SOLAR WIRELESS ELECTRIC VEHICLE DYNAMIC CHARGING SYSTEM

[1] Arji Tejasri, [1] Gurrala Sunitha, [1] Gundam Sushma, [1] Goruputi Kalyani,
[1] Dadi Venkata Shruti, ,[2] B.T. RamaKrishna Rao
[2] Associate Professor, [1,2] Department of Electrical and Electronics Engineering, Vignan's Institute of Engineering for Women, Kapujaggarajupeta, VSEZ (Post), Visakhapatnam,
Andhra Pradesh-49, India

ABSTRACT :

Solar Wireless Electric Vehicle Dynamic Charging System (SWEVDCS) incorporates advanced induction technology. With the ever-growing demand for eco-friendly solutions, this system aims to address the limitations of conventional electric vehicle charging infrastructure. Existing electric vehicle charging systems often face challenges such as limited accessibility and dependence on grid power. The proposed SWEVDCS seeks to overcome these constraints by integrating solar energy and wireless charging technologies, promoting a more efficient and environmental friendly alternative. The SWEVDCS utilizes solar panels that allow harnessing the abundant energy from the sun. The wireless charging technology eliminates the need for physical connections, enhancing user convenience and expanding the potential for autonomous charging. This whole system describes how an electric vehicle can be charged in moving conditions and also eliminates the need to stop the vehicle and charge it**.**

Keywords— Electric Vehicles (EVs), Solar Energy Harvesting, Wireless Power Transfer, Dynamic Charging, Sustainable Transportation**.**

INTRODUCTION :

The transportation sector is undergoing a significant transformation driven by the urgent need to mitigate environmental impacts and reduce dependency on fossil fuels. Electric Vehicles (EVs) have emerged as a promising solution to address these challenges by offering a cleaner and more sustainable mode of transportation. However, the widespread adoption of EVs is hindered by limitations such as limited driving range and the inconvenience associated with traditional charging infrastructure.To overcome these challenges, innovative approaches to charging infrastructure are imperative. One such approach is the integration of solar energy harvesting and wireless power transfer technologies to enable dynamic charging of EVs while in motion. This paper introduces a Solar Wireless Electric Vehicle Dynamic Charging (SWEVDC) system, which represents a significant advancement in sustainable transportation technology The SWEVDC system leverages the abundant and renewable energy resource of the sun to continuously charge EVs as they travel along roadways. Solar panels integrated beside the road surface capture solar energy, which is then converted and wirelessly transferred to the EV's through inductive coupling. This eliminates the need for conventional plug-in charging stations and enables seamless charging without interrupting the vehicle's operation.In this paper, we present the design, implementation, and performance evaluation of the SWEVDC system. We discuss the key components of the system, including solar panels, transmitting and receiving coils.
The SWEVDC system offers several advantages, including extended driving range, reduced dependency on grid electricity, and minimal environmental impact. Additionally, its compatibility with existing road infrastructure makes it a practical solution for widespread deployment. Overall, this paper contributes to the advancement of sustainable transportation systems by introducing a innovative approach to dynamic electric vehicle charging.

LITERATURE SURVEY:

Dileep Kumar Kohar [1] has developed a system that combines solar panels, spiral copper coils, and IR sensor-based control mechanisms to facilitate efficient power transfer from the road infrastructure to the EV. Through comprehensive experimentation and analysis, the study demonstrates promising results, achieving 40% efficiency at a distance of 15mm between the transmitter and receiver coils. Bugatha Ram Vara Prasad [2] presents a novel approach to EV charging by leveraging solar power and wireless technology, potentially addressing some of the challenges associated with traditional EV charging infrastructure. Anitha's [3] analysis focuses on assessing the charging system's efficiency by examining the misalignment distances between the transmitter and receiver coils. Their study illustrates the relationship between output voltage and efficiency and how they fluctuate with different degrees of misalignment. Nivedita Muganur [4] details the operation of both the transmitter and receiver parts of the charging system. The transmitter part includes components such as solar panels, a charge controller, batteries, and a wireless transmitter circuit. On the other hand, the receiver part consists of a receiving coil, rectifier, buck converter, and microcontroller. Virendra Kumar Chaudhari [5] describes the variation in voltage received by the receiver coil based on the distance between transmitter and receiver coils and the speed of the electric vehicle. Presents a table showing voltage readings at different distances between the transmitter and receiver coils.

