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Design and Development of Micro Solar-Wind (Hybrid) Power Plant

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Abstract: *This project (Design of Micro Solar Wind Plant) is about designing and manufacturing Vertical Axis Wind Turbines (VAWT), these turbines are used to convert wind speed into rotational motion. Mini Monocrystalline Solar Panels are used to convert solar radiation into electrical energy. These turbines and panels are mounted on modern designed tree structures and can be installed in public places, residential homes, offices etc. As the demand for electricity to provide convenience in many places increases, the use of renewable energy sources is also increasing in various ways. This is an independent source of electrical energy generation. Designing this power plant can save a lot of fossil fuels, electricity and capital. This project consists of design, manufacturing and installation phases.*

Keywords: VAWT, Solar panel, Modern design, Installed in any places, Independent source, Fossil fuels.

I. INTRODUCTION

According to a report from Arab News, Saudi Arabia's current demand for electricity is very high compared to the global average electricity consumption, with Saudis consuming three times the global average. This high demand is a notable one when considering different sources of energy. One of the best sources of energy where the concept of sustainability can be applied is renewable energy such as the sun, wind, and rivers. The advantage of wind energy is that wind turbines can be used 24 hours a day throughout the year, while solar panels absorb radiation from the sun and this energy is used when the wind speed is insufficient.Another concept of sustainability is how to utilize this renewable energy in an efficient and environmentally friendly manner, thus eliminating environmental hazards and improving the health and lifestyle of the Saudi Arabian community. Streets, public parks, schools and public buildings are considered the main electricity consumers. The idea of this project is to use Vertical Axis Wind Turbines (VAWTs) to convert wind and solar power into useful energy and use it as a source of electricity that can power these consumers.

II. OBJECTIVE

The main aim of this project is to get power from solar panels and wind, which is an eco-friendly resource so it has no impact on the life on earth. These mini wind turbines can usually generate anywhere between 20 kilowatts to 400 kilowatts depending on how much power you want to generate. Mini solar panels can generate 10 watts.

- More power can be generated from solar wind farms.
- With proper manufacturing, it reduces the load on the mains.
- Less land is required to set up the turbine.
- It generates more power without using large blades and large panels.
- Learn the difference between Vertical Axis Wind Turbine [VAWT] and Horizontal Axis Wind Turbine [HAWT]

III. LITERATURE REVIEW

Shaikh Mehfuz Rahman, Siddiqui Fateh Mohammed, Mohammed Anees Patka(1) : Aero-leaf wind turbine is based on idea of how to use wind energy in more effective and efficient manner. Components used are nylon fibre for aero leaf structure, steel for ring structure , generator to convert kinetic energy into electrical energy ,battery to store and supply energy ,control box to control operation and the performance . As they have calculated velocity is 10.5 m/ s and speed of wind turbine is 330 rpm. They say that this is most effective way to use wind force and generate electricity

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Sanjeev Yadav, Abhishek Mishra, Vikas Kumar Chaubey, Ankit Tiwari and Prof.Karunakar Singh (2) : The artificial leaves act as mini vertical turbines around the tree. The growth of wind energy in India is huge and it has proven to be an option to mitigate challenges like power demand, environmental pollution, greenhouse gas emissions, and depleting fossil fuels. Due to the high cost of installing solar panels, we have used only wind turbines. The components used are plastic pipes, aluminium sheets, dynamo, LEDs, digital multimeter, battery, and LDR sensor module. As per the calculations, the total power generated through the tree is 15.89 watts, approx..

Mohana Prasanth S, Assistant Prof. Mr. Bradeesh Moorthy S, Prof. Dr. Ramesh.K, Assistant Prof. Dr.Kulandaivel.D (3) :This project reviews the performance of Savonius wind turbines. This type of turbine is not commonly used. It has a slower starting speed and produces less noise. The components used in its manufacture are galvanized carbon steel for the wood, aluminium alloy for the turbine blades, a generator and a control board (controller, converter, battery) for converting DC power to AC power.Theoretically, the wind turbine was expected to generate up to 300 watts of power. After calculation, it was found that the performance of the Savonius turbine has a gap between the actual output power and the ideal output power. Several factors affect this, including external factors, human error, resource shortage, process and geometry, and wind speed shortage, and these factors cause a 31-35% drop between the theoretical and experimental results.

