DETECTION, MONITORING AND CONTROL OF TOXIC GAS USING IOT

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***Abstract* -- Toxic gas detection and control system on the field is one of the most dangerous problems in the industries. The aim of this research is to detect the leakage of toxic gas and take preventive action to control the leakage. The leakage of gas is taken as the input. This input is further processed and the output is given to the alert system, exhaust fan and solenoid valve. The input sensor used to detect the gas leak is the MQ-7 gas sensor. The analog input from the sensor is given to the system as digital input through DAQ. Then, it is compared with the condition in the LabVIEW environment and the corresponding output is obtained. This control signal is fed to the output device through DAQ which controls the gas leakage.**

Keywords --Toxic Gas, MQ7 Gas Sensor, LabVIEW, IoT.

I.INTRODUCTION

Mechanical accidents and worker carelessness are now the leading causes of dangerous gas leaks. The main cause of the reduction in the amount of oxygen gas at the factory is hazardous gas leakage, making it difficult for factory workers to breathe. Chemicals used in factories are also a pollutant in the environment. Industrial management has given priority margin over environmental protection, resulting in poor maintenance and exposure to hazardous gases into the atmosphere. That is why we decided to perform toxic gas leak detection and control research. The MQ-7 gas sensor detects the toxic gas leaking into the factory and sends that information to the control module [7]. The analog input from the sensor is given to the control module. Then, it is compared with the condition fed to the control module and the corresponding output is obtained. This control signal is fed to the output device with the help of the control module. Its outputs are the alert system, exhaust fan, and solenoid valve [9]. Its solenoid valve transmits toxic gas, which controls the toxic gas leakage.

Akshay et al (2017) proposed about Gas Leak Detector using Arduino UNO Microcontroller. Operates centered on the microcontroller, detects LPG gas leak with MQ-6 gas sensor, and sends a sound alert by buzzer while sending a message to a mobile [1]. Anuradha et al (2020) proposed Microcontroller Based Monitoring and Controlling of LPG Leaks Using Internet of Things. Operates a centered process is the internet of things with the help of a microcontroller, it detects LPG gas leaks with the help of MQ-2 and MQ-6 gas sensors and continuously monitors the gas level in the atmosphere. Once it reaches the gas leak above normal, it sends a message and operates the exhaust fan, solenoid valve, and alert sound [2]. Ashish Shrivastava et al (2013) proposed a GSM-based gas leakage detection system. The process is centered on the GSM module, which detects a gas leak and sends a message to the saved mobile number while closing the gas valve with the help of a stepper motor [3]. Deepthi Miriyampalli et al (2018) proposed their research on Gas Leakage Detection based on IoT using Raspberry Pi. With the Raspberry Pi as the main component, the MQ-135 sensor is mounted in various locations to detect gas leaks and display the message and generate an alert sound [4]. Modepalli Kavitha et al (2020) proposed their exploration on Smart Gas Monitoring System for Home and Industries. With the Arduino Uno as the main component, the MQ-135 sensor is mounted in various locations to detect gas leaks and display the alert message, generate the alert sound and close the solenoid valve for input gas [5]. Nithiya Rani et al (2014) proposed their research on Gas leakage monitoring and controlling using LabVIEW. LabVIEW software is used as the main processor to connect the MQ-2 gas sensor to the system and generate an alert sound during a gas leak and close the gas valve with a solenoid valve [6].

II. PROCESS DESCRIPTION

Figure 1 shows the block diagram of the gas leakage detection and control system in LabVIEW. In this case, we've built an acrylic box that we're imagining as a factory.

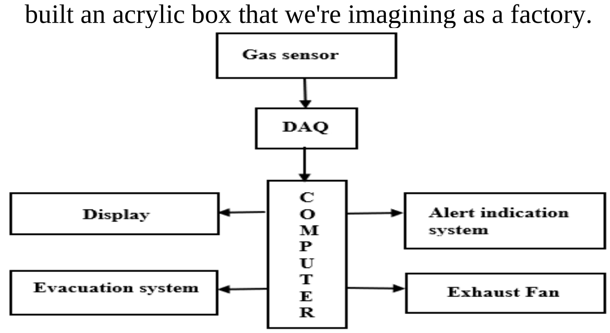

Figure 1: Block Diagram of gas leak detection system in LabVIEW.

