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Air Quality Monitoring and IoT- Past and Future

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***Abstract*—Air quality index is a key discussion area in today's time in concern with human health and environmental hazards. It directly impacts the human health. In the current scenario, mobile and other wireless based smart devices are playing an important role in day to day life. Hence, it is important and evident that the same must be used efficiently to tackle our daily problems. One common issue related to quality of surrounding environment is to know about whether the air in surrounding is under the danger level index. Intelligent devices with the help of Internet of Things (IoT) will help in pulling of the idea of equipping every device with a measuring chip or a component that is capable of checking the quality of air on its own. Every electronic equipment with mobility can be embedded with the smart device or the smart device can itself be used externally whenever and wherever required. There exist various traditional approaches those measure the level of air quality index accurately but the problems with these are that they are located or stagnant at a particular area. Hence the real time information and the real time change is not recorded. This paper proposes an architecture using IoT for measurement of air quality index through sensor and NFC in movable devices. The proposed smart architecture will help to record the quality of air data at the current location. It is also capable of helping in collection of the wide range of data for the future solution to the problem.**

Keywords—Internet of Things, Air pollution, Real time, RFID, NFC

I. INTRODUCTION

Air pollution is one of the major concerns all over the world. It is one of the key problems faced by developing nations at present throughout the world. Atmospheric pollution plays a very prominent role in the life of human beings. It is basically the life line of everyone living on the planet and considerably affects human health. In case of humans, they are exposed to bad air for extended periods of time. It is responsible for a variety of severe and deadly respiratory illnesses (e.g., asthma) and is also known to cause cancer [1]. It is not only affecting the human beings but also affects the environment badly causing global warming, ozone depletion, acid rain and many more environmental issues [2]. Hence, the concern and need for air pollution monitoring is of utmost importance and high priority at present time.

The current pollution measurement method uses expensive stationary devices or special mobile devices. The raw data thus obtained are used to further extrapolate the degree and concentration of contamination from dispersion models. This is a coarse-grained system in which only a few pollution measures were taken [1]. The widespread use of this measurement paradigm is limited by its prohibitive cost. In addition, it is desirable to access measurements in real time. This enables rapid analysis and identification of alarming pollutant values. Access to this data is currently restricted. This is only available to a few who are familiar with pollution and its effect. The importance of IoT can play an important role here.

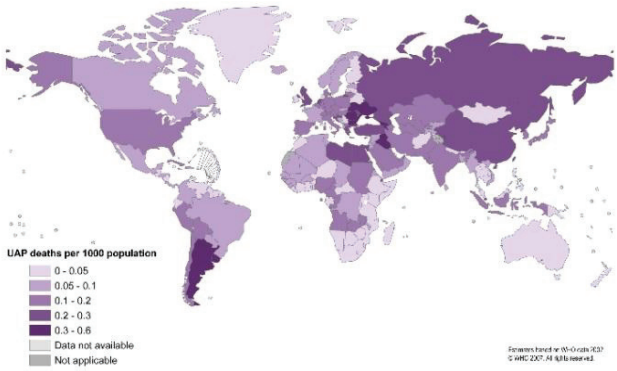

Fig. 1. Death Rates around the world due to air pollution [12]

.IoT is basically the communication of devices with each other without the external requirement. In early stages, human interacts with the devices and then the data and information are sent to internet by various communication and Wi-Fi devices [3]. In IoT architecture, each device has its own unique identification number through which it can be addressed. This helps in intercommunication through various technologies which includes Radio Frequency Identification (RFID), cloud computing, Wi-Fi, 4G Volte wireless internet access.

The availability of real time data of the air quality index will help in educating people about the conditions in their locality which will further encourage them to take preventive measures to reduce pollution. Also, if the condition becomes serious, the emergency steps of relocation or temporarily shifting can be taken [1]. It will definitely help to increase the health index of the people and will make them think about the environment after analyzing these specific sets of data which is measured in their own locality.

Availability of cheap and easy to use commodities will be capable enough to pull off the real time measurement of the air quality index. It will be a great asset in collection of more precise data. Figure 2 depicts application graph and transfer of data in IoT architecture.

