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Arduino based Air Monitoring and Filtration System

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Abstract - *In India, burning incense is a part of worship. Due to the rise of diseases and bacteria related to mosquitoes, people are turning to the use of mosquito coils as they are cheap and provide protection. However, there has been evidence of harmful gases produced by the burning of these products. Not only are these products harmful to the lungs, they can also cause cancer. The gases produced by burning incense and mosquito coils are known to release harmful chemicals into the air. If these are not taken out, people will suffer from various health conditions such as asthma. Unfortunately, there is currently no reliable scientific evidence regarding the long-term effects of airborne pollutants. This makes it important that people take measures to prevent their exposure to these harmful chemicals. One of the main factors that contributes to the development of airborne pollutants is dust . A filtration system can prevent dust accumulation on surfaces, trap airborne mold spores, bacteria, viruses, and even bad odors. That's why we wanted to develop a system that can remove these gases like CO, NO2, and SO2 and produce fresh, harmless air even after burning incense and mosquito coils.*

***Key Words*: Airborne pollutants, Incense stick, Mosquito coils, Filtration system, Monitoring System, Health conditions, Diseases .**

1. INTRODUCTION

In general, people believe that outdoor air pollution is harmful and that they are safe at home. Yet, the reality is quite different. The indoor air quality can be 10-15 times more polluted than what people breathe outside. The air in the house is polluted by various airborne pollutants, dust, and bacteria and germs that cause disease. In countries like India, where religion is given a lot of importance, incense sticks are burned as part of worshiping. Sulphur dioxide (SO2) and carbon monoxide (CO) gases have been found in burning incense stick. Gases such as CO, CO2, NO2, SO2, and others are produced by incense burning. CO, CO2, NO2, and SO2 are extremely harmful for us. If not removed, these gasses will cause various life-threatening illnesses in the house or workplace, such as Asthma and Bronchitis. In this project we have developed a low-cost air filtration system. The system will focus on reduction of Carbon Dioxide using UV laser. Carbon Dioxide is one of the green house gas and is one of the major cause of asthamatic and respiratory problems/diseases. Carbon dioxide when passed through the rays of UV light breaks into Carbon [C] and Oxygen [O_2], thereby reducing the green house Carbon Dioxide gas and increasing Oxygen content in air. Testing is done on a burning incense stick which also releases a lot of smoke apart from CO_2.

2. METHODOLOGY

To remove pollutants from the air of an office or home, air purification systems are used. Here are a few of the methods to accomplish this : HEPA Filter, Carbon Filter, UV-c Light.

One of the most common methods is HEPA filtration. Air filters with a diameter of 0.3 microns can theoretically capture 99.97% of dust, pollen, mold, bacteria, and other airborne pollutants. The diameter specification of Dust particles, pollen, mold, bacteria, as well as other airborne particles larger than 0.3 microns (m) should all be removed by this design. The diameter specification of 0.3 microns represents the worst case, the most penetrating particle size (MPPS).

Carbon filtration, or active carbon filtration, is a widely used process that works by adsorbing pollutants onto the surface of a filter. Water or air can be effectively purified by this method if certain organic contaminants (such as unwanted tastes or odours or micropollutants) are present, such as chlorine, fluorine or radon.

The ultraviolet germicidal irradiation (UVGI) method is a disinfection method that uses ultraviolet (or UV-C) light to destroy nucleic acids and disrupt DNA in order to eliminate or inactivate microorganisms. Ultimately, these microorganisms are rendered inert and unable to function properly.

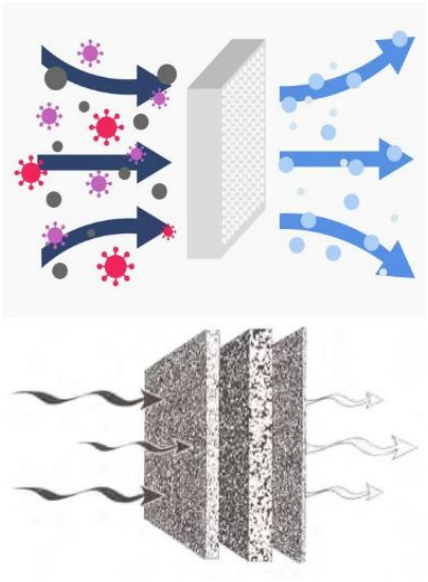

Fig -1.1: Different Methodologies.(HEPA, Carbon Filter, UV)

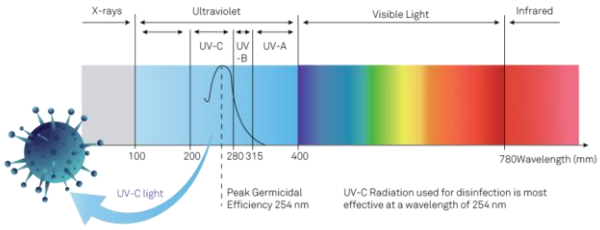

Fig -1.2: UV-c Light

3. SYSTEM DESCRIPTION

This project is divided into two parts one is monitoring system and second the filtration system .

