



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Development of Portable Power Generator by Using Dynamo

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Industrial Electronics) with Honours

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Industrial Electronics) with (Hons.). The member of the supervisory is as follow:



ABSTRAK

Laporan ini membentangkan pembangunan kuasa penjana mobiliti menggunakan dinamo. Projek ini dapat digunakan sewaktu kecemasan apabila tiada bekalan elektrik dan juga tiada sumber kuasa yang boleh dibaharui seperti kuasa solar untuk mengecas peranti elektronik, 5V. Terdapat dua jenis mobiliti powerbank iaitu powerbank biasa dan solar powerbank dan kedua-dua powerbank ini mempunyai kelebihan dan kekurangan masing-masing.

Dalam projek ini, teori, komponen dan kelengkapan yang akan diguna ialah Arduino UNO sebagai satu mikropengawal untuk mengawal modulasi lebar denyut ke MOSFET, litar DC-DC penukar boost untuk meningkatkan voltan daripada dinamo, dan satu dinamo moden. Apabila dinamo berpusing, tenaga kinetik akan bertukar kepada tenaga elektrik. Voltan keluaran yang terhasil adalah tidak stabil kerana ia bergantung kepada kelajuan pusingan dinamo. Oleh itu, satu litar menggalak dan pengatur voltan diperlukan untuk menstabil voltan keluaran tersebut. Hasil voltan keluaran yang dijangkakan akan melebihi 5V dan keluaran selepas pengatur voltan akan dikekalkan kepada 5V.

ABSTRACT

This report presents the development of Portable Power Generator by Using Dynamo. This project is used in emergency to generate power when no electric supply and no any renewable source example solar energy to charge any electronic device in range 5V. In market, there have two types famous portable power generator which is power bank and solar power bank and both power bank has its pros and cons.

In the project, theorem, component and equipment will use are Arduino UNO as a microcontroller to control the pulse width modulation to a MOSFET, circuit of DC-DC boost convertor to step up the voltage from dynamo, and a modern dc dynamo. When generate the dynamo, the kinetic energy will be convert to electrical energy. The output voltage from dynamo is not stable because it is depending on the speed rotate of dynamo. Hence it required a boosting circuit and a voltage regulator to stabilize it. The expected result for output voltage is higher than 5V and will stable in 5V after the voltage regulator.

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DEDICATION

To my beloved parents and family for their love and encouragement.

To my kind lecturers for this four years of guidance.

This project is created as a way of looking back on my life and seeing the lesson

I've learned.



ACKNOWLEDGEMENT

I would like to thank Miss Siti Halma Binti Johari as my supervisor for her guidance on completing this project. I would also like to thank all my friends that support me during working on this project.

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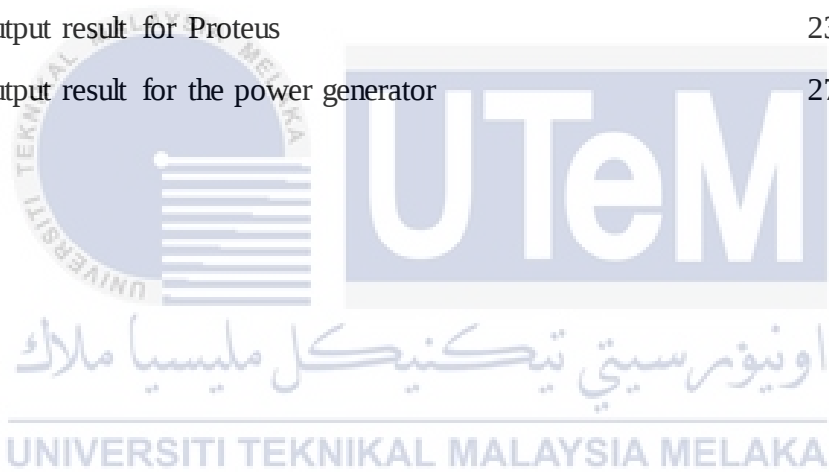
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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

L	-	Inductor value
C	-	Capacitor value
V_s	-	Input Voltage
V_o	-	Output Voltage
L_{max}	-	Maximum Inductor value
ΔI	-	Changes of inductor value
ΔV_{outmax}	-	Changes of Maximum Output Voltage
D	-	Duty Cycle
V_L	-	Voltage of Inductor
$\frac{di_L}{dt}$	-	The rate of changes of current in Inductor
$\Delta i_{L(open)}$	-	Current Changes of Inductor when switch is open
$\Delta i_{L(close)}$	-	Current Changes of Inductor when switch is close
T	-	Period
T_{off}	-	Period when switch is close
P_{in}	-	Input Power
P_o	-	Output Power
R	-	Resistance value
I_L	-	Current value in Inductor
I_{Lmin}	-	Minimum current value in Inductor
PWM	-	Pulse width modulation

CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays we are living in an information technology (IT) world. Therefore at least one man has one mobile cell phone to make or accept calls, send or receive messages, play games, online shopping or act as Global Positioning System (GPS) to reach a destination. All of the moment can done in few minutes with ours finger and a mobile cell phone. But, the battery storage for mobile cell phone is not enough as we need use it for few days without charging with plug, so a mobile power storage is needed when cell phone battery is not enough and this mobile power storage is called power bank. In market, there has many types and many brands of power bank. For example, solar power bank and power bank are the most popular in market. Both of them have pro and con. The table 1.1 show the comparison of power bank and the solar power bank.

Table 1.1: Comparison of power bank and solar power bank

Power Bank	Type	Solar Power Bank
Electric charging	Way to charge power bank	Bi-ways charging (Electric energy or Solar Energy)
- Cannot process charging when no electric energy supply - Need connect a wire which connect to a plug	Disadvantage	- Cannot process charging when no solar energy and electric energy supply. - It will feel hot when used solar energy to charge it - Solar panel easy broken down

A power bank can have many kinds of storage, but every user will realize that output power from power bank is not enough to fully charge cell phone for 2 to 3 times no matter how huge the storage. The power bank storage unit is mAh which is short of mille-Ampere per hour. As user used up the power bank battery, they need find a socket or a plug which can charge the power bank.

