An Air Monitoring and Purification Machinery

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***Abstract*—The paper provides with a systematic overview of our project. The project essentially consists of a purifier which intakes dusty air and lets out cleaner and cooler air and a monitoring unit which gives us a critical air quality check of the environment, the machine is kept in, with the help of various sensors and outputs the results on an LCD.**

***Index Terms*—Purifying unit, monitoring unit, air quality index, temperature and humidity sensors, harmful gas detectors, dust sensors, microcontroller, sieve filter.**

I. Introduction

Air pollution is an alarming cause of concern in todays world. Not only does the Particulate Matter in air has numerous health hazards, it degrades the quality of life day by day. WHO (World Health Organization) presented certain statistics in 2018 : [1]

1) Air pollution levels remain dangerously high in many parts of the world. 9 out of 10 people breathe air containing high level of pollutants such as black carbon which penetrate deep into the lungs.

2) WHO estimates that 7 million people die every year from exposure to fine particles in polluted air that lead to strokes, heart diseases, lung cancer and respiratory infections.

Such data only increase our need for cleaner air. Our project is an effort towards developing a system which not only caters to the making air free of dust and fine particulate matter but also provides data about its quality, dust density, temperature, humidity and gas contamination.

II. Motivation and Social Impact

We have been living in IIT Mandi for a year now. While on our way to our homes, mostly in metropolitan cities, we realized how lucky we are to live amongst the mountains, in a very clean environment. WHO in 2014 named Delhi as the 2nd most polluted city in the world. [2] Breathing the air in Delhi is like smoking 40 cigarettes a day. About 10,500 people die every year because of the dense fog and pollution. [2] Through this project, weve tried to improve the Air Quality in certain areas where it is much needed.

III. Underlying Principles of Science

Motion of air from high pressure to low pressure is the reason of air being sucked in easily by exhaust. We have used water sprays for two reasons. Firstly, water is a universal solvent, it increases the retentivity of dust particles on the filter. Secondly, it also acts as a coolant. Passing moist, dirty air through a filter that can adsorb dust.

IV. Design

The system can be broadly divided into 2 units which are integrated to together perform the task of qualitative and quantitative analysis of air and its purification.

A. Data Collection, analysis and display:

The devices used for data collection are the following sensors with their functioning and outputs explained briefly:

1) DHT-11 Temperature and Humidity sensor [3] which gives value of temperature in degree Celsius and relative humidity of air.

2) MQ-135 Gas sensor [4] to detect harmful gases like benzene, alcohol, ammonia, NOx , CO2 and accordingly return a numerical value according to whose range we can determine whether the air is seriously contaminated or not.

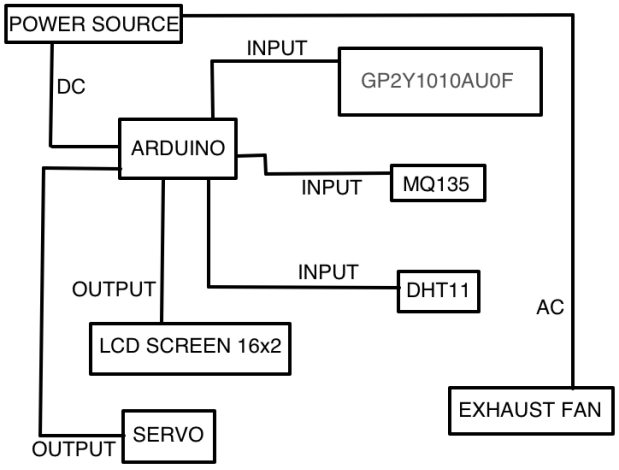
3) Sharp Dust Sensor [5] which gives the value of dust density in air in mg/m^3.

4) An LCD [6] is used to display the reading of the above devices along with the air quality check in terms of Good,

Moderate, and Poor. All these devices are interfaced with a micro-controller such as an Arduino in our case, with the help of set up of a complicated circuitry on a bread board, so that the readings are measured and displayed on the LCD.

B. Air purification:

The machinery consists of the following parts:
1) A small Exhaust fan of 22 watts, 220 volts.
2) A stator-rotor system, made using hollow pipe and plastic fins.
3) A narrowing funnel connecting the above with a long pipe.
4) A water spray system, consisting of servo motor to moist the air passing through the pipe.
5) A filter made of semi-permeable substance at the end of the pipe.
The air is sucked in through the exhaust and comes out at the end of the pipe through the filter, cleaner and cooler.



V. Working Mechanism:

The values of dust density, humidity, temperature are measured by the DHT-11 and Sharp dust sensor and displayed on the LCD. Also the air quality is displayed.

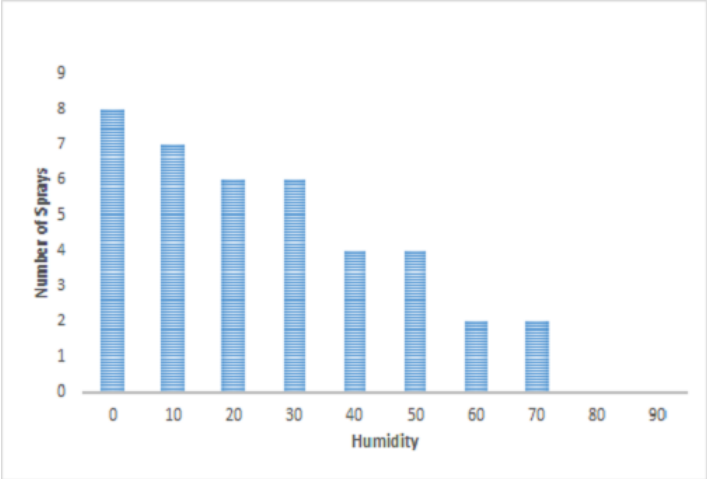
A. Air Quality Estimation:

TABLE I
Air Quality Estimation

Sharp Dust Sensor Output (mg/m^3)	MQ-135 Output	Air Quality
< 0.5	100 - 150	Good
0.5 - 0.75	150 - 200	Moderate
> 0.75	> 200	Poor

B. Spray System:

The more is the humidity of the air, the less is the number of sprays of water used, in order to save water. As the humidity of the incoming air is measured, accordingly number of sprays are estimated and the water is sprayed automatically with the help of servo motor (We have programmed it accordingly).



C. Purifying unit:

Air is sucked in through an exhaust fan and passed through a stator-rotor system. As air rotates the rotor, it essentially does work at the expense of velocity. Thus the air coming into the pipe is of lower speed and temperature. As it passes through the pipe, water is sprayed in according to the humidity. It finally reaches the filter and dust is removed. Thus we get cleaner and cooler air coming out.

VI. Modifications and Future Scope

The system works fine for small outdoor places such as bus stands and indoors. But if we want to expand the field of work, well essentially need to scale up the machinery. A bigger exhaust fan, a better filter (budget constraints) could purify large quantities of air with more efficiency (such as removing harmful gases as well). Currently our system filters out fine dust and particulate matter and gives us the qualitative and quantitative analysis of incoming air. The machinery then could be efficiently used for construction sites(dusty areas) and mining sites, where it will be hugely beneficial for site workers.

VII. Conclusion

Our team built up a project aimed at the monitoring and improvement of air quality, with a wide future scope and major benefits for the society.

VIII. Acknowledgement

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