PORTABLE WIND AND WATER POWER GENERATOR

Compiled as one of the requirements of completing the Undergraduate Program
at the Department of Electrical Engineering Faculty of Engineering

By:

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APROVAL

PORTABLE WIND AND WATER POWER GENERATOR

SCIENTIFIC PUBLICATION

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Has been reviewed and approved

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On 15, January 2020
and declared to have met the requirements

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I hereby declare that in this final project there has never been submitted to obtain a degree in a college and to the best of my knowledge there are no works or opinions that have been written and published by others, except in writing referred to in the text and mentioned in the bibliography

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Surakarta, January 8 2020

Author

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PORTABLE WIND AND WATER POWER GENERATOR

Abstrak

Portable wind and water power generator dibuat untuk orang yang suka melakukan kegiatan di alam terbuka yang tidak terdapat sumber energi listrik sebagai tempat pengisian perangkat elektronik seperti smartphone, baterai kamera dan perangkat elektronika lainnya. Portable wind and water power generator dirancang untuk mengubah aliran air dan angin menjadi penggerak generator agar dapat menghasilkan energi listrik. Perancangan portable wind and water power generator meliputi bilah kipas, generator, step up converter, USB DC, dan baterai. Setelah itu dilakukan pembuatan portable wind and water power generator. Pengujian portable wind and water power generator meliputi pengujian setiap komponen dan pengujian di lapangan. Dalam pengujian ini dilakukan pengukuran tegangan pada setiap komponen. Hasil pengujian keseluruhan komponen yang digabungkan menjadi satu kesatuan, yaitu ketika kecepatan putar generator 382 - 1405 RPM akan membangkitkan tegangan listrik sebesar 2,9 – 10,4 V lalu step up converter akan menaikan tegangan dari 4,9 - 14,7 V dan USB DC akan menstabilkan tegangan menjadi 3,5 - 5,3 V. Ketika pengujian di aliran air dengsan kecepatan air minimal 4,8 m/s barulah alat mengasilkan tegangan. Ketika pengujian angin dengan kecepatan angin minimal 6,2 m/s barulah alat menghasilkan tegangan.

Kata Kunci: Generator, jaringan.

Abstract

Portable wind and water power generators are made for people who like to do outdoor activities where there is no source of electrical energy for charging electronic devices such as smartphones, camera batteries and other electronic devices. Portable wind and water power generators are designed to change the flow of water and wind into a generator drive in order to produce electrical energy. The design of portable wind and water power generators includes fan blades, generators, step up converters, USB DC, and batteries. After that, a portable wind and water power generator is made. Testing of portable wind and water power generators includes testing each component and testing in the field. In this test voltage measurements are performed on each component. The results of the testing of all components are combined into a single unit, that is, when the rotating speed of the generator 382-1405 RPM will generate an electrical voltage of 2.9-10.4V then the step up converter will increase the voltage from 4.9-14.7V and USB DC will stabilize the voltage to 3.5 - 5.3 V. When testing in the flow of water with a minimum water velocity of 4.8 m / s, then the device generates a voltage. When testing the wind with a wind speed of at least 6.2 m / s, the device produces a voltage.

Keywords: Generator, network.

1. INTRODUCTION

The portable wind and water power generator is designed to facilitate the charging of electronic devices such as smartphones, camera batteries and others for those who like to do outdoor activities. The idea was made to create portable wind and water power plants that can produce electricity from running water or wind speed. The increasing number of renewable energy sources and distributed generators requires a new strategy for the operation and management of electricity networks to maintain or improve the quality of power supplies. Portable wind and water power generator facilitate those who like extreme activities to get electricity. The portable wind and water power generators can change any type of moving water, such as from rivers or streams and also wind energy into electrical energy. Then this electrical energy can be used to charge mobile devices when users are outside the network. The portable wind and water power generators are made with a very simple design that has a light weight and is designed to fit any backpack's size. Because it can be refilled in water or in the wind, there is no need to carry a power bank for outdoor activities. In addition, people around the world can benefit from the use of renewable energy by reducing greenhouse gas emissions and consumption of natural resources for electricity generation. Portable Power Generators are made to help and simplify power supply problems among people who carry out outdoor activities.

