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FABRICATION OF DESIGN & DEVELOPMENT OF SMALL SCALE WIND TURBINE FOR LOW POWER APPLICATION

MUHAMMAD SARIF BIN AZRI
TB17107

Thesis submitted in fulfilment of the requirements
for the award of the degree of
Bachelor of Engineering Technology in Electrical

Faculty of Engineering Technology (Electrical)
UNIVERSITI MALAYSIA PAHANG

31 JANUARY 2021

STATEMENT OF AWARD FOR DEGREE

1. Bachelor of Engineering Technology

Thesis submitted in fulfilment of the requirements for the award of the degree of Bachelor of Engineering Technology in Electrical.

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of degree of Bachelor of Engineering Technology in Electrical.

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ABSTRACT

Present final year project expand the test procedures that is needed to reenact and create the limited scale wind turbines for low power application. As a fundamental advance to lead scaled model tests focusing to get the fabrication for this task. It is for the most part realized that the voltage perusing of the breeze turbine are more fragile when there are no wind and burden of the fabrication that associated with to the breeze turbines. Along these lines, it will make the undertaking got the deterrent in building the limited scale wind turbine (SSWT) to create 5V. Along these lines, to constantly improved the voltage yield of 5V, a man-made gadget specifically Li-Po Battery is introduced at the control box. Henceforth, the 5V yield voltage can be accomplish. Futhermore, in this undertaking we have stickiness and temperature sensor to improve the mugginess and temperature of the breeze. On the outside of the Earth, wind comprises of the mass development of air. The breeze is likewise significant for employments of transportation for seeds and little flying creatures, with time things can travel a large number of miles in the breeze. Wind is essential to people since wind energy is a wellspring of sustainable power. It doesn't debase, it is unlimited and diminishes the utilization of non-renewable energy sources, which are the birthplace of nursery gasses that cause a dangerous atmospheric devation. Wind energy doesn't create squander or sully water which is critical factor given the shortage of water. The plan of th limited scope wind turbine (SSWT) is drawn utilizing a product named AutoCAD, form 2014 and Arduino UNO System for the venture program.

ABSTRAK

Projek kini memperluas prosedur ujian yang diperlukan untuk menghidupkan semula dan membuat fabrikasi turbin angin skala terhad untuk aplikasi daya rendah. Sebagai kemajuan asas untuk memimpin ujian model berskala yang berfokus untuk mendapatkan hasil fabrikasi dan voltan untuk tugas ini. Sebahagian besarnya disedari bahawa penyerapan voltan turbin angin lebih rapuh apabila tidak ada angin dan beban fabrikasi yang berkaitan dengan turbin angin. Sejalan dengan itu, ini akan menjadikan usaha mendapat pencegah dalam membangun turbin angin skala terhad (SSWT) untuk membuat 5V. Sejalan dengan itu, untuk terus meningkatkan hasil voltan 5V, alat buatan manusia khususnya Bateri Li-Po diperkenalkan di kotak kawalan. Oleh itu, voltan hasil 5V dapat dicapai. Lebih jauh lagi, dalam usaha ini kita mempunyai ketahanan dan sensor suhu untuk meningkatkan keburukan dan suhu angin. Di bahagian luar Bumi, angin terdiri daripada pengembangan udara secara besar-besaran. Angin sepoi-sepoi juga penting untuk penggunaan pengangkutan untuk benih dan makhluk terbang kecil, dengan masa yang lalu barang dapat menempuh jarak tempuh sebilangan besar batu. Angin sangat penting bagi manusia kerana tenaga angin adalah sumber tenaga lestari. Ia tidak merendahkan, tidak terbatas dan mengurangkan penggunaan sumber tenaga yang tidak boleh diperbaharui, yang merupakan tempat kelahiran gas semaian yang menyebabkan penyimpangan atmosfera berbahaya. Tenaga angin tidak menghasilkan air sia-sia atau sully yang merupakan faktor kritikal memandangkan kekurangan air. Rancangan turbin angin skop terhad (SSWT) dibuat menggunakan produk bernama AutoCAD, form 2014 dan Arduino UNO System untuk program usaha.

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LIST OF SYMBOLS

kV	Kilovolt
mm	Millimeter
min	Minute
V	Voltmeter
m	Meter
inch	Inches

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

The utilization of wind turbines for electrical force age has been around for more than 100 years. Late stresses over the expense and natural impacts of petroleum products have prodded the expansion of wind turbines across a wide assortment of ventures. A huge scope of business wind power frameworks are monetarily accessible today.

Crafted by a breeze turbine resembles a fan, aside from a fan utilizes power to make twist, yet wind turbines turn the cutting edge that turns a shaft, at that point interfaces with the generator and at last delivers power. This section is committed fundamentally to the plan of turbine frameworks for low wind speeds. I focus on more modest turbines, as the accessible force in the breeze is considerably lower at low wind speeds.

To build up this venture, I need to make significant enhancements to the breeze turbine to accomplish the task objective.

1.2 PROBLEM STATEMENT

The utilization of wind turbine in Malaysia as the wellspring of electrical age isn't broadly use as it isn't functional considering the low wind speed. Anyway for the situation where little limit of electrical inventory is required, a limited scale wind turbine could be a down to earth approach to produce power. For instance, a limited scale wind turbine can be utilized to control up specialized gadget for crisis reason during a cataclysmic event occasion where there can be a power supply disappointment. Other than that, contrasted with sunlight based energy where must be removed during day the breeze energy can be reap during day and night. In view of that judgment one of the goal for this undertaking is to plan a smaller than expected breeze turbine that ready to deliver a power at low wind speed.

