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Indoor Airquality Remote Monitoring System

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ABSTRACT: Indoor Air Pollution has become a severe issue these days. Average person spends an estimated 90% of their time indoors due to which poor indoor air quality (IAQ) poses a substantial risk to public health. Environmental Protection Agency (EPA) [6] has ranked Indoor Air Pollution among top 5 environmental public health risks. Most of the schools, colleges, workplaces have air-conditioned rooms. As a result of sealed rooms, there is no ventilation and barely any room for air to escape. Due to the ill effects of bad indoor air quality, monitoring of the parameters which contribute to air quality is necessary. In this project, we present a real time indoor air quality remote monitoring system developed using temperature, humidity, gas (CO2 and CO), smoke detection and Air Quality sensors. The sensor data can be remotely monitored on android application. The performance and usefulness of the system are demonstrated by comparing measurement results of the system every seventeen seconds.

KEYWORDS: Air Quality Sensor, Carbon Dioxide Sensor, Carbon Monoxide Sensor, Humidity Sensor, Indoor Air Quality, LM35, MG811, MQ135, MQ2, MQ7, Remote Monitoring System, Smoke Detector, SY-HS-220.

I. INTRODUCTION

Nowadays many private schools and classes have closed air conditioned room (smart classroom). Good indoor air quality in schools is important to provide a safe, healthy, productive and comfortable environment for students, teachers and other school staff. Allergic individuals seem to be at a higher risk for adverse respiratory health consequences. Poor IAQ contributes to both short and long term health issues which can lead to low productivity, absenteeism and impaired decision making in the classroom environment. Air quality improvement represents an important measure for prevention of adverse health consequences in children and adults in school.

In the year 2017, 3.6 million people have died prematurely due to poor indoor air quality. WHO used the term 'Sick Building Syndrome' [8] is a consequence of poor indoor air quality. WHO also states that many times indoor air is three times more polluted than outdoor air. Therefore, a widely-accessible, distributed IAQ system is needed for real-time monitoring in school, college and office buildings. Fig. 1 shows the range of Carbon Dioxide and Carbon Monoxide and its health effects.

Regular indoor air monitoring is typically confined to smoke and carbon monoxide (CO) detectors with binary detection results to trigger an alarm. Some advanced HVAC(heating, ventilation and air conditioning) systems use carbon dioxide (CO2) sensors to control ventilation.[5] However, neither binary CO detectors nor CO2 sensors are adequate measures of indoor air quality as a plethora of indoor air pollutants affect public health.

Systems have been made for monitoring indoor air quality before. In most of those systems, gases such as CO, CO2, SO2, NO2 and ozone have been monitored [1]. Some of the systems monitored temperature, humidity and particulate matter as well [2]. The data was monitored on serial monitor such as Raspberry pi 3 based web server [6] or on a toolkit which was developed to observe live air quality showing values and graphs [2].

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Effects	Carbon Monoxide(ppm)
Good	0.0-4.4
Moderate	4.5-9.4
Unhealthy of sensitive group	9.5-12.4
Unhealthy	12.5-15.4
Hazardous	>15.5

Effects	Carbon Dioxide(ppm)
Safe for indoors	350-1000
Complaints of drowsiness and poor air	1000-2000
Headaches, sleepiness and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may also be present.	2000-5000
Hazardous	>5000
Exposure may lead to serious O2 deprivation resulting in permanent brain damage, coma and even death	>40000

Fig. 1. Safety Range for Carbon Monoxide and Carbon Dioxide [1]

The research papers mainly comprise of various air quality monitoring systems which have already been implemented. The main purpose of this literature survey was to find the methodology and limitations of all these systems and propose a new system as the project which will be able to exceed the limitations. Identifying and removing the existence of sources or materials that may cause bad air and improving air flow are important to improve air quality was studied. After researching, the estimated value of gases which can cause harm to a human body was determined. Sensors which fit the criteria for the ranges of the gases' value were then decided accordingly.
The system we have developed monitors six parameters- temperature, relative humidity, carbon dioxide, carbon monoxide, smoke and air quality. Sensor data is collected and sent to cloud using Wi-Fi Module, for storage and analysis. ThingSpeak is used as cloud. Data is then pushed to android application which is built using MIT App Inventor. Thus, data can be remotely monitored. The main objective and purpose behind this system is for the parents to monitor the environment i.e. the classroom, their child is studying in. As the number of smart classrooms are increasing, children are more exposed to the poor indoor air quality, if not monitored and proper ventilation is not taken care of. By using this system, parents will be able to track and monitor the classroom air quality and report if any parameter is found not to be in range.

