ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Environmental Pollution Monitoring System Using Internet of Things (IoT)

Y. Justin Dhas[1]*, P. Jeyanthi[2]
[1]Faculty of Computing, Sathyabama University, Chennai, India.
[2]Department of Computer Science and Engineering, Jeppiaar Maamallan Engineering College, Chennai, India.
***Corresponding author: E-Mail: justindhasy@gmail.com**

ABSTRACT

The swift growth of infrastructure, industries, and vehicles have been creating environmental issues like greenhouse effect and diseases. To avoid such instability in the nature, we need an environmental pollution monitoring system. In this paper a solution for overseeing air pollution levels in environment is proposed. The solution includes the technology Internet of Things (IoT) which is a revolutionary way of design and configure thee systems and services based on metamorphic changes. Here the sensing devices are interfaced to the computing system to monitor the fluctuation of parameters from their normal levels. This model is adaptable for any infrastructural environment that needs continuous monitoring, controlling and behavior analysis. The working performance of the suggested model is evaluated using prototype implementation, consisting of Raspberry PI, sensor devices. The implementation is tested on two or three parameters like CO and other gases in the ecosystem with respect to the normal behavior levels or given specifications which provide a control over the pollution monitoring to make the environment smart.

KEY WORDS: Internet of Things (IoT), Raspberry pi, Pollution Monitoring, Sensor, Web services.

1. INTRODUCTION

The IoT is an integrated communication technology, in which the objects are connected anyplace, anytime, anything, anyhow. These objects are having identities, virtual personalities operative in good atmosphere. It uses intelligent interfaces to attach and communicate with sensors, devices and social contexts. The IoT development provides numerous applications on different domains, such as consumer, home, industrial, manufacturing, utilities, energy resources, transportation, environment, safety, security, retail, healthcare, bio sciences automation, smart grid and many others.

Air Pollution has surfaced globally as a result of eruptive industrial growth. Transportation by road is also one of the major causes for air pollution, which contribute to weather change that has hazardous domestic and global consequences. Present revolution in the technology mainly focuses on controlling and monitoring of different activities. These are increasingly emerging to reach the human needs.

The most vulnerable global challenges faced today are of greenhouse effect and its impact on climate with deteriorating air quality. Air pollution is increasing and causing global warming, increase in sea level, change in seasonal patterns, rainfall pattern, extreme summer and winter temperatures, droughts and floods, etc. along with various endemic and epidemic diseases. What exists is a lack of understanding of air pollution and related health risk.

An efficient monitoring system is required to monitor and assess the conditions in case of exceeding the prescribed level of parameters (e.g., smoke). The extent to which environment gets affected is noted and intimated to the user through the mobile application.

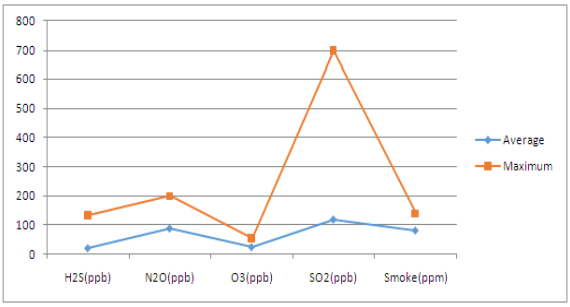

Figure.1. Representation of various pollution causing gases in atmosphere

In figure.1, it indicates the different pollution causing gases in atmosphere and each gas how much polluting the environment.

Table.1. Tabulation of various sensors with its Target gas and detection range

Model	Target gas	Detection range
MQ-2	Combustible gas (LPG)	200ppm – 5000ppm
MQ-3	Smoke, Alcohol	20ppm – 1000ppm
MQ-6	LPG and propane	200ppm – 1000ppm
MQ-8	Hydrogen	100ppm – 10000ppm
MQ-131	Ozone (O_3)	10ppb – 2ppm
MQ-135	NH_3, Benzene	10ppm – 10000ppm
MQ-136	Sulfureted Hydrogen (H_2S)	1ppm – 200ppm
MQ-137	Ammonia (NH_3)	5ppm – 500ppm
MQ-138	Ketone, Ester, Benzene	5ppm – 500ppm

Sensor devices are placed at different locations to collect the data to predict the behaviour of a particular area of interest. Table.1, provides the details about various sensors and its coverage distance or the detection range. The major objective of this research is to construct and implement an efficient monitoring system through which the required parameters are monitored remotely using internet and the data obtained from the sensors are stored for future reference.