EXISTING SYSTEM:

The growing presence of electric vehicles (EVs) on our roads reflects their effectiveness in slashing travel expenses by transitioning from costly fossil fuels to the more economical option of electricity, while also significantly reducing environmental impact. However, a primary focus lies in implementing charging systems that incentivize shorter charging durations to encourage turnover and efficient use of charging infrastructure. Currently, the prevailing charging system for EVs operates on a conductive basis, requiring the vehicle to be physically connected to a charging station to replenish its battery. Nonetheless, a notable drawback is the comparatively longer time required for charging at these stations compared to the quick refueling process of conventional vehicles. Despite this challenge, the EV charging infrastructure is rapidly expanding, with an increasing number of public and private charging stations being deployed across highways, parking lots, and urban areas.

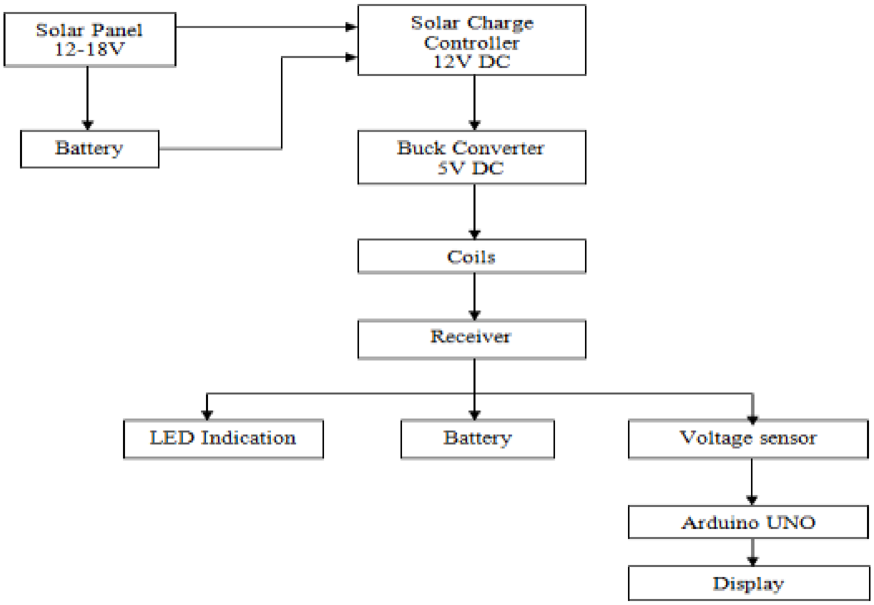
LIMITATIONS OF EXISTING EV CHARGING SYSTEM :

Existing conductive electric vehicle charging systems face several limitations that hinder their widespread adoption. Firstly, the reliance on physical connectors poses durability and maintenance challenges, leading to potential wear and tear issues over time. Secondly, the limited availability of charging stations and the time-consuming nature of the charging process contribute to range anxiety among EV drivers. Additionally, the varying charging standards and protocols across different manufacturers create compatibility issues, limiting interoperability and convenience. Furthermore, the dependence on grid electricity for charging raises concerns about energy grid strain and carbon emissions. Lastly, the lack of scalability and flexibility in charging infrastructure deployment inhibits the seamless integration of EVs into the broader transportation ecosystem.

