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Hybrid Power Generation using Solar and Wind Energy to Produce Uninterrupted Electric Power

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ABSTRACT: The increases in oil prices and the unbearable impacts of this energy source on the users and on the environment, are slowly removing conventional energy solutions, such as fuel genets based systems, from the rural development agendas. Further, Reaching the non electrified rural population is currently not possible through three extension of the grid, since the connection is neither economically feasible, nor encouraged by the main factors. Thus this problem can overcome by using "HYBRID POWER GENERATION USING SOLAR AND WIND ENERGY". Hybrid systems have proved to be the best option to deliver "high quality" to produce uninterrupted Electric Power**.**

KEYWORDS: Solar Energy, Uninterrupted Electric Power Hybrid Power Generation, Wind turbine, Renewable energy, Machine design, small-scale horizontal axis wind turbine (HAWT, Photoelectric Effect

I. INTRODUCTION

The conventional energy sources decreases day by day and they may produce pollution which is very harmful for world and increasing the global warming. So the aim of world is to reach the 40 percent rate of the Renewable energy sources in the energy production by 2020. One option to achieve this aim is to increase the rate of the solar and wind energy in energy Production. These energy sources provide 26.1% electricity for the consumption. These targets can be realized by Increasing the green energy production. This target can be realized by member states in function of geographical and economical ability. Recently in Eastern part of Europe we can finda lot of farms, situated in remote area, where electricity supply has not reached. One obvious solution for electrification of these regions is the installation of small-scale stand-alone solar and wind energy production systems. [3].

When an aero-generator and an SPV system are interfaced, the power generation from these is mutually supplemented, and the resultant hybrid system offers are liable and cost-effective electric supply in a decentralized mode. The wind-solar hybrid system mainly consists of one or two aero-generators along with SPV panels of suitable capacity, connected with charge controller, inverter, battery bank, etc. to supply AC power. [3].

Electricity has become an intricate aspect of human life. In most countries, its major sources are non-renewable energy sources such as coal, nuclear power and petroleum products. These resources not only deplete with time but damage the environment from harmful effects of their use. There arises a need for clean and renewable energy, wind energy harnessed using turbine has proven to be a useful source of electricity. In its earlier years, the wind turbine was mostly as a mechanical device, but recently, it is being used to generate large amounts of electricity [1, 2].

Over a millennium, it has been developed to become a main power source in some countries in the world and is now available in different configurations in both onshore and offshore applications. Wind and solar are the most abundant sources of renewable energy and as such, harnessing these sources should be the main focus in our goal to reach a sustainable energy dependent society. The term "wind turbine" no longer only refers to a rotary propeller but a machine known as an aerofoil powered generator, different types of wind turbines such as vertical and horizontal are

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manufactured of recent. Small turbines have been implemented to charge batteries for boats and to serve as power source to traffic signs [3, 4, 5]. While large turbines have been implemented to power homes and offices for industrial uses. A collection of large turbines which is otherwise known as wind farms are fast becoming an important source of renewable energy which have been implemented by several countries to reduce absolute dependant on fossil fuels [6].

II. AIMS & OBJECTIVES

Conventional energy supply has not been able to meet the energy needs of most developing nations. This calls for the need to invest in renewable energy systems which are not only sustainable but clean, abundant, and easily assessable. This research presents a study of wind variability by using wind data got from a weather station to design and fabricate a small-scale horizontal axis wind turbine (HAWT). This was done by using locally source materials for a Hybrid Solar-Wind power system for irrigation purposes, as a performance evaluation of the turbine.

The materials used in the fabrication of the turbine include wood, polyvinyl chloride plastic, acrylic glass. Teflon, and steel all sourced locally. From the evaluation, the power capacity of the wind turbine was derived to be 40 W, 41 W and 43 W from the voltage and current output reading on the multi-meter from three average wind speed variations of 5 m/s, 10 m/s and 15 m/s measured from handheld digital anemometers respectively. A regression analysis of the relationship between the turbine's power capacity and the wind speed. The fabricated wind turbine was connected to a hybrid power system with the second energy source consisting of a 40 W solar tracking system to give a more stable power supply. The system was used for soil monitoring irrigation purposes. The design of the new technology indicates a cheap, alternative and sustainable energy source that is more stable and suitable for smart solar panel irrigation system.

