International Journal of Scientific Research & Engineering Trends
Volume 9, Issue 2, Mar-Apr-2023, ISSN (Online): 2395-566X

IoT-based Wireless Charging for E-vehicles

***Saranya S **Keerthana B, Kiruba M, Gobika S and Kavipriya R**
*Assistant Professor, Department of Electronics and Communication Engineering, Kongunadu College of Engineering and Technology, Trichy
**Final ECE Student, Department of Electronics and Communication Engineering, Kongunadu College of Engineering and Technology, Trichy

Abstract- The demand for electric vehicles is rising as the automotive industry transitions quickly from IC engine vehicles to electric vehicles. As a result, there are now more charging stations. This concept uses an inductive coupling to wirelessly charge the car using a wireless charging system. All we have to do is park the vehicle in the charging area. Wireless power transmission is the process of moving electrical energy from a source to a load remotely without the need of wires or cables. Nikola Tesla's greatest invention was the wireless power transfer concept. There is no need for human contact with this technology. One technology that may represent a step ahead in the future is wireless power transmission. This idea has the potential to create new wireless charging opportunities for everyday use. Magnetic resonance technology, or wireless power transfer (WPT), has the potential to free people from obnoxious cords. In actuality, the WPT uses the same fundamental theory—known as inductive power transfer—that has been established for at least 30 years. In recent years, WPT technology has advanced quickly. With a load efficiency greater than 90%, the power transmission distance rises from a few millimetres to several hundred millimetres at milliwatts to kilowatts of power level. Electric vehicle (EV) charging applications find the WPT highly appealing because to its advancements in both static and dynamic charging settings. The capabilities of wireless charging systems are further enhanced by IoT integration. The charging process gets smarter and more linked with IoT. It is possible to gather and analyse data in real time, which makes managing charging stations more effective. Features like dynamic load balancing, predictive maintenance, and remote monitoring are made possible by IoT. Issues with charging time, range, and cost are resolved by the smooth integration of WPT and IoT in EV charging. Because of this convergence, conventional battery technology is no longer as important for the widespread use of EVs. The project's goal is for academics to use these cutting-edge successes to propel WPT further and encourage the wider use of electric vehicles.

Index Terms-IoT, Wireless charging, IR Sensor, Blynk, Relay, WPT

I. INTRODUCTION

We live in a technologically advanced world. Every day, new technologies are developed to improve our quality of life. Despite all of this, we continue to charge our daily electronic devices using the traditional cable route. When charging multiple electric vehicles at once, the traditional cable infrastructure becomes a tangle. Additionally, it occupies a large number of electrical outlets at the charging port. A question may come up at this point. What if these electric cars could all be charged at once using a single technology that eliminates the need for wires and doesn't cause any mess? After considering it, we came up with a concept. The most popular mode of transportation worldwide is the road.

Car use has skyrocketed, and with it, so has the need for petrol and diesel. Electric vehicles, or EVs, have gained popularity recently due to their ability to reduce greenhouse gas emissions and dependency on fossil fuels. The only issue with electric vehicles is their power storage technology, which is now their biggest disadvantage because of its poor energy density, short lifespan, and expensive cost. Therefore, our invention offers a revolutionary concept for wirelessly charging an electric car using the inductive power transfer principle with transmitting and receiving coils, while also reducing the size of the battery and eliminating the need for cords and increasing convenience.

Both the dynamic wireless power transmission (DWPT) and static wireless power transmission (SWPT) techniques can be used to charge an electric car.

II. LITERATURE SURVEY

- Supriyadi and Edi Rakhman demonstrated the effect of wire diameter (AWG) and the number of turns used is directly proportional to the amount of power that can be transferred. When the number of windings increases, more power will be transferred. When we use the enameled copper wire of 0.5mm diameter and keep the number of turns to 26, and apply the input frequency of 470KHz, the power efficiency obtained at a distance of 1 cm is about 1.51%. This result can turn on 1 Watt LED lamp.

