DEPARTMENT OF CIVIL ENGINEERING

TEAM C-HELIX

PRESENTS

AIR PURIFIER

MADE BY:

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INTRODUCTION:

This project is about designing and fabricating an air purifier system which is powered by solar energy and testing the effectiveness of the system to curb the air pollution. PM2.5 and PM10 are minute particles present in the air and exposure to it is very harmful for health where PM2.5 having a particle size of 2.5 microns and PM10 having 10micron particle size. AQI (Air quality index) that is usually considered good between 0 and 100, but at most places it is above 300 because of these particles. The focus is on extracting the suspended particulate matter(PM) from the air. It works on the basic principle of Adhesion of the suspended particles in the air with the water and settles down due to being heavier than air and providing us fresh air.

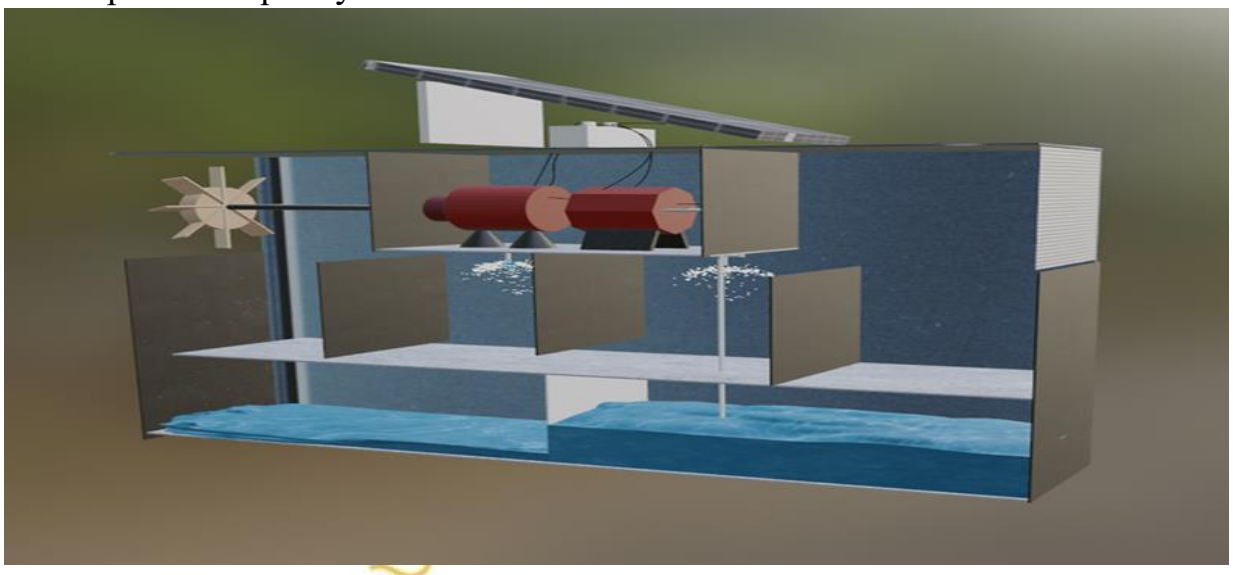
OBJECTIVES:

•The objective is to design and fabricate an air purifier system which is powered by solar energy.

•To separate out PM2.5 and PM10 particles from air.

•To attain maximum air purification efficiency.

•To improve air quality index



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3D VISUALIZATION OF AIR PURIFIER

PARTS:

1.) FAN AND MOTOR:

A 20 watt motor is installed in the beginning if the chamber. The main aim of the fan and the motor is to pull impure air inside the chamber.

The air flow rate would determine the power consumption of the fan.

The following data is known to us:

The rpm of fan, N = 1750 rpm

The diameter of duct, D = 0.1125 m

The area of duct, A = 9.93515625*10-3 m2

The following data is to be calculated:

Velocity of air flowing through fan, V=?

Rate of discharge of air through fan, Q=?

From the formula,

$V = (2*\pi*N)/60*(D/2)$

V = 3.281 ms-1

From the formula,

Q = A*V Q = 0.0326 m3s -1

Therefore, **Volume of air pumped** in/out per second is 0.0326 metric cube.

2.) Water pump:

A 24watt water pump is used for pumping water from reservoir to the atomizer. It is operated from the power that is produced by the solar panel.

3.) ATOMIZER:

When a fast gas stream is injected into the atmosphere and across the top of the vertical tube, it causes a pressure difference between the liquid in the tube and the lower pressure in the gas stream, in accordance with Bernoulli's principle. Due to this water gets converted into a mist i.e. into small water droplets.

