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# ROBUST INDUSTRIAL MONITORING SYSTEM USING NI-DAQ

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**Abstract**

Industrial monitoring is essential for ensuring safety, optimizing processes, reducing downtime, maintaining product quality, improving energy efficiency, and driving continuous improvement initiatives. It enables proactive decision-making, enhances operational efficiency, and helps companies achieve their production and sustainability goals. The objective of the proposed system is to design an efficient and robust system to control the parameters causing industrial accidents and to minimize the effect of these parameters without affecting the plant or natural environment. The proposed methodology is to model a system that can read and monitor pollution parameters and any leakages in the industrial machinery. LabVIEW is introduced in this proposed methodology; the system will acquire data from various sensors and keep track of real-time data. This system investigates the level of gases released during the industrial process, the temperature of the machinery, the detection of light using LDR, detection of flames. Each process will have a separate data-acquiring and controlling mechanism. LabVIEW provides an operation interface and manipulation of data. The main idea behind the project is to make a real-time fully automated control system using LabVIEW.

**KEYWORDS**
LabVIEW software, myDAQ, Flame Sensor, Gas Sensor, ThingSpeak

## 1 | INTRODUCTION

Industrial monitoring using myDAQ is a powerful and versatile approach to acquiring, analyzing, and controlling data in industrial settings. The myDAQ system, developed by National Instruments, provides a portable and user-friendly data acquisition (DAQ) device, is connected to sensors and devices to monitor various parameters in real-time. Industrial monitoring using myDAQ provides a reliable and flexible solution for monitoring and controlling various parameters in industrial environments. Its portable nature, sensor compatibility, data acquisition capabilities, software integration, real-time monitoring, and analysis tools make it a valuable asset for enhancing safety, optimizing processes, and achieving operational excellence in industrial settings from Khaled Bashir Shaban 2016 [5].

The main objective of this project is to design an efficient and robust system to monitor the parameters which are exceeding the threshold values of machineries in the working environment of an industry and by alerting systems minimize the effect of these parameters without affecting the plant or working environment. The proposed methodology is to model an electronic system to read and monitor pollution parameters to find out any leakages or damages in the industry. Development of an electronic system using LabVIEW in this project, this system will acquire data from various sensors and keep track of real-time data. The system investigates the level of gases released during the industrial process, the temperature of the machinery, the detection of light using LDR, the detection of flames, and respected alerting systems are also included. Each process will have a separate data-acquiring and alerting mechanism. Here LabVIEW provides an operator interface and manipulation of data. The main idea behind the project is to make a real-time fully automated monitoring and alert system using LabVIEW from Postolache. O et at. [6] and Stankovic. J.A. 2014 [5].

## 2 | LITERATURE SURVEY

There are so many works being carried out by many researchers in the field of air pollution monitoring based on IoT. This chapter illustrates some of the important and recently published papers in the field of IoT based air pollution monitoring system from Harsh Gupta et at. 2019 and Zumyla et at. and Kim. J.Y. [**Harsh**, **Zumyla**, 4] investigated The Author proposed to build a system that continuously monitors the air quality around the industry Here the author used MQ-6 and MQ2 sensors for analyzing the level of CO, CO2, and quality of smoke released in the atmosphere with the help of GSM technology for the exchange of the data from sensors to the monitoring authorities." Doma et at. [**Doma**] an IoT based stem for industrial pollution monitoring system is successfully developed and tested. We measured the presence of pollutant gases in and around different industrial areas. We also measured the temperature and humidity in that place. The messaging system is sent through the blynk server. Kelly. S. et at. [8] presented the pollution monitoring and control is very wide and provide regular inspections by using Global System for Mobile communications. This system can further be improved by sense or implementation for controlling noise, methane, dust and other parameters.

Dongyun Wang et at. [2] proposed "IoT based air pollution monitoring and control system" in the year 2018.There work considers pollution due to automobiles and provides a real time solution which not just monitors pollution levels but also take into consideration control measures for reducing traffic in highly polluted areas. The solution is provided by a sensor-based hardware modulewhich can be placed along roads. These modules can be placed on lamp posts and they transfer information about air quality wirelessly to remote server. This information can be used fortraffic control. The proposed system also provides information about air quality through a mobile application which enables commuters to take up routes where air quality is good.

Chen Xiaojun [1] published a paper "IoT- Based Air Pollution Monitoring and Forecasting System" in the year 2015, which describing an IoT based system for air pollution monitoring and forecasting. A low-cost air pollution monitoring system was proposed by Bhadoriya. R. et at. [7] and Caubel. J.J. et at.[3]. in their paper entitled "Urban Air Pollution Monitoring SystemwithForecasting Models". The system was capable of receiving, storing and pre-processing the data. It is capable of converting the data into useful information.



