

Air Pollution Monitoring System

V.S.Revathy¹, K.Ganesan², K.Rohini³, S.Tamil Chindhu⁴, T.Boobalan⁵
^{1,2,3,4}UG Student,
⁵Assitant Professor

Abstract: Air pollution has significant influence on the concentration of constituents in the atmosphere leading to effects like global warming and acid rains. To avoid such adverse imbalances in the nature, an air pollution monitoring system is utmost important. This paper attempts to develop an effective solution for pollution monitoring using wireless sensor networks (WSN) on a real time basis namely real time wireless air pollution monitoring system. Commercially available discrete gas sensors for sensing concentration of gases like CO and CO₂ are calibrated using appropriate calibration technologies. These pre-calibrated gas sensors are then integrated with the wireless sensor nodes for field deployment at the campus and the Coimbatore city using multi hop data aggregation algorithm. A light weight middleware and a web interface to view the live pollution data in the form of numbers and charts from the test beds was developed and made available from anywhere on the internet. Other parameters like temperature and humidity were also sensed along with gas concentrations to enable data analysis through data fusion techniques. Experimentation carried out using the developed wireless air pollution monitoring system under different physical conditions show that the system collects reliable source of real time fine-grain pollution data.

I. Introduction

Air pollution emerged in many parts of the world as a result of explosive industrial growth. Road transport is also one of the major contributors of air pollution which contribute to climate change that has perilous domestic and global consequences.

Generation and transport of pollutant materials are governed not only by the distributions of their sources but also by the dynamics of the atmosphere. Pollutant clouds are sometimes observed traveling along the wind directions.

To understand the involved processes in more detail we need more thorough data on the spreads of fine-grain pollutants and their variations with time. An air pollution monitoring system that is comprehensive in terms of spatial and pollutant coverage and is relatively inexpensive and autonomous is the priority

1.1.1 Existing Methods

Some of the existing instruments for air pollution monitoring are Fourier transform infrared (FTIR) instruments, gas chromatographs and mass spectrometers. These instruments provide fairly accurate and selective gas readings. A gas sensor that is compact, robust with versatile applications and low cost could be an equally effective alternative. Some of the gases monitoring technologies are electrochemical, infrared, catalytic bead, photo ionization and solid-state. The existing monitoring system largely uses smart transducer interface module (STIM) with semiconductor gas sensors which uses the 1451.2 standard.

STIM was found to an efficient monitoring system but for the power requirements and ability to expand for large deployment. One of the large scale sensor networks for monitoring and forecasting is Environment Observation and Forecasting System (EOFS). Air pollution monitoring system based on geo sensor network with control action and adaptive sampling rates proposed in also cannot be vast deployment due to high cost.

1.2 Proposed Method

Now in this project we are using locally available gas sensor for observing the polluted gases like Carbon monoxide (CO), Carbon dioxide (CO₂) and parameters like temperature, humidity. By using this method people can view the level of pollution through wireless system. It reduced cost, reliable and comfortable for any place where we are monitoring the gases.

1.3 Toxic Gases

Toxic gases are carbon dioxide and carbon monoxide. These gases are very harmful and dangerous to the people

1.3.1 Carbon Monoxide (Co)

Nature and Sources of the Pollutant

Carbon monoxide is a colorless, odorless and poisonous gas formed when carbon in fuels is not burned completely. It is a byproduct of highway vehicle exhaust, which contributes about 60 percent of all CO emissions nationwide. In cities automobile exhaust can cause as much as 95 percent of all CO emissions. These emissions can result in high concentrations of CO particularly in local areas with heavy traffic congestion. Other sources of CO emissions include industrial processes and fuel combustion in sources such as boilers and incinerators. Despite an overall downward trend in concentrations and emissions of CO some metropolitan areas still experience high levels of CO.

Health and Environmental Effects

Carbon monoxide enters the bloodstream and reduces oxygen delivery to the body's organs and tissues. The health threat from exposure to CO is most serious for those who suffer from cardiovascular disease. Healthy individuals are also affected but only at higher levels of exposure. Exposure to elevated CO levels is associated with visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability and difficulty in performing complex tasks.

Environmental Protection Agency (EPA)'s health-based national air quality standard for CO is 9 parts per million (ppm) measured as an annual second-maximum 8-hour average concentration.

