

Research Article

Monitoring of Industrial Process Parameters using LabVIEW

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Abstract

In the recent evolution in technology, working of many Industries is being controlled based on the conditions of ambient weather. The main objective is to design a well-conditioned, efficient, healthy and robust system to control the parameters which cause pollution. It can also minimize the effect of these parameters without affecting the plant or natural environment. The program is designed using LabVIEW and Arduino. In this we use an Arduino board with LabVIEW interfacing. Different sensors are placed in the industry to measure temperature, carbon monoxide, LPG and many other toxic gases. It involves measuring and monitoring of all these parameters using Virtual Instrumentation-LabVIEW. When carbon monoxide and the gas level will be high than the threshold value, the buzzer will be ON and email would also be sent. And for home usage, if there will be LPG leakage than email would be sent to the person, so LPG Cylinder Valve can be manually closed.

Keywords: Arduino, Industrial Parameters, LM35, LabVIEW, MQ-2, MQ-6, MQ-7.

1. Introduction

1.1 Introduction to LabVIEW

LabVIEW is a Virtual Instrumentation Software by which we can monitor different sensors using only single computer.

LabVIEW is abbreviation of **Laboratory Virtual Instrument Engineering Workbench** which is created by National Instruments. It is a graphical programming language which uses icons instead of text to create applications.

LabVIEW codes are also known as Virtual Instruments or VI's for short.

LabVIEW is extensively used for Data Acquisition, signal Analysis and also for hardware control.

LabVIEW consists of:

- 1) Front Panel Window and
- 2) Block Diagram Window.

Front Panel Window: Its function is to control and show indicators of the system.

Block Diagram Window: Its function is to make programs and coding of the system.

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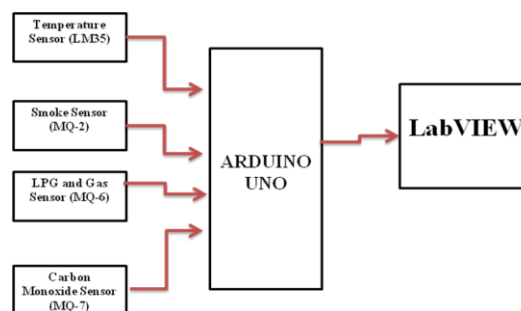


Figure 1 Block Diagram of the System

1.2 Objective of the System

The foremost objective of our project is to design hardware for monitoring of industrial process parameters and for pollution control.

Secondly, to design a virtual instrument to monitor temperature, gas leakage, fire and CO level.

Thirdly, it is to interface the hardware with software. Industrial monitoring is necessary as the Industrialization increase the degree of automation and at the same time it increases the pollution.

It proposes a PC based signal acquisition system. Analysis made by the system can be efficient using LabVIEW and it is also cost effective method for industrialization monitoring.

2. Interfacing LabVIEW and Arduino

STEP: 1 First of all, download toolkit for interfacing LabVIEW with Arduino. LIFA is the toolkit which is to be downloaded.

STEP: 2 When LIFA is downloaded, don't install it directly or else there will be an error.

STEP: 3 Open a LabVIEW and go to Tools -> Options -> VI Server.

STEP: 4 When LabVIEW is opened then after clicking on VI Server scroll down to Machine Access and click on it. Then here manually we have to add machine access list. Now add "10.211.55.13", "localhost", "*" in Machine access list. After doing all, click on OK button.

STEP: 5 Download and Open VI Package Manager.

STEP: 6 Then search for LabVIEW Interface for Arduino (LIFA) in VI Package Manager and double click on it to install it.

STEP: 7 Click on continue and after installation is completed click on finish.

Now connect Arduino with LabVIEW.

Also program is to be uploaded in Arduino for interfacing it with LabVIEW.

```
#include <Wire.h>
#include <SPI.h>
#include <Servo.h>
#include "LabVIEWInterface.h"
void setup()
{
// Initialize Serial Port With The Default Baud Rate
syncLV();
}
void loop()
{
checkForCommand();
if(acqMode==1)
{
sampleContinuously();
}
}
```

3. Components Used

3.1 Temperature Sensor (LM35)

This sensor is the most precised which has integrated circuit whose output voltage is linearly proportional to the centigrade temperature.

It does not require any calibration to provide typical accurate of +/-0.25 C at room temperature range.

This device makes interfacing to readout or control circuitry quite easy because of low output impedance, linear output, and precise inherent calibration.

It can operate over -55 C to 150 C temperature ranges.

3.2 Smoke Sensor (MQ-2)

The sensitive material of this sensor is SnO₂, which has lower conductivity in clean air. It detects fire whenever there is any smoke.

3.3 LPG Sensor (MQ-6)

It is a simple device to use which is used to sense LPG which is composed of mostly propane and butane concentrations in the air.

It can easily detect gas concentrations anywhere in ambient atmosphere from 150 to 10000 ppm.