II.SYSTEM DESIGN

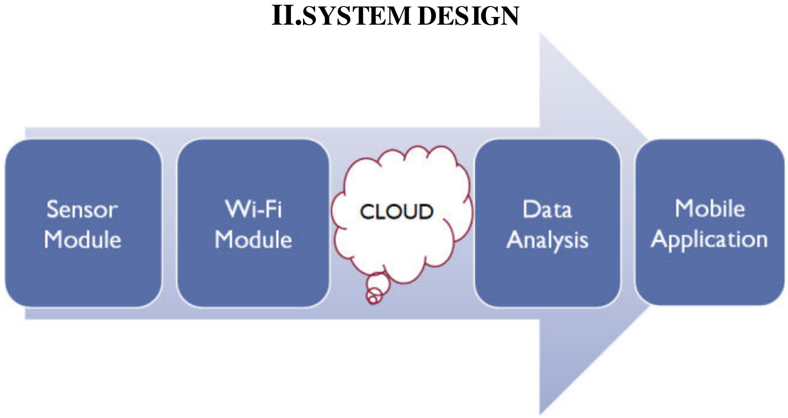

Fig. 2. System Block Diagram

Fig. 2 shows the block diagram of the proposed system. It has four main parts. First is Sensor Module which includes data aquisition from sensor and signal conditioning it. Second part is pushing the data on cloud. This has been achieved by using Wi-Fi Module which sends data from Arduino Uno to ThingSpeak i.e. cloud. Third step is data analysis which includes graphs, minimum and maximum data value for various parameters. Lastly, the fourth part includes sending data from cloud to mobile application.

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Fig. 3 shows the detailed block diagram. It shows the different sensors used. From the figure we can understand that the sensors are signal conditioned and paired up and each pair is given to a controller i.e. Arduino Uno. As we are using three Arduino Uno boards, we use three ESP8266-01 modules.

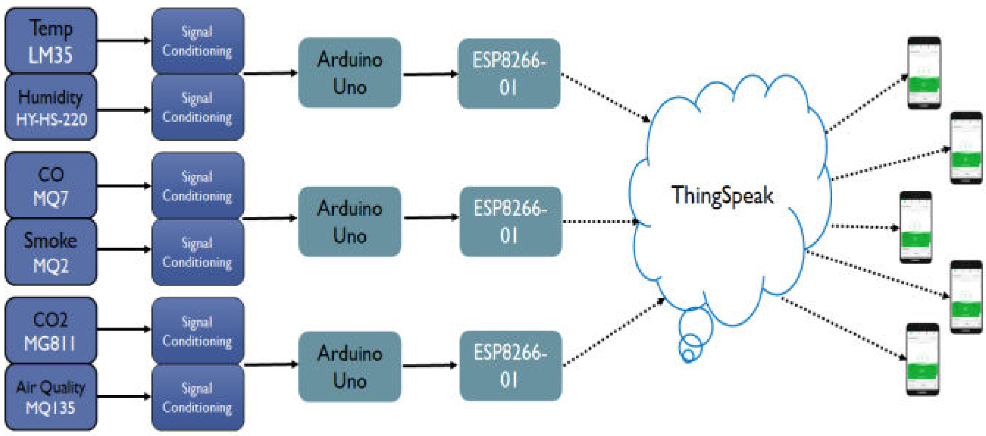

Fig. 3. Detailed Block Diagram

A. Sensor Module

Sensor module consists of sensor and a controller. The output of the sensor is passed through a signal conditioning circuit where it is amplified and then interfaced with Arduino controller.

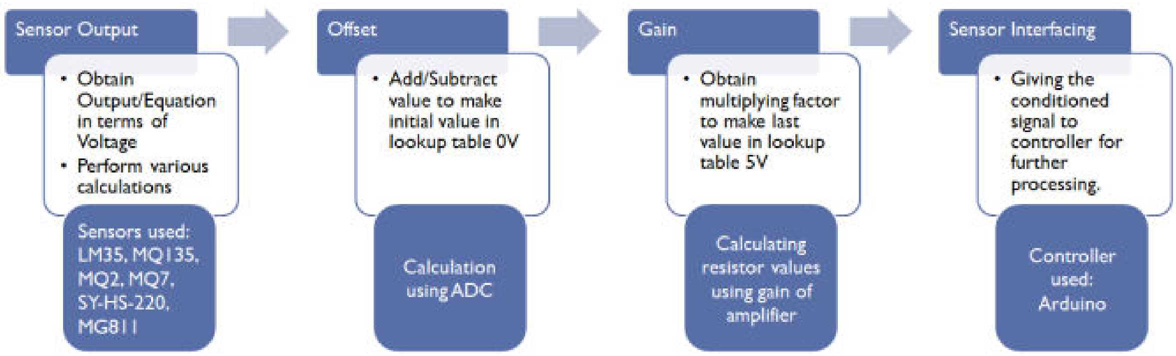

Fig. 3. Sensor Module

As shown in Fig. 3, for signal conditioning, we have used equation of straight line to formulate the output equation. y is the output in voltage whereas x is the sensor input.

y= [(y2-y1)/(x2-x1)]*x + {y1 - [(y2-y1)/(x2-x1)*x1]}

The sensors we have used are either linear or partially linear. Therefore, we have used equation of straight line. Using the output equation, look up table is made in which we have calculated the gain and offset. Offset is used to equate the first vale to 0V and gain is the multiplying factor to equate last value to 5V.

The sensor output is conditioned to 0-5V signal which is given to Arduino Uno. We have used the differential amplifier circuit shown in Fig. 4, for signal conditioning.

