College Of Engineering & Technology

Mechanical Engineering Departments

Graduation Project

Design and Building of Gas Analyzer

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Abstract

Gas concentration measurements have gained more and more attention in the old of industrial process control and environmental pollution monitoring. Industrial process produce many gases; some of these gases are toxic and harmful for human and environment. So the need for a device to measure the percentage of more than one gas in many fields and application with low cost is a challenge. In this project a gas analyzer device for nine different gasses (CO , Alcohol , CO_2 , O_3, NH_3 , LPG , H_2 , CH_4) will be built using sensors connected with computer to analyze and display the results. The MATLAB software was used to process the data from the sensors and then display the results on computer screen.

Palestine Polytechnic University

College of Engineering & Technology

Mechanical Engineering Department

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Design and Implementation Gas Analyzer

Project Team

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According to the orientations of the supervisor on the project and the examined committee is by the agreement of a staffers all, sending in this project to the Mechanical Engineering Department are in the college of the engineering and the technology by the requirements of the department for the step of the bachelor's degree.

Project supervisor signature

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Committee signature

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Department head signature …………………………

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First of all and always we thank our God "Allah" to make me live
these moments.

We are very grateful to our dear supervisor Eng.Majdi zallum, and we would like to thank him indeed for his supervision , and encouragement, and believing in our abilities..

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Chapter 1

Introduction And Project Background

1.1 Introduction

1.2 Project Description

1.2.1 Gas Analyzer

1.2.2 Analyzer

1.2.3 Sensor

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1.3 Project aim and objective

1.4 Reasons device design

1.5 Problem in the project

1.6 Applications

1.1 Introduction

In recent times there is a lot of concern regarding the presence and the concentration levels of harmful gases in the earth's atmosphere. Quantitative analysis of these is important from these as well as other considerations.

Monitoring the health of a power plant requires the monitoring oflevels of various gases in the gases that leave through the stack. In the case of internal combustion engines the analysis of the exhaust gases leaving through the tail pipe of a car provides important information about the performance of the engine. In view of thise look at the following in what follows:

a.Monitoring of exhaust gas.
b. Atmospheric pollution monitoring.
c. Exhaust gas analysis in IC Engines.

However, embark on these shall look at ways of specifying the concentration of gases. The concentration of a candidate gas in a mixture of gases may either be specified on volume basis or on mass basis . On volume basis the units are either ppm (parts per million) or ppb (parts per billion).

Gas concentration measurements have gained more and more attention in the old of industrial process control and environmental pollution monitoring, Many methods for gas detection have been developed.

Gas analysis refers to a variety of instruments and techniques that provide essential, data to many processing, manufacturing and materials research industries. Whether you are looking for detection limits at the part per million (ppm),extern manufactures the type of gas analysis system needed.

The ability to analyze one or more components of a gas mixture depends on the availability of suitable detectors that are responsive to the components of interest in the mixture and that can be applied over the required concentration range.

Gas detectors are now available that exploit a wide variety of physical and chemical properties of the gases detected , the devices resulting from the application of these detection mechanisms show a corresponding variety in their selectivity and range of response.

1.2 Project Description

1.2.1 Gas Analyzer

Gas analysis includes the detection of gases and vapors in connection with control of chemical and metallurgical processes , control of environment and in the field of safety control . A whole class of analytical instruments is available using physical method Although analyzers are considered to be electrical instruments , some knowledge of chemistry is required to understand their operating principle and to obtain correct and accurate measuring results.

1.2.2 Analyzer

Heart of any analyzer is a species-specific sensor or sensor system. Its functionality is based on a definite physical. The sensors react on variations of the property in question of the sample with corresponding variation of their property (increased light absorption or reduced electrical conductivity for instance)where from a measuring signal is obtained.

Regarding their design, analyzers may be classified as follows:

1.Portable analyzers for mobile application of one analyzer at different measuring locations for short time measurements.

2.Analyzer for fixed installations at definite locations of a plant for continuous measurements over months and years.

3.Analyzer,depending on the design, may as well contain gas filter, gas cooler and heated internal sample lines.

1.2.3 Sensors

The term sensor generally describes all kind of devices that measure a physical quantity or the change in a physical quantity such as temperature ,pressure ,gas concentrations etc. A sensor consists of actual sensing element (elemental sensor) and a transmitter. The sensing element must have a feature (e.g. conductivity, light absorption)that changes with variations of the measuring component . This reaction of the sensing element then transformed by the transmitter into a measuring signal , and here will use sensors for measurements of concentrations(Analyzer).

1.2.4 Measured Gases

There are many gases that are produced daily in the air , factors, cars, and gases that can be measured by its focus, namely:

1. Carbon dioxide (CO_2)
2. Alcohol
3. Carbon monoxide (CO)
4. Hydrogen (H_2)
5. Ozone gas (O_3)
6. Ammonia (NH_3)
7. Methane (CH_4)
8. liquefied petroleum gas (LPG)
9. Natural Gas sensor (NG)

1.3 Project aim and objectives

Design a device that scans the proportion of gas and consists of nine sensor to measure the concentration for nine gases in a medium for monitor .

The specific objectives of the project:

1. Design a device that has a low cost than the device in the market.

2. Preservation of the environment by determining the proportionof some gasesintheatmosphere.

3. Interface the outside medium to computer that can he use by normal people.

1.4Recognition of the need

There are many reasons for built this device in the project , the different between this device and the devices in the markets.

1. The cost of the equipment in the market is high and that the device will be built at a cost of per device in the market.

2. Non measuring devices in the market for long periods of time.

3. Used in the project (DAQ)Data Acquisition, not using the microcontroller or IC circuit like other devices because:

a. The error in the reading of the sensor and in the software can solved immediately.

b. The data can be documentation.

c. The number of the sensor can be increased more than the number of the analog input of the (DAQ) with some condition and new software processing.

4. Taking its from the sensors and sent to the computer through DAQ analyzed and processed by MATLAB.

5. If something wrong in the software or any mistake then immediately can be solved.

1.5 Problem in the project

Despite of the advantages of the gas analyzer, but there are some problems:

1. Calibration:

Calibration is the process of adjusting the instrument read out so that it corresponds to the actual concentration value or a reference standard. Calibration involves checking the instrument with a known concentration of a gas or vapor to see that the instrument gives the proper response. Calibration results in calibration factors or functions establishing the relationship between the analyzer response and the actual gas concentration introduce to the analyzer. Calibration is an important element of quality assurance in emission control. Reference gases are used with very accurately specified composition [1].

A .How to make the device sense the gases every time from zero if the device is putting in any place and want to get information from the same place and the same time.

b. Calibration performs an internal adjustment of the zero point and span points.

c. Zero calibrates the zero points on each range.

2. Rang of sensors.

3. Noise:

From the medium that take the information from it so will effect on the signal that come out from gas sensor.

4. Accuracy:

Accuracy indicates how close a method comes to the true value.

1.6 Applications

1. Optimization of small firing systems.

2. Monitoring of exhaust gas concentration from firing systems with all type of fuel (oil, gas, coal)as well as operational measurements with thermal incineration plants.

3. Room air monitoring.

4. Monitoring of air in fruit stores, greenhouses, fermenting cellars and warehouses.

5. Monitoring of fomenters for generating for generating biogas(input and pure sides).

6. Monitoring of gas driven motors (power generation).

7. Monitoring of exhaust gas.

8. Environmental protection.

9. Chemical plants.

10. Cement industry.

Chapter 2

Conceptual Design Functional Specification

2.1 Introduction

2.2 Conceptual Design

2.3 Functional Specification

2.3.1 Sensors (blok1)

2.3.2 Interfacing system (DAQ) (blok2)

2.3.3 Computer and software (blok3)

2.4 Project Schedule

2.5 Estimated Budget

2.1 Introduction

Gas analyzer is divided into parts and components, and all these components are connecting with each other to design the device.

When the device is built , some properties and parameters must be known that make the gas analyzer a good device that can be used in real life, and these properties are the cost of this device is not very high, simple and easy for anyone that can use the gas analyzer and it the ability to move (portability) in any place need to measure gas.The last one and the most property in gas analyzer is that the result when its work must be true and right for until it is approved as a measuring tool by the Centers for measurement and quality in Palestine.

2.2Conceptual Design

Gas analyzer is a device that will measure the concentrations of some gases by using measurement sensor and using interfacing tool to connect the measurement sensor with the computer because the computer system dial with digital signal . The signal out from the sensor is analog signaland the MATLAB software will process the data sent by the sensor.

The device is divided into three systemsShow in Figure 2.1, these are:

1. Sensors.
2. Interfacing system.
3. Computer and software system.

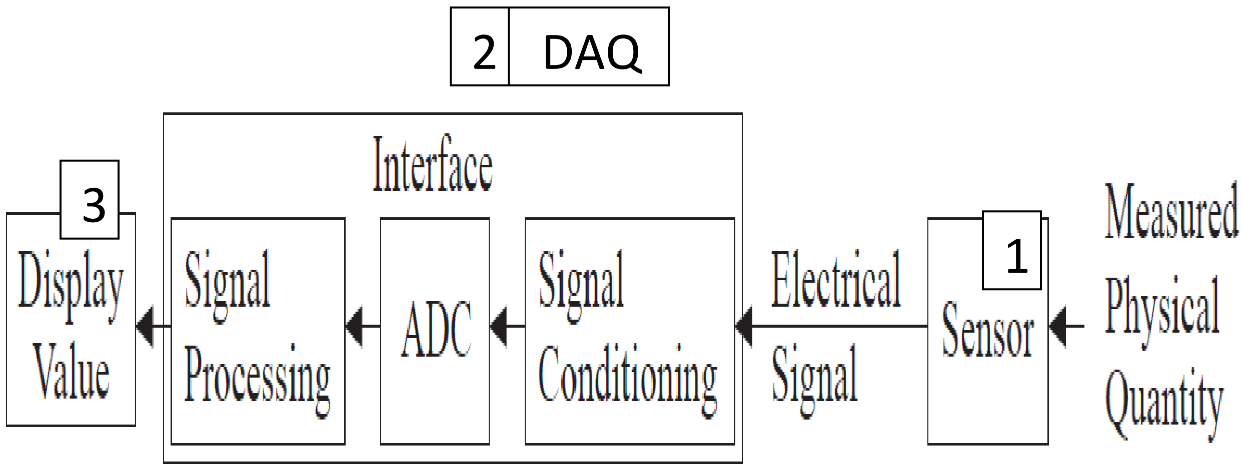

Figure 2.1: Block diagram for system

2.3 Functional Specification

In this section, more details are given for each system with its related blocks in Figure 2.1.

2.3.1 Sensors (block 1)

The concentration of gases in a medium that will be measured by using gas sensors . The chosen gases sensor must have some properties or feature for good accuracy detection, and it dependson:

1.High sensitivity.

2.Fast response.

3.Wide detection range.

4. Stable performance and long life.

5.Simple drive circuit.

2.3.2 Interfacing system (DAQ) (block 2)

Most measurement sensors are analog, that is they provide a continuous electrical signal, and the computer is digital.It can only store discrete numbers. The hardware used has electronics that can take discrete as the data acquisition system (DAQ) and digital measurements of a continuous analog signal.

2.3.3 Computer and software (block 3)

The computer is very important component for built the device, because all the data will be processed in the computer by using MATLAB software and the result will be displayon the screen of computer.

2.4 Project Schedule

The time plan views the stages of establishing the project with its components, divided into two semesters as shown in the following tables.

Table 2.1: Timing schedule of the First Semester.

Process	**Week**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Collecting data															
Analyzing of data															
Writing the documentation															
Advanced features															

.

Table 2.2 : Timing schedule of the second semester

Process	**Week**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Buying component&Full Designing															
Make experiments															
System Implementation															
Documentation															

2.5 Estimated Budget

Table 2.3: Estimated budget.

Components	Price($)	Quantity	Total($)
CO_2 Sensor	40.00	1	40
Alcohol Sensor	18.80	1	18.80
LPG Sensor	18.80	1	18.80
CO Sensor	22.50	1	22.50
H_2 Sensor	18.80	1	18.80
O_3 Sensor	28.80	1	28.80
NH_3 Sensor	18.80	1	18.80
CH_4 Sensor	18.80	1	18.80
Hydrogen Sensor	18.80	1	18.80
Data acquisition card 1208 (50 kS/s)	315	1	315
Socket for sensors	1.50	6	9
Vero Board 10x15	5.00	2	10
Computer	available	1	available
	Total		519.1 $

Chapter 3

Sensors

3.1 Introduction to Gas Sensors

3.2 Characteristics of Gas Sensors

3.3 Sensors:

3.3.1 Substance-specific electrochemical sensors

3.3.2 Metal oxide semiconductor sensors

3.3.3Circuit of the sensor.

3.4 Sensors simplification:

3.4.1 Carbone dioxide(CO_2)

3.4.2 Alcohol

3.4.3 LPG sensor

3.4.4 Carbone monoxide(CO)

3.4.5Ozone(O_3)

3.4.6 Air Quality Control sensor(NH_3)

3.4.7 Methane Gas sensor(CH_4)

3.4.8 Hydrogen Gas sensor(H_2)

3.4.9 Natural Gas sensor (NG)

3.1 Introduction to Gas Sensor[3]

Gas sensors are devices that can change the concentration of an analyzing gas into an electronic signal, and they are an important component of devices commonly known as “electric noses”. Instead of analyzing all of the individual gas constituents by techniques such as gas chromatography, optical spectroscopy, or mass spectrometry, gas sensors look for specific patterns or fingerprints of the response of different materials to the gas mixture.

The history of gas sensors can be traced back to the last century. Miners are among the first groups that became aware of the importance of detecting hazardous gases in their working environment; in the early years, small animals, such as birds, were used as a poor substitute for a quantifiable method to measure this hazard. Another spur to the development of modern atmospheric testing devices is the atmospheric hazards within enclosed spaces, like ships. In 1927, Oliver W. Johnson introduced a portable, explosive gas indicator, which is now considered the first commercial gas sensor[1].

In the past eighty years, scientists have developed various gas sensors such as electrochemical sensors, catalytic combustion sensors, infrared sensors, and diffusion fuel cell sensors. These sensors have a broad range of applications in chemical engineering, medical, agriculture, architecture and other fields. In the past century, for commercial applications, there are several major types of gas sensors that have been developed. The first are electrolyte-based potent metric sensors for automobile exhaust monitoring, based on materials. Another important type of commercial sensor is the metal oxide semiconductor gas sensor, e.g. SnO_2, which uses changes in resistance of the metal oxide to detect low concentrations of gases.