1. In Remote areas implementing power systems units at each apartment.
2. Multistoried buildings
3. Homes, schools.
4. Street lightings covering a large area.
5. Off grid applications.
6. Solar water heaters. Electric kettles solar vehicles.
7. Traffic signaling and in many applications.

III. METHODOLOGY

Methodology and Working of the "Hybrid Power Generation using Solar And Wind Energy to produce uninterrupted Electric Power": The block diagram of the system contains a solar panel, buck converter and battery. The solar panel is used to convert the solar energy to electrical energy .The normal voltage rating of the solar panel used is 12V.The principle used is PHOTOELECTRIC EFFECT for the conversion of solar energy to electrical energy .When light is incident upon a material surface; the electrons present in the valence band absorb energy and get excited. They jump to the conduction band and become free. Some reach a junction where they are accelerated into a different material by a Galvani potential. This generates an electromotive force, and thus electric energy. Buck converter is a dc-dc converter, which comprises of MOSFET switch (IRF250N), inductor, capacitor and diode. Buck
converter reduces the input voltage to

1. Solar & Wind Hybrid Power Generation Circuit Diagram: Solar and wind hybrid power systems are designed using solar panels and small wind turbine generators for generating electricity. Generally, these solar wind hybrid systems are capable of small capabilities. The typical power generation capacities of solar wind hybrid systems are in the range from 1 kW to 10 kW. Before discussing in brief about the solar and wind hybrid power system, we should know about solar power generation systems and wind- power generation systems.

2. Solar Photovoltaic Cells Working: Solar cells or solar photovoltaic cells are the devices that are used for converting solar energy into electrical energy by utilizing the photovoltaic effect. These cells are used in many real-time applications such as railway signaling systems, street lighting systems, domestic lighting systems, and remote telecommunication systems. Generally solar panel open circuit voltage (voltage when battery is not connected) is higher than solar panel rated voltage. For example, consider a 12 volt solar panel giving an output voltage of around 20 volts in bright sun light- but, whenever a battery is connected to the solar panel, then the voltage drops to 14- 15 volts. Solar cells are made of most frequently used semiconductor materials such as silicon.Solar photovoltaic (SPV) effect is a process to convert solar energy into DC electricity using an array of solar panels. This, DC electricity can

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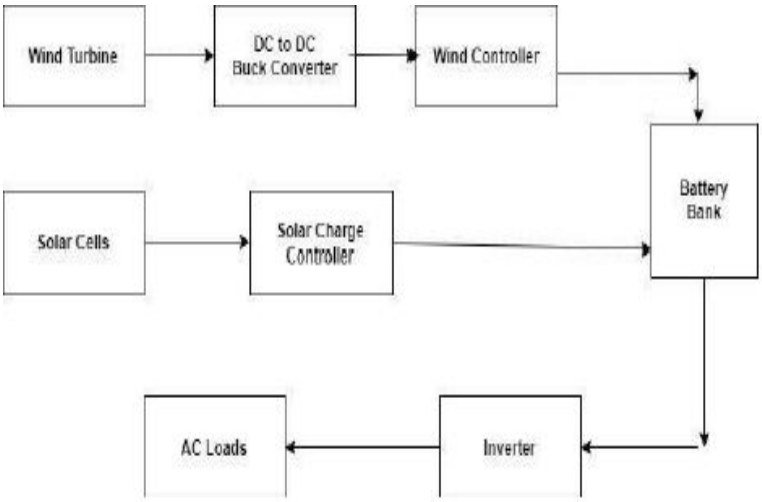
be stored in batteries shown in the figure or can be used to feed DC loads directly or can be used to feed AC loads using an inverter that turns DC electricity into 120-volt AC electricity.

3. Working of Wind Power System : Wind energy is also one of the renewable energy resources that can be used for generating electrical energy with wind turbines coupled with generators. There are various advantages of wind energy, such as wind turbines power generation, for mechanical power with windmills, for pumping water using wind pumps, and so on. Large wind turbines are made to rotate with the blowing wind and accordingly electricity can be generated. The minimum wind speed required for connecting the generator to the power grid is called as cut in speed and maximum wind speed required for the generator for disconnecting the generator from the power grid is called as cut off speed. Generally, wind turbines work in the range of speed between cut in and cut off speeds.

