INDUSTRIAL AIR POLLUTION MONITORING SYSTEM USING LABVIEW AND ZIGBEE

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Abstract

Air pollution is one of the most crucial factors affecting life and health of humans, animals & plants. A Zigbee based wireless sensor network is proposed for monitoring the levels of carbon monoxide (CO), Nitrogen dioxide (NO2), Ammonia (NH3), Sulphur(S), Methane (CH4) and other harmful gases present in air. The firmware part of the project has been developed under LABVIEW Environment. The proposed framework permits shrewd urban areas to screen air quality conditions utilizing graphical programming based LABVIEW and gives a caution if air quality attributes surpass worthy levels. The sensor information shown by various pointers on front board of LABVIEW and experimental results demonstrate the efficiency of our project

1 Introduction

A ZigBee based remote sensor network is executed in this paper which is of minimal expense sun based controlled air quality checking framework. The primary target of the proposed design is to interfacing different sensors to quantify the sensor simple information and showed in LabVIEW on the screen utilizing the graphical UI (GUI). The continuous surrounding air quality checking in keen urban communities is of more prominent importance for the soundness of individuals. The remote organization sensor hubs are put at various traffic lights in the savvy urban areas which gather and report constant information on various gases which are available in the climate like carbon monoxide (CO), nitrogen dioxide (NO_2), methane (CH_4) and moistness. The proposed framework permits keen urban communities to screen air quality conditions on a work area/PC PC through an application planned utilizing graphical programming-based LabVIEW programming and gives an alarm if the air quality attributes surpass adequate levels. The sensor network was effectively tried on the grounds of the foundation of aeronautical designing, Hyderabad. The sensor information are demonstrated by various markers on the front board of LabVIEW and furthermore various diagrams are plotted regard to time and adequacy which clarifies the seriousness of contaminated zones. [9,7]

The Tanzania Development Vision (TDV) 2025 aims to transform the nation from a least developed country to a middle-income country by 2025 through transformation from a weather and market dependent agricultural economy to a self-sustaining semi-industrialized economy [1]. This

shift in focus from an agricultural economy to a semiindustrialized one was essential for the ailing industrial sector of Tanzania. Population increase, economic development, poverty, environmental-sustainability, climate change and energy use are intimately knotted in the developing and a low-income country where achieving the balance between the economic growth and environment is an important area of concern. Tanzania has also been experiencing the similar problem due to continuous increase in the population and industries. No development can be sustainable if it triggers the violation of nature's tolerance limits. The National Environmental Policy [2] highlights the strong linkage between the development and the environmental sustainability and stresses the need to manage the environment and its natural resources in ways that enhance the potential for growth and opportunity for sustainable development of present and future generations. In addition, it explains the clear cause-and-effect relationship between poverty and environmental degradation and confirms that environmental degradation leads to widespread poverty; equally, poverty is a habitual cause of environmental degradation as it undermines people's capacity to manage resources wisely. A very glaring constraint has been lack of adequate and sound research data to guide effective decision-making and policy interventions formulation in environmental management. Urgent attention is thus needed to intensify quality and relevant environmental research. The development of an environment research agenda to serve as a guide for stakeholders in the prioritization of their research activities is widely considered to be an important prerequisite for stimulating quality and relevant environmental research.

Increased emissions of reactive trace gases from man's energy related and industrial activities have led to a wide variety of air pollution problems on urban, regional and global scales [3]. Both primary emissions and their secondary products produced in the oxidative atmosphere can lead to health and environmental consequences. Industries are major sources of water, air and soil pollution. About 80% of all of Tanzania's industries are located in urban areas. Distinguishable from domestic, institutional and other sources of pollution, industrial wastes may contain heavy metals like mercury, chromium, lead and cadmium; salts of cyanide, nitrite and nitrate; organic matter, micro-organisms and nutrients; and toxic chemicals such as pesticides. By international standards, Tanzanian industries are highly polluting, the main reasons being that there are very few industries in the country which have incorporated provisions for treating the wastes they generate and the factories have been built without including technologies which help to reduce waste. In this study, six of the pollutants are well studied and, ubiquitous in our daily lives, including carbon monoxide (CO), nitrogen dioxide (NO_2), ground level ozone (O_3), sulfur dioxide (SO2), particulate matter (PM) and lead (Pb). The six common pollutants and their health effects are depicted in Table 1.

