



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PORTABLE DUAL-AXIS SOLAR TRACKING SYSTEM

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

by

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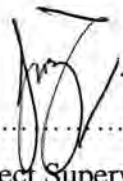
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APPROVAL

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 Electrical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:



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ABSTRACT

With the growth of technologies and development, the demands of electrical energy for daily activities increased. Oppositely, the fossil fuel used for producing electricities dwindling day by day. Besides, environmental pollution also become worst then before. Therefore, alternative energy is strongly needed in this era. Among the natural unended energy, solar is one the energy which adoptable and famous on study cases. This project proposed purposely to increase energy harvest from photovoltaic solar panel. With Dual-Axis Tracking System more energy would be produced. Because solar panel with tracking system facing to the sun in azimuth and altitude during daytime is more comparing to static solar system. Main items in dual axis solar tracking system includes sensing unit, motor, controlling unit and most important part is the solar panel. To make the energy that harvest by solar during daytimes could be used during nights, it needs a energy storage to store the output power from solar panel. The results proven the prediction. To prevent the energy cut-off dueto running out of energy in storage, stable backup supply is needed. Thus, ideal backup unit for the system is national grid for technical faulty and unexpected situation.

DEDICATION

Firstly, I would like to dedicate my research study thesis to Father God, the Lord for his blessing and loves. Besides, I also would like to dedicate to both of my parents, who supports, full encouragement and guide me along the way I growth. Here by, unforgettable dedicate to my beloved supportive guardian project supervisor, Miss Suziana binti Ahmad who always supported me, giving ideas, encourage me with opinions, listen to my problems, taught me be a better man who responsible to work and always ready to lend me a hand. Sincerely, dedicate to my lecturers, especially Mister Aminurrashid bin Nordin who spend his valuable time to support me. Last and not least, I dedicate to all my fellow friends who support and encourage me until the very last of my thesis, I sure will perpetually appreciate all of them. May God bless all of them.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

Al	-	Aluminium
ANOVA	-	Analysis of Variance
ASEAN	-	Association of Southeast Asian Nations
AT	-	Annual Turnover
Cl	-	Chlorine
F	-	F Test (ANOVA)
FMM	-	Federation of Malaysian Manufacturers
HU	-	Highly Used
IT	-	Information Technology
LU	-	Least Used
M	-	Million
MITC	-	Melaka International Trade Centre
MNC	-	Multinational Company
MU	-	Moderately Used
NOYP	-	Number of Years in Operations
NOE	-	Number of Employees
NU	-	Not Used
PP	-	Polypropylene
PCL/TPS	-	Polycaprolactone/Thermoplastic Starch Blend
RM	-	Malaysian Ringgit
SD	-	Standard Deviations
SME	-	Small Medium Enterprise
U	-	U Test (Mann Whitney Test)
>	-	More than
σ	-	Stress
ϵ	-	Strain
τ	-	Torque

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter basically give the idea about this project report. It briefly explains about the project Portable Dual-Axis Solar Tracking System. The topics include background for the project, problem statement, objective, project scope, project significance, thesis outline, and expected result. Every topic in this chapter leads to basic of the idea.

1.1 Background

In this modern era, developing became a part of human life. However, global warming and pollutions happen as serious issues because of the developments. In order to overcome these global issues, one of the ways is replacing the non-renewable energy with renewable energy to avoid the produce of harmful wastes. Follows, Green Technologies became important alternative for future. Renewable energies for sure not only environment friendly, also saving cost in long term. The common renewable energies are source from natural, such as wind energy, hydraulics energy, heat and solar energy. Solar energy is the energy which low cost and easy to adopt in life. Moreover, solar technology is a fast growing technology among renewable energy. In urban area, electricity is one of the necessities for daily life and activities. Thus, it causes the high demands, then a lot of countries facing the problem of shortage of energy supply. The shortfall of necessitates issue also have to

settle down. As result of this, the solar energy as power generate source for residential area for common usages also a great idea. Solar tracking power system does not need broad technological base, but in urban areas, there are no enough places or spaces for set up solar panel or photovoltaic panel to generate required demands. In additionally, urban areas such as city residential more live in apartments in levels. Therefore, the space or area is limited. To resolved those problems and match with Green Technology concept idea, solar energy is a best choice since it is a natural renewable energy resource without exploitation and would not cause environmental pollution.

