

# Hybrid Energy Efficient Multi Source Energy System With Iot Base Load Control



M Sreenivasa Rao, Bandi Gopi, B Sunilkanth, P Avinash, B Dileep

**Abstract:** As the demand for electricity increasing day by day there is a need for an alternative power generation from renewable energy sources. The usage of increasing these conventional energy sources and the irregular supply of the power generated by them create problems like stability, consistency, and quality of the power in the main electrical grid. The solution to this problem is the concept of hybrid energy-efficient multi-source energy systems. "Hybrid energy efficient multisource energy system includes two or more energy conversion devices or two or more fuels for the same device, that when integrated, overcome limitations that may be inherent in either". Remote areas should be equipped with hybrid energy-efficient multi-source systems. This Project gives suitable ways to generate power in rural and agency areas also. The proposed system includes three systems that are capable of renewables, mainly solar (with the auto-tracking system), wind and Piezo along with power storage devices. This system has designed to give quality un-interrupted power to the developed Hybrid energy efficient multi-source energy systems. Further, this system is applied to maintain a continuous power supply for different loads like cooling and heating.

**Keywords;** Hybrid Energy System, Solar, Wind, Piezo

## I. INTRODUCTION

The demand for electricity is increasing all over the world day by day as the population increases. The major traditional power sources such as coal, petroleum, natural gas, etc depleting due to the faster consumption of these resources. Conventional energy sources like as solar, wind & piezo are in high demand. they are clean energy sources. Solar, wind and piezo energy systems are said to be promising power-producing sources because of their availability [1]. The production of power in remote areas is one of the major and important applications of hybrid energy-efficient multi-source systems. However, the major disadvantage is only for solar and wind energy for their unpredictable nature, dependency on atmospheric conditions. The changes in solar and wind energies may not march with the time distribution of load demand. So another method of producing power by piezoelectric material is added [2]. The light energy from the sun is one of the major sources of conventional/renewable energy systems.

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Due to the regular change in the relative angle of the sun rays to the earth reduces the power obtained from the solar panel. This solar tracking system is the best way to increase the efficiency of the solar panel. Solar trackers move the panel towards the sun rays all day [3].

Wind energy is also one of the main conventional energy sources. The steady wind energy may not be real for fulfilling the electric load demands at the places having unsteady wind speeds. At those places, hybrid energy-efficient multi-source systems will be an alternative in overcoming the weakness of stand-alone wind, [4].

Piezoelectric energy production uses the strain energy caused by footsteps and vehicles overload or vibrations from the moving automobile or nothing but imbalance occurred by the strain of a tire on asphalt road to catch and harvest such energy a piezoelectric materials are perfect devices as they react to compression and produce voltage output [5].

The power obtained from the combined system is used to operate loads (heater & blower) and these two loads are connected with IoT which can be operated from any place from the world by using IoT platform power can be effectively utilized [6].

This System also equipped with a voltage sensor to scale the battery current and voltage sensor to measure the current consumed by the load [7].

## II. PROBLEM DEFINITION

Due to the depletion of un-conventional energy sources like petroleum, coal and other fuels, demand for conventional energy sources has been increasing.

The usage of increasing these conventional energy sources and the irregular supply of the power generated by them create problems like stability, consistency, and quality of the power in the main electrical grid. The solution to this problem is the concept of hybrid energy-efficient multi-source energy systems

## III. METHODOLOGY

Further studies to develop solar, wind, and other conventional energy technologies are required to continue for:

- Increasing their efficiency,
  - Laying techniques to predict their output accurately
- Conventional energy systems can give a valuable means of distributing electricity to rural areas. continuous research, development & demonstration can increase the chances of high success in the future.

In this Proposed System, we have used Solar, Wind, and Piezo as three Energy Sources to design a Hybrid Energy System. Multi-Point Tracking Technology is used to get maximum efficiency from the Solar Panel.



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This System is designed using AVR Microcontroller, LDR Sensor and Relay Driver Circuit to control the Movement of Solar panel according to the Sun Direction. This helps the 12V Solar panel to get maximum power output. Wind Mill is used to generating 12V – 15V DC Power when there is enough Wind.

