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DEVELOPMENT OF DUAL AXIS SOLAR TRACKER WITH SURFACE PANEL CLEANING SYSTEM USING ARDUINO

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A project report submitted in partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DECLARATION

I declare that this project report entitled "Development of Dual Axis Solar Tracker with Surface Panel Cleaning System using Arduino" 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.



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.

DEDICATION

This project is basically a dedication to myself for being an engineering student and for this being the very first project I have ever undertaken for the purpose of learning and working toward completing this project. It is also enthusiastic to both my mother and my father, who taught me that even the most challenging activity can be successful if it is completed one step at a time and patience is exercised throughout the process. Last but not least, I would like to extend my deepest gratitude to my supervisor, Ts. Zaihasraf Bin Zakaria, as well as to all of my other friends, for serving as tremendous pillars of support



ABSTRACT

Solar energy is quickly becoming a vital source of renewable energy. With solar tracking, it will be feasible to create more energy since the solar panel will be able to maintain a perpendicular profile to the sun's beams. Even if the initial cost of setting up the monitoring system is significant, there have been cheaper alternatives presented throughout time. This project discusses the design and building of a solar tracking system prototype with a dual axis of flexibility. Light Dependent Resistors (LDRs) are used to detect sunlight. An Arduino microcontroller serves as the foundation for the control circuit. The LDRs were configured to detect sunlight before activating the servo to position the solar panel. When opposed to conventional motors, servo motors can retain torque at high speeds. They are also more efficient, with efficiencies ranging from 80% to 90%. The project entails designing and developing a solar panel cleaning system. The primary goal of this design prototype is to clean the solar panel utilising an electrical mechanism while maintaining the efficiency or quality of the solar panel. In reality, due to the frequent dust, the solar panels must be cleaned on a regular basis. If the work is done manually, it will be highly expensive and time consuming. Water sprinklers substance must be utilised in the designed mechanism to ensure cleaning quality.

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ABSTRAK

Tenaga suria dengan cepat menjadi sumber tenaga boleh diperbaharui yang penting. Dengan pengesanan suria, ia boleh dilaksanakan untuk mencipta lebih banyak tenaga memandangkan panel suria akan dapat mengekalkan profil berserenjang dengan pancaran matahari. Walaupun kos awal untuk menyediakan sistem pemantauan adalah besar, terdapat alternatif yang lebih murah yang dibentangkan sepanjang masa. Projek ini membincangkan reka bentuk dan membina prototaip sistem pengesan suria dengan paksi dwi fleksibeliti. Light Dependent Resistors (LDR) digunakan untuk mengesan cahaya matahari. Mikropengawal Arduino berfungsi sebagai asas untuk litar kawalan. LDR telah dikonfigurasikan untuk mengesan cahaya matahari sebelum mengaktifkan servo untuk meletakkan panel solar. Apabila bertentangan dengan motor boleh mengekalkan tork pada kelajuan tinggi. Ia juga lebih cekap, dengan kecekapan antara 80% hingga 90%. Projek ini memerlukan mereka bentuk dan membangunkan sistem pembersihan panel solar. Matlamat utama prototaip reka bentuk ini adalah untuk membersihkan panel solar menggunakan mekanisme elektrik sambil mengekalkan kecekapan atau kualiti panel solar. Pada hakikatnya, disebabkan habuk yang kerap, panel solar mesti dibersihkan secara berkala. Jika kerja dilakukan secara manual, ia akan menjadi sangat mahal dan memakan masa. Bahan pemercik air harus digunakan dalam mekanisme yang direka untuk memastikan kualiti pembersihan.

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LIST OF SYMBOLS

- *Pm* Maximum power in watt
- G Irradience
- *Ac* Surface area of solar panel in meter square



LIST OF ABBREVIATIONS

- Voltage Power V -
- W _
- Ampere Α _



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CHAPTER 1

INTRODUCTION

1.1 Background

Renewable radiation is both environmentally friendly and plentiful. The sun's energy is used to create heat, light, and electricity in solar technology. These may be used in both commercial and residential settings. Since traditional energy sources such as petroleum, coal, and natural gas are depleting at an astounding pace, it has become imperative to invest in renewable energy sources that can power the future in a safe and environmentally friendly manner. In terms of potential, the sun is a huge resource. The abundance of the resource does not make harvesting easier. it is difficult due to the array cells' limited efficiency. The bulk of commercially accessible solar cells have efficiencies ranging between 10 and 20 percent. This demonstrates that there is still space for advancement. This research aims to find a solution to improve the efficiency of solar panels. Solar tracking is used. The tracking mechanism moves and adjusts the solar array in order to maximise power production. Other methods involve identifying the causes of losses and devising strategies to alleviate them.

