IoT BASED EV SMART PARKING AND GREEN CHARGING SYSTEM

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ABSTRACT- *Present decade has seen the growth and advancements in Electric Vehicle (EV). For the LPG and diesel cars that produce pollution and pose as threat to the environment, EVs are an eco-friendly and sustainable alternative particularly for CO2 reduction and alternative energy purposes. With the growing popularity of EV, there is a need for their charging ports. And parking of vehicles has always been a cumbersome task. And hence, EV also requires an efficient parking system. The project that we are working on involves a "Smart Parking as well as Green Charging system of EV". We are building an IOT based Car Parking System using Node MCU, Arduino UNO, Servomotor and 6 IR sensors. We use Internet of Things (IoT) for a hassle-free parking system and getting the information on Blynk application about the slot availability. Second part of project is charging the EV using a 15V solar panel that is used to charge a 12V battery on the platform where car is parked.*

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1. INTRODUCTION

Now-a-days Electrical vehicle is a trending topic and it is an important part of this smart world. Drawback of electric vehicles is cruising range is typically limited. So, it requires frequent recharging. Not only for electric vehicle but population is increasing exponentially and the problem due to this is, increasing traffic volume. All we know that we have limited stock of the fuel on our earth so it is need of time that we must switch to another way and electricity is the best option for it and electric vehicle is example of it. Electrical vehicle require a charging station similar to current fuel car require a petrol pump and obviously charging takes some time .So it is better to charge the car when it is parked, therefore it is efficient to combine both the charging and parking system which is based on the IoT technology which makes the system user friendly. We are using solar panel for green charging, making the system an efficient as well as a renewable.

1.1 Electric Vehicle

Electric vehicles (EVs), also referred to as battery electric vehicles, use a battery pack to store the electrical energy that powers the motor. EV batteries are charged by plugging the vehicle in to an electric power source. Although electricity production may contribute to air pollution, the U.S. Environmental Protection Agency categorizes all-electric vehicles as zero-emission vehicles because they produce no direct exhaust or tailpipe emissions. Both heavy-duty and light-duty EVs are commercially available. EVs are typically more expensive than similar conventional and hybrid vehicles, although some cost can be recovered through fuel savings.

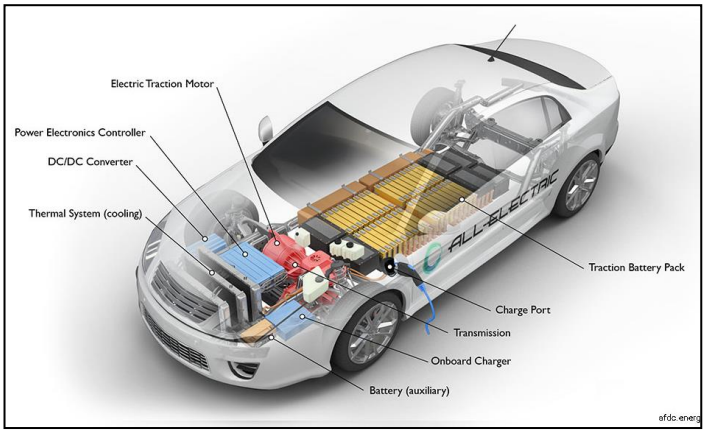

Fig 1- Electric Vehicle

1.2 EV Smart Parking System

Finding for a car parks space becomes an everyday problem for most of the public entirely to the world. It commonly takes more periods overwhelming method for most of the people in everyday life. Smart parking provides parking solution which includes smart car parks devices, cameras or calculating devices. These expedients are commonly fixed in car parks places which is used to identify the whether the car parks spot is open or not. Smart parking and parking sensors are portion of smart metropolises. Smart metropolises are motivated by IT substructure to improve the superiority of lifetime and expand commercial improvement. Smart city can collect

