IJPRSE
Progressive Research

International Journal of Progressive Research in Science and Engineering
Volume-1, Issue-4, July-2020
www.ijprse.com

Effectual Industrial Hazardous Parameters Detection and Automatic Shut Off System

Krishna Kumari Mund[1], Karmila Soren[2]

[1]*PG Student, Department of Instrumentation & Electronics, college of engineering and technology, Bhubaneswar, Odisha, India.*

[2]*Assistant Professor, Department of Instrumentation & Electronics, college of engineering and technology, Bhubaneswar, Odisha, India.*

Corresponding Author: krishnamund20@gmail.com

Abstract: An Internet of Things (IoT) enabled technology is helping industries and workers build a safer environment than ever before. Therefore, this paper proposed the use of various sensors and automation systems using IoT to protect workers in extreme environments. This paper introduced the uses of an AT-mega 328 Arduino Uno board that will be connected to Bluetooth module (HC-05) to accumulates the temperature and humidity value from the DHT-11 sensor, methane, and other natural gases concentration using MQ-4 and MQ-2 sensors as well as one smoke detector (MQ-135) and update it into the online database using Nodejs. These sensors can also be used to send a realtime alert notification to an authorized person of the industry through Whatsapp or SMS service. For monitoring as well as controlling purposes, one website is created and hosted using hypertext markup language (HTML), cascading style sheets (CSS), and javascript (JS) that will help to provide an actual essence of IoT. The system can also trigger an evacuation alarm using a buzzer when fire or smoke is detected by the smoke detector or when a gas leakage is detected. It also uses a safety shutdown solenoid valve which includes the emergency shutdown of valves if gas leakage is detected through the pipeline.

Keywords: Arduino Uno, Gas sensor and smoke detector, Solenoid valve, Temperature and humidity sensor.

I. Introduction

The industries like biomedical, agricultural, pharmaceutical, chemical, oil and gas industries are considered as the foundation of general and economic development. The Internet of Things is very important for these industries because most of the industries work in remote areas so it's very useful to get information and data back from sites. The IoT gives the ability to do this at a low cost and give access to information and technology. The Internet of Things is the platform where technology exists in small packages and that communicates in real-time back to a cloud through which we can analyze the data. The combination of the industrial safety systems and the Internet of Things gives us the capability of putting smarts where we typically would have to put people. This technology is used to make sure to best protect the staff from a health and safety perspective. This system is designed to be a multi-sensor platform and effectively it gives a combination of automation, connectivity, real-time control, and real-time visibility. It has allowed the system to simplify everything into one interface and improves the safety and reliability of the industry. These sensors can also be used to send a real-time alert to site personnel. These automatic notifications resulting in faster response to help reduce the risk of compounding injuries and in an emergency situation the workers can effectively and efficiently evacuate the worksite.

Asnor et al. [4] discussed the design and implementation of a wireless module to detect the leakage of gas. When the gas leakage is identified by this module, the system is going to be initiated. Simultaneously, it turns on a device like a fan or exhaust to clear the pollutants from the air. Kallappa et al. [7] employed the Internet of Things (IoT) to implement the sensor interface device that is used for the sensor data acquisition of industrial Wireless Sensor Networks (WSN). By combining this device with the novel and fresh ARM programmable technology, it can detect the parameters like Temperature, humidity, and gas present inside the

International Journal of Progressive Research in Science and Engineering
Volume-1, Issue-4, July-2020
www.ijprse.com

industry. Karthik Srinivas et al. [8] demonstrated a monitoring system for a hazardous atmosphere and developed a more safe and secure system to control emergency actions that mainly focuses on some important parameters: temperature, fire, gas leakage, and mobile detection. P.Dinesh Kumar et al. [9] developed a monitoring system for the industry to monitor the hazardous conditions remotely from anywhere using IoT. It is implemented in a way that it can send alert SMS to an authorized person in case any emergency took place inside the industry.