When a small portion of a solar panel is occluded by falling rubbish or a film of residue, the performance of the panel reduces dramatically, and rainfall is shown to have little or no cleaning effect. Cleaning the solar panel after it has been installed on the roof of a home, factory, or store is difficult because leftover particles prevent the sun's energy from passing through the panel properly, resulting in a reduction in the panel's ability to generate electricity. Cleaning the surface of the solar panel using a brush and water is the most straightforward, most effective, and most secure approach. The mechanically and

automatically clean method has been implemented in order to make this process more practicable. In cases when manual cleaning is required, this might be beneficial when the cleaning instrument must be moved to power plant locations, which results in a significant increase in labour costs.

1.2 Problem Statement

A solar tracker is a device that is used in a variety of systems to increase the efficiency with which solar energy is harvested. The challenge that has been presented is the construction of a system that is capable of increasing the generation of electricity by 30 to 40%. The microcontroller is responsible for implementing the control circuit. The control circuit then places the motor, which is responsible for orienting the solar panel in the most efficient manner.

1.3 Project Objective

The major objective of this project is to offer a systematic and practical technique for estimating the system wide distribution network of solar tracker and surface panel cleaning systems with a suitable degree of accuracy. Specifically, the following are the aims of the project:

- a) To development of a tracking system that constantly tracing the sun during daytime
- b) To development of a tracking system that make best use of the solar array power generation.
- c) To create a low-powered, cost-efficient cleaning system that is easy to maintain.

1.4 Scope of Project

To avoid any uncertainty of this project due to some limitations and constraints, the scope of the project are defined as follows:

- a) Solar panel efficiency must be boosted significantly by rotating solar panels continually in the direction of the sun.
- b) Make sure the solar panels received water in an efficient manner, and dirt, dust, and other loose particle accumulations were successfully removed by the system.
- c) The decision was influenced by the motor's speed, ability to withstand high torque, precision rotation within a restricted angle, and lack of noise.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Adjusting the angle of a photovoltaic array solar panel so that it faces the sun or directing solar reflectors or lenses so that they concentrate on the sun is accomplished using a solar tracker, a mechanical instrument. As the sun travels across the sky, the sun's position in the sky varies with the seasons and the time of day. The sun's location in the sky varies with the seasons and the time of day. When solar-powered equipment is directed directly towards the sun, it performs optimally. As a result, a solar tracker boosts the efficiency of such equipment as compared to equipment in a fixed location at the expense of adding complexity to the system. There are many kinds of trackers available.

It was only with the invention of the photoelectric mechanism and the subsequent development of the solar cell that it became possible to harness usable electricity from the sun. The solar cell is a semiconductor material that transforms visible light into a direct current. It is used to generate electricity. Solar arrays are made up of a sequence of solar cells that are electrically coupled together are used to create direct current (DC) voltage, which may then be used to power a load. As solar panels' efficiency improves, the usage of solar panels is becoming more widespread.

In poor areas where there is no power grid, these devices are often used. The sun's radiation is the source of photovoltaic energy. A photovoltaic cell, or solar cell, is a kind of cell that can convert light into electricity. Photographic cells are non-mechanical devices constructed of silicon alloy that generate electricity. It is important to consider the aspects that influence the efficiency of a solar panel system to increase its performance. Although

solar energy has increased in installed capacity, "there are still significant issues about the unpredictability of electricity output" that must be addressed. Because to the deposition of dirt on solar panels, the efficiency of solar panels decreases with time. Every day, the effectiveness of solar panels diminishes because of the accumulation of on the panel's surface, there may be soil, rock, stains, or several particles. Dirt deposition has the potential to obstruct some sunlight and, as a result, degrade solar photovoltaic efficiency by as much as 85 percent in certain cases.

2.2 Related review of solar energy

The term "solar energy" refers to the radiation that is emitted by the sun and is capable of either creating heat, stimulating chemical reactions, or producing electricity. Sunlight strikes Earth with an intensity that dwarfs our current and future energy demands. All future energy needs can be met if this widely dispersed resource is adequately tapped. Because of its limitless supply and lack of environmental impact, solar energy is expected to gain popularity as a renewable energy source in the twenty-first century. When compared to the non-renewable fossil fuels such as crude oil and natural gas, which have limited reserves. Earth receives significantly more energy from sunlight than from any other source, even though sunlight's intensity at the Earth's surface tends to be rather low. Radiation from the distant Sun has a large radial dispersion. More over half the sun's energy is absorbed or scattered by the atmosphere and clouds, resulting in a relatively little additional loss. There is around half visible light and half infrared radiation in the sunlight that reaches Earth, as well as trace amounts of ultraviolet and other electromagnetic radiation.

