SPARK CHALLENGE 22/23

SPARK

2N2D Atmo

Breath of Life; wellness through air quality innovation

Portable Air Quality Measuring Device

ENTC
Electronic and Telecommunication Engineering

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1.Details of the Team

1.1. Group name Team :TEAM 2N2D

1.2. Group leader's name :Nirandha Dhanomika

1.3. Group members' information (including the leader)

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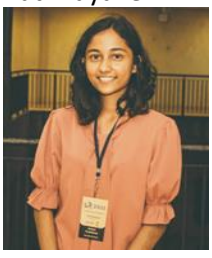
Rathnayake R.N.P 	200537F	nuthyapr@gmail.com	0702861257

1.4. External support you received to derive the solution from peer

Mr. Sunil Udukula, Director at Central Environment Authority's Lanka

Contact: 0718163362

2. Problem Description (C1)

2.1. Our Primary Area of Development

Environmental conservation and preservation

2.2. Other Supporting areas of development

Healthcare improvement

Transportation and transport efficiency

Power generation and efficiency

2.3. The Problem Statement

Environmental pollution is indeed an undeniably attractive issue that has caught the eyes of people worldwide. Air pollution is a branch issue stemming from the broader problem of environmental pollution. Human activities have significantly continued to alter the natural world for two or three decades. Thus, the consequences on air quality have degraded and they are significantly evident. Human and animal health is mostly affected in this regard. People's physical and mental health are greatly affected by air pollution, and long-term exposure increases the risk of developing respiratory and cardiovascular diseases. [1]. Furthermore, the World is an undeniably attractive issue that has caught people's eyes. Furthermore, The World Health Organization (WHO) states that around 4.2 million people die every year due to exposure to harmful air pollutants.[2]. Several factors, including the burning of fossil fuels and waste incineration, industrial emissions, vehicle exhaust, and vehicular emissions, all contribute to the deterioration of air quality around the world. Implementing effective strategies that reduce air pollution's harmful effects on our planet and its inhabitants requires an understanding of the causes and effects of the issue as a whole.

Why is air pollution an issue?

1. **Health impact**

Exposure to polluted air has a number of negative health effects on those who breathe it.

- Respiratory Diseases:

Asthma: Prolonged exposure to air pollutants can cause asthma attacks and worsen symptoms in people who already have the condition.

(COPD): Chronic obstructive pulmonary disease the development and progression of COPD, which includes chronic bronchitis and emphysema, are significantly influenced by air pollution.

Infections of the respiratory system: Polluted air can erode the respiratory system's defenses, leaving people more vulnerable to bronchitis and pneumonia.

- Cardiovascular Diseases

Heart Attacks and Strokes: When PM2.5 and other pollutants enter the bloodstream, plaques in the blood vessels form, blood pressure rises, and the risk of heart attacks and strokes increases.

Cardiac Arrhythmias: Air pollution increases the risk of irregular heart rhythms by interfering with the heart's normal electrical activity.

- Lung Cancer

Heavy metals and polycyclic aromatic hydrocarbons (PAHs), which are found in air pollution, have been linked to the development of lung cancer. The risk of contracting this fatal illness rises with continued exposure to contaminated air.

- Allergies and Respiratory Allergies

allergic rhinitis: Polluted air can bring on or make allergic rhinitis symptoms worse, including sneezing, itching, runny noses, and congestion.

Eye and skin irritations: Redness, itching, and inflammation of the eyes and skin can result from exposure to air pollutants like particulate matter and ozone.

- Genetic Mutations

DNA changes brought on by air pollution have the potential to result in genetic disorders. Reactive oxygen species (ROS) and other toxic substances that harm DNA can cause mutations to happen either directly through the interaction of pollutants with DNA or indirectly through their production.

- Epigenetic Modifications

Changes in gene expression that occur without affecting the underlying DNA sequence are also brought on by air pollution. Epigenetic changes have been linked to a number of diseases and have the potential to cause long-lasting changes in gene activity. For instance, research has demonstrated that exposure to air pollution can change the expression of microRNAs, histone modifications, and DNA methylation, all of which can affect how genes are regulated and result in disease.

- Premature Death

Worldwide, premature deaths are caused by the health effects of air pollution, especially fine particles (PM2.5) and toxic gases. Long-term exposure to contaminated air raises the risk of respiratory and cardiovascular conditions, which raises mortality rates, particularly in vulnerable groups like the elderly and people with existing medical conditions.