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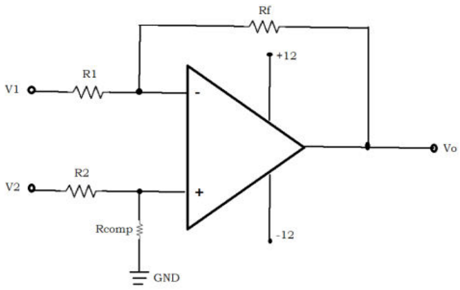

Fig. 4. Signal Conditioning Circuit

Output voltage is given as
Vo= (Rf/R1)*(V2-V1)
Where,
V2= Analog Sensor Value, V1= Offset Voltage, Rf/R1= Gain of amplifier
Let us say, R1=R2 and Rf = Rcomp
As mentioned earlier, we have mapped Vmin of sensor to Vo= 0V and Vmax of sensor to Vo=5V.
We have, Gain= Rf/R1
Therefore, Rf=Gain*R1
By this relation, we assume the value of resistor R1 and by multiplying with the calculated gain we find out the value of Rf. Usually, we assume the values of resistors in Mega Ohm to prevent Loading Effect. We can also use Kilo Ohm values provided we have another Op Amp as buffer.
Fig. 3 shows the different sensors used. The sensors along with their range are as follows:

- LM35 temperature Sensor (Range: -55ºC to 150ºC) [17]
- SY-HS-220 Humidity Sensor (Range: 30%-90%) [22]
- MQ-7 CO Sensor (Range: 10ppm-500ppm) [19]
- MQ2 Gas Sensor (Range: 300ppm-10000ppm) [20]
- MG811 CO2 Sensor (Range: 300ppm-10000 ppm) [18]
- MQ135 Air Quality Sensor

As seen in Fig. 3, above sensors are paired and interfaced with Arduino according to their placement in the classroom and thereby decreasing the need for controllers. The gas sensors are placed at low height as the gas molecules settle at low heights. CO and Smoke sensors are interfaced together whereas CO2 and Air Quality sensors are interfaced together.
Temperature and humidity sensor are interfaced together with Arduino and made it into a single module. Humidity is the water vapor content in the air. [10]Humidity is often expressed in terms of percentage which is a ration of actual amount of water vapor content to the maximum amount of water vapor the air can hold. When humidity is expressed in terms of percentage it is known as Relative Humidity (RH). Relative Humidity is important to normalize and standardize the sensor output. From Fig. 5, we can see the relation between RH and temperature. True RH value is calculated which takes into consideration temperature compensation.

True RH = (% RH) / (1.0546 – 0.00216 T): T = ºC [13]

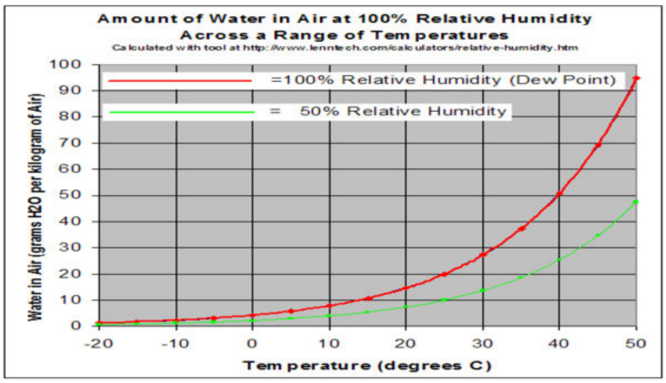

Fig. 5. Temperature-Humidity relation [10]

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B. Pushing Data on Cloud

The cloud platform used here is ThingSpeak. Wi-Fi Module used is ESP8266-01. It allows the controller to access to a Wi-Fi network to send or receive data. The controller used is Arduino Uno as it is easy to send data from Arduino to ThingSpeak using ESP Wi-Fi Module.

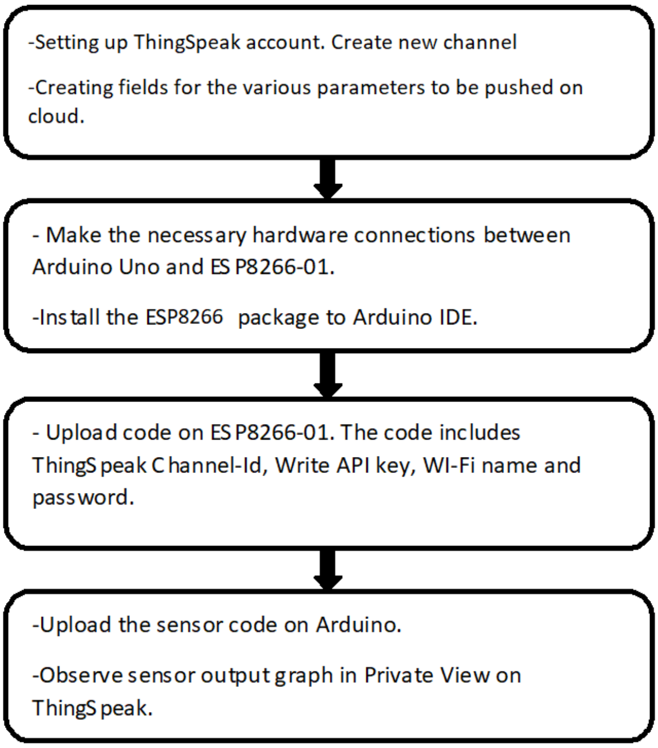
The ESP8266-01 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266-01 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. This module comes with AT commands firmware which allows you to get functionality like Arduino Wi-Fi shield, however you can load different firmware to make your own application on the modules' memory and processor. It's a very economic module and has a huge and growing community support. [web :[16]]

"ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates". [web:[15]].