The basic principles behind the operation of all the gas sensors are the sensitivity, selectivity, and reversibility of their sensing response. These terms can be defined in accordance with measurable parameters. The sensitivityof a sensor is a measure of the lowest concentration of an analyze gas that can be detected[1].

3.2 Characteristics of Gas Sensors

In order to characterize sensor performance , a set of parameters is used [2].The most important parameters and their definitions are listed below.

• Sensitivity is a change of measured signal per analyze concentration unit, i.e., the slope of a calibration graph. This parameter is sometimes confused with the detectionlimit.

• Selectivityrefers to characteristics that determines whether a sensor can respond selectively to a group of analyses or even specifically to a single analyze.

• Stabilityis the ability of a sensor to provide reproducible results for a certain period of time. This includes retaining the sensitivity, selectivity, response, and recovery time.

• Detectionlimitis the lowest concentration of the analyze that can be detected by the sensor under given conditions, particularly at a given temperature.

• Dynamic rangeis the analyze concentration range between the detection limit and the highest limiting concentration.

• Linearity is the relative deviation of an experimentally determined calibration graph from an ideal straight line.

• Resolutionis the lowest concentration difference that can be distinguished by sensor.

• Response time is the time required for sensor to respond to a step concentration change from zero to a certain concentration value.

• Recovery time is the time it takes for the sensor signal to return to its initial value after a step concentration change from a certain value to zero.

• Working temperature is usually the temperature that corresponds to maximum sensitivity.

• Hysteresisis the maximum difference in output when the value is approached with an increasing and a decreasing analyze concentration range.

• Life cycle is the period of time over which the sensor will continuously operate.

All of these parameters are used to characterize the properties of a particular material or device. An ideal chemical sensor would possess high sensitivity, dynamic range, selectivity and stability; low detection limit; good linearity; small hysteresis and response time; and long life cycle. Investigators usually make efforts to approach only some of these ideal characteristics, disregarding the others. On one hand, this is because the task of creating an ideal sensor for some gases is extremely difficult, if at all possible. On the other hand, real applications usually do not require sensors with all perfect characteristics at once. For example, a sensor device monitoring the concentration of a component in industrial process does not need a detection limit at the ppb level, though the response time at range of seconds or less would be desirable. In case of environmental monitoring applications, when the concentrations of pollutants normally change slowly, the detection limit requirements can be much higher, but response time of a few minutes can be acceptable.

3.3 Sensors

Many techniques using the sensor use it for working principal or for detection so will explain two way that the sensor used for detection.

3.3.1 Substance-specific Electrochemical Sensors

One of the most useful detection techniques for gas detection is the use of substance-specific electrochemical sensors installed in compact, field portable survey instruments[5].Substance-specific electrochemical sensors consist of a diffusion barrier which is porous to gas but nonporous to liquid, reservoir of acid electrolyte (usually sulfuric or phosphoric acid), sensing electrode, counter electrode, and (in three electrode designs) a third reference electrode. Gas diffusing into the sensor reacts at the surface of the sensing electrode. The sensing electrode is made to catalyze a specific reaction. Depending on the sensor and the gas being measured, gas diffusing into the sensor is either oxidized or reduced at the surface of the sensing electrode. This reaction causes the potential of the sensing electrode to rise or fall with respect to the counter electrode. The current generated is proportional to the amount of reactant gas present.

This two electrode detection principle presupposes that the potential of the counter electrode remains constant. In reality, the surface reactions at each electrode causes them to polarize, and significantly limits the concentrations of reactant gas they can be used to measure. In three electrode designs it is the difference between the sensing and reference electrode which is what is actually measured. Since the reference electrode is shielded from any reaction, it maintains a constant potential which provides a true point of comparison. With this arrangement the change in potential of the sensing electrode is due solely to the concentration of the reactant gas.

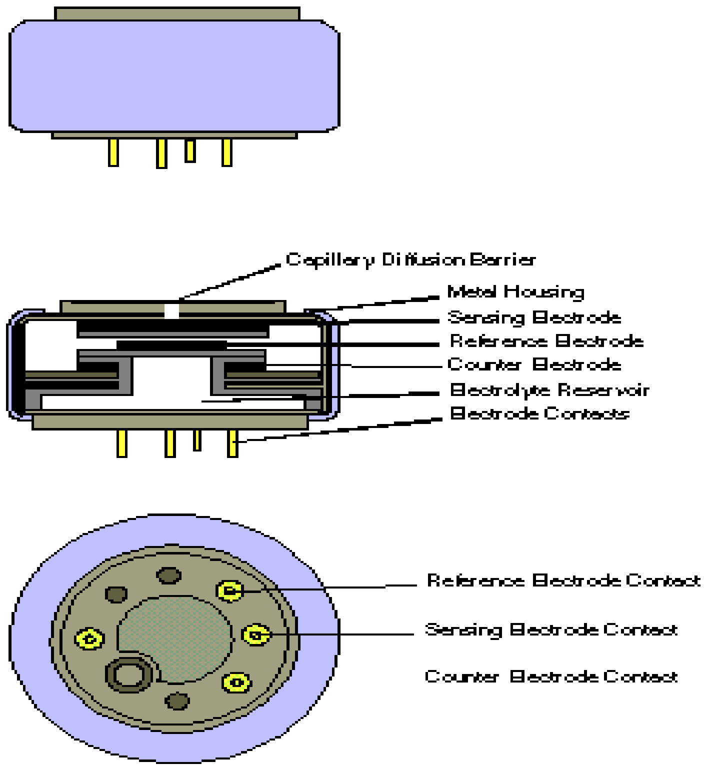

Figure 3.1: Three electrode electrochemical sensor

Electrochemical sensors are stable, long lasting, require very little power and are capable of resolution (depending on the sensor and contaminant being measured) in many cases to 0.1 ppm[5]. The chief limitation of electrochemical sensors are the effects of interfering gas readings. Most substance-specific electrochemical sensors have been carefully designed to minimize the effects of common interfering gases. Substance-specific sensors are designed to respond only to the gases they are supposed to measure. The higher the specificity of the sensor the less likely the sensor will be affected by exposure to other gases which may be incidentally present. For instance, a substance-specific carbon monoxide sensor is deliberately designed not to respond to other gases which may be present at the same time, such as hydrogen sulfide or methane, show figure 3.1 .

3.3.2 Metal Oxide Semiconductor Sensors

Metal oxide semiconductor (or MOS) sensors may be used for gases as well as combustible gas monitoring. As discussed previously in the combustible gas monitoring section, MOS sensing elements consist of a metal oxide semiconductor such as tin dioxide (SnO_2) on a sintered alumina ceramic bead contained within a flame arrestor. In clean air the electrical conductivity is low, while contact with reducing gases such as carbon monoxide or combustible gases increases conductivity. Sensitivity of the sensing element to a particular gas may be altered by changing the temperature of the sensing element show figure 3.2 .

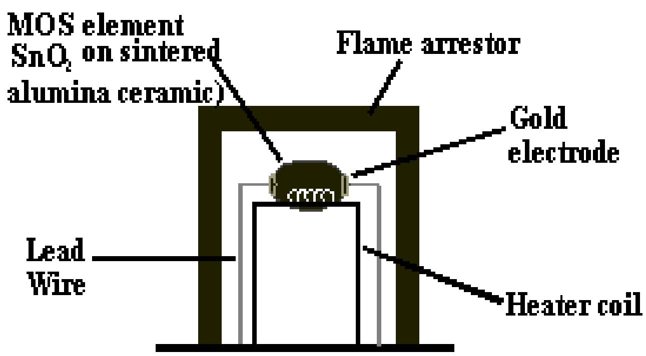

Figure3.2: Metal oxide semiconductor (MOS) sensor

MOS sensors are "broad range" devices designed to respond to the widest possible range of gases and combustible gases, including chlorinated solvent vapors and other contaminants difficult to detect by other means. This non-specificity can be advantageous in situations where unknown gases may be present, and a simple determination of the presence of gases is sufficient. Since sensitivity of the sensing element to a particular gas is mathematically predictable, a commonly used strategy is to preprogram the instrument with a number of theoretical specific response curves. If the exact nature of the contaminant is known, an identification code can be entered, and readings of the sensor will be adjusted to reflect the expected sensitivity of the sensor to the contaminant being measured. MOS sensors offer the ability to detect low (0 - 100 ppm)[5] concentrations of gases over a wide temperature range. The chief limitations concerning use of this kind of sensor are the difficulty in the interpretation of positive readings, the potential for false positive alarms, and the effects of humidity on sensor output. As humidity increases sensor output increases as well. As humidity drops to very low levels, sensor output may fall to zero even in the presence of gas. In addition, caution must be exercised when making assumptions about the contaminants which are presumed to be present. If a user keys in the preprogrammed response curve for a contaminant which is highly detectable by the sensor, but actually encounters one which is less detectable, the result may be erroneously low readings[3].

3.3.3 Circuit of the sensor

The sensor needs to be put 2 sources voltage, heater voltage （VH）and test voltage （VC）. VH used to supply certified working temperature to the sensor, while VC is used to detect voltage (VRL) on load resistance （RL）whom is in series with sensor. The sensor has light polarity, VC need DC power. VC and VH could use same power circuit with precondition to assure performance of sensor. In order to make the sensor with better performance, suitable RL value is needed: Power of Sensitivity body(Ps)[4] , show figure 3.3 :

$$(Ps) = \left(\frac{Vc^2 * Rs}{(Rs+Rl)^2}\right) \ldots\ldots(1)$$

Resistance of sensor(Rs):

$$(Rs) = \left(\frac{Vc}{Vrl-1}\right) * Rl \ldots\ldots(2)$$

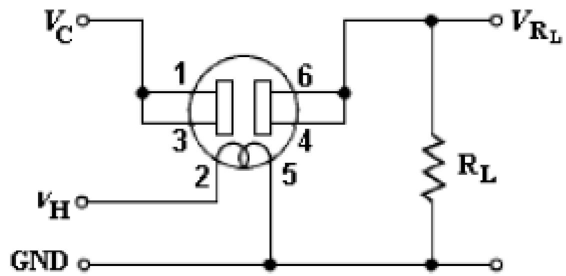

Figure 3.3: Circuit of the sensor.

3.4 Sensors simplification

The name and the properties for each sensor, that will be the project used it .

3.4.1 Carbone dioxide(CO_2)

Excellent performance CO_2 sensor, for use in a wide range of applications, including air quality monitoring, mine and tunnel warning systems , greenhouse, etc. The sensor is easy to use and can be easily incorporated in a small portable unit.

Figure 3.4:CO_2 sensor.

Working principle

The CO_2 sensor works through an electrochemical reaction that occurs when carbon dioxide passes over the sensor. From a less technical perspective, when the sensor is first provided power, the sensor begins warming up, to aid in the chemical reaction. This takes roughly 30-60 seconds, after which time the sensor will be noticeably warm to the touch. During this time, the output voltage of the sensor increases until finally leveling off when the sensor is fully "warmed up". Note that this voltage is dependent on the voltage applied across the "heater pins", and thus will decrease as the batteries wear down.

Once the warm-up period has passed, the sensor will then be in a steady state that is ready to detect CO_2. As CO_2 is applied, the output voltage will decrease abruptly, indicating its presence. Measuring this voltage drop is how will detect whether carbon dioxide is present or not. Once CO_2 is no longer applied to the sensor, its output voltage will gradually increase back to its steady state voltage. Note that this increase is about at the same rate as the warm up time, so it can take around 15-30 seconds for the sensor to indicate normal levels again ,shows Figure3.5 the typical sensitivity characteristics of the CO_2 sensor.

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When the sensor exposed to CO_2, the following electrodes reaction occurs:

Cathodicreaction: 2Li+-CO_2+$\frac{1}{2}O_2$+2e-=Li_2CO_3

Anodic reaction : 2Na+$\frac{1}{2}O_2$+2e-=Na_2O

Over all chemical reaction: Li_2CO_3+2Na=Na_2O+2Li+CO_2

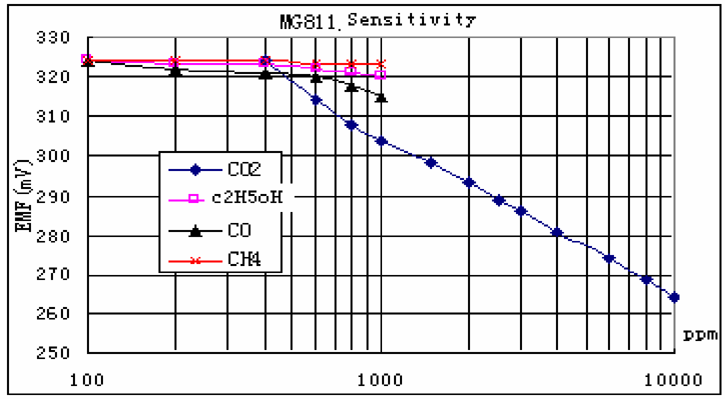


Figure 3.5:Sensitivity characteristics of the CO_2

$$(EMF) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(3)$$

Coefficients (with 95% confidence bounds):

a = 47.65 (34.86, 60.43)

b = -0.0008005 (-0.001362, -0.0002386)

c = 287.6 (273.3, 301.8)

d = -8.713e-006 (-1.532e-005, -2.105e-006)

Calibration of CO_2 sensor

To make the CO_2 sensor get the correct reading , so firstly must calibrate it to read right reading so will show two ways to calibrate the sensor.

Method 1. Using outside air to calibrate

For most applications, outside air is an accurate and effective calibration source. Outdoor carbon dioxide is generally a well-mixed atmospheric gas. That is, it typically remains at a relatively constant slowly-changing level. Currently, this level is near 390 ppm.

Although carbon dioxide is generally well-mixed in the atmosphere, in locations near carbon dioxide sources (such as running vehicles, factories, humans, etc.) carbon dioxide can vary.

To calibrate using outside air, take your sensor to an outside area away from running vehicles, people, animals, and other carbon dioxide sources. Let the sensor carbon dioxide value settle for about 20 minutes. (Since human breathing creates a significant amount of carbon dioxide, for best results leave the sensor during this time). For calibrating the sensor using the outside air carbon dioxide value of 390 ppm.