- N.UthayaBanu and U.Arunkumar's study represents the various technologies related to the Wireless Power Transfer System, which is used to avoid flux leakage during the transmission of power and to operate the cars with high efficiency and improve the quality parameters. This project also shows the process of generating a power source through renewable energy.
- Govind Yatnalkar and Husnu Narman presented a survey that the duration of charging of Electric Vehicles is limited. Therefore, wireless charging is important for Electric Vehicles to overcome the charging duration problem. This paper also provides a current scenario of the art in electric vehicle wireless charging and the parameters that are required for the charging section. The most important parameters for electric vehicle wireless charging are the distance between the transmission and reception coils, the position of the coils placed on the Electric Vehicle, battery sizes, and the time for charging.
- In the review on Intelligent Wireless Charging Stations for Electric Vehicles, induction or magnetic coupling techniques are suitable methods in WPT for EV charging. In this study, an intelligent WPT system is introduced and simulated to charge EVs. The charging process is prescribed by misalignment, innovative method is required to improve the flexibility of EV wireless charging using the fingerprint method, this technique is able to align the transmitting coil with the receiving coil automatically. Proposed system is able to save required time, minimize mistakes made by human, minimizing the use of energy, and also able to charge car based on real time information about the system. It's quite beneficial in energy saving and electricity cost reduction for EV consumers. For EV charging, Wireless power transfer is a new field of development. The efficiency of resonant inductive coupling for EV charging is shown in this paper and the discussed techniques to improve wireless charging performance for high-frequency and high-power applications. Various coil alignment methods were discussed and the fingerprint method was presented as an economical technique for creating WPT intelligence.
- Another approach to the Electrical Vehicle (EV) charging scheduling problem is presented. This paper studies the charging problem under a parking garage which involves total use of time. When an EV arrives at the entrance of the garage, it takes information such as arrival time, suggested departure time, current and required battery SOCs, and garage charging management system (CMS). The CMS can decide whether to admit or decline the customer charging requirement. It manages the required power supply based on the decision. After completion of the process, it deactivates the power supply. All the charging units are under the control of an intelligent charging network. The power supply is controlled by CMS and all charging activities are automatically switched. The EVs whose charging service is not accepted by the system are parked in non-charging areas.
- Described research review of static and dynamic wireless electric vehicle charging system. It describes information regarding wireless charging as it is proposed in high power application, including EVs. Wireless charging has many advantages over plug in charging cause of its simplicity, reliability and user friendliness. The limitation is it can be utilized when vehicle is in stationary mode, like in parking.
- This paper mentioned that electricity is going to be a major part of transportation, due to EVs. At the same time, wireless charging plays an important role in charging facilities for EVs since it provides an efficient and flexible means of charging. Also, standardization of this technology is underway which will give more flexibility and freedom to charge vehicles at any wireless-enabled parking slot.

III. IMPLEMENTATION

A few steps were involved in the IoT-based EV wireless charging station's deployment, including system integration, software development, hardware assembly, and component selection. Every phase was essential to guaranteeing the effectiveness and functionality of the system.

Component Selection
Based on their performance and compatibility with wireless power transfer and Internet of Things applications, the components were selected. Among the essential elements were:

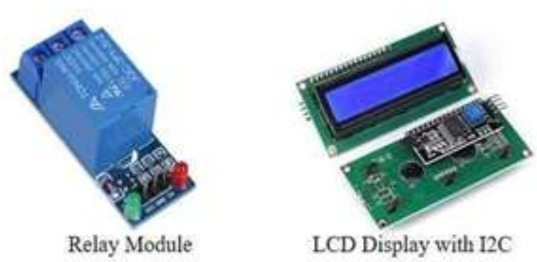

Fig. 1 Components for the project

NodeMCU (ESP8266-based): Selected for its built-in Wi-Fi capability and ease of programming using the Arduino IDE.

International Journal of Scientific Research & Engineering Trends
Volume 9, Issue 2, Mar-Apr-2023, ISSN (Online): 2395-566X

IR Sensors: Used to detect the presence of the vehicle. Two IR sensors were employed to ensure accurate detection.
Relays: Two relays were used to control the power supply to the charging coil.
Transfer and Receiver Coils: These coils were crucial for wireless power transfer.
LCD Display (16x2): Used to display the system status and charging information.
DC Power Adapter (12V 3A): Provided a stable power supply to the entire system.
Blynk IoT Platform: Facilitated remote monitoring and control through a mobile app.

Hardware Assembly
Assembling the hardware required joining the parts in accordance with the block diagram. The LCD display, relays, and infrared sensors were all connected to the NodeMCU.

The position of the receiver and transfer coils was chosen to maximise the effectiveness of wireless power transfer. The stability of the system depended on a constant power supply, which the DC power adapter provided.