- Neurological Disorders

Growing evidence points to a connection between air pollution and neurological conditions, such as childhood neurodevelopmental disorders and adult neurodegenerative diseases. The response to air pollutants or interactions with the biological processes underlying the diseases are two ways that genetic factors may modify a person's susceptibility to these conditions.

2. Environmental Consequences

The environmental effects of air pollution are extensive and have an impact on many ecosystems and natural resources. These effects result mainly from human activity-related pollution released into the atmosphere.

- Climate Change

By trapping heat in the Earth's atmosphere, air pollution, in particular the emission of greenhouse gases (GHGs) like carbon dioxide (CO2) and methane (CH4), affects climate change. This affects weather patterns and causes global warming. The scientific underpinnings of climate change, its effects, and potential mitigation measures are all thoroughly examined by the Intergovernmental Panel on Climate Change (IPCC). Their reports are useful tools for comprehending how air pollution and climate change are related [3].

- Acid Rain

Acids can be created when air pollutants, such as sulfur dioxide (SO2) and nitrogen oxides (NOx), interact with atmospheric water vapor. Acid rain occurs when these acids condense as rain, snow, or fog. Damage from acid rain is done to aquatic ecosystems, plants, and soils. Information on acid rain and its effects on the environment is available from the United States Environmental Protection Agency (EPA) [4].

- Ozone Depletion

The ozone layer in the stratosphere can be destroyed by some air pollutants, including hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs). The Earth is shielded from harmful ultraviolet (UV) radiation by the ozone layer. Information on ozone depletion and the Montreal Protocol, a global agreement to phase out ozone-depleting substances, is provided by the United Nations Environment Programme (UNEP) [5].

- Global warming

Global warming is a result of the release of GHGs, primarily from the burning of fossil fuels and industrial processes. This causes the Earth's average temperature to rise, which has a number of effects like raising sea levels, melting ice caps, and altering ecosystems. Resources on global warming and its effects are available from the National Aeronautics and Space Administration (NASA) [6].

- Loss in Biodiversity

Sulfur compounds, nitrogen compounds, and heavy metals are examples of air pollutants that can harm ecosystems and decrease biodiversity. By disrupting their habitats and changing food chains, these pollutants can cause direct harm to plants and animals. Information on the connection between pollution and the decline in biodiversity can be found in the Convention on Biological Diversity (CBD) [7].

- Air Quality Degradation

By introducing pollutants like particulate matter (PM), ozone (O3), nitrogen dioxide (NO2), and volatile organic compounds (VOCs), air pollution affects the quality of the air. These contaminants can cause respiratory issues, decreased visibility, and smog formation. Information on air quality and its effects on human health is available from the World Health Organization (WHO) [8].

- Soil and Water Contamination

Contamination of soil and water can result from airborne pollutants that land on the surface of the Earth. POPs, toxic chemicals, and heavy metals can build up in soil and get into water sources, endangering humans, animals, and plants. Resources on soil and water pollution and its effects can be found on the United Nations Environment ment Programme (UNEP) website [9].

3. Economic Costs

- Healthcare Costs

Numerous health issues, such as asthma, lung cancer, and respiratory and cardiovascular diseases, are made worse by air pollution. These illnesses can come with high healthcare costs, including prescription costs, hospital stays, and long-term care. According to a study in The Lancet, the economic cost of healthcare costs related to air pollution in 2015 ranged from $21-43 per metric ton of CO2 emitted globally [10].

- Lost Productivity

Due to elevated absenteeism, diminished work capacity, and compromised cognitive function, air pollution has a detrimental effect on workforce productivity. Air pollution-related health problems can lead to lost workdays and decreased productivity. According to a World Bank report, the estimated global cost of lost labor income due to air pollution-related illnesses and premature deaths in 2013 was around $225 billion [11].

- Environmental Damage and Restoration

Ecosystems, crops, and natural resources can all be harmed by air pollution, which can lower agricultural productivity, harm forests, and contaminate water sources. The price of repairing and rehabbing damaged ecosystems can be high. For instance, acid rain, a result of air pollution, has harmed forests and aquatic ecosystems, necessitating investments in reforestation and measures to improve water quality.

- Damage to Infrastructure

Due to chemical reactions, some air pollutants, including sulfur dioxide and nitrogen oxides, can hasten the deterioration of structures like bridges and other infrastructure. Governments and taxpayers may be burdened by the high costs associated with maintaining, replacing, or repairing damaged infrastructure.