Method 2. Using calibration gas

If you purchases a sensor with an external port, you have the capability using calibration gas.

Calibration gas can be obtained from several sources. For bestresults, purchase a calibration gas with a concentration that is similar to the concentrationsthat you plan to measure. For example, if you are monitoring a greenhouse and your levelsare typically around 1200 ppm, select a 1000 or 1500 ppm calibration gas. You will also needa gas flow regulator valve for the calibration gas. Poor calibration will occur with excesspressure, so choose a gas flow regulator that flows 0.5 liters per minute (lpm) or less.

Features

1. High sensitivity

2. Detection Range:(350-10000) ppm CO_2

3. Response Time :<60s

4. Heater Voltage: (0.1-6)V

Application

1. Air quality control

2. Ferment process control

3. Room temperature CO_2 concentration detection

3.4.2 Alcohol

This is a gas sensor ,which suitable for detecting ethanol concentration in the air . it is one of the straight forward gas sensor and hence, works almost the same way as other gas sensor, just like common Breathalyzer , show figure 3.6 .

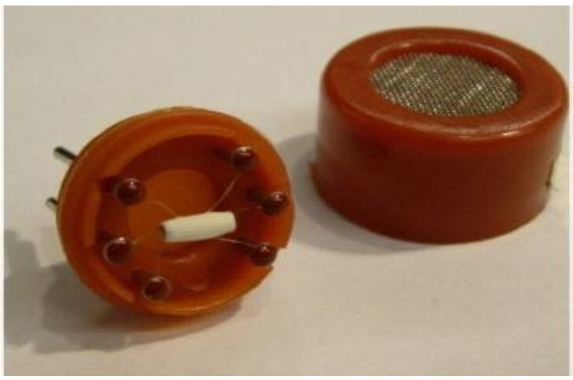


Figure3.6 : Alcohol sensor.

working principle

If the coil is heated up, SnO_2 ceramics will become the semiconductor, so there are more movable electrons, which means that it is ready to make more current flow. Then, when the alcohol molecules in the air meet the electrode that is between alumina and tin dioxide, ethanol burns into acetic acid then more current is produced. So more the alcohol molecules, more the current we will get. Because of this current change, we get the different values from the sensor.

Figure 3.7 shows the typical sensitivity characteristics of the alcohol sensor, ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 0. 4mg/l alcohol. All test are under standard test conditions[6] , show figure 3.7 .

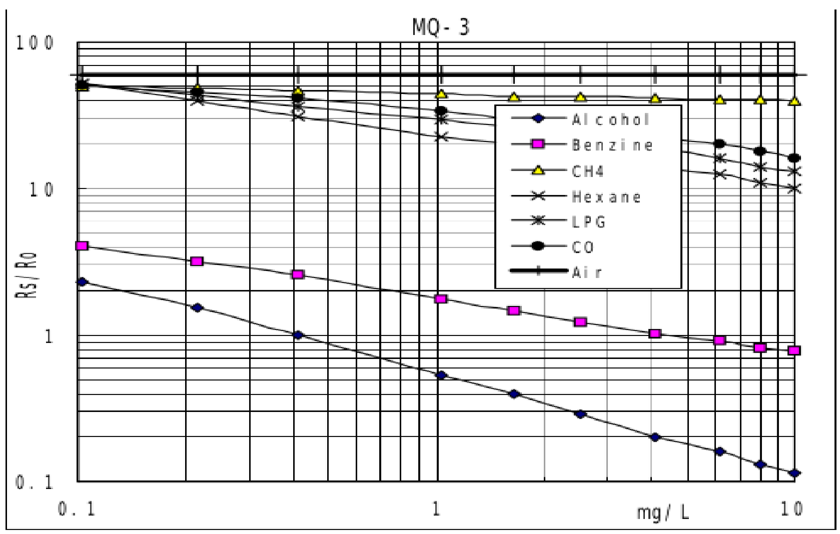


Figure 3.7: Sensitivity characteristics of the Alcohol

$$(Rs/Ro) = ae^{b(mg/l)} + ce^{d(mg/l)} \ldots\ldots(4)$$

Coefficients (with 95% confidence bounds):

a = 2.618 (2.339, 2.897)

b = -3.76 (-4.546, -2.975)

c = 0.5284 (0.3733, 0.6835)

d = -0.1859 (-0.2759, -0.09598)

Calibration of Alcohol sensor

To calibrate the alcohol sensor, calibrate the detector for 0.4mg/L(approximately 200ppm) of alcohol concentration in air and use value of load resistance(R_L) about 200kΩ(100kΩ to 470kΩ) .

Features

1. High sensitivity

2. Detection Range:(10-1000)ppm Alcohol

3. Fast Response Time: <10s

4. Voltage:

    - circuit voltage:5±0.1 V

    -heating voltage:5±0.1 V

Application

They are suitable for alcohol checker, Breathalyzer.

3.4.3 *LPG* sensor

Sensitive material of LPG sensor gas sensor is SnO_2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration , show figure 3.8 .

LPG sensor gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane, it is with low cost and suitable for different application.

Ideal sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense iso-butane, propane, LNG and cigarette smoke.

Figure 3.8: LPG sensor.

Working principle

Sensitive material of LPG sensor gas sensor is SnO_2, with lower conductivity in clean air. When the target combustible gases exist, the sensor's conductivity is higher along the gas concentration increasing. A simple electronic circuit is used to convert the change of conductivity to its corresponding output signal of gas concentration. LPG sensor gas sensor is shown in figure2.8, which has sensitivity to propane, butane and also to natural gas. The sensor could be used to detect different combustible gas, especially Methane and it is a low cost sensor and suitable for different applications.

Figure 3.9 shows the typical sensitivity characteristics of the LPG sensor, ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 1000 ppm. All test are under standard test conditions[7] .

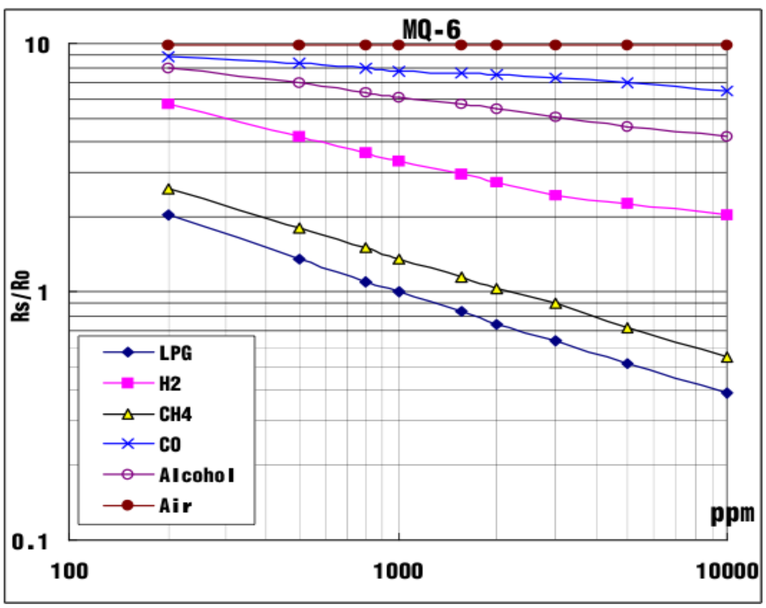


Figure 3.9: Sensitivity characteristics of the LPG

$$(Rs/Ro) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(5)$$

Coefficients (with 95% confidence bounds):

a =   1.783 (1.54, 2.026)

b =   -0.002062 (-0.00264, -0.001485)

c =   0.8215 (0.674, 0.9689)

d = -8.103e-005 (-0.0001205, -4.154e-005)

Calibration of LPG sensor

To calibrate LPG sensor, calibrate the detector for 1000 ppm of LPG concentration in air and use value of load resistance (R_L) about 20kΩ (10kΩ to 47kΩ).

Features

1. High sensitivity

2. Detection Rang: (300-10000)ppm (Butane, Propane ,LPG)

3. Fast Response Time:<10s

4. Voltage:

- circuit voltage:5±0.1 V

    -heating voltage:5±0.1 V

Application

1. Domestic gas leakage detector

2. Industrial combustible gas detector

3. portable gas detector

3.4.4 Carbone monoxide(CO)

Carbon Monoxide sensor for use in use in industrial or mining applications. This unit offers excellent long life performance with stable sensing characteristics , show figure 3.10 .

Figure 3.10: CO sensor

Working principle

Sensitive material of CO sensor gas sensor is SnO_2, 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 more 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. CO sensor 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.

Figure 3.11 shows the typical sensitivity characteristics of the CO sensor, ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 1000ppm Hydrogen. All test are under standard test conditions[8] .

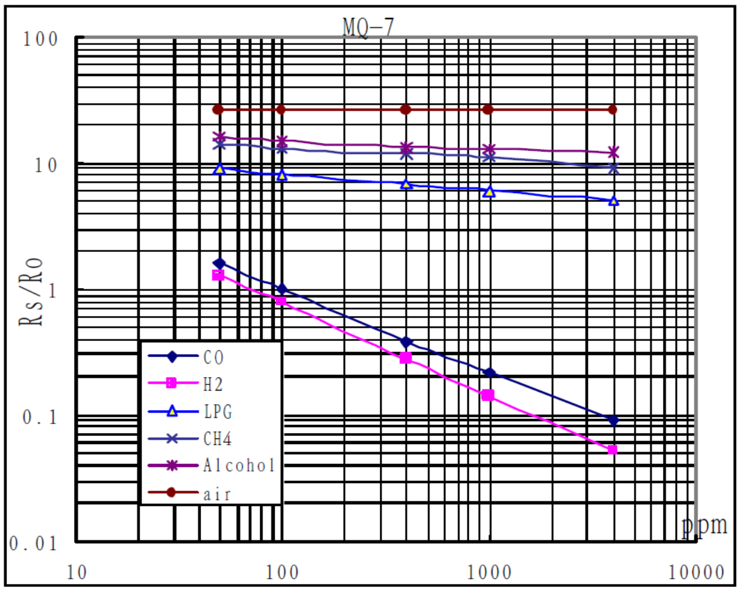


Figure 3.11: Sensitivity characteristics of the CO

$$(Rs/Ro) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(6)$$

Coefficients (with 95% confidence bounds):

a = 2.606 (1.66, 3.551)

b = -0.01528 (-0.02333, -0.007233)

c = 0.4929 (0.2264, 0.7593)

d = -0.0006306 (-0.001243, -1.855e-005)

Calibration of CO sensor

To calibrate CO sensor, calibrate the detector for 200 ppm of CO in air and use value of load resistance that (R_L) about 10kΩ (5kΩ to 47kΩ).

Features

1. High sensitivity

2. Detection Range: (20-2000)ppm CO

3. Response Time:<150s

4. Voltage:

    - circuit voltage:5±0.1 V

    -heating voltage(high):5±0.1 V

    -heating voltage(Low):1.4±0.1 V

5. Stable and long life

Application

They are used in gas detecting equipment for carbon monoxide(CO)in family and industry or car.

3.4.5 Ozone(O_3)

Detects and measures Ozone concentration . Ideal for monitoring air quality or for use in environment and research experiments , show figure 3.12.

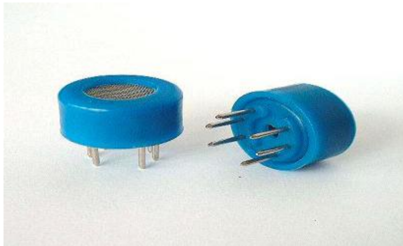


Figure 3.12: Ozone sensor.

Working principle

Sensitive material of ozone sensor is SnO_2 , which with lower conductivity in clean air. When ozone gas exists. The sensor's conductivity is more higher along with the gas concentration rising.

Figure 3.13 shows the typical sensitivity characteristics of the ozone sensor, ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 50ppm CL_2. All test are under standard test conditions[9] .

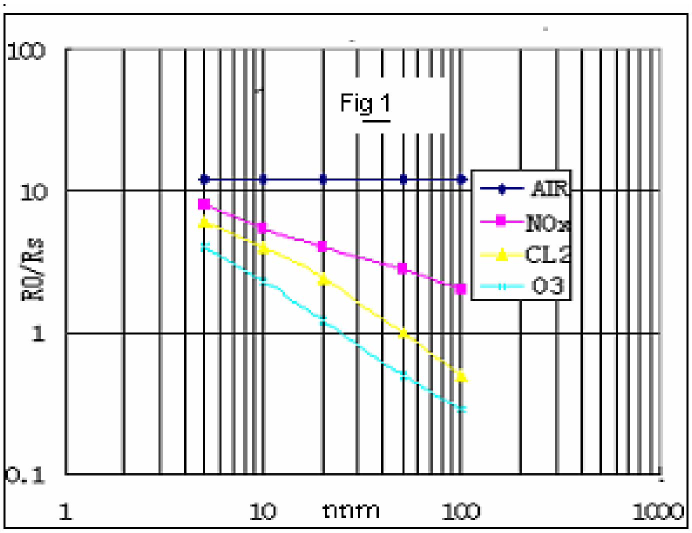


Figure 3.13:Sensitivity characteristics of the Ozone

$$(Rs/Ro) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(7)$$

Coefficients (with 95% confidence bounds):

a = 8.338 (-4.284, 20.96)

b = -0.07981 (-0.3939, 0.2343)

c = 0.5074 (-12.73, 13.74)

d = 0.0002009 (-0.3021, 0.3025)

Calibration of $\mathbf{O_3}$ sensor

To calibrate O_3 sensor, calibrate the detector for 50 ppb $\mathbf{O_3}$in air and use value of load resistance that (R_L) about 100kΩ (50kΩ to 200kΩ).

Features

1. High sensitivity

2. Detection Range: (10-1000)ppm Ozone

3. Sensing Resistance:(100-200)KΩ

4. Voltage:

   - circuit voltage:5±0.1 V

   -heating voltage:5±0.1 V

Application

1. Domestic Ozone concentration overload detector

2. Industrial Ozone concentration overload detector

3.Portable Ozone concentration overload detector

3.4.6 Air Quality Control sensor(NH_3)

Air quality sensor for detecting a wide range of gases, including NH_3. Ideal for use in office or factory , simply drive and monitoring circuit , show figure 3.14 .

