Smart Car Parking With Valet Parking System Using IoT Technology

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Abstract : Vehicle parking is a major issue in our daily life, due to this the traffic has been increasing. The technology was developed, and the population has been increased. The main objective of this Paper is to develop a hardware system and to find the number of vacant parking slots using IoT technology, to identify the number of parking slots which are available in the parking lot and park the vehicle automatically. In big cities there will be big shopping malls, restaurants, companies etc. So, to overcome that problem this project is introducing car parking with automatic valet parking system using IoT technology. This model says about how the parking is being done without human involvement, this is nothing but valet parking. The main components in the paper are Arduino which is used to control the whole system by taking the inputs and process to control the output actuators, IR sensors which senses whether the slot is occupied or empty. NodeMCU is an arduino like controller with an in-built WiFi module which connects to internet and sends the information to the server, and the status of the vehicle parking can be visualized through Blynk application. Blynk also allows the user to remotely reserve, park and retrieve the vehicle. DC motors are used to control the elevator system to lift the vehicle and place it in the specified vacant slot. This can be implemented in real time so that the users can easily check the status of the vacant parking space to park the vehicle.

Key Words - IoT, Arduino, wifi, Blynk, Valet parking.

I. INTRODUCTION

In earlier days people themselves used to park their vehicles manually. Nowadays the technology has been highly developed. Generally to the users to park their vehicles, tokens are given at the entrance and particular amount is being paid. Later valet parking is introduced where a person parks the vehicle for us. In order to park the vehicles easily the developed technology could be used so that it will be easier for the user to park his /her vehicle easily. In smart cities the shopping malls, theatres, companies ,restaurants will be more and the population will be high due to this they may face the traffic issues. So, to overcome that problem the technologies are also being developed. If we are moving to some location the parking may not be easy, in that situation we can ON the GPS and we can check the status of available parking area and we can reserve that parking area so that the user can easily park his vehicle without any time delay. Several technologies are being developed and have been developing to make the user to park the vehicle easily. Many researchers developed many technologies using different sensor and actuators, to identify parking slots which are vacant and reserve the parking spaces and park the vehicle. This is being done to reduce (or) to control the traffic and the users time will also be saved. It is safe and secure too.

The work proposes smart car parking with automatic valet parking system using IoT technology. First identify the number of vacant parking slots available in the parking lot. Secondly a hardware is developed so that it can automatically park the vehicle. The automation can be done by designing elevator system using DC motors, and placing the vehicle in the vacant space. The hardware components which are used in this paper are Arduino Mega which is used to control the parking system. NODEMCU is a arduino like microcontroller which have an inbuilt wifi module and it acts as communication between parking system and Blynk Application (mobile application). RFID reader (EM18) is used for floor and slot identification by reading the unique identification number from RFID tags. RFID tagging is an identification system which is used for identifying and tracking purposes. IR sensors are used for detecting whether the parking lot is empty (or) occupied. DC motor is used to move the elevator to the desired slot, and DC motor driver(L293D) is used to drive DC motor in both the directions and it allows to control two DC motors. Blynk Application is a mobile application which can remotely control the hardware and visualize the data in Graphical User Interface(GUI). The Arduino microcontroller along with IoT technology is used to automate all the procedure.

Microcontroller acts as the controlling unit and collects the slot availability information from sensors and through NodeMCU sends the information to Blynk application to display it to the users. User can reserve, park and retrieve to/from the selected parking slot through Blynk application.

II. EXISTING SYSTEM

Many technologies have been proposed to find out the parking space. One of the existing system such as token based parking is used to store the entry/exit related information in a parking slot. Parking tokens are issued in this system which is considered as more secure than cash based management system. Later another system such as video based system has been proposed. This system provides the driver with visual feedback when approaching an obstacle or semi-autonomously navigate the vehicle into parking slot. Video sensors are used to perform this operation. All the above systems have many disadvantages. In the token based system human is required to check the token and identify the vehicle. The token has to maintained safely by the user to get his vehicle back. Video based system also requires human supervision because of which the chance of error is high. It cannot recognize when the vehicle is moving fast, motion blur should be avoided while processing time is critical.

In our proposed system no human involvement is required to park the vehicle. So all the errors in the existing system can be avoided by our proposed system.

