# Microcontroller Based Maximum Power Tracking Solar Charger Controller

**Butala Rucha[1], Bhosale Rajani[2], Karodi Sunil[3]**
[1, 2, 3, 4, 5] Department of Electrical Engineering
[1, 2, 3] Savtribai phule pune university,India

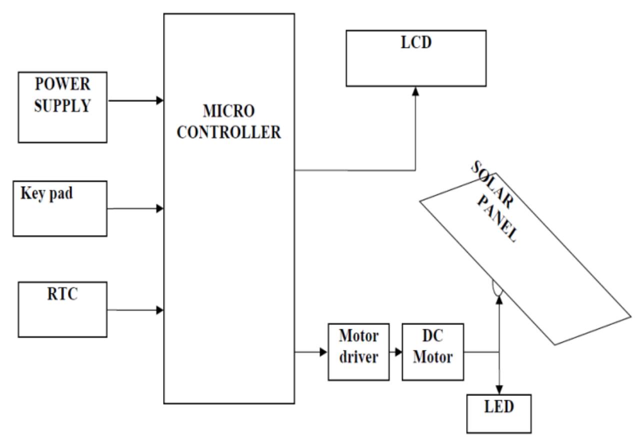
***Abstract-*** *The photovoltaic (PV) systems are of great interest nowadays due to the depletion of fossil sources and its environmental impact (greenhouse gas emissions, air pollutions and effects of accidents at nuclear power plants). The maximum power point tracking (MPPT) systems and solar trackers allow significantly efficiency increase of PV systems. This article presents the efficiency calculations for 2-axial active solar tracker taking into account losses on panel orientation for the three most specific months – December, June and September. An algorithm for tracker control is proposed and tested on the developed experimental prototype. It was established, that the optimal PV panel orientation change time interval is 15 minutes.*

***Keywords-*** Solar Tracker, Microcontroller, Battery

## I. INTRODUCTION

In present situation everyone is facing the problem with power cuts which is creating very much trouble to the people. So, to solve this problem we have a solution that is sun. Yes by using sun radiation we can get power i.e., the solar energy using which we generate the power. All we are know that there are so many renewable energy sources like solar, wind, geothermal etc. but solar energy system is very simple and easy to implement. But the main drawback of the solar system is it is very poor efficient system. By using this project we are going to improve the efficiency of solar system. Solar Panels are a form of active solar power, a term that describes how solar panels make use of the sun's energy: solar panels harvest sunlight and actively convert it to electricity. Solar Cells, or photovoltaic cells, are arranged in a gridlike pattern on the surface of the solar panel. Solar panels are typically constructed with crystalline silicon, which is used in other industries (such as the microprocessor industry), and the more expensive gallium arsenide, which is produced exclusively for use in photovoltaic (solar) cells Solar panels collect solar radiation from the sun and actively convert that energy to electricity. Solar panels are comprised of several individual solar cells. These solar cells function similarly to large semiconductors and utilize a large area p-n junction diode. When the solar cells are exposed to sunlight, the pn junction diodes convert the energy from sunlight into usable electrical energy. The energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their orbits and released, and electric fields in the solar cells pull these free electrons in a directional current, from which metal contacts in the solar cell can generate electricity. The more solar cells in a solar panel and the higher the quality of the solar cells, the more total electrical output the solar panel can produce. The conversion of sunlight to usable electrical energy has been dubbed the Photovoltaic Effect.

## II. BLOCK DIAGRAM




### BLOCK DIAGRAM EXPLANATION:

The above block diagram gives an overview of the project in the pictorial form. With the help of the block diagram we will create pre model of the project and analyze the function of the project .The explanation of the project with block diagram over view is given as follows.

### POWER SUPPLY SECTION:

This section is meant for supplying Power to all the sections mentioned above. It basically consists of a Transformer to step down the 230V ac to 12V ac followed by diodes. Here diodes are used to rectify the ac to dc. After rectification the obtained rippled dc is filtered using a capacitor Filter. A positive voltage regulator is used to regulate the obtained dc voltage. But here in this project two power supplies are used one is meant to supply operating voltage for Microcontroller and the other is to supply control voltage for motor.

