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MULTI-PURPOSE HYBRID INVERTER FOR HOUSEHOLD APPLIANCES

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Abstract: In today's world, a continuous supply of electricity is crucial for various aspects of our lives, disruptions in the power grid can lead to significant challenges. To address this issue, inverters and hybrid energy systems have emerged as effective solutions. These systems utilize the abundant and renewable sources of solar and wind energy to ensure a reliable and sustainable power supply. This paper explore the integration of solar and wind power generation with hybrid inverters and battery storage.By combining these technologies, The overall efficiency of the system can be enhanced and provide uninterrupted power supply, even during periods when solar and wind energy are unavailable or insufficient.The hybrid inverter serves as a critical component, seamlessly switching between different power sources. When solar and wind energy are inadequate, the inverter automatically switches to the mains power supply, ensuring a continuous power source for the load. Simultaneously, the battery is charged using the mains power supply, replenishing its energy reserves for future backup needs.The voltage sensor connected to the solar panel and wind turbine outputs monitors the voltage levels. If the voltage drops below a certain threshold (e.g., 12.5V), indicating insufficient power generation, a relay is triggered to switch the system to the AC mains supply. The Arduino Nano, LCD display, and HC-05 Bluetooth module are used to monitor and display the solar and wind output voltage on the LCD screen and provide remote monitoring capabilities through the Arduino Bluetooth app.

IndexTerms **- Solar and wind energy, Hybrid inverter, Arduino Nano, Arduino Bluetooth app**

I. INTRODUCTION

In today's modern world, where nearly every aspect of our lives relies on a steady supply of electricity, disruptions in the electrical grid can have profound consequences. Factors such as extreme weather conditions, high-power demands, and the scarcity of conventional energy sources pose significant challenges to maintaining a continuous power supply. To overcome these difficulties, the integration of renewable energy sources, particularly solar and wind power, with hybrid inverters and energy storage systems has emerged as a promising solution.Solar energy is considered the most abundant natural source of power, and its utilization has become increasingly crucial for the future of energy generation. Conventional power generation methods, heavily reliant on fossil fuels like coal, face numerous challenges, including scarcity, rising generation costs, transmission power loss, and detrimental environmental effects. To circumvent these limitations and create a more sustainable energy landscape, solar and wind power generation offer clean and renewable alternatives that can be seamlessly integrated.The combination of solar and wind power plants as a unified system, along with hybrid inverters and battery storage, presents an efficient approach to ensure a continuous power supply. By integrating these technologies, the overall efficiency of the system is enhanced, providing a reliable and uninterrupted power source for various applications.

Hybrid inverters play a critical role in this integrated setup by facilitating the seamless transition between different power sources. When solar and wind power are insufficient or unavailable, the inverter automatically switches to the mains power supply, ensuring a continuous power supply to meet the load demands. Simultaneously, the battery is charged using the mains power supply, thereby storing surplus energy for future use during power outages or periods of low renewable energy generation.

This combined mode of operation not only ensures a reliable power supply but also reduces the strain on conventional power generation systems, leading to a more sustainable and environmentally friendly approach. By relying on solar and wind power, which produce no harmful emissions or pollutants, we can minimize the adverse impact on the environment.