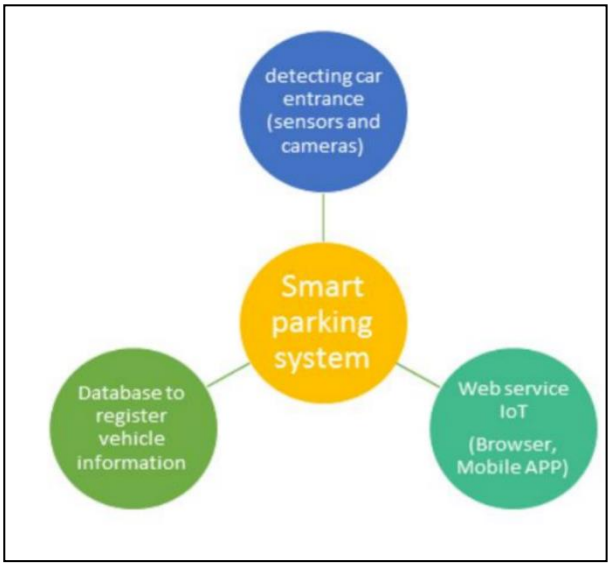

Fig 2: General Smart Parking Architecture

historical data in easy way, so that parking can be optimized. The smart parking system saves the driver time for parking a car in vacant place. The amount of time is considering for car parks spot is will be minimalized. The advantages of smart car parks systems are less pollution, safety, real time parking analytics, the space of a metropolis will be used extra proficiency, reduce street congestion, the drivers will get the benefit for reduce stress related to parking, save time and money. The general smart Parking architecture consists of three parts. The sensor and cameras are used to detect the car in entrance, Browser and mobile app used for Web service IoT, the database is used to register vehicle information.

1.3 EV Green Charging System

Consumers and fleets considering plug-in electric vehicles (PEVs)—which include plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles (EVs)—need access to charging stations. For most drivers, this starts with charging at home or at fleet facilities. Technologically, adopting the electric vehicle technology is a good initiation to go green. Building solar charging stations could constitute a small step to encourage people to opt for Electric vehicles.

Fig 3: EV Charging through Solar Panel

If the technology is already operating, local car manufacturers could consider using it in their future designs. Economically, this project will be efficient in terms of energy savings since the system generates its own energy by the PV solar panels station installed. The cost invested in fuel for normal car users could be invested in this Electric Vehicles system. Environmentally, one of the fundamental criteria that this study is based on is air quality; this project's main goal is to reduce the CO2 emissions; thus, help maintain the same air quality level. Most of the vehicles run of liquid fuel. In fact, the automotive industry constitutes a major player among the air biggest polluters. Reducing transportation-related air pollution can make a huge difference in the total amount of CO2 emissions. Fortunately, electric cars can be a good solution and substitute to vehicles that run-on fuel. Taking into consideration cost reduction, renewable energies such as solar power constitute the best solution for the implementation of electric cars. Fossil fuels constitute an exhaustible natural resource, however; solar energy guaranties an infinite supply for the coming years.

1.4 Internet of Things (IoT)

The Internet of Things (IOT), is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IOT will consist of more than 50 billion objects by 2022.

2. LITERATURE REVIEW

To understand the establishment of proposed work it is necessary to examine the existing literature and to determine how the parameters are monitored. In addition, it is important to validate how efficiency of other integrated algorithms is improved.

2.1 A Review on IoT based Electric Vehicle Charging and Parking System, International Journal of Engineering Research & Technology (IJERT) Vol. 9 Issue 08 (S. Phadtare , S.S. Wadkar , S.S. Thorat , A.S. Ghorpade, Mr.A.B. Jadav)

Electrical vehicles require a charging station similar to current fuel car require a petrol pump and obviously charging takes some time so it is better to charge the car when it is parked, therefore it is efficient to combine both the charging and parking system which is based on the IoT technology which makes the system user friendly [1]. One can upload information on cloud and simultaneously on smart phones. Car safety while parking is one of the issues faced by people. The internet of things (IoT) is best platform for monitoring the status of WPT system which is able to provide the wider connectivity, modified sensing, information processing and greater flexibility. [1] talks

about "Wireless charging system" and "Inductive Power Transfer". Under wireless charging system, this paper covers various aspects of wireless charging of electric vehicles, fundamental operation of wireless charging system including inductive wireless charging technique. It compares the inductive power transfer for different charging systems. Overall, this paper compares various smart parking, charging and combined charging-parking system, which can help to solve various issues related with it. Also, it contains a table of comparison of various research papers. Various types of methods and techniques used for parking and charging are discussed. Various sensors, controllers, software and cloud servers are available at market which will help to make system automatic, reliable and user friendly along with development of efficient IoT platform [1].

