Air Guide: Indoor Air pollution Monitoring Application

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Abstract :As Humans usually spend most of their time indoors, monitoring indoor air quality parameters and real-time information is important for maintaining a healthy life and to increase work-rate. Environmental protection agency reports show that indoor air is a lot of contaminated than outside air, primarily attributable to modification in occupancy pattern, the presence of dust, poor ventilation systems and, the existence of VOC. Hence, it is necessary for every individual to measure air quality information real-time, exceptionally whose health is delicate to poor indoor air. To monitor the quality of air, an IoT based methodology AirGuide is proposed which is based on data sensing and transmission, the parameters of the environment to be observed are picked as dust, temperature, humidity, detection of leakage of any gas and various indoor air pollutants, etc. With the help of this AirGuide Application, the user can monitor live Indoor pollution parameters from anywhere in the world using Web Client or AirGuide Android application. If any dust, temperature, humidity, leakage of gas or any air pollutants exceeds the defined threshold then an alert SMS will be sent to the user registered mobile and buzzer will ring at AirGuide Device.

IndexTerms - Indoor Air Pollution, live pollution monitoring, Dust Monitoring, Temperature monitoring, pollution Monitoring, Humidity monitoring,Air Quality Monitoring.

I. INTRODUCTION

The vast majority know that outside air pollution can harm their health but may not recognize that indoor pollutants can also have giant unsafe impacts. According to EPA, indoor pollution is 2-5x times more polluted than outdoor and Humans mostly spend 90% of their lives in indoor. Indoor concentrations of a few contaminations have expanded in recent decades because of such factors as most tightly sealed building development, reduced ventilation rate to save power consumption and expanded utilization of synthetic materials, furniture, individual care items, pesticides and household cleaners[2]. According to WHO(World Health Organization) diseases caused due to indoor pollution is 34% stroke, 26% Coronary artery disease, 22% Chronic obstructive pulmonary disease and 12% asthma [1]. Recent EPA researchers say that Indoor air pollution is one of the top 5 environmental risks for people's health. So tracking real-time indoor air pollution information is required to lead a healthy life.

some of the existing systems only focused on carbon dioxide [4][7], carbon monoxide[11], ozone concentration[3] and dust particles[5]. Individual monitoring of ozone, carbon dioxide, and dust won't provide a complete solution for Indoor air monitoring. In the most of the systems[8][10], they are displaying monitored pollution values in LCD at the device and, some of the systems storing data[9] in the local database. Monitoring data from a remote location for the user is not possible in Existing systems.

By considering the downtimes of existing systems here proposed a Low-cost IoT based system AirGuide: Indoor Air pollution Monitoring application. It provides remote monitoring of real-time live data for the user. This AirGuide Application senses the dust levels, pollution level, temperature level, humidity level and, combustible gaseous level and stores data in the cloud, this system also provides the facility to detection of leakage of LPG gas.

If any of the sensed value crosses the predefined threshold then an alert SMS will be sent to the user and alert will be given at the device by ringing the buzzer. And the user can monitor the live data through AirGuide Android application with a reliable internet connection.

II. SYSTEM OVERVIEW

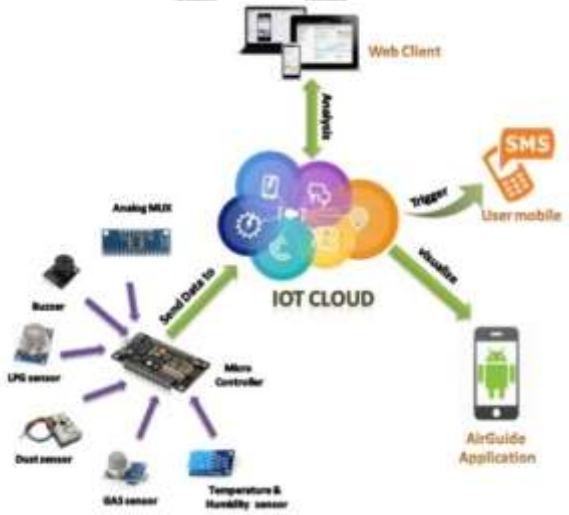

Fig1: System Architecture

A) Hardware Components:

1) Dust Sensor:

Fig2: Dust Sensor

Infrared transmitting diode and a phototransistor are corners to corner organized into this gadget Fig2, whenever dust particles touch the reflecting light in the hole it senses the data. It is particularly successful in identifying fine particles like tobacco smoke and is regularly utilized as a part of air purifier frameworks.

2) Temperature and Humidity Sensor:

Fig3: Temperature and Humidity Sensor

Humidity and Temperature Sensor module Which we are using here is based on digital signal collecting technique and provide digital humidity value and digital temperature values. It is Small in size & low energy consumption & has 20meters long transmission distance.