III. BLOCK DIAGRAM

In this Paper the block diagram of the Paper and design aspect of independent modules are considered.
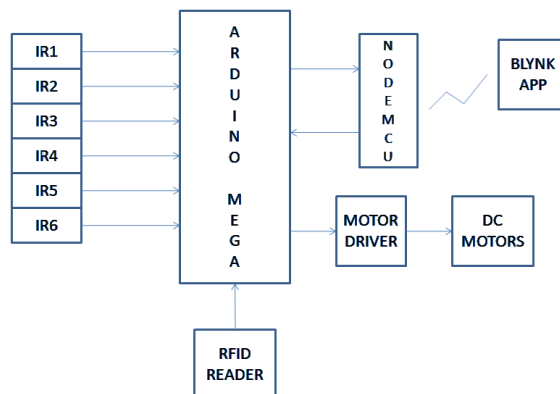
The main Blocks in this Block diagram are

1. Arduino Mega
2. Node MCU V2
3. RFID reader
4. IR Sensor
5. DC motor driver
6. Blynk Application.

The **Arduino** is a development board to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. Arduinos (we use the standard Arduino Uno) are built around an ATmega microcontroller essentially a complete computer with CPU, RAM, Flash memory, and input/output pins, all on a single chip.

The **NodeMCU** is an open-source firmware and development kit that helps you to Prototype your IoT product.

RFID reader (EM18) is used for authentication purposes, and it is used to read the unique number from RFID tags. RFID tagging is an identification system which is used for identifying and tracking purposes.

IR sensors are used for obstacle detection where in our project they are used for detecting whether the parking slot is empty (or) occupied.

DC motor is used to move the elevator to the desired slot, and DC **motor driver**(L293D) is used to drive DC motor in both the directions and it allows to control two DC motors in bi-direction and four DC motors in uni-direction.

Blynk Application is a mobile application which can remotely control the hardware and visualize the data in Graphical User Interface(GUI). The arduino microcontroller along with IoT technology is used to automate all the procedure. NodeMCU acts as communication between parking system and Blynk Application (mobile application).

IV. PROPOSED SYSTEM

The main objective of my Paper is to develop a hardware which can automatically park the vehicle in the respective slot with the help of elevator system using DC motors . The hardware components used in this Paper are Arduino Mega, NODEMCU, RFID reader, RFID tags, IR sensors, 12v DC Motors, DC Motor Driver(L293d). And we will be controlling the whole system through the BLYNK application.

BLYNK application consists of 6 LED's , where each LED represents the status of the parking slot. The parking slot has three statuses.

1. Empty
2. Reserved
3. Parked

Empty status : When the LED is off, it indicates that the parking slot is empty.

Reserved status : When the LED is glowing with medium or dull light then it indicates that the parking slot is Reserved.

Parked status : When the LED is glowing with bright light then it indicates that the parking slot is parked already.

Here NODEMCU will be connected to the BLYNK application through internet. slot availability status is monitored by Arduino mega and sends the information to Blynk app through NODEMCU. The elevator system is controlled by Arduino mega upon getting the commands from Blynk app through terminal.

There will be three options for the user for reserving a slot : RESERVE, PARK, RETRIVE. Terminal is used for giving inputs at the run time by the users. Therefore, we will be implementing three operations through the terminal:

1. Reserving a parking slot.
2. Parking a vehicle in to the slot.
3. Retrieving a vehicle from the slot.

When the **first operation** is chosen i.e., for reserving a parking slot first we have to give a keyword "reserve" in the terminal. Then a message pops in the terminal saying enter your mail id to reserve. Then mail id is given through terminal. Then Controller checks if any parking slot is free to reserve. If parking slot is available then that particular slot is reserved and a mail notification is sent to the above given mail id stating which slot is reserved and a unique password for parking and retrieving a vehicle, if no slot is free a notification will be sent to the mail stating that no parking slot is available.

When the **second operation** is chosen i.e., for parking the vehicle in the slot first we have to give a keyword "park" in the terminal. Then a message pops in terminal saying enter the slot number to park in. Then enter the slot number. If the slot is not reserved then it will display slot is not reserved to park. If any vehicle is already parked in the reserved slot then a message pops in the terminal saying vehicle already parked in the slot. Else it will ask for the authentication password for the slot which is already sent through mail while reserving the slot. Then enter the password, if the password matches then NodeMCU sends a signal to the Mega for parking the vehicle in to the slot. If the password is wrong it will be displayed as wrong password in the terminal.

When the **third operation** is chosen i.e., for retrieving the vehicle from the slot first we have to give a keyword "retrieve" in the terminal. Then a message pops in terminal saying enter the slot number to retrieve from. Then enter the slot number. If the slot is not reserved then it will display slot is not reserved to park. If no vehicle is parked in the slot then a message pops in the terminal saying no vehicle is parked in the slot. Else it will ask for the authentication password for the slot which is already sent through mail while reserving the slot. Then enter the password, if the password matches then NodeMCU sends a signal to the Mega to retrieve the vehicle from the slot. If the password is wrong it will be displayed as wrong password in the terminal.

When arduino receives command from the NODEMCU the elevator system will be started. First it will check whether the elevator is reached to particular floor by scanning RFID tag that is installed for each floor. Once the vehicle is reached to floor then second motor will be started to check particular slot by scanning RFID tag installed for each slot . If the slot is found vehicle is parked in to/ retrieved from the slot and the elevator system comes back to the ground floor.