2.2 IoT based Smart Car Parking with Wireless Charging Feature for Electric Car, International Research Journal of Engineering and Technology (IRJET) Volume:07 Issue:08 (Ms. Lekshmi M, Mr. Mayur P, Mr. Manjunatha B , Ms. Kavya U, Mr. Anil Kumar J H)

The problem of finding a parking space in metro cities is a herculean task in the fast moving world. The need of the hour is an IoT backed solution wherein the availability is based on the reservation management facility[2]. This paper talks of employing an app based IoT smart parking system. In order to prevent long waits at the EV charging station, the parking system is equipped with wireless charging scheme for electric vehicles. This serves dual advantage of parking vehicles as well as charging of electric vehicles[2]. The Wireless charger designed is a Resonant Inductive Power Transfer System employed due to its consumer suitability and its effect on battery performance. The coil coupling and power electronics infrastructure decide the efficiency of the charging system and hence facilitates the charging of Electric Vehicles at the same speed as that of standard AC plug-in chargers.

2.3 IoT Based Electric Vehicle Application Using Boosting Algorithm for Smart Cities (Shabana Urooj, Fadwa Alrowais, Yuvaraja Teekaraman, Hariprasath Manoharan, Ramya Kuppusamy)

To overcome all issues in existing vehicles and for protecting the environment, electric vehicles should be introduced by integrating an intellectual device called sensor all over the body of electric vehicle with less cost [3]. Therefore, this paper confers the need and importance of introducing electric vehicles with IoT based technology which monitors the battery life of electric vehicles. An online monitoring system which is called Things Speak has been used for monitoring all the vehicles in a continuous manner (day-by-day). These online results will then be visualized in MATLAB after an effective boosting algorithm is integrated with objective function [3]. It was observed [3] that cost of implementation is lesser and capacity of electric vehicle is increased to about 74.3% after continuous monitoring with sensors.

2.4 IoT Enabled Smart Charging Stations for Electrical Vehicles,Journal of Telecommunication Study Volume: 4 Issue: 2 (Esha Sharma, Bharath S, Adarsh Devaramani, Deepti Sr, Saravana Kumar)

[4] This paper makes a smart application to know the different tariff rates of the grid by connecting to the grid. The tariff rates include both, the power intake rate and also the outgoing power rate. When the user comes to

the grid, the application also displays the battery SOC. The main agenda of this paper[4] is to optimize low carbon technologies through one connected platform using rule based algorithms, helping to decarbonize both the production and consumption of energy. The status of the battery is computed by the Arduino uno (microcontroller), then the computed data is stored in cloud, where the ESP8266 acts as intermediate device between the microcontroller and the network. [4] The stored data is accessed by the cloud using certain applications like Adafruit, MQTT dash board etc. Hence the user will get to know about their car's battery status and also they can provide excess amount of charge to any other applications, by knowing the status of the battery.

2.5 An article on "PARKPLUS Electric Vehicle Charging for Automated Parking"

PARKPLUS Electric Vehicle Charging[5] is an integrated solution to provide project-specific EV charging capacity to PARKPLUS Automated and Semi-Automated Parking Systems. The PPEVC solution is designed for pallet-based parking systems and parking platforms that include power for manual connection when parking. In this, charging power is connected upon manual connection, or when the parking platform arrives at designated parking.

3. OBJECTIVE

- ❖ To provide information about slot availability for parking using Blynk application
- ❖ To provide wired-charging of Electric Vehicle
- ❖ To provide green charging using solar panels.

4. COMPONENTS USED

4.1 Hardware:

- Node MCU/ WiFi ESP-32
- Arduino UNO
- Power hub
- 6 IR Sensors
- Servomotor
- 16x2 LCD Display
- Solar Panel(15V)
- Programming cables
- LM35 Temperature Sensor
- Diode, LED, Capacitor
- Battery(12V)
- Regulator 7805