2.2.1 Related review of solar panel

PVs are virtually usually built in the same fundamental way: To generate 100 to almost 450 watts, a loop is formed by connecting anywhere from 36 to 96 rectilinear silicon cells. To link the smaller silver conductor wires in each cell to larger bus bars in the panel junction box, the current flows via crystalline silicone cells. The fingers and bus bar are made of silver and copper, respectively.. The cell string is laminated between two layers of EVA (ethylene vinyl acetate) foil and is protected on both sides by tempered glass and a PVF (polyvinyl fluoride) cover [1].

2.2.1.1 Related review performance of monocrystalline and polycrystalline solar panels

Monocrystalline silicon cells are made in special ovens from monocrystalline silicon cylindrical bars. They're made by cutting the bars into tiny pellet shapes (300 mm thick). Their conversion efficiency of solar light to electricity is roughly 15%, however they have a high production cost. Silicon blocks generated by melting pieces of pure silicon in specific molds are used to make polycrystalline silicon cells. Atoms do not assemble into a single crystal throughout this procedure. The efficiency with which they convert sunlight into power is around 13% [2]. Figures 2.1 and 2.2 demonstrate how solar radiation intensity and cell temperature impact the performance of a photovoltaic panel.



Figure 2.1Solar radiation fluctuation affects a PV system's characteristic curve [2].



Figure 2.2 Temperature effect on PV system's characteristic curve [2].

2.3 Related review of photo sensor

Electrical components used to detect the presence or quantity of light are known as light dependent resistors (LDRs) or photoresistors (photoresistors). It is important to note that LDRs are distinct from other kinds of resistors used in various electronic systems, including carbon film resistors, metal oxide film resistors, metal film resistors, and others. They're made to be sensitive to light and to alter resistance as a consequence.

A sensor gathers signals and turns them into electrical signals that may then be utilized by electronic equipment. Light dependent resistors (LDRs) are employed in the circuit to detect changes in the position of the sun. To use the photocell, connect it beside a resistor in series Consequently, the output at the junction is controlled by the two resistances of a voltage divider. The microcontroller's analogue input pin receives the value. [3].

2.4 Related review types of solar trackers and tracking technologies

There are a number of different types of solar tracking systems in use today.

2.4.1 Active tracker

ASTS are devices that may change the orientation of solar power systems in order to maximize energy intake by orienting the systems perpendicular to sun rays. ASTS typically incorporate components such as sun sensors and solar position algorithms as well as control units as well as limit switches are included in the transmission mechanical drive subsystems [4].

The objectives of the ASTS are to realize high accuracy ST, resistance to shocks, high stability, gentle control signals, and ease of implementation.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA 2.4.2 Passive solar tracking

Passive tracking systems rely on the differential thermal expansion of materials like refrigerants, bimetallic strips, and shape memory alloys. Typically, the mechanism consists of two opposing actuators. When the actuators are illuminated differently, unbalanced forces occur, causing the device to be orientated in such a manner that equal illumination and force balance are restored. Active trackers are more effective; however, these passive trackers are less expensive and less complex than the active trackers. In addition, given that they are thermally activated devices, variations in the temperature of the surrounding environment have the potential to affect how they function. [5].

2.4.3 Single axis trackers

A sun tracker with a single axis follows the sun in just one direction, known as azimuth, as it moves across the sky from east to west. As a consequence of this, the angle of tilt remains the same and is adapted to the latitude of the location. The dual-axis sun tracker has the ability to monitor the sun in both the azimuth and south-north directions (also known as altitude), which ensures that the photovoltaic modules correctly follow the sun. It is possible to classify the control algorithm of the sun tracking system as either an open-loop or a closed-loop approach. [6].

2.4.4 Dual axis trackers

Dual-axis tracking devices track the sun's path east-west and north-south. Dual-axis tracking systems are classified into two types: polar-altitude dual-axis tracking systems and azimuth-altitude dual-axis tracking systems. Regardless of the type of tracking system, it must have a long life, be dependable, require little maintenance, and hence have low running costs [7].

