

# IOT BASED SMART AIR POLLUTION SURVEILLANCE SYSTEM

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**Abstract :** The devastating issue of today, in this highly competitive world is air pollution. It is one of the leading factors to cause environmental and human health risks in India. Due to this, the quality of air in urban areas is drastically decreasing day by day. It also leads to many premature deaths, respiratory and cardiovascular problems, and a variety of cancers. There are various sources of air pollution from among which air pollution due to automobiles plays a crucial role. Because of this, pollution levels go beyond the safe limits causing a severe threat to the ecosystem. In order to control pollution, many real-time air quality monitoring systems have been proposed and implemented. Here this paper is all about describing the various methods, techniques and technologies that are so far have been proposed and implemented to make the living environment free from pollution. At last but not least, we conclude by specifying the goals that enhanced in the future.

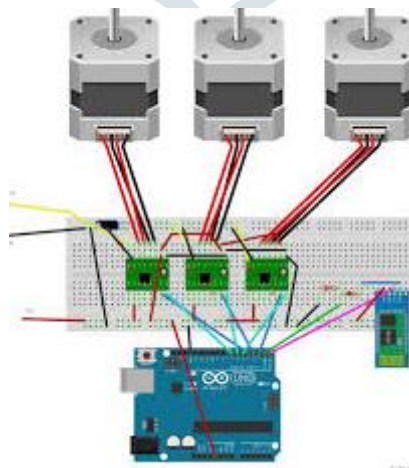
**Keywords – Air pollution, sensors, pollution prevention, wireless network.**

## I. INTRODUCTION

The most vulnerable global challenges faced today is air pollution. Air pollution presents a serious threat to urban areas, especially where human occupancy is more; it causes a severe impact on human work performance. Not only this air pollution is responsible for premature deaths, global warming, respiratory problems, cardiovascular problems and variety of cancers. There are many resources of air pollution, from among which traffic induced air pollution plays a significant role. To mitigate this air pollution and have 24\*7 control on pollution level, we need to have real-time air quality monitoring systems, so that we can have a pollution free environment. Many research works are going on this particular aspect, one of the research works has proposed a real-time air quality monitoring system that has been made successful in making the environment free from pollution for about 75%. This particular system will implement using one of the sophisticated IOT technology.

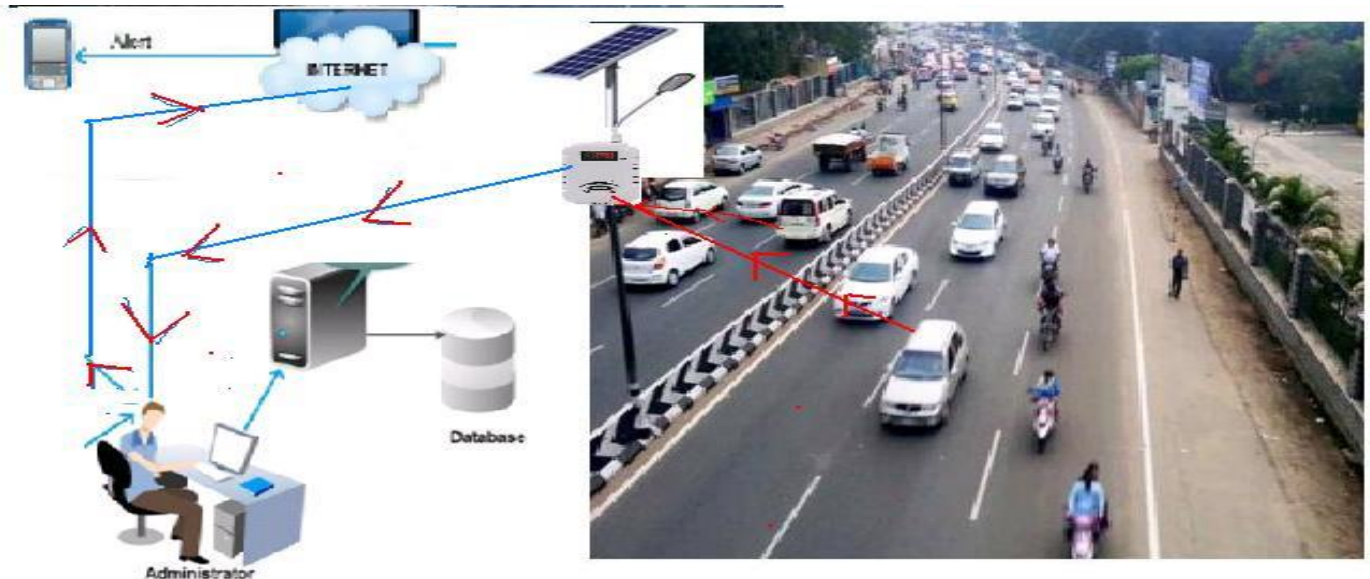
## II.IOT BASED MONITORING SYSTEM:

In the era of IOT, air pollution monitoring has overcome many of the limitations faced by the conventional monitoring system. It is the most trending networks in which devices like sensors, hardware, software and actuators(controllers) that stay connected and communicate with one other without human intervention. One of the unique features of IOT is that it just goes beyond the devices that are having no more internet connection that means without an internet connection, it allows all the accessories to stay connected and to communicate that is made possible through machine learning. The purpose of this system is not just monitoring the pollution level but also to control vehicular flow and help the users to create a safe and secure journey. By introducing IOT into the field of environmental protection following benefits to be achieved:



- IOT helps to form a sensor network in a large area without any overhead.
- By implement IOT, hardware cost will reduce.
- Since many sensors are involved, so that, it ensures accuracy.
- As the big-data analysis is required, decision making for emergency response after a pollution accident happens will also be guaranteed.
- Besides this, some of the issues will resolve:

- The bugs or errors that are resulting in software or hardware has an adverse consequence.
- The 24\*7 power supply is needed, in case of power failure, it causes much inconvenience.
- Lack of interoperability that is different devices from different companies stay connected in one network. Last but not least IOT itself is a complex network.



### III. RELATED WORKS

#### IOT BASED AIR POLLUTION MONITORING AND CONTROL SYSTEM

Air pollution is one of the most vital issues that has given serious attention. Air pollution has ravaging effects on the public and our living environment[2]. The most adverse impact of air pollution is global warming due to which the earth, and there is a chance of ozone-depletion. Not only this it is also going to affect humans by some respiratory problems, cancers, cardiovascular diseases and premature death[1]. To check air quality, this paper proposes a real-time system that is having a high spatiotemporal resolution. Real-time monitoring will enable Scientists to make informed decisions about air pollution, and this information is also beneficial to ordinary people[3]. This proposed system consists of sensors namely MQ-7 sensor for carbon monoxide, MQ-135 sensor for ammonia, MQ4 sensor for detection of methane and G37 for amount oxygen. The inputs from sensors will forward to a signal circuit that connected to microcontroller (PIC16F877A) where it is going to measure with the standard values that are already defined, and if it is above the standard value then this information will be sent to remote server via wifi (wireless network) from which the traffic control system can access it. This system employs wireless sensor network (WSN). Some of the future upcoming that are focused are 3-dimensional air pollution covering information, quality of sensors need to be that is it should get sustain to the ambient temperatures and humidity. At last, we need to have a system that consumes deficient power that is the sensor should be energy efficient.

#### AUTOMATED CONTROL SYSTEM AND INDOOR AIR QUALITY MANAGEMENT

This paper reveals the quality of air managing and controlling in more crowded areas like schools, offices and multi-stored buildings. Because of poor air quality that is due to poor ventilation, it is going to have a severe impact on human performance [4], i.e., headache, respiratory problems. The primary goal of this paper is to design an automated system which will detect and pass the information about the number of gases like smoke, CO and toxic gas in closed doors. Not only this it will also detect LPG, propane, and methane, if these gases exceed the defined frequency then they sense by sensors and will be displayed on LCD, alarm generates that information simultaneously passes to command and control center through a wireless link. This detecting and responding timely through a reaction called swift reaction. The system consists of a microcontroller (PI C 18F452), CPU, ADC (analog/digital converter) and an output controller is used. Different gases have their respective sensors like MQ4-methane, carbon monoxide MQ7, smoke MQ-2 sensor is used. Gas sensors will use to sense all types of gases. These sensors have high sensitivity and active time [5].