Trends In Carbon Monoxide Level

Long-term improvements continued between 1986 and 1995. National average CO concentrations decreased 37 percent while CO emissions decreased 16 percent. Long-term air quality improvement in CO occurred despite a 31 percent increase in vehicle miles traveled in the U.S. during the past 10 years.

Between 1994 and 1995, national average CO concentrations decreased 10 percent, while total CO emissions decreased 7 percent. Transportation sources (includes highway and off-highway vehicles) now account for 81 percent of national total CO emissions.

Survey

Co Concentration

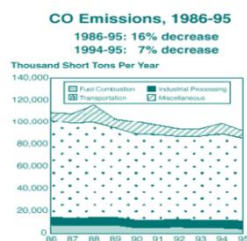


fig 1.3.1: concentration of CO

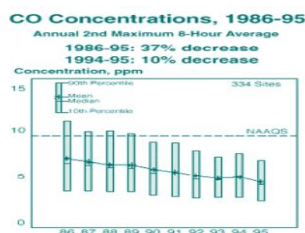


fig1.3.1: concentration of CO (8 hour average)

1.3.2 Carbon Di Oxide (Co2)

Carbon dioxide (CO₂) is a colorless, odorless and non-flammable gas that is a product of cellular respiration and burning of fossil fuels. It has a molecular weight of 44.01g/mol. Although it is typically present as a gas carbon dioxide also can be a solid form as dry ice and liquefied depending on temperature and pressure.

This gas is utilized by many types of industry including breweries, mining ore, manufacturing of carbonated drinks, drugs, disinfectants, pottery and baking powder. It also is a primary gas associated with volcanic eruptions. CO₂ acts to displace oxygen, making compressed CO₂ the main ingredient in fire extinguishers.

Occupations that are most at risk from CO₂ exposure include miners, brewers, carbonated beverage workers and grain elevator workers. CO₂ is present in the atmosphere at 0.035%. In terms of worker safety, Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) for CO₂ of 5,000 parts per million (ppm) over an 8-hour work day, which is equivalent to 0.5% by volume of air. Similarly the American Conference of Governmental Industrial Hygienists (ACGIH) TLV (threshold limit value) is 5,000 ppm for an 8-hour workday with a ceiling exposure limit of 30,000 ppm for a 10-minute period based on acute inhalation data.

A value of 40,000 ppm is considered immediately dangerous to life and health based on the fact that a 30-minute exposure to 50,000 ppm produces intoxication and concentrations greater than that (7-10%) produce unconsciousness. Additionally acute toxicity data show the lethal concentration low for CO₂ is 90,000 ppm (9%) over 5 minutes. See Table for a listing of regulatory agency standards for acceptable CO₂ concentrations in the workplace. CO₂ is a good indicator of proper building ventilation and indoor air exchange rates. Consequently it is measured in buildings to determine if the indoor air is adequate for humans to occupy the building.

Symptoms from Low to High Concentrations of CO₂

%CO ₂	Symptoms
2 to 3	Shortness of breath, deep breathing
5	Breathing becomes heavy, sweating, pulse quickens
7.5	Headaches, dizziness, restlessness, breathlessness, increased heart rate and blood pressure, visual distortion
10	Impaired hearing, nausea, vomiting, loss of consciousness
30	Coma, convulsions, death

Table 1.3.2 tabulation for toxic gas co2

Properties

Carbon dioxide (CO₂) is a colorless and odorless gas. It is non-flammable and chemically non-reactive. CO₂ is 1.5 times as heavy as air (its density is 1.80 g L⁻¹ at 25°C and 1 atm) and if it is emitted slowly, flows down-slope and may accumulate at low elevations. Concentration ranges of CO₂ in dilute volcanic plumes can range from 1 ppm to hundreds of ppm above the troposphere background of ~360 ppm and the gas has a residence times in the lower atmosphere of approximately 4 years. Due to the high levels of CO₂ required to cause harm, concentrations of CO₂ are often expressed as a percentage of the gas in air by volume (1% = 10,000 ppm). This is in contrast to other volcanic gases.

