Designing a Solar Tracking Device

Alban Dominick Msangi and Franklin Festo Francis

St. Joseph's Cathedral High School

Introduction

Approximately only 30% of the Tanzanian population has access to electricity. However the country has abundant energy resources. Among the renewable energy resources, solar energy is the most essential and prerequisite resource of sustainable energy because of its ubiquity, abundance, and sustainability. The location of Tanzania near the equator gives it the high solar potential. Tanzania gets plenty of sunshine in an average year, ranging between 2800 and 3500 hours. With horizontal solar radiation between 4 and 7 kWh per m2 (each day).

Stationary mounts, which Holds panels in fixed position, can have their productivity compromised when the sun passes to a less-than optimal angle. If solar cells are kept stationary, most of the day light may not fall perpendicular to their surface. This will not result in optimum energy production hence causing reduced efficiency of solar cells. Compensating for this, solar trackers automatically move to "track" the progress of the sun across the sky, thereby maximizing output. This increase can be as much as 10 to 25% depending on the geographical location of the tracking system. Solar tracker system is an abundant rotation of solar panel that actually follows the intensity of light to increase the power requirement.

This project aims to design the solar tracker device which tracks the sun throughout the day, all along the year to harness maximum solar energy

Method

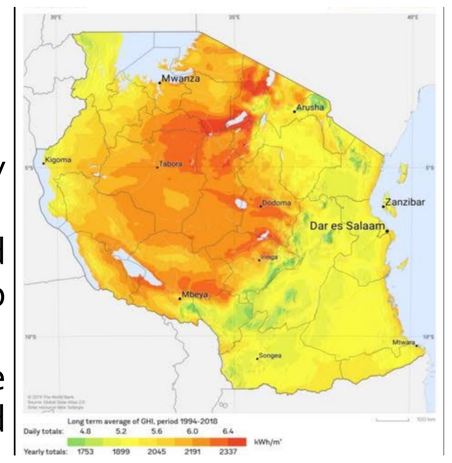
Materials used.

1.One 2W-Solar panel

2.Light dependent resistors (LDR) is a component that has a resistance that changes depending on the light intensity falling upon it.

3.Servo motor is a self-contained electrical device that rotates part of the electrical machine with high efficiency and great precision whose output shaft can be moved to a particular angle, position and velocity are part of closed loop mechanism that incorporate positional-feedback in order to control the rotational or linear speed and position.

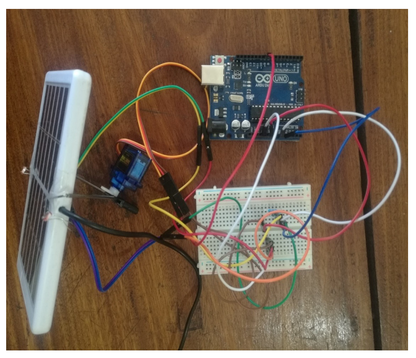
4.Arduino UNO is open source platform used for building electronics projects, computer hardware and Software Company, project and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in physical world.



5.One USB cable.

6.One Bread board

7.9V battery.



Procedures

The design of the circuit of this solar tracker involves the following stages;

Step 1: Connect the servo motor to the 5V pin and pin 7 in the board.

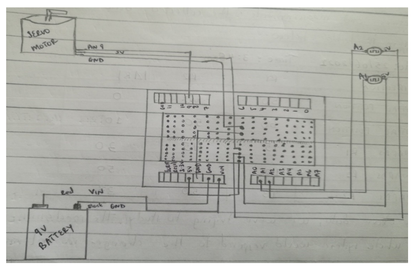
Step 2: connect resistor 1 and resistor 2 to the analog pin A1 and A2 and GND pin respectively to the Arduino board.

Step 3: connect the positive terminal of the battery to the VIN pin of the Arduino board and the negative terminal of the battery to the GND pin of Arduino pin of the Arduino board. Crocodile clip can be used to connect the terminals.

Step4: connect the USB cable from Arduino board to the computer port ready for coding.

Step 5: General coordination of the components used by programming language.

Note: The final step is very essential since it enables the general coordination of the components used by the mechanism of programming language, so a person needs to have competent coding skills.



Results

For the device to work properly, it should be able to respond on different intensity of light. The ability of device to respond on the light should correspond to the coding done on software programming. Number of trial on resistors set were done as indicated in Table 2. On the above table we were trying to study the mechanism on how the whole system would respond to the change in intensity and we realized that, the system follows the command as the stated code that the system would have to react when the difference between the two resistors is less than 10.

Generally, solar panels are placed in a fixed or fixed position, this causes the received sunlight to be less than optimal because the sun is always moving, that is, in the east-west and north-south directions. Solar panels need to be positioned perpendicular to the direction of sunlight in order to get optimal sunlight.

During the project the device was able to identify the difference in light intensity from various point and it was able to choose the suitable position to place the panel for maximum light absorption just as we expected. Therefore the device designed can work properly in different light intensity. From the project, some of the things we learned are; the ability of PV cells is further beyond such that they can reflect light rays among each other so as to gain as much power as possible.

S/N	DATE	ACTIVITY	REMARKS
1	3/03/2022-30/3/2022	Proposal writing and submitting	Proposal prepared and submitted
2	11/05/2022-19/05/2022	Projects development planning and materials collection and purchasing.	Collection and purchase done.
3	1/06/2022-15/06/2022	Circuit connection and coding.	Circuit connected and tested
4	16/06/2022-30/06/2022	Data analysis and project report preparation.	Analysis done
5	25/06/2022	Mentorship zoom meeting	Students and teachers attended.
6	1/07/2022-14/07/2022	Final report writing, video recording and submission	Done

DIRECTION	R1	R2	|R1-R2/R2-R1|
INITIAL POSITION	50	50	0
INITIAL POSITION	60	50	10
TOWARDS R1	75	45	30
TOWARDS R2	10	60	50
TOWARDS R2	13	50	37

References

1.Ismail, M. A., Kreshnave, A., Ramanathan, L., Idris, M. H., Ananda-Rao, K., Mazlan, M., and Fairuz, N., "Improving the performance of solar panels by the used of dual axis solar tracking system with mirror reflection". In Journal of Physics: Conference Series (Vol. 1432, No. 1, p. 012060). (2020).IOP Publishing.

2.S. A. Kalogirou, Design and construction of a one-axis sun-tracking, Solar Energy. 57 (1996) 465-469.

3.A. Mohamad, Efficiency improvements of photo-voltaic panels using a sun tracking system, Applied Energy. 79(2004) 345-354.

Conclusion

Even though the energy produced by the solar panel system is pollution-free and environmentally friendly, but because of its small efficiency, people are reluctant to apply solar panel technology as a renewable alternative energy source to meet their daily electrical energy needs. The results from this project shows that the solar panel can follow the light direction, which enables availability of maximum solar energy. Therefore this device can be developed further and used in society as it is cheap, although it needs regular maintenances.