A Project report on

Next-Gen EV Charging roads: Wireless, Solar and Smart solutions

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In

Electronics and Telecommunications Engineering

Under the guidance of

Dr. Nayana Chaskar

M.H. Saboo Siddik College of Engineering, Mumbai

University of Mumbai

2024-2025

CERTIFICATE

This is to certify that Students **Ansari Mohd Kashif, Faiz Mansur Malpekar, Shaikh Mohammed Aadil, Mohammad Mohiuddin Siddiqui** are the Bonafide students of M.H Saboo Siddik College of Engineering, Mumbai.

They have successfully carried out the project titled ***"Next-Gen EV Charging roads: Wireless, Solar and Smart solutions"*** in partial fulfilment of the requirement of B.E. Degree in Electronics and Telecommunications Engineering of Mumbai University during the academic year 2024-2025. The work has not been presented elsewhere for the award of any other degree or diploma prior to this.

Dr. Nayana Chaskar **(Project Guide)**	**Dr. Nayana Chaskar** **(Project Co-Ordinator)**
Er. Abdul Sayeed **(HOD)**	**Dr. Ganesh kame** **(Principal)**

Project report Approval for B.E

This project entitled ***"Next-Gen EV Charging roads: Wireless, Solar and Smart solutions"*** by **Ansari Mohd Kashif, Faiz Mansur Malpekar, Shaikh Mohammed Aadil, Mohammad Mohiuddin Siddiqui** approved for the degree of Bachelor of Engineering in Electronics and Telecommunications from University of Mumbai.

Examiners

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Date:

Place:

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Signature of all the Students in the group

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Faiz Mansur Malpekar

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Mohammad Mohiuddin Siddiqui

DECLARATION

We declare that this return submission represents our ideas in our own words and where others' ideas or words have been included; we have adequately cited and referenced the original sources. We also declared that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/facts/source in this submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permissions has been taken when needed.

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ABSTRACT

The increasing global demand for sustainable transportation solutions has led to significant innovations in the electric vehicle (EV) industry and innovative charging infrastructure. In this report, we propose the emerging concept of integrating renewable energy sources with wireless charging road systems, presenting a compelling synergy to address the challenges hindering widespread EV adoption. The current state of the electric vehicle market leads in reducing greenhouse gas emissions and dependence on fossil fuels Solar panels, wind turbines, and energy storage systems are incorporated to power the charging infrastructure, reducing its reliance on non-renewable energy sources and enhancing sustainability. Next, we present the concept of wireless charging roads, which have the potential to revolutionize EV charging. These systems leverage inductive charging technology embedded within road surfaces to replenish EV batteries while in motion, effectively. By harnessing clean energy sources, overcoming range limitations, and enhancing the overall EV experience, this technology represents a pioneering step towards a greener, more efficient, and sustainable future for mobility.

***Keywords**: Electric Vehicle, infrastructure, renewable energy, Solar Panels, turbines, wireless charging.*

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EV: Electric Vehicle

RFID: Radio Frequency Identification

IOT: Internet Of Things

IR: Infrared

LDR: Light Dependent Sensor

DC: Direct Current

AC: Alternating Current

CHAPTER 1
INTRODUCTION

Electric vehicles (EVs) are rapidly shaping the future of transportation, offering eco-friendly, energy-efficient, and cost-effective alternatives to traditional fossil-fuel-powered vehicles. However, the widespread adoption of EVs faces key challenges, particularly in charging infrastructure. To address these limitations, our project introduces a **dynamic wireless charging road integrated with renewable energy sources and an overhead locomotive system for heavy vehicles.** This system enhances efficiency, flexibility, and sustainability while reducing dependency on fossil fuels and improving charging convenience.

1.1 Motivation

The development of a **renewable energy-based EV charging road and locomotive infrastructure** is crucial for addressing modern transportation challenges. As climate change accelerates, reducing greenhouse gas emissions and improving air quality have become global priorities. Our project envisions a **hybrid charging model**—combining **dynamic wireless charging roads and an overhead locomotive system for trucks and buses**—to create a **highly efficient, cost-effective, and eco-friendly transportation network.**

By integrating **solar-powered energy storage, wireless charging coils placed on the road surface, and overhead power lines for heavy vehicles,** we aim to enhance energy efficiency, increase charging convenience, and provide a **scalable, flexible charging solution.** This project not only aligns with sustainable development goals but also **minimizes road maintenance disruptions** and **ensures continuous power supply while vehicles are in motion.**

1.2 Objective

The primary objective of this project is to **develop an advanced electric vehicle charging infrastructure** that:

- Utilizes **renewable energy sources (solar power)** for sustainable charging.

- Implements **wireless charging roads** to maintain vehicle battery levels dynamically.
- Integrates an **overhead locomotive charging system** for heavy transport vehicles.
- Optimizes **charging efficiency** by minimizing coil-to-vehicle distance.
- Enhances **infrastructure flexibility** by allowing coil replacements without road excavation.

1.3 Problem Statement

To design and implement a **hybrid electric vehicle charging infrastructure** that:

- Uses **wireless charging roads** powered by renewable energy sources.
- Integrates an **overhead locomotive charging system** for heavy vehicles.
- Addresses **efficiency and flexibility limitations** of conventional embedded-coil roads.

1.4 Outline

This project report is organized as follows:

Chapter 1: Introduces the topic.

Chapter 2: presents the literature survey on the existing techniques.

Chapter 3: provides a brief explanation of the design of the project.

Chapter 4: is dedicated to simulation and experimental results.

Chapter 5: presents the conclusions and future scope for this project.

CHAPTER 2
LITERATURE REVIEW

The Smart Grid and Electric Vehicles (EVs) with a focus on wireless charging. This study offers valuable insights into the convergence of these two domains, highlighting the potential synergies and challenges associated with their integration. By reviewing existing literature, the authors shed light on how smart grid technology can enhance the efficiency of EV wireless charging, manage grid load, and facilitate grid integration of renewable energy sources. The review emphasizes the importance of seamless communication and control systems for optimizing the charging process, reducing costs, and improving the reliability of EVs. This literature review is an essential resource for researchers and professionals seeking to understand the dynamic relationship between smart grid systems and electric vehicles, particularly in the context of wireless charging technology. [1]

The review encompasses a broad range of topics, including solar power generation, battery storage systems, and electric vehicle technology. It underscores the pressing need for sustainable transportation solutions in the face of environmental challenges and dwindling fossil fuel resources. The authors' analysis of the existing literature not only highlights the potential advantages of solar-based charging stations but also identifies the technical, economic, and environmental challenges that must be addressed for widespread adoption. This literature review serves as an essential resource for researchers, policymakers, and industry stakeholders seeking to advance the development and deployment of solar-based electric vehicle charging infrastructure. [2]

This study represents a crucial intersection of renewable energy and sustainable transportation infrastructure. The authors delve into various key facets, including solar panel technologies, energy storage solutions, charging infrastructure design, and efficient power management. Through an extensive literature review, they highlight the importance of integrating solar power with EV charging to reduce greenhouse gas emissions and reliance on non-renewable energy sources. [3]

This study makes a significant contribution to the growing body of research focused on sustainable and eco-friendly transportation solutions. The review delves into various facets of solar PV charging infrastructure, including solar panel technologies, energy storage systems, charging protocols, and grid integration. By synthesizing and analyzing the existing literature, the authors not only underscore the environmental and economic benefits of solar PV charging for EVs but also highlight the technical and regulatory challenges that must be addressed to ensure the seamless integration of these technologies. The review offers valuable insights into the current state of the field, shedding light on the innovative solutions and advancements that are paving the way for a more sustainable and efficient future in electric vehicle charging. [4]

This research delves into the innovative and sustainable integration of solar power with EV charging infrastructure, addressing the pressing need for eco-friendly and energy-efficient transportation solutions. The study conducts a thorough literature review, offering insights into the existing state of solar EV charging technology, its environmental benefits, and its potential to reduce greenhouse gas emissions. [5]

Wireless power transmission (WPT) is popular and gaining technology finding its application in various fields. The power is transferred from a source to an electrical load without the need of interconnections. WPT is useful to power electrical devices where physical wiring is not possible or inconvenient. The technology uses the principle of mutual inductance. One of the future applications finds in automotive sector especially in Electric Vehicles. This paper deals with research and development of wireless charging systems for Electric vehicles using wireless transmission. The main goal is to transmit power using resonance coupling and to build the charging systems. The systems deal with an AC source, transmission coil, reception coil, converter and electric load which are battery.[6]

This paper reviews wireless charging systems for electric vehicles (EVs), highlighting their advantages over wired systems in terms of convenience, environmental impact, and infrastructure needs. It explains key wireless power transfer methods—capacitive and inductive—and compares them. The study covers both stationary and dynamic charging systems, including models and design parameters for charging moving vehicles. It also discusses the role of control systems in improving efficiency and communication during charging. Finally, it reviews different EV battery types and their impact on charging, concluding with key findings and suggestions for future research.[7]

Electrified transportation will help to reduce green-house gas emissions and increasing petrol prices. Electrified transportation demands that a wide variety of charging networks be set up, in a user-friendly environment, to encourage adoption. Wireless electric vehicle charging systems (WEVCS) can be a potential alternative technology to charge the electric vehicles (EVs) without any plug-in problems. This paper outlines the current available wireless power transfer technology for EVs. In addition, it also includes wireless transformer structures with a variety of ferrite shapes, which have been researched. WEVCS are associated with health and safety issues, which have been discussed with the current development in international standards. Two major applications, static and dynamic WEVCS, are explained, and up-to-date progress with features from research laboratories, universities, and industries are recorded. Moreover, future upcoming concepts-based WEVCS, such as “vehicle-to-grid (V2G)” and “in-wheel” wireless charging systems (WCS) are reviewed and examined, with qualitative comparisons with other existing technology. [8]

This paper presents a new selectable regional charging wireless power transfer (SRC-WPT) system, which can charge multiple receivers simultaneously. Meanwhile, they are put on the charging area of the system. This SRC-WPT system employs a transmitter array for WPT, which rows are controlled by relays. Furthermore, the transmitters in each row have different frequency characteristics, which can be used as the natural switches. Thus, this SRC-WPT system can selectively activate the charging region for the receivers through the different frequencies and relays. Besides, when compared with the existing multi-to-multi WPT designs, the proposed control method of the SRC-WPT system is much more simple and reliable. Finally, a model is built to verify the performances of the proposed system and the corresponding control method. [9]

Electric vehicle (EV) users have the flexibility to fulfill their charging needs using either high-speed charging stations or innovative on-road wireless charging systems, ensuring uninterrupted travel to their destinations. These options present a spectrum of benefits, enhancing convenience and efficiency. The adoption of on-road wireless charging as a complementary method influences both the timing and extent of demand at fast-charging stations. This study introduces a comprehensive probabilistic framework to analyze EV arrival rates at fast-charging facilities, incorporating the impact of on-road wireless charging availability. The proposed model utilizes transportation data, including patterns from the US National Household Travel Survey (NHTS), to predict the specific times when EVs would need fast charging. To account for uncertainties in EV user decisions concerning charging preferences, a Monte Carlo simulation (MCS) approach is employed, ensuring a comprehensive analysis of charging behaviors and their potential impact on charging stations. A queuing model is developed to estimate the charging demand for numerous electric vehicles at a charging station, considering both scenarios: on-road EV wireless charging and relying exclusively on fast-charging stations. This study includes an analysis of a case and its simulation results based on a 32-bus distribution system and data from the US National Household Travel Survey (NHTS). The results indicate that integrating on-road EV wireless charging as complementary to fast charging significantly reduces the peak load at the charging station. Additionally, considering the on-road EV wireless charging system, the peak load of the station no longer aligns with the peak load of the power grid, resulting in improved power system capacity and deferred system upgrades. [10]

CHAPTER 3
METHODOLOGY

3.1 Design Methodology

The design of the Electric Vehicle Charging Infrastructure incorporates both Dynamic EV Wireless Charging Roads for smaller electric vehicles and an Overhead Locomotive Charging System for heavy transport vehicles such as trucks and buses. This dual charging approach ensures seamless energy transfer, reduces dependency on large onboard batteries, and enhances the efficiency of electric mobility.