The Wiring Connections were as follows
IR Sensors to NodeMCU: Connected to the digital input pins for detecting the vehicle's presence. Relays to NodeMCU: Connected to the digital output pins for controlling the charging process. LCD Display to NodeMCU: Connected via I2C interface for displaying status messages.

Transfer and Receiver Coils: Wired to the relays for switching the power supply.

Software Development
The Arduino IDE was used to create the NodeMCU software. The software's main responsibilities were to initialise the LCD display, relays, and infrared sensors. To determine whether a vehicle is there, the IR sensors' inputs are read. using commands from the Blynk app and inputs from the IR sensor to control the relays. adding status messages like "Welcome," "ACTIVE," and "CHARGING" to the LCD panel. linking to the Blynk platform to provide remote control and monitoring. Setup Function: Created the Wi-Fi connection to the Blynk server and initialised the hardware components. Loop Function: Based on sensor inputs and Blynk commands, the relays and LCD display were controlled while the infrared sensors were continuously monitored.

System Integration and Testing
Making sure all of the software and hardware components interacted with one another was part the system integration process. The actions listed below were taken: IR Sensor Calibration: Modified the sensors to precisely identify the presence of the car. Testing Relays: Confirmed that the relays could properly switch the power source to the charging coils. LCD Display: Verified that the appropriate status messages were displayed on the display. Integration of Blynk: tested the Blynk app to make sure the monitoring and remote control features worked.

Challenges and Solutions
During Implementation, Several Difficulties Were Faced, Including
Problems with the power supply: At first, the relays were continuously triggered by a 12V 1A power source. This problem was fixed by switching to a 12V 3A power source, which gave the system enough current. Sensor Calibration: Exact calibration was necessary to guarantee that the infrared sensors detected the car. Iterative testing and changes were used to accomplish this Integration of Blynk: It was essential to establish a dependable connection between the Blynk server and the NodeMCU. This was achieved by making sure the code was implemented robustly and optimising the Wi-Fi settings.

IV. WORKING

This project involves creating an electric vehicle (EV) wireless charging station that leverages IoT technology to manage In order to manage and regulate the charging process, this project entails building a wireless charging station for electric vehicles (EVs) that makes use of Internet of Things technologies. A NodeMCU, infrared sensors, relays, transmission and receiver coils, and an LCD display are the main parts utilised in this project. The Blynk IoT app is used for monitoring and remote control. The core of the system, the NodeMCU microcontroller, is in charge of carrying out the software that governs every aspect of the operation. It is configured to communicate with the LCD display, relay, and infrared sensors. Additionally, the NodeMCU is connected to the Blynk IoT

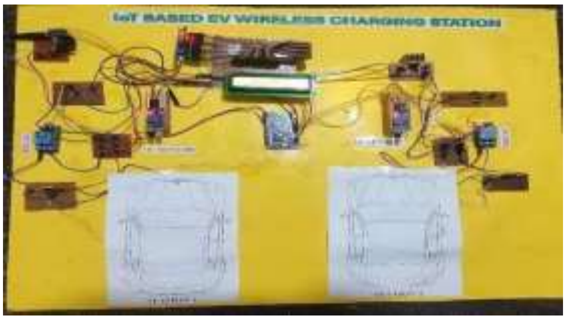

Fig. 2 Project Setup

When a vehicle is detected app, which enables remote control and charging process monitoring. The idea uses two infrared sensors to determine whether a car is at the charging stations at a specific spot, the corresponding IR sensor sends a signal to the NodeMCU. For instance, The NodeMCU receives a

International Journal of Scientific Research & Engineering Trends
Volume 9, Issue 2, Mar-Apr-2023, ISSN (Online): 2395-566X

signal from the matching infrared sensor when a vehicle is detected at a particular location. For example, IR sensor 1 (IR1) signals that Spot 1 is occupied if it senses a car. Likewise, Spot 2's state is indicated by IR sensor 2 (IR2). The system needs this data in order to determine when a car is ready to be charged. The power flow from the charging station to the car is managed via relays. If the user engages the switch through the Blynk IoT app, the NodeMCU will activate the associated relay. This happens when the NodeMCU receives a signal from the IR sensor indicating that a vehicle is there. This facilitates the transfer of power via the transfer coil.transfer coil to the receiver coil in the vehicle, initiating the charging process.