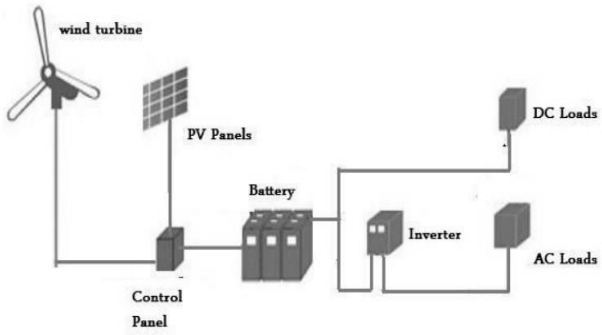


Fig1: Solar-Wind Energy with Hybrid Inverter System

II.PROPOSED MODEL DESIGN

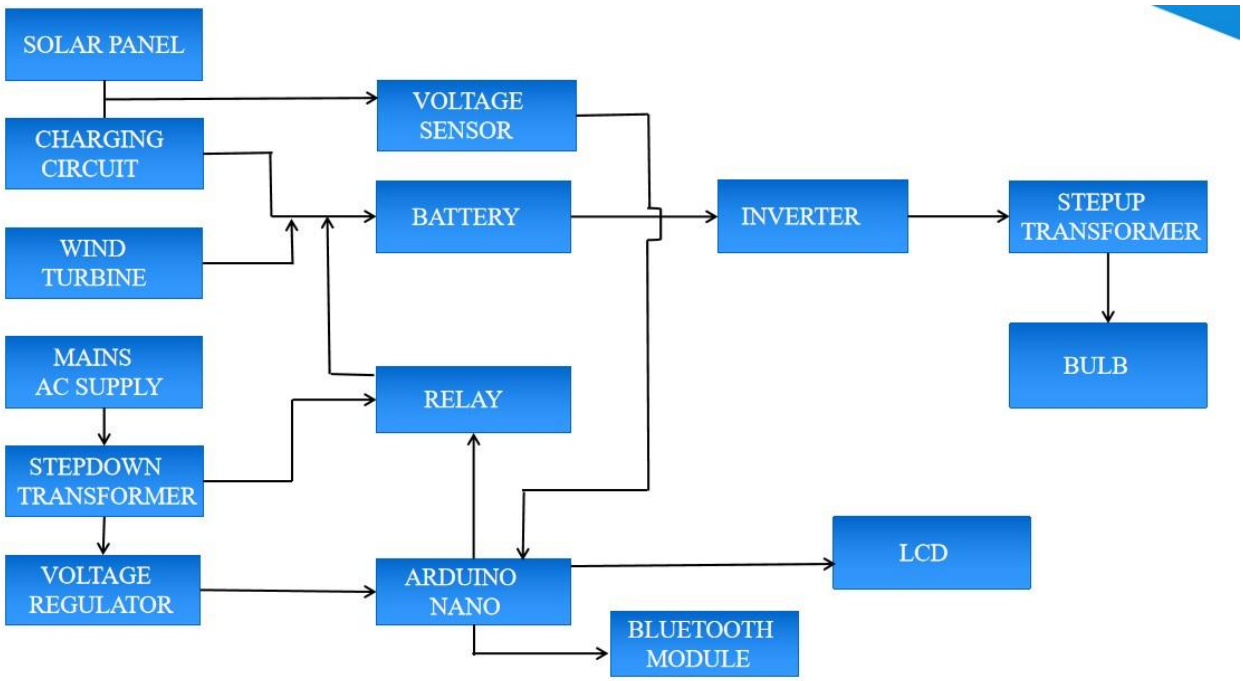
The proposed model design for the multi-purpose hybrid inverter for household appliances with battery storage and solar and wind power output monitoring is aimed at achieving a reliable and uninterrupted power supply while maximizing the utilization of renewable energy sources. The design incorporates the following key components:

1. Solar Panels: The system includes a solar panel array that harnesses solar energy and converts it into DC power. The number and capacity of solar panels can be determined based on the desired power output and available solar resources.
2. Wind Turbines: To complement solar power generation, the system incorporates wind turbines to capture wind energy and convert it into rotational motion. The wind turbines are connected to generators that produce AC power.
3. Hybrid Inverter: A hybrid inverter acts as the central control unit of the system. It takes inputs from both the solar panels and wind turbines and manages the power flow to meet the load demand. The inverter converts the DC power from the solar panels and wind turbines into AC power suitable for household appliances.
4. Battery Storage: The system incorporates battery storage to store surplus power generated by the solar panels and wind turbines. During periods of low renewable energy generation or power outages, the battery acts as a backup power source, providing continuous electricity to the load. The battery can be charged from both the renewable energy sources and the mains power supply when available.
5. Load Management System: A load management system is employed to monitor and manage the power consumption of the connected load. It ensures that power is distributed efficiently and optimally, preventing overloading or power wastage.
6. Grid Connection: The system can be connected to the main power grid as an additional power source. When the solar and wind power generation is insufficient to meet the load demand or the battery is depleted, the hybrid inverter automatically switches to the mains power supply. Simultaneously, it charges the battery to ensure it is ready for backup power usage during future outages.
7. Monitoring System:The voltage sensor connected to the solar panel and wind turbine outputs continuously monitors their voltage levels. If the voltage drops below the specified threshold indicating insufficient power generation, the relay is triggered to switch to the AC mains supply. The Arduino Nano, LCD display, and HC-05 Bluetooth module are used for monitoring the voltage levels and displaying the information on the LCD screen. The Arduino Bluetooth app allows remote monitoring of the solar and wind output voltage via the HC-05 Bluetooth module.

