

Project Report On

Design and Implement Wireless Power Transmission for Electric Vehicles

A project report submitted in fulfillment of requirements for Degree of

Bachelor of Science

In

Electronics and Communication Engineering(ECE)

National University of Bangladesh



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CERTIFICATION

We the undersigned, recommend that the project completed by the student listed, in fulfillment of Bachelor of Science Degree requirements, be accepted by the Department of Electronics and Communication Engineering (ECE), Institute of Science, Trade & Technology (ISTT).

Md. Robiul Islam

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Department of ECE

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Mirpur-13, Dhaka-1216

Affiliated by National University Bangladesh.

DECLARATION

We declare that final semester report entitled "**Design and Implement Wireless Power Transmission for Electric Vehicles**" is our own work conducted under the supervision of Md. Robiul Islam, Assistant Professor & Coordinator, Department of ECE from ISTT. We further declare that to the best of our knowledge the report for B.Sc. final semester is not a certain part of the work which has been submitted for the award of B.Sc. (Eng.) either in this or any other university without proper citation. Also, we declare that the following students worked for this project:

Rana Bepari

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ABSTRACT

Lorem Ipsum is simply dummy text of the printing and typesetting industry. Lorem Ipsum has been the industry's standard dummy text ever since the 1500s, when an unknown printer took a galley of type and scrambled it to make a type specimen book. It has survived not only five centuries, but also the leap into electronic typesetting, remaining essentially unchanged. It was popularised in the 1960s with the release of Letraset sheets containing Lorem Ipsum passages, and more recently with desktop publishing software like Aldus PageMaker including versions of Lorem Ipsum.

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Index Terms— Dynamic charging (DC), Electric vehicle (EV), Magneto-inductive (MI) , Stationary charging (SC) , Wireless power transfer (WPT)

Chapter 1

INTRODUCTION

1.1 Introduction

Electric power may be efficiently sent across a vacuum or environment via wireless power transmission (WPT). WPT allows for the transmission of power using electromagnetic wave power transfer, resonant induction for mid-range transmissions, and inductive coupling for short-range transmissions.

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1.2 Objectives

The objectives of Design & Implementation of a Wireless Power Transmission System for Electric Vehicles are given below:

- To remove the hassles of wires.
- To reduce the use of electricity

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1.3 Project Organization

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Chapter 2

THEORETICAL REVIEWS

2.1 Introduction

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2.2 Literature Reviews

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2.3 Methodology

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Chapter 3

HARDWARE AND SOFTWARE

3.1 Apparatus

For our project, We required hardware and software(Code). Both of them are important to us to build a Wireless Power Transmission System for Charging Electric Vehicles We are using Arduino UNO R3, Ultrasonic Sensors, and Relay to make our project more advanced. We also use multi-functional power like Solar Power, Battery, and Electric Power. Now we discuss each and every apparatus briefly.

3.1.1 Arduino UNO R3

The Arduino Uno board can be built with power pins, analog pins, ATmegs328, ICSP header, reset button, power LED, digital pins, test LED 13, TX/RX pins, USB interface, an external power supply. The Arduino UNO board description is discussed below.