1.1 Problem Formulation

The problems in this study can be formulated as follows:

1. How to design tools?
2. How to choose the right components?
3. How to make fan designs made so that it can turn on the generator?
4. How to make the tool function as expected?

1.2 Research Goal

The aim of this research is:

1. Create a portable electric generator.
2. Design of equipment with specifications can produce electrical energy from water and wind.
3. Able to produce electricity as expected.
4. The design of the tool is simple and easy to use.

2. METHOD

This research makes power plants that are lightweight and easy to use. The stages used in making this tool are:

1) Study literature.

2) Tool design.

3) Component selection.

4) Component assembly.

5) Tool testing.

The stages of research to make a tool are shown in figure 1.

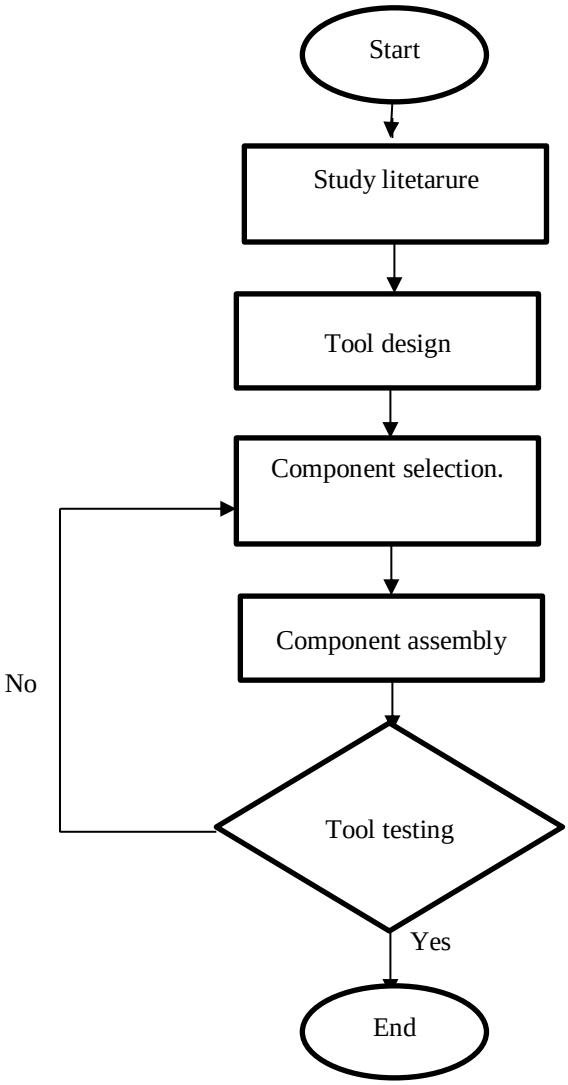

Figure 1. Flowchart

2.1 Study Literature

Study literature is the stage carried out by studying books, journals, and literature that support in the preparation of the final project.

2.2 Tool Design

Portable power generators are designed to charge the smartphone using running water or wind. The design of the tool can be seen in figure 2.

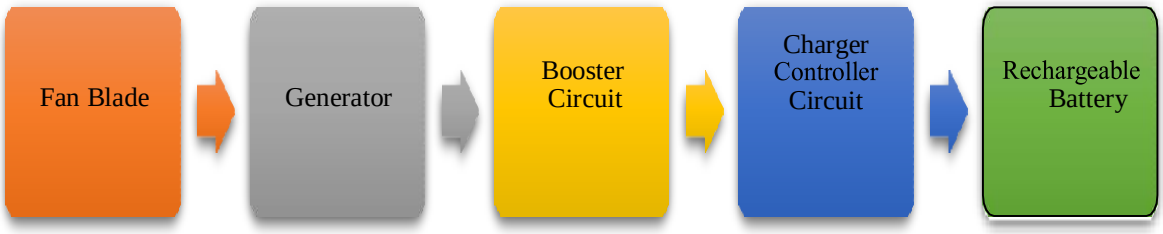

Figure 2. Tool Design

2.3 Component Selection

The selection of components is very important to do to determine the right components used in the manufacture of portable power generators.