Related Work: Some of the research works are done in order to monitor the pollution parameters for making the environment smart in that area, different techniques and methods which were used in the past.

Wireless Sensor Network (WSN) plays vital role in Smart Environment Monitoring. In this work they are mainly focusing on the making the city environment smart, by deploying WSN all across the city and public and private transportation systems. By accessing all the dynamic global sensor networks, environmental behaviours are collected as a streaming data base to identify the environmental conditions. This methodology gives the overseeing of data from stationary node deployed in city to the mobile nodes on public, private transportation.

The Application of Lab Management towards a Green Campus with the IoT, this research work uses the IoT concepts and implements the prospects of saving energy resources by proper management of energy consumable devices. Meng (2007), designed the architecture and the prototype of the IoT system. Here every consumable device is considered as objects.

Hemant Ghayvat (2015), developed WSN and IoT Based smart Homes. This work primarily aims to style and develop predictable, productive, spongy, prudent, period and realistic sensing element networks for sensible home systems. The sensing element and also the gateways square measure supported wireless networking technologies square measure deployed into the house setting. These nodes accumulate period information associated with the thing usage and movement within the house. Additional extends the sensible home system to sensible buildings and models the planning problems associated with the sensible building setting.

In optimum WSN readying Models for pollution watching it provides Network of sensing. The main contribution is to style number applied math models that cypher detector deployments capturing each the coverage of pollution beneath time-varying climatic conditions and also the property of the infrastructure.

In Modular sensor system (MSS) for urban air pollution monitoring provides a novel Modular Sensor System (MSS), which aims at tackling these issues by adopting the proposed Universal Sensor Interface (USI) and modular design in a sensor node. A compact MSS sensor node with expandable plug-and-play sensor modules and multiple Wireless Sensor Networks (WSNs) compatibility is implemented and evaluated. Yang (2016), developed an algorithm for air pollution source estimation which uses mobile sensor networks (MSN).

2. PROPOSED MODEL

This model is for monitoring smoke levels in the atmosphere to make the environment intelligent. The proposed prototype model is shown in figure.2, which is more adaptable and flexible to monitor the environmental parameters. The goal of developing pollution observation is to augment quality of life by mistreatment technology to augment the potency of services and meet residents' desires.

Consider an area that is being surveyed for estimating how much the area is affected by pollution. The constituents of air along with its proportion are calculated and if it above traditional then the officers intimated concerning it. Then the individual's are exhausted to a secure place.

The figure.2, depicts the overview architecture of air pollution monitoring system using IoT. From the environment, MQ-3 sensor automatically senses the atmospheric smoke content level and it outputs an analog value. Since raspberry pi process only the digital values, MCP3008 (i.e., ADC) is necessary. The data values from the sensor are passed to the MCP3008 for converting analog values to the corresponding digital values. The digital values are given to raspberry pi for processing and it compares with the normal actual level of smoke in the atmosphere. The data values from the raspberry pi are retrieved with the help of web service and stored in a Database. From the database, the data's are retrieved and displayed to the user through mobile application.