V. RESULTS

This Paper proposes "Smart Car Parking with Automatic Valet Parking System Using IoT Technology" is designed such that the status of parking slots can be known from anywhere in the users mobile application. An embedded hardware for automatically park the vehicle in to the slot/ retrieve from the slot. Fig 5.1 shows the Hardware setup of the project.

Figure 1: Hardware setup for the project.

Blynk app consists of different widgets which can be configured for creating our own application.

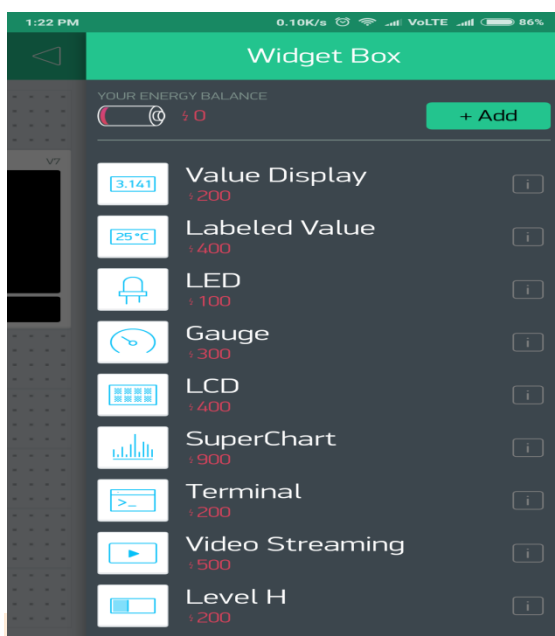Figure 2 shows different widgets available in Blynk app.

Figure 2: Widgets available in Blynk app.

Figure 3: shows the customized Blynk app for the project where three widgets LEDs, terminal and mail notification are used.
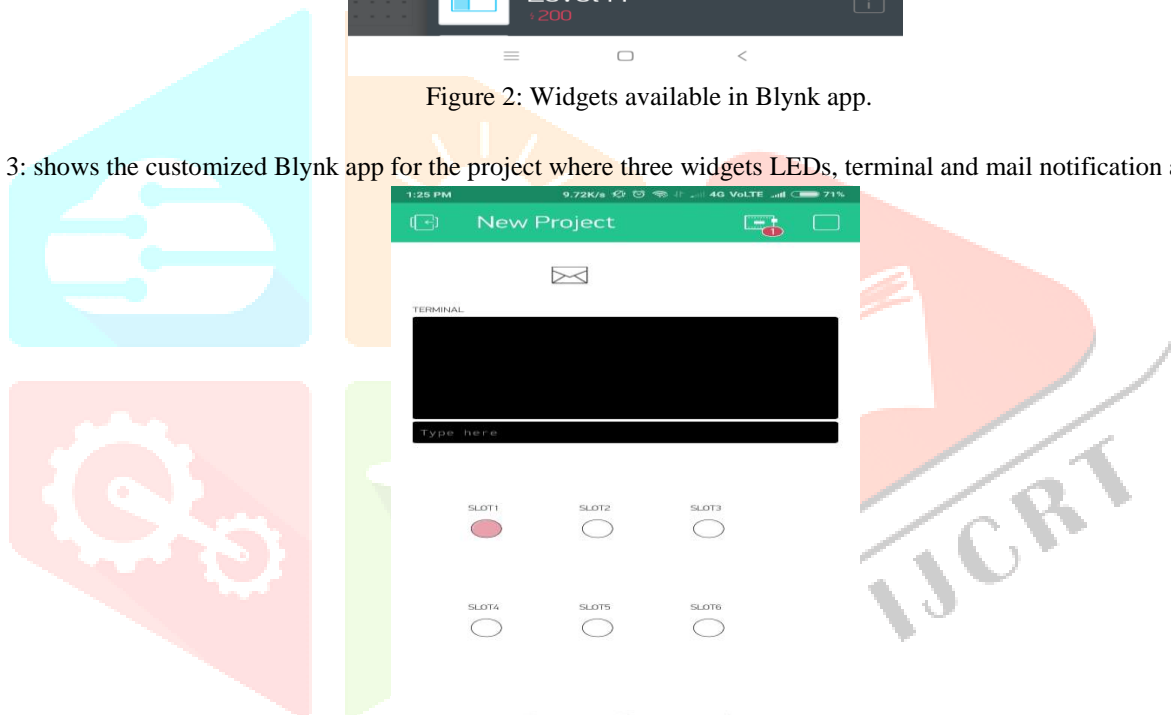

Figure:3 Customized app for the project.