2.3.1 Protective components

Paralon pipe is the right cover to protect the component. Component protectors can be seen in figure 3.

Figure 3. Protective Cover Component

2.3.2.Generator DC motor M36N-2

Generator DC motor M36N-2 is a generator used to produce the desired electrical power. This generator is installed with a turbine, so the flow of water and wind can rotate the turbine so that the generator can rotate and produce an electric voltage. M36N-2 DC motor generator can be seen in figure 4.

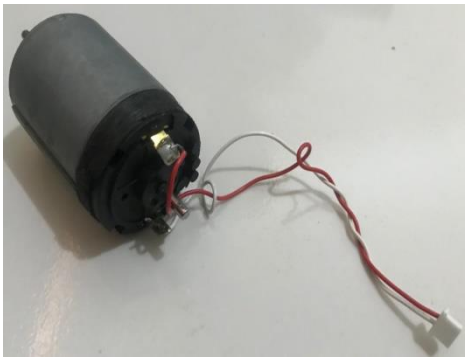

Figure 4. Generator Motor DC M36N-2

2.3.3 XL6009 DC-DC boost step up converter

Step up converter used in this project to increase the voltage generated from the generator to get the desired results. For this project, the output voltage can be increased. If there is a change in the input voltage, the output voltage will remain stable because this module also functions as a voltage booster and stabilizer. Step up converter can be seen from figure 5.

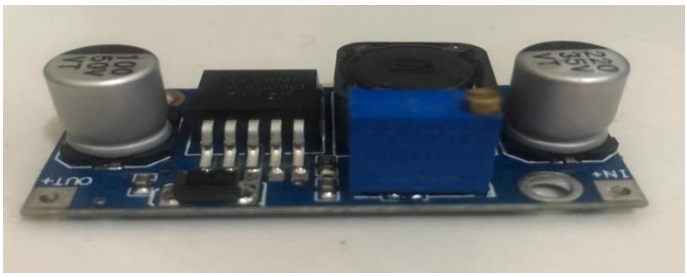

Figure 5. XL6009 DC-DC boost step up converter

2.3.4 USB DC step up boost module

The step up boost module of USB DC is a device used for voltage stabilizers. If the output sent from the DC-DC step-up converter is too large it will be stabilized to a safe input between 3 – 5 V. This component is equipped with a capacitor and a 5 V USB output port, so this component is suitable for use in making this project. The results of the voltage obtained will be transferred to power storage or directly to the smartphone if it functions using wind. USB DC step up boost modules can be seen from figure 6.

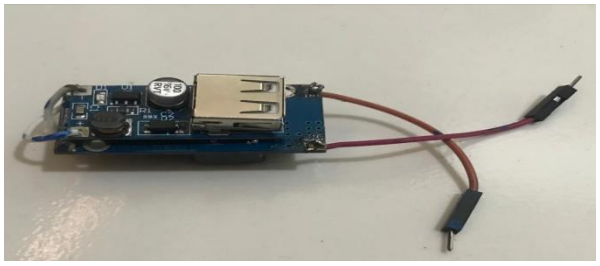

Figure 6. USB DC Step up Boost Module

2.3.5 Power Storage

Power bank is a tool to store the electrical voltage into the battery and send the electrical voltage from the battery of the smartphone device. This tool is equipped with various components:

1. Battery as power storage.
2. USB DC Amplifier Module as a component to send power from this device to mobile .
3. Lithium TP40f6 module is a device that serves to receive the electrical voltage then saved to the battery or transmit the electrical voltage from the battery.
4. Electric socket as an on/off setting on the power output voltage.

Power storage can be seen in figure 7.

Figure 7. Power Storage

2.4 Component Assembly.

Component assembly is a refinement stage where each component is assembled to make portable wind and wind generators with a simple design concept and get the desired results. Figure 8 shows the components that have been combined.

Figure 8. Assembling Components

2.5 Tool Testing

Tool testing is the process of examining whether the results correspond to what is desired. If the appliance does not meet the standards, there will be a repair tool and re-evaluation. Figure 9 shows when testing a tool.

Figure 9. Tool Testing

3. RESULTS AND ANALYSIS

The project succeeded in creating portable power plant equipment using wind speed and water flow as a turbine drive. Figure 10 shows the end result of this tool.