Table 1: Six common pollutants and their effects

Pollutant	Health Effects	Sources

Carbon Monoxide (CO)	Unlike the other air pollutants, carbon monoxide does not appear to affect the respiratory system. However, exposure to elevated levels of carbon monoxide can adversely affect the functioning of the heart, resulting in cardiac ischaemia, increased hospital admissions, and possibly increased cardiac mortality. Outdoor concentrations of carbon monoxide rarely reach dangerous levels, whereas indoor concentrations are more likely to occur at harmful levels.	Carbon monoxide is produced by the incomplete combustion of fossil fuels, largely from motor vehicles and other mobile sources.
Nitrogen Dioxide (NO_2)	Exposure to elevated levels of nitrogen oxides can contribute to respiratory illness, aggravation of asthma in children, and reduced lung growth.25 Nitrogen oxides react with other air pollutants in the atmosphere to form smog	Nitrogen oxides are produced by the combustion of fossil fuels.
Ozone (O_3)	Ozone irritates the respiratory tract. Exposure to ozone in sensitive people can cause chest tightness, coughing, and wheezing. Children who are active outdoors during the summer, when ozone levels are elevated, are particularly vulnerable. Other groups at risk include individuals with pre-existing respiratory disorders, such as asthma and chronic obstructive pulmonary disease. As a result of these negative health effects, ozone contributes to premature mortality, increased hospital admissions for acute respiratory diseases, aggravated asthma, and reduced lung function.	Ground level ozone is a key component of smog, and is formed by atmospheric reactions involving nitrogen oxides, volatile organic compounds, and sunlight. Sunlight intensity and higher temperatures exacerbate the formation of ozone. These factors explain why smog is generally a worse problem during summer months.
Sulphur Dioxide (SO_2)	Exposure to sulphur dioxide causes severe problems for people with asthma and is also associated with increased risk of lung cancer and chronic bronchitis. Sulphur dioxide also reacts with other air pollutants in the atmosphere to form particulate matter.	Most sulphur dioxide emissions are produced by the combustion of fossil fuels containing sulphur, including coal, oil, gasoline, and diesel, as well as coal-fired electricity plants and metal smelters.
Particulate Matter (PM_{25} & PM_{10})	Particulate matter causes premature mortality from cardiovascular and respiratory diseases, increased hospital admissions for cardiovascular and respiratory diseases, increased prevalence of bronchitis, increased risk of lung cancer, aggravation of asthma, and decreased lung function. Children in particular are likely to suffer from a range of respiratory ailments as a result of exposure to particulate matter. The elderly and individuals with heart ailments are also particularly vulnerable. It is important to note that there is no threshold concentration of fine particulate matter below which no health effects are found. In other words, there is no safe level of fine particulate matter – negative health effects will occur in some people even at very low levels, and the proportion of people impacted will rise as levels of fine particulate rise.	Fine particulate matter is created primarily by the combustion of fossil fuels, while coarse particulate matter originates from road dust, diesel engines, and crushing and grinding operations.
Lead (Pb)	Among children, lead exposure can cause	In the past, leaded gasoline was

	cognitive deficits, developmental delays, hypertension, impaired hearing, attention deficit disorder, reduced intelligence, and learning disabilities. While lead has been considered a major threat to children's health for many years, only recently has evidence begun to accumulate about the dangers posed by lead to menopausal women and the elderly.27 As bones become thinner with age, lead is released into the blood, contributing to an array of negative health effects including cataracts, Alzheimer's, Parkinson's and other forms of dementia, high blood pressure, and impaired kidney function	the primary source of lead emissions to the air. Today, the majority of lead emissions to the air are from lead smelters. Dust, paint chips, consumer products, and lead shot are other important sources of exposure to lead.