4.2 Software:

- Arduino IDE 8.15
- Blynk application

5. OUR PROJECT MODEL

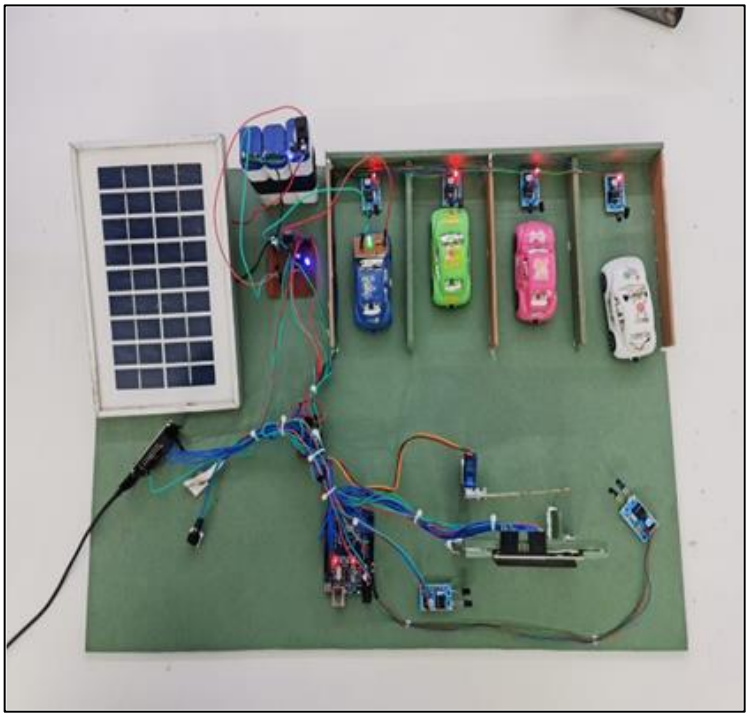

Fig 4: Project Model

6. WHY ARDUINO UNO?

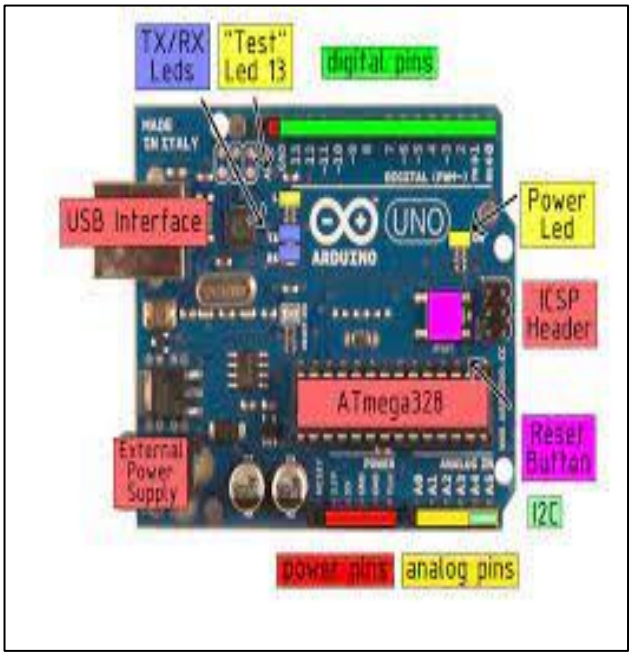

Fig 5: Arduino UNO

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-RO), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to DC adapter or battery to get started.. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

Basic function for Arduino programming:

MICROCONTROLLER	ATmega328P
OPERATING VOLTAGE	5V
DIGITAL I/O PINS	14
ANALOG INPUTS PINS	6
INPUT VOLTAGE	6-20 V
PWM DIGITAL I/O PINS	6
CLOCK SPEED	16 MHz

7. WORKING

In our part of project, we will learn how to make an IOT based vehicle Parking Slots monitoring system using Arduino, Node MCU, esp-32 WiFi module, and Blynk application. With the help of the Node MCU, esp-32 WiFi module and Blynk application, the parking slots can be monitored from anywhere around the world. In this project we will also learn how to use the tabs and led widgets in the Blynk application.

Firstly, we will start from Charging Part, The Solar Panel of 5V is connected to two diodes, one being Zener diode and Other is IN4007. This is done to regulate current in a smooth way to our main circuit. This is connected to 3 Batteries (4 V each), giving total power of 12V to the circuit and for backup. We don't need 12V for the circuit as it could damage the equipment. A capacitor (1000 micro farad, 36 V) is connected in parallel to the Batteries and with help of voltage regulator, we give only 5V to circuit. So, we used 7805 regulator for this purpose. We have used blue wires for Input and Output application, red wires for Power Supply and Green wires for ground.

There is a parking area which has four slots and every slot has one infrared sensor. Each sensor is used to detect the presence of Vehicle in the Slot. These infrared sensors are connected with the Arduino UNO. So, when a vehicle is parked in the slot, the Arduino sends a command to the Node MCU ESP-32 WiFi module, then Node MCU sends the command to the Blynk application. Two

infrared sensors are on the gate side to detect the entry and exit of vehicle.

