Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF WATER REACTION TURBINE FOR HYDROPOWER SYSTEM

ADIB HAFIZ BIN MOHD ZAMRI
B081810467

Bachelor of Electronics Engineering Technology with Honours

2021

DEVELOPMENT OF WATER REACTION TURBINE FOR HYDROPOWER SYSTEM

ADIB HAFIZ BIN MOHD ZAMRI
B081810467

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF WATER REACTION TURBINE FOR HYDROPOWER SYSTEM

Sesi Pengajian : SEM 1 21/22

Saya ADIB HAFIZ BIN MOHD ZAMRI mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☒	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)
Alamat Tetap:
NO 92, JALAN11,
FELDA BUKIT CHERAKAH 2,
42200 KAPAR,
SELANGOR DARUL EHSAN

Tarikh: 5/1/2022

(COP DAN TANDATANGAN PENYELIA)
IR. DR. MOHD FARRIZ BIN BASAR
Timbalan Dekan
(Penyelidikan dan Jaringan Industri)
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
Universiti Teknikal Malaysia Melaka (UTeM)

Tarikh: 07January 2022

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

DECLARATION

I declare that this project report entitled “Development Of Water Reaction Turbine For Hydropower System” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature	:	
Student Name	:	ADIB HAFIZ BIN MOHD ZAMRI
Date	:	5/1/2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

Signature : 

Supervisor Name : IR. DR. MOHD FARRIZ BIN HJ MD BASAR

Date : 07 January 2022

Signature : 

Co-Supervisor Name (if any) : PN NURUL ASHIKIN BINTI MOHD RAIS

Date : 7/1/2022

DEDICATION

To my beloved mother,
NORAFIDA BINTI MOHD JALUDIN,
and father,
MOHD ZAMRI BIN HITAM,
thank you for always supportive and always being there for me when I needed both of you. Your kindness Your kindness is too much and can never be repaid but I promise will make both of you and of course our family proud.

To my respected lectures,
IR. DR. MOHD FARRIZ BIN HJ MD BASAR,
PN NURUL ASHIKIN BINTI MOHD RAIS,
and PN NURUL KAUSAR BINTI AB MAJID,
thank you for all the guidance and always help in resolving the confusion encountered throughout my studies at UteM.

ABSTRACT

The pico-hydro water turbine is a power generation system that uses water current and tidal flows. Pico-hydro, in other words, is a green system that generates power without relying on any other sources. This application provides a cost-effective and efficient method of generating electricity. Although the maximum energy that may well be generated is less than 5kW, the amount of energy stored in the battery is sufficient to power small appliances such as lamps, fans, radios, and other similar items. The development of this pico-hydro system starts on designing the prototype using Autocad to get realistic look. The design characteristic must have flat surface base to get the stability for the system to hang on the vibration during rotational movement of the turbine and the actual prototype uses solid metal to have weight on the system. The turbine itself use z-blade design since the project uses water reaction turbine and PVC pipe were the material picked as it is the lightest material to get good rotational motion beside on cheapest in the market compared to GI pipe. The z-blade turbine contains several characteristics for the system such as turbine length, pipe size, and nozzle size. The z-blade turbine length was tested from 0.4 meter up to 1 meter and pipe size was 0.75 inch to 2 inch. Nozzle development and testing used sizes of 8mm, 12mm, and 16mm. The goal of this project is to create a basic water turbine for a low-head pico-hydro generation system. Two key factors, head and water flow, impact the quantity of energy produced by the pico-hydro generating system. The amount of energy that can be produced varies depending on the head with maximum length is 5m water head. This project has successfully gained 90 rpm for the turbine speed, 18.41 V of DC voltage, 4.7 A of DC current, and 63.45 Watt of output power maximumly.

