Research Paper | E-ISSN NO : 2455-295X | VOLUME : 9 | ISSUE : 6 | SPECIAL ISSUE JUNE-2023

IMPLEMENTATION OF ELECTRIC VEHICLE CHARGING STATION USING SUSTAINABLE ENERGY

DR.M.YUVARAJU	ASSISTANT PROFESSOR, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS, COIMBATORE, TAMILNADU, INDIA – 641046.
M.JENITHRAJ	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS, COIMBATORE, TAMILNADU, INDIA – 641046.
B.NILOPARNISHA	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS, COIMBATORE, TAMILNADU, INDIA – 641046.
I.POOVARASAN	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS, COIMBATORE, TAMILNADU, INDIA – 641046.
P.SOWMIYA	STUDENT, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, ANNA UNIVERSITY REGIONAL CAMPUS, COIMBATORE, TAMILNADU, INDIA – 641046.

ABSTRACT:

Today, the world is turning to electric transportation to reduce pollution from non-renewable vehicles and provide an alternative to expensive fossil fuels. But for electric cars, navigation and charging are the two main issues that affect them over conventional cars.

With the introduction of electronic devices, instead of waiting for hours at the charging station, you can now park your car in the car park or in your garage to charge it even while driving an electric vehicle. Increasing pollution and rapid consumption of fossil fuels (petroleum, diesel, etc.) pave the way for electric vehicles to enter the market.

However, charging electric vehicles with conventional energy will eliminate the goal of clean transportation. To benefit from an electric car, it is necessary to pay for the use of electricity from renewable sources such as solar and wind. In this project, the electric car is charged with three types of charging: DC fast charging, AC charging and wireless charging. Smart user authentication based on RFID (Radio Frequency Identity) is also built in.

KEYWORDS:

ELECTRIC VEHICLE, WIRELESS CHARGING, RENEWABLE ENERGY, CHARGING STATION.

INTRODUCTION

Electric vehicles (EVs) are expected to increase further in the next few years due to their fuel consumption and environmental impacts associated with their use. Therefore, there is a strong interest in working together to reduce urban pollution and greenhouse gas emissions. One of the most important problems in electric vehicle production now is the scarcity of electric charge. As the world continues to face the challenge of climate change, it is important that we move to a more energy efficient environment. Renewable energy, such as solar and wind power, is a greener and cleaner source of fossil fuels. Additionally, the widespread use of electric vehicles (EVs) can help reduce greenhouse gas emissions while improving air quality. However, EVs need to be available to realize their full potential as a clean, reliable, and convenient transportation option, including smart EV charging and renewable energy. Electric cars first appeared in the 19th century, when electricity was one of the most popular forms of motor propulsion at the time, providing comfort and ease of use in petrol cars. The internal combustion engine has been the primary propulsion of cars and trucks for nearly 100 years, but electricity is still present in other types of vehicles such as trains and all types of cars. An electric charging station is a device that connects an electric vehicle (EV) to a power outlet to charge electric vehicles, community electric vehicles and plug-in hybrid cars. Smart metering, cellular capabilities, internet connectivity etc are some of the modern features. In this project, the electric car is charged with three charging methods: DC fast charging, AC charging and wireless charging. Smart user authentication based on RFID (Radio Frequency Identity) is also built in. Wireless charging consists of a transmitter and a receiver, 220V 50Hz alternating current is converted into high-frequency alternating current, an alternating magnetic field is created by giving high-frequency alternating current to the transmitting coil, and the receiving coil is cut and created alternating current output in the receiving coil. RFID is short for "Radio-Frequency Identification" and refers to a system in which a radio wave reader can capture digital information encoded in RFID or smart paper (defined below). RFID is like barcodes where information from letters or symbols is captured by a device that stores the information in a file. However, RFID has many advantages over barcode scanner software. In particular, barcodes need to be scanned with an optical scanner while RFID tag information can be read out of sight. The rest of the paper is as follow: Section II has related work to this project. The existing and proposed works are described in Section III and IV respectively. Section V and VI discuss about the implementation and results respectively. At last, Section VII concludes the paper with conclusion.

