



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

by

CHU YEN CHUN

B071310556

931205016061

FACULTY OF ENGINEERING TECHNOLOGY

2016

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Development of Portable Power Generator by Using Dynamo

SESI PENGAJIAN: 2016/17 Semester 2

Saya **CHU YEN CHUN**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ****Sila tandakan (✓)**

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

Cop Rasmi: _____

Alamat Tetap:

15, JALAN KEMUNING

TAMAN LIMPOON

83000 BATU PAHAT JOHOR

Tarikh: _____

Tarikh: _____

****** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled “Development of Portable Power Generator by Using Dynamo” is the results of my own research except as cited in references.

Signature :

Author's Name : CHU YEN CHUN

Date :

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:

.....

(Miss Eng. Siti Halma Binti Johari)

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 berputing, 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.

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.

All praise to the god that I belief for giving me with health and opportunity to gain this treasure of knowledge and experience to complete this project. First and foremost, we would like to thank to our Universiti Teknikal Malaysia Melaka (UTeM) for helping me funding this project.

Besides, we would like to thank to Universiti Teknikal Malaysia Melaka (UTeM) especially to the Department of Electronics & Computer Engineering Technology (JTKEK), Faculty of Engineering Technology (FTK) for providing us with good environment and facilities to complete this project. Thanks also to the Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) librarian and related staff for providing us valuable information throughout the project.

Furthermore, an honourable mention goes to our families, Miss Siti Halma Binti Johari and all members for their cooperation and supports on us in completing this project. Without helps of the particular that mentioned above, we would face many difficulties while doing this project.

Lastly, I would like to thank to all lecturers and staff in FTK, UTeM, who help me in many ways and make my education journey in this four years enjoyable and memorable.

TABLE OF CONTENT

Abstrak	v
Abstract	vi
Dedication	vii
Acknowledgement	viii
Table of Content	ix~x
List of Tables	xi
List of Figures	xii
List of Abbreviations, Symbols and Nomenclature	xiii

CHAPTER 1: INTRODUCTION

1.1 Background	1~2
1.2 Problem Statement	3
1.3 Objectives of the Study	3
1.4 Scopes of the Study	3
1.4 Thesis Organization	4

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction	5
2.1 DC-DC Boost Convertor	5~8
2.2 History of Dynamo	8~10
2.3 Microcontroller	10
2.3.1 Arduino	10~12
2.3.2 Peripheral Interface Controller PIC	12~13
2.3.3 Comparison of Microcontroller	13

CHAPTER 3: METHODOLOGY

3.0 Introduction	14
3.1 Methodology	14
3.2 Flow of Project	15
3.3 Project Implementation	16
3.3.1 Project Planning	17

3.3.2 Hardware Development	17
3.3.3 Program for Hardware	17~18
3.3.4 Software Development	18
3.4 Program Flowchart	19
3.5 Coefficient Data	
3.5.1 Duty Cycle	19~20
3.5.2 Inductance	21
3.5.3 Capacitance	21
3.5.4 Parameter used in Portable Power Generator	21
 CHAPTER 4: RESULTS AND DISCUSSION	
4.0 Introduction	22
4.1 Simulation	22
4.1.1 Software	22~24
4.1.2 Portable Power Generator	25~28
 CHAPTER 5: CONCLUSION AND RECOMMENDATION	
5.1 Introduction	29
5.2 Conclusion	29
5.3 Recommendation	30
 REFERENCE	 31

LIST OF TABLE

1.1: Comparison of power bank and solar power bank	2
2.1: Equation for V_L , $\frac{di_L}{dt}$ and Δi_L	6
2.2: Comparison Arduino and PIC	13
3.1: Parameter used in Portable Power Generator	21
4.1 Output result for Proteus	23
4.2 Output result for the power generator	27

LIST OF FIGURE

2.1: Example circuit for DC-DC boost convertor	5
2.2: Equivalent circuit for switch closed	6
2.3: Equivalent circuit for switch opened	6
2.4: Hippolyte Pixii	9
2.5: Early dynamo	9
2.6: Modern dynamo	10
2.7: Arduino UNO	11
2.8: Pin declare for Arduino	12
2.9: Pin declare for PIC18F	13
3.1: Project Flowchart	15
3.2: Arduino Main Window	18
3.3: Program Flowchart	19
3.4: Coding to setup the Arduino to generate PWM	20
4.1: Circuit boost convertor	23
4.2: Output voltage verses input voltage for software	24
4.3: Portable power generator device	25
4.4: Output Waveform for Arduino pin 10	26
4.5: The result for portable power generator	28

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)
<ul style="list-style-type: none"> - Cannot process charging when no electric energy supply - Need connect a wire which connect to a plug 	Disadvantage	<ul style="list-style-type: none"> - 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.