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The block diagram of the above setup is clearly shown below with the interconnections and circuit flow. Toxic gas leaks (carbon monoxide) are controlled using an air ventilation system and the addition of a neutralizer gas. The controller's design is built on the Front Panel and LabVIEW block diagram using LabVIEW virtual instrumentation [6]. The LabVIEW has its own built-in Data Acquisition System (DAQ), which is very useful for acquiring data for carbon monoxide level control. This DAQ further processes the input and sends the output to the alert system, exhaust fan, or solenoid valve. The hardware model consists of one discharge fan for constant and smooth air regulation inside the factory [10,11]. In this system, control a carbon monoxide leak with the help of an exhaust fan and neutralizing gas.

III.PROPOSED METHODOLOGY

Figure 2 shows the process flow of gas leakage detection, monitoring, and control system. As the process begins, the first action sensor value is read Then, if the read sensor value is

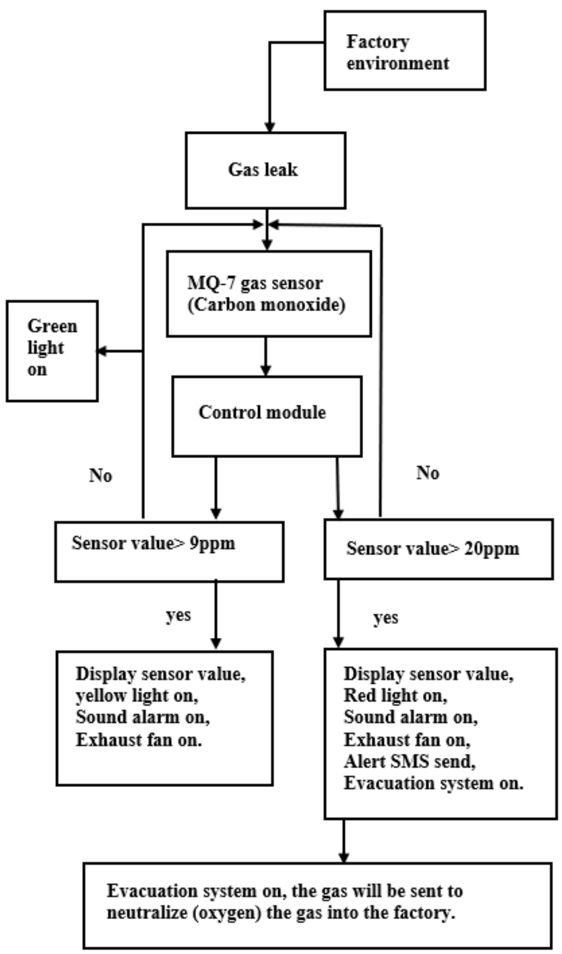

Figure 2: Process flow of gas leakage detection, monitoring and control system.

greater than the given threshold value, the conditions are met. If the given condition is satisfied or the given threshold value is less than the sensing value, the next process begins; if the value is greater than the threshold value, the sensing value is sent to the next stage action; otherwise, the next step is to read the sensor value again without performing any action; and if the sensor value exceeds the threshold value, the next process begins. The alarm and evacuation systems are then activated. The alarm system includes features such as sound notification, light notification, and the display of the alert message. The evacuation system sends neutralizing gas (oxygen) into the gas leak detection room while continuously comparing the sensor value to the given condition and the threshold value and operating according to their conditions. Either the sensing value is less than the threshold value, or it does not satisfy the condition that the alarm and evacuation systems do not respond or do not initiate the process. The sensor value is then continuously read and checked to see if the condition is satisfied or not.

