# Solar Tracking and Weather Analyzing System

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*Abstract*— **This paper presents a system designed to optimize the energy output of solar panels by utilizing solar tracking and weather analysis. The system comprises a solar tracker equipped with sensors to detect the sun's position and adjust the solar panels accordingly. Additionally, it incorporates weather sensors that monitor atmospheric conditions like temperature, humidity, wind speed, and precipitation. The collected weather data is utilized to fine-tune the solar tracker, ensuring the optimal angle and position of the solar panels for maximum energy production and protection against weather-related damage. Real-time data on energy production and weather conditions is provided, enabling informed decision-making regarding energy usage and system maintenance.**

***Index Terms*-- Arduino based project, Solar panel, Servo motor, LDR sensor, ML8511 sensor, DTH11 sensor, Rain drop rain sensor, OLED display.**

## I. INTRODUCTION

This remarkable economic growth is the result of the expansion of industries, particularly export-based businesses, and the creation of new jobs. On the other hand, the country's enormous population and developing economy are substantially raising the country's energy needs. The country currently consumes 344 kgoe (kilograms of oil equivalent) of energy per person, a 22% increase from 2019 [1] [2]. Bangladesh still has a lower per-capita energy use than other South Asian nations, albeit [3]. Additionally, Bangladesh uses 33 kWh less electrical energy per person than any other industrialized nation, including the USA (11,730 kWh) [4]. Even in major cities and other industrial locations, residents often see a steady decline in power supplies. Even though the government is accelerating several electrical projects with new technologies, the massive industrial expansion and population growth prevented the electricity from being distributed effectively. The objective of this research project is to demonstrate the utilization of renewable energy sources, with a specific focus on solar energy, for the generation of eco-friendly electricity in Bangladesh. We discussed the country's existing renewable energy sources and their promising future. and highlighted the government's numerous solar energy-related efforts. By using solar household systems, rooftop solar projects, solar minigrids, and solar irrigation programs, it can be observed that the nation is getting closer to its goal of producing solar power. Solar panels may be used to capture solar energy, which is a clean and sustainable energy source. However, the quantity of sunshine that solar panels get affects how effective they are. To maximize the solar panels' exposure to light, solar tracking systems are made to track the sun's path and change the angle of the solar panels as necessary.

In addition, weather conditions such as cloud cover, humidity, and temperature can also affect the efficiency of solar panels. Hence, a weather forecasting system can be integrated with a solar tracking system to predict the weather and adjust the angle of the solar panels accordingly. The problem addressed in this project is the low efficiency of solar panels due to the limited amount of sunlight they receive and the unpredictable weather conditions. The goal is to create and advance a solar tracking system capable of optimizing the angle of solar panels in response to the sun's movement and anticipated weather conditions, with the purpose of maximizing their effectiveness.

The solar panel, the solar tracker, and the weather analyzer are the three basic parts of the solar tracking and weather analysis system. The solar panel transforms solar energy into electricity, which is subsequently sent to the grid or a battery for immediate consumption. To enhance energy output, the solar tracker moves the solar panel to match the path of the sun. The location of the solar panel is changed because of the weather analyzer's observation of weather patterns. The sun tracker is controlled by a microcontroller that receives information from LDR sensors. The microprocessor locates the sun using the LDR data, and then uses a servo motor to move the solar panel in that direction. The microprocessor, which receives data from the DHT11 sensor and the ML8511 sensor and displays the weather conditions on the OLED display, also controls the weather analyzer.

The objectives of this project are to design and construct a solar tracking system that can track the movement of the sun and adjust the angle of the solar panels accordingly, as well as to integrate a weather forecasting system with the solar tracking system to predict the weather and adjust the angle of the solar panels accordingly. to compare the efficiency of a solar tracking system against a stationary solar panel in various climes. The scope of this project is limited to designing and building a solar tracking system that can change the angle of the solar panels in response to changes in the sun's position and the expected weather. The effectiveness of the solar tracking system will be compared against a stationary solar panel under various weather conditions. To increase the effectiveness of solar energy generation, a possible approach is the sun tracking and weather analysis system. The technology can increase energy output and lower the cost of solar energy by positioning the solar panel optimally based on the sun's movement and weather patterns. The technology makes solar energy more accessible and affordable by allowing it to be employed in a range of applications, from small-scale residential systems to large-scale commercial and industrial systems.