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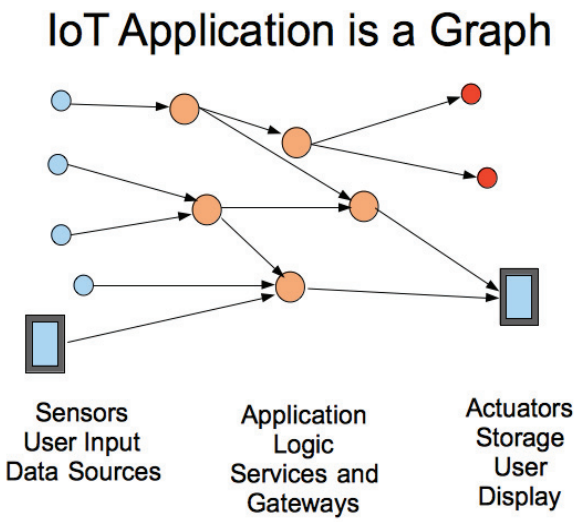

Fig. 2. IoT Application Graph [11]

Almost all the sensor-based air quality monitoring systems have inbuilt capability, those report level of different particles of pollutant to a particular server via wired modem, router etc. In this paper we propose a design to show the integration of a single-chip micro controller module. The unit can be placed in any device or in a moving vehicle. While the vehicle is on the move, the data acquired by the device is uploaded to secure server which is further used by the interested clients [4]. The data later can be integrated with tool like Google maps to produce real time pollutant index. The air quality management requires a major attention in today's scenario as it causes major problems like global warming and natural calamities with the help of IoT

Section II talks about related work in the area explored by the researchers. In section III a proposed architecture IoT based air pollution monitoring system is discussed followed by conclusion and future work.

II. STUDY OF RELATED WORK

A lot of work has been done by experts with related to this topic in past.

A. Micro-Controller based monitoring system:

A two level architecture System based on 16-bit single micro controller has been proposed which has first level consisting of D-A-Q (Data acquisition unit) and second level of Pollution server. The DAQ can be installed on any moving vehicle or it can be connected to mobile device so that it can acquire the data while moving [7].

- DAQ consist of sensor array which includes the pollution sensor including Carbon Monoxide (CO), Nitrogen Dioxide (NO2), and Sulphur Dioxide (SO2). These gases plays major role in air pollution. The DAQ also consist of GPRS (general packet radio system) which uses 3G or 4G network to transmit the data acquired by the sensors. It also protects the system with the TCP/IP [7].
- Pollution server connects to the GPRS modem via TCP/IP with the help of internet. It then connects to the database which collects and stores the data which can be accessed by the user and projected on the google maps in real time [7].

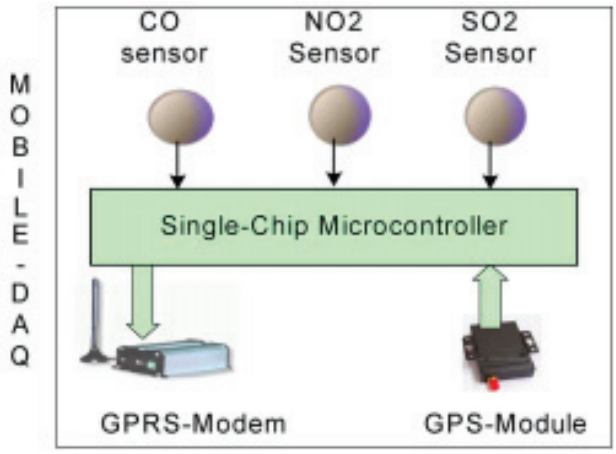

Fig. 3. Sensory system [7]

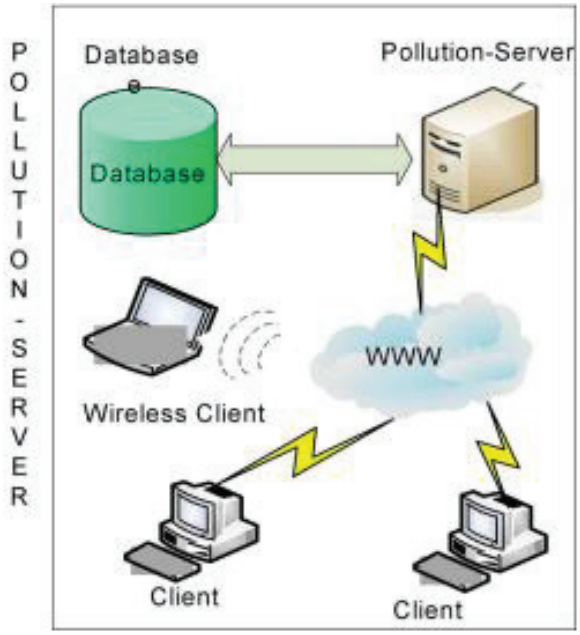

Fig. 4. Server Architecture [7]

B. A gas mobile architecture with the help of software-

The paper proposes a technique which is known as gas mobile architecture. In this architecture a mobile device is connected to the ozone sensor through a USB translator and after running mobile in USB host mode with the external power source for the sensor, result can be seen on the app [8].

- The system requires a proper application to read and calibrate the results accordingly
- The system requires a proper allocation of memory for the measurement of data and it uses the CPU as it runs.
- The accuracy of the system can be improved with frequent and real time functions of the device
- After the calibration of the data it provides a statistical result
- These types of system can be used by common people for their knowledge and awareness.