MATERIALS AND METHODS

A) HARDWARE REQUIRED

1) Solar panel
2) Windmill
3) DC generator
4) LCD
5) Arduino
6) RFID Module
7) Relay
8) DC to DC Converter
9) Battery
10) Inverter
11) Lamp
12) DC charger
13) Wireless power transmitter and receiver

B) BLOCK DIAGRAM

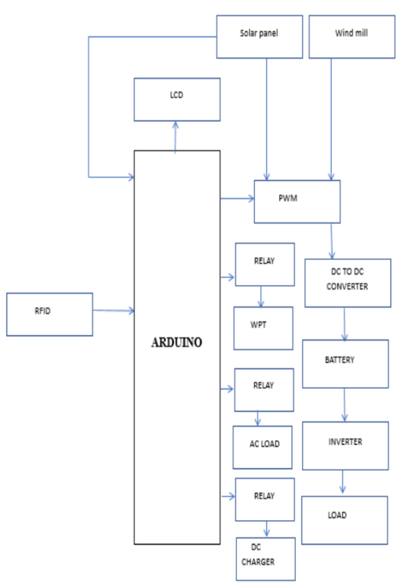

FIGURE 2: BLOCK DIAGRAM FOR WIRELESS CHARGING OF ELECTRIC VEHICLES USING RENEWABLE ENERGY.

C) PRINCIPLE

When you place a compatible car on the wireless charger, the magnetic field quickly interacts with the copper coil in the car and the magnet then generates electricity in a closed loop, which comes from electromagnetic induction.

EXISTING SYSTEM VS PROPOSED SYSTEM

A) EXISTING SYSTEM

Among the latest trends, wireless communication has emerged and is becoming more and more popular. The below block diagram comprises of Grid, rectifier, inverter, LC filter, linear transformer, super capacitor, and battery. This block diagram describes the existing system of wireless charging for electric vehicles. In the existing system the low frequency AC power is taken from the grid, is rectified, and converted to high AC power. To eliminate correlation LC filter is used in the system. High frequency AC power is input into the emitter coil, an electromotive force is induced in the receiver coil, and the electromotive force is converted from AC to DC. DC power is used to charge super capacitors. In this system, automatic control is used to control the transmitter coils of different types of electric vehicles. The control system consists of a MOSFET, a reflection filter and a saw tooth signal to achieve the desired output.

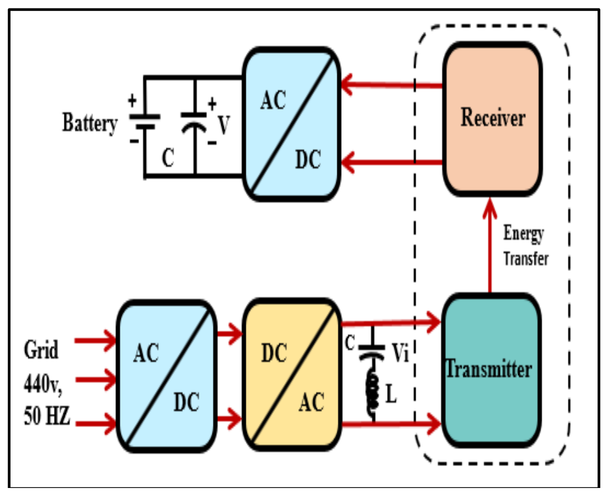

FIGURE 1: GENERAL BLOCK DIAGRAM FOR WIRELESS POWER TRANSFER FOR EV.

B) PROPOSED SYSTEM

In the proposed system, the wireless charging for electric vehicles is done with the help of renewable energy sources like solar and wind energy. This system promotes the target of having 500GW of installed renewable energy by 2030 in India.

The energy generated from the solar and wind sources is stored in the battery. And another battery is used to store the fluctuated voltage and gives constant voltage of 12V that is connected to the Arduino UNO R3. By this system the electric vehicle gets charged through three modes: DC Fast charging, AC charging and wireless charging. Smart wireless charging system uses Radio Frequency Identification. The below block diagram describes the proposed system of wireless charging for electric vehicles using renewable energy sources.