The focus of this project is to design a dynamo power bank which has use dc-dc converter which can produce a stable output of voltage and current from a dynamo. The output of the dc-dc converter will connect to a voltage regulator to stabilize the output.

1.2 Problem Statement

Output voltage of dynamos are depending on the speed of rotate to generate the power, so it is unstable output power. Therefore, to charge any electronic device, it need a stable input voltage to avoid device burst like the battery. If electricity system is break down or no electricity, the procedure to recharge the power bank is cannot to process.

1.3 Objectives of The Study

- To analyses the output from dynamo which is generate by man
- To develop portable power generator using dynamo
- To analyses output of dynamo to charge the electronic devices in range 5V .

1.4 Scope of The Study

In this project, an analyzation of the range of dynamo output voltage that will used in this project. Furthermore, a boost dc-dc converter and a feedback circuit to maintaining the output power from dynamo before that power as a supply to use to charge the device will be created. After that, this project can charge phone and power bank at anywhere without electrical energy.

1.5 Thesis Organization

This report will cover 5 chapter which are to describe the process of the thesis research. The first chapter will be an introduction which include the background of this project, problem statement, objectives, project scope and expected outcome of this project.

In chapter 2 Literature Review will be discussed the related theory about the project. Besides, this chapter will demonstrate the related devices to develop by the past researcher and contrasting the specifications of each method to see which part of the past projects can be modified to improve the development of this project.

In chapter 3 Methodology will discussed about the process flow of this projects. Furthermore, the implementation of the projects using simulation software such as Proteus 8.3 Professional will be explained. The results of the simulation will be attached in this chapter.

Besides, chapter 4 Discussion will be explained the details about hardware part of the project. The hardware physical quantities of the project will be measured and compared with the simulation one.

Lastly, the last chapter will be summarise the project report from the beginning to the conclusion. The recommendations of the projects are also stated in this report.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter will discuss the researched that related to this project. In between, in this chapter will discuss the dc-dc converter, the operation of the dynamo work and the microcontroller. In other word, after this chapter will easy to design and construct a dc-dc converter.

2.1 DC-DC Boost Convertor

From writer Daniel W.Hart, 2011, the DC-DC boost converter, we must assume few statements are correct. Firstly, the steady-state conditions are existing. Followed by the switch closed for time is DT which D is duty cycle and T is the total switching period, and open time is $(1-D)T$. Third is the inductor current must in positive, and capacitor is very large and output voltage is constant continuously at V_{out} . Lastly, all the components are ideal. In Figure 2.1 below is an example circuit for boost convertor.

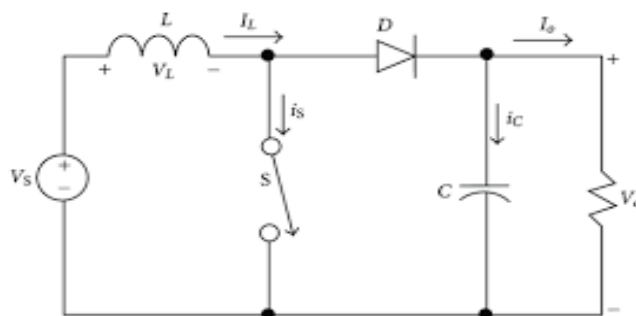


Figure 2.1: Example circuit for DC-DC boost convertor

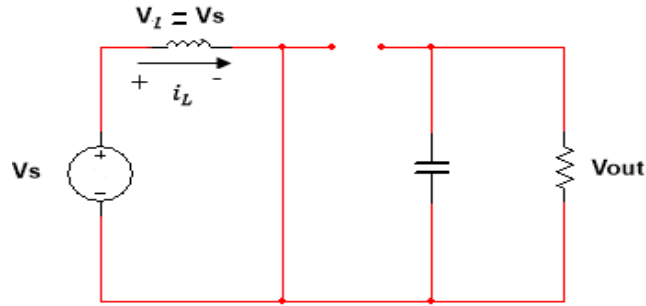


Figure 2.2: Equivalent circuit for switch closed

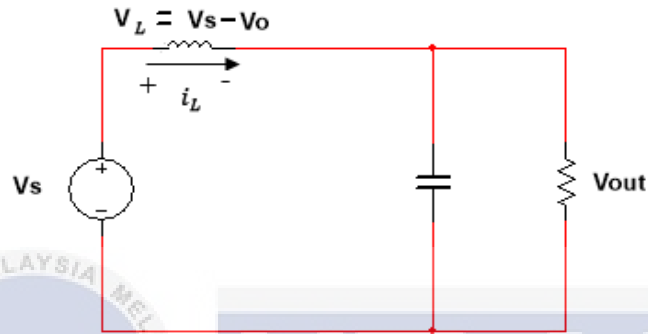


Figure 2.3: Equivalent circuit for switch opened

Therefore, there have few calculations need to do to get the coefficient for inductance and capacitance. From the circuit equivalent circuits in Figure 2.2 and Figure 2.3, we can conclude the equation as in Table 2.1 below.

Table 2.1: Equation for V_L , $\frac{di_L}{dt}$ and Δi_L .

Open Circuit	Equivalent Circuit	Closed Circuit
$V_L = V_s - V_o$	Voltage at inductor, V_L	$V_L = V_s$
$\frac{di_L}{dt} = \frac{V_s - V_o}{L}$	$\frac{di_L}{dt}$	$\frac{di_L}{dt} = \frac{V_s}{L}$
$\frac{\Delta i_{L(open)}}{T_{on}} = \frac{V_s - V_o}{L}$ $\frac{\Delta i_{L(open)}}{(1-D)T} = \frac{V_s - V_o}{L}$ $\Delta i_{L(open)} = \frac{(V_s - V_o)(1-D)T}{L}$	Δi_L	$\frac{\Delta i_{L(close)}}{T_{off}} = \frac{V_s}{L}$ $\frac{\Delta i_{L(close)}}{DT} = \frac{V_s}{L}$ $\Delta i_{L(close)} = \frac{V_s DT}{L}$

