JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

SOLAR TOP-ROOF CHARGING SYSTEM

Dr. G. Divya[1], V. Sai Deepthi[2], S. Lahari[3], N. Sravani[4]

Assistant Professor, Dept. of Electronics & Communication Engg., Bapatla Women's Engineering College, Bapatla

Student, Dept. of Electronics & Communication Engineering, Bapatla Women's Engineering College, Bapatla

ABSTRACT

The Arduino-based Solar top-roof charging system is an innovative transportation solution designed to harness renewable energy and promote sustainable mobility. This project integrates solar panels onto the roof of a car to capture sunlight and convert it into electrical energy, providing an eco-friendly alternative to traditional gasoline-powered vehicles. The system comprises two batteries: one dedicated to grid charging support and the other for solar charging while the vehicle is in motion. A sophisticated battery management system ensures seamless switching between the batteries, optimizing energy utilization and extending the vehicle's range. The core of the system is built around an Arduino microcontroller, coupled with an L298 motor driver and DC motors, enabling precise control over vehicle movement. Additionally, a Bluetooth module facilitates remote control and monitoring of the car's functions via a smartphone application. A LED is integrated into the system, enhancing safety and user experience.

Keywords: Solar panel, ARDUINO UNO, voltage sensor, Electric vehicle.

1.OBJECTIVE

To design and implement a solar top-roof charging system with a dual battery management system and Bluetooth control to overcome the identified challenges. The project aims to provide a sustainable and user-friendly solution, demonstrating the feasibility of renewable energy integration and efficient energy management.

2.INTRODUCTION

Electric cars are being used because they're cheaper to run and good for the environment. Electric cars are charged by plugging them in, which is slow. Cars can charge while moving through wireless charging [1]. Electric vehicle charging stations are more reliable and eco-friendly by using wireless charging, plug-in charging, and solar energy to power them [2]. A new solar-powered electric car charging station is effective, but installing many is challenging. They design and test it using computers, and one is now in a research center's parking IOT [3].

Bugatha Ram Vara Prasad [4] et al. proposed a solar charging station for electric vehicles. It gathers sunlight with solar panels, changes it to electricity, and manages charging to make the best use of renewable energy. M. Singh [5] proposed a system for electric vehicles to help the local power grid. It uses a communication network and smart algorithms to decide when cars charge and discharge, making better use of renewable energy and reducing reliance on the main power grid. T.D. Nguyen [6] et.al investigated dual-charge protectors for wireless power chargers. They assessed their performance and efficiency, emphasizing the potential advantages of this technology in reducing the need for physical connections. Mouli [7] created a solar-powered system that charges batteries, even when some parts of the solar panels are shaded. They used a special method called Cauchy-Gaussian sine cosine

optimization to track the best point for getting maximum power from the sunlight, making sure the system uses solar energy efficiently.

Muttaqi [8] et.al created a plan for charging electric vehicles at home. They made sure it considers how much renewable energy will be available and how much energy the house needs, so it can make the best schedule for charging the EVs while balancing energy use. Shafaati Shemami and Leo [9] suggested a plan where electric vehicles can power homes using solar energy, helping manage changing electricity prices more efficiently. Khan [10] conducted a review of different techniques associated with solar-powered electric vehicle (EV) charging stations. Electric vehicles (EVs) can be charged wirelessly, and this is often done in charging stations. Solar panels can also be used in conjunction with conditioning units to convert solar energy into electrical energy to run EVs. However, charging an electric vehicle can take more time than refueling a traditional gasoline-powered vehicle.