HOME CHARGING

Home charging involved in residential areas of private and public charging points. Using multiple home charging (HC) systems can increase EV use, especially in urban areas. HC infrastructure is better than other infrastructure types. A report on electricity and renewable energy in the United States showed that about 80% of charging stations are used for HC and most of the EV charging system will appear in the living area. This points to more charging in residential areas as well as reliance on grid-connected electric vehicles for EVs. Therefore, using more solar charging systems in residential areas can reduce grid dependency, increase electric vehicle use, and expand access to clean energy. Therefore, greenhouse gas emissions and pollution will get reduced.

WORKPLACE CHARGING

Companies are starting to use workplace charging (WC) or office charging for their employees to demonstrate their commitment to a green environmental idea. Workplaces were identified as the second most common place for employees to charge EVs in outdoors due to long-term parking, with 15-25% of charges occurring in the workplace. A few companies offer renewable energy charging in workplace. The provision of WC infrastructure can lead to daily driving, increasing the adoption and availability of electric vehicles. On the other hand, parked cars can be thought of as distributed devices that can supply power to the grid, called vehicle-to-grid (V2G). This integration allows the use of renewable energy. At the same time, renewable energy can be connected to the grid or a nearby microgrid to solve the problem of renewable energy conversion.

PUBLIC CHARGING

The Public Charging (PC) infrastructure is a charging station that EV drivers can easily access when needed. They are more suitable for the use of renewable energy sources than residential areas. Implementation of renewable provisions in residential areas has distinct problems such as parking availability, building restrictions (e.g., not enough space for solar panels) and management issues (e.g., For example, wind farms are often reserved outside the city). Public Charging stations include:

A. OPPORTUNITY CHARGING STATIONS

Opportunity Charging Stations (OCS) provide EV drivers with opportunities to charge while parking in public places such as shopping malls, airports, supermarkets, schools, parks, and restaurants. Drivers must stop for half an hour or more. Network payment contracts can be combined with OCS to create a support model where EV drivers can pay a flat monthly fee on a subscription, pay-as-you-go basis, or in some cases, free.

B. FAST CHARGING STATION

Fast charging stations (FCS) can solve the charging time issue that is critical in the adoption and delivery of electric vehicles. Fast-charging plays a significant role in expanding EVs' traveling to extent by having FCS forth the way. The off-board fast charging module is the fundamental to fast-charging stations. The corresponding current and voltage values are 20-200A and 45-450V, respectively. Such infrastructures should be sent to the control centre or station as they are all high.

C. BATTERY EXCHANGE STATION

A battery exchange station (BES) is a system where EV drivers can replace a dead battery with a fully charged one. Using BES can provide many benefits, such as very fast transaction times. Another important question regarding the advantages of BES is that no payment is made during peak demand. Other advantages of BES include low maintenance cost, long battery life and low consumption. However, BES also has some disadvantages such as high investment costs. BES structure requires sufficient space and battery management cannot guarantee battery safety.

B) IMPLEMENTATION

A. SOLAR PANEL

This module uses a solar panel, a device that converts sunlight into electricity using photovoltaic (PV) cells. Photovoltaic cells are made of materials that generate electrons when exposed to light. Electricity flows through circuits and creates direct current (DC) that can power various devices or be stored in batteries. Solar panels are usually arranged in groups called arrays or systems. A photovoltaic system consists of one or more solar panels, which are inverters that convert direct current (DC) to alternating current (AC).

FIGURE 3: ARRAY OF SOLAR PANELS

B. DC GENERATOR

Generators are used to convert motive power (mechanical energy) or fuel-based energy (chemical energy) into electrical energy for use in an external circuit. The reverse conversion of electrical energy into electrical energy is performed by an electric motor which has much in common with a generator. You can generate electricity by running many motors. They are often used as electronic devices.

