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# Air Pollution Control using Low-Cost Filters

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**Abstract:** *Air pollution is a major environmental concern these days, and it's more than just a fact; it's a painful fact that causes problems for humans, such as serious health problems According to WHO data on indoor air pollution and health, indoor air pollution causes 3.8 million premature deaths each year, including stroke, chronic, ischemic heart disease, obstructive pulmonary disease and lung cancer. As a result, the majority of research has focused on various air purification methods. The most dangerous pollutants are PM 2.5 particles. The majority of these can be found both inside and outside of buildings. Because effective air filtration is an expensive process, the solution is to cut costs while maintaining efficiency. This paper discusses the current state of human air pollution problems, low-cost and effective air purification methods like HEPA filters, activated carbon, and ultraviolet light, and how they developed this system. In addition to that, the benefits of air purification in improving indoor air quality are discussed.*

**Keywords:** Air purifier; 3d printing; additive manufacturing; activated carbon

## I. INTRODUCTION

According to the 2018 data of the World Health Organization (WHO), air pollution is responsible for seven million premature deaths each year. Activated carbon is frequently chosen as the medium to filter out gases and air pollutants emitted by motor vehicles and combustion processes. The agricultural waste to be used as source material for the device's activated carbon will primarily consist of rice husks, coconut husks, sawdust, and other common agricultural byproducts. The process of generating activated carbon can also facilitate many other types of organic matter to be used as source material. The 3D design of the prototype for 3D printing was modular to accommodate upgrades or add-ons such as reusable silica desiccants and aromatic beads for moisture absorption and fragrance respectively.

Air pollution is the presence of suspended chemicals that are detrimental to human health in the atmosphere. These particles are produced in various human activities such as fuel combustion, energy generation, and even household cooking. These chemicals are otherwise called pollutants. Recent studies also revealed that diseases persist even in people residing within areas with relatively low amounts of air pollution or with levels below the present regulatory guidelines (Zhang et al., 2019). The Philippines has the third highest recorded deaths due to air pollution with 45.3 deaths for every 100,000 people, thus making adverse air quality one of the biggest crises in the country (WHO, 2018). Exhaust from motorized vehicles and other enginery produce carbon monoxide, a component of photochemical smog. Breathing in carbon monoxide can impair the ability of the body to circulate oxygen, a necessity for all bodily organs. Nitrogen dioxide, another gas found in smog, can exacerbate asthma and bronchitis, which may develop into a respiratory infection. Nitrogen dioxide is often generated from energy and industrial generation (Ambag, 2019). Natural ventilation through the use of windows or doors has been the easiest and most effective method to improve indoor air quality (IAQ), where people spend over 80% of their time (Oh et al., 2014). However, high PM 2.5 concentrations in the outside air make using this method challenging. As a result, a market for air purifiers used to improve IAQ is expanding rapidly. Activated carbon is frequently chosen as the medium to filter out gases and air pollutants emitted by motor vehicles and combustion processes. The agricultural waste to be used as source material for the device's activated carbon will primarily consist of

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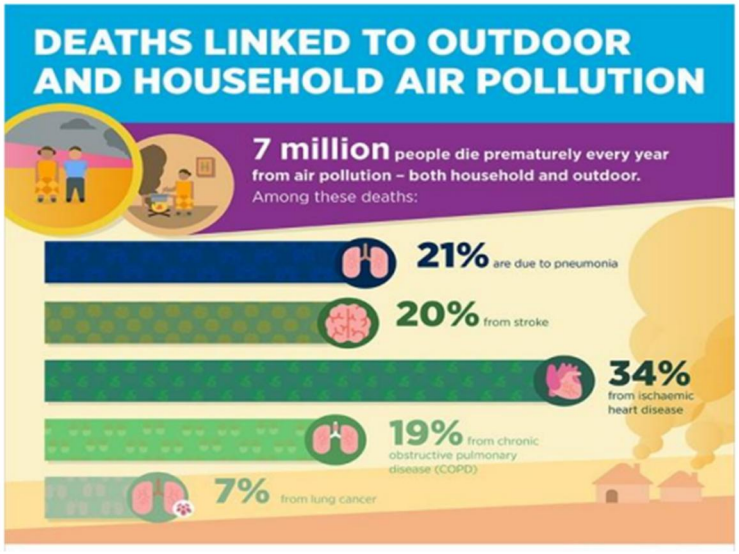


Fig. 1: WHO infographics on Air Pollution Effects to Health

**Objective:**

The purpose of this study is to: Develop a low-cost air purifier using 3D printing, bamboo, and recycling waste material such into Activated carbon filter. Integrate air pollution data collection with Raspberry Pi Internet of Things (IoT) The proposed air purifier shall be using activated carbons from biomass in combination with HEPA filters in order to create a low-cost air purifier system. It would also be capable of measuring air quality with a PM 2.5 sensor and collect/share that data to users via an Internet of Things connection. A bamboo filter casing will be used to contain the activated carbon due to its high availability and faster production due to its already hollow and cylindrical form. The filter case housing will be made of bamboo treated with coats of varnish to prevent mold and degradation, with 3d printed end caps of HEPA filters and other filtration layers.