Figure 3.14: Air quality sensor.

Working principle

The sensitive material of Air quality sensor is SnO_2, which has lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity increases drastically as the gas concentration rising. Air quality sensor has high sensitivity to Ammonia. The NH_3 sensor is composed of Al_2O_3 ceramic tube, Tin Dioxide (SnO_2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components.

Figure 3.15 shows the typical sensitivity characteristics of the Air quality sensor, ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 100 ppm ammonia . All test are under standard test conditions[10] .

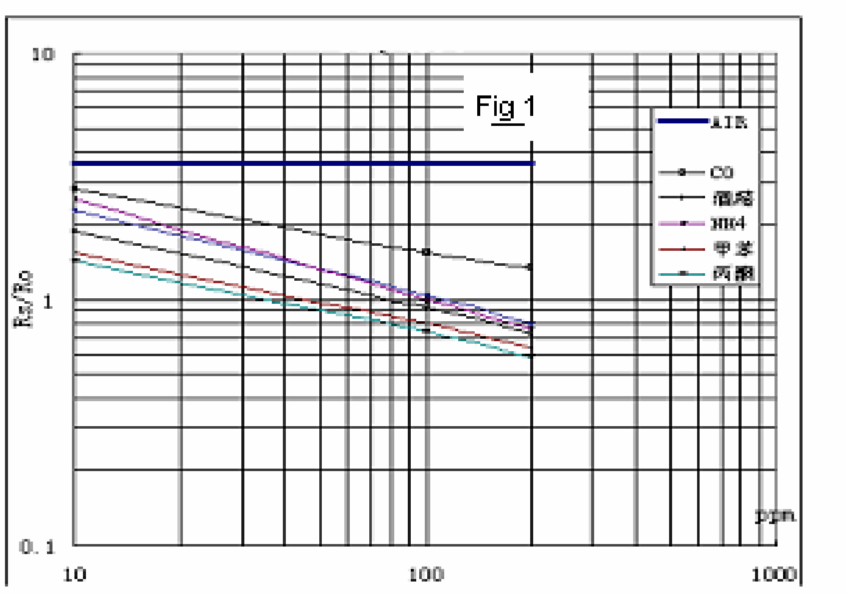


Figure 3.15:Sensitivity characteristics of the(NH_3)

$$(Rs/Ro) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(7)$$

Calibration of NH_3 sensor

To calibrate NH_3sensor, calibrate the detector for 100 ppm NH_3in air and use value of load resistance that (R_L) about 20kΩ (10kΩ to 47kΩ).

Features

1. High sensitivity

2. Detection Range:(10-1000)ppm

3. Voltage:

    - circuit voltage:5±0.1 V

-heating voltage:5±0.1 V

4. Stable and long life

Application

1. Domestic air pollution detector

2. Industrial air pollution detector

3. Portable air pollution detector

3.4.7 Methane Gas sensor(CH_4)

Natural Gas Sensor (CNG) for measuring the concentration of Methane (CH_4) in the air. Easy to implement heater drive and measuring circuit. This sensor is designed for long life and stable output.

Working principle

Figure 3.16 shows the typical sensitivity characteristics of the methane sensor, ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 1000 ppm of CH_4. All test are under standard test conditions[11] .

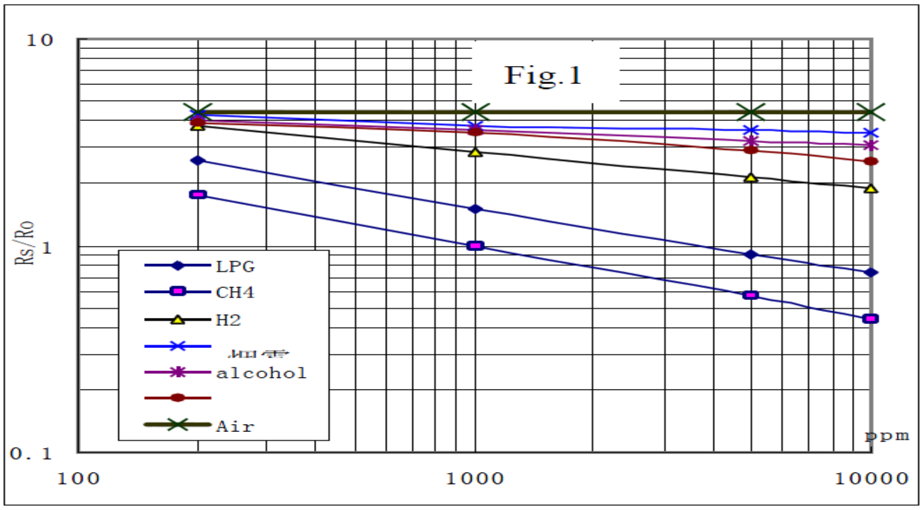


Figure3.16: Sensitivity characteristics of the (CH_4)

$$(Rs/Ro) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(9)$$

Coefficients (with 95% confidence bounds):

a = 1.457 (1.041, 1.874)

b = -0.002053 (-0.003317, -0.0007896)

c = 0.8342 (0.5495, 1.119)

d = -6.47e-005 (-0.0001253, -4.105e-006)

Calibration of CH_4 sensor

To calibrate CH_4sensor, calibrate the detector for 5000 ppm of CH_4 concentration in air and use value of load resistance that (R_L) about 20kΩ (10kΩ to 47kΩ).

Features

1.High Sensitivity

2.Detection Range: (300-10000)pm CH_4 (Methane)

3. Voltage:

- circuit voltage:5±0.1 V

-heating voltage:5±0.1V

4.Stable and Long Life

Application

1.Domestic gas leakage detector
2. Industrial Combustible gas detector
3. Portable gas detector

3.4.8 Hydrogen Gas sensor

Hydrogen Gas Sensor for measuring the concentration of Hydrogen (H_2) in the air. Easy to implement heater drive and measuring circuit. This sensor is designed for long life and stable output. Ideal for use in a Gas Leakage Circuit for detecting gas leaks ,show figure 3.17 .

Figure 3.17: Hydrogen sensor.

Working principle

Figure 3.18 shows the typical sensitivity characteristics of the Hydrogen sensor, ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 1000 ppm of H_2. All test are under standard test conditions[12] .

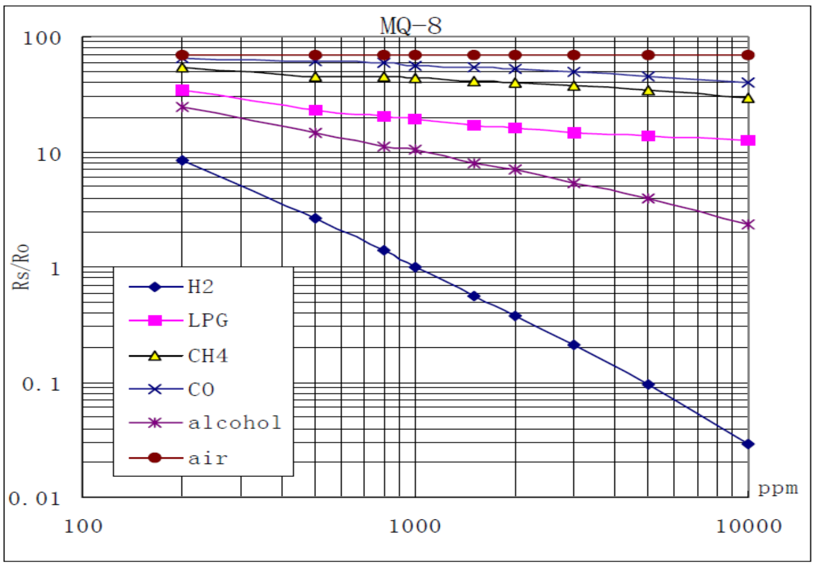


Figure 3.18:Sensitivity characteristics of the Hydrogen

$$(Rs/Ro) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(10)$$

Coefficients (with 95% confidence bounds):

a = 18.95 (16.93, 20.97)

b = -0.005279 (-0.006242, -0.004316)

c = 2.265 (1.208, 3.321)

d = -0.0008616 (-0.001183, -0.0005406)

Calibration of Hydrogen sensor

To calibrate hydrogen sensor, calibrate the detector for 1000 ppm hydrogen concentrationin air and use value of load resistance that (R_L) about 10kΩ (5kΩ to 33kΩ).

Features

1.High Sensitivity

2.Detection Range: 100 - 10,000 ppm H_2 (Hydrogen)

3. Voltage:

- circuit voltage:5±0.1V

-heating voltage:5±0.1V

4.Stable and Long Life

Application

They are used in gas leakage detecting equipment's in family and industry, are suitable for detecting of Hydrogen (H_2), avoid the noise of alcohol and cooking fumes

3.4.9 Natural Gas sensor (NG)

Detect dangerous gas leaks in the kitchen or near the gas heater. Ideal to detect dangerous gas leaks in the kitchen. Sensor can be easily configured as an alarm unit. The sensor can also sense LPG and Coal Gas , show figure 3.19 .

Figure 3.19 :H_2 sensor.

Working principle

Figure3.20 shows the typical sensitivity characteristics of the Natural Gas sensor(H_2), ordinate means resistance ratio of the sensor **(**Rs/Ro**),** abscissa is concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 1000 ppm of H_2. All test are under standard test conditions[13] .

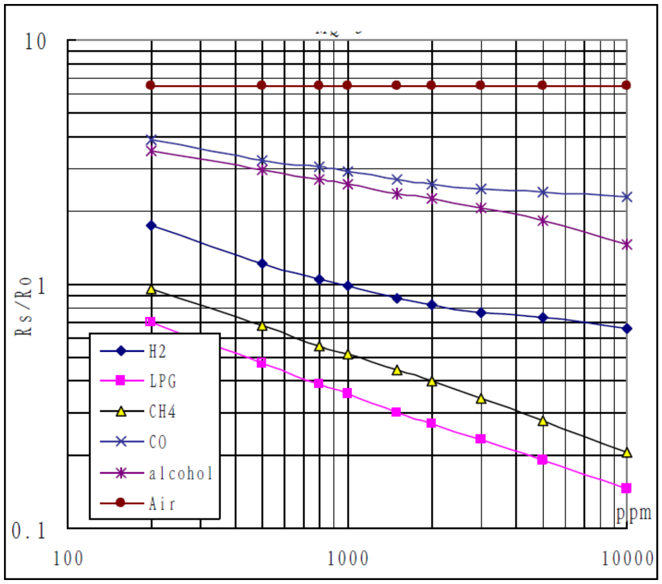


Figure 3.20: Sensitivity characteristics of Natural Gas.

$$(Rs/Ro) = ae^{b(ppm)} + ce^{d(ppm)} \ldots..(11)$$

Coefficients (with 95% confidence bounds):

a = 1.46 (1.295, 1.625)

b = -0.002165 (-0.002627, -0.001704)

c = 0.8482 (0.7736, 0.9228)

d = -2.855e-005 (-4.506e-005, -1.204e-005)

Calibration of Natural Gas sensor

To calibrate H_2sensor, calibrate the detector for 1000 ppm H_2 concentration in air and use value of load resistance that (R_L) about 20kΩ (10kΩ to 47kΩ).

Features

1. High sensitivity to natural gas, LPG

2. Detection Range:(200-10000)ppm

3. Fast Response Time:<10s

4. Heater Voltage:5V

5. Small sensitivity to alcohol, smoke

6. Stable and long life

Application

They are used in gas leakage detecting equipment in family and industry, are suitable for detecting of LPG, natural gas, town gas, avoid the noise of alcohol and cooking fumes and cigarette smoke

Chapter 4

Data Acquisition System

4.1 Data AcquisitionSystem (DAQ)

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems typically convert analog waveforms into digital values for processing.

The components of data acquisition systems include:

1. Sensors that convert physical parameters to electrical signals.
2. Signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values.
3. Analog-to-digital converters, which convert conditioned sensor signals to digital values.

Data acquisition applications are controlled by software programs developed using various general purpose programming languages such as BASIC, C, Fortran, Java, Lisp, Pascal.

Data acquisition begins with the physical phenomenon or physical property to be measured. Examples of this include temperature, light intensity, gas pressure, fluid flow, and force. Regardless of the type of physical property to be measured, the physical state that is to be measured must first be transformed into a unified form

that can be sampled by a data acquisition system. The task of performing such transformations falls on devices called sensors.

4.2 DAQ Hardware

DAQ hardware is what usually interfaces between the signal and a PC. It could be in the form of modules that can be connected to the computer's ports (parallel, serial, USB, etc.) or cards connected to slots (S-100 bus, Apple Bus, ISA, MCA, PCI, PCI-E, etc.) in the motherboard. Usually the space on the back of a PCI card is too small for all the connections needed, so an external breakout box is required. The cable between this box and the PC can be expensive due to the many wires, and the required shielding.

4.3 DAQ Software

DAQ software is needed in order for the DAQ hardware to work with a PC. The device driver performs low-level register writes and reads on the hardware, while exposing a standard API for developing user applications.

The programming languages used for data acquisition include EPICS for building large scale data acquisition systems , MATLAB , which offers a graphical programming environments , and MATLAB which provides graphical tools and libraries for data acquisition and analysis.

MATLAB is an ideal data acquisition software environment. MATLAB lets you develop data acquisition systems through Data Acquisition Toolbox and provides support for multiple hardware manufacturers. This support provides you the flexibility to mix hardware from multiple manufacturers when creating MATLAB applications, or switch data acquisition hardware in the future while continuing to use MATLAB as your software environment.

4.4 Fundamental of Data Acquisition

A data acquisition and control system, built around the power and flexibility of the PC, may consist of a wide variety of diverse hardware building blocks from different equipment manufacturers. It is the task of the system integrator to bring together these individual components into a complete working system.

