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Urban power plant

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ABSTRACT
In countries where wind energy is less feasible, an energy glean device such as highway wind turbines can still be used for applications where less power is needed. This energy can be glean using vertical axis wind turbines placed on the sides of the highways to make use of the vehicles moving in both directions. This work presents an experimental study of using a three-bladed helical specially designed and manufactured for producing electrical energy from wind energy of moving cars this type of energy use such as the street lights, traffic signals light, and light guide lines. The wind speed of vehicles passing on a highway-vertical axis wind turbines and wind power from the is measured at a number of anemometer heights on the highway sides. Results show that the vertical axis wind turbines prototype has produced up to 50-Watts of power from vehicles moving on the highway, which produce an average wind speed of 4.3 m/s. The wind turbine power curve is produced from the measured data and based on the best fit to the power curve, the efficiency of 35 percent is obtained.
Keywords: *analysis on wind mill on highways*

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I. INTRODUCTION

If the efficiency of a wind turbine is increased, then more power can be produce thus decreasing the need for expensive power generators that cause environment pollution. This would also minimize the cost of power for the common people. The wind is exactly there for the taking and doesn't cost any money. Power can be generated and stored by a wind turbine with little or pollution free. If the efficiency of the common wind turbine is increases and widespread, the common people can cut back on their power costs extremely.

Since its creation, man has continuously tried to improve the windmill. so that, over the years, the number of blades on windmills has decreased. Most common modern windmills have 5-6 blades while past windmills turbine have had 3~8 blades. Past windmill turbines be manually directed into the wind, while modern windmills can be automatically turned into the wind. To utilize the available wind resources and reduce the usage of non-renewable energy resources, wind energy is by far the fastest-growing renewable energy resource and easily available. These wind turbines can be used to provide continuous lighting. In major cities, highways are a faster route 2 for everyday reduce and in need of constant lighting makes this an efficient way to produce natural energy

II. METHODOLOGY

Due to the Vehicle motion the turbines placed beside the road starts rotating. The Mechanical Energy produced in turn causes the dynamo Mechanism to produce electrical Energy. The Electrical Voltage Produced will be Amplified Using the Amplifiers and this is connected to 12V battery. So that Battery will charge from this Wind Turbine.

Working concepts

Step 1

In the first step the High velocity wind and middle part of the highway will Strikes wind turbine blades and make a rotation in it the wind turbine blade will rotate at clockwise direction even when the vehicle moves in any of the side of the highway. because the arrangement of the wind turbine blades is in that manner.

Step 2

The vertical axis highway wind mills the wind blade turbine is attached with the two generators. One is in the top and the other one is at the bottom of the wind turbine blades. when the turbine blade rotates the attached generators will generate electricity in both way

Fig. 01 basic concept

Step 3

Thus, the mechanical energy is converted into electrical energy by using PMDC Motor and this produced power is stored in the battery and is utilize for street light, charging port for electric vehicle, traffic signals and many applications.

Main components:

Dynamo: A dynamo is an electrical generator that produces direct current electric power with the use of electromagnetism. Dynamos were the first electrical generators capable of delivering power for industry and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the rotary converter. Today, the simpler alternator dominates large scale power generation, for efficiency, reliability and cost reasons

Rectifier: Rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches.

Battery: A battery is a self-contained, chemical power pack that can produce a limited amount of electrical energy wherever it's needed. A battery slowly chemicals packed inside it into electrical energy, typically released over a period of days, weeks, months, or even years. The basic power unit inside a battery is called a cell, and it consists of three main bits. There are two electrodes (electrical terminals) and a chemical called an electrolyte in between them. For our convenience and safety, there are two more handy electrical terminals, marked with a plus (positive) and minus (negative) on the outside connected to the electrodes that are inside.12volt

Inverter: This is a quite simple DC to AC inverter that provides 220VAC when a 12VDC power source is provided. It can be used to power very light loads like night lamps and cordless telephones, but can be modified into a powerful inverter by adding more MOSFETs. It uses 2 power IRFZ44 MOSFETs for driving the output power and the 4047 IC as and a stable multi vibrator operating at a frequency of around 50 Hz

Turbine Blade

Various iterations were made for the design of the blade of turbine and concluded on particular design of the blade. As shown in the figure the blade is designed with the help of galvanized iron sheet. Holes are made on the base section and vertical end portion to make the necessary arrangement for fixing with the other part of the turbine. The design of the blade plays a vital role in proper functioning of the turbine. Thus proper care must be taken while designing the blade. It design should be focused on getting the maximum efficiency from the turbine

III. MODELING AND ANALYSIS

Before starting the design of the wind turbine, it should be made sure that sufficient wind energy is generated by the moving vehicles on the highways for the operation of the turbine. So, wind readings (peak values) were taken from different places in highway at different intervals. The graphical representation of wind readings from a highway is figure the natural wind speed is not considered here.

