



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**IMPROVEMENT IN EFFICIENCY OF  
WATER FLOATING NANO TURBINE**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering Technology (Automotive) (Hons.)

by

**MOHAMAD FARIQ AZZAD BIN MD ALI**

**B071410099**

**920627-01-5807**

FACULTY OF ENGINEERING TECHNOLOGY

2017

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **IMPROVEMENT IN EFFICIENCY OF WATER FLOATING NANO TURBINE**

SESI PENGAJIAN: **2016/17 Semester 2**

Saya **Mohamad Fariq Azzad Bin Md Ali**

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

Disahkan oleh:

\_\_\_\_\_  
Alamat Tetap:  
No.24, Lorong Penaga 27, Taman Penaga,

13100 Penaga,  
Seberang Perai Utara,  
Pulau Pinang.

Tarikh: \_\_\_\_\_

\_\_\_\_\_  
Cop Rasmi:

**\*\* 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 “IMPROVEMENT IN EFFICIENCY OF WATER FLOATING NANO TURBINE” is the results of my own research except as cited in references.

**Signature** : .....

**Author’s Name** : **Mohamad Fariq Azzad Bin Md Ali**

**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 Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

.....  
MOHAMMAD RAFI BIN OMAR  
(Project Supervisor)

## **ABSTRACT**

Renewable energy source has become a pursue for the modern world as the free energy is the goal for today's people. Water Floating Nano Turbine is a turbine model that developed in smaller scale, supplying free electrical energy for small electrical appliances. From the natural sources, such as river, stream and ocean, it can actually generate the electricity without any problems and harmful to the people. The electricity produced can be used to recharging the electronics devices that possibly pulling them out of the emergency situation. The conversion of energy process from the natural sources to useful energy involves several steps, draws out kinetic energy from the water and transform into a form of mechanical energy at the rotor axis and changed into electrical energy. The processes in running this project includes several stages which are studying past researches about this project, designing harvesting mechanism, building new water floating mechanism, selecting turbine to be used, fabrication works and project testing session. The main aim of this project is to improve the voltage produced by the turbine. The redesign works for harvesting mechanism and water floating mechanism also based on getting the best flow for the turbine to generate best voltage. As the result, the new WFNT successfully achieved the main aim where it is get to produce 1089% increment from previous version of WFNT. The three improvements made on WFNT shows positive achievement in generating higher voltage.

## ABSTRAK

Sumber tenaga boleh diperbaharui telah menjadi usaha untuk dunia moden kerana tenaga bebas adalah matlamat untuk orang-orang hari ini. Water Floating Nano Turbine adalah model turbin yang dibangunkan dalam skala yang lebih kecil, membekalkan tenaga elektrik percuma untuk peralatan elektrik kecil. Dari sumber semula jadi, seperti sungai dan lautan, ia sebenarnya dapat menjana elektrik tanpa masalah dan membahayakan manusia. Tenaga elektrik yang dihasilkan boleh digunakan untuk mengecas semula peranti elektronik yang mungkin menarik mereka keluar dari keadaan kecemasan. Penukaran proses tenaga dari sumber semula jadi kepada tenaga yang berguna melibatkan beberapa langkah, mengeluarkan tenaga kinetik dari air dan berubah menjadi bentuk tenaga mekanikal pada paksi rotor dan berubah menjadi tenaga elektrik. Proses dalam menjalankan projek ini merangkumi beberapa peringkat yang mengkaji penyelidikan masa lalu mengenai projek ini, merangka mekanisme penuaian, membina mekanisme terapung baru, memilih turbin yang akan digunakan, kerja fabrikasi dan sesi ujian projek. Matlamat utama projek ini adalah untuk meningkatkan voltan yang dihasilkan oleh turbin. Reka bentuk yang direka untuk mekanisme penuaian dan mekanisme terapung juga berdasarkan aliran terbaik untuk turbin untuk menghasilkan voltan terbaik. Akibatnya, WFNT baru berjaya mencapai matlamat utama di mana ia dapat menghasilkan kenaikan 1089% dari versi sebelumnya. Tiga penambahbaikan yang dibuat pada WFNT menunjukkan pencapaian positif dalam menghasilkan voltan yang lebih tinggi.

