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Hybrid Power Generation for Highway Application

Ms. Akanksha N. Bhongade[1], Ms. Dhanashri C. Jambhulkar[2], Ms. Pratiksha A. Padghan[3], Prof. N. V. Yawale[4]

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ABSTRACT: Wind energy is one of the most non-conventional forms of energy, and it is available in affluence. Electricity can be generated with the help of vertical axis wind turbine and solar panel. The objective of utilizing this wind energy in most emphatic manner to get the maximum electric output, and therefore we selected highway as our installation site where we can take the advantage of the vehicles moving on both the sides of the road. In the current operating work, turbine is designing and fabricated as per the specifications, the blades used are semi-circular shape and are connected to the disc which is connected to shaft. Shaft is then pair with pulley with the help of bearing, and then pulley is connected to the alternator, which generates the power. The generated power is stored in battery and then can be used for street light, signal or toll. A small model will be creating for testing purpose. Here we also are using the solar panel for more electric output. This plate is place at the top of the system so that more power is consume by solar plate. It also In this paper i.e.camless engine, the valve motion is controlled directly by a electromagnetic actuator there's no camshaft or connecting mechanisms .Precise electromagnetic actuator or solenoid controls the aims for maximum output with minimum cost indulges, so that the government can think over this project and can implement this type of vertical axis wind turbine on highways at a low cost.

KEYWORDS: Design, fabrication, Vertical axis wind turbine, electromagnetic actuator.

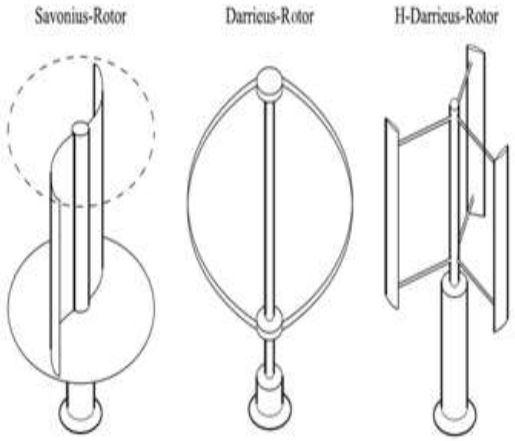
I. INTRODUCTION

Electricity plays an important role in human life. Conventional and non conventional energy sources are used for electrical power generation. Due to the frequent use of conventional sources they are going to hide away from the earth and the main draw backs are the contribution to air pollution and global warming, the search for the other sources of energy ends with non conventional sources of energy. Electricity plays and vital role for development of the country, so the production of electricity is one of the main aims of the country. About 68% of the production of electric energy is based on thermal power plant, where fossil fuels, coals, diesel are used for power generation and which is very less available and this fuels also creates pollution, greenhouse effect and global warming. Therefore power generation with the help of non-conventional resource such as wind is increasing day by day and this type of power generation is very clean and safe.

Types of wind turbine

The wind turbines are basically of two types

1) Horizontal axis wind turbine (HAWT).
2) Vertical axis wind turbine (VAWT).



Types of Vertical Axis Wind Turbine

Wind energy sources are one of the highly available and reliable renewable energy resources. Discontinuous availability of wind energy makes a limitation on its utilization. This limitation can be removed by utilization of the area where wind flow is more [1]. For this problem Highways are the better solutions. Highways are the backbone of any nation for development, it remains busy day night. Wind turbulence created by the vehicles on the road can help us to generate electrical energy [2][3]. HAWT and VAWT has successfully evolved in making of electricity from wind.

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However, recently working on VAWT has also been started due to its additional advantage over HAWT such as it does not require yaw mechanism because it can produce power independent of wind direction. VAWT can be produced at low cost then HAWT and also affordable maintenance cost. VAWT are further classified as

1) Savonious vertical axis wind turbine.
2) Darrieus vertical axis wind turbine.
3) Giro mill.

In summer wind is calm and in cloudy days wind is strong, therefore the hybrid operation of wind- solar energy conversion system is popular. Uninterrupted power generation can be done irrespective of the weather condition aims to hybrid operation. Some modifications in solar panel, i.e. Nano antenna array has been familiarize and an develop version of hybrid system having large scale production with minimum cost /unit is achieved. By the introduction of suitable DC- DC converter in between the sources and battery, overcome the high voltage transformation problems. Modified Multi level inverter topology in the output side improves the power quality, i.e. with minimum Total Harmonic Distortion (THD). Feasibility study of Hybrid wind solar system proves that this type of Hybrid Renewable Sources of Energy System is most suitable for Distributed Generation (DG) for higher loading capacity. Optimum combination of hybrid sources are evaluated on the basis of power reliability and system cost analysis the usual methods for evaluating reliability are Loss of power supply probability (LPSP), Loss of load probability (LOLP), and System performance level (SPL). In cost analysis Net Present Cost, Levelised cost of Energy and Life cycle cost.

