DESIGN AND DEVELOPMENT OF AIR PURIFIER MACHINE TO REDUCE INDOOR PARTICULATE MATTER

BY

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This Thesis Report Offered in Partial Fulfilment of the Requirements for the Degree of Bachelor of Science (B. Sc.) in Environmental Science and Disaster Management (ESDM)

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DHAKA, BANGLADESH

NOVEMBER 2022

APPROVAL

This thesis report titled "**Design and Development of Air Purifier Machine to Reduce Indoor Particulate Matter**", submitted by Emon Ahamed to the Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU), has been approved as satisfactory for partial fulfillment of the degree requirements of Bachelor of Science (B.Sc.) in Environmental Science and Disaster Management (ESDM) and accepted in terms of design and content. The presentation took place on 29th November of 2022.

28/7/22

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DECLARATION

I hereby certify that I completed this research project under the supervision of **Dr. A. B. M. Kamal Pasha, Ph.D., Professor and Head, Department of Environmental Science and Disaster Management (ESDM)**, Daffodil International University (DIU). I hereby confirm that neither this research project nor any portion of this particular research has been submitted for the granting of any degree elsewhere.

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Department of Environmental Science and Disaster Management (ESDM)

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DEDICATION

To,

My caring parents

Joynal Abedin

Beauty Begum

My respected professors and lectures

Dr. A. B. M. Kamal Pasha, PhD

Md. Azharul Haque Chowdhury

Dr. Mahfuza Parveen

Md. Sadril Islam Khan

S. M. Mahmudur Rahman

And

in remembrance of my dear superiors, juniors, coordination officers, and staffs from the ***Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU)*** *with whom I spent every moment of my undergraduate life in last four years (31st September 2018 to 31 August 2022).*

ACKNOWLEDGEMENT

To begin, I would like to offer my heartfelt gratitude to Almighty Allah for his wonderful grace, which has enabled me to successfully complete this study assignment.

I want to express my gratitude to my supervisor Dr. A.B.M. Kamal Pasha, Ph.D., Associate professor and Head Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU), for his instruction, guidance, and motivation.

I am extremely grateful to Mr. Md. Azharul Haque Chowdhury Lecturer (Senior Scale) Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU) for his instruction, direction, motivation, and he helped me in a variety of ways in my B.Sc. academic career. His guidance inspired me a lot things to do.

I am grateful to Dr. Mahfuza Parveen, Assistant Professor, Mr. S. M. Mahmudur Rahman, Lecturer, Md. Sadril Islam Khan Lecturer (Senior Scale) Department of Environmental Science and Disaster Management (ESDM), Daffodil International University (DIU) for their support, effort, and direction. This Thesis would not have been possible without their immense confidence, support, assistance, ideas, and insightful teaching.

ABSTRACT

Bangladesh is one of the polluted country all over the world as a small country the air pollution is rising day by day. Particulate matter, nitrogen dioxide, sulfur dioxide, and carbon monoxide are now polluting the environment from many causes. To reduce that kind of air pollution solution must be needed. This article from the precept, shape, colour, cloth, shrewd, modular design studies course of wise air cleaner. The air purifier powers the PM2.5 and PM10 series modules, which collect data on air quality. Following an examination of the air situation, it is miles split into three classes advanced, exact, and terrible, the facts of which will be communicated to the air purifier's show display screen. This paper's air purifier machine will make people's lives more synthetic and smart. The trial results reveal that the air cleanser's powerful purification rate is 99.257%. In this air purifier machine waters and special layering chamber has been used for particulate matter reduction. In this paper the air quality of Dhanmondi and it’s surroundings has been measured. The data and particulate matter sample has done in range distance of 300 to 500 meters randomly. This project is mainly focused on to balance fresh indoor air quality and save the houses from outside pollution of particulate matter. The device has the benefit of high degree of intelligence to comprehend the far off manage of dirt attention to recognize clearance of air and indoor rooms and gain high efficiency and energy saving of cleansing and purification.

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SYMBOLS AND ABBREVIATIONS LIST

Unit or Symbol	Name of the Symbol or Unit
µg/m3	Micrograms (one-millionth of a gram) per cubic meter of air
'	Second
°	Minute
>	Greater Than
~	Typographical Mark that Resembles a Squiggly Line
°C	Degree Celsius
V	Volt
dB	Decibels
AQI	Air Quality Index
PM	Particulate Matter
CM	Centimeter
MM	Millimeter
DC	Direct Current
RPM	Revolutions Per Minute
CFM	Cubic Feet Per Minute
L×W×H	Length×Width×Height
VOCs	Volatile Organic Compounds

CHAPTER 1: INTRODUCTION

This introduction chapter provides background information about the study endeavor. These comprise a brief description of the context, a summary of the problem, and the study's objectives. This section also shows and briefly describes the format of this research project report. This chapter is separated into five (5) sections. These are the –

1. Introduction

An air purifier machine that is able to reduce particulate matter from the air result as we are getting fresh air in the indoor environment. It will be placed outside of a building and work as an air ventilation system. Probably the air purifier machine works well on its behalf. The particulate matter is removed 99.1% by this air purifier machine which is examined in a lab by artificial pollution chambers and the result is checked by an Air Quality Intelligence (AQI) device. The suction air is processed in different sections and different kind of layers (Ren et al., 2017). The design and development of air purifier will need for those reasons the bad health affects related to ambient great particulate count, air pollutants, mainly that resulting from quality particles, has become a serious environmental problem in urban locations all over the world. The word used is particulate matter (PM). That describes an assemblage of liquid droplets and stable debris suspended in the ecosystem. Those microorganisms may also come from special locations, like power vegetation, industrial activities, transportation, brick kilns, burning biomass, sea spray, wind-blown dirt and they are created in the environment through gaseous emissions transformation (Begum et al., 1970). As a vital form of number one pollutants supply, biomass bumings contribute tons aerosol unique subjects into the ecosystem, for that reason play extensive roles in local air pollutants, and have a significant impact on the environment and human health (Charlson el al., 1992; Crutzen and Andreae, 1990; Levine, 1996). Furthermore, contaminants generated by biomass bumming can spread large distances and have a worldwide impact, even inside polar zones (Dibb et al., 1996; change et ul., 1996). Excellent particulate subjects PM2.5 from cereal straws subjected to controlled burnings, both smoldering and flame, were collected in the laboratory utilizing

a custom-made dilution chamber and sampling gear. Carbon elements (EC) and organic carbon (OC) were studied. 141 organic components were analyzed using gasoline chromatography-mass spectrum (GC-MS). Particulate natural topic supply profiles released from cereal straw burnings has been obtained. The findings revealed that organic matter accounts for a significant portion of high-quality particulate matter. As a result, an air quality equipment may be utilized to reduce particulate matter (ZHANG et al., 2007).

1.2 Problem Statement

Many new conclusions were formed based on the findings of this analysis, including the following: Exposure to PM 2.5 m in diameter (PM2.5) for several hours to weeks causes vascular disease and nonlethal occurrences. Longer-term exposure (for example, as many years) increases the risk of vessel mortality to a greater extent than short-term exposures and reduces expectancy in additional extremely exposed segments of the population by many months to many years, reductions in PM levels are associated with decreases in vessel mortality in as little as many years, and numerous credible pathological mechanisms are elucidated that lend biological credibility to those findings. This revised scientific statement is designed to provide a clinical viewpoint on the vascular concerns provided by PM exposure, as well as a brief overview of pollutant constituents. The sections that follow summarize the most important findings from medical specialty research, including mortality, morbidity, and surrogate outcome data. Following that, animal and human mechanistic studies are reviewed, and an overarching framework in which PM exposure may induce CVDs is written, despite the fact that PM2.5 mass has gotten a lot of attention as a target for regulation and medical specialty research, over 98 percent of the air waste product mass in metropolitan environments comes from gases or vapor-phase chemicals such CO, nonmethane hydrocarbons or volatile organic carbons (VOCs), NO2, NO, O3, and SO2. Each of them will have independent and likely synergistic or antagonistic effects with one another and with PM, but the vascular health impact of exposure to combinations of air pollutants isn't fully understood at the moment. Several components of pollutants play a role in both individual and population level exposures. Pollutant concentrations change over several time periods, while emission rates, climate variability, as well as both during in temperature and radiation having the most influence. Overall spatiotemporal

conduct of such a waste material is also governed by its rate of creation and the amount of time it remains in the atmosphere (Brook et al., 2010).

There is much medical evidence linking near particle pollution to negative health impacts in people (Schwartz et al., 2002). Nonetheless, fundamental volatility and disagreement persist regarding and which physical and chemical characteristics of particulate (as well as unrecognized counterintuitive environmental factors) might very well effect health hazards, how those pathophysiological mechanisms are at work, and what air quality laws should be implemented to mitigate health risks. Measuring the quantity of pollution in the air offers a level of exposure that may be used as a proxy for risk. Various research have linked such air quality data to negative health outcomes. It is furthermore used to advise risk-averse teams on how to minimize their risk. As a result, the closer the measurement is to the causing toxic part of the exposed, the greater the likelihood of management and thus the correlation to adverse health impacts in biomedical research are plausible to be measurement representations together including statistical information of methodology is considered enable assessment of dose and rate (Schlesinger and Cassee, 2003), These, however, require particle sizes and chemical phylogenesis data. In past decades, the amount of materials determined by the PM10 or PM2.5 standards has been the meter of choice for near particles, indicating relationships with a wide range of health outcomes, including morbidity and mortality among patients with vascular and/or metastatic illnesses (Brunekreef and Holgate, 2002; Pope and Dockery, 1999). It may be claimed, however, that while both PM10 and PM2.5 concentration aren't perfect, they do serve as a substitute for the BED. This reasoning is based on the fact that a large portion of the near particle mass is composed of low toxicity components such as nitrogen hydrogen sulphide and nitrate, marine salt (e.g. sodium), crustal dirt, and soil (Harrison et al., 2003). These contribute significantly to the masses metric but, save in few cases, not much to the BED. In contrast, a little amount of metallic elements and organic molecules might make a large contribution to the BED (Donaldson et al., 2005; Xia et al., 2006b).

1.3 Justification of Particulate Matter

The traditional toxicological paradigm of exposure and reaction justifies the appropriate size of publicity to underlie real epidemiological research targeted at ambient publicity to a negative impact. The better the response function, the closer the exposure metric processes the dosage. Toxicologists detect the genuine hazardous entity inside the dosage since the physiologically potent doses bed is the input parameters for the negative outcomes. Measuring exposure, on the other hand, is extremely difficult, and the link between such a mass measurement (the modern-day tool for evaluating the environmental exposure) and the bed has not always been evident. Over the last decade, the quantity of particulate matter assessed as PM10 or PM2.5 has been effective in establishing relationships among ambient particle levels as well as a wide range of fitness outcomes, such as morbidity and mortality in patients suffering from cardiovascular or respiratory illnesses. According to each toxicology and epidemiological research, the PM10 mass is really not optimum but serves as a substitute for the bed. This is self-evident given that a significant portion of the PM10 mass contains low-toxicity elements including such ammonium sulfates as well as nitrates, salt (sodium chloride), earth's crust dirt, or rather road dirt. With both the aid of analysis, tiny masses of metallic elements but instead organic vertebrates may redox cycle and contribute significantly to the bed. So, even if our future and current particulate matter criteria are based on bulk, we know that it's much simplest a rough indication of the bed, since the most of the mass is undoubtedly biologically inactive. According to research, particle-wide variation, which isn't always connected to volume, can be a better predictor of certain health outcomes. This is defined by the fact that hydrocarbon nanoparticles, the largest particle type in city air, are an important component of the particulates remember mix because they include a significant floor area, transition metals, and organics (Borm et al., 2007). Outside air pollutants area unit a fancy combo including several recognized carcinogens that has been linked to an increased risk of respiratory organ cancer in different studies over the last 50 years. Previous criticisms of the research investigates doors and unit pollutants clearly indicates that each was associated with an increased risk of respiratory organ cancer; specifically, exposure to higher levels of particles, as well as other indices of air pollutants, are associated with an increased risk of respiratory organ cancer. However, the evidence was deemed inconclusive about the

