Industrial Fire Detection, Alert and Management System

Pavithra M[1], Boomeshwaran V[2], Chilakam Bindu Reddy[3], Danaendraraj R[4], Gayam Naveena[5]

[1]Assistant Professor, Department of C.S.E, Jansons Institute of Technology, Coimbatore, India

[2,3,4,5] UG Students, Department of C.S.E, Jansons Institute of Technology, Coimbatore, India

Abstract-Industrial fire detection, alert and management systems are critical in ensuring the safety of personnel and assets in manufacturing plants and other industrial facilities. This paper presents an abstract of an industrial fire monitoring and management system that employs advanced technologies to detect and mitigate fire outbreaks. The system consists of a network of sensors that continuously monitor critical areas of the plant for potential fire hazards, such as elevated temperatures or gas leaks. When a hazard is detected, the system alerts the plant's safety personnel through a centralized control panel or mobile devices, providing real-time information on the location and severity of the fire. The system also initiates automatic fire suppression mechanisms, such as sprinklers, to contain the fire until safety personnel arrive on the scene. Additionally, the system can provide historical data and analytics that can be used to improve safety procedures and identify potential hazards before they cause harm. Overall, an industrial fire monitoring and management system can significantly reduce the risk of fire outbreaks, protect personnel and assets, and improve overall safety in industrial environments.

Keywords-IoT, LCD Display, Arduino Board, MQ2 Sensor, DHT11 Sensor, Flame Sensor, GSM, ESP8266 WIFI, Power Supply, DC Water Pump, Buzzer, Relay.

INTRODUCTION

The Internet of Things (IOT) is a self-configuring and adaptive system consisting of networks of sensors and smart objects whose purpose is to interconnect all things, including every day and industrial objects, in such a way as to make them intelligent, programmable, and more capable of interacting with humans. All different applications involving IOT whether industrial, home etc. are governed and monitored over certain parameters which are implemented and executed by the user. Hence, their implementation and execution differ with the sets of parameters for execution which is specified or wanted by the user.

RELATED WORK

Siyuan song, Ibukun Awolusi presented an Industrial Safety Management Using Innovative and Proactive Strategies is becoming an emerging technology due to the rapid use of internet. Safety is considered a top priority due to its significance in safeguarding human lives and properties, especially in high-risk industrial sectors such as aviation, oil and gas, construction, transportation, steel manufacturing, and mining industries. These industries are plagued by workplace injuries, illnesses, and fatalities because of the dangerous work environments. As such, it is very vital to integrate safety into every work process in any industrial environment just like quality is built into products and services. It is important to establish and execute an effective safety management system to prevent the risks of irreversible accidents. This chapter begins with a background to safety management in industrial engineering and a discussion of the various issues of industrial safety management. It follows with an extensive description of existing and commonly used safety performance measurement methods. Several case studies are used to explain the methods and explore the important application areas relevant to most industrial sectors. The techniques and tools for safety data collection, analysis, and sharing are introduced together with their applications for safety management. The last section explains how emerging technologies can be implemented in most industrial sectors to enhance safety management.

Industrial work environments are often characterized by dynamic resources including interactions between mobile equipment and pedestrian workers. The

hazardous work environment characteristic of industrial facilities is evident in the high rates of workplace injuries and fatalities experienced regularly. These high-risk industries include construction, steel manufacturing, oil and gas, aviation, agriculture, forestry, fishing, and hunting, etc. For instance, the construction industry remains one of the most hazardous and unsafe industries with fatality and incidence rates considerably higher than the all-industry average in many countries. Incident statistics indicate that construction workers have consistently incurred more fatal injuries than in other industries. Despite the efforts to improve safety performance, the construction sector continues to account for disproportionate injury rates accounting for the most on-the-job fatal injuries. In the United States, construction remains the most hazardous industry in terms of the aggregate number of fatalities. Thus, innovative intervention strategies are being continuously explored by researchers and practitioners to enhance management controls as well as modify human behavior and work environment to improve construction safety. Steel manufacturing is one of the most hazardous industries because of its complex socio-technical system. The steel manufacturing process involves the use of high technology and physical labor, making safety management a complicated task. Members of the U.S. steel manufacturing industry continue to experience a significant number of injuries, illnesses, and fatalities. The combination of intricate technology and physical labor creates a complicated challenge for safety managers in steel manufacturing. The fundamental goal of measuring safety performance is to create and implement intervention strategies for potential avoidance of future accidents. Recognizing signals before an accident occurs offers the potential for improving safety; many organizations have sought to develop programs to identify and benefit from alerts, signals, and prior indicators. Traditional measures of safety performance rely on some form of accident or injury data, with actions being taken in response to adverse trends in injuries. Many organizations rely heavily on failure data to monitor performance. The consequence of this approach is that improvements or changes are only determined after something has gone wrong. In most cases, the difference between whether a system failure results in a minor or catastrophic outcome is purely a matter of chance. Effective management of major hazards requires a proactive approach to risk management, so information to confirm that critical systems are operating as intended is essential. Transitioning the emphasis in favor of leading indicators to confirm that risk controls continue to operate is an important step forward in the management of major hazard risks. Accurate safety performance measurement facilitates the evaluation of ongoing safety management and the motivation of project participants to improve safety.