The main objective of this paper is to develop a safety system that is able to monitor the vital statistics of the workplace as well as staff present on-site and pass the data up to the cloud to analyze it and to give the statistics about what's going on on-site through their analytics. This takes people out of harm's away and leverages the technology to give information and data. The system can also trigger an evacuation alarm when fire or smoke is detected by the sensors. It is the technology that proactively wants workers from getting too close to industrial equipment and hazards. Keeping all these in mind, this paper provides the solution to design a low cost and safety system which includes both hardware implementation and corresponding software application for real-time purposes.

II. Methodology

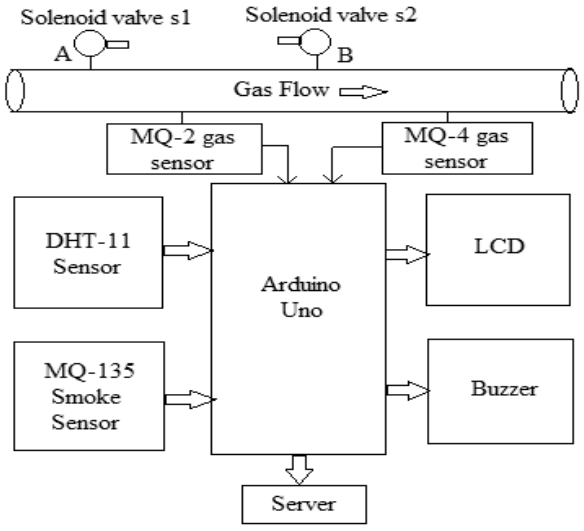

Fig.1. Block diagram of sensor module with Arduino

The hardware unit of the prototype of the system (Fig.1) consists of an Arduino Uno (Atmega328) microcontroller as the main processing unit and different sensor units that consist of temperature and humidity sensor, smoke sensor, and gas sensor. For the alert and automation systems, it uses one buzzer and multiple gas solenoid valves respectively along with an LCD display.

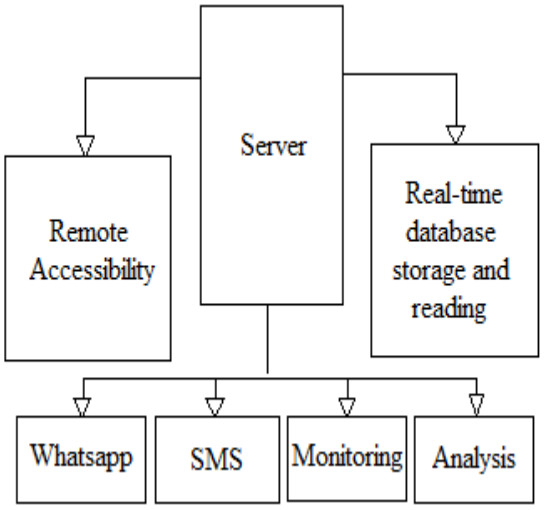

Fig.2. Block diagram of server module

The designed system is mostly the combination of three individual sections. They are:

A. Detection and Monitoring Section

B. Alerting and Notification Section

C. Elimination and Precaution Section

A. Detection and Monitoring Section

This section consists of different sensors like temperature and humidity sensor, smoke sensor, gas sensor, and one LCD. These sensors are used to detect any hazardous parameters inside the workplace. All these modules are combinely responsible for continuous monitoring of different parameter values such as temperature, humidity, smoke level, and gas concentrations. Also, one server is used that takes care of handling the Arduino output and converts the readings into graphs and tabular structure. The

readings are based on real-time operations so it is easy for the supervisors and workers to keep track of all the activities that took place in the workplace.