Parvez Raza, Prof.PrabhatR.Mishra(4) :Vertical axis turbines are difficult to mount on a shaft, so they are often installed closer to their base, such as on the ground or on the roof of a building. Lower altitudes mean slower wind speeds, so less wind energy is available for the same size turbine. Air flows close to the ground and other objects can create turbulence, which can cause noise and vibration problems such as bearing wear, which can result in increased maintenance and a shorter useful life. A rooftop turbine shaft height of about 50% of the building's height is a near optimum that maximizes wind energy and minimizes wind turbulence.

Usha S. Sahu, Dr. Rakesh K Vidhate, Prof. Ishan P. Lade(5) :Designing a hybrid power generation system using both solar and wind renewable energy for homes in remote areas that cannot be connected to the power grid. A study of the proposed system has convinced us that a solar tree with wind turbines will be the best solution to generate energy day and night. The tree-like design is more efficient than the traditional one. In conjunction with the wind turbines, we use three 15W solar panels, which generate a total of 45W. The wind generates an additional 12W, for a total of 57W. The 12V 7A battery charges in a few hours.

IV. LITERATURE GAP

The paucity of literature on the development of micro-solar wind farms highlights several key areas requiring further research, including optimizing hybrid system integration for efficient energy management, designing micro-solar wind systems for building integration, and improving performance under different environmental conditions. There is also a need for advances in energy storage solutions to manage intermittent energy supplies, material innovations to improve efficiency and aesthetics, and detailed analysis of the impact of local climate on system performance, as well as sustainability concerns around materials use, waste management, and more.

V. DESIGN OF SOLAR -WIND PLANT

DEFINITION OF AEROLEAFS:

Aero Leaf is a micro wind turbine composed of a micro generator with double blades and permanent magnets with a leaf-shaped vertical axis. The technology combines the properties of solar and wind energy. The combination of these technologies allows Aero Leaf to double its power production. The overall design of the sheet and solar panels has been studied to maximize efficiency when the wind is weak and the light intensity is low.

COMPONENTS:

Wind turbine, Solar panel, Wind and Solar controller, Battery, Generator, Shaft, Inverter, Spiral blades.

WORKING PRINCIPLE:

The main function of a wind turbine is to convert the kinetic energy of the wind into mechanical energy and finally into electrical energy. Aeroleaf solar wind turbines are essentially an improved version of wind turbines that can catch wind

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from any direction and generate electricity. The flexibility of Aeroleaf turbines allows maximum energy to be achieved. Such turbines need to be installed in locations where wind of sufficient speed approaches the turbine from a particular direction around a vertical axis and rotates according to the direction of the tangential force generated by the wind. Hence, the Aero Leaf turbine is designed with vertical axis rotation in which two lobes facing opposite directions rotate around one vertical axis. This further facilitates continuous rotation of the Aero Leaf resulting in high power output. As both the lobes mounted on one axis face opposite directions, when the wind approaches the curved part of the lobe, the force generated causes the lobe to rotate around the vertical axis.. The movement remains unhindered until the wind in a particular direction stops. Thus, in this technology, there is no need to use large blades to generate current as the leaves themselves help in generating the current. Mini solar panels are attached to the wind turbine. When the wind is insufficient, the solar panels help in generating electricity. Solar panels absorb the sunlight generated by the sun and pass that energy to a battery or controller which converts that energy into electrical energy to produce electricity. When solar and wind turbines are combined, more power can be produced.

