Sun Tracking System with Microcontroller 8051

Syed Arsalan

Abstract— The uses of alternative sources of energies are becoming widely spread in all over the world. Our sun is also a very good source of different energies; the light energy has a very remarkable value. The Solar panel converts the light energy into the electrical energy. The efficiency of solar panel can be maximized by aligning the solar panel with the sun. The sun tracking system is designed in this project, offers a reliable and affordable method of aligning a solar panel with the sun on single axis. This project is based on microcontroller 8051 with a simple circuit and sun tracking software.

Index Terms— Microcontroller 8051, Stepper motor, LDR sensor, Solar panel, Sun tracking software.

1 Introduction

THIS paper deals with the research and development of a Sun tracking system. Now a day's Renewable energy solutions are becoming increasingly popular. Maximizing power output from a solar system is desirable to increase efficiency. In order to maximize power output from the solar panels, one need is to keep the panels aligned with the sun, means that the tracking of the sun is required. This is a far more cost effective solution than purchasing additional solar panels. The tracking is done by this tracking system in a simple way, this project has two ways of tracking, auto-tracking and manual-tracking, auto-tracking is working on LDR sensor while the manual-tracking is working by the software named "sun tracking software", this manual-tracking is an optional part of this project, if the system is not tracking manually so the system uses auto tracking, this system is designed with specific methodology, this system using solar panel(photocells), stepper motor, microcontroller 8051, physical construction, and a software. The real image of the tracking system is shown in figure no 1.

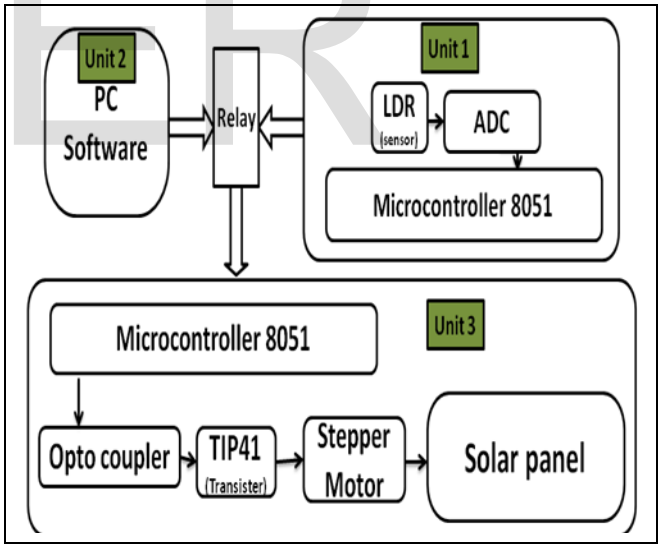
Fig. 1. "The sun tracking system"

• *Syed Arsalan is currently pursuing MPhil/PhD degree program in space sciences from institute of space and planetary astrophysics, University of Karachi, Pakistan, PH-923012900519. E-mail: syed5arsalan@yahoo.com*

2 Methods And Material

There are many different components and also the methods used to track the sun. This system has a simple combination of electronic circuit. This project contains the basic component which deals with the Solar panel, Stepper motor, Microcontroller (8051), Analog to digital convertor (ADC), Optocoupler, Tip41 (power transistor), Light dependent register (LDR), Relay, Sun tracking software.

3 Block Diagram



The block diagram of this project has three basic units, description of these units are as following:

2.1 Unit 1

2.1.1 LDR Sensor

In this project, the unit 1is using the LDR sensor to get input data of light, this data is in the analog form, on the basis of this data, system track the sun.

2.1.2 ADC (analog to digital converter)

Analog to digital converter (ADC) is using to convert the analog data, by the LDR sensor, into digital data. The microcontroller uses this digital data for tracking.

2.1.3 Microcontroller (8051)

The microcontroller 8051 has a basic role in this project; it takes action according to its program on the basis of ADC's data.

2.2 Relays

Relays are also playing an important role in this tracking system, they are using as a switch between unit 1 and unit 2.

2.3 Unit 2

This unit has the software portion for tracking; this unit allows the user to track the sun manually.

2.4 Unit 3

2.4.1 Microcontroller (8051)

In unit 3, the microcontroller 8051get the instructions from the unit 1 or unit 2 and give the instructions to the stepper motor to track the sun.

2.4.2 Opto-coupler and Tip41 (transistor)

In unit 3, the opto-coupler is using to safe the microcontroller 8051 in the circuit and the Tip41 is using as a power transistor for the stepper motor.

2.4.3 Stepper motor

The stepper motor plays an important role in this project; it directed the panel towards the sun.

2.4.3 Solor panel

All the system works to keep the solar panel directed towards the sun, the solar panel generate the DC voltages.

2.5 Input power

This system is using +5V DC power, as the input, for the all the three units and also +12V DC for the stepper motor of unit 3.

3 Working of Tracking System

This project has two ways of tracking:

Auto tracking (By the sensor)

Manual tracking (By the software)

3.1 Auto Tracking (By The Sensor, Unit 2)

The auto tracking is performed on the basis of sensor LDR. In this system the LDR get the light intensity data, this analog data is converted into the digital form by passing through ADC, now microcontroller of unit 1 get the eight bits data of light, The microcontroller 8051 of unit 1 gets the several readings of ADC, it's subroutines compare these values, If any of the values are equal, the unit 1 microcontroller 8051 not take any decision for unit 3, it waits for few minutes and check again later. If it gets the greater value of the difference, which is defined in it, it sends a bit, to move, for unit 3. If light intensity below the low light threshold level, the tracker will keep measuring at whatever position it is at until the threshold is reached. The threshold for this portion has been assigned a constant in microcontroller. This level corresponds to what was measured with the solar panel during daytime. The last portion of the routine in microcontroller allows the system to reset itself at the end of a day. After every motor movement, a register is incremented or decremented so that the net position of the tracker can be known at any given time. Once the tracker moved 180 degrees, light intensity is checked; the system will return to its starting point and enters in sleep mode.