3.1.1 Renewable Energy Integration and Charging Stations

The charging infrastructure is powered by solar panels and wind turbines, ensuring a sustainable and eco-friendly energy supply. These energy sources are carefully positioned to maximize efficiency based on local weather conditions and seasonal variations. The generated energy is stored in battery systems, which act as a buffer to supply power to the charging stations and road infrastructure. DC-DC converters regulate the power flow between renewable sources, storage systems, and charging modules.

The system is managed using Arduino Nano and ESP32 microcontrollers, enabling smart monitoring and control. The ESP32 functions as an IoT device, providing real-time updates on energy generation and distribution, while the Arduino Nano controls power flow and switching mechanisms. An LCD display shows the power source in use, whether from renewable sources or grid backup, ensuring transparency in system operation.

3.1.2 Dynamic EV Wireless Charging Roads

The Wireless Charging Road system is designed to provide on-the-go charging for electric vehicles. Transmitter coils are embedded within the road surface, powered by the renewable energy system. When an electric vehicle moves over the charging lane, IR sensors detect its presence and activate the corresponding transmitter coils. These coils induce current in the vehicle's receiver coil, enabling wireless power transfer without physical connectors.

An Arduino Nano microcontroller manages the coil activation process, ensuring that only the relevant section of the road is powered to optimize energy efficiency. As the vehicle moves forward, the previous coil section turns off while the next section activates, ensuring continuous charging. The charging status and power levels are monitored using voltage and current sensors, and the data is displayed on the system's dashboard via the ESP32 web interface.

3.1.3 Overhead locomotive Charging System

For heavy transport vehicles, an Overhead Locomotive Charging System is implemented. Overhead power lines are installed along designated lanes on highways, supplying direct grid power to electric trucks and buses. These vehicles are equipped with a pantograph system, which is manually deployed by the driver when entering the electrified lane.

The pantograph features a suspension-based adjustment mechanism, allowing it to adapt to variations in wire height while maintaining consistent contact with the overhead power lines. Arduino Nano microcontrollers are used to detect when the pantograph is connected to the overhead wire, ensuring smooth power transfer. When connected, the vehicle draws power directly from the grid while simultaneously charging its onboard battery.

If the pantograph disconnects due to lane changes or road conditions, the system automatically switches to battery mode, allowing the vehicle to continue operation seamlessly. The LCD display inside the vehicle indicates the current power source, displaying “Source: Overhead” when connected and “Source: Battery” when disconnected.

3.2 Hardware & Software Requirements

3.2.1 Hardware Specification

1) **ESP32:** Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz’s 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM. Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps. Support for both Classic Bluetooth v4.2 and BLE specifications.34 Programmable GPIOs. Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC. Serial Connectivity include 4 x SPI, 2 x I2C, 2 x I2S, 3 x UART. Ethernet MAC for physical LAN Communication (requires external PHY).1

Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI. Motor PWM and up to 16-channels of LED PWM. Secure Boot and Flash Encryption.

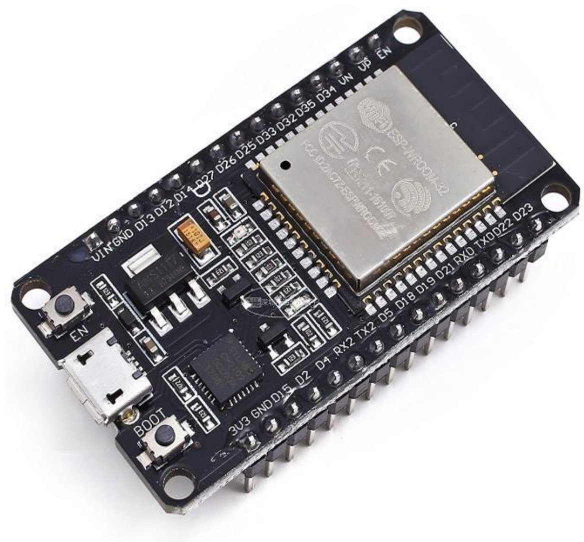


Figure 3.1 ESP-32

2) **Arduino nano**: The Arduino Nano is an open-source breadboard-friendly microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2008.

   Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

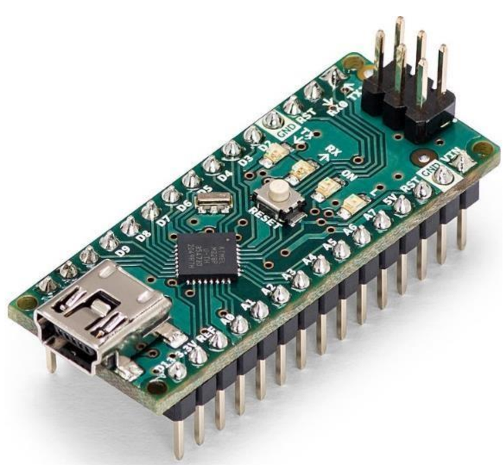


Figure 3.2 Arduino nano

3) **Solar Panels:**
Maximum Power (Pmax): 55w

Voltage Max. Power (Vmp): 12V

Current at Max. Power (Imp): 4.5A

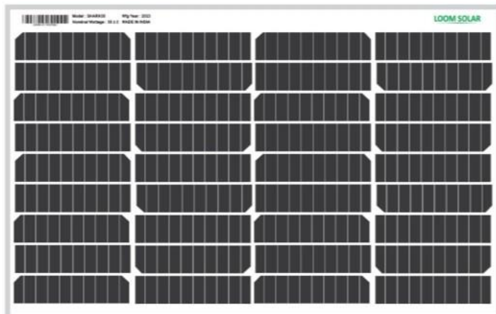


Figure 3.3 Solar panel

4) **Generator Motor:**
Poer source: DC

Voltage: 6-24 Volts

Frequency: 50 Hz

RPM: 4500

Figure 3.4 Generator Motor

5) Voltage sensor and current sensor:

Voltage Sensor:

Voltage Detection range: 0 – 25Volts

Current Sensor:

Current Detection range: 5A – 30A

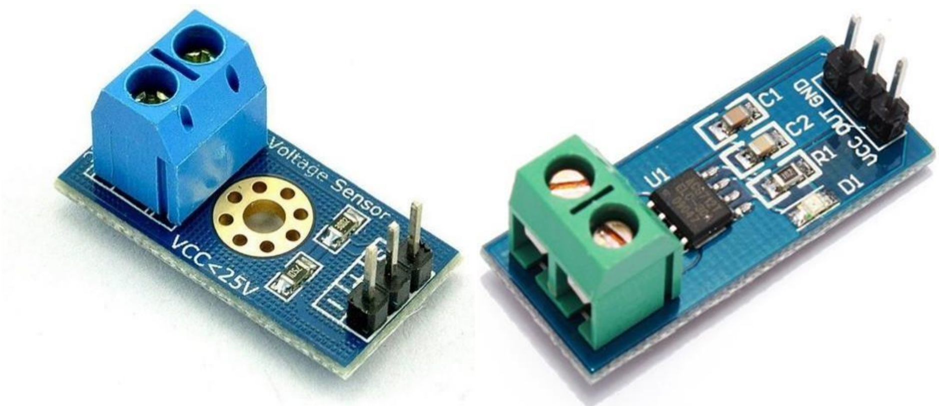


Figure 3.5 Voltage and current sensor

6) DC-DC Buck/Boost Converter:

input voltage: 3.2V- 40V DC

Output Voltage: 1.25V- 35V DC

Figure 3.6 DC-DC Buck/Boost

7) AC-DC Power Supply Module 24V 6A:

Input Voltage: 100-220

Output Voltage: 24V DC

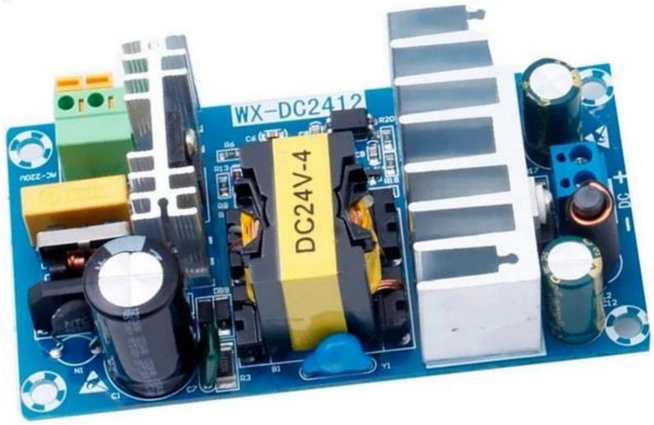


Figure 3.7 AC-DC Power Supply Module

8) Charging Control Module:

Input Voltage: DC 10-30V

Display Precision: 0.1V

Control Precision: 0.1V

Output Type: direct output

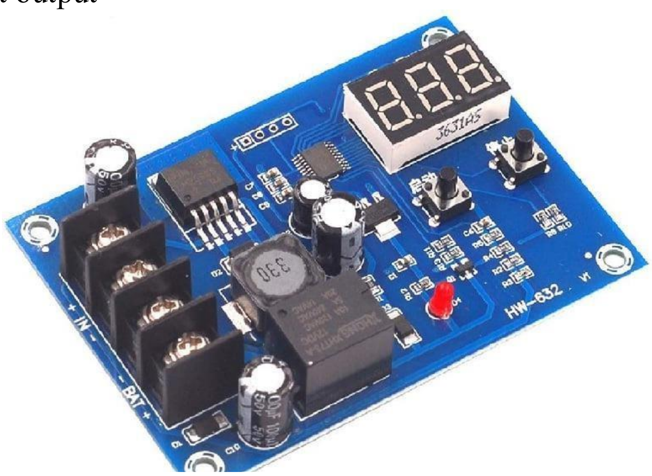


Figure 3.8 Charging Control Module

9) **Relay Module:**

Input Voltage: DC 10-30V

Display Precision: 0.1V

Control Precision: 0.1V

Output Type: direct output

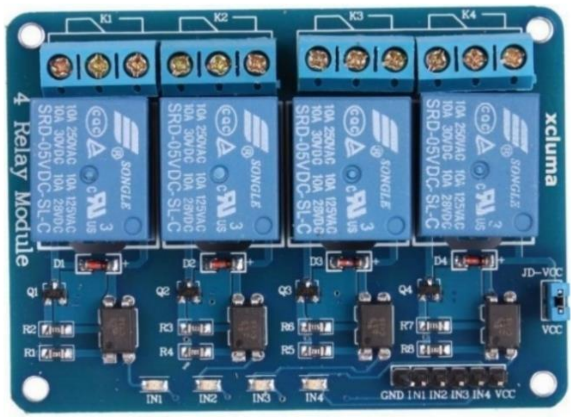


Figure 3.9 Relay module

10) **Wireless Transmitter Receiver Charging Coil:**

Input Voltage: 12VDC Output: 5V / 1A current

Normal Use Distance: 2 ~ 10mm Operating Current: 1.2-2 A.