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts. [web:[14]]

ThingSpeak has integrated support from the numerical computing software MATLAB from MathWorks, allowing ThingSpeak users to analyze and visualize uploaded data using Matlab without requiring the purchase of a Matlab license from Mathworks.[web:[14]]

Fig. 6 shows the flow of pushing real time data on ThingSpeak from Arduino using Wi-Fi Module (ESP8266-01).



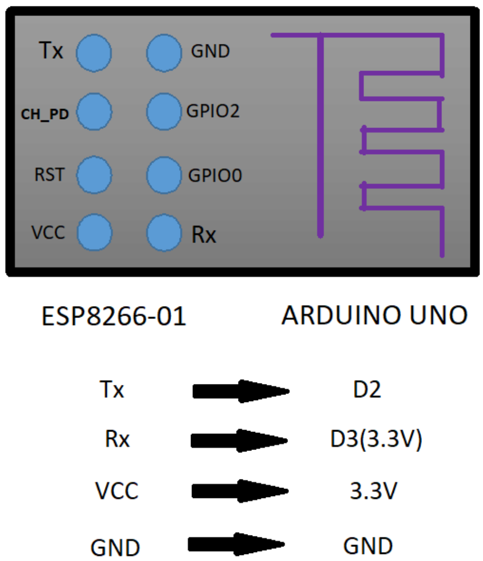


Fig. 6.Flow of pushing data to cloud Fig. 7. Connection between ESP8266-01 and Arduino

The Wi-Fi Module operates at 3.3V. Once the connection is established, the ESP8266 package is installed to Arduino IDE. Next the code is uploaded on ESP to establish network connection and then the data is pushed on ThingSpeak. Fig. 8 shows the implementation of sending LM35 temperature sensor real time data on ThingSpeak.

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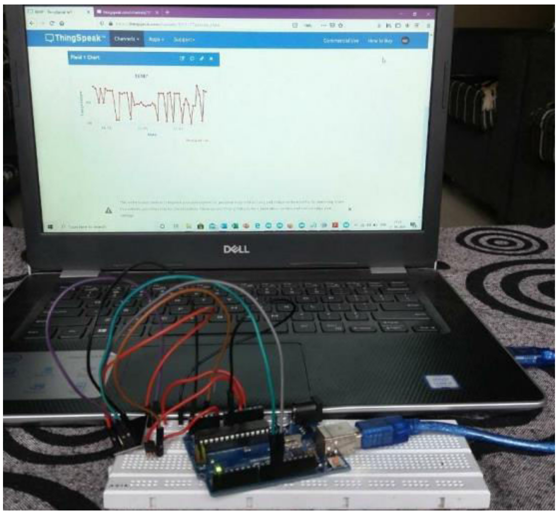

Fig. 8. Pushing LM35 real time value to ThingSpeak

C. App Development

The android app is designed on MIT App Inventor. The sensor values are read from ThingSpeak.com Status Channel which is a Mathworks cloud platform and displayed on the android app. The sensor chart is also displayed by a feature called WebViewer on the mobile app. Thus through this app, the real time sensor data can be monitored. In Fig. 9, the flowchart consists of app development in which only temperature sensor (LM35) data is accessed from ThingSpeak but more than one sensor values can be observed. By using the APK file, one can access and use the application.

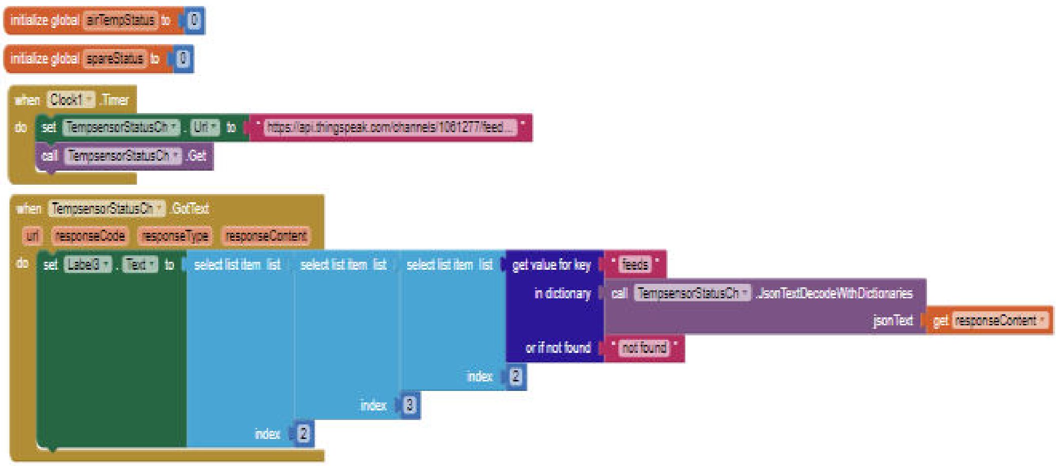

Fig. 9. App Development using MIT App Inventor

III. SIMULATION RESULT

Simulation of sensor module is performed on Proteus. Fig. 10 shows the simulation of temperature and humidity sensor module. Proteus has an inbuilt LM35 sensor which we have used for temperature. This input is given to ADC1 of Arduino Uno. For humidity, we have given an offset of 0.99V which we calculated from the look up table. We have given variable analog voltage value which we can set according to the look up table to check the corresponding output. This output is given to ADC2 of Arduino. Arduino is interfaced with LCD and temperature and humidity output can be seen on it.