## **DEDICATIONS**

This thesis is dedicated to my beloved parents Mr. Md Ali Bin Hassan and Mrs. Norain Binti Abdullah for their supports and prayers, always be there for me through my happy and hard time. Also to my beloved sister, Intan Farizatul Alia Binti Md Ali that always giving me that spirit to complete this thesis.

A special thanks goes to my project supervisor, Mr. Mohammad Rafi Bin Omar, and my former project supervisor, Mr. Ir. Mohamad Hafiz Bin Harun, for their endless supports and guidance in every aspect during the accomplishment of this thesis.

And finally to all my friends, a big thanks for their help, ideas, and supports, directly or indirectly contributes to this thesis.

## ACKNOWLEDGEMENT

*Bismillahirrahmaanirrahim,*

*In the name of Allah S.W.T, the most compassionate and the most merciful.*

Firstly, thanks to Allah S.W.T because giving me a good health and huge courage and strength to do this final year project.

Secondly, I would like to express my deepest gratitude and appreciation to my supervisor, Mr. Mohammad Rafi Bin Omar and my former supervisor, Mr. Ir. Mohamad Hafiz Bin Harun for their guidance, support, encouragement and helping to finish my Bachelor Degree Project.

I would like to expand my sincerity to all my friends, who has assisted and share the ideas, indirectly easier for me to complete this project. I wish to extend the thanks to everyone who has helped directly or indirectly in completing this project. Finally, my deepest appreciation goes to my beloved mother, father, and brother for their blessing and prayer during my studies in Universiti Teknikal Malaysia (UTeM) Melaka.



## TABLE OF CONTENTS

DECLARATION.....	III
APPROVAL.....	IV
ABSTRACT.....	V
ABSTRAK.....	VI
DEDICATIONS.....	VII
ACKNOWLEDGEMENTS.....	VIII
TABLE OF CONTENTS.....	IX
LIST OF TABLES.....	XII
LIST OF FIGURES.....	XIII
LIST OF ABBREVIATIONS, SYMBOLS, AND NOMENCLATURE.....	XVI
CHAPTER 1 INTRODUCTION.....	1
1.1 Introduction.....	1
1.2 Problem Statement.....	2
1.3 Objective.....	2
1.4 Scopes.....	3
CHAPTER 2 LITERATURE REVIEW.....	4
2.0 Introduction.....	4
2.1 History of Hydropower.....	5
2.2 History of Turbine.....	6
2.3 Types of water turbine.....	7
2.3.1 Impulse turbine.....	8
2.3.2 Reaction turbine.....	10

2.4	Axis of Turbine .....	12
2.5	Floating Water Turbine Concepts .....	13
2.5.1	Floating axis tidal turbine.....	13
2.5.2	Inclined axis stream turbine .....	13
2.6	Generators .....	15
2.7	Drainage .....	16
2.7.1	Types of drainage.....	16
2.8	Model Design .....	18
2.8.1	Dassault Systèmes CATIA.....	18
2.9	Current Measurement Device .....	20
2.9.1	Multimeter.....	20
CHAPTER 3 METHODOLOGY .....		23
3.1	Introduction .....	23
3.2	Harvesting mechanism design.....	26
3.3	Turbine selection.....	27
3.4	Water Floating Mechanism.....	30
3.5	Development of Water Floating Nano Turbine.....	31
3.5.1	Components.....	31
3.5.1.1	Standard Part.....	31
3.5.1.2	Modified Part.....	32
3.5.2	Fabrication.....	32
3.6	Project Testing.....	34
3.6.1	Test Condition.....	34
3.6.2	Testing Procedure.....	35
3.6.3	Testing Parameter.....	35

