Wireless Charging with Battery Management System and IoT based Vehicle Control

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Abstract-Although wired charging is a common and well- established method for charging electric vehicles (EVs), it has some disadvantages like convenience, wear and tear, safety, compatability etc. Wireless charging offers several advantages for EV owners, including convenience, safety, efficiency, durability, and flexibility. As the technology continues to improve and become more widely available, it is likely that more and more drivers will choose wireless charging as their preferred method of charging their EVs.IOT-based control for vehicles offers several advantages, including real-time monitoring, remote control, data analysis, integration with other systems, and predictive maintenance. As thetechnology continues to evolve and become more widely adopted.

Keyword: wireless charging, electromagnetic induction, battery management system, internet ofthings, vehicle control.

I.INTRODUCTION

Today, the Electric vehicles are becoming popular as fuel prices are becoming more expensive day by day. Because of this scenario, many vehicle manufacturers are looking for alternatives energy sources other than gas. The use of electricity sources can improve the environment as there is less pollution.Wireless charging technology is one such solutionthat promises to revolutionize the way we charge our vehicles. With the ability to charge electric vehicles without the need for cumbersome cables and plugs, wireless charging offers a more convenient and user-friendly experience for EV owners.The integration of a battery management system ensures that the charging process is optimized for the health and longevity of the EV battery, maximizing its performance and lifespan. This is crucial for the overall sustainability of electric transportation and reducing the environmental impact of our transportation systems.In addition The Internet of Things (IOT) is transforming the way we interact with the world around us, and the transportation industry is no exception. IOT-based control for vehicles is a rapidly evolving field that holds great promise for enhancing the safety, efficiency, and convenience of modern transportation.This project represents an exciting opportunity to explore the potential of IOT technology in the transportation industry and to develop innovative solutions that will shape the future of how we movearound. Also this project aims to explore the potential of wireless charging for electric vehicles, with a focus on developing a battery management system that can enhance the efficiency andeffectiveness of the charging process.

Related work:

There are several types of existing charging systems for electric vehicles, including:

1. Level 1 Charging: This is the most basic charging option and requires a standard 120-volt electrical outlet. Level 1 chargingdelivers approximately 2 to 5 miles of rangeper hour of charging time.
2. Level 2 Charging: This charging option requires a dedicated 240-volt electrical circuit and a specialized charging station. Level 2 charging provides faster charging
speeds than Level 1, delivering approximately 10 to 60 miles of range per hour of charging time.
3. DC Fast Charging: Also known as Level 3 charging, DC fast charging delivers high- powered electricity directly to the vehicle's battery, allowing for rapid charging times of 30 minutes or less. DC fast charging requires specialized charging equipment and is typically only available at public charging stations.

Proposed system:

Wireless charging technology uses electromagnetic fields to transfer energy between a charging pad and a receiver coil in the vehicle. This method eliminates the need for cables and connectors and provides a convenient charging option for electric vehicles.

The proposed system uses wireless charging technology, which are implemented in parking slots (Malls, Cinemas, Parks, Hospitals etc.,). The system is similar to weigh bridge- whenever the EV needed to charged stands above the wireless pad. Here the need for manual work is eliminated.

The parking slots can be efficiently used for both parking and charging. The owner of the area can collect the bill amount for charging.

Methodology:

Wireless charging:

The methodology of wireless charging involves thetransfer of energy from a power source to an electric vehicle without the use of cables or plugs. This is accomplished through the use of an inductive charging system, which consists of two main components: a charging pad and a receiver coil.

The charging pad is typically connected to an electrical source and generates an alternating magnetic field. This magnetic field induces a current in the receiver coil, which is located on theunderside of the electric vehicle. The current generated in the receiver coil is then used to chargethe vehicle's battery.

The process of wireless charging involves the following steps:

The electric vehicle is parked over the charging pad, which is usually installed onthe ground or embedded in a parking spot.

1. The receiver coil on the underside of the vehicle is positioned over the charging pad.
2. The charging pad generates an alternating magnetic field, which induces a current in the receiver coil.
3. The current generated in the receiver coil isused to charge the vehicle's battery.
4. Once the battery is fully charged, the charging process is automatically stopped.

To ensure the safe and efficient operation of the wireless charging system, several factors must be taken into account, including the alignment of the receiver coil with the charging pad, the distance between the two components, and the power outputof the charging pad. Additionally, a batterymanagement system may be used to monitor the charging process and optimize the health and longevity of the vehicle's battery.

