

# Controlling Solar Charger System by Means of Microcontroller

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**Abstract-** The purpose of this mission is to layout and construct a sun price controller, using mostly discrete additives. The rate controller varies its output to a step of 12V; for a battery of 200Ah rating. The design consists of four ranges which consist of modern booster, battery stage indicator, battery rate controller and electricity supply unit. The designed device may be very useful, durable, desirable cost and realizable the use of regionally sourced and less expensive additives. This work is a prototype of a commercial sun charge controller with protection systems so as to prevent damages to the battery related to unregulated charging and discharging mechanisms.

**Keywords-** Photovoltaic, Buck Converter, Arduino, Solar Cell, Renewables.

## I. INTRODUCTION

Photovoltaic sun system can be divided into simple classes, grid related (as shown in figure 1) and stale-grid (additionally known as stand on my own or isolated) solar systems. The grid connected systems feed the electricity produced via sun panels to the grid the use of an inverter.

Whilst the power is needed all through night or periods with little sunlight, the strength is taken back from the grid. In isolated systems, the excess electricity is generally saved in batteries at some stage in the day and batteries are used to energy the home equipment in times whilst photovoltaic panels do no longer produce enough strength.

Solar regulators (additionally referred to as rate controllers) play and crucial function in remoted solar structures.

Their goal is to ensure the batteries are operating optimally, particularly to prevent overcharging (through disconnecting solar panels, when batteries are complete) and to prevent too deep discharge (with the aid of disconnecting the burden when necessary) Battery lifetime reduces produced via the PV / sun Panel (Module) or array to rate a battery. The battery stores the DC electric energy in order that it may be used whilst there may be no solar strength available.

## II. LITERARY REVIEW

Electricity is the key influencing element for improvement in all sectors i.e., industrial, Agricultural, business, domestic etc., as per capita electricity consumption is one of the indicators of countrywide improvement stators. Using renewable electricity resources involves the tapping of herbal flows of strength in the surroundings. If the assets are utilized in an appropriate style the power is eliminated at a charge akin to that at which energy is being replenished.

Renewable energy is hence inexhaustible as opposed to standard assets of energy that have a constrained lifespan. Switching to smooth electricity sources can improve the nice of life all through the planet's earth, now not only for human beings, however for flora and fauna as nicely.

Therefore, using renewable power can make a contribution to environmental safety now not handiest for the existing generation however for destiny generations as well.

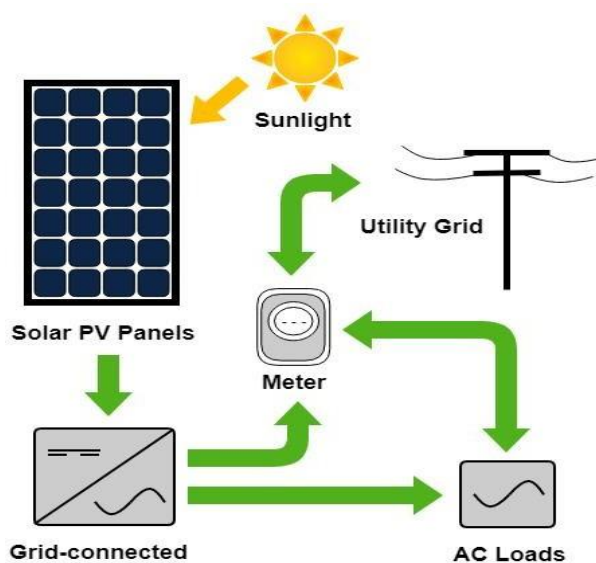


Fig 1. Basic photovoltaic system delivering to the main grid.

Because of the foregoing there may be a need to develop methods of renewable electricity conversion systems after which to substitute it in which packages of fossil fuels are renewable energy technology, a secure and various deliver of strength can be secured and assets may be restored.

Moreover, renewable electricity is extensively disbursed and is available and indigenous to almost every region of the sector.

### III. PROPOSED SYSTEM

The solar charge controller (frequently referred to as the regulator) is identical to the standard battery charger (as ashown in figure 2) controls the current flowing from the solar panel to the battery bank to prevent overcharging the batteries. As in a standard battery charger, it can accommodate different types of batteries.

