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Research Article

Dual Axis Solar Tracking System with Data Logger

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Abstract—Solar photoelectric technology is one of the most eminence resources of sustainable energy. However, the contemporary solar photoelectric system has consequential hindrance, such as high cost compared to fossil fuel energy resources, intermittency and low efficiency. Apprehending maximal energy from the sun by using photoelectric system is formidable. Various aspects that influence the energy yield of such system comprises of photoelectric material, geographical position of solar illumination, angle of sun prevalence, weather and ambient temperature, orientation of the panel. Photovoltaic panels are used to convert the sun's radiation to electrical energy, but since these cells are placed at a fixed angle, the efficiency is low so has to overcome this, we go with the tracking system. In this paper, dual axis solar tracking system with data logger is been implemented. Hardware part includes solar panel, LDR's, two geared DC motors, resistors, transistor, relays etc, and the software part has an Arduino programming used for tracking system and for logging the voltage and current column.

Keywords— ***photoelectric system, photovoltaic panels, data logging, LDR***

I. INTRODUCTION

In today's world, demand for the use of electrical energy has been incessantly growing which imposes the pressure on the existing power generation methods like fossil flues that affects the environment. In order to overcome we are going to new technologies to generate energy from renewable energy sources such as wind energy, solar energy, hydro energy etc but photovoltaic cells has a larger potential to convert solar energy to the electrical energy hence solar power is the significant source of energy.

The major idea of this work is to design a dual axis solar tracking system in order to rotate the solar panel towards the maximum sun's intensity; this is done with the help of the LDR's. We are using four LDR's which are placed at the middle of each edge of the solar panel, the output of the LDR's is compared using Arduino programming, a signal is generated and given to the motor to rotate the solar panel towards the maximum sun's intensity.

explained above, the signal from Arduino board to the motors is given with the help of the relays, motor 1 has been interfaced with two relays where one relay operates the motor in clockwise direction and other in anticlockwise direction and this will be same with motor 2. Operation of the relay depends on the Arduino programming.

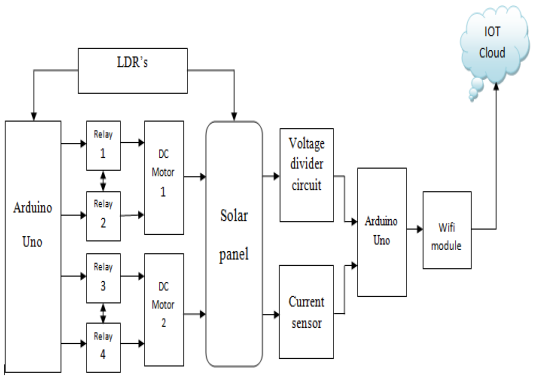


Fig 1. Block Diagram

In fig 1 the complete interfacing of the tracking system and the data logging is shown.

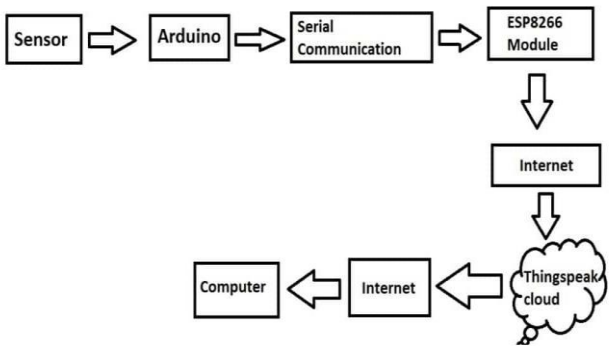


Fig 2. Block Diagram for Data logging

A voltage divider circuit and a current sensor are used to measure voltage and current and these values are sent to cloud server with the help of wifi module ESP8266. Fig 2 shows the block diagram of data logging system

II. SOLAR TRACKING SYSTEM DESCRIPTION

This system is intended to obtain the maximum solar energy from the sun. We have designed a base which appears to be a table; at the middle of the table one of the motor is fixed. The other motor is fixed at the side of the solar panel with the help of stand. This system is divided further into small parts in order to make the explanation simple: power supply circuit, tracking circuit and wifi module circuit.

