A NOVEL APPROACH OF INTERNET OF THINGS: MICROCONTROLLER BASED AIR POLLUTION MONITORING SYSTEM

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Abstract - Air pollution means the presence into the air of a substance which has harmful or poisonous effects. Traditionally, pollution measurements are performed using expensive equipment at fixed locations or dedicated mobile equipment laboratories. In this paper we introduce IOT Based Air Pollution Monitoring System in which we will monitor the fine-grained Air Quality in real-time over a web server using internet and will trigger an alarm when the air quality goes down beyond a certain level, means when there is sufficient amount of harmful gases are present in Sulpher-Die-Oxide, volume of CO2, detection of leakage of any gas -smoke, LPG, benzene and NH3. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily. We have used MQ135 sensor which is the best choice for monitoring Air Quality as it can detect most harmful gases and can measure their amount accurately. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile. We can install this system anywhere and can also trigger some device when pollution goes beyond some level, like we can switch on the Exhaust fan or can send alert SMS/mail to the user.

Index Terms - MQ135 sensor, IOT, PPM, LCD, NH3, LPG

I. INTRODUCTION

Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization and growing number of vehicles leads to release of lot of gaseous pollutants. 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. The commercial meters available in the market are Fluke CO-220 carbon monoxide meter for CO, Amprobe CO2 meter for CO2, Forbix Semicon LPG gas leakage sensor alarm for LPG leakage detection. The researchers in this field have proposed various air quality monitoring systems based on WSN, GSM and GIS. No such system is present that monitors various gases present in the environment like CO, CO2, smoke, LPG, iso-Propane, iso-Butane as well as the temperature and humidity in the environment at the same time and monitors these parameters at a remote location, provides extra precaution for the most crucial parameter and provides parameters important to all users such as temperature and humidity to every person in the range of the monitoring system.

II. PROPOSED WORK

In this paper we can use Microcontroller and Gas sensor with Wi-Fi module with other following components: a) Arduino Uno, b) Wi-Fi module ESP8266, c) 16X2 LCD display d) MQ135 Gas sensor, e) Breadboard, f) 10K potentiometer, g) 1K ohm resistors h) 220-ohm resistor, i) Buzzer

Circuit Diagram and Explanation

First of all, we will connect the ESP8266 with the Arduino. ESP8266 runs on 3.3V and if you will give it 5V from the Arduino then it won't work properly and it may get damage. Connect the VCC and the CH_PD to the 3.3V pin of Arduino. The RX pin of ESP8266 works on 3.3V and it will not communicate with the Arduino when we will connect it directly to the Arduino.

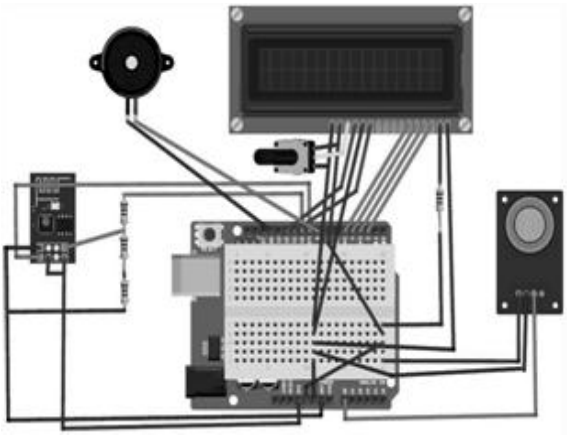

Fig. 1 Complete Circuit Diagram

So, we will have to make a voltage divider for it which will convert the 5V into 3.3V. This can be done by connecting three resistors in series like we did in the circuit. Connect the TX pin of the ESP8266 to the pin 10 of the Arduino and the RX pin of the esp8266 to the pin 9 of Arduino through the resistors.ESP8266 Wi-Fi module gives your projects access to Wi-Fi or internet. It is a very cheap device and make your projects very powerful. It can communicate with any microcontroller and it is the most leading devices in the IOT platform.

Then we will connect the MQ135 sensor with the Arduino. Connect the VCC and the ground pin of the sensor to the 5V and ground of the Arduino and the Analog pin of sensor to the A0 of the Arduino. Connect a buzzer to the pin 8 of the Arduino which will start to beep when the condition becomes true. In last, we will connect LCD with the Arduino.

Connection between ESP8266 and Arduino

Wireless communication between Electronic devices and modules is very important, to make them 'Fit' in the World of Internet of Things. HTTP protocol and HTML language have made it possible to transfer the Data anywhere in the world, over the web. In my proposed work we are building a program to Send Data to Web using Arduino and Wi-Fi module**.** For this we first need an IP address of either Global or Local server, here for the ease and demonstration purpose, we are using Local Server.

Circuit Connections

Circuit Diagram for "Post Data from Arduino to Web" is given below. We mainly need an Arduino and ESP8266 Wi-Fi module. ESP8266's Vcc and GND pins are directly connected to 3.3V and GND of Arduino and CH_PD is also connected with 3.3V. Tx and Rx pins of ESP8266 are directly connected to pin 2 and 3 of Arduino. Software Serial Library is used to allow serial communication on pin 2 and 3 of Arduino.

