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# Design and development of Air and Water pollution quality monitoring using IoT and Quadcopter

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**Abstract.** The Earth is a resource for drinking water and fresh air, which comprises of many untapped elements that lies beneath. In India one of the major problem in developing countries is that the water bodies are highly polluted and air is contaminated. Industrial facilities uses a lot of chemical as raw materials. Some of them are very harmful and contribute to pollution. This results in the incrementation in the emission of hazardous materials in air, water as well as soil. Future prosperity and stability are determined by important natural resources that is air and water. So we have designed the Water and Air Monitoring System that will help the authorities in crisis management centers to discover and anticipate contamination of water and air. The system comprises of one master drone and four slaves robot where the two of the slaves serves the purpose for detection of air pollution and the next two are used for water pollution.

**Keywords:** Water, Air, Pollution, Master Drone, Slave robots

## 1 Introduction

Clean water and fresh air are one of the most essential elements for the existence of humans and other living creatures, but with the alarming rate of pollution it is necessary to reduce the pollutants caused by mankind in order to protect the environment. Between 1 to 9 November 2016 the nature showed that how bad air quality has become and so air pollution struck the capital of India(New Delhi) causing a great destruction for all the living organisms. On 7<sup>th</sup> Nov, 2016 the Particulate Matter 2.5 levels had risen upto 999, even though only 60 microorganism is recommended [1]. On December 2002, it's been estimated that around 4000 deaths were caused due to great smog occurred in London. [2]. The most vital element among natural resource is water which is essential for the existence of living being, production of food and economic development. According to the National Sample Survey Organization (NSSO), 91.3% of rural households in Punjab use SBF to meet their energy needs for cooking [3]. Control of air and water pollution is no longer just a matter of conventional combustion products [4]. Recently, ambient air pollution with particulate matter (PM) has been classified as carcinogenic to humans (IARC, 2015) [5]. In India quiet a number of cities are facing the acute shortage of water; even though a wide variety of work depends on the water.

Pure water has virtually zero conductivity [6]. Due to industrial waste say chemicals and other hazardous material not only degrade the quality of water but also serves as a poison for all the living organism using it in a direct or indirect manner. There are several projects running for the removal of water pollution from various rivers but none of them have given the result upto the mark. Narmada project was started years ago and yet haven't been finished in cleaning up the river. According to the World Health Organization (WHO, 2011), the greatest risk to public health comes from microbes Contaminated drinking water [7]. The US Environmental Protection Agency (EPA) has imposed stringent regulations on the concentrations of many environmental pollutants in air and water [8]. In the Narmada River, turbidity, BOD and hardness is found in higher concentration when compared to the standard permissible limit. This study also revealed that the local residents were suffering from respiratory and skin diseases adversely [9]. Yellow fever and dengue were the most frequent diseases available in the nearby region. Due to increase in frequency, magnitude and potential effects water problems has turned around to be a subject of global issue and are not confined to a particular places and areas. [10]. Therefore, it is a high time for all the citizens to work upon this disastrous area for the betterment of the living being. The proposed system deals in the detection of the contamination of water as well as that of air to a greater extent without harming the nature's cycle and doesn't lead to destruction of the environment. One master drone and four slave robots will be present in the system and communication amongst them will be done through RF modem. Thereby monitoring as well as revealing the information regarding the health of air and water.

## **2 Theory**

### **2.1 Causes Of Water Pollution**

- 2.2.1** Humans usually dump and litter the solid wastes in rivers, lakes and oceans. The cardboard, Styrofoam, aluminium, plastic and glass are few littering items.
- 2.2.2** Oil is insoluble in water and thereby forms a thick sludge. During ship travel, accidentally if the oil gets spilled then it pollutes the water and hence leads to water pollution.
- 2.2.3** Sewage can lead to a major problem if chemicals and pharmaceutical substances are flushed in the toilet by people.

Air pollution equally contributes to the contamination of water bodies and effect the food chain adversely. In air pollution, algal blooms is caused by nitrogen compounds and also contributes to acidic nature of the water bodies thus causing in misbalance in health and environment as well. It may cause diseases, allergies or cause death of any species. Due to Air pollution an individual's medical conditions are aggravated and person suffers from asthma and emphysema, lung cancer, chronic respiratory disease, heart disease, and even damaging to the brain may occur.

