









IoT-Based Hi-Tech Battery Charger for Modern EVs

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Abstract. These days, we find many batteries used in Electric Vehicles are burning or blasting due to overcharging or long time charging. During such condition, the battery body temperature may rise, to avoid these types of mishaps, here this special type of battery charger is designed using the latest technology such that the battery can be charged using wireless technology and at the same time the battery voltage and its body temperature data will be monitored continuously through an embedded system. An important feature added to the system is that if the battery body temperature raises more than the threshold value, immediately supply to the battery will be disconnected automatically and an alarm will be energized. Once the alarm is energized it remains in energized condition until the reset button is activated. The battery condition will be monitored digitally and it will be displayed through an LCD interfaced with Arduino board. Another important feature added to the system is that entire information will be transmitted to the concerned mobile phone through a WiFi module using IOT technology. Wireless charging is a new technology for charging batteries that allows charging over short distances without cables. The advantage of wireless charging is that charging is quicker and easier, we need not have to plug and unplug each time, simply by placing the vehicle in its parking place where the power transmitting coil is installed under the ground, the battery starts charging automatically.

Keywords: Electric Vehicle · Arduino · IoT · Wireless Charger · Wireless Power Transfer Systems

1 Introduction

A wireless charger for electric vehicles is a new subject for discussion. Many scientists across the world are conducting many experiments on this technology to improve the efficiency and distance between the power-transmitting coil and the power receiving coil. Presently the main drawback of this system is, poor efficiency and poor distance, once this is improved this technology will become popular and we can find these chargers everywhere. In practice, in this method of charging [1], when considered to charge an

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electric car battery, the power receiving coil must be arranged below the chassis of the vehicle. Here the vehicle is not constructed, but a demo piece can be simulated. With the help of a digital monitoring system constructed with an Arduino board, battery body temperature, and its voltage can be monitored during charging or in idle condition. 12 V–2 Ah rechargeable battery is used and its terminal voltage is monitored continuously through an LCD interfaced with the Arduino board. When the EV batteries are charging [2–4] in the hot environment, especially in summer, battery cathodes are the main cause of the heat release. Effective thermal management is crucial for battery protection, especially in our country where the ambient temperature is high. Therefore, it is thought that the purpose of this effort is to prevent battery burning caused by charging-related overheating. A power transmitting coil and a power receiving coil frequently play a prominent role in wireless chargers [5–7] when it comes to charging batteries. Without using any conducting wires, the energy will be transferred from one coil to another coil using this manner. The electro-dynamic induction technique, also known as resonant inductive coupling, is used. Near-field and far-field wireless power techniques fall into these two groups. In this instance, we used near-field or non-radioactive approaches. Power is delivered over short distances by magnetic fields using inducting coupling between coils of wire or by electric fields using capacitive coupling between metal electrodes. The most used wireless technology is inductive coupling. When a secondary coil is brought near to this magnetic field, maximum energy will be grabbed which is converted as a pure DC source and which can be used to charge the battery. The output is not regulated there by voltage up and downs can be monitored by varying the distance between two coils. The Arduino processor used in the project work is having built-in-with ADC, so additional ADC is not required for converting the analog data generated by the temperature sensor. In the same manner, the battery terminal voltage is also monitored and displayed through an LCD interfaced with Arduino.

2 Wireless Power Transfer Systems

The proposed work will leverage the power of the Internet of Things [7, 8] to enable remote monitoring, control, and management of the charging process. The key strategies for increasing the effectiveness of wireless charging for electric vehicles as well as the issues with electromagnetic interference and radiation are examined. The two methods of charging an electric vehicle are conductive (or wired) charging and wireless charging.

The vehicle's charge inlet and the electric supply are connected during wired charging. Even while cable charging [9–12] is common, it has several drawbacks, including untidy cords and safety concerns in moist environments. Since a few years ago, there has been a significant increase in interest in providing electric loads over a field without using any physical connections to the grid [13–16]. Wireless power transfer systems (WPTSs) are the devices that operate the through-the-field supply. Their deployment has begun for the purpose of recharging the batteries installed in grid-detachable machinery. The equipment is supplied with power while it is moving, to remove the batteries or at the very least diminishing their capacity. Recharging occurs when the equipment is standing in a purposeful configuration. In comparison to its wired version, wireless charging of EV batteries offers several benefits [17, 18], including the elimination of the need for any plugs, cables, or outlets, friendlier charging procedures, fearless energy transfer in any

setting, and more. For these reasons, WPTSs are anticipated to have a significant impact on how EVs will be charged in the future. Finally, the primary issues with and fixes for electric vehicle wireless charging technologies are examined. Reduced petrol prices and reduced greenhouse gas emissions are two benefits of electrified transportation. A variety of charging networks must be built in a user-friendly setting to promote the adoption of electrified transportation. Systems for wirelessly charging electric vehicles may prove to be a practical substitute for current plug-in charging methods.

