DC to AC Solar Power Inverter design

Objectives:

- *Conversion of Energy:* Solar panels, a common example of Renewable resources, produce DC power. But most household appliances and power grids are conducted in AC power. The primary aim here is to convert the DC power generated by the used Solar Panel into usable AC power.

- *Independence of Energy:* Solar power can make us less dependent on traditional fossil fuels and centralized power plants by enabling individuals to produce their own electricity. This practice may lead to more energy independence and lessened sensitivity to changes in energy prices.

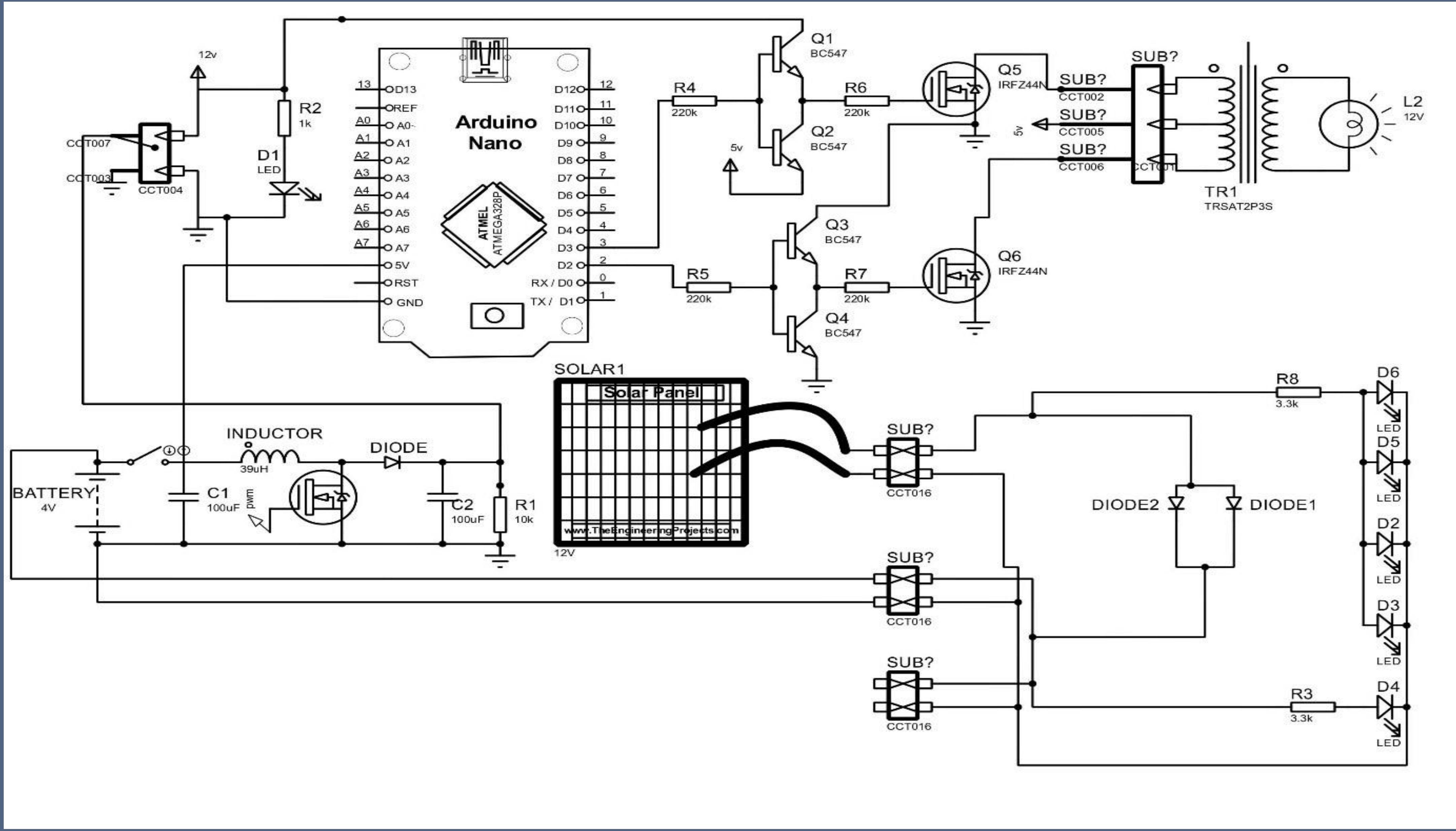
- *Power Output Optimization:* A solar power inverter can optimize the power output from solar panels. Through this, we might be able to extract the maximum power possible from the panels and feed it into the grid or use it to power appliances.

