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Solar based Advanced Movable Charging Station

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ABSTRACT: The Solar-Based Advanced Movable Charging Station is designed to address the growing need for sustainable and mobile energy solutions, particularly in remote and off-grid locations. This innovative charging station utilizes solar energy to provide a renewable, eco-friendly power source for charging electric vehicles (EVs), smart phones, and other electronic devices. The system incorporates high-efficiency solar panels, advanced battery storage, and a movable frame, enabling easy relocation and deployment in diverse environments.

KEYWORDS: Solar, EVs, Charging Station.

I. INTRODUCTION

Ever increasing effect of greenhouse gases from the conventional engine lead to the environmental concern. This paved to the booming of pollution free Electric Vehicles (EV) in the automobile industry. However, charging of EV battery from the utility grid increases the load demand on the grid and eventually increases the electricity bills to the EV owners which necessitate the use of alternate energy sources. Due to inexhaustible and pollution free nature of Renewable Energy Sources (RES), it can be used to charge the EV battery.

PROBLEM STATEMENT:

In today's world, mobile phones are considered as the important part of life. People tend to use its huge features, which consumes charging. Peoples who use to make every long journey may require charging anywhere and if they forget to bring chargers then that would create a problem. Similarly, in many developing areas where grid power is not available for few hours to several hours on regular basis, people may require electricity to charge their mobile phones to continue with their works.

SCOPE OF THE RESEARCH

This research aims to design and develop a solar-powered, movable charging station capable of providing clean and portable energy for charging electronic devices and small electric vehicles. The study focuses on integrating photovoltaic technology with a mobile platform, energy storage systems (batteries), and a regulated power supply to deliver efficient charging solutions in off-grid and remote locations. The scope includes the selection of solar panels, battery management systems, mobility mechanisms, and safety features.

II. LITERATURE REVIEW

Solar-Powered Mobile Charging Units Author(s): Aanya Singh et al. (2021) The authors explored the design of a solar-powered EV charging station tailored for urban environments. The station integrates solar photovoltaic (PV) panels with battery storage to provide off-grid charging.

Adaptive Control in Portable Solar Charging Systems Author(s): K. Hareesh & Dr. M. Saravanan (2024) This study introduced an adaptive control system for portable solar-powered charging stations. The system uses Particle Swarm Optimization (PSO) to dynamically adjust charging parameters based on real-time environmental conditions, such as sunlight intensity, battery state-of-charge, and load demand.





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Mobile EV Charging Units for Emergency and Off-Grid Use Author(s): R. Serrano et al. (2025) The authors proposed a mobile solar-powered EV charging unit that can be deployed in emergency situations, such as during natural disasters, or in remote locations lacking fixed charging infrastructure. The design incorporates a solar canopy, lithium-ion battery storage, and a flexible modular setup.

Autonomous Solar-Powered Charging Robots Author(s): Justinas Miseikis et al. (2017) This research focuses on an autonomous robotic system for solar-based mobile EV charging. The robot uses 3D vision and AI algorithms to locate parked EVs and autonomously plug them into charging stations.

III. PROBLEM DEFINITION

One or more electric motors, or traction motors, are used to propel an electric vehicle (EV). It is possible for an electric vehicle to be self-contained using a battery, solar panels, fuel cells, or an electric generator that converts gasoline to energy to be fueled by an off-vehicle collector system. There are many different types of electric vehicles, such as hybrid and all-electric cars, trucks, trains, ships, planes, and spacecraft.

IV. FUTURE SCOPE

- 1. Integration of solar tracking systems to maximize solar energy capture throughout the day.
- 2. Implementation of fast-charging technology to reduce device charging time.
- 3. Wireless charging capabilities for added convenience and flexibility.
- 4. Use of smart energy management systems with IoT connectivity for real-time monitoring and remote control.
- 5. Expansion to support charging of electric bikes, scooters, and other e-mobility solutions.
- 6. Deployment in disaster-prone or military areas as a reliable, off-grid power source.
- 7. Development of modular designs for easy maintenance and scalability based on power demand.

V. OBJECTIVE

- 1. Implement an sensor-based mechanism to detect the presence of an electric vehicle for seamless initiation of the charging process.
- 2. Incorporate a relay module for wirelessly transmitting power to the vehicle through a copper coil, ensuring safe and efficient charging.
- 3. Provide real-time feedback to users through an LCD display, indicating charging status and relevant information, enhancing user experience and system transparency.
- 4. The objectives include optimizing energy efficiency, reducing environmental impact, and ensuring compatibility with various EV models.