1.**Wind speed and electricity Production**

Serial no.	Velocity m/s	efficiency
1	5 m/s	32%
2	8 m/s	62%
3	11 m/s	92%

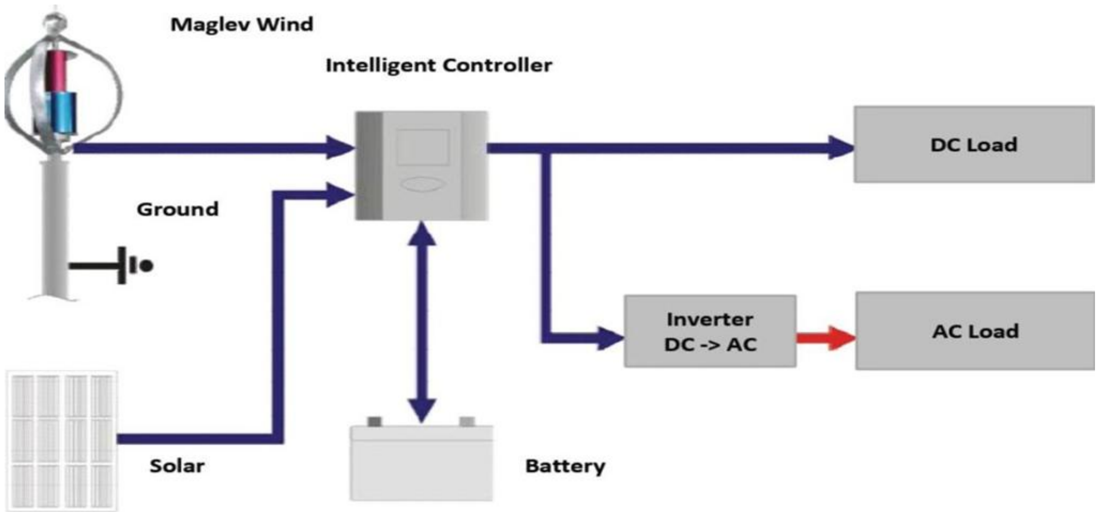

Figure 02: **Schematic Diagram of the Project**

From the readings taken, it was found that average wind speed available on highway median is around 6 m/s. Also, it is found that wind speed is higher during the night time. From the readings taken from the highways, it was noticed that wind speed is varying with respect to the height from the ground and maximum wind speed is obtained between 1 meter and 2 meters from the ground level

Design analysis

Parameters Consider While Designing VAWT

A. Speed of wind

Speed of air is the very important parameter. Because in windmill we are using the wind as a raw material for the power production. this bakes the axis rotate and this axis is coupled with a dc generator and makes its also rotate and produce electricity

B. Height of turbine

When we select the height of turbine very high then these is no effect of air or thrust created by the air When we select the height of turbine too short then the turbine not should rotate properly. So the height of turbine should be accurate, hence it is also important parameter

C. Shape of the blade

Blade selection is one of the major steps in the design of a wind turbine. Blades convert kinetic energy from the wind into rotational energy in the turbine shaft. The blades are the most difficult part of the design because they must be propelled by wind in any direction. This necessitates that the blades are curved and angled so that as much surface area is uncovered to the wind flow of air from oncoming vehicles as possible. The blades must also be lightweight.

D.Blade Design

Blade convert kinetic energy of air from fast moving vehicle into rotational energy by the turbine shaft. The rotary motion of shaft is converted into electric energy with the help of PMDC (Permanent Magnet DC) motor and electricity store in battery. Wind energy generated by moving vehicles may not be continuous as there may be idltime with no vehicle traffic and the turbine may need to stop and start frequently. Therefore, start by itself property is one of the important parameters in case of highway wind turbines

E. Cut in Speed The cut-in speed (typically between 6 and 9 mph) is when the blades start rotating and generating power. As wind speeds increase, more electricity is generated until it reaches a limit, known as the rated speed. This is the point that the turbine produces its maximum, or rated power

F. Tip speed Ratio The Tip Speed Ratio (TSR) is an extremely important factor in wind turbine design. TSR refers to the ratio between the wind speed and the speed of the tips of the wind turbine blades. The further away from the centre, the faster the blades spin.

