

Smart Electric Vehicle Charging Monitoring Using IOT

Siranthini Balraj¹, Arruthra Anilkumar^{1*}, Thejaswaroopan Mourougaiyan², Shaik Mufassir Hussain³

¹Assistant Professor, Department of Electrical and Electronics Engineering, SRM Institute of Science and Technology, Ramapuram, Chennai, India.

^{1*, 2, 3} Student, Department of Electrical and Electronics Engineering, SRM Institute of Science and Technology, Ramapuram, Chennai, India.

Abstract

As the automobile industry enters a new era, it is rapidly transitioning from internal combustion engines. The shift from traditional engine vehicles to electric vehicles has led to an increase in demand for charging stations. In this project, a wireless charging system that uses inductive coupling to charge the electric vehicle is used. To charge the wireless electric vehicle, all you need to do is park the car on the charging spot. This is made possible through a process known as Wireless Power Transmission, where electrical energy is transmitted from the source to the load without the need for any conducting wires or cables. In this particular project, infrared (IR) technology is used to facilitate wireless charging. A charging station with IR transmitters is strategically placed in designated parking spots or charging areas. Electric vehicles are fitted with IR receivers that communicate with the transmitters to establish a connection for wireless power transfer. This eliminates the need for physical plugs and cords, making the charging process more convenient and user-friendly. The IOT aspect of the system adds an intelligent layer to the charging infrastructure, making it more efficient and effective. In addition to IR transmitters, each charging station is also equipped with sensors and connectivity modules that collect real-time data, such as the availability of charging spots, charging status, and vehicle information. This data is transmitted to a central server via the internet, creating a network of connected charging stations. This network provides valuable insights into the usage of charging stations, allowing for better management and optimization of the charging infrastructure.

Keywords - Arduino, IR sensor, Electric vehicle, Cloud sensor, IOT, etc

INTRODUCTION:

Transferring electric power to an electric car in the EV can be done using resonant magnetic coupling. This involves creating an electromagnetic coupling that generates flux and EMF in the inductive coil, which works like a transformer. The system consists of two inductive coils - one is the primary coil, also known as the transmitter coil, and the other is the secondary coil, or receiver coil. After the electromagnetic coupling is achieved, the power is wirelessly transmitted to the electric vehicle for charging. Wireless charging devices can be used in high-power applications like electric vehicles and plug-in electric vehicles in stationary settings. Compared to plug-in charging systems, wireless charging solutions are more simple, reliable, and user-friendly. The stationary mode of operation is used to increase the range and storage capacity of the battery. This strategy enables the charging of the battery storage devices even when the vehicle is stationary. The transfer of power efficiency is determined by the alignment of the coil and the air gap distance between the source and the receiver. Typically, small vehicles have an air gap distance of 150 to 300 mm, while larger passenger vehicles have a greater air gap distance. We have designed a fully automatic and controllable system that includes an LCD display and an IR sensor for improved data control and display. The system is programmed to identify EV using the Arduino Uno ATmega328 and an Arduino identification IR reader. The IR data is compared with the input and output, and the relevant information is displayed on an LCD. Once the relay is turned on, the charging transmitter coil is activated, which in turn activates the receiver coils, generating an electromagnetic flux and initiating the charging process. To demonstrate the signal