exact elements of the airborne pollutants combination square measure causing the increased hazard (Samet and Cohen 2006). The International Agency for Research on Cancer (IARC) recently concluded that exposure to outdoors pollution and particle matter (PM) in outdoor air is human carcinogenic (IARC organization) and promotes carcinogenesis (IARC, in press; Loomis et al. 2013). Long-term residence expansion to doors air medical speciality analysis. The current meta-analysis included studies that produced quantitative estimates of household consumption to PM2.5 and/or PM10. Further research was required to provide quantitative measure of the change in cancer incidence or death caused by exposure to either PM indicator. It could be revealed because the alteration in threat per unit mass per meter or per percentile of exposure. Studies that presented data for the connection of cancer with various air pollutants or traffic exposure but did not provide quantitative values for PM were excluded from the meta-analysis. We considered cancer mortality and incident studies together since death may be a reliable predictor of incidence. From 2003 to 2009, survival figures reported by the law enforcement, medical specialization, and end Results (SEER) program predict overall 5-year survival statistics amongst U.S. white males and females at 14.5% and 19.5%, respectively (Howlader et al. 2013). All research values were modified to reflect the change in cancer risk per 10-g/m3 unit increase in PM2.5 or PM10 exposure. If we couldn't correctly translate the numbers from a given study to the aforementioned units, we contacted the researchers of the initial study for more information. If the information needed to generate estimates could not be provided, the study was ruled out. The findings of those studies, as well as the IARC working group's recommendation that outdoor pollution be classified as a single carcinogen, support efforts to reduce exposure to air pollutants that can come from a variety of sources. The global disease burden is calculable, with about three 22 million fatalities due by pollution exposure in 2010, up from 2 different. 91 million deaths attributable to air pollution in 1990. (Lim et al. 2012). We performed meta-analyses of papers that looked at the relationship between both PM2.5 and PM10 exposure and cancer incidence and death. Eighteen studies passed our eligibility requirements and supplied the data needed to estimate the change overall carcinoma risk per 10-g/m3 increase in PM exposure. We employed random-effects analyses to allow among both variations to contributing to meta-estimates. Types of cancer of the tracheal, bronchus and breathing organ accounted for

roughly seven percent of overall PM2.5-related mortality in 2010. The findings of this meta-analysis may be useful in better estimating the impact of carcinoma related with pollution (Hamra et al., 2014).

Types of cancer of the tracheal, bronchus and breathing organ accounted for roughly seven percent of overall PM2.5-related mortality in 2010. The findings of this meta-analysis may be useful in better estimating the impact of carcinoma related with pollution (Higgins et al. 2003).

1.4 The Effects of Health through Particulate Pollution

Efforts to understand and control the impacts of pollution upon human health and wellbeing have a long and interesting history. By the 1970s and 1980s, the relationship among internal organ health problems and extremely high concentrations of particles (PM) pollution was well established, with the first half attributable to previously well-documented substantial rise in morbidity and death from severe pollution. However, there was dispute on what amounts of PM exposure and what kinds of PM were harmful to human health. Several distinguished experts concluded that there was insufficient evidence of significant health impacts from low-to-moderate particle pollution. Others disagreed, claiming that particle pollution may have a negative impact on people's health even at low quantities. The period of the mid-1990s was an electrical amount in the history of particle pollution and health assessments. Several loosely linked pharmaceutical study initiatives from the United States have reported obvious health impacts despite extremely trace amounts of shut PM over a relatively short period of time. According to a 1997 article in the journal Science headlined "Showdown over Clean Air Science,"81 "business and environmental researchers are squarely facing up over studies connecting pollution and disease in what some consider to be the greatest environmental conflict of the recent decade." Throughout this point amount, 81 various conversations of these controversies were also disclosed. Many of the disagreements stemmed from the general populace policy implications of discovering meaningful adverse health impacts at smaller particle concentrations. Daily fatality counts were shown to be connected to PM 10, PM 2.5, and salt particles, with PM2.5 having the highest connections. Many subsequent assessments

of such knowledge are carried out. The primary research was conducted in seven key Korean cities. 166 Because PM10 and PM2.5 measurements were unavailable, PM was quantified primarily as TSP. Despite the fact that SO2 was shown to be a better proxy for PM2.5 in Korea's near air than TSP, death rates connections with TSP, like SO2, were established. The second evaluated knowledge from of the thirteen major Japanese towns 167 with fatality knowledge for the elderly (aged 65 years) and interrupted PM (special purpose observation, about PM7, for example, PM with a 500th cutoff diameter of seven m). We utilized GAM and extended linear models). It is improbable that comparably little increases in particle pollution exposure over brief periods of one or a few days may be blamed for a horribly large increase in mortality. In fact, many studies of fatality and brief daily fluctuations in PM square assess observant modest effects, such as assuming that a ten g/m3 rise in PM2.5 results in an increase in death. Based on the US average mortality rate in 2000 (8.54 deaths/1000 annually), a 50 g/m3 rise in PM2.5 would result in an average of just one. 2 fatalities per day in an abnormally large demographic of the one million (compared to a predicted rate of two3.5/day). That is, in a large population, the number of people dying from PM exposure on any particular day is negligible. It's remarkable that these research of mortality and brief changes in PM control measures can detect such minute impacts. Uncertainties in predicting such minute impacts legally raise questions about the legitimacy or correctness of those estimations. Nonetheless, relationships between daily variations in PM concentrations with daily fatality counts have been observed in many different locations and, more importantly, in large multicity studies, which have a lot less risk of selection or publication bias (Pope et al.,2006; Dockery et ul., 2006).

1.5 The Objectives of this Research are:

This research focuses on three distinct goals. These 3 main facts will be examined in this section. We attempted:

✓ To making design and development of air purifier machine.

✓ To reduce indoor particulate matter in the air through that air purifier machine.

✓ To measure the amount of particulate matter are present in some specific building.

1.6 Structure of the Study Report

This research study report is organized into five (06) chapters. The chapters are as follows:

Introduction to Chapter 1 This introduction chapter provides background information about the study endeavor. These contain a brief overview of the project's origins, health impacts, issue statement, and aims. The format of this research study report is also demonstrated and briefly explained in this chapter. This chapter is broken into five sections (05).

Chapter 02: Review of Literature This chapter goes into detail regarding particulate matter mechanics and eliminating particulates from indoor air. This chapter examines the processing of particulate matter using an air purification machine, the reasons and variables that contribute to air pollution in the interior or outdoor environment, and some relevant research done by various experts.

Methodology (Chapter 3) This chapter primarily includes a full overview of the research region as well as a discussion of the numerous systematic procedures employed to carry out this investigation. This chapter is broken into five sections.

Chapter 04: Result In a new format, this chapter summarizes the findings and conclusions of our investigation. We assumed three main objectives at the start of our study endeavor and worked on them. We attempted to gain a well-organized grasp of the objectives in this chapter by examining the obtained data and conclusions in various ways. As a result, this chapter of results and discussion is separated into four (04) distinct sections.

Chapter 05: Recommendation and Conclusion I attempted to gather all research points from the review of the literature, data collecting, data analysis, results, and comments in this last chapter of the study. We also attempted to justify the study's aims here. Recommendations are also made for the researchers to help them comprehend the next study. This chapter is broken into two (2) sections.

CHAPTER 2: LITERATURE REVIEW

Review of Literature: This chapter goes into detail regarding particulate matter mechanics and eliminating particulates from indoor air. This chapter examines the processing of particulate matter using an air purification machine, the reasons and variables that contribute to air pollution in the interior or outdoor environment, and some relevant research done by various experts.

2.1 Air Purifier System

Pollutants within homes include smoking, gas combustion, the use of solvents, house cleaning chemicals, emissions from construction materials, and contamination from the outside. In this document, we have a propensity to executed a study to figure out the most efficient air setup instrumentation for an urban residence. The analytic hierarchy methodology (AHP) technique was used to make the decision. During this investigation, three choices for the examination of the air configuration equipment were planned: Bap1700, Bap600, and Bap706, which were stratified according to the factors: purpose, characteristics and model. A panel of four professionals was chosen for this study to carry out the choice using AHP. Throughout this study, we discovered that the most efficient air setup instrument was the A1 alternate solution Air setup Bap1700. The following were considered among the available choices to assess associate air setup instrumentation: The Bap1700 is capable of removing up to ninety nine of something like the particulate of mud and spore, with a size of up to a pair of microns, a certain area unit present within the air; the Bap600 is capable of removing agents contaminants like the spore, mascot dandruff, dust but also spores of either the rust; and the Bap706 is capable of removing pollutants like microbes, dust, and smoke. The AHP strategy may be a sensible related useful option to select the important single factor setup instrumentation from a cluster of choices. The criteria created for selecting the important single factor setup equipment seem to be: scope, characteristic or model (Delgado & Flor, 2017).

2.2 Smart Air Purifier Design

People's needs for the quality of life are getting more and more extreme as society as a whole gets wealthier. This text is part of the smart air cleaner precept, form, color, and material studies courses. The design of the intelligent air cleaner equipment calls for a huge range of customer records. Through the analysis of user requirements, it will be possible to refine the cleanser's features so that the user's needs are in line with the features of the purifier; help define the target user institution; identify the consumer method; and provide the idea for the UI design within the purifier improvement process. The assessment of the relationship between people and traditional product design in the integration (Zhou, 2017).

2.3 Air Purification in Commercial Hydraulic Drives

The effects of pollutants on the dependability of hydraulic systems are caused by a complex, divergent mechanism that also has a lot of feedback. Inferring from the examination of the state mechanism, the following are the crucial fluid contamination parameters that may be observed:

(i) The overall number of particles (contamination level)

ii) Size-based distribution of the particles (gravimetric curve)

iii) The infection's physical makeup (steel, abrasive, c, loth, etc)

The conventional function is applied when the filtering score is clearly lower than the lowest clearance. In other words, manufacturers define the contamination level or filtration score based on the notional dependability on hydraulic equipment in line with both the nominal running strain. The relationship between the infection level and the filtration grade, on the other hand, isn't unique because fluid conditions are also dependent upon that capabilities of the pressure's design and various exploitation aspects (Brodski, 2000).

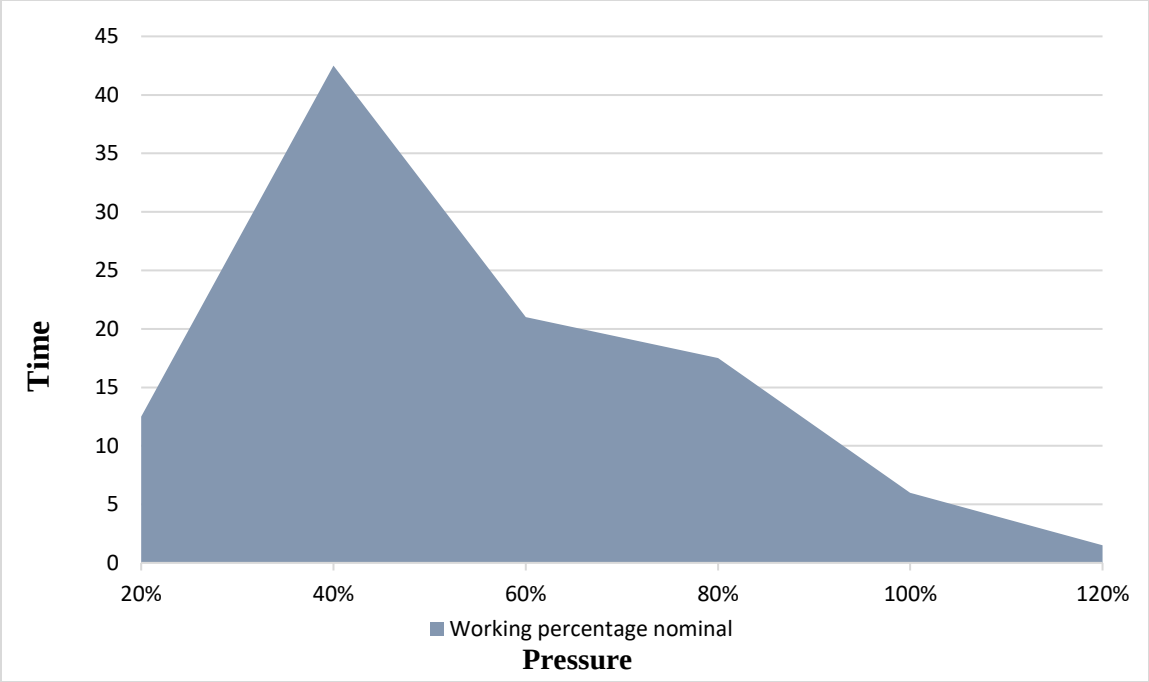


Figure 1: A typical hydraulic drive loading histogram for a mobile machine (a) (Brodski, 2000)**.**

