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STUDY AND EVALUATION OF FEASIBILITY OF WIND TURBINE FOR ELECTRIC VEHICLE

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ABSTRACT

The use of electrical vehicle is eminent in view of climate change word while. The electrical vehicle can be charged either by plug in technology or on board charging by suitable renewable energy technologies.
This paper evaluates different types of wind turbine technologies in accordance with its cost and efficiency and optimizes further the type of wind turbine technologies for utilization in electrical vehicles. It is further stated that there is need to modify the forms of existing electrical vehicles for uses of such new technologies.
The paper further reviews that the modified horizontal axis wind turbine are best suited for electrical vehicle applications, with the objective of low cost considerations.

Keywords- *Electric vehicle (EV), Wind Turbine, Optimization, Fuzzy logic, Horizontal Axis Wind Turbine.*

I. INTRODUCTION

The energy crises along with environment problem since the late 20th century raised renewed interest in electric vehicles due mainly to concerns about rapidly increasing oil prices and the need to curb greenhouse gas emissions. Electric vehicles have several advantages as compared to conventional internal combustion based automobiles in energy efficiency and exhaust.
The renewable energy with regeneration (conservation) will provide some solution to energy crises and environmental problems.
The main disadvantage to use electric vehicle is the lack of efficiency. This can be overcome by selecting suitable type of wind turbine for electric vehicle. On the other hand, electric vehicles contribute to cleaner local air because they reduce or even produce no harmful gases. The ultimate goal to plan the electric vehicle which runs on wind power is to increase the efficiency. The main problem related with this is uncertainty of wind speed. And also there are various reasons or problems which will affect the efficiency of wind turbine. To find out the best solution for it, it is necessary to study and analyze all the problems associated with this.

WIND TURBINE SYSTEM CHALLENGES:

- Improving wind turbine efficiency
- Optimizing for design performance and target
- Reliability
- Reducing the effects of variation on system performance
- Predicting manufacturing yields
- Lowering production costs
- Increasing speed of rotation

II. THEORY

A. Wind Energy

Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electrical power, windmills for mechanical power, wind pumps for water pumping or drainage, or sails to propel ships. Large wind farms consist of hundreds of individual wind turbines which are connected to the electric power transmission network. For new constructions, onshore wind is an inexpensive source of electricity, competitive with or in many places cheaper than fossil fuel plants. Small onshore wind farms provide electricity to isolated locations. Utility companies increasingly buy surplus electricity produced by small domestic wind turbines.

Offshore wind is steadier and stronger than on land, and offshore farms have less visual impact, but construction and maintenance costs are considerably higher.

Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation. Wind power is very consistent from year to year but has significant variation over shorter time scales. As the proportion of wind power in a region increases, a need to upgrade the grid and a lowered ability to supplant conventional production can occur. Power management techniques such as having excess capacity storage, geographically distributed turbines, dispatch able backing sources, storage such as pumped-storage hydroelectricity, exporting and importing power to neighbouring areas or reducing demand when wind production is low, can greatly mitigate these problems.

B. Electric Vehicle Popularization

An electric vehicle is an automobile which can be propelled partially or fully by electric motor(s), using electricity stored in its onboard rechargeable or replaceable batteries or another energy storage device. The energy crises along with environment problem since the late 20th century raised renewed interest in electric vehicles due mainly to concerns about rapidly increasing oil prices and the need to curb greenhouse gas emissions. Electric vehicles have several advantages as compared to conventional internal combustion based automobiles in energy efficiency and exhaust emission. Internal combustion engines are relatively inefficient at converting on-board fuel energy to propulsion (only about15%-20%); in contrast, electric motors are more efficient in converting stored electric energy into propulsion (around 80%), and electric vehicles do not consume energy while coasting, and some of the energy lost when braking can be captured and reused through regenerative braking, which captures as much as one fifth of the energy normally lost during braking.

While the worldwide market for all vehicles will grow by about four percent per year over the next six years, analysts estimate that electric vehicle market will grow at a rate of almost 20 percent over the same time frame. Wind energy is one of the main renewable energy sources. With increasing energy demand and lack of generation, the demand for wind energy is also increasing. Formulation of wind energy wills help to meet the future energy demand in India. Since there is a need to use electric vehicle which runs on wind turbine, which in turn conserve petroleum products.