1. Monitoring System .
2. Filtration System .

I. Monitoring System :

In monitoring system we are having our circuitry part . In which we have used arduino nano , LCD , sensors. In this circuitry we have used two sensors one is Dust sensor and another is MQ135 which is nothing but our air quality sensor. Dust sensor will sense the dust particals and give us the indication with the help of LED's. Here we have use four LED's of different colour for better understanding . Now for MQ135 it will detect the air quality and give us the indication through LCD by displaying "NORMAL" "ALERT!!" message .

II. Filtration system:

For Filtration process, we are using a pre filter, a carbon filter, HEPA filter , and UV light . We are using the "Pre filter" to perform a pre-filtration process at primary level . As we are using HEPA filter which perform the majoriety of filtration process so its necessary to protect it too as it a bit costly too , so for that we are using "Carbon Filter" outside HEPA filter . At last we are using UV light to perform Disinfection , Sensitisation & kills micro-bacteria too.

4. BLOCK DIAGRAM

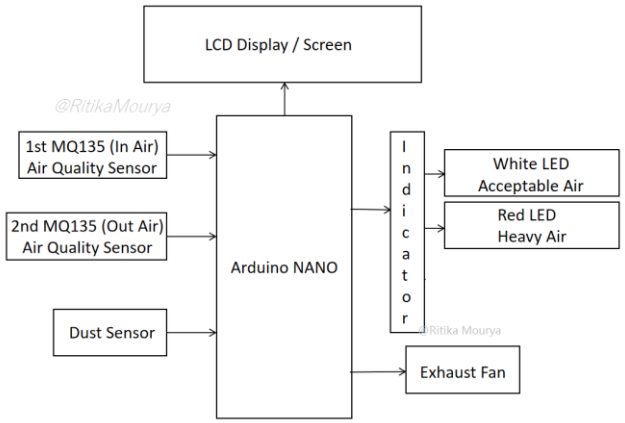

Fig -2 : Block Diagram.

5. PROTOTYPE OF FILTRATION SYSTEM

As you can see , here we have an exhaust fan and UV light , which we have been implementing in our circuitry part too .

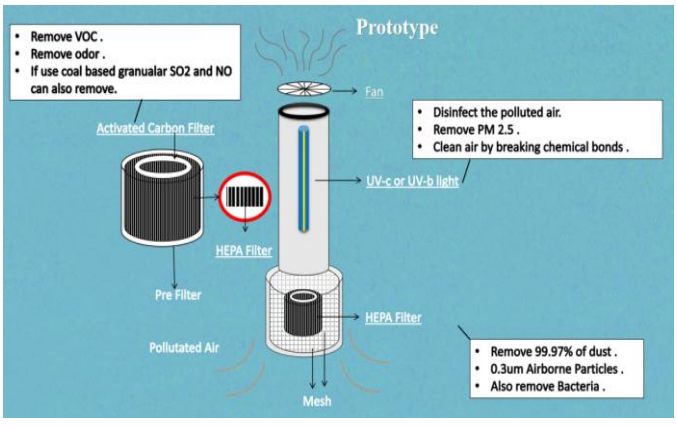

Fig -3: Prototype of Filtration System.

6. CIRCUIT OF MONITORING SYSTEM

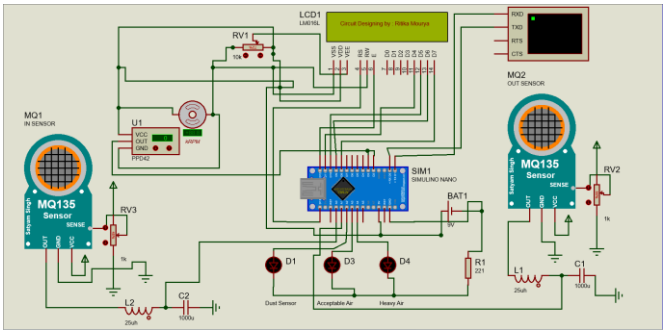

Fig -4: Circuit of Monitoring System.

