Chronological Single Axis Solar Tracker

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***Abstract*—Solar energy is a clean and freely available renewable source of energy whose use reduces polluting emissions and thus helps to control global warming. This paper describes a project aimed at maximizing the efficiency of photovoltaic cells by optimizing the use of solar energy for producing electricity. To achieve this, a solar panel is made to track the position of sun with the help of a motor and the rotation per minute of the motor is controlled by a micro-controller.**

***Index Terms*—PIC18F252, Solar panel, DC motor, Tracker, L293D**

I. INTRODUCTION

Now a days the number of applications based on solar energy and thus there is a need to device improved method to harness this energy. The best way to harness solar energy is to maneuver a solar tracker. A solar tracker is a general term used to describe a device that orients various payloads towards the sun. As compared to fixed solar devices, a solar tracker increases the output (electric output) by approximately 30%.Energy solar panel is obtained by converting energy from sun rays into electric current by solar cells present in the panel. Solar trackers are of two types:-Single axis and Dual axis. Single axis tracker has only one axis of rotation and dual axis tracker has two rotating axis, namely primary and secondary. Further trackers are classified as active, passive and chronological.

Here we have designed a chronological single axis solar tracker with a view to minimize the hardware requirements, reduce the complexity of the system and maximizing the efficiency of the tracker. For this we are using pic microcontroller, dc motor, driver IC and led module to determine the strength of electric output produced.

II. PRINCIPLE OF OPERATION

PIC18252 micro-controller is set of a predefined value, so that it will be active only for a certain period of time. This is done with the help of in-built Timer1 present in the µc. For this much period of time motor will be active and rotate the solar panel. The motor is interfaced with µc via motor driver IC, which will also source the required current to the dc motor.

As per the amount of current produced, through solar panel, the number of leds will glow in the led-mesh (or led-module). The amount of solar current and voltage produced can also be displayed using 2X16 LCD display.

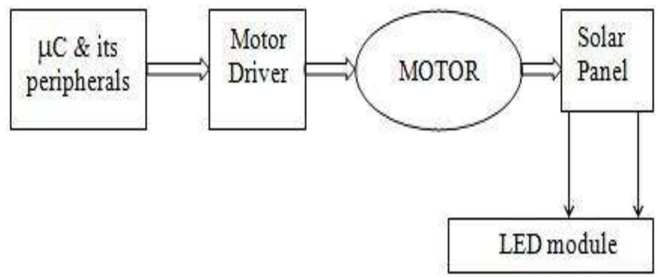

Fig. 1 Block diagram of solar tracker

The system is designed with a view to track the position of the sun by the solar panel so that rays of the sun always fall perpendicular on the panel. As only perpendicular rays can produce maximum intensity of solar energy. In this way concentrated solar rays can be made available throughout the day.

III. HARDWARE CONSIDERATION

Hardware used in this project includes microcontroller, DC motors Driver IC and solar panel. The integration of these hardware makes the idea as a product. PIC 18 F 252 is used as the central microcontroller controlling the operations of the motors and also controlling the chronological operations of the controller so that it can function effectively and operates as per the required conditions for operations. The diagram below shows the schematic and proteus version of the circuit.