For pressure due to atomizer:

Diameter at inlet of nozzle,

d = 0.0002 m

Area at inlet of nozzle, a = 3.14*10-8; Diameter of pipe, D = 0.004 m

Area of pipe, A = 50.24*10-6 m2;

Coefficient of friction of pipe, f = 0.006;

Length of the pipe, L = 1.5 m;

Net head of water at inlet of nozzle,H = 0.26 m

From the formula,

$v = \sqrt{[2gH/(1+(4fL/D)*(a/A)2)]}$

After calculation,

v = 3.408ms-1

From the formula, **p = ρ*g*H p = 2548 Ns-1**

4.) FOG MESH:

It is a type of membrane that is installed at the end of the chamber. It is typically made up of fabric or any synthetic material. It helps in absorbing the extra moisture present in the purified air.

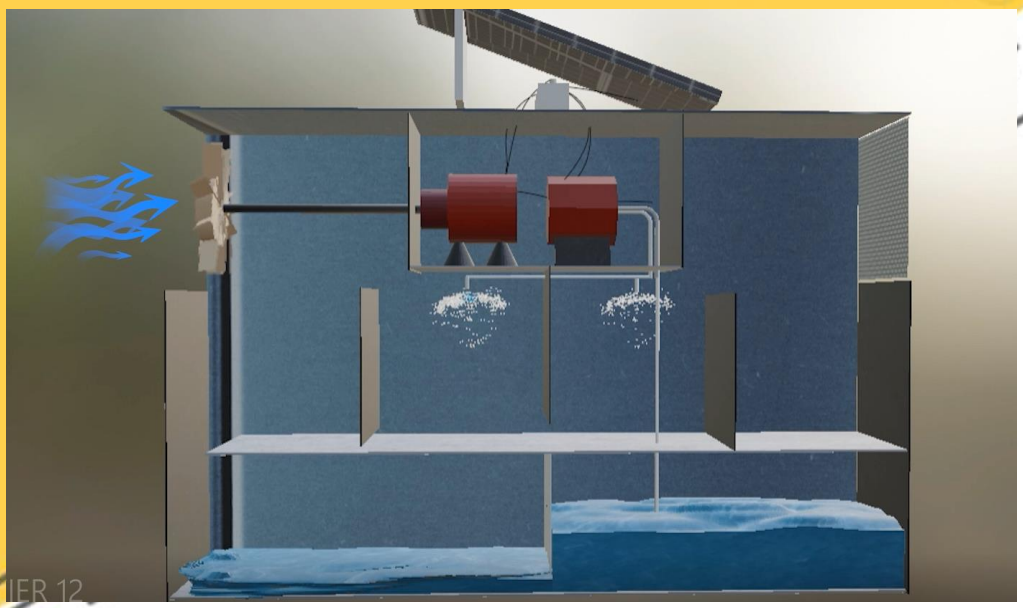
5.) SOLAR POWER KIT:

A 100 watt solar panel is used. It will produce energy for working of both the motors. Along with it a battery is installed which will provide energy during cloudy days or at night. Solar power ensures that there is no dependence on other sources of energy.

EXECUTION:

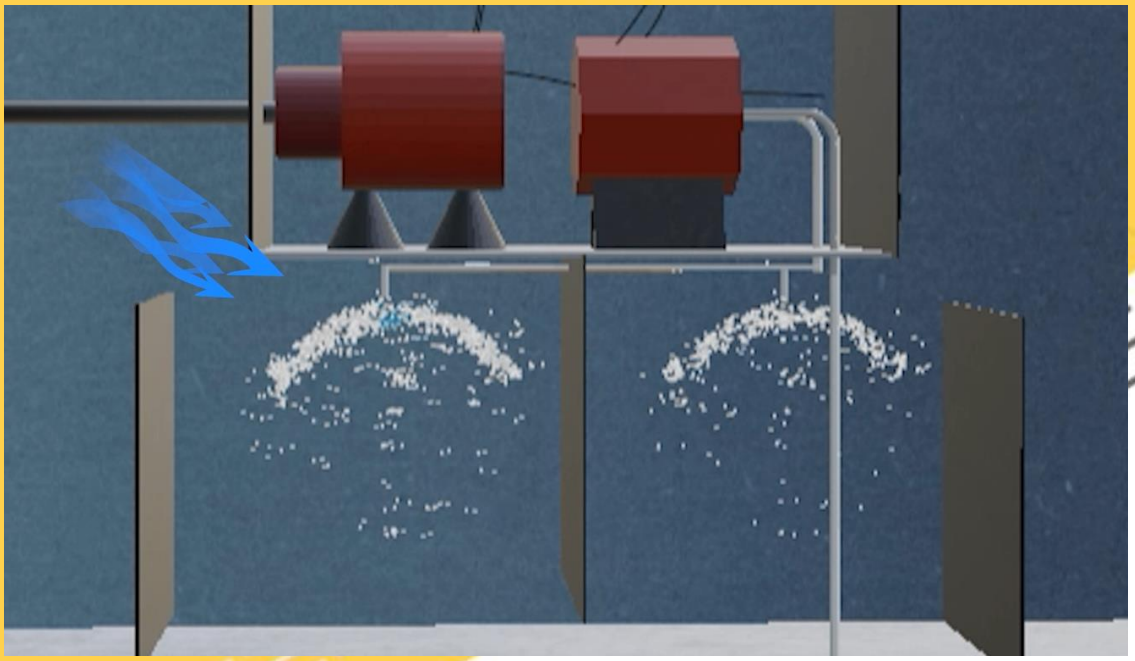
1.) There is a chamber in which air is sucked in by the fan, while the air is entering it passed through strainer.

