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Design and Working of Single Axis Solar Tracker System Using PIC16F877A

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Abstract: An attempt has been made to design and working single axis solar tracker system a using PIC16F877A microcontroller for storing ambient temperature data. Usually the sun is not really focused in visually manner, in solar radiation.Solar can seems the sun has have number of traces in visually manner. But in My project the traces has to be seen by time based, to tracking the sun, in the sun tracker.I have used proposal concentrator .I am rectified the traces to be seemed.By using 'STEPPER MOTOR' we have set the point for adjusting to track the sun tracking system.We set the point for 'CALCULATION ALGORITHIM' .By using the concentrator we have been adjusted the temperature sensor.If the temperature is 'MAXIMUM' it can be adjusted to set point it have been tracked it is to be adjusted.

Keywords: Battery, Microcontroller, Sensor, Stepper Motor, Motor Driver Circuit, Limit Switch.

1. Introduction

A solar tracker is a generic term used to describe devices that orient various payloads towards the sun. Payloads can be photovoltaic panel's reflectors, lenses or other optical devices. In standard photovoltaic (PV) applications trackers are used to minimize the angle of incidence between the incoming light and a photovoltaic panel**.** This increase the amount of energy produced from a fixed amount of energy produced from a fixed amount of installed power generating capacity. In standard photovoltaic applications, it is estimated that trackers are used in at least 85% of commercial installations greater than 1MW from 2015 to 2016.

2. Needs of Tracking

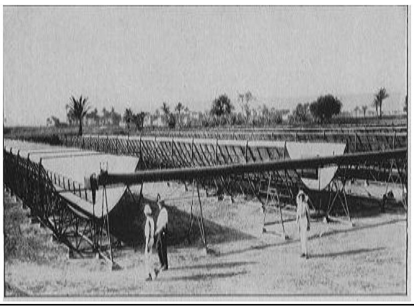
The sun's position in the sky varies both with the seasons and time of the day as the sun moves across the sky. Solar powered equipment works best when pointed at or near the sun, so a solar tracker can increase the effectiveness of such equipment over any fixed position. Passive tracking systems have some limitations first they are somewhat susceptible to high winds which can throw the tracker off the proper direction.Active tracking systems are powered by small electric motors and require some type of control module to direct them.

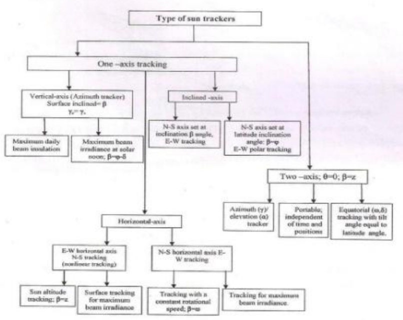
3. Methods of Tracking

Passive tracking systems have some limitations first they are somewhat susceptible to high winds which can throw the tracker off the proper direction. They can also be somewhat sluggish in getting moving in cold temperatures because they are mechanically rather than electronically driven.

Active tracking systems are powered by small electric motors and require some type of control module to direct them. They are similar in approach to the systems supporting giant TV dishes. Active systems require some electric power which can come from an external source or from the solar panels themselves depending upon the model.

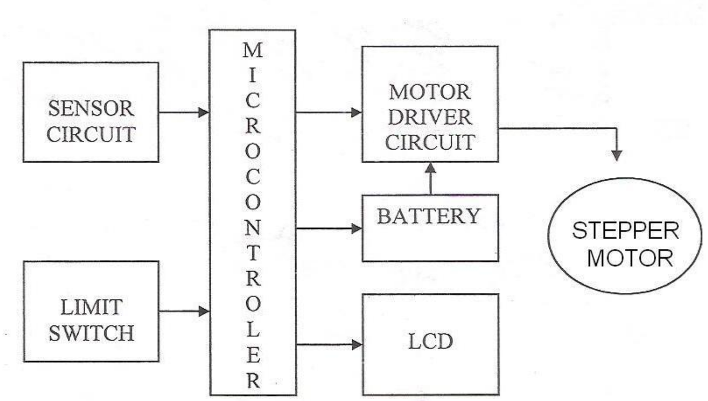
4. Types Of Tracking





5. Design of The System

Sensor circuit of two Light Dependent Resistors(LDR), gives signal to the microcontroller (PIC16F877A). The microcontroller sends signal to the motor driver circuit which in turn switches on the Stepper motor. The Stepper Liquid crystal display is used to display the text, "solar Tracking", there are two limit switches namely east limit switch and limit switch which is used for forward motion or the reverse motion of the motor. The block diagram of the sun tracking is given in the Fig 3.1 the components of the device are
1.Battery
2.Sensor circuit
3.Stepper Motor
4.Motor driver circuit
5.Microcontroller
6.Limit Switch
7.Liquid Crystal Display



6. Stepper Motor

A **stepper motor** or **step motor** or **stepping motor** is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. Switched reluctance motors are very large stepping motors with a reduced pole count, and generally are closed-loop commutated.