## 3 | EXISTING SYSTEM

Nowadays different types of industries are mushrooming all over the world. These industries are polluting our environment with toxic gases and other hazardous objects. In this context, An industrial pollution monitoring system is proposed that uses an Arduino board along with sensors that sense some kind of toxic gases, temperature, humidity, etc. Sensors such as the DHT11 sensor for sensing temperature and humidity, MQ-5 sensor for sensing the concentration of carbon monoxide and MQ-135 for sensing smoke which in turn identify the fire accident. The Arduino board collects the output from each sensor and updates it into the online database by the Blynk server. This data is analyzed and measured against a predetermined threshold value. If the calculated values are greater than the threshold value the data is recorded and an alert is sent to the person concerned. It is an IoT-based system. Here are the drawbacks of industrial monitoring using Arduino-based IoT systems, which is shown in figure 1:

- Limited processing power.
- Limited connectivity options.
- Challenges with scalability.
- Security vulnerabilities.
- Lack of real-time capabilities.
- Limited analog input channels.
- Reliability and durability concerns.

### 3.1 | Transmitter section

In the transmitter area, to screen the parameters, we mount sensors like MQ-135, MQ-5 and DHT11 to detect these parameters. The information from these sensors coordinated with Arduino UNO board works at 5V. To enable the information to go over an

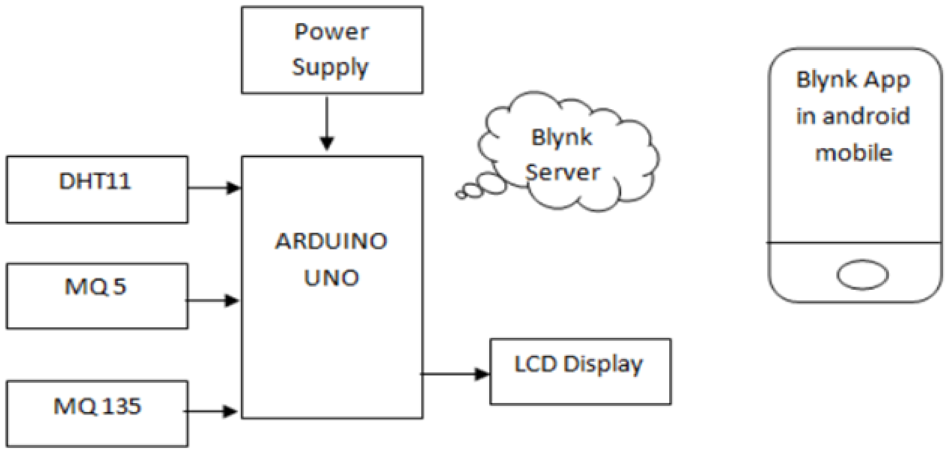


**FIGURE 1** Block diagram of the Existing system



Internet we are associating blynk server. We use a buzzer if the value of MQ-5 sensor raises above the threshold value. The LCD Display is used to display the values of the different sensors[2].

### 3.2 | Receiver section

In the beneficiary segment, hotspot is to be actuated on client's cell phone or desktop to get to internet browser. An IP address is to be entered in internet browser to get to related page which will demonstrate the observing outcomes on client's cell phone screen. From the above model, process is separated in 5 layers. The ecological parameters which are to be estimated are presented in layer 1. Investigation of the qualities and highlights of sensor gadgets is in layer 2. In layer 3, there is basic leadership on detecting, estimating and fixing the edge esteem, periodicity of affectability, timing, space of sensors. Sensor information obtaining is done in layer 4.and more, layer 5 as encompassing insight condition. The sensors can be worked by the microcontroller to recover the information from them and it forms the investigation with the sensor information and updates it to the Internet through Wi-Fi module associated with it. Client can screen the parameters on their cell phones just as desktop or workstation.

As a result of exixting method, an IoT based industrial pollution monitoring sytem is developed and tested. The values of the pollutant gases like carbon monoxide, nitrate (NO3) and carbon dioxide released from different industries. We also measured temperature and the humidity of the industrial area. The data corresponds to the pollutants gases are identified and if the values are above the threshold values the intimation is send to the mobile phone, which is initialized in the program. It is tested successfully. The buzzer also activated if the pollutant gases are above the threshold.