To improve the capacity of force age, the breeze turbine can be incorporated with other wellspring of force age. The use of an electrical gadget is additionally restricted at where there is no electrical inventory. For instance on the off chance that we go to a far off region, we simply can rely upon the force supply in type of additional batteries or force bank to keep utilizing a gadgets. Furthermore, an individual who go to amusement spot, for example, sea shore and mountain regions will likewise discover challenges to control up their hardware gadgets. Accordingly the plan of convenient smaller than normal breeze turbine is required for a superior transportation and capacity reason. During the improvement of generator part for wind turbine, the examination of every component should be scrutinized with the goal that the particular segment utilized can be known. The subtleties of kind of material utilized additionally should consider all together deciding the creation of generator part of wind turbine test. In this manner, investigation should be done to know the strength and shortcoming of making the generator part to deliver the yield voltage.

1.3 OBJECTIVES

The objectives of this study are:

- To construct a small scale wind turbine that produce 3V to 5V.
- To observe humidity and temperature of surrounding .
- To understand the concept of designing a synchronous generator.

1.4 SCOPE OF STUDY

- Analysis of literature and wind turbine generator studies.
- Research and analysis component that use in generator part.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

All through the timetable of history, networks and the development have make utilized of the sustainable power which are supposed to be endless and the force of wind is truly outstanding of the force given by the unstoppable force of life of the earth. As being expressed by Akshay, et al., (2016), wind energy reaping a reasonable favorable position over it thinking about the bridling of the energy close to waterfront territories all through India. Wind turbines are at first found inland, yet progressively in utilized seaward because of the local area requests. Albani and Ibrahim, (2013) has discovered that Vertical Axis Wind Turbine (VAWT) featured to be the awesome low wind speed application. The reliance on the local wind speed, a turbine can produce electricity of 60-90 percent of the time. When seen under low angles of attack, the lift force also contributes to the general torque generation which been stated by (Al-Faruk, & Sharifian, 2015). There are two sorts of typical turbine, which are grouped supported the tactic of rotation thanks to the axis of shaft rotational motion. A turbine with a shaft mounted horizontally parallel to the bottom is understood as horizontal axis turbine (HAWT). The second type has its shaft normal to the bottom and well-known as vertical axis turbine (VAWT). Both turbine are purposely wont to generate electricity for domestic use. Corresponding to Cantwell & Youd, (1997), because of the low cost and simple manufacturing, any composite materials that disable with chopped strand mats are widely used especially in load-bearing engineering and industrial process applications. (A.N. Johari1*, 2019)

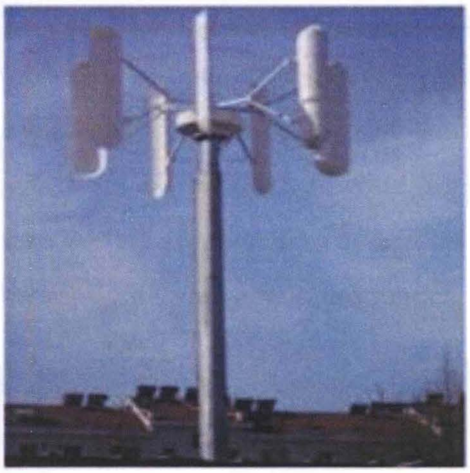

Figure 1 Example of vertical axis wind turbine blade (VAWT) XD Wind Turbine **(A.N. Johari1*, 2019)**

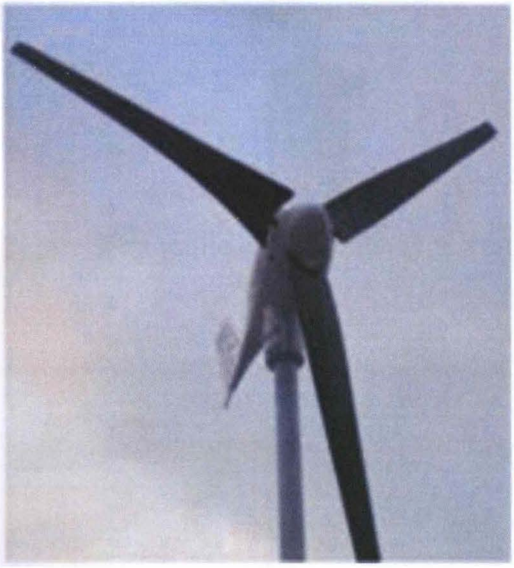

Figure 2 Example of Horizontal Axis Wind Turbine Blade (HAWT) **(A.N. Johari1*, 2019)**

HAWT are essentially utilized around a territory with vigorous headwind, for example, an open field region. This kind of wind turbine are characterized to be more effective at changing over wind energy into power While VAWT are typically utilized at zone with more slow headwind, for example, metropolitan zone. This is on the grounds that VAWT are related to be equipped for getting the breeze from all course, and needn't bother with sweet potato mechanics, rudders or downwind coming. (A.N. Johari1*, 2019)

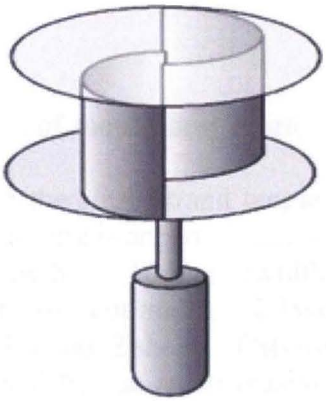

Figure 3 Example of Savonius type vertical axis wind turbine **(A.N. Johari1*, 2019)**

