Available online at www.elixirpublishers.com (Elixir International Journal)

Computer Engineering

Elixir Comp. Engg. 130 (2019) 53082-53084

ISSN: 2229-712X

Internet of Things (IoT) Based System for Monitoring and Controlling Air Pollution.

Vivek Waghmare, Aishwarya Hirve, Shubhangi Bhavsar, Urmila Dingore and Ruchika Mahajan
Department of Computer Engineering Sandip Foundation's, Sandip Institute of Technology & Research Centre, Mahiravani, Nashik - 422213

ARTICLE INFO

Article history:
Received: 12 April 2019;
Received in revised form:
23 April 2019;
Accepted: 4 May 2019;

Keywords
Internet of Things,
Air Pollution Sensor,
Raspberry Pi,
Cloud,
Python,
HTML.

ABSTRACT

he level of pollution has increased with times by lot of factors like the increase in population, increased vehicle use, industrialisation and urbanisation which results in harmful effects on human being by directly affecting health of population exposed to it. IoT Based system for monitoring and controlling Air Pollution in which monitor the Air Quality at any Industry over a web server using sensors when the air quality goes down across a certain level, means when there are sufficient amount of harmful gases are present in the air like CO_2, smoke, alcohol, benzene and NH_3. It will show the air quality in PPM on the display screen and as well as on website so that we can handle and monitor it easily. After gathered the information about air quality, this information is send to the Air Pollution Control Officer and the owner of Industry through mail and message in order to take strict action.

Introduction

The main objective of IoT Air Monitoring System is that the Air pollution is an increasing issue now a days. It is necessary to measure air quality and keep it under control for a better future and healthy life for everyone. Due to flexibility and low cost Internet of things (IoT) is getting popular. With the urbanisation and with the increase in the vehicles on road the atmospheric conditions have considerably affected. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. Monitoring gives measurements of air pollutant and sound pollution concentrations, which can then be analysed interpreted and presented. This information can be applicable in many ways. Analysis of monitoring data allows us to assess how bad air pollution is form day to day. Monitor the Air quality at any Industry using Sensors[1]. Gathered the information about Air quality is send to the Air pollution control units head and the owner of industry through mail and message ,when the air quality goes down beyond a certain level[1]. The air pollution monitoring system overcomes the highly-polluted areas which is a major issue[2].

Related Work

The commercial meters obtainable in the market are Fluke-CO- 220 carbon monoxide meter for CO, Amprobe-CO2 meter for CO2,LPG leakage detection alarm of Forbix-Semicon LPG gas leakage. The researchers in this field have established various air quality monitoring systems based on Wireless sensor network, GSM(global system for monitoring) and GIS(geographical information system). Recently each and every technology has limitations according to the intended function of zigbee is meant for users with zigbee transceiver, bluetooth.

The system uses low cost air quality monitoring nodes comprises of low cost semiconductor gas sensor with Wi-Fi modules. This system calculates concentrations of gases such as CO, CO2, SO2 and NO2 using semiconductor sensors[1]. The sensors will collect the data of individualise environmental parameters and send it to raspberrypi is act as a base station[1]. Sensors gathering realisation of data is displayed on Raspberrypi 3 based Web server. A MEAN stack is developed to display data over website[1].

The usage of a huge number of sensors assure monitoring accuracy, reduces monitoring cost and makes monitoring data in monitoring area more systematic and perfect[2]. A huge number of field data provided by front-end sensor network makes big data analysis in background application layer more direct and effective, providing a real and effective decision-making basis for emergency response after pollution accident happens[2].

Problem Statement

In order to monitor Air Pollution at the industry, in the proposed system in which measuring air quality web server. By studying the existing system it was concluded that an effective real time air pollution monitoring system is essential in todays polluted world. In existing scenarios there was a government employee which was appointed who has duty to go in each and every polluted industry area and keep a record of the emission ratio at current time.

Gagan Parmar; Sagar Lakhani; Manju K. Chattopadhyay, Air IoT based low cost air pollution monitoring system.in System for monitoring the concentrations of major air pollutant gases has been developed. The system uses low cost air-quality monitoring nodes comprises of low cost semiconductor gas sensor with Wi-Fi modules. This system measures concentrations of gases such as CO, CO_2, SO_2 and NO_2 using semiconductor sensors. The sensors will

Tele:
E-mail address: vivek.waghmare@sitrc.org

gather the data of various environmental parameters and provide it to raspberry pi which act as a base station. Realisation of data gathered by sensors is displayed on Raspberry pi 3 based Web server. The memory of raspberry pi is more limited then your probably used. Pro- posed system is use Raspberry Pi[1].

Chen Xiaojun; Liu Xianpeng; Xu Peng, IOT-based low cost air pollution monitoring system. In that system large number of sensors are used for Targeted emergency disposal measures can be taken to minimise losses in practical application and reduce the cost of monitoring. Proposed system is use an ultra-low power digital gas sensor and optical dust sensor provide an alternative to traditional electrical sensors for many applications with high accuracy [2].

Methodology

The proposed system using raspberry pi as main controller. Raspberry pi is a single board computer which contains SOC (System On Chip as multi-core processor, GPU, ROM, I/O peripheral etc) DDR RAM Memory, Ethernet port, USB Host, Micro HDMI on it. Also proposed system uses the different sensors like Optical Dust Sensor which is designed to sense PM2.5 dust particles. The CCS811 is an digital gas sensor solution which integrates a metal oxide (MOX) gas sensor to detect a wide range of Volatile Organic Compounds (VOCs) for indoor air quality monitoring.MQ135 detect/measure NH3, NOx, alcohol, Benzene, smoke, CO_2, etc.