- *Provide necessary data:* Modern solar power inverters come with cutting-edge data and analytics technologies that offer useful insights into how well the solar panels are working. By using this data, We’ll try to improve our system's effectiveness and decrease energy usage.

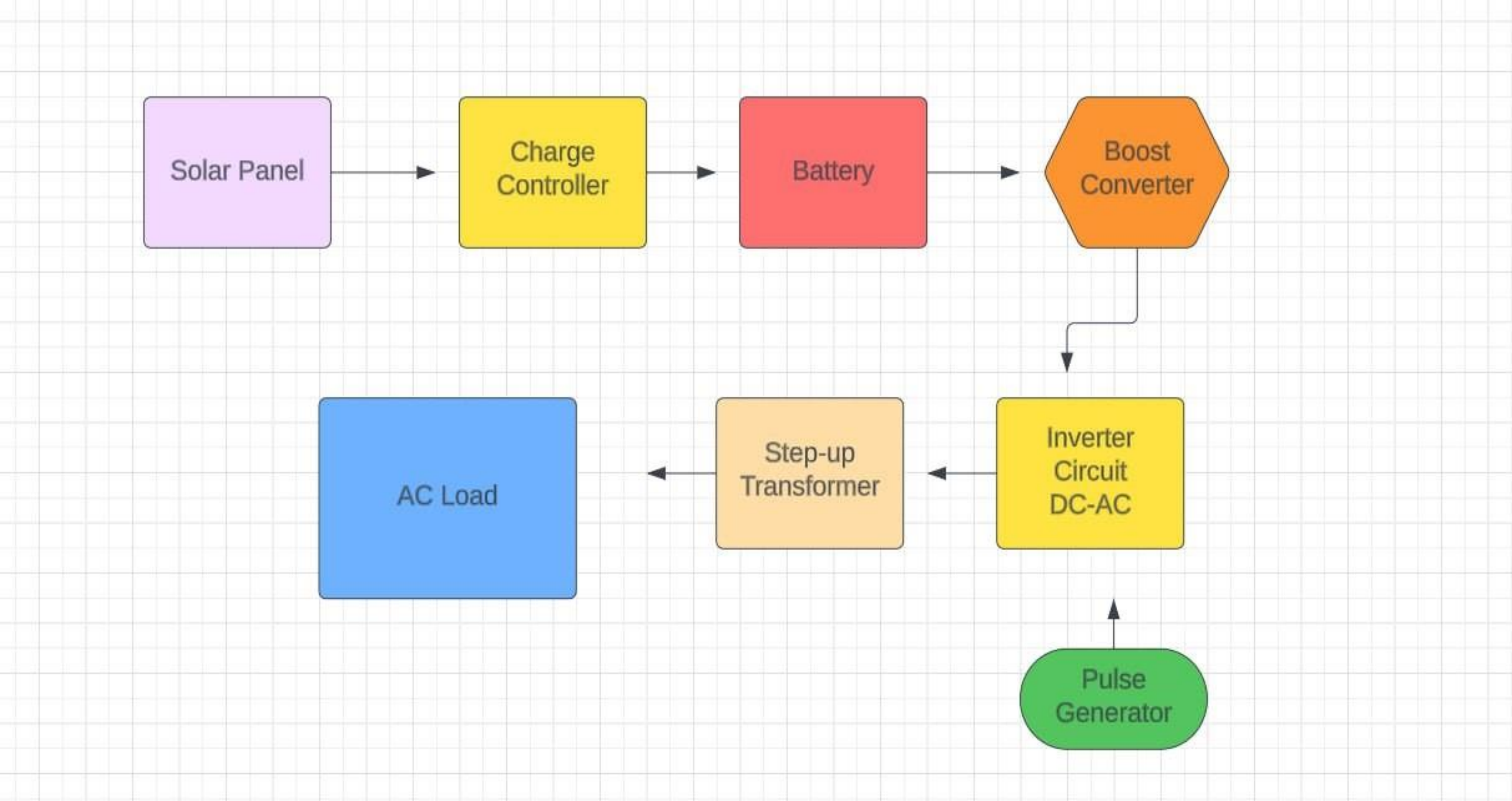
List of Equipment

- Solar panel 10W
- Solar Charge Controller
- Battery 4V 4A.
- Boost Converter.
- NANO.
- MOSFET(4ps) - IRFZ44N
- NPN Transistor 4 PS - BC547
- Step up transformer -220 V;50 Hz.
- Load(Bulb) and LEDs.
- Resistors (4 PS 220k, 2 PS 3.3k)

