International Journal of Research Publication and Reviews, Vol 4, no 5, pp 1921-1927, May 2023

International Journal of Research Publication and Reviews

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

SOLAR WIRELESS ELECTRIC VEHICLE CHARGING SYSTEM USING ESP32

Nivedita Muganur [1], Naveen Manawadi [2], Manohar Malagi [3], Manjunath Malagi [4], Sidramayya Matad [5]

[1 2 3 4] Dept. of Electronics and Communication Engineering, S. G. Balekundri Institute of Technology. Belagavi, Karnataka, India.

[5] Assistant Professor, Dept. of Electronics and Communication Engineering, S. G. Balekundri Institute of Technology. Belagavi, Karnataka, India.

ABSTRACT

In this research, Electric vehicle charging is madesimple and environmentally friendly with the Solar Wireless Electric Vehicle Charging System, a cutting-edge invention. Theelectricity produced by this technology is wirelessly delivered tothe electric vehicle to be charged using solar radiation. The system consists of solar panels, an electric car receiver, a wireless power transmitter under road, and an inverter. The power inverter transforms the DC electricity produced by the solar panels from the sun's energy into AC electricity. The wireless power transmitter wirelessly transmits AC current to the electric vehicle's receiver, which charges the battery. Compared to conventional electric vehicle charging methods, the Solar Wireless Electric Vehicle Charging System has anumber of benefits, including being ecologically friendly.

Keywords—ESP32, Solar Energy, Proximity, Wireless charging

Principle of Electric Vehicle Charging System:

The inductive power transfer (IPT) concept is used by wireless EV charging systems to transmit electricity from thecharging station to the onboard receiver of the vehicle. A charging pad on the ground and a receiving pad on the EV arethe two major parts of the system. An electromagnetic field produced by the charging pad causes a current to flow through the receiving pad. The battery of the EV is charged using this current. The system's effectiveness is based on howclose together the charging and receiving pads are. The effectiveness of the mechanism increases with the distance between the two pads. To make sure the system is effective and secure, most wireless EV charging systems operate at a frequency of 85 kHz.

INTRODUCTION

As more people become aware of the environmental advantages of utilizing electric vehicles as opposed to conventional petrol vehicles, the popularity of electric vehicles (EVs) is rising. Unfortunately, a shortage of infrastructure for charging EVs prevents their broad adoption. Researchers are striving to create wireless electric car charging systems that can offer more practical and effective charging methods in order to solve this problem. The use of wireless charging devices has the potential to transform how EVs are charged by making the procedure quicker and more practical. The most recent innovation in EVcharging is wireless electric vehicle (EV) charging systems, sometimes referred to as inductive power transfer (IPT) systems. Wireless EV charging systems transmit electricity between the charging station and the EV's onboard receiver using an electromagnetic field, in contrast to conventional EV charging systems that require cables and plugs. As there is nolonger a requirement for physical connections, it is more practical, secure, and effective. A promising innovation, wireless EV charging systems have several benefits, including easier access to charging stations, less maintenance, and better user experiences. Wireless EV charging systems are gaining popularity as the demand for electric vehicles rises because they provide a more practical and effective way to charge EVs. There are several coils inside the ground-based chargingplate or pad that are wired to a power supply. An electromagnetic field is produced around the pad or plate when power is passed via these coils. The positioning of the receiving coil on the vehicle's underbelly allows it to detect the electromagnetic field produced by the charging station. This causes an electrical current to flow through the receiving coil, which is subsequently utilized to recharge the electric car's battery.

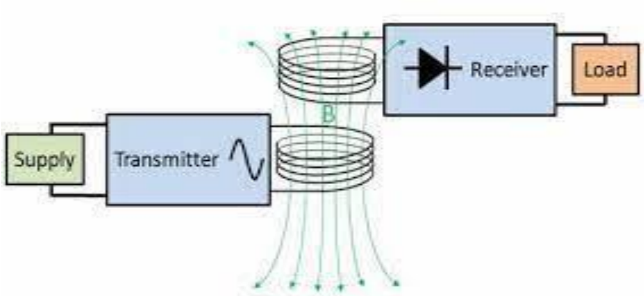

Fig 1.1 Inductive Power Transfer System

Electromagnetic induction is the method of transmitting energy through an electromagnetic field. It operates on the idea that moving a conductor through a magnetic field can produce an electric current in that conductor (in this example,the receiving coil) (created by the charging pad). When an electric car is parked or moving over a charging plate or padand its reception coil is lined up with the coils on the plate, the charging process may start. When the charging system establishes contact with the car's onboard computer, the charging pad starts to generate an electromagnetic field that transmits energy to the car's receiving coil. Inductive charging is a practical and effective method for wirelessly recharging electric vehicles, and it has the potential to completely change the way we think about EV charging infrastructure.

