IOT based biaxial solar tracking system

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Abstract- The purpose of this project is to create a self-aligning platform for solar panels and share the Information through IoT for better utilization of the renewable solar energy source that is available.This project aims to develop dual axis solar tracker with IOT monitoring system using Arduino. The solar tracking system is the most effective technology to improve the efficiency of solar panels by tracking and following the sun's movement. Thus, the project discusses the development of two-axes solar-tracking developers using Arduino Uno as main controller the system. For development of this project, four light-dependent resistors (LDRs) have been used for sunlight detection and a maximum light intensity. Two gear motors have been used to rotate the solar panel according to the sun's light source detected by the LDR. Next a WIFI ESP8266 device is used as an intermediary between device and IOT monitoring system. The IOT monitoring system is a website that functions to store data. The objective is to prepare the final prototype which will demonstrate an improved efficiency using self-aligning platform and smart IOT systems. The results indicated that the automatic solar tracking system is more reliable and efficient. The efficiencyof this system has been tested and compared with a single axial solar tracker. As a result, the two-axis solar tracking system generates more voltage current and thus power.

Index Terms- Dual Axis, Solar Tracker, IOT, WIFI ESP8266, LDR.

I. INTRODUCTION

A solar tracker is a device for orienting a solar photovoltaic panel, day lighting reflector or concentrating solar reflector or lens toward the sun. Solar power generation works best when pointed directly at the sun, so a solar tracker can increase the effectiveness of such equipment over any fixed position. . The solar panels must be perpendicular to the sun's rays for maximum energy generation. Deviating from this optimum angle will decrease the efficiency of energy generation from the panels. A few degrees of misalignment will only cause 1% to 5% of energy loss, while larger angles of 10° to 20° will significantly decrease the energy generation of up to 35%.An active tracker uses motors to direct the panel toward the sun by relying on a sensing circuit to detect light intensity.In a dual axis mount where one axis is a vertical pivot and the second axis is the horizontal. By using a combination of the two axes, the panel can always be pointed directly at the sun. This method increases the output by approximately 36% compared to stationary panels. Despite of solar energy being a good source of energy,it is needed to improve the methods to harness the energy.This can be achieved by using dual solar tracking system that has two degree of freedom that act as axes of rotation.The axis that is fixedwith respect to groundcan be consider as primary axisand the other axis that is referenced to the primary axis can be consider a secondary axis.Solar tracker is a device with the orientataionof following the sun's path to maximize energy capture.

II.ELECTRONICS AND HARDWARE DESIGN

This section describes the entire electronics and hardware components that are part of the system and how they are interfaced

A. Arduino Uno

Arduino Uno is a microcontroller board having 14 digital input/output pins,6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