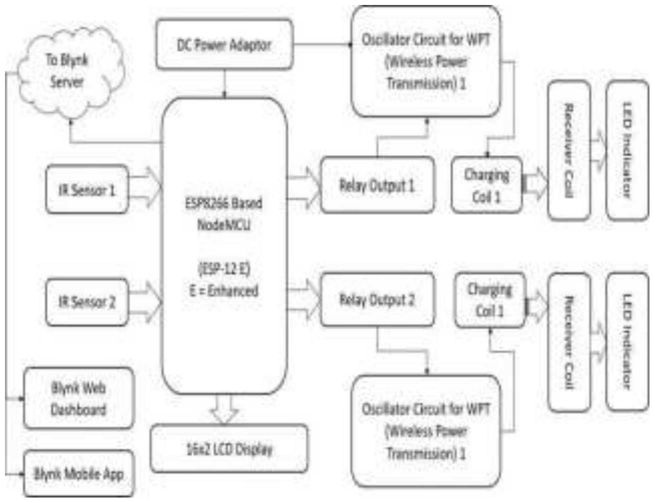

Fig. 3 Block diagram

The system incorporates an LCD display to give the user real-time feedback. The LCD display indicates "CHARGING" for the corresponding place when an IR sensor detects a vehicle and the relay is turned on. When charging is engaged and Spot 1 is occupied, for instance, the LCD will show "Spot 1: CHARGING." Users may simply check the charging state thanks to this function. A user-friendly interface for remote control and monitoring is provided by the Blynk IoT app. The charging method switch can be activated by users via the app. The NodeMCU receives the command when the app's switch is turned on, and if the appropriate infrared sensor detects a car, it activates the relay to start the power transfer. This integration allows for convenient and efficient management of the EV wireless charging station.

In summary, the EV wireless charging station project combines the capabilities of IoT with various sensors and relays to create an automated and remotely controllable charging solution. The NodeMCU serves as the brain of the system, coordinating the actions of the IR sensors, relays, and LCD display, while the Blynk IoT app provides a seamless interface for user interaction.

V. RESULT

The IoT-based EV wireless charging station demonstrated several successful outcomes, aligning with the project's goals and objectives. In line with the project's aims and objectives, the IoT-based EV wireless charging station showed a number of positive results. The outcomes, which emphasise the system's overall effectiveness, user experience, and performance, can be divided into a number of important categories.

Fig. 4 Project output

Vehicle Detection Accuracy

Performance of the IR Sensors: The IR sensors correctly identified a car in the charging zone. The calibration procedure made sure the sensors had sufficient sensitivity to identify different vehicle forms and sizes without producing erroneous.

The sensors continuously produced dependable inputs during the testing phase, which were essential for starting the charging process. Detection Speed: When a vehicle was detected, the system immediately switched from an idle to an active state thanks to the IR sensors' quick response time. In practical applications, this rapid detection capability is crucial for user ease and effectiveness.

Power Control and Wireless Charging Efficiency

Relay Operation: The charging coils' power supply was efficiently managed by the relays. The relays turned on to enable wireless power transfer when the system identified a car and got an instruction from the Blynk app. The relays' consistent and dependable operation was confirmed, and the switch went well. Charging Performance: The transfer and receiver coils in the wireless charging system operated as planned. By carefully placing the coils and fine-tuning the oscillator circuits, the power transfer efficiency was maximised. The system's practical usefulness was demonstrated when it successfully charged EV batteries in a reasonable amount of time.

User Interface and Experience
LCD Display Feedback: The user received clear, real-time status information from the 16x2 LCD display. In order to keep users updated on the state of the system, messages like "Welcome," "ACTIVE," and "CHARGING" were shown at the proper moments. The user experience was enhanced by the display's readability and updating speed. Using the Blynk App: Remote control and monitoring were made possible by the integration with the Blynk IoT platform. Through the Blynk smartphone app, users could manually control the relays and monitor the charging process's progress. Users were able to control the charging process remotely because to the app's intuitive UI and dependable connectivity, which significantly increased.

System Stability and Reliability
Power Supply Adequacy: Relay stability problems were initially fixed by switching to a 12V 3A adaptor for the power supply. The system ran without any problems or disruptions, emphasising how crucial it is to give each component enough power. Continuous functioning: To guarantee steady and uninterrupted functioning, the system underwent prolonged testing. Both software and hardware components operated in unison, preserving functionality without experiencing performance deterioration or overheating.

