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POWER GENERATION USING HYBRID ENERGY SOURCES

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Abstract: The most important element in our everyday lives is electricity. It can be generated either conventionally or in an unconventional way. Conventional energy sources are becoming more limited every day. Solar and Wind can be a viable alternative. In our everyday lives, we come across many situations in which we can turn Mechanical Energy into Electrical Energy. By combining these three energy sources together, we can have a reliable Hybrid Energy System where at least one energy source remains active during abnormal conditions and all three energy sources can work together at the same time during normal conditions. The analysis also looks at the economics of the proposed hybrid energy system, taking into account the initial setup costs, maintenance costs, and long term operational expenses.

***IndexTerms* – Wind, Solar, Piezoelectric, Hybrid Power Generation.**

I. INTRODUCTION

The project aims to develop a system that uses wind, piezo and solar energy to electrify rural areas. Wind and solar energy are treated as non-renewable energy sources. The system also uses the inverter to connect AC appliances and also to charge mobile phones. Wind and solar energy have been used since the earliest civilizations to grind grain, pump water from deep wells, and power sails. Windmills were used for many things in per-industrial Europe, including irrigation or pumping drainage, grinding grain, sawing wood, and processing other commodities such as spices, cocoa, dyes and dyes, and tobacco.Before the installation of US power line infrastructure, both water pump windmills and small windmills(wind loaders) were essential to agriculture and the development of the Great Plains and American West. In recent decades, industry has developed wind turbines to convert wind energy into electricity.Wind energy has many advantages that make it an attractive source of energy, especially in parts of the world where the transmission infrastructure is not fully developed. It is modular and relatively quick to install, making it easy to match power supply and demand. The fuel - wind - is free and plentiful, eliminating or reducing the need to buy, ship and store expensive fuels. It is flexible -the electricity produced allows households to power home appliances such as lighting and cooling, schools to power computers and televisions, and industry to use a reliable energy source. Perhaps most importantly, unlike many other sources of generation, a generator produces no harmful emissions in the process of producing electricity. The project uses a wind turbine, piezo plate and solar panels. The received wind energy is stored in the battery. It is fed to a step-up transformer to generate low-voltage alternating current.This alternating current is supplied to turn on/off electrical equipment. Thus, keeping the above discussion in mind, we implemented a hybrid power generation system using the three energy sources discussed above. The energy produced by this system is stored in the battery through a charge controller. The battery power is then fed into an inverter circuit that converts direct current to alternating current. This alternating current can be supplied to electrical devices.

II. LITERATURE REVIEW

1. Power generation using hybrid renewable energy sources (solar, wind and hydro), AMOGHA A K M. Tech Student,Department of EEE, SDM College of Engineering and Technology, Dharwad, Karnataka, India, IRJET January 2019.Wind Photovoltaic- Hybrid Generation is a new a high-energy system that combines the advantages of wind, solar and electricity. Today, renewable energy is considered a viable source of energy to meet the world's growing demand for electricity. This integrated system makes it possible to produce electricity in regions rich in sustainable natural resources.with limited or offline connections. This article creates an effective working village housing plan. The development and use of renewable energy sources such as wind, solar and electricity is an effective way to solve energy and pollution problems. But there are challenges, mainly due to fluctuations in wind and solar energy. In particular, wind energy has a significant impact on grid stability. This article focuses on the investment costs and acquisition of a hybrid renewable energy system that includes solar, wind and hydropower. The estimated cost of this system indicates a payback period of 9 years.

2. Prospect of Hybrid Solar-Wind Power Generation System in Bangladesh, Milton sarker Dhaka University of Engineering and Technology, Gazipur-1700, Dhaka, 2014.Bangladesh has a good opportunity to build solar and wind power plants. We are looking at other parts of the country and in particular we can show that in Potenga and Thakakurgaon you can generate more than 100 kW of energy with a hybrid power system..This article gave an in-depth lecture on the wind-solar hybrid

program in Bangladesh after reading this article. The Ministry of Environment and recent studies by some NGOs in the country. Ideally, a well-designed wind power system can produce green energy that is efficient, clean and reliable for many years. Renewable energy systems are very site specific and designing such systems is difficult. From this study, it can be concluded that Bangladesh has great potential for hybrid energy production.

III. COMPONENTS DESCRIPTION

SOLAR PANELS:

Photovoltaic modules consist of a large number of solar cells and use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer. Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells are usually connected electrically in series, one to another to the desired voltage, and then in parallel to increase current. The power (in watts) of the module is the voltage (in volts) multiplied by the current (in amperes), and depends both on the amount of light and on the electrical load connected to the module. The manufacturing specifications on solar panels are obtained under standard conditions, which are usually not the true operating conditions the solar panels are exposed to on the installation site.

