"Designing A Solar And Wind Hybrid Power System For Charging EV"

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***Abstract*—The transportation sector is a major contributor to greenhouse emissions. Electric vehicles offers a promising solution by reducing dependence on fossil fuels. However, the reliance on the traditional grid for charging raises concerns about sustainability. This paper explores the potential of solar and wind hybrid charging station for EVs. The paper delves into the working principles, system components, and advantages of these hybrid challenge such as intermittency of renewable sources and grid integration.Finally,the paper discusses the future prospects and research direction for this technology.**

***Index Terms*—component, formatting, style, styling, insert**

I. Introduction

The growing concerns about climate change and air pollution necessitate a shift towards sustainable transportation solutions. EVs powered by clean energy sources offer a significant advantage in this regard. However, the dependence on the electricity grid for charging raises question about the true environmental benefits, especially if the grid itself relies heavily on fossil fuels.

Solar and wind power are abundant, clean, and renewable energy sources. Integration these renewable sources into EV charging infrastructure can significantly reduce reliance on the grid and promote sustainable transportation. This paper explores the concept of solar and wind hybrid charging stations for Evs, their benefits,challenges, and future prospects.

Solar panels absorbs sunlight and convert it into electricity, while wind turbines utilize wind energy to generate power. This dual approach maximizes energy production, providing a sustainable and eco-friendly solution for ev charging. Additionally, excess energy generated during periods of low demand can be stored in batteries for later use, ensuring continuous availability of power.

A solar-wind hybrid charging station for electric vehicles (EVs) combines the advantages of two renewable energy sources to power electric vehicles. This innovative infrastructure harnesses solar energy from photovoltaic panels and wind energy from turbines to generate electricity. By integrating these two sources, the station ensure a more consistent and reliable power supply, irrespective of weather condition or time of day.
The transportation sector plays a significant role in global carbon emissions, necessitating a transition towards greener alternatives. Electric vehicles EVs have emerged as a promising solution, offering reduced emissions and dependence of fossil fuel. However, the widespread adoption of EVs hinges on the availability of reliable and sustainable charging infrastructure. Traditional charging stations often rely on grid electricity, which may still be derived from nonrenewable sources.To addresses this issue, the integration of renewable energy technologies such as solar and wind power into charging station presents a compelling solution.

II. Need of the Project

A.

A solar and wind hybrid charging station presents a promising solution to address the challenges of renewable energy intermittency and power generation variability. Integrating both solar and wind energy sources into a single charging station offers several advantages. Firstly, it enhances energy reliability by leveraging the complementary nature of solar and wind resources, as they often peak at different times. This ensures a more consistent power supply, crucial for charging electric vehicles (EVs) efficiently.

Secondly, such hybrid stations contribute to grid stability by reducing reliance on fossil fuels and decreasing greenhouse gas emissions associated with traditional energy sources. They facilitate the transition towards a cleaner and more sustainable energy system, aligning with global efforts to combat climate change.

Moreover, hybrid charging stations can be deployed in diverse geographical locations, making them versatile and adaptable to various environmental conditions. This scalability enhances their feasibility and attractiveness for widespread implementation, promoting renewable energy adoption on a larger scale.In conclusion, the integration of solar and wind energy in hybrid charging stations represents a promising avenue for research and development. Its multifaceted benefits include improved energy reliability, grid stability, and environmental sustainability, making it a compelling subject for further investigation and implementation in the transition towards a renewable energy future.

III. Literature SURVEY

the study by john smith, emily johnson, and david brown focuses on the "design and optimization of a solar-wind-battery hybrid energy system for electric vehicle charging stations." it delves into optimizing system configuration and component sizing to maximize energy efficiency and reliability while minimizing costs.

In Samantha White, Michael Garcia, and Lisa Martinez's research on the "Performance Evaluation of Solar-Wind Hybrid Power Systems for Electric Vehicle Charging Infrastructure," the emphasis is on evaluating system performance under different environmental conditions. The study aims to assess energy generation, storage capacity, and overall system reliability.