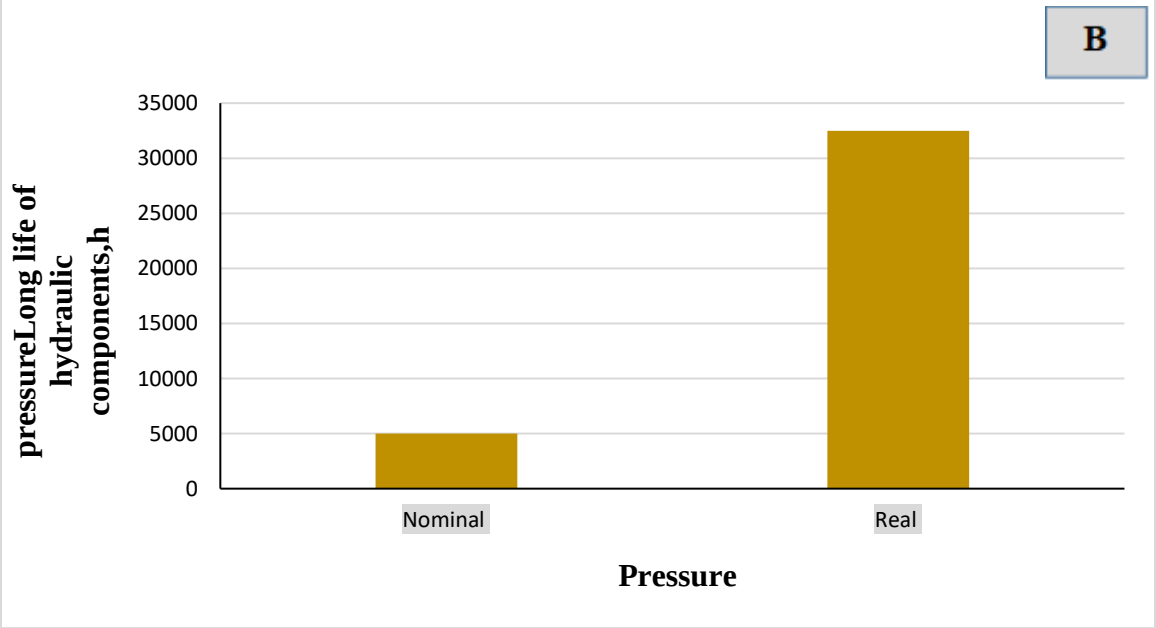


Figure 1.2: The main components' predicted long life corresponds (b) (Brodski, 2000)**.**

The increase in exploiting durability based on successive filtration effects is a major path for filter enhancement. But even though the route is not new, it has grown significantly in

the previous decade, based on the integration of purifiers of different physical natures (for example, a filter or a hydrodynamic gravity mechanism or filter) in a single constructive unit (Brodski, 2000).

2.4 Aerosol Exposure Reduction in Restricted Indoor Spies

This article examines five well-known air purifiers (three reusable and three static) that generate multipolar air ions that have been tested for their capacity to minimize aerosol exposure in confined interior environments. During 15 minutes of continuously operation within the chamber during calm air conditions, the elimination effectiveness of the more potent two wearable ionic filters reached roughly 50% and practically 100% throughout 5 hours of daily operations. Ionic hepa filters are now becoming increasingly popular in a variety of settings for eliminating dust, aeroallergens, and air microbes from indoor air. While various studies have studied the effect on unipolar and bipolar ions release upon indoor air cleansing, there are still controversial assertions (both positively and negatively) concerning the overall efficacy of commonly produced ionic air purifiers. In many of the five investigated ionic air purifiers, portable including three static unipolar air purifiers, devices with a larger ion emission charge offered superior particle removal effectiveness. The particle size and characteristics (NaCl, PSL, Pseudomfluorescentscens microbes), and even the frame temperature and breathing rate, had no effect on the ionization forced particle removal. Although dmigratesigrate to and accumulate on interior surfaces during the operation of an ionic air purifier, there might be some cases of significant contaminants, necessitating frequent cleaning of all these surfaces (Grinshpun et al., 2005).

2.5 Actual Purification Features

Humans spend eighty percentage of their time within indoor areas on average. Indoor air pollution have been linked to significant negative health outcomes. Indoor air purifiers are widely used to reduce pollution. Ionization air purifiers had already grown in popularity due to their low power consumption and noise levels, but their health effects remain unknown. This uncontrolled, double-blind crossover study is being carried out in Beijing to investigate overall cardiorespiratory impacts of ionization air filtration on forty-four

children. For five weekdays, real or sham cleansing was carried out in schools. (Almeida-Silva et al., 2014; Klepeis et al., 2001; Z hao et al., 2018). Particulate matter (PM), black charcoal (BC), oxygen (O3), and bad air quality ions (NAI) were assessed, as well as cardiorespiratory characteristics. To identify links around exposures and health markers, blended-impact approaches were utilized. Actual purification reduced significantly PM and BC, for example, PM0.5, PM2.five, PM10, and BC were reduced by 48%, 34%, and 50%, accordingly. The O3 phases remained constant, but NAI increased form 12 cm-3 until 12,997 cm-3. Actual purification resulted in a 4% increase in compelled exhaled volume in one second (FEV1) and a 14.7% reduction in partial ejected nitrogen oxide (FENO) (FeNO). However, variability in heart rate (HRV) is negatively affected. The interaction effects for NAI and PM were only seen on HRV, and alterations in HRV were higher with excessive NAI. Ionization air purifiers should provide significant respiratory advantages, although the capability's negative impacts on HRV require additional investigation (Dong et al., 2019).

2.6 Temporary Plastics Anterooms at the Surrogate Coronavirus Unfoldment

This research offers a novel temporary anteroom, as well as a transportable air purifier equipment, for converting a conventional patient room into such an isolation area. We examined the performance of the short plastic anteroom or the portable air purifier device using an aerosolization technique with a substitute oil-based total material. Furthermore, the first region of the transmitting device, as well as the influence of dreadful pressurization and door beginning at the confinement of surrogate aerosols, were evaluated. The results suggested that the transitory antechamber alone should limit the migration of about 98 % of the surrogate particulates into the neighboring hall. Furthermore, it was demonstrated that the most convenient position for a single moveable air filter unit is within the anechoic chamber, near the patient's mattress. The findings of this article can be widely applied by healthcare facilities center administrators while seeking to convert a well-known patient chamber into an airborne infections isolation room (Mousavi et al., 2020).

2.7 Prevention of Artemisia Fungal spores Rhinitis with Air Purification

They conducted a randomized, double-blind, scientifically supervised experiment with active and inactive air purifier versions. Our study comprised individuals with seasonal allergies who were sensitive to Artemisia particles and treatment of the indoor environment with air filters at night. We tested the therapeutic effectiveness of indoor air filters in Yulin, Shanxi Province, China, during the Artemisia pollen dispersing season. The difference in visual analogue rating scale from baseline was the most important end outcomes degree. Secondary outcomes were changes from base point in nasal signs or symptoms, hypersensitive sensitivity symptom rankings, Rhinoconjunctivitis Quality of Life Questionnaire replies, Epworth Sleepiness Scale scores, and tolerability rankings for the air cleanser. Based on the allergy symptoms rating, we discovered significant differences in rhinitis effects between the groups who utilized the active vs the inactive air cleaner (Li et al., 2020).

2.8 Indoor Environmental Purification and thus the Chinese People's Health Survey

Using data from the 2015 China Health and Nutrition Survey, this study examines the association between indoor pollutant removal and residents' self-rated health. Using the modified ordered logit model, we discover that indoor air filtration has a significantly positive influence on people' self-rated fitness. This beneficial effect is restricted to increasing the likelihood of residents' fitness levels being regarded as excellent, and there is no significant movement between the two degrees of awful and honest. The findings also show that, as a major source of indoor air pollution, solid fuels used in cooking considerably lowered people' self-rated health status. Additional findings demonstrate the variety of the relationship between indoor air filtration and resident health in businesses with varying features. The same categorization variations may be seen within the coefficient of strong fuels. According to the outcomes in column four, the correlation of the influence of solid gas consumption at the conscience fitness degree "precise" is massive at the 5% stage, however the coefficient on "fair" isn't huge. This finding indicates that using solid fuels has a detrimental impact on self-rated health, namely by lowering the

"correct" degree. Both sets of housing length coefficients were of excellent quality, implying that a longer housing length had a high quality influence on self-rated health. Furthermore, the correlation of the effect of home size on self-rated health level "good" is less than the coefficient on "fair," showing that an increase in housing size has a greater impact on residents' fitness degree improving to fair rather than correctly (Li et al., 2022).

2.9 The Effect of Cellular Filtration Systems on Aerosol Deposition in Classrooms

This issue mostly concerns institutions that do not have which was before ventilation systems with filters or that deal with gaseous air. Aerosol awareness is decreased here by using herbal ventilation. In this perspective, we evaluate the impact of cellular filtration systems (AP) using HEPA filters upon fine dust concentrations and their acceptability for usage in a primary school lecture hall in Germany. The three tested APs' air performance parameters differ greatly. The amount of debris, particle length distribution, and CO2 concentration were monitored in a classroom containing learners (April or May 2021) as well as using an aerosol generator without pupils. In this regard, the application of AP results in a considerable decrease in aerosol debris in the zero-particle length range studied. Extensive information on minimizing the threat of infection via virus-laden aerosols may be gathered from the ensuing effect diagrams. Finally, the observations were contrasted to Computer Simulation Mechanics (CFD) models, which aid in the ideal localization and design of hotspots and may be used to investigate the influence of aerosol propagation from a classroom stream. People in the room make pulmonary particles through breathing and speaking, and they inhale particles at the same time. The number of particles inhaled and exhaled no longer differs appreciably. As a result, patients in this disease cannot quantify airway particles and hence cannot be diagnosed. The particle intake from humans entering the magnificence, on the other hand, is measured. The rise in particle number distinguishes particle loading with (blue curve) and all without AP (pink curve); since at black curve, whereby AP is also turned on, the concave stagnates. This is because the students not enter the room in a similar way in the three situations described; in situation 1.3, the pupils had arrived in the session Fifteen minutes before the class started. The black and blue graphs depicting the AP scenarios demonstrate a decrease in debris variety here between

beginning of the course (15th minutes) and the first airflow window at the 35th minute. In conclusion, AP can be predicted to narrow the particle range. Without releasing dirt through the windshield airflow, a particle database in the single figures (dirt/cm3) may be kept. However, this informative value is restricted since distinguishing between inhaled dust and nanoparticles carried in with the bubbling air is not always achievable. The pure air reported during in the April/May observation period coincides with the height of the German growing season. Even if flying pollen is not expressly examined in this study, air purifiers may remove these bioaerosols from indoor air in the micrometres. This is also true for fungal spores, since the size range investigated in this work facilitates in the differentiation of these bioaerosols (Duill et al., 2021).

2.10 Effective Settings of Air Purifier

It is possible that particle production from the chambers cabin or within chamber is nil. The room is shut, and no one may be inside. To test, smoke is created in the compartment and then blended to be spread uniformly. The desired particle awareness is received as the preliminary awareness value. The self-circulation function of the air purifier is then initiated. The air purifier can be switched off once the appropriate time period has elapsed. Particle technology is used on the inside. A component of the outside air is managed and then blended with a big quantity of air supply within the structure to avoid the invasion of ambient dirt and to fulfill the occupant's hygienic standards. In this scenario, the bulk of the given air is return air. This is a frequent operational circumstance in rooms without the need for an air flow equipment. The air purifier is installed locally in order to remove local vortices or raise the nearby air dealer invoice, hence furthering the purifying impact at these nearby places. The total air circulation frequency of the room and systems may be lowered in various instances. In an essence, it is meant to augment the existing equipment. Indoor particle attention expressions are diverse for various structures, with distinct allocation techniques that might be difficult to recall. The author presented a coherent expression of the stepwise forward uniform distribution theory. The expression would become unified and exceedingly brief with the adoption of two innovative notions, "overall performance at the mainline of the outside air" as "overall quality on the mainline of return air."

If there is no particle generation inside and the initial consciousness is N0, this is the situation within the test chamber. The capacity of an air purifier to reduce indoor pollutant depends on the flow fee, which corresponds to the air exchange rate depending on the room amount, as well as the effectiveness of the components, which includes the air filter. Except for the position of the air cleaner, the size and allocation of supplied and return air holes will impact the air dispersion, allowing you to control the purifying performance. This will be mediated by the non-uniform value in cleanrooms (Xu, 2018).