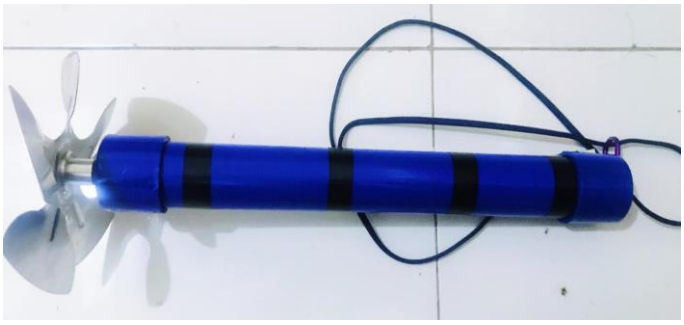

Figure 10. Portable Wind and Water Power Generator

3.1 Component Testing

Testing each component is very important to determine whether this tool works well and is safe to use. There are several stages carried out in the test, such as testing one by one component and testing the entire component when combined. In addition, the test is also carried out under load and not load conditions.

3.1.1 Testing the M36N-2 DC Motor Generator No Load

The results of testing the generator in the no load condition rotated by the motor with the regulated voltage shown are in table 1.

Table 1. The Results of Testing The Generator

Input Motor Voltage (Volt)	Rotating Speed (RPM)	Generator Voltage No Load (Volt)
1,5	117	0,7
3	245	1,6
4,5	389	3
6	737	4,6
7,5	954	5,7
9	1162	7,7
12	1434	11,1

Table 1 shows the results of testing the generator no load. When the motor is given a voltage of 1,5 V, the generator's rotational speed is 117 RPM and the generator generates an electrical voltage of 0,7 V. When the motor is raised to 3 V the generator's rotational speed increases by 245 RPM and the generator generates an electric voltage of 1,6 V. When the motor is given a voltage up to 12 V the generator rotational speed increases by 1434 RPM and the generator generates a voltage of 11,1 V. Seen from these results it can be concluded that the greater the input motor voltage makes the generator rotate speed also faster so that the generator will generate greater voltage.

3.1.2 Test XL6009 DC-DC Boost Step up Converter No Load

The results of the XL6009 DC-DC boost step up converter component with the regulated voltage can be seen in table 2.

Table 2. Testing Results of XL6009 DC-DC boost step up converter

Input Voltage (Volt)	XL6009 DC-DC Voltage (Volt)	Condition (ON / OFF)
1,5	2,2	Off
3	4,2	On
4,5	5,9	On
6	7,7	On
7,5	9,6	On
9	11,56	On
12	15,74	On

Seen from table 2 the XL6009 DC-DC boost step up converter component when given an input voltage of 1,5 V produces an output voltage of 2,2 V with the LED indicator off. When the input voltage is raised to 3 V it produces an output voltage of 4,2 V with the LED indicator on. When the input voltage is raised to 12 V it produces an output voltage of 15,74 V with the LED indicator on. Seen from these results it can be conclusion that the greater the input voltage, the step up converter will increase the voltage, but the LED indicator will light up when the input voltage is at least 3 V.

3.1.3 USB Step-Boost Module Testing No Load

The results of testing the USB DC step-up boost module no load can be seen in table 3.

Table 3. Test Results of the USB DC Step up Boost Module

Input Voltage (Volt)	USB DC voltage (Volt)	Condition (ON/OFF)
1,5	0	Off
3	3,19	On
4,5	4,12	On
6	4,13	On
7,5	4,33	On
9	4,36	On
12	4,38	On

Seen from table 3 the USB DC step up boost module component when given an input voltage of 1,5 V produces an output voltage of 0 V with the LED indicator off. When the input voltage is raised to 3 V it produces an output voltage of 3,19 V with the LED indicator on. When given an input voltage is increased to 12 V resulting in an output voltage of 4,38 V and the LED indicator lights up. Seen from the results of these tests it can be concluded that if the input voltage of 1,5 V does not produce an output voltage, but if the input voltage is 3 V then the

output voltage rises to 3,14 V. When given an input voltage ranging from 4,5 to 12 V the output voltage will be stabilized to 3,19 to 4,38 V.

