A Model for Electricity Generation By Fast Moving Vehicle

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Abstract-*As the population increases day by day the demand of energy sources also increasing and due to use of non-renewable energy sources pollution is also increasing. The availability of them is also limited. So, we need to find alternative sources which can fulfil the requirement of increasing demand i.e. solar, wind, geothermal, tidal, and nuclear. The wind is a source of free energy which has been used since ancient times in windmills for pumping water, grinding flour and electricity generation. When vehicle is in motion, the velocity of upstream air is high and can be used for electricity generation. The objectives of the work are use of innovative method by using renewable energy source and to fabricate model for generating electricity and reduce pollution. Fabrication of model for generating electricity using high wind pressure generated by fast moving vehicles, channelling the induced wind in the direction of the wind turbine, converting the energy of the wind into mechanical energy by using wind turbine and ultimately the mechanical energy into electrical energy by using a generating device. The generated electricity can be used in a vehicle for different applications like battery charging, car accessories and mountings which works on the electricity.*

Keywords-Renewable Energy, Vehicle Motion, Induced Wind, Wind Turbine, Electricity Generation

I. INTRODUCTION

Energy is an essential ingredient of socio-economic development and economic growth. Renewable energy resources exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency is resulting in significant energy security, climate change mitigation, and economic benefits. There is strong support for promoting renewable sources such as solar power and wind power. It would also reduce environmental pollution such as air pollution caused by burning of fossil fuels and improve public health, reduce premature mortalities due to pollution and save associated health costs.

Renewable energy sources like wind energy can help in reducing the dependency on fossil fuels. It has been estimated that roughly 10 million MW of energy are continuously available in the earth's wind. Recently, wind energy has become one of the most rapidly increasing renewable energy resources. The wind is a source of free energy which has been used since ancient times in windmills for pumping water, electricity generation and grinding flour. They are still dependent on the vagaries of the weather. Not just on the wind direction but on the intermittent and unpredictable force of the wind. Areas where winds are stronger and more constant, such as offshore and high altitude site are preferred locations for wind farms. Between these extremes, cost efficient installations have been developed to extract energy from the wind. Modern technology has been making improvements to the efficiency of windmills, which are now extensively used for electricity generation.

The use of alternative energy sources in automobiles is gaining importance with each passing year due to the rapidly depletion of available energy resources, the rise in fuel prices depending on this depletion, and environmental factors. The most important factors in the acceptance of alternative energy sources are the initial purchase cost of the system, the cheapness of the fuel, station availability and filling duration of the fuel, vehicle range and performance, and the environmental impact [1].

Depletion of oil resources and some environmental factors have been pushing automobile makers and the scientific communities to study on the use of alternative energy sources in automobile. LPG, CNG, hydrogen, biodiesel, ethanol and methanol could be used as alternatives for gasoline. A comparative analysis is performed for fuels, according to the comparison, LPG and CNG are best alternative fuels for economic reasons, while electric and fuel cell vehicles stand out as their emission advantages. Also, hydrogen can be considered as a key fuel due to its usage as an energy source for both internal combustion engines and fuel cell vehicle [1]. In electric vehicle battery charging is required to run the vehicle.

When vehicle is in motion electricity generation can be possible by fabrication of model for generating electricity using high wind pressure generated by fast moving vehicles, channelling the induced wind in the direction of the wind

turbine, converting the energy of the wind into mechanical energy by using wind turbine and ultimately the mechanical energy into electrical energy by using a generating device. The generated electricity can be used in a vehicle for different applications like car accessories and mountings which works on the electricity. Test of velocity measurement carried out on different vehicle by using anemometer to decide the location for testing and to find out the maximum amount of velocity obtain at different speed.