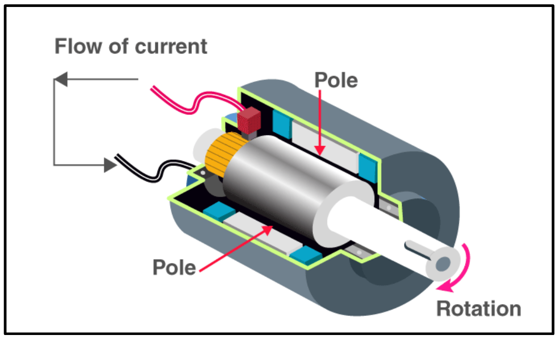

FIGURE 4: GENERATOR

C. INVERTER

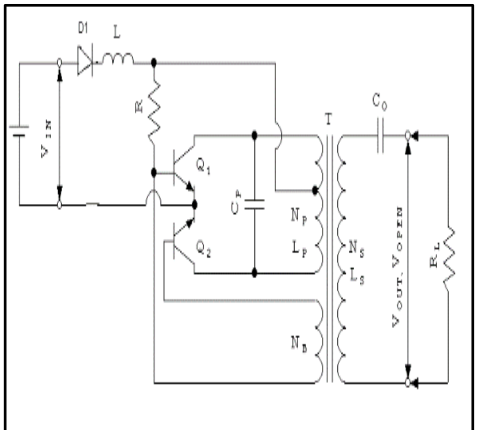

FIGURE 5: CIRCUIT DIAGRAM FOR INVERTER

This circuit is designed to receive 230VAC from a 12VDC input. AC loads can be powered from a DC source using a DC-AC converter. It consists of two transistors Q1 & amp: Q2 and one transformer (T). The output power depends on these three devices. Powered by a 12V DC input, the DC/AC converter uses a single stage inverter circuit to generate a quasi-sine wave output signal. When 12V DC is applied to the input, it first goes to diode D1 which is used to create reverse voltage. Then Q1 does first, at this time you can get 230V output positive cycle on the output transformer side. It lasts for a few seconds and saturates, followed by Q2 this time. This switching reverses the polarity on the output side with a constant output voltage of 230V. Q2 then holds and saturates for a few seconds and Q1 does. Likewise, this switching creates a 230V variable output at the transformer output. This continues until the input is applied to a circuit that provides a constant 230VAC output on the transformer side. The output voltage of the inverter is determined only by the transformer.

D. LCD

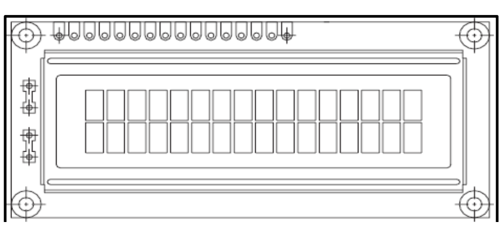

FIGURE 6: LCD DISPLAY

FEATURES

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

E. WIRELESS TRANSMITTER AND RECEIVER

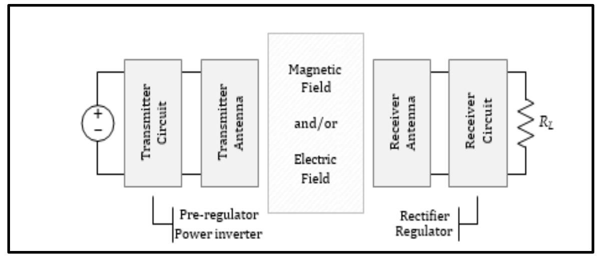

FIGURE 7: BLOCK DIAGRAM OF WIRELESS TRANSMITTER AND RECEIVER

The figure above shows a transmitter circuit consisting of a pre-regulator, square wave generator, gate driver and half-bridge power inverter. This circuit generates a concurrent periodic signal. Power FETs are driven by appropriate gate driver integrated circuits (ICs). The input of the gate driver is connected to a square wave generator such as a fixed frequency generator or a voltage controlled variable frequency generator. A pre-regulator can be thought of as a DC/DC converter whose regulated output voltage is connected to a power inverter. Changing the output voltage of the pre-regulator increases the amplitude of the square wave. Both the pre-regulator and the generator can be controlled by a microcontroller to change the amount of power transferred, save energy or optimize channel efficiency.