7. BREADBOARD IMPLEMENTATION

This is our overall implementation , Here we are using 16x2 LED (for displaying the sensor outputs) We have 2 sensors , one at the input side & other at output side . And we had use Aurdino-NANO .We had a Dust Sensor to detect the unwanted dust particles from the air . Here we are having 2 LED's , White & Red . If the Air is clean it will turn on white one otherwise Red .

Now , as in our prototype , we have been using an exhaust fan so we have resemble it here in circuitry as the mini-fan as you can see in Fig -5,6, and we have use a Driver so it will not put load on Aurdino .Now for the UV light we have resemble it with the light stick . The components which we have been using for Testing are -instant stick (its output gases mainly include Co and CO2) -sanitizer for testing our air quality sensor -leftover dust of instant stick for testing Dust sensor . So this is our setup without uploading the coding

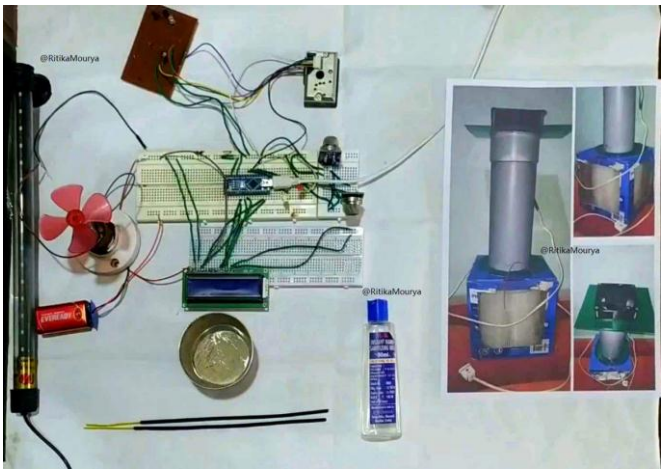

Fig -5: Monitoring System Setup

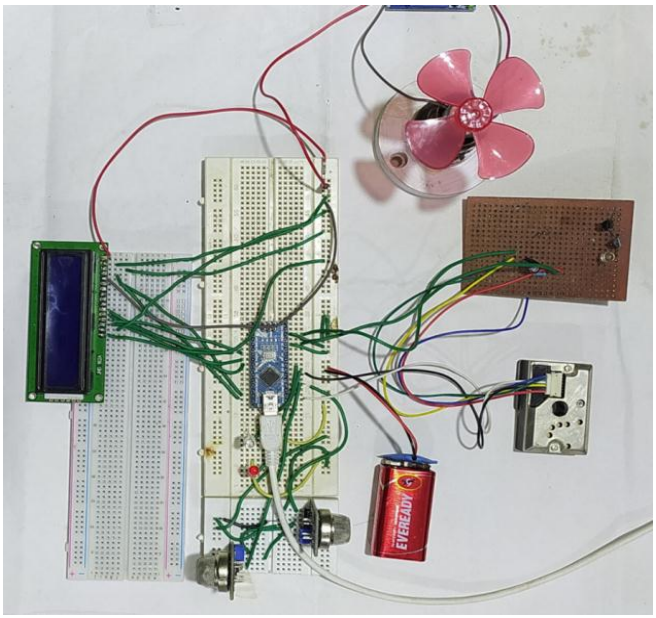

Fig -6 : Circuit Implementation of Monitoring System .