3.7	Maximum voltage measurement .....	36
CHAPTER 4 RESULT AND DISCUSSION		
4.0	Introduction.....	37
4.1	Water Floating Nano Turbine Testing.....	37
4.1.1	Voltage Generated.....	40
4.1.2	5V DC/DC Boost Converter.....	44
4.1.3	Harvesting Mechanism.....	47
4.1.4	Movement Capacity.....	48
CHAPTER 5 CONCLUSION AND FUTURE WORK		
5.0	Introduction.....	49
5.1	Project Summary and Achievement.....	49
5.2	Recommendation.....	50
5.2.1	Charging Time.....	50
5.2.2	Detachable Structure.....	50
5.2.3	Battery.....	51
REFERENCES.....		52

## LIST OF TABLES

3.3	Table 3.1: Table of specification of micro hydro turbine.	27
4.1	Table 4.1: Tabulated information and data recorded for WFNT with stream flow without 5V DC/DC Boost Converter	40
	Table 4.2: Tabulated information and data recorded for WFNT with drainage flow without 5V DC/DC Boost Converter	40
4.1.2	Table 4.3: Output Voltage with 5V DC/DC Boost Converter for Stream Flow.	44
	Table 4.4: Output Voltage with 5V DC/DC Boost Converter for Drainage Flow.	44

## LIST OF FIGURES

2.2	Figure 2.1: Early development of water turbine.	6
2.2	Figure 2.2: Roman turbine mill at Chemtou, Tunisia.	7
2.3.1.1	Figure 2.3: Pelton wheel turbine.	8
2.3.1.2	Figure 2.4: Ossberger turbine section	9
2.3.2.1	Figure 2.5: A developer of Francis Turbine, James B. Francis.	10
	Figure 2.6: Francis Turbine development also known as “sideways water wheels”.	11
2.4	Figure 2.7: Water stream turbines (a) Horizontal axis water turbine, (b) Vertical axis water turbine.	12
2.5.1	Figure 2.8: Images of floating axis wind turbine (H. Akimoto, et al, renewable energy); (a) front and side view; (b) perspective view.	13
2.5.2	Figure 2.9: Water stream turbine configurations; (a) horizontal axis and vertical axis turbines placed on a sea bed; (b) horizontal axis and vertical axis turbines placed on a sea bed supported by a float.	14
	Figure 2.10: Inclined axis water turbine on a supporting structure (a) and on a float (b); small farm of moored inclined axis turbines (c).	15
2.6	Figure 2.10: Example of motor generator.	16

2.7.1	Figure 2.11: The artificial slope field to facilitate drainage.	17
	Figure 2.12: Deep open drain type.	17
	Figure 2.13: Pipe drain type.	18
2.8.1	Figure 2.14: Dassault Systèmes CATIA V5R21 logo.	19
	Figure 2.15: Interface of Dassault Systèmes CATIA V5R21.	19
2.10.1	Figure 2.16: Analogue multimeter.	21
	Figure 2.17: Digital multimeter.	22
3.1	Figure 3.1: Flow chart of the project.	25
3.2	Figure 3.2: Existing design sketching of WFNT turbine structure.	26
	Figure 3.3: Conceptual design sketching of WFNT.	26
	Figure 3.4: New Water Wheel Design in CATIA.	27
3.3	Figure 3.5: 3.6V DC Micro hydro generator.	28
	Figure 3.6: 12V DC Micro-hydro Water Turbine.	29
	Figure 3.7: DC1.5V-36V Hand generator motor.	29
3.5	Figure 3.8: Sketching of the Sling Wire System.	30
3.5.2	Figure 3.9: New design of WFNT before assembly process.	33
3.5.2	Figure 3.10: New design of WFNT assembled.	33
4.1	Figure 4.1: First testing checkpoint for stream flow.	38
	Figure 4.2: Second testing checkpoint for stream flow.	38
	Figure 4.3: Testing of WFNT for drainage flow	39