2.) Simultaneously water is pumped from reservoir to the atomizer, which converts water into small water droplets and these droplets are suspended into the chamber along with air.



3.)These water droplets have adhesive property due to which the particulate matter and dust particles get absorbed on them.

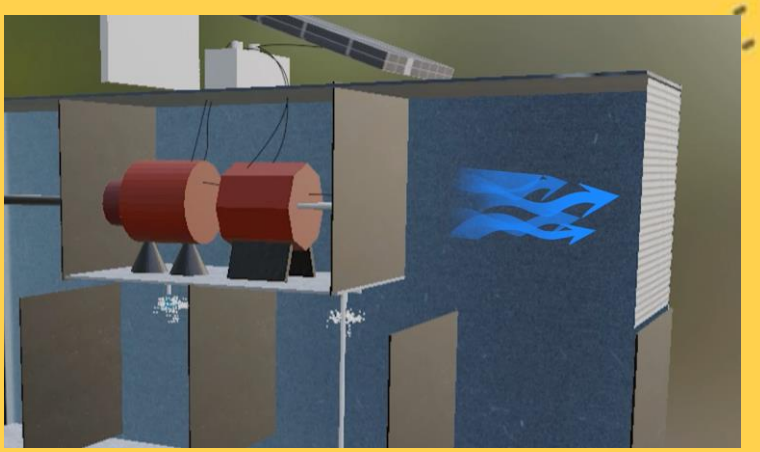
4.)Water particles on which impurities have been absorbed now gets heavier then the rest of the water particles that are coming out of atomizer. These particles then under the influence of gravity settles down and are thus separated out in a separate tank.



5.)This way air is cleaned and is flown out from chamber by exhaust fan.

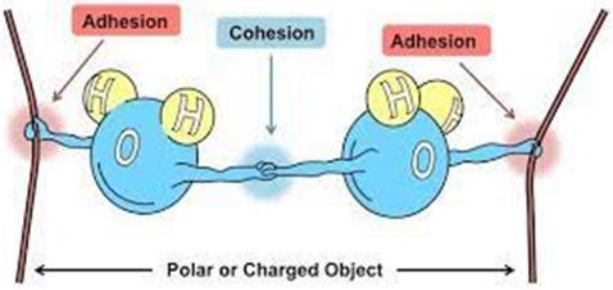
6.)The water with dust and particulate matter is collected in evaporation tank, where water under goes natural evaporation process, leaving behind the dust and particulate matter these are periodically cleaned and water is used again in air cleaning process.

7.)In case if there is any extra humidity coming out of it that can be trapped using a membrane.



WHAT HAPPENS INSIDE THE CHAMBER?

Inside the chamber when the water changes into mist, adhesion of water takes place. Adhesion is the tendency of dissimilar particles or surfaces to cling to one another (cohesion refers to the tendency of similar or identical particles/surfaces to cling to one another). Here the adhesion of water helps us in sticking PM(Particulate Matter) particles to it that helps us in purification of air. Once the impure particles get stuck with the mist they become heavy and settles down under the influence of gravity. Then these impure water flows out to a separate container.



OBSERVATIONS AND FINAL RESULT:

It was observed through calculations that a severe change in AQI was there before and after the use of air purifier. It was able to eliminate both PM2.5 and PM10 particles from the air. Following table was drawn based on the observations taken.