Wind turbine is a device that converts kinetic energy from the wind onto mechanical energy and then this mechanical energy is converted into electricity using generator. There are various types of wind turbine available in the market today.

C. Types of Wind Turbine

Industrial wind turbines fall into two general classes depending on how they spin:

a) Horizontal axis wind turbine and

b) Vertical axis wind turbine

Vertical axis machines, which spin about an axis perpendicular to the ground, have advantages in serviceability since all of the control equipment and generator are at ground level. The main drawback to this configuration, however, is that the blades cannot be easily elevated high into the air where the best winds blow. Vertical axis turbine types would hardly be able to beat the efficiency of a propeller-type turbine. As a result, horizontal axis machines "HAWT", which spin about an axis parallel to the ground rather than perpendicular to it, have come to dominate today's markets. All grid-connected commercial wind turbines today are HAWT.

Then question arises in mind is that- which type of wind turbine is more efficient? A good analogy would be antennas. A VAWT the barrel or egg whisk type - you know the ones with the long names can be regarded as dipoles i.e.: just a length of conductor - almost uni direction - they radiate everywhere. Whereas a HAWT could be regarded as a parabolic dish which has a massive gain but only in one direction. So the VAWT rotate whatever the wind direction but with less power compared to HAWT which you point into the wind.

Horizontal axis wind turbines are more efficient than vertical axis; because vertical axis only used for small power applications.

It is seen that tri or three bladed horizontal axis wind turbines is more efficient type as compared to other types of wind turbines.

The efficiency of a wind turbine could be defined as the electrical energy generated divided by the power that has been taken from the wind. In what follows, efficiency is considered to be the electrical energy generated divided by the power available from the wind.

III. METHODOLOGY

A. Optimization Tool

Wind is a safe, clean, and nature-friendly type of energy. Thus, many countries are interested to invest on the wind energy. However, the main disadvantage of wind is due to the fast changes in wind's speed and direction. Hence, the wind power varies depending on the environmental factors, which causes the need for accurate on-line identification of the optimal operating point. Wind energy conversion systems can work by fixed and variable speed using the power electronic converters [3]. The variable-speed type is more desirable because of its ability to achieve maximum efficiency at all wind speeds. The main operational region for wind turbines according to wind speed is divided into partial load and full load. In the partial-load region, the main goal is to maximize the power captured from the wind. This goal can be achieved by controlling the generator torque such that the optimal tip speed ratio is tracked.

The past few years have witnessed a rapid growth in the number and variety of applications of fuzzy logic (FL). FL techniques have been used in image-understanding applications [7]. Fuzzy logic poses the ability to mimic the human mind to effectively employ modes of reasoning that are approximate rather than exact. With FL, we can specify mapping rules in terms of words rather than numbers. In most applications, an FL solution is a translation of a human solution. FL can model nonlinear functions of arbitrary complexity to a desired degree of accuracy. FL is a convenient way to map an input space to an output space. FL is one of the tools used to model a multi-input, multi-output system.

A control strategy to optimize power output performance of wind energy conversion system. In order to obtain optimum power output from a wind turbine generator system, it is necessary to drive the wind turbine at an optimal rotor speed for a particular wind speed. Fuzzy logic based control algorithm is implemented with the embedded microcontroller which will track the maximum power point (MPP) by generating appropriate generator load references. The designed controller then forces the system to operate towards the dictated load reference.

IV. ANALYSIS

TABLE I

FUZZY FICTION OUTPUT TABLE

Types of wind turbine	Speed	Starting torque	Efficiency	Cost	Solidity	Stability	TSR	Weight
1) HAWT								
Single bladed type			30%				12 to 16	
Two bladed HAWT			30-45%				8 to 12	
Three bladed HAWT			Upto 45%		<5%		5 to 8	
Multi-bladed HAWT			25-40%		50-80%		0.8 to 2	
Up-wind			>30%					
Downwind type			25-35%					
2) VAWT								
Darrius			25-35%		10-20%		3 to 5	
Savonieus					100%		.8-1	
Air turbine								
Gas turbine								
Hydro turbine								