B. Alerting and Notification Section

This section consists of a server that is responsible for sending the alert notification to the concerned department or person via Whatsapp and SMS. Here, two gas sensors are connected through the solenoid valves (s1 and s2) which will continuously monitor the leakage in the gas pipeline from point A to B, and if there is any leakage detected or any smoke is detected due to the fire outbreak, it will give a signal to the microcontroller. The microcontroller will activate the buzzer or alarm to notify the workers and automatically turn off the gas supply using a solenoid valve and helps in removing the leaked gas by turning on the exhaust/fan and in case of smoke it will turn on a sprinkler to prevent any fire due to electrical circuit malfunction and then by using the server system, it will send an SMS to the authorized person alerting them about the situation.

C. Elimination and Precaution Section

This section consists of a specific and unique type of valve termed as a gas solenoid valve which is having similar characteristics to other valves but this valve has its own inbuilt motor and this gives automatic control (On/Off) to the valve. A relay is also used which provides an automatic shutdown system for the valves in emergency situations like gas leakage. To remove the leaked gas an exhaust/fan will be connected. Similarly, a water sprinkler can be used when smoke is detected by the sensor due to any fire outbreak. The sprinkler can reduce the fire up to a certain limit. This whole process will be controlled by the Arduino Uno controller.

III. Software Used

HTML, CSS, JS, Node.JS, and C language are used for achieving desired results with some libraries like Twilio for WhatsApp usage and more. HTML, CSS, JavaScript are used to design and style the web pages and to display the parameter value in the form of graph and tabular structure. Node.JS takes care of handling the Arduino output and converts the readings into graphs and tabular structure.

The node server also takes care of sending the alert message/notifications to the authorized person. The readings and activities are based on real-time operations. And the last one Twilio is used for sending the notification to the user/employee through WhatsApp and SMS in case of emergency.

IV. Result and Discussion

The system is designed and tested under realistic working conditions. Amongst other conditions, it advanced the existing manual efforts of planning illuminated work environments with automatic data collection that is then compared to as planned data. To facilitate this, the system used the Bluetooth module and server system. Different sensor modules are used to gather environmental data that are able to conduct measurements of temperature, humidity, and air quality. Once these components are assembled we get what we call the smart. With this solution, we can issue real-time warnings to workers.

A. Hardware Implementation

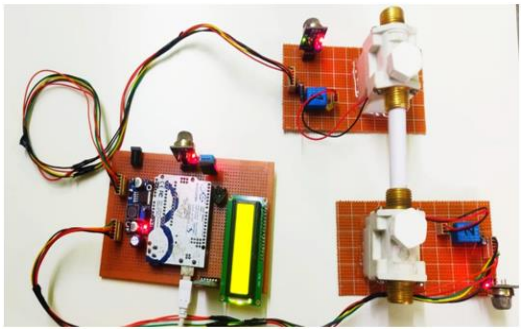

Fig.3.Hardware setup

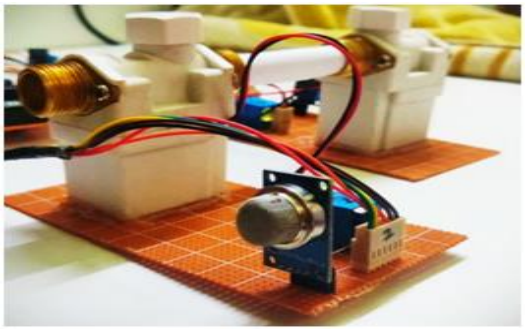

Fig.4. Solenoid valves with gas sensors

International Journal of Progressive Research in Science and Engineering
Volume-1, Issue-4, July-2020
www.ijprse.com

Fig.5. LCD display for updates

B. Web Server

For better analysis and visualization, various graphs are plotted using the server which gives a clear idea of the situation. All the data are stored on the local server. Using this data graphs and tables are constructed for all three parameters. For temperature, humidity, and air quality three representative graphs for 24-hour continuous observation are presented. Thus, the designed system gives better results. This graph will tell what the minimum and maximum readings recorded on a particular day. It also shows the time parameter and the reading will be recorded and updated every sec. The data in the table will be updated after every 5 readings.

The readings collected are displayed in the browser in below graphical format.