A. Power Supply Circuit

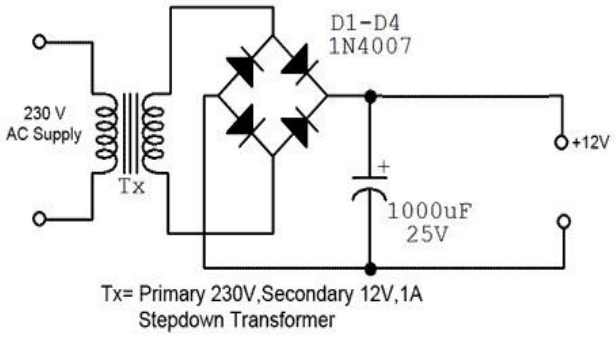


Fig 3. Schematic diagram of Power supply circuit

In power circuit we are using step-down transformer, which steps down the voltage from AC -240V to AC -12V. In order to step-down the voltage we are using full bridge rectifier, which uses 1N4007 diode and four such diodes are used.Also a capacitor of 1000 microfarads is used for filtering purpose. The schematic diagram of the power supply circuit is shown in fig3.

B.Tracking Circuit

In tracking circuit four LDR's are used and each LDR is connected in series with the 10 K Ohm resistors so this acts as a voltage divider circuit. The supply to this circuit is given from the Arduino board and the outputs of the LDR's are connected to the four analog pins of the Arduino board. As we know that the analog pins can read DC voltage from 0-5V, as per this the resistor value is choosen. We have internal ADC , which converts the analog values into digital values, with the help of Arduino programming the digital values are compared and the signal is given to the motors through the relays. We have used four relays, each motor is directed with help of two relays, one relay operates the motor in clockwise direction, and the other relay operates the motor in anticlockwise direction, this is done with the help of the program. Further relays are interfaced with the motors.

The connection the components are shown in fig 4. Fig 4 shows the schematic diagram of the tracking system. Supply block shown is fig 4 is already explained above with help of fig 3.

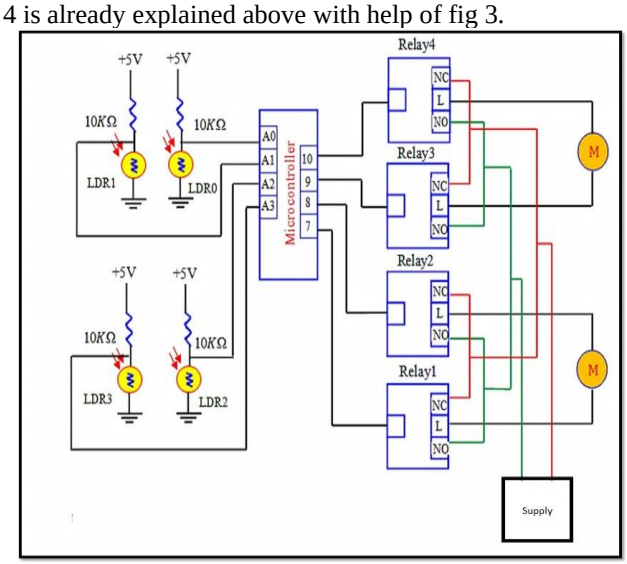


Fig 4. Schematic diagram of tracking system

C. WIFI Module Circuit

In this module the connection of the wifi module ESP8266 with the Arduino board is shown. Wifi module is powered with 3.3V from Arduino board, and the sensing circuits i.e., the voltage divider circuit and the current sensor which are used to measure the voltage and current are connected to the solar panel terminals as shown in the fig 1. The voltage divider circuit consists of two resistors connected in series where one end is powered with 5V, other end connected to ground and junction point is connected to Arduino. The schematic diagram for the interfacing of wifi module and Arduino is shown below in fig5.

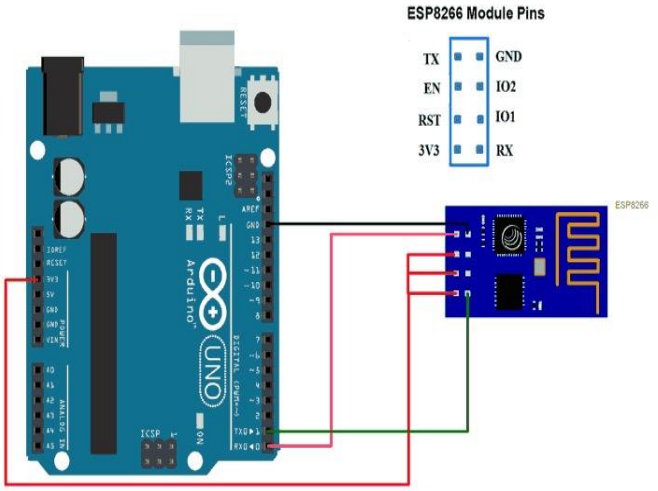


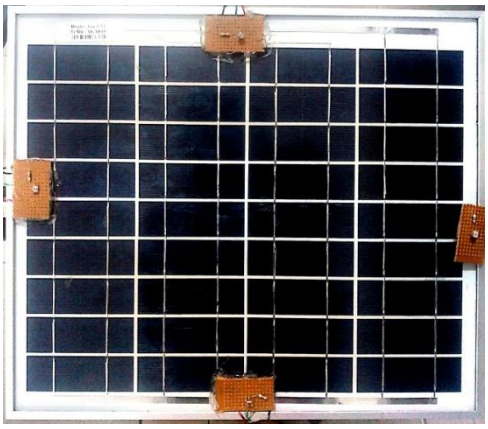
Fig5. Interfacing of Wifi module

D. Hardware

The hardware implementation is done in step by step procedure and will be explained in detail in further.

