WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

E-Vehicle Charging System Using Renewable Energy Via Wireless Power Transfer

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ABSTRACT

The typical way of charging an e-vehicle is ineffective for achieving optimum efficiency due to the fast expansion of e-vehicles in recent trends. A wireless power transmission system and a solar power transfer system are suggested in this research. So, by utilizing this technology, we can charge the electric vehicle in three distinct methods at once, resulting in excellent charging efficiency for an electric vehicle. The electric vehicle battery has a battery management system to keep track of its temperature and overall health.

Keywords: WPT, SPT, BMS

1. INTRODUCTION

Wireless power transfer is a method of transferring electrical power from a primary source to a load which is connected to the secondary source without any physical connections by using an air gap. The fundamental components of a wireless power system are two coils, namely the transmitter and receiver coils. The transmitter coil is powered by alternating current, which generates a magnetic field. This field, in turn, induces a current in the receiver coil. The process of wireless power transfer relies on the inductive transmission of energy from the transmitter to the receiver via an oscillating magnetic field. The transmitted signal is converted from direct current into high-frequency alternating current by specialized electronics to achieve this.

In wireless power transfer, the transmitter coil is energized with alternating current, producing magnetic field. When a secondary coil is fixed near that magnetic field, the field induces an alternating current in the receiving coil. Wireless communication refers to the transmission of information over a distance without using wires or cables, and can span a low or high distance. WPT enables facilities like distant communication that would be impractical or impossible to achieve using wired connections. Wireless power transmission, or wireless energy transfer, involves the transmission of electric power from a power source to an electrical load without the need for interconnecting wires. This method of transmission is advantageous in situations where interconnecting wires are inconvenient, hazardous, or impossible. It is important to note that wireless power transmission and wireless telecommunications are different in terms of their purpose such as radio, where the received signal strength is critical to ensure it can be distinguished from ground noise.

Efficiency is a crucial parameter in wireless power transmission as the energy from the engendering plant must reach the receiver to make the system economically useful. The two most common methods of wireless power transmission are direct and resonant magnetic induction. Other methods currently under consideration include radio waves such as microwaves or beam of light technology. Wireless communication is typically considered a branch of telecommunications. It enables services such as long- range communication that would be impractical or impossible using conventional methods.

The wireless transfer of energy using the solar panel we can get unlimited amount of energy and by connecting it to the charging station we can get store the current to the battery. By using the induction coils we can transfer the power from charging station to Electric vehicle. Since there will be loss of energy from solar, we are using MPPT system to get maximum amount of energy from the solar and send it to the battery in the charging station. In the electric vehicle there will be buck converter which will maintain the voltage range of the energy and supply it to the vehicle. By using these systems, we can charge the vehicle without any external disturbance and the battery can be protected from overheating and overcharging.

2. THEORY OF OPERATION

This approach allows the produced energy to be delivered via magnetic coupling to the internal components of the vehicle, completely insulating them from the outside atmosphere and preventing any internal heat dissipation. In operation, the solar battery supplies power, which is then transmitted to the

receiver side via coupling of transmitter and receiver coils. The receiver side battery functions as a safeguard to maintain a stable bus volt and total power level. One sort of renewable energy is solar energy, which is particularly eco-friendly. This renewable energy may be utilized in a variety of ways, including to power machinery and motors as well as household appliances Solar first uses the sun's energy. Then, this DC power is tracked at its highest level. Second, it examines the panel output and compresses it to the battery voltage. In fact, it calculates the optimum power the panel can output to charge the battery and changes the received voltage to the optimal voltage to get the most ampere into the battery.

Finally, the wireless charger circuit receives the maximum DC power. There, wireless battery charging makes use of a magnetic or inductive field to connect two things. A standard battery is attached at the receiver end. The battery will then be charged. In this scenario, exceeding the permissible charge power could potentially damage the battery due to the battery charge power limit on the load side. As a result, to avoid such issues, it is advisable to operate the solar battery in buck mode, regardless of whether the intensity of the sun's irradiance is high or low.