PROPOSED SYSTEM :

The proposed solar wireless electric vehicle dynamic charging system is a ground-breaking solution aimed at revolutionizing the way electric vehicles (EVs) are charged. Through the strategic placement of solar panels along roadways and in parking lots, sunlight is harnessed and converted into electricity, providing a renewable energy source for charging. This power is then wirelessly transmitted to EVs via embedded charging infrastructure, eliminating the need for physical connections and enabling seamless charging while driving. EVs equipped with compatible receiver coils seamlessly receive power, charging their batteries efficiently as they travel. The integration of solar panels with the smart grid enables bidirectional power flow and energy optimization. The scalable design of the system allows for expansion to accommodate growing EV adoption and the integration of additional charging infrastructure. By providing a sustainable and convenient charging solution, this innovative system promotes the widespread adoption of electric vehicles and contributes to a cleaner and greener transportation ecosystem.

1. BLOCK DIAGRAM OF PROPOSED SYSTEM :



2. HARDWARE COMPONENTS :

- **SOLAR PANEL:** A solar panel is a device that converts sunlight into electricity by using photovoltaic (PV) cells. A 10W solar panel can be used for various applications that require a low to medium amount of power. It can be used to power LED lights, fans, and other low-power appliances. A 10W solar panel is perfect for charging a mobile phone or a small electric vehicle with a lithium-ion battery.

Fig.1: 10watts Solar Panel

- **TRANSMITTING & RECEIVING COILS:** Transmitting coils in dynamic EV charging systems generate alternating magnetic fields for wireless transmission. Receiving coils, placed within the range of the transmitting coil's field, induce current via electromagnetic induction. Receiving coils are engineered to efficiently capture induced currents and convert them into electrical energy for charging the vehicle's battery. Efficient coil design ensures optimal energy transfer and minimizes losses during dynamic charging operations.

Fig.2: Transmitting & Receiving coils

- **VOLTAGE SENSOR:** The ZMPT101B AC Voltage Sensor module is an electronic component used to measure the AC voltage of a power system or electronic equipment. It is a non-invasive sensor module, which means that it does not require direct contact with the voltage source, making it safer to use than some other voltage measurement methods

Fig.3: Voltage Sensor

- **ARDUINO UNO:** Arduino Uno is an open-source microcontroller board based on the ATmega328P chip, equipped with digital and analog input/output pins for interfacing with various sensors, actuators, and devices. It is commonly used for prototyping and DIY electronics projects due to its ease of use, versatility, and extensive community support. The Uno can be programmed using the Arduino Integrated Development Environment (IDE) to control hardware and perform various tasks.

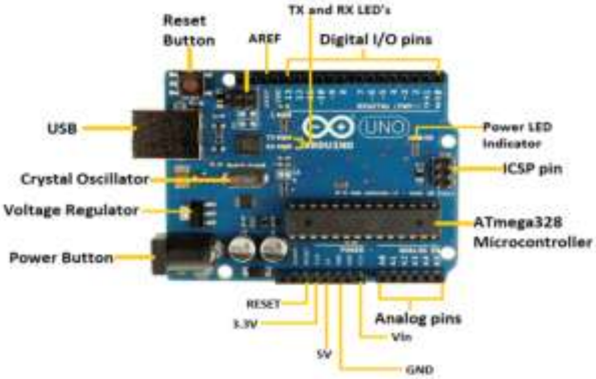


Fig.4: Arduino Uno

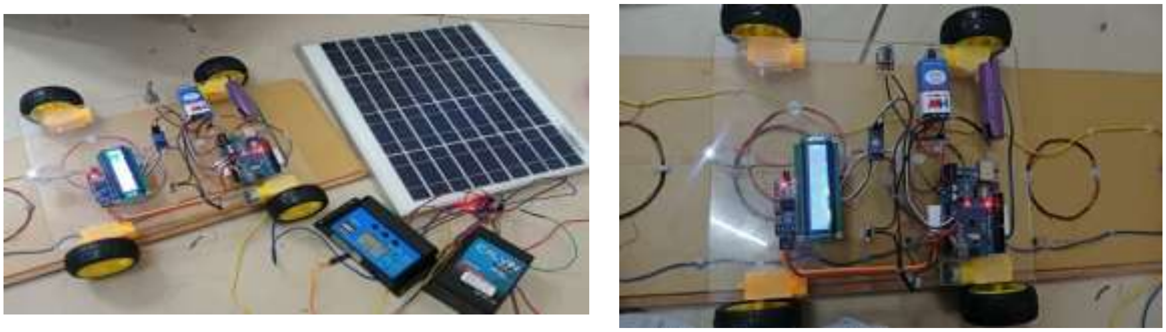
- **16*2 LCD DISPLAY:** A 16x2 LCD (Liquid Crystal Display) is a commonly used alphanumeric display module with 16 columns and 2 rows of characters. It typically has a backlight for visibility in low-light conditions. These displays are widely used in embedded systems and electronics projects for displaying text-based information such as sensor readings, messages, and menu options.