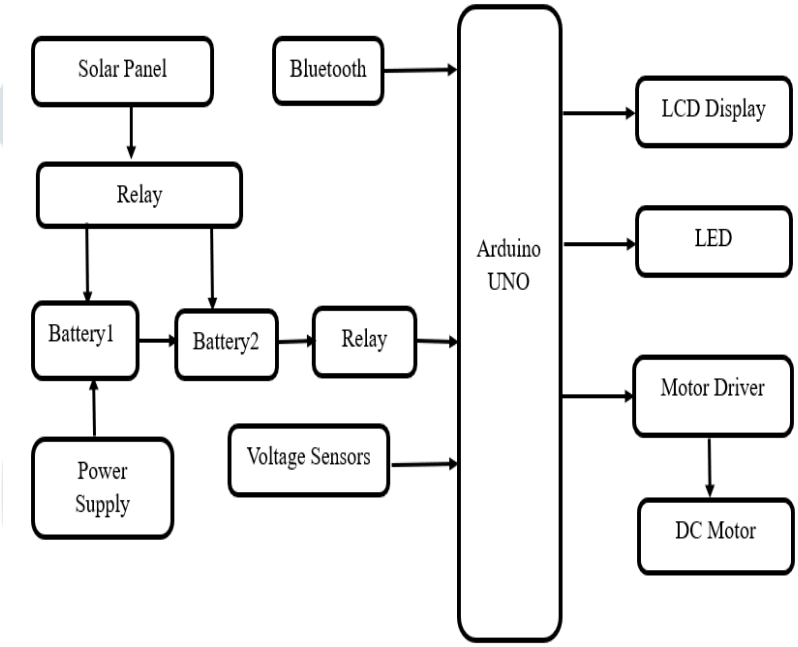
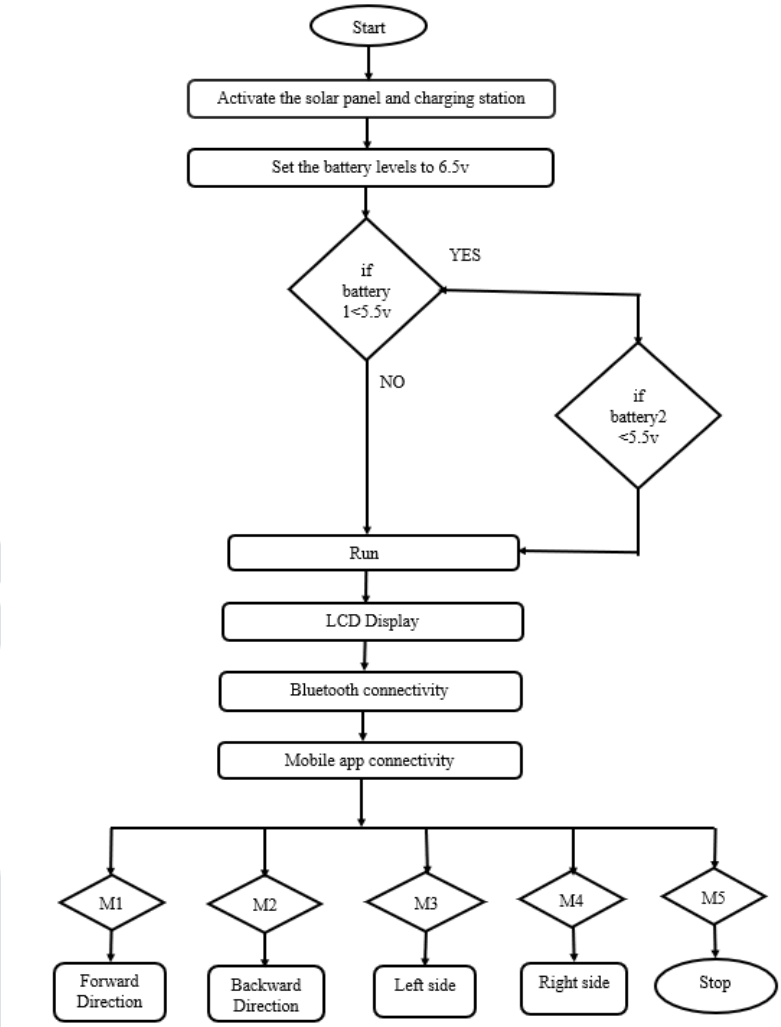


