Advanced IOT Based Pollution, Temperature Detection Using Raspberry PI Controller and Mobile Application

[1] Kiran Kumar V, [2]Dr. Venkatesh Prasad K S

Authors affiliation, school of computer science and engineering, REVA University, Bangalore

Abstract.

With huge increase in population, has resulted in extreme demand for food, water, home, electricity, roads, cars, and numerous different commodities. These demands have created large, tremendous amount of strain on our natural resources and contribute to contamination of the land, water, and air. Examining the destruction and depletion of our treasured natural resources is an urgent necessity. To protect and improve the standard of our environment, the Republic of India's government created the Environment (Protection) Act, 1986 to regulate environmental pollution (land, water, and air). Thermal wastes streaming out of electricity-generating units, e.g., thermal control plants constitute another vital category of pollutants. Thermal wastewater reduces or eliminates the total number of creatures that are sensitive to high temperatures, and it may improve plant development in extremely cold environments, but only after harming the inborn greenery and fauna. This paper presents IoT based pollutant gas (e.g. CO - Carbon Mono-Oxide by using MQ-2 sensor) and temperature (by using DHT-11 sensor) are monitored with 2 different approaches by using android application based on users' current location. Approach 1). In this approach, an IOT-based method using physical controllers Raspberry Pi and hardware sensors are integrated to constantly check the Air Quality Index at sensitive areas where elderly people reside. Approach 2). In this approach, if smart devices itself are equipped with sensors for gas and temperature detection, it would be very easy and better analysis could be done at based on current location of the user with the help of mobile application.

Keywords. CO, MQ-2, DHT-11, AQI, Mobile Application.

1. INTRODUCTION

With huge increase in population size has resulted in extreme demand for food, water, home, electricity, roads, cars, and numerous different commodities. These demands have created large, tremendous amount of strain on our natural resources and contribute to contamination of the land, water, and air. Examining the destruction and depletion of our treasured natural resources is an urgent necessity. In existing systems, the pollution board authorities ought to deploy necessary controllers together with sensors to at numerous locations and may visualize data that are deployed to IoT Cloud (Thing Speak) with the

assistance of web or mobile application. The applications that are designed shows the information selected at specific location. If the user is travel, then the prevailing system fails to show the near controllers real time data. In this paper, we've have proposed two completely different approaches to monitor the pollutants based on the data gathered from numerous locations of the controllers being installed, dynamically supported by user's location using smart devices likes Mobiles, Tablets. Laptop etc.

2. INTERNET OF THINGS

With the large increase in usage of smart devices, through internet one will communicate with another device. Internet of Things is that the most well-liked technology which will provide solutions to real time watching of the hardware system from remote location and save the information gathered from these devices over Cloud Storage. With IoT we tend to could retrieve the information, perform some statistical analysis, and forecast an equivalent to the public authorities or to the end user.

3. LITERATURE SURVEY

Several papers have been published on pollution monitoring system.

A system has been built [1], in which the authors proposed to build a system to continuously monitor various pollutants that are released from various industries by installing physical hardware devices like Arduino Controllers, MQ-2 gas sensors and DHT-11 temperature sensors.

A system has been built [2], In which the authors have proposed a system to monitor 7 various kinds of pollutants with the help of physical hardware resources installed at various locations at regular intervals of time and if the pollutants that are released from the industries goes beyond the user's pre-set value, an e-mail or SMS will be delivered.

A system has been built [3], in this project with the help of Node MCU micro controller's authors have proposed a system that can sense the real time data of various pollutants through gas and sound sensors that are saved in IoT Cloud and report the same to public authorities.

A system has been built [4], In this paper, authors have proposed a system that can sense the real time data (by using MQ-6, MQ-7 MQ-135) of various pollutants deployed at workshops and commercial buildings that are saved in IoT Cloud (Google Cloud Platform) and report the same to public authorities.

A system has been built [5], in which the authors have proposed a system to build with raspberry PI 3 model along gas sensors like humidity sensor DHT-11, MQ-2 / 7 gas sensors and interfaced 2714 NO2 sensors that can send values being read from these sensors to Thing Speak IOT Cloud.