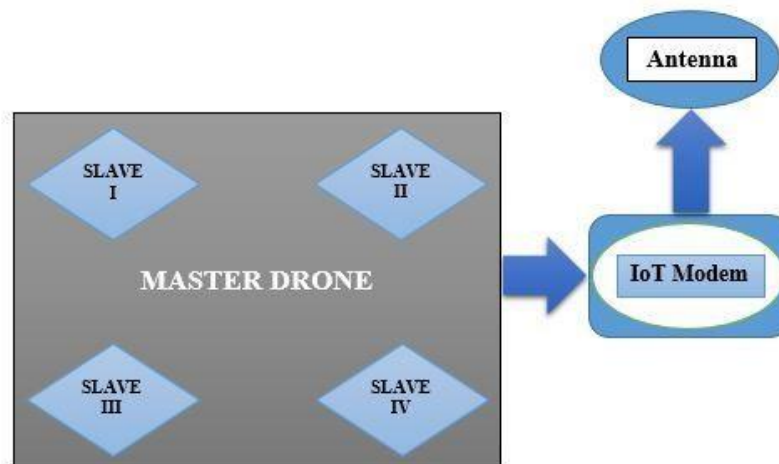
### **2.2 Causes Of Air Pollution**

- 2.2.1 Emissions from industries and manufacturing activities.
- 2.2.2 Burning of fossil fuels. Carbon oxides ( $\text{CO}_x$ ) is highly emitted from motor vehicles & Hydrocarbons (HC) and Nitrogen Oxides ( $\text{N}_x\text{O}_y$ ).
- 2.2.3 Household and farming chemicals. (crop dusting, fertilizers dust emits harmful chemicals into the air)
- 2.2.4 Deforestation is also a main cause that contributes to air pollution and green – house effect.

### 2.3 Key Facts:

- 2.3.1 Out of every 100 individuals almost more than 40 are affected due to water borne diseases and 30 are going through air borne diseases such as asthma.
- 2.3.2 Dead marine life on the coast and many other wind up on the beaches, killed by the contaminants in their habitat.
- 2.3.3 Likewise plants too are affected via different ways say acidification, eutrophication and ground-level ozone.
- 2.3.4 People working in the outward region mostly suffers from the burning sensation in eyes and throat. Their lungs are also damaged and leads to several diseases.

## 3 Proposed System

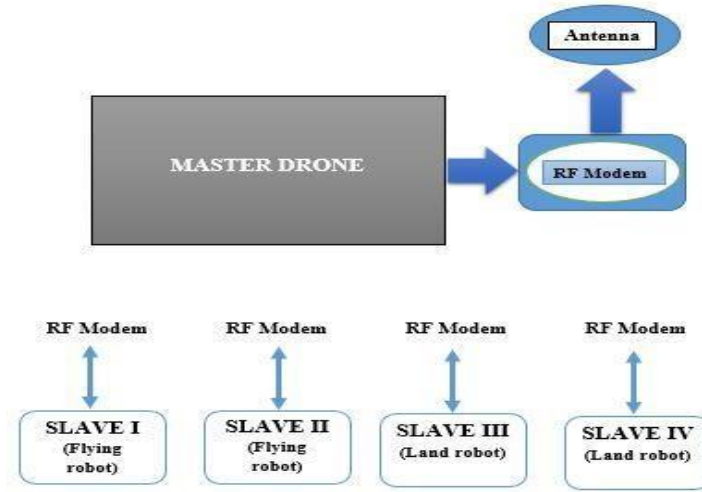


**Fig. 1.** Block Diagram of Master Drone

### 2.1 Master Drone

The proposed system consists of one master drone and four slave robots. Where the two slaves are flying robots and they will serve the purpose for detection of air pollution and the next two slaves will be land robots and are used to monitor water pollution. The four slaves will always be accommodated inside the master drone which will have a payload of 1kg. Each slave robot will weigh 200-250gms. In that area where the

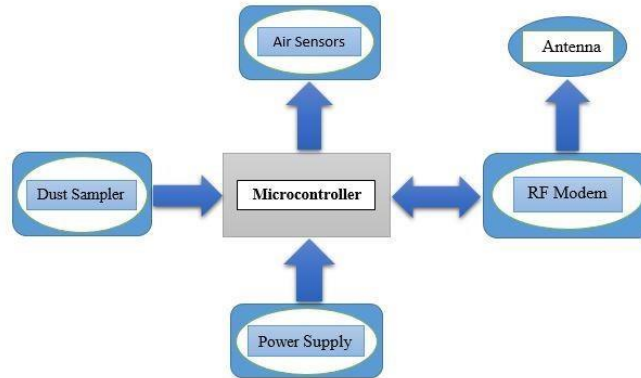
pollution needs to be monitored, master drone will be sent and the four slaves residing inside it; will come out. The four slaves will send real time data to master drone through RF Modem. In this way the exact location of all the slaves could be determined. The drone will help in recording and maintaining the data received from the four slaves.



