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Electric Vehicle Wireless Charging Station

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Abstract **- Wireless Power Transmission (WPT) is a rapidly advancing technology utilized across various domains, facilitating power transfer from a source to an electrical load without the necessity of physical connections. WPT proves particularly valuable in scenarios where conventional wiring is impractical or impossible. This technology operates on the principle of mutual inductance. One promising application lies within the automotive sector, notably in Electric Vehicles (EVs). This Research paper focuses on the research and development of wireless charging systems tailored for EVs, employing Tesla Coils for power transmission. The primary objective entails the establishment of efficient charging systems comprising a DC power source, transmission coil, reception coil, and the battery serving as the electric load.**

Keywords: Electric Vehicle, Wireless Charging, WPT, Wireless Power Transmission.

I. INTRODUCTION

In the modern era, there's a global shift towards electric mobility to combat pollutant emissions from traditional fossil fuel vehicles and offer a cost-effective alternative for transportation. However, electric vehicles face challenges regarding their travel range and charging infrastructure, hindering widespread adoption. The advent of wireless charging technology addresses these issues by eliminating the need for lengthy charging station stops. Now, electric vehicles can be effortlessly charged while parked at designated spots or within garages, and even while in motion. Inspired by the success of wireless data, audio, and video transmission, the concept of transferring power wirelessly has gained traction. Nikola Tesla, a pioneering scientist, made significant contributions to this field with his groundbreaking inventions, including wireless power transfer. His experiments with wireless power transmission began in 1891, culminating in the development of the Tesla coil. In 1901, Tesla embarked on the ambitious project of constructing the Wardenclyffe Tower to establish a revolutionary wireless energy transmission system. However, due to financial constraints and Tesla's debts, the tower met a tragic fate, being demolished for scrap on July 4th, 1917. [9]

II. BASIC PRINCIPLE

The fundamental principle behind wireless charging is akin to the operation of a transformer. In this setup, there exists a transmitter and a receiver. Initially, the standard 220V 50Hz AC power supply is converted into high-frequency alternating current. This high-frequency AC is then supplied to the transmitter coil, generating an alternating magnetic field. As this field intersects with the receiver coil, it induces the production of AC power output within the receiver coil. However, for efficient wireless charging, it's crucial to maintain resonance frequencies between the transmitter and receiver. To achieve this, compensation networks are integrated at both ends. Subsequently, the AC power received at the receiver end is rectified into DC and channeled to the battery via the Battery Management System (BMS).

III. SYSTEM CONSTRUCTION

Constructing a Wireless EV charging station using Arduino, an ultrasonic sensor, Tesla coil, batteries, LCD display, and relay module involves setting up the ultrasonic sensor to detect EV presence, activating the Tesla coil via a relay module upon authentication, and displaying charging available slots on an LCD. Arduino code manages sensor interfacing, authentication logic, and relay control for wireless charging. Testing ensures sensor accuracy and Tesla coil efficiency, while safety precautions mitigate hazards like overheating.

2.1 Arduino Uno

The Arduino Uno is a microcontroller board powered by the ATmega328P chip. It boasts 14 digital input/output pins, with 6 supporting PWM output, along with 6 analog inputs. Equipped with a 16 MHz quartz crystal, USB connection, power jack, ICSP header, and reset button, it's a comprehensive package to support the microcontroller. Getting started is a breeze - simply connect it to a computer via USB or power it using an AC-to-DC adapter or battery. The Uno is a forgiving platform for experimentation; even if mistakes occur, the chip can be easily replaced for a minimal cost, allowing for a fresh start. The name "Uno," meaning "one" in Italian, was selected to coincide with the release of

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Arduino Software (IDE) version 1.0. While the Uno board and IDE 1.0 marked the initial standard for Arduino, the platform has since evolved with newer releases. As the inaugural USB Arduino board, the Uno serves as the reference model for the Arduino ecosystem, with various other boards available for different purposes.

2.2 Relay Module

A 5V relay serves as an automated switch frequently employed in automatic control circuits to manage high-current loads with a low-current signal. The relay operates within an input voltage range of 0 to 5V. It features 5 pins.