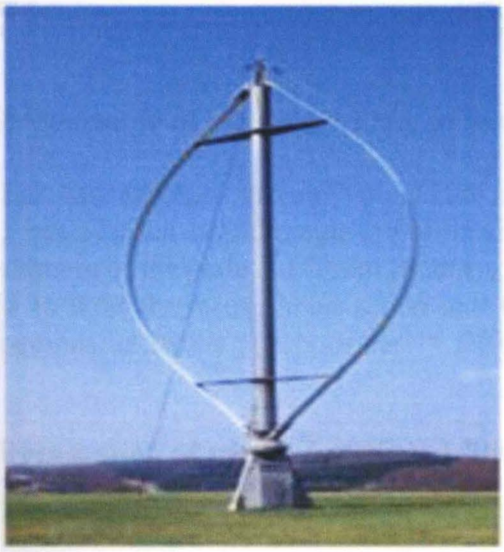

Figure 4 Example of Darius type vertical axis wind turbine 10KW Vertical Axis Wind Turbine (VAWT) **(A.N. Johari1*, 2019)**

2.2 MATERIALS AND METHODS

Materials

Ellis and Found (1983) found that the water take-up by polyester tars makes the net weight increment in the cover with the unlocked edges which is not exactly that of the fixed edges just as the water take-up by the overlay is bigger than by the gum alone or that more material is extricated from a cover than from a bended example pitch. Fiber-glass (cleave strand tangle) is utilized as layers of the creation in this examination. The substance reagents utilized as answer for the layers are unsaturated-polyester tar, hardener of Methyl Ethyl Ketone Peroxide (MEKP) with the proportion of 100:1 (Polyester sap: Hardener). The apportion of the fiber-glass hack strand tangle and the polyester-gum is 30:70 (Fiber glass: polyester tar). (A.N. Johari1*, 2019)

Preparation of mould and solutions for fabrication process

By utilizing the slash strand tangle fiber glass as the surface for the lay-up interaction, pre-dimensioning is accomplished for each streamlined scoop example. The estimation is 600mm (length) x 100mm (width) x 30mm (stature). Each streamlined scoop was portrayed before cut and has 2 layer (2 bits of cleave strand tangle). For the Mold for streamlined scoop, 2 sheets of Styrofoam is utilized to get the ideal formed of streamlined airfoil. Joined by the multi-reason latex, the sheets of Styrofoam is appended to one another immovably. The edge of the joined streamlined airfoil is then managed for the ideal airfoil formed which is NACA 2412 Airfoil shape (profound cambered) to get a smooth streamlined progression of air for rotational purposes. The measurement for the plate is 150mm (width) x 400mm (length). (A.N. Johari1*, 2019)

Preparation of mould for plate of Savonius Wind Turbine

For plate example, around 8 pieces are made for top and base part of wind turbine. Around 2 bits of slash strand tangle are utilized to conceal the entire examples of the plates. The element of the plate is 150mm (width) x 400mm (length). The motivation behind the plate is to hold the streamlined scoop and to go about as the lodging for the pivoted edge composites (folds). (A.N. Johari1*, 2019)

Preparation of mould for Hinged Blade Composite (Flaps)

For arrangement of manufacture measure for folds of the breeze turbine, around 32 sheets of cleave strand mats are dimensioned and cut. The entirety of the sheets are accommodated 16 arrangements of folds for the Savonius wind turbine. The measurement for the fold is 200mm (width) x 600mm (length). (A.N. Johari1*, 2019)

Preparation of solutions for fabrication process

For all creation or lay-up cycle for all readied Mold, the arrangements utilized is polyester tar with the expansion hardener of Methyl Ethyl Ketone Peroxide (MEKP) with the proportion of 100:1 (Polyester tar : Hardener). The proportion of the fiber glass cleave strand tangle and the polyester pitch is 30:70 (Fiber glass : Polyester tar). (A.N. Johari1*, 2019)

Cutting process

The cutting and managing measure accomplished for all created example, for example, streamlined scoop, plates, folds and screen pipe. The way toward cutting and managing done by utilizing the vertical curve saw given by the Mechanical Laboratory, Faculty of Engineering, UPM. The cutting interaction of the forested areas for the arrangement of the center point of the breeze turbine by utilizing Jig Saw done likewise at the Mechanical lab, Faculty of Engineering, UPM. The examples is first outlined and dimensioned by utilizing hand scratcher and afterward managed and cut perfectly for best outcomes. (A.N. Johari1*, 2019)

End product of fabrication process

The final result of manufacture cycle of the folds of the Savonius Wind Turbine. Around 16 examples with copper skeleton inside the folds for underlying scaffolding and the pivoted copper empty bar connected at the backside of each folds for nothing rotational purposes. The cycle of infusions of polyester sap blend with the hardener into each copper empty pole for reinforcing and cementing the development of the pivoted copper empty bar for connection of the folds. The interaction utilizing a needle type for little region infusion.
(A.N. Johari1*, 2019)

The assembly of the product

The gathering of one of the 4 side of the sharp edge for Savonius Wind Turbine. By consolidating the finished streamlined scoop, screen channel just as plate, the lodging for the pivoted edge composite is done flawlessly by connection to the center utilizing 6mm screws and nuts for inflexibility and strength purposes. The gathering of set of folds on one side of the edge of Savonius Wind Turbine. The distance between the folds is 6 inch (152.4 mm). This is fixed to make the folds cover with one another for close and open component when the rotational of entire turbine is occurring by the presence of sufficient measure of wind speed. (A.N. Johari1*, 2019)

