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AN EFFICIENT WIRELESS POWER TRANSFER SYSTEM HYBRID BASED CHARGING STATION FOR ELECTRIC VEHICLES

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ABSTRACT:
This paper deals with hybrid wireless power transfer (WPT) technology for charging of electric vehicles (EV). The hybrid WPT is used to charge the EV in two ways. Firstly, the primary source of charging is photovoltaic (PV) based battery charging, and secondary charging is grid-based charging. The hybrid WPT consists of two main parts: the transmitter, which includes a PV-based battery charging unit, a grid-based charging unit, an arduino, an IR sensor, an LCD display, and the transmitter coil. The second part is the receiver, which includes a BLDC motor, LCD display, temperature sensor, power controller, and receiver WPT module. The arduino uses to control the transmitter side by using IR sensor the when the vehicle is detected, it decides which power source is used to transmit. Then the receiver side WPT receiver coil charges the battery and displays the temperature and battery percentage. Then the stored energy is used to run the EV BLDC motor.

Keywords: Wireless Power Transfer, BLDC, IR Sensor, Inductive power transfer, E Vehicle Charging.

I. INTRODUCTION:

We integrate solar power with WPT solar power to the advantage of the user. Due to its advanced power and energy intensity, an EV battery is much too difficult to build. Lithium-ion batteries are the greatest choice for electric vehicles, despite the fact many different kinds of batteries are now utilized in tools. Nowadays, the WPT has had great success as a transportation system problem. The review of the WPT system in this study covers high-frequency output power, magnetic induction concepts, existing and proposed systems, solar energy, and just a few other subjects, such as protective considerations. We think that by emphasizing the most recent WPT triumphs, success will be attained on a global scale. High-power applications, such as EVs and plug-in electric vehicles, have accounted for the majority of inductive charging system usage. WCS is more advantageous than wireless charging in terms of usability, reliability, and convenience. WCS has a number of drawbacks, but its biggest drawback is that it can be used in static settings or while the car is stopped. They also have a number of disadvantages, including issues with magnetic compatibility, limited power transfer, bulky construction, limited range, and high performance. WPT is a protocol used by compact

electronic chargers. But, the most important modern convenience is the ability to charge electric cars and rockets without using any fuel. The fundamental working principle of inductive Wireless power transfer charging is that an inductor has two parts. The primary winding is performed by one component, and the secondary winding is performed by the other. The frequency changer's main function is to convert low-frequency Ac voltage to high-frequency AC electricity. The high-frequency AC is sent from the primary feature to the secondary feature.

II. REVIEW OF THE LITERATURE:

[1] Nikola Tesla invented resonant inductive coupling, also known as "electro-dynamic induction," in 1894 to wirelessly light phosphorescent and incandescent lamps. This was located at the 35 South Park Avenue research lab in New York City, and later at the 46 E. Houston Street laboratory. Nikola Tesla patented a device known as the high-voltage in 1897. [2] An experiment with incandescent light powered wirelessly by electromagnetic induction was conducted in 1910. An electromagnet, a coil of wire with alternating current flowing through it, was used to create the base of a large cylinder. It develops a magnetic field. The lamp is connected to another coil of wire above the magnet's pole. The magnetic field produces electricity, which powers the lamp. The lamp will now appear to be an original Edison lamp with a carbon filament. [3] In 2013, American physicist and inventor Hatem Zeine proved how wireless transmission utilizing phased array antennas can produce electrical energy up to 30 feet. It operates on the same radio frequency bands as Wi-Fi. [4] In 2015, researchers from the University of Washington evaluated power over Wi-Fi at ranges of up to 20 feet. They also test Wi-Fi to see if it can wirelessly trickle-charge nickel-metal hydrogen and potassium coin-cell battery packs from up to 28 feet away. [5] Federal Communication Commission (FCC) certified the first mid-field radio frequency (RF) transmitter of wireless power in 2017. [6] Automobile manufacturers are designing electric vehicles (EV) to substitute gasoline and diesel vehicles beginning in 2030, with the goal of reducing emissions and increasing fuel savings. EVs, with their ecofriendly sources of power, maximise environmental benefits while emitting zero emissions, lowering levels of air pollution. [7] The basics and software solutions for wireless transmission of power (WPT) in electric cars are enclosed in this book (EVs). Wireless transfer of power (WPT) is a method that enables gadgets to be operated without even being wired to the power grid. WPT can greatly benefit electric vehicles by eliminating the requirement for users to manually process recharge the vehicles' batteries, resulting in safer charging operations. [8] Remote power transmission (WPT) that uses magnetic resonance is a technology that could liberate humans from the tyranny of wires. Indeed, the WPT uses the same basic concept that has been established for at least 30 years under the name of inductive power transfer. WPT technology has advanced quickly in recent years. [9] The basic principles of inductive power transfer are provided to provide an understanding of the systems' operation and design. Following that, compensation modules and soft-switching methodologies are mentioned. We present premastered decoder layouts that deviate from traditional power electronics topologies. Methods of control are described in detail alongside topologies, and control generalities are included. To provide a wider context for the technology, the article then identifies other essential factors of wireless power transmission systems such as coil prototypes, infrastructural facilities, cost, and safety regulations. [10] The increased utilization of hybrid cars necessarily involves the creation of new charging mechanisms that are