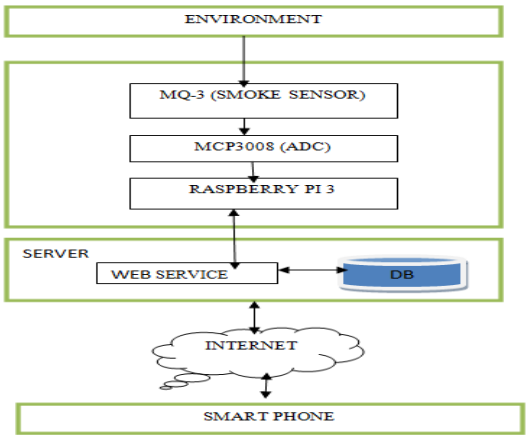

Figure.2. Proposed System Model

The MQ-3 may be ignitable gas associated smoke device recognize the absorption of flammable gas within the air. The MQ-3 sensor outputs reading as an analog voltage. The device will live concentrations of ignitable gas of 300 ppm to 10,000 ppm. The MQ-3 sensor is sensitive to LPG gas, i-butane, propane gas, methane, alcohol, Hydrogen and smoke. This sensor is employed in gas effusion detecting equipment in industry and in portable gas detector.

Modules Description:

Device Module: This module is about hardware components of the system. Device includes sensors, ADC convertor and raspberry pi and its basic accessories. The MQ-3 sensor senses smoke level in the atmosphere and output the result in the analog format. Before data are passed to the raspberry pi, it must be converted in to the digital value. For this purpose, we are using MCP3008 analog to digital convertor. The ADC converts the sensor outputted analog values to corresponding digital values. Then raspberry pi does the further processing.

The fig.3, shows the Pin diagram for connecting hardware components

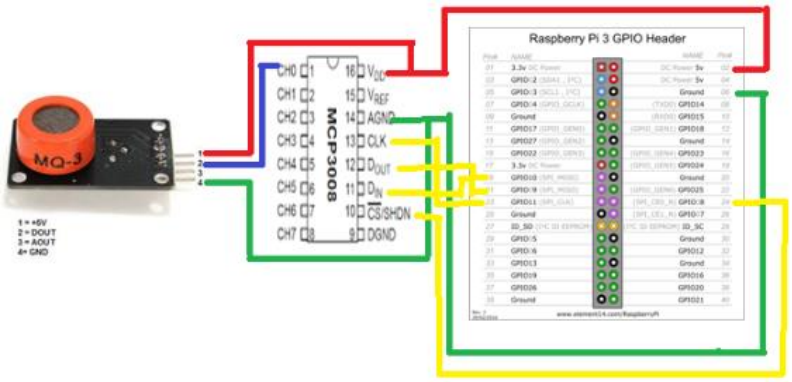

Figure.3. Pin diagram for connecting hardware components

Storage Module: In this module, the sensed data are stored in the database and stored data are analyzed and used for future reference. In a server some services are running to connect with the database this service will act as ubiquitous computing.

The fig.4, shows how data's are stored in database with the help of Machine to Machine Communications service. For Machine to Machine communication we are using web services as a middleware. Web service provides interoperability between devices. It is used to communicate our gateway and the web server for storing the sensed details and also it helps to share the stored data into public usage.

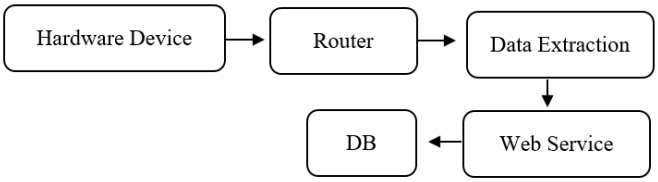

Figure.4. Storage Module

Application Module: If the gas content in the atmosphere exceeds the normal threshold level, then it is intimated to the corresponding officials through an android application. The applications connects the storage module by using web services. The web services is act as a middleware in between Data and Application Layer. In fig 5, all the stored contents are displayed to end user via android application.

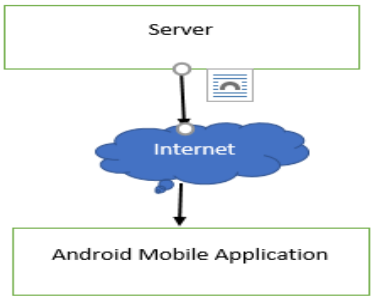

Figure.5. Application Module

Fig.6, shows the flow of entire pollution monitoring system. The sensor senses pollution causing gases and its level in the atmosphere. It outputs as an analog value to the convertor. The convertor converts the analog values to the corresponding digital values and pass it to the raspberry pi for the further processing. From the raspberry pi, data are retrieved and stored in the database with the help of web service. The data's are accumulated in the database for further reference and analysis purpose. The data are get from the database with the help of web service and intimated to the user about the pollution level in the atmosphere. Based on the result, people can take necessary prevention practices to shield them from the harmful.