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2.5 Related review of cleaning system for surface solar panel

Two distinct methods Dry cleaning is more common in dry regions and is often used because there is a shortage of water or because accessing water might be problematic. One of the issues that might arise from using dry cleaning is the possibility of causing scratches on the first glass layer of solar cells, which can lead to irreparable damage to the panels. Wet cleaning is growing in popularity in areas that have easy access to a local water supply as well as in-home cleaning systems that are intuitively laid up. Depending on the sort of spot on the solar panels, water or other cleaning solutions might be utilized [8].

2.5.1 Conventional cleaning methods

Many research have been undertaken on different ways for cleaning PV panels using water. Furthermore, much work has been put into developing water-free techniques. Such integrated studies are quickly becoming an essential approach for increasing power production while saving water. Following a study of much research, cleaning techniques may be roughly characterized as follows.

2.5.2 Manual solar panel cleaning systems

Problems with manual cleaning include the risk of staff injury and panel damage, difficulties in movement, and a lack of maintenance. This strategy requires a large number of repetitions and might take some time to accomplish. A non-conductive substance, such as non-absorbent rags, brushes, or other equipment, should be used to clean the surfaces if human labour is required. [9].

2.5.3 Vacuum cleaning systems

In order to remove dust from surfaces like carpets, windows, and other hard-toreach places, vacuum suction cleaners employ an air pump to generate a partial vacuum. Suction pressure is often generated by a vacuum cleaner's electric motor. The power that is sent into the system is essentially transformed into airflow and then measured in air watts. Operators must be well trained since physical contact with the cleaner on the panel is inevitable. Scratches and dust build up over time, reducing the amount of sunlight that can be absorbed. [10].

2.5.4 Automatic wiper cleaning systems

A collection of mechanical equipment, such as motors or robots, is required to drive the brushes or wipers, and a water storage tank with sprinklers is utilized to clean the PV panel surface. Cleaning robot power consumption varies based on the angle of the solar panel, wind speed, and dirt layer thickness. It has been demonstrated that when wind speed increases, so does electricity usage [11].

2.5.5 Robotic cleaning systems

Robotic-assisted cleaning has also been put to good use. However, hand cleaning is difficult given the harsh desert circumstances, water, and its transfer to the locations where the power plants are located are expensive, and future worker pay are unknown. It is an automated cleaning procedure that uses very little electricity and does not require any consumables or mechanically moveable components. Current surface cleaning approaches are expensive, inconvenient, wasteful, and may degrade collector surfaces. However, the automatic cleaning mechanism keeps the solar collector clean throughout its working life to ensure optimal reflectiveness and generated electricity [12].

2.6 Related review of microcontroller for solar tracking and cleaning systems

Embed computers that use standard (sequential) programming techniques and do not have an operating system are referred to as "microcontroller technology". Microcontrollers are distinct from microprocessors in this aspect because of this feature. Modern single-board computers such as the Raspberry Pi board commonly run their operating system from an on-board secure digital (SD) card due to DIY influences on microprocessor technology. Microcontroller-based systems are more difficult to programmed than single-board computers (SBCs), even if they are similar in terms of application development. [13].

2.6.1 Arduino

Arduino is a free and open-source microcontroller that can be programmed, erased, and reprogrammed at any time. developed to make it affordable and simple for enthusiasts, students, and professionals to build devices that interact with their surroundings via the use of sensors and actuators. It is an open-source computing platform that is based on basic microcontroller boards and is used to build and programmed electrical devices. Additionally, it, like other microcontrollers, can serve as a minicomputer by accepting inputs and manipulating the outputs of a range of electrical devices [14].

2.6.2 Raspberry Pi

The Raspberry Pi-based design is equivalent to a standard ECL configuration (computer, potentiated and photodetector). The Raspberry Pi-based arrangement can be used in place of a typical ECL setup, saving money without compromising sensitivity or adaptability [15].

2.7 Formulas

$$\eta = \frac{P_m}{(G * A_c)}$$

 $Pm = maximum \ power \ in \ watt \ (10 \ watt)$ G = irradiance(input light in watt/m2) (average Malaysia 1643 kWh m-2) $Ac = surface \ area \ of \ solar \ cell \ in \ m2(0.350 * 0.24 * 0.017)$ Answer: 34.537 mW

2.8 Summary

Finally, this chapter shows an in-depth understanding of the study's factors. The papers and past research have been used to develop the notion of solar tracker and surface panel cleaning system as a sustainable energy source and how it might be included into this project. This chapter also includes references to earlier journals, publications, and studies in the hopes that they would serve as a comprehensive resource for this undertaking.