Very High
High
Medium
Low
Very low(zero)
Excellent
Good
Fair
Defined
Undefined

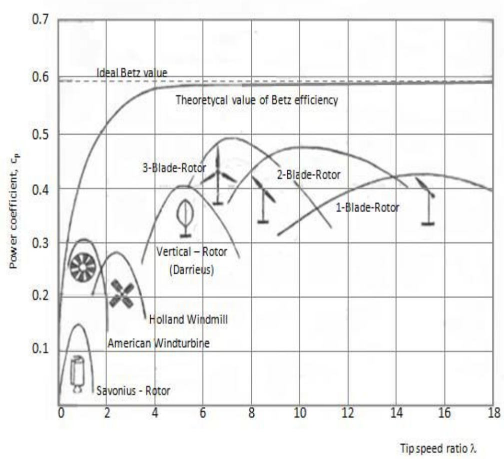

Fig. 1 Characteristics of turbines which shows comparison between types of wind turbine

V. CONCLUSION

The table shows that the best wind turbines for the application of electric vehicle are 1) three bladed HAWT 2) two bladed HAWT.

The three bladed HAWT has 45% efficiency; also they are available in the market with greater stability. The two bladed HAWT which has 30-45% efficiency, also has high speed of rotation.

REFERENCES

1. *Olle Sundstrom and Carl Binding, Optimization Methods to Plan the Charging of Electric Vehicle Fleets, IBM Research, Zurich 8803 Ruschlikon, Switzerlan*
2. *Masaaki Takagi, Hiromi Yamamoto and Kenji Yamaji, Evaluation of Expanded Allowable Capacity of Wind Power in Power Systems by Charge Control for Plug-in Hybrid Electric Vehicles, Electrical Engineering in Japan, Vol. 178, No. 4, 2012*
3. *Borhan, Hoseinali, Optimization-based Power Management of Hybrid Power Systems with Applications in Advanced Hybrid Electric Vehicles and Wind Farms with Battery Storage, 2011*
4. *S.M. Ferdous, Walid Bin Khaled, Benozir Ahmed, Sayedus Salehin, Enaiyat Ghani Ovy , Electric Vehicle with Charging Facility in Motion using Wind Energy, World Renewable Energy Congress, 2011*
5. *Pudji Irasari, Experiment and Analysis of Car Alternator for Wind Turbine Application, Journal of Mechatronics, Electrical Power, and Vehicular Technology Vol. 02, No 1, pp 1-10, 2011*
6. *Giovanni Petrone and Carlo de Nicola, Domenico Quagliarella, Jeroen Witteveen, John Axerio-Cilies*

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and Gianluca Iaccarino, Wind Turbine Optimization Under Uncertainty with High Performance Computing, 29th AIAA Applied Aerodynamics Conference 27 - 30 June 2011

7. *Zijun Zhang, Performance Optimization of Wind Turbines, PhD diss., University of Iowa, 2012*
8. *Shakil Ahamed Khan, Md. Ismail Hossain, Mohammad Jakir Hossain, Fuzzy Logic Based Control Scheme for Power Optimization of a Small Wind Turbine System with DC-DC Converter, IJECT Vol. 2, Issue 2, June 2011*
9. *Ilie CATANĂ, Carmen-Anca SAFTA, Valentin PANDURU, Power Optimisation Control System of Wind Turbines by Changing the Pitch Angle, U.P.B. Sci. Bull., Series D, Vol. 72, Iss. 1, 2010*
10. *Eric Rosenbloom, A Problem With Wind Power, September 5, 2006*
11. *Boško P. Rašuo, Aleksandar Č. Bengin, Optimization of Wind Farm Layout*
12. *Giovanni Petrone, Carlo de Nicola, Domenico Quagliarella, Jeroen Witteveen, John Axerio-Cilies, Gianluca Iaccarino, Wind Turbine Optimization Under Uncertainty with High Performance Computing, 29th AIAA Applied Aerodynamics Conference 27 - 30 June 2011, Honolulu, Hawaii*
13. *W. Short and P. Denholm, A Preliminary Assessment of Plug-In Hybrid Electric Vehicles on Wind Energy Markets, Technical Report NREL/TP-620-39729 April 2006*
14. *Karam Maalawi, Special Issues on Design Optimization of Wind Turbine Structures*

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