Survey

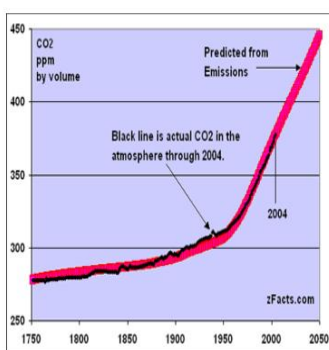
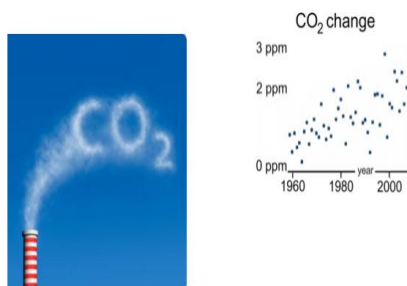


fig1.3.2: emission of CO₂

II. Hardware Description

2.1.1 Block Diagram

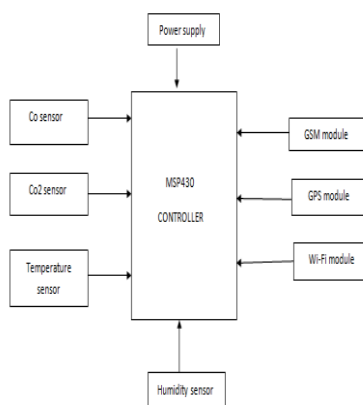


Fig 2.1.1 Block diagram

The block diagram consists of

1. Power supply
2. Sensor network
3. Connector launch pad
4. Internet part

2.2 Power Supply

2.2.1 Introduction

The present chapter introduces the operation of power supply circuits built using filters, rectifiers and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally regulating to obtain a desired fixed DC voltage. The regulation is usually obtained from an IC voltage regulator unit, which remain the same if the input DC voltage varies or the output load connected to DC voltage changes.

2.2.2 Block Diagram

A block diagram containing the parts of a typical power supply is shown below. The AC voltage, typically 120 Vrms is connected to transformer which steps that AC voltage down to the level for the desired DC output.

AC input → step down transformer → rectifier → filter → regulator

A diode rectifier that provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. A regulated circuit can use this DC inputs to provide a DC voltage that not only has much less ripple voltage but also remains the same DC value even if the input DC voltage varies somewhat or the load connected to the output DC voltage changes this voltage regulation is usually obtained using one of a number of popular voltage regulation IC unit.

Power Supply Consists Of Following Unit

- Step down transformer
- Rectifier unit
- Input filter
- Regulator unit

2.2.3 Circuit Diagram

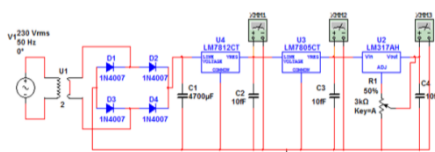


Fig 2.2.3 circuit diagram of power supply

2.2.4 Circuit Diagram Explanation

Step-Down Transformer

It is used to step down the main supply voltage by using step down transformer. It consists of primary and secondary coils. The output from the secondary is also AC wave form. so we have to convert AC voltage in to DC voltage by using rectifier unit.

Full Wave Rectifier

The full wave rectifier circuit is one that is widely used for power supplies and many other areas where a full wave rectification is required. Full wave rectification can also be achieved using a bridge rectifier which is made of four diodes. The full wave rectifier circuit is used in most rectifier applications because of the advantages it offers. It can provide better rectification than other rectifiers. So we have desired to use full wave rectifier for rectification.

Advantages

- More efficient use of the transformer
- Utilizes both halves of the AC wave form
- Easier to provide smoothing as a result of ripple frequency

Filter

If a capacitor is added in parallel with the load resistor of a rectifier to form a simple Filter Circuit, the output of the rectifier will be transformed into a more stable DC Voltage. The principle of the capacitor is charging and discharging. At first, the capacitor is charged to the peak value of the rectified waveform.

Beyond the peak, the capacitor is discharged through the load resistor until the time at which the rectified voltage exceeds the capacitor voltage. Then the capacitor is charged again and the process repeats itself. There are two types of filters used in the power supply circuit. They are,

- Input filter
- Output filter

- 1) If the capacitor is added before the regulator it will act as an input filter. It is used to filter the ripples from rectified output.
- 2) If the capacitor is added after the regulator it will act as an output filter. Even though the regulated output does not have many ripples again the IC regulators output is given to the output filter then to the load.