4. HARDWARE DESCRIPTION

To demonstrate, we have used two different sensors, MQ-2 gas sensor to detect CO and DHT-11 to detect humidity/temperature.

a) DHT-11 Sensor

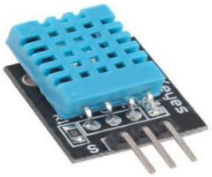


Fig 1. DHT-11 sensor

DHT-11 is used to sense temperature and humidity. DHT11 are often interface with any microcontroller like Arduino, Raspberry Pi. It has high reliability and glorious semi-permanent stability. The digital signal is straightforward to scan victimization any microcontroller. Only three connections are expected to be made to utilize the sensor - Vcc, Gnd and Output.

b) MQ-2 Sensor

Fig 2. MQ - 2 CO Gas Detection Sensors

MQ2 is one in every one of the generally involved gas identifiers in MQ sensor series. It's a Metal chemical compound Semiconductor Gas detector additionally called Chemiresistors because the detection is predicated by varying the obstruction of the detecting material. Once the gas comes in touch with the fabric. Employing an easy resistance network, convergences of gas might be distinguished. MQ - 2 indicates the kind of gas within the type of associate analog signal and an Analog-to-Digital device MCP 3008 is employed to convert it to digital and interface to the Raspberry Pi.

c) MCP 3008

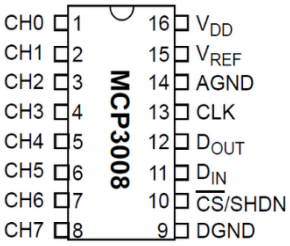


Fig 3. MCP 3008

The MCP3008 is a negligible cost 8-channel 10-bit Analog to Digital converter. The MCP3008 associates with the Raspberry Pi utilizing a SPI sequential association. We can use either the hardware SPI transport, or any four GPIO pins and programming SPI to banter with the MCP3008. To connect the MCP3008 to the Raspberry Pi with a computer code SPI affiliation you would like to create the subsequent connections:

MCP3008 VDD to **Raspberry Pi 3.3V**
MCP3008 VREF to **Raspberry Pi 3.3V**
MCP3008 AGND to **Raspberry Pi GND**
MCP3008 DGND to **Raspberry Pi GND**
MCP3008 CLK to **Raspberry Pi pin 18**
MCP3008 DOUT to **Raspberry Pi pin 23**
MCP3008 DIN to **Raspberry Pi pin 24**
MCP3008 CS/SHDN to **Raspberry Pi pin 25**

Fig 5. MCP Wiring with Raspbeery PI Controller

5. PROPOSED SYSTEM

In this paper, we have proposed two different approaches to monitor CO pollutant by using MQ-2 gas sensors that are hazardous to human life. We have as well as temperature sensors (DHT-11) to detect the maximum temperature/humidity and the same can be used for necessary action against the organization responsible for disposing of such exceeded level of pollutants by Government authorities like National Pollution Control Board. The project can also be used to monitor other hazardous pollutant agents like SO2, NO2, Lead, PM2.5 etc. With the increase in usage of smart devices, we have proposed a system to make public also be aware of various pollutants in the nearby areas by using an Android Application. In existing system, several applications that are being developed helps in visualizing the data by selecting a specific location of the devices being deployed. But in our proposed system, the application is developed in such a way that the user when using the mobile app can easily get to know about all the nearby controller (devices/ stations) data dynamically with the help of GPS sensors data embedded within the mobile devices.

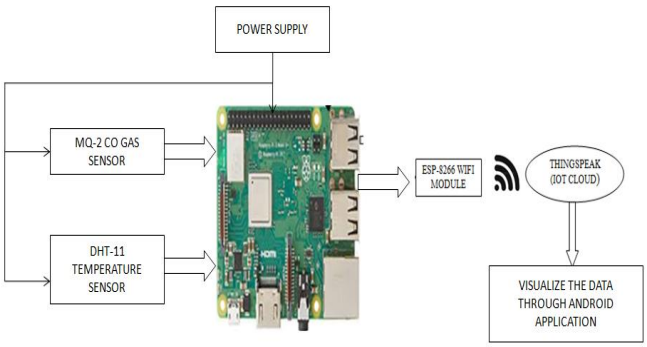


Fig 6. Architecture Design Specification

A. Approach-1 - By using Micro-controllers and sensors

In this approach, the physical hardware devices like Raspberry PI, DHT-11 and MQ-2 gas sensors are interfaced and deployed at varied locations within the town. Raspberry PI controllers contain an in-built support for Python programming language. With the assistance of adafruit- library imported to python language, we could read the sensors data. The data that has been read are basically an analog signal that must be regenerate to digital numerical and MCP 3008 ADC Controller is getting used. The data in Thing Speak can be used to perform certain statistical analysis to forecast the data based on Time Series Machine Learning Models.