The basic elements of a data acquisition system, as shown in the functional diagram of Figure 4.1, are as follows:

1. Sensors and transducers.

2. Field wiring.

3. Signal conditioning.

4. Data acquisition hardware.

5. PC (operating system).

6. Data acquisition software.

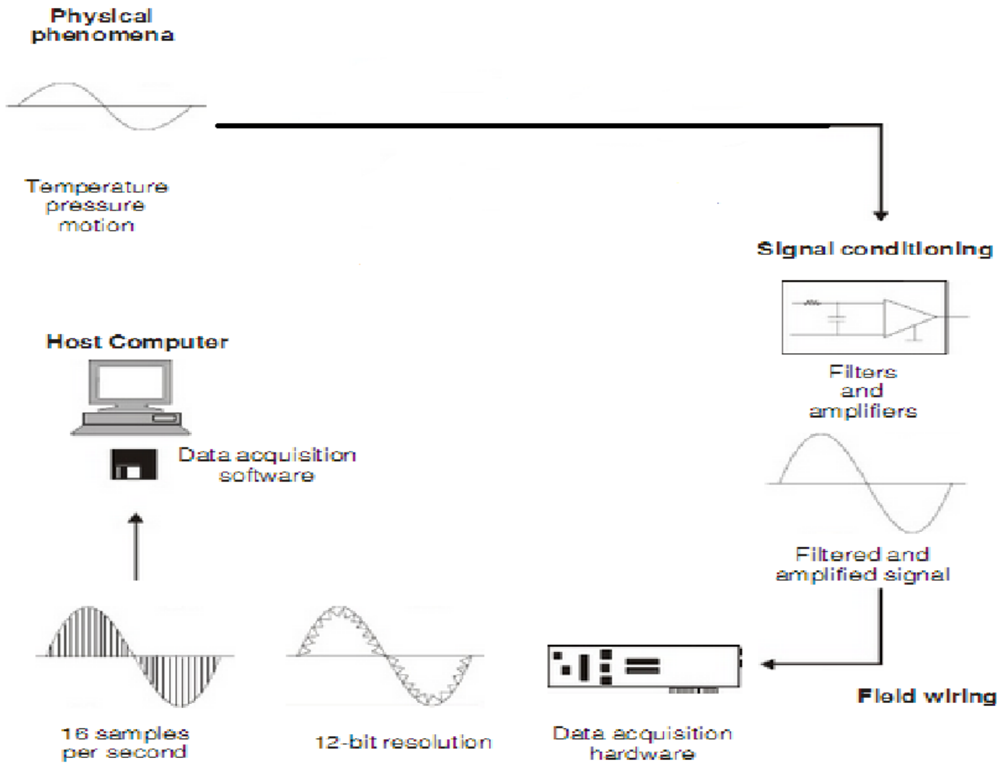


Figure4.1: Functional diagram of a PC-based data acquisition system

4.2.6 Resolution

The resolution of the converter indicates the number of discrete value it can produce over the rang of analog value . the value are usually stored electronically in the binary form , the resolution usually expressed in bits.

$$\text{Resolution}=(2^{x}) \tag{4.1}$$

4.5 Types of Data Acquisition Systems

The data acquisition systems has many of types , and it depending on how is the data acquisition systems is connecting.

4.5.1 Wireless Data Acquisition System

Wireless data acquisition systems can eliminate costly and time consuming field wiring of process sensors. These systems consist of one or more wireless transmitters sending data back to a wireless receiver connected to a remote computer.

4.5.2 Serial Communication Data Acquisition System

Serial communication data acquisition systems are a good choice when the measurement needs to be made at a location which is distant from the computer.

4.5.3USB Data Acquisition System

The Universal Serial Bus (USB) is a new standard for connecting PCs to peripheral devices such as printers, USB offers several advantages over conventional serial and parallel connections , USB is ideal for data acquisition applications. Since USB connections supply power, only one cable is required to link the data acquisition device to the PC, which most likely has at least one USB port.

4.6 Introducing the USB-1208 FS

The USb-1208 FS is a USB 2.0 full speed analog input and digital I/O data acquisition device supported under popular Microsoft,Windows operation systems. It designed for UB 1.1 ports , and tested for full compatibility with both USB 1.1 and USB 2.0 ports. The USB-1208FS features eight analog inputs, two 12-bit analog output, 16 digital I/O connections, and one 32-bit external event counter.

The analog inputs are software configurable for either eight 11- bit signal -ended inputs , or four 12-bit differential inputs . Sixteen digital I/O lines are independently selectable as input or output in two 8-bit ports. A32-bit counter can count TTL pulses. The counter increments when the TTL levels transition from low to high (rising -edge) . ASYNC (synchronization) input /output line lets you pace the analog input acquisition of one USB module from the clock output of another.

The USB-1208FS is powered by the +5 volt USB supply from your computer . No external power is required . All I/O connections are made to the device screw terminals

4.6.1 USB-1208 Block Diagram

USB-1208 function are illustrated in the block diagram show figure 4.2 :

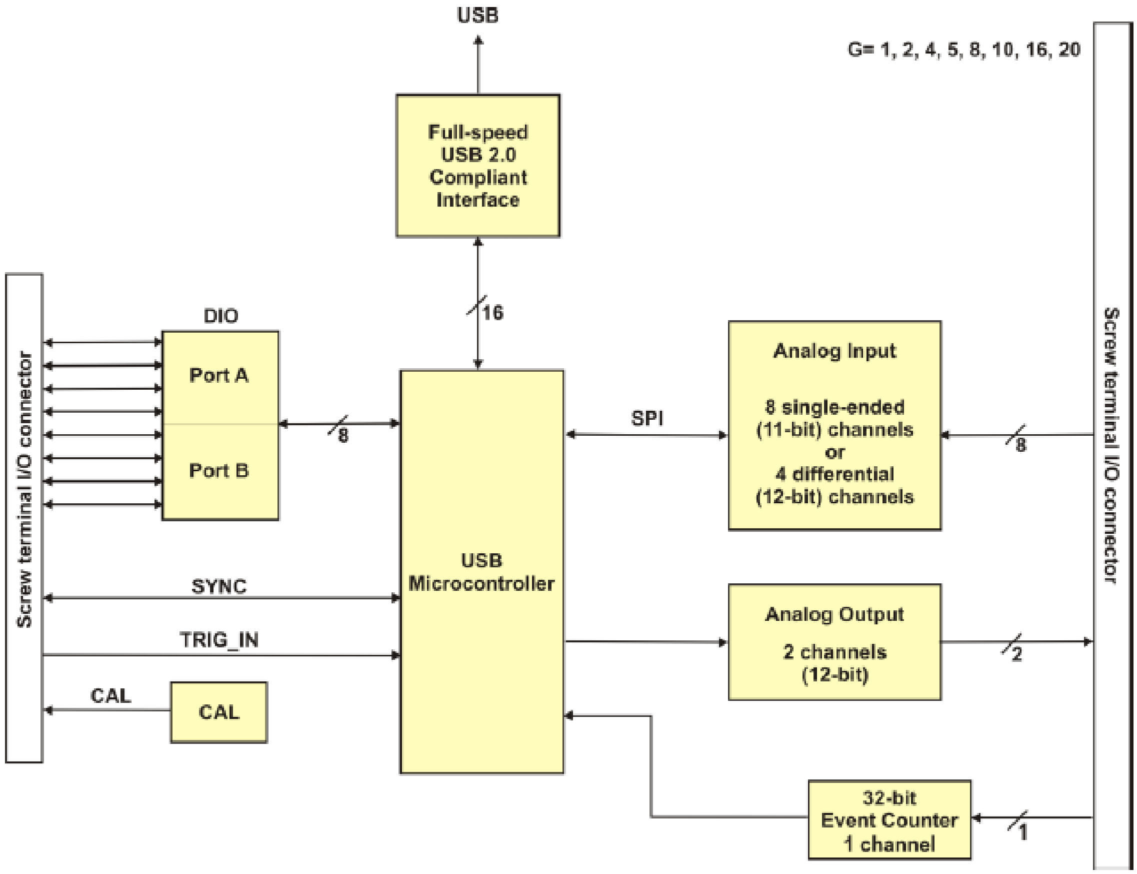


Figure 4.2: USB-1208 block diagram

4.6.2 External Component

The USB-1208 has the following external component, as the figure 3.4 shown:

1- USB connecter.

The USB-connector provides +5V power and communication, no power supply needed.

2- LED.

The LED indicated the communication status; is cannot disabled.

3- Screw terminal banks.

The screw terminals provide the following connections:

1. Eight analog inputs (CH0 IN to CH7 IN)

2. Two analog outputs(D/A OUT 0 to D/A OUT 1)

3. 16 digital I/O connections (portA0 to portA7, and portB0 to portB7)

4. One external trigger input (TRIG_IN)

5. One external event counter input (CIR)

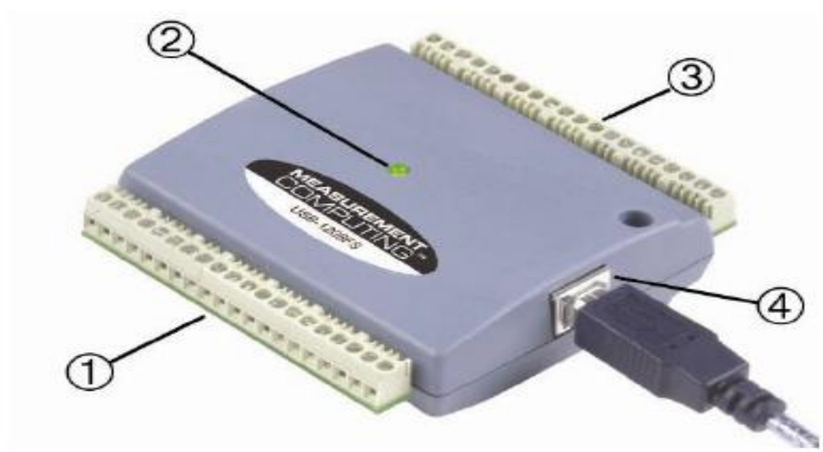
6. One SYNC I/O for external clocking and multi- unit synchronization(SYNC)

7. One calibration output (CAL)

8. One power output (PC+5 V)

9. Five analog ground connections (AGND) and four digital ground connections (GND)

10. One ground connection (GND)



1	Screw terminal pins 21 to 40	3	Screw terminal pins 1 to 20
2	LED	4	USB connector

Figure 4.3: External component

Chapter 5

Implementation

5.1 Introduction

5.2 Electrical Connection

5.3 MATLAB Software

5.3.1 Data Acquisition Toolbox

5.3.2 Key features

5.3.3 To setup DAQ with MATLAB

5.4 Result of the project

5.1 Introduction

In the previous chapters was talking about the component that will use in the project, the sensors, DAQ and MATLAB software and describe the function of each of the component. From that information of the component the project was started implementing of project and was component by component, first every sensor tested without the connection to DAQ, second step was connect one by one of the sensor to the DAQ, after that the connection was completely right the project was compilation all its component. In this chapter will be explain the implementation process, providing photos of the project in different viewpoint, and the target from every part.

5.2 Electrical connection

Eight sensor will connect to gather in one circuit and each sensor need 5 volt and to keep that every sensor get the 5 volt, so the connection must be in parallel that will make the sensor run and give right reading.

The circuit show in figure 5.1 describes the simulate electrical connection between the gas sensors and the connection to the data acquisition card (1208FS) with MATLAB software, to interface the DAQ with computer by MATLAB to get the data from the sensors to plot the results in graphs and compare it with the other data that optioned from other gas sensors .

The project use transformer to convert the 220 volt to 12 volt and a current 1.5 A, so the input voltage is 12 volt but the all sensors worked on 5 volte to run so in this case must use regulate can transfer the 12 volte to 5volte (7805), show figure 5.2 Show the regulator form.

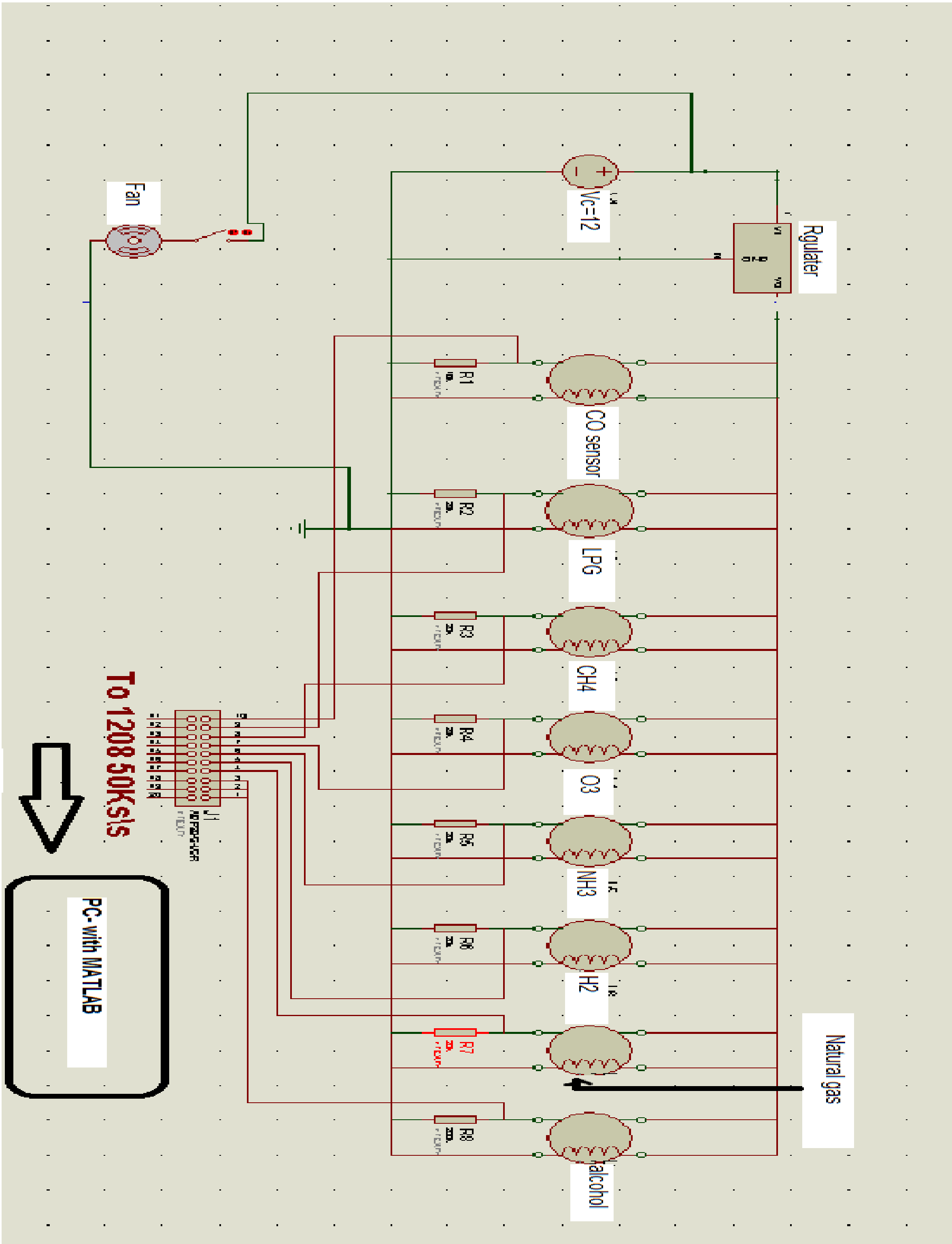


Figure 5.1 :Simulated project circuit

Figure 5.2 : Regulator

Each sensor have two Vc and two ground , Vc connect to pin A and H_1 and the ground connect with pin H_2 and B, figure 5.3 show the pin connection of the sensors .

