IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 7, July 2021

DOI 10.17148/IJIREEICE.2021.9716

A Raspberry-Pi Based Embedded System to Monitor Air and Sound Pollution Using IoT

Chetan B V[1], Mohammad Aftab Y H[2], Dheeraj Kumar S[3],

Chandan Patil R V[4], Pavankumar I Dodawad[5]

Assistant Professor, Dept. of ECE, GM Institute of Technology, Davangere, India[1]

Final Year Student, Dept. of ECE, GM Institute of Technology, Davangere, India [2,3,4,5]

Abstract: In recent day situation, the continuous increase in air and sound pollution prove to be an disturbing problem. It has become compulsory to control and appropriately monitor the situation. In this work, an Internet of Things (IoT) based methodology to monitor the Air Quality Index, Noise Intensity, Temperature and Humidity of a region has been proposed. The evaluation of methodology is performed on Raspberry Pi implementation with interfacing of a web server Thing Speak that has an API for posting and reviewing the data to the channel. Python is used for programming and interfacing the Raspberry Pi with various sensors viz. temperature/humidity sensor, sound sensor and gas sensor for collecting the data. The proposed system incorporates four segments, namely, the Air Quality Index Monitoring Module, the Sound Intensity Detection Module, the Cloud based Monitoring Module and the Anomaly Notification Module. Firstly, the Air Quality Index is measured studying the presence of the five critical air pollutants. Then the sound intensity is detected using relevant sensor. The Cloud based Monitoring Module ensures the process of obtaining the data with the help of Wi-fi-module present in Raspberry Pi which fulfils the objective of analysis of information on periodical basis. Lastly, the Anomaly Notification Module alerts the user in case of an undesired condition.

Keywords: Internet of Things, Thing speak, Raspberry Pi.

I. INTRODUCTION

Air, Sound, Temperature and humidity are main factors that most contribute to the global climate patterns. Their changes shall affect the environment worldwide where life cycles of plants and animals become different. This paper describes the implementation of a wireless air, sound, temperature and humidity for autonomous monitoring on a Raspberry Pi. Hence, the objective of this paper is two-fold, first is to emphasize the development of wireless environment for autonomous monitoring on an embedded Raspberry Pi. Secondly, we have explained the development of an alert system for monitoring the readings when it reached a certain condition. Finally perform the analysis on the result obtained from sensors readings in the experimental areas. It is also shall reduce the uses of manual monitoring such as analog thermometer that contribute to a lot of errors for the reading to be taken. It is good to be notified when a certain temperature condition is met for the next step to be taken. In this model, we are using a Raspberry Pi 3B microcontroller, which will have gas sensors, temperature and humidity sensors and noise sensors connected to it, to monitor the fluctuating environmental parameters. OS is coded with Python language for retrieving air, sound, temperature and humidity readings where the values are sensed through sensor and sent to the internet. The rest of this paper explains about literature review, methodology, result and its discussion for analysis part.

II. RELATED WORK

L.Ezhilarasi et al. [1] have proposed a monitoring technique using a Zigbee wireless sensor network to monitor the various environmental parameters. It uses RFID means to store and retrieve data through electromagnetic transmission to an RF integrated circuit. The WSN gateway method is used to conveniently collect the data at any time and place.
Mohannad Ibrahim et al. [2] have proposed the design of a cost-effective environmental monitoring device using Raspberry pi. The information is collected by the sensors and uploaded to the internet where it could be accessed anytime. The system was found to be accurate in terms of measuring humidity, temperature etc.
Muhamad Fazril et al. [3] have presented an implementation of wireless temperature and humidity monitoring on a Raspberry Pi. The objective of this project is to design a monitoring temperature and humidity reading kit which implemented on Raspberry Pi. The study focuses on the embedded project for sensing the temperature and humidity in room and library area.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 7, July 2021

DOI 10.17148/IJIREEICE.2021.9716

S.Prabha et. al [4] have proposed a system which is low cost, has high computational strength, compact and requires low power. It achieves high accuracy in monitoring the surroundings with the sensors from anywhere in the world.
Somansh Kumar et al. [5] have given the idea of a real-time air quality monitoring system including various parameters like P.M. 2.5, CO2. This paper presents a real-time standalone air quality monitoring system which includes various parameters: PM 2.5, carbon monoxide, carbon dioxide, temperature, humidity and air pressure.
Indranil Banerjee et al. [6] have used Raspberry pi 3B+ microcontroller along with different real time sensors to analyze the environmental parameters and then take appropriate action based on the generated results.