Battery Management System:

We have used lithium ion battery same as original batteries used in EV. This batteries will be made ofindividual lithium cells connected in series/parallel(in our project we have connected two lithium cells3.7v each in series so total 7.4v system for runningEV).When more than one lithium cell is used battery management is needed. BMS is like a brainof Lithium battery pack. It protects the Lithium battery pack from overcharging, over-discharging, and over-drain, which results in a good backup and healthy battery life. It also protects the Battery pack from explosion, fire, and damage. A voltage sensoris used to verify the charging status.

IOT based vehicle control:

NodeMCU is an open-source development board designed for the Internet of Things (IOT) applications. It is based on the ESP8266 WiFimodule. The NodeMCU board is equipped with a USB-to-serial converter, which allows for easy programming and debugging.

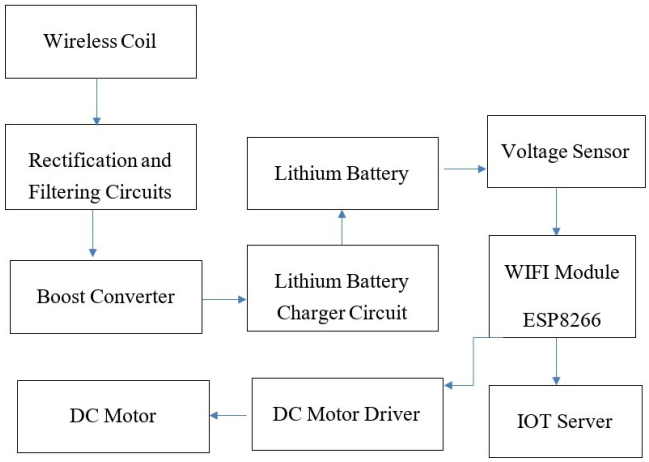
The NodeMCU board has a small form factor and is equipped with a variety of I/O pins, including digital inputs and outputs, analog inputs, and I2C and SPI communication interfaces. This makes it a versatile platform for a wide range of IOTapplications.

The working of NodeMCU involves several steps.First, the board needs to be powered up eitherthrough a USB connection or an external power source. Once powered up, the NodeMCU board canbe programmed using the Lua scripting language orthe Arduino Integrated Development Environment(IDE).

We have programmed using Arduino IDE. Once the code is uploaded to the NodeMCU board, it canbe executed to control the board's various I/O pins,read sensor data, communicate with other devices over WiFi, and perform a wide range of otherfunctions depending on the application.

Block Diagram:

Vehicle block:



II.HARDWARE SPECIFICATIONS:

A) Lithium ion battery:

The rechargeable lithium-ion battery is made of one or more power-generating compartments called cells. Each cell has essentially three components. - positive electrode, negative electrode and electrolyte. A positive electrode connects to the battery's positive or + terminal. A negative electrode connects to the negative or − terminal. And a chemical called an electrolyte in between them. The positive electrode is typically made from a chemical compound called lithium-cobalt oxide (LiCoO2) or lithium iron phosphate (LiFePO4). The negative electrode is generally made from carbon (graphite). The electrolyte varies from one type of battery to another.

The electrolyte carries positively charged lithium ions from the anode to the cathode. The movement of the lithium ions creates free electrons in the anode which creates a charge at the positive current collector. The electrical current then flows from the current collector through a device being powered (cell phone, computer, etc.) to thenegative current collector. The separator blocks theflow of electrons inside the battery.

B) Wireless Coil:

Transmitter:

The AC source voltage supplies the ac voltage at input of the coil. But before directly applying it to the coil a high frequency transformation is performed by which the frequency gets increased from 50Hz to several kHz. This is effectively donein order to achieve long distance and to reduce thepower consumption. This frequency transformationis done by using switching devices by which alternately the devices can be made to generate the

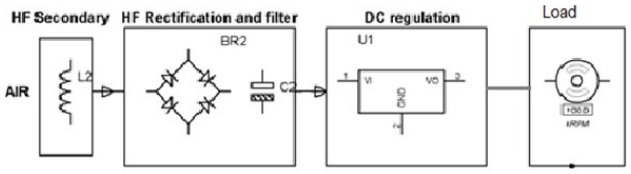
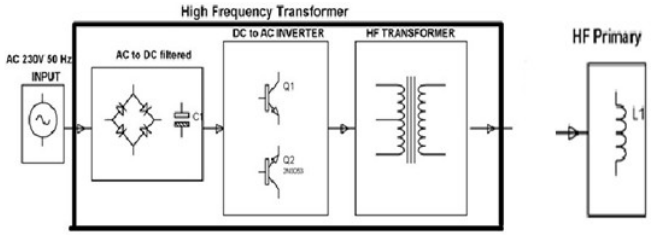


Fig: Transmitter Section

pulses and given as input to transmitting inductor (primary coil) & the voltage flow through this coilis in the form of electromagnetic waves which is then transmitted towards receiving inductor(secondary coil).

