

Design of Solar Outdoor Air Purifier with Air Quality Control

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Abstract: Air pollution is an addition of pollutants to the atmosphere that causes environmental damage. Industrial development and deforestation, which are two of the main causes of air pollution, have increased the mortality rates of people dying from diseases such as respiratory diseases and lung cancer. To fight against this serious threat to humanity, we decided to support this society and do something to detect the amount of pollution in the air and greatly reduce the amount of pollution in the air by using MQ135 and dust sensor.

Keywords: MQ135, Air pollution, dust sensor

I. INTRODUCTION

In the project we detect impurities with a gas sensor. The sensor is connected to the Arduino, which consists of code that helps us detect the amount of contaminants in the air. And it will display on LCD display. To filter air different types of filters are used. And the important part of this project is that, this system will be powered by solar panels. Solar panels will charge the battery and the system will take electricity from battery. By using buck boost module battery will get constant 12v supply without ripple.

II. BLOCK DIAGRAM

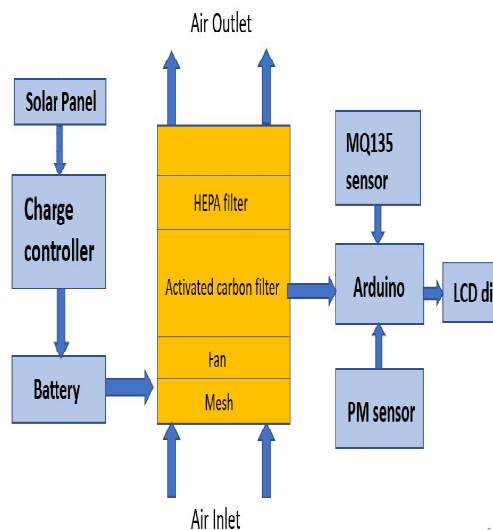


Figure 1: Block diagram of air purifier

III. AUTOCAD DESIGN

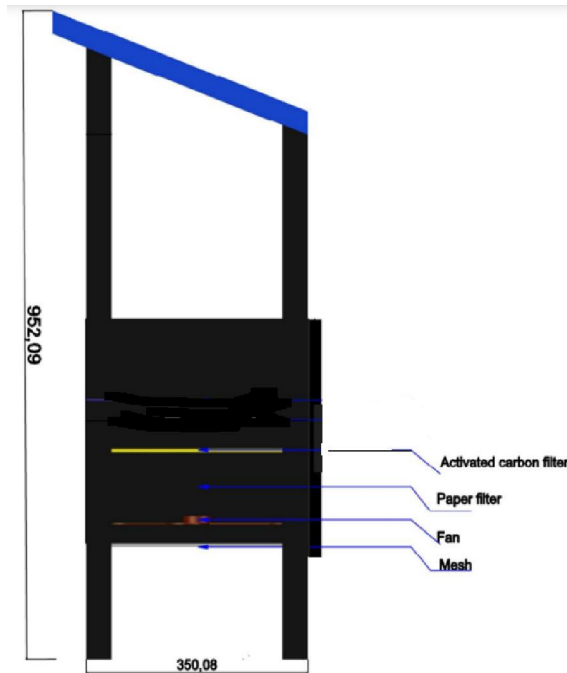


Figure 2: Autocad design

IV. TECHNICAL SPECIFICATIONS OF SYSTEM SUB COMPONENTS

4.1 Solar Panel



Figure 3: Solar Panel

Operating voltage	12 volt
Wattage	40
Panel Technology	Poly Crystalline
Voltage at max power	19.25 volts
Current at max power	2.08 amps
Open circuit Voltage	22.50 volts
Short circuit Current	2.22 amps
Dimensions	430*665*35 mm

Table 1 : Solar panel specifications

4.2 MQ135 Sensor:



Figure 4: Mq135 sensor

- Fast response and High sensitivity
- Stable and long-life Simple drive circuit
- Used in air quality control equipment for buildings/offices, is suitable for detecting of NH₃, NO_x, alcohol, Benzene, smoke, CO₂.
- Working voltage: DC 5 V
- Use to sense various gases like Co₂, nitrogen, Sulphur, etc.

4.3 PM2.5 sensor



Figure 5: PM2.5 Sensor

The PM2.5 sensor module works on the physical principle of light scattering, also known as optical particle counter (OPC), measures dust particles illuminated by laser light at a 90° angle. The light scattered from each particle is collected at approximately 90° by a mirror and detected by a photo-diode.

4.4 Carbon filter

Carbon filters capture hazardous gases like VOCs and formaldehyde. Activated Carbon filter, or charcoal filter, is a bed of activated carbon typically in granular or powdered block form, and consists of millions of tiny absorbent pores. The filter is treated to be extremely porous, and is used for filtration against gases, chemicals and Volatile Organic Compounds (VOCs). Carbon air filters remove toxic gasses such as VOCs, sulfur dioxide, and benzene as well as fumes, and odors (i.e., from smoking, painting, automobile exhaust) that are present in the air by adsorbing them into the surface of the activated carbon filter.