- Energy Expenditures

Fossil fuels, which are an important source of energy for businesses and transportation, are frequently responsible for air pollution. Implementing strategies to reduce air pollution, like switching to renewable energy sources or cleaner technologies, might call for sizeable financial outlays in the short run.

Importance of Air pollution minimization

Small to large scale

Due to the alarming effects air pollution has on human health, the environment, and the economy, more people are becoming aware of the significance of reducing it. People of all ages are seriously at risk from air pollution, which can cause respiratory and cardiovascular conditions as well as early death. Additionally, it harms the environment, causing acid rain, ozone depletion, climate change, and biodiversity loss. The financial costs of air pollution, which include lost agricultural production,

infrastructure damage, higher healthcare costs, and decreased trade and investment, emphasize the urgency of taking action even more. Recognizing the seriousness of the effects of air pollution, we are compelled to give priority to actions that reduce pollution, protect human health, safeguard the environment, and promote sustainable economic growth.

How it happens

Natural and anthropogenic (man-made) sources of air pollution can be distinguished.

Natural causes of air pollution include:

a. volcanic eruptions, which release gases, ash, and particulate matter into the atmosphere.

b. Dust and Pollen: When breathed in, wind-borne dust, pollen, and spores from plants and trees can irritate the respiratory system

Anthropogenic Sources:

Industrial Emissions: Through operations like manufacturing, power generation, and chemical production, industries release a sizable number of pollutants into the atmosphere.

b. Vehicle Emissions: The exhaust fumes from cars, trucks, and other vehicles release pollutants like carbon monoxide, nitrogen oxides, and particulate matter, which contribute to air pollution.

c. Power Generation: When fossil fuels like coal and oil are burned to generate electricity, pollutants like sulfur dioxide, nitrogen oxides, and greenhouse gases are released into the atmosphere.

d. Residential Sources: Especially in developing nations, residential activities like cooking, heating, and burning biomass or fossil fuels all contribute to air pollution.

e. Agricultural Activities: Using pesticides, burning agricultural waste, and methane emissions from livestock all contribute to air pollution.

f. Waste Management: When waste is improperly disposed of or burned, airborne pollutants are released.

Attempts to minimize air pollution

Numerous initiatives from international organizations have suggested limiting the emission of harmful gases that result from the combustion of fuels, particularly petroleum to cater to this environmental concern.[12]

The Paris Agreement

One of the most pertinent suggestions in The Agreement of Paris included commitments from numerous nations to cut back on the production of polluting gases [13]. In terms of the environment, its main goal is to keep the annual increase in global temperature to under two degrees Celsius. In fact, if the global temperature rises above this level, the environment and all the planet's ecosystems could be negatively impacted [14].

The WHO develops air quality guidelines that offer suggestions for legislators and medical professionals on how to enhance air quality and safeguard the public's health. These guidelines establish limits for a number of air pollutants, including sulfur dioxide, nitrogen dioxide, ozone, and particulate matter (PM2.5

and PM10). They act as a guide for nations setting national standards for air quality and creating plans to lessen air pollution.

United Nations Framework Convention on Climate Change (UNFCC)

The UNFCCC is an international agreement with the goal of reducing climate change and stabilizing atmospheric greenhouse gas concentrations. The UNFCCC indirectly contributes to minimizing air pollution by reducing emissions of greenhouse gases, including those linked to air pollution. Nations can discuss and coordinate their efforts to combat climate change and reduce air pollution at the annual Conference of Parties (COP).

Regulations of the International Maritime Organization (IMO)

The IMO, a special UN agency, establishes rules to cut down on air pollution from ships and other marine vessels. Through the adoption of progressively stricter limits on the sulfur content in marine fuels, the IMO's regulations include restrictions on sulfur oxide emissions from ships. With these actions, the maritime sector's harmful air emissions, like sulfur dioxide and particulate matter, are intended to be reduced.

Although these frameworks provide international collaboration to reduce air pollution, it is still a serious and ongoing problem.

Challenges at air pollution minimization

Rapid urbanization and industrialization

Rapid urbanization and industrialization have resulted in increased pollution from power plants, factories, vehicles, and construction projects, contributing to air pollution. Inadequate Implementation and Enforcement

Despite the existence of international treaties and national laws, it can be difficult to effectively implement and enforce them. The implementation of air pollution control measures may be hampered by a lack of resources, inadequate monitoring systems, and different levels of commitment among nations.