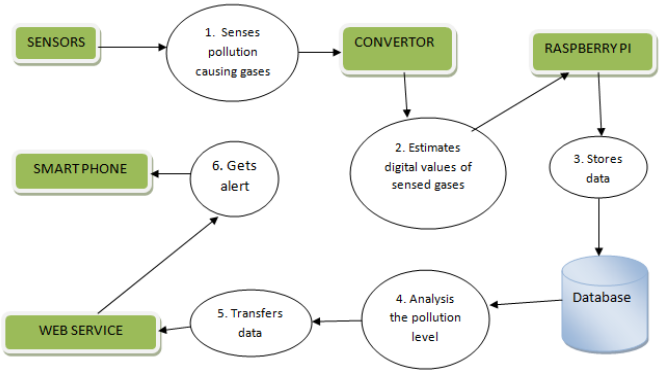

Figure.6. System Flow Architecture

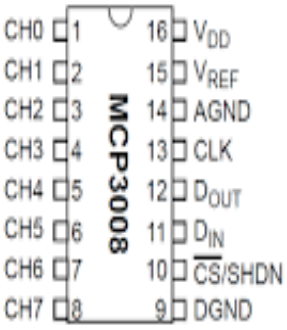

Figure.7a. PIN diagram for MCP3008

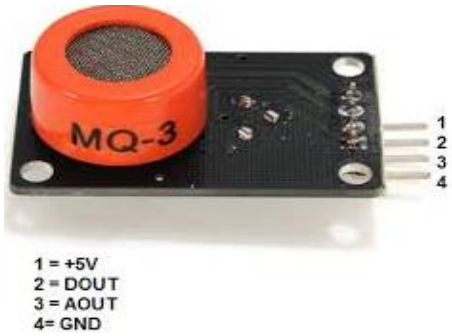

Figure.7b. PIN diagram for MQ3

The Fig.7a and 7b, shows the PIN diagram for the ADC Convertor and MQ3 Sensor. Here we can connect eight different sensors at a time.

3. RESULTS AND DISCUSSION

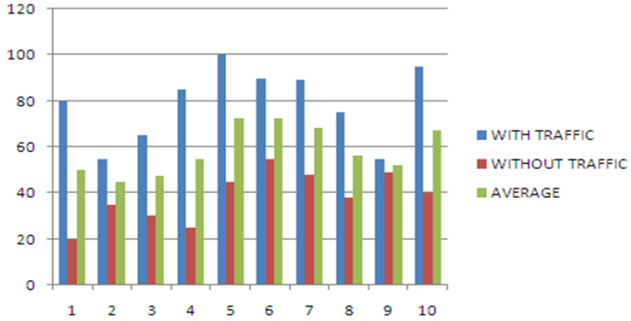

Figure.8. Pollution Level With and without traffic

In fig.8, analysed the data in both condition with and without traffic. The chart shows the average pollution level of traffic conditions. In traffic condition pollutions are emitting more than the without traffic conditions.

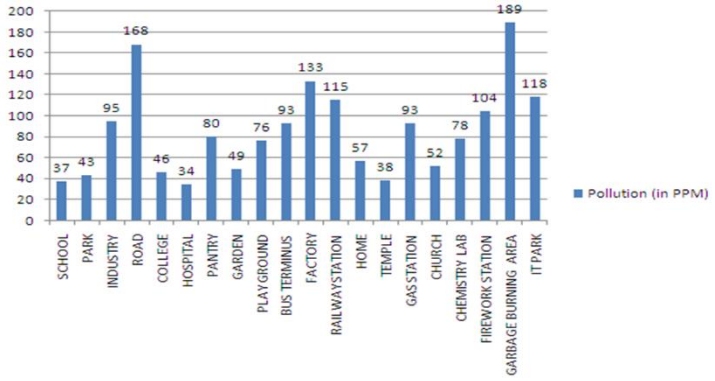

Figure.9. Pollution level in different Location

We tested our system with different locations and analysed data. Fig.9, shows the analysed report of different location.