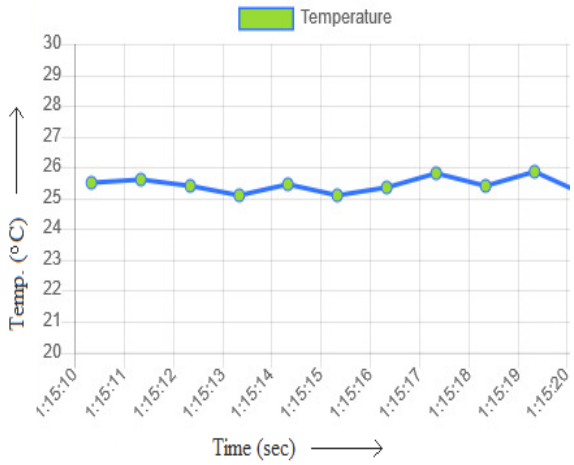

Fig.6. Temperature graph displayed in the web browser

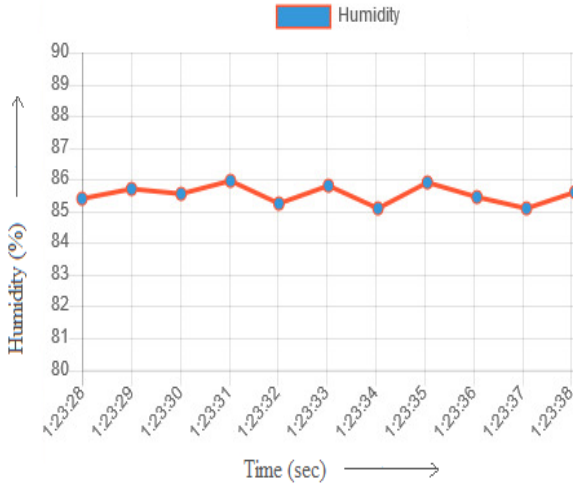

Fig.7. Humidity graph displayed in the web browser

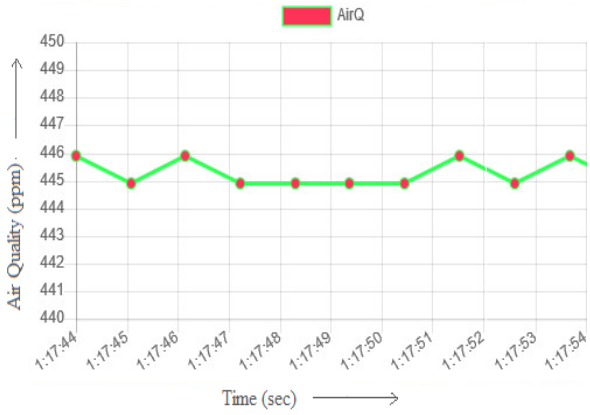

Fig.8. Air quality graph displayed in the web browser

For better understandability, these readings are displayed in a table with conditional formatting as well.

Table 1: Readings in Tabular Form

Temperature	Humidity	Air Quality
25.77	85.77	446
25.5	85.5	445
25.4	85.4	445
25.21	85.21	445
25.18	85.18	446

The cells in white indicate that readings are normal and the ones that are in gray indicate readings are more than preset threshold values and they need attention. The graph and above table keep updating continuously with the latest readings. For our illustration, here we are sending Whatsapp notifications using Twilio. An example is described here which shows the delivered notifications for excess temperature,

