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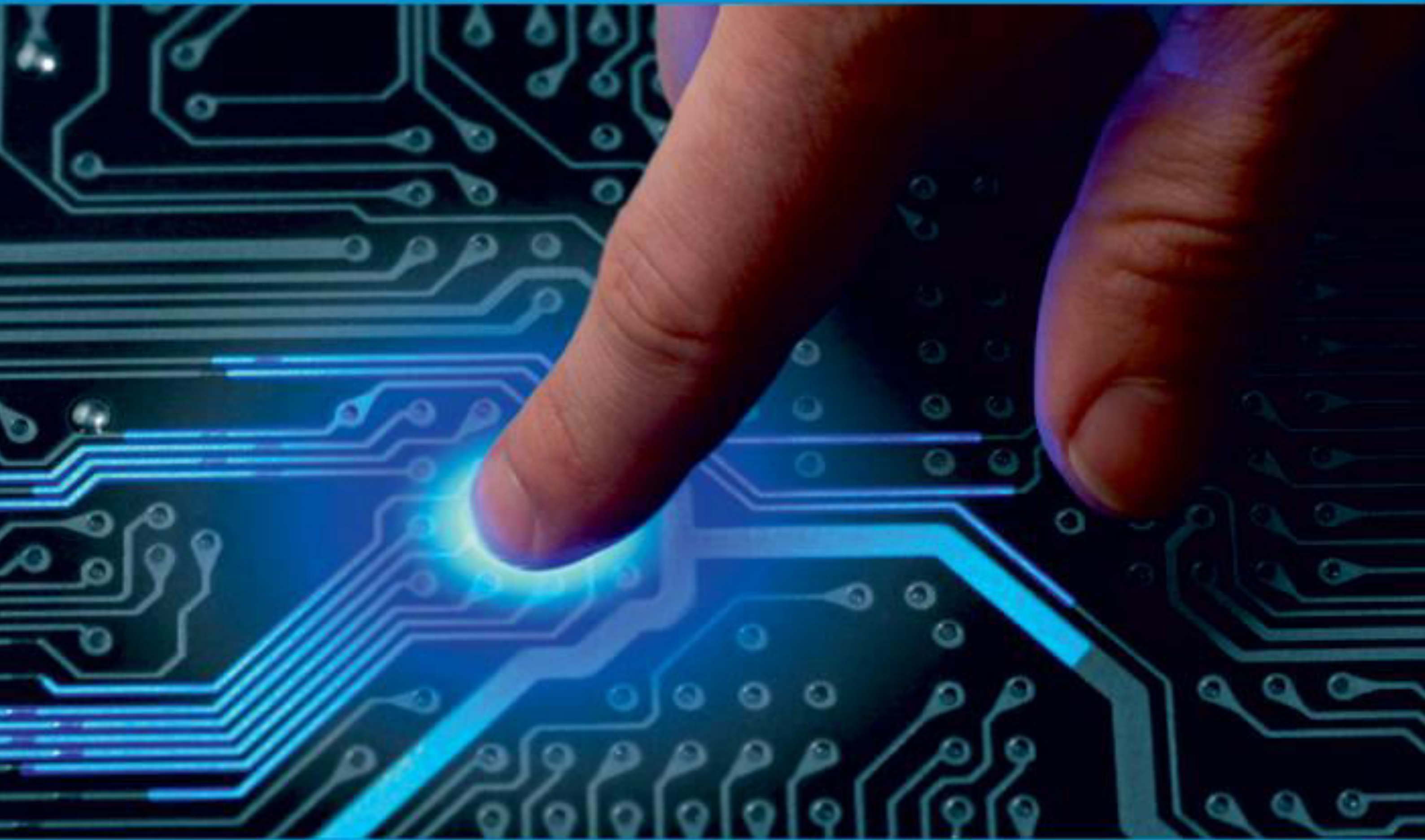

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Implementation towards Design and Development of Wireless Electric Car Charging Station