3.2 Manual Tracking (By The Software, Unit 3)

In manual tracking we used software named "Sun Tracking Software"; this software is created on VB.NET, with the help of this software we can move the solar panel in our desired direction on one axis, this software uses the parallel port to communicate with the circuit of unit 3, when the system using manually then it's circuit switched on solar tracking software from sensor and user can move the solar panels on one axis by the arrow keys. It can be used as an optional part in this system, if it is not in use so the system works on auto tracking. Figure 2 (a) and (b) shows the two different views of software.

Fig. 1 (a) View of software.

Fig. 1 (b) Next view of software.

3.3 Working of Unit 3 Section

Both the unit 1 and unit 2, sends the instructions to unit 3. Basically unit 3 operates the stepper motor (which is connected

with the solar panel's stand) on 180 degrees on one axis; the microcontroller 8051 of unit 3 gets the two bits instructions (to move forward or backward) from the unit 1 and unit 2 and uses the four bits data for stepper motor.

5 Representation of Circuit

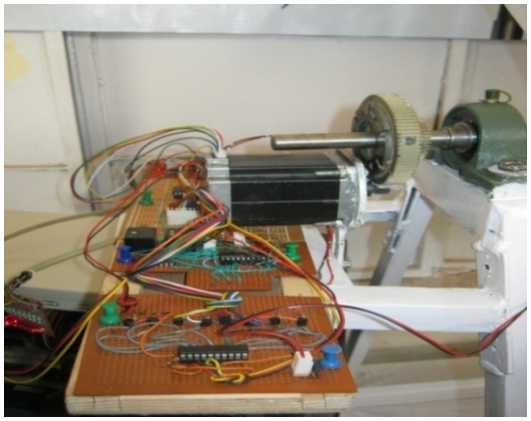


Fig. 2 (a) Stepper motor with circuit.

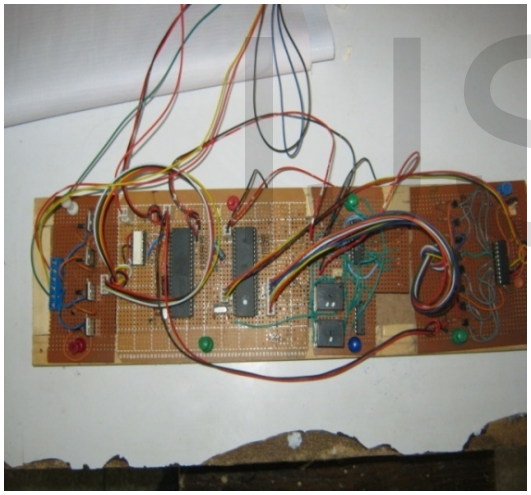


Fig. 2 (b) Complete circuit.

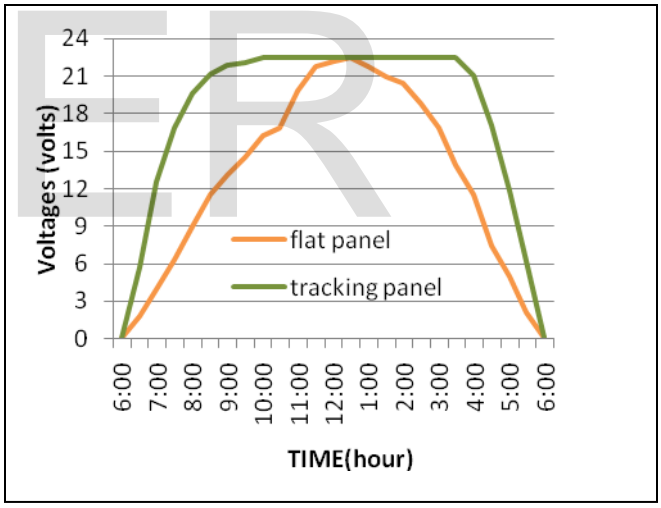
6 Results

The output from the static or flat solar panel and the tracking solar panel are showing in the following table, these outputs are obtained during the 6:00 AM to 6:00 PM, the readings are observed after every half an hour. The output results are measured in the Voltages (Volts).

TABLE 1
Output values in the form of voltages(volt) and time(hour)

Time	flat panel	tracking panel	Time	flat panel	tracking panel
6:00	0	0	12:30	22.5	22.5
6:30	1.7	5.6	1:00	21.8	22.5
7:00	3.9	12.5	1:30	21	22.5
7:30	6.3	16.8	2:00	20.4	22.5
8:00	8.9	19.6	2:30	18.8	22.5
8:30	11.5	21.2	3:00	16.9	22.5
9:00	13	21.9	3:30	13.9	22.5
9:30	14.5	22.1	4:00	11.5	21.1
10:00	16.2	22.5	4:30	7.4	17.1
10:30	16.9	22.5	5:00	4.9	11.8
11:00	19.8	22.5	5:30	2.1	6.2
11:30	21.8	22.5	6:00	0	0
12:00	22.2	22.5	-	-	-

7 Graphical Representation



8 Conclusion

In this project, the sun tracking system is developed based on 8051 microcontroller. The microcontroller 8051 based circuit is used in this system with a minimum number of components and the use of stepper motors enables accurate tracking of the sun. After examining the information obtained in the data table section and in plotted graph, It has been shown that the sun tracking systems can collect maximum energy than a fixed panel system collects and high efficiency is achieved through this tracker, it can be said that the proposed sun tracking system is a feasible method of maximizing the light energy received from sun. This is an efficient tracking system for solar energy collection.

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