Fig-1: Block diagram of Solar top-roof wireless charging system

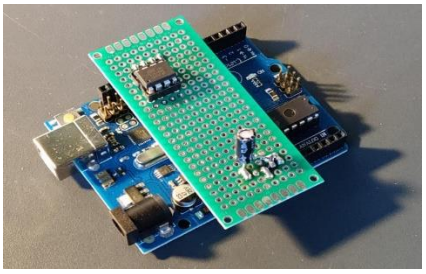
The proposed Arduino-based Solar top-roof charging system is a groundbreaking transportation solution designed to overcome the limitations of existing methods by harnessing solar energy for propulsion while offering advanced control, monitoring, and user-friendly features. The system integrates solar panels onto the roof of the vehicle to capture sunlight and convert it into electrical energy, which is used to power the vehicle's propulsion system and auxiliary components. The vehicle is equipped with a dual-battery management system, where one battery is dedicated to charge from solar panels, and other powers the vehicle during its optional phase.

3.HARDWARE DESCRIPTION



A. ARDUINO UNO HAT:

An Arduino UNO HAT is a board that can be attached to an Arduino UNO to add extra features and functionalities. HAT stands for "Hardware Attached on Top." It is a type of shield that extends the capabilities of the Arduino UNO, allowing for more complex projects and applications. The HAT can include various components such as sensors, LEDs, buttons, and other electronic modules, and can be programmed using the Arduino IDE. These boards facilitate prototyping by eliminating complex wiring. Users can easily integrate sensors or other modules into their projects without extensive hardware knowledge. Arduino UNO HAT offer versatility for various applications, from robotics to IOT.



B. SOLAR PANEL:

A solar panel is a device that converts sunlight into electricity using photovoltaic cells. These cells are made of materials that produce excited electrons when exposed to light, which then flow through a circuit to produce direct current electricity. Solar panels are often arranged in groups called arrays or systems and can be used for various applications, such as providing electricity for off-grid homes or feeding electricity into the grid. They offer several advantages, such as reducing greenhouse gas emissions, and lowering electricity bills. However, they also have some disadvantages, such as depending on sunlight availability and intens ity, requiring cleaning, and having high initial costs.

C. LCD DISPLAY:

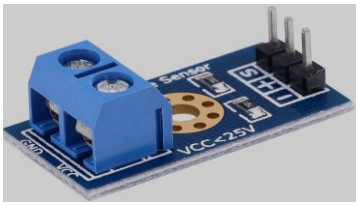
A 16x2 LCD display is a type of Liquid Crystal Display (LCD) that has 16 columns and 2 rows of characters. It is a common display used in electronic devices, such as microcontrollers, calculators, and measurement instruments. The display is made up of a matrix of pixels, which can be turned ON or OFF to create characters or graphics. The display is controlled by a microcontroller or a computer, which sends signals to the display to turn ON or OFF the pixels. LCD displays offer several advantages, such as low power consumption, high contrast.

D. HCO5 BLLUETOOTH:

The HC-05 is a Bluetooth module that can be used to add wireless communication capabilities to electronic devices. It is a popular module that is compatible with the Bluetooth 2.0 standard and supports both Serial Port Profile (SPP) and HID (Human Interface Device) protocols. The module can be connected to a microcontroller or a computer through a UART interface, and it can communicate with other Bluetooth devices within a range of up to 10 meters.

E. VOLTAGE SENSOR:

A voltage sensor measures potential difference in a circuit, offering an output signal proportional to the voltage. It aids in monitoring and controlling electrical systems, providing crucial feedback for safety and efficient operation.

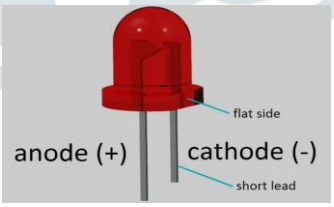


F. RELAY:

A relay functions as an electrically controlled switch, with an input side for a small signal and an output side for controlling a larger circuit. It toggles the output circuit based on the presence of the input signal. Widely used to manage high-power devices with low-power signals.