In steady-state operation, the total inductor current must be zero. So

$$\Delta i_{L(open)} + \Delta i_{L(close)} = 0$$

$$\frac{(V_s - V_o)(1 - D)T}{L} + \frac{V_s DT}{L} = 0$$

Solving for V_o ,

$$V_s(D + 1 - D) - V_o(1 - D) = 0$$

$$V_o = \frac{V_s}{1 - D} \quad (Eq. 1)$$

To calculate the coefficient of the inductor must make sure that the inductor current is continuous, which meant always positive. Therefore, the condition necessary for continuous, the minimum inductor current, I_{Lmin} must be greater than 0. The I_{Lmin} is determined by using the average value and the change in current. From initial we assumed that all components are ideal, so meant no power loss from supply to output. Therefore,

$$P_{in} = P_o$$

$$V_s I_L = \frac{V_o^2}{R}, \quad I_s = I_L$$

$$I_L = \frac{V_o^2}{V_s R} = \frac{\left(\frac{V_s}{1 - D}\right)^2}{V_s R} = \frac{V_s}{(1 - D)^2 R}$$

$$I_{Lmin} = I_L - \frac{\Delta i_L}{2} = \frac{V_s}{(1 - D)^2 R} - \frac{V_s DT}{2L}$$

To solve the L,

$$I_{Lmin} > 0$$

$$\frac{V_s}{(1 - D)^2 R} - \frac{V_s DT}{2L} > 0$$

$$\frac{V_s}{(1 - D)^2 R} > \frac{V_s DT}{2L}$$

$$L_{min} > \frac{D(1 - D)^2 R}{2f} \quad (Eq. 2)$$

To solve capacitor, C,

$$Q = IT = CV_o$$

$$\frac{V_o D}{R} T = C \Delta V_o$$

$$\frac{\Delta V_o}{V_o} = \frac{D}{RCf}$$

$$\text{output ripple, } r = \frac{D}{RCf} \quad (\text{Eq. 3})$$

From Tyagi, P., Kotak, V. C., & Singh, V. P. S. 2014, "...a dc –dc boost converter can achieve a high boost voltage gain with a high duty ratio which near to 100%. But, in practice, the step-up voltage gain is limited due to the effect of power switches, rectifier diode, the equivalent series resistance (ESR) of inductors and capacitors. Therefore in practical, some of the assumptions are not available to use.

2.2 Dynamo History

From researched of Henry.J, 2008, the first dynamo based on Faraday's principles was built in 1832 by Hippolyte Pixii, a French instrument maker as shown in Figure 2.4. It used permanent magnet which was rotated by a crank. The spinning magnet was placed so that its north and south poles passed through by a piece of iron wrapped with insulated wire.



Figure 2.4: Hippolyte Pixii

The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law of induction. Dynamos have developed few times until today still have some uses in low power applications, particularly where low voltage DC is required, since an alternator semiconductor rectifier can be inefficient in these applications. In Figure 2.5 is the early dynamo and Figure 2.6 is modern dynamo.

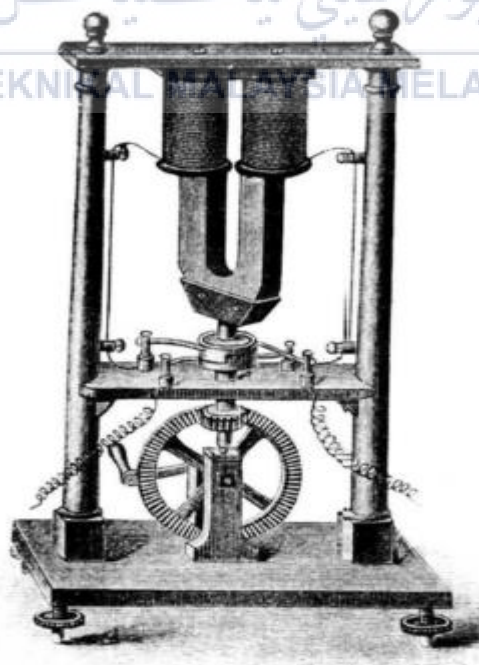


Figure 2.5: Early dynamo



Figure 2.6: Modern Dynamo

A dynamo machine had a stationary structure which called "stator", which provides a constant magnetic field, and a set of rotating winding is called the armature which turned into that field. The motion of the wire within the magnetic field causes the field to push on the electrons into the metal, creating an electric current in the wire. On a small machine, the constant magnetic field is provided by one or more permanent magnets; the larger machines are provided by one or more electromagnets to constant magnetic field, which are usually called field coils.

2.3 Microcontroller

Microcontroller is a device to set the program to give a signal in analog or control devices.

2.3.1 Arduino

From Micheal, 2015, Arduino is used in many educational program in whole world and it do not need a deep understanding of the technical details because it is designed to be used nontechnical people. In Mcroberts, 2010, the biggest advantage of the Arduino over other microcontroller is Arduino ease of use. Non-“techie” people can pick up the basics and be creating their projects

in a relatively short amount of time by their own. Artists, in particular, seem to find it the ideal way to create interactive works of art quickly and without specialist knowledge of electronics. From research D'Ausilio, A. (2012), she said "Arduino boards offer one critical advantage: the both hardware and software, which capitalizes on the massive non-expert community that has flourished around the Arduino concept. A very rough estimate of the size of the community can be gleaned from a Google search reporting more than 12 million hits for "Arduino." In fact, a large user base and the growing market have shown increasing interest around the Arduino concept. There are hundreds of open-source projects one can use or modify according to specific (experimental) needs."

The Arduino board is made up of an Atmel AVR Microprocessor, a crystal or oscillator and a 5-volt DC supply. It has a USB socket to connect to a PC or Mac for uploading or retrieving data which depending on which Arduino that used. The board exposes the microcontroller's input and output pins so can connect those pins to other circuits or to sensors. In Figure 2.7 is example of Arduino and Figure 2.8 is declaration for pins Arduino UNO.