The MQ-7 sensor is used in this method to detect carbon monoxide. When the process begins, the sensor's value is read as the first step. The MQ-7 gas sensor's sensitive material is SnO_2, which has lower conductivity in clean air. It discovers by strategy for high and low-temperature cycles and distinguishes CO when low temperature (warmed by 1.5V). Along with the gas, the conductivity of the sensor increases. It cleans various gases adsorbed under low temperature at the point when the high temperature (warmed by 5.0V) is reached. The MQ-7 sensor value is fed into the DAQ as analog data. With the help of DAQ, analog data sends information to the computer, which then initiates the next step in the process. Compare the system's given levels, which are safe, medium, and dangerous. It then compares the available value to the system to determine whether the given conditions are met. The DAQ sends the value of MQ-7 to the computer, which then sends the system signal to the output devices to run. The computer output signal has a 5V DC and a 12V DC voltage. The relay switch and the alarm system are powered by 5V DC. 12V DC power is supplied to the exhaust fan and solenoid valve. When the sensor value is less than 9 PPM, the condition is safe. The green light illuminates as if it were present, while the sensor value is still being read, and the system compares whether the sensor value is less than 9 PPM or greater than 20 PPM. At the same time that the yellow light flashes, the computer powers on the exhaust fan. Following that, DAQ sends the sensor value to the computer. That has to work with the system's value, and it is currently in the position. If this level exceeds 20 PPM, the exhaust fan and solenoid valve will be sent to the gas to be neutralized by leaving the solenoid valve open. It continues with the process of comparing the statements that are followed by the values sent to the computer after the sensor value after the DAQ. We implemented this process with LabVIEW assistance and a small acrylic box factory setup.

IV. RESULTS AND DISCUSSION

The gas sensor's output is fed into the LabVIEW software. It is then followed by an analog meter and a graph to determine the extent of the gas leak. The comparison condition

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function will then be activated. It is then followed by a series of actions, including a controller for the fan, a controller for the solenoid valve opening because the gas insert was neutralized, and an alert sound, as well as a Message sending via Simple Mail Transfer Protocol (SMTP). The gas leak input is a gas sensor installed in the system that continuously detects the presence of gas. The level of toxic gases from the input gas sensor is continuously monitored by the meter. The output of the gas sensor is a digital value to LabVIEW.

Based on the Waveform chart, the given sensor value provides a graphical representation of the presence of the gas in the atmosphere. The threshold value is set for three conditions: less than 9 PPM, 9 to 20 PPM, and greater than 20 PPM. In general, a green light indicates that we are safe; no more toxic gas has been detected and displayed on safe. If the presence of carbon monoxide exceeds 9 PPM, the screen displays a message indicating that toxic gas is present, and the exhaust fan is activated. When the presence of gas reaches 20 PPM, it is dangerous, but not dangerously so. The yellow light begins to indicate a dangerous situation, as does the exhaust fan and the sound alarm. The neutralizing gas to be sent in the toxic gas leakage location (oxygen) is also implemented, as is the message alert. When the presence of gas exceeds 20 PPM, the situation becomes extremely dangerous. The red light begins to flash, the exhaust fan begins to run, the alarm sound, and the solenoid valve opens. The neutralizing gas to be sent in the toxic gas leakage location (oxygen) is also implemented, as is the message alert. The following preset will be used to implement the message alert: If the toxic gas level exceeds the threshold value, a message alert will be sent to higher-ranking officials and the Control Centre. First, the carrier network must be added, followed by the mobile numbers of the required individuals. The subject and body of the text will be predefined. The text message will then be sent using the SMTP outgoing mail server algorithm. This front-panel waveform chart, display, and message sending mobile number, analog meter, and indicating lights are shown, but the color of the indicating light and display message change. The message and light color changes are determined by the given condition.