Benefits:

Compared to conventional charging systems, wireless EVcharging solutions provide several advantages. Convenienceis one of the key advantages. Drivers may charge their electric vehicles more quickly and effectively using wirelesscharging since they do not need to physically connect them to the charging station. Moreover, wireless charging reducesclutter around the charging station by doing away with the need for thick wires and connections. In addition to greater safety, wireless charging solutions also eliminate any chanceof electric shock or trip dangers. The device can also functionin hostile areas and is suited for all types of weather. Also, because there are no wires or connectors that might be broken, wireless charging systems require less maintenance than conventional charging systems.

Challenges:

Notwithstanding the advantages, there are still several issues with wireless EV charging systems that need to be resolved. The price of installation is one of the biggest obstacles. The higher installation costs of wireless charging systems compared to conventional charging systems may prevent their general adoption. The problem of interoperability presents another difficulty. As there are currently no global standards for wireless EV charging, it may be difficult for EV owners to locate charging stations that work with their cars. The alignment of the two chargingand receiving pads as well as their distance from one anothercan have an impact on the effectiveness of wireless chargingsystems. Lastly, greater study is required to address worries about the possible effects of electromagnetic fields on humanhealth.

Application:

Systems for wireless EV charging have several uses in various sectors of the economy. One of the main uses is in theautomobile sector, where EVs may be charged at publiccharging stations, in residences, and at work. In order to improve charging efficiency and convenience, EVs may alsoemploy wireless charging in transit vehicles like buses, trams, and trains. The technique is also applicable to the aviation sector and may be used to refuel electric planes. Electric forklifts and other forms of industrial equipment may be charged using wireless charging systems in the industrial sector.

LITERATURE REVIEW

In the study [1], the significance of renewable energy sourcesand the rising demand for electric vehicles are covered at theoutset of the presentation. The authors next give an overviewof the various wired and wireless EV charging techniques thatare available. They highlight the ease and safety benefits of wireless charging as well as the possibility of using solar energy to charge EVs. The authors then go into the different aspects that influence the design and functionality of a WPTsystem, including the operating frequency, the separation between the transmitter and reception coils, the size and shape of the coils, and the system efficiency. They detail themathematical model utilized to enhance the system's performance and go through the fundamentalsof resonant WPT.

In the study [2], the report provides a review of prior researchon solar energy and EV charging stations. The authors stresshow crucial it is to have a dependable and sustainable charging infrastructure for the increasing number of EVs. They go over the advantages of using solar energy for EV charging stations as well as the difficulties in developing them, such as the fluctuation in solar energy production and shifting weather patterns. The suggested mathematical modelaccounts for the EVs' wireless charging, battery storage, andsolar energy production. The writers also take into account how the system's performance is impacted by environmentalfactors like temperature and humidity. The simulation findings demonstrate that the suggested system may offer EVs efficient and dependable charging services while reducing environmental impact.

In the study [3], the article comes to the conclusion that wireless charging technologies have the potential to revolutionize transportation by offering a practical, secure, and environmentally friendly substitute for conventional charging systems. The author's stress that considerable obstacles still need to be solved before wireless charging forEVs can be a useful and widely used technology. The overallassessment of wireless charging solutions for EVs in this study is helpful and emphasizes both the advantages and disadvantages of various technologies. The results of this study can be a helpful resource for academics and industry professionals studying EV charging infrastructure.

In the study [4], the essential tenets of IPT systems areintroduced in the first section of the study, along with the underlying physics of magnetic coupling, resonance phenomena, and mathematical models for IPT system behavior. The main parts of an IPT system, such as the transmitter and receiver coils, power electronics, andcommunication interface, are then reviewed by the writers. The study then provides a thorough analysis of the many optimization options that have been suggested for IPT systems, including improving the efficiency of the power electronics, optimizing the communication protocol, and optimizing the coil design and positioning. The benefits and drawbacks of each technique are discussed, along with the difficulties that must be overcome to get the best system performance.

In the study [5] the proposed IPT system is thoroughlyexamined by the authors, who also provide analyses of efficiency, the equivalent circuit model, and the magnetic coupling coefficient. They also offer experimental findings to support the effectiveness of the suggested system. The articleconcludes that the suggested IPT system can offer an effective and dependable charging solution for EVs while minimizing environmental impact. The authors argue that additional study is required to improve the design and efficiency of the suggested system. The research suggests a novel design strategy for IPT systems that balances performance, cost, and efficiency considerations. The research suggests a novel design strategy for IPT systems thatbalances performance, cost, and efficiency considerations. The suggested method is based on the employment of a dual-sided inductor as the magnetic coupling component and a series-parallel resonant converter (SPRC) as the power electronics interface. The suggested method is based on the employment of a dual-sided inductor as the magnetic coupling component and a series-parallel resonant converter(SPRC) as the power electronics interface.