Fig. 11 shows the simulation of Carbon Monoxide sensor module on Proteus. Here an offset of 0.455V is given to the differential amplifier. Along with it, using potentiometer we can generate the analog voltage value according to lookup table to test the sensor working. This is given to ADC0 of Arduino Uno which is interfaced with LCD display. Caron Monoxide can be views on the Liquid Crystal Display.

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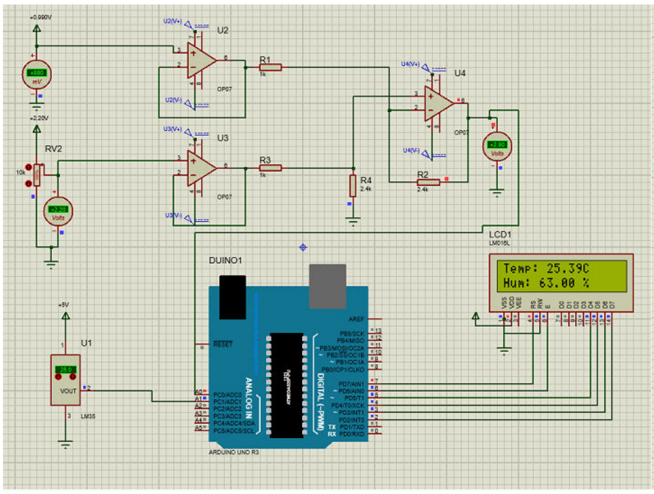

Fig. 10. Simulation of Temperature and Humidity

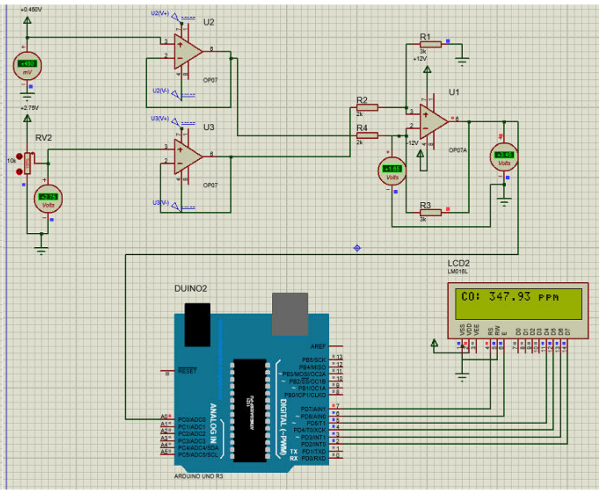

Fig. 11. Simulation of Carbon Monoxide

Fig. 12 shows the simulation of Carbon Dioxide sensor module on Proteus. An offset of 0.1V is given to buffer. Buffer provides electrical stability and provides electrical impedance transformation while the signal is given to the differential amplifier. Lookup table consists of the relation between sensor input and conditioned 0-5V signal. To check this working an analog voltage is provided to the differential amplifier. The output is then given to ADC0 of Arduino Uno and then observed on LCD.

Fig. 13 show the simulation of MQ2 smoke detection sensor. The sensor data is given to Arduino Uno which is interfaced with LCD. It displays the suggestions such as open door when the smoke levels rise.

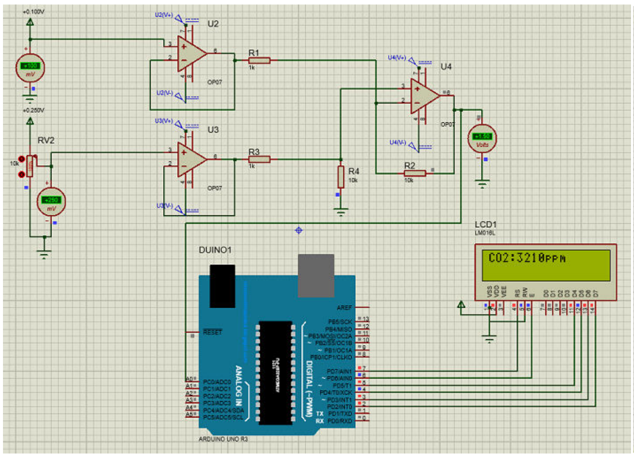

Fig. 12.Simulation of Carbon Dioxide

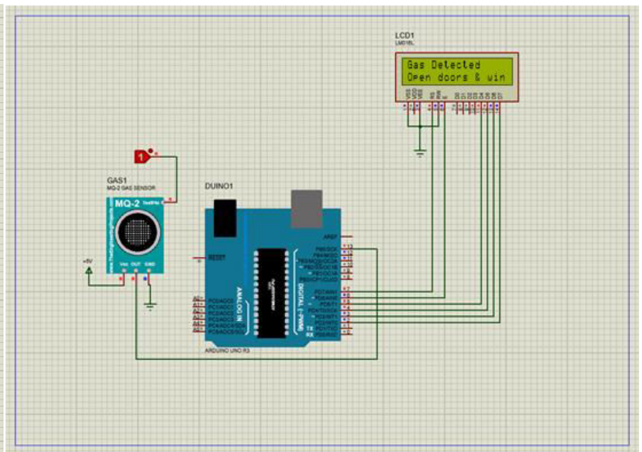

Fig. 13. Simulation of MQ2 Smoke Detection Sensor

IV. HARDWARE TESTING

We implemented the hardware testing on breadboard. We made our own power supply for 5V and ±12V for the circuit. The Op Amps require ±12V for working whereas the controller used i.e. Arduino Uno requires 5V for operation. The operating voltage of ESP8266-01 is 3.3V.