Figure 2.7: Arduino UNO

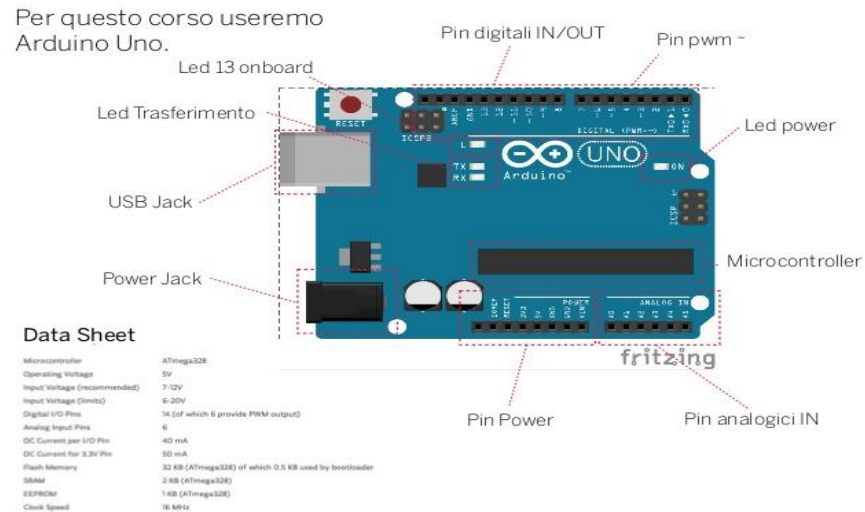


Figure 2.8: Pins declare for Arduino

The Arduino has hardware and software. Both are open sources, which include code, schematics and design can be taken freely by anyone to do what user like with them. The Arduino hardware only can control and respond to electricity, so specific components are attached to it and enable to interact with real world. These components can be potentiometer, sensor which can convert some aspect of the physical world to digital so the board can continue on actuator that set as output.

2.3.2 Peripheral Interface Controller PIC

Peripheral Interface Controller is a low cost computers- in-a-chip. It allows user add creative, cleverness and functions that as a big computer for almost any electronic product or project. The first of the microprocessor 4-bits Intel 4004 and Intel 8008 more capable microprocessor than Intel 4004 were released in year 1971. From Mazidi & Rolin, 2008, the PIC had small amounts of data RAM, hundred bytes of ROM for program, a timer and few pin for input or output ports and all of this is on a single chip. In microcontroller, the ROM is used to store program that user set. Furthermore, the PIC 18 chips have on-chip program ROM in the form of flash memory and it will label a capital latter

alphabet, “F”. The flash version is for fast change because the flash memory can erase the previous program in few second. Figure 2.9 show an example of the PIC group 18.

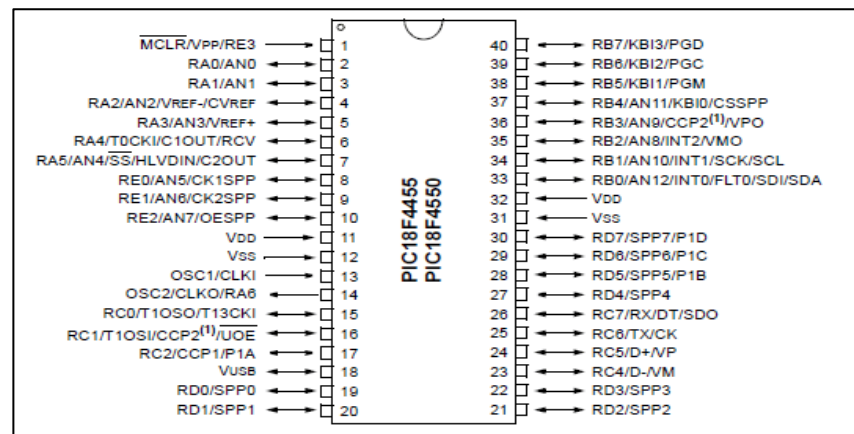


Figure 2.9: Pin declare for PIC18F

2.3.3 Comparison Microcontroller

Table 2.2 Comparison Arduino and PIC

Arduino	Description	PIC
Easy	Setup	Difficult
Easy	Write a program to control the electronic device	Medium
High	Cost	Low
No	Control a high feature program	Yes

CHAPTER 3

METHODOLOGY

3.0 Introduction

This part is to describe the flow of the how the project form. On this part contain the flow chart that expound the general strategy taken along the project carry out. This part will cover all the component parts with a specific end goal to clarify in suitable element of the task methodology and system to achieve goal of this chapter.

3.1 Methodology

This project required to study the boost converter circuit and how the basic of the boost circuit work. The coefficient of the duty cycle is play an importance role to boost the voltage.

The algorithm of the minimum inductor and the minimum capacitor also need to study which to reduce the percentage of output ripple voltage and made sure the current flow through circuit is in continuous control mode.