Receiver:

Fig: Receiver Section



The receiving inductor (secondary coil) is used to receive the electromagnetic waves which produce the voltage inside the coil which is in AC form. This voltage passed through rectifier & filter circuitry which converts the AC voltagein DC form & removes the unwanted contents using filter. This circuit used to provide smooth DC voltage. The received voltage may be in unregulated form which must be regulated usingVoltage regulator so at the output we get regulated DC voltage. This regulated voltage is then given to the load which drives it.

Node MCU

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from EspressifSystems, and hardware which is based on the ESP-12 module.

The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained Wi-Fi networking solution offering as a bridge from existing micro controller to WiFi and is also capable of running self- contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connectNodeMCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

IR PROXIMITY SENSOR

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation and looks for changesin the field or return signal. The object being sensedis often referred to as the proximity sensor's target. Proximity sensors can have a high reliabilityand long functional life because of the absence of mechanical parts and lack of physical contact between sensor and the sensed object.

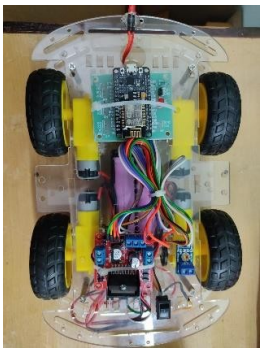
Software Arduino IDE

The Arduino IDE is a popular open-source software that allows you to write and upload code to microcontrollers, including the ESP8266.

To use the Arduino IDE for programming ESP8266, you need to follow these steps:

- ✓ Install the Arduino IDE software on your computer.
- ✓ Open the Arduino IDE software and go to "File" -> "Preferences".
- ✓ In the "Additional Boards Manager URLs" field, add the following URL: "http://arduino.esp8266.com/stable/package_esp8266com_index.json" (withoutquotes).
- ✓ Go to "Tools" -> "Board" -> "Boards Manager".
- ✓ In the search field, type "esp8266" and select "esp8266 by ESP8266 Community".
- ✓ Click on "Install".
- ✓ After installation, go to "Tools" -> "Board"and select your ESP8266 board.
- ✓ Connect your ESP8266 board to your computer using a USB cable.
- ✓ Go to "Tools" -> "Port" and select the correct port for your board.
- ✓ You can now write your code in the Arduino IDE and upload it to the ESP8266board by clicking on the "Upload" button.

III.RESULT:



IV.CONCLUSION

In this project, we implemented wireless energy transfer systems based on resonant inductive coupling with application to the charging of electric vehicles. In this work we also analyzed the implications of metal plates, ferrites and ground adjacent to the energy transfer system. The main outcome is presented together with what should be focused on in future studies. A wireless energy transfer system based on two inductively coupled resonant circuits separated by an air gap. It is showed that the coupled wireless energy transfer system has two resonance peaks and that the separation of these peaks increase with increasing coupling coefficient. To avoid the self-resonance ofthe coils, the length of the coil wire such that the self-resonance frequency appears at much higher frequencies than the frequency of operation is limited. Metal plates above the secondary coil can efficiently shield the surrounding from magnetic fields. However, the magnetic fields induce eddy currents in the metal plates, which decrease the coupling coefficient and increase the resistive losses. Ferrites, a material with very low eddycurrents and high permeability, is placed on both the primary (transmitter) and secondary side(receiver) and it efficiently cancel the negative effects of the shielding plates and improve the coupling coefficient. Proper alignment and positioning of the coil is achieved in this project. A miniature model demonstration with power gettingtransferred from primary to secondary is achieved.The same concept could be adopted with scaling features in electric vehicles.

FUTURE SCOPE:

Wireless charging for moving electric vehicles (EVs) is a relatively new technology that is still in the development and testing phase. The basic idea is to use wireless charging technology to charge thebatteries of electric vehicles as they move, eliminating the need for frequent stops to recharge.

Overall, while wireless charging for moving EVs isstill a developing technology, it has the potential tobe a game-changer in the world of electric mobility, offering a more seamless and efficient charging experience for EV drivers.

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