WIND POWER AND OUTPUT POWER

Depends on the highway's car speeds, the speed of wind that hits the turbine blades is different and should be measured. This provides the expected wind power from the moving vehicles. The output power of the VAWT is separately measured to evaluate the efficiency of the wind turbine. The power available in the wind is determined by:

$$\text{Wind power} = \frac{1}{2} \rho A v^3 \qquad \text{(Eq 1)}$$

where, v is the velocity of the wind (m/s),
ρ is the air density kg/m3;
A (m2) is the cross-sectional area
that wind passes through the wind turbine. The cross-sectional area is the diameter of the rotor (D) multiplied by the height of rotor (H). The reference density used is the standard sea level value (1.225 kg/m3). The power extracted by the wind turbine is determined by:

$$\text{Power extracted} = \frac{1}{2} \rho A v^3 \eta C_p \qquad \text{(Eq 2)}$$

Here Cp is the power coefficient,
which shows efficiency of a wind turbine design and η is the efficiency of mechanical drive unit. Wind turbines cannot convert all of the wind energy into work and, unlike other generators, they can only produce energy in response to the wind that is immediately available.

The maximum power that can be extracted from a given wind stream is defined by what is known as the Betz limit. The maximum value for the power coefficient is called the Betz limit (Cp-max = 0.5926), but it's hard to get this efficiency exact from wind turbine during experiment. Also, the swept area limits the volume of air passing through the wind turbine. The rotor converts the energy contained in the wind in rotational movement. So, the greater the swept area, the greater the power output obtained for the same wind conditions

Design of a VAWT and solar with specifications

Sr.no.	Components	specification	
1	Hight of blade	15cm	
2	Width of blade	5cm	
3	Angle of curvature	150	
4	Base hight	15cm	
5	Base width	10cm	
6	Gear ratio	1:6	
7	Number of blades	3	

IV. RESULTS AND DISCUSSION

Data has been collected by the use of digital anemometer at different location on the highway medians. The changes were recorded at different height and different location. The graph given below gives the actual data collected in highway for wind velocity at different height during certain interval of time.

The input power can be calculated by using the formula

$$P = M * \omega$$

Were, M- Input torque
ω- Angular velocity

The angular velocity can be calculated by knowing the rpm of the blade shaft and the torque can be calculated by knowing the velocity of the wind.

Table relation b/w various parameters

SR.NO.	HEIGHT (M)	RPM	ANGULAR VELOCITY	TORQUE(Nm)	POWER (WATT)
1	2.0	108	11.25	9.11	102.48
2	2.2	125	13.25	8.25	109.31
3	2.4	135	14.40	8.52	122.68
4	2.7	138	15.62	8.65	135.11

Theoretically, the power output of any wind turbine is,

Pa=1/2* □□3

□ Air density at that particular height and location, (normally 1.225 kg/m3)

A- Swept area by blades.

V- Wind velocity in m/s

Table: wind velocity and power output

Sr.no	Wind velocity (m/s)	Power output (watts)
1	**3**	**56.9**
2	**5**	**256.5**
3	**7**	**285.0**

Practically,
At 3 m/s wind velocity turbine is rotating at 110rpm which accounts for 69 watts according to the equation. Hence one can obtain an output of 70-90 watts with an average wind speed of 3-5m/s.

V. CONCLUSION

Conclusively, extensive data is collected on wind patterns produced by vehicles on both sides of the highway. Using the collected data, a wind turbine is designed to be placed on the medians of the highway. Although one turbine may not provide adequate power generation, a collective of turbines on a long strip of highway has potential to generate a large amount of energy that can be used to power streetlights, other public amenities or even generate profits by selling the power back to the grid.

This design concept is meant to be sustainable and environmentally friendly. Additionally, a wind turbine powered by artificial wind has a myriad of applications. Theoretically any moving vehicle can power the turbine such as an amusement park ride. The highway wind turbine can be used to provide power in any city around the globe where there is high vehicle traffic.

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