Research Article

Smart Air Quality Monitoring System in Realtime using IoT

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Abstract:As the countries become industrial, the pollution level to our environment is increase and this becomes a significant downfall for the health of people and additionally affects the scheme. In this paper a model based on 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 remotely monitoring the pollution information through one web-based graphical malicious program.

Keywords: Arduino, Pollution Monitoring, Internet of Things, Gas sensors**,** Noise Detector, Fire sensor**,** Ultrasonic sensor.

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 ask. 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].

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].

In the 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 sends 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 [5]. 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 [6]. The proposed system can provide micro-scale air quality monitoring in real-time through the WSN technology [7].

The 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 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 [13].

2. Methodology

This research makes human find out which content of the air is polluted. With module NodeMCU ESP8266, we can monitor the air pollution remotely, because there is a Wi-Fi in NodeMCU ESP8266. This makes the air condition can be monitored every time NodeMCU ESP8266 is used as the micro controller. This board has Wi-Fi module that acts as the internet connector and information accessing for the air quality. This is the reason why this board is chosen as some of tools for this research, besides the price of this board is very cheap as well.

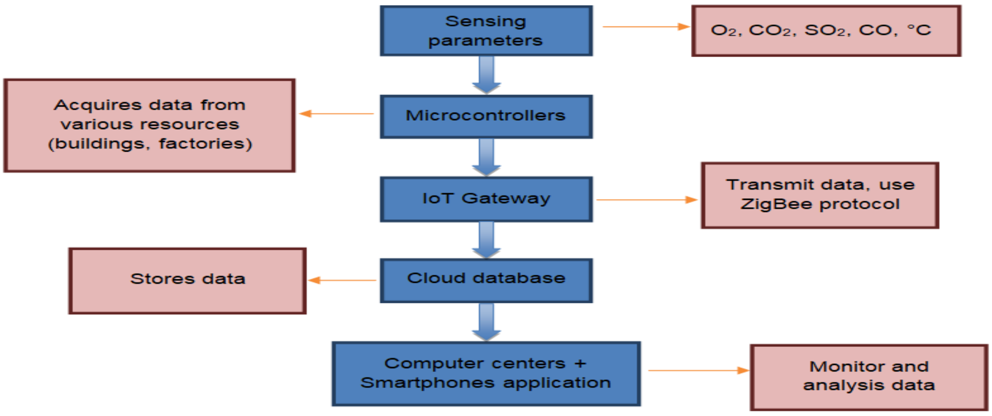

Figure. 1 Block Diagram of IOT based air quality monitoring

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.

2.1 Hardware

2.1.1 Arduino Uno

Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc.

2.1.2 MQ-135

Air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benzene steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for Air quality monitoring application

2.1.3 ESP8266

ESP8266 Wi-Fi Module is a self-contained System on Chip (SOC) with an integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. This IOT module is capable of hosting an application. In this system, the IoT concept is used to upload the output data from the microcontroller into the data cloud.

2.2 Software

2.2.1 Android Application

In this system, the Android application plays a major part. It is one which is held by the users. It helps the user or passengers of a bus to know the information about the bus they need to travel. It acts as an intermediate between the cloud and the user.

3. Results and Discussion

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. Fig. 2 shows the hardware connection of the proposed system. Fig.3 is the result that has been displayed in the user's android application for their bus route. The user has entered 16F as an input. For that the application has fetched his next bus and it is in Porur at present.

The results are reliable and show very little variation despite making continuous reading for 24 hours and with repeated resets. Fig. 8 shows the variation of CO_2 in two different environments. The experiment was performed in open fresh air and indoor room air having considerable number of people. Fresh air CO_2 level are usually in the range 350-400ppm while maximum safe indoor level is up to 1000 ppm. From the figure 3 it can be clearly seen the result.

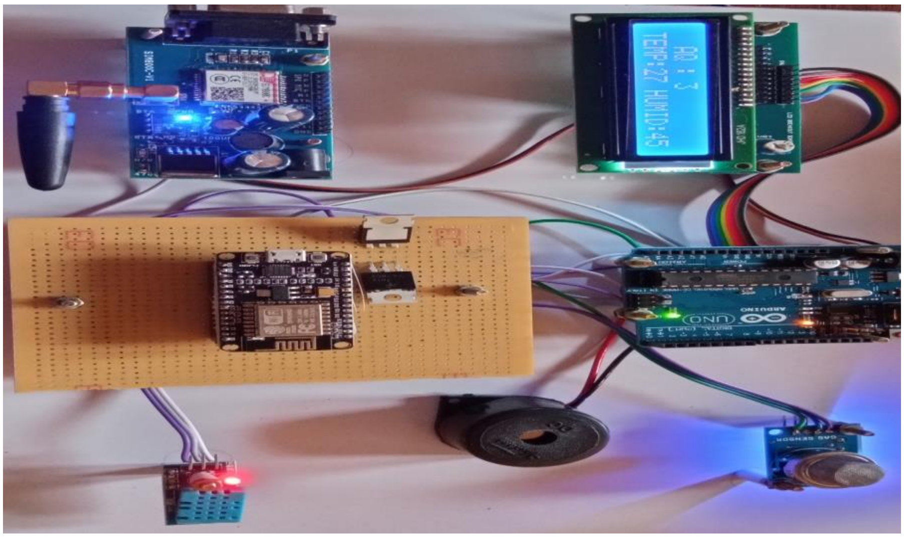

Fig. 2 Hardware Setup of The IOT based air quality monitoring system

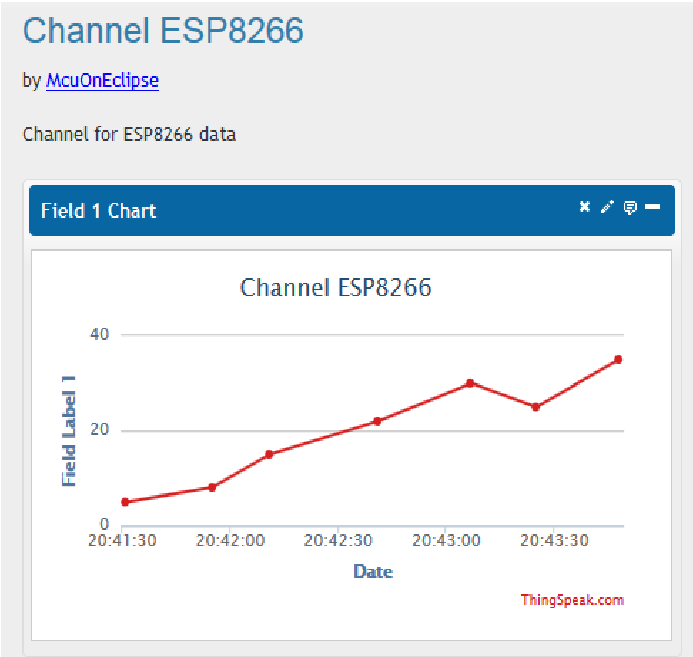

Fig. 3 Data visualization using Thing Speak cloud

Conclusion and Future Enhancements

This module 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 and also can be implemented in Google Maps for live map view of pollution level.

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