## 4 | PROPOSED SYSTEM

In the proposed system as shown in figure 2 2 the Ni my-daq is introduced as the controller of the sensors called LM35, LDR, Multi-Spectrum Infrared (MSIR) Flame Detectors, MQ6 ,sensor these four sensors are connected to mydaq this will be programmed with the help of LabVIEW software in the LabVIEW software the threshold values are given to all sensors so that, this will monitor and maintain, the pollution parameters to find out any leakages or damages in the industry.

The system investigates level of gases released during industry process, temperature of the machineries, detection of light using LDR, detection of flames, respected alerting systems are also included. Each process will have a separate data acquiring and alerting mechanism. Here LabVIEW provides operation interface and manipulation of data and. The main idea behind the project is to make a real time fully automated monitoring and alert system using LabVIEW. If the values gone beyond the threshold, then the alerts of lm35 is given by the Red led and the LDR output is given with the yellow LED and the Flame senor output will be given by ramp pulse buzzer and the Mq6 sensor buzzer output will be given with square pulse buzzer. Then the complete data log recorded by the sensors will be given to the Thingspeak so that the wave forms of the sensors will be recoded and the threshold values exceeds means it will send alert through the Twilio app. So that the damage can be reduced the necessary precautionary actions. the flow chart of the proposed systems is shown in figure 3 3.

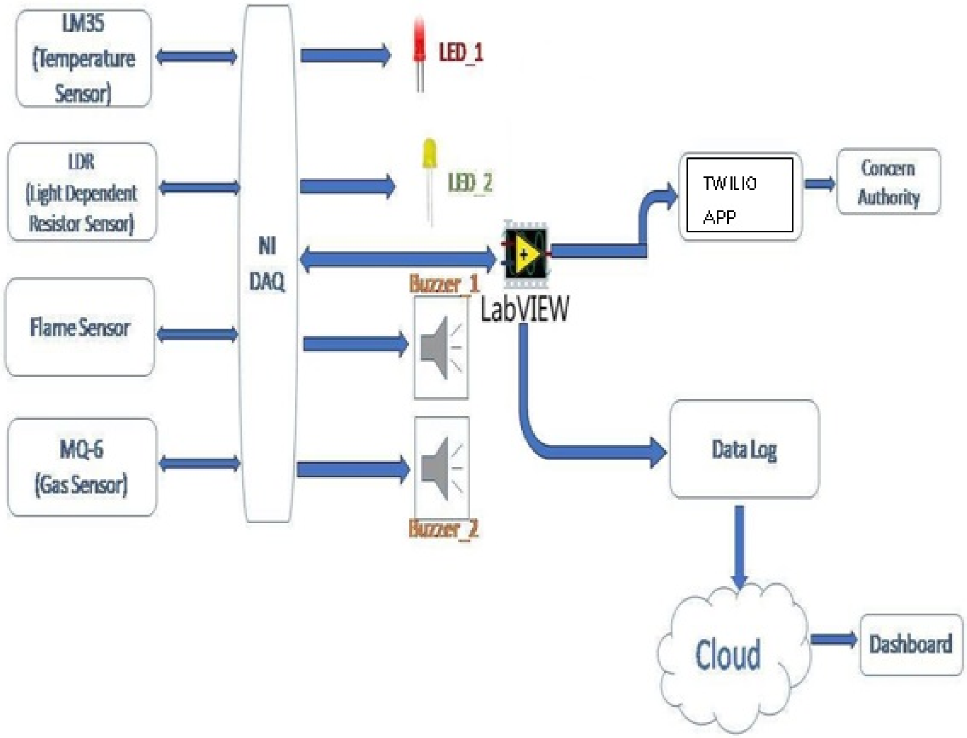


**FIGURE 2** Block diagram of proposed system

## 4.1 | Functional blocks

### 4.1.1 | LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4C at room temperature and ±3⁄4C over a full 55 to +150C temperature range. Low cost is assured by trimming and calibrationat the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1C in still air. The LM35 is rated to operate over a 55 to +150C temperature range, while the LM35C is rated for a 40 to +110C range (10 with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

### 4.1.2 | LDR

LDR (Light Dependent Resistor) as the name states is a special type of resistor that works on the photoconductivity principle means that resistance changes according to the intensity of light. Its resistance decreases with an increase in the intensity of light. It is often used as a light sensor,It works on the principle of photoconductivity whenever the light falls on its photoconductive