II. LITERATURE REVIEW

A.Ugurlu et al. [1] discussed on alternative sources in automobile. Depletion of oil resources and some environmental factors have been pushing automobile makers and the scientific communities to study on the use of alternative energy sources in automobiles. In this study, a comparative analysis is performed for fuels such as LPG, CNG, hydrogen, biodiesel, ethanol and methanol, which Could be used as an alternative to gasoline and diesel, and electric, hybrid and fuel cell vehicles

J.Wanga et al. [2] showed the Feasibility study of a hybrid wind turbine system – Integration with compressed air energy storage. , the paper presents the recent research work at Warwick on the feasibility study of a new hybrid system by integrating a wind turbine with compressed air energy storage It can be concluded that the proposed hybrid system of wind turbine and CAES is feasible with a great potential for future industrial applications

T.Okazaki et al.[3] showed the Concept study of wind power utilizing direct thermal energy conversion and thermal energy storage Present wind power is intermittent and cannot be used as the base load energy source. Concept study of wind power utilizing direct thermal energy conversion and thermal energy storage named Wind powered. Thermal Energy System (WTES) is conducted.

C.Torasa et al.[4] explained the application of roof ventilator for electricity generation. Since Thailand is located in the tropical climate, the buildings, houses and industrial facilities prefer installing roof ventilators to vent hot air out of the roof. The results of the study were found that roof ventilator would begin to generate a voltage of 0.2 - 0.3 V. at wind speed of 0.5 m/s.

D. Petkovic et al. [5] showed soft methodology selection of wind turbine parameters to large affect wind energy conversion. It is important to determine and analyse the most influential factors on the produced energy, it is desirable to select and analyse factors that are the most influential to the converted wind energy like, blade pitch angle, rotor speed, and wind speed and rotor radius.

S.Ani et al. [6] explained concept of small wind power generation using automotive alternator. The objective of this paper is to evaluate the feasibility of using claw pole automotive alternator as a generator for small wind turbine and to compare its energy yield and generated electricity cost with commercially available systems Concepts such as the selection of suitable turbine parameters and gear ratio were used to achieve good matching of the turbine characteristics with measured alternator performance in order to improve the energy yield from the alternator in battery charging application.

Y.Bao et al. [7] Studied experimental examination on a new switched reluctance wind power generator system. In this study, a method of harnessing wind power on-board of an electric vehicle using switched reluctance generator (SRG) coupled to a wind turbine, which is mounted on the vehicle is discussed. A new integrated wind turbine is proposed according to the requirements of the wind turbine for EVs. The investigation into the realization of on-board power generation with wind assisted SRG operation is very encouraging and provides good energy generation through on-board SRG on an EV.

III. OBJECTIVES & METHODOLOGY

Based on the literature survey, following objectives are defined.

- To select the wind mill blade and generator.
- To fabricate a sustainable, innovative and environmental friendly model for electricity generation and reduce pollution.

To fulfil above objectives following methodology is followed.

- Step 1- Test performance on different vehicles for velocity analysis by anemometer.
- Step 2 - Selection of blade material and blade.
- Step 3 - Selection of dynamo for model.
- Step 4 – Fabrication of whole model.
- Step 5 - Test performance on developed model.
- Step 6 - Results & Conclusions

IV. CONSTRUCTION

The process of fabricating a wind turbine for electricity generation by fast moving vehicle involves the conceptual implementation of a number of electrical and mechanical subsystems to create a machine capable of converting the energy contained in wind to useful electrical

energy. Concepts such as the selection of suitable turbine parameters, generator performance in order to improve the energy yield from the induced wind and vehicle application as the location and the design. Another method of harnessing wind power in vehicle using switched reluctance generator (SRG) coupled to a wind turbine, which is mounted on the vehicle [7]. Wind turbines are manufactured in different sizes and powers. Wind turbines are divided into 2 classes: small Wind turbines (SWTs), having a rotor-swept area of 200 m2 or less, and large Wind turbines (LWTs), with a rotor-swept area larger than 200 m2.

Two types of axes are important in micro wind turbines (MWTs): vertical axis micro wind turbines (VAWTs) and horizontal axis micro wind turbines (HAWTs). The cut-in of a VAWT is lower than that of a HAWT. However, the efficiency of a VAWT is lower than that of a HAWT. The blades of a HAWT are perpendicular, and the rotation axis is parallel to the direction of wind. So select HAWT for fabrication of wind turbine [7]. Selection of efficient blades for model is important for better efficiency and output. The blade should have less weight, higher lift force, and better capture of kinetic energy of wind. Since the blade of the micro wind turbine is not very long, it is designed to be in mono thickness along the blade length [5]. Aerofoil, forward, straight and backward curve blade can be used in the turbine. Select blade which is efficient.