Figure 5 The assembly of one complete new turbine with hinged blade composites

(A.N. Johari1*, 2019)

Figure 5 shows the last gathering of one complete new turbine of Savonius type. With by and large estimation of 1000mm (width) x 600mm (stature), the turbine has been effectively set up and prepared be tried close by streamlined lab, UPM. A steel seat is altered to introduce the arrangement of bearing for the rotational and testing purposes. Thinking about the focal point of the turbine, the bearing is changed in accordance with be at the focal point of gravity of the entire breeze turbine. (A.N. Johari1*, 2019)

2.3 RESULT AND DISCUSSION

An anemometer utilized for estimating the breeze speed of the breeze turbine. It is done close by research center of Aerodynamic and Propulsion Lab, Faculty of Engineering, UPM (open territory) to quantify the breeze speed that influence the beginning rotational speed of the New Savonius Vertical Axis Wind Turbine. A few readings have been made all through the testing of rotational interaction close by the lab.
(A.N. Johari1*, 2019)

Testing analysis on rotational of the new SVAWT with respect to wind speed

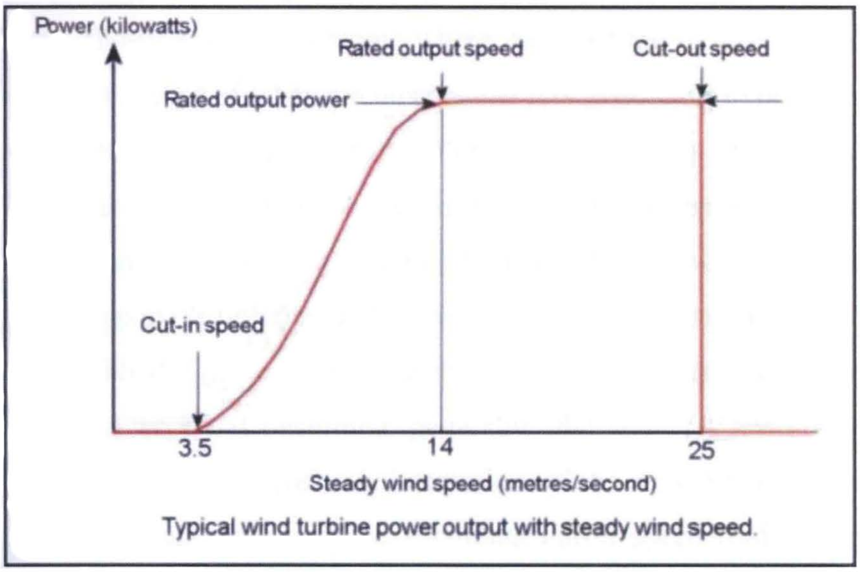

Figure 6 Typical wind turbine power output with steady wind speed (Retrieved form National Wind Watch, Inc. 2005) **(A.N. Johari1*, 2019)**

Figure 6 shows the average breeze turbine power yield with consistent breeze speed by Savonius Vertical Axis Wind Turbine. This chart utilized to set features or focus for the improvement that going to be upgraded all through this task. From the figure, the cut-in speed is the speed where the sharp edges begin to go. The appraised wind speed is the speed of turbine with the most extreme rotational speed and cut-out speed is the speed where the turbine typically shut-down to evade primary harm. (A.N. Johari1*, 2019)

For the new sort of vertical pivot wind turbine which is Savonius with the improvement of adding pivoted cutting edge composites have been created utilizing hand lay-up method. The general estimation of new wind turbine is 1000mm (width) x 600mm (tallness). The utilization of polyester tar blended in with MEKP hardener makes the relieving interaction time decrease bit by bit and save more opportunity for greater cycle of creation contrasted with other sort of sap. The created composites likewise show great qualities where the entirety of the examples are working in a decent way and can uphold the measure of power applied by the breeze speed from the scope of 2m/s until 8m/s. The estimation of cut-in speed done close by Aerodynamic Lab, Faculty of Engineering, UPM, shows a decent outcome where, to make the breeze turbine begin to turn, it just requires the base of 1.5m/s in this manner it is reasonable to be utilized in low speed zones or at the end of the day rural and metropolitan zones for homegrown use. The use of Styrofoam as the form for streamlined scoop, and screen pipe has add to the decrease cost of creation as opposed to utilizing 3D printed shape which cost a higher consumption. The lay-up cycle utilizing a glass sheet just as smooth surfaces, for example, compressed wood with the guide of form discharge wax is material and adequate to make in an enormous scope. Concerning generally, the new SVAWT wind turbine has been effectively planned, creation interaction of the new SVAWT wind turbine has been effectively performed and the rotational cut-in speed trial of the new SVAWT wind turbine has been effectively tried. (A.N. Johari1*, 2019)

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will further describe about the designs of the small scale wind turbines. For low power application. Planning is the first action need to take into account before starting any task given as a careful planning work will produce a promising result. A flow chart also has been constructed to describe the whole progress of the testing to be done.

The methodology for fabricating and producing the low voltage small scale wind turbine is visualized in the flow chart shown in the figure below. In a literature review on the previous and present Small Scale Wind Turbine, the problems described in the current system are studied. With the addition of new parts, which are DC motor, humidity and temperature sensor and arduino UNO, the idea we came up with is. We also make the detector more compact and can keep it in our storage where it is easy to carry anywhere. This Small Scale Wind Turbine's priority is to ensure that the device works to sense wind and ambient humidity and temperature.