2 Literature Survey

Pravin, J., Deepak Sankar, [1] The majority applications of pollution monitoring systems are in industries. The control of the parameters which causes pollution and deteriorates the industrial and natural environment pattern is a great challenge and has received interest from industries especially in Petro chemical industries, Paper making industries, Water treatment industries. The main objective of our project is to design a device which controls the parameters causing pollution and to minimize the effect of these parameters without affecting the plant or natural environment. The proposed methodology is to model a system to read and monitor pollution parameters and to inform pollution control authorities when any of these factors goes higher than industry standards. A mechanism using GSM and LabVIEW is introduced in this proposed methodology, which will automatically monitor when there is a disturbance affecting the system. The system is implemented using LabVIEW software. The system investigates level of CO gas released during industry process and temperature of the machineries. Our proposed method is more accurate to derive the desired parameters. LabVIEW is the powerful and versatile programming language for operating and controlling the pollution monitoring system and GSM is suitable for interactive environment for signal transfer.

Divyata Khachane1, Prof. Anjali Shrivastav2 [2] Wireless sensor network have gained much attention in recent years and now a days it is used in applications of various domain which leads to development of smart sensors. These sensor nodes can sense, measure, and collect information from the environment and, based on some control decision process and transmit the sensed data to the user. Hence wireless sensor network also leads to research of smart sensors that are used in emerging applications.

Suchita B. Waghmare [3] Environmental pollution is one of the most important factors which affect the health of living being and the ecosystem. It is a great challenge to control industrial pollution and to maintain the natural environment. The main objective of this paper is to design a productive and powerful system to control industrial pollution and monitoring reduce their adverse effect. In this system, data of temperature and humidity is collected from the sensor by using AT-mega 2560 Arduino board. Hence through this system, the pollution caused by the industry can be monitored and control effectively using LabVIEW.

Daudi S. Simbeye1[4] Environmental conditions have a major impact on our well-being, comfort and productivity. This paper proposes an industrial air pollution monitoring system based on wireless sensor network system that enables sensor data to be delivered within time constraints. Obtaining these accurate real-time results in-situ allows regulatory agency to take necessary action whenever pollution occurs. The analysis focuses on six substances, known as criteria

air pollutants – ozone, particulate matter, sulphur oxides, nitrogen oxides, carbon monoxide, and lead. The sensors self-organize themselves in a radio network using a routing algorithm, monitor the area to measure the gas levels in air and transmit the data to a central node, sometimes called a pollution server or base station (interfaced with coordinator), or sink node, that collects the data from all of the sensors. The usage of this system will reduce human health effects of industrial air pollutants and potential damage to other aspects of the environment.

Jadhav D. A.1[5] Air pollution has harmful effects that cause acid rain global warming. To reduce these effects air pollution monitoring system is important. A low power wireless sensor network and control of inter-node data reception for use in the real time acquisition and communication of air pollutants such as SO2, CO, NO2 and NO etc. The main objective is achieved by interfacing various sensors to measure the common air pollutants. The measured data is displayed on the monitor using the graphical user interface (GUI). The data-based server is attached to the pollution server for storing the pollutants level. Pollution server is interfaced to Google maps to display real time pollutants, pollutants level and locations in large areas.

Souhir BEDOUIa[6], Air pollution is one the most crucial factors affecting life and health of human, animals and plants. In this paper, a wireless solution is proposed for monitoring the level of hydrogen sulfidegas (H_2S). The software part of the project has been developed under LabVIEW environment. The experimental results demonstrate the efficacy of our project in terms of fast detection and real time response.

Shivani Harale1[7], Air pollution is the most important factor that affects the health and life of animals, humans and plants. Environmental conditions have a great effect on our comfort productivity and well-being. The current state of the air quality control for manufacturing industries in our country is based on taking a few samples on monthly basis, which means there is no information provided about time distribution of polluted materials intensity during the day. This paper puts forward an industrial air pollution monitoring system based on wireless sensor network system. That activates sensor data to deliver it within time constraints so that appropriate action can be taken. The focus of the analysis is on four substances also known as criteria air pollutants are particulate matter, Sulphuroxides, Carbon monoxide and nitrogen oxides. Using this system will reduce the effects of air pollution on human health and reduce damage to other aspects of the environment. Industrialization has increased the degree of automation which increases pollution by releasing pollutants into the atmosphere. Industrial air pollution monitoring is the collection of information at different locations of an industry and at regular time intervals to provide the date which may be used to define current conditions. Due to the parameters complexity, there are variations between different industries. The aim of the proposed system is in building a robust system to measure the industrial pollution so as to decrease human interference in monitoring to provide a healthy workspace for the workers. The system evaluates the industrial pollution continuously and alerts when there is an increase in emissions to take action to control it using wireless technology which is Internet of Things.