METHODOLOGY

The principal used to achieve solar wireless charging system is IPT (Inductive Power Transfer). Thefundamental idea behind IPT is that by running an alternatingcurrent through a coil, a magnetic field is created. Another coil that is close to the first coil experiences a current due tothis magnetic field. The device linked to the second coil can then be powered by the induced current.

The receiving coil is normally positioned on the underside ofthe car in an electric vehicle charging system, in fig 3.1 the charging pad is typically installed on the ground. The two coils are aligned and the charging process starts when the vehicle is parked over the charging pad. The IPT system is made to be reliable, effective, and practical. When a vehicle is there, the system immediately recognizes it and starts charging.

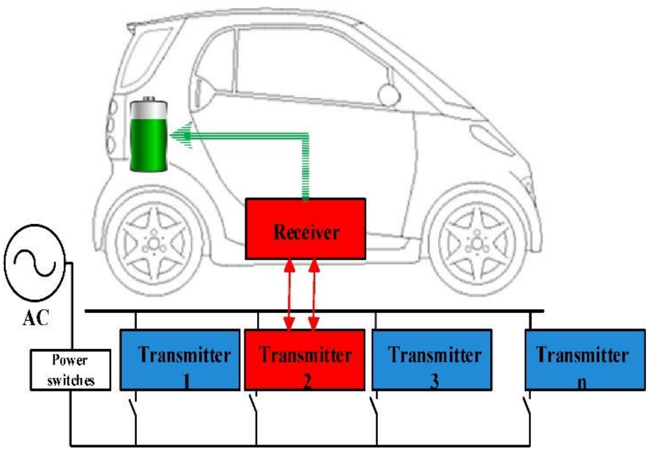

Fig 3.1: Power transmission from transmitter coil to receivercoil

Working of Transmitter Part:

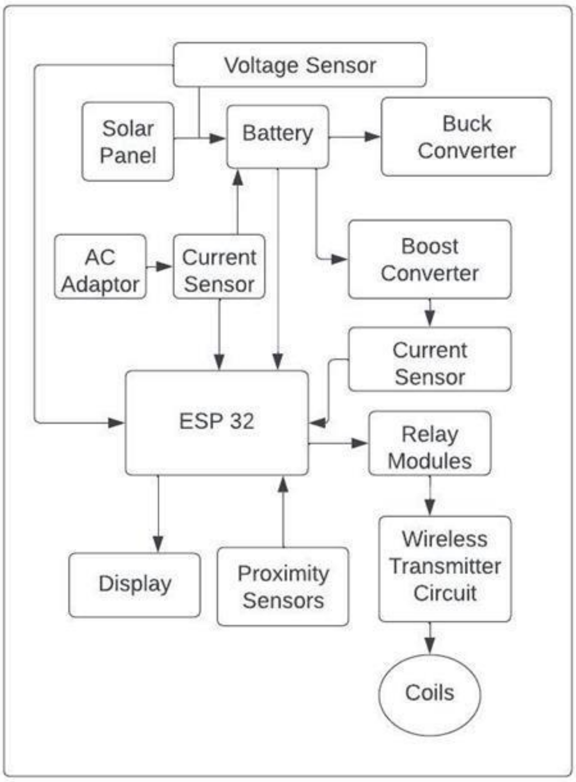

Fig 3.2: Transmitter part

In fig 3.2 the solar panel is used to capture solar energy and convert it into electrical energy. It is connected toa charge controller to regulate the amount of current and voltage supplied to the battery. The battery is used to store the electrical energy generated by the solar panel. It is connected to a battery management system (BMS) to monitorand regulate the battery's charging and discharging process. The buck converter is a DC-DC converter that reduces the voltage level from the battery to a lower level for efficient power transfer. The boost converter is a DC-DC converter that increases the voltage level from the battery to a higher level for efficient power transfer. The current sensor is used to measure the current flowing through the system to monitorand control the power transfer. The ESP 32 is a microcontroller used to control and manage the system'soperation, including monitoring and regulating the power transfer process. The proximity sensor is used to detect the presence of the receiver vehicle and activate the charging process. The relay module is used to switch the power supplyto the transmitter coil and control the power transfer process.The copper coil is used to generate a magnetic field to transfer power wirelessly to the receiver. The wireless transmitter circuit is used to control the power transfer process and communicate with the receiver to ensure efficient and safe charging.