Limitations of Technology and Infrastructure

Making the switch to cleaner technologies and infrastructure is a difficult process that calls for significant financial outlays, innovative research, and enabling legislation. Due to technological limitations or the requirement for significant infrastructure upgrades, some regions or industries may encounter difficulties in implementing cleaner alternatives.

Transboundary Air Pollution

Air pollution can travel over great distances and is not constrained by physical boundaries. When pollutants from one nation or region have an impact on the quality of the air in another, that is considered transboundary air pollution. To effectively address the issue, this calls for international coordination and cooperation.

Lack of Public Awareness and Engagement

Addressing air pollution depends heavily on public engagement and awareness. Many people might not fully comprehend how air pollution affects their health or how they can reduce it. For sustained efforts to reduce air pollution, raising awareness, encouraging behavioral changes, and fostering public participation are essential.

2.4. Impact of finding a solution on climate change

The Atmo solution has a positive impact on the climate in simple terms:

Fighting Pollution: Air pollution contributes to climate change. By accurately monitoring air quality, Atmo helps identify sources of pollution and encourages actions to reduce harmful emissions. This helps in combating climate change by reducing pollution in the air.

Encouraging Sustainability: Atmo provides real-time data and insights, empowering people to make environmentally friendly choices. This can include using less energy, switching to cleaner fuels, or adopting eco-friendly transportation. These actions help reduce greenhouse gas emissions and promote a more sustainable future.

Adapting to Climate Change: Atmo helps assess how climate change affects air quality. This information aids in adapting to the changing climate and protecting public health. It helps communities prepare for extreme weather events and other climate-related challenges.

Smart Integration: Atmo can connect with other smart systems and technologies. This integration supports the development of smart cities that optimize resource use and reduce carbon footprints. By integrating air quality data with climate initiatives, Atmo contributes to a climate-resilient and sustainable world.

3. Solution Description

3.1. Arriving at your solution(C1)

Problem formation:

Starting on December 7 and 8, 2022, the National Building Research Organization (NBRO) in Sri Lanka noticed that the air quality had deteriorated in many areas of the country. This was due to the high concentrations of PM2.5, which are tiny particles that can harm children, plants, animals, and people with respiratory conditions.

The situation worsened because of the weather system in the Bay of Bengal. The combination of local pollution and transboundary pollution caused the air quality to get even worse. It also made the weather colder than usual, which could be bad for people and animals.

To stay safe, people were advised to wear face masks, spend less time outside, and stay indoors as much as possible. This was especially important for children, pregnant women, and those with breathing problems. It was also recommended to avoid activities like cycling and reduce the use of machines and engines that create more pollution.

We team Atmo found ourselves disturbed in the above situation and wanted to find a solution anyhow, because it made a big impact on the day-to-day lives of mankind. And we knew for sure, that this is not an issue only limited in our country, so we researched a little deep into the topic

One such incident had occurred in Delhi, India. Delhi has experienced severe air pollution in recent years, particularly during the winter months. The city went through a "smog crisis" in November 2019, during which the air quality became very risky. The city was covered in a thick layer of smog due to the extreme pollution levels, which had a negative impact on health and daily life.

The incident in Delhi serves as a reminder of the dangers of air pollution worldwide and the urgent need for solutions. It demonstrated how air pollution has a significant impact on millions of people's health and wellbeing.

We, the Atmo team, were inspired to create a solution as a result of incidents like the one in Delhi and the understanding of how pervasive the issue of air pollution is.

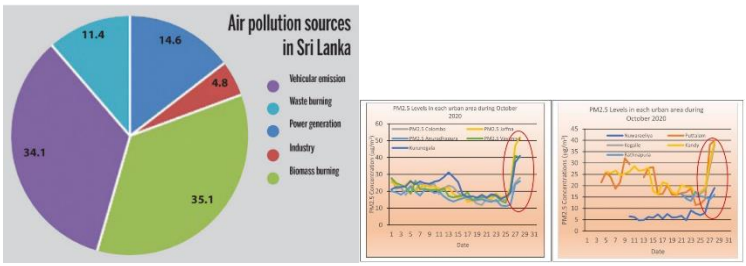
Considering all the above, we identified it is a significant issue globally that affects both humankind and the entire ecosystem. We felt that equipping people, communities, and governments with the knowledge and resources they need to monitor and address air quality issues, will be a promising solution to address this issue.