reception from the transmitter coil, we have incorporated an LED light onto the reception coil.[1] a wireless charging system is used to charge the vehicle wirelessly via inductive coupling. The transmission of electrical energy from source to load from a distance without any conducting wire or cables is called Wireless Power Transmission. The concept of wireless power transfer was the greatest invention by Nikola Tesla. Also, an Internet of things based collection system is designed in which a person can use the RFID to pay the charging charges of that vehicle. The system checks if the person has sufficient balance and then deduct the charging charges and update the balance. The via inductive coupling and pay our charging charges through RFID tags. Wireless power transmission might be one of the technologies that are one step towards the future. This project can open up new possibilities of wireless charging that can use in our daily lives[1]. wireless charging system by using inductive coupling. There was a growing market to construct the wireless charging system in the various kinds of electronic devices. There were many kinds of methods in wireless charging system. Among them, inductive coupling method was the simplest method. The system used Arduino micro controller to produce the required frequency for driving the induction coil because it gave more accurate frequency than other controllers. In this circuit, N channel mode MOSFET IRFZ44N was used for driving the inductive coil because of its accurate switching timing and ratings. An important issue associated with all wireless power systems was limiting the exposure of people and other living things to potentially injurious electromagnetic fields. Finally, the wireless charger for mobile phones became an important role of human life style because of its simple design and safety for humans. The most powerful output can be obtained at switching frequency of 100 kHz for the design shown in earlier sections[2]. Nowadays Mobile communication not only restricted for voice transmission but also used for various multimedia applications like transfer of text, images, videos, playing games etc. Continuous use of mobile phones needs charging of the batteries again and again. Imagine a system where your cellular phone battery is always charged, You don't have to worry if you forget the charger. In this paper two methods are studied first is wireless charging of mobile phones using microwaves which eliminates the need of separate charger for mobiles .In this method the charging of mobile phones is done using microwaves when we talk on that particular mobile .The microwave frequency used is 2.45Ghz.The second method is charging of mobile phones using Bluetooth[3]. explored the benefits of integrating renewable solar energy with EV charging infrastructure placed at car-sharing service's parking

lot. It formulates a Linear Programming approach that maximized both solar energy utilization and customer satisfaction. Comprehensive evaluation of our algorithm was performed using real-world EV charging traces. They demonstrated the feasibility of a grid-isolated solar-powered charging station and show that a PV system proportional to the size of a parking lot adequately apportions available solar energy generated to the EV serviced[4]. analyse the PV system design and EV charging in a holistic manner considering the above aspects. The new contributions of the work compared to earlier works are as follows: 1. Determination of the optimal orientation of PV panels for maximizing energy yield in Netherlands and comparing it with the use of tracking systems. 2. Possibility of oversizing the PV array power rating with respect to the power converter size based on metrological conditions of the location. 3. Dynamic charging of EV using Gaussian charging profile and EV prioritization, which is superior to constant power charging. 4. Determination of grid impact of two different types of workplace/commercial charging scenario considering 5 days/week and 7 days/week EV load by running round-the year simulation. 5. Optimal sizing of local storage considering both meteorological data and smart charging of EV[5].

IMPLEMENTATION AND METHODOLOGY:

Here it is aimed create a wireless electric vehicle (EV) charging system using an Arduino, an IR sensor for vehicle detection, and IOT updates for vehicle battery charging status.

To begin, gather all the necessary components such as Arduino boards, IR sensors, wireless charging modules, IoT modules (e.g., ESP8266 or ESP32), power supplies, and vehicle interface components.

Next, connect the IR sensor to the Arduino for vehicle detection and ensure that the sensor is calibrated to detect vehicles accurately. Write code for the Arduino to monitor the IR sensor for vehicle presence and implement logic to detect when a vehicle is parked over the charging pad.

To enable wireless charging, follow the manufacturer's guidelines for setting up the charging pad technology you're using (e.g., inductive or resonant).

Finally, connect an IoT module (e.g., ESP8266 or ESP32) to the Arduino for internet connectivity. Implement code on the IoT module to send vehicle battery status updates to a cloud platform.

Components required:

HARDWARE REQUIREMENTS

- Atmega 328 controller

The Microchip 8-bit AVR RISC-based microcontroller features 32KB of ISP flash memory with read-while-write capabilities, 1KB of EEPROM, 2KB of SRAM, 23 general purpose I/O lines, 32 general purpose working registers, and three flexible timer/counters. Additionally, it includes a 6-channel 10-bit A/D.