2.2.1 Recent Air Purification in Belgium

A potential technology for reducing a range of air pollutants such as Night and VOC's, particularly in high-pollution areas such as heavily traveled subterranean streets, road tunnels, city environment, and so on. For best results, bring the photocatalyst, oxide, into the primary layer of something like the concrete pavement. Furthermore, the combination of TiO2 with concrete products provides some synergistic benefits, as the reaction product can be adsorbate on the surface and will eventually be washed away by rain. The Belgian roadway studies center (BRRC) researched a primary application on the aspect roadways of a significant entry axis in ports with the establishment of ten.000 m2 of photocatalytic paving blocks. However, for the time being, the perception of laboratory testing in the direction of outcomes in situ remains critical for establishing the efficacy in large-scale applications. Furthermore, the durability of the air cleaning function over time remains challenging for utility in brick roadways. In this light, many new trial systems have been launched in European countries in recent years to assess "real-life" behavior, such as an online field site founded within the Roland II tunnel of country's capital and the development of new photocatalytic sidewalks on business zones in the urban centers of Wijnegem as well as Serial liar (province of Antwerp). This work begins with a brief examination of the photocatalytic principle as applied to concrete, in order to maintain some significant findings from laboratory experiments while acknowledging the critical factors that come into play. Similarly, the range of ways and effects received for the prevalent implementation in port (2005) and at a specific point throughout the execution of the many simulations in Wijnegem but also Lier (2010-2012) and in country's capital (2011-2013) is awarded. To determine the efficacy of photocatalytic materials in the aspect

of air purification, distinct testing methodologies have been developed. A prime level read is provided while a separation is also created by way of the type of air flow; within the flow-through procedure in accordance of ISO 22197-1, the air with a level of 1 ppmV of NO passes once-most effectively over the structure that is lit by a UV-lamp with effort level equal to 10 W/m2 inside the range between 300 and 400 nm, as illustrated in. Following that, overall Nighttime (= add of NO as well as NO2) concentrations at the gap is measured, and the discount (in%) is determined. It's also worth noting that within Europe, efforts are being made to standardize and widen new standards for photocatalysis. Regardless, the examination method employed for the present outcomes is still entirely based on the existing ISO standard. The pre-treatment of samples within in the laboratory is also critical to achieving consistent results, and it is particularly dependent on the form of the raw product (such as concrete and paints) (Boonen & Beeldens, 2014).

2.2.2 Residential Buildings' Indoor Air Quality During Bushfire Smoke Activities

Residential structures are important places to seek refuge from wildfire smoke, but the air quality within those buildings will become severely polluted as a result of smoke penetration. As a result, certain residential structures may provide forced protection from poor air quality, particularly during protracted smoking activities. This article assesses the influence of wildfire smoke on interior air quality in residential houses and suggests methods and guidelines for lowering indoor levels of particulate and other pollutants. The study investigates the many pursuing tactics used to live pollution and evaluates the influence of the building envelope, filtration technologies, and conveyable air cleaners used to improve indoor air pleasant. According to the study, wildfire smoke would significantly raise the levels of toxins in residential structures. Interestingly, a number of studies have revealed indoor levels of PM2.5 of around 500g/m3 during wildfire smoke events. Several Australian homes are extremely leaky (i.e., >15 ACH) as compared to those in nations like the US. Methods like raising the building can aid prevent smoke infiltration, but even in tight homes waste levels can later rise with time. As a result, an appropriate design, implementation, and operation of household ventilation systems that include particle filtration is also required to reduce interior exposures during protracted smoke events.

Future research on wildfire smoke penetration in dwellings may identify filtering equipment that might eradicate gaseous pollution. Future research areas include evaluations of air filtration systems aimed at eliminating gaseous pollution within houses, as well as the operation and validation of low-cost sensors for pursuing elevated levels of PM2.5 and other pollution. Furthermore, there are forced analyses in which lay people join in pursuit and use various intervention approaches in their homes. The usage of low-cost sensors by homeowners and participants of subject technology ability programs can help to offer real-time information to tenants (Rajagopalan & Goodman, 2021).

2.2.3 Portable Air Cleaners Control Construction design Debris and Radon Future offspring

After injecting smoke and radon into a space chamber, decaying rates for debris but also radon progeny percentages were assessed with and without the use of an air cleaner. Particle concentrations were obtained by particle length for general numerical awareness and quantity attention. The herbal degradation rate for tobacco smoking was estimated to just be 0.2 hr-1 in tests without the use of an air cleaner. Air cleaning costs for debris were determined to be insignificant for a number of tiny panel filters, a home ionizer, and a few of mixing fans. The particle elimination charges of the precipitators and extended floor filters tested were high, and a HEPA type filter out performed the best green air cleaner. The examination of radon progeny management revealed equivalent conclusions; air cleaners that were successful in removing debris were also effective in removing radon progeny. Plateout of unconnected radon progeny is an important removal method at low particle concentrations. The plateout price for detached progeny was determined to be 15 hr-1 based on on information from such analyses. As a particle awareness feature, the unattached proportion and general elimination charge owing to accumulation of connected and unattached nucleons have been anticipated for each radon decay product. Even while air cleaning is effective in reducing overall radon progeny, amounts of unattached radioactive particles can increase with greater air cleaning. Particulate air cleaner operation concepts Particulate air cleaners are classified into two types based on their operation: mechanical filtration and electrostatic filters. Mechanical filters remove trash from air by applying mechanical forces to the particles with the help of the airflow and filtering out

media. Electrostatic filters, on the other hand, depend mostly on electrostatic interaction to remove particles from the air mechanically filtering. The removal of particles from air by mechanical filtration is typically accomplished by passing the air through a fibrous medium. In a clear out, particulates can be deposited upon this fibers through one of five primary methods (Nazaroff, 1966).

2.2.4 The Contribution of Particulate Matter by Traffic Discharge

One of the primary sources of particle count in the environment is highway traffic. Despite its relevance, quantifying its contribution to respiratory concentrations poses significant hurdles. This paper initially examines the characteristics of particle emissions from street engines, such as emissions or non-exhaust (abrasion and re-suspension assets). It then summarizes the many methodologies available for quantifying the contribution of street visitors. This involves tunnel or highway measurements, dual website internet research, the use of vehicle-specific tracers, and a variety of other procedures. Finally, the usefulness of receptor modeling approaches is summarized. Based on the study, it is possible to conclude that, while traffic emissions continue to contribute significantly to position one Emission levels in urban areas, numerical knowledge of the role, especially of non-exhaust pollutants to PM concentrations, remains inadequate. PM emissions from street autos comprise tailpipe exhaust emissions, emissions from automotive components like as brake, tyre, and snatch, and re-suspension of dust non-exhaust emissions. Non-exhaust emissions contribute significantly to the rough mode of PM 2.5-10 (Pant & Harrison, 2013).

2.2.5 Ultrafine Debris from Indoor Air Environments by Way of Ionizers

The ELPI was used to evaluate the evolution of indoor particle attention as well as particle length distribution in real time in a space (24.3 m3) test chamber with the ion emitter turned on. The air cleansing aspect was evaluated when the findings were compared to natural degradation. The particle aerodynamics size range of zero.04-2 m was chosen because it represents several bioaerosol retailers that cause increasing illnesses, as well as those may be employed in biological warfare or in the event of bioterrorism (Choe et al., 2000; Grinshpun et al., 2002). The ion emission quickly influenced the particle electrical fee

dispersion (also evaluated from inside test chamber with both the ELPI). It was found that partial discharge ion transmitters (either positive or negative), capable of developing an ion density of one 0 five-106 e cm3, may be effective in regulating micro and ultrafine particle pollutants in indoor air conditions, such as a typical working or residential room. At a high ion discharge charge, particle mobility increases to the point that particle migration results in particle deposition on separators and other indoor structures. The debris was charged largely by the diffusion charging process within the tested particle size and ionic density ranges. The particle length had no effect on particle removal effectiveness, however it did increase with increasing ion emissions rate and time of emission. The performance features of three available commercially ionic air purifiers that generate unipolar ions by corona discharge at extremely high emission rates were investigated. A 30-minute operation using the most powerful gadget tested led in the eradication of almost 97% of zero. In contrast to the natural decay effect, 1 m detritus and about 95% of 1 m particulates from the air are removed (Uk Lee et al., 2004).

2.2.6 Factors of Particulate Matter in the Air

To determine the contribution of potential pollution sources, integrative data for fine and coarse fractions samples taken between May 2001 and March 2005 are evaluated using Positive Matrix factorization (PMF). The outcomes were compared to past supply parceling findings. To investigate the directivity of native sources, contingent possibility operate (CPF) plots were created for each supplier victimization native wind information. Back physical phenomenon ensemble techniques were used to identify potential supply sites and transboundary transport channels of PM2.2 dished out sources. The Future supply Contribution function (PSCF) domain stretched around the receptor site in Bangladesh's capital (23.77°N, 90.38°E) throughout a range of one.5° to 42.5°N as well as 56.5° to 110.5°E. The PSCF results square measure up to the dependent probability operate (CPF) analysis, which employ three hour average native wind dimensional data to determine the likely directions of the sources. Each PSCF and CPF assist in locating prospective supply sites, albeit on vastly different distance scales. These results show that native sources dominate coarse particle square measure. However, both local and regional supplies contributed to the higher fine PM levels in Bangladesh's capital. Thus, regional

management measures are required in addition to local activities to improve air quality in megacities in this region, such as the capital of Bangladesh. Urban pollution but also its consequences are also becoming a major issue for emerging countries. To address pollution issues, it is critical to understand the available sources and its strengths so that steps may be done to successfully enhance air quality. Native sources are managed through indigenous initiatives, but regional and transboundary issues will necessitate intergovernmental participation. Particles will either chill the atmosphere by scattering subtropical light (sulfate and molecular carbon particles) or warm it via absorption of relatively short wave light (black carbon particles) (Ramanathan and ballad maker, 2008). Black charcoal (BC) will also have two effects. First, it acts as an immediate absorber of actinic rays, which cause direct warming in the surrounding air. Second, the accumulation of black charcoal on ice or snow, such as on mountain range glaciers (Kehrwald et al., 2008) is a component of what's inflicting them to apace soften. As a result, there are compelling motivations to understand the magnitude and origins of black carbon (Begum et al., 1970). In this work, we utilized the fundamental composition of diameter particles to identify several unique explanation fractions of small particulates and investigated the relationship of the those components with daily deaths in each of the 6 cities. Correlational examination of victimization-specific rotation For each municipality, we have a semi - conducting material issue categorized as soil and earth's crust material, a lead issue categorized as automotive emissions, an antioxidant issue categorized as burning coal, and up to two more components. We gathered daily death counts through National Center for Statistics data and calculated city-specific mortality connections with each supply issue using Poisson regression, correcting for temporal trends, weather, as well as other supply variables. The inverse variance mean score of the city-specific values was used to create the combined impact estimates. A ten microg/m increment in Air pollutants from vehicle engines accounted for a four. 4% raise in daily fatality [95% sampling error (CI), 1.7-5.2%], whereas an equal rise in particulate matter from combustion of coal sources resulted for a one. 1% rise [CI, 0.3-2.0%]. PM 2.5 earth's crust particles had little effect on daily mortality. These findings suggest that combustion particles in the mixture from mobility and charcoal combustion sources, but not fine earth's crust particles, are linked to increased mortality. Particle size is an important driver of the placement and efficacy of pulmonic

deposition, but it is also a proxy for particulate supply and composition. PM2.5-10 is mostly composed of crustal particles formed by agricultural, mining, construction, road activity, and other associated sources, as well as particulates of biological origin. PM2.5 is mostly composed of burning particles from automobiles as well as the combustion of coal, gasoline, and wood, but it also comprises crustal fragments from finely pulverized roadway dirt and soils. Despite a substantial amount of evidence accumulating on the harmful consequences of PM2.5 (1-11), the particular sources and ingredients responsible for these harmful effects have not been discovered. We exploited the fundamental constitution of size-fractionated particles in this work to identify numerous unique source-related fractions of tiny particles. We next investigated the connection of those percent with daily fatality in each of the six cities, combining the city-specific results in a meta-analysis to get overall risk levels for each fraction. Another technique is to assess the relationship between daily fatalities and particular portions. We built city-specific models that included number of hours of leads, iron, sulphur, metals, chromium, aluminium, and atomic radius 30 one at a time and combined to confirm earlier materia medica research revealing that components may well be required in near particle toxicity (23-26). Trend, period, and weather were all controlled for as shown (Laden et al., 2000).