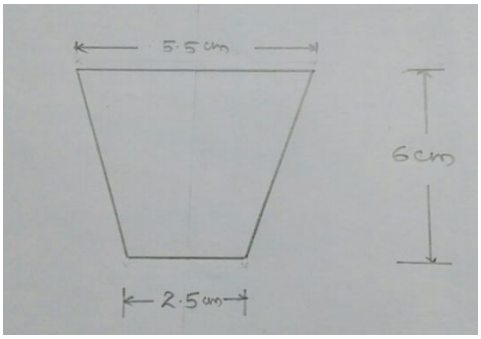

Fig.2 Photograph of Blade Dimensions

Efficient generator/dynamo for model is very important, the factor affecting on selection of generator/dynamo are Cost, weight, size, torque, obtained power and application. The PMSG have mechanically lower rotational speed. This means that the PMSG has a higher number of poles. Magnets used in PMSGs have a major impact on the performance of PMSGs.

Fig.1 Photograph of Dynamo

Fabrication of model begins after the selection of all above components and can be done by using various fabrications and manufacturing techniques. Blades are made up of galvanized iron. Galvanized iron is iron which has been coated in a layer of zinc to resist corrosion in an environment where corrosion is likely to occur. Galvanized iron has long life, less cost and easily available. It performance is reliable and predictable. Four blades mount by using brass breezing on welding rod of 0.3cm which is made up of carbon steel, angle between two blades is 90 degree.

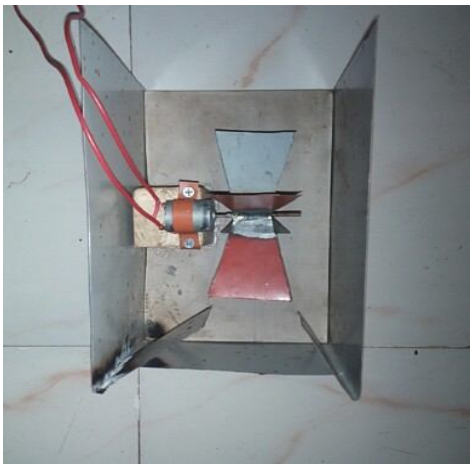

Fig.3 Photograph of Actual Model (T.V)

Table: 1 Specification

Components Name	Material	Dimensions(Cm)	Quantity	Cost
Base	Wood	22.5×15×1.7	1	30
Block	Wood	7.5×4.5×4.5	1	10
Dynamo	NA	NA	1	120
Blade	Galvanised Iron	NA	4	50
Shaft	Carbon &Carbon Manganese Steel	Diameter =0.40 Length = 2.5	1	5
Casing	Galvanised Iron	NA	1	100
Screw	Mild Steel	Tr 0.8×0.1	11	45

Wood is used to build a base of 22cm×15cm×1.7cm for support the entire structure of model. On the base wooden

block of 7.5cm×4.5cm×4.5cm is mounted to support the dynamo. Dynamo fixed on the block by a metal strip and two screws. Shaft of dynamo and shaft on which blades are mounted joint together by lap joint using soldering. If we use other joining process like welding or brazing to joint shafts then dynamo winding may get burn due to heat generated during joining process. Soldering is process which is carried out at low temperature. Casing is providing for safety purpose and it made up of galvanized iron. Converging shape channel is also providing for channelling the wind induced due to vehicle motion. Then, the fabricated model will be tested on the vehicles.

V. WORKING

After the fabrication of model, it is mounted just above the headlight of two wheeler for testing and performance. Some of the guidelines followed for exact location of model:-

1. It should not block the driver's view;
2. It should capture as much as wind;

When vehicle start to work, due to motion of vehicle wind will induced, the induced wind is channelled in the direction of blades through channel which is made in casing. If the wind is properly directed towards the wind turbine blades, optimum electricity will be generated.