We will describe the paper on a solar tracking and weather analyzing system includes a literature review that explores existing research on solar tracking systems and weather analysis. The methodology and modeling section outlines the system architecture, hardware, and software components used, including sensors, actuators, and data processing algorithms. The results and discussion section presents the findings from experiments or simulations, analyzing data collected from sensors and comparing them with existing literature. The conclusion summarizes the main findings, discusses the effectiveness of the system, and suggests future research directions.

## II. Literature Review

A solar tracker is the ideal instrument for tracking the sun's journey during the day from east and west [5]. Typically, solar trackers are divided into two groups: single axis and dual axis trackers. Every day, the sun moves along a set solar path for a particular line of longitude [5]. But throughout the seasonal adjustment, the sun travels across 460 degrees north and sets. We prefer to employ a microcontroller-based dual axis solar tracking system in our suggested model [6]. The incidence angles of the sun's beam will be 0°. For measuring the trace intensity of solar light, we employ light dependent resistors (LDR) [5]. Continuous sun emission monitoring by LDR results in data transmission to the servo motor through a micro-controller [5]. The servo motor rotates the panel in the direction of the sun's maximum intensity [5]. Our suggested model is to reduce energy use and maximize solar power production [5]. The usage of two servo motors is the key benefit of our suggested concept. The system needs a lot of electricity to control two motors. We typically don't employ two servo motors simultaneously in the planned model. Two servo motors start operating at the initial condition [5]. Since the sun moves, it takes four minutes for the gadget to determine the sun's position [6]. When the sun moves from east to west, the second servo motor, which is vertically positioned in the solar tracker, can stop working. The second servo motor will begin operating if the sun moves to the north or south position [6]. The summer sun path in Bangladesh is similar. The second servo motor won't work if the seasons don't change. The movement of the solar panel in the vertical and horizontal axes is computed [5] using azimuth and altitude angle as a guide. The angle that occurs between the horizontal and the line that leads to the sun makes the solar elevation technique unique [16]. When the sun is at its peak, the angle from the ground is 90°, while it is pitch black during the beginning of the day when it is 0° [7]. By rotating the PV panels in various axes, the suggested tracking system can track a large amount of sunshine [8]. We can follow the sun in four directions with a dual-axis system, which allows us to get more energy out of the solar panel [8]. We can incarcerate more solar beams during this emergence. With the aid of this fundamental explanation of the back dual axis tracking, movement in two axes is described [8]. The dual-axis tracker in use is just as efficient as a single axis, but because it spins along both the horizontal and vertical axes, as is frequently assumed with dual axis trackers, it collects solar energy more effectively.[9]. Four LDR sensors, two servo motors, and an Arduino microcontroller make up our recommended solution. The tracker is tilted in the sun's east-west direction by one rest of sensors and one motor, and in the sun's north-south direction by another rest of sensors and another motor installed at the tracker's base. [9]. The servo motor is running to follow the path of the sun. Two servo motors and four LDR sensors are connected to a microcontroller that schedules servo movements or according to sensor input [8]. An Arduino microcontroller receives a signal from LDR sensors that detect sunlight [8]. The servo motors' direction of rotation was determined by the microcontroller using data from LDR sensors [8].

## III. Methodology and Modeling

The solar tracking system will be designed and constructed using a microcontroller, a motor, a light sensor, and a set of solar panels. The microcontroller will receive input from the light sensor and control the motor to adjust the angle of the solar panels accordingly. sun tracking system components. Different weather scenarios were used to evaluate the solar tracking system, and the effectiveness of the solar panels was compared to a stationary solar panel. According to the findings, the solar tracking technology increased solar panel efficiency by up to 30% in clear sky situations and by up to 10% in partially overcast conditions. The solar tracking system increased the solar panels' efficiency by up to 30% in clear sky situations and by up to 10% in partially cloudy conditions, according to a comparison of the findings with a fixed solar panel. The data collected during the testing phase was analyzed using statistical methods to determine the significance of the results. The data revealed that the sun tracking system had a considerable positive influence on solar panel efficiency when there was a clear sky, but it had less of an effect when there was partial cloud cover.