autonomous and require little user intervention. This paper examines the technologies used for the wireless charging of electric vehicles. It focuses on technology aspects on the induction principle, capacitive-based techniques, radiofrequency waves, and laser power in particular. As previously stated, the simplicity of each methodology is determined by the obligations placed on wireless power transfer. [11] For years, researchers have been attempting to eliminate wires from our daily lives. Wires were needed to send interaction between parties when the telephone or the telegraph was first invented. Wireless power transmission is now extremely beneficial to society. Wireless transmission exchange is already executed in a modern environment in certain instances, but it isn't a component of the "public consciousness". [12] Wireless Transmission Exchange (WPT) technology enables electrical energy to be transferred wirelessly from a receiver to a transmitter. WPT innovation provides a more suitable and appropriate alternative for so many industry sectors than transferring power by cables due to its numerous advantages. WPT technology will decrease wire aggravation and improves power methods. [13] take a scenario where in a self-driving Electric or hybrid (EV) requires an automatic charging system that does not require human intervention. In this regard, a fully automatable, quick, secure, expense, and efficient charging framework that offers a profitable revenue model and rapid adoption in electrified transportation systems is required. Wireless charging systems can reveal these characteristics. Wireless power transmission (WPT) is a high-tech technology that provides flexibility, comfort, security, and the potential to be fully automated. [14] Also with the quick expansion of the global economy and sector, the amount of automobiles on the road grows dramatically, inevitably resulting in significant natural resource exhaustion and hence increased pollution. The electric vehicle (EV) is a green and clean mode of transportation that uses electrical power instead of conventional fossil fuel energy, significantly reducing the need for conventional environmental assets and effectively reducing strain on our living environment. [15] Foundations and Design of Broadband Transferring Power for Charging Stations The approach explains the basics and software solutions of wireless power transmission (WPT) in electric vehicles (EVs). Wireless transfer of power (WPT) is a method that enables gadgets to be operated without even being wired to the power grid. WPT can greatly benefit electric vehicles by eliminating the requirement for users to manually process and charge up the vehicles' batteries, culminating in safer able-to-charge processes.

III. PROPOSED SYSTEM:

Our proposed system based on two power sources one is PV source another one is normal AC supply. The electricity is transmitted wirelessly, the battery must be charged after the transmitter has finished. The condition of the battery is monitored by a number of sensors. In order to apply the WPT and hybrids EH for self powered electronics in EV batteries. The voltage that is exchanged between the WPT transmitter and the WPT receiver, each of which has a distinct battery and is checked for temperatures and charging status, can be determined using a variety of sensors.

IV. WPT TRANSMITTER

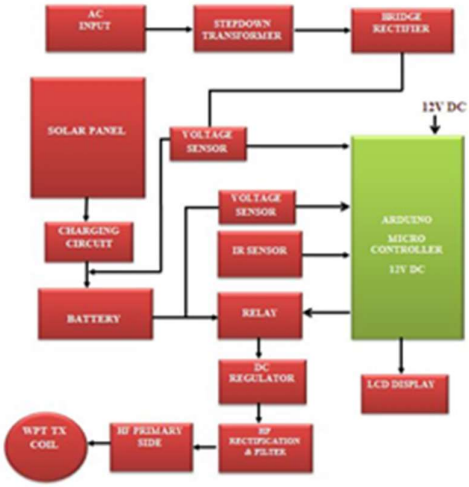


Fig 4.1 Transmitter block diagram

The WPT transmitter consist of IR sensor interfacing ,power supply unit (PSU), Arduino Micro-controller.

A. IR SENSOR INTERFACING

IR sensor interfacing includes amplification, filtering, and other signal conditioning, as well as analog-to-digital conversion. A microcontroller may contain an analog-to-digital converter (ADC), but the sensor must be compatible with the ADC input. The IR sensor used detects the vehicle and sends a signal to the arduino. Then the relay is used to switch on and off the power supply for transferring the power from the transmitter coil.