Umesh M. Lanjewar[8], This study proposes air pollution monitoring system and analysis of pollution data using association rule data mining technique. Association rule data mining technique aims at finding association patterns among various parameters. In this paper, association rule mining is presented for finding association patterns among various air pollutants. For this, Apriori algorithm of association rule data mining is used. Apriori is characterized as a level by-level complete search algorithm. This algorithm is applied on data captured by various gas sensors for CO, NO2 and SO2 sensors.

Manikannan.G[1][9], Internet of Things is a worldwide emerging technique which contains “smart devices” that can able

to sense and connect with surroundings and interact with the users and other devices. IoT technology provides an effective method for solving the environmental pollution problem. To overcome the problems, we propose a three-phase air pollution monitoring system with IoT. An IoT kit was developed using MQ gas sensors, Arduino UNO, and a Wi-Fi module (ESP8266). This system can be placed in various cities to monitoring air pollution in their surroundings. The MQ gas sensors gather data from air and forward the data to the Arduino UNO. The Arduino UNO transmits the data to the cloud via the ESP8266 module. We also developed an Android based application termed as Air-Monitoring. So that users can access the air quality data from the cloud. This system will be equivalent to Google Traffic or the Navigation application of Google Maps for pollution Data. Finally, with the available air quality data the AQI (Air Quality Index) levels can be calculated for future Prediction.

A. R. Al-Ali[10], An online GPRS-Sensors Array for air pollution monitoring has been designed, implemented, and tested. The proposed system consists of a Mobile Data-Acquisition Unit (Mobile-DAQ) and a fixed Internet-Enabled Pollution Monitoring Server (Pollution-Server). The Mobile-DAQ unit integrates a single-chip microcontroller, air pollution sensors array, a General Packet Radio Service Modem (GPRS-Modem), and a Global Positioning System Module (GPS-Module). The Mobile-DAQ unit gathers air pollutants levels (CO, NO2, and SO2), and packs them in a frame with the GPS physical location, time, and date. The frame is subsequently uploaded to the GPRS-Modem and transmitted to the Pollution-Server via the public mobile network. A database server is attached to the Pollution-Server for storing the pollutants level for further usage by various clients such as environment protection agencies, vehicles registration authorities, and tourist and insurance companies. The Pollution-Server is interfaced to Google Maps to display real-time pollutants levels and locations in large metropolitan areas. The system was successfully tested in the city of Sharjah, UAE. The system reports real-time pollutants level and their location on a 24-h/7-day basis.

3 Methodology

There is a continuous environmental damage that has been occurring due to harmful gases released from industries. Many of the Industries are not concerned about the authorized level of gases which is provided by the Government and running their industries because of this, too there is huge loss to the Environment. For those industries which release these harmful gases by violating the rules issued by the Government then our device senses these gases and sends a warning. If this occurs again after a certain time delay it alerts and sends an emergency message to the police department.

4 Block diagram

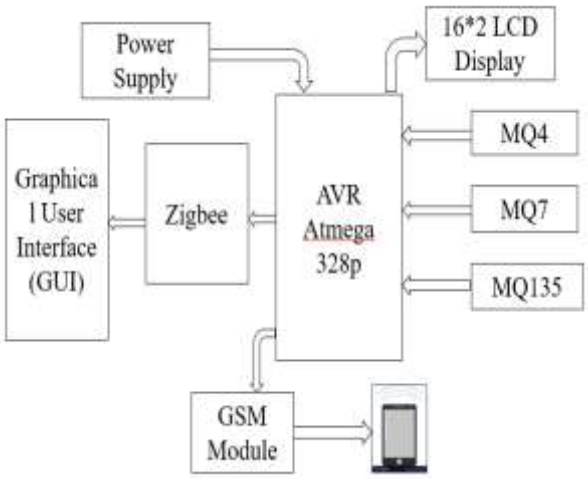

Fig1: Block diagram

The Block Diagram Consists of different gas Sensors, Arduino, GSM Module, LCD Display etc. When the Power Supply is given to the Hardware circuit the gases Carbon monoxide (CO), Ammonia (NH3), Methane (CH4) are sensed by the sensors MQ4, MQ7, MQ135 which are present in air. The sensed information is given to the Microcontroller, then the level of the gases is displayed on the LCD Screen. When this Hardware kit is connected to the LabVIEW Software with the