8. FLOW CHART

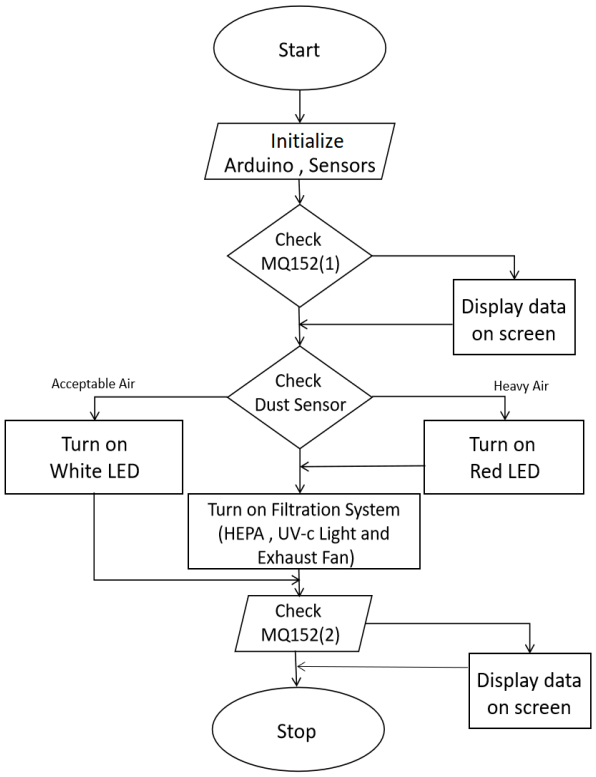

Fig - 6 : Flow Chart

9. SOFTWARE & CODING

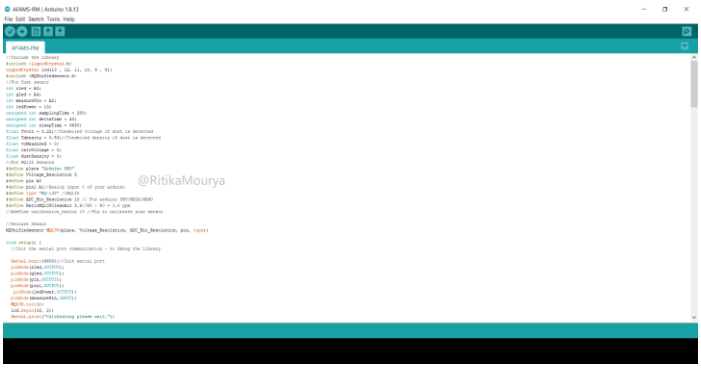

Fig -6 : Arduino IDE Software and System code.

10. WORKING

Firstly we will turn on the power . Then we will dump our code in the arduino . After dumping our code arduino will start running . So our LCD is turned on and the resemblance of our exhaust fan & UV light also gets turned on . That we an see that in Fig -7

Fig - 7 : Display Screen

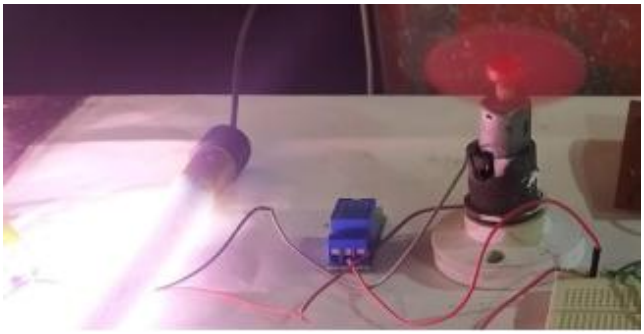

Fig - 8 : Resemblance of our exhaust fan & UV light

Now we will see the working of our Dust sensor , here it will turn on white LED because it has not detected any dust in the surrounding as you can see here , which means the air is dust free can see it in Fig -9

And now we will start sprinkling the instance stick dust over the Dust sensor and it detect dust in surrounding so it will turns Red ref Fig 10,11

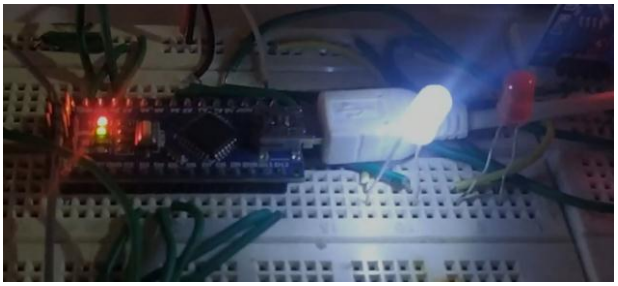

Fig -10 : White LED turned ON - Clean Air

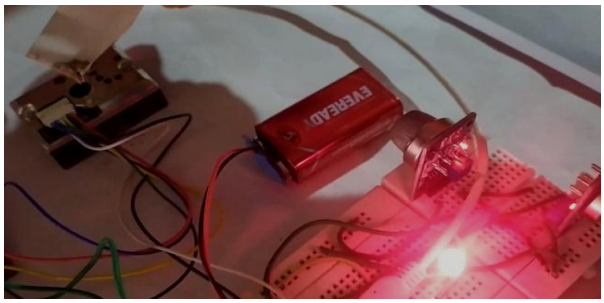

Fig -11 : Sprinkling dust over sensor .