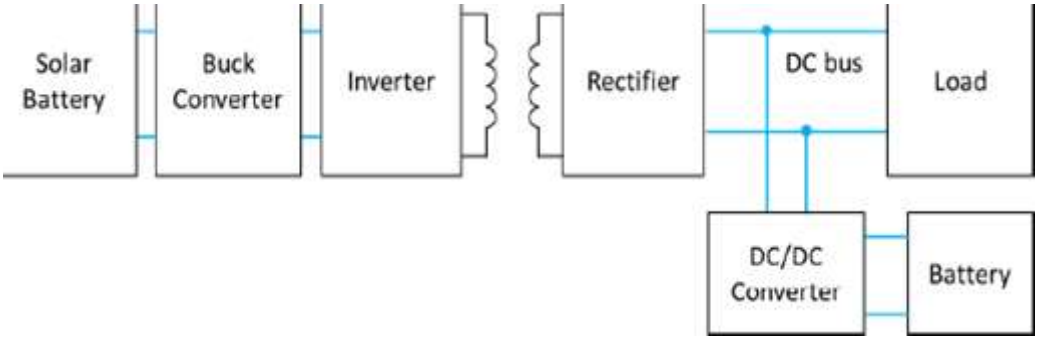

Fig 1. Block diagram

Both hardware and software make up the system. Figure 1 depicts the system's hardware, which consists of a solar battery with a buck converter that supplies current to the E vehicle's battery through mutual induction. Moreover, because a DC-DC converter controls the DC bus voltage, any surplus solar battery power that is not used by the load should be stored in the battery. The battery should provide the missing power when the produced power is inadequate to support the load.

III. PROPOSED SYSTEM

The major goal of this optional system is to provide wireless energy transfer to vehicles while utilizing renewable sources and obtaining as much energy as possible from those sources for electric vehicles. This system involves the use of PWM method. It is a type of power storing method which is specifically used for wireless transmission of the energy. The power from the solar cells is transferred through induction coil and it is received in the vehicle. This power is stored in a battery to transfer it to the load in the vehicle.

The battery is monitored by using BMS technology. This system is specifically preferred for E-vehicle where the battery is used as main source for the system. The whole system is monitored by Arduino uno which shows the battery status of the vehicle and also the temperature status. By using these system we can produce wireless transfer of energy to the system.

A. Hardware Components

1) Arduino Uno (ATmega 328)

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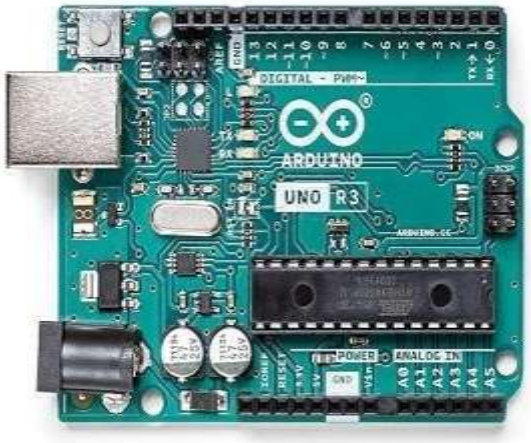

Fig 1. ATmega 328

Based on the ATmega328 microcontroller, the Arduino Uno is a board designed for microcontroller programming. It is equipped with fourteen DI/O, 6 AI, a 16 MHz resonant circuit, a USB port, jack, and a reset. It comes with all the necessary components to support the microcontroller and can be connected to a computer through USB or powered using an adapter or battery. The absence of the FTDI USB-to-serial driver chip is a common feature of previous boards, and it is also absent in the Uno. Instead, it uses an The Uno board revision 2 utilizes an Atmega16 microcontroller that has been programmed as a USB-serial converter. Additionally, it features a resistor that pulls the 8U2 HWB to ground, which simplifies the process of entering Device Firmware Upgrade mode.

The Arduino is powered using usb cable and also by external source. the supply can be given to it by using adapter which covert the ac to dc format. Battery lead can be inserted into the connector ground and input voltage pin. the external supply can get up to 6 to 20 v. minimum 5v supply is required for the board to function or else it does not function properly. more than 12v may overheat the regulator and lead to dysfunction of the board. The supply should be given between 7 and 12 v.

With a bootloader taking up 0.5 KB of memory, the ATmega328 microcontroller has a total memory capacity of 32 KB. In addition, it has a total of two kilobyte of SRAM and one kilobyte of EEPROM memory, both of which are capable of being read from and written to.