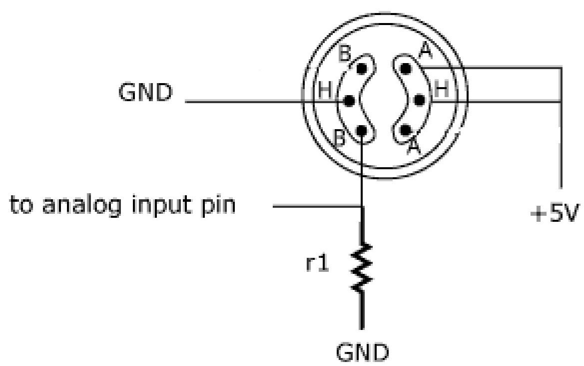


Figure 5.3: The pin connection of the sensors

With pin B it will connect the resistance, from that resistance will get the change in the voltage, the voltage go to the DAQ and by MATLAB software Simulink will get the concentration of the gas by using data acquisition toolbox.

With each sensor connect resistance (RL) in series, the reading of the sensor will take it from the voltage of that resistance. The value of each resistance of each sensor is for:

Alcohol sensor RL=200kΩ[7].

Carbon monoxide (CO) and Hydrogen RL=10KΩ[9,14].

Methane (CH_4) and liquefied petroleum gas (LPG) RL=20KΩ[8,12].

AndOzone gas (O_3) and Ammonia (NH_3) RL=20 KΩ[10,11].

The real component of the project connection of the sensors is shown in figure 5.4

Figure 5.4: Real component connection

The project need something to pulls air, so will be built hood air through the use of a fan and put it in a box and the box have a small openings, to insert tubes out of the small box over the sensor, and this fan operate on 12 volts data acquisition card (1208FS) gives only 5 volts, and it will get the power before the regulator connection with a switch .

Figure 5.5: Fan

The connection of the hood (fan) with the with the voltage supply is show in figure 5.6, and it's run on 12 volt. Hood wills pumping air into the sensors inside the pipeline until it is closed every reader on the gas Alone

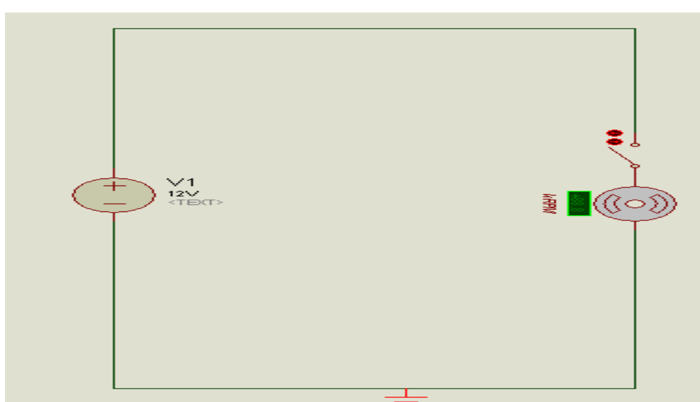


Figure 5.6: Fan circuit

After connect built the hood air from the (fan) and putting it in its place in the project and connect the circuit of the connection of the sensors and connected all the output sensor wire to the data acquisition card (1208FS) so the figure 5.7 down show how it's become

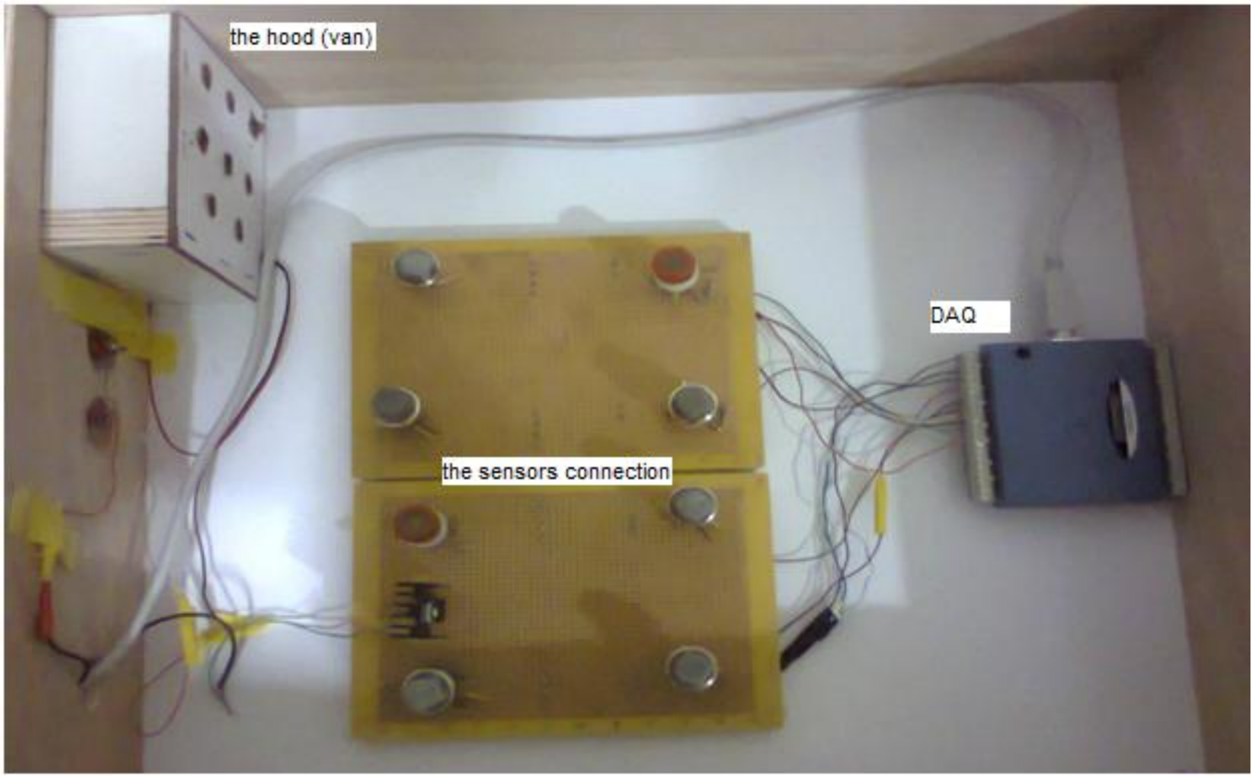


Figure 5.7: Project component connection

Each sensor connect to analog input,figuer 5.8 show the connection the analog output of the sensors with the pins of the DAQ, here the sensor and the number of channal and the number of the pin in the DAQ:

1. Carbon monoxide (CO) :to channel (0) pin (1)
2.liquefied petroleum gas (LPG): to channel (1) pin (2)
3. Alcohol: to channel (2) pin (4)
4. Ozone gas (O_3): to channel (3) pin (5)
5. Methane (CH_4): to channel (4) pin (7)
6. Natural Gas sensor: to channel (5) pin (8)
7. Hydrogen: to channel (6) pin (10)
8. Ammonia (NH_3): to channel (7) pin (11)

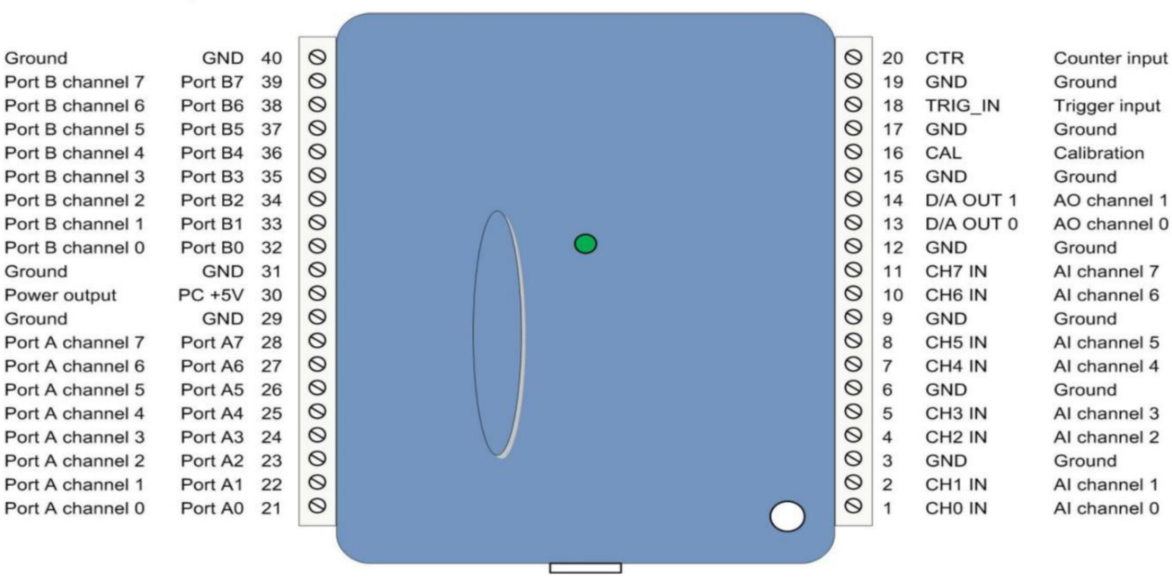


Figure 5.8 : DAQ connection

Each sensor must be placed in a small box figuer 5.9, as well as from the Fund is passed tube with a small diameter and a link at the end with the hood until the pumping the air for each sensor and then is taken to read each sensor.

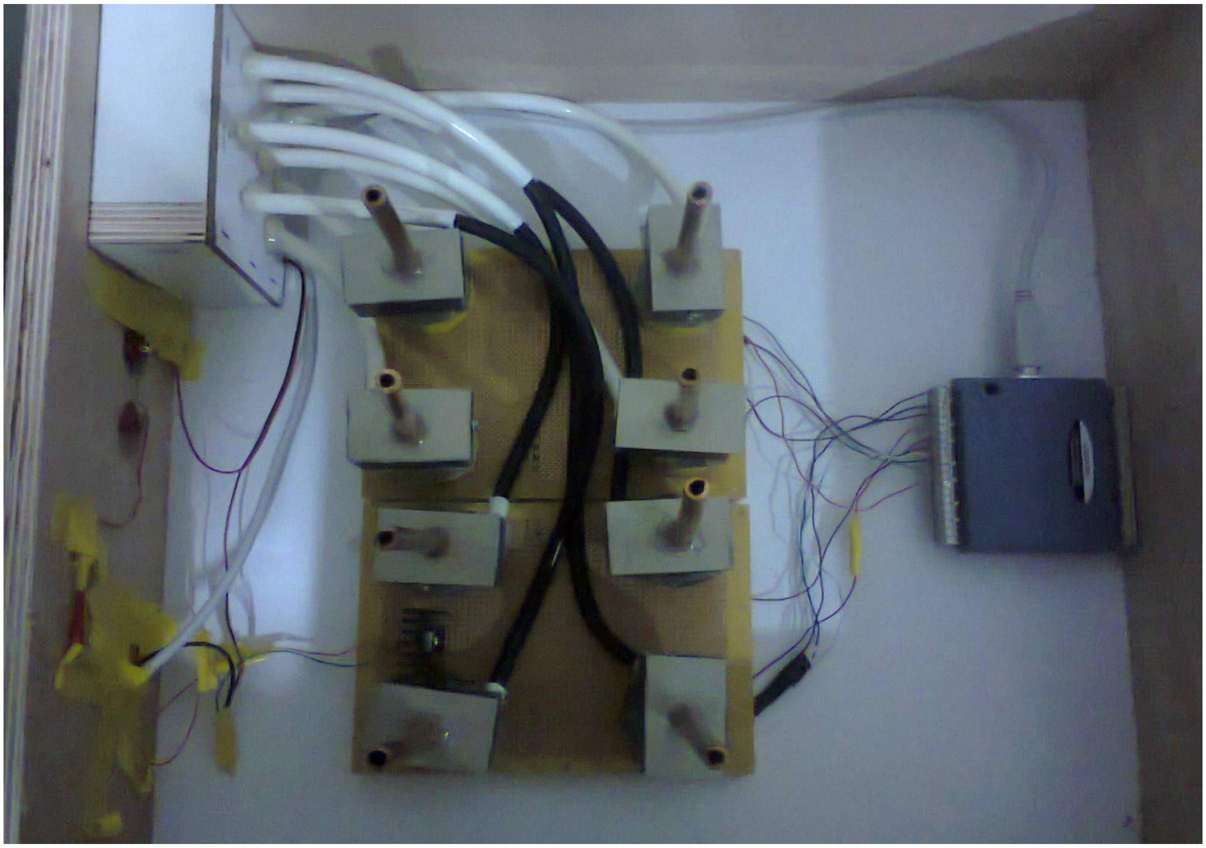


Figure 5.9 : Fan connection

CO_2sensor

The connection of this sensor is face some problem, when is connect to the DAQ give the sensor around 1.32 volt so and no change to the reading, and when is connect to TL084 is give error reading and it give a saturation state so the project will not use it.

5.3 MATLAB Software

The software used for designing the user interface for this project is MATLAB software (MATLAB 2008). This is a platform and development environment for a visual programming language from Math work. The software has pre-built blocks from its library, and each block has specific functionality.

5.3.1 Data Acquisition Toolbox

Data Acquisition Toolbox provides functions for connecting MATLAB to data acquisition hardware. The toolbox supports a variety of DAQ hardware, including USB, PCI, from National Instruments, Measurement Computing, Advantech, Data Translation, and other vendors.

