



# STATIC WIRELESS CHARGING STATION FOR ELECTRIC VEHICLES

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**Abstract:** This paper proposes a wireless charging system for electric vehicles (EVs) that aims to address the limitations of traditional plug-in charging systems. The wireless charging system utilizes inductive power transfer technology to transfer energy wirelessly between the charging pad and the EV battery. The system incorporates efficient power transfer through mutual induction and a control system for safe and reliable operation. The system's key features include automatic alignment and power transfer control, fault detection, and thermal management. The study also evaluates the system's efficiency, electromagnetic compatibility, and electromagnetic interference. The proposed wireless charging system offers a convenient and safe charging solution for EVs, reducing the need for physical connection between the charger and the vehicle, and enabling efficient charging while on the go.

**Keywords – Mutual induction, Electric vehicles, Static wireless charging.**

## I. INTRODUCTION

Electric power is crucial in many aspects of daily life, including smartphones, laptops, cameras, sensors, bionic implants, satellites, and oil platforms. Nikola Tesla first suggested the concept of wireless power transfer in 1891 and showed off the first wireless power transfer system for lighting. When there are too many cables connected, using small power outlets can be dangerous and cumbersome. Thomas Parker virtually introduced the first electric car in 1884. Since there were no rechargeable batteries for storing electricity before to 1859, French physicist Gaston Plant developed the lead-acid battery and lessened the drawback. In several nations, electric vehicles are more widely used. These vehicles can be little or large, including buses, big cars, and two-wheelers. As the usage of electric vehicle by consumers is increasing day by day, the wireless charging is one of the best charging option for them. The wireless charging is an alternate to charge an EV because of its high reliability with plugging system removed.

## II. METHODOLOGY

System for wirelessly supplying power to an electric vehicle's battery. It is made up of three components: a transmitter to create the AC signal that has to be transmitted, a transmitting and receiving coil to move power wirelessly, and a receiver to change the AC signal into DC voltage so that the electric car's battery may be charged. The method being implemented aims to provide a wireless power supply system prototype to recharge an electric vehicle's battery and prevent energy waste.

## III. WORKING PRINCIPLE

The working principle of a static wireless charging system for electric vehicles is based on the concept of inductive power transfer. The system consists of two primary components: the charging pad (or ground pad) and the receiver pad (or vehicle pad). The charging pad is connected to a power source, such as a power grid or a renewable energy system, and is placed on the ground. The receiver pad is installed on the underside of the electric vehicle, and is positioned directly above the charging pad. When the two pads are in close proximity to each other, the charging pad generates an alternating magnetic field, which induces an alternating current (AC) in the receiver pad. The receiver pad then converts the AC into direct current (DC) to charge the vehicle's battery. The key to the system's

efficiency is the use of resonant magnetic coupling, which enables energy transfer over a distance without the need for physical contact or wires. The resonant coupling occurs when the natural frequencies of the two pads are tuned to match each other, allowing for maximum power transfer.

Mutual Inductance formula:

$$\text{Emf} = M (dI_1 / dt) \text{ OR } M = \text{emf} / (dI_1 / dt)$$

The working principle of mutual induction is as follows:

- When an AC current flows through a coil of wire, it creates a changing magnetic field around the coil.
- The changing magnetic field induces a voltage in an adjacent coil of wire, as the magnetic field lines cut across the turns of the coil.
- The voltage induced in the adjacent coil is proportional to the rate of change of the magnetic field, the number of turns in the coil, and the orientation of the coil with respect to the magnetic field.
- If the two coils are connected to a load, such as a resistor or a circuit, the induced voltage can cause a current to flow through the load, producing an electrical signal or power transfer.
- The degree of mutual induction between the two coils depends on the distance between the coils, the size and shape of the coils, and the frequency of the AC current.