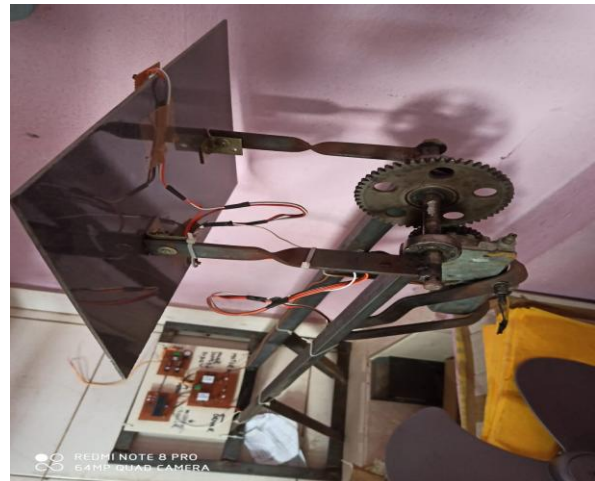
Foot Step Power Generator is designed to generate power from Human Foot Steps. This System allows a platform for placing foot Steps. Piezo Sensor is mounted below the platform to generate a voltage from footsteps.

Output Voltages from these three different sources are used to charge the 12V Battery using an LM317 based Charging Circuit. Battery Voltage is further used to drive an IoT based Application, that control two Loads (Blower and Blub) from anywhere in the World. Using an Android Application, the user can control these loads via the Internet. Blynk based IoT Web server is used for IoT based applications. ON / OFF status of the Load can be seen in the LCD Module.

User has to connect the IoT based web Application and Hardware device with Internet. After a successful connection to the internet, the user can control this load using Blynk based Android Application.

This System also equipped with a Voltage Sensor to scale the Battery current and Current Sensor measures Current Consumed by the Loads.

Hence, the efficiency of the solar plate with auto-tracking is greater than the efficiency of the solar plate without auto-tracking



“Figure 1”, a solar plate with an auto-tracking mechanism

## IV. EXPERIMENTATION & RESULT

- There are 3 systems to generate power  
SOLAR SYSTEM  
WIND SYSTEM  
PIEZOELECTRIC SYSTEM

### A. A TEST FOR SOLAR ENERGY

This test is conducted in a laboratory which is having normal light intensity at 28<sup>0</sup>C

- An open-circuit voltage can produce up to 0.5v - 0.6v at 25<sup>0</sup>C by a single photovoltaic cell. The output voltage of a photo-voltaic cell is affected by temperature, Higher the temperature lower the cells output voltage, In the full sun for every 25<sup>0</sup>C increase, the output voltage is reduced by about 5%.

- In this project, the solar system with auto-tracking is used so that the maximum amount of light can be observed which draws maximum power output  
As we know from Fourier law of heat conduction  $Q = -K*A*\partial T/\partial X$

By comparing this equation with  $P = -K*A*\partial L/\partial X$   
Here P – Total Power obtained from the plate  
here K – thermal conductivity of the solar plate  
A – Area of a cross-section of the plate  
 $\partial L/\partial X$  - Amount of light falls on the plate

“K” is the constant property

If we increase “A” size of the plate will be increased but It is not required

So the only variable is “ $\partial L/\partial X$ ”

We can write it as  $P = \partial L/\partial X$  (power obtained will depend on the amount of light falls on it)

Amount of light fall is more for a solar plate with auto-tracking

- power obtained from a solar plate is  $P= V * I$   
In the case of min intensity of the sun, the voltage obtained is

$$V = 11v \text{ to } 12v$$

In case of maximum intensity of sun voltage obtained is

$$V = 18v$$

Table-I: voltage obtained for specific light intensity

| Intensity of light | Voltage obtained |
|--------------------|------------------|
| minimum            | 11-12v           |
| maximum            | 18v              |

- power obtained from the solar plate is  $P= V * I$   
voltage = 18v  
current = 2000mA  
power =  $18*2=36W$

### B. A TEST FOR WIND ENERGY

This test is conducted in the laboratory by maintaining the wind velocity at 5m/s to 8m/s by using a regulated blower.