CHAPTER 3

METHODOLOGY

3.1 Introduction

The method and procedure used to construct this project are discussed in this chapter. This is a crucial chapter in which all the work that went into creating this project will be explained. Each stage is detailed according to the flow chart planning and Gantt chart timetable, including data analysis, which will contribute to attaining the project's goals while delivering the anticipated outcomes and verifying that the project is carried out effectively and realistically. To keep the project on schedule, the work is divided into four stages. Stage one consists of preparation work, which includes technical analysis guided by a variety of sources, including journals, project papers, and previous research. The implementation of stage one, which comprised data analysis and concept design, is stage two. The hardware should be conceived and produced in stage three, which is the working implementation of stage two. The fourth stage will concentrate on the interaction between all project components as well as troubleshooting any present issues.

3.2 Methodology



Figure 3.1 General process flowchart.

It's important to do a thorough investigation of the project before moving on to the next level of the development process. After then, the project's issue statement is nailed down. The next stage is to gather all the data from the primary components, including the solar panel, tracking technology, cleaning system, and microcontroller. Using a solar charger controller, the battery gets charged. To finish this step, the two conceptual designs must be compatible with one another.

After the system is completed, the next stage is to create and construct the hardware. Afterwards, the project's structure should be developed and integrated with the system. Checkups and reconstructions may be necessary to attain the desired outcome.

Finally, to ensure that it is working effectively, the system must be checked several times. If the system faces a difficulty and does not provide the expected results, troubleshooting is necessary.

The design for this hardware component was created using Proteus. The project's last component is the checking component, which is finished after all of the elements have been completed. This component verifies that the hardware is connected to one another, as well as the sufficiency of the code programmed, the troubleshooting process, and the right or erroneous functioning of the project. If no difficulties develop, an analysis will be performed to record the output data, the project's success, and thorough information throughout the whole of the project, from start to finish.

3.2.1 Stage 1: Project Research Planning

At this level, the aspect that has to be solved is the issue stated in the problem statement by designing and implementing a system capable of increasing electricity production. The microcontroller is responsible for implementing the control circuit. The control circuit then appropriately places the motor that is utilised to orient the solar panel. The project a solar panel cleaning system that uses an electro-mechanical cleaning mechanism at specified intervals to clean solar panels.

3.2.2 Stage 2: Development of the Project System Operation

The general system functioning of the project has been determined at this point, and it consists of solar, charger controller, and battery. The solar will provide the electrical energy, and the charger controller will be installed between the solar and the battery. In this project, the microcontroller Arduino UNO is also used to operate the geared motor and the solar panel cleaning system.



Figure 3.2 Block diagram for general system operation.

3.2.3 Stage 3: Project Determination

This is the stage at which the right component, programme code, hardware, and mechanical design for this project prototype are applied. This project is divided into three sections: mechanical design, electrical system design, and software design.

3.2.4 Stage 4 Complete Project Integrations

The establishment of a full project integration occurs after the mechanical design, electrical design, and software design phases for the solar tracker and cleaning system for solar panels are completed. All project components and programme code will be installed and implanted in a real project prototype to ensure project functioning. During this phase, the project will be tested and changed on a regular basis until it meets the project's objectives.



3.3 Circuit Process

Figure 3.3 Proteus simulation solar tracker circuit.

Although the circuit design for solar trackers is straightforward, the actual installation of the device requires extreme caution. After building a circuit in which four LDRs and four 100 K resistors are connected in the style of a voltage divider, the output is

then provided to four analogue input pins on an Arduino. Two DC motors should be connected to Arduino UNO using digital pins 13, 9, 10, and 11. These are located on the Dual H-Bridge Motor Drivers (L298) board. There is a remote control that has a switch that can either be auto or manual, as well as a switch that can either be single or dual axis. As long as the first switch is set to the manual position, you are able to manually spin the panel by using any one of the four buttons (clockwise-anticlockwise in horizontal and vertical axis). When this switch is set to the manual position, auto tracking of the system is enabled; the tracking mode can be either single or dual, depending on the setting of the second switch.

The project simulation circuit and component type chosen for usage in the project are realized in electronic design. To build and simulate the project circuit for simulation circuit is Proteus 8 software.

3.4 Equipment

The equipment and materials that will be used in this project are solar panel, light dependent resistor, solar charge controller, rechargeable battery, geared de motor, Arduino UNO, water pump, water level sensor and battery.

3.4.1 Arduino UNO

Prototyping using Arduino relies on small, user-friendly hardware and software that is open source. Receiving sensor input may have an impact on several actuators, including illumination, motors, and more. Programming the Arduino microcontroller using the Arduino programming language and the Arduino development environment is required for all of the Arduino's functions. Arduino creations may operate alone or in conjunction with other computer programmes and hardware.