During the design process, the Arduino is used to create a draft software design. Its purpose is to generate a significant signal from the turbine on the wind condition status to generate voltage and humidity sensors to calculate and record both humidity and temperature. After that, before the desired result is obtained, the software is evaluated. Once the desired result has been obtained, the production process has commenced. Based on needs and compatibility, the materials and components are selected. After the prototype was designed, the testing phase began. If there are mistakes when testing the prototype, before the desired results are acquired, the testing process will be repeated.

3.2 Designation of Windmills

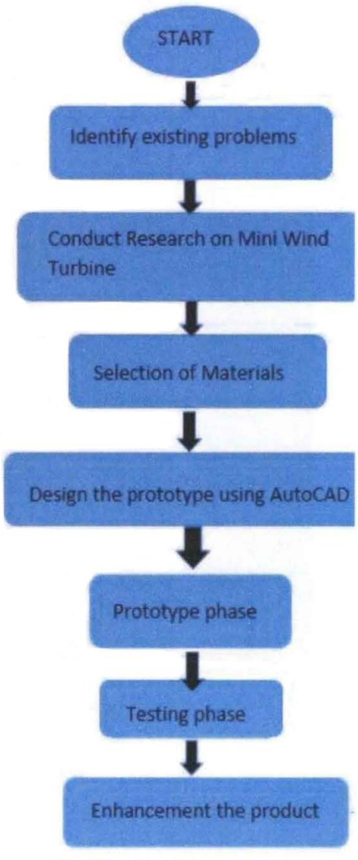

Figure 7 Flowchart for methodology of Small Scale Wind Turbine (SSWT)

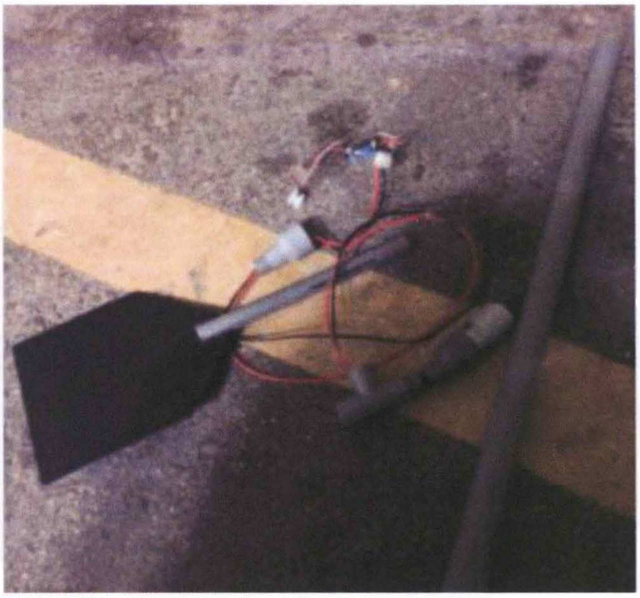

Figure 8 The components before the colouring process

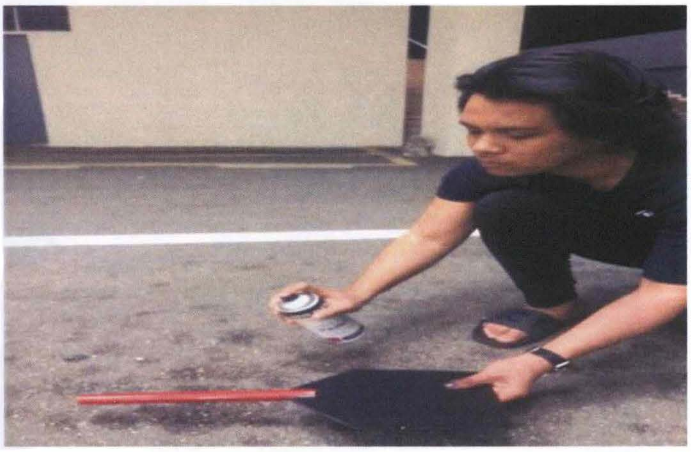

Figure 9 Colouring parts of the windmills

Figure 10 Troubleshoot the prototype at different places

Figure 11 Testing the durability of the prototype

3.3 Block Diagram

Block diagram is a diagram of a system in which the main parts or functions are represented by blocks connected by a line. The main part of the system is connected to the block diagram of the wind turbine system. The control system of these wind turbine shown in Figure 26 below.

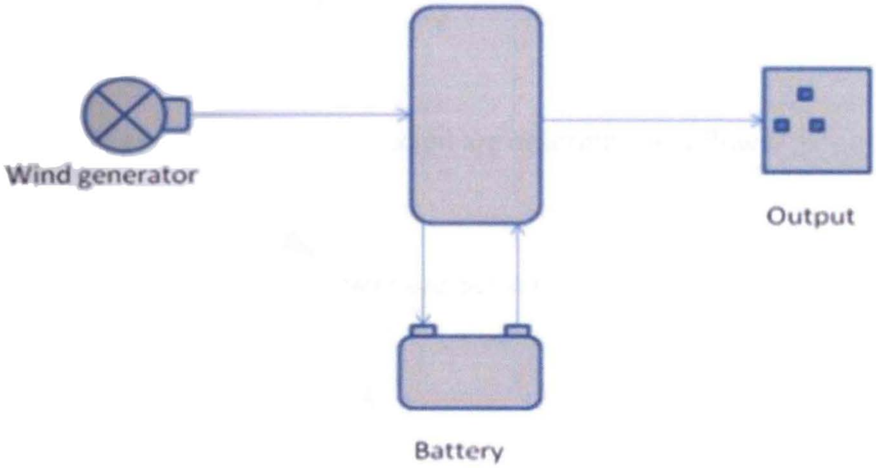

Figure 12 Block Diagram of the project

3.4 Design Considératives

We surveyed the latest Small Scale Wind Turbine for Low Power Application during the literature review. Several combinations of the designs and modules used in Small Scale Wind Turbine (SSWT) as well as their respective roles. During the component choice process, the hardware and software are determined.

