Pakistan Journal of Science, 71 (4 Suppl.): 2019, Page 6-9
ISSN: 2411-0930

A LABVIEW BASED ANALYSIS ON THE USE OF WIND TURBINE TREE ON SMALL SCALE

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ABSTRACT: Nowadays, conventional energy resources have increasing environmental and economic issues. In this regard, renewable energy resources are needed to cope with these issues. One of them is wind energy resource. Much of the current wind turbine research focuses on large-scale wind turbines. Many efforts are being done to get energy from wind turbine on large scale while ignoring its usage on small scales as in offices or homes. The principle issue confronted by researchers about wind turbine is specific huge area, height of turbine required and maintenance problem. Furthermore, the most undertaking problem is its inability for commercial usage, homes and offices on a small scale. In this paper, LABVIEW demonstrated a wind turbine connected with an induction generator with attributes of wind speed (V-wind), Pitch fill (β), blade speed proportion (λ), performance coefficient turbine (C_P), mechanical force output (P_m), the current output and power generator output. It has proved that the efficiency can be maximized while adjusting the various factors. Results demonstrates that the wind turbine tree can be worked at its optimum energy while minimizing the load on the wind turbine for an extensive variety of wind speed. These modifications can be done on one's turbine naturally and the analysis of wind turbine on small scale by using new technology wind turbine tree.

Keywords: LabVIEW, LabVIEW Simulation, Tree shaped wind turbine.

INTRODUCTION

produces energy of use excessive years the Over and warming global ,pollution air on effect bad are today world the in nations All .changes environmental is that energy wind on investigation lead to contending .development energy on approach the of one as utilized boundless ,green ,agreeable naturally a is it ,Moreover less is energy wind The .sources energy renewable and aggressive cost (Bielecki *et al.,* 2015).

a is ,vent tree ,technology wind new the of One considerably a look that turbines wind vertical of variety of bit a resembles tree the Although .tree a like measure ,land urban any at in fit would that craftsmanship current all much power to capacity the have not would which as together trees the of few a utilizing ,case any In .alone a along or center recreation a in components scene the to effect an of amount greater a have would roadside tall m11 are trees These .adjacent structures and homes out stretched most its at measurement in (ft 26) m8 and range indistinguishable an about it makes which ,point is tree the of edge white The .trees urban numerous from sit that turbines 72 hold can it and ,steel from made ,clamor counterbalances introduction This .vertically .noiselessly turn to turbine the permitting

progressing quickest world the is energy Wind power wind the of conversion the is it ,energy renewable the is It .turbine of help the with power mechanical into by energy mechanical into converted is which energy energy mechanical then which by turbine wind of rotation electrical the produce which generator the run to used .types two into arranged be can turbine Wind .energy rotation their of basis the on made is arrangement This as given are turbine of types two The .construction and Wind Axis Vertical and Turbine Wind Axis Horizontal Turbine(Yang *et al.,* 2009).

as known also is Turbine Wind Axis Horizontal horizontal on located generator and shaft Rotor .HAWT their and ,tower of side upper the at turbine of axis wind large Most .wind the towards be should direction axis the from rotor rotate which ,gearbox contain turbines is turbine The .generator electrical an run that fast very owert the with wind of direction opposite the in located tower the by produce disorder the to due.

as known also is Turbine Wind Axis Vertical The .axis-y in placed is shaft rotor turbine this in ,VAWT turbine the that is arrangement this of purpose main is It .direction wind the into placed be not does direction The .wind variable to heading wind of benefit main the ground to relate can components other and generator to need not does tower arrangement this due ,vertically .easier maintenance their makes this and them support the into blades the rotating when drag creates VAWT The wind pivot vertical of drawback main the is this ,wind turbine (Joshuva and Sugumaran, 2016) axis Vertical. Darrieus is One .types two in classified further is turbine the resembles It .turbine eggbeater as known VAWT a creates it ,however ;high is efficiency Its .eggbeater which ,tower on weight cyclic and torque large very need they ,problem this to Due .quality its decrease torque beginning the in ,start to source power external low be will (Kang *et al.*, 2014; Khan *et al.*, 2018; Khan *et al.* 2016) .