ABSTRAK

Turbin air pico-hydro ialah sistem penjanaan kuasa yang menggunakan arus air dan aliran pasang surut. Pico-hydro, dengan kata lain, adalah sistem hijau yang menjana kuasa tanpa bergantung kepada mana-mana sumber lain. Aplikasi ini menyediakan kaedah penjanaan elektrik yang kos efektif dan cekap. Walaupun tenaga maksimum yang mungkin dijana adalah kurang daripada 5kW, jumlah tenaga yang disimpan dalam bateri adalah mencukupi untuk membekalkan kuasa kepada peralatan kecil seperti lampu, kipas, radio dan barangan lain yang serupa. Pembangunan sistem pico-hydro ini bermula dengan mereka bentuk prototaip menggunakan Autocad untuk mendapatkan rupa yang realistik. Ciri reka bentuk mesti mempunyai tapak permukaan rata untuk mendapatkan kestabilan untuk sistem bergantung pada getaran semasa pergerakan putaran turbin dan prototaip sebenar menggunakan logam pepejal untuk mempunyai berat pada sistem. Turbin itu sendiri menggunakan reka bentuk bilah-z kerana projek itu menggunakan turbin tindak balas air dan paip PVC adalah bahan yang dipilih kerana ia adalah bahan yang paling ringan untuk mendapatkan gerakan putaran yang baik selain paling murah di pasaran berbanding paip GI. Turbin bilah-z mengandungi beberapa ciri untuk sistem seperti panjang turbin, saiz paip dan saiz muncung. Panjang turbin bilah-z telah diuji dari 0.4 meter hingga 1 meter dan saiz paip adalah 0.75 inci hingga 2 inci. Pembangunan muncung dan ujian menggunakan saiz 8mm, 12mm dan 16mm. Matlamat projek ini adalah untuk mencipta turbin air asas untuk sistem penjanaan pico-hidro berkepala rendah. Dua faktor utama, kepala dan aliran air, memberi kesan kepada kuantiti tenaga yang dihasilkan oleh sistem penjanaan pico-hidro. Jumlah tenaga yang boleh dihasilkan berbeza-beza bergantung kepada kepala dengan panjang maksimum ialah kepala air 5m. Projek ini telah berjaya memperoleh 90 rpm untuk kelajuan turbin, 18.41 V voltan DC, 4.7 A arus DC, dan 63.45 Watt kuasa keluaran secara maksimum.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, IR. DR. MOHD FARRIZ BIN HJ MD BASAR, and co-supervisor, PN NURUL ASHIKIN BINTI MOHD RAIS for their precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support which enables me to accomplish the project. Not forgetting my fellow colleague, SYAMIL HAZIM BIN JAAFAR, ARIFF'AFIF' BIN ARIFIN, KHAIRIL AZIZI BIN AZMAN JAILANI, AHMAD SYAKIR RAIMI BIN AHMAD SAZLI, MUHD IZZUDIN BIN MOHD ZIN, and MUHAMAD IKRAM HAKIMI BIN SAIFUL NIZAL, for the willingness of sharing their thoughts and ideas regarding the project.

My highest appreciation goes to my parents, NORAFIDA BINTI MOHD JALUDIN, MOHD ZAMRI BIN HITAM, and family members for their love and prayer during the period of my study. An honourable mention also goes to AMIRA SYAZWANI BINTI AHMAD MAKHTAR for all the motivation and understanding. Thank you to my academic advisor, PN NURUL KAUSAR BINTI AB MAJID for giving up her time and effort to help me all the time whenever I needed her.

Finally, I would like to thank all the staffs, fellow colleagues and classmates, the faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

η	-	Efficiency
F	-	Force
m	-	Mass
a	-	Acceleration
ρ	-	Density Of Water
V	-	Velocity
P	-	Pressure
A	-	Area
h	-	Height
g	-	Gravitational Force

LIST OF ABBREVIATIONS

V	-	Voltage
A	-	Ampere
W	-	Watt

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

The introduction chapter tell about an alternative way on generating electrical power. In this chapter, the lack of use of this system is strongly underlined by stating the problem statement, objectives, and scopes.

1.2 Pico-Hydro Water Turbine

Water can be used more wisely than we used today as this element can be used to generate electricity as fact stated that 70 percent of the whole earth is covered by water. The rising cost of living today has opened the eyes of our society that it is necessary to find alternatives to reduce and minimize daily expenses. One of the ways is to generate electricity for the use of part of the daily electrical goods and not rely entirely on the country's national electricity supplier who charges on a monthly basis which may inflate the bill every month. Pico-Hydro water turbine is uncommon in Malaysia where the average community and our government itself does not see the potential of this power system as an investment with a good return because there are still lack of examples and evidence of its effectiveness in Malaysia.

Hydropower system is electrical power that we can gain from the produced energy of falling water or fast-running water and influenced by several aspects such as the electrical power produced is depends on the speed of running water, the motor limit gained power, and also the nature factors [1].

The Pico-Hydro generation system, which produced energy using water as a primary source, is an effective way to assist rural people. Reducing the amount of fuel used to create power will be a huge step forward for the world [2].

The length or range of water from the tank until it reaches the turbine is referred to as the head. Pico-hydro with various levels of head has developed rapidly during the last decade. Figure 1.1 down below illustrate the basic pico-hydro system and how the system works.