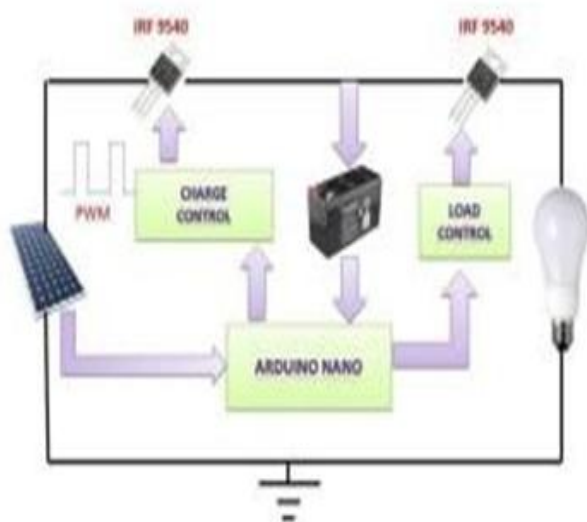


Fig 2. Block Diagram.

The absorption voltage can select the float voltage, and it can often also set the time and tail current. They are best suitable for lithium-iron-phosphate batteries since when the controller is in full charge, it remains at the fixed float or maintains a voltage of about 13.6V (3.4V per cell) for the rest of the day.

The most popular charging profile is the same simple sequence found on a quality mains adapter, i.e., bulk mode – absorption mode – float mode. Entry to bulk charging mode happens at sunrise in the morning.

If the battery voltage drops down the specified voltage for longer than a specified period, e.g., 5 seconds (re-entry). This re-entry into bulk mode works better for lead-acid batteries since the voltage drop and drop are more significant than lithium-based batteries, which retain a higher, more stable voltage for the rest of the discharge period.

### IV. MATERIALS AND METHODS

#### 1. Photo Voltaic (PV) Module:

A PV module is used for converting photon into electron and with solar light incident, electric electricity is generated. A selenium-or silicon-based totally sun cell exhibits open-circuit voltage of best 0.5V and quick-circuit cellular modern of the order of 1milliampere for six.4cm<sup>2</sup> area of the cellular at 6458-meter candles. Therefore, a massive wide variety of such silicon or selenium sun cells want to be connected in collection and parallel to offer any big strength.

For nearly all programs, the one-1/2 volt produced with the aid of a unmarried cellular is inadequate. Consequently, cells are related together in collection to boom the voltage. Numerous of these series strings of cells can be related together in parallel to boom the modern-day as nicely.

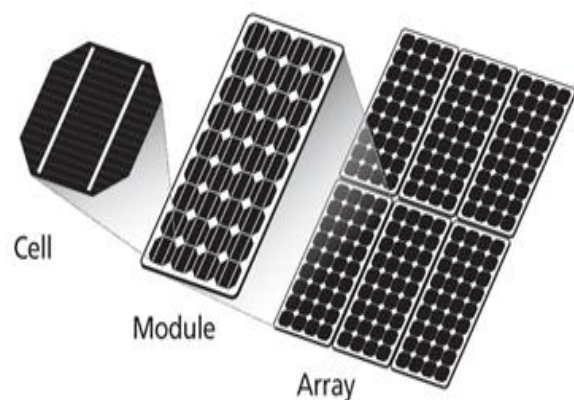


Fig 3. Solar cell to solar array.

Those interconnected cells and their electrical connections are then sandwiched between a pinnacle layer of glass or clean plastic and a decrease level of plastic or plastic and metallic. An outer frame is connected to growth mechanical energy, and to offer a manner to mount the unit. This bundle (as shown in figure 3) is called a "module" or "panel". Typically, a module is the fundamental building block of photovoltaic systems.

#### 2. Arduino Uno:

Arduino Uno is a microcontroller board based totally on 8-bit ATmega328P microcontroller. Along with ATmega328P, it is composed other additives including crystal oscillator, serial communique, voltage regulator, and many others to assist the microcontroller.

Arduino Uno (as shown in figure 4) has 14 virtual input/output pins (out of which 6 can be used as PWM outputs), 6 analog enter pins, a USB connection, a strength barrel jack, an ICSP header and a reset button.

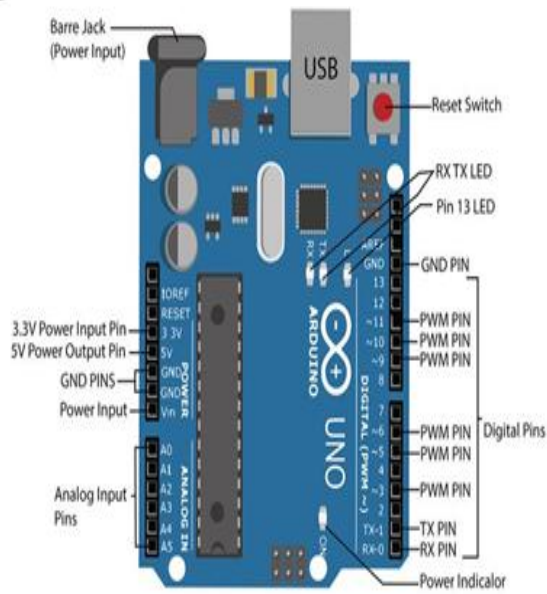


Fig 4. Arduino Pinout Diagram.