VI. METHODOLOGY

METHODOLOGY

1. Problem Identification and Requirement Analysis

- Studied the need for sustainable and cost-effective transportation.
- 2. Component Selection
 - Motor: Selected a suitable BLDC hub motor for efficient propulsion and low maintenance.
 - Battery: Chose a lithium-ion battery for its high energy density, lightweight, and rechargeability.

3. Design and Planning

- Created a basic design layout for the electrical system integration.
- Planned the placement of battery, motor, and control units on the cycle to ensure balance and safety.

4. Assembly and Integration

- Installed the motor onto the rear or front wheel hub.
- Mounted the battery pack securely on the frame (typically on the rear carrier or down tube).





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VII. HARDWARE DETAILS

Material Details for Movable charging station

1. SOLAR PANEL:

A solar panel, also known as a photovoltaic (PV) panel, is a device that converts sunlight directly into electrical energy using the photovoltaic effect. It is the primary source of power in the Smart Solar Bench system, enabling the bench to operate independently of the conventional electrical grid

2. TRANSFORMER:

A step-down transformer is an electrical device that reduces the voltage from a higher level to a lower level while increasing the current

3. VOLTAGE REGULATOR

A voltage regulator is a device that maintains a stable and consistent output voltage, regardless of changes in the input voltage or load conditions.

4. RECTIFIER:

A rectifier is an electronic circuit that converts alternating current (AC) to direct current (DC). It achieves this by using diodes or other semiconductor devices to allow current to flow in only one direction.

5. ARDUINO:

Arduino is an open-source platform consisting of both hardware (a microcontroller board) and software (an IDE), used to create interactive electronic projects.

6. SWITCH:

A switch is a device that controls the flow of electricity or data in a circuit or network. It can be an electrical component that connects or disconnects a circuit, interrupting or diverting the current.

VIII. FABRICATION WORK

FABRICATION WORK

1. Conceptual Design and Planning

• Finalize the design based on requirements like power output, mobility, and safety.

2. Selection and Procurement of Components

3. Frame Fabrication

• Material Used: Mild Steel (MS), Stainless Steel, or Aluminum

4. Solar Panel Mounting

- Fix the solar panels on a tiltable frame to adjust angle for maximum sun exposure.
- Secure the panels using brackets, bolts, or clamps.

5. Electrical Integration

- Connect solar panels to the charge controller.
- Connect charge controller output to the battery bank.

6. Installation of Safety and Protection Systems

- MCBs and fuses to prevent short circuits.
- Surge protection devices for lightning or voltage spikes.

7. Testing and Quality Checks

- Solar panel output test under sunlight.
- Battery charging/discharging test.

IX. RESULTS

RESULTS

The design and fabrication of the solar-based advanced movable charging station were successfully completed. The developed system efficiently harnessed solar energy to charge multiple electronic devices simultaneously. It demonstrated effective mobility, stability, and consistent power output under various environmental conditions. The integrated battery storage allowed for uninterrupted charging even during low sunlight periods. Overall, the project proved to be a reliable, eco-friendly, and portable solution for off-grid and emergency charging needs, fulfilling the initial design objectives and promoting the use of renewable energy.





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APPLICATIONS

1. Disaster Relief & Emergency Situations :- Provides essential power during natural disasters (e.g., earthquakes, floods, hurricanes) when the main grid is down.

2. Rural and Remote Areas :- Perfect for off-grid villages or communities without access to electricity.

3. Military & Defence :- Ideal for troops stationed in remote locations or during field operations.

4. Outdoor Events & Festivals :- Used at music festivals, fairs, sports events, or marathons to provide charging points for attendees and staff.

5. Mobile Clinics & Health Camps :- Powers diagnostic devices, fans, lights, and mobile phones in temporary healthcare setups.

X. CONCLUSION

The solar-based advanced movable charging station represents an innovative and sustainable solution to the growing demand for portable and off-grid power sources. By harnessing clean, renewable solar energy, the system effectively provides electricity for charging mobile devices and small electronic equipment, especially in areas where access to traditional power infrastructure is limited or unavailable.

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