SOLAR TRACKING SYSTEM

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***ABSTRACT*- In order to get highest efficiency from the solar cells, changing the direction of the solar panel in the solar tracking system should be made necessary. The solar monitoring system is set up by means of GPS and GSM facilities. Global System for Mobile communications(GSM) and Global Positioning System(GPS) are the two features which play a major role to monitoring the solar system any parts of the world. A solar tracking system is fit on the top of the houses, industries which gains maximum output of solar energy from the sun. An important tool of microcontroller chip PIC 16F73 is used as its highly programmable to perform various tasks**

***Keywords* – GSM, GPS, MICRO CONTROLLER**.

1. INTRODUCTION

Photovoltaic's is the field of technology and research related to the application of solar cells as solar energy. Solar cells have many applications. Individual cells are used for powering small devices such as electronic calculators. Photovoltaic arrays generate a form of renewable electricity, particularly useful in situations where electrical power from the grid is unavailable such as in remote area power systems, Earth-orbiting satellites and space probes, remote radiotelephones and water pumping applications. Photovoltaic electricity is also increasingly deployed in grid-tied electrical systems.

Solar Energy has been the power supply of choice for Industrial applications, where power is required at remote locations. Most systems in individual uses require a few kilowatts of power. The examples are powering repeater stations for microwave, TV and radio, telemetry and radio telephones. Solar energy is also frequently used on transportation signaling e.g. lighthouses and increasingly in road traffic warning signals. Solar's great benefit here is that it is highly reliable and requires little maintenance so it's ideal in places that are hard to get to.

While the output of solar cells depends on the intensity of sunlight and the angle of incidence, it means to get maximum efficiency; the solar panels must remain in front of sun during the whole day. But due to rotation of earth those panels can't maintain their position always in front of sun. This problem results in decrease of their efficiency. Thus to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel. The Solar Tracking System is made as a prototype to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of sun where we get maximum output.

2. OBJECTIVES

Our aim is to design the system, which will automatically track the sun's position and accordingly change the direction of the solar panel to get the maximum output from the solar cell.

Along with this we are going to make a solar monitoring system using GSM and GPS module.

3. PROBLEM DEFINITION

To implement a solar tracking system which will automatically track sun's position to increase the efficiency of solar system. The GSM facility is provided within the system which helps the user to monitor the system from anywhere in the world.

4. METHODOLOGY

PIC 16F73 from Micro-chip Corporation

This popular PIC 16F73 chip has inbuilt ADC and on-chip ROM in the form of program and data memory. This is ideal for development since flash memory can be erased in seconds compared to the twenty minutes or more needed for the 8751 for this reason the PIC 16F73 is used in place of the 8751 to eliminate the waiting time needed to erase the chip & thereby speed up the development time. To use the PIC 16F73 to develop a micro controller based system requires a ROM burner that supports flash memory; however, a ROM eraser is not needed. Notice that in flash memory you must erase the entire contents of ROM in order to program it again. PROM burner itself does this erasing of flash & this is why a separate eraser is not needed.

Voltage Regulator 7805:

We need the regulated 5 V output for the most of the IC's used in our system. Now the output of bridge rectifier is unregulated DC. To get 5V regulated DC output from it we have used regulator IC 7805. The 7805 is designed with adequate heat sinking and can deliver output currents in excess of 1A. It has internal thermal overload protection and internal short circuit current limiting. For proper operation a common ground is required between input and output voltages.

MAX 232 (DS 14C232):

The DS14C232 is a low power dual driver/receiver featuring an onboard DC to DC converter. ICC is specified at 3.0 mA maximum, making the device ideal for battery and power conscious applications. The driver's slew rate is set internally and the receivers feature internal noise filtering, eliminating the need for external slew rate and filter capacitors. The device is designed to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE).

Stepper Motor and its Interfacing with Micro Controller :

Stepper motor is a digital actuator whose input is in the form of programmed energization of the stator windings and whose output is in the form of discrete angular rotation.

Selection of the stepper motor:

To select appropriate stepper motor for our system was important task before use. We had gone through following criterion of the stepper motor to get the appropriate one.

The selected stepper motor must provide specified,

1) Positioning accuracy (δ), expressed in mm/microns, or deg/minutes of arc
2) Speed of operation (V), specified in mm/sec or deg/sec or rad/sec
3) Acceleration (α), expressed as the operating speed v, starting from rest

The steps involved in the selection of stepper motor are as follows,

1) Compute,
   i. Step angle θs from δ
   ii. Stepping rate Fs (Steps/sec) from V
   iii. Acceleration α (rad/sec^2)
   iv. Total moment of inertia Jt reflected on the motor shaft
   v. Total torque Tm required to be developed by the motor
   vi. Select a range of stepper motors having a step angle θs
2) Refer to torque Vs. stepping rate curves of the motor selected in step 2. Select a stepper motor which is capable of delivering torque $T \geq Tm$ computed in step 1(v) at a stepping rate $F \geq Fs$ (steps/sec) computed in step 1(ii)
3) Determine whether the stepper motor selected can provide the necessary acceleration α.