The 14 digital enter/output pins can be used as enter or output pins by using the use of `pinMode()`, `digitalRead()` and `digitalWrite()` features in Arduino programming. Together with 14 virtual pins, there are 6 analog input pins, every of which offer 10 bits of resolution, i.e. 1024 one of a kind values.

They degree from 0 to five volts but this limit can be elevated via using AREF pin with analog Reference () characteristic.

### 3. Buck Converter:

A DC-to-DC converter or Chopper is a static device which converts a supply of direct modern (DC) from one voltage stage to another. it is a class of strength converter.



Fig 5. Buck Converter Board.

Consequently, Chopper may be idea of as an equal of an AC transformer, in view that they behave in an same manner.

In electronic electricity circuits there may be a need for converting the voltage stage according to the specification. it can be better than the enter side or can be lower if so we need to use dc choppers. We're making use of step-down chopper in our circuit. The buck converter (as shown in figure 5) is used to transform an enter DC voltage to a lower output DC voltage of the same polarity (figure4.1).

By way of various the obligation ratio  $T_{on}/T$  of the switch, the average output voltage may be controlled the operation of the dollar converter is fairly simple, with an inductor and switches (commonly a transistor and a diode) that control the 24 inductors. It alternates between connecting the inductor to supply voltage to save strength in the inductor and discharging the inductor into the burden.

### 4. Inverter:

An inverter is an electric powered device that converts direct contemporary (DC) to alternating modern-day (AC); the converted AC may be at any required voltage and frequency with using appropriate transformers, switching, and manage circuits. Inverters are generally used to deliver AC strength from DC assets together with solar panels or batteries.

The maximum commonplace energy inverter is 12v to 230v inverter. Perhaps this is because 12v batteries are common. This kind of electricity inverter typically draws modern from DC battery. This battery should be capable of provide a high drift of electrical present day. Commonly lead acid battery can server this purpose nicely. This contemporary is then transformed to 230V square wave opportunity current so that we might also empower those electric powered home equipment which work on 230v instead of 12V.

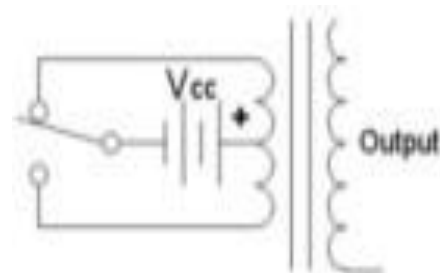


Fig 6. Basic Inverter Circuit.

This simple inverter circuit, DC strength is attached to a transformer (as shown in figure 6) via the centre tap of the primary winding. A transfer is hastily switched to and fro to allow contemporary to go with the flow returned to the DC supply following trade paths via one end of the primary winding and then the opposite.

The alternation of the course of contemporary inside the primary winding of the transformer produces alternating cutting-edge (AC) inside the secondary circuit.



## 5. PCB Layout:

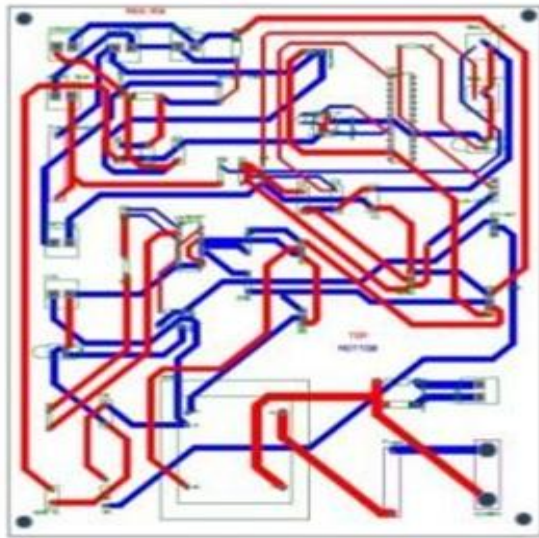


Fig 7. Main PCB Layout.

Above PCB format is ready in ALTIUM designer summer time 09 software program.

