ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

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DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Course Code: EEE 4504
Course Title: Power Electronics Lab

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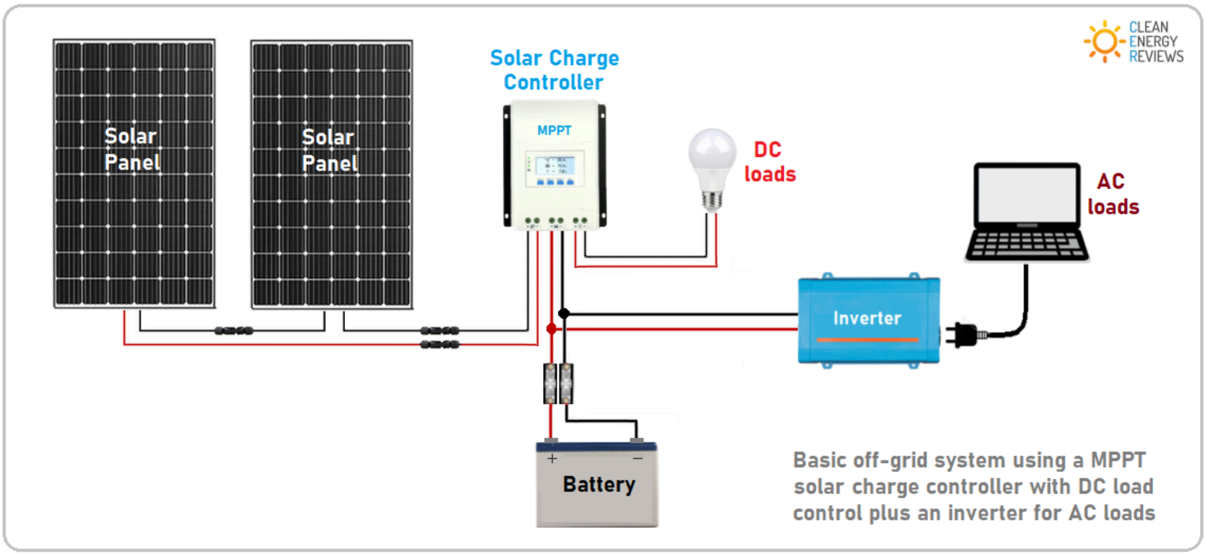
Introduction:

The proposed project aims to address the phenomenon of solar power capture, its conversion using an inverter and finally using it to power a load. This system utilizes DC batteries, MOSFETs and a potentiometer for constructing a charge controller.

Project Idea:

The project is divided into two modules: 1) charge controller 2) inverter. The charge controller has been constructed using a potentiometer, 3 mosfets, diode and a fuse. Instead of using solar panels, however, we have used DC batteries. The inverter was constructed using a 555 timer, which will provide timed pulses, switching the mosfets on alternatively.

MPPT (Maximum Power Point Tracking):



Source: https://www.cleanenergyreviews.info/blog/mppt-solar-charge-controllers

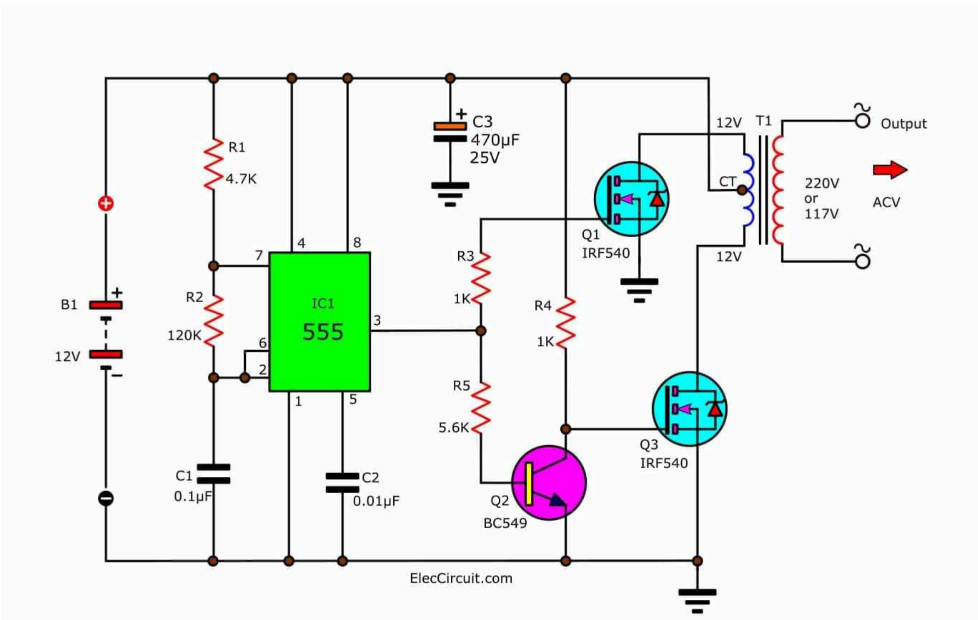
MPPT, or Maximum Power Point Tracking, is the acronym. This method maximizes the efficiency of turning solar energy into electrical power in photovoltaic (solar) systems. In order to guarantee that the solar panels generate the most power possible from the sunlight falling on them, MPPT controllers or algorithms modify the electrical operating point of the panels. In order to maintain the most efficient power output, this optimization entails continuously monitoring the solar panels' output and modifying the voltage and current in response to variations in the weather, including temperature and sunlight intensity. By optimizing the energy harvest from solar panels, MPPT helps to lower the system's cost and increase its efficiency.