Fig.9.Sample Whtasapp alert notification

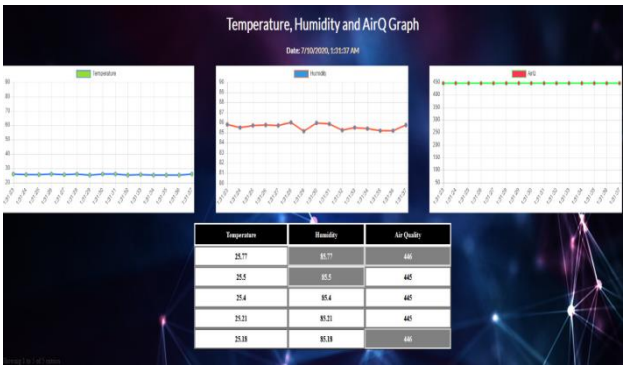

Fig.10.Resultant graph and table of the proposed system in the web browser

V. Conclusion

This system can be successfully applied mainly to fulfill three important aspects in the industries: monitoring of different parameters like temperature, humidity, and air quality in real-time, detecting various hazardous situations inside the workplace before it becomes dangerous, and lastly automatic control systems. The designed system is of low cost, provides high security, reliability, and easily accessible. This proposed system can also provide complete automation solutions by using various sensors, control valves, control systems, and optimization software that helps the industry to run safely and to their optimum production. This system includes both software-defined environment and hardware optimized platforms and systems which truly enable the Industrial Internet of Things.

REFERENCES

[1]. N. Nithya, DR. S. Jayanthi (May 2015), "Arm based real-Time monitoring and controlling of industrial parameters using GPRS", International Journal for Trends in Engineering and Technology, 5(2), pp. 185-188.

[2]. Kunja Bihari Swain, G. Santamanyu, Amiya Ranjan Senapati (2017), "Smart Industry Pollution Monitoring and Controlling Using IoT", 3rd International Conference on Sensing, Signal Processing and Security, pp. 74-78.

[3]. S. Ramalingam, K.Renugadevi, M. Abirami (2018), "Smart and Secure industrial pollution monitoring and alert system using IoT", International Journal of Research in Advent Technology, pp. 283-288.

[4]. Asnor Juraiza Ishak, Sarmad Nozad Mahmood, Abadal – Salam T. Hussain (August 2019), "GSM Based Gas Leak Monitoring System", Periodicals of Engineering and Natural Sciences, 7(2), pp. 670-678.

[5]. Ravi Kishore Kodali, Greeshma, R.N.V., Kusuma Priya Nimmanapalli, Yatish Krishna Yogi Borra (2018), "IOT Based Industrial Plant Safety Gas Leakage Detection System", 4th International Conference on Computing Communication and Automation.

[6]. P. Kanaka Maha Lakshmi, P.S.G. Aruna Sri, P.Gopi Krishna (April 2019), "An IOT Based LPG Leakage Sensing and Alerting System", International Journal of Innovative Technology and Exploring Engineering, 8(6), pp. 1155-1161.

[7]. Kallappa, B. B. Tigadi (June 2016), "Industrial safety parameters monitoring in IoT environment", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 5(6), pp. 5511-5516.

[8]. Karthik Srinivas, Vinay M. Prabhu, Srikrishna and Suraj M (2017), "Industrial Safety Automation Using Iot", Int. Conf. on Signal, Image Processing Communication & Automation, pp. 347-352.

[9]. P.Dinesh Kumar, M.Umayal Saranya Mano, K.M.Umayaal, B.Subodhini, V.K.Abinaya (March 2017), "Industrial Monitoring using IoT", International Journal of Innovative Research in Computer and Communication Engineering, 5(3), pp. 5624-5629.

[10]. Mrs.R.Jayalakshmi (July 2018), "Iot Based Industrial Automation System Using Arduino Uno", International Journal of Advanced Research Trends in Engineering and Technology, 5(7), pp. 17-21.

[11]. Abhishek Sharma, Sudha Pal, Vaibhav Jain (March 2018), "IoT Based Smart Security System for Prevention of Industrial Hazards", International Research Journal of Engineering and Technology, 5(3), pp. 886-891.

[12]. Gayathri .K (2019), "Implementation of Environment Parameters Monitoring in a Manufacturing Industry using IOT", 5th International Conference on Advanced Computing & Communication Systems, pp. 858-862.