Ic Voltage Regulator

Description

The MC78XX/LM78XX/MC78XXA series of three terminal positive regulators are available with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate. The AC power supply gets converted into constant DC by this circuit. By the help of a voltage regulator DC, unregulated output will be fixed to a constant voltage. The circuit is made up of linear voltage regulator 7805 along with capacitors and resistors with bridge rectifier made up from diodes.

Features

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

2.3 Sensor Network

1. Temperature sensor
2. Humidity sensor
3. CO sensor
4. CO2 sensor

2.3.1 Temperature Sensor

Temperature sensors are vital to a variety of everyday products. For example, household ovens, refrigerators and thermostats all rely on temperature maintenance and control in order to function properly.

Temperature control also has applications in chemical engineering. Examples of this include maintaining the temperature of chemical reactor at ideal set-point, monitoring the temperature of possible runaway reaction to ensure the safety of employees and maintaining the temperature of streams released to the environment to minimize harmful environmental impact.

2.3.2 Lm35 Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling.

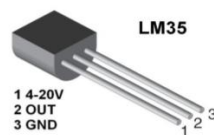


Fig 2.3.1 temperature sensor LM 35

The LM35 device does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^\circ\text{C}$ at room temperature and $\pm 3/4^\circ\text{C}$ over a full -55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy.

The device is used with single power supplies or with plus and minus supplies. As the LM35 device draws only $60\ \mu\text{A}$ from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a -55°C to 150°C temperature range, while the LM35C device is rated for a -40°C to 110°C range (-10° with improved accuracy).

The LM35-series devices are available packaged in hermetic to transistor packages, while the LM35C, LM35CA and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-lead surface-mount small-outline package and a plastic TO-220 package.

2.3.2 CIRCUIT DESCRIPTION

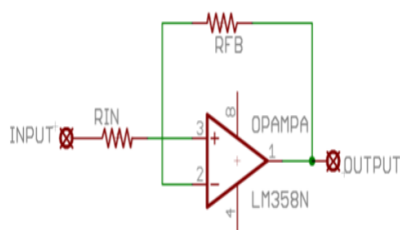


Fig.2.3.2 Circuit description of temperature sensor

2.3.3 LM35 GAIN

LM35	IC	AV	%ERROR
0.32V	0.98V	3.062	-1.71
0.5V	1.55V	3.1	-2.90
0.7V	2.15V	3.07	-2
0.86V	2.6V	3.02	-0.438
1V	3.02	3.02	-0.33

Table 2.3.1 gain for temperature sensor

2.3.3 Features

- Calibrated Directly in Celsius (Centigrade)
- Linear + 10-mV/ $^\circ\text{C}$ Scale Factor
- 0.5 $^\circ\text{C}$ Ensured Accuracy (at 25 $^\circ\text{C}$)
- Rated for Full -55°C to 150°C Range
- Suitable for Remote Applications
- Low-Cost Due to Wafer-Level Trimming

2.3.4 Humidity Sensor (Hy-Hs-220)

To measure humidity, amount of water molecules dissolved in the air of playhouse environments a smart humidity sensor module SY-HS-220 is opted for the system under design. The photograph of humidity sensor SY-HS-220 is shown in the figure. On close inspection of figure, it is found that the board consists of humidity sensor along with signal conditioning stages. The humidity sensor is of capacitive type, comprising on

chip signal conditioner. However, it is mounted on the PCB which also consists of other stages employed to make sensor rather smarter. The PCB consists of CMOS timers to pulse the sensor to provide output voltage. Moreover, it also consists of oscillator, AC amplifier, frequency to voltage converter and precision rectifiers



Fig.2.3.4 Humidity sensor

Incorporation of such stages on the board significantly helps to enhance the performance of the sensor. Moreover, it also helps to provide impediment to the noise. The humidity sensor used in this system is highly precise and reliable. It provides DC voltage depending upon humidity of the surrounding in RH%. This work with +5 Volt power supply and the typical current consumption is less than 3 mA. The operating humidity range is 30% RH to 90% RH. The standard DC output voltage provided at 25°C is 1980 mV .

