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A Review on IoT Based Pollution Monitoring System

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Abstract - As the countries become industrial, the pollution level to our environments will increase and this pollution becomes a significant downside for the health of the population and additionally affects the scheme. In this paper a model based on (internet of things) IOT is proposed with the aim to monitor pollution level. The most serious environment pollution is air pollution because diverse air pollutant causes harm to human health and causes global warming. The pollution monitoring system is extremely vital to keep away from such adverse imbalance in nature. With the speedy growth in the industries which are the main sources of pollutants, the problem of pollution is becoming a serious concern for the health of the population. The proposed outline includes a set of sensors like gas sensors, noise detector, fire sensor and ultrasonic sensor as hardware having Arduino platform with the combination of software architecture for "anytime anywhere" observance and management of pollution information through one web-based graphical malicious program. IOT is the "framework of the information society it embodies efficiency, correctness, and economic benefits."

Keywords –pollution monitoring, internet of things(IOT), gas sensors, noise detector, fire sensor, ultrasonic sensor, Arduino.

1. Introduction

The Internet of Things (IOT) is a formation in which matter, people are provided with restricted identity and the skill to relocate data over a network without requiring two-way handshaking between human-to-human i.e. source to destination or human-to-computer interaction. Internet of Things extends web property prior ancient devices like desktop and portable computer, smart-phones to a variety of devices and day by day things that develop embedded tools to communicate & interrelate with the external environment through the internet. The aim of the Internet of Things is to support "Ubiquity" that enables things to be connected anytime, with anything and anyone ideally uses any path/network and any service. [1]

The IOT's characteristics, including an ultra large-scale network of things, device and network level heterogeneity, and large numbers of events generated impulsively by these things, will make growth of various applications and services a very tough task. In general, middleware will ease a development method by group action heterogeneous computing and communications devices, and supporting interoperability within various applications and services. In recent times, there have been a number of proposals for IOT middleware. These proposals mostly addressed wireless sensor networks (WSN), a key component of IOT, but do not consider radio frequency identification (RFID), machine-to-machine (M2M) communications, and supervisory controls and data acquisition (SCADA), other three core elements in the IOT vision. [2]

To design an IOT based pollution monitoring system which can be accessed with the help of Wi-Fi module and to examine the pollution level of a particular place or site. To pick up the data from the atmosphere or contents of atmosphere various sensors are used. Air pollution sensors live the standard of air whereas noise pollution sensors live the sound levels. The ultrasonic sensors sense the distance between the lids of the Garbage Bin. The data recorded by the ultrasonic sensors. Fire alarm, and monitoring system are integrated with IOT Platform, It can sense smoke, the rise in temperature, flame, etc. Data from all these sensors are basically analog signals. These signals are converted to its equivalent digital form. A Wi-Fi module is also integrated in the system to transfer the data to another location or to access the data from remote location.

Also, to show data on the system LCD is connected to the Arduino Uno. This system frequently measures pollution levels and a report is sent to the Wi-Fi module through the Arduino Uno. The Wi-Fi module sends a notification to the servers. This allows the authorities who want the data of

diverse areas to monitor air pollution in different areas, and take action against it.

2. Literature Review

This paper presents a network for both indoor and outdoor air quality monitoring. The sensor response is strongly dependent on parameters such as temperature, humidity, and cross influence of the other gases. For the calculation of several air quality values two types of sensor data processing architectures are implemented using JavaScript and Lab VIEW Web publisher technologies. The first one is a neural network algorithm implemented in JavaScript in the embedded server (Web sensor) and represents one of the main novelties of the work. The second software architecture is implemented in the network PC and performs tasks like sensing nodes data reading through TCP/IP remote control, air pollution events detection and gas concentration estimation based on neural network inverse models of gas sensors and data logging and Web publishing of air quality data. [3]

The ideal portable device is to have embedded sensors installed on subjects, e.g., a vehicle, a person, or an animal. Sensor device is an innovative integrated sensor system using novel design polymer modified tuning fork sensors. The device encompasses sample collection and transport, sample conditioning with interferon's removal and sample air zeroing capabilities for baseline establishments, thus enabling it to form a standalone and portable unit. Ambient air is being drawn into the device either through the particle filter (detection mode) or the zero filters (calibration mode). The filtered air is then subsequently passed through the interfere filter for sample conditioning and then introduced to the tuning fork sensors inside a sensor cartridge. The responses of the sensors will subsequently be digitized and transmitted wirelessly to a user interface device, such as a cell phone or a less portable device, such as a laptop or desktop computer. Bluetooth technology, a widely available wireless communication standard, is employed in the wireless communication of the device; enabling high flexibility in user interface selection. [4]

