DUAL APPLICATION WIND MILL FOR ON-GRID AND OFF-GRID APPLICATIONS

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Abstract:
Power plays a great role wherever man lives and works. The living standard and prosperity of a nation vary directly with the increase in the use of power. The electricity requirement of the world is increasing at an alarming rate due to industrial growth, increased and extensive use of electrical gadgets. According to world energy report, we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas (21%) and coal (23%). It is well known that the time is not so far when all these sources will be completely exhausted. So, alternative sources should be used to avoid energy crisis in the nearby future. The best alternative source is Wind energy. The papers present an idea to design a system which makes the induction motor running through Wind energy. [1] Wind energy is treated as renewable source of energy. The project makes use of a wind turbine. The wind energy obtained is stored to a battery. The battery supply is fed as input to pulse generator and in turn to a MOSFET which is capable of generating ON/OFF pulses at different frequencies. This is fed to a step up transformer to generate a low voltage AC. This AC is fed to appliance like induction motor of single phase.

Keywords:
Wind turbine, Battery, Inverter circuit, Induction motor, MOSFET

1. INTRODUCTION:

The wind turbine has many advantages that make it an attractive energy source, especially in parts of the world where the transmission infrastructure is not fully developed. It is modular and can be installed relatively quickly, so it is easy to match electricity supply and demand. The fuel – the wind – is free and plentiful, which eliminates or reduces the need to purchase expensive fuels. It is flexible – with the power generated, households use can use appliances, such as lighting and refrigeration, schools can use computers and televisions, and industries can access a reliable power source. Perhaps most importantly, the generator does not produce any harmful emissions in the process of generating the electricity, unlike many other generation sources.

The main parts of the windmills are as follows:

1. The rotors consisting of the blades and the hub.
2. The drive train and gears along with the mechanical brakes. The brakes are used in the maintenance work and when a storm is coming.
3. The generator which generates electricity.
4. The yaw system which rotates the housing toward the direction of the wind.
5. Tower and foundation.
6. Battery and the electrical system to transmit to the grid.

Principle: The working principle is that when the wind passes through the blades, the blades experience a lift due to the aerodynamic air foil shape. Due to the lift produced, the blades move and start rotating. The yaw unit aligns it towards the incoming wind direction when the winds change. The rotation of the blades is transmitted through the gear train and couplings to the generator that generates electricity. The electricity is then transmitted through the wires to the storage batteries or directly to the grid.

The design of wind turbine is modelling [2] by Solid works computer aided design (CAD) software. The computational fluid dynamics (CFD) is conducted by Solid works Flow Simulation. The method of virtual wind tunnel [3] simulation was adopted for wind turbine internal flow analysis with several of wind speed, in order to obtain the result of wind turbine performance in various levels of wind data. The data of solar radiation and wind speed were collected from the Malaysian Meteorological Department, then system configuration analysis done by simulation tool, HOMER. The basic requirement of electric primary load is determined in 12.06 kW per day for single household which is included the essential load demand such as lighting, computer and

household appliance. The optimization analysis is conducted for generating most feasible system configuration and determines the quantity of components in the hybrid energy system, in order to meet the load demand of household and achieve the autonomy power supply with storing excess power generated in batteries storage for the sustainable energy storage.

2. LITERATURE SURVEY:

In order to gather reasonable information about renewable energy resource potentials of the country, hybrid energy systems, rural electrification techniques applying combined resources a detailed study of this all was needed. Different research efforts for the application of renewable energy options have been conducted for the access of renewable energy resource potentials and stand-alone hybrid systems. The following different authors were conducted for a range of hybrid systems at different times, sites and different countries; however, the methodology applied for the simulation was HOMER.

According to EM [4] simulation of a standalone electricity production for the remote settlements in Cameron was conducted. The study also presented the energy requirement in rural villages is basically for lighting, radio and television entertainments. The magnitude of the energy demand is in the range of 0.2 to 1 kWh/day. They simulated and modeled four different system configurations [5] such as; (hydro-LPG generator-battery), (solar-LPG generator-battery), (micro hydro-diesel generator-battery), (solar-diesel-battery). From the simulation result the cost of energy for different renewable energy option was found to be 0.296 €/kWh for micro hydro hybrid system generated from a 14kW micro hydro generator, 15 kW LPG generator and 36kWh of battery storage. Furthermore, the second simulation for PV hybrid system [6],[7] was accounted for 18kW PV generator, 15kW LPG generator and 72kWh of battery storage, the cost of energy was obtained as 0.576 €/kWh for remote petrol price of 0.1€/litter and LPG price of 0.7€/m3. The micro hydro system proved to be the cheapest option for the southern parts of Cameroon at a minimum flow rate of 200litter/second, while the PV hybrid was the cheapest in the southern parts of the country.