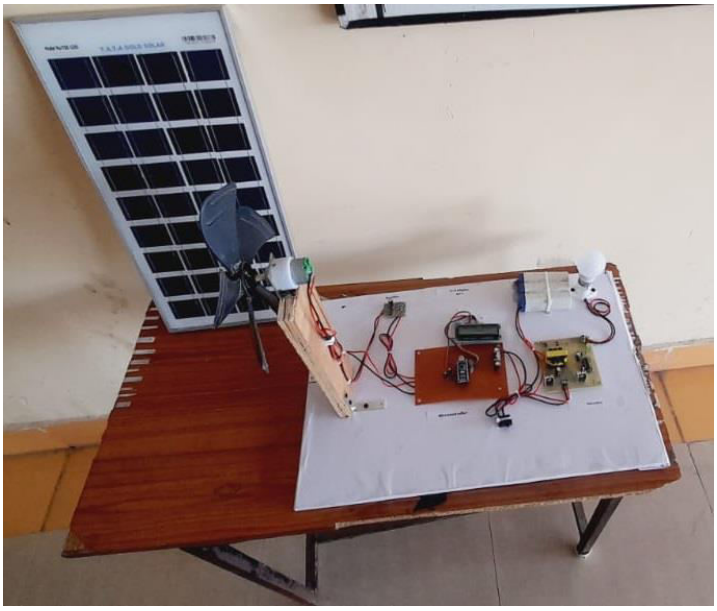
4. Wind Turbine : Wind turbine can be defined as a fan consisting of 3 blades that rotate due to blowing wind such that the axis of rotation must be aligned with the direction of blowing wind. A gear box is used for converting energy from one device to another device using mechanical method; hence, it is termed as a high precision mechanical system. There are different types of wind turbines, but the frequently used wind turbines are horizontal axis turbines and vertical axis turbines. The figure shows different blocks of the wind turbine generator system.

5. Wind Turbine Generator : An electrical generator is coupled with wind turbine; hence, it is named as wind turbine generator. There are different types of wind turbine generators and these wind turbine generators can be directly connected to the power grid or loads or batteries based on different criteria. In general, there are of types:

- Squirrel cage induction generator
- A wound rotor induction generator
- double fed induction generator



III (a) Hybrid Power Generation using Solar And Wind Energy to produce uninterrupted Electric Power



IV (a) Model of Hybrid Power Generation using Solar And Wind Energy to produce uninterrupted Electric Power

IV. EXPERIMENTAL RESULTS, OBSERVATION

From the wind data collected and from IV (a) Model of Hybrid Power Generation using Solar And Wind Energy to produce uninterrupted Electric Power, an analysis carried out on the collected wind to give a wind speed distribution. The wind turbine electrical circuit was connected to an LED of power 1 W to read and record the current and voltage outputs from the multimeter for the three fan variations at an interval of 10 s for 2 min. It was noted that some time was taken for the output to stabilize, and the current was consistent at 3 A. Figures 12, 13, and 14 shows the relationship between the wind speed and experimental turbine power at the three fan variations. The R2 value was used to evaluate the scatter-plot of the turbine power values around the fitted regression line and draws comparison between the figures. It can be interpreted that the low wind speed is the most suitable to produce a stable power of 40Was the wind turbine power distribution R2 value is the highest at 0.9602; so as to avoid damage to wind turbine components from uncontrolled wind speed. Let the solar and wind current be i1 and i2 respectively, and voltage be V and i be the internal drop urrent in charger controller module Now, Total power : - V (i1+i2-i)

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Now, let efficiency of the inverter, ŋ = 0.85**.** So, hybrid power in the form of the AC of the system, ŋ = 0.85 V (i1+i2-i) The process has not completed yet, it will be completed soon.

V. CONCLUSION

In conclusion Hybrid Power Generation using Solar And Wind Energy to produce uninterrupted Electric Power, Reaching the non electrified rural population is currently not possible through the extension of the grid, since the connection is neither economically feasible, nor encouraged by the main actors. Further, the increases in oil prices and the unbearable impacts of this energy source on the users and on the environment, are slowly removing conventional energy solutions, such as fuel genset based systems, from the rural development agendas. Therefore, infrastructure investments in rural areas have to be approached with cost competitive, reliable and efficient tools in order to provide a sustainable access to electricity and to stimulate development. One of the key strengths of the system lies in its ability to continuously monitor environmental conditions along railway tracks and detect changes indicative of potential flash flood events. By leveraging advanced technologies and real-time monitoring capabilities, the system has provided accurate and actionable information about track conditions, facilitating informed decision-making by railway authorities. The system's integration of sensor networks with existing railway infrastructure systems has further enhanced its effectiveness, enabling seamless communication and interoperability between sensor nodes and control centres.