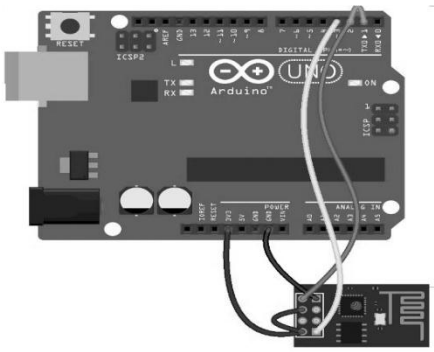

Fig. 2 Connection between ESP8266 and Arduino

Circuit Explanation

Circuit is very simple, for this project we only need Arduino and ESP8266 Wi-Fi module. A 16x2 LCD is also connected for displaying the status messages. This LCD is optional. ESP8266's Vcc and GND pins are directly connected to 3.3V and GND of Arduino and CH_PD is also connected with 3.3V. Tx and Rx pins of ESP8266 are directly connected to pin 2 and 3 of Arduino. And Pin 2 of Arduino is also shorted with Tx pin (Pin 1) of Arduino. This pin is shorted for displaying response of ESP8266 directly on Serial monitor of Arduino. Software Serial Library is used to allow serial communication on pin 2 and 3 of Arduino.

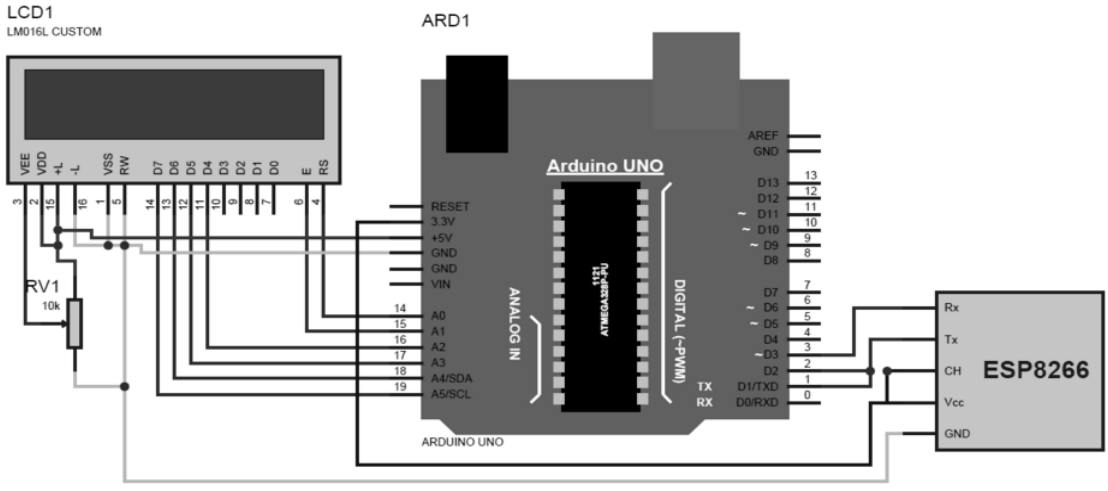

Fig. 3 Circuit Connection and explanation

LCD Connection

The connections of the LCD are as follows:

Connect pin 1 (VEE) to the ground.

Connect pin 2 (VDD or VCC) to the 5V.

Connect pin 3 (V0) to the middle pin of the 10K potentiometer and connect the other two ends of the potentiometer to the VCC and the GND. The potentiometer is used to control the screen contrast of the LCD. Potentiometer of values other than 10K will work too.

Connect pin 4 (RS) to the pin 12 of the Arduino.

Connect pin 5 (Read/Write) to the ground of Arduino. This pin is not often used so we will connect it to the ground.
Connect pin 6 (E) to the pin 11 of the Arduino. The RS and E pin are the control pins which are used to send data and characters.
The following four pins are data pins which are used to communicate with the Arduino.
Connect pin 11 (D4) to pin 5 of Arduino.
Connect pin 12 (D5) to pin 4 of Arduino.
Connect pin 13 (D6) to pin 3 of Arduino.
Connect pin 14 (D7) to pin 2 of Arduino.
Connect pin 15 to the VCC through the 220-ohm resistor. The resistor will be used to set the back light brightness. Larger values will make the back light much darker.
Connect pin 16 to the Ground.

Working Procedure

The MQ135 sensor can sense NH3, NOx, alcohol, Benzene, smoke, CO2 and some other gases, so it is perfect gas sensor for our Air Quality Monitoring Project. When we will connect it to Arduino then it will sense the gases, and we will get the Pollution level in PPM (parts per million). MQ135 gas sensor gives the output in form of voltage levels and we need to convert it into PPM. So for converting the output in PPM, here we have used a library for MQ135 sensor. Sensor was giving us value of 90 when there was no gas near it and the safe level of air quality is 350 PPM and it should not exceed 1000 PPM. When it exceeds the limit of 1000 PPM, then it starts cause Headaches, sleepiness and stagnant, stale, stuffy air and if exceeds beyond 2000 PPM then it can cause increased heart rate and many other diseases. When the value will be less than 1000 PPM, then the LCD and webpage will display "Fresh Air". Whenever the value will increase 1000 PPM, then the buzzer will start beeping and the LCD and webpage will display "Poor Air, Open Windows". If it will increase 2000 then the buzzer will keep beeping and the LCD and webpage will display "Danger! Move to fresh Air".

III. CONCLUSION

The system to monitor various parameters of environment using Arduino microcontroller, Wi-Fi Technology is proposed to improve quality of air. With the use of technologies like WSN and GSM enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this paper. The detection and monitoring of dangerous gases is taken into account in a serious manner and related precautions have been considered here in the form of an alert message and a buzzer so that the necessary action may be taken. It is estimated that this system will have a great acceptance in the market as it is a centralized system for a complete monitoring function. This monitoring system can be enhanced by adding wireless network card for storage of values from sensors attached to microcontroller as well as more gas sensors could be used like Sulpher-Die-Oxide, volume of CO2, and detection of leakage of any gas -smoke, LPG, benzene and NH3 etc.

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