III. PROPOSED SYSTEM FOR AIR AND SOUND POLLUTION MONITORING

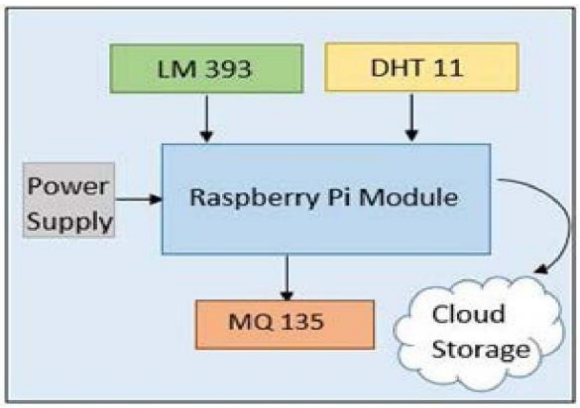

Fig. 1 Block diagram of the proposed system

Fig.1 shows the block diagram of the proposed Cloud Based Air and Sound Pollution Monitoring System with Temperature and Humidity Sensing. The details of the blocks shown in Fig.1 are as follows..

A. Raspberry Pi Model 3B
In this work, we are using a Raspberry Pi 3B module. It is an ARM based credit card sized SBC (Single Board Computer) created by Raspberry Pi Foundation. A Wi-Fi and Bluetooth module is already present in the Raspberry Pi 3B. Using this module, we can send the acquired converted digital counterparts of the parameters, over the internet, to a Cloud based storage area.

B. LM393 Sound Sensor
In this work, to monitor the sound pollution, a sound sensor, LM393 is used. When sensor detects sound, it processes the output signal voltage which is sent to Raspberry Pi which again performs the necessary processing required for monitoring the parameter.

C. MQ135 Gas Sensor
In this work, to monitor the air pollution and to determine the air quality index, a gas sensor, MQ135 is used. MQ135, gas sensor operates at 5V voltage and 40 mA current. It efficiently detects the Nh3, NOx, smoke and CO2 level in air.

D. DHT11 Temperature and Humidity Sensor
DHT11 is a humidity and temperature sensor. It can be used to monitor the temperature and humidity levels in a region. It can be interfaced with a Raspberry Pi module and can give immediate results. In this work, we are using this sensor to monitor the varying humidity and temperature levels.

IV. METHODOLOGY

The proposed system consists of the following modules, namely, the Air Quality Index Monitoring Module, the Sound Intensity Detection Module, the Cloud-based Data Monitoring Module and finally the Anomaly Notification Module. Air Quality Index is measured depending on five criteria pollutants, namely, ground-level ozone, particulate matter, Carbon monoxide, Sulphur Dioxide and nitrogen dioxide. In this work, we are using MQ -135 Air Quality or Gas Detection Sensor. It efficiently detects the NH3, NOx, smoke and CO2 level in air. LM393 Sound Detection Sensor is utilized to measure sound intensity with the motive to monitor Sound Pollution in an area. When sensor detects sound, it processes the output signal voltage which is sent to Raspberry Pi which again performs the necessary processing

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 7, July 2021

DOI 10.17148/IJIREEICE.2021.9716

required for monitoring the parameters. DHT11 Sensor is utilized to measure humidity and temperature in an area. The sensor detects the humidity levels and processes the output signal voltage, which is sent to the Raspberry Pi module. For the incorporation of the cloud system we need internet access. Hence we use ThingSpeak, it retrieves and stores the data from the sensors connected to the systems through internet that uses hypertext transfer protocol (HTTP) from the local network to the cloud. For anomaly notification module, we are using Twilio which allows programmatically making and receiving phone call, sending and receiving text messages and performing other communication functions. User gets notified whenever the pollution level increases the threshold level through mail or SMS. Fig.2 shows the flow of data through the algorithm of the proposed system.