The proposed system is a cost-effective system, simple to design and easily portable when compared to a conventional method. This proposed system does not have any disadvantages [3],[4].

## **AUTOMATED CONTROL SYSTEM FOR AIR POLLUTION DETECTION IN VEHICLES**

Vehicles have become an indispensable part of everyone's life. It leading cause of air pollution and also, will emit harmful gases, but this emission has to be in the limit, and when the discharge exceed the standard values then the real problem begins there. Emission is due to incomplete combustion of fuel in vehicles and due to poor maintenance of vehicles. Cost for the emission level will set by Bharat Stage Emission[1]. All the automobile industries shall comply with these standards. The overcome all the inconvenience, this paper proposed a semiconductor sensor that was fixed at the exhaust of the vehicle, and it monitors the emitting gases. When this emission crosses the limit, it will show to the user in the digital reading then it will stop the supply of fuel to engine and vehicle will stay after 5-seconds. The global positioning system(GPS) will show the user a nearby mechanic or service station. Many research activities are going on to develop semiconductor sensors[2]. This process implements by using a smoke detector, a microcontroller(ATMEL 89S52) and fuel injector are used. The smoke detector detects oxides of carbon, nitrogen and sends to microcontroller where it compares with the values that set and sends a signal to fuel injector where it will stop the supply of fuel to the engine. The proposed system is beneficial to make use of the environment free from pollution.

## **INTELLIGENT VEHICLE COUNTER- A ROAD TO SUSTAINABLE DEVELOPMENT AND POLLUTION PREVENTION**

As a minimum of two-wheeler vehicles is affordable by everyone, the increase in population is directly related to the transports vehicle. The light and heavy transports are increasing day by day causing traffic accidents and due to these vehicles traffic induced air pollution has also become a matter of significant concern — the only way to mitigate this by driving less[1]. We need to have a sustainable development that is without depletion of natural resources; we reach the current and as well as future needs[2]. The main objectives of the paper are to develop an effective system to reduce air pollution by vehicular detection and counting. Here this system is making use of Intelligent Transportation System in which users will come to about traffic, seat availability much priorly so that the user can have saved his time to travel and have comfort journey[4]. The main aim is to have a vehicle counter for automatic detection and counting of vehicles on highways in case of high traffic. This vehicle counter is deployed by using background registration, subtraction, and detection of foreground object for counting followed by tracking and detecting the vehicle. Many governments put their efforts to have a real-time solution for reliable traffic flow[6]. This type of system is much-needed to make the traffic network smart[5].

## **A SURVEY ON APPLICATIONS OF WIRELESS SENSOR NETWORKS IN REAL TIME AMBIENT AIR POLLUTION MONITORING AND AIR QUALITY IN METROPOLITAN CITIES**

Nowadays air pollution is a burning topic in our society. By this air pollution many gases such as CO, SO, NO, PM, etc releases and causing damage to the health of living things. To overcome this problem, we need to introduce a network called wireless sensor network(WSN).WSN in a sense a group of dispersed sensor nodes for monitoring the conditions of the environment and providing the collected information at the center. The main feature of the sensor node in the sensor network is consuming low power and includes multi-functionality. Here the user accesses the internet for the gateway of sensor nodes in a sensing field so that the user can check the air quality in any environment. If air measure and air quality exceed the limit that causes infection, at that time some of the gases releases and these gases monitors at real-time by using WSN and also sends information to the ambient area, by this, we can reduce the air pollution. Good air is the most critical aspect of the lives of humans. We conclude that using WSN technology is a challenge for monitoring the exact concentration of pollutants in metropolitan cities.