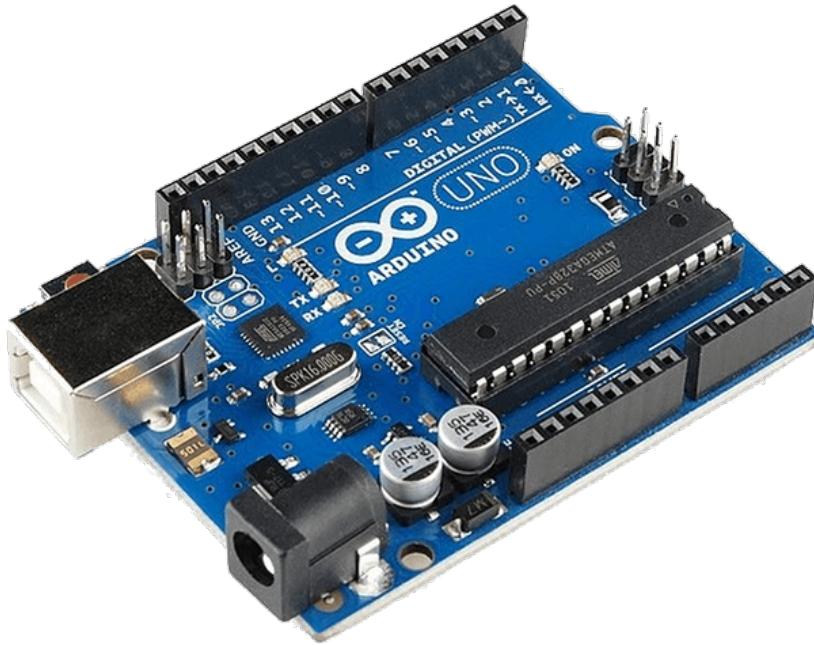


Figure 3.1: Arduino Uno R3

- **Power Supply**

The Arduino Uno power supply can be done with the help of a USB cable or an external power supply. The external power supplies mainly include AC to DC adapter otherwise a battery. The adapter can be connected to the Arduino Uno by plugging into the power jack of the Arduino board. Similarly, the battery leads can be connected to the Vin pin and the GND pin of the POWER connector. The suggested voltage range will be 7 volts to 12 volts.

- **Input & Output**

The 14 digital pins on the Arduino Uno can be used as input & output with the help of the functions like `pinMode()`, `digitalWrite()`, & `Digital Read()`.

Pin1 (TX) & Pin0 (RX) (Serial): This pin is used to transmit & receive TTL serial data, and these are connected to the ATmega8U2 USB to TTL Serial chip equivalent pins.

Pin 2 & Pin 3 (External Interrupts): External pins can be connected to activate an interrupt over a low-value, change in value.

Pins 3, 5, 6, 9, 10, & 11 (PWM): This pin gives 8-bit PWM o/p by the function of analogWrite().

SPI Pins (Pin-10 (SS), Pin-11 (MOSI), Pin-12 (MISO), Pin-13 (SCK): These pins maintain SPI communication, even though offered by the fundamental hardware, are not presently included within the Arduino language.

Pin-13(LED): The inbuilt LED can be connected to pin-13 (digital pin). As the HIGH-value pin, the light-emitting diode is activated, whenever the pin is LOW.

Pin-4 (SDA) & Pin-5 (SCL) (I2C): It supports TWI communication with the help of the Wire library.

AREF (Reference Voltage): The reference voltage is for the analog i/p/s with analogReference().

Reset Pin: This pin is used for resetting (RST) the microcontroller

- **Memory** The memory of this Atmega328 Arduino microcontroller includes flash memory- 32 KB for storing code, SRAM-2 KB EEPROM-1 KB.

- **Communication**

The Arduino Uno ATmega328 offers UART TTL-serial communication, and it is accessible on digital pins like TX (1) and RX (0). The software of an Arduino has a serial monitor that permits easy data. There are two LEDs on the board like RX & TX which will blink whenever data is being broadcasted through the USB. A Software Serial library permits serial communication on Arduino Uno digital pins and the ATmega328P supports TWI (I2C) as

well as SPI communication. The Arduino software contains a wired library for simplifying the utilization of the I2C bus.

*** The features of Arduino Uno R3 includes the following:**

- The operating voltage is 5V
- The recommended input voltage will range from 7v to 12V
- The input voltage ranges from 6v to 20V
- Digital input/output pins are 14
- Analog i/p pins are 6
- DC Current for each input/output pin is 40 mA
- DC Current for 3.3V Pin is 50 mA
- Flash Memory is 32 KB
- SRAM is 2 KB
- EEPROM is 1 KB
- CLK Speed is 16 MHz

3.1.2 LCD Display

LCDs is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light that is passing through the molecule of the polarized glass and also causes a change in the angle of the top polarizing filter. As a result, a little light is allowed to pass the polarized glass through a particular area of the LCD.



Figure 3.2: LCD Display

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3.1.3 Ultrasonic Sensor

Ultrasonic sensor working principle is either similar to sonar or radar which evaluates the target/object attributes by understanding the received echoes from sound/radio waves correspondingly. These sensors produce high-frequency sound waves and analyze the echo which is received from the sensor. The sensors measure the time interval between transmitted and received echoes so that the distance to the target is known.

