

# Development of Sun Tracking Solar Panel Using Arduino

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**Abstract:** As we can already observe, the global warming has a heated influence on the world. Here the impact of global warming can be taken advantage of. For operating electrical appliances, we can use solar energy as electricity. The difficulty we can observe presently is most of the solar panel used only statically by a user. The solar panel cannot charge if the solar panel is located on the east and the sun is situated on the west. So, this project is termed the "Solar Tracker". The LDR was used to feel the strength of the light at 30 degrees or a total of 180 degrees each and relayed the data to Arduino. This Arduino compares the data and rotates a servo motor toward the sun in the proper direction. The servo motor rotates the solar panel according to the highest light intensity. The solar tracker project aims to improve output power from stationary solar tracking systems. A 180-degree rotation is detected by this sun tracking device resulting the amount of energy a solar panel can generate here is far more than when it can only generate in one direction. Indirectly, the cost of acquiring more solar panels will reduced. The technology also reduces the time it takes for customers to shift the solar panel's orientation to face the sun.

**Keywords:** Solar Tracking, Arduino, Light Dependent Resistor, LCD Display, Solar Panel

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## 1.0 INTRODUCTION

In this chapter, explains on the project background, the problem statement, the objectives and the project scope. This is the initial steps for this project to proceed are comprehensive. The background of the project describes the reasoning behind the chosen project. The main issue that the world is currently experiencing is the depletion of fossil fuels. This is because, today rapid development and the demand for electrical energy is extremely great. Non renewable energy sources such as petroleum and coal will deplete if people continue to consume them. As a result of these issues, scientists all around the world are now seeking for renewable energy sources such as solar. This energy is the best solution to the world's current problem.

The purpose of this project is to use an Arduino to build a solar panel that tracks the sun. Solar energy is the amount of energy gathered from the sun. All living species on the world benefit from and are supported by this energy. The majority of renewable energy flows are made up of warmth and sunlight, as well as assets derived from the sun, such as wind and wave power, hydroelectricity, and biomass. Solar energy is gaining traction as an environmentally acceptable renewable energy source that does not contaminate the environment, encourages conservation, and provides limitless power from the sun.

solar energy spans a vast range of technologies and may be applied to wide range of purposes. Solar photovoltaic electricity is a form of solar energy that uses the sun's energy to generate power.

Photovoltaic (PV) is a system that uses semiconductors that show photovoltaic effects to produce electric power by converting solar or solar power to direct current electricity. Solar panels consist of several cells which contain a photovoltaic material are used for power generation. Like single crystalline silicone, polycrystalline, amorphous silicon, cadmium telluride, and copper indium solenoid/sulfide are materials used for photovoltaic purposes. These photovoltaic solar systems are environment-friendly and can also be used to boost the energy quality and the reliability.

## 2.0 LITERATURE REVIEW

Due to the scarcity of fossil fuels, scientists are now research alternative energy sources. Solar energy is one of the renewable energy sources available. Solar panels that convert solar light to electrical current based on the photoelectric effect are one approach to turn solar energy into electricity. The more the energy equivalent of light to the solar panel surface is changed into electricity, the

higher the solar panel coefficient of usefulness. The solar panel creates the electrical energy proportional to its full capacity as the intensity of light flowing to its surface increase. The light intensity on the panel is maximum when daylight enters the panel.

Only by increasing the efficiency of the solar panels by 10% to 20% can they be made more effective. As a result, increasing the size of the panels or increasing the intensity of illumination on the surface is required to improve the quantity of electricity generated by the solar panel. However, the size of the solar panels and necessitates a large amount of space. Furthermore, getting the most energy from the solar panel capacitance is a simple and cost-effective way to enhance the amount of power. (al-Khwarizmi Tashkent.,2019) [1]

Arrangement of sunlight detector is necessary in the case of a transfer to anew point, depending on the initial information, which comprises the tracking systems northern geographical orientation, elevation, slope, and geographical coordinates. As a consequence, a sensor-based ST systems is presented that is an active tracking system with closed-loop control. In closed-loop detection systems based on feedback circuits, light- dependents resistance (LDR) sensors are utilized. The sun is monitored regardless of its geographical position using data from the LDR, which is processed by a microcontroller. There is no need to calibrate a solar tracker when it comes to displacement. They also have a number of benefits, including as cheap cost, simplicity, and efficiency. For these reasons, several researches have incorporated this form of sensor in their systems