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ABSTRACT: The rapid growth of electric vehicles (EVs) has underscored the importance of efficient and convenient charging infrastructure. This project aims to design and develop a cutting-edge Wireless Car Charging Station (WCCS) to address the evolving needs of electric vehicle owners. The primary objective of this project is to create a stateof-the-art wireless charging solution that enhances the EV user experience by offering hassle-free and efficient charging capabilities. Stage 1 of this project is dedicated to the initial design and development phases, laying the foundation for subsequent stages. Key activities in this stage include conceptualization, system architecture design, component selection, and prototype development. The project team will begin by conducting a thorough analysis of the current EV charging landscape, identifying existing challenges and opportunities. This will guide the conceptualization process, ensuring that the WCCS design aligns with the current and future needs of the EV market. The system architecture design will involve defining the essential components and subsystems required for the WCCS, including the power transfer system, communication protocols, safety mechanisms, and user interface. Component selection will be based on a comprehensive review of available technologies, considering factors such as cost-effectiveness, reliability, and environmental impact. A crucial aspect of this stage is to identify and procure the necessary components for building the initial prototype. This prototype will serve as a testing platform for assessing the system's performance, efficiency, and safety. It will also help in demonstrating the feasibility of wireless charging for electric vehicles. In conclusion, Stage 1 of the "Project Design and Development of Wireless Car Charging Station" sets the groundwork for the creation of a groundbreaking charging solution for electric vehicles. The project will continue through subsequent stages, focusing on system optimization, testing, and validation, with the ultimate goal of deploying efficient and accessible Wireless Car Charging Stations in the near future.

KEYWORDS: EV charging landscape ; Wireless Car Charging Stations; cost-effectiveness, reliability, and environmental impact.

I. INTRODUCTION

The global automotive industry is undergoing a paradigm shift with the increasing adoption of electric vehicles (evs) as a sustainable alternative to traditional internal combustion engine (ice) vehicles. This transition is driven by environmental concerns, government regulations, and the growing demand for cleaner and more energy-efficient transportation solutions. As the number of electric vehicles on the road continues to rise, the need for an efficient and convenient charging infrastructure has become increasingly apparent. Currently, most evs rely on plug-in charging stations, which necessitate physical connections, pose challenges related to user inconvenience, and may require costly infrastructure installations. These limitations have created a demand for innovative and user-friendly solutions that can accelerate the adoption of electric vehicles. Wireless car charging technology has emerged as a promising solution to overcome these challenges and make evs more appealing to a broader range of consumers. The development of wireless car charging stations is an exciting area of research and innovation within the field of sustainable transportation. These stations have the potential to revolutionize the ev charging experience by offering a convenient, efficient, and future-proof solution that can cater to the diverse needs of electric vehicle owners.

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II. RELATED WORK

This chapter aims to conduct a comprehensive review of various research papers, encompassing details such as author requirements, research perspectives, an overview of project ideas, and general constraints. Additionally, it will outline the necessary algorithms and functionalities required for this seminar, including techniques, functional requirements, and performance criteria. The advancement of Information and Communication Technology has brought forth numerous information security threats. Effectively addressing these threats is crucial in preventing potential harm to individuals or institutions and safeguarding data on computer systems. In this context, Machine Learning (ML) has emerged as a challenging and promising technique that can be utilized to tackle these security issues. The literature review section of this project report delves into the evolving landscape of Electric Vehicle (EV) charging infrastructure. As the world transitions towards a more sustainable and environmentally conscious future, the design and development of EV charging systems have gained paramount significance. This review aims to provide a comprehensive overview of the key concepts, technological advancements, and current trends within the realm of EV charging, laying the foundation for the subsequent exploration of our own design and development efforts in this vital domain. By examining existing research, industry standards, and the latest innovations, we can gain valuable insights into the challenges and opportunities that lie ahead in creating efficient, accessible, and user-friendly charging solutions for electric vehicles. There are some issues that require to be improved, especially regarding the way that the system detects the status of the spots, as well as how it sends the information on to the server. For instance, the system has to be interconnected to the Internet just in case the connection is slow, which renders it useless. The other issue is that the system requires to be continually connected to a power source (electricity) to ensure that the cameras and lighting for camera imaging are efficient. The other limitation of the system is that it does not have a reservation where the user can book a slot for their vehicle. The S. J. Gerssen-Gondelach and A. P. C. Faaij, In an EV, the battery is not so easy to design because of the following requirements: high energy density, high power density, affordable cost, long cycle life time, good safety, and reliability, should be met simultaneously. Lithium-ion batteries are recognized as the most competitive solution to be used in electric vehicles [1]. However, the energy density of the commercialized lithium-ion battery in EVs is only 90–100 Wh/kg for a finished pack [2].1 This number is so poor compared with gasoline, which has an energy density about 12 000 Wh/kg. To challenge the 300-mile range of an internal combustion engine power vehicle, a pure EV needs a large number of batteries which are too heavy and too expensive. The lithiumion battery cost is about 500$/kWh at the present time. Considering the vehicle initial investment, maintenance, and energy cost, the owning of a battery electric vehicle will make the consumer spend an extra 1000$/year on average compared with a gasolinepowered vehicle [1]. Besides the cost issue, the long charging time of EV batteries also make the EV not acceptable to many drivers. For a single charge, it takes about one half-hour to several hours depending on the power level of the attached charger, which is many times longer than the gasoline refueling process. The EVs cannot get ready immediately if they have run out of battery energy. To overcome this, what the owners would most likely do is to find any possible opportunity to plug-in and charge the battery. It really brings some trouble as people may forget to plug-in and find themselves out of battery energy later on. The charging cables on the floor may bring tripping hazards. Leakage from cracked old cable, in particular in cold zones, can bring additional hazardous conditions to the owner. Also, people may have to brave the wind, rain, ice, or snow to plug in with the risk of an electric shock. The wireless power transfer (WPT) technology, which can eliminate all the charging troublesome, is desirable by the EV owners. By wirelessly transferring energy to the EV, the charging becomes the easiest task. For a stationary WPT system, the drivers just need to park their car and leave.