3.2 Project Flowchart

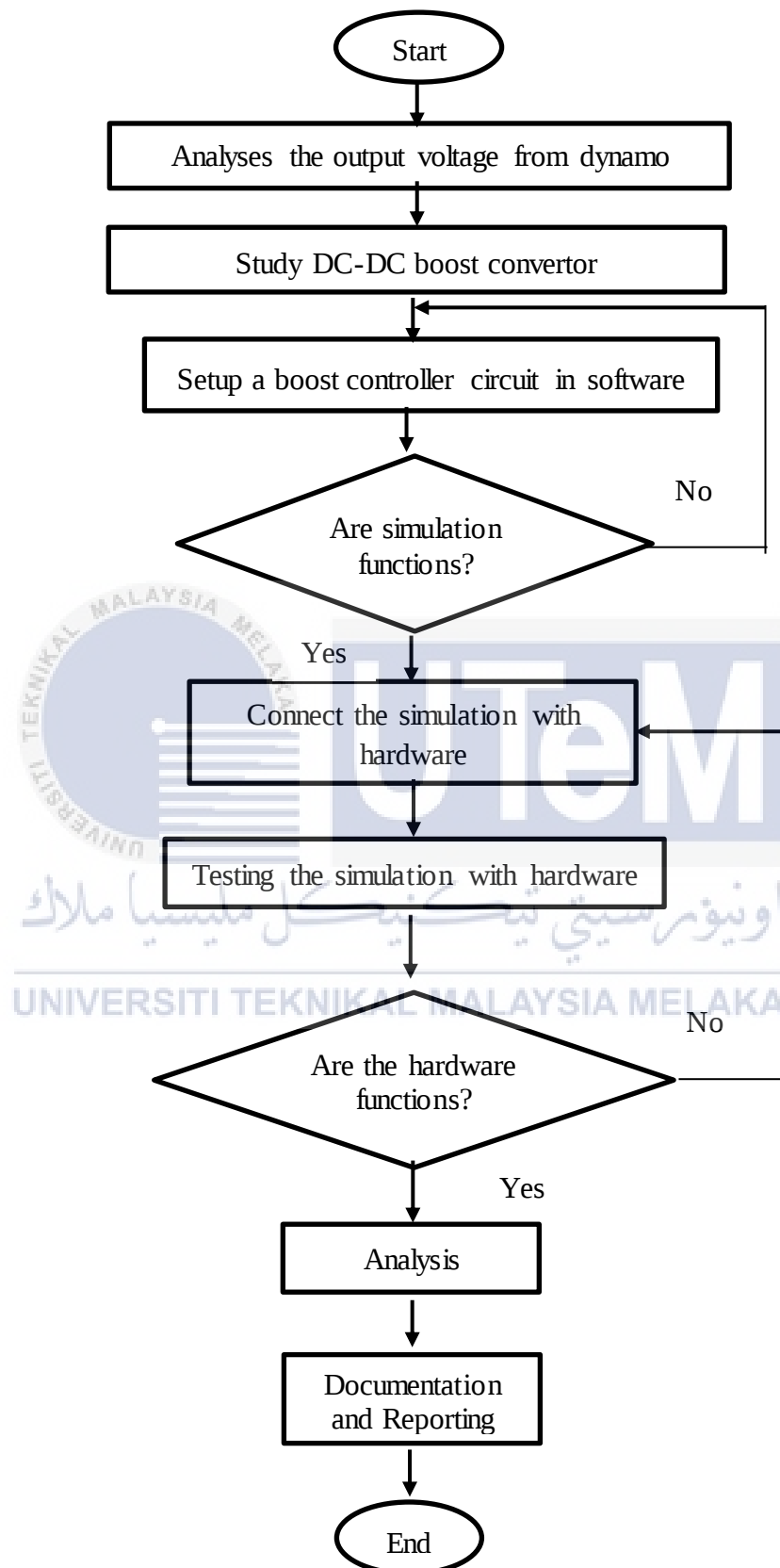


Figure 3.1: Project Flowchart

In Figure 3.1 show the chart for complete this project. As beginning, the output voltage of dynamo is increasing when the turning speed is increase. Therefore, some analysis needed example the maximum voltage that dynamo can generated to take before calculated the duty cycle, coefficient of the inductor and capacitor. Next, construct a simulation circuit in Proteus software, and write a program code to give signal active the microcontroller. As the simulation in software is functioning, buy components and construct the circuit same as the software circuit. If no, try another input voltage which still in the range to redo. After finished constructed the circuit, generated the dynamo and do analysis. If the circuit is not function, a troubleshooting must be taken.

3.3 Project Implementation

There are several strategy of the project which is for the project plan to be success. This is a plan setup to ensure the successful implementation of a project. The strategy is created to ensure this project are completed on time and on budget, and then implemented correctly. There are a few stages before the task assessment:

1. Project planning
2. Choosing the device
3. Process implementation and experimental testing
4. Report writing

3.3.1 Project Planning

Project planning is discipline for stating how to complete a project within a certain period, usually with defined stages, and with designated resources. At beginning, the task arranging extension is characterized and the fitting strategies keeping in mind the end goal to finish the undertaking are resolved. For the project, the arranging stage is separated into two primary components which are equipment and programming necessary.

3.3.2 Hardware Development

The Arduino UNO were used as a microcontroller to control the pulse width modulation in this project. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins which 6 pins can be used as PWM outputs for the pins 3, 5, 6,9,10 and 11. There are 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. A MOSFET as a gate drive to control the duty cycle for whole circuit.

3.3.3 Program for Hardware

The program for this hardware will be burned in the Arduino UNO microcontroller board respectively using Arduino IDE software. Firstly, the code process started with the understanding of the device specification and the correct connection of the component to the Arduino UNO microcontroller3

Next, the program code that will be writing is called “sketch” based on Arduino IDE software. Then, the flowchart for the whole process created to represent the exact same as sequence of operation that will performed. After that, all the program code will be verified for analyzing any error. After the program code successfully verified, the program will be compiled and upload into the Arduino by USB data cable.

3.3.4 Software Development

In this project, Arduino Software will be used. This software is used to set the PWM and send the signal to the Arduino hardware. In figure 3.2 is show the main window of the Arduino software.



Figure3.2: Arduino main window.

3.4 Program Flowchart

Figure 3.3 below is the flowchart of program.

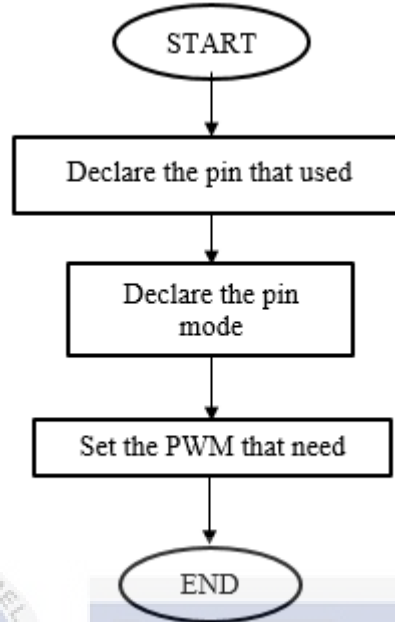


Figure 3.3: Program flow

In the Figure 3.3, to enter the program in the Arduino software must declare which pin will be used and it work as input mode or output mode. Lastly, set the duty cycle that will used to generate the pulse to the MOSFET.