## II. AIR POLLUTION & CONTROL

Traditional TSP samples may also be used to determine the levels of chemical elements and compounds in the particles which may pose a risk to human health. sampler is used to collect TSP samples. The high volume air sampler draws a large known volume of air through a pre-weighed filter for 24 hours.

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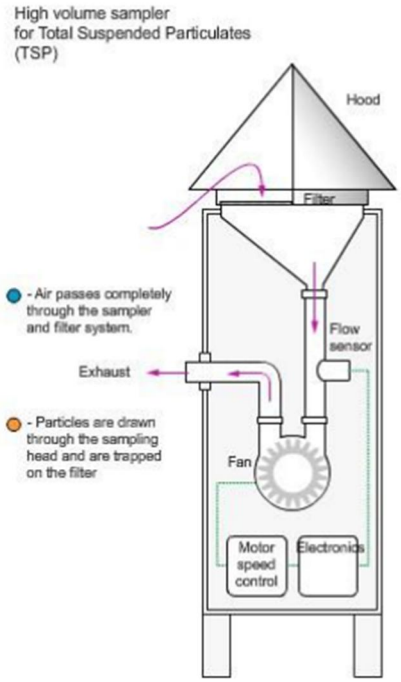


**Fig. 2: Illustration of TSP sample**

As shown in the illustration, the sampler filter traps the TSP particles as air passes through the instrument. After sampling, the filter is re-weighed and the difference in filter weight is the collected particulate matter mass. Dividing the mass by the volume of air sampled gives the concentration of TSP. If required, the particulate matter retained on the filter is analysed to determine the concentration of pollutants, such as lead or other metals. Metals can also be monitored continuously using an XACT instrument. The design of the air inlet means that a TSP high volume air sampler is unlikely to collect airborne particles with diameters greater than 100 micrometres (µm) in diameter. This type of sampling usually takes place at 6-day intervals due to the need to manually change the filters.

## III. METHODOLOGY

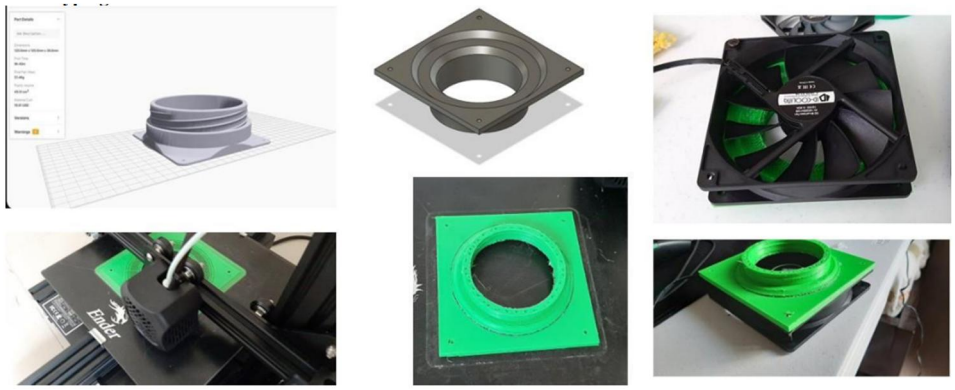

Fig. 3: 3D Design Optimization and Printing of Filter Module


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Fig. 4: 3D Synthesis of Activated Carbon from Rice Husk Filter

Testing Using a makeshift gas chamber and an Arduino with Particulate Matter (PM) sensor. The researchers were able to test the initial prototype.