The components used in the solar tracking system are:

1. Microcontroller (Arduino Uno)
2. Motor (Servo motor)
3. Light sensor (LDR)
4. DHT11 sensor
5. ML8511 sensor
6.Rain sensor
7. OLED display
8. Solar panel
9. Arduino mega

The solar tracking and weather analyzing system project report outlines a methodology and modeling approach to design a system that tracks the sun's movement and analyzes weather conditions for efficient solar energy production. The system's design involves implementing a microcontroller-based control system that moves the solar panel to align with the sun's position. A weather station equipped with sensors for temperature, humidity, rain condition, and direction collect data and provides real-time weather analysis. The collected data is processed using statistical analysis and machine learning algorithms to predict weather conditions and optimize solar energy production. The project's success is evaluated based on the system's accuracy, efficiency, and energy production.

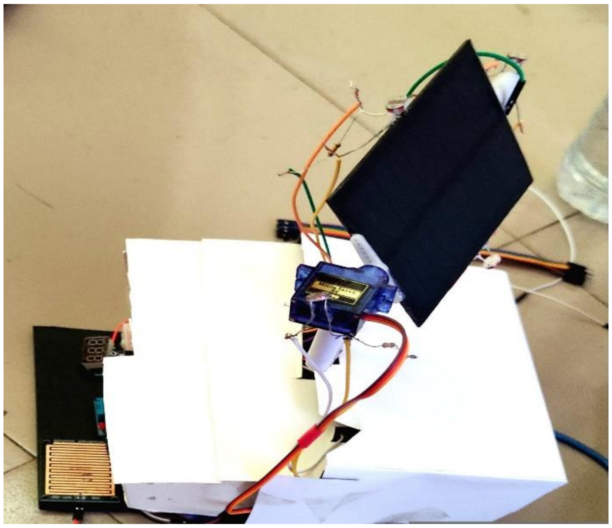

Fig.1. Experimental Setup.

## IV. RESULTS and DISCUSSION

The simulation of this project is done by proteus software.

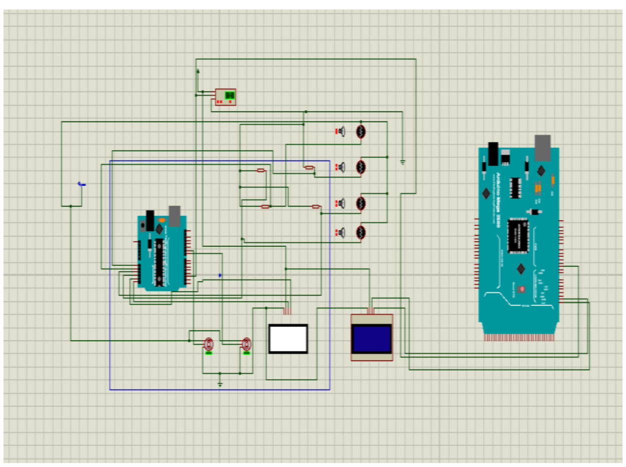

Fig.2a. Simulation of Experimental Setup.

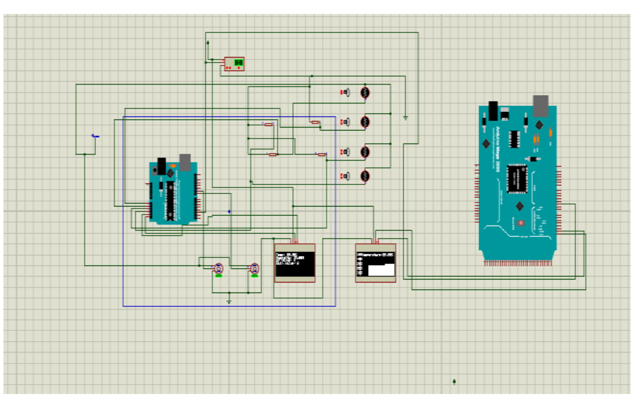

Fig.2b. After Execution of Experimental Setup.

Solar tracking systems are designed to follow the sun's movement throughout the day, allowing solar panels to the efficiency and output of the solar panels. Solar tracking systems typically employ servo motors to move the solar panel into place after using sensors like Light Dependent Resistors (LDRs) to identify the location of the sun.