a. Placing of LDR's

As explained before we are using four LDR's, in which each LDR is placed at the middle of each edge of the solar panel. LDR is connected in series with a resistor of 10 K ohm, this is done because the analog pins of Arduino can measure a DC voltage from 0-5V. One end of resistor connected to 5V supply, LDR one end connected to ground and the resistor and LDR other end are shorted and connected to the analog pin of Arduino. Fig 6 shows the placing of LDR's on the solar panel.



b. Connections of tracking part

A transformer which steps-down the voltage from AC- 230V to AC-12V is used to supply the entire system; interfacing of the relays with motors is shown below. Relay will operate for 12V so we are using a transistor with resistor and led, transistor is used to amplify the voltage and led's will indicate whether the motor is rotating in clockwise or anticlockwise direction. This is shown in fig 7.

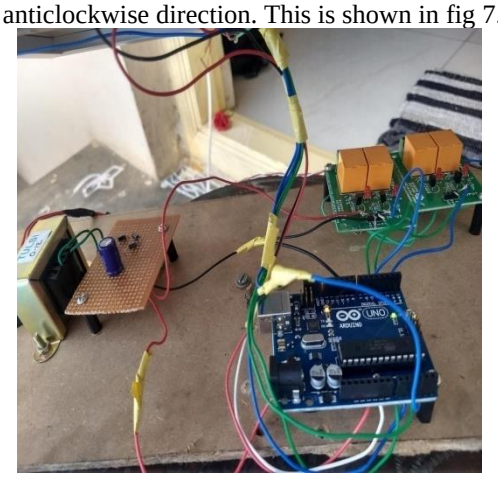


Fig 7. Tracking hardware

c. Connections of data logging circuit

In this, the connection of the voltage divider circuit and the current sensor with ESP8266 wifi module is shown, also the interfacing of these with arduino board is shown in fig 8.

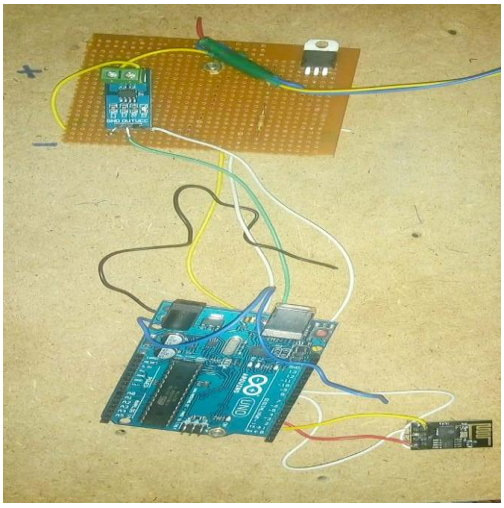


Fig 8. Wifi module

d. Complete hardware

The overall project hardware pictures are shown in fig 9 and fig 9.