## **SURVEY ON SENSOR CALIBRATION IN AIR POLLUTION MONITORING DEPLOYMENTS**

Air pollution is a significant issue in urban areas, and it is profoundly affecting the lives of the people. Urban air pollution is majorly affecting the quality of life by releasing the pollutants like particulate matter(PM), ozone(O<sub>3</sub>), carbon monoxide(CO), etc which are causing diseases. One of the studies of the World Health Organization(WHO) calculated that 11.6% of all deaths in 2012 are because of air pollution. To reduce all these diseases, and ends we need to check the levels of air in which it is going to be useful. For this, we have to carry out a low-cost, portable, low power air pollution sensors. This sensor provides information about air pollution before it .is caused. This information helps people to take precautions before their health is at risk. This low-cost sensor is also known as state-of-the-art sensors. The next sensors are groups into two groups. They are particulate matter(PM) sensors and gaseous sensors. These sensors describe the mixture of particles present in the air which are to pollute. The examination provides the overall mechanism of state-of-the-art or low-cost sensors. All these sensors work with the help of error sources, calibration models, re-calibration strategies, etc. It offers convenience in the quality of measurements. Hence it is a challenging task.

**A SURVEY OF WIRELESS SENSOR NETWORK BASED AIR POLLUTION MONITORING SYSTEMS**

Over the past few years, air pollution has become a significant research topic. Air pollution majorly causes heart diseases and minor damages the health. In 2010, the European Commission produced danger to the UK with legal actions for breaking of PM limits, so that the UK should pay \$300 million per year. Here we use different types of sensor networks like SSN(Static Sensor Network), VSN(Vehicle Sensor Network), CSN(Community Sensor Network), etc to reduce pollution. We should also start next generation air pollution monitoring and survey system(NGAPMS) which fills the space between conventional monitoring systems and air quality models. It involves real-time tracking. In SSN environment, the sensor nodes installed at the traffic or street light poles or walls. In CSN, the sensor nodes carried by the users. The user can share pollution levels through their smartphones with some applications. In VSN, the sensor nodes are taken by public vehicles like buses, taxis, etc., so that the cars share information about pollution through mobile applications, etc. Mobility or geographic coverage environment, the ranking of all the sensor networks is as  $VSN > CSN > SSN$ . In the temporal, the ranking order will be  $SSN > VSN > CSN$ . In will provide cost efficiency, the ranking order. During the maintenance, the ranking is  $VSN > SSN > CSN$ . In data quality, the ranking is  $SSN > VSN > CSN$ . These sensor networks consume low power, low cost, and are also active concerning real-time monitoring performance, spatiotemporal resolution, and quality.

**AIR POLLUTION AND FOG DETECTION THROUGH VEHICULAR SENSOR**

We can develop a method which is useful to find air pollution and fog from vehicles. For that purpose, we require sensors to get the primary data/information from cameras and light detection and recognition [LIDAR] instruments. We talk about ho is information to be restricted(controlled) and unified and analyzed to find out the air pollution or fog. The experimental results conferred for weather conditions like air pollution screening that the identification process works better than adequate results. This governing driving when compared to a camera the only system. Finally, we conclude that the integration of front camera and LIDAR laser scanner is proper as a sensor instrument set for air pollution and fog identification that can give precise data to driving assistance and weather alerting system. LIDAR technology will allow advanced object identification used for qualified detection. LIDAR is a bright technology for air pollution and fog. The diameter of the molecules is from 0.5nm to several 10km. As LIDAR uses a short wavelength of light in the seeable spectrum, typically ultraviolet. The progressively automotive industry is developing and bringing forth new driving help functions to reinforce vehicle drivers.

**A STUDY ON MONITORING OF AIR QUALITY AND MODELING OF POLLUTION CONTROL**

The serious global challenge today, we are facing is Global Warming and its effects on collapsing air quality. Air pollution may cause global warming, acid rains and may create change in seasonal temperatures. The quality of air in India is poor. Air Pollution occurs due to vehicular emission and dust chemicals released from industries and burning of waste etc. Air Pollution considered as the main reason for global warming. Air pollution is a significant problem in developing countries. Agra is the most polluted cities in the country. We can control emission using a four-step strategy: measurement and assessment, set standard, emission reduction, implications, and execution. Air pollution is extraordinarily complex and challenging to manage. Everyone should be aware of air pollution and its related issues. It's essential to learn environmental studies so that we come to know its importance. We need to be aware and conscious of the environment.