2.2.7 Indoor Air Significance Observing

- We present a review article and assessment of the primary sources of significant waste material discharges, their health consequences, and issues linked with IAP-based illnesses, such as sick building sickness (SBS) and building-related ailment, in this paper (BRI).

- Furthermore, the methods and techniques for waste material concentration management and reduction are detected, and the latest developments in attempts to resolve and enhance IAQ with their varied advantages and potentials are highlighted.

- As a result, during the last decade, research on air internal operations has started to shift from outside to inside contexts, reflecting fashion changes related to increased levels of urbanization.

- Meanwhile, IAP refers to the presence of pollutants such as organic compounds (VOCs), air pollutants (PM), inorganic materials, physical chemicals, and genetic factors, all of which are present in high concentrations in the ambient air of non-industrial constructions and may have negative effects on the body.

- To protect people from such contaminants, IAQ has formed and has been established as a hunting ground.

- Most IAQ characteristics include waste material concentration, thermal characteristics (degree, airflow, moisture content), light, and noise.

- Because of the possibility of pollutants being transported from outside to inside, it is well acknowledged that outside material concentrations and structural airtightness have a significant impact on IAQ.

- Various indoor air contaminants are known to have negative effects on IAQ and public health. (Van Tran et al., 2020).

CHAPTER 3: METHODOLOGY

Methodology: This chapter primarily includes a full overview of the research region as well as a discussion of the numerous systematic procedures employed to carry out this investigation. This chapter is broken into five sections.

3.1 Mechanism of Air Purifier

At first we will make different kind of chambers then we measure the presence of air conditioning (Jeong et al., 2017). There will be two different kinds of chamber, one artificially chamber is used for particulate matter making. Another artificially made chamber that chamber will use for output result. The connection between those two we will made the air circulation system which directly interconnected to the air purifier machine. In the chamber-1 particulate matter pollution will made then we will pass those particulate matter through the air compression. Those compressed air will goes to the machine through an air circulation system then the air purifier machine the machine will process those air by removing the particulate matter after that those purified air will send to chamber-2 for the output result observation. Those processed air will trap in the chamber 2 for find out the result of air purification. After that, we will set my machine for the air circulation system so that the improvement result in that room can be counted or can be recorded the air quality of that place. Two different size artificial compartment has been made by box. The first one is used to make artificial pollution of particulate matter. Those particulate matter moves one to another chamber by the air compression. Probably 100 gram dust particles is used in the artificial pollution chamber. The size of the box dimension compartment 417×369×369 MM (Lenth×Width×Height) which was initial compartment. By that compartment polluted air is sent to the air purifier machine then the machine process the air then purified comes to the final compartment. There's particulate found 0.1528 gram. The dimensions of the finished compartment box were 40×40×60 CM. Finally, the air quality in that chamber is good, as evaluated by an Index of Air Quality equipment (Flank AQI); (Zhang et al., 2011).

3.2 Design of the Air Purifier Machine

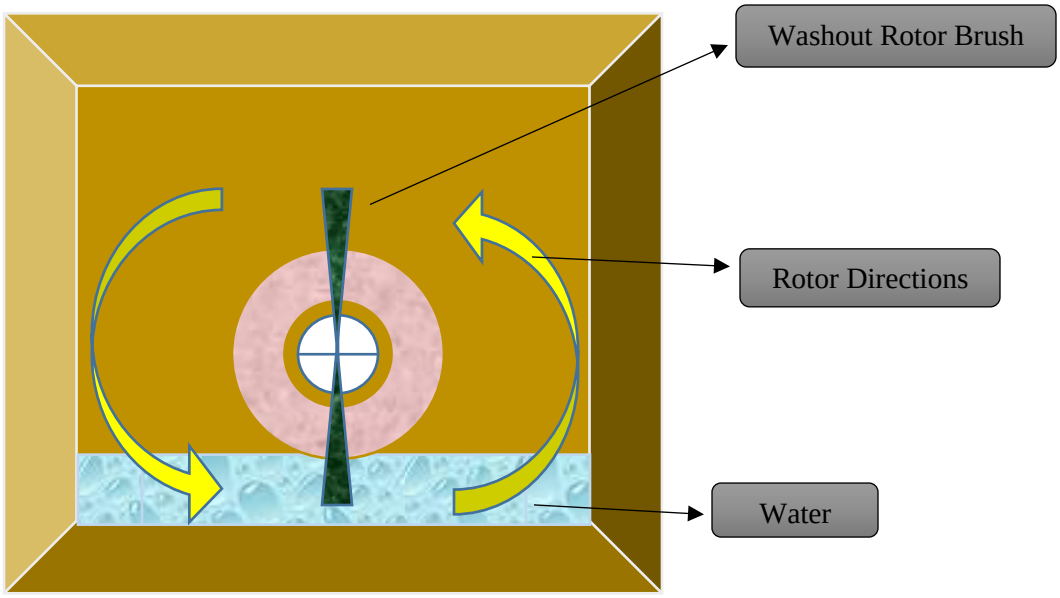


Figure 1: Chamber 1

It is the primary chamber of the air suction appearance of the water and air cyclizing system. When the enter in this section by the air compression system then the rotor brush hit the polluted air at maximum speed 6500 RPM after that washout through the presence water of that chamber 1. By that repeating process most the particulate matter reduce from the air. Particulate deposition occurs under the layer of water then those particulate matter and water washout through a hole from that chamber. The amount of water used in this chamber 300 ml and 12 volt DC motor placed (Singh et al., 2020).

3.2.1 Used Materials Chamber 1

- DC Motor 12 Volt 6500 RPM
- 300 ml water
- Rotor Brush
  - ✓ Length is 7 Inch
  - ✓ Width is 2.3 Inch
  - ✓ Height is 2.5 Centimeter

- Size of the Primary Air Inlet Chamber
  - ✓ Length is 1 Feet 1.5 Inch
  - ✓ Width is 6.5 Inch
  - ✓ Height is 8 Inch
- Primary Air Entrance Window
  - ✓ Length×Width×Height
  - ✓ 7×6.5×8 (Inches)

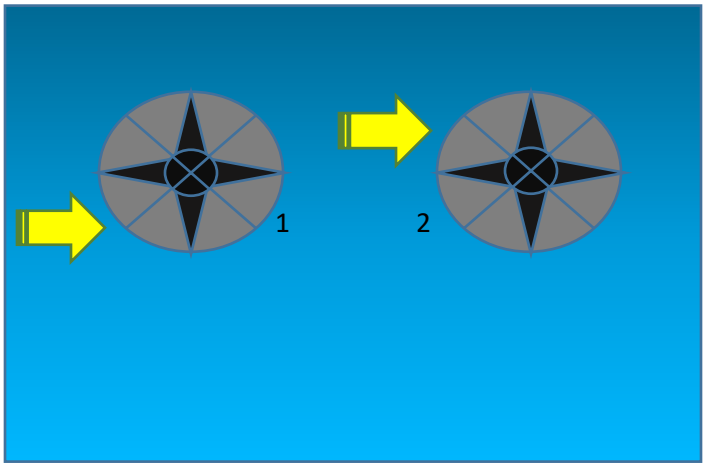


Figure 2: Compressed Air Ventilator

After water washed-out the air enter by compressed ventilators. There's two 12 volt DC fan has been used for boosting the power of the air. That increase the air flow towards the processing layers of the filter (Lu et al., 2021).

3.2.2 Used Materials

- 12 volt 0.16A 1.92W DC (Fan 1)
  - ✓ Item Dimensions: 4.72×0.98×4.72 Inches (Length×Width×Height)
  - ✓ RPM Speed: 1500 Maximum

- ✓ Air Flow Capacity: 52 Cubic Feet Per Minute
- ✓ Noise: 18 Decibels
- ✓ Weight: 122 Gram

- 12 volt 0.16A 1.92W DC (Fan 2)
  - ✓ Item Dimensions: 4.72×0.98×4.72 Inches (Length×Width×Height)
  - ✓ RPM Speed: 1500 Maximum
  - ✓ Air Flow Capacity: 52 Cubic Feet Per Minute
  - ✓ Noice: 18 Decibels
  - ✓ Weight: 122 Gram
- Size of Air Inlet Window: 4.6 Inches

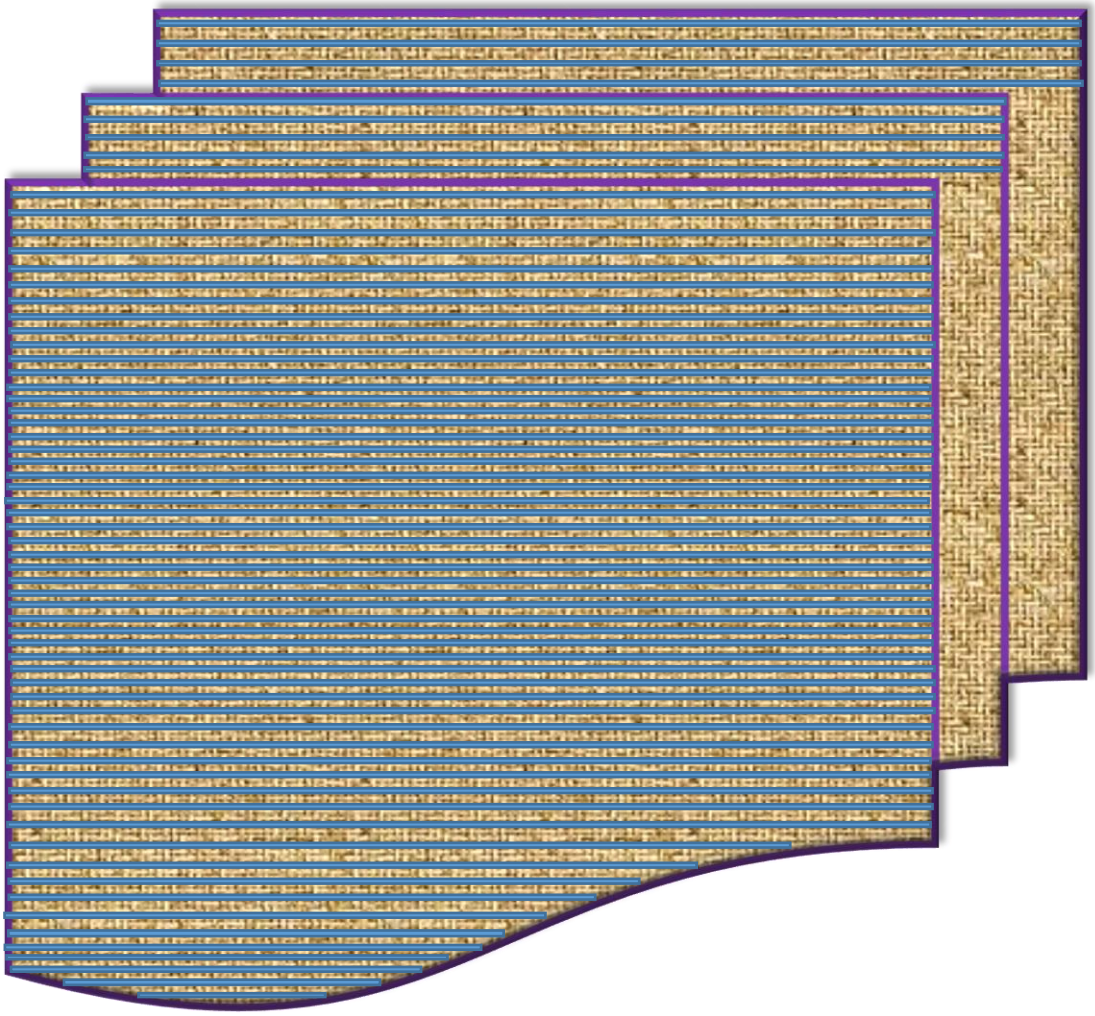


Figure 3: First Layer of Chamber 2

That 3 similar part coated layer. It is the first layer of the chamber 2 here's the speedy air flow passes the air thought very small holes then one by one those small hole cover 3 layer of that part result as the particulate matter reduced by the trapping system (Peck et al., 2016).