3.5 Coefficient data

3.5.1 Duty Cycle

In this project, the duty cycle, D is used to generate a pulse width modulation (PWM) give signal to the MOSFET that used in the boost convertor circuit. From Xiong et al., 2011, PWM is a technique for getting analog signal results with 8-bits digital signal. From Erickson, n.d. , the D is similar to time fraction which the switch is connected in position on stated, and therefore $0 \leq D \leq 1$. The Safaa Alaa Eldeen Hamza, 2012, D also defines as the duration of the signal is high (on) state as a percentage of the total time of it takes to complete one cycle. By using and rearranged the equation 1, the voltage input

that set as 4V and voltage output that need to get is 8V, therefore the duty cycle that will used in this portable dynamo power generator is 50%

In the hardware, the duty cycle is generated by using the output pin 10 in Arduino Uno. In the data sheet for Arduino Uno, the output pin which can generated the pulse width modulation are pin 3, pin 5, pin 6, pin 9, pin 10 and pin 11. In this few pin, the frequency for pin 10 is 490Hz. The range of analog signal scale is 0 to 255. When need take the duty cycle on 50%, which meant half from the maximum of the of the analog signal. The result will be half of the high state (255) which is 127.5. In the figure 3.4 below is stated the coding to generate the PWM on pin 10 at Arduino Uno.

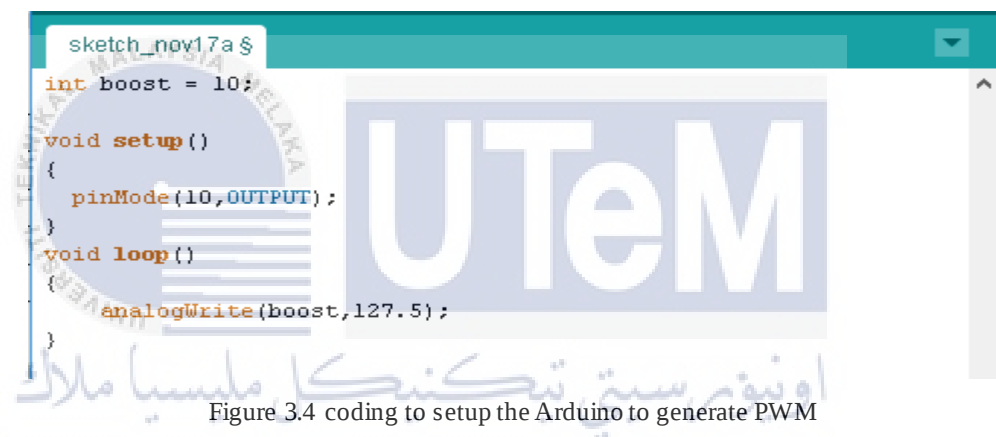


Figure 3.4 coding to setup the Arduino to generate PWM

As in line one is setup the pin that to use in Arduino is pin 10 and named it is boost. Followed in the command in void setup is set the mode for the pin 10 is output. In the void loop which meant the Arduino hardware will do an infinite loop for the process that set in it. As the project, the coding is writing as `analogWrite(boost,127.5)` meant, the boost pin will generate the analog output with half cycle.

3.5.2 Inductance

From the equation 2, the parameter of the D is equal to 0.5, the parameter for R is 100Ω and the switching frequency from the Arduino output pin 10 is 490Hz. Therefore, by insert all the parameters, the minimum inductance is 0.0127H meant it need minimum 13mH to boost the voltage from 4V to 8V in continuous connection mode of the current. Therefore, the inductor in portable power generator is used 22mH.

3.5.3 Capacitance

By using the equation 3, the parameter output ripple voltage that is 12%, the inductor value is 22mH, the resistor is 100Ω and the frequency is 490Hz. Therefore, insert all the parameter, the minimum value of capacitor is $97\mu\text{F}$. Therefore, the capacitor in portable power generator is used $100\mu\text{F}$.

3.5.4 Parameter for dc-dc boost convertor

Table 3.1: Parameter used in Portable Power Generator

Description	Value
Duty cycle	50%
Resistance	100Ω
Inductance	22mH
Capacitance	100μ
Switching frequency	490Hz

CHAPTER 4

RESULT & DISCUSSION

4.0 Introduction

This chapter will discuss the result that defined in the process to do the hardware by simulation result and real-time. Based on data, we can define the effectiveness and the ability of the product.

4.1 Simulation

In this project, there had 2 parts of simulation are undergone to get the data and result, which are by software and by hardware.

4.1.1 Software

In figure 4.1 show the simulation circuit for boost convertor with a 5V voltage regulator in Proteus software.

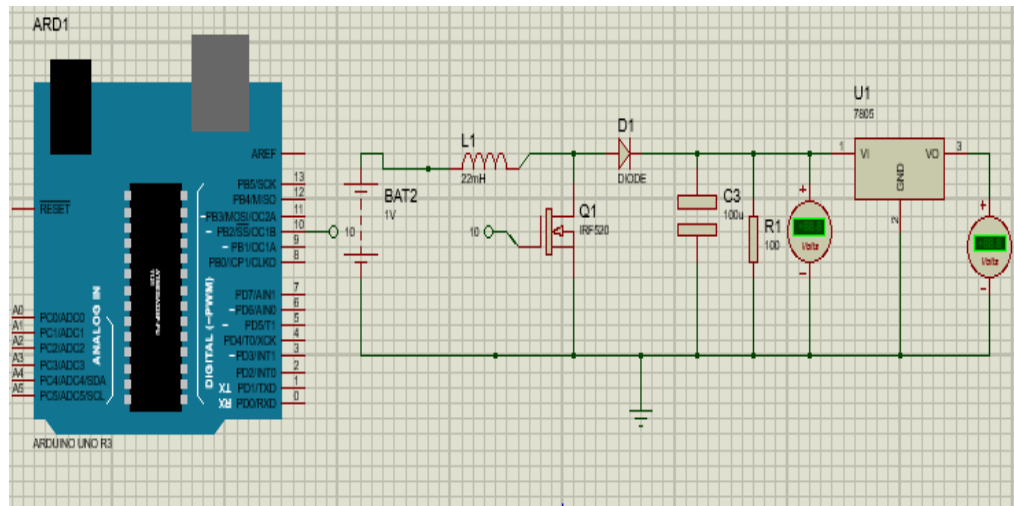


Figure 4.1 Circuit boost convertor

The simulation for the circuit in figure 4.1 is constructed at the Proteus software. By changing the input voltage values, the data for output voltage before and after voltage regulator was taken. Table 4.1 and figure 4.2 shown the results for the changing data before and after the voltage regulator.