This article proposes the design and execution of two-axis solar detector system that moves PV panels in the direction of solar radiation in two x and y axes at the same time. A solar sensor (LDR) is used as a system input in the recommended tracking system, which is a basic, low-cost active system based on close-loop control. Tracking tactics using LDR sensor participants are detailed without the need of microcontroller, a simple logic circuit designer, or a Wheatstone bridge. Wheatstone bridge circuits are utilized in control circuits to increase sensitivity, measurement, and comparison of LDRs. (Saedi M, Effatnejad R., 2021) [2]

The main control circuit employs the Node Mcu microcontroller. The programming of this device is done in such a way that when the LDR sensor detects sunlight, it directs the DC Motor to spin the solar panel in the desired direction. The solar panel is then positioned such that it receives the most amount of sunlight possible. In comparison to the other motors, the DC motor is the simplest and most elegant, with a high torque and a modest enough speed. Although there are numerous methods for enhancing solar panel efficiency while lowering costs, one

of the most effective is tracking. Tracking aids in the panel's wider projection to the Sun, resulting in increased power production. It could be a dual-axis tracker or a single-axis tracker.

The "Automatic Solar Tracking System" project was built using a solar panel with a 12volt output, a Node Mcu as an MCU, a motor drive with an IC L293D, two LDR sensor modules, and a 10 r.p.m. motor. A 9-volt battery, a basic DC motor, and a current sensor. A wooden foundation is planted on the ground, iron rods are joined on both sides in a cross-shaped pattern, and hollow cylindrical rods are connected on both sides, with the DC motor clinging to one side of the hollow rod.

The solar detector system's circuit is divided into three components. The input stage consists of two LDR modules organized to form a voltage divider circuit, a microcontroller programmed using Arduino concept software, and a drive circuit that incorporates a DC motor to help in the rotation of the solar panel (Ghosh J., 2019) [3]

The amount of energy available from the sun considerably outnumbers any potential need. The sun is the source of energy for life in our solar system. The earth receives enough energy from the sun to meet its energy demands for a year in just one hour, which is roughly 5000 times the total energy intake to the earth's energy budget from all other sources combined. This proposal is based on the idea of using a sun tracking device to improve efficiency. The usage of solar tracking has been found to increase the efficiency of solar energy production by 30-40%. There are several different types of trackers that may be used to maximise the amount of electricity that solar panels can produce. Dual axis trackers are among the most efficient, but they are also the most complicated. Dual trackers are the ideal solution for regions where the sun's position changes throughout the year and during different seasons. Single-axis trackers are a preferable choice for locations near the equator where the apparent position of the sun does not alter significantly.

The issue at hand is the installation of a solar tracking system capable of increasing the efficiency of solar power gathering by photovoltaic cells while also having the ability to adjust to different seasons. The circuit used an Arduino to operate a motor that placed the solar panel in the best possible position. The major goal of this project was to employ an Arduino-based solar tracking system to improve the efficiency of solar PV panels. The single axis solar tracking system that was conceived and deployed proved to be adequate and improved efficiency considerably. The sun tracking device improved efficiency more in the morning and evening hours, with the highest boost in efficiency being around 5%. The existence of four

seasons-based modes is also shown to be beneficial in lowering the device’s power usage. This energy is stored in the battery and can be used for other purposes around the house or in the workplace. (Sofiya M., 2020) [4]

### 3.0 MATERIALS AND METHODS

This chapter shows in detail how the entire system methodology and step flow employed in "Solar Tracker" is applied. This chapter also outlines more about the project's planning for the development of software and hardware. Through this chapter I will cover the entire project planning and the progress planning.