**Fig. 2.** Block Diagram of Main System

## 2.2 Flying Robot

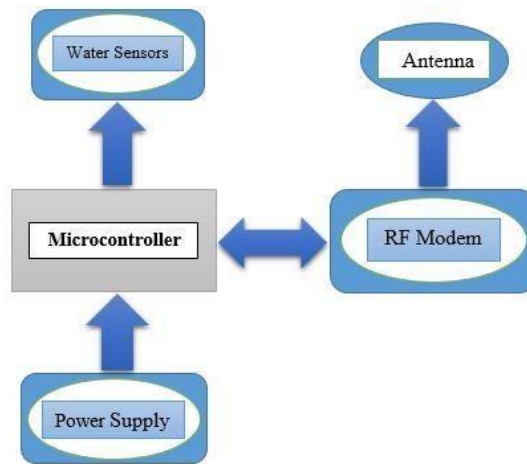
It consists of Microcontroller (Arduino UNO), Dust Sampler, Air monitoring sensors like MiCS-2714 Gas Sensor (NO<sub>2</sub>), MQ-9 Gas Sensor, MiSC-2614 Gas Sensor (Ozone), Humidity sensor, MQ-2 Gas Sensor & temperature sensors, RF Modem & DC power supply. The different kinds of sensor will serve the assigned purposes and send the real time data to the master drone through RF Modem. The data will be uploaded from master drone to the server via IoT Modem and this will help in analyzing the different levels of air pollution present in that particular area, so that the necessary steps can be taken by the governing authority.



**Fig. 3.** Block Diagram of Air Robot

### 2.3 Land Robot

It consists of Microcontroller (Arduino UNO), Water sensors which include oxidation-reduction potential (ORP), pH, conductivity (salinity), dissolved oxygen (DO), turbidity, temperature and various dissolved ions , RF Modem and DC power supply. Here also the different kinds of sensor will serve the assigned purposes and send the real time data to the master drone through RF Modem. The data will be uploaded from master drone to the server via IoT Modem and this will help in analyzing the different levels of water pollution present in that particular area, so that the necessary steps can be taken by the governing authority.



**Fig. 4.** Block Diagram of Land Robot

## 3 Component Description

**Table. 1.** Equipments used

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Sl. No.	Equipment	Specification
1	Microcontroller	Arduino UNO
2	Power Supply	5V DC
3	RF Modem	433MHz
4	Antenna	3dB
5	Sensors	Water Sensors, Dust Sampler

S.No.	Device	Specifications
1.	Arduino UNO	Microcontroller board based upon the ATmega328P.
2.	RF Modem	It works at a frequency of 2.4GHz. Used to receive and transmit data.
3.	IoT Modem	It's used to transmit data to the cloud.
4.	Water Sensors	It's used to measure different levels of pollution in water bodies.
5.	Air Sensor	Air Sensor is designed to analyzed different levels of air pollution.
6.	Power Supply	12V/1A lithium ion battery, AC power supply.

## 4 Result and Discussion

The air and water monitoring system is nowadays very important and essential. This technology minimizes the level of pollution which is present in the air as well as in water. In this way the contamination would be highly reduced. The air-water borne diseases can not only be prevented but also the animals, humans and plants can live in the healthy environment. The proposed system is efficient, cost effective, approachable and environment friendly.

## 5 Future Scope of the work

Access to clean water and air is indispensable to human life. Yet managing this access in an efficient and effective manner is an immensely complex challenge. Due to air pollution, people are highly prone to respiratory diseases for example bronchitis and heart problems which has increased the number of hospital beds. The air pollution has led to major health effects when compared to other environment factors. Contaminated water too leads to bad health and effect living creatures residing in the water bodies. Due to limited and lack of human efforts & modern technology, it isn't feasible to control pollution in each and every area. If this project is installed then organisations would get a better chance to control the pollution efficiently thereby maintaining the fragile ecosystem. Thus making our environment a better place for each and every individual.

## References

1. Sweta Goswami (7 November 2016). "Delhi's worst smog yet wakes up govt, emergency measures announced". Hindustan Times.
2. Brunekreef, Bert, and Stephen T. Holgate. "Air pollution and health." *The lancet* 360.9341 (2002): 1233-1242.
3. Sidhu, Maninder Kaur, et al. "Household air pollution from various types of rural kitchens and its exposure assessment." *Science of The Total Environment* (2017).
4. Thomas, Moyer D., and R. H. Hendricks. "Effects of air pollution on plants." *Air pollution* 239 (1961).
5. Pedersen, Marie, et al. "Ambient air pollution and primary liver cancer incidence in four European cohorts within the ESCAPE project." *Environmental Research* 154 (2017): 226-233.
6. Gehlot, Anita, et al. "WPAN and PSO based Water Quality Monitoring with LabVIEW as data logger."
7. Dixit, Rakhi Bajpai, et al. "Emergence of toxic cyanobacterial species in the Ganga River, India, due to excessive nutrient loading." *Ecological Indicators* 72 (2017): 420-427.
8. Ho, Clifford K., et al. "Overview of sensors and needs for environmental monitoring." *Sensors* 5.1 (2005): 4-37.
9. Katakwar, Mukesh. "Narmada river water: Pollution and its impact on the human health." *IJCS* 4.2 (2016): 66-70.
10. Markovic, Natasa, Aleksandar Stanimirovic, and Leonid Stoimenov. "Sensor web for river water pollution monitoring and alert system." 12th AGILE International Conference on Geographic Information Science "Advances in GIScience", Hannover, Germany, ISSN. 2009.