B. POWER SUPPLY UNIT (PSU)

In a PSU, mains AC power is converted to short-voltage regulated DC energy. It is used to convert 120 volts of AC mains electricity into something more convenient, such as 12 volts DC. There are two types of linear power supplies and switch-mode power supplies. A converter is used in a linear power supply to decrease the voltage. A high direct current voltage is generated by rectifying and regulating the alternating current signal.

PV panel 12V (10 watts) is used as the other source of supply where the solar DC power is stored via charging unit-battery management system (BMS) module is used to charge the 12V battery and the power stored in the battery is used to transmit the power form transmitter WPT to receiver WPT coil.

This type of external energy supply is often housed in a case like an AC plug, also known as an AC/DC adapter. Chargers and rechargers are converters for rechargeable batteries gadgets (battery chargers). A power adapter connects to a mains power source to provide voltage and power to electrical devices that need power but do not have internal components to draw power from it. An external power supply's inbuilt circuit board is very similar to that of a built-in or internal power supply.

C. ARDUINO MICRO-CONTROLLER PROGRAMMING

An Arduino micro-controller is a configurable integrated circuit that can perform a variety of functions based on how it is programmed. It used to control the IR sensor and display whether the vehicle was found or not, then operated the relay to transmit power to the transmitter's WPT coil. It is also used to display whether the power transmission transmitted is using PV or AC power and also shows the voltage of both supplies in the display

V. WPT RECEIVER

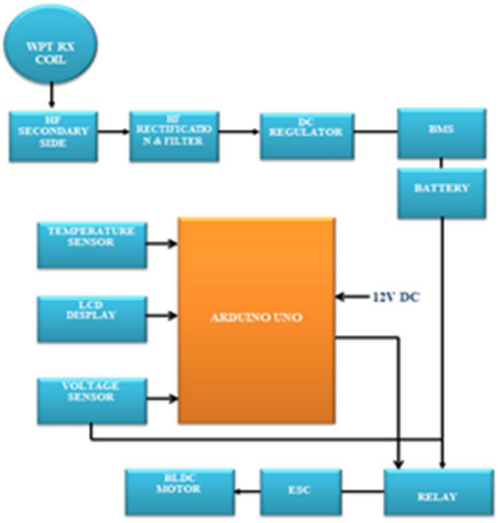


Fig 5.1 Receiver side block diagram

A. TEMPERATURE SENSOR INTERFACING

A temperature sensor is used to measure the temperature of the battery, and it converts analogue data to digital using an Arduino microcontroller. When the temperature of the battery is increased with the help of the microcontroller, the entire power supply to the receiver side or to the supply to run the BLDC motor is cut off. This is used to prevent or protect the battery from damage and explosion of the battery. The temperature is then monitored on the LCD display with the help of an Arduino microcontroller.

B. POWER SUPPLY UNIT(PSU)

On the receiver side, the power is transferred from the transmitter WPT coil to the receiver WPT coil. The transmitted power is passed through the BMS to the 12 V battery for charging. The stored power in the battery is given to the Arduino microcontroller and BLDC motor.

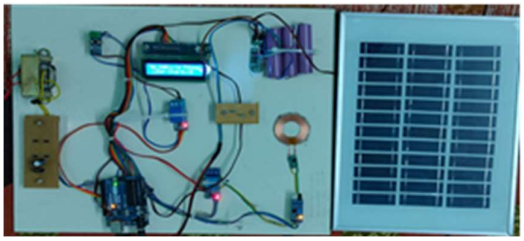
C. ARDUINO MICRO-CONTROLLER PROGRAMMING

The Arduino micro-controller is a configurable integrated circuit that can perform a variety of functions based on how it is programmed. The Arduino identifies the battery percentage and temperature of the battery using a temperature sensor. The data's of temperature and percentage of battery are displayed in LCD display using arduino. It also operates the relay for the BLDC motor to run if enough power is stored in the battery to run the motor. If the temperature rises above 35 degrees, the whole receiver circuit is cut off with the help of an arduino.