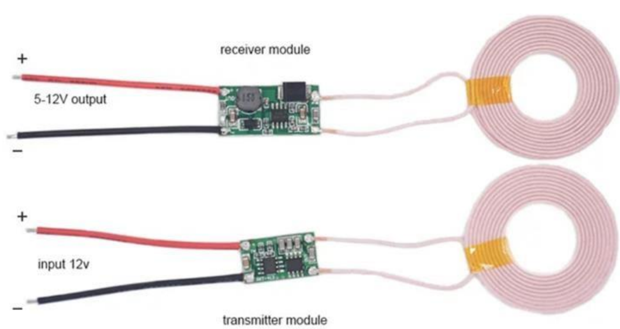


Figure 3.10 Wireless Transmitter and Receiver Coil

11) **RFID Scanner:**

13.56MHz contactless communication card chip. Working current：13 – 26mA / DC 3.3V

Standby current：10 – 13mA / DC 3.3V

Sleep current：<80uA Peak current：<30mA

Working frequency：13.56MHz

Card reading distance ：0～60mm （Mifare1 card)

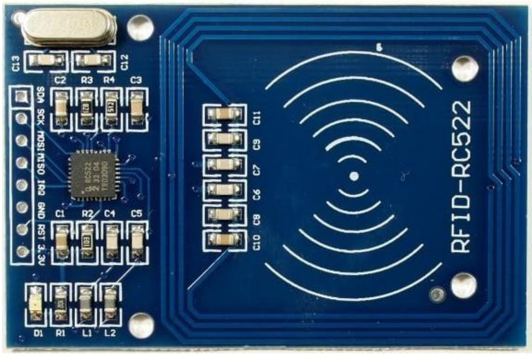


Figure 3.11 RFID Scanner

12) 20x4 LCD Display:

Characters: 20

Lines: 4

Character Color: Black Backlight: Yellow

Input Voltage (V): 5

Figure 3.12 20x4 LCD Display

13) Li-ion Battery:

Size: 18650.

Nominal Capacity: 2600mAh Nominal Voltage: 3.6V

Discharge: 5.2A Max Continuous Positive: Flat

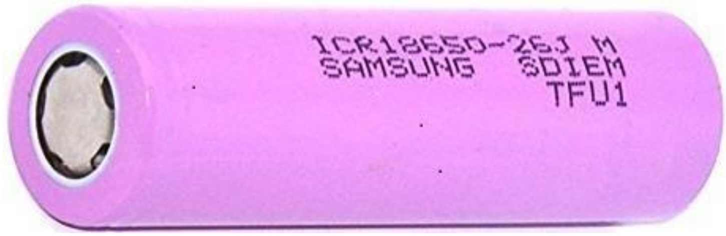


Figure 3.13 Li-ion Battery

14) IR Sensor:

VCC external 3.3V-5V

voltage GND external GND.

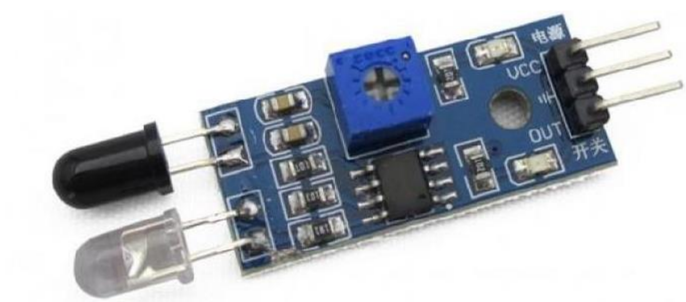


Figure 3.14 IR Sensor

15) LDR Sensor Module:

External 3.3V-5V VCC

DO digital output interface, a small plate (0 and 1)

AO small board analog output interface

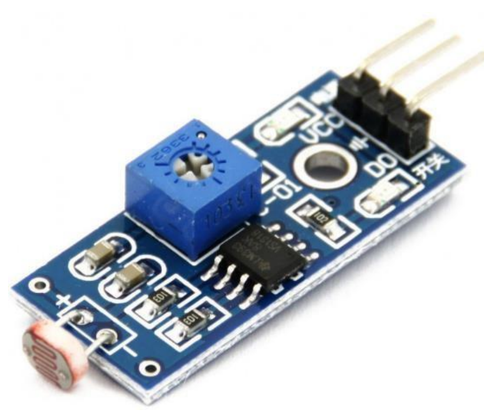


Figure 3.15 LDR Sensor Module

16) Servo Motor (SG90):

Model: SG90

Weight: 9 gm

Operating voltage: 3.0V~ 7.2V

Servo Plug: JR

Stall torque @4.8V: 1.2kg-cm

Stall torque @6.6V: 1.6kg-cm

Figure 3.16 Servo Motor SG90

17) Servo Motor (MG996):

Weight: 55g

Dimension: 40.7×19.7×42.9mm

Stall torque: 9.4kg/cm (4.8v); 11kg/cm (6.0v)

Operating speed: 0.19sec/60degree (4.8v); 0.15sec/60degree (6.0v)

Operating voltage: 4.8 ~ 6.6V

Gear Type: Metal gear

Dead band width: 1us

Figure 3.17 Servo Motor MG996

3.2.2 Software Requirement

1) Arduino IDE:

The Arduino Integrated Development Environment (IDE) is used to program the Arduino Nano and ESP32 in the rescue buoy. It allows writing, compiling, and uploading code to control various components like water pumps, motor driver, servo motor, LED modules, and sensors. The IDE supports C/C++ programming, enabling efficient communication between the microcontrollers and connected modules. It also facilitates debugging and serial monitoring to test and optimize the system's performance.

Figure 3.18 Arduino IDE

```
// Core Libraries (included by default)
#include <Arduino.h>      // Core Arduino functions
#include <Wire.h>         // I2C communication
#include <SPI.h>          // SPI communication
#include <EEPROM.h>       // Read/write to permanent storage
#include <Servo.h>        // Servo motor control

// Popular External Libraries (need to be installed)
#include <LiquidCrystal_I2C.h>  // I2C LCD displays
#include <DHT.h>                 // DHT temperature/humidity sensors
#include <Adafruit_NeoPixel.h>   // WS2812 LED strips
#include <ESP8266WiFi.h>         // WiFi functionality for ESP8266
#include <PubSubClient.h>        // MQTT client
#include <OneWire.h>             // OneWire protocol
#include <DallasTemperature.h>   // DS18B20 temperature sensors
#include <IRremote.h>            // IR communication
#include <FastLED.h>             // LED strip control
#include <Stepper.h>             // Stepper motor control

// Example usage of some common libraries:
```

Figure 3.19 libraries for each component in our project

This image shows a categorized list of Arduino libraries used in programming microcontrollers. It is divided into two sections:

1) **Core Libraries (included by default)**: These are standard libraries like Arduino.h, Wire.h, and Servo.h, used for basic functions, I2C/SPI communication, EEPROM access, and servo motor control.
2) **Popular External Libraries (need to be installed separately)**: These include libraries such as LiquidCrystal_I2C.h for LCD displays, DHT.h for temperature/humidity sensors, Adafruit_NeoPixel.h for LED strips, ESP8266WiFi.h for WiFi, and others for various sensor and communication functionalities.

3.3 System Design:

3.3.1 Block Diagram:

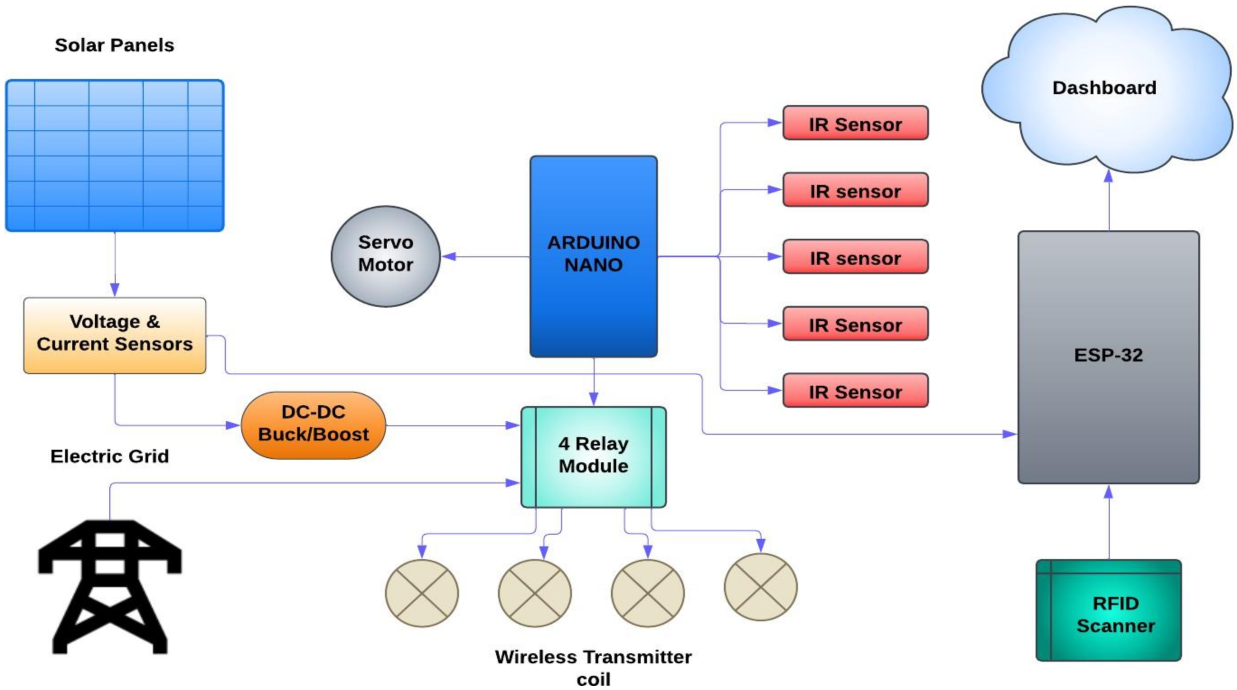


Figure 3.20 Block Diagram of Road

- **Solar Panels**: These provide renewable energy to power the system.
- **Voltage & Current Sensors**: These sensors monitor the energy from solar panels.
- **DC-DC Buck/Boost Converter**: This adjusts the voltage levels between the solar panels and the electric grid to ensure stable power delivery.
- **Arduino Nano**: Acts as the central controller of the system, controlling the relay module and interfacing with other components.
- **Servo Motor**: Likely used to move or adjust a mechanical part of the system.
- **4 Relay Module**: Controls the power delivery to the wireless transmitter coils that charge the vehicles.
- **Wireless Transmitter Coil**: These coils transfer power wirelessly to vehicles on the road.
- **IR Sensors**: These detect vehicles passing over the charging area.

- **ESP-32**: A microcontroller used for wireless communication, possibly sending data to the dashboard and monitoring the system.
- **RFID Scanner**: Could be used to identify vehicles for dynamic charging or track vehicle movements.

