Charging of Car Battery In E.V Using Wind Energy

Prof.Ashwini Deshpande[1], Nikhil Isaac[2], Anuj Bhole[3], Abhishek Bhadange[4], Vaibhav Dhotre[5], Yashwant Chavan[6]

[1, 2, 3, 4, 5, 6] Pimpri Chinchwad College of Engineering

Abstract- *Fossil fuels play a vital role in our day-to-day lives..However, these are all non-renewable sources of energy i.e. They are available in limited amounts. With the increase in population and their consumption, the stock of fossil fuel seems to be approaching its end and hence there is a prior need to switch to renewable sources of energy. The following concept is an attempt towards a green and pollution free environmental future.The concept is to introduce a system which can recharge the battery when the electric car is in motion i.e. without stopping the electric car for charging. To implement this, the most renewable source of energy being considered is Wind Energy. To implement this wind energy, the Vertical Axis Wind Turbine (VAWT) is used which can easily generate power even in unstable weather conditions such as turbulent, gusty wind.These also function well in mountain and coastal areas.*

Keywords- Battery , Charging , VAWT , Turbine

I. INTRODUCTION

Wind energy is a renewable source of energy and can be used to generate electricity. Wind Turbines convert the wind energy into electricity by rotating propellers (blades) around a rotor. The rotor connects to the generator through a shaft. A series of gears are present to speed up the rotation and allow for a physically smaller generator. The wind turbine generator converts mechanical energy into electrical energy. The electricity produced can be used to charge the batteries of the vehicle.The EVs are not regularly utilized and the market status is not up to the mark because such vehicles are required to be recharged generally for every 60–70 km drive and less cost effective.

To recharge the Battery packs of EVs hours of time is required. This is an important factor which affects the usage of EVs.In this concept we are going to introduce the environment friendly technique of charging electric car batteries while in motion using wind energy in which we will be having a simple mechanism of wind turbines of small diameter because of the use of VAWT system.

II. VAWT

Vertical Axis Wind Turbine (VAWT) is an advanced type of wind turbine, developed to utilise air for making wind energy. The main application to use VAWT is, it cannot take more space and adjust properly. It requires a smaller space than HAWT and others.

For calculating power of wind the formula is

$$P_w = (\rho A V^3)/2$$

Where,

Pw = power of wind turbine

P = Density of air.

A = area of turbine

V = velocity of wind

For calculating turbine power the formula is

$$P_t = (\rho A V^3) / (2.COP)$$

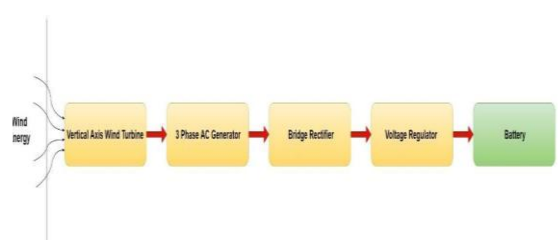
Where,

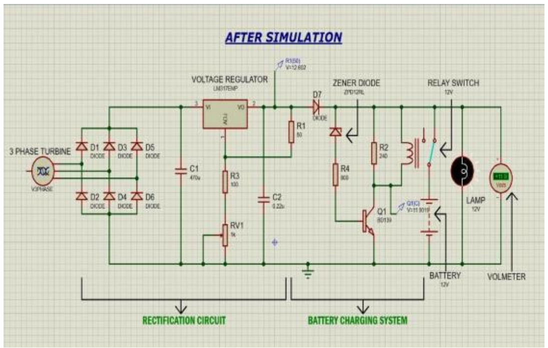
PT = power energy of turbine

COP = coefficient of performance (0.1-0.2 for small turbines)

For finding dimension and number of VAWT blades, the above formula helps us.

III. FLOWCHART AND CIRCUIT





The circuit diagram is divided into two parts - Rectification circuit and Battery Charging System.