2.3 Ultrasonic Sensor

An ultrasonic sensor is a device capable of measuring the distance to an object by utilizing sound waves. It operates by emitting a sound wave at a specific frequency and then detecting the reflected wave. By analyzing the time it takes for the wave to travel to the object and back, the sensor can determine the distance between itself and the object. Typically, these sensors emit ultrasound waves at a frequency of 40,000 Hz, which travel through the air. If there's an obstacle in the path of the wave, it reflects back to the sensor. By considering the time taken for the round trip and the speed of sound, the distance can be calculated. The HC-SR04

Ultrasonic Module features four pins: Ground, VCC, Trig, and Echo. The Ground and VCC pins should be connected to the respective Ground and 5 volts pins on the Arduino Board, while the Trig and Echo pins can be connected to any Digital I/O pin on the Arduino Board.

2.4 LCD (16x2) [MCP23008-based]

The Liquid Crystal Display (LCD) is a commonly utilized component in various embedded projects owing to its affordability, accessibility and programmability. It's ubiquitous, found in everyday electronic devices such as mobile phones, calculators, and more. Typically, a character on an LCD comprises forty pixels or dots, and the total number of pixels on the display can be calculated as (32 x 40), totaling 1280 pixels. When interfacing with a microcontroller, it's essential to instruct the LCD about the specific locations of these pixels.

III. BLOCK DIAGRAM

The project titled "Wireless Electric Vehicle Charging Station" involves programming an Arduino Uno to control the operation of the charging system. Three ultrasonic sensors are connected to the Arduino and positioned in front of the charging slot to detect the presence of a vehicle. If a vehicle is detected in the slot, the relay will automatically switch on, allowing current to flow through the Tesla coil, which serves as the primary coil and is buried underground. The secondary coil, installed in the vehicle, interacts with the magnetic field generated by the primary coil, inducing an electromotive force (emf) according to Faraday's law. This emf causes current to flow in the secondary coil, effectively charging the vehicle's battery.

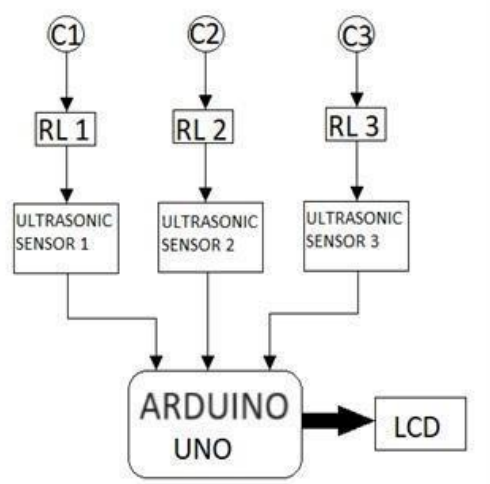

Figure 1: Block diagram

IV. RESULT

In this process of wireless power transmission, the receiver coil is situated in the down side of the vehicle, and electricity is supplied from the primary coil to the secondary coil (electromagnetic induction). The technology achieves the technique of wireless charging station.

