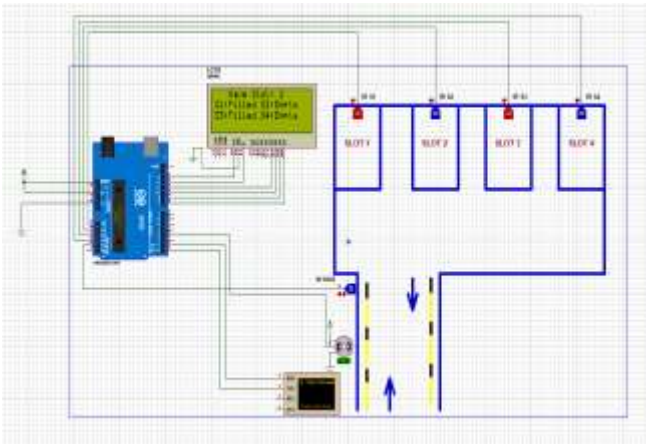

Figure 10

As shown in the figure (fig. 10) the number of available spaces are displayed at the LCD screen along with the details of availability of all the spaces as in this project we have only used 4 slots. IR sensor being 1(red) represents that the slot is filled, and 0(blue) represents that the slot is empty.

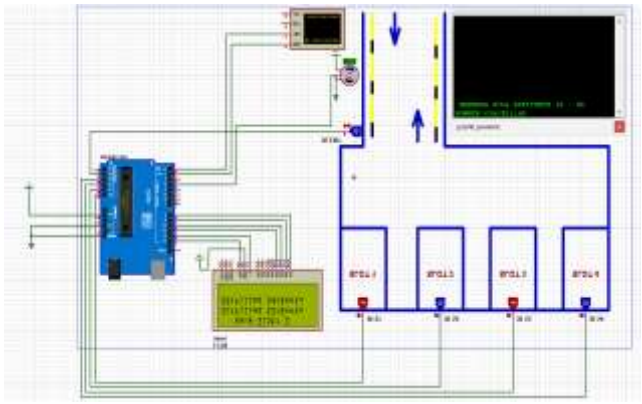

Figure 11

When an input is made in the terminal window, representing a vehicle entering the parking, the slot which is available nearest to the entrance is given as the output in the terminal window as shown in the figure(fig. 11)

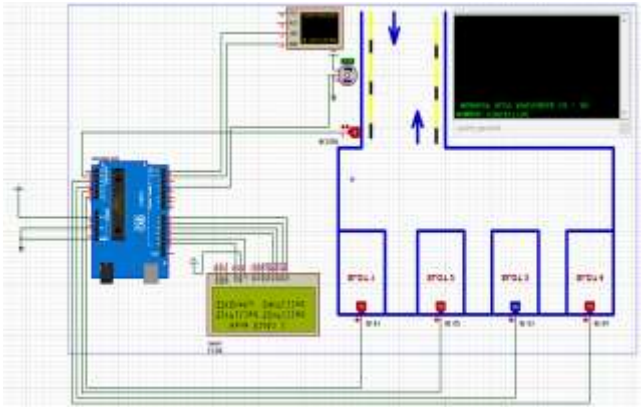

Figure 12

While the vehicle exiting the parking, represented by the IR sensor changing to 1, the gate opens allowing the vehicle to exit (fig. 12).

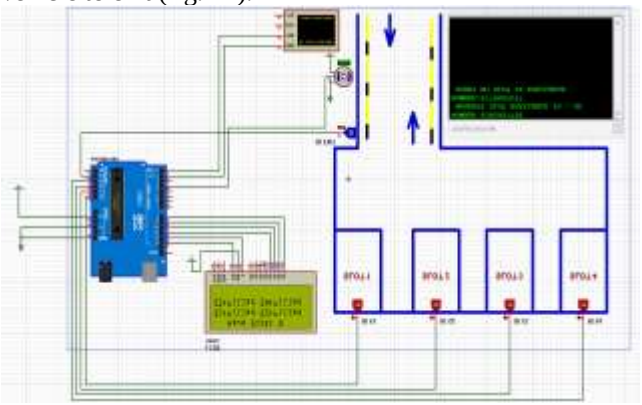

Figure 13

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When all the slots in the parking are full(fig. 13), as the input in all the IR sensor is 1 and is there is an input in the virtual terminal then an output is sent such that all the parking slot are filled.

VI. WORKING PROTOTYPE

A working prototype is a crucial milestone in any project, and I am thrilled to share that my project has reached this stage. It represents a significant step forward in our project's development, as it allows us to test and validate our ideas in a real-world setting.

The prototype is a functional model that demonstrates the core features and functionalities of our project. It is designed to simulate the final product and provide us with valuable insights into how it will work in the real world

Through the development of this prototype, we have gained valuable experience and learned many lessons that will help us refine our project further. We can now identify areas that require further development and improvement and work towards perfecting the final product.

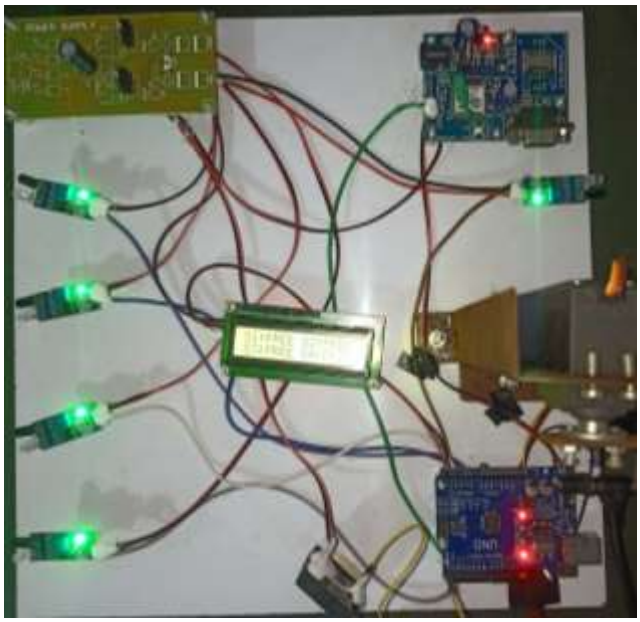

Figure 14

Figure 15

Figure 16

The Figures (fig. 14 & 15) show the working model of the proposed idea assembled using the components mentioned above. In this model we have registered four mobile numbers of our team members with individual RFID cards that are show in the (fig. 15).

VII. RESULTS

Figure 17

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The above figure(fig. 17) shows the screenshots of the messages sent by the working model of the proposed system to the mobiles numbers registered with the corresponding RFID cards.

VI. CONCLUSIONS

The proposed system can be implemented in almost all the existing parking systems. The simplicity of the proposed model makes the user understand the working and the need of such parking system and makes it easy for the public and the parking lot management to implement such system in the already existing system. This automated car parking system allows easy and rush free parking of the vehicles and thus reduces the time taken to check for a parking space.

The prototype for the proposed system has been designed and the software as well as the control circuit has been implemented successfully. It demonstrates the working of the planned automated smart parking system with the help of RFID.

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