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# Integrated Power Generation Using A Tri-Mode Hybrid Technique

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**ABSTRACT—**The continuous demand in energy consumption andrelative depletion of fossil fuel reserves has established greateravenues for exploration of renewable energy resources. These resources are characterized by their intermittent nature and are feasible only for specific geographical locations. In order to overcome these critical issues, this paper proposes hybrid energy system (HES) which is operated in off-grid mode and is suitable for high altitude demographic users where the access to the national grid is challenging. The proposed system uses a mixture of renewable energy resources and a storage device. The critical design aspects and modeling of the individual components used in the HES are deliberated.

## I. INTRODUCTION

Electricity is most needed for our day to day life.There are many ways of electricity generation either by conventional energy resources or by non-conventional energy resources.The new source should be reliable, pollution free and economical. The non-conventional energy resources should be good alternative energy resources for the conventional energy resources.

There are many non-conventional energy resources like solar, tidal, wind, piezo, geo thermal etc. Solar and wind are easily available in all condition.

In good weather condition we can use all sources combine.

The DC supply from the battery is then converted into AC supply with suitable circuits and can be applied to AC appliances. This system can be very useful for rural electrification.

Hybrid wind power generation refers to the integration of wind energy with other complementary sources of power to create a more reliable and efficient energy generation system. This approach aims to address the intermittency and variability of wind power by combining it with other sources that can provide a consistent power output. The most common hybrid configuration involves combining wind power with conventional sources like solar, battery storage, or traditional fossil fuel generators.

Here is an introduction to the key aspects of hybrid wind power generation:

I. wind power overview

Wind power involves harnessing the kinetic energy of the wind to generate electricity. Wind turbines convert this energy into electrical power, but the output can be variable due to fluctuations in wind speed and direction.

II. Hybridization with other energy sources

Hybrid wind power systems are designed to mitigate the challenges of intermittency associated with wind energy. By combining wind power with other energy sources, such as solar, storage, or conventional power plants, the overall system becomes more stable and reliable.

III. Solar wind hybrid systems

Combining wind and solar power is a common hybrid approach. Wind and solar resources often complement each other, as wind speeds are typically higher at night and during winter, while solar power is most abundant during the day. This combination helps in achieving a more consistent and continuous power output.

Advantages of a solar-wind-piezoelectric Hybrid System:

1. Stability and Reliability:

Combining multiple renewable sources provides a more stable and reliable power supply, reducing the impact of impact of intermittency from individual sources

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2. Increased Energy Capture:
The hybrid system can capture energy from different

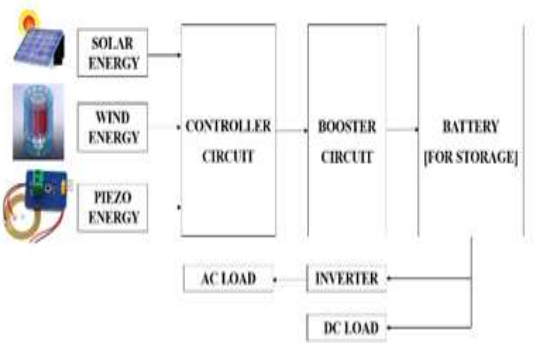


Fig 1.Hybridenergy systemMaximizing overall energy production

Generating power using a combination of solar energy, wind energy, and piezoelectric technology involves integrating these renewable energy sources to create a more reliable and efficient system.
Here's a conceptual overview of how such a hybrid system could work:

A. solar Energy
solar panels: Photovoltaic cells (solar panels) capture sunlight and convert it into electricity.
Daytime Operation: Solar power generation is most effective during daylight hours when sunlight is available

B. Wind Energy
Wind Turbines: Wind turbines harness the kinetic energy of the wind to generate electricity.
Variable Generation: Wind power can be harnessed both day and night, with varying intensity depending on wind speed and other meteorological factors.

C. Piezoelectric Energy
Piezoelectric Devices: These devices are strategically placed in areas with vibrations or mechanical movements.
Mechanical Energy Harvesting: Piezoelectric materials generate electric charge in response to mechanical stress or vibrations, converting mechanical energy into electrical energy.

D. Hybrid System Integration
Control System: An intelligent control system manages the integration of solar, wind, and piezoelectric sources.
Energy Storage: Excess energy generated during peak production periods is stored in batteries or other energy storage systems for use during periods of low or no renewable energy production.
Inverter System: Converts the direct current (DC) generated by solar panels and piezoelectric devices into alternating current (AC) for use in the electrical grid.

## II. HARDWARE COMPONENT DESCRIPTION

This project is an exclusive project which is used to power electrical appliances by generating power using solar, wind, and piezoelectric energy sources. The hybrid generated power is stored in a battery through a charging circuit. The battery supply is then fed to an inverter circuit which converts DC supply to AC supply. This AC supply can be fed to the electrical appliances. The block diagram of the project is shown in Figure 1 and different hardware components are briefly explained in successive subsections. A. Solar Panel
B. Wind Turbine
C. Piezoelectric Plate
D. Charging Circuit
E. Inverter Circuit
A. Solar Panel

A typical solar panel comprises a glass substrate as a front side transparent protective member at a light-receiving side and back-side protective member. Ethylene-vinyl acetate copolymer (EVA) films as sealing films arranged between the glass substrate and the backside protective member, and solar cells or silicon photovoltaic elements sealed by the EVA films. Solar panels have a large number of solar cells which are used to convert power from sunlight. The solar panel isconnected to the charging circuit which gives the output of 12 volts/10watt and the charging time of the solar panel is approximately 5 hours.