1.2 Problem Statement

Our country is rich with fossil fuel such as petroleum and coal. These make us rely on fossil fuel to get the energy, power supply in passed. Although, the fossil fuel leads country to economic stable or even prosperity, but this is the results of extensively use of the fuel. As a matter of fact, all fossil energy is a natural energy but consumable energy and not really friendly with environment, may even cause pollution. Until the renewable energies technology been introduced as the alternate energy to overcome global warming and reduce to pollution level. The source of power energy then start replace by natural, renewable environmental friendly energy which suitable with our country landscape, like hydraulic energy. However, for those villages which in remote areas in the country are always out of national grid coverage. In order to meet the demands, install solar tracking systems is a great idea. The system not only easy to install, it also could be implement easily. Moreover solar energy sources are harmless to natural.

1.3 Objective

The aims of the project are:

- a) To study the electrical parameters of solar panel.
- b) To understand a mechanism for moving solar panel.
- c) To design and develop solar tracking system that work in dual axis.

1.4 Project Scope

This project is divided into several major activities which is studying about materials and component (solar panel, motor and sensor). Then, develop hardware and programming using Arduino UNO. The project functions, once the sensor detect light; the signal will be send from sensor to the programming system. Then programming system decides which motor should move to make the sensor face right toward the light. The solar panel set up parallel with the sensor.

- a) Develop the system that pair with energy storage in order to store the generated power from solar panel. The energy stored is for use during night time or during the time solar panel cannot generate and supply power normally. Software implementation using Arduino programming, Hardware implementation using microcontroller, motor with driver, photodiode sensor.
- b) The system is backup with national grid. To avoid unexpected situation such as the demands of supply higher then storage energy during the time solar panel not generating power. Consequently, the system must have a backup supply.

1.5 Project Significance

This project will be a significant endeavour in promoting ideal alternate power generator, solar tracking system that makes life better and healthier. This project will likewise be beneficial to the environment which not only environment friendly, also synchronize with the Green Technology concept for greater future.

1.6 Thesis Outlines

There are five chapter in this thesis include of introduction of the project, literature review which is the works of others that related with this project, the method that used to implement the knowledge into project, data result get from testing prototype and lastly conclusion and recommendation for overall of thesis.

Chapter 1: This part briefly discusses on the general idea of this project including of introduction, problem statement, the target of this project, the scope of project, project significant and thesis outlines.

Chapter 2: This part focuses more to study the literature review which is previous work that related with this project. It is important in order to obtain the some knowledge or concept of Solar Tracking. Then, briefly explain about developments related with this project.

Chapter 3: The brief clarifications of methodology are discussed in this chapter. It consists of flowchart of whole project and the descriptions of component that will be used to develop project for solve the problem statement.

Chapter 4: Here is where going to discuss about the data collection from prototype testing for develop the project. Comparison make between self-idea andthe other similar product.

Chapter 5: The overall of the project discussion area. In this chapter also telling recommendation about the project study, and some ideas of improve, suggestion for future innovator and researcher.

1.7 Expected Result

The expectation of the result is wish to come out a prototype of Dual-Axis Solar Tracking System paring to solar panel with energy storage. It is about to make solar panel face right to the source of sunlight more accurate and longer time by motor support with mechanism body. Besides, by supporting with energy storage, making the energy power source produce can be use even during night time. Then, the national grid is just as a backup supply. With this, the percentages of rely on consumable energy will decrease.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Chapter 2 in the chapter that include the useful information that relate to the project which help to understand more about Dual-Axis Solar Tracking System. The information is from several previous researches and different study cases with different concept of solar tracker. For develop a project, study and research the materials and components use is an important and helpful step. The study materials are from journal, books, article, and website. Although having several resources for the information, but the focus more on journals, study from others experiences on the similar project.

2.1 Related Previous Project Work

These are the chosen sample journals that concerning with the Portable Dual-Axis Solar Tracking System. There are a lot of components, materials, concepts, or even ideas synchronize with the project to be developing in those selected sample journal. Therefore, they have been use as reference for the project, Portable Dual-Axis Solar Tracking System.

2.1.1 A High Power Generation, Low Power Consumption Solar Tracker)

Salsabila Ahmad, Suhaidi Shafie and Mohd Zamal Abidin Ab Kadir (2012) produced “A High Power Generation, Low Power Consumption Solar Tracker”. This paperwork presented a project which has dual-axis tracking system, powered by Programmable Logical Controller (PLC) and formula that pre-calculated by the altitude and azimuth of the sun. According to them, the solar tracker unit system generated higher power compare to non-tracking unit. Besides, the tracking system consumes about 5.89% from the generated power. The different between our projects are the control program. A High Power Generation, Low Power Consumption Solar Tracker using Programmable Logical Controller and I proposed to use Arduino UNO as powered program of system.