3) Air Pollution Sensor:

Fig4: Air Pollution Sensor

The Air pollution sensor which we are using can identify CO2, NOx, alcohol, NH3, benzene, and smoke. This sensor module gives value in ppm (parts per million).This sensor has wide detection scope and has a stable Life.

4) LPG Gas Sensor:

Fig5: LPG gas Sensor

The LPG sensor which we are using can recognize LPG, LNG, propane, iso-butane, cooking exhaust and tobacco smoke. This LPG sensor has a high sensitivity a quick reaction time

5) Microcontroller:

Fig6: Microcontroller

Here we are using NodeMCU Microcontroller. This Microcontroller consist of ESP8266 wifi enabled chip based on TCP/IP protocol[14]. It is low cost and low power consumption board.

6) Piezo Buzzer:

Fig7: Piezo Buzzer

Here we used 5v Piezo Buzzer which can make sound up to 100db.
7) 16 channel analog multiplexer:

Fig8: 16 channel analog multiplexer:
NodeMCU has only one analog pin so in order to extend the analog pins we are using 16 channel analog multiplexer.

B)Hardware Implementation:

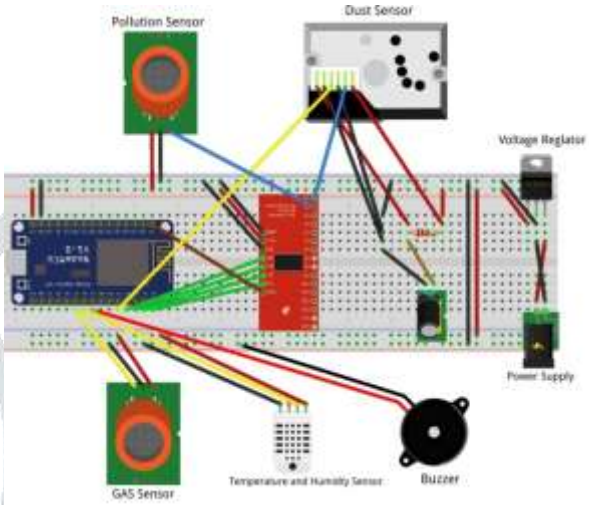

Fig9: Bread Board Circuit

A 5v power supply is supplied to the breadboard with the help of an LM7805 5v regulator. All the Vcc's GND's data pins, resistors, and capacitors are connected as shown in the Breadboard circuit Fig9. all the sensors, Multiplexer, NodeMCU are connected with jumper wires and arranged in a box which looks like as Fig10.

Fig10: AirGuide Device

C) Software Implementation:

- Arduino IDE (Integrated Development Environment): This is the one of the IDE used to program for NodeMCU [17]. Code to the Microcontroller is written in C language including the various required sensor libraries, Ubidots cloud library, and Ubidots device authentication access token. This IDE helps us to write, compile and upload the code into the NodeMCU.
- Cloud: Here we used UbidotsCloud[15] platform which provides user-friendly interaction towards the users. In order to get the authentication access token firstly user need to register and create a device in the Ubidots cloud. Ubidots also provides SMS alerts facility, a user registered mobile will get an SMS alert whenever data receiving towards clouds exceeds the defined threshold.
- Android Studio: AirGuide Android application is developed in Android Studio by using Ubidots Android SDK. With this AirGuide App, the user can monitor live real-time data of AirGuide Device from any remote location.

III. FLOW STEPS:

- NodeMCU connects to the wifi router using SSID and Password provided in the code.
- NodeMCU also Connects to the user Ubidots cloud account based on device authentication access token provided in the code using HTTP protocol.

- Dust sensor, temperature and humidity sensor, Pollution sensor and, gas sensor sense the dust, temperature, humidity, Pollution and, gas data respectively.
- NodeMCU receives the data from sensors using GPIO pins.
- NodeMCU posts dust, temperature, humidity, Pollution and, gas data towards the respective data fields in Ubidots.
- Ubidots shows the live real-time data in the dashboard as shown in Fig15.
- AirGuide Android Application also shows the live real-time data on the dashboard.
- If dust, temperature, humidity, Pollution and, gas data levels received by NodeMCU from sensors exceeds the defined normal threshold, then AirGuide make a noise using 5v piezo Buzzer.
- If dust, temperature, humidity, Pollution and, gas data levels received by Cloud from NodeMCU exceeds the defined normal threshold, then Ubidots sends the SMS to the user registered mobile as shown in Fig18.