Fig. 14 shows the hardware implementation of temperature and humidity sensor. To check the variation in temperature we hold the LM35 IC tightly, due to which heat is generated and hence we verify the variation in temperature. For humidity testing, we placed a moist napkin near the sensor to see the variation in output.

Fig. 15 shows hardware testing of Carbon Monoxide and Smoke Detection sensor, MQ2. Initially to find the maximum sensor output for MQ7 sensor we placed the sensor inside an inverted bowl and with it placed incense stick which releases carbon monoxide. We used the maximum value to make the lookup table and using which did our calculations as mentioned earlier. We tested for both MQ7 and MQ2 using an incense stick as shown in Fig. 15. As mentioned

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earlier, MQ7 and MQ2 are both interfaced with the same controller thereby forming a single module. And therefore the interfaced LCD displays Carbon Monoxide and Smoke/LPG alternately.

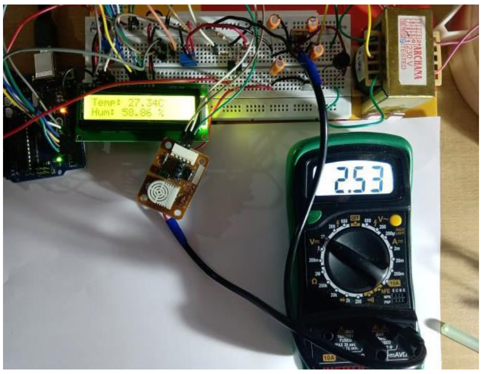

Fig. 14. Hardware testing of temperature and humidity sensors

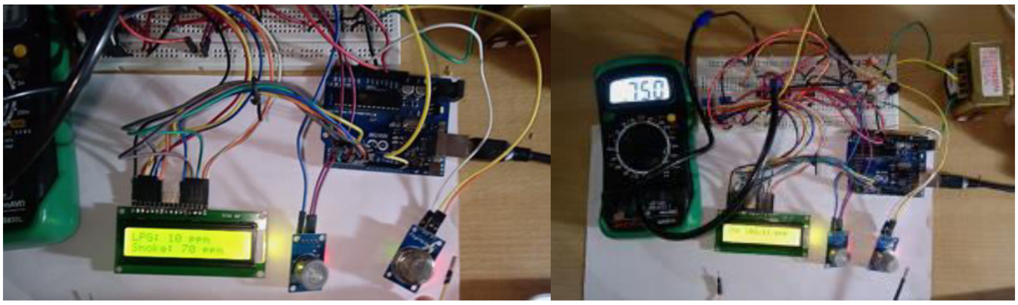

Fig. 15. Hardware testing of carbon monoxide and smoke detection sensor

Fig. 16 shows the hardware implementation of Carbon Dioxide and Air Quality sensor. For checking CO2, we exhale on the sensor (MG811) and see the variation in output. Gas sensors are very sensitive and must be handled with care. We calibrated MQ135 and tested the sensor with an incense stick. If the air quality is below 1000 ppm, "Clean air" is displayed. If it is somewhere between 1000 to 2000 ppm, "A bit polluted, check ventilation" is displayed. And if the value goes beyond 2000 ppm we displayed "Dangerous air, go outside"
As we know, both MG811 and MQ135 are interfaced with the same controller to form a unit module, the LCD displays Carbon Dioxide value and Air Quality alternately one at a time.

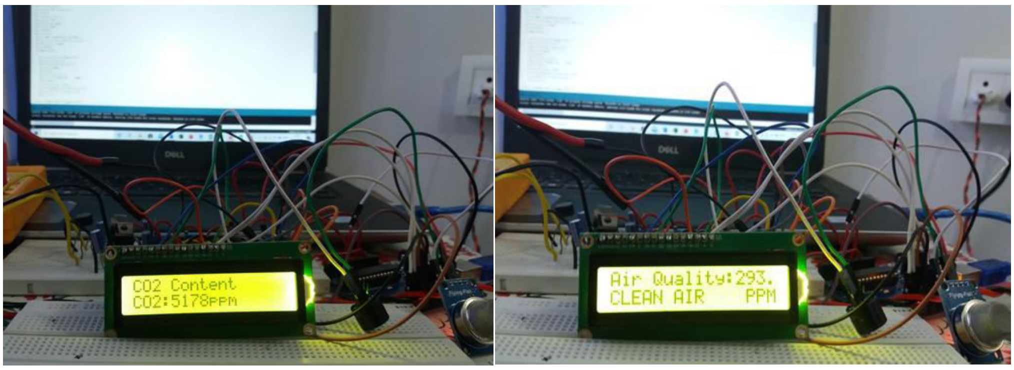

Fig. 16. Hardware testing of carbon dioxide and air quality sensor

VI.RESULT AND DISCUSSION

After sensor interfacing, the real time sensor data is pushed on ThingSpeak at an interval of 17 seconds. On ThingSpeak we observe real time data. In Fig. 17 we can see the real time data of LM35 in a graphical format on the cloud.From cloud, the data is sent to a mobile application. The mobile application is built using MIT App

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Inventor. We have tried to send the real time data and the graph showing the visual variation in values. Fig.18 is the screen shot of the application built with temperature sensor value.
Our main objective is that parents can remotely monitor the indoor air quality of the classroom their child is studying in. We implemented the hardware at one place, and monitored it on this application at a different place i.e. remotely and thus achieving our objective.