Calculation based on PM2.5 reading

Moisture content = (AQI of fan + pump + incense stick) – (AQI of fan + pump) =180 - 118 = 62

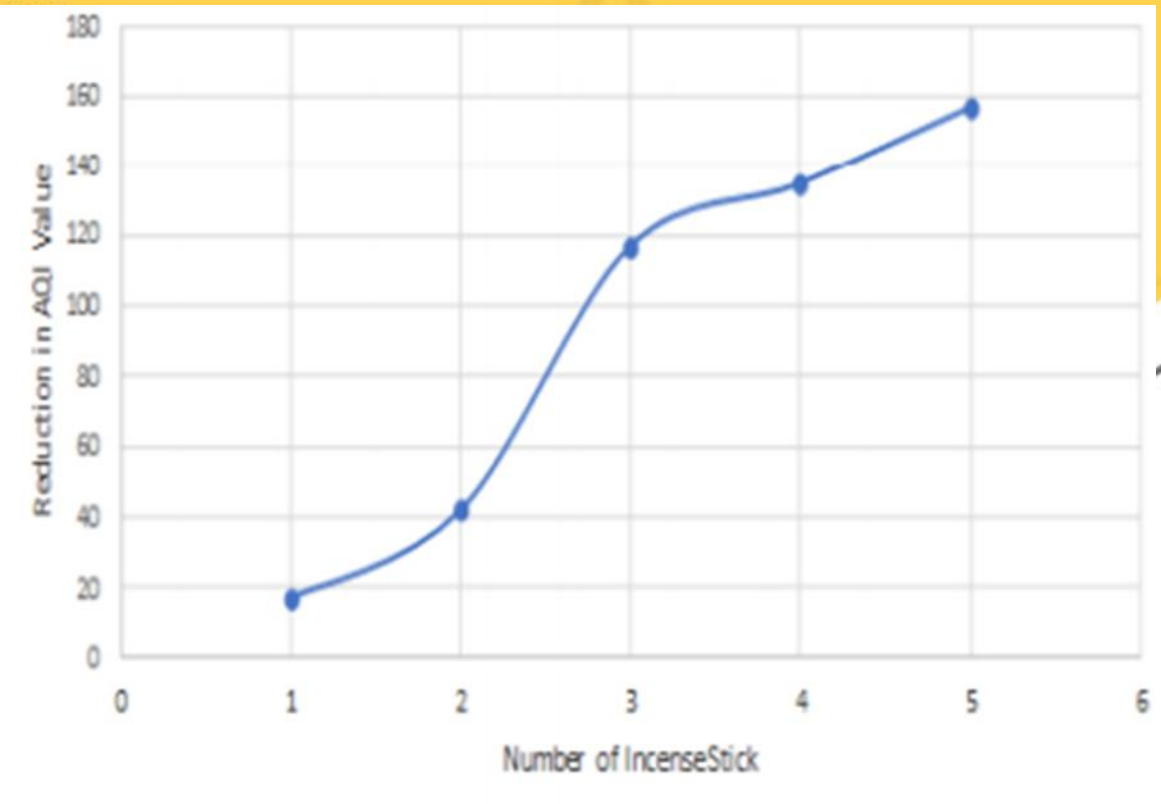
Amount of purification = AQI of incense stick – Moisture content = 999 - 62 = 937

Purification percentage = (reduction of AQI/AQI of incense stick)*100

= 93.79%

APPARATUS USED	PARTICULATE MATTER	MAXIMUM VALUE	MINIMUM VALUE	CONSTANT VALUE
AMBIENT ENVIRONMENT	PM2.5	75	61	65
	PM10	100	81	87
FAN	PM2.5	77	65	67
	PM10	103	87	89
FAN + PUMP	PM2.5	130	117	118
	PM10	173	156	157
FAN + INCENSE STICK	PM2.5	147	119	132
	PM10	196	158	176
FAN + PUMP+ INCENSE STICK	PM2.5	200	167	180
	PM10	267	223	240

We also absorbed change in air quality index values at different level of pollution. To obtain different pollution levels inside a room the experiment was done with the help of incense stick(Agarbatti). Following graph was plotted based upon the observations.



Through the graph we are able to understand that how at different pollution our air purifier worked. We observed that how with increase in pollution level a greater change in AQI was observed indicating that both PM 2.5 and PM10 particles were removed.

How its better than the already existing air purifiers?

1.) Most the already existing air purifiers emits ozone gas along with the pure air, that is in another way harmful for everyone.

2.) Also this purifier works completely of solar energy so no extra load on power companies would be there.

3.) It also has a low maintenance cost, once installed it will last for longer period of time.

SOCIAL BENEFITS:

- This purifier will help us to reduce pollution.
- Its installation is cheap and can be easily installed near the chimneys of industries or even at home.
- No extra power would be needed for its working as the solar panels itself would generate energy for pump working.
- It's a onetime investment and once installed no extra charges would be there.
- Easy to maintain**.**
- Can filter both PM2.5 and PM10 particles up to ~94% and ~97% respectively.

LEARNING OUTCOMES:

- It tells us about the removal of fine pollutants from air with help of water.
- It also tells us about how absorption is helpful in air purifying.