Then we researched deeper to find more about the problem we are facing, our modes of information collection contained:

- Getting insights from experts in the field

We were able to contact Mr. Sunil Udukula, a director at Central environmental authority, Sri Lanka. Our conversation with him showed us the current conditions of air pollution of Sri Lanka, and what really contributes most to that, insights gained from him was valuable. He pointed out about the pollutant gas release from garbage dumps in SL, which we haven't thought of as a root cause to air pollution in Sri Lanka Contact: 0718163362

- Read many newspaper articles, research papers, journals, etc. Here are a few interesting facts grabbed from those, which made us realize the severity of the issue we are facing.



- Considered the standards of air quality: Air condition measuring Indexes

The level of air pollution at a particular location is indicated by the Air Quality Index (AQI), a numerical measurement. Higher values denote more severe pollution and higher health risks. It ranges from 0 to 500. With the help of the AQI, the level of air quality can be divided into good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous.

It considers various pollutants and their concentrations to determine the overall air quality level. Common pollutants included in these indexes are particulate matter (PM2.5 and PM10), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO). Each pollutant is assigned a specific weight or importance based on its health effects.

In Sri Lanka, the Central Environmental Authority (CEA) is responsible for monitoring and assessing air quality. The CEA utilizes the National Air Quality Index (NAQI) to provide information on air pollution levels in different regions of the country. The NAQI considers the concentrations of major pollutants and categorizes air quality levels accordingly.

Ongoing projects and proposals by CEA

In Battaramulla and Kandy, the ARM&M Unit in Sri Lanka runs two ambient air quality monitoring stations that provide real-time data for air quality management and public education.

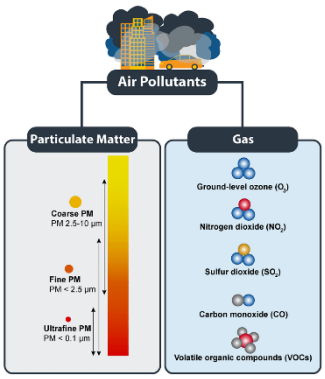
These monitors six air pollutants, including carbon monoxide, nitrogen dioxide, Sulphur dioxide, and fine particulate matter. To increase public awareness of air quality and related health issues, the Air Quality Index (AQI) is released to the general public. For data analysis, the monitoring stations also incorporate meteorological parameters. The Vehicular Emission Test (VET) Trust Fund provides funding for the observational activities. In addition, Jaffna, Kurunegala, and Anuradhapura cities are testing sensor-based air quality monitoring equipment donated by the World Health Organization.

Figure 1: Battaramulla AAQMS Site

Figure 2: Kandy AAQMS Site

Through specific regulations, noise pollution from businesses and construction activities is reduced. International standards are followed when measuring vibration levels. Regulations are put into place to measure air emissions and effluent discharge in order to track pollutant emissions from industries. The agency also contributes to the creation of standards for measuring rail noise in rapid rail transit systems and traffic noise on expressways. These recommendations help with the design, building, and administration of transportation projects while taking environmental effects into account. As well as noise impact assessments and compliance verifications, the guidelines cover noise measurements, monitoring, modeling, and prediction. Since 2018, these rules have been in effect.

Problem breakdown:



- We checked how we can arrive at a solution

First of all, we identified what are the available pollutant gases in the environment.

PM, or particulate matter - PM is a typical stand-in for an air pollution indicator. There is ample proof that exposure to this pollutant has harmful effects on one's health. Sulfates, nitrates, ammonia, sodium chloride, black carbon, mineral dust, and water are the main constituents of PM.

Carbon monoxide - A toxic gas known as carbon monoxide is created when carbonaceous fuels like wood, gasoline, charcoal, natural gas, and kerosene are burned partially.

Ozone (O3) - One of the main components of photochemical smog is ground-level ozone, which should not be confused with the ozone layer in the upper atmosphere. Ground-level ozone is created when gases react with sunlight.

Nitrogen Dioxide (NO2) - NO2 is a gas that is frequently released during the burning of fuels in the industrial and transportation sectors.

Sulfur oxides (SO2) - Colorless gas SO2 has a pungent odor. It is made by smelting sulfur-containing mineral ores and burning fossil fuels like coal and oil.