3.3.3 Materials Used

- Materials Type: Polypropylene
- Small Hole Size: 0.5 to 2 Micrometers
- Filter Size Dimension: 11 Inch×3.8cm×8 Inch
  - ✓ Length: 11 Inches
  - ✓ Width: 3.8 CM
  - ✓ Height: 8 Inches

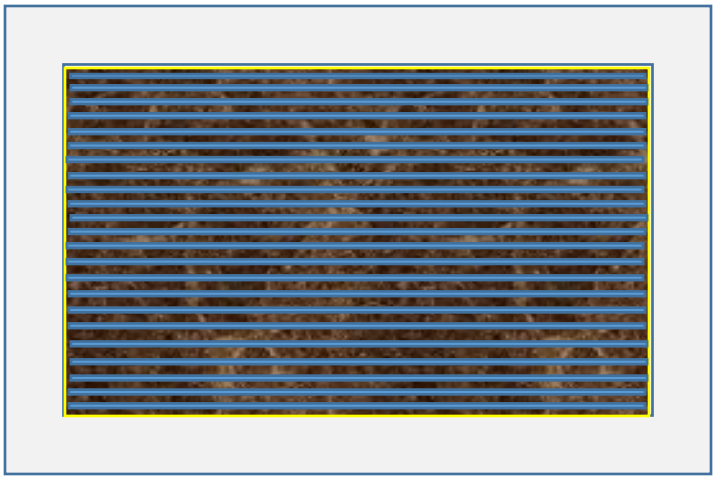


Figure 4: Second Layer of Chamber 2

That layer is used to remove bad odor from the air so, there's activated carbon and metal net are present. A good way to enhance coping with powdered activated carbon is impregnated right into a urethane foam substrate with suitable air permeability.

It effectively deodorizes diverse sorts of scent additives in air and VOCs (volatile natural compounds) together with formaldehyde, toluene, and xylene (Wang & Zhang, 2011).

3.3.4 Materials used

- Application: Gas Adsorption of Air Purifier Filter
- Type: Activated Carbon, Metal , Big Hole Fiber Cloth
- Filter Size Dimensions are: 10 ×1×8 (Inch)
  - ✓ Length is: 10 Inches
  - ✓ Width is: 1 Inch
  - ✓ Height is: 8 Inches

- Others Elements: Al, Mn, Zn, Fe, Li, Ca

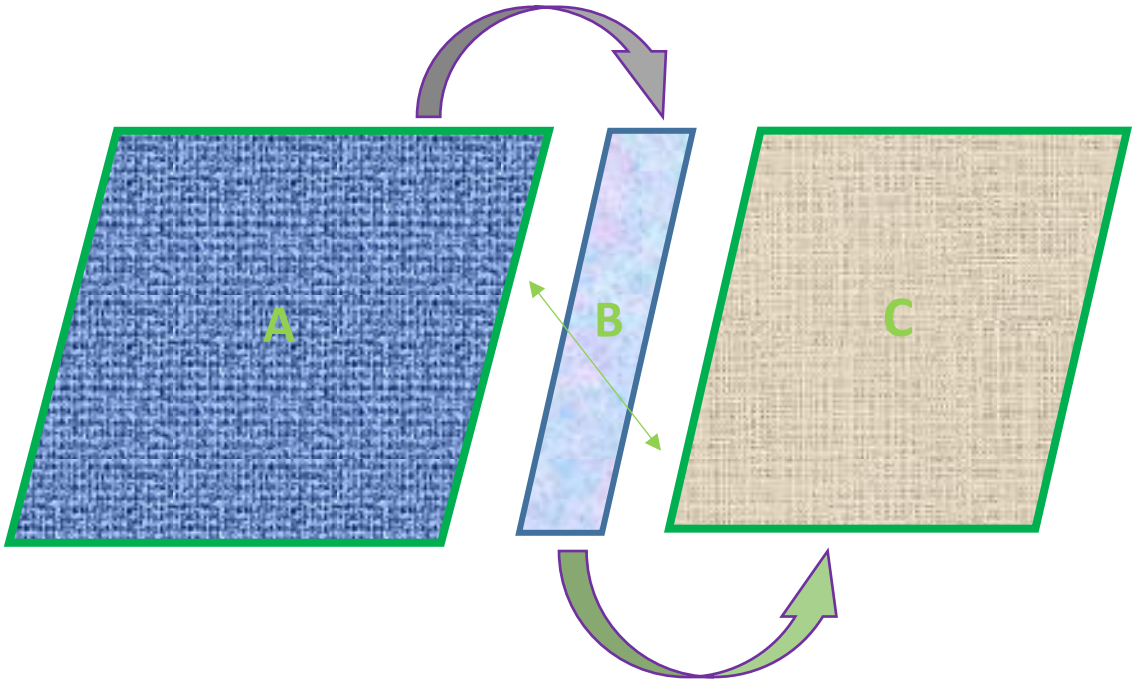


Figure 5: Final Layer of Chamber 2

That is the final coated air filter layer, most of the particulate matter are removed in that section. The air passes thought one by one layers in a slow process. From (A) air moves to

the (B) part then air goes to the part (C) which is outlet of the fresh air. Result as it is able to provide the particulate less fresh air (Hay et al., 2015).

3.3.5 Materials Used

- A type: Polypropylene Cloth
  - ✓ Filter Size Dimension : 11 ×0.2×8 Inches (Length×Width×Height)

- B type: Cotton filter
  - ✓ Filter Size Dimension : 8 ×0.5×6 Inches (Length×Width×Height)

- C type: Wetlaid Micro Cloth
  - ✓ Filter Size Dimension : 11 ×0.2×8 Inches (Length×Width×Height)

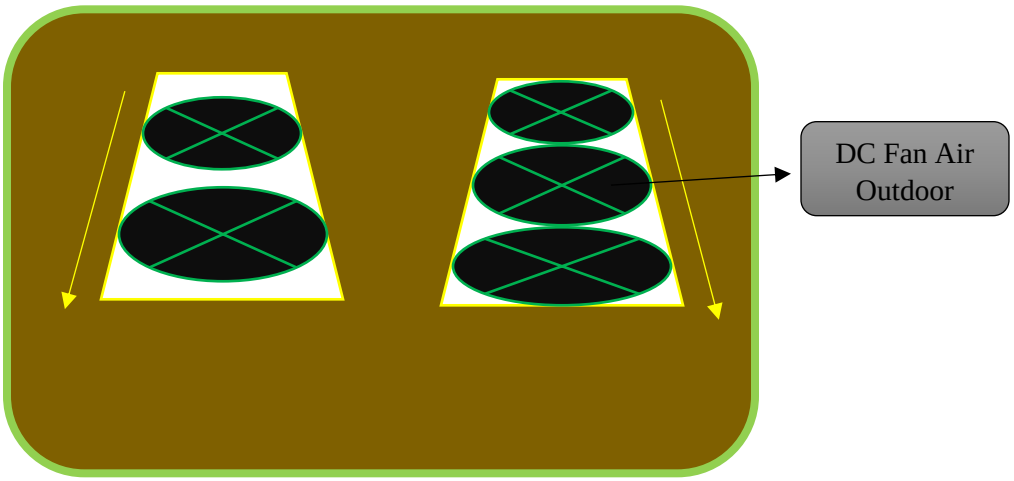


Figure 6: Fresh Air Outlet

In that figure we can see fresh air outlet windows. The inside air is compressed out by the powerful 12 Volt DC fans. Totally 5 DC fans has been used for getting the exact power suction limit. Finally the processed air comes out by those compressed system (Kosanke, 2019).

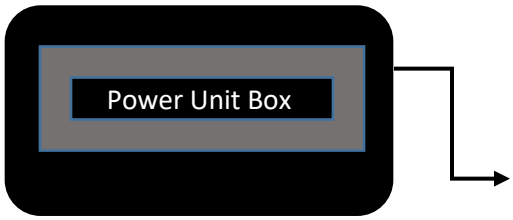
3.3.6 Materials Used

- DC Fan Used: 5 Pcs

- Power Consumption: 12 Volt 0.16A 1.92W

    - ✓ Item Dimensions: 4.72×0.98×4.72 Inches
    - ✓ Length: 4.72 Inches
    - ✓ Width: 0.98 Inches
    - ✓ Height: 4.72 Inches
    - ✓ RPM Speed: 1500 Maximum
    - ✓ Air Flow Capacity: 52 Cubic Feet Per Minute (CFM)
    - ✓ Noice: 18 Decibels
    - ✓ Each Fan Weight: 122 Gram Per Pcs

3.3.7 Power Used



- Power Input: 220-240 Volt
- Output Current:
    - ✓ Cot 1: 16 Volt DC
    - ✓ Output 2: 12 Volt DC

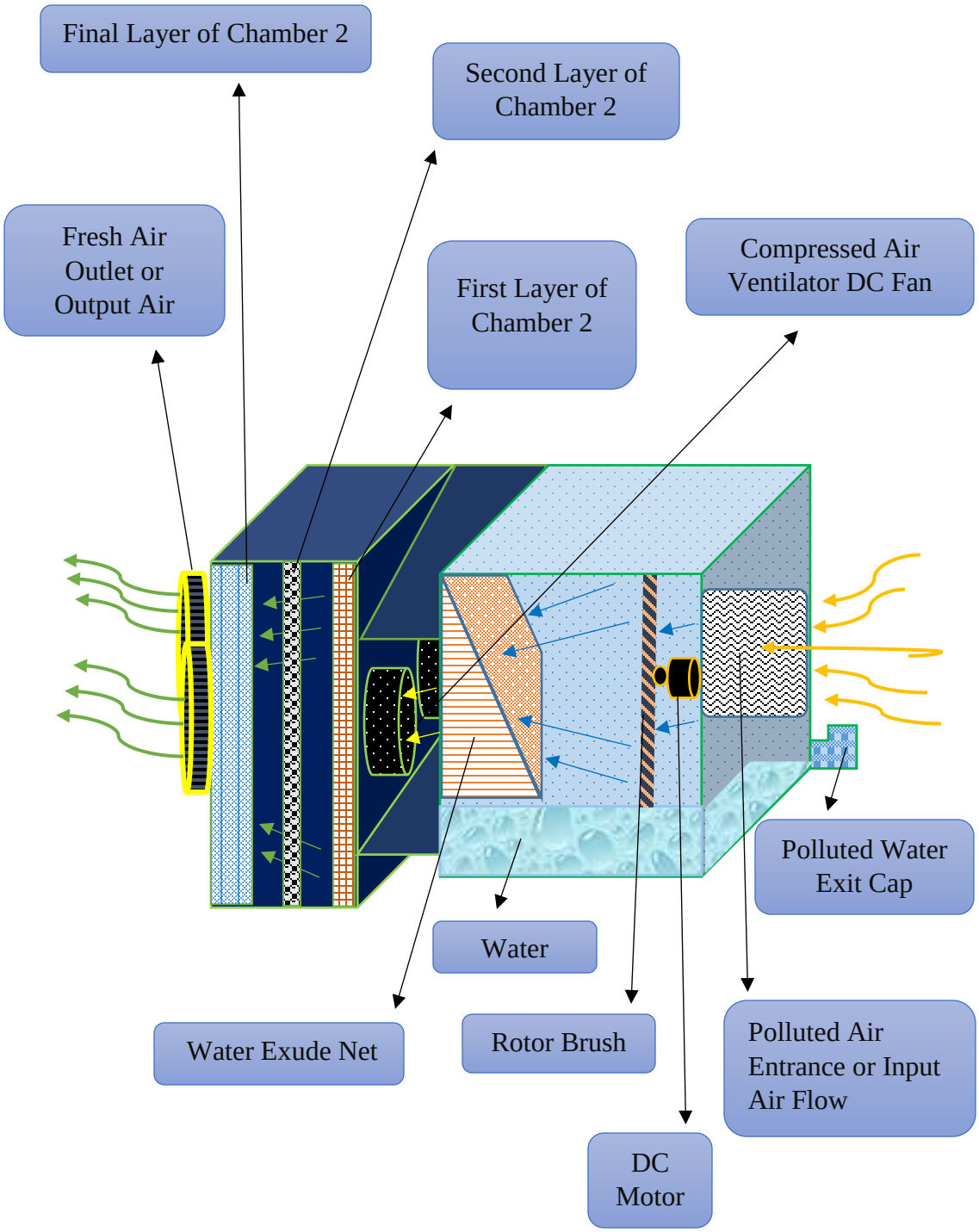


Diagram: Schematic Mechanism Air Purifier Machine

3.4 Study Area

The distribution of particulate matter were measured in Dhanmondi and Its surrounding areas. The distance was 100 to 500 meter distance one to another sampling location. In that the focused areas were Dhanmondi 8/A, Poribag, Indra Road, Green Road, Panthapath, Katabon, Kalabagan, Rayer Bazar, Jigatola, Nilkhekt Giasuddin Road and Bata Signal. Following those areas some houses has been selected for sampling the indoor air quality system (Wu et al., 2002). After marking that house first, second and third floor's each room selected for measuring Air Quality Index by Flank device and 24 hours deposited dust or particulate matter are collected (Gawrońska & Bakera, 2015). Which is measured by weight machine in the lab (Yang et al., 1991). The Dhanmondi region is located between **23`o34'** and **23`o45'** north latitude and between **90`o21'** and **90`o23'** east longitude.