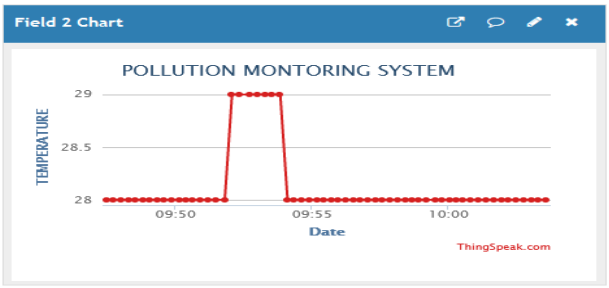


Fig 7. Sample Temperature Sensors data being recorded at Thing Speak

If the user is travelling, with the help of android application being developed, can get to know information about various pollutant agents that's being gathered by all the controllers which is at 5 KM of radius from the current location of the users. The mobile application also has an option to pre-set the maximum threshold value for Temperature and Carbon-Mono-Oxide. If the controller is reporting beyond the pre-set value when the user is travelling, then he/she gets an immediate notification as "Bad Status" for travelling in that area and necessary action can be taken against it. When the location is changed, automatically this application would display all the device/stations data that are being gathered in IOT Cloud based on user's current location at 5 KM.

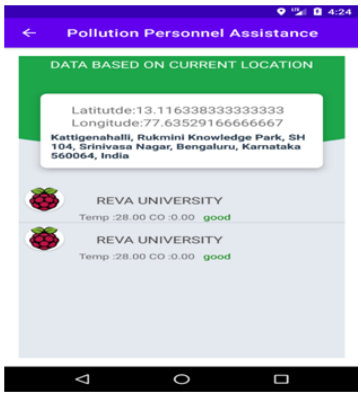


Fig 8. Displaying Controller recorded data near by REVA University.

In the above snapshot, the application shows the user is currently at REVA University and there are two controllers available at 5 KM and the pollutant or temperature is not more than the pre-set value of the end user. For testing purpose, we have simulated the data to be the same for both the controllers. The user can click on any one or the controller listed above and can visualize the last 7-, 15- or 30-days report and can take necessary action.

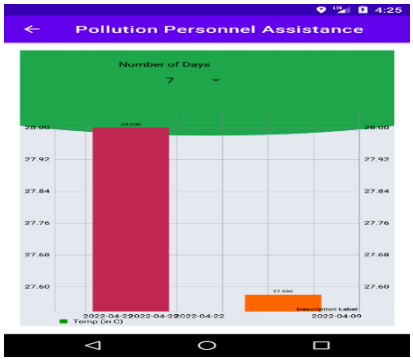


Fig 9. Application showing last 7 days report of specific controller chosen

If there aren't any controllers being placed at a distance of five kilometres of radius from user's location, the application would show "No close Controllers data Found!!!"

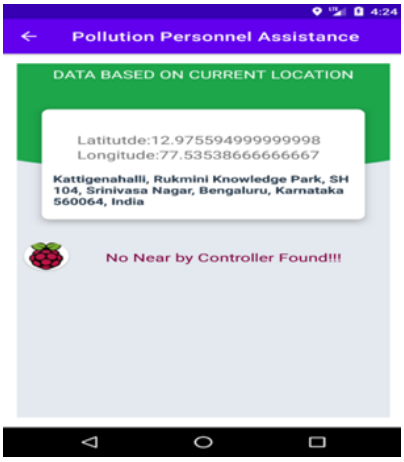
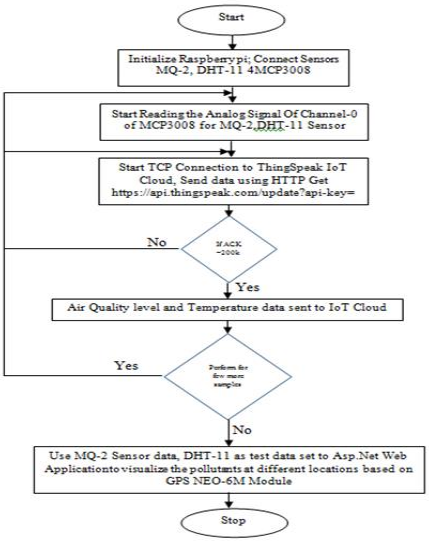