Fig2: Prototype model with Load connection

The proposed model design of the multi-purpose hybrid inverter for household appliances with battery storage and solar and wind power output monitoring aims to provide a seamless integration of renewable energy sources while ensuring a continuous and reliable power supply. By optimizing the utilization of solar and wind energy, efficiently managing the battery storage, and incorporating the flexibility of grid connection, this system offers a sustainable and resilient solution for meeting household power needs.

III. BLOCK DIAGRAM



IV. HARDWARE COMPONENTS

S.NO	NAME OF THE COMPONENT	SPECIFICATION	QUANTITY
1	SOLAR PANEL	(18V DC, 10W)	1
2	WIND TURBINE	1000 RPM, 12V	1
3	INVERTER	12VDC-12VAC	1
4	BATTERY	12VDC	1
5	ARDUINO NANO	22PINS	1
6	LIQUID CRYSTAL DISPLAY(LCD)	16*2	1
7	TRANSFORMER (STEP UP)	(12/230V)AC	1
8	TRANSFORMER (STEP DOWN)	(230/12V)AC	1
9	BLUETOOTH MODULE	2.4GHz ISM BAND	1
10	VOLTAGE SENSOR	-	1
11	VOLTAGE REGULATOR	-	1
12	BULB	0.5W	1

Table 1: Hardware components of the Prototype.

V. RESULT

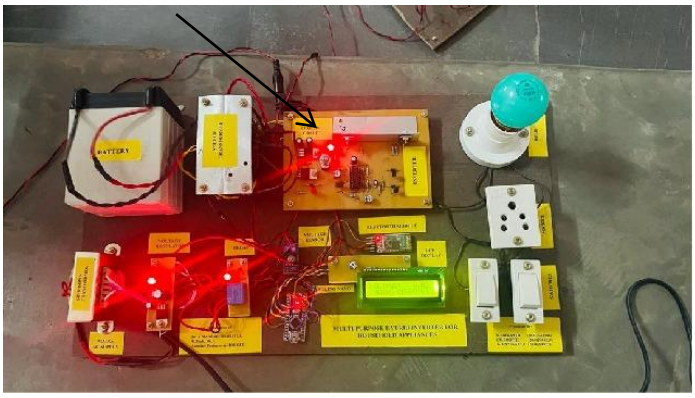


Fig3: Battery Charging with Solar & Wind Turbine

Fig4: Battery Charging with AC Main Supply

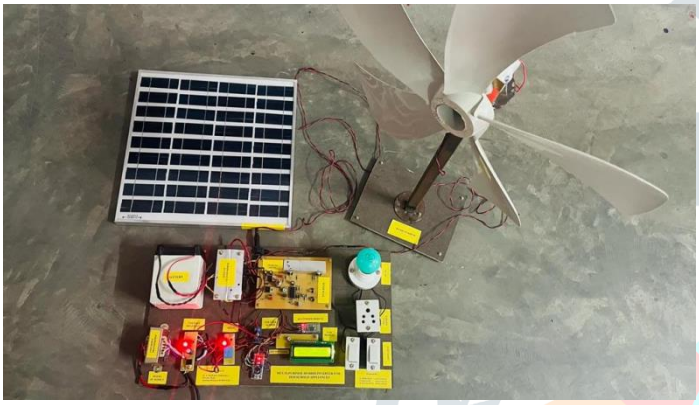


Fig5: Multi purpose hybrid inverter for household appliances with Load connected

Fig6: Multi purpose hybrid inverter for household appliances without Load connected

VI. CONCLUSION

The described hybrid inverter system that combines solar and wind power generation, battery backup, and the ability to switch to AC mains supply offers several advantages. It provides a continuous power supply, reduces reliance on conventional power sources, utilizes renewable energy, and allows for cost savings. The inclusion of a battery bank ensures backup power during low energy generation or power outages, increasing the system's reliability. The monitoring and control capabilities through Arduino Nano, LCD display, and Bluetooth module enable real-time monitoring and efficient management of the system.

VII. REFERENCES

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