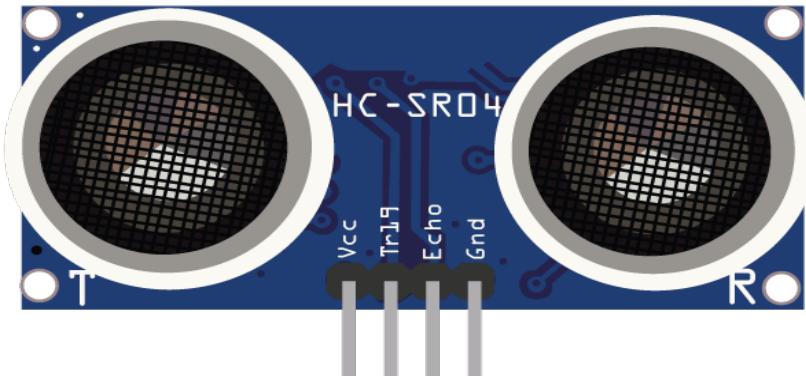


Figure 3.3: Ultrasonic Sensor

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3.1.4 Relay (5 Volts)

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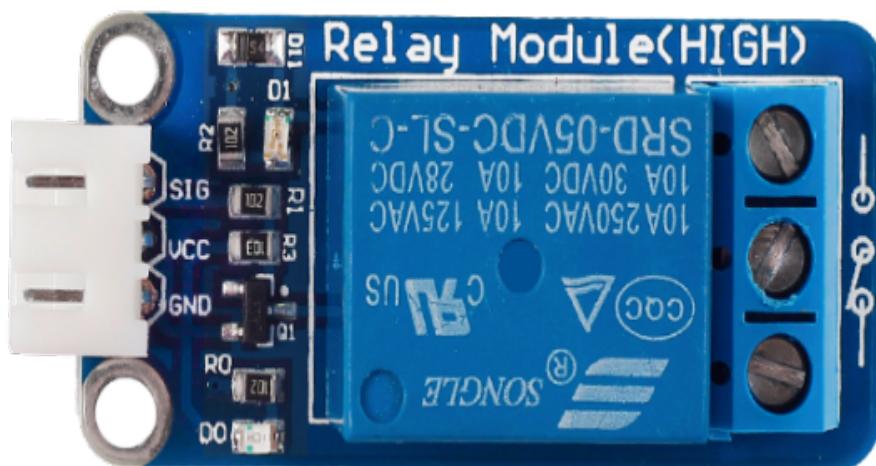


Figure 3.4: Relay (5 Volts)

Solid state relays will have a sensing element to sense the input voltage and switch the output using opto-coupling.

* Testing of a Relay

Since they are electromechanical devices, relays can wear out eventually and stop working over-time. But there are a few techniques to test if a relay is working or not. These techniques include:

- Testing a Relay with a Multimeter
- Build a simple circuit to test the Relay
- Use a DC Power Supply to see whether a relay is functioning properly

3.1.5 Mini Tesla Coil

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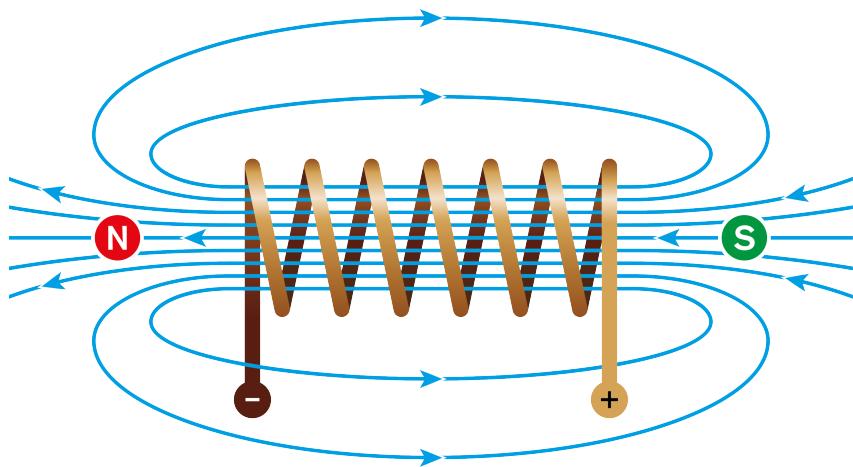


Figure 3.5: Tesla Coil

Setting up a Tesla coil with an adjustable rotary spark gap gives the operator more control over the voltage of the current it produces. This is how coils can create crazy lightning displays and can even be set up to play music timed to bursts of current.

