Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF BICYCLE POWERED BATTERY CHARGER USING DYNAMO AND DC GENERATOR

NUR AQILAH BINTI NOR MOHAMAD

Bachelor of Electrical Engineering Technology with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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PROJEK SARJANA MUDA II

Tajuk Projek : Development of Bicycle Powered Battery Charger Using Dynamo and DC Generator.

Sesi Pengajian : Semester 2 Tahun 2022/2023

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I declare that this project report entitled "Development of Bicycle Powered Battery Charger Using Dynamo and DC Generator" 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 : NUR AQILAH BINTI NOR MOHAMAD

Date : JUNE 21st 2023.

APPROVAL

I approve that this Bachelor Degree Project 2 (PSM2) report entitled "Development of Bicycle Powered Battery Charger Using Dynamo and DC Generator" is sufficient for submission.

Signature : 

Supervisor Name : DR. AZHAN BIN ABDUL RAHMAN

Date : JUNE 21st 2023.

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 with Honours.

Signature : .....

Supervisor Name : DR. AZHAN BIN ABDUL RAHMAN

Date : JUNE 21st 2023.

.....

DEDICATION

This study is dedicated to my beloved parents, who have been my source of inspiration, guide and give me strength, when I thought of giving up, who continually, provide their moral and spiritual support.

A special thanks is truly dedicated for my Supervisor, Dr Azhan Bin Abdul Rahman, who guided me through thick and thin of completing my project for along the two semesters of Bachelor's Degree Project. He encouraged me to finish this whole project in time.

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Also not to forget to my pals who are always available for me to ask for their help anytime I need them. I am truly grateful of having them in my circle.

ABSTRACT

Cycling nowadays is not only a means of transport. Technology in bicycle making has rapidly evolves that the it is now a multimillion industry and the price of bicycle used for casual exercise during weekends can easily reached up to thousands of ringgit. Cycling normally involves transfer of kinetic energy from human to the bicycle through several mechanical parts and elements. However, the produced kinetic energy usually goes to waste apart from moving the bicycle forward. Therefore, this project aims to develop an energy storage system that can store the energy produced during the cycling activity to be used for charging of electrical appliances such as mobile phone afterwards. In order to achieve the relevant objective, two methods are used in this project for the battery charging method. Some other methods are also used such as the trial method to try the suitability of the method to charge the battery. The methods used are to use a dynamo as an AC generator and a DC machine as a DC generator. These two types of generators have different sizes in terms of diameter where they require different speeds to reach the required RPM. The dynamo needs more cycling energy to reach the same RPM as the DC generator because of its smaller diameter compared to the DC generator. Through the accumulated results and the analysis done, the prediction of the required voltage can be obtained through a linear equation resulting from the graph of the resulting voltage against RPM. As the conclusion, it is expected that this project can be carried out outside of this project and mounted on a bicycle for daily use in the future.

ABSTRAK

Berbasikal pada masa kini bukan sahaja sebagai alat pengangkutan. Teknologi dalam pembuatan basikal telah berkembang pesat sehingga kini menjadi industri berjuta-juta dan harga basikal yang digunakan untuk senaman santai pada hujung minggu dengan mudah boleh mencecah sehingga ribuan ringgit. Berbasikal biasanya melibatkan pemindahan tenaga kinetik daripada manusia kepada basikal melalui beberapa bahagian mekanikal dan elemen. Walau bagaimanapun, tenaga kinetik yang dihasilkan biasanya menjadi sia-sia selain daripada menggerakkan basikal ke hadapan. Untuk menjayakan objektif yang berkenaan, terapat dua metod yang digunapakai di dalam projek ini untuk kaedah pengecasan bateri. Beberapa kaedah lain juga digunapakai seperti kaedah cuba jaya untuk mencuba kesesuaian kaedah tersebut untuk mengecas bateri. Kaedah yang digunakan adalah menggunakan dynamo sebagai AC generator dan mesin DC sebagai dc generator. Kedua dua jenis generator ini mempunyai beza saiz dari segi diameter dimana ianya memerlukan kelajuan yang berbeza untuk mencapai sekian rpm yang diperlukan. Dynamo memerlukan lebih tenaga kayuhan utk mencapai RPM yang sama dengan generator DC kerana saiz diameternya yang lebih kecil berbanding generator DC. Melalui keputusan yang terkumpul dan analisis yang dilakukan, anggaran terhadap voltan yang diperlukan boleh didapati melalui persamaan linear yang terhasil oleh graf voltan terhasil melawan RPM. Sebagai kesimpulan, dijangka bahawa ini mampu untuk dijalankan di luar daripada projek ini dan dipasang pada basikal untuk kegunaan harian pada masa akan datang.