As an alternative domestic power supply is used to generate the magnetic field in transmitter coil whenever thereis no sufficient current supply for the battery through solar panel.

Here the AC adaptor is used to convert AC power from themain power source to DC power for use by the system. Fig 3.2 shows the implementation of series of transmitter coil onpath

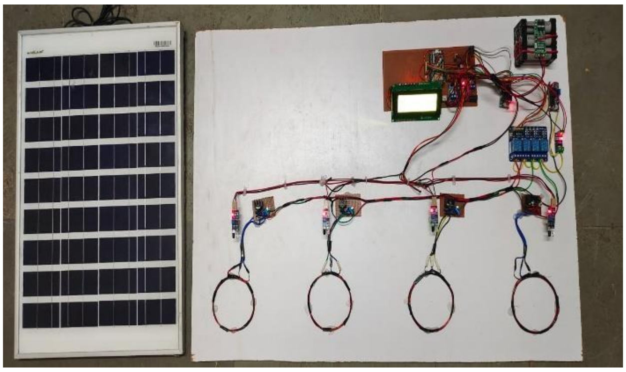

Fig 3.2: Series of Transmitter coil mounted on path. (Transmitter part of solar wireless electric vehicle chargingsystem)

Working of Receiver Part:

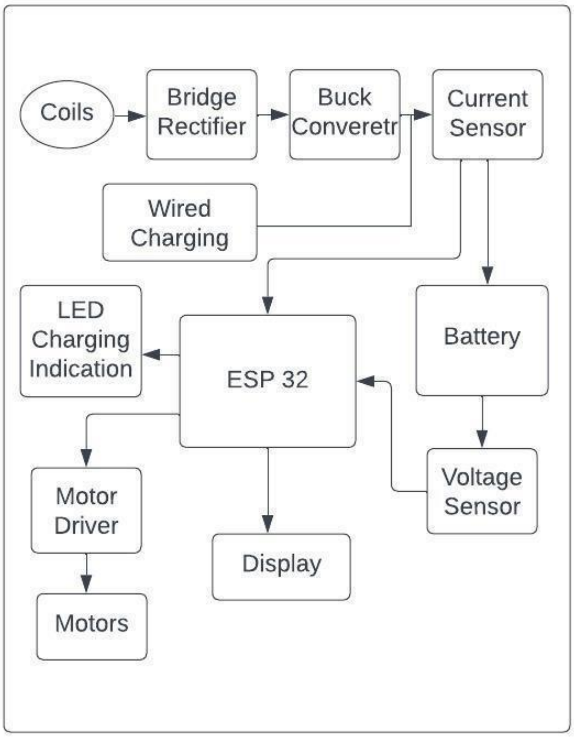

Fig 3.3: Receiver Part

In fig 3.3 the receiving coil is responsible for receiving the magnetic field generated by the transmitting coil and converting it into an electrical signal. The electrical signal isthen sent to the full bridge rectifier, which converts the AC signal into DC. The DC signal is then sent to the buckconverter, which regulates the voltage and current to the appropriate levels required by the battery. The buck converter is also responsible for maintaining a constant output voltage even when the input voltage changes due to variations in themagnetic field. The current sensor measures the current beingdrawn by the battery and sends this information to the ESP32microcontroller. The voltage sensor measures the batteryvoltage and sends this information to the ESP32 as well. TheESP32 microcontroller processes the information from the current and voltage sensors and controls the operation of thebuck converter, ensuring that the battery is charged safely andefficiently. The ESP32 also communicates with the display toshow the charging status and with the LED charging indicator to provide a visual indication of the charging status. The motor driver is responsible for controlling the motor, which is used to position the receiving coil for optimal charging efficiency. The motor driver receives instructions from the ESP32 microcontroller and adjusts the position of the receiving coil accordingly. Finally, the battery is charged using the wireless charging system and the charging status isdisplayed on the display and the LED charging indicator. Once the battery is fully charged, the ESP32 microcontrollerwill stop the charging process and the wireless charging system can be disconnected.