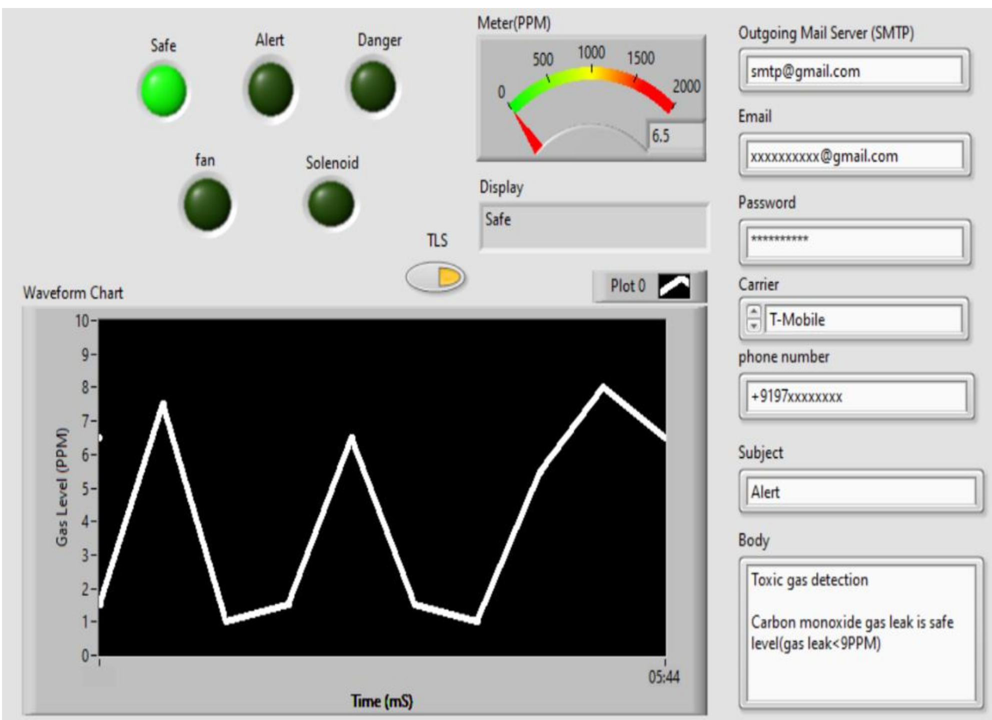

Figure 3: HMI of gas leak detection system displaying safe condition.

Figure 3 shows the HMI of the gas leak detection system displaying safe condition when it turns into green. The above figure indicates that the carbon monoxide level is below 9 PPM. The light that indicates that it is a safe zone and the analog meter displays the actual PPM level of carbon monoxide measured.

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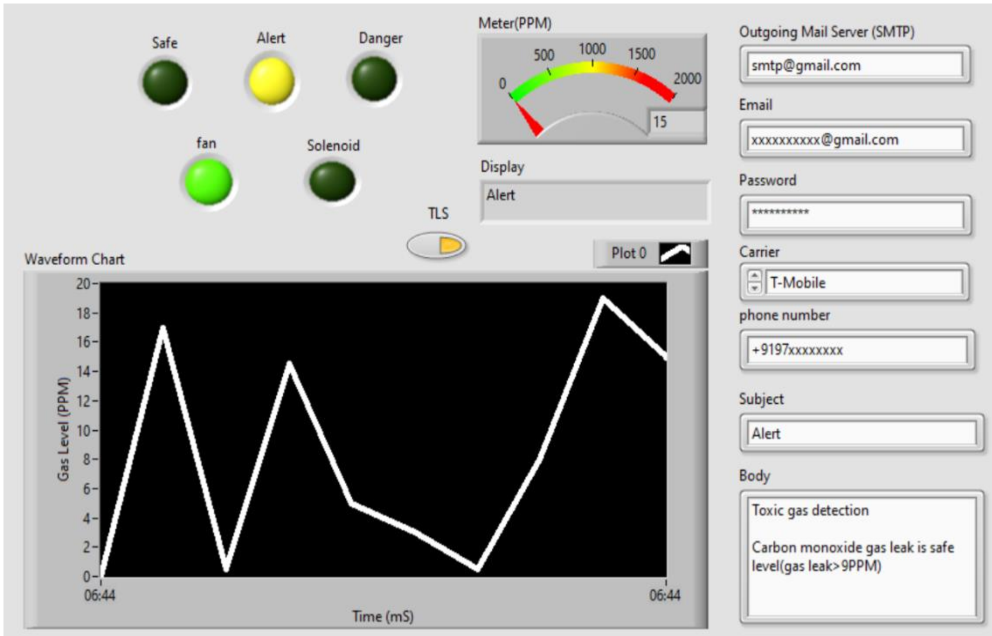