type pull a is VAWT Savonius is one other The whose and turbine type pull a is which ,turbine .turbine type pivot horizontal than lower is productivity start to source power external need not do Savonius) starting-self is it becauseKusiak and Song 201 ,0.(

MATERIALS AND METHODS

Wind turbines work by change of the kinetic energy of the wind into torque by which turbine rotate and run the generator. The wind contains the mass, when this mass is moving it has active energy. As the wind turbine rotates, wind energy is converted into mechanical energy which is then used to run the generator and generator produce electrical energy (Bielecki *et al.*, 2014). as energy mechanical converts energy wind The :outlines blades of types two are There .rotate turbine the type Drag and type Lift

Every one of the issues associated with wind turbine can be overcome by another development known as 'Arbre à Vent' or 'Wind Tree' 'Wind Tree' has been intended to resemble a tree with branches small scale wind turbines called 'Aeroleaves', subsequently bio mimicking common trees. The tree trunk and branches are comprised of steel, while the leaves are 3D printed with plastic. They faced the difficulties especially in urban communities, where wind speed is low. The "Aeroleaves" are vertical hub wind turbines which are efficiently intended to pivot even at low wind speeds, for example, 7kmph. Urban winds are not extremely solid but rather they are turbulent (Nailu *et al.*, 2009).

A 'Wind Tree' has an evaluated limit of around 3.1kW. As indicated by the designers, it can control 15 road lights of 50W or can meet 83% of the power needs of a French family unit barring warming or run an electric auto for 10,168 miles for every year (Khan and Rizvi, 2013). At a pinnacle energy of 65-watt per leaf, each tree speaks to an introduced limit of 3.5 kW, or what might as well be called a little home sun based exhibit. The vertical-pivot outlined of the little leaf turbines with a magnet get together empowered them to begin creating vitality at the low wind speed limit of 4.5 mph with no diverting sound, making them perfect for urban settings (Yang *et al.*, 2009).

Operational Network: A single turbine is considered to analyze the power generation through different aspects like wind speed altitude, wind energy and tip speed ratio. The parameters that have been taken under consideration for turbine are rotor speed, angle of attack and power coefficients. The other factors that have been analyzed are wind speed and turbine speed. Presently the other parameter Power coefficient can be seen on LabView by executing its equations and predefined qualities. Calculation of power through power coefficient is described as in the following equations:

$$P_m = \frac{C_P(\lambda,\beta)1}{2}\rho A V^3 \quad (1)$$

$$C_P(\lambda,\beta) = C_1\left(\frac{C_2}{\lambda_i} - C_2\beta - C_4\right)e^{-\frac{C_5}{\lambda_1}} + C_6\lambda \quad (2)$$

The wind turbine works on the guideline of air motion. The turbine Power output is given as in equation (3):

$$P = \frac{1}{2}\rho C_P A V^3 \quad (3)$$

Power coefficient characterizes the capacity of airstream turbine to imprisonment of wind energy through the proportion of extracted power to wind power working of both pitch point and tip speed proportion listed as:

$$C_P = f(\beta,\lambda) \quad (4)$$

For settled pitch, the main element influencing the force coefficient is the tip speed proportion which is given by:

$$\lambda = \frac{\omega R}{V} \quad (5)$$

The numerical estimate of force coefficient is described as:

$$C_P(\lambda,\beta) = C_1\left(\frac{C_2}{\lambda_i} - C_3\beta - C_4\right)e^{\frac{-C_2}{\lambda_i}} + C_6\lambda \quad (6)$$

$$\frac{1}{\lambda d} = \frac{1}{(\lambda + 0.08\beta) - 0.035}\Big/(\beta^2 + 1) \quad (7)$$