Fig 1: Atmega 328 controller

- IR sensors
- Relay

A relay is a type of switch that is operated by an electrical signal. It uses an electromagnet or a solid-state mechanism to activate the switch. Relays are commonly used to control circuits with low-power signals or when multiple circuits need to be controlled by a single signal. They were widely used in telephone exchanges and early computers for performing logical operations.

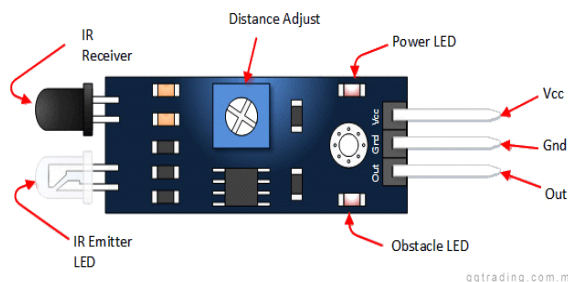


Fig 3: Relay

- Node MCU

NodeMCU is an open-source platform for IoT. It consists of firmware that runs on the ESP8266 Wi-Fi SoC from Expressive Systems, and hardware that is based on the ESP-12 module. The term NodeMCU usually refers to the firmware, while the board is called Devkit. NodeMCU Devkit 1.0 includes an ESP-12E on a board that facilitates its use, as well as a transformer and a USB interface. The NodeMCU

Infrared (IR) sensors are utilized to detect obstacles. They transmit IR signals (radiation) in a specific direction, and the IR receiver receives the signal. These sensors operate on a voltage range of 3-5V DC, and can detect objects within a distance range of 2-30cm, at a detection angle of 35 degrees. The detection distance range can be adjusted via a potentiometer: clockwise rotation increases detection distance, while counter-clockwise rotation reduces it.



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- Fig 2: IR sensors

(Node Micro Controller Unit) is a development environment for software and hardware that is open source and built around an inexpensive System-on-a-Chip (SoC) called the ESP8266.

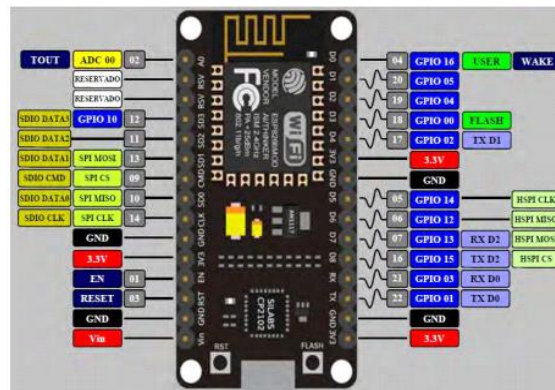


Fig 4: Node MCU

- Induction coil

Energy is transferred via mutual induction, such as in a transformer or wireless charging pad. Devices can be wirelessly charged by placing them on the electric brushes of the pad.

SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded C
- Cloud Server
- Proteus

PROBLEM STATEMENT:

The adoption of (EV) is growing rapidly in today's urban landscape, driven by environmental concerns and advancements in EV technology. However, the current EV charging infrastructure is facing critical challenges, including sub optimal resource utilization, inefficient energy management, and inadequate monitoring systems. To overcome these issues, there is an urgent need to develop a comprehensive Smart EV Charging and Monitoring System (SEVCMS) utilizing the Internet of Things (IoT) technology.

The main goal of a wireless (EV) charging system that uses Infrared (IR) and Internet of Things (IOT) technology is to offer a convenient and efficient method for charging EV without the need for physical connections. This type of charging system operates wirelessly, providing an eco-friendly charging solution for EV while also exploiting IOT connectivity for better control, monitoring, and data analytics.

PROPOSED SYSTEM:

The usage of cars has drastically increased, leading to a higher need for petrol and diesel. This has led to the implementation of electric vehicles in our country. Studies show that most electrical energy transfer occurs through wires, and on average, more than 30% of this energy is wasted. To combat this, our project uses wireless charging mechanisms, reducing the need for cables.