### 3.1 BLOCK DIAGRAM

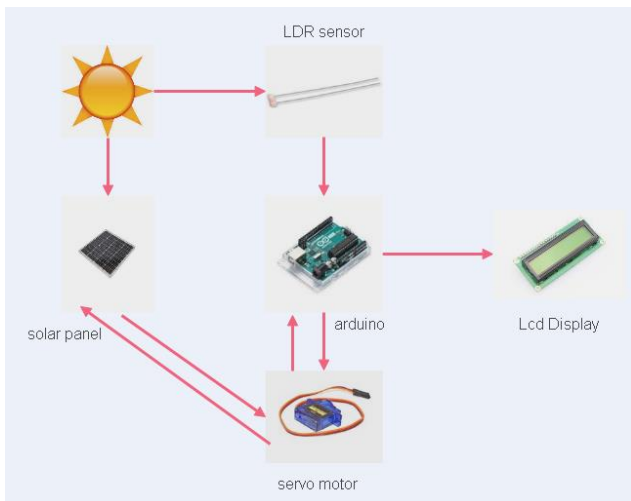


Figure: 1 Block Diagram

Figure 1 shows the Solar Tracker block diagram for the full system operations process that will be configured for the project. First and foremost, the sun must emit light in order for this system to work. Otherwise, the system will be in standby mode. It cannot be used at night. The sensor then detects the intensity of the light and transmits the data to the Arduino. The microprocessor will then compare the light intensity based on the sensor data, and the data will be communicated to the servo motor. The servo motor then turns the solar panel in the right direction based on the Arduino data. Finally, the LED display will indicate the voltage reading as well as the system functioning.