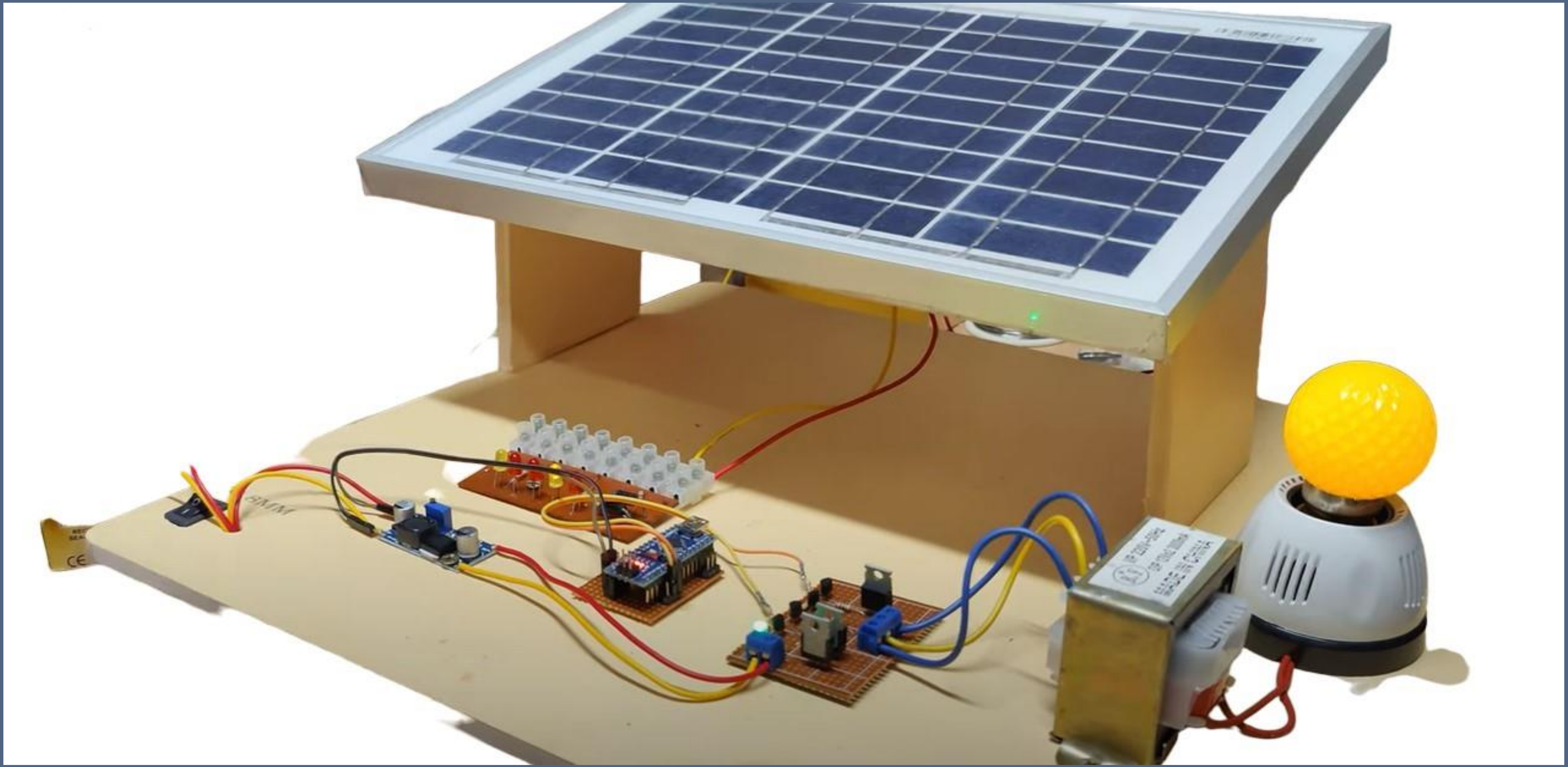
Circuit Diagram

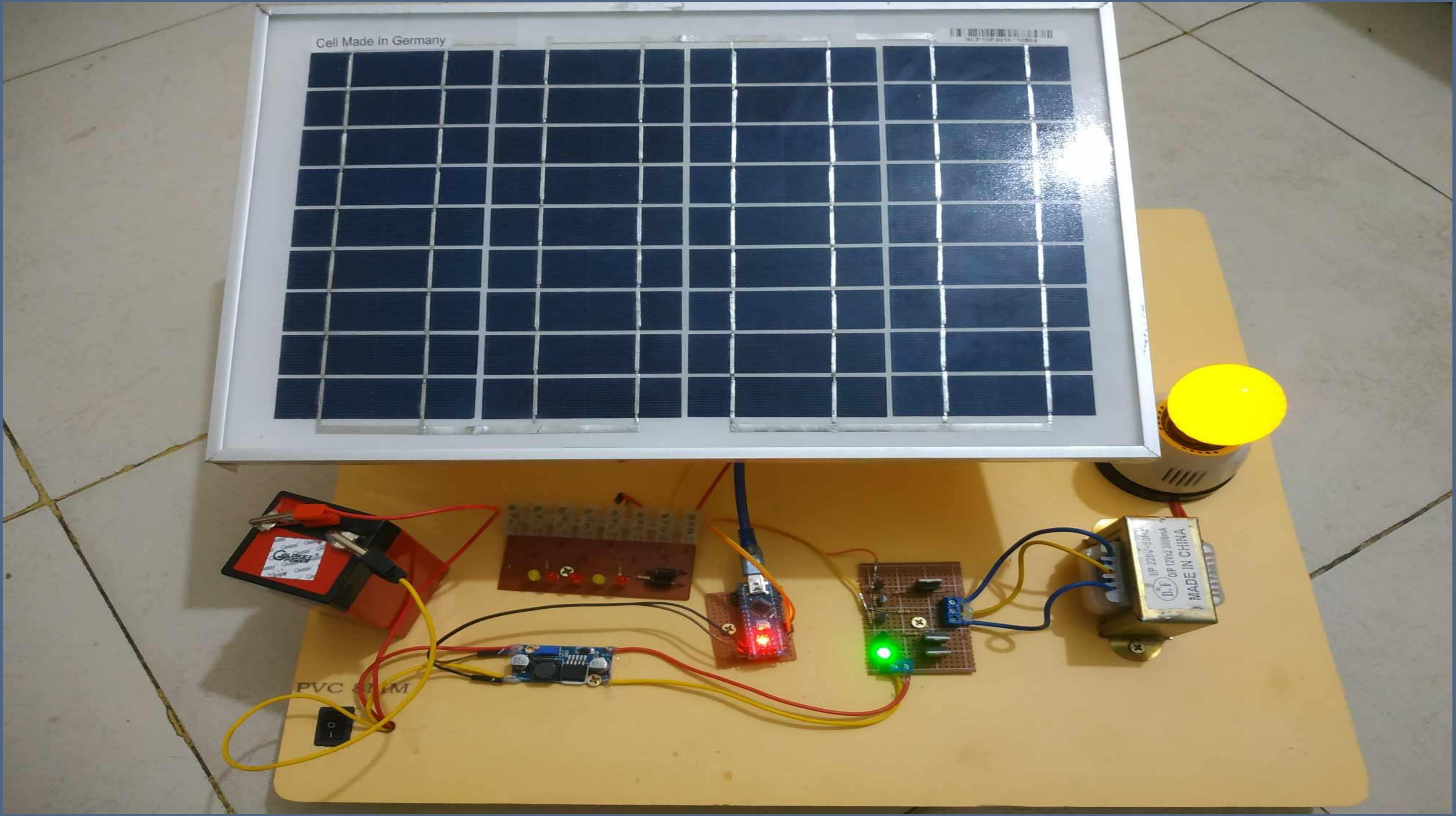


Block Diagram



Project Picture during Operation




Cell Made in Germany
MADE IN CHINA

Working Principle

Here Solar Panel generates direct current (DC) electricity by using the photovoltaic effect. As we know that majority of home appliances and electronics run on Alternating Current (AC), so power inverters were mainly used to make transform DC electricity from our used solar panels into AC electricity that can be utilized to power appliances in households.

4-volt supply passes through the used Boost Converter which consists of a capacitor, inductor, potentiometer, and built-in IC; this Booster increases the supply voltage from 4 volts to approximately 12 volts. The Potentiometer of the Boost converter is used to vary and adjust the voltage pulse according to my desired outcome. Output supply from the Booster goes to the Inverter circuit which consists of four NPN transistors, three MOSFETs, and Resistors. the

Pulse width modulation (PWM) method is used to generate a pulse and that frequency pulse comes from the used Microcontroller through two 220k resistors, initiates switching operation in that transistor, and then goes to MOSFETs. There are extra four resistors to prevent the network from the current overflowing risk. An extra MOSFET among the three was used to avoid any unexpected heating issues.