III. PROPOSED SYSTEM

A. *Hardware Requirements:*

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- Flash Memory: 32 KB (of which 0.5 KB is used by the bootloader)
- SRAM: 2 KB
- Clock Speed: 16 MHz
- Communication Interfaces: UART, I2C, SPI
- Power Supply: USB or External DC source (7-12V)

B. *Software Requirements:*

The Arduino Integrated Development Environment (IDE) is a popular open-source software platform used for programming and developing applications for Arduino microcontrollers and similar hardware platforms. Here are the key aspects and features of the Arduino IDE:

• Cross-Platform Compatibility: Arduino IDE is available for multiple operating systems, including Windows, macOS, and Linux, making it accessible to a wide range of users.

• User-Friendly Interface: The IDE is known for its simplicity and user-friendly interface, making it an excellent choice for beginners and experienced developers alike. It provides an integrated development environment with a text editor for writing code, a message console for debugging, and a series of buttons for common functions like uploading code to the microcontroller.

• Code Editor: Arduino IDE includes a code editor with features like syntax highlighting, automatic code completion, and error checking, making it easier for users to write and edit code.

• Library Support: Arduino has a vast library of pre-written code (libraries) for various sensors, modules, and devices. These libraries simplify the process of interfacing with hardware components, allowing users to focus on their specific projects rather than reinventing the wheel.

• Board and Library Manager: The IDE features a built-in board manager and library manager, which makes it simple to install and configure board defi- nitions for different microcontroller models and to add or update libraries as needed. 19

• Serial Monitor: A built-in serial monitor allows users to send and receive data between the microcontroller and the computer. This is essential for debugging and for communicating with the microcontroller during program execution.

• Compatibility: While Arduino IDE was initially designed for Arduino micro- controllers, it can also be used with various other microcontroller platforms, such as ESP8266, ESP32, and others, by adding the appropriate board support packages.

• Community Support: The Arduino community is extensive and supportive, offering forums, tutorials, and project examples that help users troubleshoot issues, learn new skills, and share their own creations.

• Extensibility: Advanced users can modify or extend the Arduino IDE by creating custom libraries or adding support for new microcontroller platforms, enabling it to adapt to evolving needs and technologies.

C. *Description of Proposed System:*

The block diagram represents the core components and their interconnections within a wireless car charging system, highlighting the vital elements involved: the AC/DC Converter, the Battery Management System (BMS) Battery Bank, and the Wireless Charging Coil.

Step 1: AC/DC Converter: - Input: AC Power Source (typically grid electricity) - Function: The AC/DC Converter is responsible for converting alternating current (AC) from the power source into direct current (DC), which is compatible with the battery system's requirements. - Output: DC Power Supply - Explanation: The AC/DC Converter serves as the initial step in the charging process. It takes electricity from the grid or an AC power source and transforms it into the type of power the battery bank can utilize for storage. This DC power supply then feeds into the BMS Battery Bank for storage and later use.