help of Zigbee which is used as both Transmitter and Receiver. By running Block diagram and Front Panel of LabVIEW we can get desired outputs such as level of gases and Graphical Representations for each Sensor. If there is any Occurrence of Abnormal values sensed by the sensors then GSM is used to transfer the abnormal message which is received from the Arduino to the mobile number which is previously saved in the Arduino code

5 Flow chart

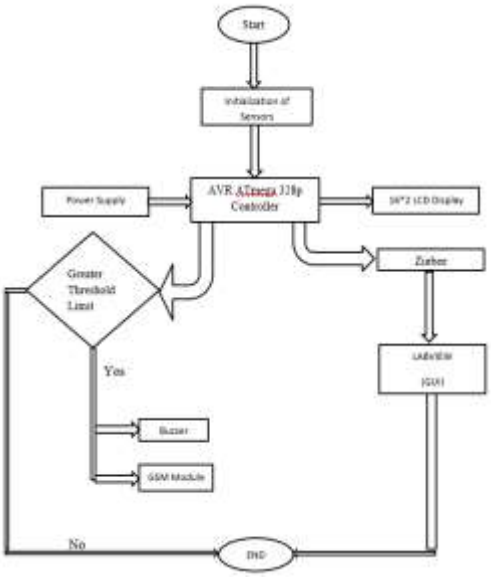

Fig 2: Flow chart

Step1: The Sensor information can be sensed by initializing the sensors, whenever there is a Power Supply.

Step2: The sensors data is passed to the Microcontroller, then the level of gases can be displayed on the LCD Screen.

Step3: When this hardware is connected to LabVIEW by using Zigbee we get desired outputs such as level of gases and Graphical Representations.

Step4: If these levels goes beyond the threshold limit then there is a rise in signaling device which makes a buzzling sound and sends an SMS to the mobile using GSM module.

Step5: The process continues as long as it makes sense.

6 Results

Fig 3 is the snapshot of the implemented hardware kit. It can be observed that 3 different types of sensors are placed i.e., MQ4, MQ7, and MQ135 and the temperature and humidity sensor i.e., DTH11. The S1 shows the value of MQ4. S2 shows the value of MQ7. S3 shows the value of MQ135. T shows the value of temperature and H shows the value of humidity.