2.1 Wireless Power Transfer (WPT)

Wireless power transfer, also known as inductive charging or wireless charging, eliminates the need for physical cables by using magnetic fields to transfer power between a charging pad or ground-based transmitter and a receiver installed in the EV. WPT technology is still evolving, and its efficiency varies based on the specific system and implementation.

2.2 Conductive Charging (Conventional Chargers)

Conductive charging involves physically connecting the EV to a charging station using a cable. This method has been widely used and is the most common way of charging EVs today. The efficiency of conductive charging depends on various factors, including the charging infrastructure, cable quality, and the onboard charger of the EV. Generally, conductive charging has an efficiency range of 85% to 95%, with modern chargers typically achieving efficiency levels toward the higher end of that range.

3 Block Diagram of HI-TECH Battery Charger

As per the block and circuit diagrams shown in this chapter, the process or functional description begins with the Remote control unit. Little energy will be transported over a distance of about 35 cms because this project work incorporates electromagnetic field coils, which demonstrate the fundamental theory of wireless energy source (Figs. 1 and 2).

During our trial runs, we found that around 300milli amps of current is obtained at a source voltage of 12 approximately. This power is enough to charge the battery arranged in the electric vehicle. The battery used here is rated for 12 V–2 Ah (Ampere hour), when this battery is charged with a 300 mA power source, then the charging time can be defined as battery rating/charging current rating, I.e. $2/0.3 = 6.6$ h. So if a high power source is used, then the battery can be charged in less time.

Charging Time = Battery Rating/Charging Current Rating

Charging Time = 2A h/0.3 A

Charging Time = 6.67 h

Therefore, with a 300mA power source, it would take approximately 6.67 h to fully charge the 12 V, 2 Ah battery. Keep in mind that this calculation assumes ideal charging conditions and does not account for factors like charging efficiency or any safety mechanisms that may be implemented in the charging process.

The following chapter includes a thorough functional explanation, and the key components of this system are listed below.