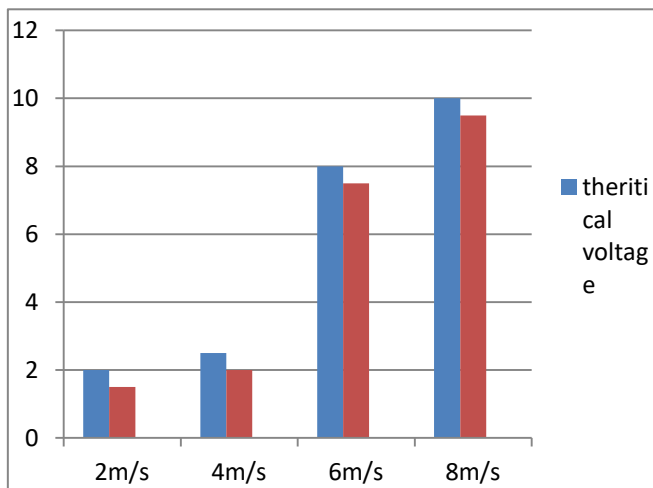
- Specifications of windmill  
motor speed = 1000rpm  
voltage = 12v  
current = 250Ma



Figure “2”, vertical windmill

Table-II: voltage obtained for specific speed

| Wind speed | Motor speed | Voltage obtained |
|------------|-------------|------------------|
| min(5m/s)  | 700 rpm     | 6v               |
| max (8m/s) | 1000 rpm    | 12v              |



“Figure 2(a)”, Wind velocity vs voltage obtained

C. A TEST FOR PIEZO-ELECTRIC ENERGY

In this test, “quartz” material acts as piezoelectric material which is having a property of resisting to applied loads this resistance in turns produces voltage as output

In this test six plates of each 3cm of diameter is used which generates a less output power than both solar and wind systems

The output voltage from piezoelectric material is in AC (Alternating Current). To convert AC voltage to DC voltage bridge rectifier is used. The output voltage of Piezo-electric

material is 10V to 30V DC and Current 10 – 15 Micro Ampere. further, this DC voltage is used to charge the battery.

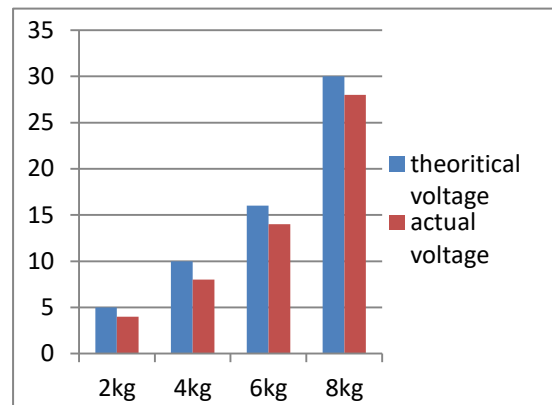
- voltage obtained  $V = 10v$  to  $30v$  per 1plate  
current  $I = 10mA$  per 1plate
- In this project, 6 plates are used so the total current obtained is 60mA



“Figure 3”, piezoelectric plates

Table-III: voltage obtained for specific weight

| weight    | voltage obtained |
|-----------|------------------|
| 4kg – 5kg | 10v              |
| 7kg – 8kg | 30v              |



“Figure 3(a)” Weight vs voltage obtained

D. POWER CONSUMPTION

- In this project light and blower is used as loads their power consumption as shown in the table
- Time is taken to charge the battery = 4-5hr

Table-IV: voltage obtained for specific weight

| loads                        | Power consumption(w) |
|------------------------------|----------------------|
| Without load (for circuits)  | 5W                   |
| Heater as load               | 10w                  |
| Blower as load               | 10w                  |
| Both(heater &blower) as load | 20w                  |

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## D. CALCULATION FOR COOLER

- Area to be cooled = 5 feet<sup>2</sup>  
 $= (5 \times 0.3) \times (5 \times 0.3)$   
 $= 2.25 \text{ m}^2$