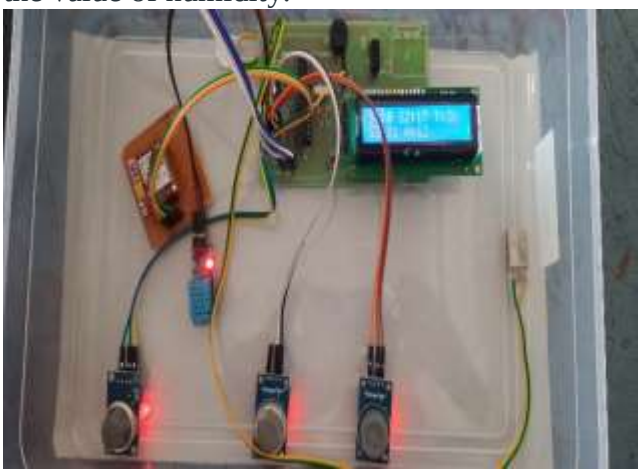

Fig 3: Hardware Kit

7 Labview outputs:

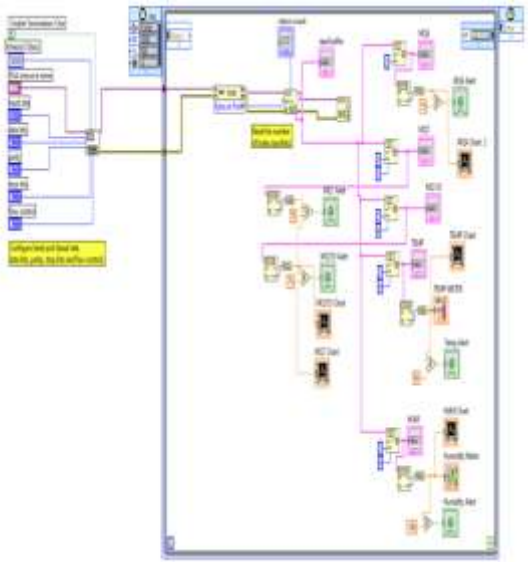

Fig 4: Block Diagram of GUI using LABVIEW

In LabVIEW we will take the serial input voltage from VISA Serial to port and then it is connected to read buffer to read the number of bytes specified. Each sensor reads 2 bytes. After reading the bytes it is connected to the comparator to compare the threshold limit. After comparison the alert buttons are placed, and the graphical charts placed individually

for each sensor. The block diagram of GUI using LabVIEW is shown in Fig 4.

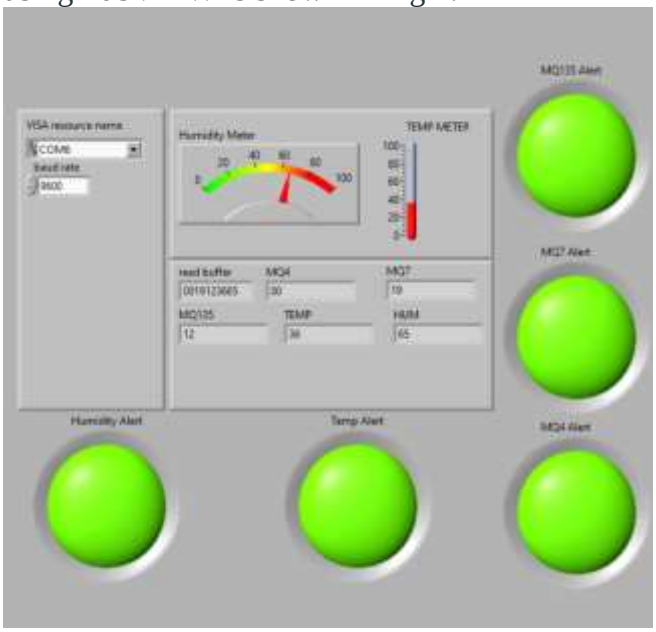

Fig 5: Front Panel of LABVIEW

When we run the block diagram it shows the front panel of LabVIEW as shown in figure. The green colour buttons are the alerts of each sensor. The humidity sensor shows the value through the indicator, temperature also shown as well through temperature meter. In read buffer the 10-digit values are displayed. MQ4, MQ7, MQ135, temperature and humidity show their levels. Fig 5 is the screenshot of the Front panel of the implemented GUI using LabVIEW.