Step 2: BMS Battery Bank: - Input: DC Power Supply from AC/DC Converter - Function: The Battery Management System (BMS) Battery Bank is responsible for managing and storing electrical energy. It safeguards the battery against overcharging or overdischarging, optimizes charging and discharging processes, and monitors the battery's overall health and performance. - Output: Stored Electrical Energy - Explanation: The BMS Battery Bank is a critical component for ensuring the safety and efficiency of the charging process. It controls the state of charge, temperature, and voltage of the battery, and it prevents any adverse events, such as overcharging, which can be detrimental to the battery's lifespan. The energy stored in the battery bank is then directed to the Wireless Charging Coil.

Step 3: Wireless Charging Coil: - Input: Stored Electrical Energy from BMS Battery Bank - Function: The Wireless Charging Coil is the heart of the wireless charging system. It generates an alternating magnetic field that transfers electrical energy to the electric vehicle (EV) without the need for physical connections. - Output: Wirelessly

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Transmitted Electrical Energy to the EV's Coil - Explanation: The Wireless Charging Coil is responsible for the wireless power transfer to the EV. When an EV parks over the charging pad or coil, the alternating magnetic field generated by the Wireless Charging Coil induces a voltage in the EV's own receiving coil. This voltage is then rectified, converted back into DC power, and used to charge the EV's battery.

The detailed explanation of the block diagram of the proposed system is explain below:

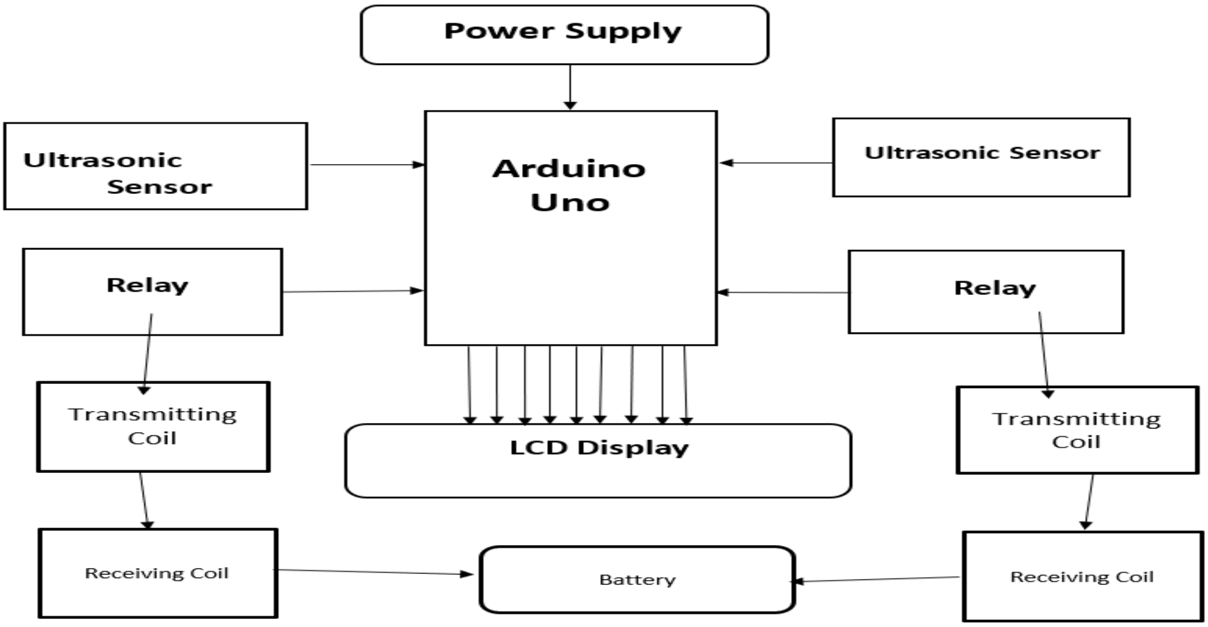

Fig1: Proposed System

IV. DESIGN CONSIDERATIONS

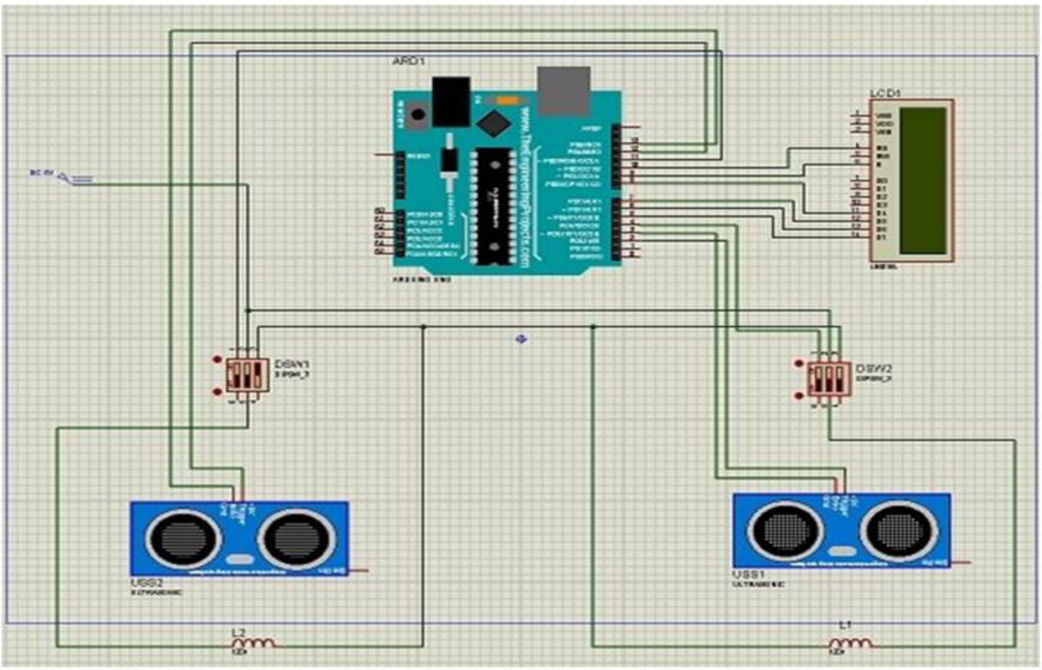

Fig2: PCB Design

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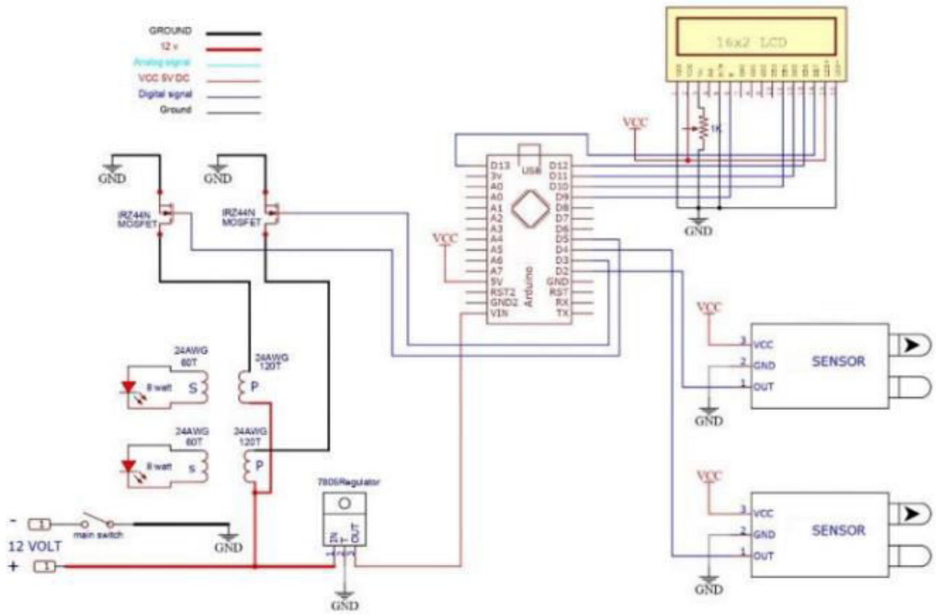

Fig3: Circuit Design

V. RESULTS

In this section, we present the outcomes of our project, focusing on the key findings, data, and observations obtained during the design and development of the Electric Vehicle (EV) charging system.