A **Stepper Motor** or a **step motor** is a brushless, synchronous motor which divides a full rotation into a number of steps. Unlike a brushless DC motor which rotates continuously when a fixed DC voltage is applied to it, a step motor rotates in discrete step angles. The **Stepper Motors** therefore are manufactured with steps per revolution of 12, 24, 72, 144, 180, and 200, resulting in stepping angles of 30, 15, 5, 2.5, 2, and 1.8 degrees per step. The stepper motor can be controlled with or without feedback.

7. How A Stepper Motor Works?

Stepper motors work on the principle of electromagnetism. There is a soft iron or magnetic rotor shaft surrounded by the electromagnetic stators. The rotor and stator have poles which may be teethed or not depending upon the type of stepper. When the stators are energized the rotor moves to align itself along with the stator (in case of a permanent magnet type stepper) or moves to have a minimum gap with the stator (in case of a variable reluctance stepper). This way the stators are energized in a sequence to rotate the stepper motor. Get more information about working of stepper motors through interesting images at the stepper motor Insight.

8. Types of Stepper Motor

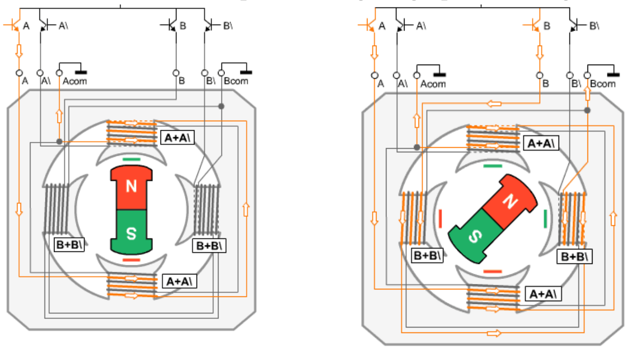
By construction the step motors come into three broad classes:

1. Permanent Magnet Stepper
2. Variable Reluctance Stepper
3. Hybrid Step Motor

These three types have been explained in detail in the following sections.

9. Working of Stepper Motor

Now lets discuss the operation principal of a stepper motor. When we energize a coil of stepper motor, The shaft of stepper motor (which is actually a permanent magnet) align itself according to poles of energized coil. So when motor coils are energized in a particular sequence, motor shaft tend to align itself according to pole of coils and hence rotates. A small example of energizing operation is given below.



You can see in the example, when coil "A" is energized, A north-south polarity is generated at "A+A\" as in the figure above and magnetic shaft automatically align itself according to the poles generated. When the next coil is energized the shaft again align itself and take a step. Hence the working principal.
We have seen that to make the stepper motor work, we need to energize coil in a sequence.

Step Sequence

Stepper motors can be driven in two different patterns or sequences. namely, Full Step Sequence

- Bulleted list item
- Half Step Sequence

we will go through these sequences one by one.

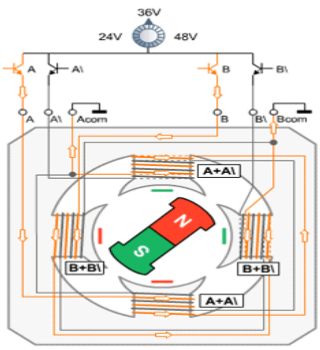
Full Step Sequence

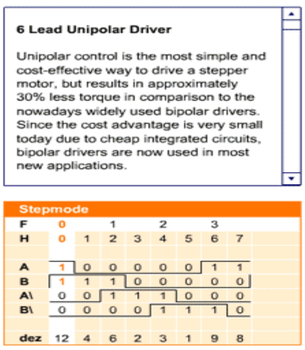
In the full step sequence, two coils are energized at the same time and motor shaft rotates. The order in which coils has to be energized is given in the table below.

Full Mode Sequence

Step	A	B	A\	B\
0	1	1	0	0
1	0	1	1	0
2	0	0	1	1
3	1	0	0	1

The working of the full mode sequence is given in the animated figure below.





10. Stepper Motors and Their Principles of Operation

A stepper motor is a type of DC motor which has a full rotation divided in an equal number of *steps*. It is a type of actuator highly compatible with numerical control means, as it is essentially an electromechanical converter of digital impulses into proportional movement of its shaft, providing precise speed, position and direction control in an open-loop fashion, without requiring encoders, end-of-line switches or other types of sensors as conventional electric mot

11. Stepper Motor

The steps of a stepper motor represent discrete angular movements, that take place in a successive fashion and are equal in displacement, when functioning correctly the number of steps performed must be equal to the control impulses applied to the phases of the motor. The final position of the rotor is given by the total angular displacement resulting from the number of steps performed. This position is kept until a new impulse, or sequence of impulses, is applied. These properties make the stepper motor an excellent execution element of open-loop control systems. A stepper motor does not lose steps, i.e. no slippage occurs, it remains synchronous to control impulses even from standstill or when braked, thanks to this characteristic a stepper motor can be started, stopped or reversed in a sudden fashion without losing steps throughout its operation.