“Figure 4”, blower

- The main purpose of any cooler is to remove heat present in the specified area for this purpose a wet cloth with submerged motor is used.
- With the help of submerged motor 5lit of water per hour is circulated through the wet cloth.
- Therefore, Heat transfer rate  $Q = m \cdot c_p \cdot \Delta t$ .

$$= 5 \times 4.1 \times (313 - 303) \quad [5\text{lit} = 5\text{kg}]$$

$$= 205 \text{KJ} / \text{Hr}$$

Initial temperature  $T_1 = 313\text{K}$ ,

$$= 5.35\text{W}$$

Final Temperature  $T_2 = 303\text{K}$

- Heat Transfer rate  $h = Q / A \cdot \Delta t$   
 $= 55.35 / (2.25 \times 10)$   
 $= 2.46 \text{W} / \text{m}^2 \text{K}$
- Therefore, Coefficient of Performance (COP) =  $Q/W = 55.35/12 = 4.61$ .

## F. CALCULATION FOR HEATER

- Area to be Heated = 5 feet<sup>2</sup>  
 $= (5 \times 0.3) \times (5 \times 0.3)$   
 $= 2.25 \text{ m}^2$



“Figure 5”, heating coil

- Therefore, Heat transfer rate  $Q = m \cdot c_p \cdot \Delta t$ .

$$= 5 \times 1.29 \times (313 - 303) \quad [5\text{lit} = 5\text{kg}]$$

$$= 64.5 \text{KJ} / \text{Hr}$$

Initial temperature  $T_1 = 303\text{K}$ ,

$$= 17.415\text{W}$$

Final Temperature  $T_2 = 313\text{K}$

- Heat Transfer rate  $h = Q / (A \cdot \Delta t)$   
 $= 17.415 / (2.25 \times 10)$   
 $= 0.774 \text{W} / \text{m}^2 \text{K}$

• Therefore, Coefficient of Performance (COP) =  $Q/W$

$$\text{COP} = 17.415 / 12 = 1.45$$

## V. SUMMARY

In this Proposed System, Solar, Wind, and Piezo as three Energy Sources to design a Hybrid Energy System. Multi-Point Tracking Technology is used to get maximum efficiency from the Solar Panel. This System is designed using AVR Microcontroller, LDR Sensor and Relay Driver Circuit to control the Movement of Solar panel according to the Sun Direction. This helps the 12V Solar panel to get maximum power output. Wind Mill is used to generating 12V – 15V DC Power when there is enough Wind. Foot Step Power Generator is designed to generate power from Human Foot Steps. This System allows a platform for placing foot Steps. Piezo Sensor is mounted below the platform to generate a voltage from footsteps.

Output Voltages from these three different sources are used to charge the 12V Battery using an LM317 based Charging Circuit. Battery Voltage is further used to drive an IoT based Application, that control two Loads (Blower and Blub) from anywhere in the World. Using an Android Application, the user can control these loads via the Internet. Blynk based IoT Web server is used for IoT based applications. ON / OFF status of the Load can be seen in the LCD Module.

User has to connect the IoT based web Application and Hardware device with Internet. After a successful connection to the internet, users can control this load using Blynk based Android Application.

This System also equipped with a Voltage Sensor to scale the Battery current and voltage Sensor measures Current Consumed by the Loads.

In this project, the alternative solution for the lifetime of battery and dynamo is proposed by using a piezo-electric generator which is free from pollution. The piezoelectric generator has active materials to generate a charge when force is applied.

## VI. CONCLUSION

Demand for electrical energy is increasing day by day. hybrid energy-efficient multi-source is the solution as an alternative for the rising demand.



This research work describes the functionality application of the extra devices to increase the power quality performance of the power systems with a large share of distributed energy resources, which includes large renewable sources such as Solar, wind farms, etc.

Opting the technologies for three sources to have increased efficiency, technologies like the auto-tracking system to trace enough sunlight as it changes the direction with respect of time in a day.

The battery receives the energy from the three sources and gets charged at any time as there three sources that are alternative to one another as they work at different times. Like solar energy in the day time and wind energy whenever there is wind and piezo energy as we walk on the steps or roof.

Hence connecting the whole three systems to the IoT with Blynk software helps to operate the load from the place we go, through our mobile phones with the help of the internet.

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