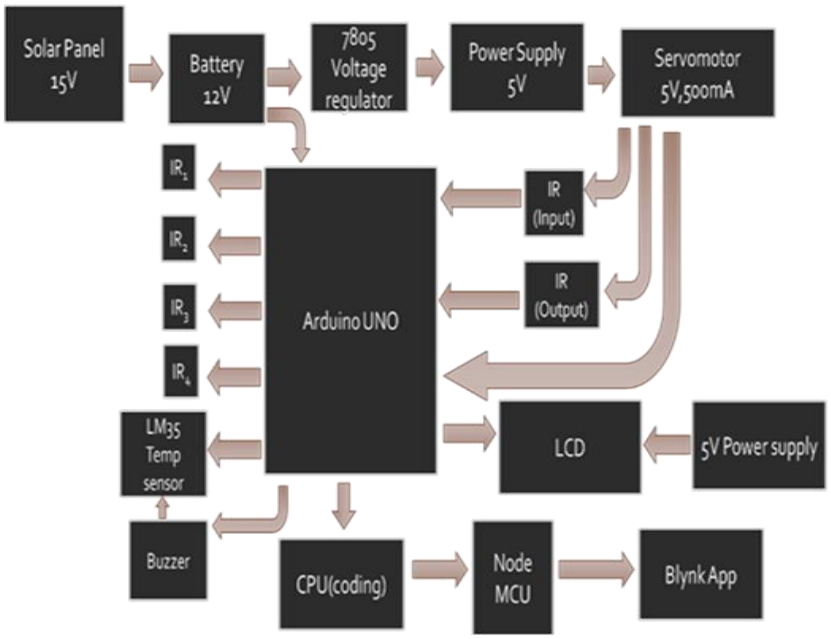

Fig 6: Block Diagram

We have used a temperature sensor LM35 connected Analog pin of Arduino UNO which is set to the 55 Degree Celsius of parking station temperature, so that is will alarm a buzzer connected to the digital pin of Arduino UNO at the time of fire. Arduino UNO has B-type port which can be powered by a USB cable connected to the power bank or Laptop.

LCD's First pin is grounded and second pin is connected to 5V supply, VEE is connected with 1K ohm resistance to adjust the contrast of LCD. RS is connected to D7 of Arduino UNO. RW is for read purpose only, hence grounded. Enable connected to D8 of Digital. Leaving 4 pins for ASCII chars. Connect D4 to 9, D5 to 10, D6 to 11, D7 to 12. LED + to 5V and LED – to ground.

Buzzer is connected to 6, A0 connected to LM35, D3 connected to Servomotor. IR sensors in this manner – IR1 to 1, IR2 to 2, IR 3 to 3, IR 5 to 4, IR 6 to 5 of Analog and IR 4 to 2 of Digital.

Servomotor is connected to Node MCU (2.4Ghz). It is connected in following manner.

Node MCU connected to Arduino as – D0 to A1, D1 to A2, A2 to A3, D3 to D2.

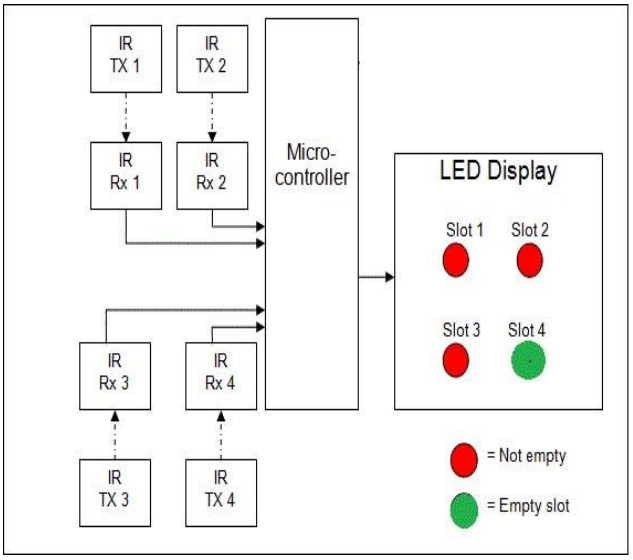

Fig 7: Showing slots in Blynk app

The code was written in Arduino IDE software and uploaded to Arduino UNO. Then we installed the Blynk application from play store which is free of cost. Created an account and made a new Blynk project. This will generate a token no. which we have already uploaded to the Arduino UNO to track the slots of parking station.