Speed of a stepper motor can be controlled in a broad range of values by altering the frequency of input impulses. For example if the angular displacement per step is 1,8 degrees, the number of total impulses required for a complete revolution is 200, so for an input frequency of 400 impulses per second the speed of the motor is 120 rpm. Stepper motors can operate with input frequencies up to 2000 impulses (steps) per second, with step values from 0,3 to 180 degrees.

Stepper motors have power ratings ranging from the Microwatt domain to not exceeding a few Kilowatts, thus being preferred in low to medium power applications, where precision high-speed movement is required, rather than in heavy duty applications where torque is a key factor. These motors employed in plotters, disc drives, printers, robotic arms, CNC machines and others of the type.

12. Microcontroller

Micro controller is the heart of the sun tracking mechanism. It is a complete microprocessor system built on a single IC. Since its emergence in the early 1980's the microcontroller has been recognized as a general purpose building block for intelligent digital systems. It is finding using diverse area, staring from simple children's toys to highly complex spacecraft.

Today microcontrollers are very commonly used in wide variety of intelligent products. For example most personal computer keyboards are implemented with a microcontroller, May low cost products, such as Toys, Electric Drills, Microwave Ovens, VCR and a host of other consumer and industrial products are based on microcontroller.

Microcontroller is a general purpose device, which integrates a number of the components of the microprocessor system on to single chip. It has inbuilt CPU, memory and peripheral to make it as a mini computer. A microcontroller combines on to the same microchip.

Microcontroller will combine other devices such as

A timer module to allow the microcontroller to perform tasks for certain time periods.

A serial I/O/ port to allow data to flow between the controller and other devices such as a PIC or another microcontroller.

An ADC to allow the microcontroller to accept analog input data for processing.

Microcontrollers are:

Similar in size

Consumes less power.

Inexpensive

Microcontroller is a standalone unit, which can perform functions on its own without any requirement for additional hardware like I/O ports and external memory. The heart of the microcontroller is the CPU core. In the past, this has traditionally been based on an 8-bit microcontroller unit. For example Motorola uses a basic 6800 microprocessor core in their 6805/6808 microcontroller devices.

In the recent years, microcontroller have been developed around specifically designed CPU cores, for example the microchip PIC (Peripherals Interface Controller) range of microcontrollers.

The features of PIC core are,
High Performance risk CPU
Only 3s single word instruction to learn
All single cycle instructions
Flash memory upto 8k
Interrupt capacity (upto 14 sources)
8 level deep hardware stack
Operating speed upto 20MHz
200 ns instruction cycle
3 timers
8 ADC channels (each 10bits)
2 CCP ModulesS
2 serial communication ports

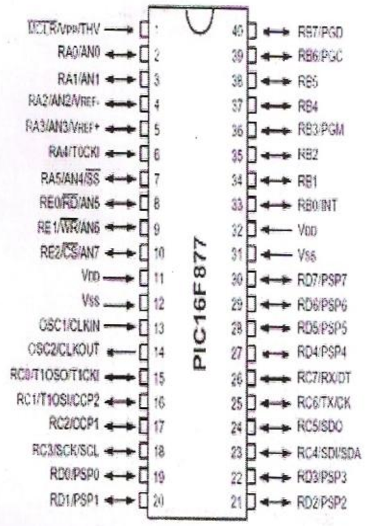


Fig. 3.7 Pin diagram of microcontroller PIC16F877A

13. Results and Discussions

These are used for available full efficiency to working the tracker system .we set a point and adjusted the temperature sensor it is to be maximum the motor is rotated and it is tracked and it is stopped again it is rotated when temperature is maximum to gain the efficiency.

For gaining the efficiency to available it can be executed By 'MICROCONTROLLER'. 'MICROCONTROLLER' IT IS TO FIND OR COLLECTING THE 'DATA ACCUSATION'. 'DATA ACCUSATION' MEANS TO CONTROL THE 'STEPPERMOTOR**.**

14. Final Conclusion

This is the more efficient system for solar tracking. The proposed solar constrain can move 'BOTH SIDES' for reaching "HIGHEST TEMPERATURE".

The "STEP-by-STEP" ROTATION is used for acquiring "MAXIMUM TEMPERATURE''.It is a simple and efficient system.It can used for "'SOLAR POWER PRODUCTION", "IRON MELTING", "SOLAR TRACKING", etc.,

15. Future Suggestions

It is more "EFFICIENT SYSTEM".If the data is displayed the data is stored for useful purposes.IN FUTURE IT CAN BE VERY USEFULL AND IMPROVED EFFICIENCY.THIS CAN BE ACHIEVED BY MAKING MODIFICATIONS IN CODING AND WITHOUT ANY CHANGES IN THE MACHANICAL PART OF TH EXISTING MODEL.

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