With the toolbox it can be configure data acquisition hardware and read data into MATLAB and Simulink for immediate analysis. And can also send out data over analog and digital output channels provided by data acquisition hardware. The toolbox's data acquisition software includes functions for controlling analog input, analog output, counter/timer, and digital I/O subsystems of a DAQ device, and can access device-specific features and synchronize data acquired from multiple devices.

Data Acquisition Toolbox, in conjunction with the MATLAB technical computing environment, give the ability to measure and analyze physical phenomena figure 5.10. The purpose of any data acquisition system is to provide to deal with the tools and resources necessary to do so.

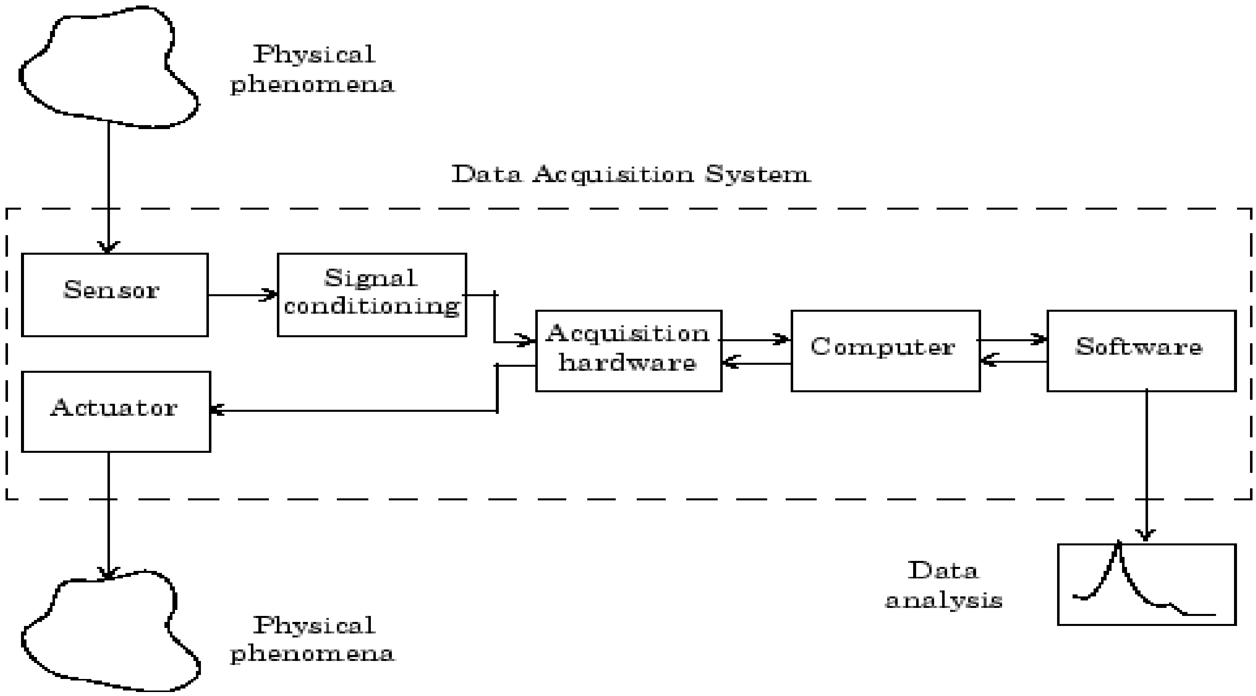


Figure 5.10: Steps of signal processing

5.3.2 Key Features

Data acquisition toolbox appropriates that make deal with any data acquisition card is easy and it can be used for any type of the DAQ.

• Support for a variety of industry-standard data acquisition boards and USB modules.

• Support for analog input, analog output, counters, timers, and digital I/O.

• Direct access to voltage, current, like gas sensors, and thermocouple measurements.

• Live acquisition of measured data directly into MATLAB or Simulink.

5.3.3 To setup DAQ with MATLAB

1. Connect the DAQ to the PC
2. Start the InstaCal program.
a. Go to Start->All Programs->Measurement Computing->InstaCal
3. Select the DAQ device listed in the main window.
4. Click on configure, set the DAQ in Single sided mode
5. Exit out of the program.
6. Run the Simulink file of the project, then run the software to take the value of the reading of the sensor in (ppm)

7. If any error happened to the analog input remove the USB-1208FS from the computer and close the MATLAB software and then connect the USB-1208FS then run the MATLAB software.

The tools that the project uses it from the data acquisition tool in the Simulink are is analog input block for get the sensors reading to use the signal for processing and convert the voltage signal into resistance and from that can take the gases concentrations in (PPM) and digital output block is used for running the (Hood), the hood used for collect the air to the sensors.

The project used anther tools form Simulink (Embedded MATLAB Function Block), the (Embedded MATLAB Function Block) is an easy and convenient way to write MATLAB m-code that can be incorporated into a Simulink modulo convert the voltage signal into resistance .

To plot and save the figure for any time can be return to it, can be by put (out block) in MATLAB Simulink ,and use command in MATLAB workspace and the command is:

```
>>plot(yout(1:Y,X)
```

Y is number of sample multiply by the running time.

X is number (1-8).

The project MATLAB software in Simulink part show in figure (5.11), and the software will work between (2-5)min, and will plot the change in the (ppm) with the time by using(XY Graph block) and saving the data that can be return to it for any time .

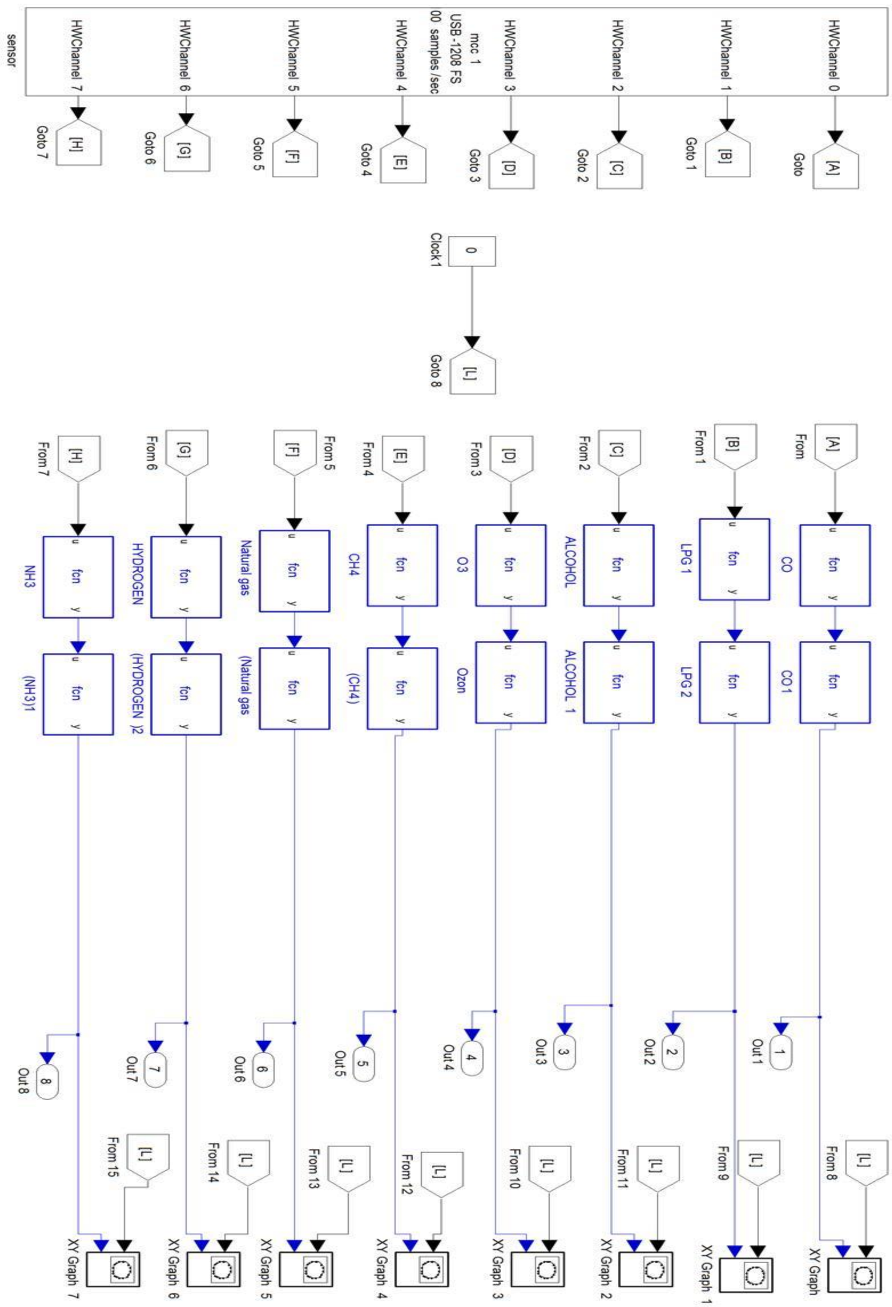


Figure 5.11: Software in MATLAB.

5.4 Result of project

The project was tested in the outside in the different place, like: car, home and the result of the sensors shows in the table and figures in this section at room temperature.

The table down shows the last 50 reading of the sensor from 30001 reading in the five minute that the project was running in it:

CO(PPM)	LPG(PPM)	alcohol(PPM)	O3dsdasd(PPM)	CH4(PPM)	Natural gas(PPM)	HYDROG (PPM)	NH3(PPM)
164.989772	231.641987	0.14594606	15.7709847	82.2804519	0.00018599	21.550946	1.3780334
156.22143	167.24176	0.7722154	4.9755296	104.30108	268.38293	4.954897	1.378033
88.976195	1417.2813	0.1523139	4.9453334	119.79535	103.20794	9.912349	1.378033
164.06305	163.70724	1.1586875	3.9480025	383.27761	0.0057384	154.0218	1.378033
157.89001	243.04719	0.1339982	12.064338	82.280459	214.69174	5.619871	1.378033
93.377635	596.24523	0.1352767	0	85.174423	46.939963	1.625760	1.378033
88.429837	1370.4575	0.1537656	4.9453334	433.98315	8.04E-05	6.345861	1.378033
173.36867	192.15171	0.1432025	23.488131	80.671276	192.68941	9.912349	1.378033
119.64822	992.45682	0.1265822	19.184938	107.44151	109.76049	12.12717	1.378033
146.63513	160.24738	0.1391829	0	80.671276	0.0002643	186.2287	1.378033
152.60953	170.85256	1.2183627	6.2324311	406.57792	0.0011451	186.2287	1.378033
139.55219	180.22442	0.9040580	6.3087738	415.4716	0.0004413	126.8955	1.378033
173.36862	312.39003	0.7504652	5.8110490	406.57792	0.0013315	214.9682	1.378033
92.646678	742.49991	0.7576448	3.9002274	383.27765	0.0107251	280.2238	1.378033
176.55725	138.73061	0.1365662	23.488135	94.018699	214.69173	16.03776	1.378033
94.865599	1370.4570	0.1314796	21.367510	97.809742	220.50147	4.954897	1.378033
90.083153	243.04712	0.9577269	4.5000536	233.57509	0.0004413	108.7201	1.378033
162.24420	143.24766	0.1815438	23.670259	82.280451	23.831713	2.088168	1.378033
95.167491	775.01874	0.1290077	21.367510	402.21762	0.0003148	280.2238	1.378033
175.48008	188.09072	0.1339988	15.485321	151.97617	0.0107251	286.7464	1.378033
90.083153	1003.2349	0.1230295	23.857321	344.82924	9.74E-05	7.135551	1.378033
177.64908	137.25680	1.1472150	4.4455983	150.47426	0.0006122	7.991538	1.378033
93.084231	151.10527	0.9215781	4.7825006	95.895385	177.41911	16.03776	1.378033
93.968583	1355.2593	0.1230295	19.007658	97.809742	232.51024	16.03776	1.378033
91.780581	1355.2593	0.1612373	20.954143	363.46040	0.0002222	273.7509	1.378033
154.19114	208.17693	0.9670036	4.0207642	92.178926	0.0083932	46.12065	1.378033
167.84204	628.99446	0.1418497		87.736181	0.0001176	136.4814	1.378033
86.950928	775.01874	0.1494498	3.5490494	86.873778	0.0038629	122.2255	1.378033
132.91042	165.46502	1.1027320	4.1957997	111.77778	0.0001551	2.849145	1.378033

87.888095	229.1811	0.1567118	21.652075	82.280451	15.859554	12.12717	1.378033
93.084231	681.54641	0.1124236		95.895385	0.0215666	226.9102	1.378033
168.81754	195.25488	0.9304746	5.4181571	243.20340	0.0074067	245.2703	1.378033
142.49076	174.54135	0.7224336	4.6674545	406.57792	9.74E-05	293.3176	1.378033
88.158392	170.85256	0.7870733	4.0207642	104.30100	91.035006	12.12717	1.378033
91.494501	208.17693	0.3510840	5.8822301	82.280451	8.04E-05	4.954897	1.378033
94.865599	1370.4570	0.1582060	11.455953	86.873778	0.0120950	239.0923	1.378033
134.65091	197.35146	0.6663426	3.9002274	359.64254	0.0215666	2.088168	1.378033
86.421478	766.75589	0.1290077	16.916776	126.50049	4.2505403	9.912349	1.378033
89.527272	1370.4570	0.1612373	23.137243	85.174424	248.28058	2.446788	1.378033
91.780581	205.96534	1.0248068	6.4642761	309.14946	2.93E-05	280.2238	1.378033
164.98977	195.25488	0.1418497	4.9755296	337.68689	0.0009826	299.9362	1.378033
170.80705	149.50000	1.0348156	3.806405	103.27482	42.045059	2.088168	1.378033
164.06301	169.03750	0.1459460	22.019464	83.921844	56.108086	4.954897	1.378033
163.14789	217.26333	0.1290077	0	77.547026	0.0006122	4.954897	1.378033

Table 5.1 :Result of sensors .

In this section the figures show the concentration of some sensors , and the result of sensors as following :

1- Alcohol sensor result, figure 5.12 shows the concentration of alcohol at room temperature around 27 degree .