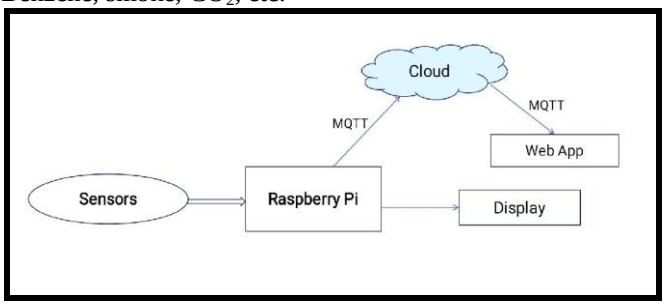

Figure1. Proposed System Architecture for Air Pollution monitoring system.

Raspberrypi

Raspberrypi is System on Chip(SOC). SOC is integrated circuit which is integrates all component of computer or other electronic system. Those are Processing unit, input and output port and secondary storage, GPU, WiFi module etc. SOC consumes less power and take up less area then CPU. its improve the performance. Proposed system using raspberrypi 3B plus.

Cloud

Cloud is usually Internet-based. Cloud allows users and enterprises with various computing capabilities to store and process data publicly and privately by public cloud and private cloud. In Public cloud, general public can access systems and service easily. In private cloud, system and services are accessible within the organisation. There are number of application provided by cloud like online file storage, photo editing software, digital video software, twitter-related application, creating image album, web application for antivirus, presenting software, word processing, finding a way on the map, e-commerce software.

Proposed system uses AWS (Amazon Web Services) cloud. AWS cloud platform is expand and it is freely available It gives security, more flexibility and reliability.

Sensors

Sensors continuously sense smoke of factory and environment and detect the data.

If factory exceed the polluted air. Data is recorded & stored to the server. Through web browser mail is sent to the Air Pollution Control Officer. As well as mail & message sent to the owner of Factory.

CCS811 Sensor

The CCS811 is an ultra-low power digital gas sensor solution. It is integrates a metal oxide (MOX) gas sensor. It has Standard I²C digital interface. CCS811 sensor is used detect a Total Volatile Organic Compounds (TVOCs), eCO2, Temperature and Humidity.

eCO2- The equivalent CO2 (eCO2) output range for CCS811 is from 400ppm to 8192ppm. Values outside this range are clipped.

TVOC

TVOC stands for The Total Volatile Organic Compound. TVOC is output range for CCS811 is from 0 ppb to 1187 ppb. Values outside this range are clipped.

BMP085

BMP085 is a barometric pressure sensor. It measures the range of between 30000 and 110000 Pa. Pa meaning the Pascal unit. 1 hPa (hectoPascal) is equal to 100 Pa or kPa (kiloPascal), which is 1000 Pa. BMP085 used for measuring the altitude in AGL (Above Ground Level) It is also provides a temperature measurement, anywhere from 0 to 65 °C. The BMP085 has a digital interface, I^2C to be specific. BMP085 sensor used for Weather forecast.

Optical Dust Sensor

PM2.5 dust sensor is a digital universal particle concentration sensor, it can be used to obtain the number of suspended particulate matter in a unit volume of air within 0.3 to 10 microns.

MQTT

MQTT is stands for message queuing telemetry transport. It is an ISO standard messaging protocol. It is simple and lightweight messaging protocol. It has low bandwidth. It makes easy to establish communication between multiple devices.

Mathematical Model

S = {I, O, F, Success, Failure}
I = Inputs of system
I = {i1, i2, i3}
i1 = PM2.5 (Dust) Sensor
i2 = CSS811 Sensor
i3 = BMP085 sensor
O = {Outputs of system}
O = {o1, o2, o3, o4}
o1 = OLED display
o2 = Buzzer
o3 = RGB Led
o4 = Send data on cloud
F = Functions of system
F = {f1, f2,}
f1 = Calculate Pollution
f2 = Store data on cloud
Success = Success Case System working as per requirement
Failure = Failure Case System not working as per requirement

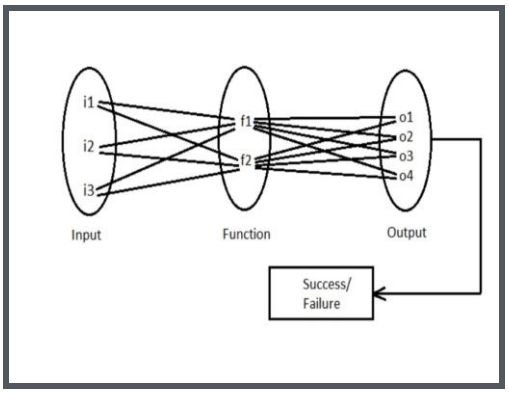

Figure2. Mathematical Model

Conclusion

The system to monitor the air of environment using IoT technology is proposed to detect quality of air. With use of IoT technology enhance the process of monitoring various aspects of environment such as air quality monitoring issues. Here the using of gas sensors gives the sense of different type of dangerous gas level and raspberry pi is the main aspect of this project which controls the entire process. The proposed system over comes the problems of pollution of industrial areas which is measure issue and reduced man power. It sustain the new technology and influential the healthful life concepts.

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