### 3.2 FLOW CHART AND CIRCUIT DIAGRAM

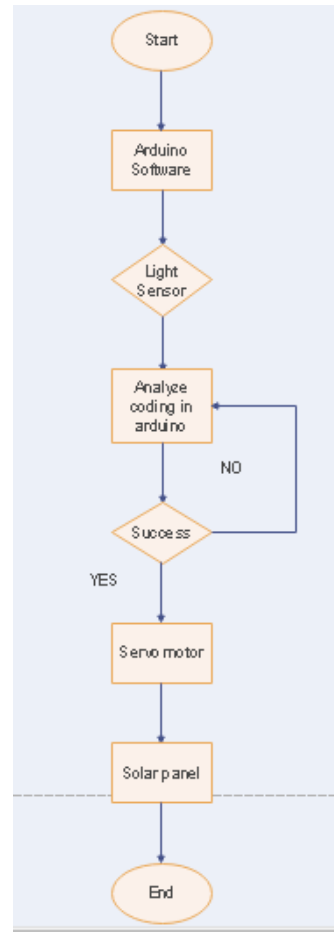


Figure 2: Flow chart

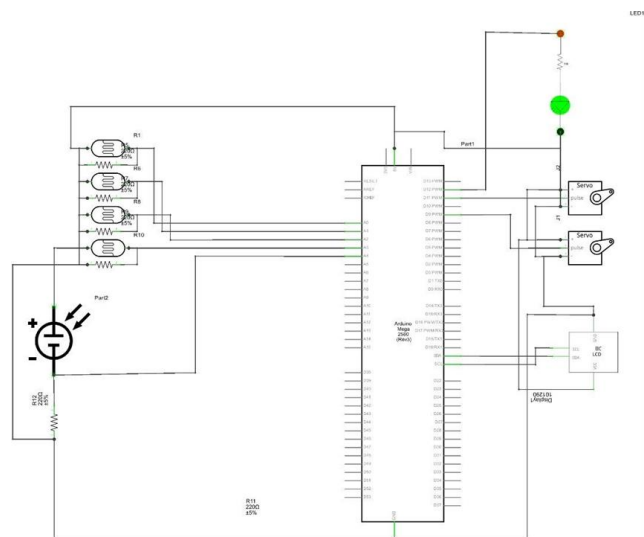


Figure 3: Schematic Circuit Diagram

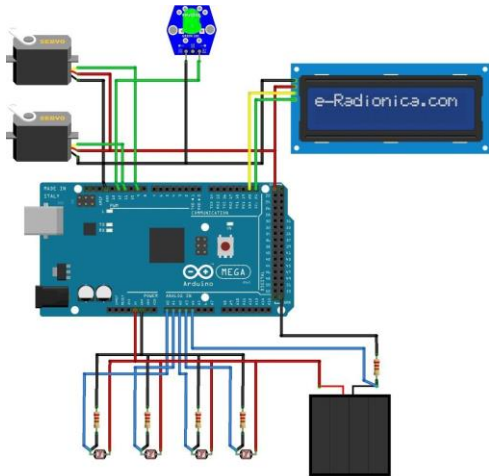


Figure 4: The Connection

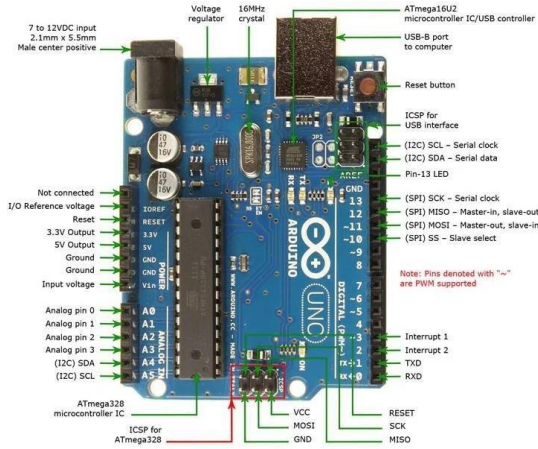


Figure 5: Schematic Diagram Arduino UNO

### 3.3 LIST OF THE COMPONENT



Figure 6: Component

To sum up everything that has been stated so far, this chapter deals with the technique of a project that is separated into various subjects. It comprises a number of subtopics pertaining to project development, block diagram, flow chart, circuit diagram, design and hardware. It defined the functioning principle of the project for the block diagram. The system flow and procedure from the beginning to the end of the system was explained in the flow chart. Next, the diagram of the circuit displays the

connection must be made to work. The sketch diagram is for the true prototype of the resignation. This chapter has detailed all of the main components. The price is also indicated on this prototype.

## 4.0 RESULT

### 4.1 RESULT 1



Figure 7: Voltage and System Running

Figure 4.2 show the voltage and system running on the LED Display. LED Display is one of the main screens displays that are being commercially used. The biggest advantage of the LED display is its efficient and low-energy consumption, which is especially needed for handhelds and chargeable devices. An LED display consists of a number of LED panels that, in turn, consist of several LEDs. LEDs have numerous advantages over other light emitting sources that can be used alternatively. Aside from being power efficient, LEDs produce more brilliance and greater light intensity. When the project power is ON, the LCD will show the system running and voltage display. LED panel is one kind of public information display monitor. It will be the most Microgrid display technology in the areas of display. Solar energy can provide power for electronic displays. As a kind of the ideal public information display media, electronic display may broadcast video signal and the demonstration writing, the image such as television, video recording, VCD and so on directly. So, I integrate solar energy utilization techniques into electronic display techniques.

### 4.2 RESULT 2

A photoresistor's sensitivity varies depending on the wavelength of light. If the wavelength is outside of a specific range, it has no effect on the device's resistance. In that range of light wavelengths, the LDR can be said to be insensitive. Varied materials have different wavelength versus sensitivity spectral response curves. Extrinsic light-dependent resistors are often constructed for longer wavelengths of light, with a preference for infrared

wavelengths (IR). When operating in the infrared region, it's important to keep in mind that heat might alter readings by increasing the device's resistance owing to thermal effects. The spectrum response of photoconductive detectors built of various materials is depicted in this diagram, with the operating temperature indicated in K and written in parenthesis.

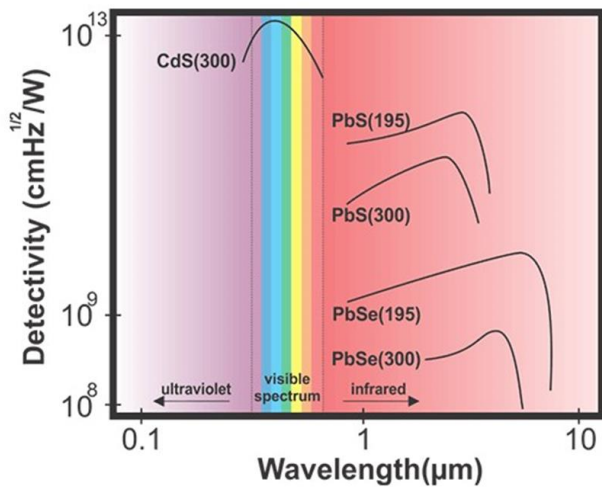


Figure 8: Wavelength of Light Dependent Resistor (LDR)

### 4.3 RESULT 3

A solar tracking device was put to the test. The results showed that the orientation of the sun was always fixed in relation to the solar panel. As a result, I was able to calculate the maximum solar flux. When the system moved away from the direction of the sun, the rate at which it received solar radiation decreased. There was a decrease in the pace at which sunlight went through the system as the angle of deviation increased. On cloudy days, solar tracker provided the same amount of energy. When the sun irradiation dropped, the electricity generated ways dropped to zero at the same time, suggesting that the systems performed poorly on cloudy days. As a result, while the solar tracker absorbs incident solar radiation efficiently on sunny days, it is worthless on overcast days. As a result, on cloudy days, the tracking mode did not provide appreciable improvements in power output. As a result, during cloudy days, the tracking mode should be disabled to conserve energy used to power the system.