F. RELAY

A relay is an electrically operated switch. In this module, the current flowing through the relay coil creates a magnetic field that attracts the lever and changes the switch contacts. Since the coil current can be turned on or off, the relay has two switch positions and is a two position (transition) switch. A relay allows you to switch one circuit into a second circuit that can be disconnected from the first circuit.

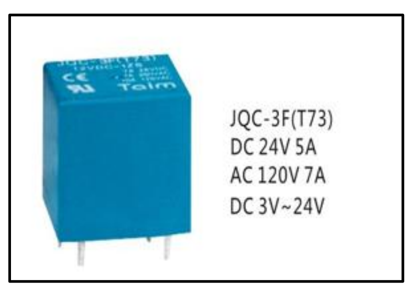

FIGURE 8: RELAY

G. RFID MODULE, CARD

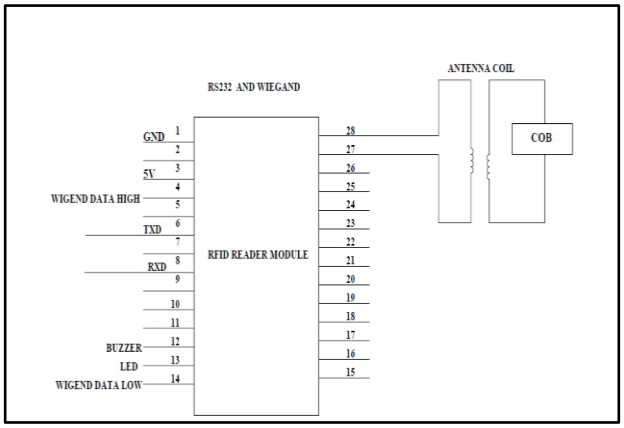

FIGURE 9: RFID READER MODULE

RFID readers are used to read RFID tags (with certain unique data stored when the chip is created). RFID readers and RFID tags are wrapped around a coil. When an RFID tag is displayed next to an RFID reader, it collects unique tag data (a combination of numbers and symbols) from the RFID tag. When an RFID tag is placed near a reader, electromagnetic induction occurs between the coils to power the chip inside the tag. This chip sends data to the reader in an electromagnetic way. The reader receives this electromagnetically transmitted data and outputs it sequentially.

RESULT

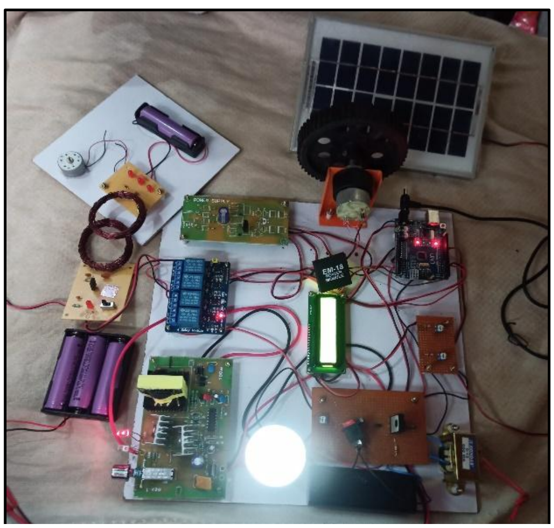

FIGURE 10: OUTPUT OF THE PROPOSED MODULE

The solar panel is connected to the voltage divider and the DC generator from the wind turbine is connected directly to the Arduino. When the driver parks the Electric Vehicle (EV) in the station of this proposed system, the main switch gives supply to the Arduino which is connected by the 5V adaptor. The voltage booster which is connected to induction coil, battery and voltage divider boost the fluctuated output voltage and gives constant output voltage of 12V. The LCD display which is connected to the Arduino display 12V constant output voltage and the output from the solar panel and wind turbine. And the RFID which made connection with Arduino demands the access card to choose three modes of charging. For charging the electric vehicle through the three modes of charging, the inverter is connected for each. When the driver scans the access card for wireless charging, the electric vehicle gets charged through the transmitter and receiver coil. The system gets stop when the access card scans again in RFID reader module. In this module the lamp gets glow when the driver chooses AC charging through scanning the access card.

