e-ISJN: A4372-3114
p-ISJN: A4372-3115

ISSN: 2321-7782 (Online)
ISSN: 2347-1778 (Print)
Impact Factor: 7.529

Volume 9, Issue 1, January 2021

International Journal of Advance Research in Computer Science and Management Studies

Research Article / Survey Paper / Case Study

Available online at: www.ijarcsms.com

A Review on Design & Development of Air Quality Visualization System using IoT

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Abstract: ***Our surrounding world developing very rapidly and this consistent advancement around our surroundings somewhere affect on human health. Due to increase in population variety of facilities or even innovations raise side effects on human body. As we all know that the pollutants which invisible by nature, need to be trace with their availability. Because of toxic or acute effects of such invisible pollutants, our entire world or even belongings demand such model which can recognize the hazardous pollutants & their availability levels. In this paper our proposed model which is rooted on combinational platform of Bigdata, cloud computing, REST API & IOT (Internet of Things) with relevant software and hardware. The seriousness of air pollutants extremely harmful to rise global warming & for human being's health. Our proposed model plays a vital role to avoid such adverse effects. The consistent growth of vehicle on road and industries formation, both is centre of origin for harmful pollutants. This model's outline includes variety of gas sensors & chemical sensors as hardware with Raspberry platform with software architecture which will observe & manage the pollution information on web server. IOT is a consolidated framework about to improve correction, efficiency of the modules and also increased economic benefits.***

Keywords: Bigdata, REST API, Cloud Computing, IOT (Internet Of Things), gas sensor, chemical sensor.

I. INTRODUCTION

The heavy industry that has grown around the world & the diversity of chemical along with contamination resulting from human's routine, released into environment have raised serious concerns on the effects of such materials on the ecosystem & human health. Therefore, countries around the world have increased their regulation in terms of monitoring as well as controlling & treating pollution. Such regulations raised the issue of finding a suitable, cost-effective and reliable technology to encounter the pollution effects. [1]

Air Quality has gained widespread attention over the last decade, and lately has been in spotlight because of China's metropolitan cities exhibiting alarming pollution levels. In a typical Air Quality measurement system, there are multitude of sensors which senses the interested air quality parameters, the sensors are mounted on back of a node which provides sampling, collection, and communication, and they are connected to a gateway which relays it further or does local storage. We briefly cover the required background to understand our air quality system. [2]

IOT based sensor modules of Air Pollution Monitoring System will monitor the air quality in real time over a web server using internet & an email will be sent to authorities. Meanwhile when there are sufficient amount of harmfull pollutants present in the air like CO2, smoke, alcohol, benzene, LPG, NH3 & NOX. This will show the air quality in PPM on the publicly mounted display and as well as on web page so that it can monitor very easily. The system can be installed any where especially those territories where we want to analyze the air quality.

The proposed system is using a prototype implementation consists of sensing devices. These sensing devices are interfacing with wireless embedded computing systemto monitor the fluctuation of parameter levels from their normal levels. The aim is to build powerful system to monitor environemntal parameters.

II. Literature Review

Air pollution has significant influence on the concentration of constituents in the atmosphere leading to effects like global warming and acid rains. To avoid such adverse imbalances in the nature, an air pollution monitoring system is utmost important. This paper attempts to develop an effective solution for pollution monitoring using wireless sensor networks (WSN) on a real time basis namely real time wireless air pollution monitoring system. Commercially available discrete gas sensors for sensing concentration of gases like CO and CO2 are calibrated using appropriate calibration technologies.These pre-calibrated gas sensors are then integrated with the wireless sensor motes for field deployment at the campus and the Coimbatore city using multi hop data aggregation algorithm. A light weight middleware and a web interface to view the live pollution data in the form of numbers and charts from the test beds was developed and made available from anywhere on the internet Other parameters like temperature and humidity were also sensed along with gas concentrations to enable data analysis through data fusion techniques. Experimentation carried out using the developed wireless air pollution monitoring system under different physical conditions show that the system collects reliable source of real time fine-grain pollution data.[3]

Integration of WSN with IoT has made WSN as an invaluable resource to IoT as enounced in9,14. It can be concluded that the contrived Air Quality Monitoring System renders an efficacious integration between WSN and IoT, as a result a staple goal of remote monitoring the air quality in the specific area of interest has been attained and the same has become more user oriented. In this work the conventional application protocol “HTTP” is used for sending and receiving of data and the number of nodes is limited to four. The foci of the future work is on building module for calculating the air quality index with the data aggregated from multiple sensor web nodes. Also to establishing the connectivity using IoT specific protocols like MQTT or COAP and also to increase number of node deployments so as to have broad coverage area. [4]