Daniel Wilson, Sarah Clark, and Kevin Adams present a case study in urban environments in their paper, "Integration of Solar and Wind Energy for Electric Vehicle Charging: A Case Study in Urban Environment." This research investigates the feasibility, economic viability, and environmental impact of integrating solar and wind energy systems into electric vehicle charging infrastructure, "Optimal Siting and Sizing of Solar and Wind Hybrid Systems for Electric Vehicle Charging Infrastructure," focuses on identifying optimal locations and configurations for solar and wind hybrid systems to maximize energy output and cost-effectiveness.

IV. SYSTEM DEVELOPMENT

Block diagram

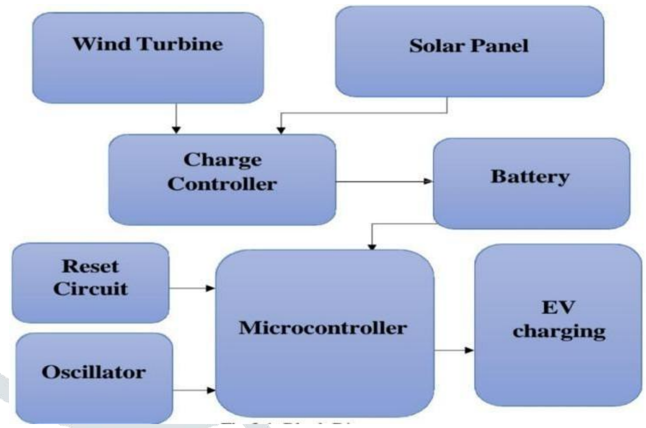


fig.1

A wind and solar power sources are generating voltage, which is then regulated by a charge controller to charge a battery. The charge controller is connected to the battery, and a micro-controller is managing several aspects of the system. The microcontroller is responsible for managing the power supply, reset circuit, and oscillator circuit. It receives a 5V DC supply from the power supply unit and serves as the main controller for the system. Additionally, there's an LCD display that shows the generated voltage from both the solar and wind sources. This display provides real-time feedback on the energy production of your renewable sources. When an electric vehicle (EV) charger is connected to the battery, indicating that the bike is charging, a light on the bike turns on, providing a visual confirmation that the charging process is underway.

SNUBBER CIRCUIT

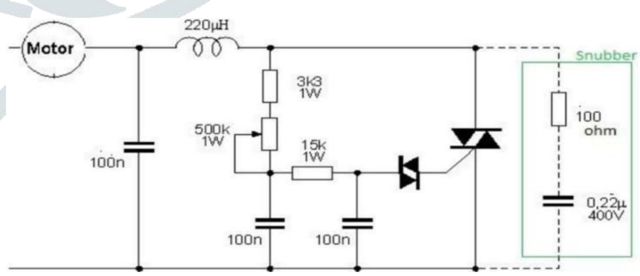


fig.2(snubber circuit0

a sncubber circuit limits or stops switching voltage amplitude and its rate of rise ,therefore reducing power dissipation.in its simplest form, a snubber circuit. Basically consists of a resister and capacitor connected across the thyristor. In a simple power switching network with a power semiconductor switch and a resistive load, the device voltage and current are large when the power semiconductor is switching between on or off.in essence, this result is high power dissipation across the device and a consequential high loss of energy.

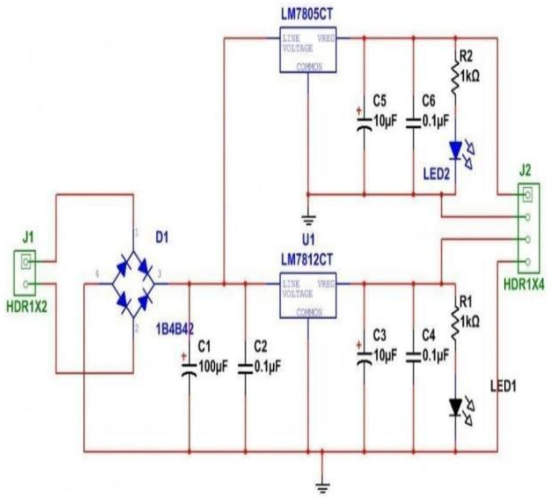


Fig.3(Power supply circuit)

In this project, a microcontroller (Atmega) is used as a sensing and controlling device.The power supply circuits(Fig.) built using filters, rectifiers, and then voltage regulators. Starting with an dc voltage, a steady dc voltage is obtained by maintain the polarity of supply the DC voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes. A rectifier is used for the maintain the polarity of battery supply. A bridge IC is used for that purpose. To get the power supply for the circuit. The filtered output fed to the input pin i.e. pin no.1 of the regulator IC 7805 and 7812. This gives the fixed 5V and 12V DC power Supply respectively. The block diagram of power supply is shown in fig above.