Through terminal in app as shown in Figure:4 users interact with the parking system to reserve, park or retrieve vehicle from slot.
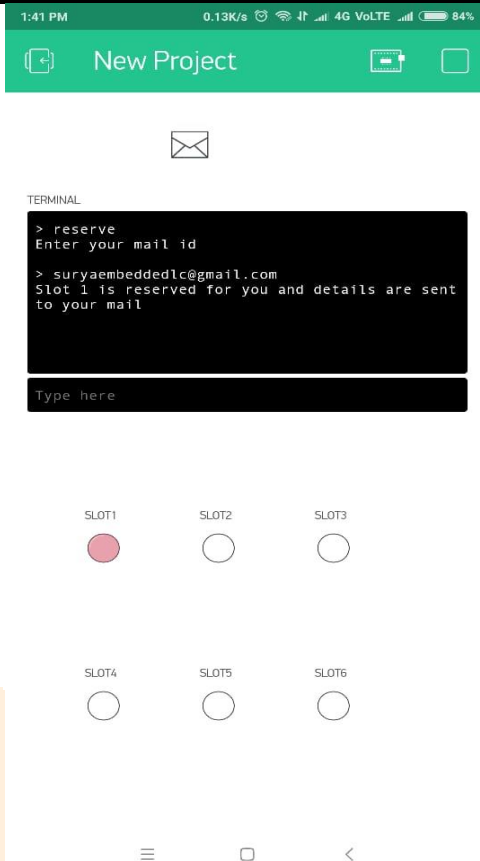
Figure:4 Giving commands through terminal.

To reserve a slot first user enters **reserve** in terminal. Then a message pops in terminal **enter email id to reserve a slot**. Once the email is entered all the parking slots are checked if any slot is found free then that is allocated and also generates a password to use the slot and sent to the user as a mail notification saying **slot n is reserved for you and the authentication password is xxxx** as shown in Fig 5.5. If no slot is found free then sends a notification saying **No slot is free to reserve**. Once the slot is reserved the led color is changed to light red.
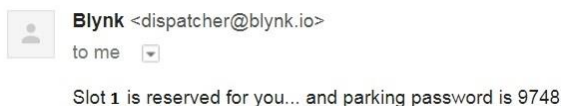

Figure:5 Mail notification sent on reserving a slot.

To park the vehicle user enters **park** in terminal. Then a message pops in terminal saying **enter slot number to park**. Once the slot number is entered first it will check whether the slot is reserved or not. If the slot is reserved then it will check whether vehicle is already parked in slot. If the slot is vacant then **enter authentication password** is shown in the terminal. Once user enters the password it is compared and if matched the elevator starts to park the vehicle in to the slot. When the vehicle is parked in slot the led in blynk app will turn RED as shown in Figure 6.
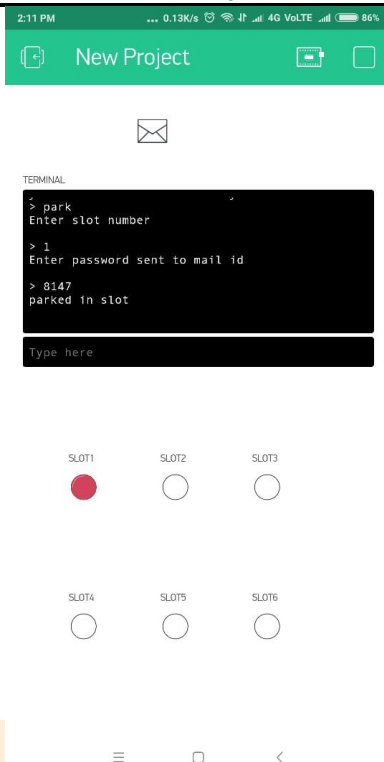
Figure:6 Park command and LED status after parking.

Figure:7 RFID tags and reader arrangement.

Figure:7 shows the arrangement of RFID reader to the lift and RFID tags to the stair and slots in the hardware.

Figure:8 shows the IR sensor arrangement in each slot.

Figure:9 shows the parking vehicles in the slots.

To retrieve the vehicle from the slot user enters **retrieve** in terminal. Then a message pops in terminal saying **enter slot number to retrieve from**. Once the slot number is entered first it will check whether the slot is reserved or not. If the slot is reserved then it will check whether vehicle is already parked in slot. If the slot is full then **enter authentication password** is shown in the terminal. Once user enters the password it is compared and if matched the elevator starts to retrieve the vehicle from the slot. When the vehicle is retrieved from slot the led in blynk app will turn off as shown in Figure10.

Figure:10 After retrieving vehicle from slot.

VI.ACKNOWLEDGMENT

1. The hassle in searching for available parking lots has been completely eliminated by reserving the lots via IOT system.
2. The security feature of the system is enhanced with the password requirements upon entrance to the parking lot.
3. The designed system could be applied.
   everywhere due to its ease of usage and effectiveness.

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