IV. RESULTS AND DISCUSSION

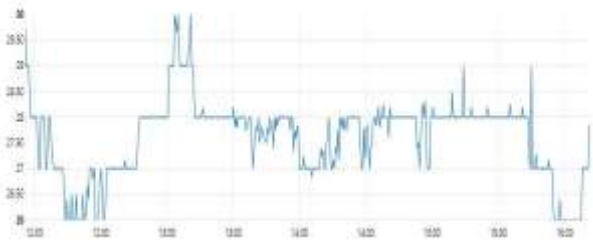

Fig11: Temperature Curve

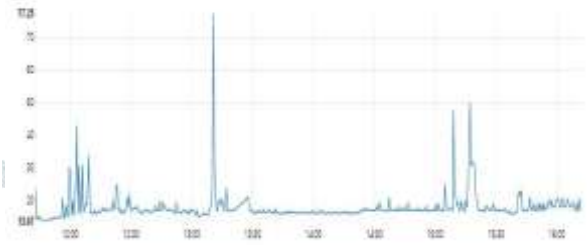

Fig12: Humidity Curve

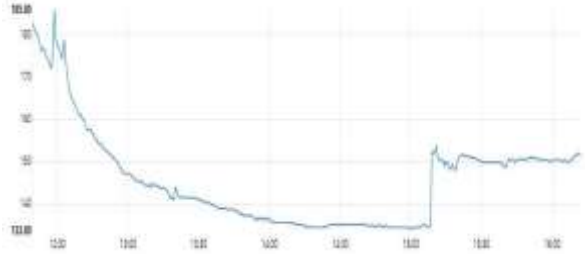

Fig13: Air pollution Curve

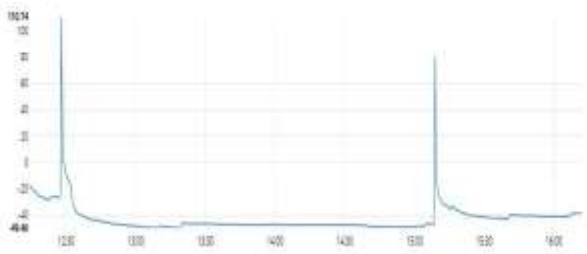

Fig14: LPG Gas Curve

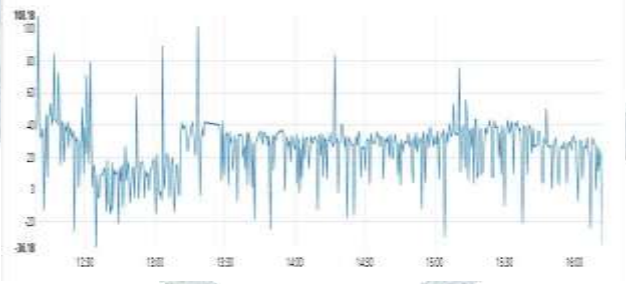

Fig15: Dust Curve

Fig16: Real-time Cloud Live Dashboard

Fig17: Live Dashboard in AirGuide App

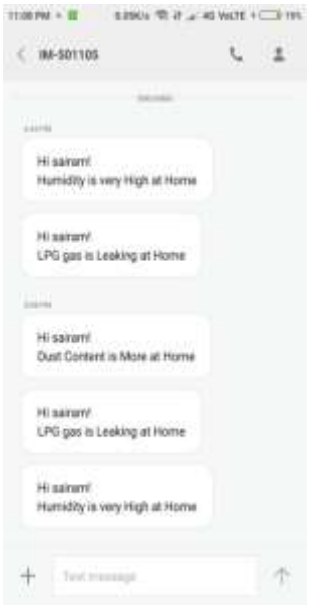

Fig18: SMS alerts to the user

Fig11 to Fig15 shows the line graph for 4hrs Continuously monitored Temperature, Humidity, Pollution, LPG and Dust data with the help of AirGuide device. If Air doesn't contain any Dust or LPG contents then Dust and LPG sensor will get into sleep mode for efficient energy consumption. where we can see negative values in Fig15 and Fig14, if they detect any Dust or LPG contents in the air then Dust sensor and LPG sensor will get activated. Fig16 shows the Live monitoring of data in cloud dashboard, Fig17 shows the live monitoring of data and monitoring the previous data in Android App and Fig18 shows the SMS alerts sent to the user registered mobile if any of the parameter value exceeds the normal defined threshold range.

V.CONCLUSION:

In this work, we have developed a Low cost and Low power consumption IoT based AirGuide Application where the total development cost is below Rs.2200. With the help of AirGuide, a user can monitor the indoor air pollution levels remotely through a web app or with the AirGuide app. If any dust, pollution, gas, temperature or humidity exceeds the basic threshold value then an alert SMS will be sent to the user registered mobile and simultaneously buzzer will ring at the AirGuide device. So, the user can take necessary precautions. Here we considered only Home related Pollution Parameters, in further we will extend this work in Medically related Pollution parameters and Industrially related pollution parameters.

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