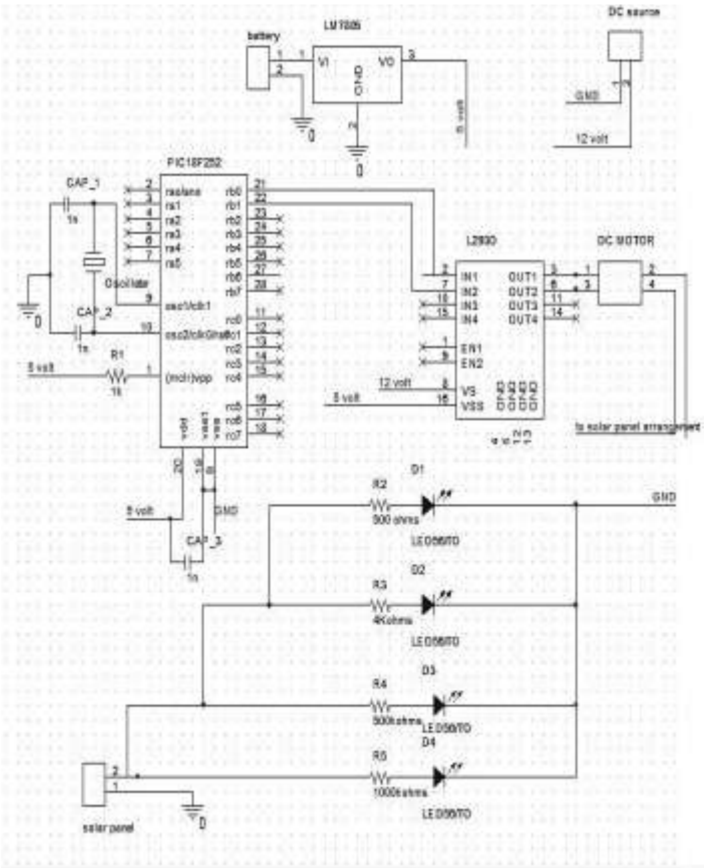

Fig. 2Proteus design and simulation of the system

A. PIC18F252 Micro-controller

PIC stands for Peripheral Interface Controller. PIC microcontrollers are manufactured by Microchip Technology Corporation. PIC18F252 microcontroller has a RISC architecture having 28 pins that comes with standard features.

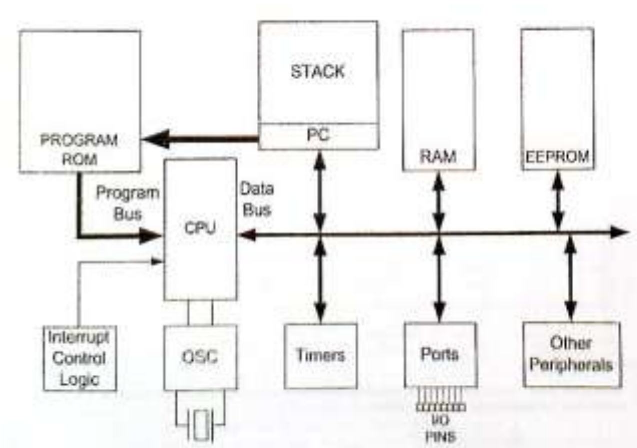

Fig. 3. Simplified view of PIC microcontroller

Some of the peripheral features are:

• High current sink/source 25 mA/25 mA
• Three external interrupt pins
• Timer0 module: 8-bit/16-bit timer/counter with 8-bit programmable prescaler
• Timer1 module: 16-bit timer/counter
• Timer2 module: 8-bit timer/counter with 8-bit period register (time-base for PWM)
• Timer3 module: 16-bit timer/counter
• Secondary oscillator clock option - Timer1/Timer3
• Two Capture/Compare/PWM (CCP) modules. CCP pins that can be configured as:
- Capture input: capture is 16-bit, max. resolution 6.25 ns (TCY/16)
- Compare is 16-bit, max. resolution 100 ns (TCY)
- PWM output: PWM resolution is 1- to 10-bit, max. PWM freq. @: 8-bit resolution = 156 kHz 10-bit resolution = 39 kHz
• Master Synchronous Serial Port (MSSP) module, Two modes of operation:
- 3-wire SPI™ (supports all 4 SPI modes)
- I2C™ Master and Slave mode

B. L293D – Motor driver IC

The L293D is a quadruple high-currenthalf-H driver compatible only with TTL Logic. The L293 has been developed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D provides bidirectional drive currents of up to 600-mA at voltage ranges 4.5 V to 36 V. L293D drives inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in only positive-supply applications. H bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards[2].

C. MOTOR

For tracking the sun dc motor is used. DC motors are of two types: Separately excited and Self excited. Self-excited are again classified into three types: Shunt type, Series type and Compound type. Here we have used brushless shunt type dc motor. As the name implies, the field winding and armature winding are connected in shunt i.e., in parallel with each other across a dc supply. Shunt motor is used because its torque is directly proportional to the armature current (Ia).thus the rotor speed can be controlled by controlling the armature input voltage. The maximum permitted value of Ia is also called as ‘rated value of Ia’.it means that for rated Ia at any value of input armature voltage, the maximum torque that can be generated will be constant.