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μ	-	micro
V	-	Volt
A	-	Ampere
Ω	-	ohm
H	-	Henry
F	-	Farad
K	-	kilo
I	-	current
Hz	-	Hertz

LIST OF ABBREVIATIONS

AC	-	Alternating current
DC	-	Direct current
PHS	-	Pumped Hydro Storage
VRB	-	Vanadium Redox Bromide
ZnBr	-	Zinc bromide
NaS	-	Sodium sulphur
NiCd	-	Nickel cadmium
e-bike	-	Electronic bicycle
LED	-	Light emitting diode
CO	-	Carbon monoxide
CO2	-	Carbon dioxide
EV	-	Electric vehicle
SoC	-	State of charge
Li-ion	-	Lithuim-ion
SLA	-	Sealed-lead acid
p-n	-	Positive-negative
VRLA	-	Valve-regulated lead acid
LCD	-	Liquid crytsal display
USB	-	Universal serial bus
RPM	-	Rotations per minute
PWM	-	Pulse with modulation

CHAPTER 1

INTRODUCTION

1.1 Overview

This project is a study on energy generation. If we look at a large scale, energy sources are such as hydropower, nuclear energy, solar and some more. A study is conducted on the generation of small energy produced and have potential of being renewed. In general, energy is the ability do work. Batteries are grouped into two types, which are rechargeable and non-rechargeable batteries. When the battery has run out of its capacity, the non-rechargeable battery will be disposed, while the rechargeable battery will be charged using a specific charging method depending on the type of battery.

A battery charger is needed to charge a rechargeable battery. Typical type of battery charger are the plug-in charger, which plug-in battery charger that is powered by electricity. The common source of electricity used in our country is hydropower, as is the power supplied in every domestic or industrial area. There is also another source that supplies electricity in our country that has already started to be used by the public, which is solar energy. Solar energy which is renewable energy is also a good initiative because it uses sunlight as a source and considering that our country is a country with a hot and humid climate that is irradiated by sunlight throughout the year.

Instead of depending on the electrical power supply, another alternative that can be used to charge the battery is to use a generator. For instance, the lights that turn on from cycling

are through the dynamo. A dynamo is a generator that changes the form of energy from mechanical tire rotation to electrical energy to power up the lamp. However, the method is an alternating current method where the light will only light up if there is cycling, and otherwise it will not light up. Instead of the energy released is simply wasted, it is better if it is stored in the form of energy that can be stored in the battery for other uses.

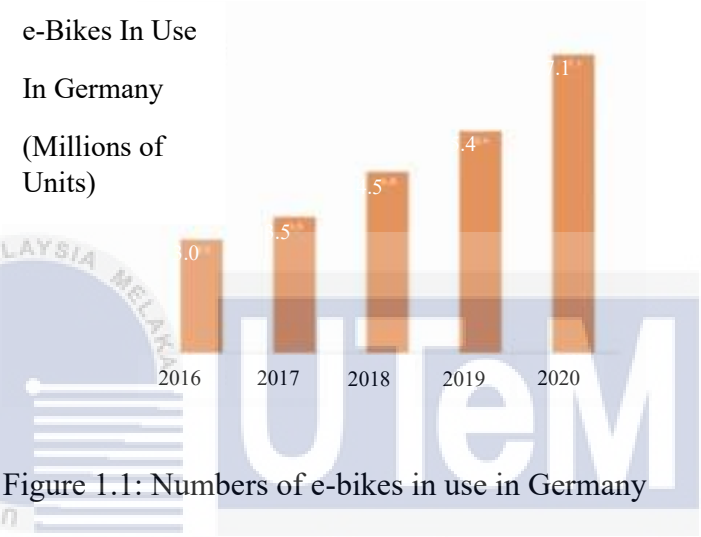

Figure 1.1: Numbers of e-bikes in use in Germany

Figure 1.1 above shows the graph of numbers of e-bikes in use in Germany from year 2016 to 2020 in millions of units. The trend shows an increment number of bicycle that are used in that country in 4 years. After all, the number of e-bikes rolling on German streets has grown from 5.4 to 7.1 million units in 2020 alone, and there is no end in sight for this growth [1]. The increase in the sale of the bikes shows that the increase in demand by consumers. The increase in the number of bicycle users also contributes to the increase in energy production through cycling. Therefore, it is good if the generated energy that is simply wasted is utilized by means of storage in the form of renewable energy.

For this project, the energy is the parameter that is generated by the cycling activity and then being converted from mechanical to electrical energy to charge a DC equipment. Several previous work and studies related to energy have been done to be references in order

to complete this project. So, this project proposes about the production of energy through the rotation of bicycle tires that can be stored to charge the battery.

1.2 Problem Statement

Mechanical energy is readily available everywhere. Cycling leisure activity has become a trend nowadays. As we know, bicycles have tyres that produce kinetic energy when pedalled in motion mode. The energy produced if not utilized will be wasted just like that. So the problem is a waste of energy from cycling, and the way to solve it is we can collect the wasted energy and store it for future use.

1.3 Project Objectives

The objectives of this project is to propose a systematic and effective methodology to store wasted energy produced by a moving bicycle tyre. Specifically, the objectives are as follows;

a. to study on research from previous work by others,
b. to do pre-simulation circuit using appropriate software,
c. to develop a battery storage system that can collect energy through cycling movement.
d. to measure the voltage required for battery charging,
e. to determine suitability of the battery to be charged by cycling movement based on the energy required.

1.4 Scope of Project

To avoid any uncertainty of this project due to some limitations and constraints, the scopes of the project are defined as follow;

a. a rechargeable 12V sealed lead-acid battery with 4500mAh capacity,
b. the size of energy stored is from the energy produced by the rotating bicycle tyre with 3000 rotation per minute maximum,
c. the accumulated energy is collected through two types of generator; 29mm diameter AC generator and 39mm diameter DC generator with size with range 0 to 20V maximum that converts kinetic energy to electrical energy,
d. a smartphone with Lithium-polymer type, 5000mAh battery capacity,
e. voltage regulation in the charging circuit using a charge controller and a variable voltage regulator that is set to 15V.