**MICROCONTROLLER SECTION:**

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

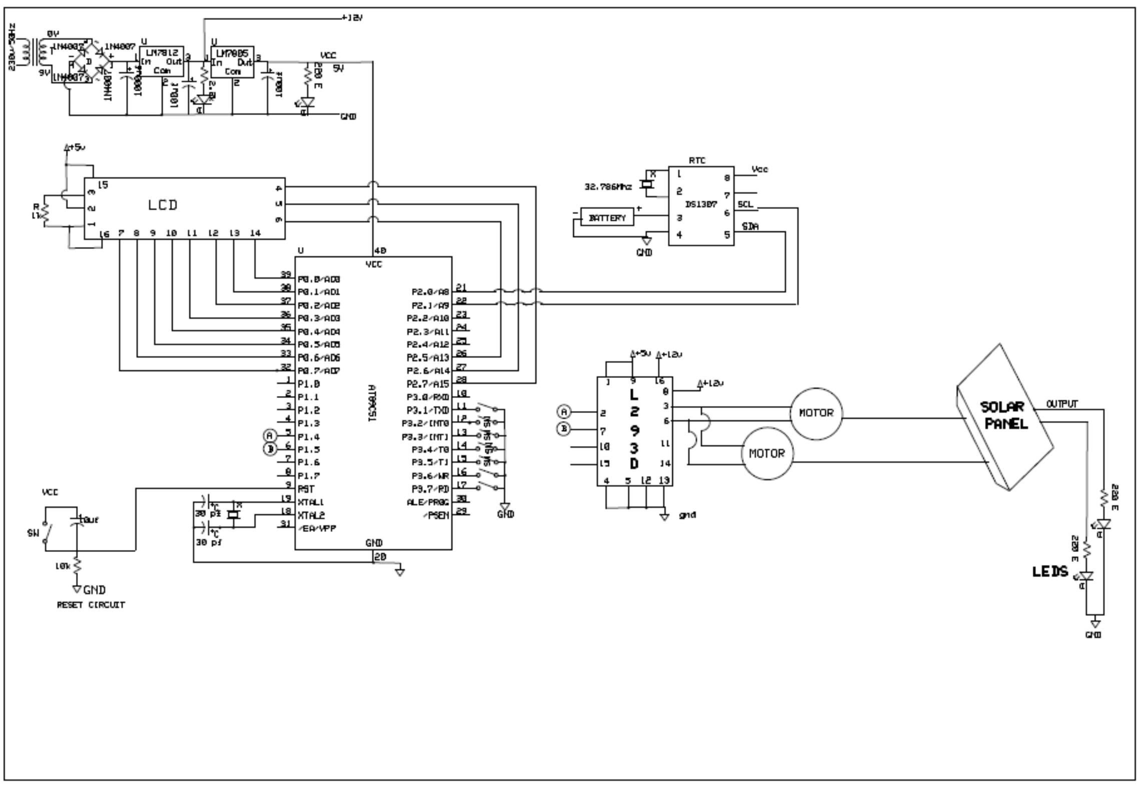
**LCD DISPLAY SECTION:**

This section is basically meant to show up the status of the project. This project makes use of Liquid Crystal Display to display / prompt for necessary information.

**RTC:**

This section basically employs a RTC i.e. DS 1307. Realtime clock (RTC) counts seconds, Minutes, hours, date of the month, month, day of the week, and year with leapyear compensation valid up to year 2100. The protocol by which it communicates is Twowire serial interface. By using this RTC exact time is given to the controller in terms

**SCHEMATIC DIAGRAM:**




**SCHEMATIC DESCRIPTION:**

Firstly, the required operating voltage for Microcontroller 89C51 is 5V. Hence the 5V D.C. power supply is needed by the same. This regulated 5V is generated by first stepping down the 230V to 18V by the step down transformer. The operating voltage required by the motor is 12V with an increase in current driving capability. Hence another supply is required to generate 12V. In the both the Power supplies the step downed a.c. voltage is being rectified by the Bridge Rectifier. The diodes used are 1N4007. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator allows us to have a Regulated Voltage. In Power supply given to Microcontroller 5V is generated using 7805 and in other power supply 12V is generated using 7812. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from the first section is fed to 40th pin of 89c51 microcontroller to supply operating voltage and from other power supply to relay circuitry. The microcontroller 89C51 with Pull up resistors at Port0 and crystal oscillator of 11.0592 MHz crystal in conjunction with couple of capacitors of is placed at 18th & 19$^{th}$ pins of 89c51 to make it work (execute) properly. Seven switches are connected to P3.1 to P3.7 respectively. The LCD is interfaced to Microcontroller. The data pins of LCD are connected to Port 0. The control pins of LCD are connected to Port 2 as shown in schematic. RTC is interfaced to port 2 pins only.