This paper introduces a Wireless Sensor Network (WSN)-based air quality monitoring system using IOT central server and gases sensors. This system is very simple as compared to the existing air quality monitoring systems. This project is also used for pollution monitoring purpose in cites. In future, this prototype can be extended in real time implementations of urban cities.[5]

Air pollution has significant influence on the concentration of constituents in the atmos-phere leading to effect likes global warming and acid rains. To avoid such adverse imbal-ances in the nature ,and air pollution monitoring and controlling system utmost important .Using empirical analysis, polluted air automatic monitoring system has high precision ,but large bulk ,high cost .By using IOT ,this system can reduce the hardware cost .The system can be laid out in a large number in monitoring area to form monitoring sensor network..Besides the functions of polluted air automatic monitoring system .it also exhibits the function of controlling. These system combines air quality information provided by sensors which are connected to ATMEGA328 micro controller.IOT is the internet- work-ing of physical devices vehicles and other item s embedded with electronic sensors, actua-tor and network connectivity that enables these objects to collect and exchange the da-ta.IOT is the “Infrastructure of the information society it include efficiency ,accuracy and economic benefits”.[6]

The proposed system consists of the Wireless Sensor Network for acquiring climate data locally. In WSN various Environment monitoring sensors are placed inside the field, sensors include Gas sensors (ie. CO, SO2 , NO2 , Temperature , PM2.5 and PM10), temperature sensor. Using this information, Environment monitoring parameters calculated remotely at control system and display on the remote station android mobile wirelessly. This Unit consists of a Wi-Fi module, sensors, a microcontroller, and power sources. Several WSUs can be deployed in-field to monitor as a distributed sensor network for accurate Environment monitoring system. This setup can also be used to measure the temperature of atmosphere using

temperature sensor, Gas related information using IR sensor & electrochemical sensor. Each unit is based on the microcontroller RASPBERRY PI LPC2148 that controls the Wi-Fi module and processes information came from the all sensors.[7]

The environmental monitoring system might offer several potential benefits; it provides monitoring services for remote areas. Three different wireless sensors for implementing IoT-based solutions for environmental monitoring were designed, developed, and analyzed. The analysis of the three implementations revealed the fact that Wi-Fi technologies is suited for monitoring applications that can successfully compete with the MQTT protocol. As expected, Wi-Fi consumes more energy but enables the development of solutions with reduced total cost of ownership through the use of the existing infrastructure. Its' earthquake detection capability can help saving millions of lives. The total life-cycle cost of the system is minimized and could theoretically run for months on end entirely without the need for human intervention. Due to its ability to automatically upload to the internet, one correctly placed system can provide easily accessible weather data for the whole community. It can be used to predict the onset of bad weather using signs such as changing temperature and humidity. Raising the awareness of how society is affected the region's environmental policies and have the knowledge basis to push for the change. The analysis presented in this paper represents a starting point for the selection of a direction in the implementation of IoT-based environmental monitoring applications, providing an overview of the potential and challenges of each one of the three developed wireless sensors.[8]

An extremely growth in an industrial and infrastructural frameworks creating environmental affairs like atmospheric changes, malfunctioning and pollution. Pollution is becoming serious issue so there is need to build such a flourishing system which overcomes the problems and monitor the parameters that affecting the environmental pollution. The solution includes the technology **Internet of Things (IOT)** which is a hook up of computer science and electronics. It can provide means to monitor the quality of environmental parameters like Air, Noise, Temperature, Humidity and light. To monitor pollution levels in industrial environment or particular area of interest, wireless embedded computing system is proposed. The system is using a prototype implementation consists of sensing devices, Arduino uno board, ESP8266 as wi-fi module. These sensing devices are interfacing with wireless embedded computing system to monitor the fluctuations of parameters levels from their normal levels. The aim is to build powerful system to monitor environmental parameters.[9]

IOT Based Air Pollution Monitoring System **in** which we will monitor the Air Quality over a webserver using internet and will trigger a alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO2, smoke, alcohol, benzene and NH3. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily. [10]