By the above formulae

$$C_1 = 0.5, C_2 = 116, C_3 = 0.4, C_4 = 5, C_5 = 21, C_6 = 0 \quad (8)$$

RESULTS AND DISCUSSION

Power Calculation: The formula of the wind turbine power information is describing in demonstrated by,

$$P_m = \frac{1}{2}\rho A V^3 \quad (9)$$

where p_m is the power created by wind, ρ (Rho) is the air thickness (kg/m3) and is of 1255 kg/m3, A is the area of a circle in the wind turbine blade (m2), besides is w speed of wind in m/s. For simulation, wind speed ranges from 5m/s to 30m/s is used which is shown in Fig. 1.

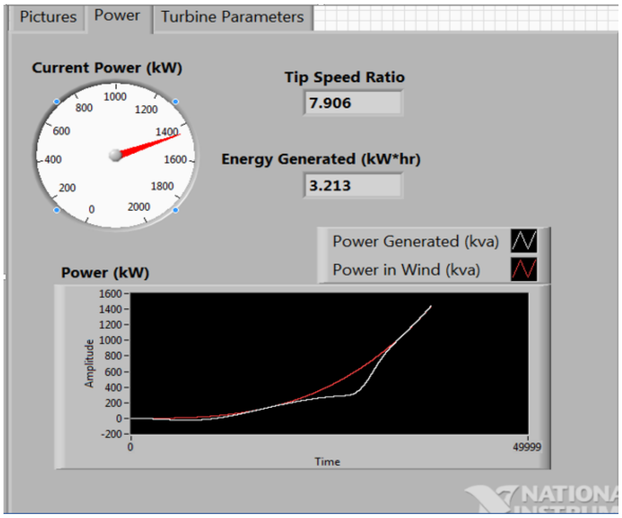

Figure-1: Power and Energy Graph.

Wind Speed with Altitude: For characterization equation of wind speed with altitude is depicted in (10):

$$\bar{V}_H = \bar{V}_{ref} = \frac{\frac{LnH}{Z_O}}{\frac{LnH_{ref}}{Z_O}} \qquad (10)$$

$\bar{V}_H$=Mean air stream speed at height H (m/s),
$\bar{V}_{ref}$=Mean air stream speed at position Href (m/s),
H= height (m),
H_{ref} = location raise (measuring height) (m),
ln = natural logarithm,

Energy Calculation: Mathematically energy is produced by the integration of power.

Tip Speed Ratio: It is the ratio of tagential speed to linear speed. TSR is directly releavent to efficieny. The formula for tip speed ratio is implemented as listed in (11).

$$V_{rw} = \frac{\omega R}{V} = \frac{2\prod NR}{V} \qquad (11)$$

where N is speed of rotor.

Angel of attack: The other important factor is angle of attack. This adjustment base on our analysis and observations about wind speed and direction, and then set the direction of turbine according to the direction of wind. It's simulation structure is shown in Fig. 3.

In this order, adjust the settings for angle of attack such that the speed of wind is above 12m/s then the angle of attack changes continuously and below that it will be 0.For this, we have to use the sub master controller option.It is observed that after 12 m/s the angle of attack changes while when it comes to beneath 12 then it turn into zero.

Rotor speed: Speed of rotor is directly affected to the power production. As the speed of rotor changes hence power produced also changes perceptively. Rotor speed changes by changing of the speed of wind. Its simulation result is shown in Fig 2.