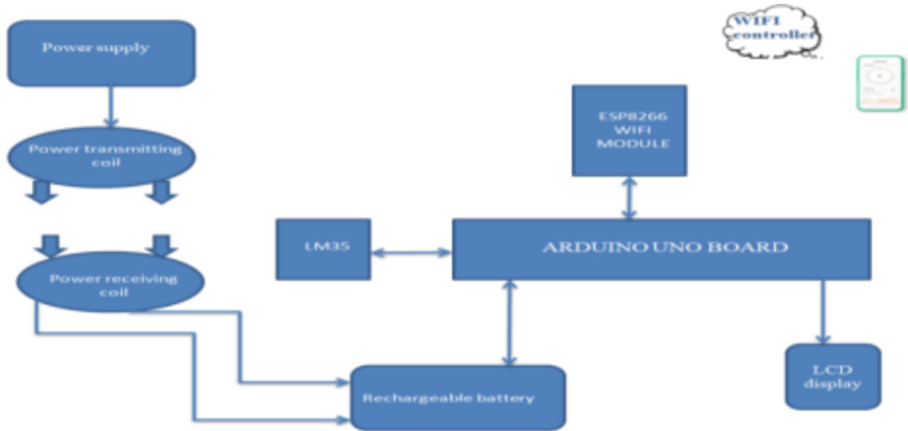


Fig. 1. Block Diagram of Hi-Tech Battery Charger

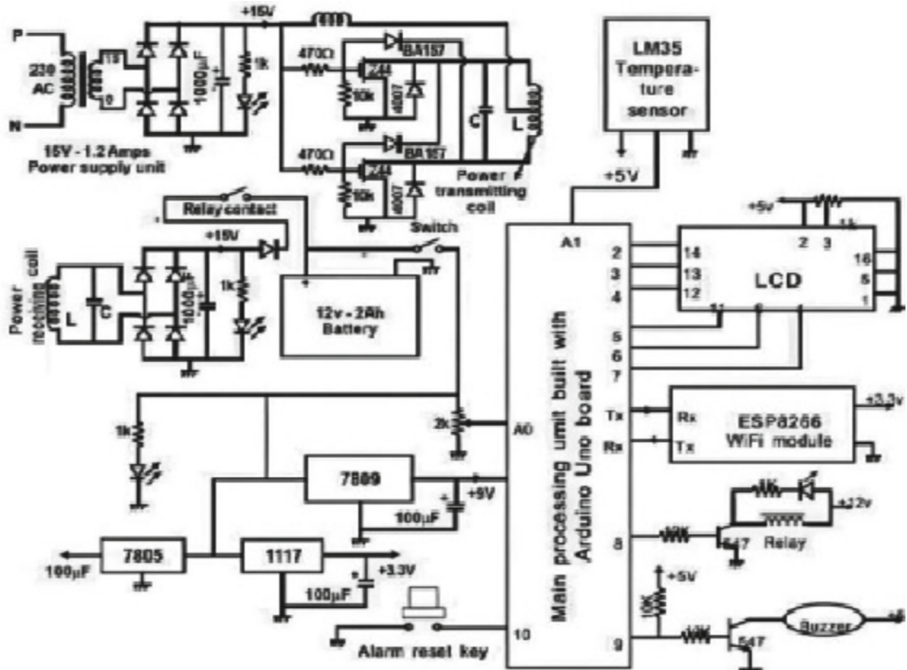


Fig. 2. Circuit Diagram of Hi-Tech Battery Charger

3.1 PCB Hardware Circuit

The PCB is designed at the first level of construction, with component, and circuit mounted on it, and sensors are connected to it (Fig. 3 and Fig. 4).

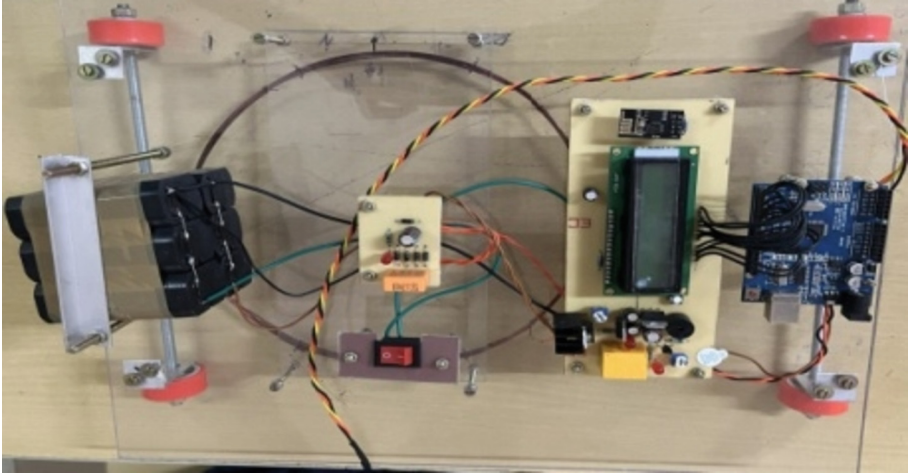


Fig. 3. Power transferring circuit

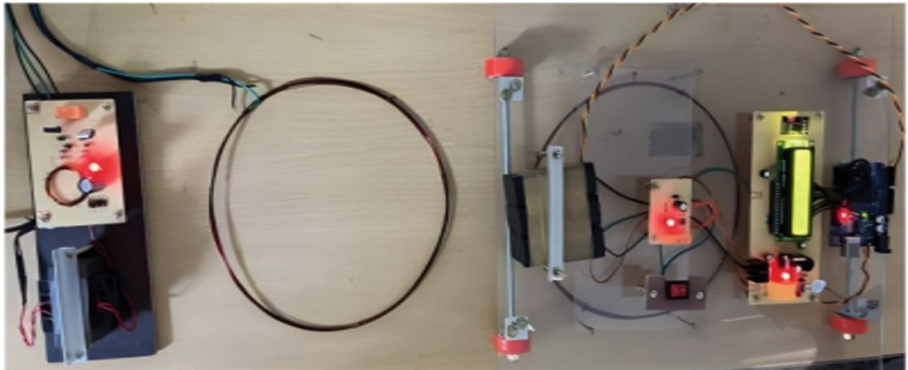


Fig. 4. PCB Hardware Diagram

3.2 Working of Proposed System

Design Implementation of Cost Effective Wireless Power Transmission system is presented in this project work, since it is a prototype module low power transmitter circuit is constructed with power MOSFETs. To induce more current into the primary coil, two MOSFETs are used and are configured in a Push-pull mode of operation. With the help of a diode connected in feedback mode to both power MOSFETs and switches in a sequence (alternatively one after another) such that both MOSFETs will not conduct at a time. As the primary coil is made as center tapped and is divided into two sections, each section will be energized individually through corresponding MOSFET. If the top MOSFET energized bottom remains in de-energized condition, similarly if the