A feasibility study conducted by for a standalone solar/wind-based hybrid energy system to supply electricity for rural areas in Ethiopia. [8] This paper presented the simulation of PV/wind/diesel and battery to cater electricity demand for 200 household's model community. The paper showed the most cost-efficient combination from the hybridizing of diesel generator/battery and converter with no contribution of renewable sources fractions. It also presented other cost-effective combinations of diesel generator/PV and converter; in this case the dispatch strategy applied was the load following strategy. The conclusion of the author is viable to deploy the above stated power configurations in the areas where these resources are stated.

A paper presented in for Saudi Arabia about off grid Wind/Diesel generator hybrid power systems to cater energy for settlements in the hot coastal regions of Dhahran. This paper considered the provision of energy basically from wind energy for a model community of 100 households. As wind resources is an intermittent source of energy and thus for the fluctuation of energy supply, wind/diesel and battery hybrid system was considered as a solution by the author. A hybrid system containing PV/wind/micro-hydro and diesel generator simulation model was presented by [9] for Sundargarh district of Orissa state, India.

3. Implementation:

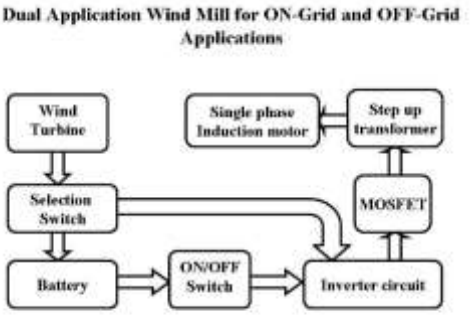

Fig : Flow Diagram

From the help of above flow diagram, the design of an induction motor running through Wind energy possibility is explained. Wind energy is treated as nonrenewable source of energy. The system depending on the selection switch status either directly runs the motor through inverter based on the Wind power which stores the energy to a battery and then runs the motor through the inverter. The project makes use of a wind turbine. The wind energy obtained is stored into a rechargeable battery. The battery power supply stored is fed as input to the pulse generator and in turn to a MOSFET which is capable of generating ON/OFF pulses at different frequencies. This output is fed as input to a step-{up transformer which is used to generate a low voltage AC. This AC voltage is fed to the appliances like induction motor of single phase.

IC CD 4047 is mainly used in Inverter circuits. It's very compact and has a very high life in inverter circuits. CD4047B consists of a gatable astable multi vibrator with logic techniques incorporated to permit

positive or negative edge-triggered mono stable multi vibrator action with retriggering and external counting options. CD 4047 is the low power Mono stable / Astable Multi vibrator that require only an external capacitor and a resistor to give the output pulses.

4. Related Work:

The brief introduction of different modules used in this project is discussed below:

4.1. Wind Turbine:

A **wind turbine** is a device that converts kinetic energy from the wind, also called wind energy, into mechanical energy; a process known as wind power. If the mechanical energy is used to produce electricity, the device may be called a wind turbine or **wind power plant**. If the mechanical energy is used to drive machinery, such as for grinding grain or pumping water, the device is called a windmill or wind pump. Similarly, it may be referred to as a **wind charger** when used for charging batteries.

The result of over a millennium of windmill development and modern engineering, today's wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging or auxiliary power on boats; while large grid-connected arrays of turbines are becoming an increasingly important source of wind power-produced commercial electricity.

The working principle [10] is that when the wind passes through the blades, the blades experience a lift due to the aerodynamic air foil shape. Due to the lift produced, the blades move and start rotating. The yaw unit aligns it towards the incoming wind direction when the winds change. The rotation of the blades is transmitted through the gear train and couplings to the generator that generates electricity. [11] The electricity is then transmitted through the wires to the storage batteries or directly to the grid. The **dynamo** was the first electrical generator capable of delivering power for industry. The dynamo uses electromagnetic induction to convert mechanical rotation into direct current through the use of a commutator. Through a series of accidental discoveries, the dynamo became the source of many later inventions, including the DC electric motor, the AC alternator, the AC synchronous motor, and the rotary converter. Alternating current generating systems were known in simple forms from the discovery of the magnetic induction of electric current.

Speed: If the turbine rotates with 1000RPM, it generates 12.5 volts. [12] Rotor Speed: 1000RPM (Max) Depth of water taken by the motor: The motor takes the water with the following speed 80litres per hour

4.2. Battery and IC4047:

Fig : Rechargeable Battery

Rechargeable batteries have lower total cost of use and environmental impact than disposable batteries. [13] Some rechargeable battery types are available in the same sizes as disposable types. Rechargeable batteries have higher initial cost but can be recharged very cheaply and used many times. During charging, the positive active material is oxidized, producing electrons, and the negative material is reduced, consuming electrons. These electrons constitute the current flow in the external circuit. The electrolyte may serve as a simple buffer for internal ion flow between the electrodes, as in lithium-ion and nickel-cadmium cells, or it may be an active participant in the electrochemical reaction, as in lead–acid cells.