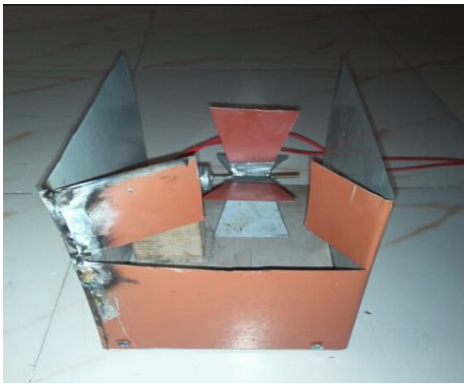

Fig. 4 Photograph of Actual Model (F.V)

The moving vehicle like railway trains or aeroplanes can also encounter wind. The kinetic energy from the wind is converted into the mechanical energy by blades and further mechanical energy is converted into electrical energy by dynamo. The speed of vehicle is increasing the kinetic energy of wind increases and ultimately mechanical energy increases. So, rate of electricity generation will be directly proportional to the vehicle speed. If the model can be designed and is able to produce energy at a cost less than its opposition of fossil fuels and nuclear energy, then the project is deemed economically viable.

VI. RESULTS AND DISCUSSIONS

Velocity measurement test carried out on different vehicles for different speed by using anemometer, the result of average velocities on different vehicles are shown in table.

The maximum velocity of induced wind at 20km/hrs is 3.78 m/s and at 90km/hrs is 20.98m/s. for each vehicle total five reading taken and average of the reading is mention in above table. Anemometer is placed near window for four wheeler and above the headlight for two wheeler to velocity measurement.

Table : 2 Average velocities on different vehicle (m/s)

Vehicle speed (Km/hrs)	Hero Honda splendour plus	Hero Honda passion plus	Bajaj XCD	Tata indigo CS	Tata indica vista
10	3.06	3.2	3.3	3.6	3.78
20	4.22	4.56	4.7	4.74	5.3
30	5	5.14	5.4	6.26	7.46
40	7.72	7.8	7.9	8.08	8.32
50	8.32	8.4	8.6	8.78	9.28
60	11.16	11.3	11.6	11.8	12.05
70	13.2	13.26	13.35	13.8	15.14
80	14.94	15.3	15.6	16.7	17.86
90	16.4	17.24	17.5	19.6	20.98

The performance test conducted on the Bajaj XCD vehicle at different speed, the results of testing are shown in table.

At the speed of 10km/hrs the average velocity of induced wind is 3.2 m/s and the voltage generated by model varies between 0.30 to 0.70. Fluctuation in voltage occurred due to variable velocity of induced wind.

Table: 3 Results

Speed (km/hrs)	Average Velocity(m/s)	Voltage range (volt)
10	3.2	0.30 – 0.50
20	4.56	0.70 – 1.1
30	5.14	2.6 – 2.9
40	7.8	3.4 – 3.9
50	8.4	4.6 – 5
60	11.3	5.9 – 6.3
70	13.26	7.5 – 8.2
80	15.3	9.2 – 9.6
90	17.24	10.3 – 10.8

VII. ADVANTAGES AND DISADVANTAGES

The wind is free and with modern technology it can be captured efficiently. Wind energy plays important role in development of country. Wind energy is environment friendly.

The advantages are design and fabrication of model is

- It is very easy and economical to fabricate.
- The kinetic energy of induced wind can be used for different application.
- Model has very less weight and less area so it is portable.
- It is environment friendly.

The disadvantages are

- It does not produce the same amount of electricity all the time.
- It creates noise at high speed.
- It cannot produce electricity at low speed.

VII. CONCLUSIONS

The fossil fuels are highly polluting and cannot form a completely sustainable society. The renewable energy sources do have the potential to provide significant amount of energy to meet requirement of increasing demand. Wind energy is the growing energy source in the world. Wind energy does not harmful to environment.

This paper investigated the feasibility study of model for electricity generation by fast moving vehicle. When the vehicle is in motion the upstream air has very high velocity. This high velocity air can be used for electricity generation. Though there are certain challenges need to overcome. The maximum voltage generated by model at the speed of 90km/hrs. is 10.8volt. The generated electricity can be used for different application.

VIII. FUTURE SCOPE

Design of model can be modified to obtained better results. The induced wind may be used for improve braking system of vehicle. Small compressor can be integrated with model to compress air and this compressed air is useful for vehicle cleaning. Fluctuation of electricity generation will be overcome by supplying air to wind turbine using compressor of vehicle.

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