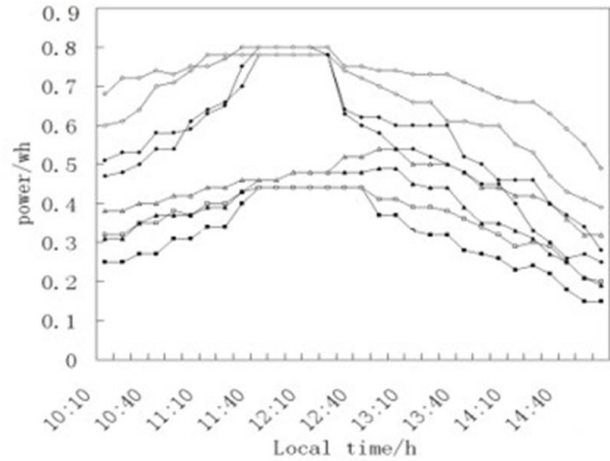


Figure 9: Power is generated through out time in sunny day (in 10-minute increments)

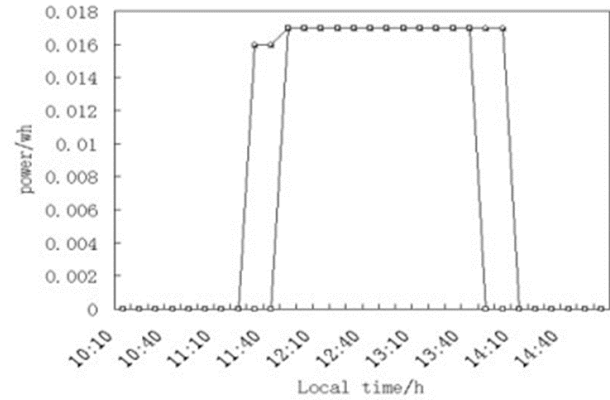


Figure 10: On cloudy days, power generated over time (plotted in 10-minute intervals)

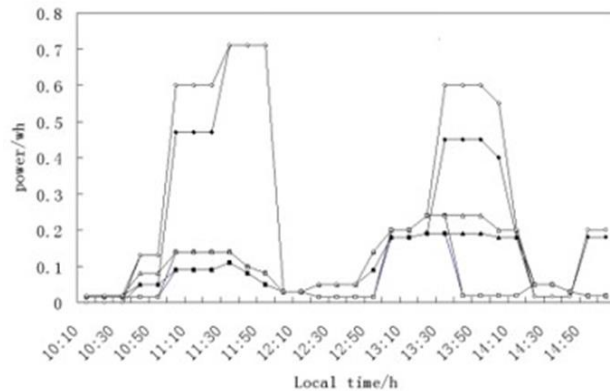


Figure 11: On days when it was sunny and cloudy, power generated over time (in 10-minute increments)

Figures 9 and 10 show the power generated by the solar tracker on days when it was cloudy and sunny. Under these conditions, the power generated was highly variable. Furthermore, the amount of power generated by the solar tracker during sunny periods of the day exceeded the amount of power generated by the solar panel by up to 25%. In figure 11, the solar tracker's electricity output either increased or dropped since it was sunny and cloudy day.

#### 4.4 RESULT 4

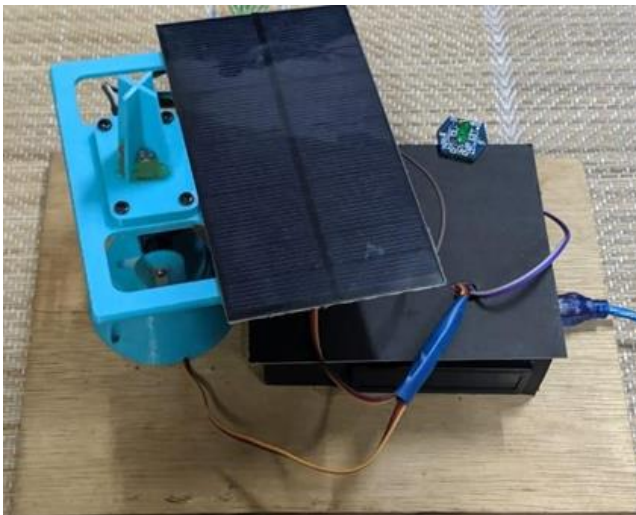


Figure 12: The actual prototype of Solar Tracker

In the previous form of solar tracking device, there are several issues. The issue is the solar panel which is only used for fixed installations. The power that can be generated is low because of this issue. The second issue is the cost of the solar tracking device for the family, which use more power than is normal since more than one solar panel has to be installed in order to generate enough power. This project is therefore designed to solve the problem. It can detect a 180-degree rotation by this solar tracking device. The solar panel produced here is therefore very high compared with when the solar panel can stay in just one direction.