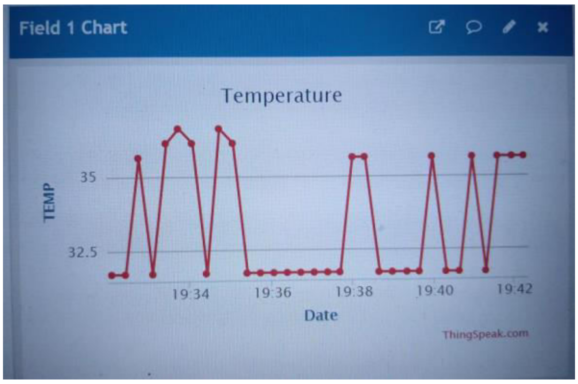

Fig.17.Output on ThingSpeak

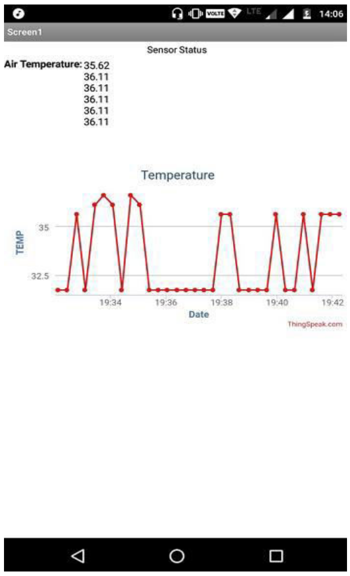

Fig.18.Android Application

VII.CONCLUSION

Many systems have been developed to monitor and control both indoor and outdoor air quality. Indoor Air Quality is not paid attention to as compared to outdoor air quality. Air quality remote monitoring system allows users to monitor the parameters on a mobile application remotely.
Every system has limitations and scope of improvement and further study. One main limitation is that internet is 8 needed for viewing real time data on mobile application. Another limitation is the maintenance of the system. Gas sensors are very sensitive and the components require different operating voltages. For example controller needs 5V, ESP8266 needs 3.3V and the Op Amps need ±12V. Therefore, connectivity and maintenance play an important role here.
This paper presents a basic system which collects sensor data, pushes it on cloud and displays the value and graph on mobile application. Many additions can be made to this project such as more detailed work in Data Analysis, alarms, sending messages or calls in emergency situations. Particulate Matter i.e. PM2.5 and PM10 can also be monitored. This system did not include Particulate Matter due to lack of availability of sensor. Technology and methodologies evolve and thus every system can be made more optimized and efficient.