Table 4.1: Output result for the Proteus

Voltage input, V	Output voltage before voltage regulator, V	Output voltage after voltage regulator, V
0	0	0
0.5	0.92	0.35
1.0	2.30	1.18
1.5	3.82	2.65
2.0	4.97	3.80
2.5	6.41	5.00
3.0	8.05	5.00
3.5	9.77	5.00
4.0	10.7	5.00

From the table 4.1, as the input voltage increase, the output voltage also increases. This is due to the boost convertor circuit is functional to simulate in Proteus software. The output voltage after the voltage regulator when the input voltage reached 2.5V and above. As a conclude by simulation in Proteus, the input voltage reached 2.5V and above, the output will get 5V after voltage regulator

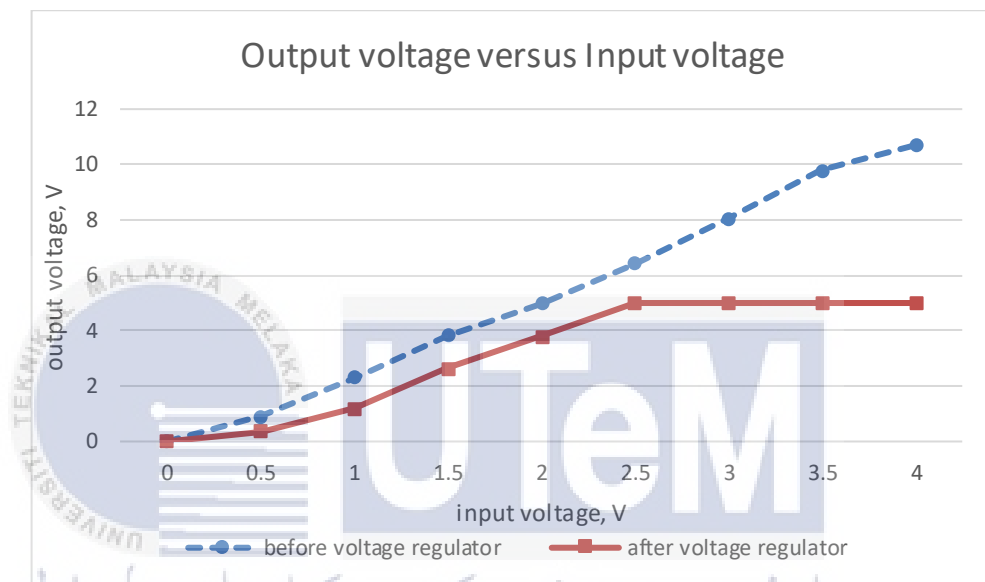


Figure 4.2: Output voltage verses input voltage for software

From Figure 4.2, the output voltage before voltage regulator increase linearly with input voltage. The voltage output after voltage regulator also increase linearly and constant after input voltage at 2.5V. From the graph, the output voltage before and after voltage regulator have voltage drop at the voltage regulator.

4.2.2 Portable Power Generator

In figure 4.3 below show the simulation circuit for the boost convertor with 5V voltage regulator in hardware.

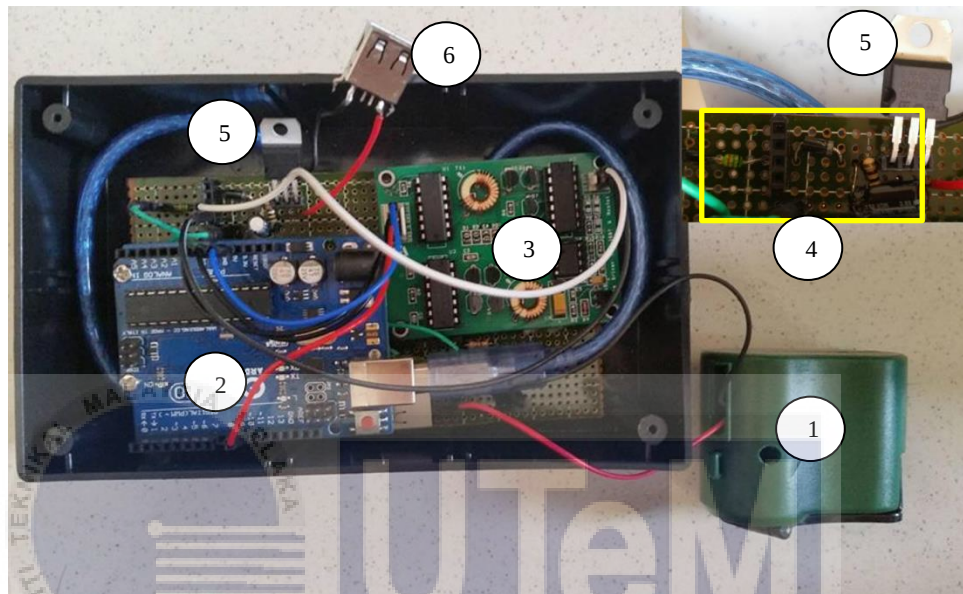


Figure 4.3: Hardware device

In the figure 4.3 above, the circuit can divide into 6 parts. Each parts are play importance role to work the dynamo generator. The first part is the dynamo supply. In this project, the dynamo that used is named as hand crack. It can generate from 0V to 5.9V. Secondly is the microcontroller Arduino Uno. It functions to control and give the signal of PWM to the gate driver. Followed by gate driver for MOSFET is send the signal to active or close the gate pin of the MOSFET. After gate driver, the LC filter circuit is to reduce the ripple of the output voltage. After that is the voltage regulator part which is to maintain the voltage after a limit voltage. Lastly is the output to charge the device in range 5V. Figure 4.4 is the output waveform for duty cycle when set as 50%. Table 4.2 and figure 4.5 show the result for the hardware simulation.