It is highly sensitive device and also has fast response time.

Output of the sensor is in the analog form. For the drive circuit, we need to give power the heater coil with 5V and connect the output to an ADC.

3.4 Carbon Monoxide Sensor (MQ-7)

It is a simple device to use which is used to sense Carbon.

It can detect gas concentrations anywhere from 20 to 2000 ppm.

It is highly sensitive device and also has fast response time.

Output of the sensor is in the analog form. For the drive circuit, we need to give power to heater coil with 5V and connect the output to an ADC.

4. Simulations and results

4.1 Working

The working of this system starts with the sensing of the sensor. In this system there are four sensors which are LM35, MQ2, MQ6 and MQ7. They sense carbon monoxide, temperature, smoke and LPG respectively. They give analog output as per the concentration of gas present in ambient environment and gives analog output to Arduino. The Arduino takes the analog input from the sensor. Then as Arduino is interfaced with LabVIEW, Analog output is converted in digital and LabVIEW's front panel shows the value of the sensors. Conversion of the analog value into its corresponding value in volts and parts per million is calibrated with respect to ambient weather conditions. This conversion is done by the equations as given below:-

- 1) To convert analog to volts = {5*analog value from the sensor}/1023
- 2) To convert volts to ppm = {x*volts}

Where x is the multiplying factor calculated as per the sensor by calibrating it in our own environment.

And there is a limit specified in the program of LabVIEW that when these gases exceed threshold limit of concentration, buzzer sounds.

• Temperature

When temperature is continuously sensed by LM35, we can monitor and control it using LabVIEW. First we have to set maximum and minimum limit of the temperature.

There will be 3 conditions for the temperature, which are:

- 1) When Temperature exceeds maximum limit→ Condition will be **HOT** and it will indicate by RED LED.

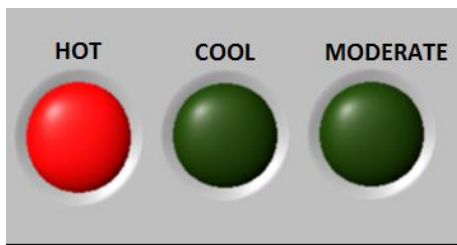


Figure 2: Front panel during HOT condition

2) When Temperature is below minimum limit → Condition will be **COOL** and it will indicate by BLUE LED.

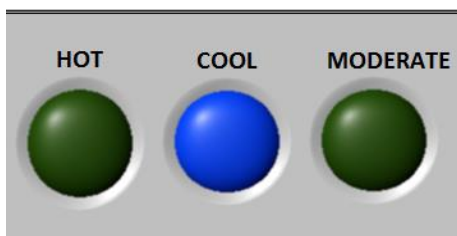


Figure 3: Front panel during COOL condition

3) When Temperature is in between maximum and minimum limit → Condition will be **MODERATE** and it will indicate by GREEN LED.

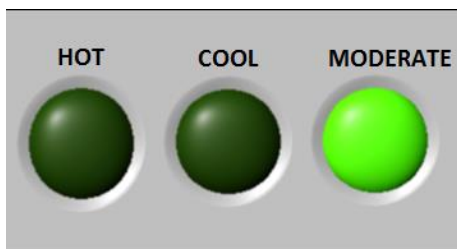


Figure 4: Front panel during MODERATE condition

• **Smoke**

Now, when smoke is sensed due to fire or any reason, sensor will sense and when the value will exceed the threshold limit it will automatically send E-mail and Buzzer will be operated.

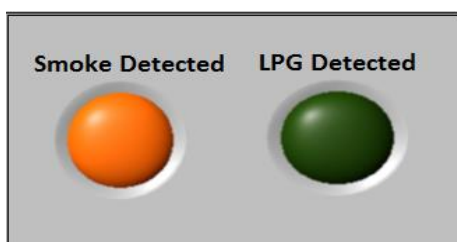


Figure 5: Front panel when SMOKE is detected

• **LPG**

Now, when LPG is sensed due to gas leakage or any other reason, sensor will sense and when the value will exceed the threshold limit it will ON the buzzer and

automatically send E-mail so that person can manually close the valve of the gas cylinder.

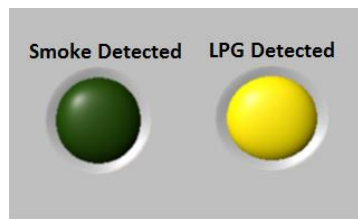


Figure 6: Front panel when LPG is detected

• **Carbon Monoxide**

Level of Carbon Monoxide is continuously sensed by MQ-7 sensor. We need to calibrate its PPM level in different conditions and places. Air Quality Index (AQI) depends upon the following levels of PPM:

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk
Moderate	51 to 100	Air quality is acceptable, however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Figure 7: Air Quality Index

So for industrial area, its calibration in PPM value is:- $x = (500/1023) = 0.48875$

Here, x is the multiplying factor. It is multiplied by volts coming from MQ-7 sensor.