Figure 6: Carbon filter

4.5 Paper filter:



Figure 7: Paper filter

Filter paper is a semi-permeable paper barrier placed perpendicular to a liquid or air flow. It is used to separate fine solid particles from liquids or gases.

4.6 Buck boost module:

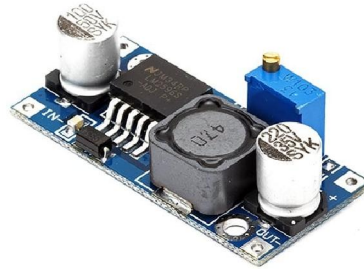


Figure 8: Buck boost module

The buck–boost converter is a type of DC-to-DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. It is equivalent to a flyback converter

4.7 DC fan



Figure 9: DC fan

The DC fan is powered by direct current. Typically this fan runs on 5v, 12v, etc. In this project, we used 4 dc fans of 12v connected in parallel.

V. SIMULATION OF SOLAR PANEL

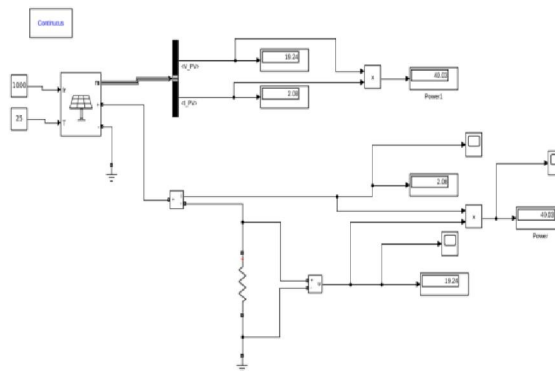


Figure 10: Simulation

VI. RESULT OF SIMULATION

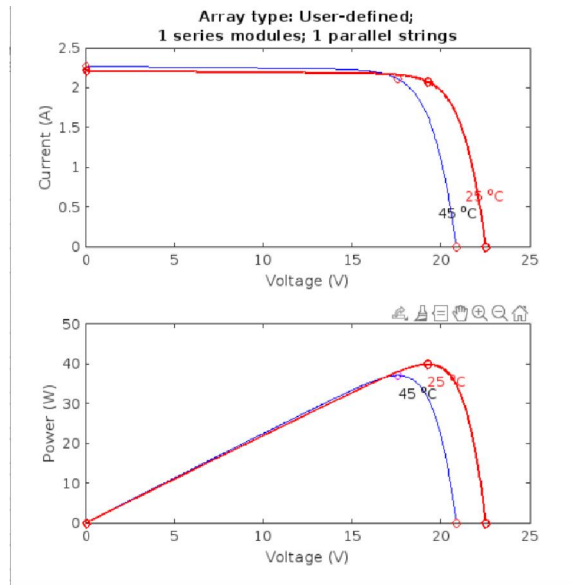


Figure 10: Graph of V vs I & V vs P

Testing of system sub components

Location:- Pune		
Time	Solar Irradiance (w/m2)	Solar panel output (watt)
07:00	107	0.51
08:00	320	4.59
09:00	500	11.2
10:00	630	17.68
11:00	730	23.63
12:00	740	24.27
13:00	695	21.46
14:00	610	16.4
15:00	550	13
16:00	300	4
17:00	90	0.3
Total	5272	137.04

Table 2:- Solar panel voltage output

VII. THEORETICAL BACKGROUND

Time taken to charge a 12V/7Ah battery from 40W Solar panel:

Solar panel and components specifications:

12 volt/7Ah battery

40-watt solar panel

Solar charge controller In order to estimate charge controller's maximum output:

$$40W / 12V = 3.33A$$

Taking power losses (20%) and efficiency of solar-charge controller:

$$75\% * 3.33A * (1 - (20 / 100)) * (75 / 100) = 1.998A (\sim 2A)$$

Taking Lead-Acid battery efficiency:

$$85\% * 7Ah * (1 / (85 / 100)) = 5.95Ah (\sim 6Ah)$$

Time to charge entire battery approximately, if it charges 2A per hour:

$6Ah / 2A = 3 \text{ hrs}$

Taking into account, most of the charge controllers have absorption charging time 2 hrs: $3 \text{ hrs} + 2 \text{ hrs} = 5 \text{ hrs}$

Therefore, it will take around 5 hrs to charge the 12V/7Ah battery entirely.

VIII. CONCLUSION

There are many different kinds of air purifier available in the market with different technologies. Some may have HEPA, carbon, ionizing, UV technology and many more. Some purifiers also contain more than one technology for advanced functioning and better results. Thus, choose the best one matching your requirement and budget. The main function of HEPA Filter is to remove contaminated viruses from the air and provide clean and pure air. Thus, HEPA Filter is a crucial purchase element for the one suffering from dust or pollen allergy. Strict standards have been set for the filters to be classified as HEPA. A HEPA Filter should be able to remove 99.97% particles being small as 0.03 microns.

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