This paper proposes vehicular Wireless sensor networks (VSN) architecture to monitor microclimate based on GSM short messages and geographic information of vehicles. They show prototype to monitor the concentration of carbon dioxide (CO2) gas in areas of interest. CO2 gas is a critical index of air quality and global warming. In our prototype, a vehicle is equipped with a CO2 sensor, a GPS receiver, and a GSM module, which form a ZigBee based intra-vehicle wireless network. Each of such vehicles thus serves as a vehicular sensor. These vehicular sensors roam inside the area of interest and periodically report their sensed data through GSM short messages. The reported data is collected by a server, which is integrated with Google Maps to demonstrate the result. [5]

The proposed wireless sensor network air pollution monitoring system (WAPMS) comprises of an array of sensor nodes and a communications system which allows the data to reach a server. The sensor nodes gather data autonomously and the data network is used to pass data to one or more base stations, which forward it to a sensor network server. The system send commands to the nodes in order to fetch the data, and also allows the nodes to send data out autonomously. The development of the system is to help the government to devise an indexing system to categorize air pollution. [6]

This paper proposed an urban air quality monitoring system based on the wireless Sensor network (WSN) technology and incorporated with the global system for mobile communications (GSM). The system consists of sensor node, a gateway, and a back-end platform controlled by the Lab VIEW program through which sensing data can be stored in a database. The proposed system can provide micro-scale air quality monitoring in real-time through the WSN technology. [7]

This paper describes MAQS (Mobile Air Quality Sensing), a personalized mobile sensing system for IAQ (indoor air quality) monitoring. MAQS estimates human-dependent air quality factors (e.g., CO2 and contagious viruses) using CO2 concentration, and estimates other air quality factors (e.g., volatile organic compounds (VOCs)) using air exchange rates. MAQS integrates smart phones and portable sensing devices to deliver personalized, energy-efficient, IAQ information. [8]

In proposed work they use a MiCS-OZ-47 sensor from e2v to sense the ozone concentration in the atmosphere based on the measured resistance of the sensor's tin dioxide (SnO2) layer. Digital communication is achievable over the board's RS232-TTL interface, which is directly connected to an off-the-shelf HTC Hero Smartphone providing a USB Mini-B port. They show that it is feasible to use Gas Mobile to create collective high-resolution air pollution maps. This is essential to obtain widespread acceptance of participatory sensing equipment. [9]

They present a wireless sensor network (WSN) for monitoring indoor air quality, which is critical for people's ease, health, and protection because they spend a large percentage of time in indoor environments. The network they propose consists of several sensor nodes organized as

ZigBee network, cluster-tree configuration. The pyroelectric infrared sensor (PIR) board is connected to the sensor board over GPIO pins to provide the information about the people presence. They used a commercially available sensor MiCS-5121 from e2v technologies. It is a sensor that detects VOC (including CH4) and CO. A main apprehension in such networks is energy efficiency because gas sensors are power-hungry, and the sensor node must operate unattended for several years on a battery power supply. [10]

The system consists of several distributed monitoring stations that communicate wirelessly with a backend server using machine-to-machine communication. Each station is equipped with gaseous and meteorological sensors as well as data logging and wireless communication facility. The backend server collects real time data from the stations and converts it into information delivered to users through web portals and mobile applications. Data over four months has been collected and performance analysis and assessment are performed. [11]

The proposed outline comprises a set of gas sensors that are utilized on stacks and infrastructure of a ZigBee WSN and a central server to support both short-term real-time incident management and a long-standing strategic planning. This architecture would use gas sensing capable motes made by Libelium. These motes use the ZigBee communication and provide a real-time low cost monitoring system through the use of low cost, low data rate, and low power wireless communication technology. They also introduce a simple but efficient clustering protocol dubbed hereafter "Clustering Protocol for Air Sensor network" (CPAS) for the proposed WSN-AQMS framework. CPAS proves to be efficient in terms of network energy consumption, network lifetime, and the rate at which data is communicated. [12]

In the proposed model sensors to measure the percentage of pollutants present in the particular areas of the city. By using Bluetooth manager the collected data will send to server. Then we apply ID3 data mining algorithm which is useful for calculation of the percentage of pollutants. 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. [13]

In the proposed system a method for detection and analysis of exhaust gases produced by the gasoline vehicles. The method is predicated on infrared multi-wavelengths absorption within range of one.3 – 2.3 μm and can be implemented by using multi-waves array of light emitting diodes (LEDs). Projected approach permits many absorption spectra to be coated by one light-emitting diode absorption line. Simulation was in serious trouble a 6-element multi-wavelengths light-emitting diode array. They demonstrate that the tactic is very relevant for the appliance to open-path detectors wherever the radiation supply and also the receiver settled at a distance of tens of meters from each other. [14]