An IR sensor is used to sense the vehicle and check if it is properly parked in the parking slot. A relay is also utilized in the project as a switch, which can initiate or stop the charging process when needed. The complete system is smart and internet-connected, enabling users and owners to monitor or track the system using a web application.

An LCD screen is used to display the charging status, making it easy to understand.

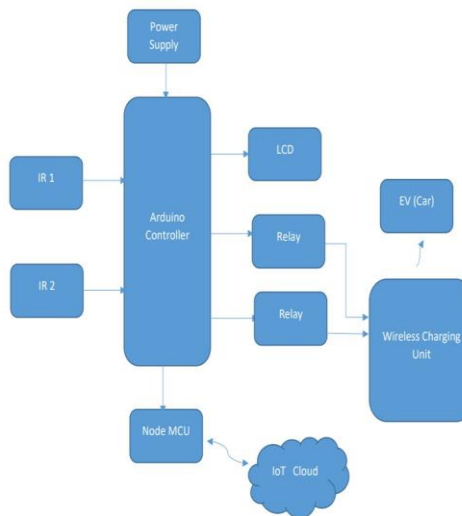


Fig 5:Block Diagram

OUTCOME:

Wireless EV charging technology eliminates the need for physical plug-in connections, making it more convenient for EV owners to charge their vehicles. With the use of IR sensors, the charging process can initiate automatically without any user intervention, which further simplifies the charging process. Additionally, IOT connectivity allows for real-time monitoring of charging sessions and collection of data such as battery status, charging power, and energy consumption. This data can then be analyzed to provide EV owners with insights into their charging habits and efficiency.

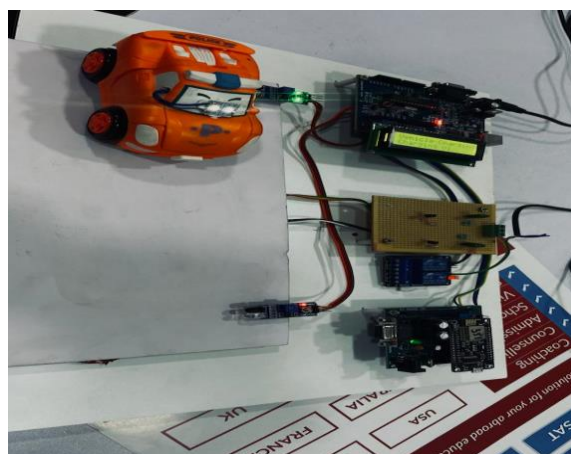


Fig 6: Our project outcome

BENEFITS:

The Smart EV Charging and Monitoring System uses IOT technology to ensure efficient and optimal

utilization of electric vehicle (EV) charging stations. This helps to reduce energy wastage and grid strain, promoting energy sustainability by integrating renewable energy sources, load balancing, and intelligent grid management. The system provides a user-friendly mobile or web application that enables EV users to access real-time information about available charging stations, charging status, and payment options. This convenience is crucial for encouraging EV adoption and improving user experience. To ensure safety and security, the system is equipped with IOT - enabled monitoring that can detect faults, overheating, or unauthorized access. Swift responses to potential issues can be made as a result. The system is scalable and designed to accommodate a growing number of EV and charging stations. Its integration with other smart city solutions, such as traffic management and energy grids, fosters a holistic and interconnected urban ecosystem. As global efforts to reduce greenhouse gas emissions and promote sustainable mobility continue to gain momentum, the Smart EV Charging and Monitoring System using IoT plays a pivotal role in bridging the gap between EV infrastructure readiness and user requirements, enhancing the quality of urban.

CONCLUSION:

In this project, we focus on the wireless electric vehicle battery charger that operates using variable frequency control power supply. Our goal is to achieve wireless transfer of electric vehicle power through inductive coupling. Wireless power transfer technology has the potential to eliminate the need for cumbersome cable connections required to recharge small electronic devices. This promising technology has made significant progress in recent decades and has led to the development of various user-friendly applications. Wireless charging technology has practical applications in various communication systems.

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