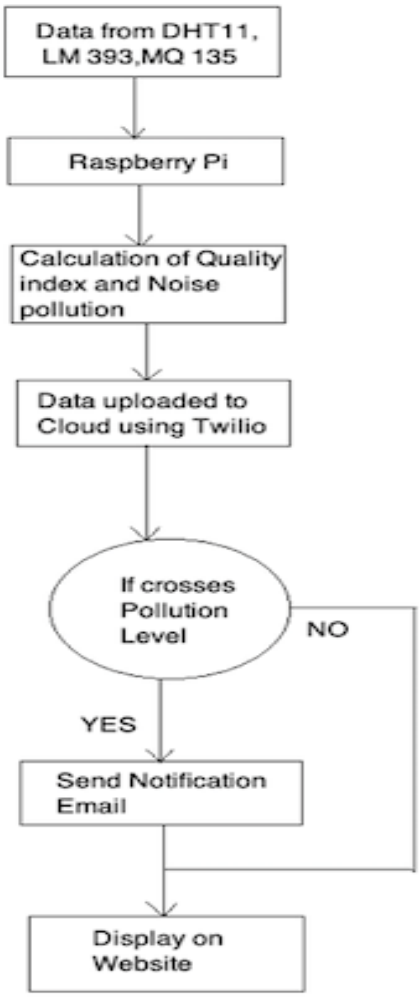

Fig. 2 Flow graph of data flow in the proposed system

V. RESULTS

Thingspeak is used for real-time monitoring air quality level (smoke level), noise level, temperature level and humidity level. The testing results of the proposed system over a period of one week is depicted in Fig. 3, Fig. 4, Fig. 5 and Fig. 6 for air quality, noise level, temperature and humidity respectively.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 7, July 2021