8. FLOWCHART OF SMART PARKING SYSTEM

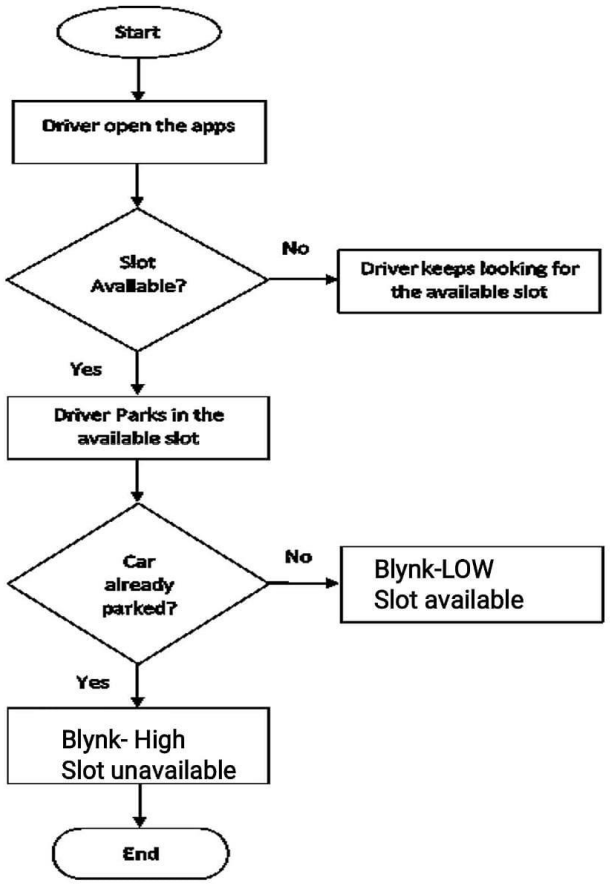

Fig 8: Flowchart of Smart Parking System

9. Blynk Application

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server - responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

1. Create a Blynk Account

An account is needed to save your projects and have access to them from multiple devices from anywhere. It's also a security measure.
You can always set up your own Private Blynk Server and have full control.

2. Create a New Project

After you've successfully logged into your account, start by creating a new project.

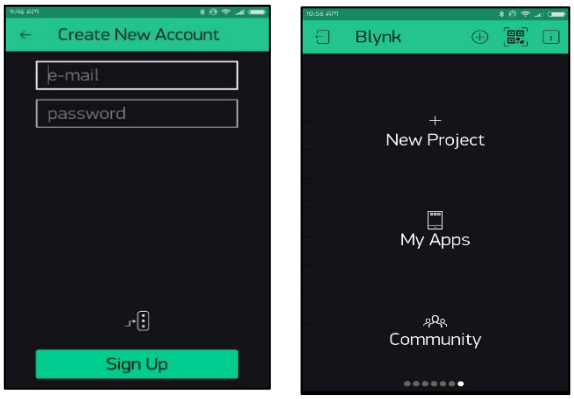

Fig 9(a) and 9(b): Creating new project in Blynk App

3. Choose Your Hardware

Select the hardware model you will use. Check out the list of supported hardware.

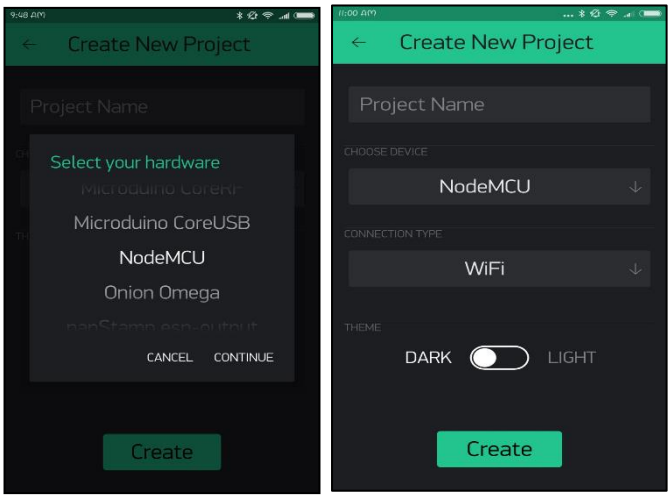

Fig 10(a) and 10(b): Choosing Hardware

4. Auth Token

Auth Token is a unique identifier which is needed to connect your hardware to your smartphone. Every new project you create will have its own Auth Token. You'll get Auth Token automatically on your email after project creation.