A PV junction Box is attached to the back of the solar panel and functions as its output interface. External connections for most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. A USB power interface can also be used. Solar panels also use metal frames consisting of racking components, brackets, reflector shapes, and troughs to better support the panel structure.

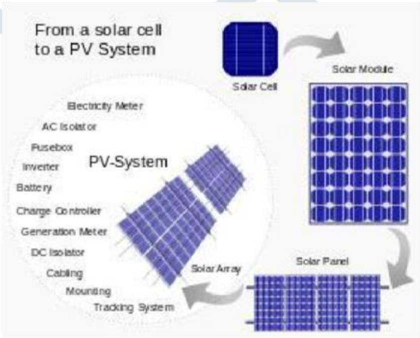


Fig1: Construction of the solar panel from a single photovoltaic cell.

Each module is rated by its DC output power under standard test conditions (STC) and hence the on field output power might vary. Power typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. Some commercially available solar modules exceed 24% efficiency. Currently, the best achieved sunlight conversion rate (solar module efficiency) is around 21.5% in new commercial products[32] typically lower than the efficiencies of their cells in isolation. The most efficient mass-produced solar modules have power density values of up to 175 W/m^2 (16.22 W/ft^2). The current versus voltage curve of a module provides useful information about its electrical performance. Manufacturing processes often cause differences in the electrical parameters of different modules photovoltaic, even in cells of the same type. Therefore, only the experimental measurement of the I–V curve allows us to accurately establish the electrical parameters of a photovoltaic device. This measurement provides highly relevant information for the design, installation and maintenance of photovoltaic systems. Generally, the electrical parameters of photovoltaic modules are measured by indoor tests. However, outdoor testing has important advantages such as no expensive artificial light source required, no sample size limitation, and more homogeneous sample illumination.

Scientists from Spectrolab, a subsidiary of Boeing, have reported development of multi-junction solar cells with an efficiency of more than 40%, a new world record for solar photovoltaic cells. The Spectrolab scientists also predict that concentrator solar cells could achieve efficiencies of more than 45% or even 50% in the future, with theoretical efficiencies being about 58% in cells with more than three junctions. Capacity of solar panels is limited primarily by geographic latitude and varies significantly depending on cloud cover, dust, day length and other factors. In the United Kingdom, seasonal capacity factor ranges from 2% (December) to 20% (July), with average annual capacity factor of 10–11%, while in Spain the value reaches 18%. Globally, capacity factor for utility-scale PV farms was 16.1% in 2019. Overheating is the most important factor for the efficiency of the solar panel. Depending on construction, photovoltaic modules can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar radiation range (specifically, ultraviolet, infrared and low or diffused light). Depending on construction, photovoltaic modules can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar radiation range. Hence, much of the incident sunlight energy is wasted by solar modules, and they can give far higher efficiencies if illuminated with monochromatic light. Therefore, another design concept is to split the light into six to eight different wavelength ranges that will produce a different colour of light, and direct the beams onto different cells tuned to those ranges.

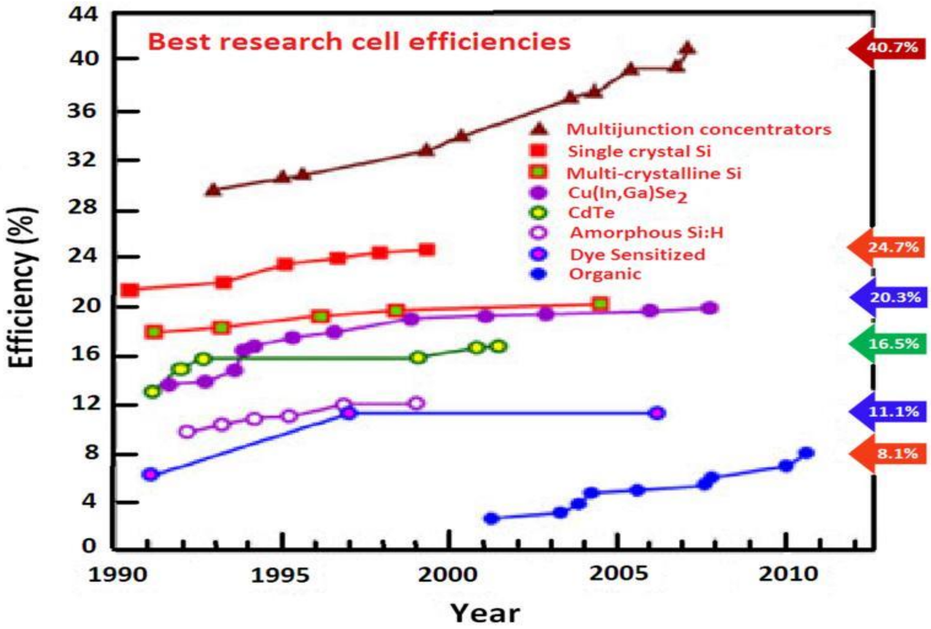


Fig 2 : Reported timeline of a solar module energy conversion efficiencies since 1990