2.1.2 Design and Construction of an Automatic Solar Tracking System)

TMd. Tanvir Arafat Khan, S.M. ShahrearTanzil, Rifat Rahman and S M ShafiulAlam (2010) come out a project journal which title “Design and Construction of an Automatic Solar Tracking System”. This project amazingly similar with the project that proposed by me is where build a solar tracking system solar cell (also known as solar panel). The makers also use Light Dependent Resistors (LDRs) as sensor for the tracking system. The system is work by microcontroller. Then, combination of stepper motor and mechanism works in prototyping the project. The only differences are their project works in bidirectional rotation and microcontroller use, whereas the project idea that proposed work in dual axis and using Arduino board as controlling unit.

2.1.3 Model Predictive Control of 2-axis Solar Tracker for Solar Energy System

WANG Wei, LI Shaoyuan (2012) with the premise of constraint conditions produced “Model Predictive Control of 2-axis Solar Tracker for Solar Energy System” which used to study about the problem of dual-axis solar tracker control. According to the studies outcome, the position of the sun is keep changing every second. Due to the situation, the fix solar panel, solar cell having low conversion efficiency because not facing to the sun perpendicularly always. From the journal provided, they noted that there are THREE ways to carry out the control of solar tracking: Uniform Tracking Method, Irradiance Comparison Method and Space-time Synchronization Method. From those listed methods, I realize that my study case is focusing more on the second method, Irradiance Comparison Method, where as their study case is focusing third method, Space-time Synchronization Method.

2.1.4 Design, Development and Performance Test of an Automatic Two-Axis Solar Tracker System

“Design, Development and Performance Test of an Automatic Two-Axis Solar Tracker System” is the research results by Prabodh Bajpai and Subhash Kumar (2011). This also another project journal that having high similarity with my proposed project idea. Using light dependent resistors (LDRs) to form a solar sensor, microcontroller as the program control unit. Steppers motors fix to mechanism to drive the solar panel in the desired position to gain the maximum power generate. Although overall of this project is highly identical with my proposed idea, but they do not have the backup system for night time.

2.1.5 A Three Level Solar Panel System with an Automated Solar Tracker

H. M. Moniruzzaman, Munia Patwary and Mosaddequr Rahman (2014), carry out a project with title “A Three Level Solar Panel System with an Automated Solar Tracker”. The authors of project totally come out a refresh idea about the design of multi panel of solar tracking system. The mechanism build in ladder design where there is first level, second level and third level and solar panel are installed in every level. Then, this project is using idea method of Uniform Tracking or Space-time Synchronization Method, because the design does not have sensing item in the system. Even though this project is different from the design and also the method use, but the idea and the objective still synchronize with research study, therefore it also consider as a reference case.

2.1.6 Solar Power Battery Charger with a Parallel-Load Resonant Converter

Yu-Lung Ke, Ying-Chun Chuang, Mei-Sung Kang, Ching -Ming Lai, Yuan-Kang Wu and Chien-Chih Yu (2011) present “Solar Power Battery Charger with a Parallel-Load Resonant Converter”. This is the project journal that focuses more on renewable alternative energy. To overcome the problem of solar cell could not generate power during night and low illumination intensity, energy storage use to be the place to store energy. There is a must to have charger circuit in the system for power generated from solar panel to charge the storage (battery). This journal being chosen as one of the reference because storing the energy generated from solar tracking system in a part of the proposed project idea.

2.1.7 High-Efficiency Dual-Axis Solar Tracking Development using Arduino

Zolkapli, M., AI-Junid S. A. M., Othman Z., Manut, A., and Mohd Zulkifli M. A. (2013) having an outcome of cooperation “High-Efficiency Dual-Axis Solar Tracking Development using Arduino”. This is the project which study about a renewable energy, solar energy. Develop a solar tracking system to gain maximum output power from sunlight through solar panel. This system is set up by a solar cell, support by mechanical works, using five light dependent resistors (LDR) as sensor, two servo motor and Arduino UNO as control unit for whole system. From the surface, the project is only the type of motor used is different with mine. Servo motors are used in this project and my idea for project is using stepper motors, therefore this journal also be selected as reference for my project work.

2.1.8 Performance Comparison of Dual-Axis Solar Tracker vs Static Solar System in Malaysia

J. F. Lee, Nasrudin Abd. Rahim (2013) represent their research outcome of cooperation, “Performance Comparison of Dual-Axis Solar Tracker vs Static Solar System in Malaysia”. The research is mainly compared and discussed about the efficiency of tracking and fixed photovoltaic (PV) solar system on the quality and quantity in Malaysia climate. Research comparison between dual-axis solar tracking system and the mounted static solar system from the harvest result. It shows the solar panel with tracking system produce thrive output energy compare to the fixed, static solar system. The solar tracking system is most directly approaches adopted to produce more energy from photovoltaic than static solar system. From the result, we know that the solar tracking system make the solar panel face to the sun during daytimes. Therefore the panel receives maximum sunlight then increase the energy generation. According J. F. Lee