A hybrid solar-wind energy system uses two renewable energy sources. Hence, efficiency and power reliability of the system increase. However, aggregating inherently stochastic power sources such as wind and solar to achieve reliable electricity is a non-trivial problem. To use wind and solar energy resources more efficiently and economically, the optimal sizing of hybrid PV/wind systems is important. The hybrid renewable power generation is a system aimed at the production and utilization of the electrical energy stemming from more than one source, provided that at least one of them is renewable. A wind turbine is a device that converts the kinetic energy of the wind into AC or DC electricity. Several wind turbines manufactures, such as Vestas, RE power, Games, Siemens, GE Wind Energy, Emerson, etc. were evaluated for use in this model. The size of the turbine model to be used within a project was based on available wind turbine models, the wind resource at the site, and the ability to perform maintenance. The wind profile and wind speeds at each specific site were evaluated to identify which turbine was suitable for the particular site conditions. As the wind turbine itself may be as much as 70% of the total project cost it was vital that it produced the optimal electricity for the given site.

The main motive behind this is to design a vertical axis wind turbine which effectively uses the wind energy generated by the vehicle speed on the highway. So the maximum wind energy can be extracted by the vertical axis wind turbine as compared to the horizontal axis wind turbine. We have designed modified Savonious vertical axis wind turbine which is more emphatic than old Savonious design. in modified vertical axis turbine the blade of the turbine are twisted to gain maximum spin on low pressure of the wind, we also try to achieve less vibration at gear moment.

This turbine works under all the environmental condition as well as cyclone. This design of the blade enables the turbine to rotate in clockwise and anticlockwise directions. The arrangement of solar plate is in such a way that it also helps to stored energy from the sun as a backup for the power generation. The solar system generates the electrical energy by sun radiation in day time and from vehicle headlight during night time the generated electrical energy we can use street lighting, toll gates etc.

Solar Plates

The major benefit of solar Everyday tremendous amount of energy in the form of heat and radiations released by sun. Solar energy is a unlimitless source of energy which is available at no cost energy over other conventional power generators is that the sunlight can be directly harvested into solar energy with the use of small and tiny photovoltaic (PV) solar cells [4][5]. Solar pates are those devices which are used to absorb the sun's rays and convert them into electrical energy. A solar panel is actually a compilation of solar (or photovoltaic) cells, which is used to generate electricity through photovoltaic effect. These cells are arranged in a grid-like format on the surface of solar panels. Thus, it may also be represented as a set of photovoltaic modules, mounted on a structure supporting it. When it comes to wear-and-tear, these panels are very bold. Solar panels wear out extremely slow.

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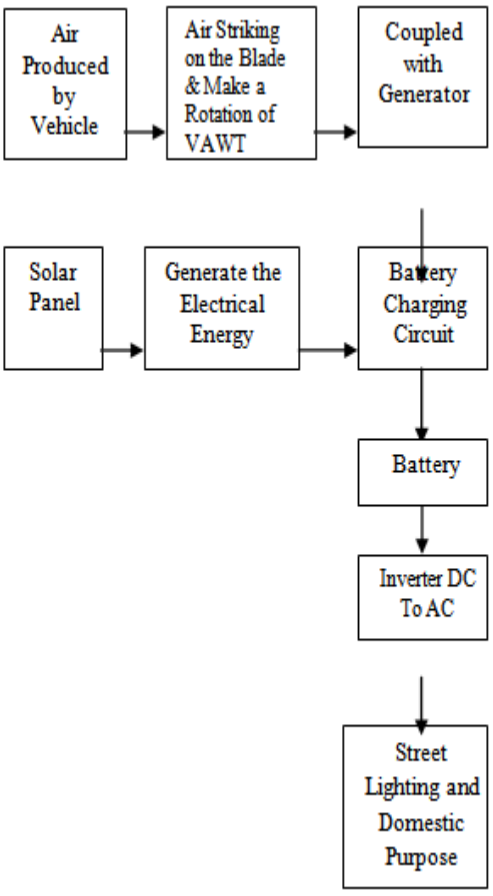
solar plate

Installation of solar panels in homes helps in combating the noxious emissions of greenhouse gases and thus helps reduce global warming. Solar panels do not lead to any form of pollution and are very clean. They also reduces our reliance on fossil fuels (which are limited) and traditional power sources. These days, solar panels are used in wide-ranging electronic appliances like calculators, which work at last up to the sunlight is available. However, the only major drawback of solar panels is that they are expensive. Also, solar panels are need to installed outdoors as they need sunlight to get charged.