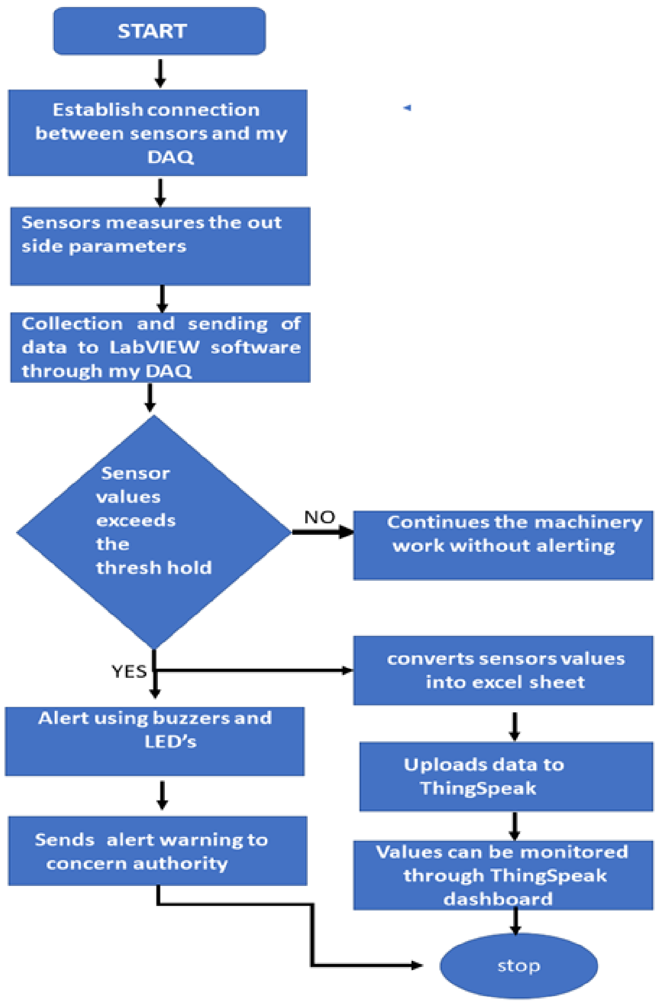


**FIGURE 3** Flow chart of the proposed system

material, it absorbs its energy and the electrons of that photoconductive material in the valence band get excited and go to the conduction band and thus increasing the conductivity as per the increase in light intensity. Also, the energy in incident light should be greater than the bandgap gap energy so that the electrons from the valence band got excited and go to the conduction band.

### 4.1.3 | FLAME SENSOR

A flame sensor definition is a type of detector that is used to detect as well as react to the occurrence of a fire or flame. A flame sensor frequently responds faster more precisely as compared to a heat or smoke sensor because of the mechanisms it utilizes to notice the flame. Flame sensors are usually used to verify whether the furnaces are functioning correctly. These sensors are also used in an ignition system to get precise actions otherwise to inform the operator.Flame sensors use UV (Ultraviolet) or IR (InfraRed) or UV-IR technology to identify flames below a second. These sensors react to a detected flame based on the installation, although it includes sounding an alarm, disabling a fuel line activating a fire control system. The flame sensor with UV technology works by simply sensing the UV radiation. Generally, all fires generate UV radiation at the ignition point so, in case of a fire, the sensor would become alert of it generate a series of pulses that are changed by detector electronics and gives an alarm output.