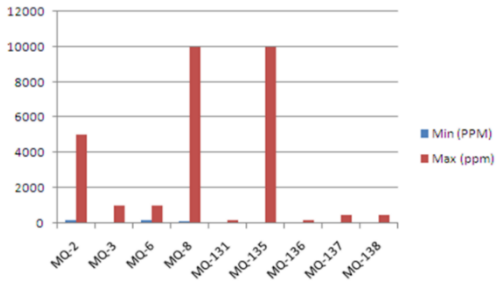

Figure.10a. Sensors and its Coverage distance

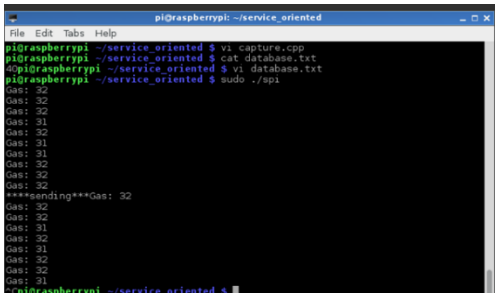

Figure.10b. Raspberry Pi output after sensing smoke

4. CONCLUSION AND FUTURE WORK

The monitoring device utilizes public transportation to collect pollutant gases such as CO, smoke. The data shows the pollutant levels and their local air quality standards. Here successfully designed the pollution monitoring system which shows the real time air pollution data on web page which can be accessible from anywhere within the network range.

The data's that are collected by the sensors could be used by the administrators to take necessary action such as emergency warning messages and evacuation of people to snug places. Further implementing contamination monitoring systems will help to gauge supplementary pollution. Based on the past stored records, we can predict the future pollution level.

REFERENCES

Atzori L, Iera A and Morabito G, The internet of things, A survey, Computer Networks, 54 (15), 2010, 2787–2805.

Bellavista P, Cardone G, Corradi A, and Foschini L, Convergence of MANET and WSN in IoT urban scenarios, IEEE Sens. J., 2013, 3558–3567.

Boubrima A, Bechkit W H, Rivano, Optimal WSN Deployment Models for Air Pollution Monitoring, IEEE Transactions on Wireless Communications, 1 (1), 2017, 2723-2735.

Cai J.F, Ji H, Liu C, and Shen Z, Blind motion deblurring from a single image using sparse approximation, in Proc. IEEE Conf. CVPR, 2009, 104–111.

Gupta P, Kumar R, Singh S.P and Jangid A, A study on monitoring of air quality and modeling of pollution control, 2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), 2016, 1-4.

Hemant Ghayvat, SubhasMukhopadhyay, Xiang Gui and Nagender Suryadevara, WSN- and IOT-Based Smart Homes and Their Extension to Smart Buildings, 2015, 10350- 10379.

Leung W.Y, Yi K.S, Leung M.L, Meng and Mak T, Modular sensor system (MSS) for urban air pollution monitoring, IEEE Sensors, 2016, 1-3.

Meng-Shiuan Pan and Yu-Chee Tseng, ZigBee Wireless Sensor Networks and their Applications, Department of Computer Science National Chiao Tung University Hsin-Chu, 2007, 30010.

Nashwa El-Bendary, Mohamed Mostafa M. Fouad, Rabie Ramadan A, Soumya Banerjee and Aboul Ella Hassanien, Smart Environmental Monitoring using Wireless Sensor Networks, 2013.

Yang X, Du J, Liu S, Li R and Liu H, Air pollution source estimation profiling via mobile sensor networks, International Conference on Computer, Information and Telecommunication Systems (CITS), 2016, 1-5.