bottom MOSFET energized top remains in off condition. In this manner of switching, the switching frequency depends on the fast recovery diodes connected in the feedback loop.

4 Results

(Fig. 5, Fig. 6, Fig. 7 and Fig. 8).

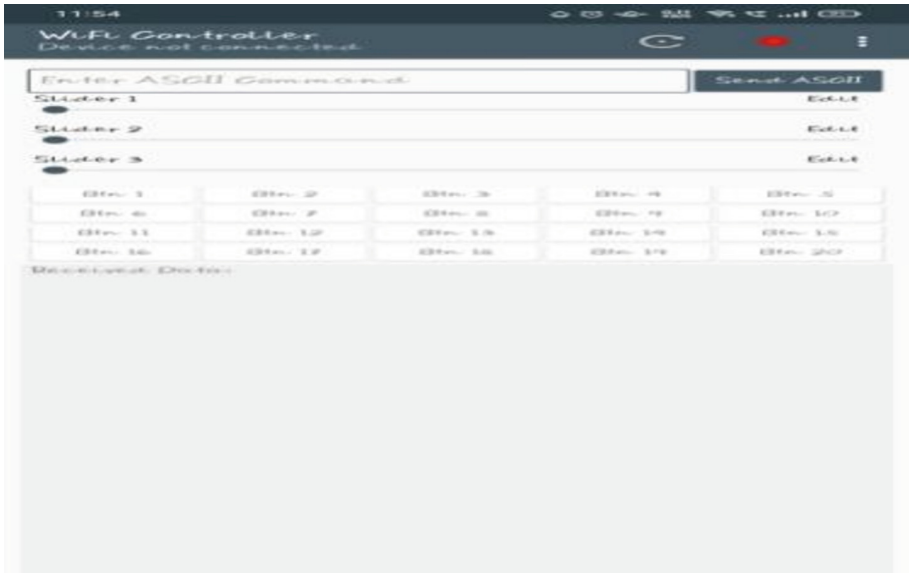


Fig. 5. Homepage display

Through Website we can see the output. When the system get started a current is given to the kit and converts to DC and then arduino and WIFI gets on. The Website was designed for the Internet of Things. It can control hardware remotely, it can display current data, it can store data, visualize it and do many other cool things. Instead, it's supporting the hardware of your choice. Whether your Arduino or Node MCU is linked to the Internet over Wi-Fi, App will get you online and ready for the Internet of your Things. The website serves as a sophisticated and user-friendly platform, offering a multitude of functionalities that make it an indispensable tool for anyone exploring the realm of the Internet of Things (IoT). When the system is activated, a current is supplied to the IoT kit, seamlessly converting it to direct current (DC), thereby powering up the Arduino and WIFI components. As a dedicated IoT platform, the website has been meticulously designed to cater to the diverse needs of IoT enthusiasts and professionals alike. Its primary purpose is to provide a seamless and intuitive interface through which users can remotely control their connected hardware. Whether you are at home, in the office, or halfway around the globe, the website empowers you to interact with your IoT devices with ease and efficiency.