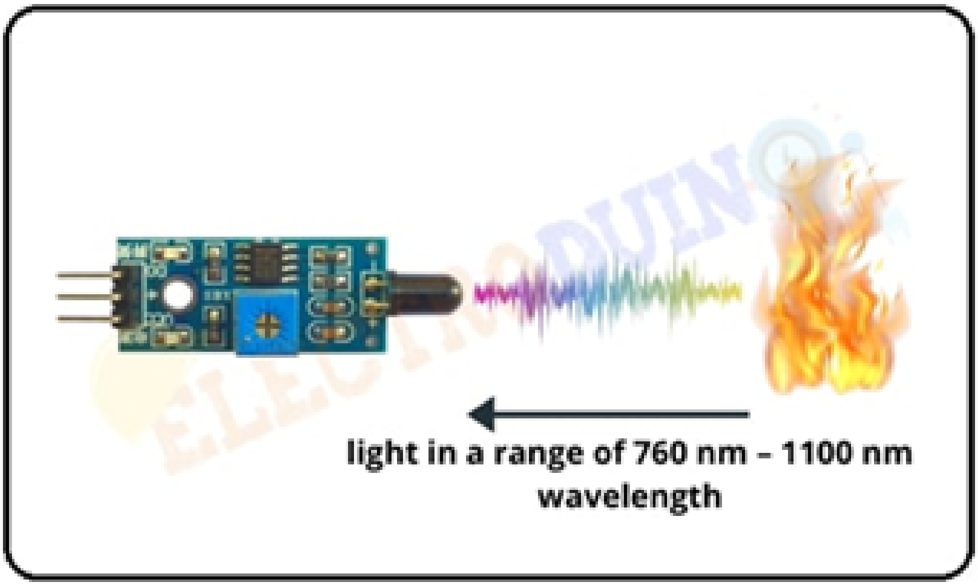


**FIGURE 4** Flame Sensor

### 4.1.4 | MQ6 GAS SENSOR

MQ6 Gas sensor is a Metal Oxide Semiconductor (MOS) type Gas Sensor mainly used to detect the LPG and Butane gas concentration in the air either at home or in industry. This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless-steel mesh. Whenever gas comes into contact with the sensing element, the resistivity of the element changes. The change is then measured to get the concentration of the gases present. Its sensing range is very suitable for gas leak detection in homes and places like hotels, restaurants where cooking is done using LPG cylinders.

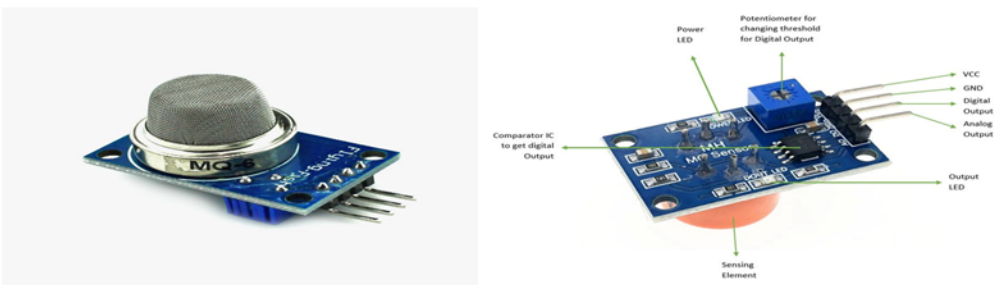


**FIGURE 5** MQ6 Gas Sensor and its driver device

### 4.1.5 | NI myDAQ (national instruments Data Acquisition)

Accelerate productivity and develop measurement systems: faster using LabVIEW because it provides a single environment that combines native NI DAQ hardware integration with extensive libraries for signal processing and data visualization. Improve measurement performance and accuracy: with innovative hardware and software technology that has established NI as a world leader in DAQ. Combine LabVIEW and NI DAQ hardware: to create reusable measurement solutions that can be programmed and reconfigured to meet evolving needs. The NI ecosystem is great when you have to interface to sensors and actuators.

- The dataflow nature of LabVIEW enables parallel processing naturally as part of the language.
- Lowered barrier to entry for FPGA-based programming
- Two Differential Analog Input and Analog Output Channels (200 ks/s, 16 bits, +/- 10 Volts)
- Access matched analog input and output channels in a +/- 10-volt range through the screw terminal connectors or +/- 2-volt range through the 3.5mm audio jacks.
- +5, +15-, and -15-Volt Power Supply Outputs (up to 500m Watts of Power)
- USB powered for maximum mobility, myDAQ supplies enough power for simple circuits and sensors.
- Eight Digital Input and Digital Output Lines (3.3 Volt TTL-Compatible)
- Use software-timed digital lines for interfacing both Low Voltage TTL (LVTTL) and 5-volt TTL digital circuits. Each line is individually selectable for input or output.
- 60 Volt Digital Multimeter (DMM) for Measuring Voltage, Current, and Resistance

# 5 | RESULTS AND ANALYSIS

## 5.1 | Experimental setup

An Industrial monitoring system using NI - myDAQ is developed and tested as shown in figure 6 7. The values from Mq6, Lm-35, LDR, Flame senor is tested and the values are been displayed in the tabular format and the front panel image also displayed here to check working of Mq6 we used LPG gas and to measure the Lm35 temperature outcome we used hot air blower , and to read the values of Ldr we used low lighting and we used lighter fire to record the flame senor values, we used buzzer sensor as physical output indications for the MQ6 and Flame sensor with different sounds we used red led for LM35 and yellow Led as indication for the LDR. pollutants gases are identified and if the values are above the threshold values the intimation is send to the mobile phone, which is initialized in the program and the exceeded values are displayed on the dashboard of Thingspeak that can be accessed by concern authority It is tested successfully.