4.1.1	Figure 4.4: Graph of Water Velocity against Turbine Speed for Stream Flow	41
	Figure 4.5: Graph of Water Velocity against Turbine Speed for Drainage Flow	42
	Figure 4.6: Graph of Turbine Speed (rpm) against Voltage Generated (V) for Stream Flow.	42
	Figure 4.7: Graph of Turbine Speed (rpm) against Voltage Generated (V) for Drainage Flow.	43
4.1.2	Figure 4.8: Graph of Generated Voltage against Boosted Voltage for Stream Flow.	45
	Figure 4.9: Graph of Generated Voltage against Boosted Voltage for Drainage Flow.	45
4.1.3	Figure 4.10: Existing Water Wheel for WFNT.	47
	Figure 4.11: New Water Wheel for WFNT.	47
4.1.4	Figure 4.12: Existing Two-Pole Floating Mechanism for WFNT.	48
	Figure 4.12: New Sling Wire Floating Mechanism for WFNT.	48

## **LIST OF ABBREVIATIONS, SYMBOLS, AND NOMENCLATURE**

UTeM	-	Universiti Teknikal Malaysia Melaka
CATIA	-	Computer Aided Three-Dimensional Interactive Application
CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering
PVC	-	Polyvinyl Chloride
VOM	-	Volt-Ohm Meter
V	-	Unit of Voltage (Volt)
WFNT	-	Water Floating Nano Turbine



# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

Electricity is one of the most important elements for people to carry out their daily routine. From the electricity, all the companies around the world are able to provide their products to the people in order to fulfill their daily routine. All the electrical appliances require electricity to operate. Without electric source, all the electrical appliances could not be operated (Stephen, 1998).

The lovers of adventurous outdoor activity often use electronics mobile devices such as smart phones, battery powered lamp, and a power bank as well as the portable electricity storage as the tools to facilitate them while in the forest area. These electronic devices are using battery as power supply and needs to be charged when the battery is running low. As we all know, there are no electric supply in the forest and this can be a big problem for the adventurer when they are in needs or in emergency (Nivala, et al , 2003).

From the natural sources, such as river, stream and ocean, it can actually generate the electricity without any problems and harmful to the people. The electricity produced can be used to recharging the electronics devices that possibly pulling them out of the emergency situation. The conversion of energy process from the natural sources to useful energy involves several steps, draws out kinetic energy from the water and transform into a form of mechanical energy at the rotor axis and changed into electrical energy (Vary, 1984).

To make the turbine operate in good condition, it is consisting of aerodynamic and it is related from the design that we have been chose or decide. For an example, if the stream is in closure space, the aerodynamic would be very low and if the stream doesn't have any end, the aerodynamic of stream would be high.

## **1.1 Problem Statement**

Nano turbine has been invented to recharge small electric device. It has been developed by the previous researcher but there are lots of weaknesses especially the voltage output. The low voltage output was resulted by the limited capability of motor generator to produce voltage. At the same time, there is no water harvesting mechanism attached to the nano turbine structure. The harvesting mechanism significantly used to harvest the maximum water flow concentrated to the turbine. On the other hand, the up and down movement of nano turbine reduced significantly because of floating mechanism not properly designed. To overcome these problems, improvement of Water Floating Nano Turbine (WFNT) will be performed in this study.

## **1.2 Objective**

The objectives of the present project are as follow:

1. To redesign the existing WFNT to improve harvesting mechanism from water flow source.
2. To increase the maximum voltage generated by WFNT.
3. To redesign the WFNT that will overcome the up and down movement capacity.