Figure 3.4 Arduino UNO.

3.4.2 Light Dependent Resistor



Figure 3.5 Figure 3.5 Light Dependent Resistor (LDR).

One of the most basic types of optical sensors is a photon resistor or photocell, which functions as a light-sensitive resistor. Cadmium sulphide (CdS) and gallium arsenide (GA) are used in their construction (GaAs). CdS photocells are used to detect light in this sun tracker gadget. The photocell is a passive component whose resistance is directly proportional to the amount of light it is exposed to. It is connected to the capacitor in series. The dark resistance and light saturation resistance of the photocell used in the tracker are taken into consideration while selecting the photocell. Saturation of the CdS cells with light means that no further decrease in resistance can be achieved by increasing the light intensity. The amount of light emitted by the sun is around 30,000 lux, which is measured in Lux.

3.4.3 Dual H-Bridge Motor Drivers L298



Figure 3.6 Dual H-Bridge Motor Drivers (L298).

The L298 is a dual H-Bridge controller that can control two DC motors simultaneously. A DC motor with a voltage range of 5 to 35V and a peak current of up to 2A may be powered by the module. The voltage provided to the motor's VCC determines this. 5V regulator may be engaged or deactivated via a jumper on the module. To power an Arduino board, we may use the 5V pin as an output if the motor supply voltage is greater than 12V and the 5V regulator is enabled.

3.4.4 Solar panel



Figure 3.7 PolyCrystalline solar panel.

PolyCrystalline or MultiCrystalline solar panels are made up of several silicon crystals in a single PV cell. Polycrystalline solar panel wafers are made by melting together many silicon pieces. Because they are constructed of multiple silicon crystals, these solar panels are square in form and have a gleaming blue colour. These solar panels capture solar energy and convert it to electricity.

3.4.5 DC motor 12V



A gear motor combines the functions of a motor and a gearbox into a single device. UNIVERSITI TEKNIKAL MALAYSIA MELAKA The torque output of a motor may be increased by using a gear head to reduce its speed. Gear motors are primarily evaluated on three criteria: speed (rpm), torque (lb-in), and efficiency (lb-in/in2) (percent).

3.4.6 Water pump

There is a 12V, 5A water pump with a maximum pressure of roughly 100 PSI and a cut-off pressure of about 60 PSI. The water pump was chosen based on the fact that the 12" drip irrigation tubing required 60 PSI. The output pressure may be easily changed thanks to

the pressure switch. Also included were hose clamps and I/O tubing to make sure all connections were made correctly and safely.



Figure 3.9 12V Water pump.



Figure 3.10 Solar charger controller.

The solar charge controller is intended to prevent solar panels from overcharging your 12-volt GEL or Flooded battery. It also protects against the dangers of a reverse battery connection. The charging current or battery voltage will be shown on the LCD meter via this controller. This charge controller is designed to be long-lasting and energy efficient. The battery discharge rate is precisely regulated, and the battery discharging rate curve continually modifies the over-discharge voltage.

3.4.8 Battery 12v 7Ah



Figure 3.11 Battery.

The 12v 7Ah battery is a popular 12-volt battery used in cable boxes and home security systems. Its small size makes it suitable for a wide range of applications, including security and backup power systems. To prevent spills and leaks, the exterior shell is comprised of tough ABS plastic. The battery is made using Absorbent Glass Mat Technology, which allows it to produce strong currents on demand and has a long service life. This battery is need only 4 hours to full recharge if we are using the right method to charge this battery with solar of course it can be use more than 3 years.

3.4.9 Basic component

Table 3.1 Basic component.

No	Component	Function
1.	Resistor	To restrict the current and supply just the necessary
		biassing to key active components such as transistors and
		ICs.
2.	Industrial Push Button	This kind of switch requires the push and release of a
	Switch	button to operate. Internal spring mechanisms in most
		pushbutton switches restore the button to its "out" or
		"unpressed" position when not in use.
3	Slide Switch	Sliding switches are mechanical switches that may be used
		to regulate a circuit without having to physically splice or
		cut wire, allowing for more precise control of a circuit's
		current flow.

3.5 Software

The Arduino IDE will be used to monitor and manage the project and Proteus will be used to show the prototype solar tracker and surface panel cleaning system.

3.5.1 Arduino IDE



In order to develop and upload code to the Arduino boards, the Arduino IDE is an open-source software platform. Windows, Mac OS X, and Linux users may all benefit from the IDE programmed. C and C++ are supported programming languages. In this case, the acronym IDE refers to an Integrated Development Environment.