**RESEARCH OF INDOOR MOBILE BIOLOGICAL AIR PURIFIER PEDESTRIAN TRACKING SYSTEM**

As technology is evolving the people's demand for quality of life is increased. The Mobile biological air purifier detects the footer and translate air pollutants around the pedestrian environment, and improves the quality of air and protects the environment. In this, as per 3-dimensional measurement principle of binocular vision, a tracking system is constituted which adopted haar+adaboost algorithm with camshaft algorithm to recognize identification and tracking of the pedestrian, purifier and adopted Kalman filter. The experimental results show that the system can identify the mobile biological purifier tracking pedestrians precisely. In this, the natural purifier uses binocular vision camera and mobile purifier under an indoor environment.

**The 3-Dimensional measurement principle of binocular stereo vision:**

It uses two cameras in parallel alignment; the optical center is the endpoint, the bond between two optical centers as in X-axis. Pedestrian detection and tracking algorithm for mobile biological air purifier:

**Haar+Adaboost Algorithm:**

It is the boosting algorithm application that has a shower the strong classifier trained by AdaBoost with weak error rate.

**Camshaft Algorithm:**

It uses a color model to transform an image or picture to color probability dispersion.

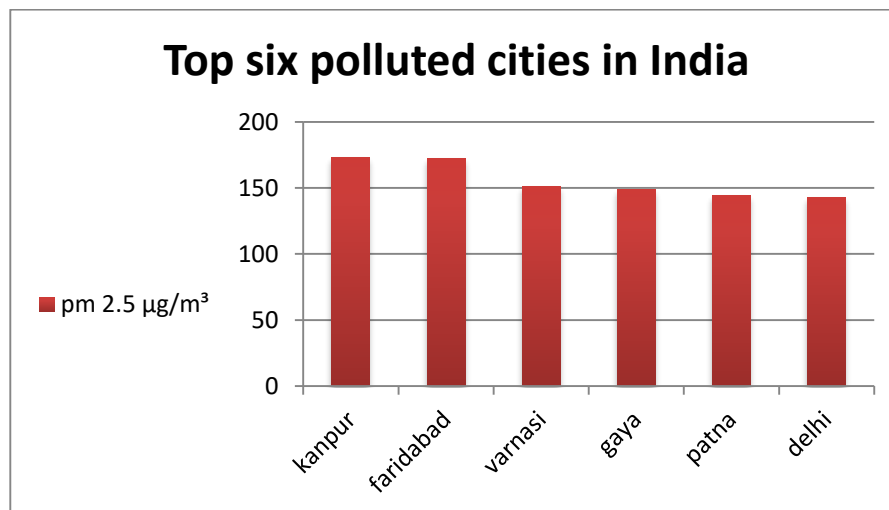
**The Kalman Filter:**

It is an optimal recursive appraisal method which filters state vector discrete data. In the experiment, cameras installed on the adjustable bracket, and the purifier is in the camera view.

The mobile biological purifier is very useful as the natural purifier cannot move; the purification around a pedestrian is not possible. All the algorithms used in this are helpful to improve the pedestrian detection, tracking and to correct place of the purifier. It is useful to track pedestrian accurately.

**IV.COMPARISON OF HIGHLY POLLUTED ENVIRONMENT IN INDIA**

The graph represents the comparison of highly polluted areas in and around major cities.

**V.CONCLUSION**

This paper is handy to researchers and planners to have a quick grasp of the methods and technologies that existed implemented. Though the existing monitoring systems are concluded with a good quality of work precisely, they are massive, expensive. All these systems can meet up to 70-80%. There is a need to make the environment 100% pollution free. In the future, We need to have IOT based 3-dimensional air pollution monitoring system which monitors the quality of service(QoS) of sensors that consumes less power and performance is an energy-efficient system.

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