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Design & Implementation of Combined Power Generation System with Solar & Vertical Axis Wind Plant at Road Side

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ABSTRACT: This paper focus on use of air on highway divider with the help vertical axis wind turbine. When the vehicle passed on highway it produces a considerable amount of air due to its speed. this air tangentially strikes on the blade of the vertical axis wind turbine and its make a rotation of the turbine in only one direction. The solar system is used to generate electrical energy & also installed in away that it diverts the vehicle air towards the turbine. The generator with gear mechanism is connected to the shaft of the vertical axis wind turbine and solar system stored in a battery. This stored energy which can be further used for lighting, toll gates, etc.

I. INTRODUCTION

The demand for the electricity is much higher than the production of electricity. One of the major problems ever since the natural resource are going to finish one day. The fossil fuel major role in production global worming, greenhouse gas, etc. currently 68% of electrical energy production by the thermal power plant and remaining 22% included hydro power plant , nuclear power plant, gas power plant and as we realized the fossil fuel is finished in one day. Solar and wind both are renewable energy source .Solar energy available begins of day and wind energy is maximum on the highway due to vehicle. The main motive behind this project is to design a vertical axis wind turbine which effectively uses the wind energy generated by vehicle speed on the highway. The maximum wind energy can be extracted by the vertical axis wind turbine as compare to the horizontal axis wind turbine.

We have designed modified savouries vertical axis wind turbine which is more efficient than old savouries design. This turbine works under all the environmental condition and cyclone. The arrangement of solar plats is in such a way that they divert the vehicle air towards the turbine for effective use of vehicle air. The solar system generates the electrical energy by sun radiation in day mode and from vehicle headlight during night mode the generated electrical energy we can use street lighting, toll gates etc.

II.LITERATURE REVIEW

The idea to utilize wind turbine on the highway is entirely unique. There have been attempts by several individuals & group to recycle energy from highways. We refer M. K. Sharma “The study of wind from energy potential highway”. In International Journal Of Engineering Research & Technology, 2012. in that there are used only wind energy. & we include here the combination of wind & solar energy to increase efficiency.[1]

. Durries vertical wind turbine:

The first aerodynamic vertical axis wind turbine was developed by gorges Durries in france and frist patented 1927. Its principle of operation depend on the fact that its blade speed is a multiple of the wind speed, resulting in an apparent wind throughout the hole revolution coming in as a head wind with only a limited.[2]

- Impulse Savonius VAWT:

The Savonius turbine is a vertical axis machine while uses a roter that was introduced by finnish engineer S.J. Savonius in 1922. In its simplest form it is essentially two cups or half drum fixed to a central shaft in opposite direction.[2]

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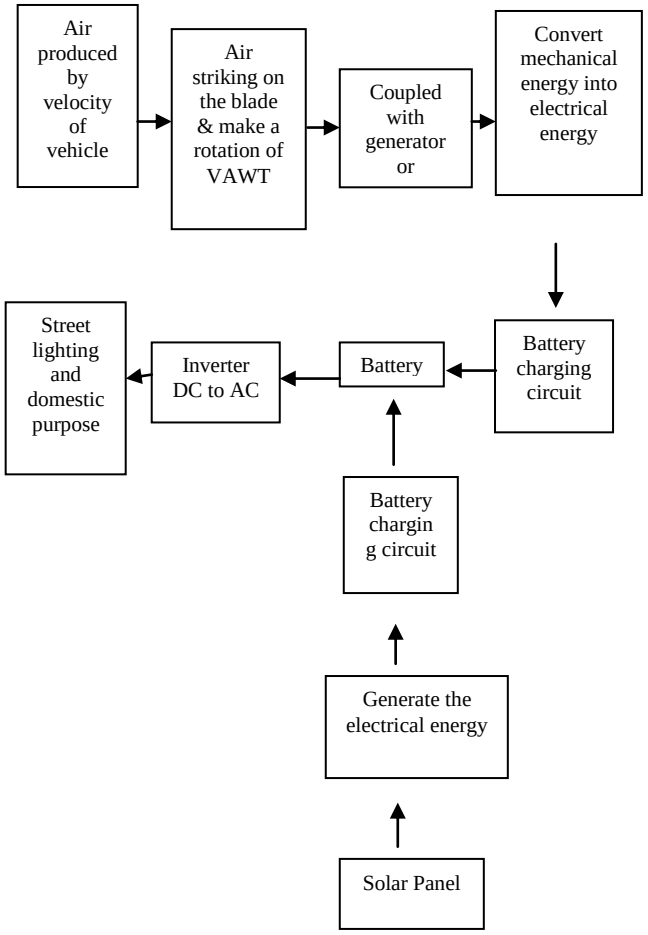
BLOCK DIAGRAM



III.PROJECT OBJECTIVES

- To use the maximum amount of wind energy from vehicle running on highway.
- To covert kinetic energy to electrical energy.
- To reduce pollution due to burning of fossil fuel.
- To reduce the load on electrical power plants.
- Off grid applications.