G. LED (Light Emitting Diode):

An LED is a tiny light powered by electricity, emitting light through special materials. They come in various colors, used in indicators, defenses, and home lighting. Noteworthy for energy efficiency, durability, and easy electronic control. LEDs have anode and cathode terminals, requiring a resistor for controlled current. Used individually or in clusters, their glow can be altered with different covers.

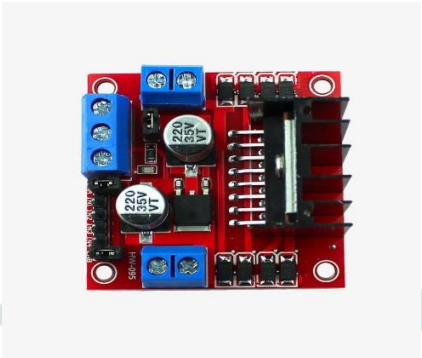


H. BATTERY:

A battery is like a little power pack that stores energy and gives it out when needed. It's made up of chemicals inside a case, and when you connect wires to it, those chemicals react and produce electricity. Batteries come in different shapes and sizes, like the ones in toys, phones, or cars. When a battery runs out of energy, we can recharge it or replace it with a new one to keep using our devices.

I.MOTOR DRIVER:

The L298 motor driver IC is widely used for DC motor control, featuring dual H-bridge circuits for independent motor control. Each H-bridge includes four transistors for managing current flow, enabling forward, reverse, and braking functions. Ideal for robotics and automation, it supports up to 3 amperes at 35 Volts DC. Motor speed is regulated using PWM signals on the enable pin, with speed proportional to the duty cycle.

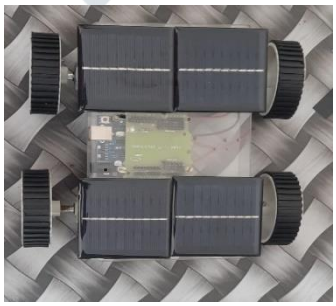


J. DC MOTOR:

DC motors are devices that convert electrical energy into mechanical energy to produce rotational motion. They consist of two main parts: a stationary part called the stator and a rotating part called the rotor. When electric current flows through the wires in the stator, it creates a magnetic field that interacts with the magnetic field generated by the rotor. This interaction causes the rotor to rotate, resulting in motion.

K. VEHICLE:

The vehicle used here is a manually moved with four wheels.



4.RESULT

The results of the ST-RCS project demonstrate the practicality of implementing a solar top-roof charging system. Managed by an Arduino UNO, this system efficiently replenishes EV batteries using solar power. Utilizing wireless power transmission, the

system seamlessly transfers power until battery levels are low, whereupon it switches to an alternate battery using a relay mechanism. When battery1 is less than 5.5v automatically it switches to battery2, by using relay.

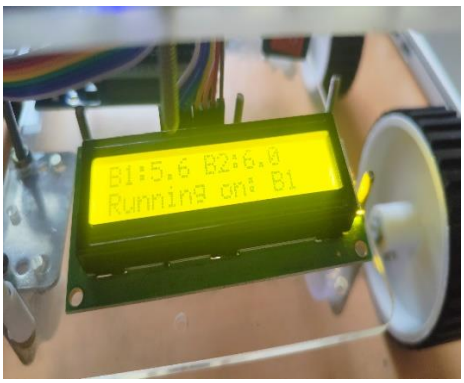


Fig: Battery running on B1

Fig: Battery running on B2

Weather conditions prompt the activation of battery 2, directed towards charging stations. A user-friendly LCD display offers clear visibility into the charging process, enabling users to easily monitor progress.

Fig: ST-RCS while charging

This technology harnesses sustainable solar energy, enabling electric vehicles to charge while parked or in motion. Usability testing reveals that the system offers convenient and user-friendly operation, with users expressing satisfaction with the simplicity and effectiveness of the wireless charging process. Compared to conventional charging methods, the solar top-roof wireless charging system offers comparable charging speeds and greater convenience, particularly in scenarios where access to charging infrastr ucture is limited.