In a unmarried PCB we are efficaciously designed our DC-DC Converter, Microcontroller Board, Inverter Circuit with all the vital protections. The PCB is of double layer kind with crimson lines denote the higher layer and the blue lines denote the lowest layer of the PCB. Thickness of strains is two mm every with minimal spacing between them is three mm

## V. WORKING PRINCIPLE

PV is a technique of generating electrical electricity via changing sun radiation into direct contemporary strength the use of semiconductors that well-known shows the PV impact. Photovoltaic electricity technology employs solar panel compressed of array of cells containing a photovoltaic cloth. The PV generator is shaped by means of aggregate of many PV cellular linked in series and parallel to provide the desired fee of the output voltage and contemporary. PV mobile is attached to DC-DC converter.

Controller utilized in venture is PIC16F876A. Controller on this assignment used for many purposes. To generate the variable PWM for DC-DC converter. To manipulate a battery voltage and Controlling load variant. DC-DC converter is used to transform the enter dc voltage from sun panel into the required output dc voltage compatible with the battery. Output dc voltage maybe more than or lesser than the input dc voltage. Separate controller circuit is needed to accomplish that. The output of DC-DC converter is hooked up to battery. Here battery desires the series of battery which can be connected in parallel. The battery will save the energy produced by means of the

panel. The block is attached to the inverter. The battery used in our system is wellknown 12 volts battery if from EXIDE enterprise. An inverter converts the DC voltage to an AC voltage. In most instances, the input DC voltage is generally decreased even as the output AC is equal to the grid supply voltage of both one hundred twenty volts, and 240 Volts relying on the country.

The inverter can be built as standalone device for applications together with solar electricity, or to work as a backup power deliver from batteries which can be charged one by one. The opposite configuration is while it is a part of a larger circuit along with a power deliver unit, or a UPS. In this situation, the inverter input DC is from the rectified mains AC, at the same time as from either the rectified AC in the within the country when there is electricity, and from the batteries on every occasion there is a power failure.

## VI. HARDWARE PART AND RESULT

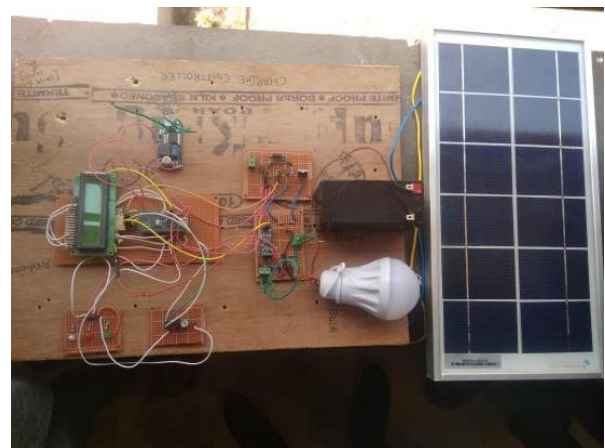


Fig 8. OFF Condition.



Fig 9. ON Condition.

The heart of the fee controller is Arduino board. The Arduino microcontroller unit senses the sun panel and battery voltages. According to these voltages it comes to a decision the way to rate the battery and manage the load.

The quantity of charging present day is decided with the aid of distinction among battery voltage and price set factor voltages. The controller uses two stages charging set of rules. According to the charging set of rules it gives a hard and fast frequency PWM sign to the solar panel side p-MOSFET. The frequency of PWM sign is 490.20Hz (default frequency for pin-3). The obligation cycle 0-one hundred% is adjusted by way of the error signal. The controller gives excessive or LOW command to the load facet p-MOSFET in step with the dusk/dawn and battery voltage.

## VII. CONCLUSION

Cope up with the existing hassle of load sharing in rural regions. Make a use of freely to be had renewable herbal resources successfully in every person hand.

Remove all of the drawbacks related to conventional electricity sources (ex.-their depletion), power era the use of these traditional electricity sources (ex.- harmful through products, emission of risky gases in environment, high manufacturing and walking value, heavy transmission and distribution losses). Shop massive capital invested to setup a sun power plant in distinct locations, transmission price for sporting the generated energy from solar plant to every residence in a country, big piece of land utilized by these sun energy plants especially where available land could be very much less. Keep needless wastage of consumer's cash in buying batteries and simultaneously purchasing using power.

These types of drawbacks are efficaciously eliminated via this challenge. This mission will assist each individual to building their very own reliable, price green, small spaced mini power plant of their homes. Now every home can generate strength for its private use saving masses of herbal assets, money if you want to in the long run improve a country's financial system.

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