3.1.4 Testing of Components That are Given a Load

Test results all components when combined into a single unit and rotated with a motor whose input is set. The test results can be seen in table 4.

Tabel 4. The Result Testing of Components That are Given a Load

Input Voltage (Volt)	Rotating Speed (RPM)	Generator Voltage (Volt)	XL6009 DC-DC voltage (Volt)	USB DC Voltage (Volt)	Condition (ON/OFF)
1,5	108	0,6	1,2	0	Off
3	214	1,4	2,2	0	Off
4,5	382	2,9	4,9	3,5	On
6	704	4,5	6,7	4,45	On
7,5	928	5,2	8,6	5	On
9	1102	7,1	10,5	5,2	On
12	1405	10,4	14,7	5,3	On

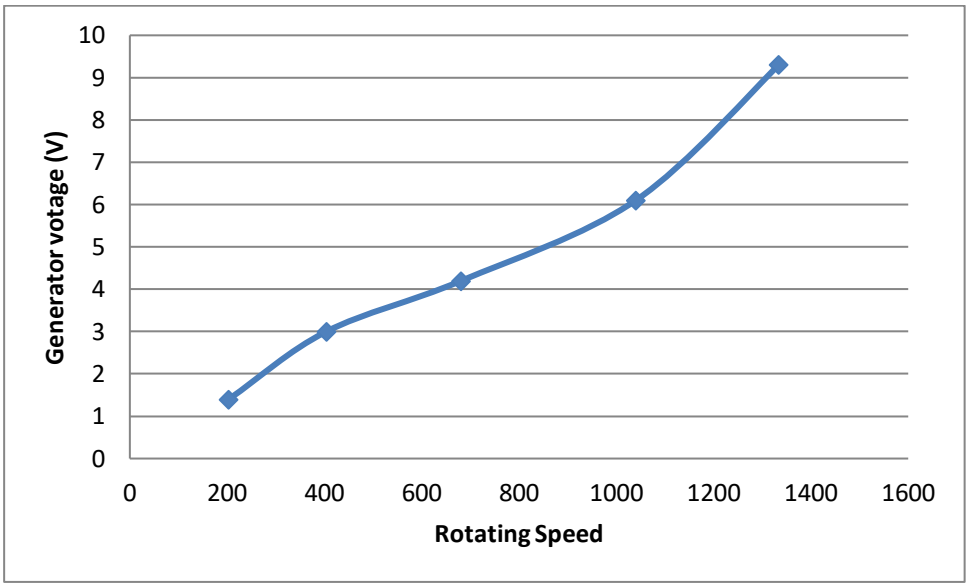

Figure 11. Generator Voltage given load

Seen from table 4 when the motor is given a voltage of 1,5, the generator rotational speed is 108 RPM, then the generator will generate a voltage of 0,6 V. The step up converter will increase the voltage by 1,2 V because the voltage does not match the component specifications the USB DC does not produce output voltage. When the motor is given a voltage of 3 V the motor rotational speed rises to 108 RPM and the generator will generate a voltage of 1,4 V. The step up converter will increase the voltage to 2,2 V because the voltage does not match the

component specifications, the USB DC does not produce an output voltage. When the motor is voltageed up to 12 V the motor rotational speed rises to 1405 RPM and the generator produces a voltage of 10,4 V. The step up converter increases the output voltage to 14,7 V and the USB DC stabilizes the output voltage to 5,3 V. Seen from the results above if the motor is given a voltage of 1,5 and 3 V, the generator rotational speed of 108 - 214 RPM and generate voltage of 0,6 and 1,4 V. Step up converter will increase the voltage to 1,2 and 2,2 V because the voltage does not meet the component specifications, the USB DC does not produce an output voltage. When the motor is given a voltage ranging from 4,5 to 12 V, the generator rotational speed is 382 to 1405 RPM and generates a voltage of 2,9 – 10,4 V. The step up converter will increase the voltage from 4,9 – 14,7 V and the USB DC will stabilize the voltage to 3,5 – 5,3 V.

3.2 Field Test Results

The results of field testing are done through two stages, that is using water flow and wind strength. This is done because this tool is intended for outdoor conditions with water flow and wind strength as a turbine generator drive.