The accuracy is $\pm 5\%$ RH at 25°C. As shown in the fig 3, it provides three pins recognized as B, W and R. The pin labeled W provides the DC output voltage, where as the pin labeled B is ground. The VCC of +5V is applied at the pin R. The humidity dependent voltage is obtained and subjected for further processing. Signal Conditioner: As stated earlier, a smart humidity sensor SY-HS-220 provides the D.C. output voltage (mV) linearly

2.3.5 Features

These modules convert the relative humidity to the output voltage

S.NO	SPECIFICATION	RANGE
1	RATED VOLTAGE	DC 5.0V
2	CURRENT CONSUMPTION	<3.0Ma
3	OPERATING TEMPERATURE RANGE	0-60°C
4	OPERATING HUMIDITY RANGE	30-90%RH
5	STORABLE TEMPERATURE RANGE	-30°C ~ 85°C
6	STORABLE HUMIDITY RANGE	within 95%RH
7	STANDARD OUTPUT RANGE	DC 1.980 mV (at 25°C, 60%RH)
8	ACCURACY	$\pm 5\%$ RH (at 25°C, 60%RH)

Table.2.3.5 features of humidity sensor

2.3.6 Co Sensor (Mq-7)

This is a simple-to-use Carbon Monoxide (CO) sensor suitable for sensing CO concentrations in the air. The MQ-7 can detect CO-gas concentrations anywhere from 20 to 2000ppm.

This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The drive circuit is very simple all you need to do is power the heater coil with 5V adds a load resistance and connects the output to an ADC.



Fig.2.3.6 co sensor (MQ7)

Sensitive material of MQ-7 gas sensor is SnO₂, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5V). The sensor's conductivity is higher along with the gas concentration rising. When high temperature (heated by 5.0V), it cleans the other gases adsorbed under low temperature. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-7 gas sensor has high sensitivity to Carbon Monoxide. The sensor could be used to detect different gases contains CO, it is with low cost and suitable for different application.

2.3.7 Circuit Description

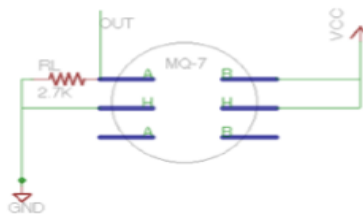


Fig.2.3.7 circuit description of MQ7

2.3.8 Character

- Good sensitivity to Combustible gas in wide range
- High sensitivity to Natural gas
- Long life and low cost
- Simple drive circuit

2.3.9 Application

- Domestic gas leakage detector
- Industrial CO detector
- Portable gas detector

2.3.10 Tabulation For Sensor Value

INPUT=5V (constant)

S.NO	GAS RANGE	SENSOR OUTPUT (PPM)
1	No gas	330
2	Low gas	450
3	High gas	900

Table 2.3.10 values of MQ7 sensor in various gases

2.3.11 Carbon-Dioxide Sensor (Mq4)

Carbon dioxide is a non-toxic and non-flammable gas. However, exposure to elevated concentrations can include a risk to life. Whenever CO₂ gas or dry ice is used, produced, shipped or stored. CO₂ concentrations

can rise to dangerously high levels. Because CO₂ is odourless and colourless leakages are impossible to detect, meaning proper sensors are needed to help ensure the safety.



Fig.2.3.11 carbon dioxide sensor

Sensitive material of MQ-4 gas sensor is SnO₂, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature and detect CO₂ when low temperature (heated by 1.5V).The sensor's conductivity is higher along with the gas concentration rising. When high temperature (heated by 5.0V), it detects Methane, Propane etc. Combustible gas and cleans the other gases absorbed under temperature.

2.3.12 Temperature Considerations

The CO₂ gas sensor is somewhat sensitive to temperature changes. In most cases, variations in CO₂ readings due to temperature changes are small (<100 ppm on low range, <1000 ppm on high range). With good experimental design, the variation in CO₂ readings due to a temperature change will be negligible compared to the overall change in CO₂ concentration. If an entire experiment is to be conducted at a constant temperature you could improve the accuracy of the readings by calibrating the sensor at that temperature. The sensor is designed to operate between 20 degree Celsius and 30 degree Celsius. It can be used outside of this temperature range.

However, the readings will be less accurate, even if you calibrate the sensor at the lower or higher temperature. This does not prohibit taking readings using incubation temperatures or outdoor readings at temperatures warmer or colder than the 20 to 30 degree Celsius range. Allow enough time for your CO₂ gas sensor to stabilize at the desired operating temperatures. The sensor is mainly based on the degree in Celsius.