### **1.3 Work Scope**

In this project, several work scope will be followed to complete this project accordingly to the objectives without any misjudgment. The work scopes of this project are:

1. The redesign of WFNT only focused on the harvesting mechanism on the turbine structure.
2. Improvement towards the motor turbine voltage generation is set within 5VDC to 7VDC.
3. The use of buoy is implemented to reestablished the water floating mechanism.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This part provides the past study of the project based on the mastery and details needed to design and develop the project. Literature is a process to review and explore to help process the introduction of new techniques for improving the Water Floating Nano Turbine based on the past researches. To build up this project, it is important to experience a few looks into that are identified with the possibility of this project. The research that will focus on every hardware and software that will be used as a part of doing this project. With this project, it will help in accomplishing the possibility of the venture in view of what techniques are reasonable to be utilized.

This study will provide review from previous research in order to make a large scope of water turbine and hydroelectric, obtain any turbine problems, generates new ideas and concept. The source of these study must be satisfactory in the system format, for example, books, papers, articles and internet sources that are authorized.

## 2.1 History of Hydropower

Electricity generation is the process of generating electric power from the primary sources. It can be harvested in many ways. The power harvested from the falling water energy or fast flowing water, which may be harvested for applicable uses is called hydropower or hydroelectric power. Hydropower, the vitality created from running water, is one of the most seasoned free energy sources and the aggregate worldwide capacity of electric power for hydropower, including extensive small hydroelectric power, hydroelectric power, and ocean power, was roughly 820 Giga Watt in 2005, which represented very nearly 20% of renewable energies as stated in (Martinot, 2006)

Small hydroelectric power systems were progressively utilized as an option of energy sources. So, a small hydroelectric power system is located in small rivers or streams with minor environmental effect. In such way, a dam is not necessary to be built for installing a small hydropower system.

The water turbines able to be categorised by the type of motor generator used, or the water assets in the fitted place. The water turbine or hydro turbine system works as the turbine rotates by forming the kinetic energy of the rotating turbine from potential energy of the water. The benefit of this turbine is high efficiency. Nevertheless, the cost for building a dam or waterway is high and causing huge ecological issues. Water stream turbines are turned by the power of the waterway or the sea ebb and flow. These turbines are fundamentally similar to wind turbines that submerged, however the density of water is 800 times higher than air. There are two sorts of water stream turbines; horizontal axis turbines and vertical axis turbines.

## 2.2 History of Turbine

The word "turbine" itself, first used to describe a water-powered prime mover by Claude Burdin in 1822, was and remains ambiguous in usage, and was obtained from the Latin word means "spinning" or a "vortex" (Constant, 1983). The water turbine is not adequately defined by such criteria as reaction (moved by the reaction of water issuing from the blades) versus impulse (moved by the impact of water striking the blades) or by vertical versus horizontal rotational axes (Constant, 1983).

Hydroelectric power was utilized as a part of China no less than 2000 years' prior; the waterwheel was concocted in antiquated Greece and Rome, and in the year 13 B.C., a Roman architect and author Marcus Vitruvius Pollio portrayed a grain mill driven by a waterwheel and a cogwheel outfit. The assortment of waterwheel applications expanded enormously through the Middle Ages (Fasol, 2002).

Performing work with assistance of moving water or air is an ancient idea. Water wheels and windmills are the foremost models of antequate mankind's creation to catch some of nature's energy and turn it into benefits. The Romans were pounding corn using a waterwheel as ahead of schedule as 70 B.C., and present day types of windmills were utilized in Persia around A.D. 700. Both of them are ancestors of the turbines as stated by Ali, A. (n.d.).



Figure 2.1: Early development of water turbine (Georgescu, et al, 2007)

The Roman Empire water turbine with two helix-turbine mill locales on the third or early fourth century A.D. The horizontal water wheel with calculated cutting edges was fitted at the base of a water-filled circular shaft. The mill-race allows water enter the pit digressively, forming a winding water segment which made the completely submerged water wheel act like an actual turbine (Wilson, 1995), as shown in Figure 2.1. Fausto Veranzio in his book *Machinae Novae* (1595) depicted a vertical axis with a rotor is like a Francis turbine (Rossi et al., 2009).