We then started finding available solutions and things we should consider:

Air monitoring stations

Simply put, we found that many areas, particularly in Latin America [9], lack air quality monitoring stations. Although some fixed-site monitoring stations have been established by environmental protection

agencies and nonprofit organizations, they are few in number and unable to cover the entire country. Because of this, it is difficult for nations to effectively limit their emissions and combat air pollution.

The current monitoring stations are also limited. As a result of their fixed installation points and lack of the necessary infrastructure, they are only able to provide approximations of the air quality.

Therefore, we considered using inexpensive sensors to create a solution to these problems. Combining these sensors with standard machinery can result in a more efficient and adaptable air quality monitoring system. These sensors plus a microcontroller, a battery, and other sensors were our first picture of the solution. We thought of internet of Things (IoT) devices because they can communicate using various protocols.

Existing devices check- Market Analysis

Device Name	**Features**
Air Quality Meter PCE-CMM 10	Measuring CO2 Concentration, Air temperature
Air Quality Monitor AM7000	Output real-time data of PM2.5, CO2, HCHO
SAF Aranet 4	Measuring CO2 percentage
Temtop M10 Air Quality Monitor	Presents indoor air quality readings

Taking all these into consideration,

Our solution:

2N2D Atmo - Smart Air Quality Measuring device.

Why 2N2D Atmo?

Issues we considered to solve:

Maintain better indoor air quality: We were aware of the significance of monitoring indoor air quality because people spend a lot of time indoors. The Atmo measures pollutants produced by cleaning, cooking, burning wood, decorating the home, smoking, and other sources to give information about the indoor air quality.

Maintain better outdoor air quality: Measure and track pollutants from sources like traffic pollution and wildfire smoke entering the building will be useful. Users are able to be aware of the air quality entering their indoor environments thanks to this.

To attend to the above issues;

We design to assess the quality of the air inside your house, place of business, or place of education. It'll simply measure the number of pollutants around the user environment. Traffic pollution and air pollution that enters the building from cooking, cleaning, burning wood, interior decoration, smoking, and wildfire smoke can be detected and displayed as well.

Features

Accuracy and Reliability: We hope for a high priority on the measurements' accuracy and dependability. To ensure accurate readings, our device will use premium sensors and goes through a rigorous calibration process.

Comprehensive Pollution Monitoring: We will use sensors to monitor a variety of pollutants, including particulate matter (PM2.5 and PM10), carbon dioxide (CO2), temperature, humidity, and volatile organic compounds (VOCs), which are known to have serious negative effects on health. Users will be given a holistic understanding of their indoor and outdoor air quality thanks to this all-encompassing approach.

Real-time Data Analysis: To process and interpret the gathered data in real-time, the 2N2D Atmo incorporates advanced data analysis capabilities. This will enable users to have quick access to practical insights and make wise environmental decisions.

User-Friendly Interface: We will create a simple and user-friendly interface for the device that makes it simple for people of all backgrounds to navigate and comprehend the information provided about air quality.

Smart features and connectivity options: Available in the device enabling users to access air quality data remotely via a mobile app or web interface. Users can manage and monitor air quality using this feature from any location, enabling proactive actions to enhance their surroundings.

This feature will be developed to send warnings to the relevant parties and inform the government and relevant authorities if a particular threshold pollutant level exceeds. This will support the relevant authorities to identify the sources that release significant amounts of air pollutants to the environment and to take relevant actions based on that.

As a plugin:

To drones

Atmo can be used to conduct aerial air quality monitoring in particular locations or regions by being fastened to drones. Drones with Atmo can collect real-time data on air quality from various heights and locations, giving a thorough understanding of the air pollution levels in a given area. It will be really useful since drones can locate and collect information from places where humans cannot approach.

Emergency Response and Disaster Management: Drones with Atmo can be used to monitor the air quality in affected areas during emergencies like fires or natural &manmade disasters. Making decisions about evacuation, resource allocation, and recovery efforts requires knowledge of this information in order to assess the environment's safety.

Environmental Monitoring and Research: Activities for environmental monitoring and research can be supported by drones equipped with Atmo. They enable researchers to study the effects of different factors on air pollution, such as industrial emissions, wildfires, or pollutant dispersion. They can be used to gather data on air quality in remote or inaccessible areas.

To Vehicles

The device will use advanced sensors to analyze the exhaust gases emitted by vehicles.

Air purification activation

It can provide real-time air quality data that can be used to activate or manage air purifiers. When pollutant levels exceed predetermined thresholds, Atmo can send signals to activate air purifiers by integrating with compatible smart home systems or devices. In response to declining air quality, this integration enables a more automated and effective method of air purification.