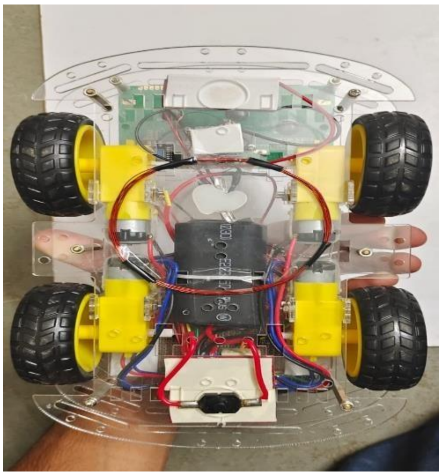

Fig 3.4: Receiving coil mounted below the vehicle

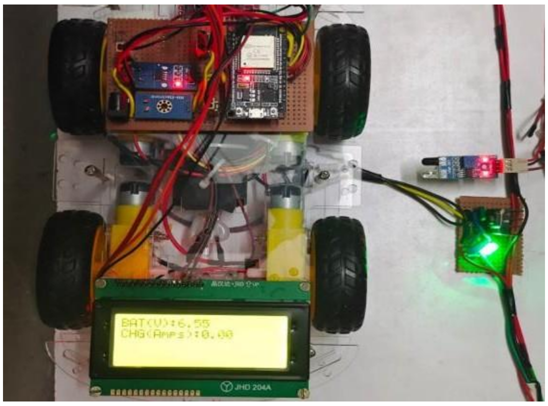

Fig 3.5: ESP 32 and other circuitry on the Chassis

RESULTS

The Solar Wireless Electric Vehicle Charging System is astate-of-the-art innovation that might completely change howelectric vehicles are charged. In comparison to conventional cable charging methods, this technology offers several benefits, including convenience, improved efficacy, cost effectiveness, and environmental friendliness. Drivers nolonger need to physically plug in their cars to charge them thanks to the wireless charging technology, which simplifiesthe procedure. The method can charge electric automobiles ata rate that is equivalent to that of conventional cable chargersand is also very effective, with little energy lost duringtransmission. In addition, wireless technology lowers maintenance costs associated with conventional cable charging systems, and the utilization of solar power greatly lowers the cost of charging electric cars.

Fig 4.1: Displaying results at transmitter part

Table 4.1: Values of transmitter part display

S.No	Component	Results
1	Battery	11.93v
2	Solar panel	6.37v
3	Domestic power supply	3.72amps
4	Transmitting Coil	15.24amps

Fig 4.2: Displaying results at receiving part

Table 4.2: Values of receiver part display

S.NO	Component	Results
1	Battery	7.01v
2	Receiving coil	0.81amps

CONCLUSION

The solar wireless electric vehicle charging system, in summary, is a promising innovation that has numerous advantages over conventional cable charging methods. Itlessens dependency on fossil fuels and enables quick and easycharging of electric vehicles without the use of bulky wires or connectors. A clean and renewable source of energy, the solar panel on the charging pad can generate electricity by using the sun's energy. Since there is no need for physical contact during the wireless power transfer between the charging pad and the vehicle, there is less chance of electricalhazards and damage to the charging cables. The battery is charged securely and effectively thanks to the employment ofan ESP32 microcontroller and other electronic components, which enables efficient and intelligent management of the charging process. Drivers can track the development of theircharging session thanks to the LED charging indication and display, which provide clear feedback on the vehicle's charging status.

REFERENCS

1. S. S. Patil and S. S. Lomte, (2020). "Optimal wireless power transfer for solar-powered electric vehicle charging".
2. S. S. Patil and S. S. Lomte, (2021) "Solar-powered wireless electric vehicle charging system Modeling and simulation".
3. Y. Li and Y.Cao,(2019) "Wireless charging technologies for electric vehicles: Enabling the future transportation system".
4. W. Yu et al, (2021) "Design and analysis of inductive power transfer systems for electric vehicle charging".
5. L. Zhang et al, (2021) "Modeling and optimization of inductive power transfer systems for electric vehicle charging".
6. Bugatha Ram Vara Prasad, M. Geethanjali, M. Sonia, S.Ganeesh, P. Sai Krishna,(2022) "Solar Wireless ElectricVehicle Charging System".
7. Prajakta Pawara, Shweta Deokate2, Archana Dighule, Rutuja Swami,(2022) "Solar based wireless EV charger".
8. Mohammad Abdullah Al Mamun, Mohammad Istiak, Khandakar Abdulla Al Mamun, Sharifa Akter Rukaia,(2020) "Design and Implementation of A Wireless Charging System for Electric Vehicles".
9. Rajbansi Devmani Kamalbahadur, S. Prabhu Ram, Konar,S.Suresh,M.R.Venugopalan,R.Karthikeyan,(201 7) "Wireless Charging of Electric Vehicles by Solar Powered Charging Station".
10. KundanKumar, Kantipudi V.V.S.R. Chowdary, P. Sanjeevikumar; Ramjee Prasad (2021) "Analysis of Solar PV Fed Dynamic Wireless Charging System for Electric Vehicles".