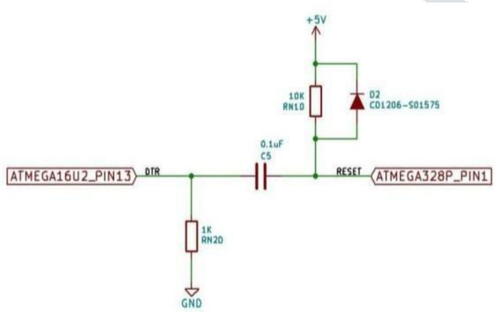


Fig.4 (Reset circuit)

Reset occurs when the RST pin is supplied with a positive pulse in duration of at least 2 machine cycles (24 clock cycles of crystal oscillator).After that, the microcontroller generates an internal reset signal which clears all SFRs, except SBUF registers, Stack Pointer and ports (the state of the first two ports is not defined, while FF value is written to the ports configuring all their pins as inputs).Depending on surrounding and purpose of device, the RST pin is usually connected to a power-on reset push button or circuit or to both of them.

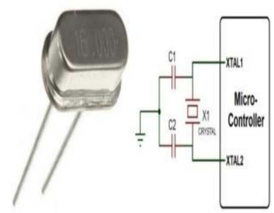


Fig.crystal 16MHz oscillator

V. Components Used

- Micro controller (Atmega 328 P)
- LCD Display 16 x 2
- Spur gear
- Blade
- Bearing
- Battery
- Snubber circuit
- Solar panel
- Power supply
- Reset circuit
- Crystal 16MHz
- L-clamp

VI. Working of Solar Panel and wind

Solar panels work by converting sunlight into electricity through the photovoltaic effect. Each panel consists of many solar cells made of semiconductor materials, such as silicon. When sunlight hits the cells, it excites electrons, creating a flow of electricity. This direct current (DC) is then converted into alternating current (AC) by an inverter, suitable for powering homes and businesses. The efficiency of solar panels depends on factors like sunlight intensity, angle, and shading.

Vertical axis wind turbines (VAWTs) generate electricity by harnessing wind energy through a rotating vertical shaft. Unlike horizontal axis turbines, VAWTs have blades that rotate around a central vertical axis, allowing them to capture wind from any direction without needing to face the wind directly. As the wind passes through the turbine, it causes the blades to spin, driving a generator to produce electricity. VAWTs are ideal for urban and residential settings due to their compact design and ability to operate in turbulent wind conditions.

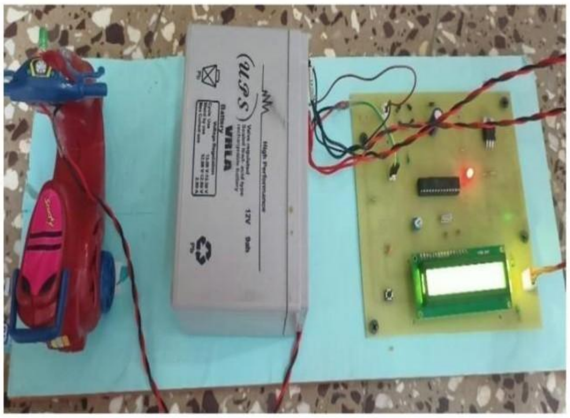


Fig. 5. Hardware of kit

Fig. 7. output (solar and wind)

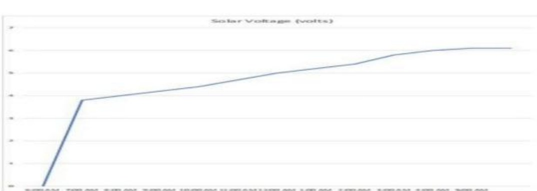
VII. Performance Analysis

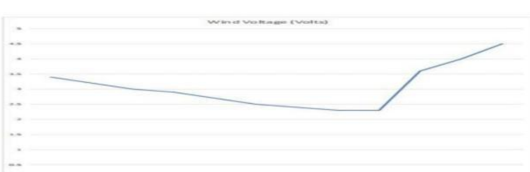
The below figure shows the output of the experiment done solar and wind on 27-04-24