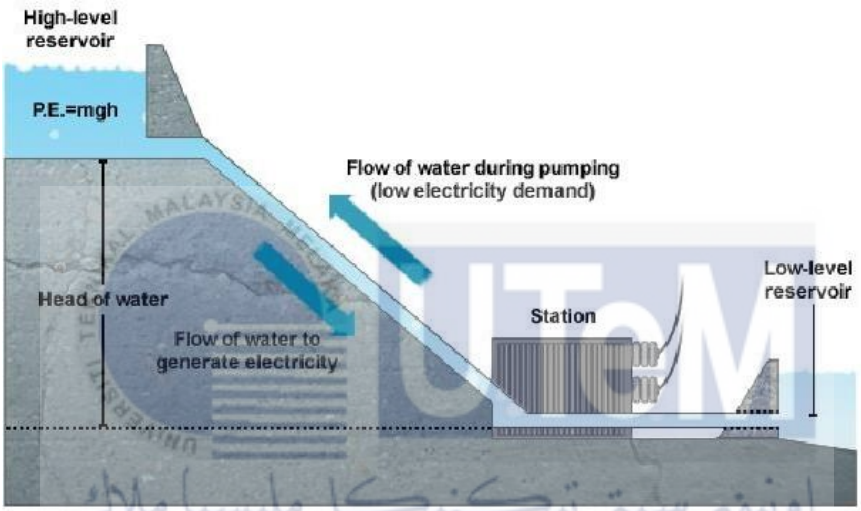

Figure 1.1 Construction of Hydropower system

(Source:

https://www.researchgate.net/profile/Siwar_Kriaa2/publication/301619790/figure/download/fig2/AS:354675732828162@1461572692963/A-pumped-storage-hydroelectric-power-station.png)

Low head hydroelectric power development refers to the development of hydroelectric power with a head of less than 30 meter, however precise definitions vary. The vertical height between the water level at the hydro intake and the water level at the point of release is known as the head. Creating power with only a low head drop in a river or tidal flows could provide a renewable energy source with minimum environmental impact.

In recent years, there has been a surge in interest in using pico-hydropower system to generate electricity. This cost-cutting method should be implemented globally to lessen the environmental impact. Furthermore, this system should be sufficient to provide main power to small households in the event of a blackout, but only for small appliances such as lamps, fans, radios, and other similar items.

1.3 Problem Statement

Large-scale and widespread pollution as well as declining or shortage of natural resources such as biodiesel, coal and petroleum will be challenging to do the conventional energy technology. Other problem is also on choosing the renewable energy system which must suitable on the geographical factor. Today, electricity is an obligation in daily life including residents in rural areas. The development of large -scale electrical systems is very difficult to implement in rural areas and this is also very costly.

Problems	Solution
Large-scale pollution	Pico-hydropower system has less environmental effect than hydropower system
Geographical Factor	Pico-hydropower system does not require certain big amount of water current, the system will run as long have water flow.
Rural area electrification	The cost of developing a hydropower system is very expensive and unprofitable for the use of rural areas. So, the use of pico-hydropower system is the right choice as it is the cheapest cost and can help a little in lighting up houses in rural areas.

1.4 Objective

i) to design a simple water reaction turbine for pico-hydropower system.

ii) to construct a system that can generate clean energy electricity below 5kW.

iii) to investigate the performance of simple reaction water turbine for low head condition.

1.5 Scope of Project

The scope work of the project is to develop a low head Pico sized hydropower system to gain energy below than 5kW as the size is Pico and it will use the low head water reaction turbine to make it work perfectly. To be clear, a low head means where height of head to be explore is below than five meters in this situation. This project take advantage from the strong and never-ending flow of water on the consuming water reservoirs to gain the energies. As additional information, there will have a stable power gain condition because there are no climate changes which happen on natural flowing water such as river. As said that we are using the water reaction turbine, the water must hit turbine fan to spin it by kinetic energy and can generate the electrical energy to be used for some purposes. The water head parameters that used in this project is below 5-meter and the project focused on developing a simple water turbine. The max power output expected to be less than 250W since the generator capacity used below 250W.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discuss about theories that been used in this project. In addition, previous research that have been done completely also been understudy all over again to gain valuable data for the project.

2.2 Hydro Electric Power

The world is currently still heavily dependent on non -renewable energy sources (fossil fuels) such as coal, oil and natural gas, which are rapidly declining and becoming increasingly expensive, the role of renewable energy has been recognized as very important in the future of sustainable development [3]. Fossil resources appear to be most widely used in almost all countries contributing significantly to the deterioration of environmental conditions by depleting the ozone layer and therefore not being able to survive forever.

Hydropower is a good example of renewable energy where its use is very optimal now and its potential use for future power generation should not be underestimated. Hydropower is obtained from the energy produced by flowing or falling water. Hydropower has become a main source on generating electricity in the 19th century.