WIND TURBINE:

A wind turbine is a device that converts the kinetic energy of wind into electrical energy. As of 2020, hundreds of thousands of large turbines, in installations known as wind farms, were generating over 650 gig watts power, with 60 GW added each year. Wind turbines are an increasingly important source of intermittent renewable energy, and are used in many countries to lower energy costs and reduce reliance on fossil fuels. One study claimed that, as of 2009, wind had the "lowest relative greenhouse gas emissions, the least water consumption demands and the most favourable social impacts" compared to photovoltaic, hydro, geothermal, coal and gas energy sources. Smaller wind turbines are used for applications such as battery charging and remote devices such as traffic warning signs. Larger turbines can contribute to a domestic power supply while selling unused power back to the utility supplier via the electrical grid.

Wind turbines are manufactured in a wide range of sizes, with either horizontal or vertical axes.

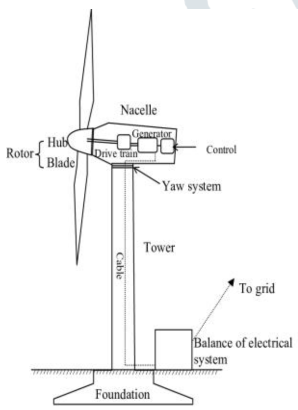


Fig3: Horizontal-axis Wind Turbine

Fig4: vertical-axis wind turbine.

Wind turbines can be used in hybrid energy systems with other distributed energy resources, such as micro grids powered by diesel generators, batteries, and photovoltaic.

PIEZOELECTRIC PLATES:

The Piezoelectric effect is an effect in which energy is converted between mechanical and electrical forms. It was discovered in the 1880's by the Curie brothers. Specifically, when a pressure (piezo means pressure in Greek) is applied to a polarized crystal, the resulting mechanical deformation results in an electrical charge. Piezoelectric microphones serve as a good example of this phenomenon. Microphones turn an acoustical pressure into a voltage. Alternatively, when an electrical charge is applied to a polarized crystal, the crystal undergoes a mechanical deformation which can in turn create an acoustical pressure. An example of this can be seen in piezoelectric speakers. (These are the cause of those annoying system beeps that are all too common in today's computers). Electrets are solids which have a permanent electrical polarization. (These are basically the electrical analogs of magnets, which exhibit a permanent magnetic polarization). Figure 3 shows a diagram of the internal structure of an electret. In general, the alignment of the internal electric dipoles would result in a charge which would be observable on the surface of the solid. In practice, this small charge is quickly dissipated by free charges from the surrounding atmosphere which are attracted by the surface charges. Electrets are commonly used in microphones.

Permanent polarization as in the case of the electrets is also observed in crystals. In these structures, each cell of the crystal has an electric dipole, and the cells are oriented such that the electric dipoles are aligned. Again, this results in excess surface charge which attracts free charges from the surrounding atmosphere making the crystal electrically neutral. If a sufficient force is applied to the piezoelectric crystal, a deformation will take place. This deformation disrupts the orientation of the electrical dipoles and creates a situation in which the charge is not completely cancelled. This results in a temporary excess of surface charge, which subsequently is manifested as a voltage which is developed across the crystal.

In order to utilize this physical principle to make a sensor to measure force, we must be able to measure the surface charge on the crystal. Figure 4 shows a common method of using a piezoelectric crystal to make a force sensor. Two metal plates are used to sandwich the crystal making a capacitor.

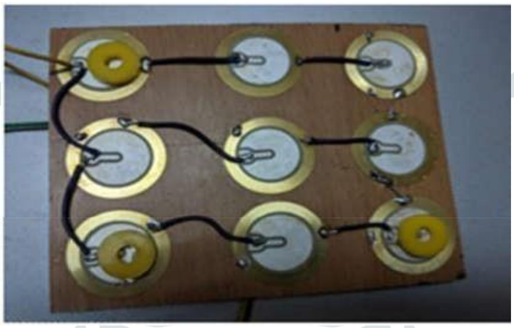
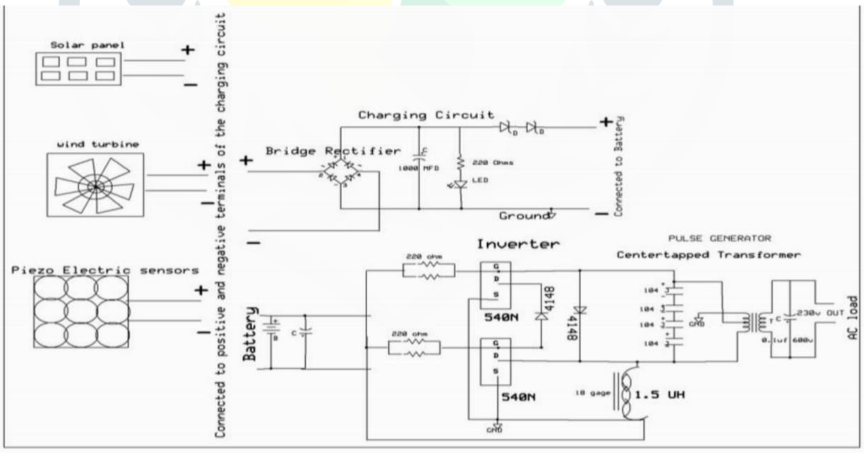