5. BLOCK DIAGRAMS

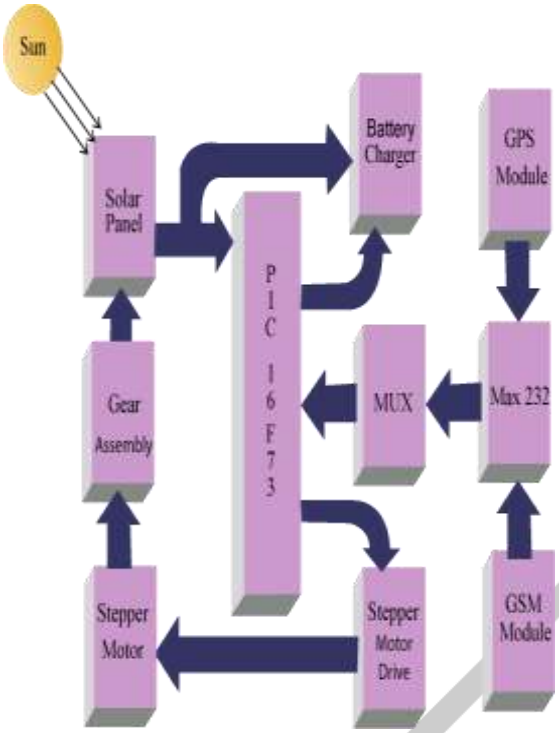

Figure 1: Solar Tracking System

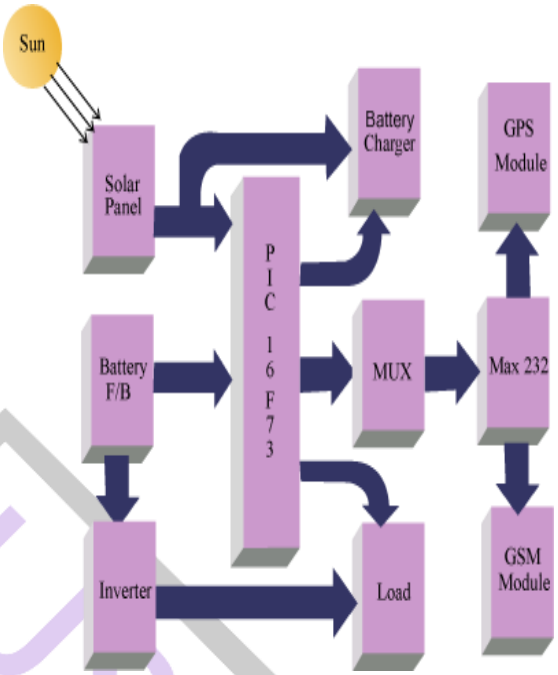

Figure 2: Solar Monitoring System

BLOCK DIAGRAM DESCRIPTION

The system comprises of following eight sections:

Solar Cell:

A solar cell, sometimes called a photovoltaic cell, is a device that converts light energy into electrical energy. A single solar cell creates a very small amount of energy (about .6 volts DC) so they are usually grouped together in an integrated electrical panel called a solar panel. Sunlight is a somewhat diffuse form of energy and only a portion of the light captured by a solar cell is converted into electricity

When the sun rays fall on the solar cell in some particular direction then only we get maximum output .The output of solar cells depends on the intensity of sunlight and the angle of incidence. To get the maximum output the solar panels must remain in front of sun during the whole day. Hence the solar cells are rotated in the direction of sun's position where we get maximum efficiency; the solar cell captures the sun's rays and gives the analog output to the ADC.

Sunlight is made up of packets of energy called photons. When the photons strike the semi-conductor layer (usually silicon) of a solar cell a portion of the photons are absorbed by the material rather than bouncing off of it or going through the material.

When a photon is absorbed the energy of that photon is transferred to an electron in an atom of the cell causing the electron to escape from its normal position. This creates, in essence, a hole in the atom. This hole will attract another electron from a nearby atom now creating yet another whole, which in turn is again filled by an electron from another atom. This hole filling process is repeated a few zillion times and voila, an electric current is formed.