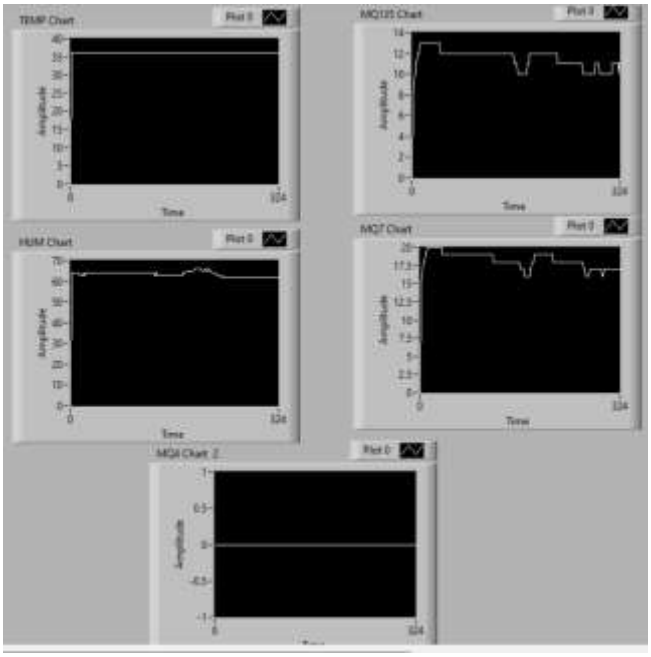

Fig 6: Graphical Representation of Sensors

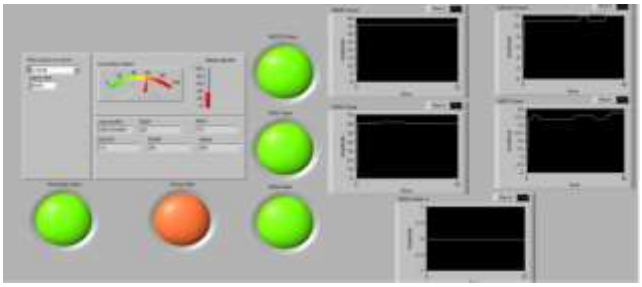

Fig 7: Abnormal Values of Front panel of LABVIEW

From the above front panel shown in Fig 7, we observe the green color button changes to red because of abnormal values which means the respective sensor crosses the threshold limit.

Fig 8: Abnormal message

From the above figure 8, we observe the message received that Alert: Abnormal sensor conditions found; this will occur when we place a sim in GSM module it sends an alert message if the threshold limit crosses.

Conclusion:

The field of pollution monitoring system is very wide and this project is an attempt to minimize the problem of cost and regular inspections by the pollution control board. The Pollution Control Board can take necessary actions against the industries depending upon the amount of release of effluents. To make inspections by Pollution control board involve huge cost.

A mechanism using Zigbee and LabVIEW is introduced in this proposed methodology, which will automatically monitor when there is a disturbance affecting the system. The system is implemented using LabVIEW software.

Future scope:

The performance and robustness pollution monitoring system can be further improved by implementing sensors for controlling dust, smoke moisture and other parameters their by improving the industrial and natural environment.

References

[1] Pravin J[1], Deepak Sankar A[2], Angeline Vijula D[3] INDUSTRIAL POLLUTION MONITORING SYSTEM USING LabVIEW AND GSM International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol.2, issue 6th june,2013.

[2] Divyata Khachane[1], Prof. Anjali Shrivastav Wireless sensor Network and its Applications in Automobile Industry International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 05 | May-2016 www.irjet.net p-ISSN: 2395-0072 .

[3] Suchita B. Waghmare[1], Industry pollution control and monitoring using LabVIEW and the Internet of Things Journal of Engineering, Computing and Architecture.

[4] Daudi S. Simbeye[1] , Industrial Air Pollution Monitoring System Based on Wireless Sensor Networks Journal of Information Sciences and Computing Technologies.

[5] Souhir Bedoui , Abdennaceur Kachouri , Air pollution monitoring system using LabVIEW.

\[6] [1]shivaniharale@gmail.com, [2]pb@aitdgoa.edu.in, Air Pollution Monitoring System International Journal For Innovative Research In Multidisciplinary Field ISSN: 2455-0620 Volume - 6, Issue - 9, Sept – 2020 Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value: 86.87 Impact Factor: 6.719 Received Date: 26/08/2020 Acceptance Date: 10/09/2020 Publication Date: 30/09/2020 .

[7] Umesh M. Lanjewar[1], J. J. Shah[2] , Air Pollution Monitoring & Tracking System Using Mobile Sensors and Analysis of Data Using Data Mining International Journal of Advanced Computer Research (ISSN (print): 2249-7277 ISSN (online): 2277-7970) Volume-2 Number-4 Issue-6 December-2012 .

[8] Umesh M. Lanjewar[1], J. J. Shah[2] , Air Pollution Monitoring & Tracking System Using Mobile Sensors and Analysis of Data Using Data Mining International Journal of Advanced Computer Research (ISSN (print): 2249-7277 ISSN (online): 2277-7970) Volume-2 Number-4 Issue-6 December-2012.

[9] Manikannan.G[1], Vijayalakshmi.T[2], Prabakaran.P[3], Mobile - Air Pollution Monitoring System using Internet of Things (IoT) ISSN: 2455-2631 © November 2019 IJSDR | Volume 4, Issue 11.

[10] A. R. Al-Ali, Member, IEEE, Imran Zualkernan, and Fadi Aloul, Senior Member, IEEE, A Mobile GPRS-Sensors Array for Air Pollution Monitoring 1666 IEEE SENSORS JOURNAL, VOL. 10, NO. 10, OCTOBER 2010.