5. Run The Project

When you are done with the Settings - press the PLAY button. This will switch you from EDIT mode to PLAY mode where you can interact with the hardware. While in PLAY mode, you won't be able to drag or set up new widgets, press STOP and get back to EDIT mode.

10. RESULTS AND DISCUSSION

Low: Slots are empty, entry will be provided
High: Slots are filled, no entry will be provided

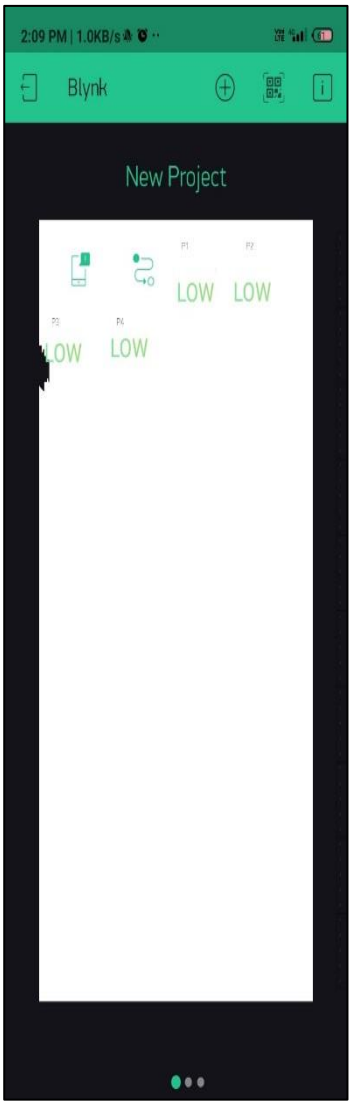

Fig 11(a): Car can enter till all slots are HIGH
P1, P2, P3, P4: LOW

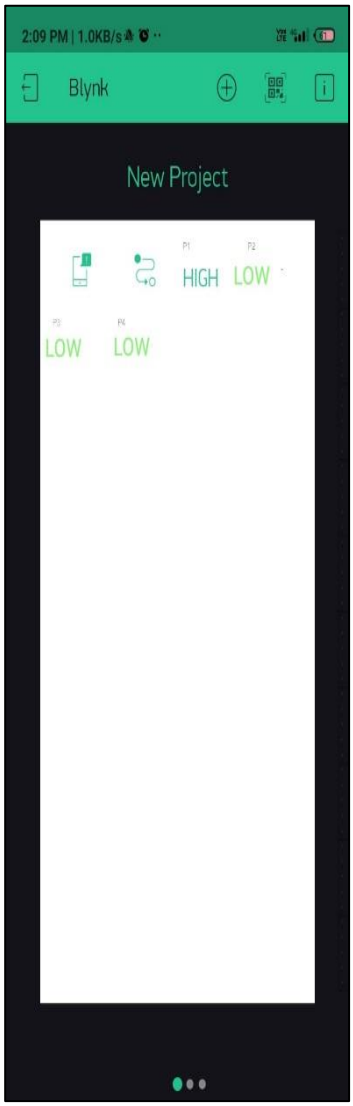

Fig 11(b): Car on P1 slot
P1: HIGH

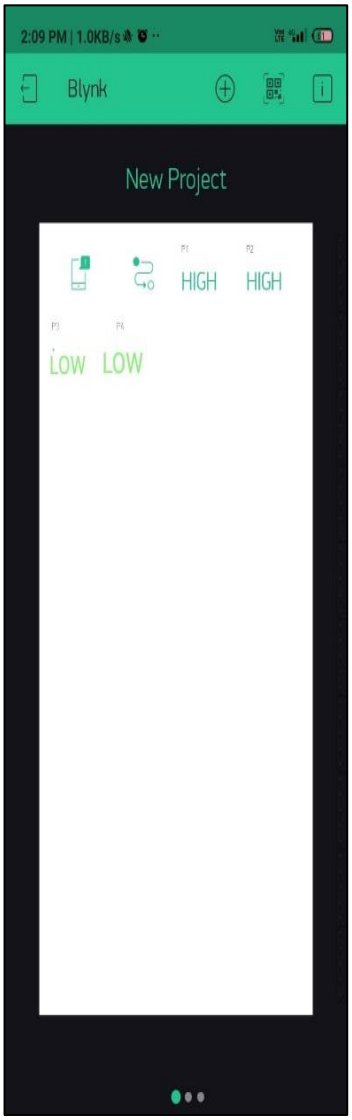

Fig 11(c): Cars on P1 & P2 slots
P1, P2: HIGH

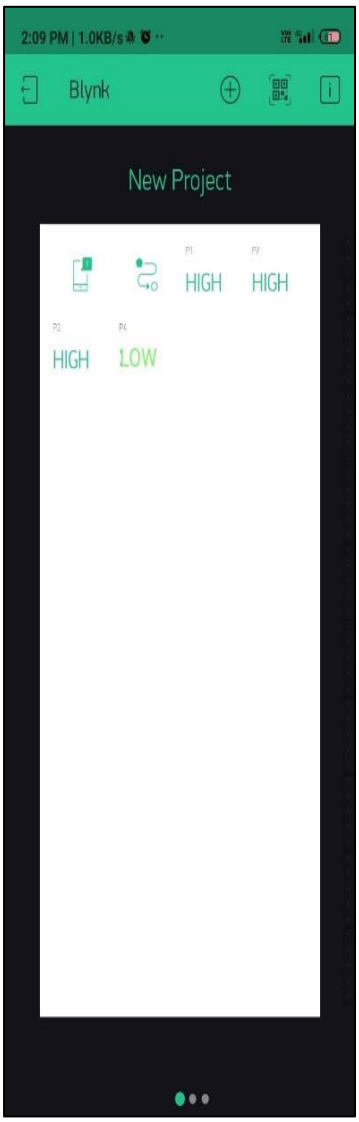

Fig 11(d): Cars on P1, P2 & P3 slots
P1, P2, P3: HIGH

Fig 11: Showing parking slots in Blynk Application

11. CONCLUSION

This work is useful for the car parking people to park their vehicle effectively. The electric vehicle charge point provision is provided for all the parking slots to recharge their vehicle during parking time. The system also provides a green charging system which is eco-friendly and sustainable. Advantages of our project over the limitations of Electric Vehicle users are:

- Optimised Parking
- Reduced Traffic and Reduced Pollution
- Green charging system
- New Revenue Options
- Fast Payments
- Decreased Management Costs
- Real-Time Data and Trend Insight

Furthermore, if you want in depth information about how this research paper was made and concluded, you can watch the video in the link below.

https://drive.google.com/file/d/1Dt4vlohiPPviVGzEJrmQwRIZMksntfWS/view?usp=drivesdk

12. FUTURE SCOPE