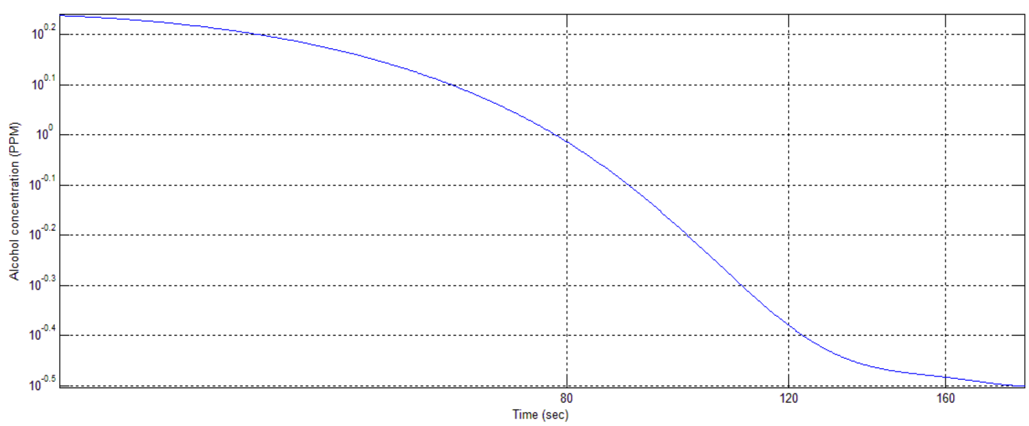
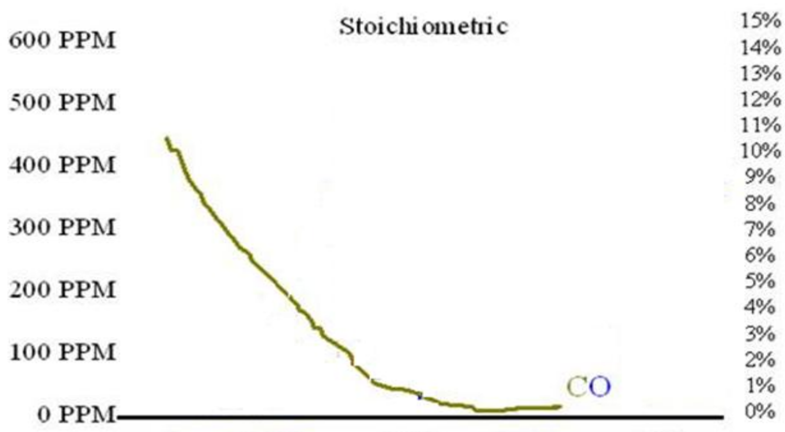


Figure 5.12 : Concentration of alcohol .

The device was running for five min and stopped and run again In the first of figure 5.12 at room temperature when igniting the spira near the sensor figure 5.13, the concentration of alcohol increase directly to near 0.5mg/lto 3 mg/l and then start decrease figure 5.14 show the decreasing of the reading

Figure 5.13: Spira

2- Monoxide (CO)sensor result, figure 5.15 show the concentration of CO in the outside for the car and temperature is around 33 degree.



.Figure 5.14: The concentration of CO in car.

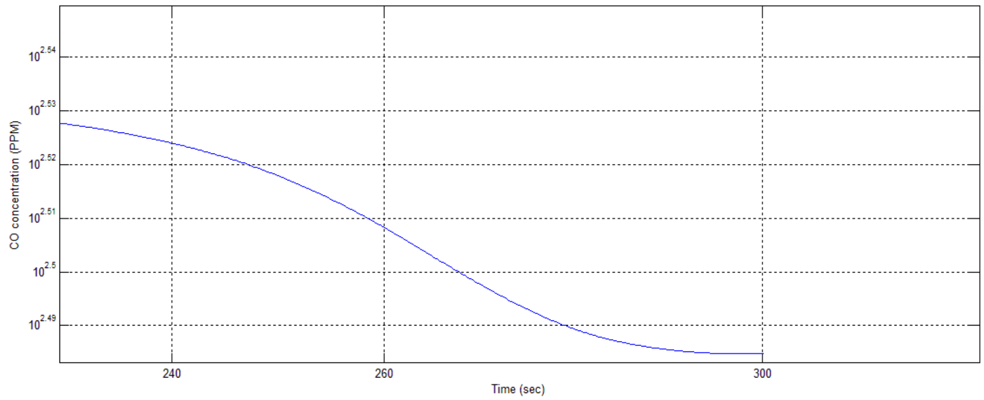


Figure 5.15 : Concentration of monoxide (CO).

In the first 50 secsensor coil was heating the concentration of monoxide is give 300 PPM after that the reading become decreasing, in 90 sec was increasing because the car is working and after that start decrease slowly after 270 sec figure 5.16 show that .

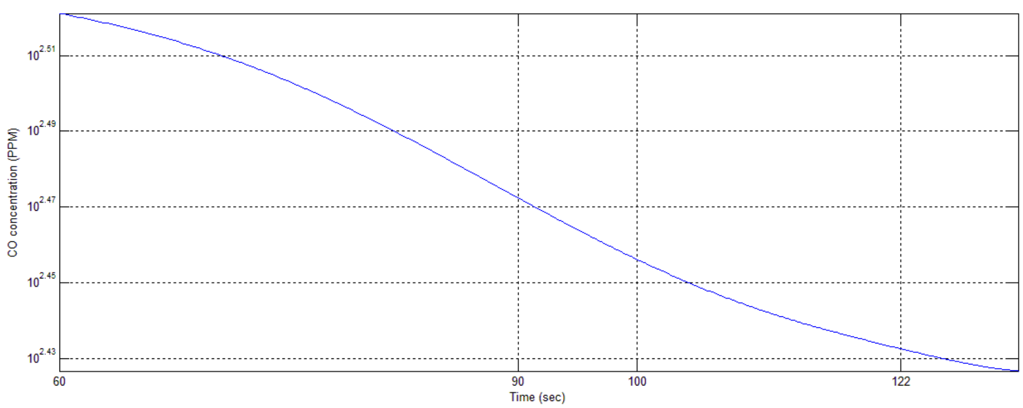


Figure 5.16 : Concentration of monoxide (CO) from(160-300) sec.

3- Liquefied petroleum gas (LPG) sensorresult , figure 5.17 show the concentration of LPGin the kitchen at temperature around 30 degree .

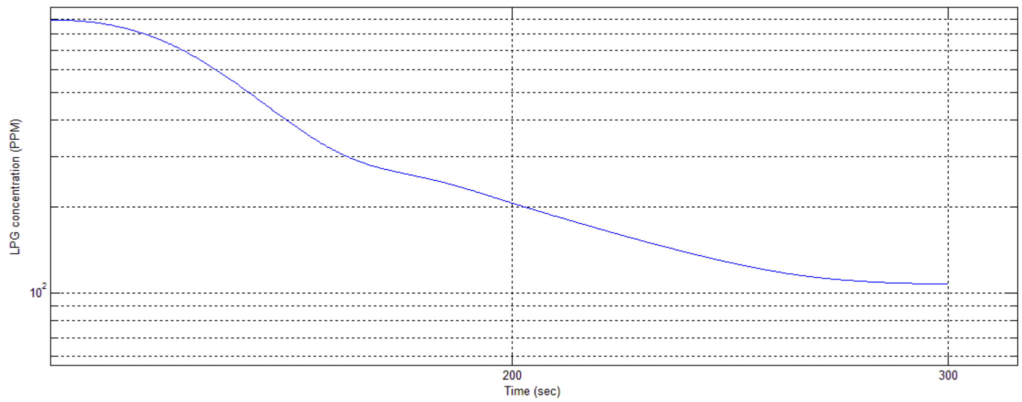


Figure 5.17 : Concentration of (LPG).

The first 30 sec the coil of the sensor was heating after that the sensor was start reading at 70 sec when igniting the LPG source near the sensor figure 5.18

.

Figure 5.18: LPG source

4- Hydrogen sensor result, figure 5.18show the concentration of Hydrogen in the kitchen at temperature around 30 degree .

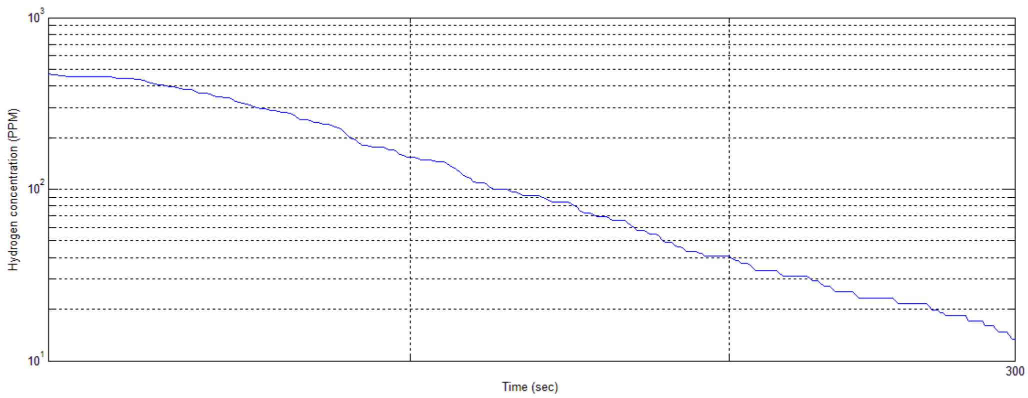


Figure 5.19 : Concentration of Hydrogen .

The device was running for five min and stopped and run again In the first of figure 5.19 when igniting the water evaporated near the sensor figure 5.18, the concentration of Hydrogen increase directly to near 150 PPM to 600 PPM and then start decrease 90 sec.

Figure 5.20: Hydrogen source

5- Ammonia (NH_3) sensor result, figure 5. 21 show the concentration of ammonia outside and around the temperature 30 degree.

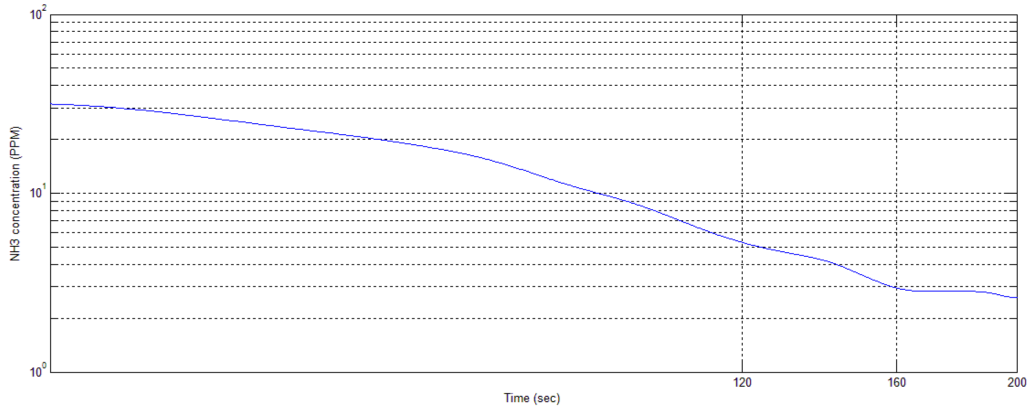


Figure 5.21 : Concentration of Ammonia .

The concentration of ammonia start from 30 PPM when it start because the coil start heating and then decrease to 1.5 PPM .

6-Methane sensor (CH_4) result, figure 5.22 show the concentration of methane in the room and the temperature around 27 degree .

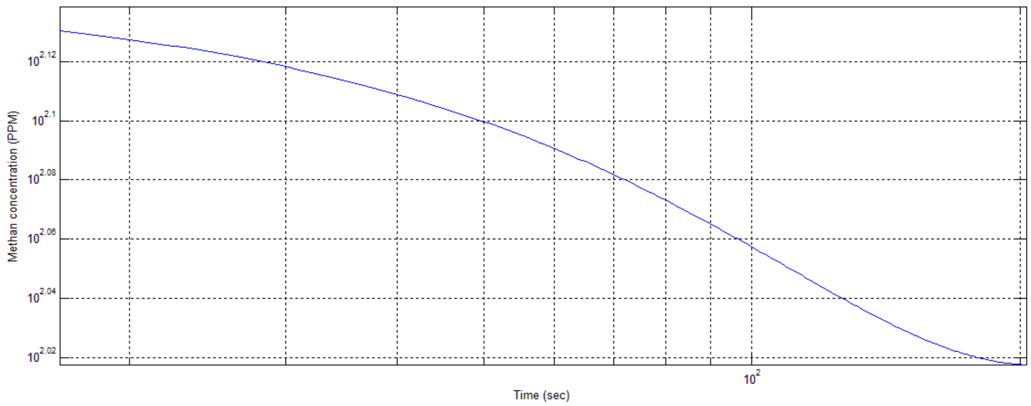


Figure 5.22 : Concentration of Methane gas.

The concentration of ammonia start from 450 PPM when it start because the coil start heating and then decrease to 160 PPM and continue decreasing .

Chapter 6

Conclusion and Recommendation

6.1 Conclusion

6.2 Result of the project

6.3 Recommendation

6.1 Conclusion:

The gas analyzer will improve every day because the tool that used to convert the analog input to digital input and the gas sensing is set to grow with increasing requirements for safety and environmental protection across many industries. The current range of any gas sensing technologies has served us well but the future holds many new possibilities. Power and size reductions and an improvement in ruggedness will allow a new generation of body worn devices. These ways will be developed to improve performance whilst at the same time reduce cost; new sensors will be targeted at enhancing environmental protection.

The project was successfully complete, it is give reading but it cannot gage on the reading because no reference can be return to it but the reading is nearly to some value in the air from previous reading that some books mansion it. The MATLAB software was good to deal with the data acquisition card and the cost was reducing.

6.2 Result of the project:

The project was tested with a device that measured the concentration of the NH_3 gas from the two values it was the same and this test was done in the sixth floor of the university.

The device give (zero ppm) reading and the project gives around (2 ppm), so they are close to each other

6.3 Recommendation:

Finally it is good to mention some recommendation that can contribute to the provision of enhancements to the project, could have been done, not have the enough financial support .we summarized the recommendation in the following points:

1. Implement this idea of system that needs to keep the air safety.
2. It can be used as SCADA system to monitoring it on the web pages by using LABVIEW software and may by MATLAB software.
3. It can be reducing the price of the component of the project by using (Arduino)
4. Can be added more gas sensor to masseur it concentration

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Appendix