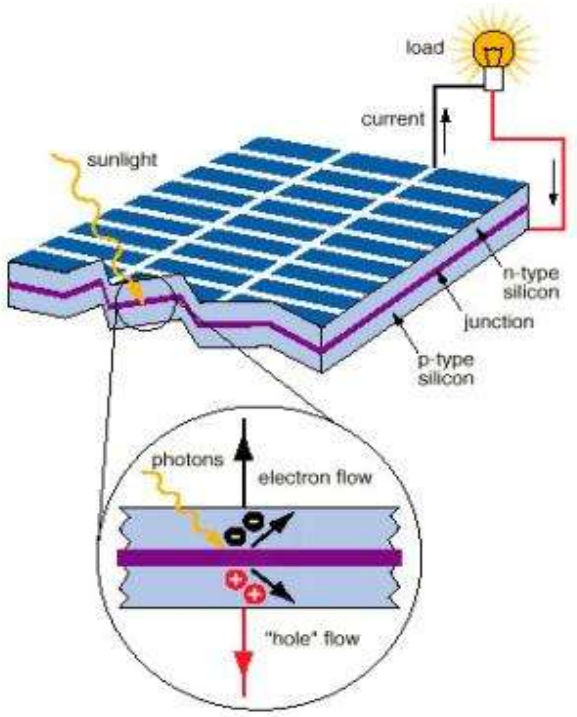

Figure 3: Solar panel

PIC Controller:

This is the heart of the project, as we know the processor is the heart of any project. Here PIC controller takes that job. The chip used is Atmel 16F73. There are two memory blocks in each of these PIC controllers. The program Memory and Data Memory have separate buses so that concurrent access can occur. The program memory can be read internally using Special Function Resistors in PIC. PIC 16F7X devices have a 13 bit program counter capable of addressing an 8K word x 14 bit program memory space. The PIC 16F73 devices have 8K x 14words of FLASH program memory.

Stepper motor:

Stepper motor is a digital actuator whose input is in the form of programmed energization of the stator windings and whose output is in the form of discrete angular rotation.

The stepper motor is used to rotate the solar panel accordingly where we obtain maximum voltage.

LCD:

Most of the projects with the any processor/microcontroller CPU (8085/8051/ARM) require some form of display. In market various displays are available like 7-segment, 5*7 matrix LED and LCD, bar graph, LCD, etc. It's important for deciding the required display set for our project. Selection of display depends on various factors like power consumption, ambient light conditions, surrounding temperature, visibility from long distance, total information to be display, cost of display, circuit/lines required for display interfacing, etc.

MAX 232 :

In our project we have used MAX 232 for interfacing our system with the GSM port and computer. The voltages generated by solar panel are given to computer serially through the hyper terminal. For this we require serial I/O interfacing standard. RS 232 is widely used serial I/O interfacing standard.

Since RS232 is not compatible with the microcontroller, we need a line driver(voltage converter) to convert the RS232's signals to TTL voltage levels that will be acceptable to the 16F73's TxD and RxD pins.

The MAX232 converts from RS232 voltage levels to TTL voltage levels, and vice versa. One advantage of the MAX232 chip is that it uses a +5 V power source that is the same as the source, which is the same as the source voltage for the 16F73.

PC interface:
A continuous database can be maintained on the PC. The memory and RTC can be used to store the records of position of the solar cell in timely manner. Hence we can monitor our system whether it's working properly as and when required.

GSM interface:

The current Panel voltage, Panel Current, Battery voltage, Battery Temp. can be received on handset by sending one SMS. AT Commands are used in mobile interfacing with Micro Controller so that we can monitor our system.

Following different AT Commands are used in mobile interfacing with Micro Controller.

- AT+CMGF=1 - Used to select text mode
- AT+CMGS= "9850815204"' – Sends a message to given mobile number. On successful delivery a message reference number is returned.
- 'AT+CPMS="ME" -Preferred SMS message storage. Set command selects memory storage to be used for reading and writing, etc.
- 'AT+CMGR=' Reads message.
- 'AT+CMGD=1'-Delete messages.

SWITCHING IC 4052:

The switching IC 4052 is used to decide whether GSM interface or GPS interface is to be activated**.**

The database will be continuously maintained in PC and whenever we receive signal from GSM unit that time switching takes place and voltage at that particular time is sent on the handset.

5.CONCLUSION

Thus we have tried to make an automated solar tracking system which will increase the efficiency of the solar panel system available. Although there is higher initial cost involved we have tried to make the system cost effective .This is just the beginning, we can add different enhancements to make the system more efficient so that it will work round the year. The solar panels using this system compared with the system prevalent at present has many advantages.

- ❖ In the present system, solar panels used are stationary which gives less output and hence decrease the efficiency. But by making use of tracker solar panels we can increase efficiency of solar system.
- ❖ The operator interference is minimal since the system is automated this increases efficiency of the stationary solar system.
- ❖ The GSM facility provided by the system helps the user to monitor the system from anywhere in the world.
- ❖ There is a lot of hard work involved in developing such a project. Through years of experience the project will get better.
- ❖ Each project will get better than previous one as practice can make us perfect.

6. FUTURE WORK

There are always remains an infinite scope of improvement to a system design. Its only the time and financial constraints that impose a limit on the development. Following are the few enhancements that may add further value to the system.

- Two axial systems can be made to track the sun in azimuth and elevation angle.
- During rains, rainfall sensors can be used to keep the system working.
- For making the system more reliable Fault indicators can be added.
- The computer and System Control Unit would have a wireless communication with the mechanical structure of solar panel.
- To make emergency control better more powerful microcontrollers e.g. PIC18Fxx would be used.

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