As 500 is extreme value of PPM and 1023 is maximum analog voltage coming from MQ-7 Sensor.



Figure 8: Front panel showing Air Quality Index

4.2 Coding

The coding for this project is developed in the block diagram. It has been developed for sensing different parameters like temperature, smoke, CO level and LPG.

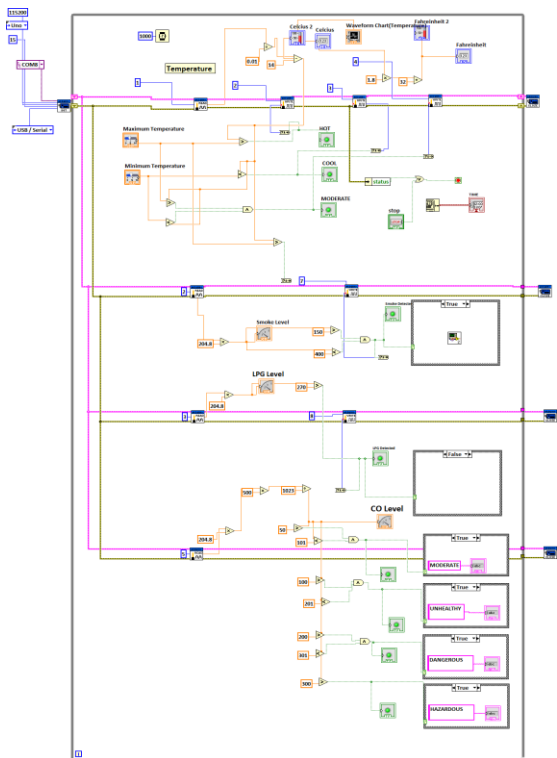


Figure 9: Block diagram of the system

4.3 Implementation

Here, we have implemented our circuit for the simulation. We have successfully monitored all four sensors through LabVIEW.

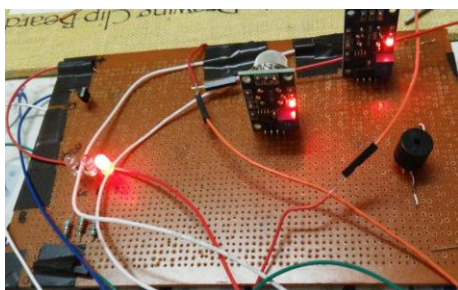


Figure 10: Circuit of LM35, MQ-7, MQ-6

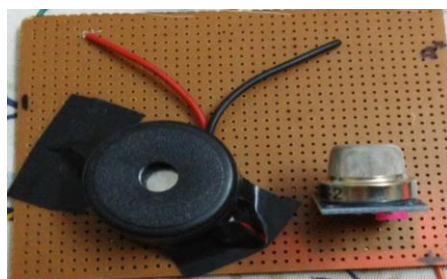


Figure 11: Circuit of MQ-2

4.4 Result Analysis

Below image shows the front panel of the LabVIEW and the results of all four sensors.

Table 1: Result analysis

Parameters	Results
Room Temperature in Celsius	28 Centigrade
Smoke Level	86 PPM, Threshold value → Above 200 PPM
Carbon Monoxide Level (Industrial Area)	160 PPM, AQI → (UNHEALTHY)
LPG Level	157 PPM, Threshold value → Above 300 PPM

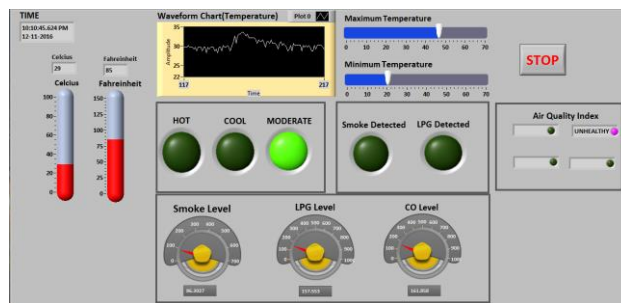


Figure 13: Front panel of whole system

Conclusions

Our work deals with the design and development of smoke detection, temperature monitoring, detection of concentration of Carbon Monoxide in the environment, monitoring of fire and alerting system for Industries and many other areas and initiate measures for accidental fires or high temperature or gas leakage. E-mail provides the information in case a fire or gas leakage occurs. From this developed system we can also ensure that we are living in a safe environment and we can reduce the amount of pollution which is going on increasing day by day. As we are aware of the effects of pollution which is very dangerous for all of us so we all should try to maintain the level of pollution in a safe limit by continuously monitoring CO levels. This is a reliable and efficient system for fire alert, gas leakage alert, CO levels and Temperature levels

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 Data sheet of MQ-2 Smoke Sensor
 Data sheet of MQ-6 LPG Sensor
 Data sheet of MQ-7 Carbon Monoxide Sensor
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