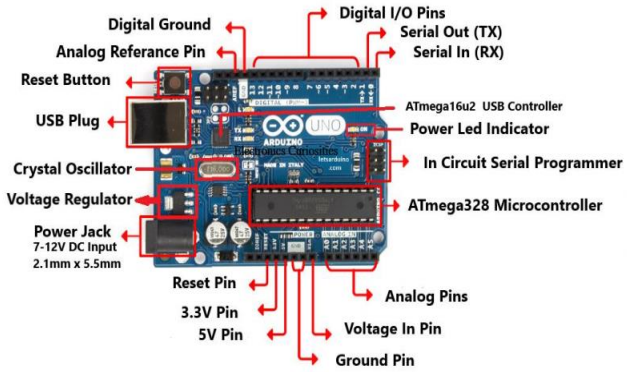


Fig. 1. Arduino UNO

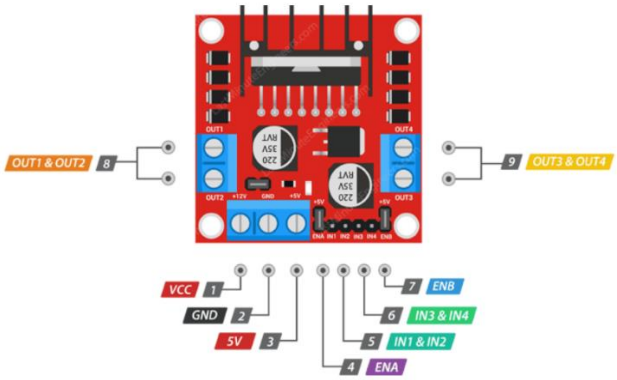


Fig. 3. Motor Driver L298N

B. LDR

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices

Fig. 2. LDR

C. *Motor Driver L298N*

L298N is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L298N is a 10-pin IC which is capable of controlling a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L298N IC, Dual Hbridge Motor Driver integrated circuit (IC). The l298N can drive small and quiet big motors as well.

D. ESP8266 Wifi module

ESP8266 offers a complete and self-contained Wi-Fi networking solution, which allow it to either host the application or to offload all Wi-Fi networking functions. When it is the only application processor in the device, it is able to boot up directly from an external flash. It has integrated cache to improve the performance of the system in such applications, and to minimize the memory requirements.

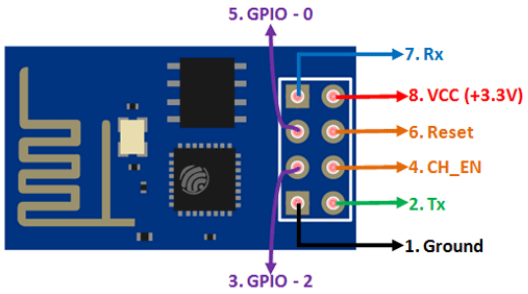


Fig. 4. ESP8266 Wifi Module

E. DC Gear Motor

DC Gear motor is an electric motor that runs on direct current (DC) electricity. DC motors can handle directly from rechargeable batteries. 10 RPM DC Gear Motor is used in this case.

Fig. 5. Gear Motor

III.INVENTOR DESIGN

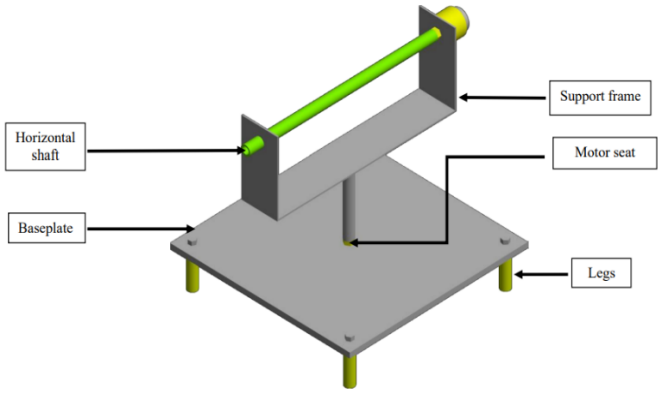


Fig. 6. Inventor Design

A. Support frame:

The support frame, see Figure 6, is assembled from three individual 2 mm thick water-cut aluminum sheet metal pieces. The engine mount for the stepper motor and clearance holes for the pitch axle and main axle have been drilled out.

B. Legs:

The leg is an carbon steel rod with a 20 mm diameter that attached to the 4 corners of the baseplate. It support the whole structure of tracking mechanism.

C. Motor seat:

Two dc motors of 10 rpm speed are fixed to the structure, one to the horizontal shaft and the other one is placed to the vertical axle for rotation on vertical axis. These motors are seated on the motor seats.

D. Base plate:

The base plate takes up the load from main axle, support frame, solar panel and pitch axle. A robustness requirement is needed, so unlike the other parts the base plate is water cut from a 3mm steel plate. For support and stability, it has four 30 mm legs of aluminum which hold up the construction.

IV.METHODOLOGY

To establish the right approach and evaluate if the project is possible. to accomplish, fundamental research about similar projects and hardware is required. Components like different types of stepper motors, , photoresistors and solar panels are evaluated and determined.