Fig 10. Displaying No Controller data near by REVA University

B. Approach-1 -Proposed System Flow chart



B. Approach-2 - Smart Device Embedded Sensors data visualization

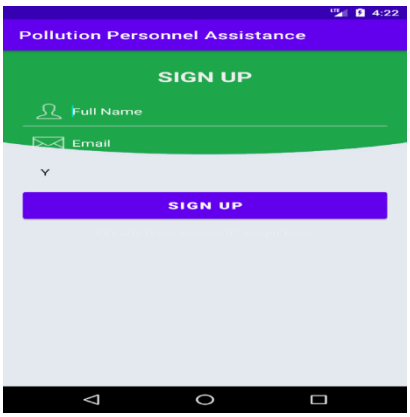


Fig 11. SIGN UP Screen of Android Application

In the previous approach, concerned pollution control board authorities must install the devices/stations at various locations where the pollutants are reported in high. It would be very difficult for the Government/Concerned Authority to install and provide continuous power supply and also maintenance, all together incurs more cost. To address these issues, in approach 2, if it is possible for smart device manufacturers to embed gas sensors (Compact MQ -2 example) and temperature sensors at the back panel, then within android application at the time of registration of the user for the first time, SIGN UP has an option (third option as shown in above activity) to read the current location of the users. If the user has agreed upon to share current location along with embedded sensors data, then whenever the application is running in background, the current location of the user will be saved to the database along with the temperature and gas sensor values that it has read at the time of being in that area. If no, then user's current location information will not be sent to our database.

With this tecnique has a very feasible solution to overcome the difficulties in isntalling and maintaining the physical devices for the concerned authority and 24/7 authorities has to keep an eye on the system installed. To overcome all these problem we have automated a system with the help of android based application which gives information directly to the end user (pubilc) and also Government can make use of this data for forecasting the data for next few days by using ML algorithms.

For example, if a client is at REVA University, then the application has been designed in such a way so that it will get to every one of the devices information close by the client's location at a radius of 5 KM. There could be a few clients around REVA University who have introduced our application on their savvy gadgets and furthermore given the authorization to save their continuous current area data. Subsequently that multitude of information will be collected in view of number of cases of the information and a similar will be provoked to the client's console. At first when the activity is opened, it will show the ongoing client's location with the help of GPS sensor. Android upholds Location Listener interface that can be utilized to follow the client's area in view of scope and longitude.

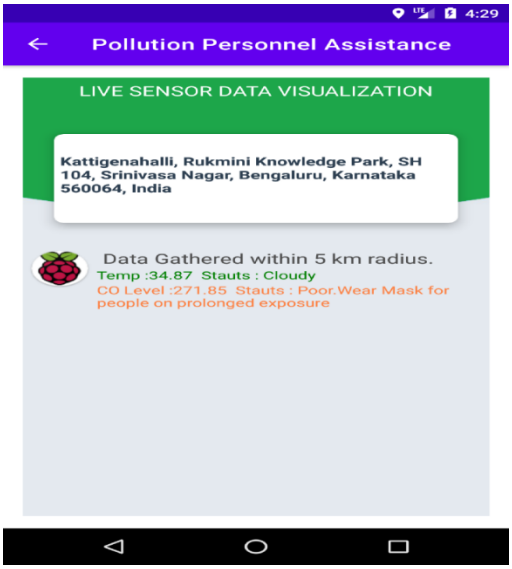


Fig 12. Live Sensor Data Visualization with data shared from smart devices.

In Real time situation, at a particular location there could be hundreds and thousands of savvy devices being utilized inside a span of 5 KM and the best part is every one of the devices are utilizing our application, then the continuous temperature and gas sensors information are stacked in the data set and the equivalent can be utilized for conglomeration. But for development and testing purpose, whilst this activity is opened, we've simulated inside to load about 25 facts for every of the sensor records (temperature and CO pollutant gas values), in order that the records may be aggregated from all of the smart devices (like laptops, mobile, tablets etc.) that are at a radius of five KM.

6. FUTURE ENHANCEMENT

In this paper, we proposed a system that carries out the contamination checking arrangement of Temperature and Carbon Mono-Oxide gases without actual deployment of devices/stations however with built-in sensors of shrewd gadgets considering client's ongoing area. So, when the area of the clients is changed consequently our application will ascertain the information that is amassed from the brilliant devices which are at area of the client’s area a good ways off of 5 KM of span. In this task, the information is additionally saved IoT Cloud Thing Speak. Further, a similar activity can likewise be reached out to forecast the various sensors and temperature information for a week or custom number of days in view of the investigation of the information that is being put away at Thing Speak IoT Cloud by using machine learning algorithms.

7. CONCLUSION

In this project, proposed a system that can continually monitors air quality in an ongoing area and showcases the air quality on the android application not only for the concerned authorities but also for public users. In this undertaking we are attempting to carry out the contamination observing arrangement of Temperature and Carbon Mono-Oxide gases without actual establishment of devices and gadget/stations yet with implanted sensors of smart devices considering client's ongoing area. So, when the location of the clients is changed consequently our application will work out the information that are collected from the brilliant gadgets which are at area of the clients area a good ways off of 5 KM of range.

8. REFERENCES

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