Air pollution is evolving as a severe environmental concern due to its enormous impact on the well being of the people, universal environment and also on the global economy. Conventional air pollution systems are not able to provide air pollution data of high spatiotemporal resolution due to non-scalability and limited data availability. With the advances in the areas of Micro Electro Mechanical Sensor (MEMS) and Wireless Sensor Network (WSN), the researchers proposed various state-of-the-art air pollution monitoring systems for measuring major air pollutants like CO2, CO, O3, SO2, VOC and Particulate Matter (PM) with better results. A comprehensive review of continuous air pollution surveillance of both indoor and outdoor pollution by employing WSN is presented. It presents the various techniques and algorithms employed in the design of dedicated air pollution monitoring systems using WSN. A comprehensive and detailed review of the existing methods of Air Quality Monitoring systems using WSN is done along with their comparisons.[11]

In this paper we present an IoT Crowd Sensing platform that offers a set of services to citizens by exploiting a network of bicycles as IoT probes. A survey aimed at identifying the most interesting bikeenabled services for users was conducted among 288 users that usually use a bike in their daily life. The following services were identified: a) real time remote geo-location detection of the users' bikes, b) anti-theft service, c) information about traveled route (distance, duration, and rise), and d) air pollution monitoring. Then, starting from an enabling scenario, the details of each service were defined and the architecture of

the SmartBike platform was designed. It is composed of three main components: the SmartBike devices for data collection, the end-user devices (e.g., smartphones and tablets) as user interfaces for the real time bike geolocation detection and the anti-theft service, and the SmartBike central servers for storing revealed data and providing a web interface for data visualization. To evaluate the feasibility of the approach and the suitability of the platform, an initial prototype of the presented platform was implemented and the platform was tested by a volunteer.[12]

We introduce current home Internet of Things (IoT) technology and present research on its various forms and applications in real life. In addition, we describe IoT marketing strategies as well as specific modeling techniques for improving air quality, a key home IoT service. To this end, we summarize the latest research on sensor-based home IoT, studies on indoor air quality, and technical studies on random data generation. In addition, we develop an air quality improvement model that can be readily applied to the market by acquiring initial analytical data and building infrastructures using spectrum/density analysis and the natural cubic spline method. Accordingly, we generate related data based on user behavioral values. We integrate the logic into the existing home IoT system to enable users to easily access the system through the Web or mobile applications. We expect that the present introduction of a practical marketing application method will contribute to enhancing the expansion of the home IoT market. [13]

IoT architectures and AAL technologies not only will remain side by side adding scientific improvements to enhanced living environments but also lower the cost of ubiquitous solutions. Despite the many technologic advances some difficulties in the construction of IoT solutions, several issues remain, mostly related to the privacy, data confidentiality, and security of such systems. Despite all the advantages of healthcare systems based on IoT architectures, several open issues continue to exist, such as availability, reliability, mobility, performance, scalability, and interoperability. Any proposed system should find ways to respond to these problems. It is extremely important to repeat that this kind of healthcare system should be used to support medical treatments as an important complement to medical supervision.[14] Existing air pollution monitoring systems are mentioning in Table 1.

Table 1: Existing Air Pollution Monitoring System

S.No.	Title	Reference	Year	Remark
1.	Smart Environmental Monitoring Using Wireless Sensor Networks	[1]	2013	Overview and working of wireless sensors with repect to environment monioring.
2.	Wireless Air Quality and Emission Monitoring	[2]	2016	Explanation about air pollutants, effects, provided smart solution using Wireless devices.
3.	Air Pollution Monitoring System	[3]	2016	Proposal to develop effective solution for pollution monitoring using WSN.
4.	IOT enabled Air Quality Monitoring System (AQMS) using Raspberry Pi	[4]	2016	Integration between WSN and IoT
5.	IOT based Air Quality Monitoring System	[5]	2017	WSN based air quality monitoring system using IoT central server and gases sensors.
6.	A Review on Air Pollution Monitoring and Controlling system Using IOT	[6]	2017	IoT system enabled with ATMEGA 328
7.	A survey on WiFi based Air Pollution Monitoring System	[7]	2017	Unit consists of aa WiFi module, sensors, a microcontroller and power sources.
8.	IOT based smart environmental monitoring using arduino	[8]	2017	Cost effective environmental monitoring device
9.	IoT based environmental pollution monitoring system	[9]	2017	A platform that provide monitoring with various parameters using sensors and ATMEGA 328
10.	IoT based Air Pollution Monitoring system using Arduino	[10]	2017	Arduino based air pollution monitoring system
11.	Urban air pollution monitoring using wireless sensor networks	[11]	2017	WSN based urban air pollution monitoring proposal
12.	Smartbike: an IOT crowd sensing	[12]	2017	IoT crowd sensing platform

	platform for monitoring city air pollution			
13.	Sensor basd optimization model for air quality improvement in home IoT	[13]	2018	AWS based home IoT platform
14.	A system based on the Internet of Things for real-time particle monitoring in buildings	[14]	2018	iDust a real time PM exposure system