Charging Station	P1	P2	P3
Parking Slot	Occupied	Empty	Empty

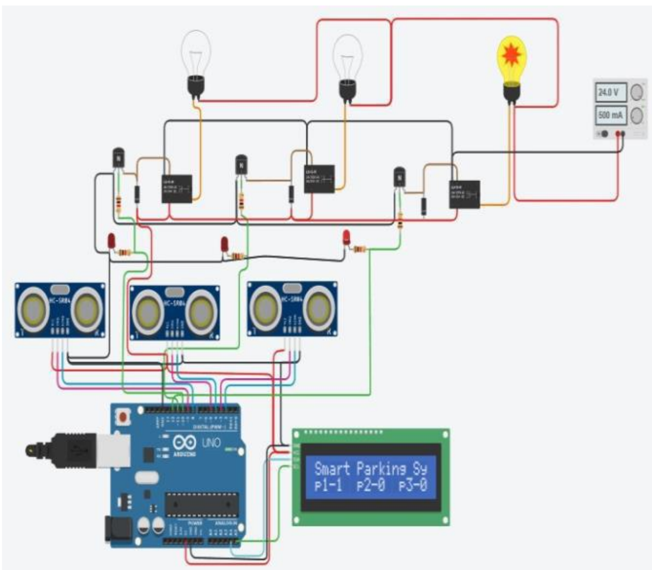

Figure 2: Circuit diagram

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V. ADVANTAGES

5.1 Low-Power and High-Power Application

The wireless charging technology finds utility across a spectrum of applications, catering to both low-power and high-power requirements. It can be implemented in portable gadgets like smartphones, wearable, and laptops, which usually operate at power levels below 100 watts. Additionally, it serves larger electronic devices and appliances such as electric vehicles, hybrids, and medical equipment, where charging demands range from 1 to 300 kilowatts.

5.2 Promotes Durability of Devices and Accessories

The technology operates by charging devices without the need for physical electrical connections, thereby eliminating the necessity of inserting cables into charging ports. This reduces the risk of wear and tear on both the charging wires and ports of the devices caused by frequent plugging and unplugging. Utilizing a wireless charging solution that securely attaches to a device, like Apple's MagSafe Charging, can further minimize wear and tear, enhancing the durability of devices and accessories.

5.3 Reduced Risk of Electrical Faults

Frequent plugging and unplugging of charging cables into ports can lead to material damage, heightening the risk of electrical faults. However, with wireless charging through electromagnetic induction, there is no physical electrical contact, reducing the likelihood of such faults. Additionally, the enclosed nature of the electronic components during wireless charging protects them from corrosive moisture and oxygen, further mitigating potential risks.

5.4 Water Resistant and Dust Resistant Devices

Devices can now be made resistant to water and dust, thanks to advancements in technology. By eliminating the need for charging ports, manufacturers can create products that are fully sealed. This trend towards portless connectivity is supported by wireless charging. Premium wearable devices are leading the way with their sleek, sealed designs.

5.5 Specific Medical Applications

In the realms of medicine and engineering, researchers are delving into specific medical applications of wireless charging. Ongoing studies and experiments are underway to assess the potential of inductive charging for powering implants, sensors, and other embedded medical devices. This innovation aims to eradicate the necessity for invasive corded charging methods.

5.6 Dynamic Charging for Vehicles

Planners envisioning futuristic smart cities are mindful of the increasing adoption of electric vehicles. However, one challenge is the time required for recharging, with some vehicles needing up to 4 hours for a full charge. To address this, designers propose integrating inductive charging coils into roads, allowing electric vehicles to be continuously charged while in motion, thereby mitigating the need for lengthy charging stops.

VI. CONCLUSION

In conclusion, electric vehicle wireless charging using Arduino Uno has the potential to revolutionize the way to charge our electric vehicles and providing greater convenience, efficiency, and sustainability. The technology offers more benefits such as eliminating the need for cables and connectors, remote monitoring and control of charging activities, and integration with renewable energy sources. However, further research and development are necessary to address challenges such as the limited range of Arduino Uno communication and the high cost of implementation. With continued innovation and investment, the use of Arduino Uno in electric vehicle charging systems can contribute to the transition to a cleaner and more sustainable transportation system.

ACKNOWLEDGMENTS

It is with great pleasure and a sense of honor that we present our project titled "Harnessing Power from Speed Breakers for Electric Vehicle Charging Stations." Completing this major project marks a significant milestone in our academic journey, and its success would not have been possible without the guidance and support of our mentor, Prof. Puja Sutar. We are deeply grateful for her invaluable direction and encouragement throughout the development of this report. Prof. Sutar's dedication, patience, and enthusiasm provided us with clarity and purpose, leading to the successful completion of our project. We extend our sincere thanks to all the staff members for their cooperation and assistance. Additionally, we express our heartfelt appreciation to Dr. S. R. Deore, Head of Electrical Department and Dr. V. N. Pawar, the Principal, for his support and encouragement.

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