2.3.13 Circuit Description

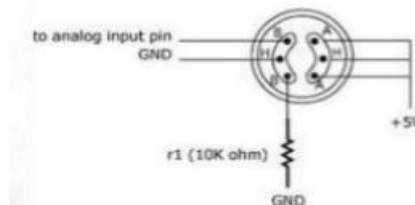


Fig.2.3.13 circuit diagram of MQ4

2.3.14 Characteristics

- Good sensitivity to CO/Combustible gas
- High sensitivity to Methane, Propane and CO
- Long life and low cost
- Simple drive circuit

2.3.15 Application

- Domestic gas leakage detector
- Industrial gas detector

III. Connector Launch Pad(Cc3200)

3.1.1 Introduction

Code Composer Studio

(CCStudio or CCS) is an integrated development environment (IDE) to develop applications for Texas Instruments (TI) embedded processors.

Code Composer Studio is primarily designed as for embedded project design and low-level (bare metal) JTAG based debugging. However, the latest releases are based on unmodified versions of the Eclipse open source IDE, which can be easily extended to include support for OS level application debug (Linux, Android, and Windows Embedded) and open source compiler suites such as GCC.

Early versions included a real time kernel called DSP/BIOS and its later inception SYS/BIOS. Currently, the successor to these tools, the TI-RTOS embedded tools ecosystem, is available for downloading as a free plug-in to Code Composer Studio.

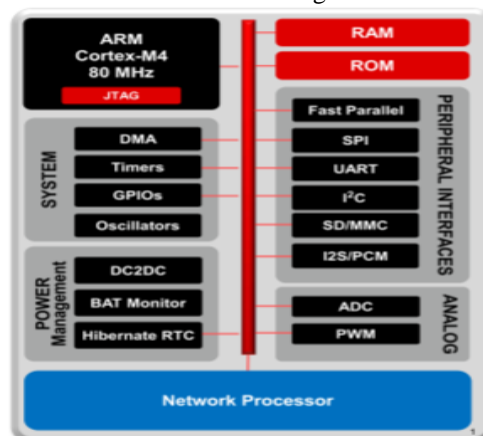
3.1.2 Architecture

The CC3200 module LaunchPad (CC3200MODLAUNCHXL), which encapsulates the industry's first programmable wireless microcontroller (MCU) module with built-in Wi-Fi connectivity. Created for the Internet of Things (IoT), the SimpleLink CC3200MOD is a wireless MCU module that integrates an ARM Cortex-M4 MCU, allowing customers to develop an entire application using a single device. The CC3200MOD integrates all required system-level hardware components including clocks, SPI flash, RF switch, and all required passive component.

The various configurations of the CC3200MODLAUNCHXL, a low-cost evaluation platform which hosts the CC3200MOD. The module LaunchPad also features programmable user buttons, RGB LED for custom applications, temperature and accelerometer sensors, as well as onboard emulation for debugging. The LaunchPad stackable headers interface demonstrates how to expand the functionality of the CC3200MOD when interfacing with other peripherals on existing BoosterPack add-on boards, such as graphical displays, audio codec, antenna selection, environmental sensing, and more. The CC3200MODLAUNCHXL is provided as a complete platform solution including software, sample applications, tools, users and more.



3.1.4 Block Diagram



3.1.5 Features

- FCC, IC, CE, and Wi-Fi® CERTIFIED™ modules, with ability to request certificate transfer for Wi-Fi Alliance members
- CC3200MOD, SimpleLink Wi-Fi, internet-on-a-chip™ module solution with integrated MCU
- 40-pin LaunchPad standard that leverages the BoosterPack ecosystem
- FTDI-based JTAG emulation with serial port for flash programming
- Two buttons and three LEDs for user interaction
- Backchannel universal asynchronous receiver/transmitter (UART) through USB to PC
- On-board chip antenna with U.FL for conducted testing
- On-board accelerometer and temperature sensor for out-of-box demo
- Micro USB connector for power and debug connections

4.1 Internet

The Internet is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to link several billion devices worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless and optical networking technologies.

The Internet carries an extensive range of information resources and services such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), the infrastructure to support email and peer-to-peer networks for file sharing and telephony.