3.3.2 Circuit Diagram:

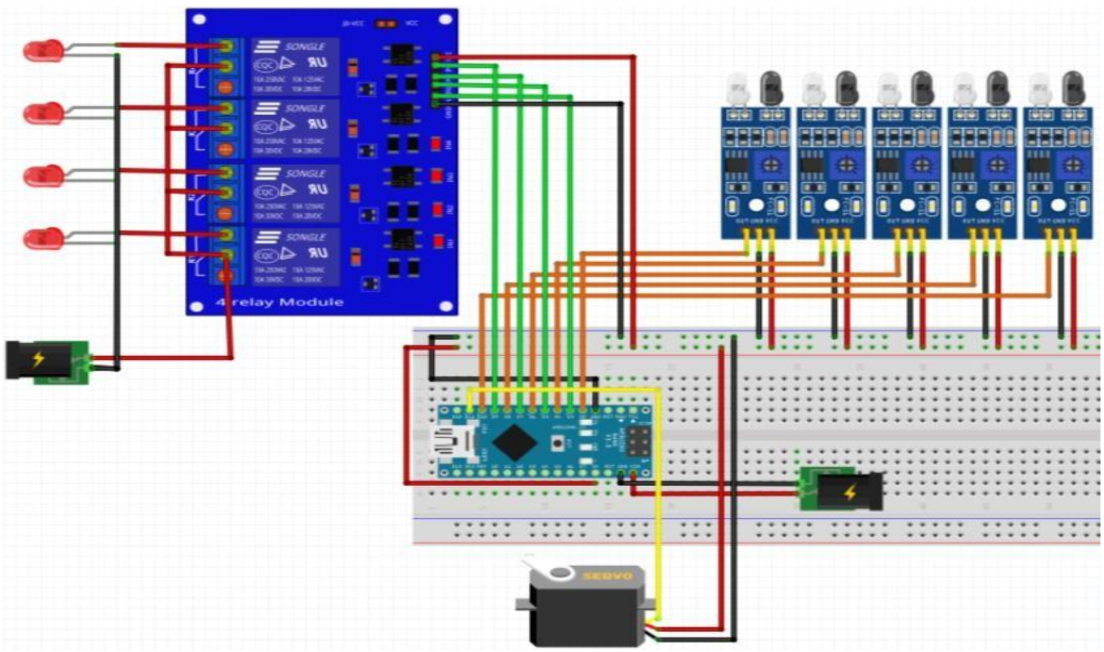
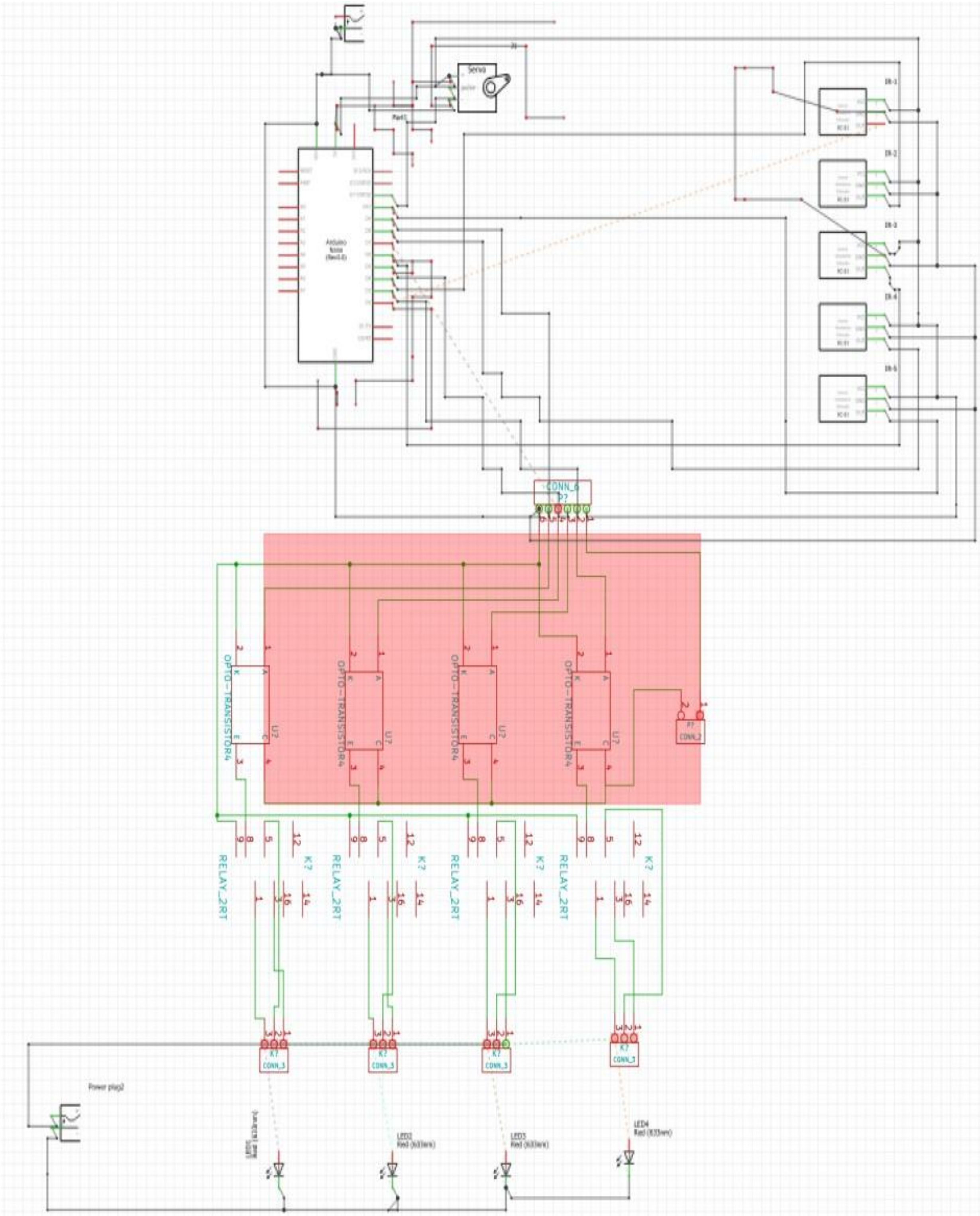


Figure 3.21 Circuit Diagram of Road

- **Arduino Nano** connected to various **IR sensors** for vehicle detection.
- **Relay Module** linked to the **wireless transmitter coils** for switching the power on and off for charging.
- A connection between the **DC-DC converter** and the relay module ensures stable power supply.
- The **ESP-32** is wired to an **RFID scanner**, which likely reads vehicle data for monitoring or billing purposes.
- The power components, including a **servo motor** and **battery connections**, are also shown, indicating how the system is powered and controlled.

3.3.3 Schematic diagram:



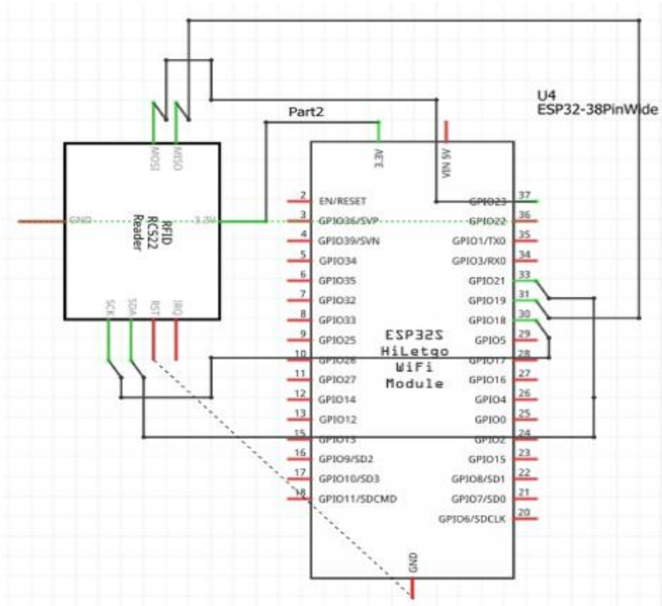


Figure 3.22 Schematic Diagram of Road

CHAPTER 4
SIMULATION AND EXPERIMENTAL RESULTS

4.1 Dynamic EV Wireless Charging Roads

The Wireless Charging Roads working starts with the Arduino Nano and ESP-32. The ESP- 32 has RFID Scanners connected to it, when someone wants to charge the EV while on go, then he has to switch to the Wireless Charging Lane, firstly user has to scan the correct RFID Card after the authentication is proper the Dashboard of the Road will update the RFID status and allow the user to move ahead. Now when the EV comes in front of IR sensor the IR sensor will detect the EV and send the signal to the Arduino Nano, the Arduino Nano will then send signal to the servo connected to it to open the barrier, now the barrier will open, and the EV will move ahead on the road. The Wireless charging road is made up of Magment which is Cement with small magnet particles mixed in it. Also, the road has transmitter coils laid on it and on the side IR sensors are placed. When the vehicle comes in front of the IR the IR detects it and the Arduino Nano turns a particular Relay to ON, which turns that region coils ON and the current is induced in the receiver coil of the EV. When the EV moves to the

next IR the previous relay goes OFF and the next relay turns ON, and the cycle continues till the EV does not go away from the lane. The energy supplied to the coils are generated by the Solar Panels and in inappropriate weather conditions the AC grid supplies the power to the coils.

The Arduino Nano and ESP-32 are the micro controllers available in the project. Both the micro controllers are connected to the voltage and current sensors. The role of Arduino Nano is to take the Analog inputs from the voltage and current sensors and calculate the values and show the values on the 20x4 LCD display. On the other hand, ESP-32 here acts as an IoT device which is also acting as a web server, it shows the Voltage, Current and Watts generated by Solar Panels and Wind Turbines on the Dashboard. It has an RFID scanner connected to it, so when someone shows the correct RFID card the ESP-32 turns the Relay to ON due to which the wireless charging coils turns ON and the RFID status is also updated on the dashboard.