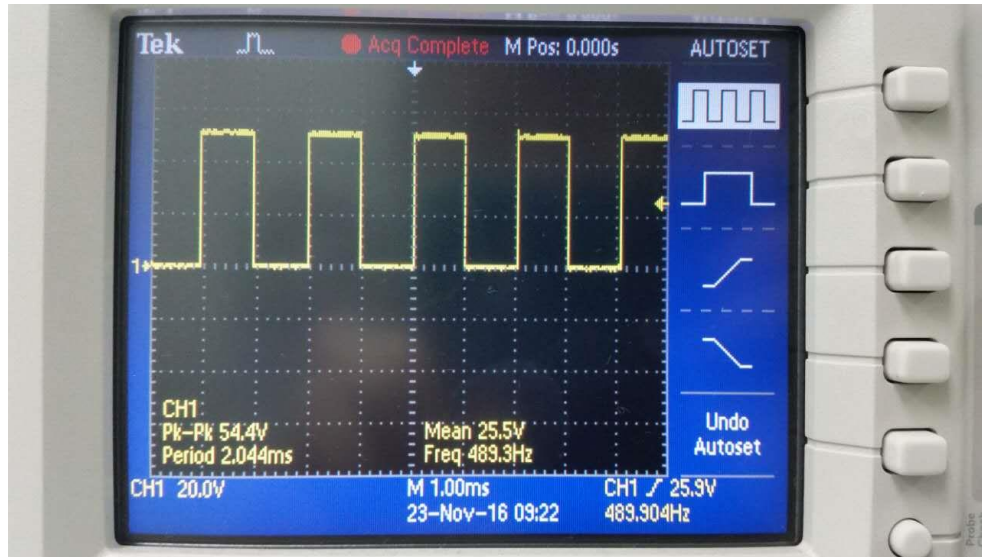


Figure 4.4 output waveform of pin 10 at Arduino

In the figure 4.4 is the square waveform of the output pin 10 at Arduino Uno which is set the coding in figure 3.4 and displayed in oscilloscope. The time period to complete a cycle for the waveform is 2.044ms. The frequency on the pin 10 is around 490Hz. The peak-to-peak voltage is 54.4V and its mean voltage for a cycle is 25.5V. Therefore, the switching frequency for the pin 10 at Arduino UNO is 490Hz.

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Table 4.2: Output result for the power generator

Voltage input, V	Output voltage before voltage regulator, V	Output voltage after voltage regulator, V
0.00	0.00	0.0
0.67	0.92	0.0
2.20	3.45	2.32
4.35	5.32	3.89
4.69	5.63	4.32
4.67	5.63	4.23
4.85	5.83	4.78
4.93	5.90	5.00
5.13	6.09	5.03
5.45	6.89	5.03

From the table 4.2, output voltage increase as the input voltage increase. When input voltage which generated by dynamo reached 4.93V, the output voltage after boost converter is reached 5.90V and the voltage will drop to 5V after voltage regulator. In other word, when the voltage after boost convertor reached 5.90V and above, the output voltage after voltage regulator will constant at 5V.

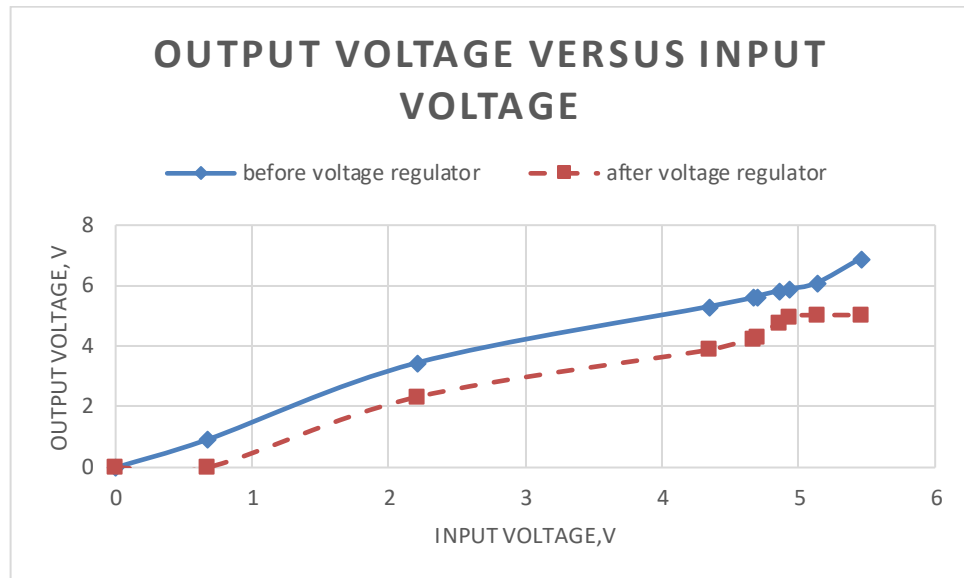


Figure 4.5: The result for portable power generator

From the figure 4.5, there have difference between graph of output simulation before and after voltage regulator. The output voltage before voltage regulator increase linearly with input voltage. The voltage output after voltage regulator also increase linearly and constant after input voltage at 5V. From the graph also, the output voltage before and after voltage regulator have voltage drop at the voltage regulator.

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CHAPTER 5

CONCLUSION & FUTURE WORK

5.0 Introduction

In this chapter, the content will prove that the project is successful. Furthermore, there will be few suggestions for future work were given so that this product can be improved to more sustainable.

5.1 Conclusion

After complete this project, the maximum output voltage for the dynamo is 5.48V as input voltage. Therefore, to determine all the coefficient data for example inductor and capacitor value must lower than the maximum input voltage. After that, to stabilize the output voltage for dc-dc boost convertor. The demerits of this project are the signal communication between the controller and MOSFET and the output voltage drop due to power loss in components.

5.2 Recommendation

There will be some improvement can be done until this product more sustainable and adaptable. The improvement can be focus on the accuracy of the boost voltage technique, the stabilize the output voltage by voltage regulator that set in circuit more quickly and reduce the cost of the project. The corroboration can be applied to this project are:

- i. Study the DC-DC boost convertor method by using other microcontroller
- ii. Increase the duty cycle when boost
- iii. Create the project more mobility



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A. PROJECT PLANNING	
List down the main activity for the project proposal. State the time frame needed for each activity.	
	2016 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 2016 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Project Activity	BP Briefing 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Mid Term Break

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Study Week

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Final Semester Examination

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