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Calculating Pollution in Metropolitan Cities using Wireless Sensor Network

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Abstract: Pollution is certainly not the new thing in today's world. Calculating pollution in urban areas can efficiently promote better planning and encourage better use of transport which may lead to bring huge social and economic benefits. Based on the wireless sensor network (WSN) technique, our system investigates the pollution of different areas in metropolitan cities. We design the architecture of WSN based pollution monitoring system which collects pollution range from different areas and send the collected information to Server. Wireless sensors used to calculate the percentage of harmful gases present in the air which is useful to avoid different health related issues in that particular area by using Data Mining. Real time results have shown the good performance of the proposed calculation scheme compared to other traditional scheme. By calculating polluted air in different areas using wireless sensors can be useful to calculate percentage of harmful gases and ultimately reduce the pollution in air. Our system not only measures the pollutant level, temperature, humidity but also we can forecast possibility of future pollution range by using data mining algorithm on our database.

Keywords: wireless sensor network, server, data mining, pollutants.

I. INTRODUCTION

Pollutants are nothing but the substance or energy which causes adverse effect on environment, human health, animal species, plants etc. Air pollutants are the main cause for pollution which may arise from combustion process, motor vehicles, industry. In 18th and 19th century, the industrial revolution was base on the use of coal. The burning of coal for domestic purposes caused pollution level reached to very high level. These causes traffic disruption and dramatically rise in death rates.

In 19th century, due to emissions of sulfur dioxide and nitrogen oxide, with the combination of water molecules in the atmosphere leads to produce acids which caused Acid Rain. Nitrogen oxides can produce naturally by lightning strikes and sulfur dioxide is produced by volcanic eruptions. The adverse effect of acid rain causes paint to peel, corrosion of steel like bridges, erosion of stone statues, forests, freshwater and soil, damage to building and having bad impact on human health, aquatic life and animals.[Wikipedia].

Pollution is an undesirable change in physical, chemical or biological characteristics of air, land or water that harmfully affected the life or create potential health hazard to living organism. Air pollution is a major risk factor for multiple health conditions including infections in skin and eye, irritation of the nose, throat and eyes, heart disease, lung cancer, bronchitis, difficulty in breathing and coughing [1]. The main cause of pollution is Carbon dioxide (CO₂) gas is a very poisonous gas. It is produced by incomplete combustion of fuel such as coal or wood, natural gas [4].

II. MOTIVATION

The major cause for many premature deaths is air pollution. There are near about 2.4 million people die each year due to pollution according to World Health Organization. Air pollution causes worse effect on people health, environment which may lead to acid rain, smog, deterioration of the ozone layer and global warming. Different types of refrigerants have been used in air conditioners over the years. Chlorofluorocarbons (CFCs) are major contributors to ozone-layer breakdown which may cause good or bad effects on human health depending on where it occurs. Pollution monitoring and controlling is very important to improve people's comfort, health and safety. A pollution monitoring system with sensor nodes in metropolitan cities is mainly motivated by the needs of carbon emission measurement and real-time surveillance for CO₂ management in cities. There is a very strong need for the implementation of a pollution monitoring and controlling system globally. The better way to control pollution is to continuously monitor and measure the exceeding levels of pollutants.

III. RELATED WORK

To monitor air quality in, Wireless Sensor Networks (WSN) is used. The problem of air pollution is becoming a major concern for the health of the population, with the fast growing industrial activities on the island. In previous study, the system collects pollution data using mobile hardware modules, transmits the data regularly using GPRS to server, and generate a pollution map of the city using its geographical information system which was available at anytime from an easy-to-view website with maximum coverage. The system has been implemented and tested in Dubai[8].

An air pollution geo-sensor network consisting of 24 sensors and 10 routers was installed to monitor several air pollutants [5]. To measure CO, NO₂ and SO₂, a smart sensor microconverter equipped with a network capable application processor that downloads the pollutants level to a personal computer for further processing which helps to monitor and control environmental air pollution [2]. After certain period of time, a real-time monitoring wireless sensor system came into picture which measures toxic environmental volatile organic compounds with the help of Bluetooth device interface. It provided high sensitivity and selectivity [3].

Clementine software is used to cluster 53 year of cluster data from 1951 to 2003 of Air Pressure, Air humidity and dusty days per month with k-means clustering algorithm. Dusty days are classified into 5classes and decision rule has been exported between air pressure, air humidity and dusty days of January, February and March of each year and other month of year dusty days[9].Google maps are used in pollution monitoring system which consist of Mobile Data-Acquisition Unit and a fixed Internet-Enabled Pollution Monitoring Server. The Mobile-DAQ unit gathers air pollutants levels, and packs them in a frame with the GPS physical location, time, and date. The frame is uploaded to the GPRS-Modem and transmitted to the Pollution-Server via the public mobile network. The Pollution Server was attached to database server for storing the pollutants level. for environment protection agencies, vehicles registration authorities, and tourist and insurance companies.

Google Maps was interfaced to display real-time pollutants levels and locations in large metropolitan areas. The system was successfully tested in the city of Sharjah, UAE[6]. In order to comply with requirements of oil and gas industry, an air quality monitoring system was proposed based on ZigBee wireless sensing technology. It uses ZigBee wireless network to send results to the monitoring center so that, if some abnormal situations happens, a quick warning will be generated to remind staff to take effective measures to prevent major accidents and protect human lives in industry[7].