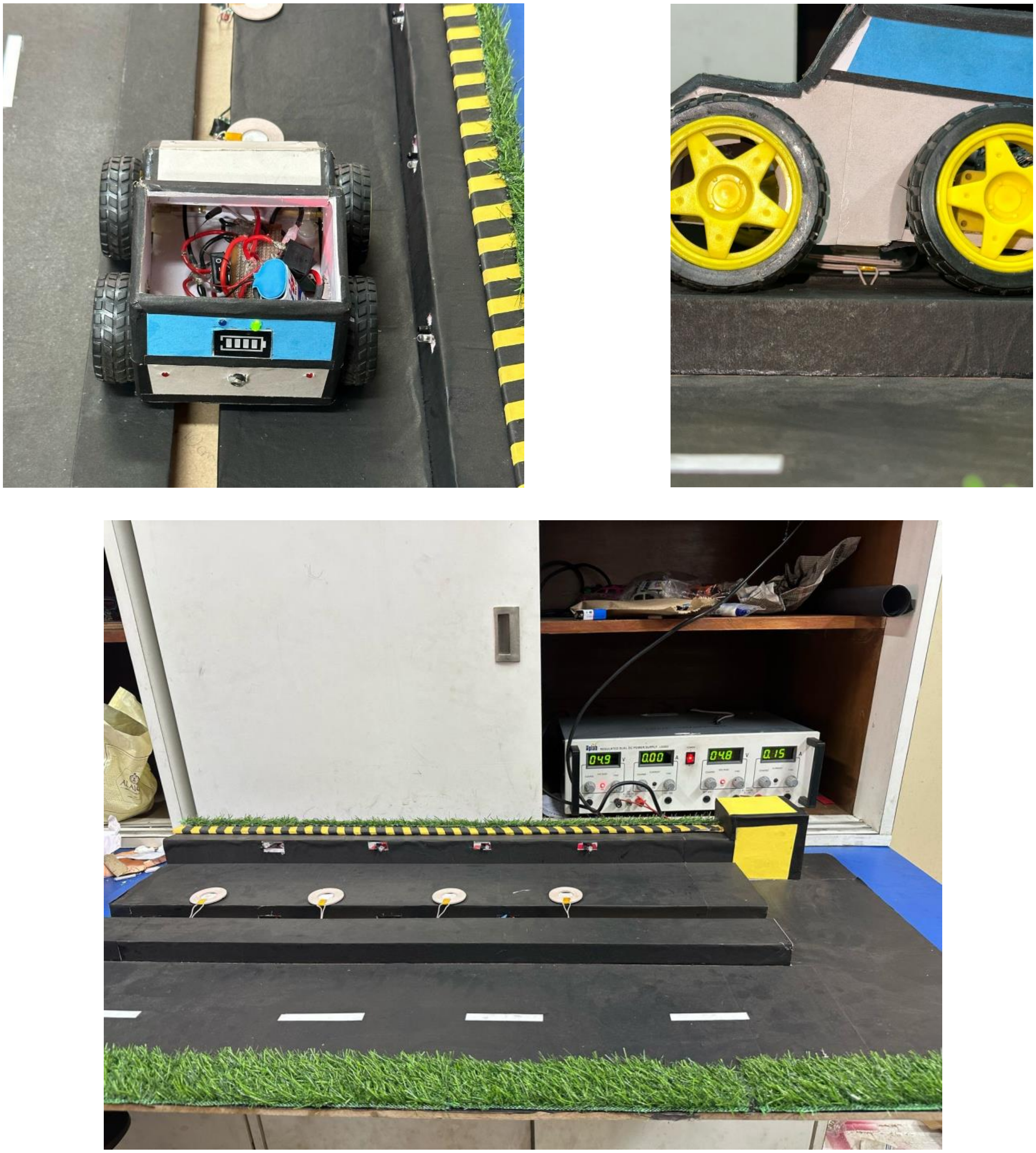


Figure 4.1 Prototype Model of Wireless Charging Road

4.2 Renewable Energy based Electric Vehicle Charging Station

The Charging Stations working starts form the solar panels and wind turbines. The Solar Panels and Wind Turbines generate energy and then the energy is measured by the Voltage and Current sensors. After that the energy is then passed through the DC-DC Buck/Boost Converters, these devices stabilize the voltage and current generated and then this stabilized energy is passed through the Charging Control Module. The Charging Control Module plays a very important role in the system, it is connected to the batteries on the station, it automatically turns the charging ON and OFF according to the battery voltage. If the battery is at low voltage the charging will be turned ON and if the battery is at its max voltage the charging will be turned OFF. The batteries are then attached to the charging points available at the charging station.

Also, there is a backup option of AC charging available, when the conditions are not good to generate sufficient amount of energy through the renewable resources then the AC supply will be used to charge the vehicles. The grid is connected to a AC-DC Power Supply which drops the high voltage to low voltage and converts the AC power to DC, and then this DC power transferred to the Charging Ports available on the station.

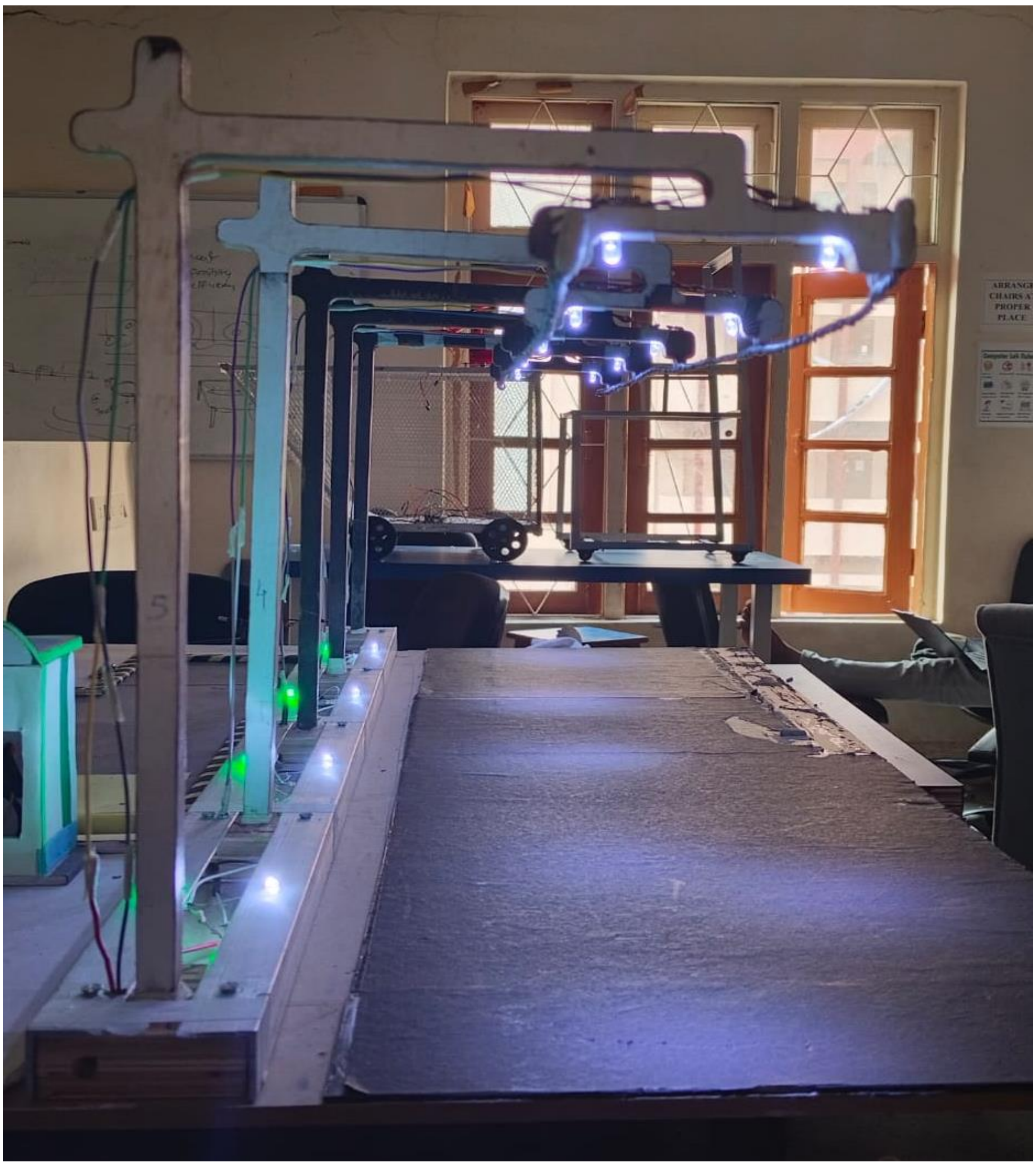
4.3 Overhead Locomotive Charging System

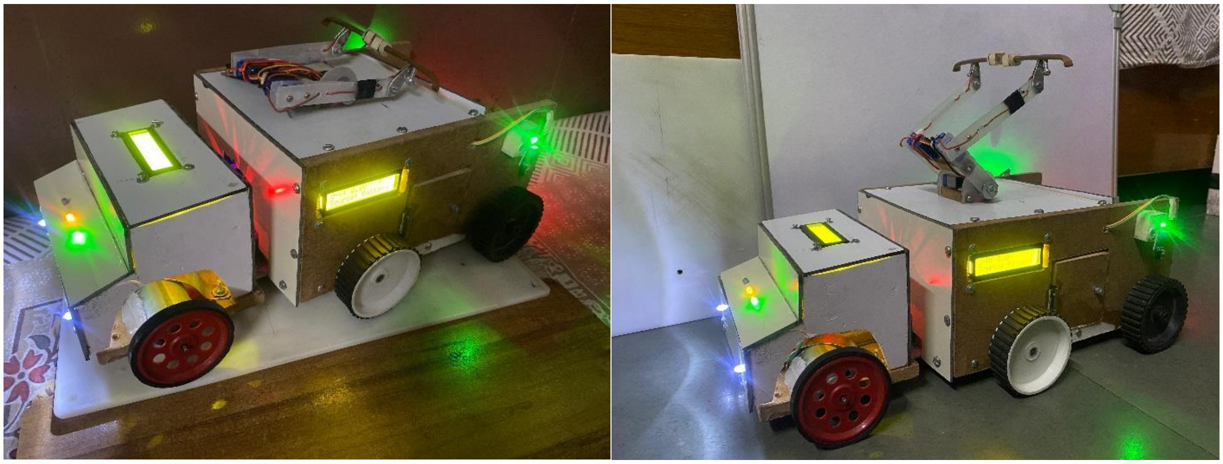
The **Overhead Locomotive Charging System** is designed to provide a continuous power supply to heavy-duty electric transport vehicles, such as trucks and buses, while they are in motion. This system utilizes overhead power lines, similar to electric railway networks, with manually operated pantographs that establish a connection between the vehicle and the power source. The overhead power lines are strictly supplied by the grid, ensuring a stable and high-power energy supply. Unlike automated systems, RFID and IR sensors are not used in this project. Instead, the driver manually deploys the pantograph when approaching the overhead wire lane. The pantograph is equipped with a suspension system that adjusts its height dynamically, ensuring stable contact with the overhead wire even if the wire position varies. Once connected, the Arduino Nano detects the connection and allows power flow from the overhead line to the vehicle.

While connected, the vehicle runs directly on the overhead power supply while simultaneously charging its onboard battery. If the pantograph disconnects, such as due to a lane change or reaching the end of the electrified section, the system automatically switches to battery mode to continue the journey. An LCD display on the vehicle indicates the current power source, showing

"Source: Overhead" when connected to the overhead line and "Source: Battery" when running on stored battery power.

This system offers several advantages, including high power efficiency due to direct energy transfer, reduced battery dependency, and enhanced adaptability through its suspension-based pantograph. By integrating overhead charging for heavy vehicles alongside dynamic wireless charging for regular EVs, this project establishes a comprehensive, scalable, and efficient electric transportation infrastructure.