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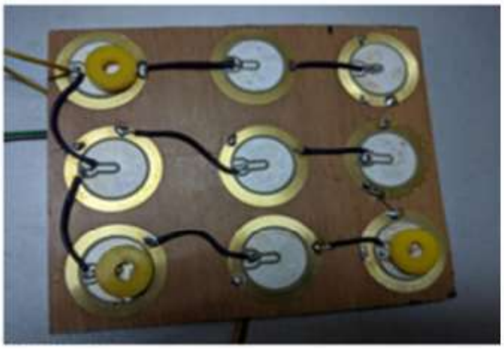
B. Wind Turbine

The wind is a renewable source of energy. A wind turbine connected to the shaft of the wind blades is used to convert the kinetic energy of the wind into electrical energy. The wind turbine is of two types depending upon the rotating axis of the blades. The first is a vertical axis wind turbine and the second one is horizontal axis wind turbine. In our project, we have used a horizontal axis wind turbine (HAWT) as shown in Figure 3. The HAWT has the main rotor shaft and electrical generator at the top of a tower and must be pointed to the direction of the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a servo motor. Most have a wind turbine consists of a gearbox, which turns the slow rotation of the blades into a quicker rotation. The output of the turbine depends on the speed of the wind. The power generated by the turbine is fluctuating. To obtain a continuous supply of power first the electricity is stored in a battery unit and then it is transferred to the load. We simply used a 12 volts DC generator as a wind turbine whose shaft is suitably connected to the blades. The wind turbine is connected to the charging circuit which gives the output of 12volts /10wats and the charging time of the wind turbine is approximately 8 hours.

C.Piezoelectric

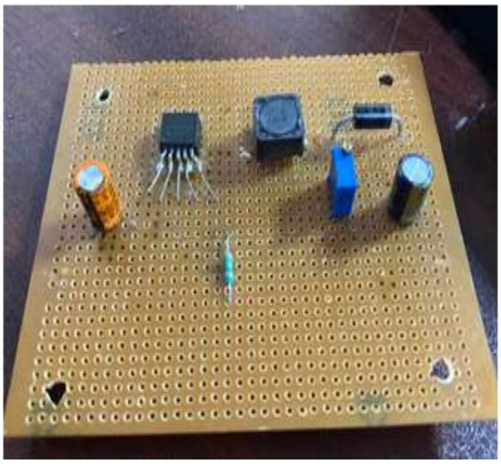


Sensor Plate The harvesting of piezoelectric energy with the help of a piezoelectric generator is based upon the piezoelectric effect. The piezoelectric generator principle states that the conversion chain starts from vibration for which a mechanical energy source is required. The vibrations are converted into electricity via the piezoelectric sensor element. The electricity produced is then afterward formatted by a static converter before supplying to the load i.e. electrical device. The piezo plate is connected to the charging circuit which gives the output of 2v and the charging time of the piezo plate is approximately 20 hours.

D. Charging Circuit

From three separate charging circuits are developed to charge the batteries from the three different energy sources. The solar panel is connected to the charging circuit which gives the output of 12volts/5watts and the charging time of the solar panel is approximately 5 hours. The wind turbine is connected to the charging circuit which gives the output of 12volts/10watts and the charging time of the wind turbine is approximately 8 hours. The piezo plate is connected to the charging circuit which gives the output of 2volts and the charging time of the piezo plate is approximately 20 hours. The output of the charging circuit is fed to the 12volts/1Amp battery. Thus the battery is charged simultaneously.

E. Inverter Circuit



Most of the electrical appliances require AC supply, so the DC output of the batteries will be converted into AC voltage with the help of an inverter and then it will be transferred to the loads. The inverter must be having over-voltage

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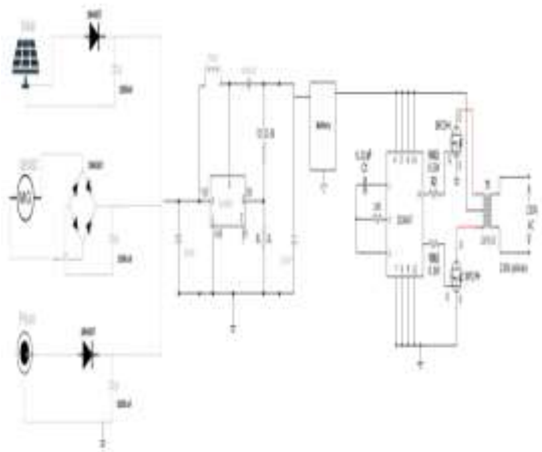
protection, reverse polarity, and short circuit protection. The inverter does not produce any power. The power is provided by the DC source. We used IC CD 4047 in the inverter circuit. The IC CD 4047 is mainly used in Inverter circuits. It's very compact and has a very high life in inverter circuits. CD 4047 is a low power Monostable / Astable Multivibrator that requires only an external capacitor and a resistor to give the output pulses. The output obtained from this inverter circuit as shown in Figure 7 i.e. 12volts AC is applied to a Step-up transformer to obtain 230volts AC.

## III. EXPERIMENTAL SETUP

As per the discussion of the hardware components our main objective is to generate hybrid power using solar, wind and piezoelectric sensors. The system is designed such that the generated energy can be used to turn ON the electrical appliances.

The circuit is designed for the given problem statement and is implemented in the given conditions to verify the working of the project. The three sources are connected to the charging circuit which hybridizes the power and thus decreases the charging time to 3.5 hours.



## IV. CONCLUSION

In this project, we used non-conventional energy sources such as solar, wind, and piezoelectric in a hybrid way to generate power. All three energy sources have their advantages, which are utilized here to supply power even in unwanted environmental conditions. Incorporating these threesources together developed a reliable hybrid energy system where during abnormal conditions at least one source stays active and during normal condition all three can act together. This system can be very useful for rural electrification.