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REFERENCES

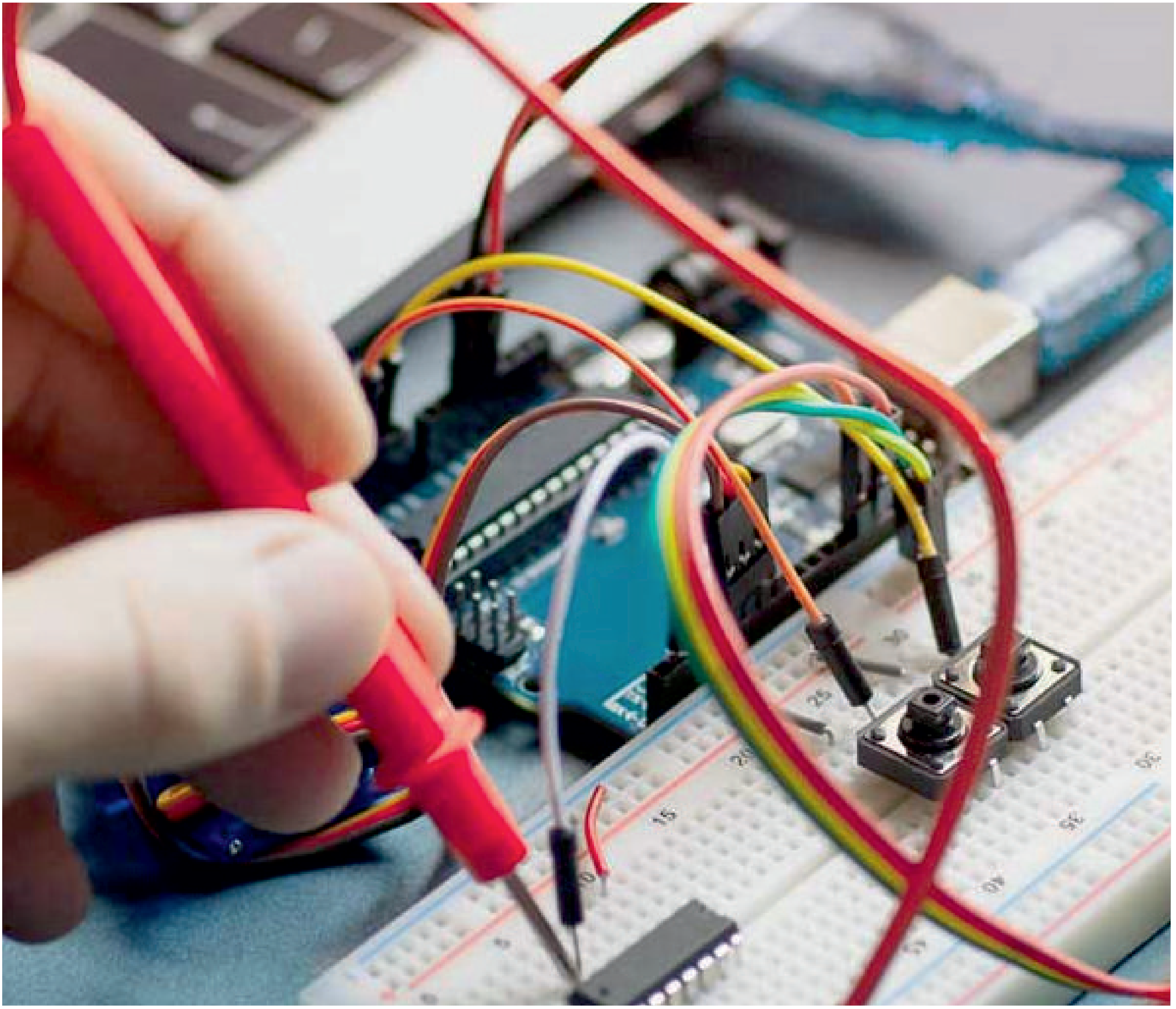
[1] Jung-Yoon Kim, Chao-Hsien Chu, and Sang-Moon Sin, *ISSAQ: An Integrated Sensing Systems For Real Time Indoor Air Quality Monitoring*. IEEE SENSORS JOURNAL, VOL.14.NO.12,DECEMBER 2014.
[2] Sanyantani Bhattacharya, Sridevi S, Pitchiah R, *Indoor Air Quality Monitoring Using Wireless Sensor Network*. 2012 SIXTH INTERNATIONAL CONFERENCE ON SENSING TECHNOLOGY(ICST).
[3] Anuj Kumar, Hiesik Kim, and Gerhard P. Hancke, Senior Member, IEEE, *Environmental Monitoring System: A review*.
[4] Abdullah Kadri, Elias Yaacoub, Mohammed Mushtaha, and Adnan Abu-Dayya, *Wireless Sensor Network for Real-Time Air Pollution Monitoring*. 978-1-4673-2821-0/13/$31.00 c 2013 IEEE.
[5] Sherin Abraham, Xinrong Li, *A Cost-Effective Wireless Sensor Network System for Indoor Air Quality Monitoring Applications*. The 9th international conference on future networks and communications (FNC-2014).
[6] GaganParmar, Sagar Lakhani, Manju K. Chattopadhyay, *An IoT Based Low Cost Air Pollution Monitoring System*. Proceeding International Conference on recent innovations is signal processing and embedded systems (RISE2017) 27-29 October, 2017.
[7] B.O. Oyebola, V.T. Odueso*LM35 Based Digital Room Temperature Meter: A Simple Demonstration*. Equitorial journal of computational and theoretical science, 2(1):6-15, January 2017.
[8] Ling-Jyh Chen, Senior Member, IEEE, Yao-HuaHo, Hsin-Hung Hsieh, Shih-Ting Huang, Hu-Cheng Lee, and SachitMahajan, Student Member, IEEE, *ADF: an Anomaly Detection Framework for Large-scale PM2.5 Sensing Systems*. DOI 10.1109/JIOT.2017.2766085, IEEE Internet of Things Journal
[9] Poonam, Prof. (Dr.) Yusuf Mulge, *Remote Temperature Monitoring Using LM35 sensor and Intimate Android user via C2DM Service*. 2013.

WEBLIOGRAPHY

[10]https://study.com/academy/lesson/what-is-dew-point-definition-formula-calculation.html
[11]https://electronics-project-hub.com/send-lm35-data-to-thingspeak-esp8266-gsm-nodemcu/
[12]https://sensing.honeywell.com/index.php?ci_id=49925&la_id=1#:~:text=When%20temperature%20compensating%20a%20humidity,method%20for%20measuring%20dew%20point.
[13]https://robokits.co.in/iot-internet-of-things/esp8266-wifi-serial-module-esp-01-for-iot-applications
[14] https://thingspeak.com/
[15] https://en.wikipedia.org/wiki/ThingSpeak
[16]https://robokits.co.in/iot-internet-of-things/esp8266-wifi-serial-module-esp-01-for-iot-applications

DATASHEETS

[17] LM35 Precision Centigrade Temperature Sensors, Texas Instruments, SNIS159H –AUGUST 1999–REVISED DECEMBER 2017
[18] MG811 CO2 Sensor, Hanwei Electronics Co. ltd, www.hwsensor.com
[19] Technical Data MQ-7 Gas Sensor, Henan Henwei Electronics Co., Ltd, www.hwsensor.com
[20] MQ-2 Semiconductor Sensor for Combustible Gas, Henan Henwei Electronics Co., Ltd, www.hwsensor.com
[21] MQ-135 Gas Sensor, Henan Henwei Electronics Co., Ltd, www.hwsensor.com
[22] Humidity Sensor Module SY-HS-220 specifications, rhydoLABZ INDIA
[23] ESP-01 WiFi Module Manual, Shenzhen Anxinke Technology CO;LTD, www.ai-thinker.com



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