**Procedure to assemble and configure the proposed system**

- In this labviw program, we used two DAQ assistants which are DAQ assistant- 1 and DAQ assistant-2.
- DAQ assistant-1 is used to fetch the data from the sensors MQ-6 and Flame. The data fetched from these sensors is digital data (Boolean Indicators).
- Split array VI is used to divide the data from DAQ assistant-1 .It will divide the data as first subarray and second subarray.
- When we run the program in LabVIEW, we can observe that data is transferring to the Thingspeak dashboard but message can only be sent when the value exceeds the threshold.

**Front panel description of the system**

- Here the waveform chart is used to indicate the MQ6 outputs
- The thermometer represents the LM35 outputs
- Leds indicates the LDR outputs
- Frequency indicates the Flame voltage

**Sensor signals in ThingSpeak dashboard**

From the dashboard of ThingSpeak shows :

- Field 1 chart shows the wave chart of LD
- Field 2 chart shows the wave chart of LM 35 (Temperature) senso
- Field 3 chart shows the wave chart of MQ-6 sensor
- Field 4 chart shows the wave chart of Flame sensor

**OUTPUT BY TWILIO APP**

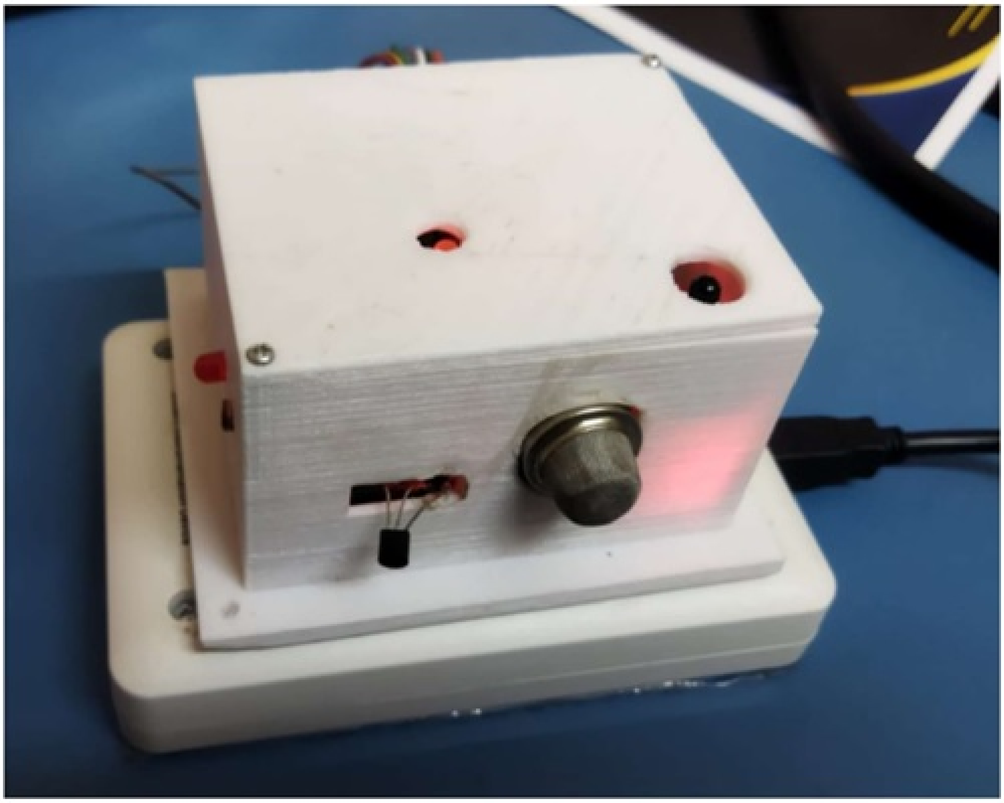

**FIGURE 6** Experimental setup

## 6 | CONCLUSIONS

In conclusion, an industrial pollution monitoring system using NI – my DAQ, Thingspeak, and Twilio app can be an effective way to monitor and manage pollution levels in industrial settings. my DAQ provides accurate and reliable data collection, while Thingspeak allows for real-time monitoring and data visualization. The Twilio app can be used to send alerts and notifications to relevant stakeholders in case of any unusual changes in the pollution levels. An INDUSTRIAL MONITORING SYSTEM USING NI- my DAQ is successfully developed and tested. We measured the proximity of all the sensors. We also obtain a real-time continuous data by the wave chart. Alerting message was sent to the higher authorities. The messaging system and alerting mechanism worked successfully. We have mentioned the measured values in the table no 5.1 for the future developments one can test beyond those values by making necessary modifications and also, in further we can shift to my RIO also which is an advanced device of the myDAQ.