The concentration of most important air pollutant gases from the air are sensed by using the commercially available gas sensors. Each of those detectors is correctly labeled as per the quality strategies, and these gas sensors are then incorporated with the wireless sensor motes exploitation multi-hop knowledge aggregation algorithmic program. Air waste material knowledge is collected from the developed check beds within the kind numbers, and this knowledge is formed obtainable on the net through the mixture of sunshine weight middleware and a web interface. [15] Wasp mote along with the gas sensors board allows monitoring the parameters to determine the quality of air we breathe. Air pollution monitoring with Wasp mote is simple and economical due to its features of wireless communication among the sensors. [16]

Table 1: Existing Air Pollution Monitoring Systems

Sr. No.	***Title***	***Reference***	***Year***	***Remark***
1.	Smart Sensors Network for Air Quality Monitoring Applications	[3]	2009	Both indoor and outdoor air quality monitoring and The air quality data is published using Web server

2.	A Vehicular Wireless Sensor Network for CO2 Monitoring	[4]	2009	The architecture based on vehicular wireless sensor networks (VSNs) and GSM networks.
3.	A Wearable and Wireless Sensor System for Real-Time Monitoring of Toxic Environmental Volatile Organic Compounds	[5]	2009	The sensitivity and selectivity accomplished through the use of novel tuning fork sensor modified by design polymers and selective filtering.
4.	Wireless Sensor Network Air Pollution Monitoring System	[6]	2010	It uses an Air Quality Index to categorize the various levels of air pollution.
5.	Developed Urban Air Quality Monitoring System Based on Wireless Sensor Networks.	[7]	2011	GSM and ZigBee based system and design for researchers only.
6.	MAQS: A Personalized Mobile Sensing System for Indoor Air Quality Monitoring	[8]	2011	MAQS stands for Mobile Air Quality Sensing. requires Wi-Fi scanning only indoor air quality monitored

7.	Participatory Air Pollution Monitoring Using Smartphone	[9]	2012	Here Cellular network is used wireless communication; it is feasible to use Smartphone to create collective high-resolution air Pollution maps.
8.	Context-Adaptive Multimodal Wireless Sensor Network for Energy-Efficient Gas Monitoring	[10]	2013	Capable of monitoring indoor air quality ZigBee communication protocol
9.	Wireless Sensor Network for Real-Time Air Pollution Monitoring	[11]	2014	Totally GPRS based system with Arduino platform and data will be available on mobile as well as web page
10.	Wireless Sensor Network-based Air Quality Monitoring System.	[12]	2014	ZigBee communication is used; output data will present on Email, SMS, and Web server.
11.	Wireless Sensor Network Based Pollution Monitoring System in Metropolitan Cities.	[13]	2015,	Detects pollution in air on the basis of data mining Algorithm; Bluetooth module is used for communication

12.	Multi-wavelength IR Method for Monitoring Air Pollution in Cities.	[14]	2016	The method is based on infrared multi-wavelengths absorption in the range of 1.3 – 2.3 µm and can be implemented by using multi waves array of light emitting diodes (LEDs).
13.	Real Time Pollution Monitoring Using Wireless Sensor Networks.	[15],[16]	2016,2013	The wasp mote gas sensors kit is used which allows to monitor air pollution.

3. Proposed Monitoring System Overview

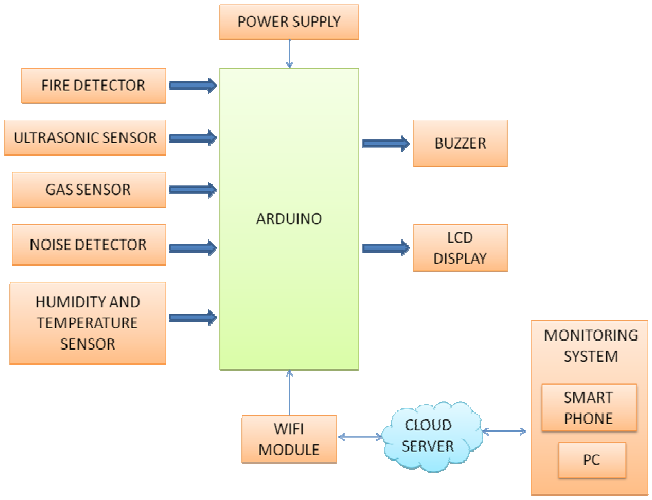

Fig.1 Proposed Monitoring System

The proposed system aims at designing pollution monitoring which can be established in a specific locality and to expand web data available for the public. This system can be used by anyone to get in live updates about the pollution in their region. It uses Arduino fused with sensor. For air and pollution individual gas sensors like carbon monoxide, ammonia along with particulate matter, humidity, and smoke which measures the concentration of each gas individually. Noise is detected by noise detector. For fire detection two Sensors, namely, Temperature, and Smoke sensors are located, and to remove the garbage bins depths the ultrasonic sensors are positioned in the waste bins. The Arduino is programmed to turn on the buzzer, and LCD, when the sensor parameters reach a threshold value. Arduino sends the data to the Wi-Fi module and Web page helps to monitor the status to the user.