The hardware components selected are described as follows:

- PVC pipe
- Humidity and Temperature Sensor
- Propeller
- Basement (10x7)inch
- LCD (16x2)
- Switch
- Fuse
- Li-Po Battery 12V
- 775 DC Motor

The software selected is described as follows:

- Arduino UNO System
- AutoCAD 2014

3.5 Fabrication of Small Scale Wind Turbine (SSWT)

According to the simulated design, the materials are assembled during the production process. First of all, the measurement and drilling process of the holes takes place. The stand pole is used as a key part that will be added to it later by the modules. Side view of the layout. The other components are often fixed where broad measurements need to be drilled.

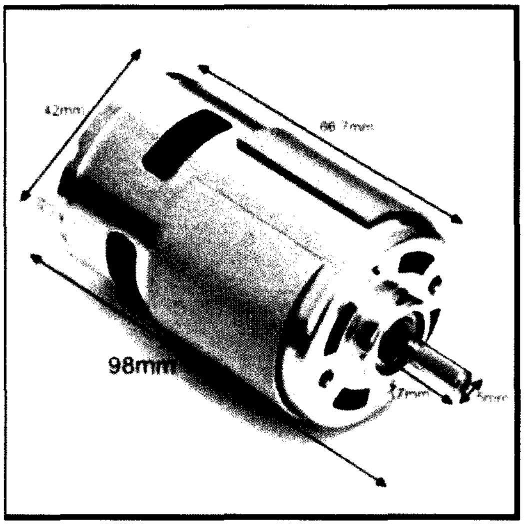

Figure 13 Dimension of the component (775 DC motor)

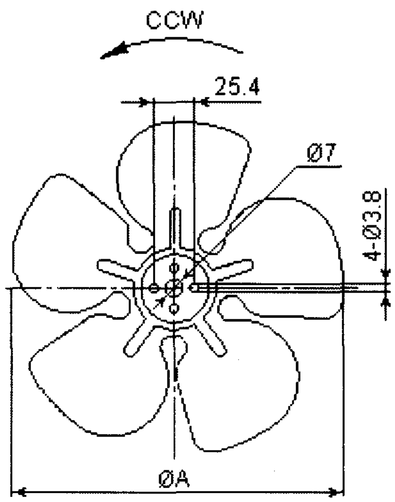

Figure 14 Dimension of the propeller use for prototype

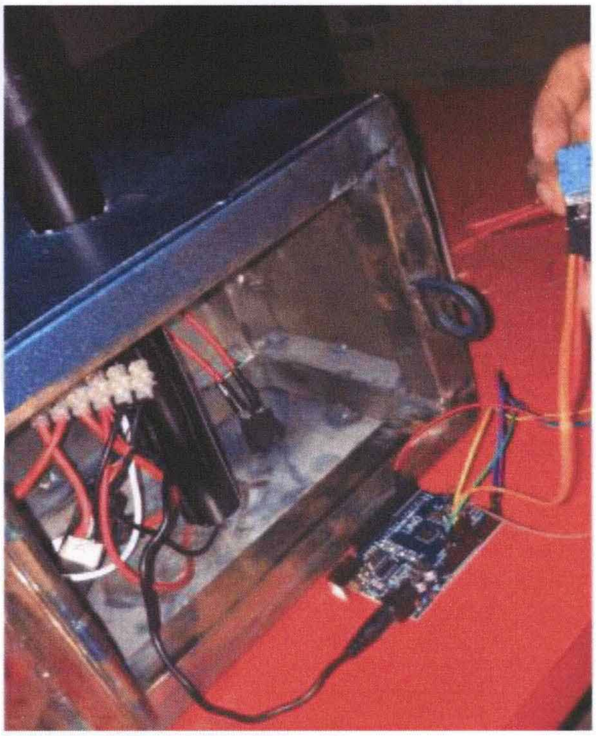

Figure 15 the action of installing hardware and electrical cable

Figure 16 Installation of the stand of SSWT

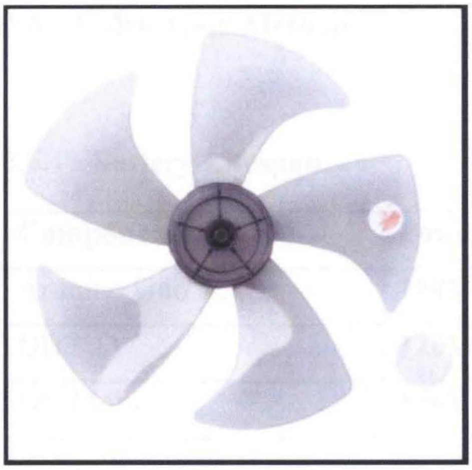

Figure 17 The Propeller of the Small Scale Wind Turbine

Figure 18 The welding result of Basement of the SSWT

Material use for Basement of the prototype:

- Stainless Steel

  We choose stainless steel for the basement of the prototype for the wind turbine because steel are strong material that can hold the whole of the prototype safely and firmly.