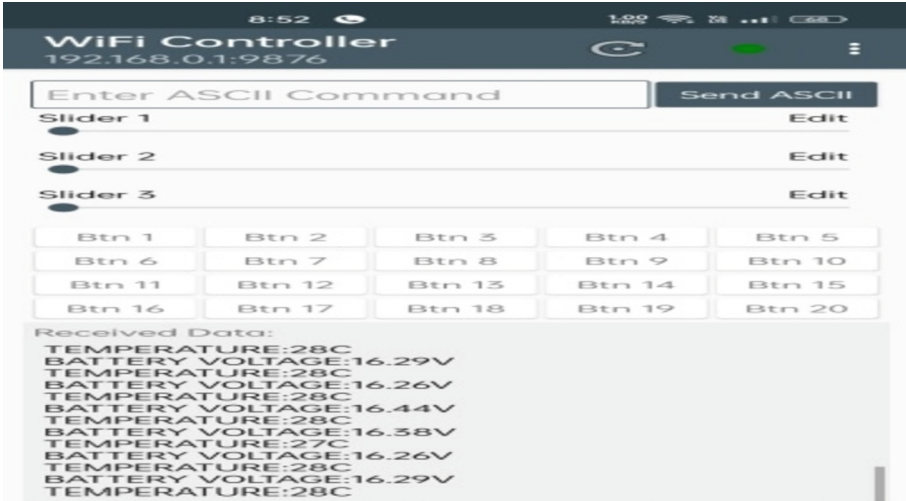


Fig. 6. Dashboard

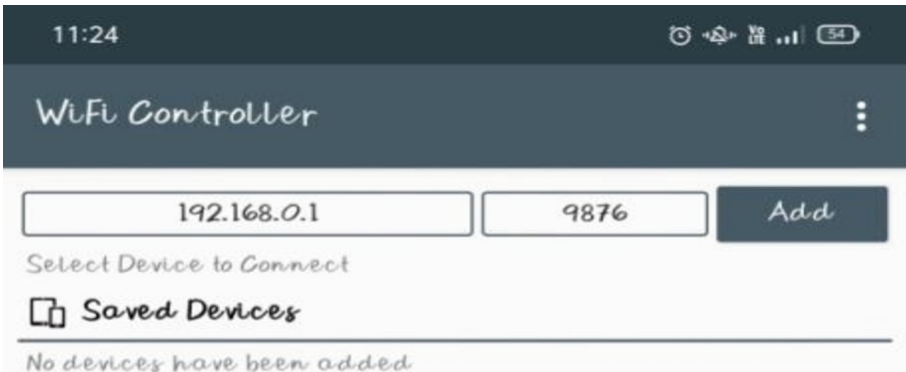


Fig. 7. Login page

Beyond remote control, the website functions as a comprehensive data hub. It allows users to access and display real-time data generated by their IoT devices. From sensor readings to performance metrics, the website presents this information in an easily understandable and visually appealing format. This real-time data visualization gives users valuable insights into their IoT devices' behavior, performance, and environment, enabling them to make informed decisions and optimizations. Additionally, the website offers a powerful data storage feature. Users can securely store historical data, enabling them to track trends and conduct in-depth analyses over extended periods. The ability to access historical data ensures that users have a comprehensive understanding of their IoT devices' long-term performance, facilitating data-driven decision-making and strategic planning.



Fig. 8. Signup page

The website's versatility is a standout feature, accommodating a wide range of IoT hardware choices. It readily supports both Arduino and NodeMCU, making it a truly agnostic platform. No matter the user's preference for IoT hardware, the website adapts effortlessly, seamlessly integrating with the chosen device and establishing a seamless connection to the Internet over Wi-Fi. Moreover, the website does not stop at mere data representation and control; it also enables users to perform various other cool and innovative tasks. The possibilities are boundless, limited only by the imagination and creativity of the user. From triggering automated actions based on sensor data to setting up alerts and notifications, the website empowers users to customize their IoT experience according to their unique needs and preferences.

5 Conclusion

The development of a hi-tech battery charger for modern electric vehicles using the Internet of Things technology is a significant step towards making EVs more convenient and efficient for users. The field of wireless transmission of electrical energy between two magnetically coupled coils requires lot of experiments to obtain better results. In our trail runs we have winded many types of magnetic coils, we have tried with different Gauge wires, with different turn's ratio, different sized coils, etc. Finally we have focused and concluded on one set of coils winded with 21 SWG wire with a ring size of 8", both primary and secondary coils are having six turns each. With these coils we found that the range increased slightly when compared with other coils. Finally the distance between the two coils is defined as 50mm, at this distance the battery is charged with less current, when the distance is decreased by less than 30 mm, we observed that the battery is charging at around 300 ma. Since it is a prototype module, low power transmitter is constructed because of restricted power source at primary side. Not only power source, economy is also criteria, but after conducting so many experiments we are very confident that we can build a high power transmitter and range also can be increased accordingly.

The development of a hi-tech battery charger for modern electric vehicles (EVs) using Internet of Things (IoT) technology marks a significant milestone in advancing the convenience and efficiency of EV usage. By incorporating IoT, the charger gains the ability to communicate and exchange data with other devices, ensuring seamless integration with the vehicle and enabling smart charging capabilities.

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