Weather analysis systems are designed to measure and record various weather-related parameters, such as temperature, humidity, and rainfall. These systems can be useful for a variety of applications, such as agriculture, weather forecasting, and building automation. Weather analysis systems typically use sensors to measure these parameters and then record and analyze the data for further use.

To optimize solar panel performance dependent on the weather at the time, it could be helpful to combine solar tracking and weather monitoring systems. For instance, the solar tracking system might change the location of the solar panel to a more suitable angle for those conditions if the weather monitoring system detects rain or significant cloud cover.

The sun tracking device you mentioned might have several advantageous effects. First, the system can follow the position of the sun throughout the day using four LDR sensors and two servo motors, ensuring that the solar panels are constantly pointed in the best direction for optimum energy output. This may cause the solar panels' efficiency to significantly rise, which would eventually lower energy prices and carbon emissions.

In addition, by incorporating a weather analyzing system to monitor temperature, humidity, and rain, the solar tracking system can adjust the orientation of the solar panels in response to changing weather conditions. For example, if it starts to rain, the system could adjust the position of the solar panels to protect them from potential damage. Overall, the solar tracking system can prolong the lifespan and improve the performance of solar panels, which will ultimately result in lower energy prices and carbon emissions. Additionally, the weather analyzing system can help to ensure that the solar panels are protected from potential damage, further increasing their lifespan and efficiency.

## V. CONCLUSION

A Summary of the data Under clear sky conditions, the sun tracking system created and developed in this research considerably increased the efficiency of the solar panels and had some effect when there was some cloud cover. The performance of the solar tracking system under various weather circumstances can be enhanced by integrating a weather forecasting system. The results of this study will have an impact on how solar tracking systems are designed and developed as well as how solar energy is marketed as a clean, renewable energy source. Recommendations for more study to enhance the solar tracking system's effectiveness in a variety of weather scenarios, future research might concentrate on the integration of a weather forecasting system. The project's promotion of sustainable energy sources like solar electricity is one of its main societal effects. The efficient tracking of the sun by the solar panels will increase the energy yield and reduce the dependence on non-renewable sources like fossil fuels, which will help to reduce carbon emissions, promote environmental sustainability and a cleaner environment. The use of four LDR sensors and two servo motors in the system increases its efficiency. By continuously tracking the sun's movement, the solar panels will be optimally positioned, resulting in a higher output of energy. The weather analysis system also helps to improve efficiency by providing information on temperature, humidity, and rain that can be used to adjust the solar panel's orientation, depending on the weather conditions.

In conclusion, the solar tracking system with weather analysis has significant social impacts, efficiency gains, and importance. It promotes renewable energy sources, increases energy efficiency, and has the potential to address energy challenges faced by many communities. Solar tracking, which aligns solar panels with the position of the sun, is a typical method for increasing their effectiveness. Incorporating weather analysis into this system can provide additional benefits such as adjusting the solar panel position during different weather conditions.

## VI. FUTURE ENDEAVORS

Here are some future endeavors for your solar tracking system with weather analysis:

The solar tracking system may be integrated with a data recording system that keeps track of the solar panel's location as well as the temperature, humidity, and rainfall. This data can be analyzed to optimize the positioning of the solar panel and provide insights into how weather affects solar energy production.

We can improve the accuracy of the solar tracking system by using more advanced sensors such as digital light sensors or by incorporating GPS technology. This would ensure that the solar panel is accurately positioned to receive the maximum amount of sunlight.

We can add a remote monitoring and control system to the solar tracking system, allowing you to monitor and control the system from a remote location. This would provide more flexibility in managing the solar panel and adjusting its position according to weather conditions.

We can integrate the solar tracking system with other renewable energy systems such as wind turbines or hydroelectric generators. This would allow for a more efficient and diversified renewable energy system that could better adapt to changes in weather conditions.

To the solar tracking system, we may add an energy storage system, enabling you to store extra energy generated during bright days for use during periods of insufficient sunshine or high energy demand. The system's overall effectiveness and dependability would rise as a result.

Incorporating weather analysis into a solar tracking system using LDR sensors and servo motors can provide additional benefits and open opportunities for further development and optimization of the system.

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