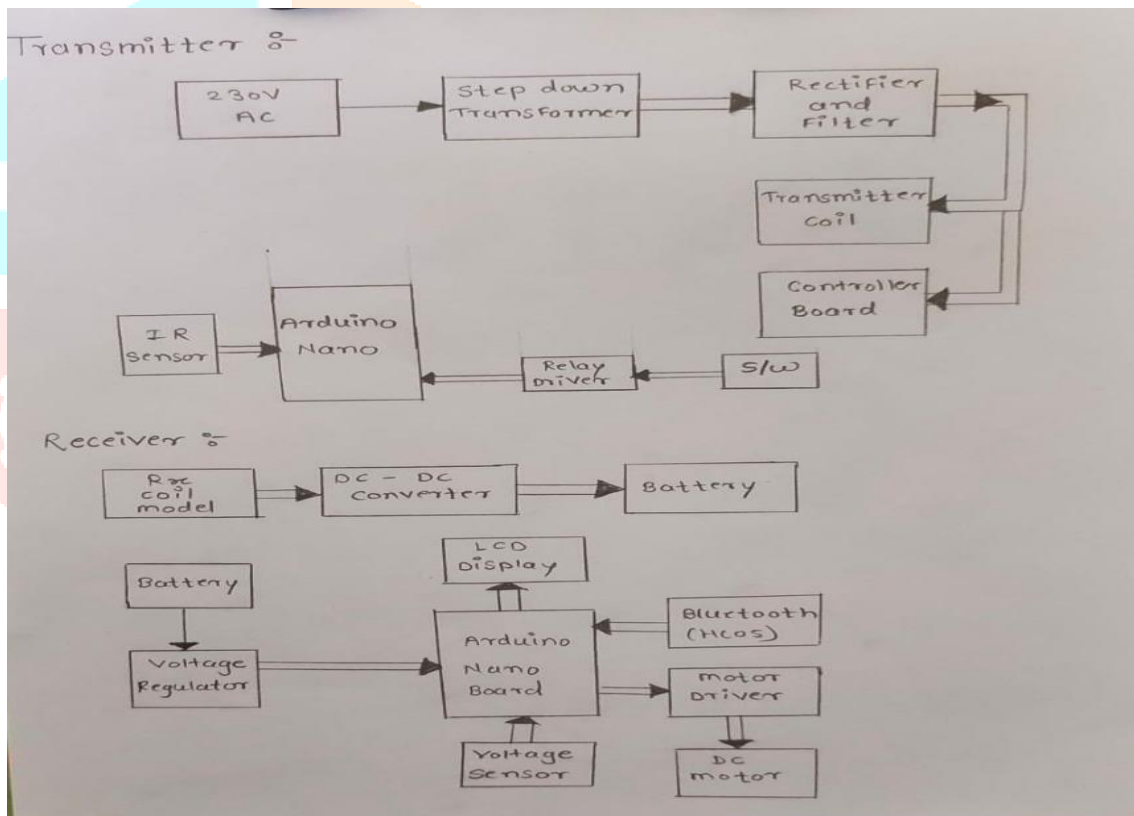


Fig 1 – Block diagram of overall system

#### IV. TRANSMITTER

The transmitter in a wireless charging system for electric vehicles (EVs) is typically referred to as the charging pad or the ground pad. The charging pad is responsible for generating an alternating magnetic field that induces an alternating current (AC) in the receiver pad (vehicle pad) to wirelessly transfer energy to the EV battery.

The charging pad consists of several components:

- Power source: The charging pad is typically connected to a power source, such as a power grid or a renewable energy system, to provide the necessary electrical power for the wireless charging process.

- Resonant coil: The charging pad contains a resonant coil that generates an alternating magnetic field when an AC current is applied. The resonant coil is usually made of copper wire wound around a ferrite core to increase the magnetic field strength.
- Power electronics circuit: The power electronics circuit in the charging pad consists of a power amplifier, a resonant capacitor, and a tuning circuit. The power amplifier is responsible for amplifying the AC current and driving the resonant coil. The resonant capacitor is used to tune the resonant frequency of the charging pad to match that of the receiver pad. The tuning circuit adjusts the resonant frequency of the charging pad to maintain maximum power transfer efficiency.
- Control system: The control system in the charging pad monitors the position and orientation of the vehicle to ensure proper alignment with the charging pad, and adjusts the power output to maintain the desired charging rate. The control system also includes safety features, such as fault detection and thermal management, to prevent overheating and electrical hazards.