While the Tesla coil does not have much practical application anymore, Tesla's invention completely revolutionized the way electricity was understood and used. Radios and televisions still use variations of the Tesla coil today.

3.1.6 Solar Panel

When the sun shines onto a solar panel, energy from the sunlight is absorbed by the PV cells in the panel. This energy creates electrical charges that move in response to an internal electrical field in the cell, causing electricity to flow.



Figure 3.6: Solar Panel

Solar energy technology doesn't end with electricity generation by PV or CSP systems. These solar energy systems must be integrated into homes, businesses, and existing electrical grids with varying mixtures of traditional and other renewable energy sources.

3.1.7 Battery

A battery Ignition System is utilized in a vehicle to produce a spark in the spark plug with the assistance of a Battery. It is generally used in the 4-wheeler automobile however these days it's also utilized in two-wheeler cars in which 6-volt or 12-volt battery components the present-day the ignition coil



Figure 3.7: Battery

3.1.8 Jumper Cable

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

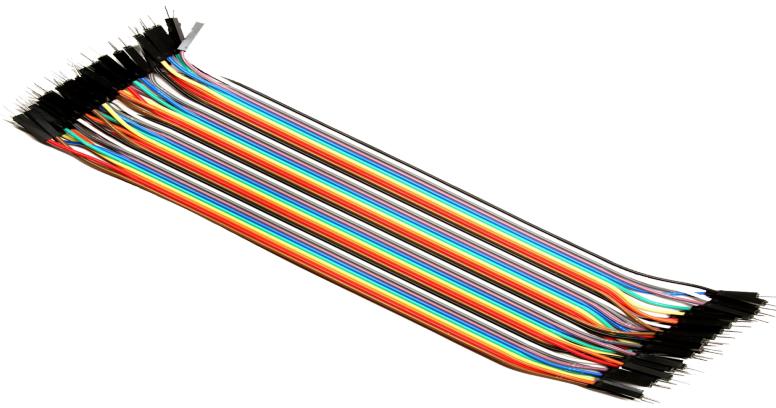


Figure 3.8: Jumper Cable

3.1.9 Power Supply

A DC 5V power supply works by converting an input voltage, typically AC (alternating current), to a regulated 5V DC (direct current) output. Several components and techniques are involved in

the process of converting the input voltage to a 5V DC output, as explained below:

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Figure 3.9: Power Supply

3.1.10 Software : Arduino IDE



The screenshot shows the download page for Arduino IDE 2.1.1. On the left, there's a logo of two overlapping circles with a plus sign in the center. Next to it, the text "Arduino IDE 2.1.1" is displayed. Below this, a paragraph of text describes the new features of the release. A link to the "Arduino IDE 2.0 documentation" is provided. Another section mentions "Nightly builds". Under "SOURCE CODE", it says the Arduino IDE 2.0 is open source and its source code is hosted on [GitHub](#). On the right side, a teal-colored sidebar titled "DOWNLOAD OPTIONS" lists download links for Windows, Linux, and macOS, along with their respective file types (e.g., Win 10 and newer, 64 bits for Windows).

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software.

The sketch is saved with the extension

Toolbar Button

The icons displayed on the toolbar are **New**, **Open**, **Save**, **Upload**, and **Verify**.

It is shown below:

Upload

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3.2 Code

* Code are started from below for **Arduino UNO R3**:

```
//Copyright © Rana Bepari - 2023

#include <LiquidCrystal.h>

int rs = 10 , en = 9 , d4 = 8 , d5 = 7 , d6 = 6 , d7 = 5 ;
LiquidCrystal lcd ( rs , en , d4 , d5 , d6 , d7 ) ;

//Device A
const int trigPinA = 2;
const int echoPinA = 3;
const int relayPinA = 4;
long durationA;
int distanceA;

//Device B
const int trigPinB = 12;
const int echoPinB = 13;
const int relayPinB = 11;
long durationB;
int distanceB;

const int DISTANCE_THRESHOLD = 10;
```

```

void setup()
{
    lcd.begin ( 16, 2 ) ;
    lcd.setCursor(1,0);
    lcd.print("SWPT System By");
    delay(3000);
    lcd.setCursor(1,1);
    lcd.print("Rana & Sukanta");
    delay(5000);
    lcd.clear();
    lcd.clearWriteError();

    //Sensor A
    pinMode (relayPinA,OUTPUT);
    pinMode (trigPinA,OUTPUT);
    pinMode (echoPinA,INPUT);

    //Sensor B
    pinMode (relayPinB,OUTPUT);
    pinMode (trigPinB,OUTPUT);
    pinMode (echoPinB,INPUT);

    Serial.begin(9600);
}

void loop()
{
    lcd.blink();
}