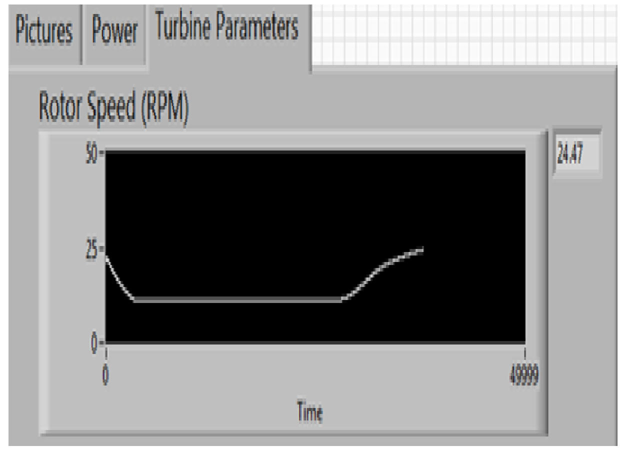

Figure-2: Rotor Speed Connection in LABVIEW

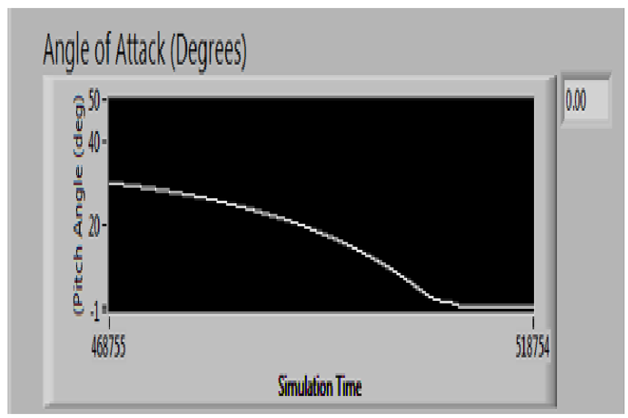

Figure-3: Angle of Attack Graph

Controlling the Angle of Attack: Angle of attack depeds on two factors stalling control and pitch angle control as too much speed of wind and low negligible speed both are not affeted for turbine.

Power Coefficients: Formula for torque is given as

$$T = \frac{1}{2}\rho_a A_m V^2 R \qquad (12)$$

Cp is derived on LABVIEW and predetermined values of cp's based on our observation. Its simulation structure is given by the Fig. 4.

For the factors like wind speed turbine speed are the variable parameters which we set manually and then observe the different behaviour of the parameters of turbine. They can be seen through front panel named as is "Environmental Control" on LABVIEW as shown in Fig.5. A simple indicator is used to examine the wind speed and set the values from 5m/s to 30m/s because experimentally these values are used. Turbine view wind direction all these parameters are control by their simulation structures and these view pictures are taken from various sources and different behaviour is observed.

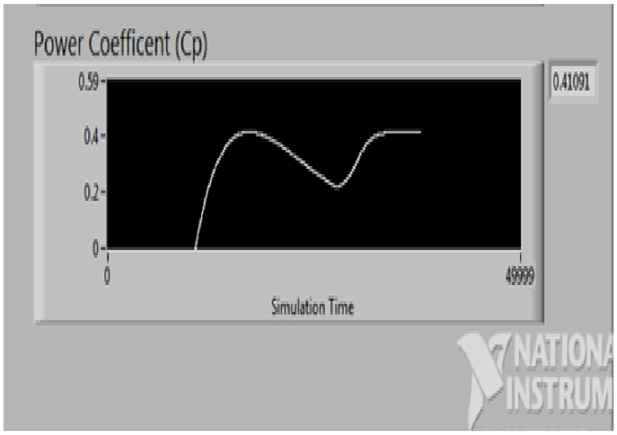

Figure-4: Graph for Power Coefficients

Conclusion: Wind energy is the one of source of reduction of energy crises especially for coastal areas where the wind speed is as high as it can rotate the turbine and can produced power this is the cheapest way for power production through the natural resource. But unfortunately, wind turbine failed for use on small scale. So, it's practice to design a wind turbine tree to utilize the wind on small scales as in offices homes. More than one turbine is used on one structure for capturing more wind but on small scale. To install the turbine in any area all the parameters associated with turbine should be examined on any software and control it accomplish that these types of parameters. To overcome the problem associated with wind turbine should studied the wind turbine on LabVIEW and changing its parameters as required. Its analysis and simulation of wind turbine shows that one can maximized our power or efficiency while adjusting numerous factors. These alterations can be done on one's turbine naturally.

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