## V. RECEIVER

The receiver in a static wireless charging system for electric vehicles (EVs) is typically referred to as the receiver pad or the vehicle pad. The receiver pad is installed on the underside of the EV and is responsible for receiving the alternating magnetic field generated by the charging pad (ground pad) and converting it into a direct current (DC) to charge the EV battery.

The receiver pad consists of several components:

- Resonant coil: The receiver pad contains a resonant coil that receives the alternating magnetic field generated by the charging pad and induces an alternating current (AC) in the coil. The resonant coil is usually made of copper wire wound around a ferrite core to increase the magnetic field strength.
- Rectifier circuit: The rectifier circuit in the receiver pad converts the AC induced in the resonant coil into a DC voltage that can be used to charge the EV battery. The rectifier circuit typically consists of a diode bridge, a capacitor, and a voltage regulator.
- Control system: The control system in the receiver pad monitors the charging status of the battery and communicates with the control system in the charging pad to optimize the power transfer process. The control system also includes safety features, such as temperature sensors and fault detection, to prevent overheating and electrical hazards.

The receiver pad is designed to be compatible with different EV models and charging requirements. The size and shape of the receiver pad may vary depending on the EV's dimensions and ground clearance. The power output of the receiver pad can also be adjusted to match the battery capacity and charging rate of the EV.