The other is the solar power crisis. Because of continuous Earth movement, the fixed solar panels do not explicitly target the sun. As a consequence, this unit does not generate as much power as it can. Solar tracking device is the better solution in order to achieve the full output power. This is why the solar tracker project is designed. In order to obtain more power, the solar tracker can monitor the sunlight. In turn, the costs of purchasing more solar panels would be reduced. The systems often reduce the time it takes for users to adjust the solar panel's orientation to the sun.

Then, by utilizing solar energy, this initiative pledged to assist the environment in reducing pollution and gaining more energy. Nowadays, energy is produced utilizing resources that can be exhausted, such as fuel. Nonrenewable energy usage must be reduced in order for resources to last longer for future generations.

#### 5.0 DISCUSSION

This chapter offers as an overview of what to expect from the development project's outcomes. To ensure the project's success, the approach and test established in prior study can be used. This achievement contributed to the project goal of developing a system that can move a servo motor and show the direction based on the intensity of light. It also can reduce cost of purchasing more solar panel. Besides, this project is design for detect and compare the intensity of light to obtain the maximum source of light energy.

#### 6.0 CONCLUSION

As the result, the Solar Tracker was successfully implemented. The components such as an LDR module, a Servo motor, and a photovoltaic array, among others, are staged in the project. According to this, unlike other traditional energy sources, it would not pollute the environment and would serve as a source of energy obtained from the Sun. This technology is a valuable asset because it provides an environmentally friendly alternative in a polluted society. This technology would be able to send out waves of hope in the midst of a bustling civilization where pollution is encroaching on every aspect of existence. The ability of the system to work determines its viability. When compared to other mind-bending technologies, it has the potential to be a pathfinder.

Furthermore, the concept of this system can be used to homeowners that desire to lower their electricity expenses by using solar power. This technology will aid in the generation of more electricity while also reducing the amount of money spent on electricity bills. Solar electricity will be resold to electricity suppliers like Tenaga Nasional Berhad (TNB), with the price reduce from the electricity bill.

## 6.0 REFERENCES

### Journal

- [1] Sofiya, M. (n.d.). WEATHER ADAPTIVE ARDUINO BASED SUN TRACKING SOLAR PANEL
- [2] Chandra, G. R., Howji, S. P., Sumadeepthi, M. v, & Vignesh, K. E. (n.d.). Sun Tracking Solar Panel. In International Journal of Research and Advanced Development (IJRAD): Vol. ISSN.
- [3] Ghosh, J. (2019). AUTOMATIC SOLAR TRACKING SYSTEM
- [4] Pawar, P., Yadav, A., & Makwana, P. (2018). Solar Tracking System Using Arduino. <https://www.solarpowerworldonline.com/>.
- [5] Amaize, P., Sanni, T. F., Aigboviosa, A. P., Anthony, A., Claudius, A., Uzairue, S., Timilehin, S., & Imafidon, V. (n.d.). Arduino Based Solar Tracking System for Energy Improvement of Pv Solar Panel Reliability of electric power systems View project CONTROL OF HYBRID ENERGY STORAGE SYSTEM FOR EFFICIENT ENERGY MANAGEMENT View project Arduino Based Solar Tracking System for Energy Improvement of Pv Solar Panel. <https://www.researchgate.net/publication/328389970>
- [6] Saeedi, M., & Effatnejad, R. (2021). A new design of dual-axis solar tracking system with ldr sensors by using the wheatstone bridge circuit. IEEE Sensors Journal, 21(13), 14915–14922.
- [7] al-Khwarizmi Tashkent, M. (2019). Modeling and Research of Automatic Sun Tracking System on the bases of IoT and Arduino UNO; Modeling and Research of Automatic Sun Tracking System on the bases of IoT and Arduino UNO.