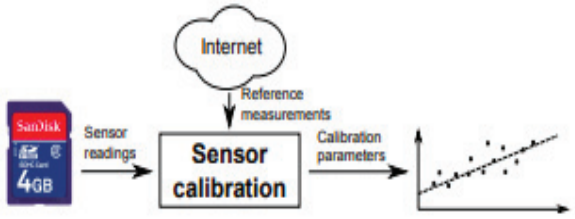

Fig. 5. Sensor Calibration [8]

Fig. 6. Hardware Design [8]

C. Monitoring system based on sensor node functionality:

This system works on the principal of how the signal works and the amount of time it takes to deposit on the sensor. It has many components such as:

- Signal conditioning- The relation between the deposition and the cleaning of the geese on the sensor is noted [9].
- Changes in air- The sensor plates working in the device gather the concentration of various gases in the environment and also notes the changes happening due to change in location. It only measures the change in pollutant gases such as carbon monoxide (CO), carbon dioxide (CO2) etc. [9].
- Signal calibration - The signal transmitted and data of sensor plate deposition are collected and plotted to form a map.
- The system contains a processing unit which is controlled by micro controller which coordinates with the sensory devices and maintains the working interval. If after a certain measurement pollution level is less than the danger level it waits longer but if it is more than specified limit it runs the system after a short interval for the accuracy of data[9].

D. Haze Watch Project

This project is pilot project done by a student in Sydney. The project develops a compatible sensory system which can be easily carried and can be mounted on the top of a vehicle. This process involves various steps-

- The sensors used in this the device is basic micro controller and gas sensors which is used in previous paper as well [10]
- The proposed model uses Bluetooth module to transmit the data from the sensors and with the help of GPS, also share the location of the sensors
- The app developed required just a basic android phone with minimal Bluetooth connection to transmit the data
- The app itself is capable for accumulating and calibrating to plot the result as required which is later uploaded to the Server and refreshes every hour by the government authority for the awareness [10].

III. PROPOSED ARCHITECTURE

This paper deals with IOT and Air pollution. From starting and previous proposed architecture requires the configuration with battery and a device to monitor the data.

A. Proposed hardware

- The system should be minimized to a chip set which includes a RFID, a micro controller and an attached rechargeable battery integrated in a single unit.
- As we know that RFID itself is capable to hold some amount of data and if a person goes with this unit, the sensors will work and collect the data which will get stored in RFID and with the Help of NFC we can transfer the data to our phone just like we make payment at the pos merchant through the NFC enabling.

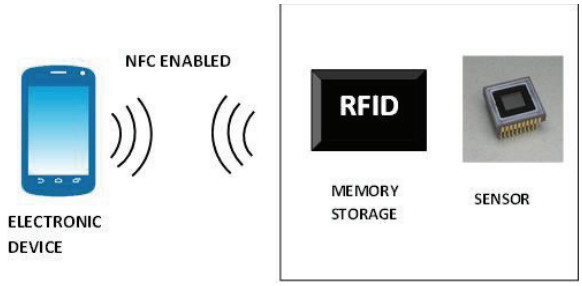

Fig. 7. NFC based data transfer

- This will reduce the hassle of connecting the device with the phone. When it is required to read data and find the level, we just need to tap the unit to the mobile phone.
- This will also reduce hassle of carrying the mobile all the time. We just need to carry the unit and whenever we need to find the level, the RFID present inside the device will store the data. Whenever the unit is tapped to mobile it will show the result and transmit the data to required server.
- It can work with any device that has NFC enabled and the software which is required to read the stored data.
- The Data stored in the memory should be removed after a particular time and should be transferred to

the device because the data holding capacity of the RFID is limited.

- The data later stored in the mobile should be presented to required authority or may be submitted to the server which is easily accessible to everyone so that the main motive of the system gets fulfilled that is everyone should get aware of the air quality they are breathing.

IV. FUTURE SCOPE

The architecture proposed in the system will help in analysing the air quality for the particular surrounding in the real time and it will help the authorities to get the accurate data for the action.

V. CONCLUSION

In this paper we have discussed about the previous work and studies in the area of air pollution monitoring system. In these past years some interesting and relevant work has been implemented and observed that work is dedicated to real time monitoring on data of real quality. But these systems or implementations are not apt in the time of today with respect to technology and smart devices. The work towards real time air pollution monitoring system lacks in using the latest communication technology that is IoT. The work in this paper is to study this gap this are to propose an idea and design that makes us of IoT technologies - RFID and NFC. This design will reduce the complexity in the present available monitoring system and make the avaibility of air quality data easy to access and use.

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