IV. PROPOSED SYSTEM

Air pollution is extremely dangerous and need to be monitored continuously having potential which may lead to death. There are different pollutants present in the air which may need to monitor for better living. There are some areas in the city which are highly polluted because of population, vehicles, industries etc. The polluted areas are very dangerous to human health which need continuous monitoring.

We use various sensors to measure the percentage of pollutants present in the particular areas of the city. Using sensors we can also detect temperature and humidity present in the air. By using Bluetooth controller the collected data will send to server. Then we apply ID3 data mining algorithm which is useful for calculation of the percentage of pollutants in the air as well as temperature and humidity. With the help of data mining algorithm, we will give future predictions to the particular area in the city and can also provide alarm to highly polluted area.

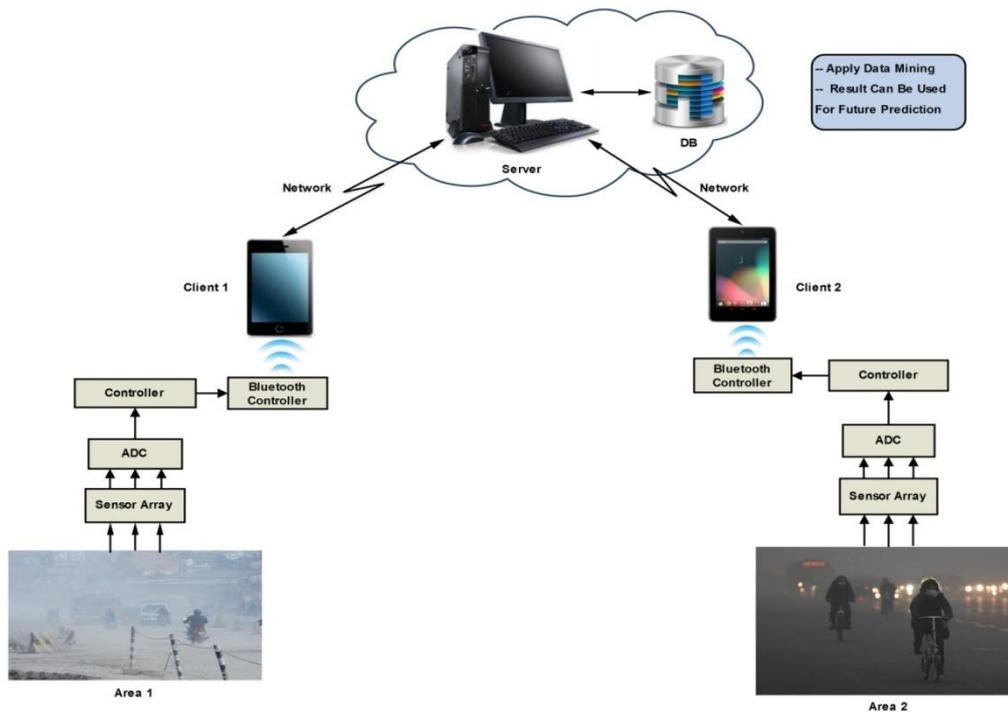


Fig. 1 System architecture

FEATURES

1. Develop architecture to define nodes and their interaction.
2. Collect air pollution readings from different region of interest.
3. Collaboration among thousands of nodes to collect readings and transmit them to a gateway, which minimizes duplicates and invalid values.
4. Use of appropriate data aggregation to reduce the power consumption during transmission of large amount of data between the thousands of nodes.
5. Visualization of collected data from the WSN using statistical methods such as tables and line graphs.
6. Provision of an index to categorize the various levels of air pollution, which represent the seriousness of air pollution
7. Generation of reports as well as real-time notifications during serious states of air pollution for use by appropriate authorities.

Currently, the Air Monitoring Unit in Mauritius makes use of bulky instruments which lacks resources. This reduces the flexibility of the system and makes it difficult for proper controlling and monitoring. Our system will try to enhance this situation by being more flexible and timely. It will provide accurate data with indexing capabilities.

V. FUTURE SCOPE

This system is use for air quality monitoring and controlling which will provide the harmless air. A control strategy is a set of discrete and specific measures identified and implemented to achieve reductions in air pollution. These measures may vary by source type, such as stationary or mobile, as well as by the pollutant that is being targeted. The purpose of these measures is to achieve the air quality standard or goal. Costs and benefits are assessed in the development of the control strategy.

CO₂ is the main cause of pollution in air which is mainly caused by vehicles. By detecting and monitoring the quality of air in certain area will prevent the health related problems in that area such as headaches and dizziness and after a certain period of time it may lead to death. Air pollution monitoring is considered as very complex as well as very important task. Traditionally data loggers were used to collect data periodically which was very time consuming and quite expensive. The use of wireless sensor network can make air pollution monitoring less complex and more instantaneous readings can be obtained [6, 7].

VI. CONCLUSION

After studying and understanding literature survey and our base papers we are calculating the air pollution using different sensors in particular area in pune like Hinjewadi which is considered as the greenest area in city. Due to excessive use of Air Conditioner (AC) in IT industry generates harmful gases which may lead to adverse effect on human health like headache, dizziness, irritation in eyes. The prolonged effect of pollution may lead to death. The Chemical industry near pune like Kurkum area is mainly responsible for chemical gas emission that is harmful for human health.

To detect such harmful gases in particular area we have used different sensors to get values of pollutants in the air. By using data mining algorithm we can predict the future pollution in particular area. Our system not only just monitors harmful gases in the air but also gives future prediction which is useful for better environment

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