Fig: Solar Top-Roof Charging System

5.CONCLUSION

The Arduino-based Solar top-roof charging system represents a significant advancement in sustainable transportation technology, offering a practical and eco-friendly alternative to conventional gasoline-powered vehicles. By harnessing the power of solar energy, this innovative vehicle reduces reliance on fossil fuels, minimizes carbon emissions, and promotes environmental sustainability. Through the integration of intelligent battery management systems, Bluetooth connectivity, and advanced control algorithms, the Solar charging system provides efficient energy utilization, user-friendly operation, and enhanced convenience. Its versatility allows for applications in personal transportation, urban mobility, fleet operations, recreational activities, public transit, and emergency response, making it a versatile solution for various transportation needs. Moreover, the Solar top-roof charging system exemplifies the potential of renewable energy integration and smart technologies in shaping the future of transportation. By promoting clean energy usage, reducing environmental impact, and enhancing energy independence, it contributes to a greener and more sustainable world.

REFERENCES

[1] C. C. Mi, G. Buja, S. Y. Choi, and C. T. Rim, "Modern Advances in Wireless Power Transfer Systems for Roadway Powered Electric Vehicles," in IEEE Transactions on Industrial Electronics, vol. 63, no. 10, pp. 6533-6545, Oct. 2016.

[2] A. Shahin, J. -P. Martin, S. Pierfederici and A. M. Sharaf, "Integration of Renewable Energy sources to Wireless Charger of Electrical Vehicle," 2021 22nd IEEE International Conference on Industrial Technology (ICIT), Valencia, Spain, 2021, pp. 397-402, doi: 10.1109/ICIT46573.2021.9453645.

[3] M. C. Kisacikoglu, "Vehicle-to-grid (V2G) reactive power operation analysis of the EV/PHEV bidirectional battery charger," Ph.D. dissertation, University of Tennessee, Knoxville, 2019.

[4] Bugatha Ram Vara prasad, T. Deepthi, N. Satyavathi, V. Satish Varma, R. Hema Kumar, "Solar charging station for electric vehicles," Int. J. Adv. Res. Sci. Commun. Technol., vol. 7, no. 2, pp. 316–325, 2021, doi: 10.48175/IJARSCT-1752.

[5] M. Singh, K. Thirugnanam, P. Kumar, I. Kar Real-time coordination of electric vehicles to support the grid at the distribution substation level IEEE Syst J, 9 (2019), pp. 1000-1010, 10.1109/JSYST.2013.2280821.

[6] T. D. Nguyen, S. Li, W. Li, and C. Mi, "feasibility study on bipolar pads for efficient wireless power chargers," in Proc. APEC Expo., Fort Worth, TX, USA 2020.

[7] G. R. C. Mouli, J. Schijffelen, M. van den Heuvel, M. Kardolus, and P. Bauer, "A 10kw solar-powered bidirectional EV charger compatible with Chademo and COMBO," IEEE Trans. Power Electron., vol.34, no. 2, pp. 1082-1098, Feb. 2019.

[8] K. M. Muttaqi, R. Islam, and D. Sutanto, "Future power distribution grids: Integration of renewable energy, energy storage, electric vehicles, superconductor, and magnetic bus," IEEE Trans. Appl. Super cond., vol.29, no.2, pp.1-5, Mar.2019.

[9] M. Shafaati Shemami, M. Saad Alam, and M. S. J. Asghar, "Fuzzy control assisted vehicle-to-home (V2H) energy management system," Smart Sci., vol. 6, no. 2, pp. 173–187, Apr. 2018.

[10] S. Khan, A. Ahmad, F. Ahmad, M. Shafaati Shemami, M. Saad Alam, and S. Khateeb, "A comprehensive review on solar powered electric vehicle charging system," Smart Sci., vol. 6, no. 1, pp. 54–79, Jan. 2018.