Solar And Wind Output(27/04/2024)

Hour Of The Day	Solar Voltage (Volts)	Wind Voltage (Volts)
6:00 AM	3.8	3.4
7:00 AM	4	3.2
8:00 AM	4.2	3
9:00 AM	4.4	2.9
10:00 AM	4.7	2.7
11:00 AM	5	2.5
12:00 PM	5.2	2.4
1:00 PM	5.4	2.3
2:00 PM	5.8	2.3
3:00 PM	6	3.6
4:00 PM	6.1	4
5:00 PM	6.1	4.5

Below graph shows the variation in voltage in hours of the day





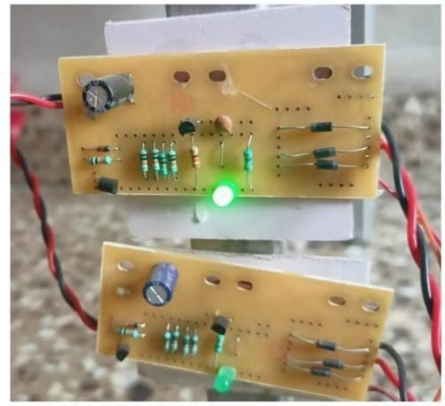


Fig. 6.snubber circuit during operating condition

Fig. 8. power circuit and LCD display

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A. Application

1. Renewable Energy Integration: By harnessing solar and wind energy, the project promotes the use of clean, renewable energy sources, reducing reliance on fossil fuels and contributing to the mitigation of climate change.

2. Energy Independence: Solar and wind energy are abundant and locally available resources, providing greater energy independence by reducing dependence on imported fuels and volatile energy markets.

3. Cost Savings: Over time, the use of solar and wind energy can lead to significant cost savings compared to traditional energy sources, as sunlight and wind are free and abundant resources. Additionally, the long-term operational costs of maintaining the hybrid system are typically lower.

4. Environmental Benefits:The project helps to reduce greenhouse gas emissions and air pollution associated with conventional fossil fuel-based power generation, leading to improved air quality and public health outcomes.

5. Grid Stability and Reliability: Integrating solar and wind energy into the grid diversifies the energy mix, enhancing grid stability and reliability by reducing reliance on a single energy source and mitigating the impacts of supply disruptions.

B. Advantages

1. Remote Areas: Providing sustainable energy solutions in remote locations where traditional power infrastructure is lacking or expensive.

2. Transportation Hubs:Offering clean energy charging options for electric vehicles at airports, bus stations, and train terminals to promote green mobility.

3. Residential Complexes:integrating the system into residential communities to offer eco-friendly charging solutions, reducing dependence on grid electricity and fostering sustainable living.

4. Commercial Complexes:Installing the system in commercial properties to provide employees and customers with clean energy charging options, demonstrating corporate commitment to environmental sustainability.

5. Smart Cities:Contributing to smart city initiatives by reducing carbon emissions from transportation through the adoption of renewable energy-powered charging stations.

C. Future Scope

1. *Environmental Impact: Promoting cleaner transportation by using renewable energy reduces greenhouse gas emissions and helps combat climate change.*
2. *Energy Independence: Using solar and wind power reduces dependence on non-renewable energy sources like oil and coal.*
3. *Technological Advancements: This project will likely lead to advancements in hybrid energy systems, making them more efficient and cost-effective.*
4. *Infrastructure Growth: As electric vehicles become more popular, infrastructure for renewable energy charging stations will expand.*

CONCLUSION

D. Conclusion

Solar and wind hybrid charging stations offer a promoting sustainable transportation by enabling EV charging with clean energy sources.While challenges exist regarding intermittency and initial costs, technological advancements, policy support, and strategic research can pave the way for widespread adoption. As the world transitions towards a cleaner future, hybrid charging stations stand to play a crucial role in enabling sustainable electric mobility.

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