4. Conclusions

The proposed system 'IOT based pollution monitoring System' shall provide the smart solution regarding air and noise pollution in addition to fire detection and overflowing of waste bins. The ideas proposed in this paper will prove to be a good module for creating the infrastructure for the smart city. This review helps in identifying all possible smart pollution monitoring methods that can be implemented to make city clean. In future, the system can also implement the Google map which is used for live map view of pollution level.

References

[1] Anup W. Burange, and Harshal D. Misalkar, "Review of Internet of Things in Development of Smart Cities with Data Management & Privacy", International Conference on Advances in Computer Engineering and Application, IEEE 2015.

[2] Mohammad Abdur Razzaque, Marija Milojevic-Jevric, Andrei Palade, and Siobhán Clarke. "Middleware for Internet of Things: A Survey"IEEE Internet Of Things Journal, VOL. 3, NO. 1, FEBRUARY 2016.

[3] Octavian A. Postolache, J. M. Dias Pereira, and P. M. B. Silva Girão, "Smart Sensors Network for Air Quality Monitoring Applications", IEEE Transactions on Instrumentation and Measurement, Vol. 58, No. 9, September 2009.

[4] Francis Tsow, Erica Forzani, Anant Rai, Rui Wang, Ray Tsui, Sal Mastroianni, Christopher Knobbe, A. Jay Gandolfi, and N. J. Tao "A Wearable and Wireless Sensor System for Real-Time Monitoring of Toxic Environmental Volatile Organic Compounds", IEEE Sensors Journal, Vol. 9, No. 12, December 2009.

[5] Shu-Chiung Hu, You-Chiun Wang, Chiuan-Yu Huang, and Yu-Chee Tseng, "A Vehicular Wireless Sensor Network for CO2 Monitoring", IEEE SENSORS 2009.

[6] Kavi K. Khedo1, Rajiv Perseedoss2 and Avinash Mungur3, "Wireless Sensor Network Air Pollution Monitoring System", international journal of wireless and mobile network, vol. 2, no. 2, may 2010.

[7] Liu J.H, Chen Y.F, Lin T.S, Lai D.W, Wen T.H, Sun C.H, Juang J.Y,Jiang J.A, "Developed urban air quality monitoring system based on wireless sensor networks", Fifth International Conference on Sensing Technology (ICST), Palmerston North, New Zealand, pp. 549–554, December 2011.

[8] Yifei Jiang, Kun Li, Lei Tian, Ricardo Piedrahita, Xiang Yun, Omkar Mansata, Qin Lv, Robert P. Dick, Michael Hannigan, Li Shang, "MAQS: A Personalized Mobile Sensing System for Indoor Air Quality Monitoring", UbiComp'11, September 17–21, 2011.

[9] Hasenfratz D, Saukh O, Sturzenegger S, Thiele L, "Participatory Air Pollution Monitoring Using Smartphones. In Mobile Sensing: From Smartphones and Wearables to Big Data", ACM: Beijing, China, 2012 .

[10] Vana Jelicic, Michele Magno, Davide Brunelli, Giacomo Paci, and Luca Benini, "Context-Adaptive Multimodal Wireless SensorNetwork for Energy-Efficient Gas Monitoring", IEEE Sensors Journal, Vol. 13, No. 1, January 2013.

[11] Kadri A, Yaacoub E, Mushtaha M, Abu-Dayya, "A Wireless sensor network for real-time air pollution monitoring,"1st International Conference on Communications, Signal Processing, and their Applications (ICCSPA), Sharjah, UAE, pp. 1–5, February 2013.

[12] Mansour S, Nasser N, Karim L, Ali A, "Wireless Sensor Network-based air quality monitoring system," International Conference on Computing, Networking and Communications (ICNC), Honolulu, HI, USA, pp.545–550, February 2014.

[13] Shwetal Raipure, Deepak Mehetre, "Wireless Sensor Network Based Pollution Monitoring System in Metropolitan Cities", IEEE 2015.

[14] Fanchenkoa,b,, Alexander Baranov a, Alexey Savkina "Multi-wavelength IR Method for Monitoring Air Pollution in Cities Sergey", IEEE 2016.

[15] Movva Pavani, P.Trinatha Rao"Real Time Pollution Monitoring Using Wireless Sensor Networks", IEEE 2016.

[16] R.A.Roseline1, Dr.M.Devapriya2, Dr.P.Sumathi3 "Pollution Monitoring using Sensors and Wireless Sensor Networks: A Survey", International Journal of Application or Innovation in Engineering & Management ,July 2013.