Fig 4.1 internet links

More than 190 countries are linked into exchanges of data, news and opinions. According to Internet Live Stats, as of December 30, 2014 there was an estimated 3,037,608,300 Internet users worldwide. The number of Internet users represents nearly 40 percent of the world's population. The largest number of Internet users by country is China, followed by the United States and India.

4.1.1 World Wide Web (Www)

Many people use the terms Internet and World Wide Web or just the Web, interchangeably but the two terms are not synonymous. The World Wide Web is only one of hundreds of services used on the Internet. The Web is a global set of documents, images and other resources logically interrelated by hyperlinks and referenced with Uniform Resource Identifiers (URIs). URIs symbolically identifies services, servers, other databases, the documents and resources that they can provide. Hypertext Transfer Protocol (HTTP) is the main access protocol of the World Wide Web. Web services also use HTTP to allow software systems to communicate in order to share and exchange business logic and data.

World Wide Web browser software such as Microsoft's Internet Explorer, Mozilla Firefox, Opera, Apple's Safari and Google Chrome lets users navigate from one web page to another via hyperlinks embedded in the documents. These documents may also contain any combination of computer data including graphics, sounds, text, video, multimedia and interactive content that runs while the user is interacting with the page. Client-side software can include animations, games, office applications and scientific demonstrations. Through keyword-driven Internet research using search engines like Yahoo! and Google users worldwide have easy, instant access to a vast and diverse amount of online information. Compared to printed media, books, encyclopedias and traditional libraries the World Wide Web has enabled the decentralization of information on a large scale.

4.1.2 Webpage

A web page (or webpage) is a web document that is suitable for the World Wide Web and the web browser. A web browser displays a web page on a monitor or mobile device. The web page is what displays but the term also refers to a computer file, usually written in HTML or comparable markup language. Web browsers coordinate the various web resource elements for the written web page such as style sheets, scripts and images to present the web page. Typical web pages provide hypertext that include a navigation bar or a sidebar menu to other web pages via hyperlinks often referred to as links.

On a network a web browser can retrieve a web page from a remote web server. On a higher level the web server may restrict access to only a private network such as a corporate intranet or it provides access to the World Wide Web. On a lower level, the web browser uses the Hypertext Transfer Protocol (HTTP) to make such requests.

Here we create the web pages for temperature, humidity, CO and CO₂. These values are shown by the graph to the user

5.1 Software Implementation

5.1.1 Energia

Energia is an open-source electronics prototyping platform started by Robert Wessels in January of 2012 with the goal to bring the Wiring and Arduino framework to the Texas Instruments connector launch pad and MSP430 based Launch Pad. The Energia IDE is cross platform and supported on Mac OS, Windows and Linux. Energia includes an Integrated Development Environment (IDE) that is based on Processing.

The foundation of Energia and Arduino is the Wiring framework that is developed by Hernando Barragan. The Energia team adopts the philosophy of learning by doing and strives to make it easy to work directly with the hardware. Professional engineers, entrepreneurs, makers and students can all benefit from the ease of use Energia brings to the microcontroller.



Fig 5.1.1 symbol of energia

Energia started out to bring the Wiring and Arduino framework to the Texas Instruments LaunchPad. Texas Instruments offers a connector launch pad TM4C1294X, MSP430, TM4C, C2000 and CC3200 Launch Pad. The Launch Pad is a low-cost microcontroller board that is made by Texas Instruments. The latest release of Energia supports the majority of the Launch Pad product offerings.

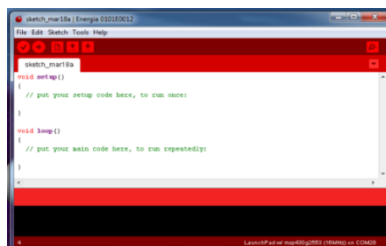


Fig5.1.2 setup window for energia

6.1 Hardware Requirement

- MSP-EXP430G2553 Launch Pad
- Laptop with connector launch pad CC3200
- Windows/ Linux operating system