**LCD:**

Here a 16X2 LCD module is used. The data lines (D0D7) of this LCD are given to the port P0. The control pin RS is connected to P2.7, which selects either command register or data register within the LCD. The R/W pin is connected to P2.6, which selects the Read or Write operation. The Enable pin (EN) is connected to P2.5, which enables the LCD operation.

**LCD connections to Micro controller:**

**Pins Connections**

1 VSS (ground)
2 VCC (+5V)
3 10k pot
4 RS, this pin is connected to P2.7 of the micro controller
5 R/w, this pin is connected to P2.6 of the micro controller
6 EN, this pin is connected to P2.5 of the micro controller
714 (D0D7)
these pins are connected to the port (P0) of the micro controller

**Micro Controller connections:**

**Pins Connections**

9TH RESET
18th and 19th Crystal Oscillator circuit
20th Ground
13
40th VCC (+5V DC) supply

**RTC CONNECTION:**

1st, 2nd CRYSTAL OSC (32.706MHZ)
3RD BATTERY
8TH VCC
4TH GND
5TH P2.0
6TH P2.1

**L293D CONNECTION**:

2nd, 7th, 10TH, 15TH – P1.4 to P1.7
8TH –VCC (12V)
Motors connected to 3, 6, 11,14th pins of L293D (driver circuit).

**CIRCUIT DESCRIPTION:**

The required operating voltage for Microcontroller 89C51 is 5V. Hence the 5V D.C. power supply is needed by the same. This regulated 5V is generated by steppingdown the voltage from 230V to 18V and 12V in the both receiver and transmitter section now the step downed a.c voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified a.c voltage is now filtered using a ‘C’ filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +5V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100μF. Now the output from this section is fed to 40th pin of 89c51 microcontroller to supply operating voltage. The microcontroller 89C51 with Pull up resistors at Port0 and 14 crystal oscillator of 11.0592 MHz crystal in conjunction with couple of 3033pf capacitors is placed at 18th & 19th pins of 89c51 to make it work (execute) properly. According to this project we are going to improve the efficiency of solar system. In which solar panel will turn according to the sun rotation with predefined angle. So by using DC motor we are going to turn the panel according to the time. As the time passes the panel rotates with the help of motor. Here RTC (Real Time Clock) is used to give the exact time intervals to the controller. In key pad there are seven switches; two modes will be there i.e., manual mode and demo mode, If we go for manual mode, we have to enter the time, three switches (increment, decrement and enter) are available for entering time and two switches for rotating the panel backward and forward. In demo mode, it will automatically rotate according to the time fed in microcontroller, in this mode two switches are there for on and off this mode. Whenever the radiation of the sun falls on the solar panel it grasps the radiation and stores in it and it will send the message to the controller about its power which is stored in it. Using this power we are switching on two leds. Microcontroller will receive this information and display on LCD.

## III. APPLICATIONS

- **Solar Thermal Electric Power Plants:** Solar thermal energy involves harnessing solar power for practical applications from solar heating to electrical power generation. Solar thermal collectors, such as solar hot water panels, are commonly used to generate solar hot water for domestic and light industrial applications.

97 This energy system is also used in architecture and building design to control heating and ventilation in both active solar and passive solar designs.