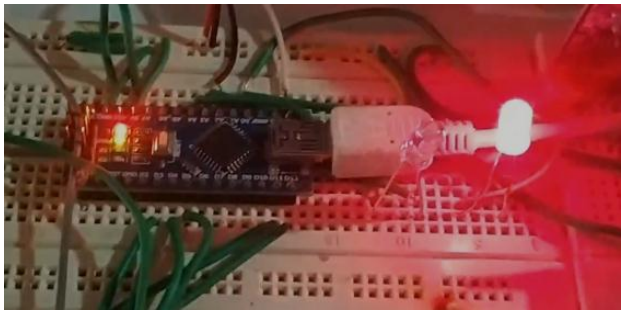

Fig -11 : Red LED turned ON - Polluted Air

As we have used LCD to display input & output reading of the component detected so lets see how it works . Now we will check our sensors using incense stick because it contain co2 components in it .Now let the input sensor detect it and it turns green which means the sensor detect the gases see Fig -12 and now it will show the reading in the LCD here .You can see the variation in the input & output reading . Fig -13

Fig - 12 : MQ135 Sensor turned ON - Green light

Fig - 13 : Sensor Reading Display on Screen .

11. ANALYSIS & RESULT

Observation table consist of :

1) Gases that were detected during testing CO , Alcohol and CO2 in both input and output sensor.

2) Dust presence in surrounding .

3) Dust Density .

Table -1: Observation table

Sr No.	Gases and Chemical Detected						Dust Present or not	Dust Density
	CO		Alcohol		CO2			
	IN Sensor	OUT Sensor	IN Sensor	OUT Sensor	IN Sensor	OUT Sensor		
1	3.91	2.25	1.87	1.24	400.56	400.12	Dust not detected!!	0.1
2	4.46	3.24	2.25	1.78	403.83	401.56	Dust not detected!!	0.15
3	4.48	3.73	1.98	1.19	401.34	401.19	Dust detected!!	0.36
4	4.53	4.22	2.34	1.91	402.43	401.96	Dust detected!!	0.43
5	5.65	5.00	2.76	2.39	405.87	404.25	Dust detected!!	0.45

This readings were generated by burning the **incense sticks.** And this reading are taken by Arduino IDE serial monitor .

12. COSTING & BUDGET

Following are the costing of component used in both Monitoring as well as Filtration System :

1. MQ135 SENSOR - 2 pieces - 190 Each - 380 Rs
2. DUST SENSOR - 1 piece - 520 Rs
3. ARDUINO NANO - 1 piece - 350 Rs
4. 16x2 LCD - 1 piece - 150 Rs
5. RELAY - 1 piece - 90 Rs
6. BATTERY + CAP - 1 piece - 40 Rs
7. POT - 1 piece - 30 Rs
8. LED's Red , White - 10Rs
9. SOLDERING WIRE - 2 pieces - 21 Each - 42 Rs
10. CONNECTING WIRE - 14 Rs
11. CONNECTING PINS - 30 Pins - 30 Rs
12. RESISTOR - 5Rs
13. DOUBLE SIDED TAPE - 30 Rs
14. Philips HEPA Filter - 497 Rs
15. UV lamp. - 275 Rs
16. Steel Mesh. - 80 Rs
17. UV choke. - 100 Rs
18. Polycarbonate. - 136 Rs
19. PVC pipe. - 120 Rs
20. PVC cap. - 50 Rs
21. Fiber Sheet - 199 Rs
22. Carbon - 550 Rs
23. Feviquick. - 50 Rs
24. Cutter. - 40 Rs
25. Wire. - 10 Rs
26. Nut Bolt+M-seal. - 30 Rs
27. Thermacol. - 50 Rs
28. Exhaust - 290 Rs

13. CONCLUSIONS

The project intends to develop an air filtration system using multiple filtration techniques to give out purified air in the atmosphere .Various indoor pollutants can be easily refine .It is user friendly - As you can see in the prototype the structure is compatible to understand by the end user .The budget of the project is cost effective .

ACKNOWLEDGEMENT

Time has indeed come when we take up on ourselves the pleasant feeling of acknowledging the guidance and support offered to us by individuals who helped us in materializing this seemingly unending task. The most important acknowledgment of gratitude i wish to express is to my mentor and guide, Prof. Vishal Rathee, Department of Electronics Engineering, Shri Ramdeobaba College of Engineering and Management, who has put his valuable wisdom at our disposal. It has been a greatly enriching experience for me to work under his caring guidance.

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