## 7 | MEASURED VALUES

| Parameters | Measured values |
|---|---|
| MQ6 (Lpg gases) | 36400ppm |
| LM35 | 49 degrees |
| LDR | 2.19(low lighting) |
| FLAME SENSOR | 4 millivolts |

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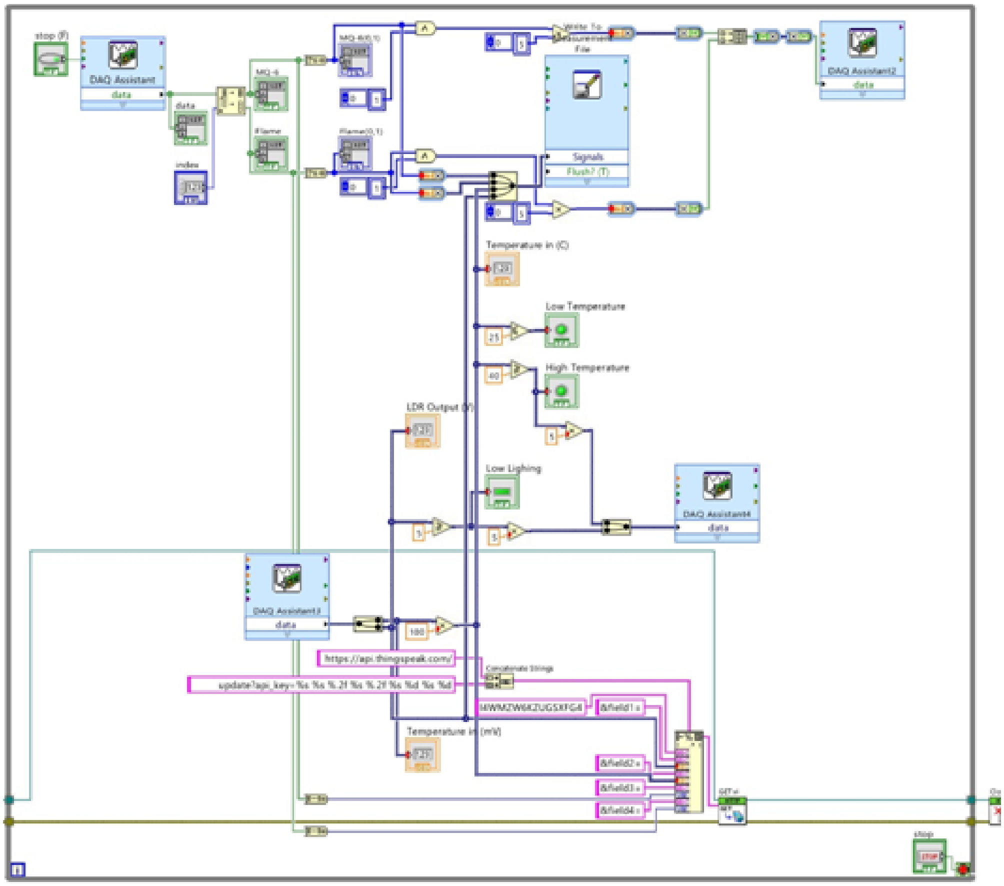