3.5.2 Proteus Design Suite



Figure 3.13 Proteus Design Suite Software.

The Proteus Design Package is a proprietary software tool suite that is predominantly utilised for the purpose of automating electrical design. Creating schematics and electronic prints for the production of printed circuit boards is the primary function of the programme, which is mostly utilised by electronic design engineers and technicians.

3.6 Limitation of proposed methodology

This project's development is hampered by a few restrictions. Due to this project's concentration on the actual prototype and hands-on labor rather than computer simulations, the final product cannot be guaranteed to be faultless. Because of this, no one can promise that the end outcome will be flawless. In addition, the project's overall cost is estimated to be considerable. This project likewise takes a long time to finish.

3.7 Summary

A synopsis of the chapter's content has been provided, including the design process and materials utilized. The values of certain components may change because of the circuit's suitability. Changes will be made to the project in the future or already in progress to improve its performance.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

After developing, constructing, and effectively integrating the dual axis solar tracker system, an improvement in the performance of solar panels, lightweight, and low power systems is successfully realised. In order to detect the incident light in a variety of conditions, the system is tested at several times of the day and in the presence of a variety of orientations of the sun. With the help of panel motion, the performance is measured according to the level of productivity that is optimal.

4.2 Results and Analysis



Table 4.1 Voltage values of Static and Tracking Panel at different times in a day.

JA Cumur, Comment, and a go go				
Time	Static Panel (V)	Tracking Panel (V)	Temperature (°C)	
8.00am/ERS	14.60 AL N	ALAY 14.90 MELA	A 25	
9.00am	15.13	15.10	25	
10.00am	15.45	15.80	26	
11.00am	15.71	16.04	29	
12.00pm	15.78	16.00	29	
1.00pm	15.91	16.00	30	
2.00pm	15.23	15.80	31	
3.00pm	15.22	15.55	31	
4.00pm	14.81	15.43	30	

5.00pm	12.75	15.31	30
6.00pm	12.28	15.29	29

Table 4.2 Ampere values of Static and Tracking Panel at different times in a day.

Time	Static Panel (A)	Tracking Panel (A)
8.00am	0.03	0.03
9.00am	0.04	0.04
10.00am	0.30	0.44
11.00am	0.30	0.50
12.00pm	0.42	0.60
1.00pm	0.46	0.61
2.00pm	0.47	0.47
3.00pm	0.43	0.49
4.00pm	0.07	0.08
5.00pm	U .0.05 (S.	0.06
-6.00pm RSIII 1	EKNIKAI0.03ALAYSIA	MELAK0.04

Both tables show that there has been an increase in the output both in terms of voltage and power, and this improvement is visible in both tables. When compared to static and tracking solar panels, the output at 8:00 in the morning has seen a significant improvement. The disparities between these two components become increasingly apparent as time passes and as the sun continues to rotate around the sky.

Throughout the entirety of the analysis, it is possible to observe that the movement of the solar panel does not always proceed in a smooth manner in relation to the act of receiving light from the sun. It is possible that this is due to the sensitivity of the LDR sensor, which has been subjected to the light of the sun. It's possible that the length of time the sensors are exposed to the sun's rays will make them less sensitive. Because of this, the sensors' ability to accurately detect solar energy may be compromised as a result.

Time	Static Panel (W)	Tracking Panel (W)
8.00am	0.43	0.47
9.00am	0.60	0.60
10.00am	4.63	6.95
11.00am	4.71	8.02
12.00pm	6.62	9.60
1.00pm	7.47	9.76
2.00pm	7.15	7.42
3.00pm	6.54	7.61
4.00pm	1.03	1.23
U5.00pmRSITI T	EKNIKAI0.63ALAYSIA	MELAK0.91
6.00pm	0.36	0.61

Table 4.3 Power values of Static and Tracking Panel at different times in a day.

Time	Irradiance (CLEAR WHEATHER)
8.00am	170
9.00am	390
10.00am	545
11.00am	675
12.00pm	755
1.00pm	860
2.00pm	965
ALAY 3.00pm	965
4.00pm	750
5.00pm	755
6.00pm	600
نىكل ملىسىا ملاك	ونىۋىرسىتى تىك

Table 4.4 Irradiance values at different times in a day.

Table 4.5 Volatge values of Clean and Dirty Panel at different times in a day.