Figure 4: HMI of gas leak detection system displaying alert condition.

Figure 4 shows the HMI of the gas leak detection system displaying alert conditions. The above figure indicates that the carbon monoxide level is above 9 PPM and the carbon monoxide level is above 9 PPM to 20 PPM. The light is an indication is the alert zone and the analog meter displays the actual PPM level of carbon monoxide measured.

Figure 5: HMI of gas leak detection system displaying danger condition.

Figure 5 shows the HMI of the gas leak detection system displaying dangerous conditions. The above figure indicates that the carbon monoxide level is above 20 PPM. The light is an indication is the danger zone and the analog meter displays the actual PPM level of carbon monoxide measured.

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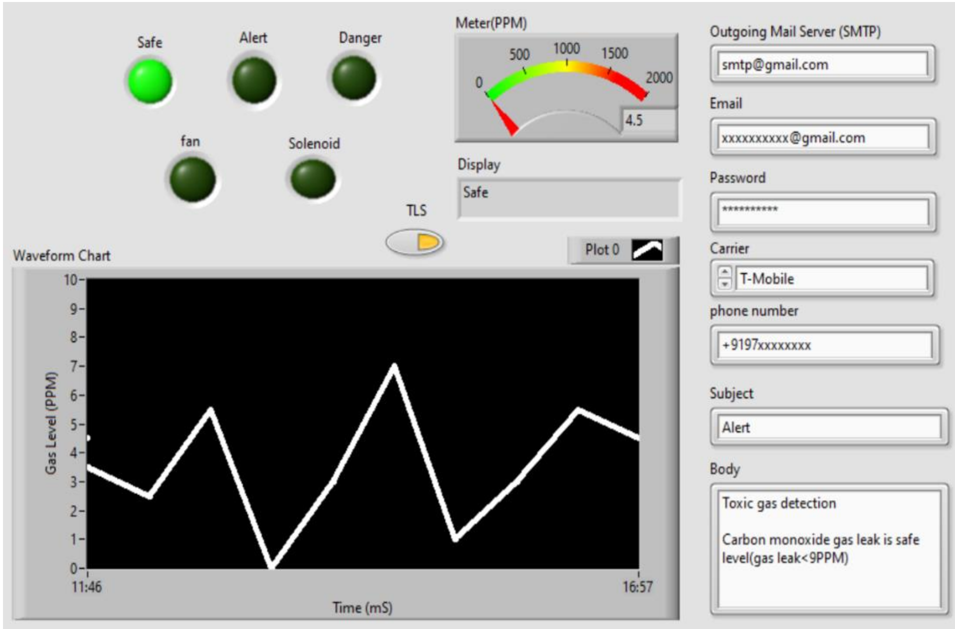

Figure 6: HMI of gas leak detection system displaying danger to a safe condition.

Figure 6 shows the HMI of the gas leak detection system displaying danger to a safe condition. The above figure indicates that the carbon monoxide level is above 20 PPM to below 9 PPM. There is a safe zone indicating this and the analog meter displays the actual PPM level of carbon monoxide measured.

VI. CONCLUSION

In this research article we have carried out the detection of gas leakage and monitoring for a 100sq.ft room. The leakage detection shows a significant improvement and control for the given environment. This monitoring and control can be implemented for an industrial environment using a network of sensors which can be monitored through IOT. Monitoring and control can also be incorporated with machine learning algorithms combined with graph theory so that monitoring and controlling will show the best results.

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