Inputs from Booster are connected to the Microcontroller’s Vin and GND pins by which that component is getting powered up. The charge controller charges up the battery and indicator LEDs present the battery level state, solar powering, and charge control. DC supply is increasing to 12 volts AC electricity in the Inverter portion. Then the Step transformer converts that 12-volt AC electricity to a 220-volt AC supply and this supply goes directly to the bulb holder to turn the Load Bulb On.

Frequency generator Microcontroller Code

```
//Define the PWM output pins
Const int pwmPin1 = 2;
Const int pwmPin2 = 3;
void setup() {
 // Set the PWM pins as OUTPUT
    pinMode(pwmPin1,Output);
    pinMode(pwmPin2,Output);
}
void loop() {
int delayTime = 1.46;
// Turn on the PWM pins at their maximum duty cycle (255) for ON time
 digitalWrite(pwmPin1, HIGH);
 digitalWrite(pwmPin2, 0);
 delay(delayTime);
```

```
//Turn off the PWM pins for OFF time
digitalWrite(pwmPin1,0);
digitalWrite(pwmPin2,HIGH);
delay(delayTime);
digitalWrite(pwmPin1,HIGH);
digitalWrite(pwmPin2,0);
delay(delayTime);
}
```

Maximum Power Point Tracking (MPPT) voltage -A significant Performance Parameter:

- A solar power inverter's Maximum Power Point Tracking (MPPT) voltage range refers to the range of DC voltages at which the inverter's MPPT algorithm may efficiently work to produce the most power possible from the connected solar panels. MPPT is a method used in solar inverters to optimize the energy harvesting process by shifting the operating point of the inverter to the point where the solar panels create the maximum power.
- MPPT voltage range might differ based on the model type, manufacturing company, and design. Generally, it is described by two voltage values; Minimum MPPT Voltage (Vmin) and Maximum MPPT Voltage (Vmax). This voltage range is important since the voltage output of solar panels varies with temperature, shade, and light irradiance. The MPPT algorithm of the inverter constantly tracks the output voltage and current of the solar panels and modifies its input impedance to maintain the system's maximum power point regardless of the surrounding environment.

International standards/regulations that needed to be maintained if we would have made the circuit for the real market:

INVERTER OUTPUT		
Rated output power	10000W	12000W
Output wave	Pure sine wave	
Nominal output voltage	230 VAC (P-N) / 400 VAC (P-P)	
Nominal output current	14.3A per phase	17.4A per phase
Nominal output frequency	50 Hz / 60 Hz	
Rate of wave distortion(THD)(Linearity loads)	Off grid≤2%; Grid discharge ≤3%; Grid charge ≤3%	
Peak efficiency	≥93%	
Overload capability	100%<load≤110%,30 minutes; 110%<load≤125%,1 minutes; 125%<load≤150%,30 seconds; load<150%,10 seconds; Short circuit,5 seconds	
AC INPUT		
AC input maximum current	26.0A per phase	34.8A per phase
Nominal frequency	50Hz / 60Hz	
Acceptable input voltage range	Defaults 186Vac ~253Vac per phase;Narrow 174Vac ~272Vac per phase; Wide 95Vac ~272Vac per phase	
BATTERY		
Type of Battery	Lithium battery or lead-acid battery	
Nominal Voltage	48VDC	
Low Voltage Protection Point	Charger 34.0VDC; Inverter 40.0VDC	
Absorption Voltage	50.0VDC	
Refloat Voltage	54.8VDC	
Float Voltage	57.2VDC	
SOLAR CHARGER AC CHARGER		
PV Open Circuit Voltage	145VDC	
Max Solar Charging Current	60A per channel	
Max AC Charging Current	60A per phase	80A per phase
Max Charging Current	120A per phase	140A per phase

Fig: Some important output parameters for the inverter

(https://sinovoltaics.com/learning-center/certifications/certifications-solar-inverters/)

For inverters, converters, and comparable electrical energy systems equipment, including grid-connected solar power systems, there are safety criteria laid out in the international standard ‘IEC 62109-2’. It is a member of the IEC 62109 family of standards for power electronics equipment safety. The safety features of inverters used in photovoltaic (PV) applications, which include solar power systems, are the emphasis of IEC 62109-2. Inverters connected to solar panels and grid systems must operate correctly and safely, and the standard tackles several safety issues.