3.6 Calculation Method

3.6.1 Battery Lifespan

Components	**Power**
Arduino Uno R3	**100W**
DHT 11	**126W**
DC Motor	**150W**

Total Power of Prototype = 376W

Total Power of Battery = 7.4V×2000mAh = 14800W

Lifespan of Battery = Battery power capacity / Power consumption

= 14800W / 376W

= 39.36 Hour [2 Days 4 minutes]

CHAPTER 4

RESULT AND DISCUSSION

4.1 Reading of the Multimeter while troubleshoot the prototype

Figure 19 Reading of voltmeter for the first day- we test the project on non breezy area

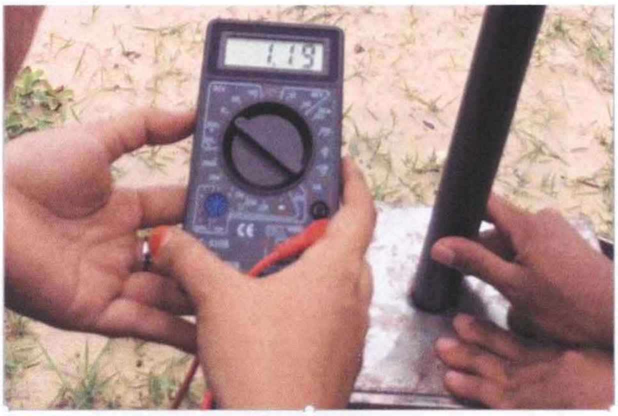

Figure 20 Reading of voltmeter for the second day – we test our project at UMP Lake

Figure 21 Reading of voltmeter for the third day – we test our project at the breezy area

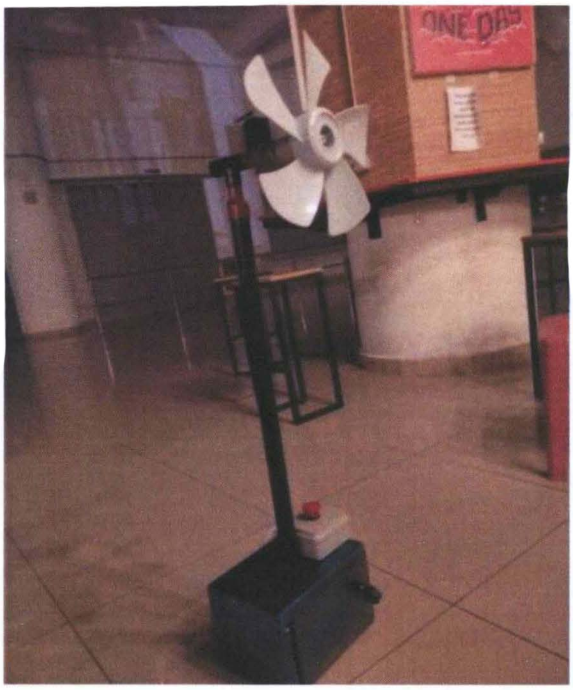

Figure 22 The prototype of SSWT after installation & fabrication

4.2 The relationship between Voltage and Power

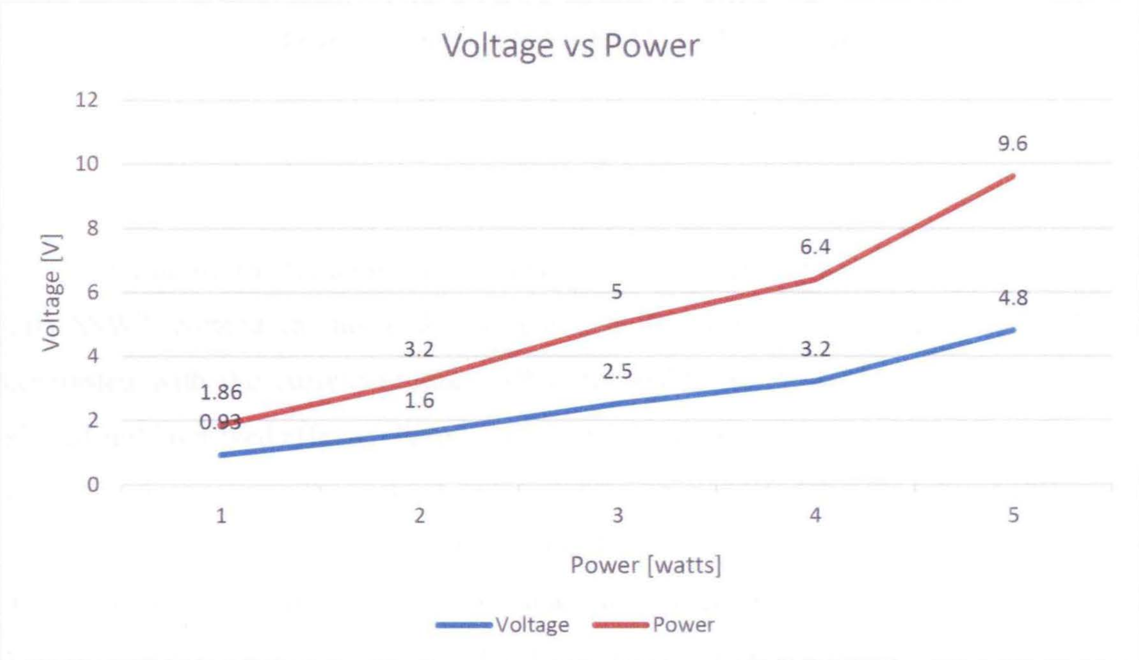

Figure 23 Line graph of Voltage vs Power

From the line graph in Figure above, it shows that the relationship between voltage and power. The higher the voltage, (V) can be achieve, the higher the power, (w) can we get for this project.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