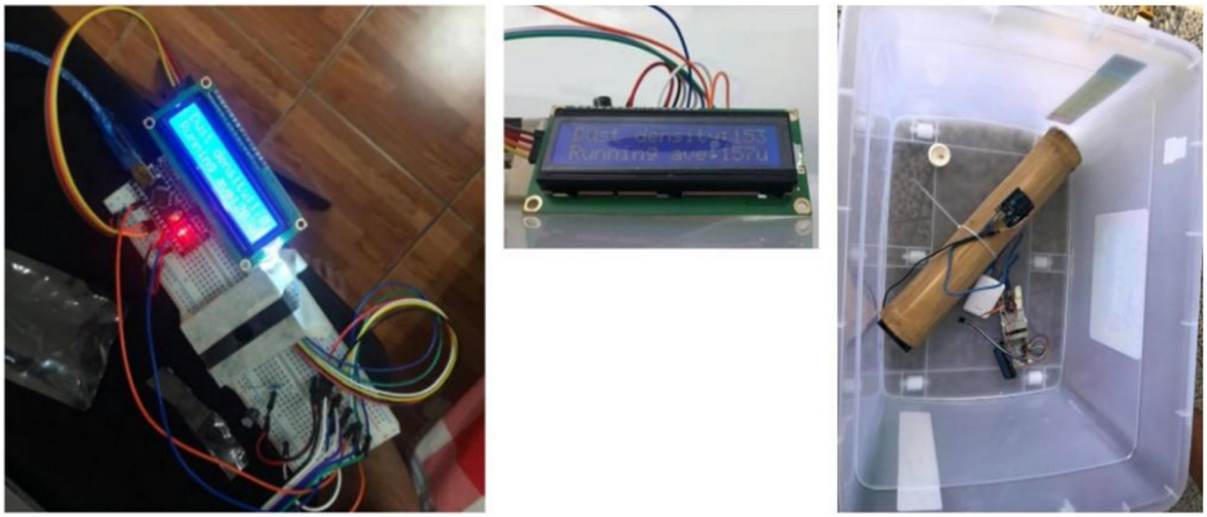

Fig. 5: Testing of the Prototype

## IV. RESULT DISCUSSION

It could be gleaned from the Table below that the prototype has improved the air quality inside the improvised gas chamber. An initial 177 ppm air quality with smoke inside the chamber was contained. By triggering the Air Purifier protoype, a measured 140 ppm Air Quality was recorded.

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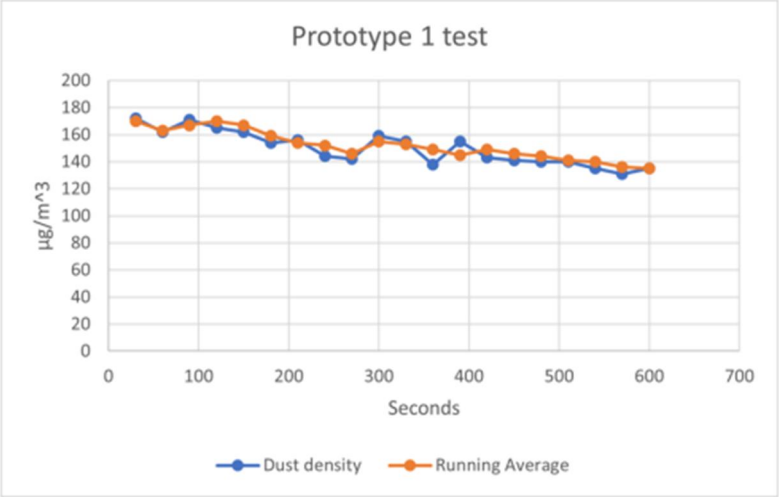


## V. CONCLUSION

The project aims to study and develop a low-cost indoor air purifying system. People face a serious respiratory problem with air quality today. Inhaling unhealthy air has a negative impact on people's health and causes a variety of ailments. Indoor pollution is currently on the rise due to a variety of factors, including biological pollutants such as bacteria, mold, mildew, viruses, and animal waste. In addition, mosquito coils, wood, and microplastics are all burned are released into the air. As a result, For the purpose of reducing the amount of pollution coming from various sources and protecting people and the indoor environment from potentially harmful gasses, this air pollution purification system was created. Incorporating Arduino technology into the purification system enables the user to estimate the level of pollution in their entire indoor space, and the purification system automatically kicks in when the reading reaches a dangerous level. The Arduino microcontroller and purification structure were more reliable and effective for low-cost development. To absorb PM 2.5 particles, HEPA filters were developed, which have a multi-layered structure of glass fibers. They do guarantee a 99.97% efficiency rate. Activated carbon is a traditional method of purification that has few to no disadvantages. UV light proves to be an effective strategy for combating bacterial contaminants, as long as the wavelength of light employed is not harmful to humans. This paper compiles a list of some of the air purification systems that are both cost effective and efficient. People with respiratory diseases can gain a lot of benefits from this air purifying system, which also includes AQI monitoring. The system had the following features: indoor air quality index based on real-time monitoring, daily air quality forecasts, air quality dips associated with health risks, and specific reporting for indoor air quality measures.

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