**FIGURE 7** Block diagram panel of the proposed system



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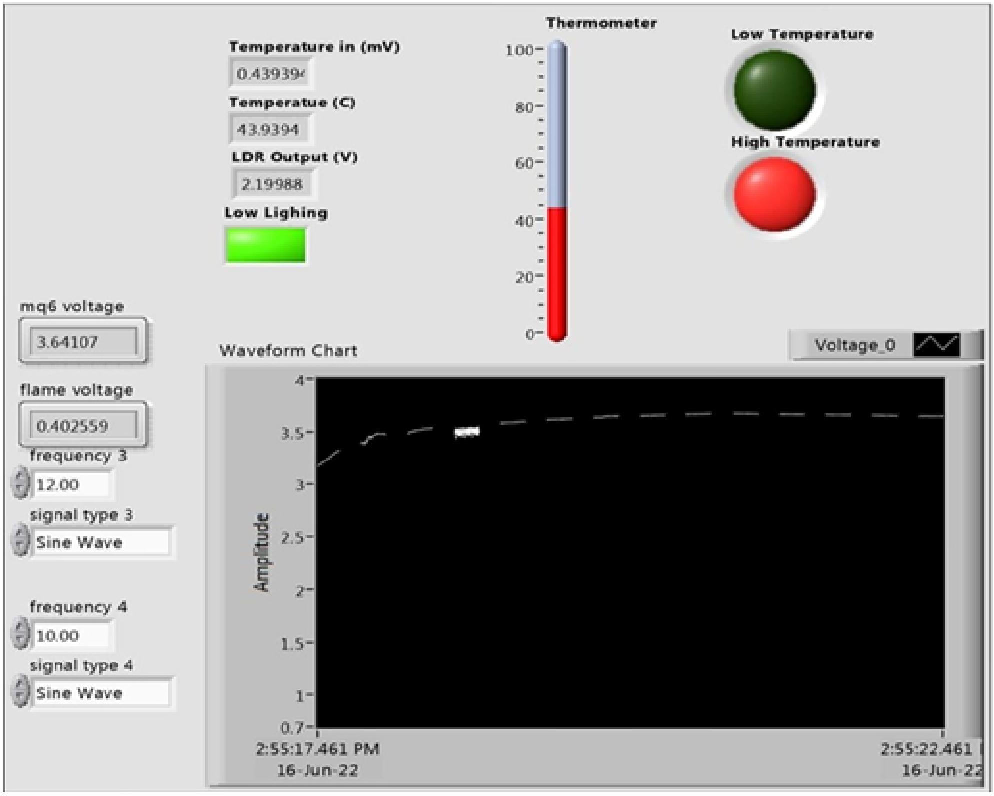


**FIGURE 8** Front panel of the proposed system


**FIGURE 9** Sensor signals in ThingSpeak dashboard

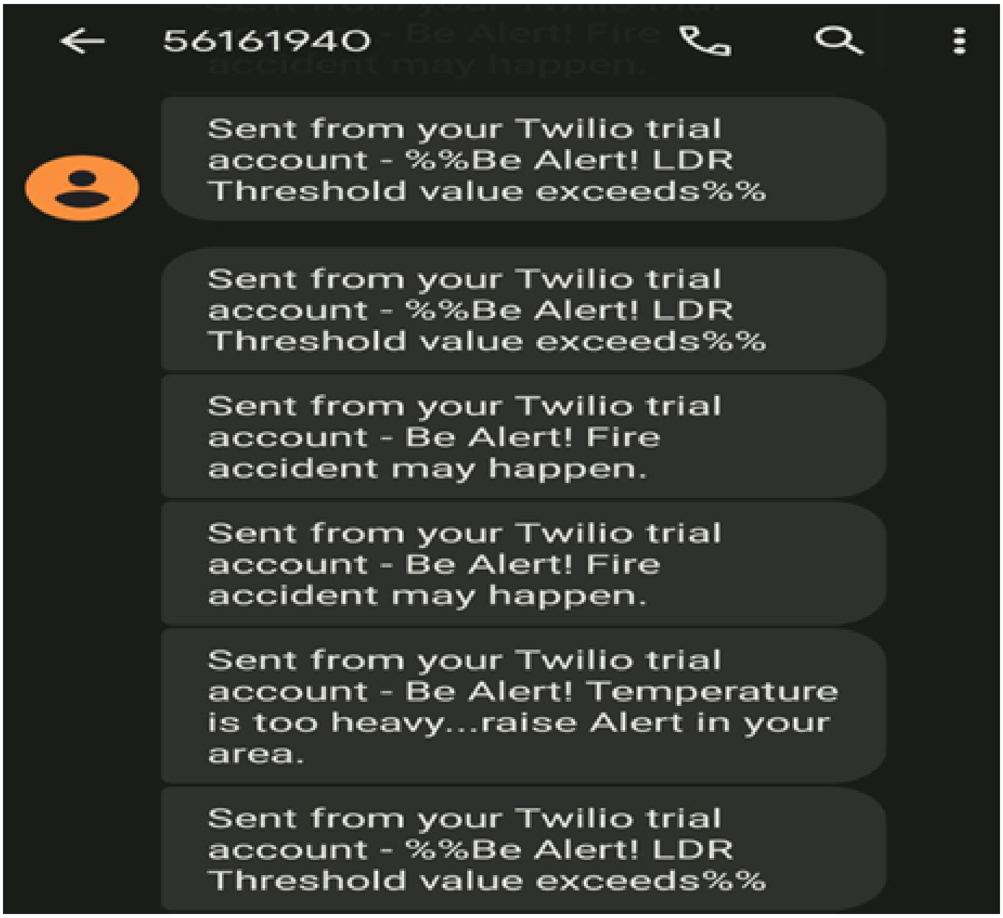


**FIGURE 10** Alert message from ThingSpeak twilio app