Fig.5: 16*2 LCD Display

METHODOLOGY :

In a solar wireless electric vehicle dynamic charging system, the process begins with the solar panel capturing sunlight and converting it into electrical energy. This energy is then regulated by the solar charge controller, ensuring optimal charging efficiency while protecting the battery from overcharging. The battery serves as an energy storage unit, storing solar energy during daylight hours for later use in charging the electric vehicle. A buck converter is employed to adjust the battery voltage to the appropriate level for powering the transmitter circuit. The transmitting coils responsible for generating alternating magnetic fields with the help of transistor. A 10k resistor is utilized to bias the transistor's base and limit current flow. On the receiving end, coils induce current from the transmitted magnetic fields, with a voltage sensor measuring the voltage across these coils to provide feedback. An LED indicator visually communicates the charging status, while a potentiometer offers control over vehicle wheel movements, adjusting speed or direction. Additionally, an LCD display offers real-time updates on charging status and vehicle control settings, providing a comprehensive interface for monitoring and managing the system. Overall, this integrated system facilitates efficient and wireless charging of electric vehicles using solar energy, while enabling control over vehicle movement for enhanced user experience and functionality.

3. HARDWARE SETUP



Experimental setup using IOT application

The hardware setup for a solar wireless electric vehicle dynamic charging system includes high-efficiency solar panels, a solar charge controller, and rechargeable batteries for energy storage. Wireless charging infrastructure with inductive charging coils is integrated. On the receiving side, the setup includes a receiver coil installed in the electric vehicle (EV) for wireless energy transfer. This coil interfaces with the vehicle's onboard charging system to convert received energy into electrical power.

4. EXPERIMENTAL RESULTS

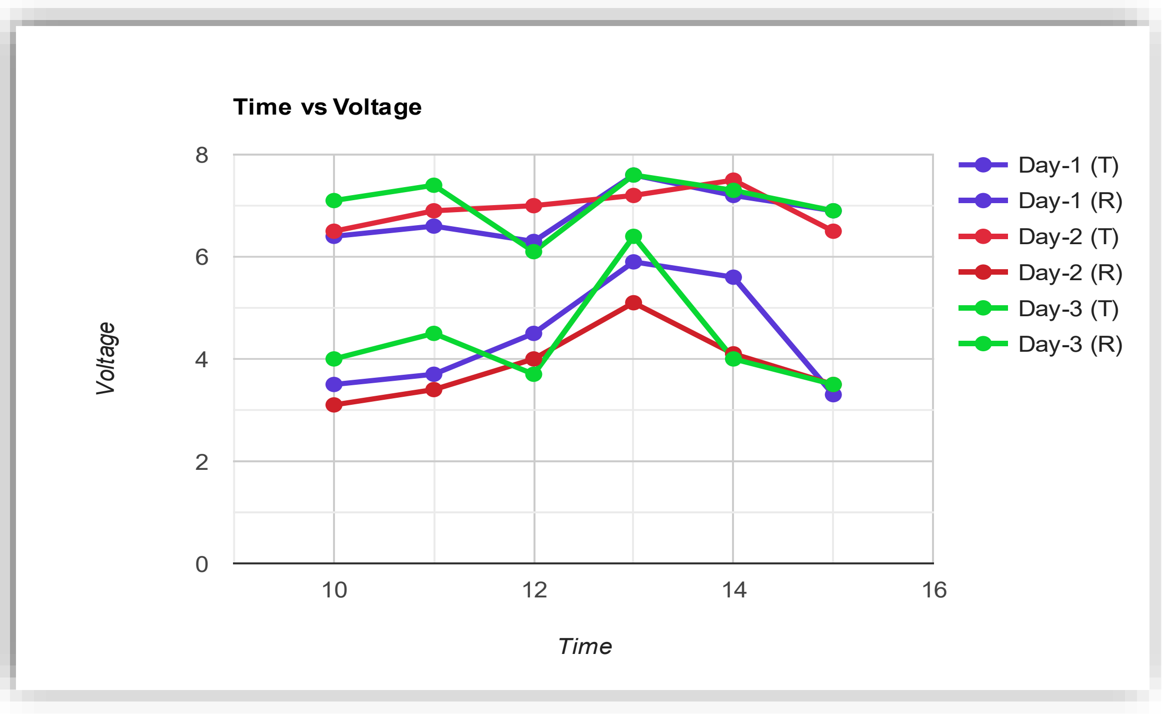
The provided data illustrates the fluctuating solar panel output voltage and receiving voltage over a period of time, showcasing variations and trends in the power generation and reception process. The data reveals both expected and unexpected changes, providing insights into the efficiency and performance of the solar system.

