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Design of EV Charging Station by Using Multimode Operation

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ABSTRACT:

When it comes to EV charging stations are limited to supporting only one type of charging standard, which can lead to compatibility issues, longer wait times, higher costs, and fragmented infrastructure. The aim of this project focusing on the multimode operation of EV charging stations is to implement solutions that enable charging stations to support multiple charging standards or protocols. It means the charging station can accommodate different types of electric vehicles with varying charging requirements. For example, some EVs use AC charging, while others use DC fast charging. With multimode operation, the charging station provides both types of charging stations, allowing more flexibility and convenience for EV owners. It uses solar power from the sun to charge your EV when it's available. If there's not enough sunlight, it can also connect to the electrical grid to get power. The charging station even has a battery to store extra energy for later use. It's all about making EV charging easy and eco-friendly.

Key Words: Solar Pannels, Wind Mill, Steel pipes, Panel Box, Supporting Rod, Wheels, DC-AC Converter, Charge Controlling Circuitry, Base Tray, Electrical &Wirings, Base Frame, Supporting Frame, Screws and Fittings, Arduino, LCD Display.

OVERVIEW:

Designing an EV charging station with multimode operation is a complex task that requires careful consideration of several key factors.

- The station must be able to support different charging modes, including fast charging, slow charging, and bidirectional charging, to cater to the diverse needs of electric vehicle (EV) users.
- This involves implementing advanced power electronics and control systems to manage power flow and communication between the EV and the charging
- The design should prioritize safety and reliability, with built-in monitoring and diagnostic capabilities to detect and address any issues promptly.
- Additionally, the station should be compatible with various EV models and comply with relevant standards and regulations to ensure interoperability and ease of use. Integrating renewable energy sources into the design can also enhance sustainability and reduce the station's environmental impact.

REVIEW OF LITERATURE:

1. **Badrinath Kulkarni, Devaji Patil, Rahul. G. Suryavanshi - Published in: 2018 International Conference on Computational Techniques, Electronics and Mechanical Systems (CTEMS)**

IOT Based PV assisted EV Charging Station for Confronting Duck Curve:

We're studying how solar power affects the electricity demand curve, called the duck curve. To balance it, we suggest charging electric vehicles at multi-level stations with IoT integration. This helps smooth out the curve and encourages more people to use electric vehicles. We also propose replacing fossil fuel taxes with a centralized system for taxing EV charging to promote green transportation.

2. **Yuta Susowake, Huang Yongyi, Tomonobu Senjyu, Abdul Motin Howlader, Paras Mandal - Published in: 2018 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC)**

Optimum Operation Plan for Multiple Existing EV Charging Stations:

In recent years, electric vehicles (EVs) have been promoted to reduce carbon emissions. However, their unfamiliarity and lack of infrastructure hinder their adoption. This research suggests attaching EV charging stations to convenience stores. By working together, these stations can sell to more customers, increasing profits and proving the effectiveness of the business model.

3. **Lili Gong, Wu Cao, Jianfeng Zhao - Published in: 2017 IEEE Conference on Energy Internet and Energy System Integration (EI2)**

Load modeling method for EV charging stations based on trip chain:

We're looking into how electric vehicle (EV) usage affects power grids. We propose a new way to predict charging demands based on trip patterns. By analyzing trip data, we categorize charging stations and simulate their loads using Monte Carlo methods. The results confirm the method's effectiveness, showing how EV adoption impacts grid peak loads.

COMPONENTS:

1.HORIZONTAL WIND MILL:

Designing an EV charging station with a horizontal windmill involves integrating wind power generation with grid connectivity, allowing for switching between power sources based on availability and demand. Key considerations include windmill size and placement, power electronics for grid connection and battery charging, and smart control systems for efficient operation.

2.VOLTAGE REGULATOR:

In the design of an EV charging station with multimode operation, a voltage regulator is essential for maintaining a stable voltage level. It ensures safe and efficient charging by managing fluctuations in power sources like the grid, renewable energy, or backup power supplies.

3.SOLAR PANEL:

Integrating solar panels into an EV charging station with multimode operation enables sustainable and grid-independent operation by harnessing solar power for direct charging or battery storage, enhancing reliability and reducing environmental impact.