7.1 Simulation Output

7.1.1 Temperature and Humidity

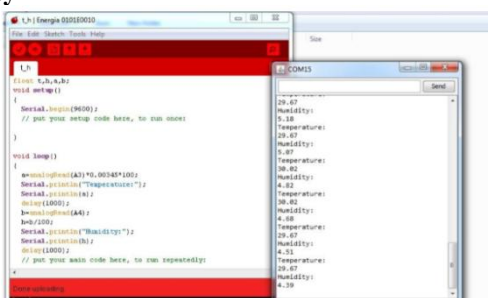


Fig 7.1.1 simulation output for temperature and humidity

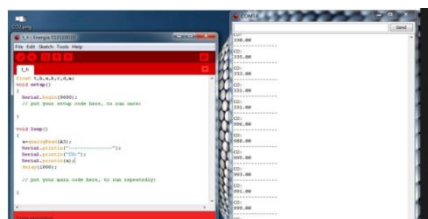


Fig 7.1.2 simulation output for CO

7.1.3 Carbon Dioxide (Co2)

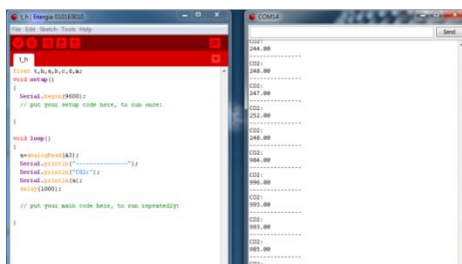


Fig 7.1.3 simulation output for CO2

8.1 Hardware Output

8.1.1 Temperature Sensor



S.No	TEMPERATURE MESURMENT(for every 1 ms delay)			
	PROJECT LAB	GARDEN	LIBRARY	ENTRANCE
1	26.91	23.32	27	27.8
2	26.91	23.9	26.91	28
3	27.25	24.01	26.91	27.9
4	25	23.4	26.67	29.01

Fig 8.1.1 hardware output for temperature sensor

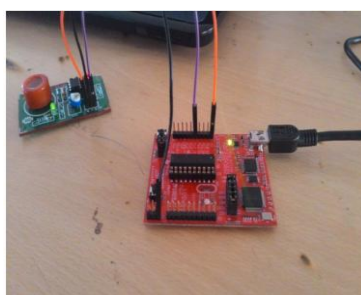
8.1.2 Humidity Sensor



S.NO	HUMIDITY MEASUREMENT(for every 1ms delay)			
	PROJECT LAB	GARDEN	LIBRARY	ENTERANCE
1	1.46	1.2	0.94	1.04
2	1.57	1.37	1.03	0.88
3	1.62	1.39	0.94	1
4	1.38	1.31	0.92	0.84
5	1.45	1.14	1.04	0.97

Fig 8.1.2 hardware output for humidity sensor

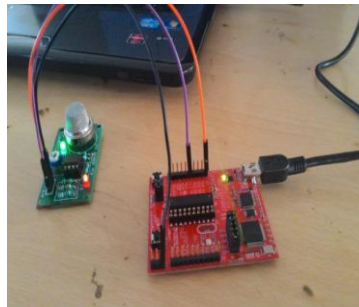
8.1.3 Co Sensor



S.NO	CO MEASUREMENT (for 1ms delay)			
	PROJECT LAB	GARDEN	LIBRARY	ENTERANCE
1	331	321	342	348
2	386	310	435	402
3	343	327	401	398
4	340	376	321	319
5	355	345	322	387

Fig 8.1.3 hardware output for CO sensor

8.1.4 Co2 Sensor



S.NO	CO2 MEASUREMENT (for every 1ms delay)			
	PROJECT LAB	GARDEN	LIBRARY	ENTERANCE
1	188	191	162	100
2	185	176	123	98
3	185	155	182	89
4	188	180	163	96
5	188	189	125	90

Fig 8.1.4 hardware output for CO2 sensor

IV. Conclusion

The importance of real-time wireless air pollution monitoring system is investigated considering the vital technical and economic issues for vast area deployment. Commercially available gas sensors were calibrated using the appropriate calibration technologies. These pre-calibrated sensors are then interfaced with the wireless sensor motes forming multi hop mesh network. A light weight middleware and web based interface were developed for online monitoring of the data in the form of charts from anywhere on internet. Pilot deployment of the system was carried out at the campus and at the Coimbatore city. Experimentation carried out using the developed wireless air pollution monitoring system under different physical conditions show that the system collects reliable source of real time fine-grain pollution data.