Feasibility Check:

Technical Feasibility:

The technology required for air quality measurement and data analysis was researched and taken into consideration.

We use sensors and monitoring equipment capable of measuring pollutants such as PM2.5, PM10, SO2, NO2, O3, and CO which are widely accessible.

Connectivity options such as Wi-Fi or cellular networks can be utilized to transmit data from the device to a centralized system.

The integration of IoT capabilities allows for remote monitoring and control of the device.

The device can be powered by rechargeable batteries or connected to a power source, ensuring continuous operation.

We carried out an environmental and regulatory check and came to the conclusion that Atmo air quality measuring device is the best solution one can come up with.

3.2. Proof of Concept (C1)

Design Factors

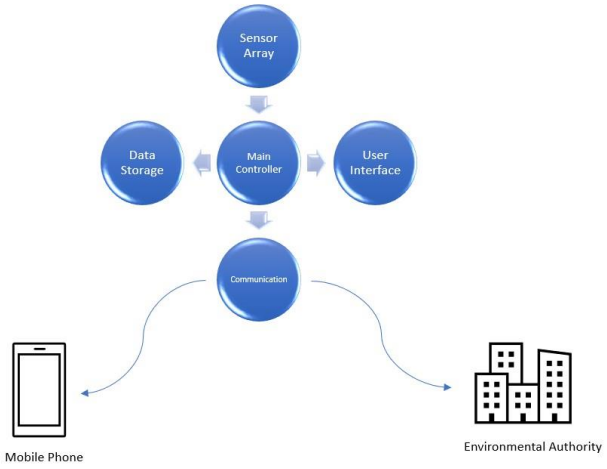
Multi-Pollutant Detection: The device can detect a wide range of air pollutants such as carbon monoxide, nitrogen dioxide, volatile organic compounds, particulate matter and ozone.

Sensor Selection: Sensors should be reliable and accurate to get the expected results.

Real-Time Monitoring: The device provides real-time air quality measuring.

Power Efficiency and Easy Maintenance: Optimized power management for the device and designing for the easy maintenance is important for the user convenience.

Functional Block diagram



3.3. Sustainability (C5)

The Atmo air quality measuring device contributes to several Sustainable Development Goals.

Good Health and Well-being (SDG 3): By giving consumers knowledge about air quality and possible pollution sources, the device helps in the promotion of good health and well-being. The device enables users to take proactive steps to decrease their exposure to pollutants.

Sustainable Cities and Communities (SDG 11): By increasing public awareness of air pollution, the device helps to build sustainable cities and communities. Individuals, companies, and educational institutions can take action to minimize their pollution contributions by identifying the sources of air pollutants, creating healthier and more environmentally friendly environments.

Affordable and Clean Energy (SDG 7): The tool encourages energy efficiency by assisting users in locating energy waste and pollution sources. The gadget aids in the development of cost-effective and clean energy solutions by addressing and eliminating energy waste in heating, cooling, ventilation, and other energy-consuming activities.

Responsible Consumption and Production (SDG 12): The tool encourages energy efficiency by assisting users in locating energy waste and pollution sources.

Climate Action (SDG 13): By identifying and tracking pollutants with an impact on the climate, such as carbon monoxide (CO) and volatile organic compounds (VOCs), the device indirectly aids in the fight against global warming. The tool can encourage behavioral changes that lower emissions and aid in mitigating climate change by increasing awareness of these pollutants and their sources.

Industry, Innovation, and Infrastructure (SDG 9): The gadget is a cutting-edge way to keep track of air quality. Its creation and application need technological progress, analysis, and cooperation among numerous stakeholders.

Partnerships for the Goals (SDG 17): Governments, corporations, and civil society organizations must work together and form partnerships in order to achieve the SDGs. Technology developers, manufacturers, distributors, and users work together to build and deliver the product. These collaborations make it easier for people to adopt and use the device widely.

4. Social and Environmental Impact Assessment (C4)

Social Impact

The device promotes awareness of the value of good air quality and how it affects health. It enables people to take educated decisions and act to better their environments, resulting in healthier living and working situations, by giving real-time information and warnings.

This device helps people in locating and addressing potential causes of air pollution by identifying and monitoring contaminants. As a result, the risk of respiratory conditions, allergies, and other health problems linked to poor air quality may be decreased.