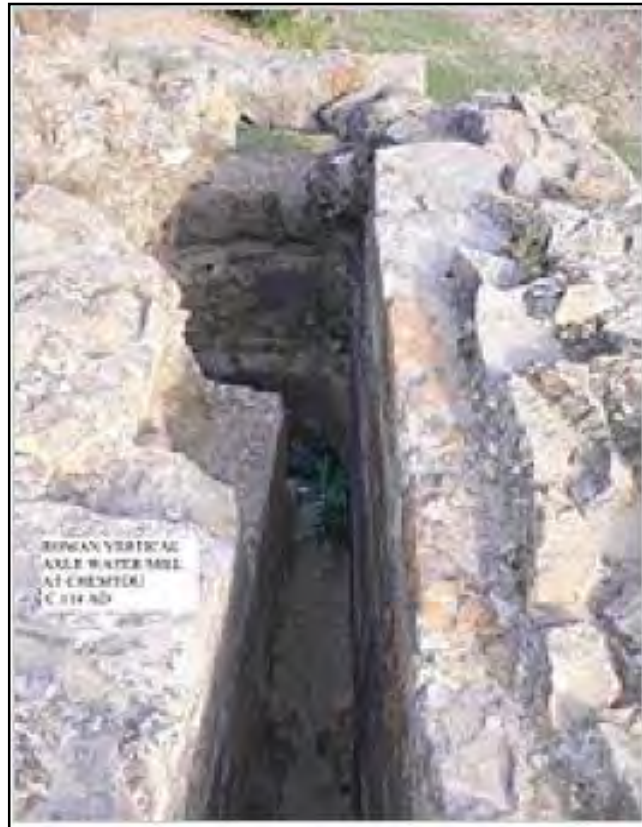


Figure 2.2: Roman turbine mill at Chemtou, Tunisia (Wilson, 1995)

### 2.3 Types of water turbine

Turbines were classified by their operation principle that can be impulse turbine or reaction turbines (Paish, 2002). The type of hydroelectric power turbine chose based on the standing water height that known as “head” and the volume of water at the site.

### 2.3.1 Impulse turbine

The impulse turbine basically uses water speed to turn the wheel and releases to atmospheric pressure. Pelton, Turgo, and Crossflow are 3 main types of impulse turbine in use (Paish, 2002). The water flow hits every bucket attached at the wheel and no suction on the drawback of the turbine, then the water outpouring the base of the turbine lodging after hitting the runner. Almost all the vitality of the water goes into impelling the pail and the diverted water falls into a release channel beneath. An impulse turbine mostly used for high head and low flow applications (Paish, 2002).

#### 2.3.1.1 Pelton Wheel

In 1880, Lester Allan Pelton patented a water turbine called Pelton turbine. It is used for low flow rates and very high heads, providing high efficiency (Georgescu et al., 2007).

The Pelton wheel is the favoured turbine for hydropower. When the available source of water moderately high, the hydraulic head is at low stream rates position, where the geometry of Pelton wheel is most proper. The construction of Pelton wheel is shown in Figure 2.2.

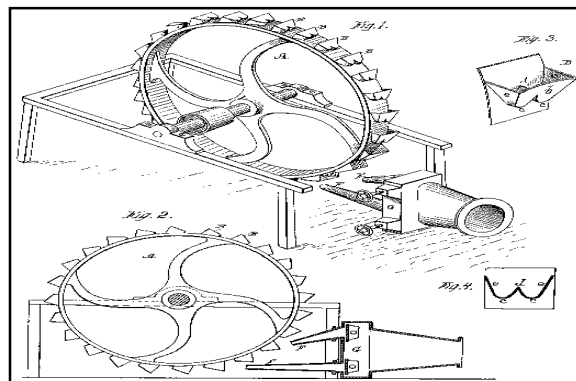


Figure 2.3: Pelton wheel turbine (Pelton, 1880)