Fig5: Piezoelectric Sensor Plate

IV.PROPOSED SYSTEM

BLOCK DIAGRAM:



The Expected result of the project "Hybrid Power Generation using Solar, Wind and Piezo" is that the generated energy can be used to turn ON the electrical appliances. By using non-conventional energy sources it is very easy to save power.

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.

Below are the steps for the implementation of the project.

1) Turn ON the kit by giving the power supply through the battery which is charged by the hybrid power generation.
2) The Inverter converts the DC to AC and the transformer steps up the AC voltage which is fed to the 230 volts AC output and thus the bulb glows.

3) The solar panel is connected to the charging circuit which gives the output of 12volts/5watts and the charging time using the solar panel is approximately 5 hours.
4) The wind turbine is connected to the charging circuit which gives the output of 12volts/10watts and the charging time using the wind turbine is approximately 8 hours.
5) The piezo sensor plate is connected to the charging circuit which gives the output of 2volts and the charging time using the piezo plate is approximately 20 hours.
6) The three sources are connected to the charging circuit which hybridizes the power and thus decreases the charging time to 3.5 hours.
7) The output of the charging circuit is fed to the 12volts/1Amp battery. And the battery is charged simultaneously.
8) The output of the battery is sent to the square wave inverter circuit which coverts the 12volts DC input to 12volts AC output.
9) A square waveform is generated at the output of the inverter circuit by using a CRO as shown in Figure 10.
10) The 12volts AC from the inverter circuit is fed to the step-up transformer which gives 230volts AC which can then be used for the power of the electrical appliances.
11) A bulb holder and a 3-pin socket are connected as our final output which can be used to glow the bulb and charge a mobile phone.
12) Therefore by hybrid power generation, we can glow the bulb and thus get the desired output.

V. RESULTS

The Expected result of the project “Hybrid Power Generation using Solar, Wind and Piezo” is that the generated energy can be used to turn ON the electrical appliances. By using non-conventional energy sources it is very easy to save power.

The project makes use of a wind turbine, piezo plate and solar panels. The wind energy obtained is stored to a battery. The battery supply is fed to pulse generator and in turn to a MOSFET which is capable of generating ON/OFF pulses of different frequencies. This is fed to a step-up transformer to generate a low voltage AC. This AC is fed to Switch ON/OFF the electrical appliances.

VI. CONCLUSION

Developing hybrid systems for power generation is the most convenient and efficient solution compared to renewable energy sources. Not only is it low cost, it is also environmentally friendly. Another thing is that it can be used to generate electricity in hilly areas, where it is very difficult to distribute electricity through traditional methods. Its setup can be determined based on need. All people in this world should be motivated to generate electricity from non-conventional sources. Long life span, less maintenance is some of its plus point. It just requires some high initial investment.

We know that the production cost per unit in a hybrid system is high, but the available resources are used efficiently. This hybrid system is capable of recovering from any accidental or unwanted situation. The hybrid system can cater to remote and rural areas. So it is clear that the hybrid system is a good choice. Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

VII. FUTURE SCOPE

The project at developing a system which makes use of wind, piezo and solar energy for rural electrification. Wind And solar energy is treated as non-renewable source of energy. The system also uses inverter to switch the AC devices. This project can be extended using GSM module, it will send the information regarding the status of the battery (how much energy it consumed) to the respective authorities. In future we can use this project in order to control devices automatically in industries, hospitals, homes etc. This kind of automation provides greater advantages like accuracy, energy conversation, and reliability and more over the automated systems do not require any human attention.

As the energy conversation is very important in the current scenario and should be done to a maximum extent where ever it is possible. In future we can use this project in several applications by adding additional components to this project. The controlling of devices can be done using mobile phone technology, personal computers, touch screens, remote controls etc. The monitoring and controlling devices is done by using different sensors according to the information we can make alterations.

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