```

```
lcd.print("Welcome");
lcd.clear();
lcd.setCursor(1,0);
lcd.print("SWPT System By");
delay(3000);
lcd.setCursor(1,1);
lcd.print("Rana & Sukanta");
delay(5000);
lcd.clear();

//Please Write Your code and Remove all

delay(1000);

}
```

Chapter 4

DESIGN AND FABRICATION

4.1 Block Diagram

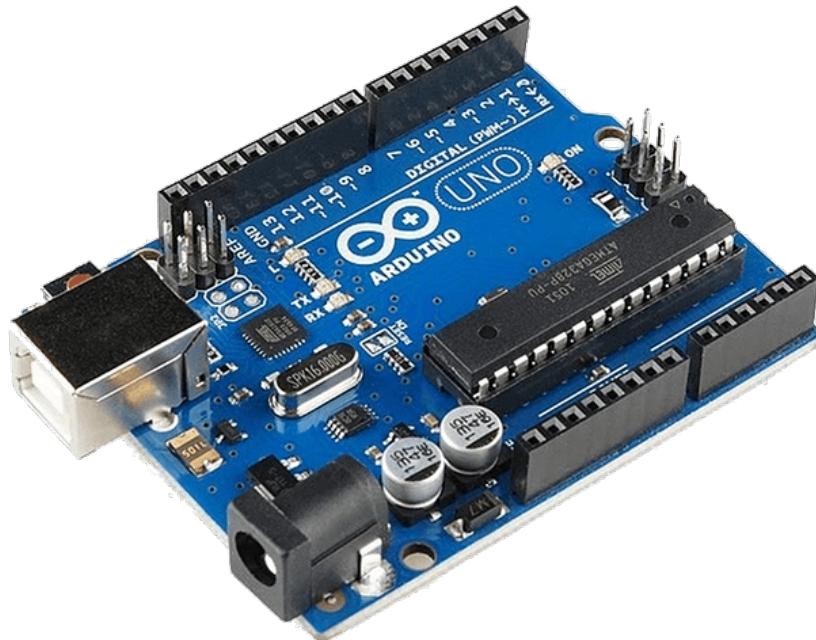


Figure 4.1: Block Diagram

[Replace the image with your Block Diagram]