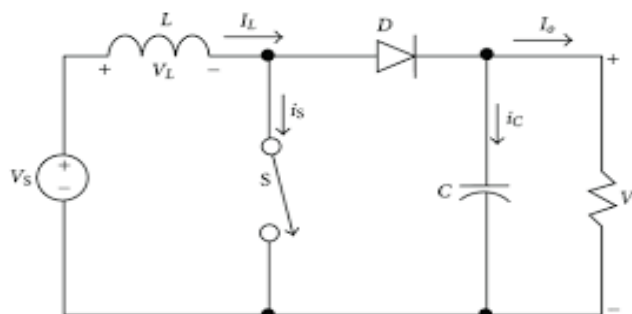


Figure 2.1: Example circuit for DC-DC boost convertor

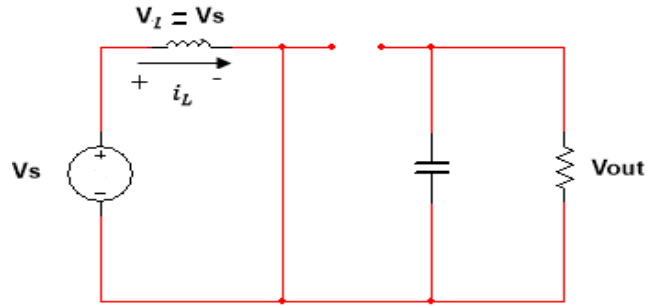


Figure 2.2: Equivalent circuit for switch closed

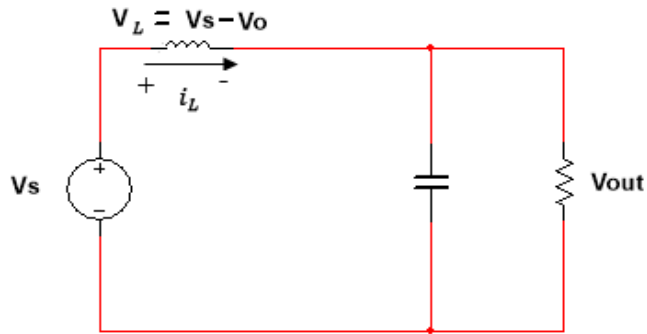


Figure 2.3: Equivalent circuit for switch opened

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	$V_L = V_s$
$\frac{di_L}{dt} = \frac{V_s - V_o}{L}$	$\frac{di_L}{dt}$	$\frac{di_L}{dt} = \frac{V_s}{L}$
$\frac{\Delta i_{L(open)}}{T_{on}} = \frac{V_s - V_o}{L}$	Δi_L	$\frac{\Delta i_{L(close)}}{T_{off}} = \frac{V_s}{L}$
$\frac{\Delta i_{L(open)}}{(1-D)T} = \frac{V_s - V_o}{L}$		$\frac{\Delta i_{L(close)}}{DT} = \frac{V_s}{L}$
$\Delta i_{L(open)} = \frac{(V_s - V_o)(1-D)T}{L}$		$\Delta i_{L(close)} = \frac{V_s DT}{L}$

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

$$\begin{aligned}\Delta i_{L(open)} + \Delta i_{L(close)} &= 0 \\ \frac{(V_s - V_o)(1 - D)T}{L} + \frac{V_s DT}{L} &= 0\end{aligned}$$

Solving for V_o ,

$$\begin{aligned}V_s(D + 1 - D) - V_o(1 - D) &= 0 \\ V_o &= \frac{V_s}{1 - D} \quad (Eq. 1)\end{aligned}$$

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,

$$\begin{aligned}P_{in} &= P_o \\ V_s I_L &= \frac{V_o^2}{R}, \quad I_s = I_L \\ I_L &= \frac{V_o^2}{V_s R} = \frac{\left(\frac{V_s}{1 - D}\right)^2}{V_s R} = \frac{V_s}{(1 - D)^2 R} \\ I_{Lmin} &= I_L - \frac{\Delta i_L}{2} = \frac{V_s}{(1 - D)^2 R} - \frac{V_s DT}{2L}\end{aligned}$$

To solve the L,

$$\begin{aligned}I_{Lmin} &> 0 \\ \frac{V_s}{(1 - D)^2 R} - \frac{V_s DT}{2L} &> 0 \\ \frac{V_s}{(1 - D)^2 R} &> \frac{V_s DT}{2L} \\ L_{min} &> \frac{D(1 - D)^2 R}{2f} \quad (Eq. 2)\end{aligned}$$

To solve capacitor, C,

$$\begin{aligned}Q &= IT = CV_o \\ \frac{V_o D}{R} T &= C \Delta V_o \\ \frac{\Delta V_o}{V_o} &= \frac{D}{RCf} \\ \text{output ripple, } r &= \frac{D}{RCf} \quad (\text{Eq. 3})\end{aligned}$$

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.

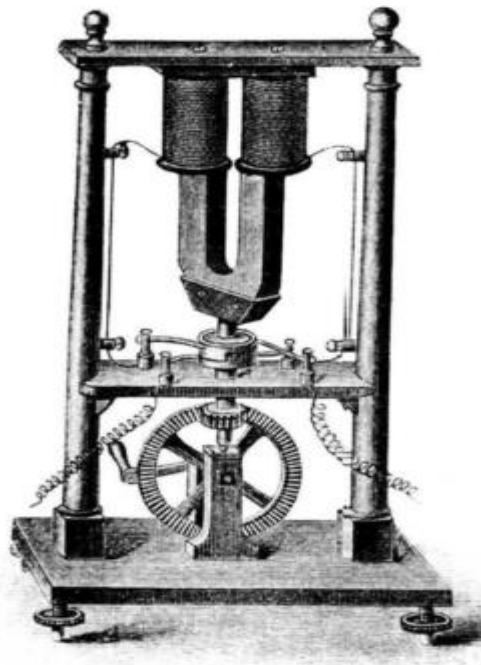


Figure 2.5: Early dynamo



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