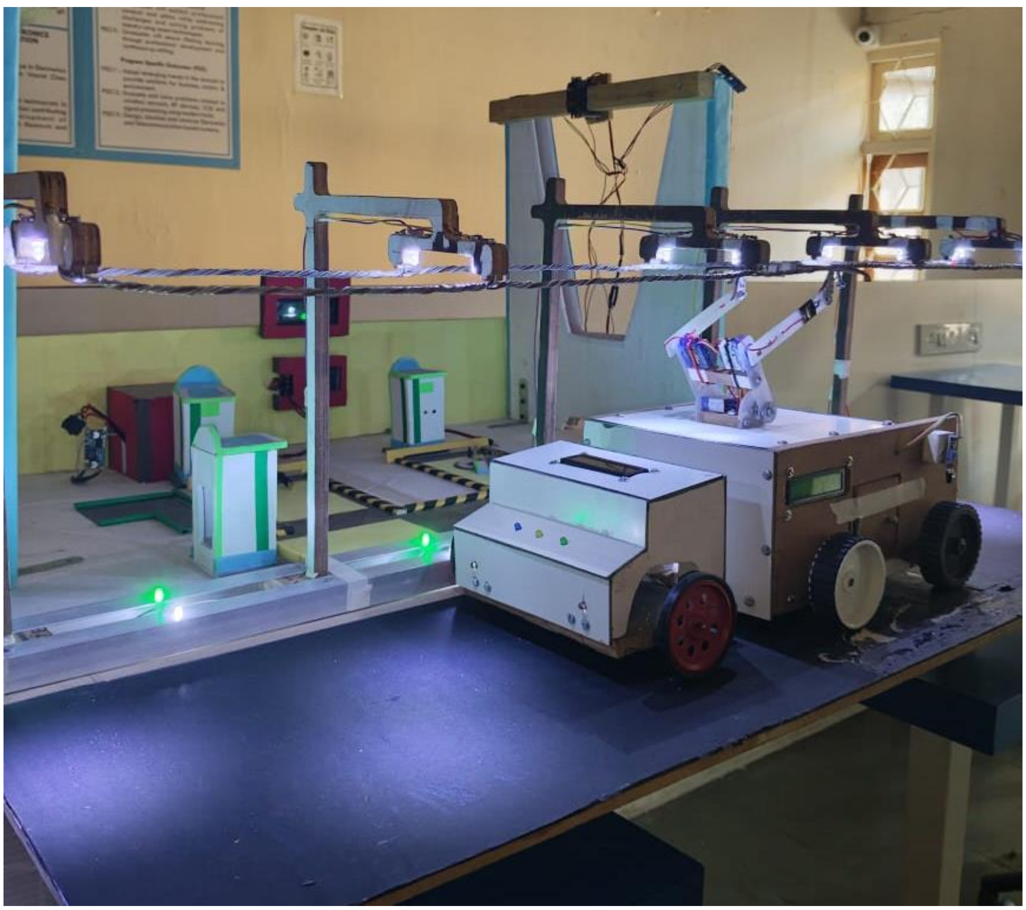


Figure 4.2 Overhead Locomotive system

CHAPTER 5
CONCLUSION & FUTURE SCOPE

5.1 Conclusion

The establishment of a renewable energy-based EV charging infrastructure marks a significant step towards a sustainable and eco-friendly future. By integrating wireless charging roads and overhead locomotive systems powered by solar and wind energy, this initiative not only reduces carbon emissions but also enhances the feasibility of electric vehicle adoption. The project aligns with global climate goals, offering a smarter, more efficient, and greener transportation network.

This holistic approach benefits not only the environment but also individuals and industries seeking cost-effective and energy-efficient mobility solutions. As a next-generation EV charging system, "Next-Gen EV Charging Roads: Wireless, Solar, and Smart Solutions" stands as a beacon of progress, paving the way for a cleaner, smarter, and more sustainable world.

5.2 Future Scope

The future scope for your project, a renewable energy-based EV charging station, is rich with potential advancements. Explore advanced energy storage solutions to ensure uninterrupted service. Implement grid integration for bidirectional energy flow for vehicle-grid interaction. Develop high-speed charging infrastructure for faster replenishment of electric vehicles. Utilize smart grid technology and demand response for efficient energy management. Employ energy management software and seek green certifications and incentives. Expand the charging network to serve a wider area and enhance user experience. Conduct educational outreach for greater EV adoption, promising a more sustainable and efficient transportation ecosystem. Locomotive charging employs specialized overhead catenary systems and ground-level third rail solutions capable of rapid power transfer. For locomotives, static charging stations at terminals complement dynamic charging systems along electrified routes, ensuring continuous operation.

References

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Appendix-I: CODES USED

1. .WIRELESS ROAD CODE: When an IR sensor detects a vehicle, it activates a relay or moves a servo for the last sensor.

```
#include <Servo.h>


const int irSensorPins[] = {2, 4, 6, 8, 10};

const int relayPins[] = {3, 5, 7, 9};

const int servoPin = 11;


Servo servo;


void setup() {
  for (int i = 0; i < 4; i++) {
    pinMode(irSensorPins[i], INPUT);
    pinMode(relayPins[i], OUTPUT);
    digitalWrite(relayPins[i], LOW);
  }
  servo.attach(servoPin);
  servo.write(90);
}


void loop() {
  for (int i = 0; i < 5; i++) {
    int irSensorState = digitalRead(irSensorPins[i]);


    if (irSensorState == LOW) {
      if (i == 4) {
        servo.write(180);
```

```
      delay(3000);
      servo.write(90);
    } else {
      digitalWrite(relayPins[i], LOW);
    }
  } else {
    if (i != 4) {
      digitalWrite(relayPins[i], HIGH);
    }
  }
 }
 delay(100);
}
```

2. NANO CODE – This code reads voltage and current from analog pins connected to solar and wind systems and displays the values on an I2C LCD screen.

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 20, 4);

const int solarVoltagePin = A0;
const int solarCurrentPin = A1;
const int windVoltagePin = A2;
const int windCurrentPin = A3;

void setup() {
  lcd.init();
```

```
  lcd.backlight();
  lcd.clear();
}

void loop() {
  float solarVoltage = (analogRead(solarVoltagePin) * 1.35 / 12.3);
  float solarCurrent = (analogRead(solarCurrentPin) * 2.5 / 10023.0);
  float windVoltage = (analogRead(windVoltagePin) * 1.35 / 12.3);
  float windCurrent = (analogRead(windCurrentPin) * 2.5 / 10023.0);

  lcd.setCursor(0, 0);
  lcd.print("Solar Voltage: "); lcd.print(solarVoltage, 1); lcd.print("V");
  lcd.setCursor(0, 1);
  lcd.print("Solar Current: "); lcd.print(solarCurrent, 2); lcd.print("A");
  lcd.setCursor(0, 2);
  lcd.print("Wind  Voltage: "); lcd.print(windVoltage, 1); lcd.print("V");
  lcd.setCursor(0, 3);
  lcd.print("Wind  Current: "); lcd.print(windCurrent, 2); lcd.print("A");

  delay(1000);
}
```

3. **SOLAR TRACKER CODE:** Compares LDR sensors and moves a solar panel (via servo motor) to point toward the brighter light source.

```
#include <Servo.h>

Servo solarServo;
```

```
int ldrPin1 = 2;
int ldrPin2 = 3;
int threshold = 100;

void setup() {
  solarServo.attach(9);
  Serial.begin(9600);
  solarServo.write(90);
  delay(1500);
}

void loop() {
  int ldrValue1 = digitalRead(ldrPin1);
  int ldrValue2 = digitalRead(ldrPin2);

  if (ldrValue1 == HIGH && ldrValue2 == LOW) {
    tiltSolarPanel(1);
  } else if (ldrValue2 == HIGH && ldrValue1 == LOW) {
    tiltSolarPanel(-1);
  } else {
    tiltSolarPanel(0);
  }
}

void tiltSolarPanel(int direction) {
  int currentPos = solarServo.read();
  int newPos = currentPos + (direction * 1);
  newPos = constrain(newPos, 80, 110);
```

```
  solarServo.write(newPos);
  delay(100);
}
```

4. PANTOGRAPH CODE

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Servo.h>
#include <math.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

Servo servo1, servo2, servo3;

const int servoPin1 = 9, servoPin2 = 10, servoPin3 = 11;
const int switchUpPin = 2, switchDownPin = 4, signalPinFromUno = 3;
const int irSensorPin1 = A1, irSensorPin2 = A2;
const int led1 = 12, led2 = 13;

float restAngle1 = 12, restAngle2 = -10, restAngle3 = 170;
float upAngle1 = 82, upAngle2 = 35, upAngle3 = 100;

bool isPantographUp = false, autoLowered = false;
unsigned long suspensionStartTime = 0;
float currentAngle1 = upAngle1;

int lastUpState = HIGH, lastDownState = HIGH, lastSignalState = HIGH;
int lastIR1State = HIGH, lastIR2State = HIGH;
```

```
unsigned long lastBlinkTime = 0, blinkTimeout = 1000;
bool vehicleMoving = false, lastVehicleMoving = false;
String lastPantographStatus = "Pantograph Ready";

void setup() {
  Serial.begin(9600);
  lcd.init(); lcd.backlight();
  lcd.setCursor(0, 0); lcd.print(lastPantographStatus);
  lcd.setCursor(0, 1); lcd.print("Vehicle Stopped ");
  pinMode(switchUpPin, INPUT_PULLUP);
  pinMode(switchDownPin, INPUT_PULLUP);
  pinMode(signalPinFromUno, INPUT);
  pinMode(irSensorPin1, INPUT); pinMode(irSensorPin2, INPUT);
  pinMode(led1, OUTPUT); pinMode(led2, OUTPUT);
  servo1.attach(servoPin1); servo2.attach(servoPin2); servo3.attach(servoPin3);
  servo1.write(restAngle1); servo2.write(restAngle2); servo3.write(restAngle3);
  delay(500);
}

void loop() {
  int 35ownsta = digitalRead(switchUpPin);
  int 35ownstate = digitalRead(switchDownPin);
  int signalFromUno = digitalRead(signalPinFromUno);
  int ir1 = digitalRead(irSensorPin1), ir2 = digitalRead(irSensorPin2);

  // Detect motion via IR
  if (ir1 != lastIR1State || ir2 != lastIR2State) {
    lastBlinkTime = millis(); vehicleMoving = true;
```

```
} else if (millis() – lastBlinkTime > blinkTimeout) {
 vehicleMoving = false;
}

if (vehicleMoving != lastVehicleMoving) {
 lcd.setCursor(0, 1);
 if (vehicleMoving) {
  lcd.print("Vehicle Moving  "); digitalWrite(led1, LOW); digitalWrite(led2, LOW);
 } else {
  lcd.print("Vehicle Stopped "); digitalWrite(led1, HIGH); digitalWrite(led2, HIGH);
 }
 lastVehicleMoving = vehicleMoving;
}

lastIR1State = ir1; lastIR2State = ir2;

// Auto lower
if (signalFromUno == LOW && lastSignalState == HIGH && isPantographUp) {
 lcd.clear(); lcd.setCursor(0, 0); lcd.print("Power Lost!");
 lcd.setCursor(0, 1); lcd.print("Auto Lowering… "); delay(1500);
 lowerPantograph(); autoLowered = true;
}

// Manual raise
if (36ownsta == LOW && lastUpState == HIGH && !isPantographUp) {
 raisePantograph(); autoLowered = false; delay(200);
}
```

```
  // Manual lower
  if (37ownstate == LOW && lastDownState == HIGH && isPantographUp) {
    lowerPantograph(); delay(200);
  }

  lastUpState = 37ownsta; lastDownState = 37ownstate; lastSignalState = signalFromUno;

  // Suspension effect
  if (isPantographUp) {
    float bounce = sin((millis() – suspensionStartTime) * 0.005) * 2.5;
    servo1.write(upAngle1 + bounce); servo2.write(upAngle2); servo3.write(upAngle3 – bounce);
    delay(10);
  }
}

void raisePantograph() {
  Serial.println("Pantograph going up");
  lcd.clear(); lcd.setCursor(0, 0); lcd.print("Pantograph");
  lcd.setCursor(0, 1); lcd.print("Going UP…     ");
  float angle2 = restAngle2, angle3 = restAngle3;
  for (float angle1 = restAngle1; angle1 <= upAngle1; angle1++) {
    servo1.write(angle1); angle3 = restAngle3 – (angle1 – restAngle1);
    servo3.write(angle3);
    if (angle1 >= (restAngle1 + upAngle1) / 2 && angle2 < upAngle2) {
      angle2++; servo2.write(angle2);
    }
    delay(15);
  }
```

```
  servo1.write(upAngle1); servo2.write(upAngle2); servo3.write(upAngle3);
  isPantographUp = true; suspensionStartTime = millis();
  lastPantographStatus = “Pantograph UP”;
  lcd.clear(); lcd.setCursor(0, 0); lcd.print(lastPantographStatus);
  lcd.setCursor(0, 1); lcd.print(“Active Suspensn”);
}

void lowerPantograph() {
  Serial.println(“▼ Pantograph going down”);
  lcd.clear(); lcd.setCursor(0, 0); lcd.print(“Pantograph”);
  lcd.setCursor(0, 1); lcd.print(“Going DOWN…   “);
  float angle1 = upAngle1, angle3 = upAngle3;
  for (float angle2 = upAngle2; angle2 >= restAngle2; angle2--) {
    servo2.write(angle2);
    if (angle2 <= (restAngle2 + upAngle2) / 2 && angle1 > restAngle1) {
      angle1--; angle3++; servo1.write(angle1); servo3.write(angle3);
    }
    delay(15);
  }
  while (angle1 > restAngle1) {
    angle1--; angle3++; servo1.write(angle1); servo3.write(angle3); delay(15);
  }
  servo1.write(restAngle1); servo2.write(restAngle2); servo3.write(restAngle3);
  isPantographUp = false;
  lastPantographStatus = “Pantograph Down”;
  lcd.clear(); lcd.setCursor(0, 0); lcd.print(lastPantographStatus);
  lcd.setCursor(0, 1); lcd.print(“                “);
}
```