IV. CIRCUIT COMPONENT

- Solar panel
- Wind generator
- Battery
- Inverter
- Lamps
- Rectifier
- **Solar panel**

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Photovoltaic solar panels absorb sunlight as a source of energy to generate direct current electricity. A photovoltaic (PV) module is a packaged, connected assembly of photovoltaic solar cells available in different voltages and wattages. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.The most common application of solar energy collection outside agriculture is solar water heating systems.

- **Vertical-axis wind turbines (VAWT):**

A vertical-axis wind turbines (VAWT) is a type of wind turbine where the main rotor shaft is set transverse to the wind (but not necessarily vertically) while the main components are located at the base of the turbine. This arrangement allows the generator and gearbox to be located close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind,[1][2] which removes the need for wind-sensing and orientation mechanisms. Major drawbacks for the early designs (Savonius, Darrieus and giromill) included the significant torque variation or "ripple" during each revolution, and the large bending moments on the blades. Later designs addressed the torque ripple issue by sweeping the blades helically (Gorlov type).

A vertical axis wind turbine has its axis perpendicular to the wind streamlines and vertical to the ground. A more general term that includes this option is "transverse axis wind turbine" or "cross-flow wind turbine." For example, the original Darrieus patent, US Patent 1835018, includes both options.

Drag-type VAWTs such as the Savonius rotor typically operate at lower tipspeed ratios than lift-based VAWTs such as Darrieus rotors and cycloturbines.

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|| Volume 9, Issue 7, July 2020 ||

- **Battery:**

A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, mobile phones, and electric cars.[1] When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.[2] The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.

Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and mobile phones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smartphones, to large lead acid batteries or lithium-ion batteries in vehicles, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year,[5] with 6% annual growth.

Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. In automobiles, this is somewhat offset by the higher efficiency of electric motors in converting chemical energy to mechanical work, compared to combustion engines.

V. CALCULATION OF WORKING MODEL

.E K = $\frac{1}{2}$ M$\mathbf{V^2}$

M= PAV

K.E= $\frac{1}{2}$ PAV. $\mathbf{V^2}$

= $\frac{1}{2}$PA. $\mathbf{V^3}$ watt

A=Swept area of turbine

P= density of air (1.225 kg/$\mathbf{m^3}$

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V= wind velocity
For we required P= 105 watt

$P= \frac{1}{2} PA\mathbf{V^3}$

Wind velocity 10 m/s
Density of air (1.225 kg/$\mathbf{m^3}$)

$105 = \frac{1}{2} * 1.25 * A * (\mathbf{10})^3$

A = 10867 sq.m
A= D*H sq.m .....(D =Diameter of the Blade)
Taking diameter 1 meter
Height of turbine calculated as,

$H = {}^{A}/_{D} = {}^{1}/_{1} = 10$

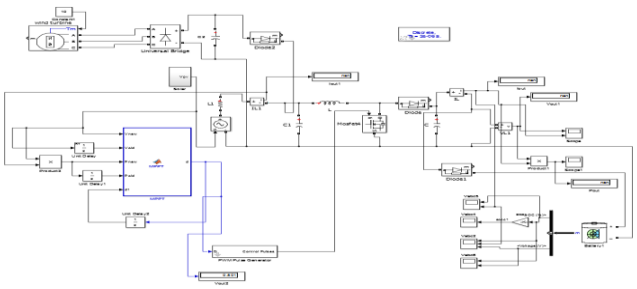
Diameter and height of turbine 1 m

- **Density of air- 1.225 kg/$\mathbf{M^2}$**
- **Wind velocity- 10 m/s**

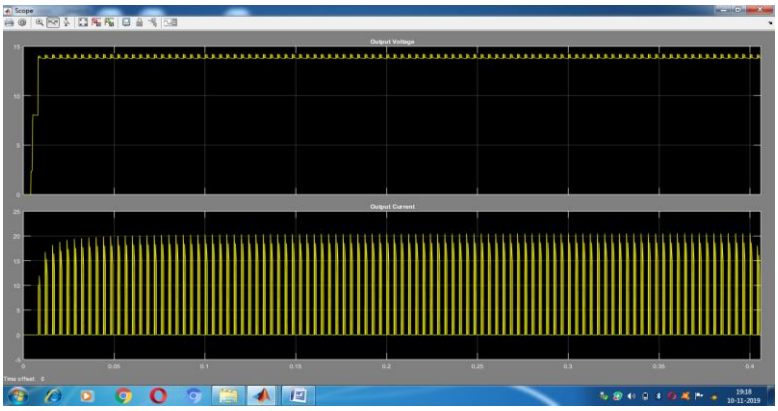
Sr. No	Material Parameters	Rating
1	Blade(height)	1.0 mtr
2	Turbine(Radius)	0.5 mtr
3	Blade chord (length)	0.13 mtr
4	Turbine (Swept area)	1.867 sq.mtr

Approximately Power produce = 105 watt.