In the rectification circuit, the AC voltage is received from the wind turbine which is a 3 phase AC generator. To rectify this voltage it is supplied to the 3-phase bridge rectifier, which comprises 6 diodes, 2 per phase. The rectifier is made by combining 2 half-wave rectifier circuits. This rectifier ultimately converts AC voltage to DC but it is impure DC voltage. It has to be further filtered out with the help of a smoothing capacitor followed by a voltage regulator. Capacitor is connected parallel to the rectifier and it is used for filtering out the impure DC voltage. During the time the rectifier is conducting and the potential is higher than the charge across the capacitor, the capacitor will store energy from the transformer; when the output of the rectifier falls below the charge on the capacitor, the capacitor will discharge energy into the circuit. But it does completely filter out the voltage. For further filtration voltage regulator is used.
Once we have a stable dc voltage according to the requirements of our car battery it is passed through the battery management system which has safety features like voltage spike and overcurrent protections and auto shutoff when the desired voltage/charge is obtained on the car battery. We have incorporated a diode to prevent reverse current. We have also built an auto shutoff using relay, transistors and zener diodes

IV. CALCULATIONS

To calculate wind turbine power, you need to estimate two values: the available wind power and the efficiency of the wind turbine. Multiplying these two values produces an estimate of the output power of the wind turbine. Below you can find the whole procedure:

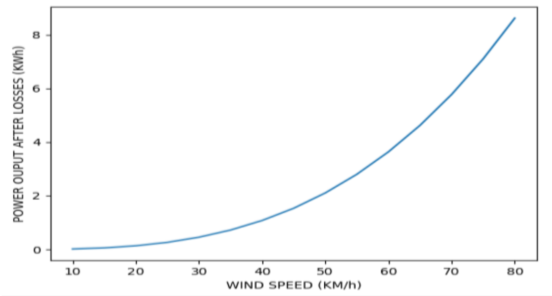
1. Sweep area of the turbine
   Before finding the wind power, you need to determine the swept area of the turbine according to the following equations:
   For HAWT: $A = \pi * L^2$
   For VAWT: $A = D * H$
   where:
   - L is the blade length - the radius of the horizontal-axis turbine
   - D is the diameter
   - H is the turbine height
2. Calculate the available wind power
   Once you know the sweep area, you can find the available wind power according to this formula:
   $P_{wind} = 0.5 * \rho * v^3 * A$
   where:
   - A is the sweep area
   - ρ is the air density, assumed to be 1.225 kg/m^3 by default (you can change it in *advanced mode*)
   - v is the wind speed - the typical usable range is approximately 3-25 m/s
   - Pwind is the available wind power
3. C_p is the turbine efficiency. It must be lower than the Betz limit (59.3%), and is typically between 30-40%
   - kw are the wake losses due to neighboring turbines and the terrain topography, typically 3-10%
   - k_m are the mechanical losses of the blades and gearbox, typically 0-0.3%
   - k_e are the electrical losses of the turbine, typically 1-1.5%
4. Calculating the output power
   To find the wind turbine power, simply multiply the efficiency by the wind power available:
   $P_{output} = \mu * P_{wind}$

V. OUTPUT AND OBSERVATIONS

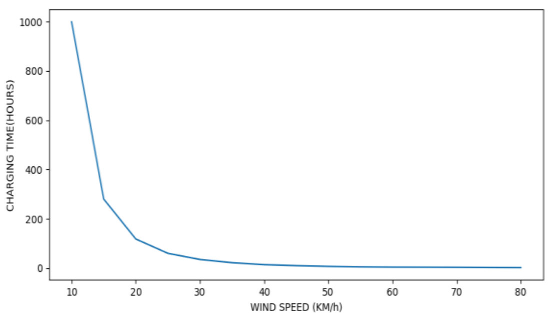
Observation table obtained after plotting the values according to the formula

SR NO.	WIND SPEED	OUTPUT POWER	CHARGING TIME
1	10	0.016	999
2	15	0.057	280
3	20	0.135	118
4	25	0.263	60
5	30	0.455	35
6	35	0.722	22
7	40	1.078	14
8	45	1.534	10
9	50	2.105	7
10	55	2.801	5
11	60	3.637	4
12	65	4.624	3.7
13	70	5.775	3.2
14	75	7.103	2.5
15	80	8.620	2

Graph obtained by plotting power against wind speed.



Graph obtained after plotting values of charging time against wind speed



VI. CONCLUSION

Our investigation of this charging system using wind has shown that the following can be done to improve the energy capture of the wind turbine:

1. The speed of the car (relative winD speed) must be above 30 km/h to make the system viable
2. The wind turbine can be operated at any rpm (within the range of allowable operation).
3. Once the peak torque is reached, the DC converter can be used to keep constant torque (at the peak value).
4. There is a need to control the terminal voltage Vs at any rpm which was achieved by using a voltage regulation circuit.

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