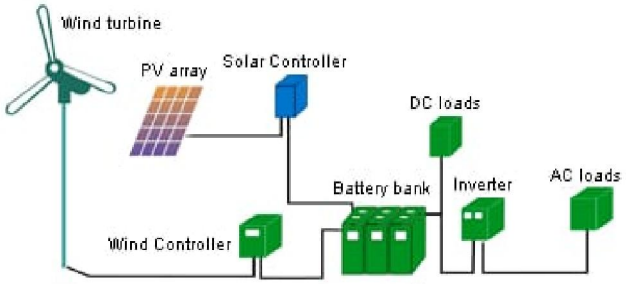

Fig. 1 Schematic diagram

DESIGN OF TREE AND WIND TURBINE:

We use Helix Vertical Axis Wind Turbines, which refers to a blade design on a Vertical Axis Wind Turbine (VAWT) that curves and twists in a spiral around a central axis like a screw thread, allowing the turbine to capture wind energy from all directions without having to point the turbine into the wind, resulting in less noise and vibration and smoother power generation compared to straight blades. It creates a helical shape that helps distribute aerodynamic forces more evenly throughout the rotation cycle. At this stage we reached the stage where we could start planning the design of the tree. This planning started by defining the height, width and weight of the tree, we agreed that it should be 3-4 meters tall, weigh 16.5kg and 2 meters wide to get as much wind as possible. The materials used for the tree model are steel for the trunk, aluminum for the branches and durable plastic for the Aero Leaf modules, mini solar panels and mini wind turbines. After looking at research papers we found that aluminum would not be able to hold the turbines properly so we used carbon galvanized steel for the branches.

Fig 2. Tree model.

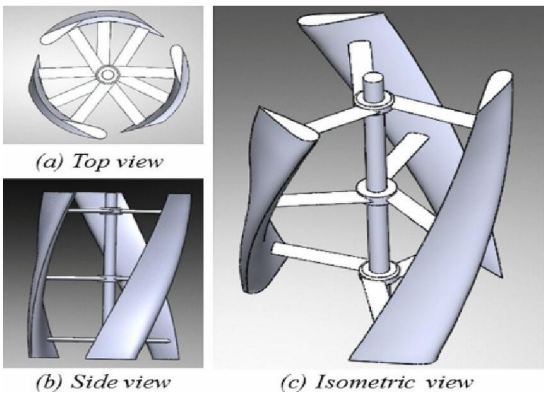

Fig 3. Helicalwind turbine

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DESIGN OF SOLAR –WIND POWER PLANT:

Solar panels are mounted underneath the turbine blades and consume solar radiation from the sun to generate electricity. The diagram below shows that the solar panels can be mounted directly on the poles or separately underneath the turbine blades..

Fig 4. Solar wind power plant

VI .TECHNICAL SPECIFICATIONS

Maximum height	3 – 4 m
Weight	16.5 kg
Distance between aeroleaf	0.5 m
Required voltage	48 V
Invertor output voltage - 230 V	230 V
Maximum output power by one solar- wind	35 to 40 watt
One wind turbine produce	30 watt
One mini solar panel produce	5 – 10 watt
Minimal required wind speed	2.5 m/s (9 km/hrs)
Maximum wind resistance (continuous)	43 m/ s (155 km/hrs)
Maximum wind resistance (gusts)	50 m/s (180 km/ hrs)
Total wind turbine produce	Max 210 watt
Total solar panel produce	Max 35 watt
Total combination of solar and wind turbine	245 watt

TABLE 1 : SPECIFICATION

VI. RESULT

The electricity generated by wind and solar power can be measured separately, and the electricity generated is effectively utilized according to the home appliances, and is generated efficiently by hybrid equipment.

VII.CONCLUSION

This project represents the development of a solar-wind hybrid power plant that will increase the efficiency of energy generation. This project will reduce the electricity bill and make it environmentally friendly. It will reduce pollution and eliminate greenhouse gas emissions. The fuel will be freely available and will be cost effective. Hence, this project is undertaken to easily generate electricity from wind and solar.

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