• Hardware Design: We successfully designed and implemented the hardware components of the EV charging system, including the power management unit, communication interface, and the physical charging connectors. The system met the specified power requirements and safety standards, ensuring efficient and secure charging operations.

• Software Development: The software component of our EV charging system was developed to handle user authentication, payment processing, and real-time monitoring. The graphical user interface provided a user-friendly experience for customers, allowing them to start and stop charging sessions seamlessly.

• Charging Efficiency: We conducted extensive tests to evaluate the charging efficiency, measuring factors such as charging time, energy transfer, and any losses in the system. The results demonstrated that our system met industry standards for efficiency, reducing charging time and energy consumption.

• User Experience: Feedback and usability testing were conducted with a group of users to assess the overall experience. Users reported high satisfaction with the interface and the reliability of the charging system.

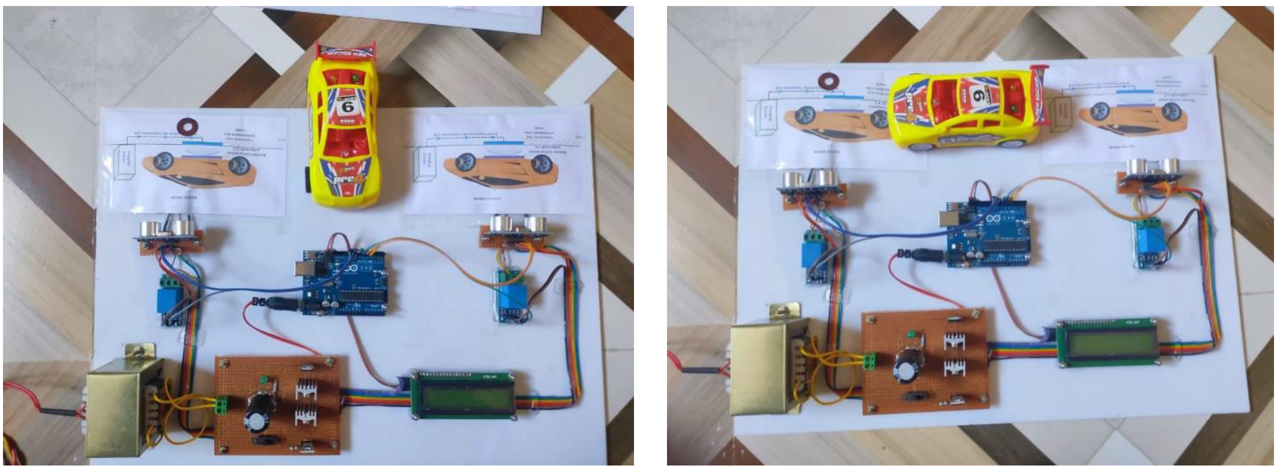

Fig4: Implementation Setup

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VI. CONCLUSION & FUTURE SCOPE

The design and development of the Electric Vehicle (EV) charging system presented in this project report signifies a significant step forward in the realm of sustainable transportation and clean energy solutions. Through meticulous planning, rigorous testing, and user-centric design, our project has yielded a reliable and efficient EV charging infrastructure. The integration of user-friendly software and a robust hardware platform ensures a seamless charging experience, meeting the demands of modern EV users. Our results demonstrate not only the viability of our system but also its potential for scalability and future advancements. As the world accelerates its shift toward electric mobility, our project's contribution to reducing charging time, energy consumption, and enhancing the overall user experience is particularly noteworthy. Furthermore, the adherence to safety standards underscores our commitment to ensuring the well-being of both users and their electric vehicles. Looking forward, this project lays the groundwork for continued research and development in the field of EV charging. Future iterations can build upon our modular design and expand the network to accommodate more charging stations, further supporting the growth of electric vehicle adoption. In essence, our project stands as a testament to the potential of innovation and technology in addressing the global challenge of sustainable transportation. With a keen eye on efficiency, user satisfaction, and environmental impact, our EV charging system is poised to contribute to a cleaner, greener future for all.

In the future, the system accuracy can be improved by hyper tuning the parameters of the different transfer learning algorithms. It is observed from the literature that the standard dataset for MODI characters and numerals is not available. The dataset of the MODI characters and numerals can be created and standardized.

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