EXISTING SYSTEM

No ways to detect un-even condition in industry. Manual intervention required for monitoring. CCTV used which only monitor but no Alert generation. Alert and their appropriate actions not present manually. Time consuming approach to detect and generate Alert Manually. Industrial-based intelligent smart emergency response system that can control security and safety of the industry intelligently within the minimum time and the design of a system using wireless sensor networks, fire alarm sensor, and human detecting sensor to address the problems with existing disaster emergency response systems in times of fire hazard. The system has decentralized control that can intelligently guide evacuees based on the detection of humans for removing them from industry to minimize the loss of human life and industrial assist. The existing system was able to secure the industry but not within enough time as the system was designed using various sensors but not as a single unit to address the problems in times of fire or any other. Each sensor was connected to the system separately and function individually which makes the system slow. The modified system can secure the industry intelligently within minimum time as the system is designed using different sensors as a single unit to address the problems in times of fire or any other.

DRAWBACKS

Requires an Internet connection for remote monitoring.

Some Prior knowledge of the system is needed for the Supervisor/Manager.

Installation should be done based on the range of the industry.

Impacting Load shedding.

PROPOSED SYSTEM

- Here we use IOT's such as temperature sensor, gas sensor, flame sensor.
- Temperature sensor senses the temperature, flame sensor senses if there is any flame and the gas sensor senses the gases present in the environment.
- The Web UI-Node Red will display the sensed values in the dashboard. Whereas IOT Board process the data from the sensors.
- if any changes detected in the environment then it will turn on the water sprinklers , exhaust fan and fire alarm.
- It will also send an emergency alert so that the registered user will receive a SMS and nearby fire station will be notified.
- It could provide the data analytics report to monitor the temperature periodically.
- It could also significantly reduce the environmental temperature inside the industry.
- Automatic fire suppression mechanisms, such as sprinklers, can be activated by the system in response to a potential fire hazard.
- These mechanisms can help contain the fire until safety personnel arrive on the scene and take over control.

MERITS

- Ensuring safety of personnel.
- Protecting Assets.
- Reducing Insurance Premium.
- Improving compliance.
- Enhancing Reputation.
- Reduce damage to property.
- Prevent harm to personnel.

MODULES DESCRIPTION

A module is a software component or part of a program that contain one or more routines. One or more independently developed modules make up a program. The project "IOT BASED INDUSTRYAUTOMATION" consists of two main modules they are,

- Hardware
- Software

HARDWARE:

1. ARDUINO UNO

The Microcontroller used here is an Arduino UNO. The UNO is a Microcontroller board based on ATMEGA 328P.

The ATMEGA 328P has 32kB of flash memory for storing code. The board has 14 digital input and output pins, 6 analog inputs, 16 MHz quartz crystal, USB, an ICSP circuit and a reset button. The UNO can be programmed with the Arduino software.

2. RFID

RFID TAGS:

These tags comprise of a semiconductor device for storage of its distinctive range and a coil that acts as an antenna for diverging its hold on information. It should or might not have electric battery relying upon its sort either active or passive severally. Passive tags are used that doesn't have electric battery. As presently because the tag comes within the RFID reader coverage vary, Reader emits radio signals which supplies power for passive tags and it re-emits the radio-based signal with information to the reader. Purpose of RFID tags is to unambiguously establish merchandise.

RFID READER:

EM-18 is employed that operates at 5volts DC and fewer than 50mA. The frequency at that it works in 125 kHz. It will cover a distance of 10cm. It ceaselessly emits RF signals throughout its range and whenever an RFID tag is within its area, it retrieves the knowledge held on within the tag. Purpose of RFID reader is to retrieve the merchandise information from their RFID tags.

SOFTWARE:

1. COLLECT

There are sensors all around—in our homes, smart phones, automobiles, city infrastructure, and industrial equipment. Sensors detect and measure information on all sorts of things like temperature, humidity, and pressure. And they communicate that data in some form, such as a numerical value or electrical signal.

2.ANALYZE AND VISUALIZE DATA

Storing data in the cloud provides easy access to your data. Using online analytical tools, you can explore and visualize data. You can discover relationships, patterns, and trends in data. You can calculate new data. And you can visualize it in plots, charts, and

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1. Convert, combine, and calculate new data
2. Schedule calculations to run at certain times
3. Visually understand relationships in data using built-in plotting functions
4. Combine data from multiple channels to build a more sophisticated analysis

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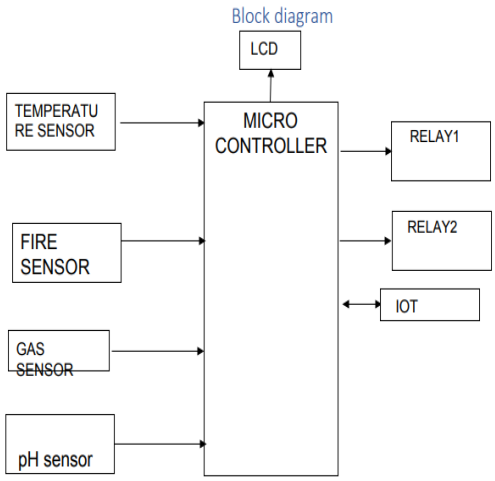
SENSORS

A sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes depends upon transducer in its environment and send the information to other electronics, frequently a microcontroller. A sensor is always used with other electronics.