Appendix-II: COPIES OF THE REFERENCE

[1] https://ieeexplore.ieee.org/document/6671718

[2] https://ieeexplore.ieee.org/document/8821896

[3] https://ieeexplore.ieee.org/document/8976673

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COPY OF THE REFERENCE PAPAER

Wireless Electric Vehicle Charging System

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Abstract*---Electric vehicles require fast, economical and reliable charging systems for efficient performance. Wireless charging systems remove the inconvenience to plug in the device to be charged when compared with the conventional wired charging systems. Moreover, wireless charging is considered to be environment and user friendly as the wires and mechanical connectors and related infrastructure are not required. This paper presents basic structure, operating principles and distinct features for wireless charging of EVs. First, the general techniques for wireless power transfer are described and explained. Next wireless charging systems for electric vehicles are classified and discussed in depth. Both the stationary and the dynamic wireless charging systems are discussed and reviewed. In addition, innovative and unique solution proposed is Dynamic Wireless Charging System. Dynamic charging systems seek to charge an EV while it is in service and is moving. It based on magnetic coupled resonant power transmission in which the transmitting coil of this charging system can selectively turn ON/OFF for charging vehicles while driving. Due to this energy is not wasted as transmission coil is energized when vehicle came in contact with receiver coil. The magnetic flux, a voltage is induced in the receiver coil when comes in line with transmitting coil. Control system functions of a wireless charging system of an electric vehicle. Findings of this state of the art review are discussed and recommendations for future research are also provided.

***Indexed Terms*— Electric vehicle, Wireless charging, Dynamic Charging, Arduino UNO, IR Sensor**

I. INTRODUCTION

Electric vehicles (EVs) are one of the promising solutions to improve economic efficiency and reduce the carbon footprint in the transportation sector. Earlier research is focused on the plug-in and conductive solutions for charging the EVs and addressed the challenges of integrating this technology into electricity networks. Plug-in EVs have limited travel range and require large and heavy batteries. Therefore, conductive charging strategies require long waiting time that limits the applicability of EVs compared to gasoline-powered vehicles. More recent research efforts introduced wireless or inductive charging solutions that enable in-motion charging of the EVs which makes EV more favourable for the daily use of many drivers [1]. Earlier publications addressed the quantified potential benefits and challenges of wireless charging [2]-[4], the power electronic interfaces utilized for this technology [5]-[8], WCS placement [4], and battery sizing of the EVs with wireless charging technology [9]. The main advantages of wireless charging technology include increasing the travel range, reducing the battery size and mitigating the prolonged waiting time for charging. Such advantages enhance the economic and environmental benefits as well as the adoption rates of EVs in the transportation networks.

Wireless charging – also referred to as in-motion charging is different from the conventional charging technologies as it enables charging the EV battery while driving in the transportation network. Therefore, the electricity demand for wirelessly charging the EVs is determined by the traffic volume in the transportation network and the decisions made for charging the EVs as they travel over the charging stations[10]. Therefore, unlike the conventional plug-in charging solutions, wireless charging technology underlines the interdependence between the traffic routing and the EVs' charging strategies. The EV routing determines the electricity demand at different WCS, which in turn, would affect the electricity charging prices at these stations. Therefore, as the number of EVs with wireless charging capabilities increase, the characteristics of the demand imposed by the wireless charging of EV the day-ahead operation of the electricity network. In this paper, the proposed decentralized approach addresses the interaction between the electricity and transportation networks by capturing the imposed wireless charging demand which is further determined by the traffic flow pattern and the price of electricity.

Wireless charging EV is a type of EV in which charging is done using wireless power transfer (WPT) technology, which does not require any physical contact in the process of transferring electric energy. WPT has been successfully applied for charging various handheld devices, such as medical devices, electronic toothbrushes, and smart phones. It has also been widely used for automated material handling systems in semiconductor fabrication and flat-panel display production lines. Wireless charging technology was first commercialized for automobiles to eliminate the conventional charging of 'plug-in' EVs – charged by connecting a wired cable from a charger to the vehicle. The first wireless charging technology to be deployed was stationary, the system having been designed to charge EVs in garages or public parking spaces, when the vehicle is not operating for an extended period. Because a physical connection is not required, there has been major interest in the possibility of charging EVs while they are in transit. Charging an EV while in motion is called dynamic wireless charging. A typical dynamic wireless charging EV is a pure, battery-only EV that takes its electrical charge in motion, remotely, from a wireless charger installed underneath the road surface. Roads capable of supplying electric power to wireless charging EVs are called electrified roads or charging lanes. There is also a third wireless charging category, quasi-dynamic wireless charging, in which the charging takes place when the EV decelerates to or accelerates from a resting position. For both dynamic and quasi-dynamic wireless charging, charging can be done while the EV is in transit. These new charging mechanisms extend the operational range of EVs with both rapid boost charging during brief station stops and dynamic or "on the fly" charging opportunities.

Stationary wireless charging makes the charging process safer and more convenient. However, in terms of charging time, frequency, the operation of the vehicle, and charging station allocation, stationary charging is not significantly different from conventional plug-in conductive charging. In contrast, dynamic and quasi-dynamic wireless charging enables the EVs battery to be charged while in operation. This capability has raised new operations and infrastructural design issues that had never been raised for conventional plug-in EVs. These issues are the focus of this paper. Note that in this paper, references to "wireless charging EV" indicate dynamic and quasi-dynamic wireless charging EVs, if not specified.). It should also be stated that although the term wireless charging EV suggests a single vehicle unit, it should be understood as a system comprised of EVs and the charging infrastructure. Further terminological and categorical distinctions are discussed in subsequent sections.

II. METHODOLOGY

If wired charging system is built at various charging stations. Wired charging station having more disadvantages such as space required is more, socket are different types, a small substation required, converter circuit is installed at every charging station, range of wire is limited and also time required for charging is more. This all problems is solved by wireless electrical vehicle charging system.

The traditional wired or plug-in charging systems are not user and environment friendly. To reduce the charging time, a large number of batteries can be used or the drained batteries can be swapped with the charged batteries when needed. There is energy waste due to line loss when the coil is conducted for long time. Its service life will be decreased because of continuous working.

III. BLOCK DIAGRAM

The block diagram consists of the Arduinouno, IR sensor, transmitter coil, receiver coil, AC to DC converter, relay, battery, DC motor, LED as shown in figure 1.

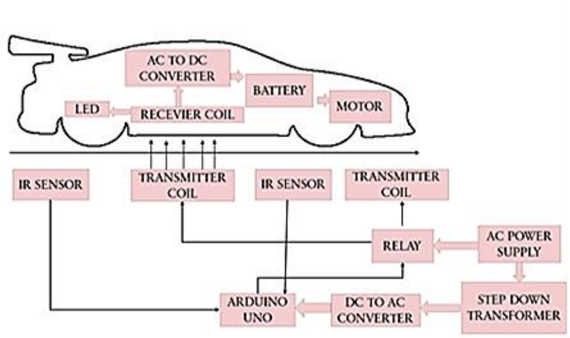

Figure 1: Block Diagram

Arduinouno is the main component of the project as it control and monitor the parameters, IR sensor will detect the presences of the vehicle and sends the signal to Arduinouno. Depending upon the vehicle position, relay is turned on to energize the transmitter coil.

The receiver coil present in the vehicle gets energized by the transmitter coil by mutual coupling, the energy produced is given to AC to DC converter, and the converter is connected to the battery. The battery gives power to the motor to run.

IV. WIRELESS CHARGINGARCHITECTURE

Wireless charging system architecture consisting of AC supply which is used as the source to fed the transmission coil. From the principle of resonant coupling, the reception coil is coupled. The output is given to AC-DC converter to obtain rectified DC to charge the battery which is connected to load. The coils in the project which is used to transmit power wirelessly are called magnetic resonators. This creates magnetic field in the region around a transmission coil, tune a reception coil to the same resonant frequency as the source, it will couple resonating anywhere within that region, converting oscillating magnetic field into an electrical current within the reception coil this response is called coupled magnetic response. The power can be fed to the load for charging a battery. Block diagram of wireless charging system is shown in Fig. 2 connected in series to series topology [6].

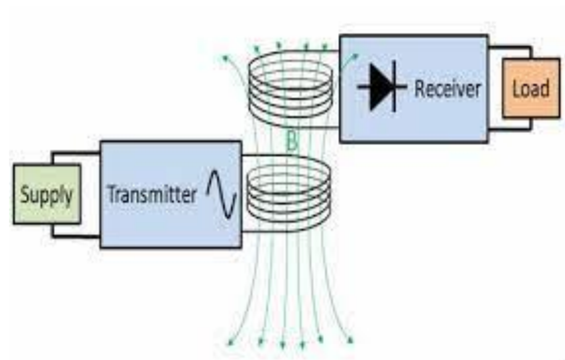

Figure 2: Wireless Charging

V. HARDWARE COMPONENTS

The power supply unit will provides +5V for the components to work. IC LM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down the ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

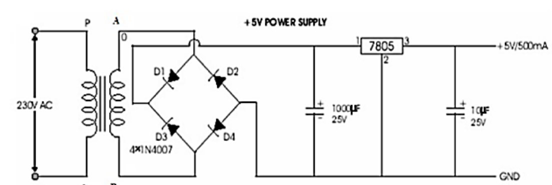

Figure 3: Circuit Diagram of Power Supply

Arduino Uno:- The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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.