III. Overview of Proposed System

Our proposed system model is having objective to design and develop pollution monitoring which will be implanted on a defined location & to expand concern web oriented data ready to available for the public. The proposed system flow and proposed flow of research implementation is mentioned in Figure 1 and Figure 2 respectively.

In this proposed system we will retrieve data from relevant sensors from selected localities. ESP8266 WiFi module will collect all the data from sensors & also from third party libraries. After collect data , that data will send to remote databases. The data repositories will having connectivity with the user interafce through a web application. This web application can be used by every one to get in lively updates about the pollution levels in their concern locations. This web application will be able to visualized data in the form of reports or in chart formats.

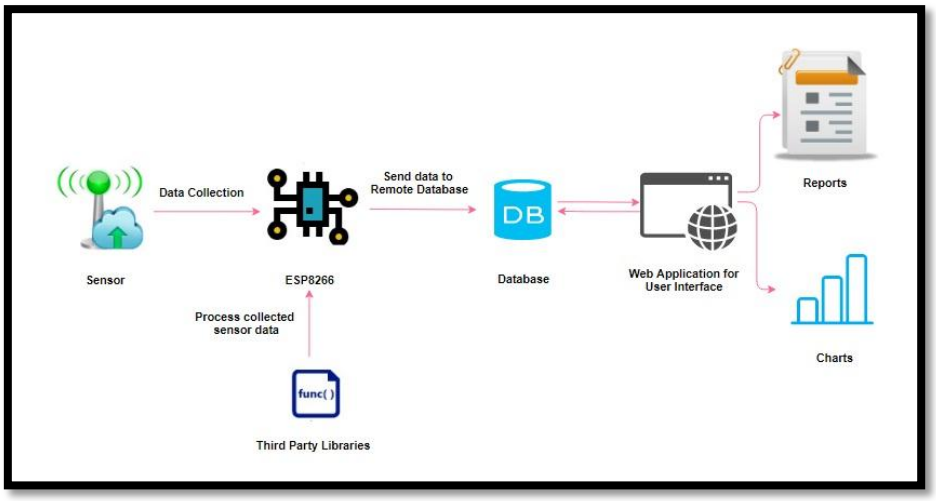

Figure:1 Proposed Flow Diagram for Research Implementation

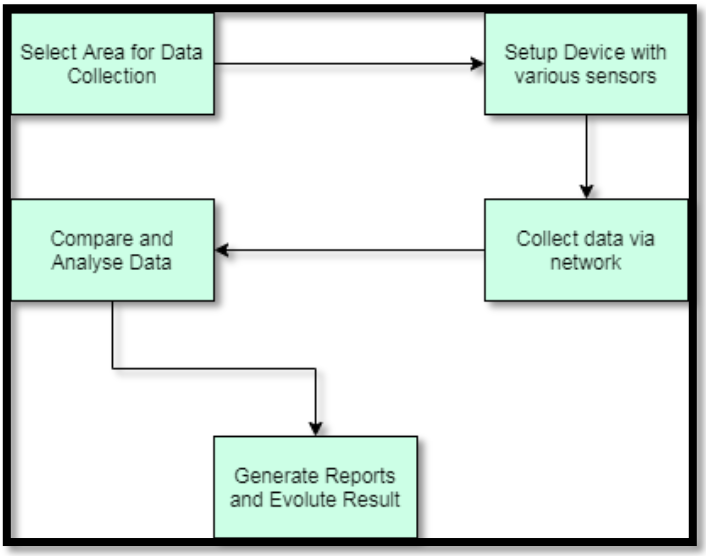

Figure:2 Proposed System Flow

IV. CONCLUSION

Our proposed system named "Design and Development of air quality visualization system using IoT" shall smartly visualize the available air pollutants from defined locations. The proposal of mentioned ideology in this review paper will provide a good functionality for developing the infrastructure for smart city. Our review paper will help in recognising possibly all smart air pollution visualization methods which will be implemented to become a clean city. For future implementation our proposed system will also implement the GPS module to be used for live mapping of pollution levels in various localities.

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