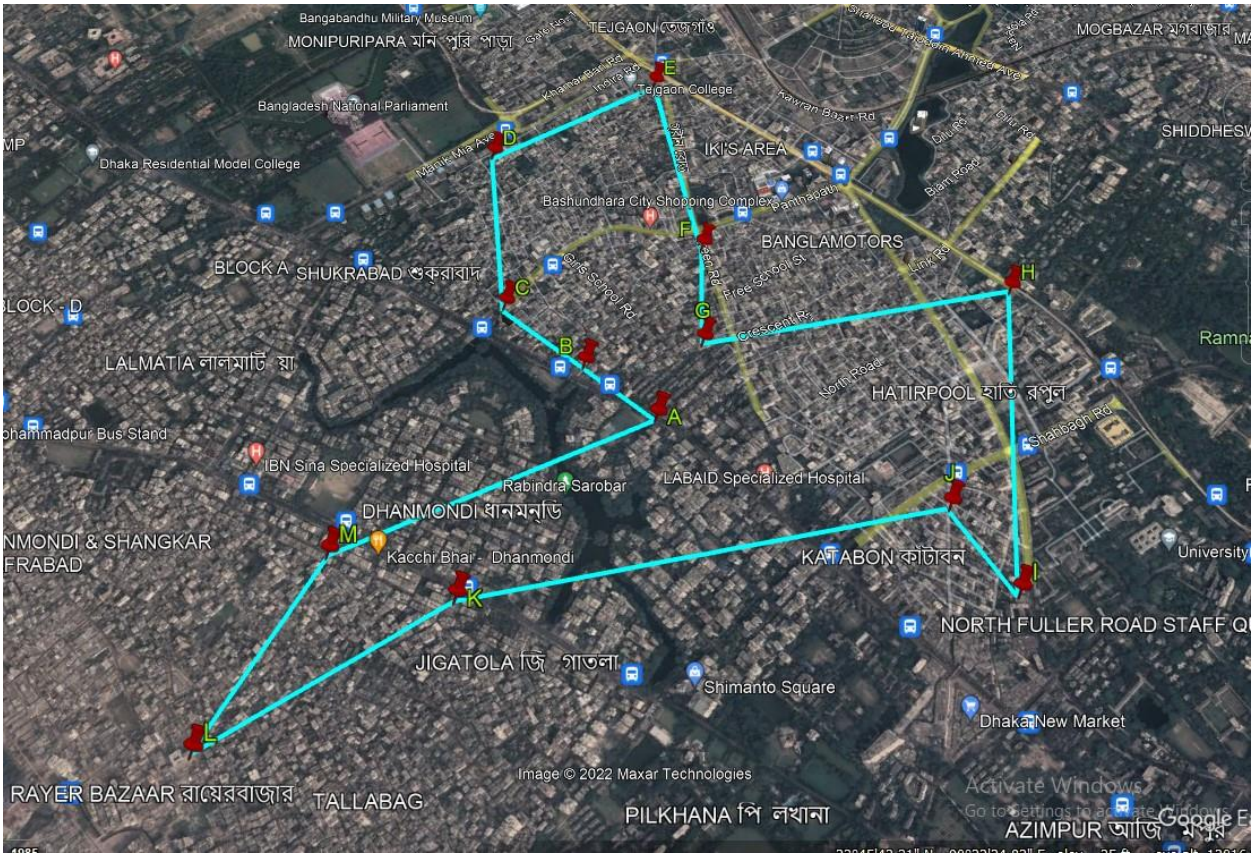


Figure: Sampling locations map (taken by google earth pro)

3.4.1 Exposure Particulate Matter Measurement

Building No.	First Floor (µg/m3)			Second Floor (µg/m3)			Third Floor (µg/m3)		
	AQI	PM2.5	PM10	AQI	PM2.5	PM10	AQI	PM2.5	PM 10
1	14	9.7	15.4	11	8	11.1	18	12.8	17.9
2	17	12.3	17.2	23	16.6	23.3	17	12.2	17.1
3	46	32.3	45.3	36	25.6	35.8	35	24.7	34.5
4	210	150.5	210.7	205	146.1	204.6	71	50.2	70.3
5	43	30.1	42.2	33	23.3	32.6	44	31.2	43.7
6	39	27.7	38.8	23	16.1	22.6	20	14.4	20.1
7	30	21.1	29.5	26	18.2	25.5	23	16.5	23.1
8	43	30.7	43	23	16.6	23.2	20	14.5	20.5
9	37	26	36.4	28	20.1	28.1	31	22.4	31.3
10	32	22.7	31.8	26	18.5	25.9	33	23.6	31.1
11	15	11.2	15.6	11	8	11.2	28	20.1	28.1
12	23	16.4	22.9	31	22.1	30.9	25	17.6	24.7
13	66	47.8	67	28	20.2	28.3	36	25.7	35.9

There were 13 buildings where data was collected, each building three different floor has been taken ground, first and second floor for measuring air quality index. Samples are also collected from those locations. The distance of those building 300 to 500 meters randomly. Sampling data is shown above table.

3.4.2 Area Wise Sampling & Measuring

Building No.	Weight (Gram)	Room Size
1	**1st** floor: 6.9501g **2ed** floor: 3.3794g **3rd** floor: 3.88279g	**1st** floor: 14×15×10 Feet **2ed** floor: 13×15×10 Feet **3rd** floor: 16×14×10 Feet
2	**1st** floor: 9.1141g **2ed** floor: 9.5109g **3rd** floor: 7.3635g	**1st** floor: 15×14×11 Feet **2ed** floor: 14×14×11 Feet **3rd** floor: 14×13×11 Feet
3	**1st** floor: 9.9810g **2ed** floor: 4.5159g **3rd** floor: 7.5458g	**1st** floor: 11×13×10 Feet **2ed** floor: 14×11×10 Feet **3rd** floor: 15×12×10 Feet
4	**1st** floor: 13.2978g **2ed** floor: 8.8801g **3rd** floor: 3.5150g	**1st** floor: 15×12×10 Feet **2ed** floor: 15×12×10 Feet **3rd** floor: 15×14×10 Feet
5	**1st** floor: 9.6855g **2ed** floor: 8.6372g **3rd** floor: 2.9033g	**1st** floor: 14×14×10 Feet **2ed** floor: 13×14×10 Feet **3rd** floor: 14×13×10 Feet
6	**1st** floor: 4.0997g **2ed** floor: 4.1461g **3rd** floor: 5.0938g	**1st** floor: : 14×11×10 Feet **2ed** floor: 14×12×10 Feet **3rd** floor: : 15×12×10 Feet
7	**1st** floor: 8.0561g **2ed** floor: 4.7140g **3rd** floor:3.5155g	**1st** floor: : 15×12×10 Feet **2ed** floor: 14×15×10 Feet **3rd** floor: 15×12×10 Feet
8	**1st** floor: 10.6607g **2ed** floor: 7.5694g **3rd** floor: 7.4792g	**1st** floor: 14×18×10 Feet **2ed** floor: 14×12×10 Feet **3rd** floor: 15×14×10 Feet
9	**1st** floor: 11.5099g **2ed** floor: 8.1192g **3rd** floor: 5.0800g	**1st** floor: 14×11×10 Feet **2ed** floor: 12×12×10 Feet **3rd** floor: 14×12×10 Feet

10	**1st** floor: 7.7889g **2ed** floor: 4.6429g **3rd** floor: 6.3932g	**1st** floor: 15×12×10 Feet **2ed** floor: 14×13×10 Feet **3rd** floor: 14×12×10 Feet
11	**1st** floor: 8.9799g **2ed** floor: 4.5666g **3rd** floor: 6.1709g	**1st** floor: 13×15×10 Feet **2ed** floor: 14×12×10 Feet **3rd** floor: 15×12×10 Feet

Total Weight: 226.90141 Grams

3.4 Outcome Measurement

The following pattern was discovered after the elimination of particles of percentage PM 2.5, PM 10, and AQI. After air filtration, the issue intensity of PM 2.5 particle was reduced by 86% and the mess concentrations of PM 10 particulate was reduced by 99%. There was a significant difference in total mess concentrations of PM 2.5, PM 10, and AQI when the air purifier was turned on and off.

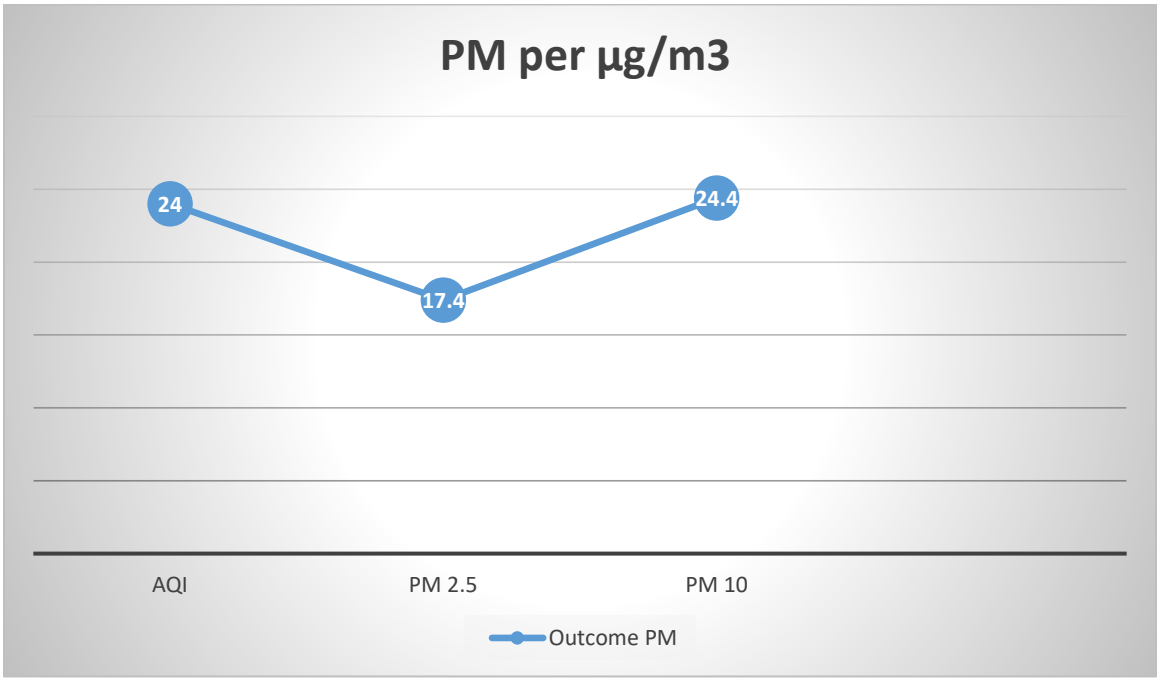


Figure: Outcome after air purification data

That data is observed after doing several hour data air purification by the air purifier machine. Where's

- ✓ AQI 24
- ✓ PM 2.5 is: 17.4 ug/m3
- ✓ PM 10 is: 24.4 ug/m3

That level of particulate matter indicates healthy air concentration (Cheng et al., 2007).

3.5 Statistical Analysis

MS Office 2013 for Windows was used to complete the statistical analysis. A paired t-test was used to determine the differences in mass consciousness of various sized PMs that after air cleaner was turned on throughout each sample scenario. Statistical significance was reduced to 5% (p 0.05). The increase and reduction percentages in mass awareness of ions, as well as the drop % in case of PM, were computed by dividing the multiplication and lowered concentrations by their initial dye concentration and multiplying the result by a hundred. That was distinguished among areal air measurements and following testing and data processing.