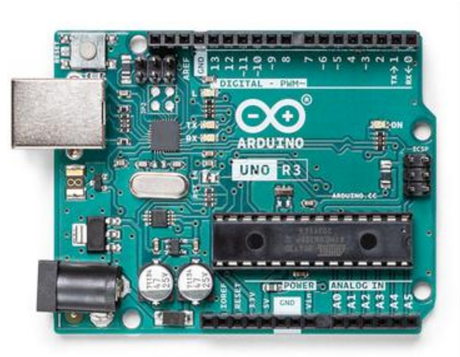

Figure 4: Arduino Uno

Wireless Power Supply Transmitter Receiver Charging Coil Module:-The 12V 2A Large Current Wireless Charger Module Transmitter Receiver Charging Coil Module is for a variety of small electronic products, wireless charging, power supply development, and design, with a small size, easy to use, high efficiency, and low price characteristics.

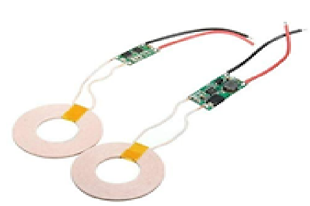

Figure 5: Transmitter Receiver Charging Coil

Specifications:
- Model: XKT-412.
- Input Voltage: 12V.
- Output Voltage: 12V.
- Operating Current: 1.2-2 A.
- Receive Coil: 3mm, the receiver output 5V / 1A current
- Transmitter Length × Width × Height(mm) : 17 * 12 * 4
- Receiver Length × Width × Height(mm) : 24 * 10 * 3
- Coil Height: 2mm
- Coil Diameter: 38mm

Dc Motor with Gear Box:-A DC motor in simple words is a device that converts direct current (electrical energy) into mechanical energy. We in our project are using brushed DC Motor, which will operate in the ratings of 12v DC 0.6A.

The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems called DC drives.

Figure 6: DC Motor with Gear Box

Relay:- A relay is an electromechanical switch, which perform ON and OFF operations without any human interaction. General representation of double contact relay is shown in fig. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

Figure 7 : Relay

Battery:-A battery is a device that converts chemical energy directly to electrical energy. It consists of a number of voltaic cells; each voltaic cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the electrode to which anions (negatively charged ions) migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cation (positively charged ions) migrate, i.e., the cathode or positive electrode.

Figure 8: Battery

IR Sensor:-An IR (Infrared) sensor is a type of electronic device that is used to detect the presence of infrared radiation. Infrared radiation is a form of electromagnetic radiation that is invisible to the human eye, but can be detected by electronic sensors.

IR sensors typically consist of an IR source, such as an LED, and an IR detector, such as a photodiode or phototransistor. The IR source emits a beam of infrared radiation, which is reflected off of objects in its path. The reflected radiation is then detected by the IR detector, which generates an electrical signal that is proportional to the intensity of the reflected radiation.

Figure 9: IR Sensor

Wireless charging EV is a type of EV in which charging is done using wireless power transfer (WPT) technology, which does not require any physical contact in the process of transferring electric energy. The wireless charging EV is one of emerging transportation Systems for EV's. The system makes use of charging infrastructure embedded under the surface of the road that transfers electric power to the vehicle while it is in transit.

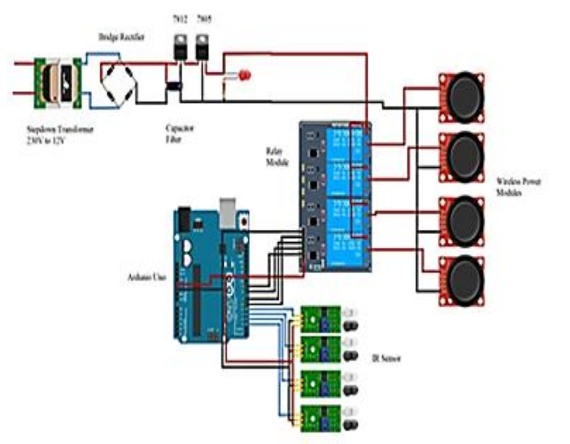

Figure 10: Circuit Diagram

VI. IMPLEMENTATION

Arduino Software:-You'll need to download the Arduino Software package for your operating system. When you've downloaded and opened the application you should see something like this:

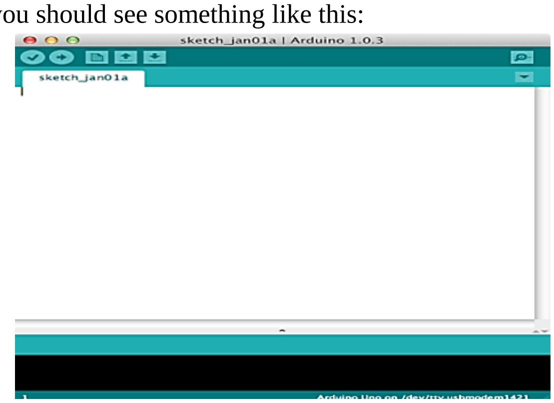

Figure 11: Arduino IDE

This is where you type the code you want to compile and send to the Arduino board.

The code you write for your Nodemcu esp8266 are known as sketches. They are written in C++.

Every sketch needs two void type functions, setup() and loop(). A void type function doesn't return any value.

The setup() method is ran once at the just after the ESP8266 is powered up and the loop() method is ran continuously afterwards. The setup() is where you want to do any initialization steps, and in loop() you want to run the code you want to run over and over again.

- The Initial Setup

We need to setup the environment to Tools menu and select Board.

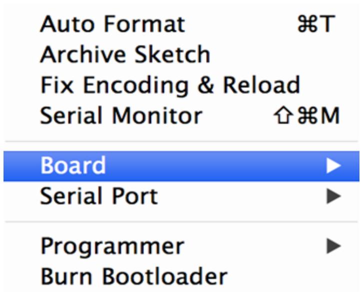

Figure 12: Select Board

Then select the type of Arduino you want to program, in our case it's the ESP8266.The code you write for your Nodemcu esp8266 are known as sketches. They are written in C++.

- Compiling the Code

If this is your first time you've ever compiled code to your Arduino before plugging it in to the computer go to the Tools menu, then Serial Port and take note of what appears there. Here's what mine looks like before plugging in the Arduino UNO:

Plug your Arduino UNO board in to the USB cable and into your computer. Now go back to the Tools > Serial Port menu and you should see at least 1 new option of serial ports appear.

On Windows you should see *COM* followed by a number. Select the new one that appears. Once you have selected your serial or COM port you can then press the button with the arrow pointing to the right.

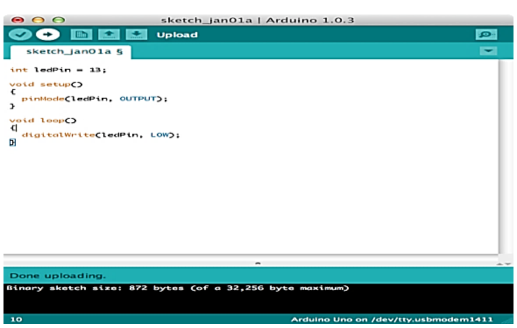

Figure 13: Compiling Uploading Program

- Flowchart:-

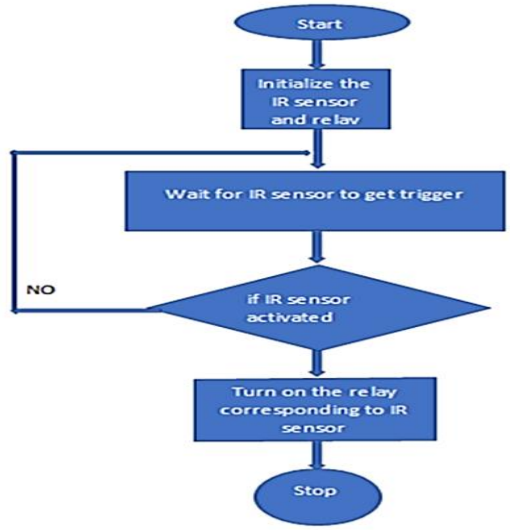

Figure 14: Flow Chart

VII. RESULT

The transmitting coils are buried under the road at certain distance, and that can selectively on/off for charging vehicles while EVs are in motion. The transmitting coils are connected by the relays to the cable. The Vehicle communication module will detect the entry of vehicle by use of sensors which are connected to Arduino module. The Arduino signals the relay to open the transmitting coil when the EV runs to the transmitting coil L1, the sensor will signal the contact of the relay S1 to on, and the transmitting coil L1 will be energized, resonating with the receiving coil, transmitting energy wirelessly to the EV. Meanwhile, transmitting coil L2 is standby. When the EV runs on the interval between two transmitting coils, L1 and L2 will be connected in series. This charging method can avoid the impact caused by suddenly energizing of transmitting coils on the wireless charging system. While the EV pulls away, S1 will be open and L1 will be de-energized. The transmitting coils can staged charge the EV by selective on/off.

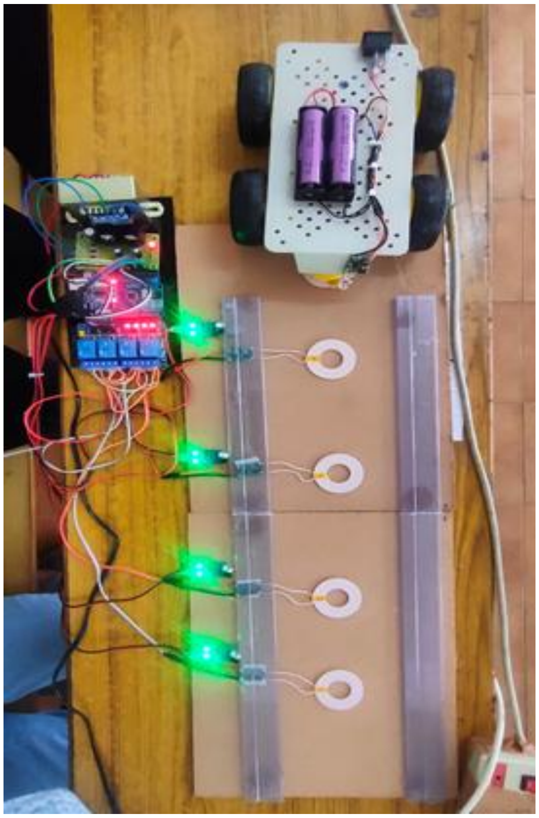

Figure 15: Complete Project Photo

CONCLUSION

We have discussed and reviewed charging of electric vehicles using wireless power transmission. Wireless charging is considered a better alternative to traditional wired charging systems as it is user and environment friendly. Furthermore, it eliminates the need for wires and mechanical connectors, and therefore, avoids the associated Wireless charging systems for electric vehicles hassles and hazards. Wireless charging systems also reduce the range anxiety and enhance the system efficiency. The wireless power transmission, in general, takes place using either microwave, laser or mutual coupling. However, only mutual coupling based techniques are generally used for wireless charging. The mutual coupling based techniques, inductive and capacitive power transfer, are employed for contactless power transfer and charging of electric devices. Both these techniques are discussed, compared and contrasted, and it is concluded that the inductive power transfer has advantages and is the prime method for wireless charging of electric vehicles. For this purpose, static, semi or quasi dynamic or completely dynamic methods of wireless charging can be employed. These modes of wireless charging of electric vehicles are explained in this article. In addition, important aspects of a wireless charging system, such as, charging pad, compensation topologies, system misalignment, communication and control are reviewed and discussed. As various parameters of a charging system are determined by the batteries, a brief overview of battery types and models is also provided.

ACKNOWLEDGMENT

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