- **RESULT ANALYSIS**

T-Transmitting voltage **R-Receiving voltage**

Time	Day-1 (T)	Day-1(R)	Day-2 (T)	Day-2 (R)	Day-3 (T)	Day-3 (R)
10:00AM	6.4V	3.5V	6.5V	3.1V	7.1V	4V
11:00AM	6.6V	3.7V	6.9V	3.4V	7.4V	4.5V
12:00PM	6.3V	4.5V	7V	4V	6.1V	3.7V
1:00PM	7.6V	5.9V	7.2V	5.1V	7.6V	6.4V
2:00PM	7.2V	5.6V	7.5V	4.1V	7.3V	4V
3:00PM	6.9V	3.3V	6.5V	3.5V	6.9V	3.5V

- **GRAPHICAL REPRESENTATION OF ABOVE TABULAR FORM**



Time vs Voltage in different days

The solar wireless electric vehicle dynamic charging system exhibits significant variations in transmitting and receiving voltages across morning, midday, and late afternoon periods. From 10:00 to 12:00, voltage fluctuations between 6.1v to 7.1v for transmitting and 3.1v to 4v for receiving suggest instability, potentially affecting charging efficiency. However, by 13:00, transmitting voltages peak at

7.6v and receiving at 6.4v, indicating improved efficiency, which persists with minor fluctuations until early afternoon.In the late afternoon, from 14:00 to 15:00, both transmitting and receiving voltages experience a slight decline, ranging from 6.3v to 6.9v and 3.3v to 5.6v, respectively. These variations suggest challenges in maintaining consistent power delivery, emphasizing the need for optimization strategies. Overall, the system's dynamic behavior underscores the importance of adaptive control mechanisms to ensure reliable charging performance, especially during periods of varying solar conditions and peak demand.

CONCLUSION :

The solar wireless electric vehicle dynamic charging system represents a significant advancement in sustainable transportation technology. Through meticulous integration of solar power capture and wireless charging, it optimizes energy utilization and enhances user convenience. By harnessing sunlight to charge electric vehicles wirelessly, it reduces reliance on traditional energy sources and mitigates environmental impact. The seamless coordination between components, including the solar panel, charge controller, and transmitting coils, ensures efficient energy transfer and protects battery health. With real-time feedback mechanisms like the LED indicator and voltage sensor, users can monitor charging progress and vehicle control settings with ease.

FUTURE SCOPE :

Looking ahead, there's a lot of exciting potential for the solar wireless electric vehicle dynamic charging system project. One big area to focus on is making the system even better at transferring energy from the sun to electric vehicles. This might involve finding new materials or ways of setting things up to make the process more efficient. Another important thing to think about is making the system work well in different situations, like on highways or in cities. We can also explore ways to connect it with smart energy systems, so it can work together with existing power networks. Additionally, as self-driving cars become more common, we can think about how to make dynamic charging systems that fit with them.

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