Chapter 4: Results and Discussion

In a distinct format, this chapter covers the findings and outcomes of our investigation. We assumed three main objectives at the start of our study endeavor and worked on them. We attempted to gain a well-organized grasp of the objectives in this chapter by examining the obtained data and conclusions in various ways. As a result, this chapter of results and discussion is separated into four (04) distinct sections. The sections are as follows:

4.1 The Findings of Study and Result Measurement

The overall status of the efficiency of air purifiers in terms of particle exposure is reviewed, as well as its efficiency on PM constrained exposure. This is also provided in order to depict particles length dynamics in conjunction with the present and disappearance of an external source. The investigation seeks to compare PM levels with suggestions made using a novel approach. Finally, the improvement in AQI as measured by quantitative health threats following the installation of air purification is discussed. An experiment with artificial pollution chambers is described below. The Flank AQI gadget was used to obtain measurements before and after starting on the air purification equipment.

Size of PM	During purifier machine OFF	During purifier machine ON	Decreased amount	Duration
PM 2.5	510.7 µg/m3	17.4 µg/m3	86.819%	12 hours
PM 10	805.6 µg/m3	24.4 µg/m3	99.257%	12 hours

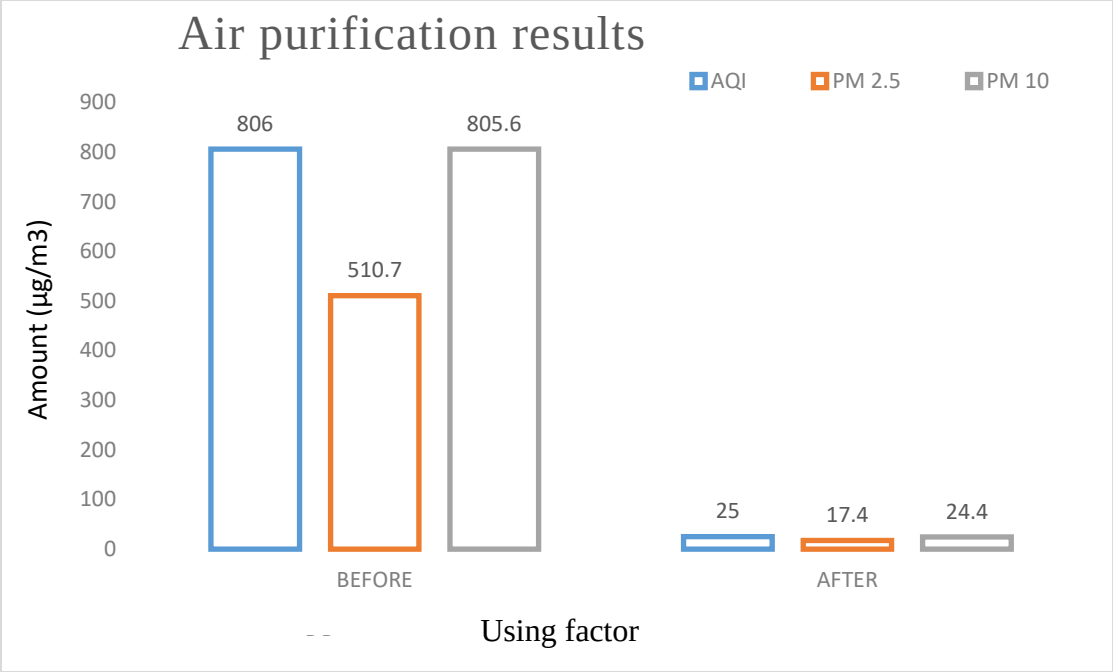


Figure: Result Findings

4.2 Amount of Particulate Matter Used Chamber and Finding Result

Initial	Final	Remaining Particulate Matter	Time Taken
5 Gram	0.0010 Gram	0.999 Gram	4 hours
100 Gram	0.1528 Gram	59.8472 Gram	8 hours

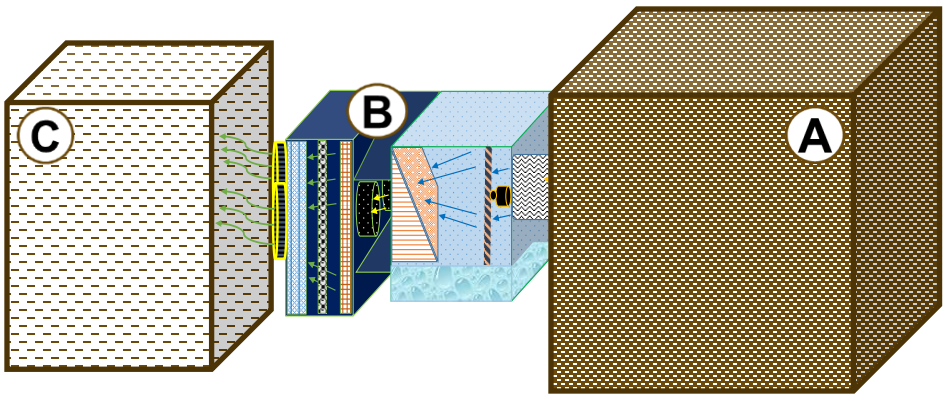


Figure: Practical experiment design

Above we can the reduction result of particulate matter over time. Running time of the machine was 12 hours making artificial air pollution of dust chamber. The findings from that design and development of air purifier machine has done it works. After using that machine the level of particulate matter has been decreased. Testing by making artificial chambers the transformation of particulate matter mostly reduce. Given amount of dust was 100 grams among them only 0.1528 grams of particulate matter are found in the final chamber.

4.3 Location Wise Air Quality Indication Based on Particulate Matter Only (https://scijinks.gov/air-quality/)

NO.	Location	Significance of AQI Indication	Reasons of Pollution
1.	Dhanmondi 8/A	Healthy	
2.	Bata Signal	Good	
3.	Katabon	Good	
4.	Lake Circus	Unhealthy	Beside there contraction work is running
5.	Poribag	Good	
6.	Jigatola	Good	
7.	Green Road	Good	
8.	Rayer Bazar	Good	
9.	Indra Road	Good	
10.	West Rajabazar	Good	
11.	Kalabagan	Good	

12.	Modhubazar, West	Dhanmondi	Good	
13.	Panthapath		Moderate	Commercial Use

4.4 Comparative Examine the Efficiency of Filtration Systems in Aspects of PM

Each air purifier with different specifications and clean Air distribution cost (CADR) used in the present study shown distinct performance in terms of lowering the awareness of varied sized PM and ions. The differing decrease percentage in the mass attentiveness of various sized PM. The discount % range shown in table five is generally based on the lowest to maximum reduction percentage in the scenario of anions and cations. A comparable discount % was discovered in some sample situations and is provided as a single discount percent even as all of the multiplied values have now not been covered. The following samples had been from 13 houses, each of which received weekly sampling at some point of the examine period of the amassed filters, 13 samples in PM2.5 and eleven samples in PM10, 2.5 have been excluded from the analysis due to pump mistakes or clear out contamination. Endotoxin concentrations had been no longer detected in any of the clean filters. The geometric imply of the PM2.5 endotoxin concentrations become zero. This fee become appreciably less than the corresponding value, 0.15 u/m3, for the sham air purifiers ($p = 0.002$,). In comparison, the PM10 to 2.5 endotoxin concentrations decreased barely all through using the real air cleaner; but, the distinction become not massive. In calculation, the PM2.5 mass concentrations while the usage of the authentic air purifier had been substantially much less than the identical even as using the sham air cleanser but, there had been no variations observed for the PM10 to 2.5 mass concentrations. Consequently, we consider that the effects of this look at may be generalized (Shiraishi & Ishimatsu, 2009).

CHAPTER 5: CONCLUSIONS and RECOMMENDATION

I attempted to gather all research points from the review of the literature, data collecting, data analysis, results, and comments in this last chapter of the study. We also attempted to justify the study's aims here. Recommendations are also made for the researchers to help them comprehend the next study. This chapter is broken into two sections:

5.1 Conclusion

A machine has been designed and developed to minimize particulate matter such as PM 10, PM 2.5, and AQI adds an element only on particulate matter. Data is collected in different houses of Dhanmondi area and it’s surroundings. So that after apply that air purifier machine the indoor air quality must be improved. It can comprehend faraway monitoring of indoor dirt attention to lengthen the existence of filter mesh, as a consequence enhance the performance of indoor cleansing to reap wise system. The coordinated manipulate of sweeper and cleanser is realized the use of ground dust deduction, so that it will understand the indoor air fine and the thickness of the floor dirt control and control in an all-spherical manner. The small size of particles is harmful for the health causes different kind of disease will occurs. That air purifier machine has been tasted of its effective works so that the result be considered that most harmful particles can be removed during passing the air from the outside air quality. It passes the fresh air into the indoor environment. By programming, the smart air purifier may achieve intelligent and autonomous sensing of air quality. Meanwhile, it can continuously check the interior air quality. This research offered a design strategy that may be observed and managed by the user via a mobile device, resulting in user-friendly and incredibly smart control. In the future, the smart air purifier research path will be to investigate novel purification technologies. We discovered that our air purification displays are updated more regularly than 82.4% of the market's clever air purifiers. As a result, how to lessen the frequent of filter screen change has been my primary concern.

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Appendix – I

Table of Building Coding Names

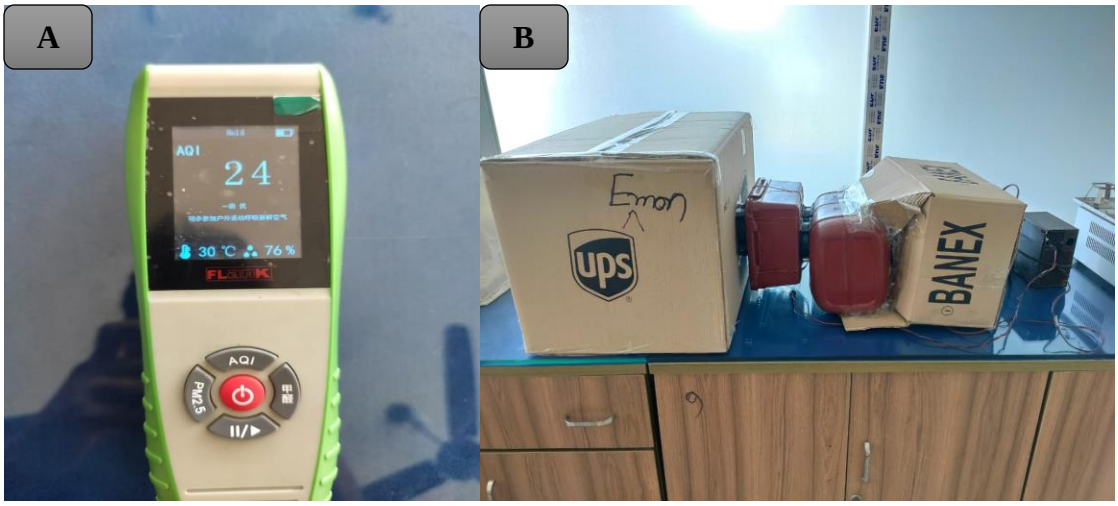
Building Name	Address
Building 1	House No 27, Building- Urban Park, Road#8, Dhanmondi R/A, Dhaka
Building 2	Siddiki House, 274/2, Bata Signal, New Elephant Road, Dhaka
Building 3	278/3 Giasuddin Road, Katabon, Dhaka
Building 4	98/3 Lake Circus, Kalabagan, Dhaka
Building 5	Vanduri Tower, 1/B Poribag, Dhaka
Building 6	21/1, Haque Mansion, Jigatola, Dhaka
Building 7	Rouf's Heritage, 197 Green Road, Dhaka
Building 8	223/KA & 24A,B&D, Indra Road, Tejgaon, Dhaka
Building 9	182,Godighar Rayerbazar, Dhaka
Building 10	49/5E West Rajabazar, Dhaka
Building 11	127, Wasi Vila, Kalabagan
Building 12	149, Modhubazar, West Dhanmondi, Dhaka
Building 13	Tridhara Tower, Panthapath, Dhaka

Appendix – II

Photographs

During field data collecting and measuring air quality of those specific location

(A) The measuring exact weight samples that is collected from different houses.
(B) Setup the initial and final chamber for air purifier machine accuracy.



(A) Air quality measuring device and final chamber Air Quality Index rate.

(B) After doing setup configuration and on running process of particulate matter reduction.