Solar energy is green energy which is easily available in day time and easily stored.. The stored energy used as a street lighting and domestic purpose [6]. We can generate electricity by using PV cell. It is huge source of never ending energy. Because of easily availability, amount of source and popularity it is preferred for this model. Solar panel contains photovoltaic material which generates electrical energy when sun light falls on it. Depending upon the light intensity and position of the sun radiation the output electrical energy will be generate. The given model have two Poly crystal line type solar panels are used because their efficiency is greater than other which is 14-16 per cent. The specification 10W, 17.5V, 0.64A each is used. In this model two solar panels are mounted on top of the pole. The output of solar panels is given to battery through PWM charge controller.

II. WORKING PRINCIPAL:

The vertical axis wind turbine is used to transmute the kinetic energy into mechanical energy. The light weight blade materials (mica sheet) are used for constructing the vertical axis wind turbine. The whole turbine is assembling with shaft and blades which is fitted by nut bolts. To achieve the unidirectional motion of the turbine the blades are bended by 300 angle curve shape and shaft of the turbine connected to the shaft of generator. The moving vehicle on highway may be all type vehicles (heavy or small). Whenever vehicle moves on both side of the highway divider then some pressurized air is produced due to the speed of vehicle. This pressurized air is strike on the blade of vertical axis wind turbine and turbine makes a rotation. The shaft of the vertical axis wind turbine is connected to generator with the help of gear mechanism [7]. The generated electricity is an alternating quantity; the output of the generator is rectified by rectifier and stored in the battery. The solar system is mounted on except of the vertical axis wind turbine, the function of the solar system not only generate the electricity but also provides the constant air flow in a direction of the blade of vertical axis wind turbine. The position of solar plates is inclined in nature at an angle 45 degree.



Block Diagram of Hybrid Power Generation for Highway

A solar cell or photovoltaic cell is an electrical device that converts the light energy directly into electricity by the photovoltaic effect,

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which is the
physical and chemical phenomenon. photoelectric cell is defined as a device whose electrical parameter such as current, voltage or resistance varies when exposed light. The generated electricity is stored in the battery. The stored energy from both sources is used as a street lighting and domestic purpose. Fig. 3 shows the related diagram of hybrid power generation for highway applications. In this system also going to use the concept of permanent magnet, The concept of levitation caused by repulsion of opposite pole in the permanent magnet reduced the friction between the stator and wind turbine rotor, so that the overall power output of the turbine increases. This technology has been mainly utilized in the rail industry in the far East and also use foe highway application. By placing these two magnets on top of each other with like polarities, so that magnetic repulsion will be strong enough to keep both magnets at a distance away from each other. The force created as a result of this repulsion can be used for suspension purposes and is strong enough to balance the weight of an object depending up on the threshold of the magnets.

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III. RESULT

Testing of vertical axis wind turbine

Sr no	Wind speed in m/s	Voltage in volts	Current in ampere	Power in watts
1	4 to 5	6.2	2.1	13.2
2	5 to 6	8.9	2.5	24.0
3	6 to 7	9.2	2.6	23.9
4	7 to 8	9.3	2.7	25.1

IV. CONCLUSION

There exists a worldwide concern regarding the energy security and sustainable development of energy across the globe. The role of renewable energy has there-fore become more significant. The developed world is already on track for re-ducing the fossil fuel usage and developing the areas of renewable energy tech-nologies. Through this study, an insight into the energy situation and renewable energy potential of Libya was given. It was identified that Libya has an econom-ically feasible power generation potential of wind and solar energy. Using the HOMER simulation code, a grid- tied wind-solar hybrid power generation system was modeled for a selected location in the Al-Marj's area of Libya (MARJU), located on the coastal belt near Benghazi. Through the simulation process, the installation of ten 100 kW wind turbines and 150 kw solar PV arrays was identi-fied as a most feasible economical design to supply average load connected to grid where payback period of the design was 2.6 years.

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AUTHORS PROFILE

Akanksha Nilkanth Bhongade, U. G. in Electrical Engineering at Sant Gadge BabaAmravati University. Email:akankshabhongade7@gmail.com Paper publish in International research journal of Engineering and technology
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Dhanashri Chandrakant Jambhulkar, U.
G. in Electrical Engineering at Sant Gadge Baba Amravati University. Email:dhanashri.j12@gmail.com Paper publish in International research journal
of Engineering and technology (IRJET) two axis with four sensors solar tracking system.

pratiksha Anand Padghan, U. G. in Electrical Engineering at Sant Gadge BabaAmravatiUniversityEmail: pratikshapadghan1998@gmail.com
Paper publish in International research journal of Engineering and technology (IRJET) two axis with four sensors solar tracking system.