3.2.1 Testing With Water Flows

Testing is done in a way of a tool inserted into several different water streams. The turbine will spin when the water currents hit it and the turbine will move the generator so the appliance can produce an electrical voltage. This appliance is tied with a rope so that the appliance does not carry water flow. These test results can be seen in table 5.

Tabel 5. The Result Testing With Water Flows

Water Speed (m/s)	USB DC Voltage (Volt)	Condition (ON/OFF)
2,2	0	Off
2,6	0	Off
3,4	0	Off
4,8	3,2	On
5,9	3,4	On

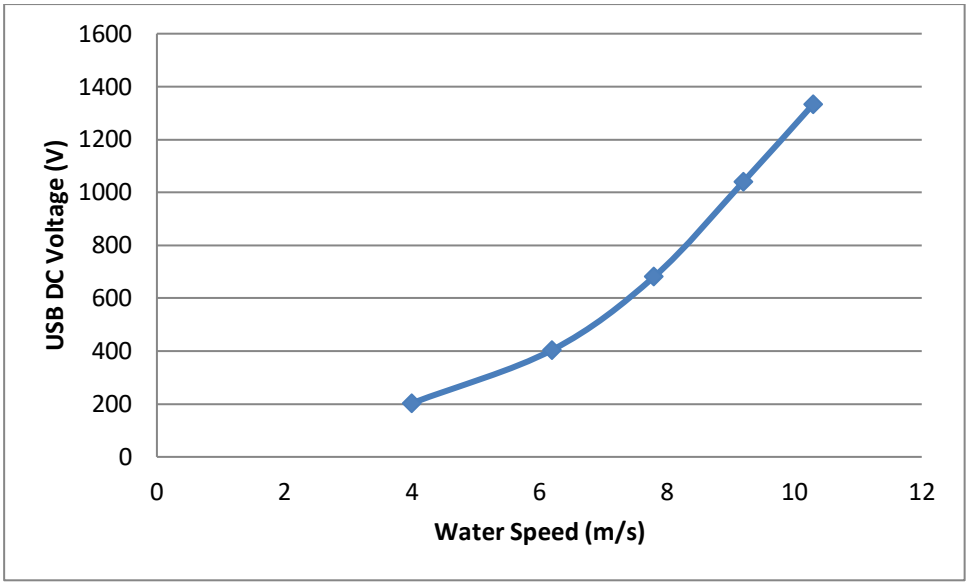

Figure 11. The Result Testing With Water Flows

Seen from the table 5 if water speed 2,2 to 3,4 m/s then the generator does not produce voltage and LED indicator in the condition off. When the water speed rises to 4,8 m/s then it generates a voltage of 3,2 V and the LED indicator is lit. Then when the water speed of 5,9 m/s produces 3,4 V voltage and LED indicator is lit. From the above results can be concluded that if the water flow at least 4,8 m/s then the new tool will produce voltage and if the water flow is getting bigger then the resulting voltage is also greater.

3.2.2 Testing with Wind Strength

This test is done is a way of the tool an brought on a motorcycle that is running. The turbine will spin when the wind hits and the turbine will move the generator so that the tool can produce electricity. The results of this test can be seen in table 6.

Tabel 6. Test Results Testing With Wind

Wind Speed (m/s)	Rotating Speed (RPM)	Generator Voltage (Volt)	XL6009 DC-DC Voltage (Volt)	USB DC Voltage (Volt)	Condition (ON/OFF)
4,0	203	1,4	2,2	0	Off
6,2	404	3,0	4,9	3,6	On
7,8	681	4,2	6,4	4,4	On
9,2	1040	6,1	8,9	5	On
10,3	1334	9,3	10,8	5,1	On