For charging, the electrical vehicles, plug in charging is used. In wireless charging there is no need to ON-OFF the plug. Hence, there will be less human interaction; it reduces risk of electric shock due to wired connections. Plug-in EVs have limited travel range and need large and heavy batteries. The wireless charging technology has main advantage is, it increases the travelling range, reduces the battery size and waiting time for charging the vehicle. Such advantage will increase the economic and environmental benefits as well as the adoption rates of EVs.

Inductive power transfer method delivers power wirelessly via magnetic coupling from a static transmitter to secondary receiver. In between primary source and secondary load there is a large air gap. The power transfer efficiency depends on the coil alignment and air gap distance varies between source and receiver. With increase in air gap, the power transfer efficiency decreases. Magnetic coupling coefficient defines the degree of close coupling between the primary and secondary winding.

13. ACKNOWLEDGEMENT

We have taken efforts in this research paper. However, it would not have been possible without the kind support and help of many individuals. I would like to extend my sincere thanks to all of them.

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Our thanks and appreciations also go to all our colleagues in developing the project and to publish this research paper, who have willingly helped us out with their abilities.

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[4] IoT Enabled Smart Charging Stations for Electric Vehicles, Journal of Telecommunication Study Volume:4 Issue:2 (Esha
Sharma, Bharath S, Adarsh Devaramani, Deepti Sr, Saravana Kumar)

[5] An article on “PARKPLUS Electric Vehicle Charging for Automated Parking”