This device promotes the use of environmentally friendly behaviors by emphasizing the negative effects of specific actions, such as cooking, cleaning, or burning wood.

Environmental Impact

This encourages energy saving by pointing out ineffective behaviors and energy waste. Users can change their energy consumption habits to reduce greenhouse gas emissions and the impact of energy production on the environment.

This device enables users to identify and fix indoor air pollution sources, such as cooking practices, cleaning supplies, or smoking. It helps to lower pollutant emissions and improve indoor and maybe outdoor air quality by increasing awareness and facilitating behavioral changes.

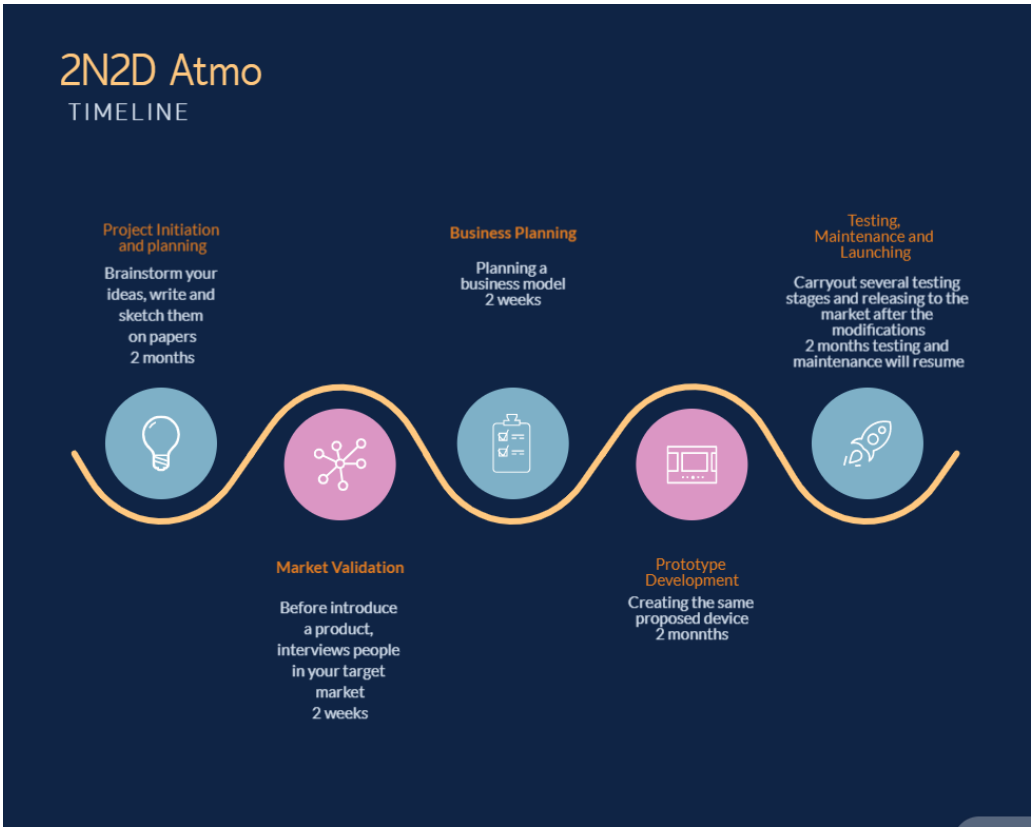
Researchers and decision-makers can benefit greatly from the insights that aggregated data acquired by the device can offer.

The device indirectly aids in climate change mitigation efforts by detecting and monitoring pollutants like CO2 and VOCs that cause climate change.

5. Logistics(C3)

5.1. Task breakdown and Time.

Timeline



Task Breakdown:

Since we are at the proposal stage of the project, we broke down our main tasks into 4 specific areas and appointed responsible persons. But when it comes to implementing, we all will be given tasks in each task, and will collaboratively complete the full end product.

- Technical Review and implementation — Nuthya Prathibhani
- Documentation — Dulini Himeka
- Legal Review and compliances implementation — Dinil Naotunna
- Funding and Revenue Maintaining — Nairandha Dhanomika

5.2. Contribution to Pi-Mora and the Raspberry Pi-related activities.

Participated at Pi Mora workshop by Yasiru Senarath on Ethical Hacking –Dulini Himeka

Active committee members at SLRC branch, EClub - Nuthya Prathibani, Dulini Himeka

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