4.BATTERY:

Batteries in a multimode EV charging station store excess energy from renewable or grid sources, providing backup power, stabilizing the grid, and enabling flexible, reliable operation.

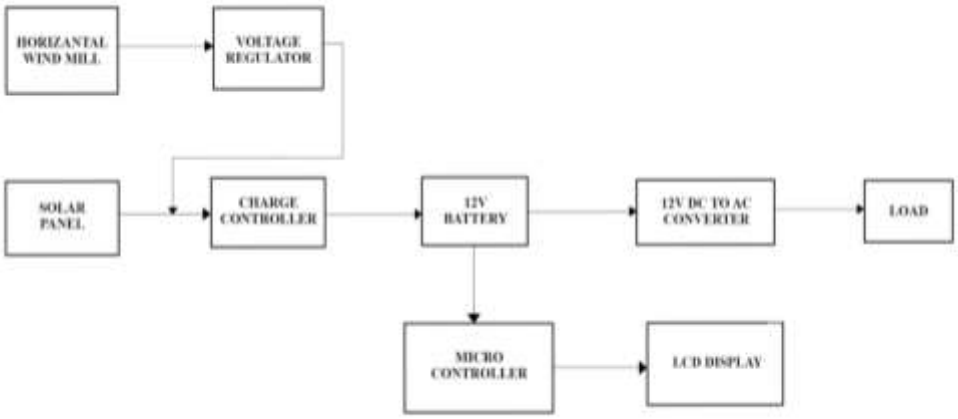

Fig. Block diagram

5.DC-AC CONVERTER:

In a multimode EV charging station, a DC-AC converter (inverter) is crucial for converting power from DC sources like batteries or solar panels into AC power for charging electric vehicles, enabling grid interaction and renewable energy integration.

6.LCD DISPLAY:

An LCD display in a multimode EV charging station provides users with real-time charging status, power source information, cost and energy details, and user controls for an enhanced charging experience.

7.MICRO CONTROLLER:

An LCD display in a multimode EV charging station provides users with real-time charging status, power source information, cost and energy details, and user controls for an enhanced charging experience.

Working principle:

A multimode EV charging station efficiently charges electric vehicles using various power sources like the grid, renewable energy, and batteries, managed by components such as converters, controllers, and smart systems. It ensures safe and efficient charging by regulating the flow of electricity, storing excess energy for backup, and stabilizing the grid. Users interact through an LCD display, which provides real-time information and controls for starting, stopping, and adjusting the charging process. Overall, a multimode EV charging station offers a sustainable, flexible, and user-friendly solution for charging electric vehicles.

CALCULATIONS OF DESIGN:

- Solar Panel Rating

Daily watt hours= average hours of sunlight*solar panel watts*85%

(As not all the sunlight is converted into electricity, we tested to determine that the Jackery solar panels are 85% efficient.)

P = 4*40*0.85 = 128wh

- Horizontal Wind Turbine Rating

$P = 0.5\ Cp\ \rho\ \pi\ R^2\ V^3$

$P = 0.5*0.45*1.225*\ \pi*(0.17)\ ^2*(8)\ ^3$

P = 12.8125w

ECONOMIC ASPECTS ACCORDING TO PEOPLE NEEDS:

- The economic viability of EV charging stations using multimode operation is contingent upon several factors. Initial setup costs, including equipment and infrastructure, play a significant role, as do ongoing operational expenses such as electricity and maintenance. The pricing strategy for charging services is crucial, with flexibility in pricing plans potentially increasing profitability. External factors like government incentives and regulations also heavily influence the economics. Analyzing and optimizing these aspects based on people's needs and market conditions are essential for ensuring the financial sustainability of these charging stations.

FINAL RECAP:

In designing EV charging stations using multimode operation, several key components and considerations are paramount. Firstly, the incorporation of renewable energy sources, such as wind power, is essential for sustainability and cost-effectiveness. This necessitates the integration of horizontal windmills for power generation. Additionally, the use of efficient charge controllers and DC-AC converters is crucial for managing and distributing the electricity generated. LCD displays are integral for providing real-time information to users. Moreover, the overall design should prioritize user convenience, operational efficiency, and economic viability, aligning with the evolving needs of electric vehicle users and the broader market trends towards sustainable energy solutions.

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