To start the testing phase of the project the required components are purchased. The first mode involved reading values from photoresistors to evaluate which direction the stepper motors would rotate while the second mode is based on reading the output from the solar panel.The software is developed in parallel to the hardware development. When more substantial circuits are formed it also demands more advanced software to control it. Much of the time is also invested in the mechanical construction to support all the components. The entire construction is designed in CAD in order to visualize the proportion of the prototype before it is manufactured. When the construction is finalized and the components are assembled, a substantial amount of calibration and adjustments are needed for the prototype to function as desired before the final testing can begin.However, there are some factors that could influence and disturb the results in a negative way.

- The daily hours of sunshine
- Daily cloudiness
- Wind speed and direction
- Average temperature and humidity

These factors need to be in an acceptable interval from each other during the tests to achieve comparable results.

V.EXPERIMENTAL RESULTS

Experiments results were observed by placing the designed system in open air. Table I, II show the output power for PV systems (Single axis tracking and Dual axis tracking). The output power data is collected during 9:00 A.M. to 4:30 P.M. In Table III comparison of output power is shown in Graphical form for two cases.

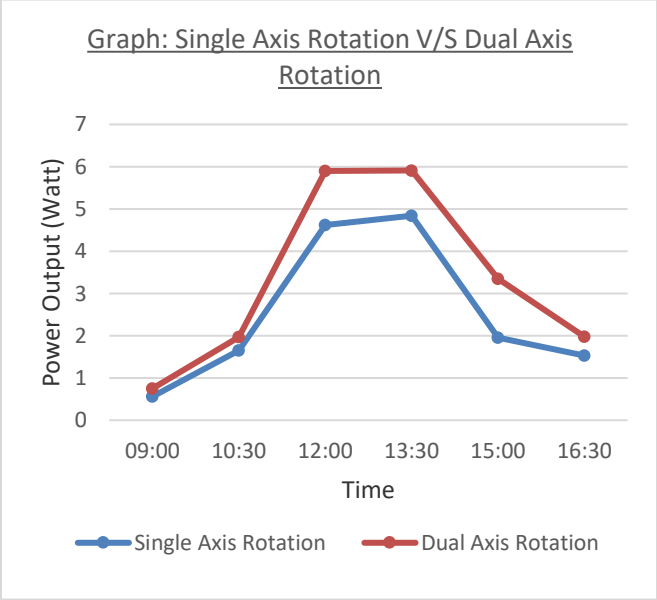
Table 1: Single Axis Rotation

Time	Voltage(V)	Current(mA)	Power(W)
09:00	7.1	79	0.56
10.30	8.23	201	1.65
12:00	10.17	455	4.62
13:30	10.28	471	4.84
15:00	9.05	216	1.95
16:30	7.98	192	1.53

Table 2: Dual Axis Rotation

Time	Voltage(V)	Current(mA)	Power(W)
09:00	7.55	98	0.75
10:30	8.69	227	1.97
12:00	11.85	498	5.90
13:30	11.95	495	5.91
15:00	11.38	295	3.35
16:30	9.05	219	1.98

Table 3: Comparison of Output Power



VI. CONCLUSION

Solar tracking mechanisms improve the energy gain of solar power plants. Automatic solar tracking system is generally the one that reaches the highest energy gain in every region. It is therefore the most versatile system, since it can be installed anywhere, guaranteeing a high energy gain. Solar trackers are recommended everywhere from an energetic point of view, since they always increase the amount of collected energy. Two degrees of freedom orientation is feasible. Arduino Uno controller is used to control the position of DC motors which ensures point to point intermittent motion resulting from the DC geared motors. Standalone working and wireless communication is achieved with computer or mobile which makes the system reliable and observable. The use of LDR sensors and high precision voltage and current sensor guarantees a more accurate and efficient tracking system. It now displays the sensors Parameters to the User over the internet Using effective application and also alerts user when sensors parameters above specific limits. This makes remotely monitoring of solar plants very easy and ensure best power output.

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