2) Buck Boost Regulator

Fig 2. Buck Boost Regulator

One type of AC-to-DC regulator, commonly referred to as a chopper, is the buck-boost converter. It is commonly utilized to boost the DC voltage in a similar fashion as a transformer is used in AC circuits. This converter is similar to a flyback converter, but it uses a single inductor instead of a transformer. The term "buck-boost converter" is used to describe two separate configurations. AC to DC converters are also called as choppers. This regulator can be operated as either alternating to direct current (step up or step down) based on the duty cycle of the converter, The converter is connected to an input voltage source through a SSDs, while a diode is used as the second switch.

Pulse Width Modulation (PWM) involves switching the measured switch active and inactive. PWM requires a broad range of frequencies to operate the switch and achieve the desired output voltage, which is considered a disadvantage. On the other hand, period modulation is preferred in AC-DC converters due to its simplicity in construction and usage. Here the modulation value of the frequency remains constant. this converter can be operated on two modes one is active and conducting mode. This is indicated when the switch is turned on and it represents a short circuit in the converters current flow. After this shift the electric current is passed through the DC input. during this shift, the charge is stored in the inductor which shows the current flow is active through the load and the switch becomes inactive. due to this, the current direction remains unchanged in the inductor.

3. Relay

Fig 3. Relay

An electromechanical relay is a device that can be used to connect or disconnect an electrical circuit. It consists of a movable mechanical part that can be controlled electrically by an electromagnet. A relay operates similarly to a mechanical switch, but it can be controlled by an electronic signal instead of being manually turned on or off. It is important to note that this principle of operation is only applicable to electromechanical relays

4. Proximity Sensor

Fig 4.Proximity Sensor Module

Proximity sensors are non-contact sensors that are designed to detect the presence of objects or targets when they enter the sensor's field. These sensors employ various methods to detect targets, including sound, light, infrared radiation (IR), or electromagnetic fields. Proximity sensors have found widespread use in various applications, such as smartphones, plants, auto driving vehicles, field military systems, among others. There are many types, each with their unique method of detecting targets. Inductive proximity sensors and capacitive proximity sensors are the two most commonly used types of proximity sensors.

5) BMS Module

Fig 5.BMS Module

A battery management system is a technology that is used to supervise the battery of the vehicle, which is an array of battery leads electrically grouped in a stack manner configuration to produce the required range of voltage and current to the load for a period of time. External devices are informed of operating status. The term "battery" refers the whole pack in this application; Li-ion leads have the maximum energy mass which is the preferred choice for Battery cells are commercially used by various consumer items like laptops and electric vehicles and they perform well if used within a specific safe operating range. However, if they are used outside this range, they can cause negative effects on battery performance or even lead to disastrous consequences. To ensure the safe operation of battery packs, a BMS is necessary. The BMS has a challenging role, requiring expertise in areas such as electronics, digitalized systems, control system, due to its complex and comprehensive supervisory responsibilities.

6. 16x2 LCD Display

Fig 6.16x2 LCD Display

LCD 162 is an electronic display device that can display messages and data. It features a 16-column and 2-row configuration, which allows it to show 32 characters, each have 5x8 pixels. Most 16x2 displays utilize multi-segment LEDs. LCD 162 is a popular choice for DIY circuits, electronic projects, and devices due to its low cost, programmability, and ease of use, despite the availability of other display types with various configurations like 82, 81, 161, and 102.

7. DS18B20 Temperature Sensor

Fig 7. Temperature Sensor Module

The DS18B20, developed by Maxim Integrated, is a programmable temperature sensor that operates on a single wire. It is commonly used in extreme places where chemicals and other toxic materials are used and to measure temperature. Due to its strong case it can be used to place in harsh conditions and the installation requires zero work. With an accuracy of 5°C, it can measure temperatures ranging The sensor has the ability to operate across a wide temperature range, from -55°C to +125°C. With a unique address and the need for only one pin for data transfer, it is well-suited for monitoring temperature at various positions by using limited pins available in the microcontroller. Communication with the instrument is obtained. The sensor reading is stored in a two-byte register and can be recite using the One Wire approach by transmitting a information sequence. In order to read the values from the microcontroller ROM command is required. To communicate with the sensor, address value and sequence of each ROM memory is required and this can be obtained from the datasheet.