## VI. SCHEMATIC DIAGRAM

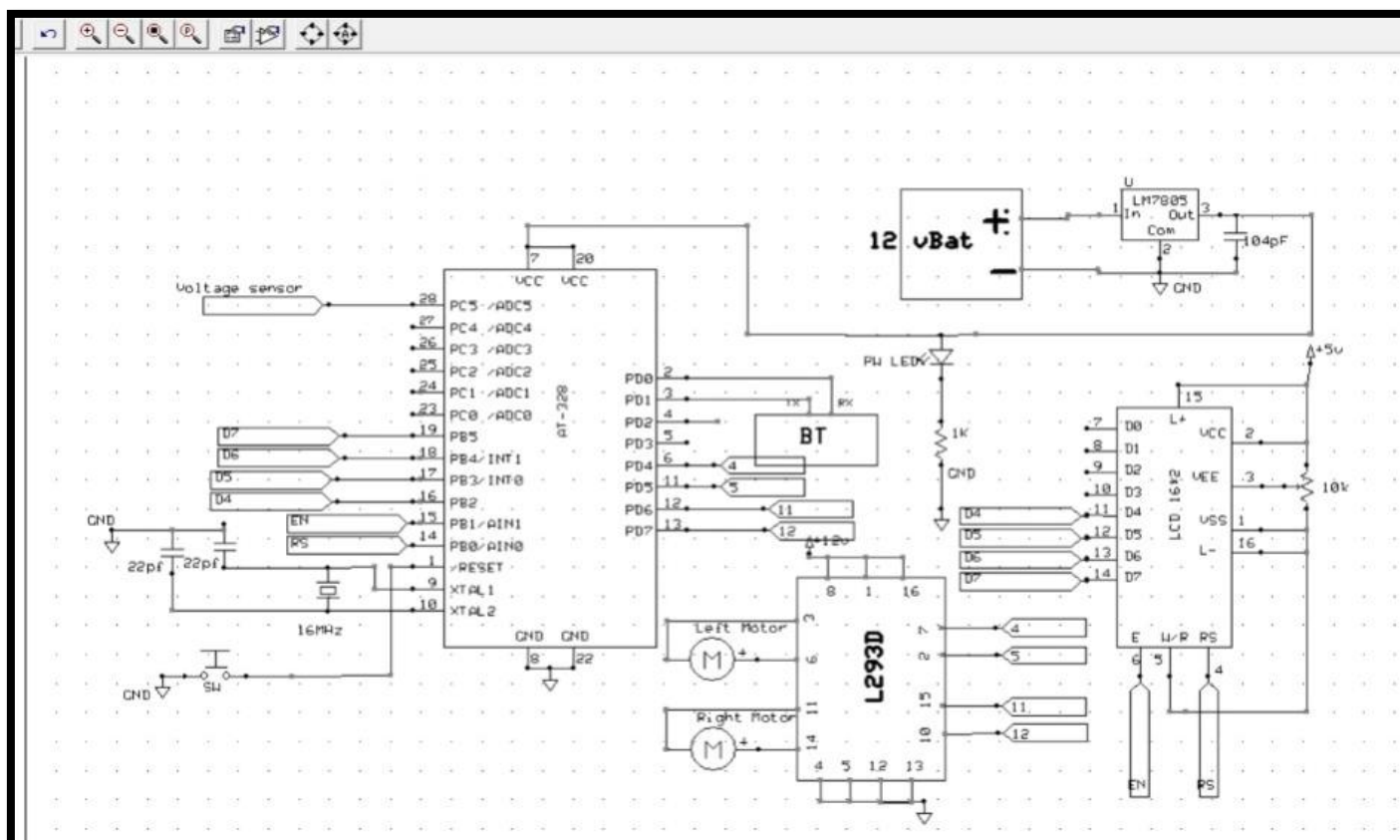


Fig 2 – Schematic diagram

Main components of schematic diagram :

- **Arduino Nano** : Arduino Nano is a microcontroller board based on the ATmega328P microcontroller, which is capable of running a variety of programs and controlling various sensors and devices. It is powered by the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). It is a compact board that can be easily integrated into various electronic projects. To display information on an LCD display using Arduino Nano, you would typically connect the display to the board using pins. The display can be either a character LCD or a graphical LCD, depending on the requirements of the project.
- **Voltage Regulator** : A voltage regulator is an electronic device that maintains a constant output voltage despite changes in the input voltage or load. It is commonly used in electronic circuits to provide a stable DC voltage to power various components and devices. By using IC7805 regulator with high dc voltage step down into 5 volt dc. In general it can withstand voltage range from 7.2 to 35 volt.
- **Motor Drive** : An integrated circuit chip known as a motor driver IC is typically used to operate motors in autonomous robots. Robotic motors and microprocessors are connected by motor driver integrated circuits (ICs). The L293 series of ICs, including the L293D, L293NE, and others, are the most often used motor driver ICs. These ICs are made to manage two DC motors at once. Two H-bridges make up L293D. The simplest circuit for managing a motor with a low current rating is an H-bridge. In this tutorial, the motor driver IC will just be referred to as L293D. Having 16 pins, L293D.
- **LCD display** : The parallel interface of LCDs necessitates simultaneous manipulation of many interface pins by the microcontroller in order to control the display. The following pins make up the interface: a register select (RS) pin that manages where data is written to in the LCD's memory. You can choose between using an instruction register, which is where the LCD's controller looks for instructions on what to do next, or a data register, which stores the information that appears on the screen. a Read/Write (R/W) pin that chooses between reading and writing mode 8 data pins (D0–D7) of the register can be written to with the use of an enable pin. When you write to a register, the states of these pins (high or low) correspond to the bits or values that you are writing. The Arduino needs seven I/O pins for the 4-bit mode and eleven for

the 8-bit mode. Example demonstrates how to operate a 16x2 LCD in 4-bit mode since practically anything for displaying text on the screen can be done in this mode.