The primary advantages of using MPPT include:

1. **Increased Efficiency:** No matter how the weather or the amount of sunshine changes, MPPT continuously modifies the solar panels' electrical working point, enabling them to produce their maximum amount of power. Comparing this optimization to systems without MPPT results in improved energy conversion efficiency.
2. **Enhanced Energy Harvesting:** Over time, more energy is produced because MPPT makes sure the solar panels take in the most power possible from the sun by dynamically tracking the greatest power point.
3. **Adaptability to Different Conditions:** Solar systems with MPPT technology can adjust to shifting environmental factors like temperature swings and shade by continuously locating the best operating point for maximum power output.
4. **Cost Savings:** By optimizing the quantity of usable energy produced by the solar panels, MPPT's enhanced energy harvesting efficiency can save money during the system's lifetime.

Inverter:

The power obtained from solar panels is DC which is unfit for the use of household appliances, for which we require AC power. We connect an inverter for this purpose.



555 inverter circuit with MOSFET

A 555 timer inverter is a simple and efficient way to convert direct current (DC) to alternating current (AC). This circuit is commonly used for powering low-power devices in emergency situations where AC power is unavailable.

Here's a table summarizing the key components and their functions:

Component	Function
555 timer IC	Main component configured as an astable multivibrator to generate continuous switching pulses
Transformer	Steps up the voltage of the switching pulses
Transistors (NPN and PNP)	Drive the transformer according to the pulse input at their bases
Resistors	Set the frequency and duty cycle of the output waveform
Capacitors	Time constants for the astable multivibrator
Diode	Protects the circuit from reverse current

Because of its astable multivibrator configuration, the 555 timer oscillates between two stable states (high and low) without the aid of an outside trigger. The settings of two resistors (R1 and R2) and a capacitor (C1) control the astable multivibrator's output frequency.

The NPN and PNP transistor bases receive the switching pulses from the 555 timer, which power the transformer. The secondary winding receives an AC output voltage from the transformer, which increases the voltage of the switching pulses.

The frequency of the astable multivibrator determines the inverter's output frequency. The resistor and capacitor values can be changed to modify this.

Working Principle:

The whole project has been divided into two modules: 1) Charge controller 2) Inverter. A charge controller regulates the voltage and current coming from solar panels or wind turbines to ensure the efficient and safe charging of the batteries. In this project, we’ve used the MPPT charge controller, as the title suggests, which operates on the basis of ***Perturb and Observe*** principle. By perturbing, or introducing a change in the resistance through the potentiometer (and thereby the voltage), we observe a change in the output power, manifested in the brightness of the bulb. By incrementing the voltage, the power gradually increases as well, and after a certain amount of increment, reaches its peak value, which we denote as ‘maximum power point.’ Thereafter, increasing the resistance causes a decrease in voltage and a reduction in output power. In this manner, it is possible to track the maximum power point of the system.

The function of the inverter is simple: it converts the output DC power of the solar panel to AC power, in order to render it usable for practical purposes.

Equipments & Cost:

- Irfz44n mosfet
- 47K Pot
- 10A Diode
- 25A Fuse
- Digital Voltmeter
- Smart Battery Charger
- Mini Solar Panel
- 220 Ohm resistor
- 10uf 400v capacitor
- 1N4007 diodes

Total cost: **2450 tk** (approx.)

Conclusion:

This project seeks to offer a simple mechanism to regulate the power point of a solar power-controlled system. Solar power is getting more popular with time; this ascending popularity necessitates the use of power point tracking systems to maximize the output power of solar panels. Although the project proposed and demonstrated is quite basic and is suitable for devices with a very small power demand, it can be scaled for larger, more energy-demanding applications.