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Time	Voltage Solar Panel (CLEAN) (V)	Voltage Solar Panel (DIRTY) (V)
8.00am	14.90	12.22
9.00am	15.10	13.00
10.00am	15.80	13.12
11.00am	16.04	13.35
12.00pm	16.00	13.41
1.00pm	16.00	13.60
2.00pm	15.80	13.90

3.00pm	15.55	14.13
4.00pm	15.43	14.00
5.00pm	15.31	12.66
6.00pm	15.29	12.10



Figure 4.1 Voltage and Temperature output generate comparative.



Figure 4.2 Ampere output generate comparative.



Figure 4.3 Power output generate comparative.



Figure 4.4 Irradiance output generate.

According to the previous finding, the most significant improvement takes place when both solar panels are oriented toward the sun at one o'clock in the afternoon. This was the time of day when the solar panel received the most light from the atmosphere. As the hours progress, the results are very similar to one another, however the solar tracker has a greater reading than the static solar panel. Perhaps it has something to do with the setting of the investigation and the environment in which it is being carried out.

The sunlight intensity drops in the morning and late evening, and the values obtained are lower than those obtained during the day. The efficiency gain may be computed. It is important to remember, however, that there will be times when the improvement in power production for the tracking system over the fixed system is minor, particularly on overcast days. This is predicted since there would be little change in sunlight intensity between the two systems. Similarly, on a particularly hot day around midday, both systems produce almost the same amount of heat since the sun is perpendicular to the horizon. As a result, both systems get about equal amounts of irradiation.



Figure 4.5 Dirty Solar Panel.



Figure 4.6 Clean Solar Panel.



Figure 4.7 Volatge output generate from Clean and Dirty Panel.

Because of the water that is utilized by the system, it will be necessary to clean the system on occasion to prevent mildew or other types of buildup on the components of the system. However, regular upkeep of the equipment shouldn't be an issue because the system has been designed to need just a minimum of care thanks to the few components that it contains and its straightforward layout.

The line graph in Fig. 4.7 illustrates that the power generation by a 16.00 V system was at its highest point throughout the whole period at 12.00 PM after cleaning, while the power generation was at its lowest point at 14.90 V at 8.00 AM. On the other side, the maximum power without cleaning was 14.13 V at 3:00 PM, and the minimum voltage was 12.22 AM. Both of these readings were taken without cleaning. This demonstrates that the creation of dust was a significant factor in the voltage losses.

It is also evident that dust deposition on dusty panels leads to a drop in power generation, and that the resultant power loss grows at a rapid pace at first, but that it ultimately slows down to a more manageable level, and that power reduction finally reaches a maximum level. Voltage and current are equally important in the process of producing electricity from solar panels.



CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Despite its usefulness, sunshine is a natural resource that comes with a number of problems that cannot be solved. With the assistance of our dual axis solar tracking device, it would be of great benefit to others to gain an understanding of the impact that sunshine makes. The findings of the research would be beneficial not only to the solar tracking system, but also to the installation of many other solar energy systems. In this chapter, the findings were presented, and suggestions were given for directions that the research should go in the future.

5.2 Conclusion

To get the most out of the solar panel's output of electricity, an LDR sensor was integrated into a dual-axis solar tracking system that was constructed. During the day, this apparatus can follow the sun in a continuous path. A DC motor was activated to move the solar panel in accordance with the supported orientation of the panel, which was provided by an LDR sensor. Aside from that, we can notice that the efficiency of the dual axis solar tracking system has increased when compared to the efficiency of a static solar system.

5.3 Future Works

Dual axis sun tracking is not as common as single axis solar tracking, even in countries where solar energy accounts for a significant fraction of the generation of electricity. This is because many people believe that single axis tracking is simpler. On the other hand, tracking along many axes can considerably boost performance. Because of the very inexpensive PV panel, this project has made significant progress. On a commercial scale, both the cost-effectiveness and reliability of the recommended device may be evaluated.

Nevertheless, PV panels based on polycrystalline materials of a better grade may also be utilized for this model, and a material-based analysis can be carried out amongst all these different systems. To get at an accurate assessment of the performance of the apparatus, observations need to be carried out over an extended period. Testing the machine's performance in a foggy environment is another essential step in the process.

Through the process of cleaning solar panels, the effort seeks to have a positive influence on the environment. Cleaning solar panels improves its efficiency and production, which may encourage future customers to select renewable energy as a more cost-effective and environmentally good alternative. Because it relies on water for cleaning and sunlight for powering itself, the solar panel cleaner is beneficial to the environment because it makes use of renewable energy resources rather than non-renewable ones. The destruction of less habitat and the improvement of environmental quality are both beneficial to other species.

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APPENDICES

Appendix A



Appendix B



Appendix C



Appendix D