B. Software Components

The Arduino IDE (Integrated Development Environment) is a software tool used for programming Arduino boards offered by Arduino.cc that is primarily utilized for writing, compiling, and uploading code to Arduino devices. This open-source solution is compatible with almost all Arduino modules, and is easy to install and use, making it a popular choice for programming microcontrollers.

The Arduino IDE is a user-friendly platform that offers a comprehensive environment for most Arduino applications. Its top menu bar includes standard options such as "File" , "Edit" , "Sketch", "Tools" , and "Help." In the intermediate section, users can easily enter their computer code using a simple text editor. The lowest partial of the software is reserved for an output that displays the status of the compilation process, memory usage, error messages, and other important information related to the program.

4. RESULT AND ANALYSIS

The project components have been arranged in an efficient manner to address the power differences between the output of the solar battery and the power required by the load. The power is transferred from the primary coil to the vehicle and it is enhanced by using a buck converter to regulate the solar battery. If the output power of the battery is insufficient to meet the load and battery power requirements, the system operates in MPPT mode. However, if the overall output of the solar battery exceeds the required load and battery power, the regulator manages the solar battery in buck mode.

Fig 8. Charging Station Setup

The setup consists of MPPT which contains the solar energy convertor. It observes the power from the solar cells and convert them into current. The received current will be more so in order to rectify that we are using the rectifier circuits. And MOSFET are also present to reduce the current amplifications. A relay present to send the 5v signal to the proximity sensor in order to detect the vehicle parking over the system. In order to transfer the

current from the MPPT a induction coil is situated at the near end of the system. In contains around 50 turns of copper coil to get the maximum of power from the system.

The power can also be stored in the battery which is of 17v. It can directly store the power from the solar cells and we use them in case of solar cells failure or low intensity of sun. The stores power will be in DC. So, to convert it into AC we are using inverter circuit to convertthe power because the E vehicles receives only AC type of power.

Fig 9. E-vehicle setup

The power from the charging station is transferred through the winding in the station. A secondary coil is present in the vehicle to receive the power. The received power will be in AC, in order to use that power it should be converted in to DC to store in the vehicle battery. For that bridge rectifier is used. Filter capacitor is present in order to reduce the signal noises. The power may vary based on the transmission so in order to rectify that buck boost converter circuit is preferred. It converts the minimum voltage from the station into high voltage to the system. Voltage regulator also preferred to maintain the voltage stability. The battery level is displayed on the LCD. voltage and charging status of the vehicle. A temperature sensor is used to show the battery status of the vehicle. These conditions can be monitored by using BMS technology. This system maintains the battery power supply and heating status of the battery in the vehicle.

For safety measure the temperature sensor is configured to break the circuit if the temperature reaches certain level. This maintains vehicle battery life and increases the load present in the system. Short circuit prevention measure also presents for the safety of the system. In order to show the wireless transfer of energy, the solar cell is connected to the MPPT and the system is activated. The primary coilstarts producing the current. The vehicle is parked over the coil and the energy is transferred through the secondary coil. The vehicle has a set of LED lights that are connected to the coil, and when a current flows through them, the LEDs light up, indicating that there is a current flowing from the solar cells. We can store the current from the station by connecting the battery in the converter in the vehicle. We can also add load to show thecurrent is flowing in the system.

6. CONCLUSIONS

In addition to conventional wired charging, this article reviewed solar and wireless charging options for electric vehicles. Even when the car is moving during the day, charging continues via solar power transfer, slowing the discharge. In addition, when an electric vehicle is being charged via wire in a charging station, wireless charging also takes place using coils that are kept underneath the charging station. This leads to quicker and more efficient charging.

7. FUTURE SCOPE

The future of electric vehicle charging looks bright as more governments commit to decreasing carbon emissions and shifting to better energy sources. To make charging more accessible and easy for EV drivers, the government and private enterprises are investing in developing public charging infrastructure. When EVs are not in use, V2G technology allows them to return energy to the grid. This can help to balance the grid and lessen the need for new power plants. Nevertheless, the future of EV charging appears promising, with numerous potential for innovation and expansion in the industry.

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