All in all, the fundamental destinations of this venture have been accomplished. The SSWT created in this task was planned lightweight and more modest in size contrasted with the current breeze SSWT accessible on the lookout. These could be altered and improved effectively to fulfill the business needs as it might assist with setting aside the energy. From the trials, it very well may be suggested that the limited scale wind turbine can save energy utilization and the breeze energy is totally perfect and eco-accommodating. At long last, it is advantageous to make reference to that the chance of SSWT's improvement will assist with wiping out the ergonomic issues and createa protected material taking care of in future.

To address a few troubles and vulnerabilities identified with the investigation of miniature and limited scope wind-based age frameworks in metropolitan territories, this paper examined and thought about two general methodologies: consistent state execution appraisal and dynamic execution evaluation. The consistent state execution evaluation depends on the utilization of low-goal input wind speed information (i.e., estimated, assessed, or Rayleigh/Weibull conveyance addressed hourly yearly normal breeze rates) and utilization of just some fundamental in-development on thought about WTs (i.e., WT maker's force bend). For the unique exhibition evaluation, dynamic model of a WT ought to be utilized related to a higher-goal input wind speed information, to get more reasonable aftereffects of the examination.

For the consistent state execution evaluation, just as for the underlying determination of ideal WTs in objective applications, this paper proposed four conventional WT models. Albeit basically totally considered WTs vary in both appraised controls and cleared territories, the introduced investigation exhibits that four proposed conventional SSWT can be utilized for the precise portrayal of most of wind turbines at present accessible available. The conventional SSWT models can be additionally utilized for the advancement of a precise total model of countless miniature/little SSWT (e.g., in a metropolitan zone), which is at first talked about in and is a subject of the continuous work of the creators. The proposed philosophy additionally takes into account a straightforward option of the new nonexclusive SSWT models, with fitting attributes, on the off chance that when the new kinds of SSWT happen later on.

5.2 Limitations

It ought to be noticed that the outcomes for the normal yearly energy yields and money saving advantage examination acquired during both consistent state and dynamic execution appraisal are shown and looked at in this paper utilizing the real wind speed estimations at a few areas. As needs be, input wind energy for the consistent state execution appraisal is demonstrated utilizing Weibull disseminations with various shape factors and mean breeze speeds. The comparing aftereffects of the financial investigation, especially those for restitution periods, recommend that miniature SSWT with evaluated power 1.5 kW or less, which make up 84% of all introduced miniature/little SSWT in the various zones, have the longest compensation time frame, which might be significantly more than their normal lifetimes.

Examination of the aftereffects of consistent state and dynamic execution appraisals recommends that considerable blunders (>50%), regularly overestimating SSWT power/energy yields, might be acquired during the consistent state execution evaluation.

REFERENCES

[1]. *Exmork New Energy Company. (2010). 1 kW Wind Turbine Specification [Online]. Available: http://www.exmork.com/1 kw-wind-turbine.htm*

[2]. *Engineering Recommendation G83/1: Recommendations for the Connection of Small-Scale Embedded Generators (Up to 16A per Phase) in Parallel with Public Low-Voltage Distribution Networks*, Energy Networks Association, London, U.K., Sep. 2003, pp. 1–62.

[3]. *wind Power Inverter, Windy Boy 110 LV. Installation Guide*, SMA Technology, Niestetal, Germany, 2010, pp. 1–84.

[4]. *Roland, B. S., (1988). An Introduction to Boundary Layer Meteorology. Kluwer Academic Publishers (1988).*

[5]. Committee, A., Division, A., Cermak, J. E., Davenport, A. G., Durgin, F. H., Irwin, P.

[6]. A., ... Isyumov, N. (n.d.) (1982). *Wind tunnel studies of buildings and structures By Jack E. Cermak- N. Isyumov- American Society of Civil Engineers. Task Committee on Manual of Practice for Wind Tunnel Testing of Buildings and Struct.*

[7]. Counihan, J. (1969). An improved method of simulating an atmospheric boundary layer in a wind tunnel. *Atmospheric Environment (1967), 3(2), 197–214. https://doi.org/10.1016/0004-6981(69)90008-0*

[8]. Irwin, H. P. A. H. (1981). The design of spires for wind simulation. *Journal of Wind Engineering and Industrial Aerodynamics*, *7*(3), 361–366. https://doi.org/10.1016/0167-6105(81)90058-1

[9]. https://www.sciencedirect.com/science/article/abs/pii/S0960148119308936

[10]. *P.R. Ebert, D.H. Wood, Observations of the starting behaviour of a small horizontal-axis wind turbine, Renew. Energy 12 (3) (1997) 245–257. [12] Giguere P, Selig MS. Low reynolds number airfoils for small horizontal axiswind turbines. Wind Engineering 1997;21:379.*

[11] A.N. Joharil*, M. I. (2019, March 20).

Gantt chart

Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13
Fabrication of design	■	■	■	■	■	■							
Software programming		■	■	■	■	■	■	■	■	■	■	■	
Testing and troubleshooting								■	■	■	■	■	■
Analysis of data								■	■	■	■	■	■
Project submission												■	■
Project presentation													■