The energy used to charge rechargeable batteries usually comes from a battery charger using AC mains electricity, although some are equipped to use a vehicle's 12-volt DC power outlet. Regardless, to store energy in a secondary cell, it has to be connected to a DC voltage source. The negative terminal of the cell has to be connected to the negative terminal of the voltage source and the positive terminal of the voltage source with the positive terminal of the battery. Further, the voltage output of the source must be higher than that of the battery, but not much higher: the greater the difference between the power source and the battery's voltage capacity, the faster the charging process, but also the greater the risk of overcharging and damaging the battery.

IC CD4047

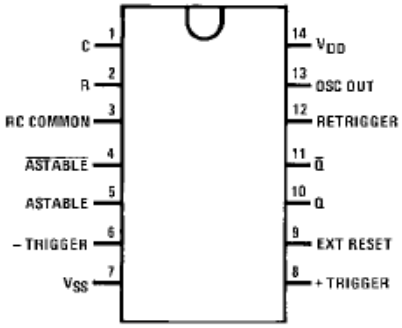

Fig : IC4047 Pin diagram

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Monostable mode Monostable mode can be obtained by triggering the + input of the IC using a low to high pulse or by a high to low pulse at the – input. The IC can be retriggered by applying simultaneous low to high pulse in both the + and – inputs.

Astable mode This can be obtained by keeping a high / low level at the Astable input. Output frequency depends on the timing components.

4.3. Induction Motor:

An **induction** or **asynchronous motor** is a type of AC motor where power is supplied to the rotor by means of electromagnetic induction, rather than a commutator or slip rings as in other types of motor. Their speed is determined by the frequency of the supply current, so they are most widely used in constant-speed applications, although variable speed versions, using variable frequency drives are becoming more common. [15] The most common type is the squirrel cage motor, and this term is sometimes used for induction motors generally.

- Single-phase induction motors are not self-starting without an auxiliary stator winding driven by an out of phase current of near 90o. Once started the auxiliary winding is optional.
- The auxiliary winding of a permanent-split capacitor motor has a capacitor in series with it during starting and running.
- A capacitor-start induction motor only has a capacitor in series with the auxiliary winding during starting.
- A capacitor-run motor typically has a large non-polarized electrolytic capacitor in series with the auxiliary winding for starting, then a smaller non-electrolytic capacitor during running.
- The auxiliary winding of a resistance split-phase motor develops a phase difference versus the main winding during starting by virtue of the difference in resistance.

5. CONCLUSION:

This research paper has discussed the performance of the DUAL APPLICATION WIND MILL FOR ON-GRID AND OFF-GRID APPLICATIONS. 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. This dual renewable power generation system was designed and developed. During the conducted experiments, the wind system acted as a main source of energy based on wind power. Moreover, the safety factor was calculated to be within the limits of two that shows the proposed system can meet the industrial safety limits.

6. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

7. FUTURE SCOPE:

Wind is very much a sustainable energy source because it is an energy source that does not create waste or cause carbon emissions, soot, smog, acid rain or global warming. Alongside solar and waste to fuels, wind power is among the cleanest and most sustainable energy sources we can use. Wind Energy can be used in combination [16] with fossil fuel gensets and/or Photo-voltaic arrays in a hybrid system. It can be used even for Water pumping near Water Reservoir Storage. We

can use in Railway Wind Mill models which are especially used for metro railways as the air emitted in high speed of trains have high frequency which goes wasted can be utilized for power generation. Highway Wind Mill makes use of both the wind directions and rotates in one direction. If the speed of the turbine increases, the energy /output obtained also increases. The generated power is stored in battery bank can be further utilized for lighting purpose on highways during night.

8. RESULTS:

Fig: Image of DUAL APPLICATION WIND MILL FOR ON-GRID AND OFF-GRID APPLICATIONS

The paper represents an innovative idea on "DUAL APPLICATION WIND MILL FOR ON-GRID AND OFF-GRID APPLICATIONS" which is mainly intended to design a system which makes the induction motor running through Wind energy possible. It can be made to run through the On-grid power or the available wind power stored in the batteries from the wind energy through Off-grid. The system depending on the selection switch status either directly runs the motor through inverter through Wind power or stores the energy to a battery and then runs the motor through the inverter. The project makes use of a wind turbine. 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 appliance like induction motor of single phase.

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