A. MERITS COMPARED TO EXISTING APPROACH

1. The greater the use of renewable energy, the fewer charging points are needed to counter the electricity.

2. This module uses a boost converter to step up a low output voltage to a high voltage.

3 The proposed system reduces the use of charging ports.

4. This module leads to a pollution-free society.

CONCLUSION

There are many approaches and works around wireless charging of electric vehicles (EVs). In our work, the transition to renewable energy and smart charging of electric vehicles is critical to a more sustainable and cleaner future, and the system we propose will reduce dependence on fossil fuels, improve air quality and reduce climate change through investment. shows that it can help alleviate in the fields of renewable energy, smart electric vehicle charging systems and smart energy management. All of us can help build a better future for ourselves and future generations by making informed choices about our energy and transportation options.

REFERENCES

1. Agarwal, K.; Jegadeesan, R.; Guo, Y.X.; Thakor, N.V. Wireless Power Transfer Strategies for Implantable Bioelectronics. IEEE Rev.Biomed. Eng. 2017, 10, 136–161.

2. Wireless Power Consortium. Qi Specification Power Delivery; V1.3.; Wireless Power Consortium: Piscataway, NJ, USA, 2021.

3. Standard IEC 63028:2017; Wireless Power Transfer Airfuel Alliance Resonant Baseline System Specification (BSS). International Organization for Standardization: Geneva, Switzerland, 2017.

4. Raab, F.; Asbeck, P.; Cripps, S.; Kenington, P.; Popovic, Z.; Pothecary, N.; Sevic, J.; Sokal, N. Power amplifiers and transmitters for RF and microwave. IEEE Trans. Microw. Theory Tech. 2002, 50, 814–826.

5. Microsemi, P. Gallium Nitride (GaN) Versus Silicon Carbide (SiC) In the High Frequency (RF) and Power Switching Applications; Digikey:Thief River Falls, MN, USA, 2014.

6. Schuylenbergh, K.; Puers, R. (Eds.) Inductive Powering; Analog Circuits and Signal Processing; Springer: Dordrecht, The Netherlands, 2009.

7. Mai, R.; Liu, Y.; Li, Y.; Yue, P.; Cao, G.; He, Z. An Active-Rectifier-Based Maximum Efficiency Tracking Method Using an Additional Measurement Coil for Wireless Power Transfer. IEEE Trans. Power Electron. 2018, 33, 716–728.

8. Cochran, S.; Costinett, D. Frequency Synchronization and Control for a 6.78 MHz WPT Active Rectifier. In Proceedings of the 2018 IEEE 19th Workshop on Control and Modeling for Power Electronics (COMPEL), Padua, Italy, 25–28 June 2018; pp. 1–7.

9. Colak, K.; Asa, E.; Bojarski, M.; Czarkowski, D.; Onar, O.C. A Novel Phase-Shift Control of Semibridgeless Active Rectifier for Wireless Power Transfer. IEEE Trans. Power Electron. 2015, 30, 6288–6297.

10. Ahn, D.; Hong, S. A Study on Magnetic Field Repeater in Wireless Power Transfer. IEEE Trans. Ind. Electron. 2013, 60, 360–371.

11. Rindorf, L.; Lading, L.; Breinbjerg, O. Resonantly coupled antennas for passive sensors. In Proceedings of the 2008 IEEE Sensors, Lecce, Italy, 26–29 October 2008; pp. 1611–1614.

12. Baker, M.W.; Sarpeshkar, R. Feedback Analysis and Design of RF Power Links for Low-Power Bionic Systems. IEEE Trans. Biomed. Circuits Syst. 2007, 1, 28–38.