- **Photovoltaics:** Photovoltaic or PV technology employs solar cells or solar photovoltaic arrays to convert energy from the sun into electricity. Solar cells produce direct current electricity from the sun's rays, which can be used to power equipment or to recharge batteries. Many pocket calculators incorporate a single solar cell, but for larger applications, cells are generally grouped together to form PV modules that are in turn arranged in solar arrays. Solar arrays can be used to power orbiting satellites and other spacecraft and in remote areas as a source ofpower for roadside emergency telephones, remote sensing, and cathodic protection of pipelines.
- **Solar Heating Systems:** Solar hot water systems use sunlight to heat water. The systems are composed of solar thermal collectors and a storage tank, and they may be active, passive or batch systems.
- **Solar Lighting:** Also known as day lighting, this is the use of natural light to provide illumination to offset energy use in electric lighting systems and reduce the cooling load on HVAC systems. Day lighting features include building orientation, window orientation, exterior shading, saw tooth roofs, clerestory windows, light shelves, skylights, and light tubes. Architectural trends increasingly recognize day lighting as a cornerstone of sustainable design.
- **Solar Cars:** A solar car is an electric vehicle powered by energy obtained from solar panels on the surface of the car which convert the sun's energy directly into electrical energy. Solar cars are not currently a practical form of transportation. Although they can operate for limited distances without sun, the solar cells are generally very fragile. Development teams have focused their efforts on optimizing the efficiency of the vehicle, but many have only enough room for one or two people.
- **Solar Power Satellite:** A solar power satellite (SPS) is a proposed satellite built in high Earth orbit that uses microwave power transmission to beam solar power to a very large antenna on Earth where it can be used in place of conventional power sources. The advantage of placing the solar collectors in space is theunobstructed view of the sun, unaffected by the day/night cycle, weather, or seasons. However, the costs of construction are very high, and SPSs will not be able to compete with conventional sources unless low launch costs can be achieved or unless a space based manufacturing industry develops and they can be built in orbit from off earth materials.

- **Renewable Solar Power Systems with Regenerative Fuel Cell Systems:** NASA has long recognized the unique advantages of regenerative fuel cell (RFC) systems to provide energy storage for solar power systems in space. RFC systems are uniquely qualified to provide the necessary energy storage for solar surface power systems on the moon or Mars during long periods of darkness, i.e. during the 14day lunar night or the12hour Martian night. The nature of the RFC and its inherent design flexibility enables it to effectively meet the requirements of space missions. And in the course of implementing the NASA RFC Program,researchers recognized that there are numerous applications in government, industry, transportation, and the military for RFC systems as well.

## IV. CONCLUSION

The project "HIGHEFFICIENCY SOLAR TRACKER DEVELOPMENT AND EFFECTIVENESS ESTIMATION" has been successfully designed and tested. Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

## REFERENCES

[1] Renewables Global Status Report 2013. http://www.ren21.net/REN21Activities/GlobalStatusReport.aspx

[2] T. Esram and P. L. Chapman, "Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques," IEEE Transactions on Energy Conversion, vol. 22, no. 2, pp. 439–449, Jun. 2007.

[3] C. Roncero-Clemente, S. Stepenko, O. Husev, V. Miñambres-Marcos, E. Romero-Cadaval, and D. Vinnikov, "Three-Level Neutral-Point- Clamped Quasi-Z-Source Inverter with Maximum Power Point Tracking for Photovoltaic Systems," Technological Innovation for the Internet of Things, vol. 394, L. Camarinha-Matos, S. Tomic and P. Graça, Eds., ed: Springer Berlin Heidelberg, 2013, pp. 334-342

[4] C. Roncero-Clemente, O. Husev, V. Minambres-Marcos, S. Stepenko, E. Romero-Cadaval and D. Vinnikov, "Comparison of three MPPT algorithms for three-level neutral-point-clamped qz-source inverter," 8th International Conference on Compatibility and Power Electronics (CPE) 2013, pp.80-85, June 2013.

[5] C. Roncero-Clemente, O. Husev, V. Minambres-Marcos, E. Romero- Cadaval, S. Stepenko and D. Vinnikov, “Tracking of MPP for threelevel neutral-point-clamped qZ-source off-grid inverter in solar applications,” Journal of Microelectronics, Electronic Components and Materials, vol. 43, no. 4, pp. 212 – 221,

[6] O.Veligorskyi and Y.Vagapov, “Improvement of perturb and observe MPPT method for photovoltaic systems: case of study,” International Journal of Renewable Energy Technology, vol. 4, no. 2, pp. 141–156,

[7] E. Lorenzo, M. Perez, A. Ezpeleta, and J. Acedo, “Design of tracking photovoltaic systems with a single vertical axis,” Progress in Photovoltaics