DOI 10.17148/IJIREEICE.2021.9716

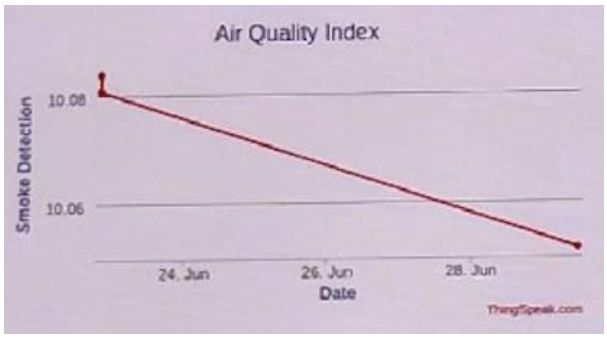

Fig. 3 Air quality (smoke level) monitoring

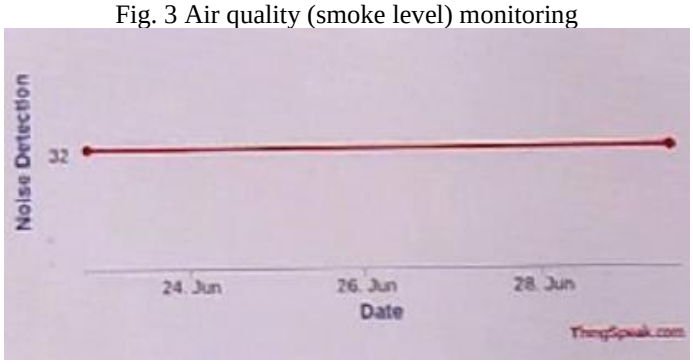

Fig. 4 Noise level monitoring

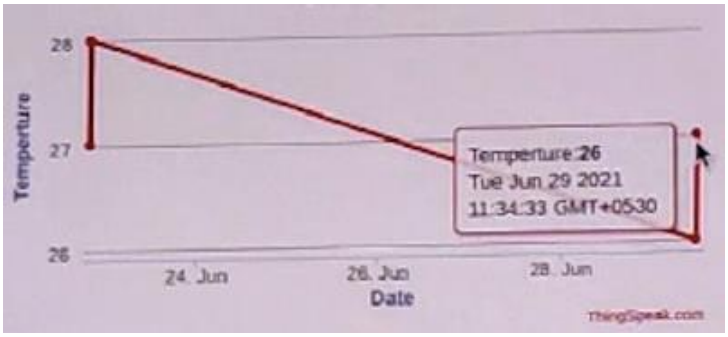

Fig. 5 Temperature monitoring

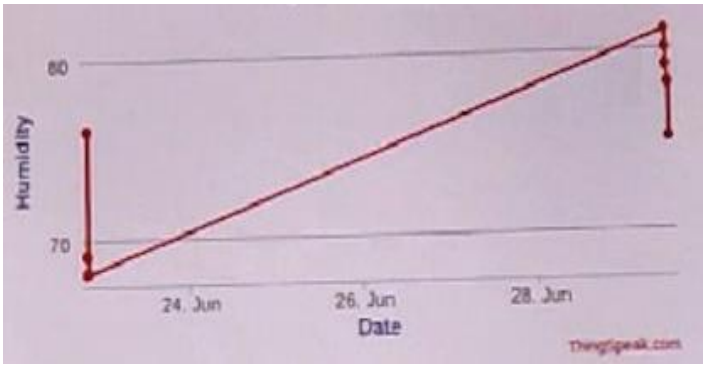

Fig. 6 Humidity monitoring

Fig. 7 shows samples of the alert messages sent to the user/concerned, whenever any of the parameters viz. air quality, noise, temperature or humidity are beyond the expected normal levels.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 7, July 2021

DOI 10.17148/IJIREEICE.2021.9716

Fig. 7 Alert notifications sent via sms

VI. CONCLUSION

This work has presented a way for monitoring various environment parameters using a Raspberry Pi 3B module wirelessly. It can be concluded that using proposed system air, noise, temperature and humidity can be effectively monitored using Thingspeak. From the result obtained, it can be said that the factor of day and night only does not influence the temperature and humidity level. However, the analysis also indicates that the level of humidity is dependent on the temperature level where, the higher the temperature, the lower the humidity and vice versa. The concept of IoT helps to monitor and hence, motivates to take necessary action to improve the quality of air, monitor the level of noise, temperature and humidity. The monitoring of accumulated data in the cloud storage helps to analyze the various patterns in the environmental parameters and accordingly notifies the public.

REFERENCES

[1]. L.Ezhilarasi, K.Sripriya, A .Suganya, K.Vinodhini, " A System For Monitoring Air And Sound Pollution Using Arduino Controller With Iot Technology.", International Research Journal in Advanced Engineering and Technology (IRJAET) , vol. 3, no. 2, pp. 1781 – 1785, March 2017.
[2]. Mohannad Ibrahim, Abdelghafor Elgamri, Sharief Babiker, Ahmed Mohamed, "Internet of things based smart environmental monitoring using the Raspberry-Pi computer." Fifth International Conf on Digital Information Processing & Communications (ICDIPC), pp. 159-164, 2015.
[3]. Muhamad Fazril, Roslina Mohamad "Implementation of Wireless Temperature and Humidity Monitoring on an Embedded Device", 2018.
[4]. S.Prabha, R.Surya Raghav, Ch. Moulya "Analysis and Monitoring Air Quality System using Raspberry Pi" 2020.
[5]. Somansh Kumar, Ashish Jasuja," Air quality monitoring system based on IoT using Raspberry Pi.", International Conference on Computing, Communication and Automation (ICCCA), 2017.
[6]. Indranil Banerjee "Advanced Air Quality Monitoring System Using Raspberry Pi." 2019.
[7]. Biao Jiang, Christian F. Huacon, "Cloud-based Smart Device for Environment Monitoring", 2017.

BIOGRAPHIES

Chetan B V is Assistant Professor in the Department of Electronics & Communication Engineering, GM Institute of Technology, Davangere with 9 years of experience. He has received B.E and M.Tech degrees from VTU, Belagavi in 2010 and 2012 respectively. His research interests include Digital System Design, Embedded Systems, Image Processing and Pattern Recognition.

Mohammad Aftab Y H, Dheeraj Kumar S, Chandan Patil R V and Pavankumar I Dodawad are final year B.E students in ECE department, GM Institute of Technology, Davangere. They have good research interests in the field of embedded systems and IoT.