VI. WORKING DETAILS:

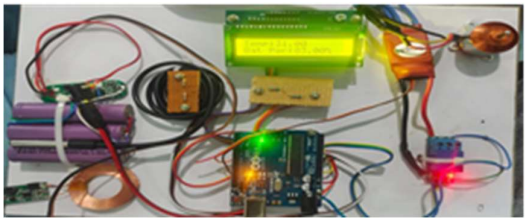
As part of this project, we relied on two sources of power,primary source - solar panel and secondary source - an AC supply. When solar energy was unavailable, we used AC supplies. Through Arduino, we can use solar power if the solar panel supplies more than 5 volts. The solar panel delivers direct current to the system, and the DC is transferred to the BMS (Battery Management System). Using the BMS, the battery is charged. Through the relay, power is transmitted from the BMS to the voltage sensor, which charges the battery. Alternatively, you can use an AC source. As a bridge rectifier, it converts AC power into DC power, thereby acting as an interface. A bridge rectifier converts an AC supply into a DC supply when it is shifted through an AC transformer. We charge the battery using the voltage sensor. In order to

charge the battery, both sources are used, and the battery is connected with two wires, one to the Arduino and the other to the WPT (Wireless Power Transfer). It was necessary to use an IR sensor in order to enable the WPT module. In order to detect whether a vehicle is present or not, an IR sensor is used. When the vehicle is not detected, the LCD display shows that the vehicle has not been detected, and when it is detected, it displays that it has been detected. In order to enable the relay, an IR sensor is used. The relay is used to control the WPT (Wireless Power Supply). By using WPT, the battery power can only be transferred through a relay.



Transmitter Diagram

We attached a 12V battery to the temperature sensor on the receiver side. The temperature sensor is connected to the Arduino via the rectifier. The transformer in the receiver transfers power to the WPT (Wireless Power Transfer) to charge the battery. The WPT module received contains an LED indicator and PN junction diode for preventing reverse charging. Using the BMS (Battery Management System), the WPT module charges the battery. There are two wires connecting the battery. For charging, one is connected to an Arduino, and the Arduino is connected to the LCD display.



Receiver Diagram

The LCD display shows the temperature and battery percentage of the system. In order to find the battery's voltage power, we used a voltage sensor. Whenever a process is run on battery power, we integrate a parallel connection between Arduino and the relay to use battery power. The relay serves as a switch and has two ends. One is connected to the battery, and the BLDC motor is powered by the battery. The BLDC motor has three phase. We want to run in one phase of the BLDC so we used Electronic speed controller (ESC).

VII. EXPERIMENTAL RESULTS:

The Wireless power transfer involves in multiple areas, along with magnetics, communication, power electronics, and electric engineering. The Proposed study of a WPT system can be very complex over the areas of nature and the ambiguous of the system. The below figure 7.1 shows the LCD Display that shows changing status and voltage power. This is based on solar power supply.

Fig 7.1 Charging using solar source

The below figure 7.2 shows the LCD Display that shows changing status through current power of AC. This is based on AC power supply.

Fig 7.2 Charging using AC Supply

The receiver side LCD display shows temperature of the vehicle and battery percentage of the system in figure 7.3.

Fig 7.3 Receiver Side LCD display

The given figure 7.4 is the final outcome of the project. This contains both transmitter and receiver and solar panel. This project is the future reference for the e-vehicle hybrid charging process using WPT technology.

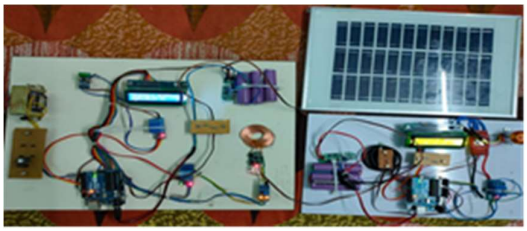


Fig 7.4 Transmitter and Receiver Final Outcome

CONCLUSION AND FUTURE SCOPE:

The Hybrid based charging station for electric vehicle using WPT technology is presented. The proposed technique provides the solar based charging and grid based charging of electric vehicle. The experimental results are confirming that the proposed system working in hybrid mode of operation. Thus the uninterruptable charging of EV is obtained using the proposed technique.

Wireless power transfer technology is a field that has a huge potential of becoming a

mainstream technology in the future because in today's world charging the EV is only happens through the plug in and out cable mode. The proposed wireless power transfer circuit can be used for EV charging applications. With the necessary research and development in this field, in the future, the advanced circuit as used the coil design can be imported from the wireless power transfer circuit that is closer to the real world hardware. With adequate development and innovation in this field, it is certainly possible to create wireless power charging stations capable of charging in hybrid mode which uses 2 or more source of energy like solar,wind etc for electric bicycles and electric cars or any heavy EVs from the same power charging station, at a faster charging rate than currently available charging techniques.

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