4.2 Circuit Diagram

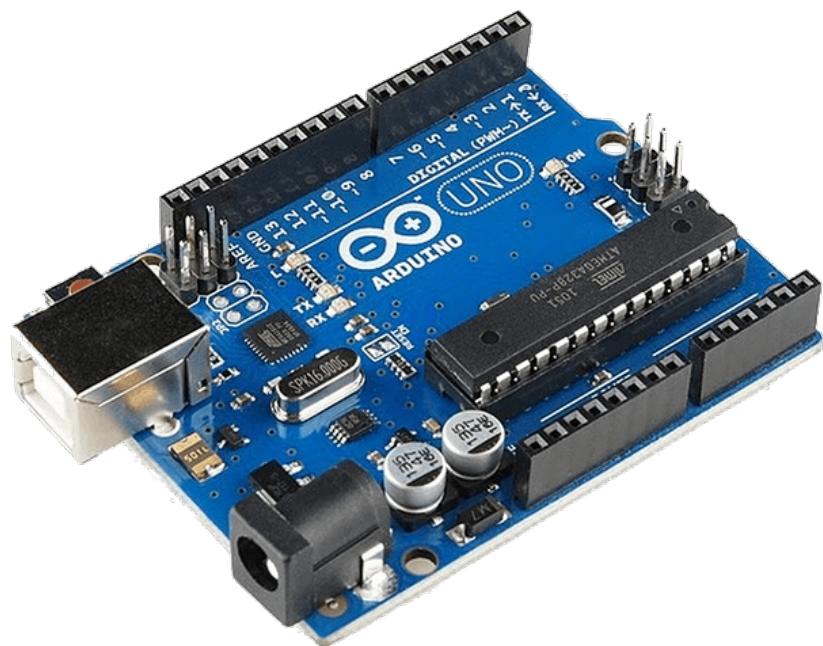


Figure 4.2: Circuit Diagram

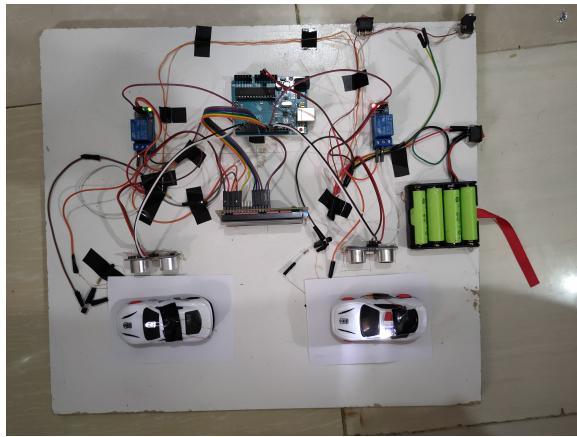
[Replace the image with your Circuit Diagram]

4.3 Experimental Result

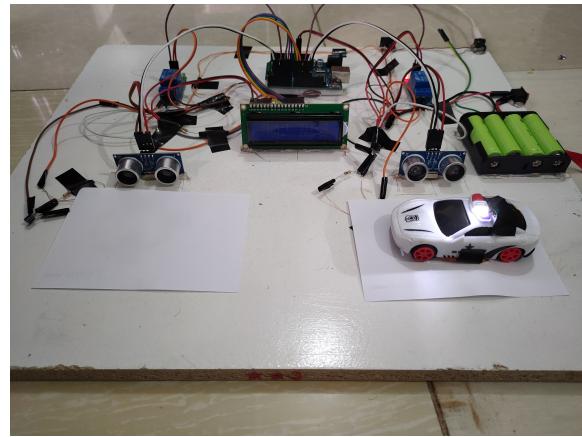
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4.4 Project Images



(a) Top View of the project



(b) Front View of the project

Chapter 5

FUTURE PLAN AND CONCLUSION

5.1 Future Plan

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5.2 Conclusion

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References

References

- [1] Shu Yuen Ron Hui, Wenxing Zhong, and Chi Kwan Lee. A critical review of recent progress in mid-range wireless power transfer. *IEEE Transactions on Power Electronics*, 29(9):4500–4511, 2013.
- [2] Siqi Li and Chunting Chris Mi. Wireless power transfer for electric vehicle applications. *IEEE journal of emerging and selected topics in power electronics*, 3(1):4–17, 2014.
- [3] Toshiyuki Fujita, Tomio Yasuda, and Hirofumi Akagi. A dynamic wireless power transfer system applicable to a stationary system. *IEEE Transactions on Industry Applications*, 53(4):3748–3757, 2017.
- [4] Su Y Choi, Beom W Gu, Seog Y Jeong, and Chun T Rim. Advances in wireless power transfer systems for roadway-powered electric vehicles. *IEEE Journal of emerging and selected topics in power electronics*, 3(1):18–36, 2014.
- [5] Anindya Chitta Bagchi, Abhilash Kamineni, Regan Andrew Zane, and Richard Carlson. Review and comparative analysis of topologies and control methods in dynamic wireless charging of electric vehicles. *IEEE Journal of Emerging and Selected Topics in Power Electronics*, 9(4):4947–4962, 2021.
- [6] Matjaz Rozman, Augustine Ikpehai, Bamidele Adebisi, Khaled M Rabie, Haris Gacanin, Helen Ji, and Michael Fernando. Smart wireless power transmission system for autonomous ev charging. *IEEE Access*, 7:112240–112248, 2019.
- [7] Alicia Triviño, José M González-González, and José A Aguado. Wireless power transfer technologies applied to electric vehicles: A review. *Energies*, 14(6):1547, 2021.