Fig 9. Hardware

E . Flow Chart

The flow chart for the tracking system is shown below in fig 10

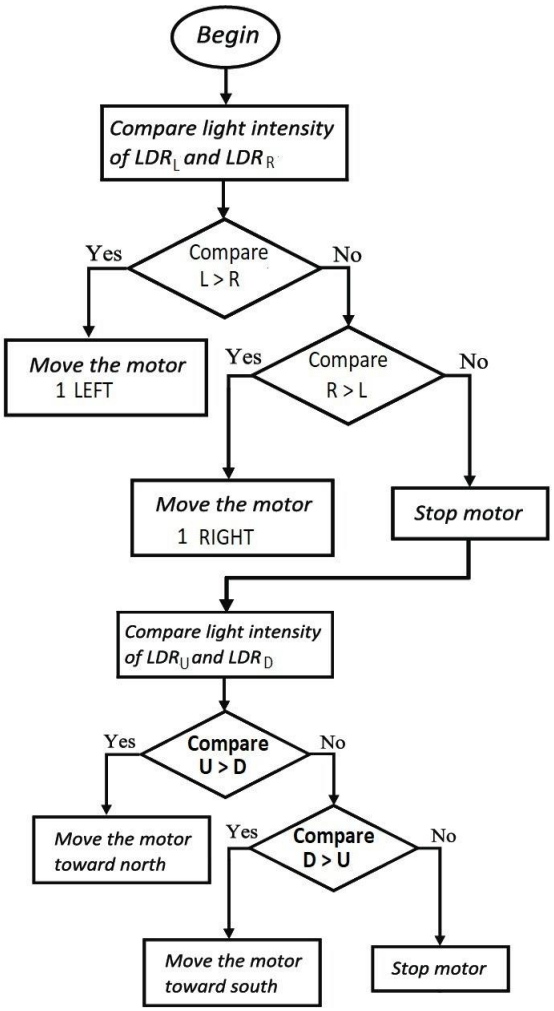


Fig11. Flow chart for tracking program

III.RESULT ANALYSIS

First voltage and the current are measured from the solar panel which was kept under the sun with the help of the multimeter. The manual readings of the voltage and current taken is showed in both pictures, where fig 12 shows the voltage measured and fig 13 shows the current measured and these values are tabulated for different timings which are represented in the table1.

A. Manual readings

Time	Voltage in (V)	Current in (A)
4:10 PM	19.56	0.41
5:16 PM	19.50	0.23
6:00 PM	18.08	0.15

Table 1

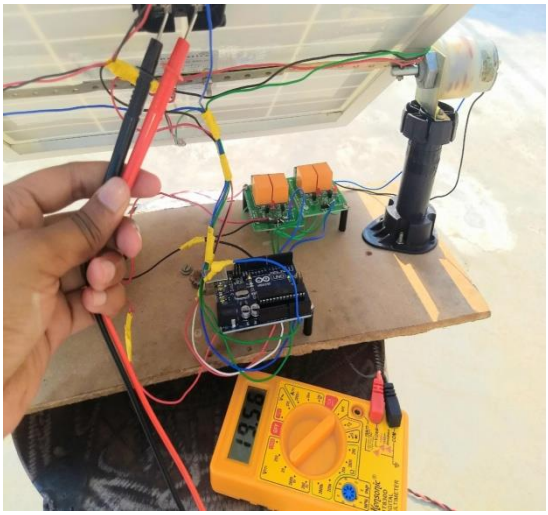


Fig 12. Measurement of voltage

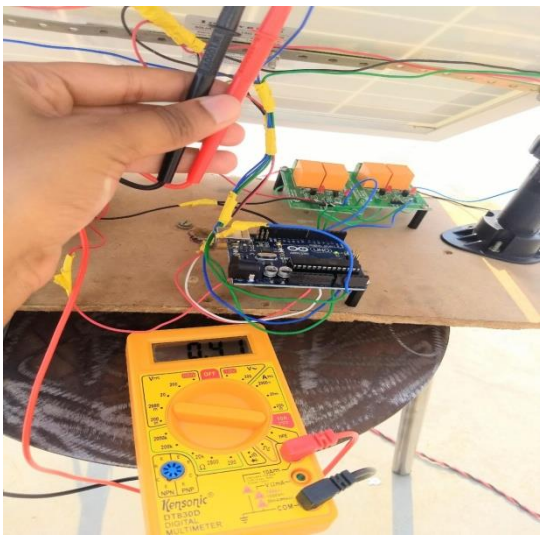


Fig 13. Measurement of current

B. Data logging output images

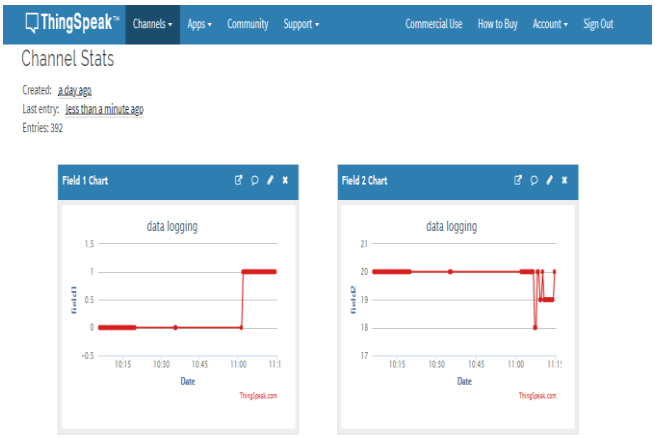


Fig 14. Current and Voltage output

III. CONCLUSION

This paper gives the details regarding how the dual axis solar tracking system is implemented with the help of the LDR's and checking for the rotation of the solar panel. Arduino program helps us with easy tracking of the sun's intensity by comparing the outputs of the LDR's. The wifi module circuit will help us to record the data such as voltage and the current form the solar panel this is done using Arduino program. This is real time accessing of the data which can be referred for the future use in order to calculate the efficiency of the system and compare it with the fixed solar panel or the single/dual axis solar tracking system.

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