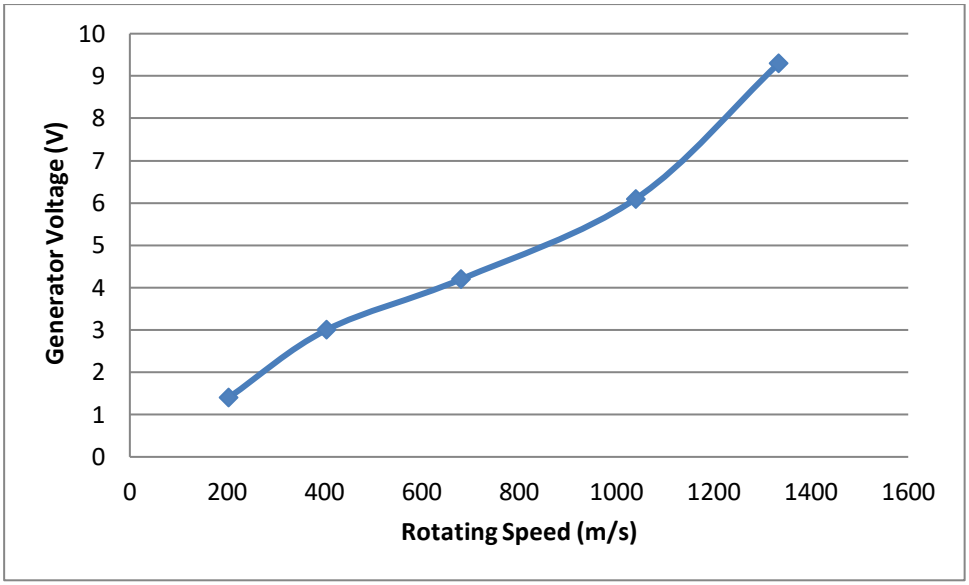

Figure 12. The Result Generator Voltage with wind

Seen from table 6 when the wind speed of 4,0 m / s makes the generator rotate speed to 203 RPM and the generator generates a voltage of 1,4 V. The step up converter will increase the voltage to 2,2 V because the voltage does not match the component specifications the USB DC does not produce output voltage. When the wind speed rises by 6,2 m / s, the generator rotational speed rises to 404 RPM and the generator will generate a 3 V voltage. The step up converter will increase the voltage to 4,9 V and the USB DC will stabilize the voltage to 3,6 V. When the wind speed reaches 10,3 m / s, the generator rotational speed increases to 1334 RPM and the generator will generate a voltage to 10,4 V. The step up converter will increase the voltage to 14,7 V and the USB DC will stabilize the voltage to 5,3 V. Seen from these results it can be conclusion that if the wind speed is at least 6,2 m / s, then it can only produce voltage and if the wind speed is greater then the voltage produced will also be even greater.

4. CLOSING

Based on testing this tool the following conclusions can be drawn:

1. This tool can work well when the generator rotation is at least 382 RPM.
2. When the generator produces a voltage that varies from 0,6 – 10,4 V, the step up converter component will increase it to 1,2 – 14,7 V and the USB DC component stabilizes the input voltage from 4,9 - 14,7 V to 3, 5 – 5,1 V.
3. When test a tool in a water flow, with variations in speed ranging from 2,2 – 5,9 m / s, the device can produce an output voltage when the water flow velocity is at least 4,8 m / s.

4. When testing the instrument with the wind used as a generator drive, the wind speed variations from 4,0 – 10,3 m / s produce a generator voltage of 1,4 – 9,3 V.

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REFERENCE

K.Sudhakar & Priyank Saxena. (2013). A novel design of wind driven mobile battery charger. *International Journal of Science, Engineering and Technology Research (IJSETR)*, 2(3), 687–689.

Rizk, J. and Nagriak, M.H. (2013). Design of permanent magnet generator for wind energy application. *Power Electronics, Machines and Drives (PEMD2010) 5th IET International Conference, Australia.*

S.N. Singh, Sumit Kumar Jha, Sudhir Kumar. (2011). Wind driven mobile charging of automobile battery. *International Journal of Engineering Science and Technology (IJEST)*, (3):1:68-74.

Saikumar.P, Thamaraikannan.D, Yuvaraj.G, & Yuvaraj.C. (2015). Wind Energy Based Mobile Battery Charging and Battery Applications. *International Journal for Research and Development in Engineering (IJRDE)*, pp- 006-011.

X. Yang, D. Patterson, and J. Hudgins,. (2012). Permanent magnet generator design and control for large wind turbines. *IEEE Power Electron*, pp. 1–5.