Moreover, the system's user-friendly interface, The small-scale horizontal axis wind turbine (HAWT) was constructed with the sole aim of enhancing the power capacity of renewable energy system through a hybrid connection with the solar panel, used to power a soil monitoring irrigation system. From the performance evaluation of the developed HAWT, the power capacity of the wind turbine was derived to be 40 W, 41 W and 43 W from the voltage and current output reading from three average wind speed variations of 5 m/s, 10 m/s and 15 m/s measured from handheld digital anemometers respectively. A regression analysis of the relationship between the turbine's power capacity and the wind speed showed that the turbine operates best at low speed of 5 m/s, with an R2 value of 0.9602. The developed HAWT was subsequently deployed to an irrigation system, and the soil volumetric moisture content has been determined at different depths of 20, 30 and 50 cm of R2 of 0.85, 0.88 and 0.95 respectively. From this study, it has been demonstrated that with sufficient wind speed at acceptable tower height, the wind turbine has the capability of providing an alternative, sustainable, and cost-effective power source.

Renewable energy sources are currently one of the most, if not the only, suitable option to supply electricity in fragmented areas or at certain distances from the grid. Indeed, renewableare already contributing to the realization of important economic, environmental and social objectives by the enhancement of security of energy supply, the reduction of Green house gases and other pollutants and by the creation of local employment which leads to the improvement of general social welfare and living conditions.Hybrid systems have proved to be the best option todeliver “high quality” community energy services to rural areas at the lowest economic cost, and with maximum social and environmental benefits. Indeed, by choosing renewable energy, developing countries can stabilize their CO2 emissions while increasing consumption through economic growth.

VI. FUTURE SCOPE AND APPLICATION

India ranks fifth in the world in wind power generation at 9600 MW. The coastal region and some parts of Gujarat and Rajasthan in India witness very favourable wind regime, and therefore, the wind power development in these areas has been significant. For commercial exploitation of wind energy, wind velocity at a site should be more than 6 meter per second and corresponding wind power density more than 200 watt per meter sq. In Northern India such high wind velocities are found only on high hilly regions where installation of large scale wind power projects is itself not feasible due to lack of infrastructure. Haryana has a very limited sub mountainous region on the foot hills of the Shivalik range in the northern part of the State and in south Haryana there are mainly the Arawali hills. Wind monitoring carried out by Haryana Renewable Energy Development Agency (HAREDA) through Centre for Wind Energy Technology(CWET) during 1998-99, indicated that the wind velocity at Morni(Panchkula) and Abheypur (Gurgaon) at 25 meter above ground level was 14.9-20.9 kmph and 12.5-17.12 kmph for for considerably long period in a year. Promoting wind energy in Haryana was a real challenge with technological barriers in such low wind speed areas. It was then mooted that Haryana should go for a small wind energy system which requires average wind velocity of 4 m/s. The idea to utilise the wind-solar power potential of the Morni Hills area adjoining Himachal Pradesh was conceived keeping in view the availability of good solar insolation levels(approx.500 W/m2) supplemented by fairly good wind speeds required for small wind hybrid projects. Sun & wind normally complement each other with sun energy being

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available for the period when wind energy is comparatively low and vice-versa. Thus the combination of sun and wind provided an ideal solution.

The wind-solar project had been installed by the Haryana Renewable Energy DevelopmentAgency(HAREDA) in November 2008 at a cost of Rs 34 lakh with financial assistance from the Union Ministry of New and Renewable Energy(MNRE). The power plant has 6.6 kW power generation from wind energy and 3.4 kW power generation from solar. The power so generated is being supplied to 24 houses of Chakli and Ramsar villages for two lights, one fan and six street lights. The hybrid power plant has been generating 12 units of electricity per day on an average basis and sometimes when the wind velocity is high, the power generated is about 30 units per day. The average cost of generation power in this mode comes out to be about Rs. 15/-per unit. The plant has generated about 2865 units of electricity in one year. The villagers are contributing Rs.50/- per month towards energy charges and are enjoying 24x7 electricity. The power availability in these villages has increased from about 50% to 100%. i.e; form 7-12 hours in the pre project scenario to 24 hours in the post project period.