Brushless motors can be operated in modes in which they can be frequently stopped with the rotor in defined angular position. A brushless dc motor can be easily controlled by a controller with increase in efficiency as compared to brushed dc motors

D. Solar Panel

Solar panels are also called as polycrystalline photovolticcell. The semiconductor material used is silicon. Solar panels are constructed by assembling number of photovoltaiccells together. It works on the principle of photovoltaic effect. It converts the energy of light directly into electricity.

IV. PROGRAMMING DETAILS

A. Calculation of timer value

DC motor used has angular speed of 60rpm.

i.e.	1min	→	60 rotations
“	1/60hrs	→	60rotations
:.	1 rotation	→	1/60*60 hrs.
i.e.	1/60*60 hrs.	→	360^o
:.	180^0	→	180/60*60*360 hrs.
i.e.		→	30 sec
:. for	180^orotation	→	30 sec

Now to track the positions of the sun continuously, the tracker should rotate 15^o in 1 hour.

For 180^o rotation	→	the tracker should be activate for 30 sec
:. For 15^o rotation	→	the tracker should be activate for only 2.5 sec (30*15/180)

So in all, in 1 hour, the µc should be active for 2.5 seconds or should be in sleep mode for 59.96 minutes

B. Program flow chart

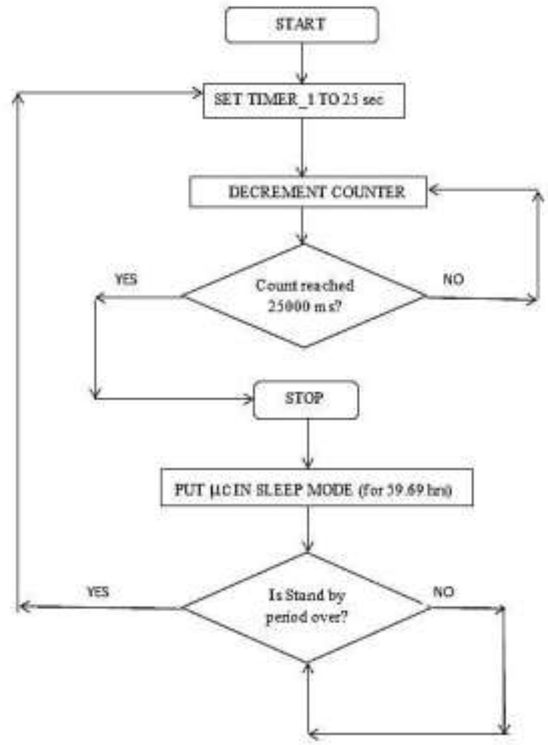

Fig. 4Flow chart of program

V. FUTURE SCOPE

The project provides a futuristic fission in harvesting of solar energy in a more efficient and suitable way. The project has developed a small prototype which can open the doors of advancing the utilization of solar energy in near future at affordable prices. The solar tracker will help in future to make bigger systems which can be chronologically operated and helped in efficient tracking the position of the sun. The energy harvested can be used in number of home application, driving engines which use electricity or diesel, or even in driving cars and micro-light aircraft. Implementation of this model on large scale will ensure that bigger models can be implemented using better and bigger motors.

VI. CONCLUSION

The designed solar tracker can successfully track the position of the sun with high efficiency of output produced. As the system is predefined time based, i.e. chronological, it won’t require physical alignment of tracker of tracker when it is switched on. By changing the timer value, this system can track the position of sun in any location around the globe.

REFERENCES

[1] Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, "*PIC Microcontroller and Embedded System*," Pearson Education, INC., Pearson Prentice Hall.

[2] Al Williams, Microcontroller projects using the Basic Stamp (2nd ed.2002). Focal Press. p. 344. ISBN 978-1-57820-101-3.

[3] Martin P. Bates, "*Programming 8-bit PIC Microcontrollers in C*", second edition

[4] The Solar Electricity Handbook - A simple, practical guide to usingphotovoltaic PV systems published by Greenstream Publishing

[5] Gopal K. Dubey, "Fundamentals Of Electrical Drives" 2nd Edition, Narosa Publishing House