Challenges and Solutions
Initial Power Supply Problems: The relays were continuously triggered when a 12V/1A power supply was utilised initially. By switching to a 12V 3A power source, which offered enough current for steady operation, this problem was fixed. Calibration of Sensors: To prevent false triggers and guarantee precise vehicle recognition, the IR sensors' sensitivity had to be adjusted. The best sensor performance was achieved by testing and iterative changes. Wi-Fi Access: The system's IoT capability depended on the NodeMCU and Blynk server having a steady Wi-Fi connection. Strong error-handling procedures were incorporated throughout the implementation to preserve connectivity and bounce back from possible network problems.

Overall System Performance
Efficiency and Convenience: The system's objective of offering electric vehicles a wireless charging solution that is both efficient and convenient was accomplished. A smooth user experience was made possible by the combination of precise vehicle detection, dependable power regulation, an intuitive user interface, and strong IoT integration.

Scalability and Future Developments: The project showed promise for scalability and offered opportunities for additional development. Future enhancements can involve increasing the IoT's capabilities for more sophisticated monitoring and control, adding more sensors for improved functionality, and optimising the wireless power transmission efficiency

VI. CONCLUSION

This paper presents a novel IoT-based wireless charging station for EVs, offering a seamless and efficient charging solution. This study introduces a brand-new Internet of Things (IoT) wireless EV charging station that provides a smooth and effective charging experience. Common problems with conventional cable charging stations are resolved by the efficient control and monitoring made possible by the integration of NodeMCU, IR sensors, relays, and the Blynk app. In order to improve functionality, future work will concentrate on expanding the system's scalability and investigating new IoT features. We are introducing the Wireless Power Transmission in this system. since the number of electric vehicles on the market is growing. We may charge our cars with the wireless charging technology. This system demonstrates the effectiveness and execution of the charging station in future technology. Overall, this paper compares various smart parking, charging, and combined charging-parking systems, which can help to solve various issues related to it. Also, it contains a table of comparison of various research papers.

There are various types of methods and techniques used for parking and charging are discussed.

REFERENCES

1. Supriyadi, Edi Rakhman, Suyanto, Arif Rahman and Noor Cholis Basjaruddin, “Development of a Wireless Power Transfer Circuit Based on Inductive Coupling, “TELKOMNIKA, Vol.16, No.3, June 2018, pp. 1013~1018
2. N. uthaya Banu, U. Arun Kumar, A. Gokula Kannan, M.K. Hari Prasad and A.B. Shathish Sharma, “Wireless Power Transfer in Electric Vehicle by Using Solar Energy, “ Asian Journal of Electrical Sciences, Volume 7, Issue 1, January-June 2018
3. N. uthaya Banu, U. Arun Kumar, A. Gokula Kannan, M.K. Hari Prasad and A.B. Shathish Sharma, “Wireless Power Transfer in Electric Vehicle by Using Solar Energy, “ Asian Journal of Electrical Sciences, Volume 7, Issue 1,January-June 2018
4. Govind Yatnalkar and Husnu Narman, “Survey on Wireless Charging and Placement of Stations for Electric Vehicles, “Conference: 2018 IEEE International

Symposium on Signal Processing and Information Technology (ISSPIT), December 2018
5. Md M. RANA, WEI XIANG, Internet of Things Infrastructure for Wireless Power Transfer Systems, IEEE Access, volume 6, pp.19295-19303, 24 Jan 2018.IEEE
6. Sahil Rupani, Nishant Doshi, A review on smart parking using internet on things (IOT), The 3rd International Workshop on Recent advances on Internet of Things: Technology and Application Approches (IoT-T&A 2019) Nov 2019, Coimbra, Portugal.
7. Julian Timpner, Lars Wolf, A Back-end System for an Autonomous Parking and Charging System for Electrical Vehicles, International Electrical Vehicle Conference Greenville, SC, USA IEEE 2012
8. Mehmet Sukru Kuran, Aline Carnerio Viana, Luigi Iannone, Daniel Kofman, Gregory Mermound, Jean P. Vasseur,A Smart Parking
9. Adilet Sultanbek, Auyez Khassenov, Yerassyl Kanapyanov, Madina Kenzhegaliyeva, Mehdi Nagheri, Intelligent Wireless Charging Station for Electrical Vehicles, International Siberian Conference on Control and Communication, 2017, IEEE
10. Zhe Wei, Yue Li, Yongmin Zhang, Lin Cal, Intelligent Parking Garage EV Charging Scheduling Considering Battery Charging Characteristic, IEEE Transaction on Industrial Electronics, Vol 65, 3 March 2018