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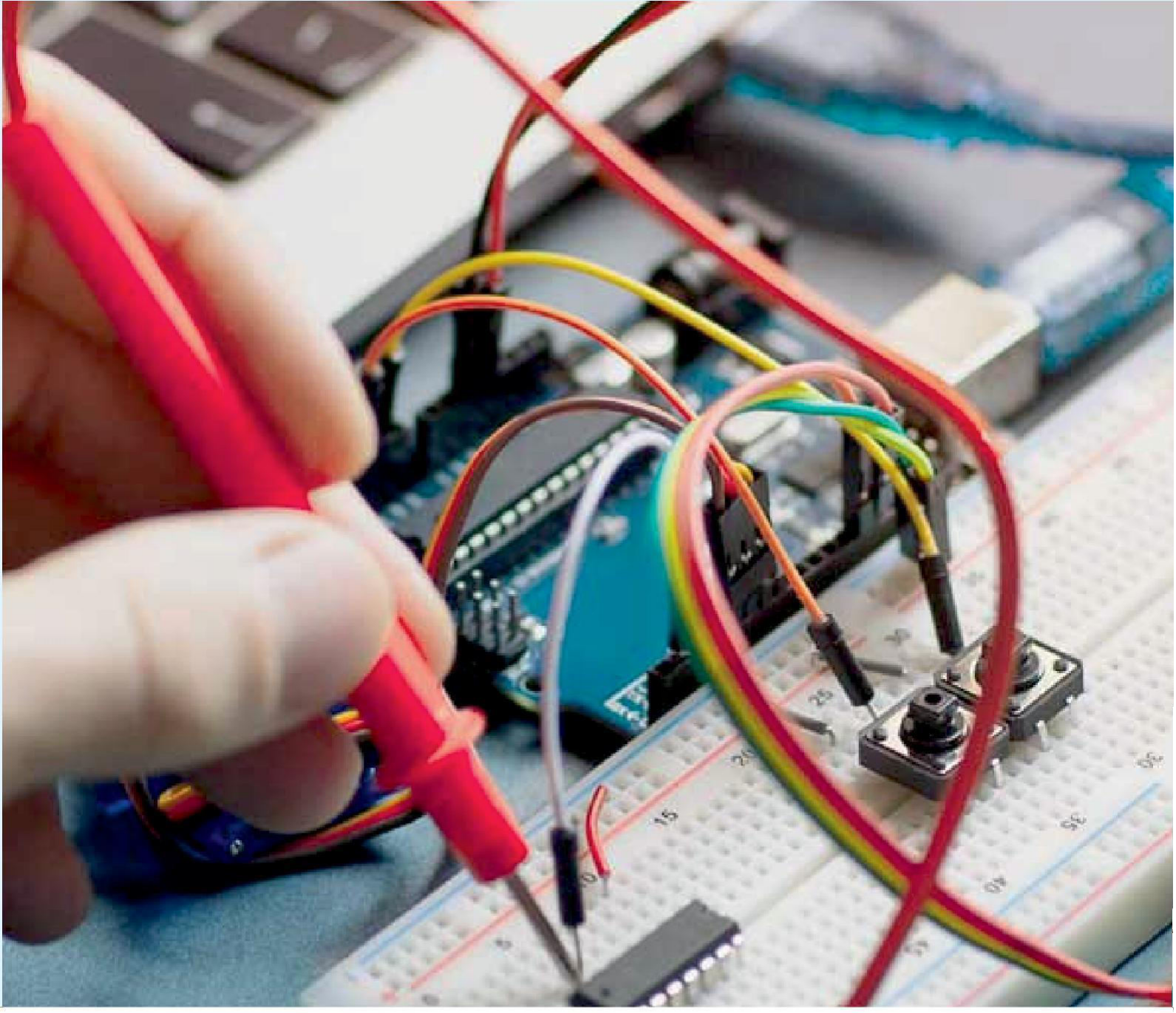

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