VI. SIMULATION



VII. RESULTS



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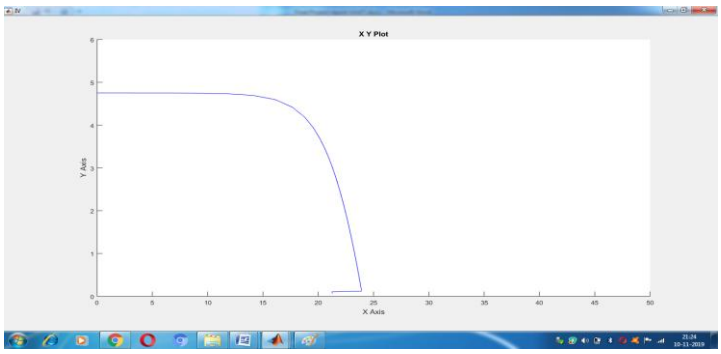

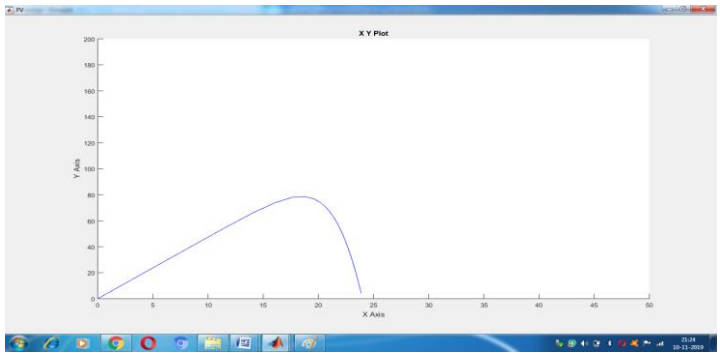

VIII. OPERATION

of vertical axis 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 wind turbine and turbin1e makes a rotation The shaft of the vertical axis wind turbine is connected to generator with the help of gear mechanism. 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 besides of the vertical axis wind turbine, the function of the solar system not only generate the electricity but also provides the constant air flow towards the blade of vertical axis wind turbine. The position of solar plates is in inclined nature at an angle 45 degree.

A solar cell or photovoltaic cell is an electrical device that convert the energy of light directly into electricity by the photovoltaic effect, which is the physical and chemical phenomenon. It is photoelectric cell, defined as a device whose electrical parameter such as current, voltage or resistance varies when exposed light. Solar cells are the building blocks of photovoltaic modules. The generated electricity is stored in the battery. The stored energy used as a street lighting and domestic purpose.

IX. APPLICATIONS

- The Windspire, a small VAWT intended for individual (home or office) use was developed in the early 2000s by US company Mariah Power. The company reported that several units had been installed across the US by June 2008.[17]
- Arborwind, an Ann-Arbor (Michigan, US) based company, produces a patented small VAWT which has been installed at several US locations as of 2013.[18]
- In 2011, Sandia National Laboratories wind-energy researchers began a five-year study of applying VAWT design technology to offshore wind farms.[19] The researchers stated: "The economics of offshore windpower are different from land-based turbines, due to installation and operational challenges. VAWTs offer three big advantages that could reduce the cost of wind energy: a lower turbine center of gravity; reduced machine complexity; and better scalability to very large sizes. A lower center of gravity means improved stability afloat and lower gravitational fatigue loads. Additionally, the drivetrain on a VAWT is at or near the surface, potentially making maintenance easier and less time-consuming. Fewer parts, lower fatigue loads and simpler maintenance all lead to reduced maintenance costs."

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- A 24-unit VAWT demonstration plot was installed in southern California in the early 2010s by Caltech aeronautical professor John Dabiri. His design was incorporated in a 10-unit generating farm installed in 2013 in the Alaskan village of Igiugig.
- Dulas, Anglesey received permission in March 2014 to install a prototype VAWT on the breakwater at Port Talbot waterside. The turbine is a new design, supplied by Wales-based C-FEC (Swansea),[21] and will be operated for a two-year trial.[22] This VAWT incorporates a wind shield which blocks the wind from the advancing blades, and thus requires a wind-direction sensor and a positioning mechanism, as opposed to the "egg-beater" types of VAWTs discussed above.
- The Dynasphere, is Michael Reynolds' (known for his Earthship house designs) 4th generation vertical axis windmill. These windmills have two 1.5 KW generators and can produce electricity at very low speeds.

energy system, suppose anyone source fails to generate another source will keep generating the electricity and will give the continuous power to the load. The renewable energy sources such as solar and wind energy are used to generate the electricity

X. RESULTS

The Power generation start from 200rpm at that rotation 50w power is generated. by combination of solar and wind energy.

Final Working Model

XI. CONCLUSION

This system is environmental friendly. The working model of our project is combined energy source with solar system and vertical axis wind turbine system which is a good and effective solution for power generation, basically this system involves the combination of two energy system, suppose anyone source fails to generate another source will keep generating the electricity and will give the continuous power to the load. The renewable energy sources such as solar and wind energy are used to generate the electricity

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