## VII. EXPERIMENTAL RESULTS

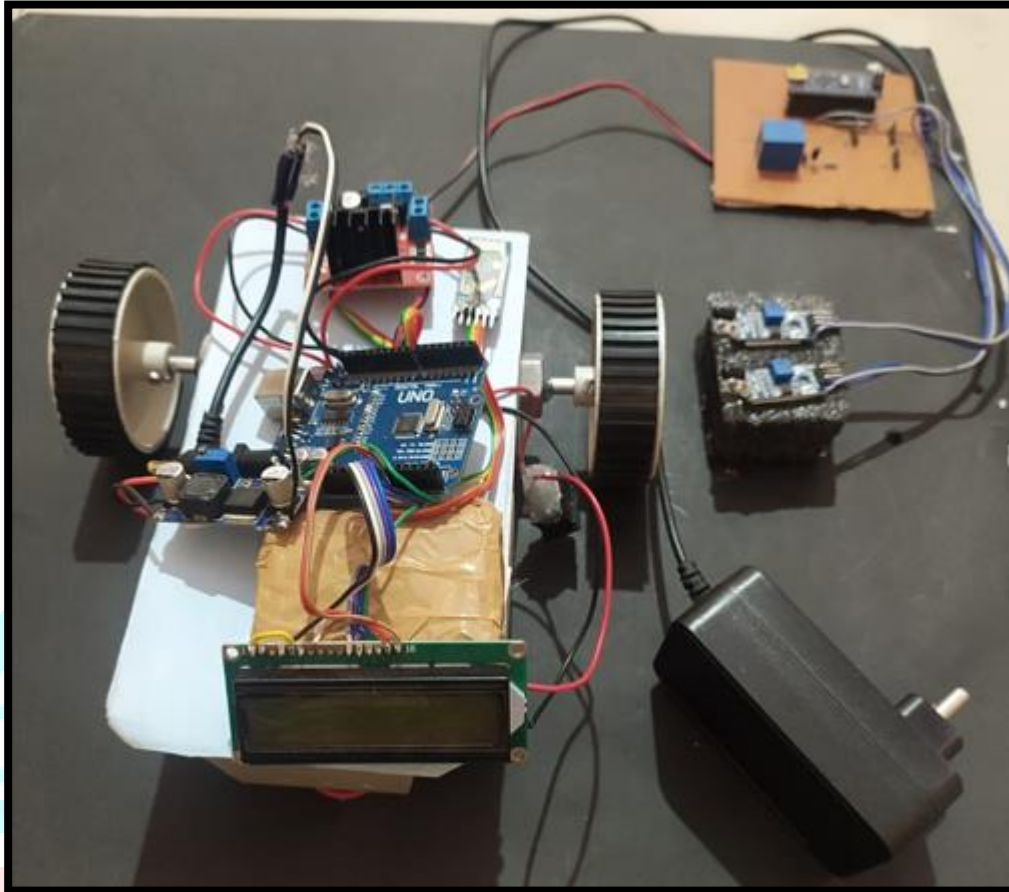


Fig 3 – Photograph of prototype static wireless charging system for EV



Fig 4 – Output voltage of LCD

Transmitter coil voltage	12 V
Receiver coil voltage	10V
Distance between coil	6cm

Table 1 – Table of experimental result

## VIII. CONCLUSION

A static wireless charging station for electric vehicles offers several benefits such as convenience, safety, and reduced environmental impact. The system eliminates the need for cables and connectors, making the charging process simpler and more efficient. It also reduces the risk of electrical shock and eliminates the need for manual handling of cables. Furthermore, the use of wireless charging stations for EVs reduces greenhouse gas emissions and improves air quality since EVs produce zero tailpipe emissions. This contributes to a cleaner and healthier environment for all.



The static wireless charging system for EVs works based on the principle of mutual induction, where energy is transferred wirelessly from a transmitter coil to a receiver coil on the EV. The charging process involves power transfer, monitoring, and control of the charging process, and disconnection of the charging system once the battery is fully charged.

Overall, a static wireless charging system for EVs represents a promising technology for the future of transportation, offering a convenient, efficient, and sustainable way to power electric vehicles. The efficiency of wireless EV charging by magnetic resonance over long distance and we found the efficiency to be 97.2% for a distance of 6cm.

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