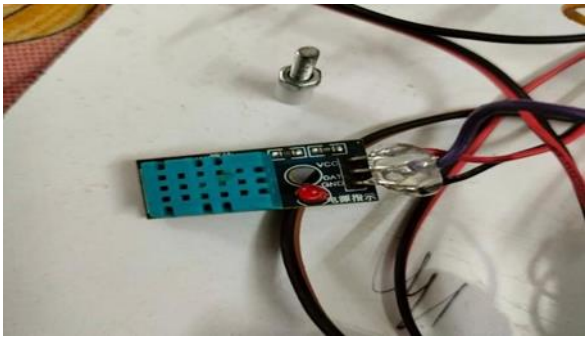


MQ2 Sensor

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke, and carbon monoxide. MQ2 gas sensor is also known as chemo resistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas.

DHT11 Sensor

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.



Flame Sensor

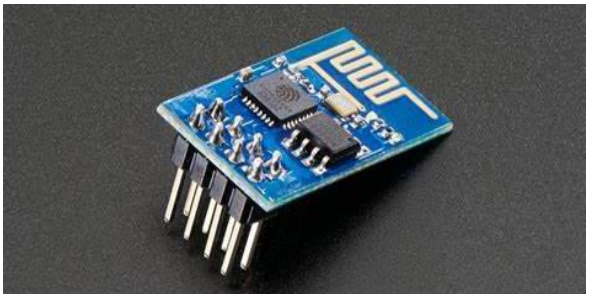
Flame Sensor module or Fire Sensor module is a small size electronics device that can detect a fire source or any other bright light sources. This sensor basically detects IR (Infrared) light wavelength between 760 nm – 1100 nm that is emitted from the fire flame or light source. The flame sensor comes with a YG1006 Phototransistor sensor which is a high speed and high sensitivity. Two types of IR Infrared Flame Sensor Module available in the market one having three pins (D0, Gnd, Vcc) and another one having four pins (A0, D0, Gnd, Vcc) both are can be easily used with Arduino and other microcontroller boards.

LED Display

An LED display consists of many closely-spaced LEDs. By varying the brightness of each LED, the diodes jointly form an image on the display. To create a bright colour image, the principles of additive colour mixing are used, whereby new colours are created by mixing light in different colours. An LED display consists of red, green and blue LEDs mounted in a fixed pattern. These three colours combine to form a pixel. By adjusting the intensity of the diodes, billions of colours can be formed. When you look at the LED screen from a certain distance, the array of coloured pixels is seen as an image.

ESP8266 WIFI

The ESP8266 arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability, and the amazing thing is that this little board has a MCU (Micro Controller Unit) integrated which gives the possibility to control I/O digital pins via simple and almost pseudo-code like programming language. This device is produced by Shanghai-based Chinese manufacturer.



DC WATER PUMP

Micro DC 3-6V Micro Submersible Pump Mini water pump For Fountain Garden Mini water circulation System DIY project. This is a low cost, small size Submersible Pump Motor which can be operated from a 3 ~ 6V power supply. It can take up to 120 liters per hour with very low current consumption of 220mA. Just connect tube pipe to the motor outlet, submerge it in water and power it. Make sure that the water level is always higher than the motor.

POWER SUPPLY

This is a simple approach to obtain a 12V and 5V DC power supply using a single circuit. The circuit uses two ICs 7812 and 7805 for obtaining the required voltages. The AC mains voltage will be stepped down

by the transformer, rectified by bridge and filtered by capacitor to obtain a steady DC level. The 7812 regulates this voltage to obtain a steady 12V DC. The output of the IC1 will be regulated by the 7805 to obtain a steady 5V DC at its output. In this way both 12V and 5V DC are obtained.

BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or key stroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices. Active buzzer 5V Rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to "plug and play. “A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric.

CONCLUSION AND FUTURE WORK

From the project that we have made we can conclude that our project "IOT Based Industrial Automation" covers all the necessary aspects required by an industrialist who wants to operate/monitor the entire industry conveniently and effectively. There is no factor to be changed as far as the safety of industry is concerned. This project would help a person to be notified about all the necessary actions that are important for him to be aware of and would not cause any harm to him in the industry or to the products which are manufactured. The cost of actual implementation is also considerably less compared to other designs, due to the availability of low-priced sensors. Future work will look into the actual implementation of the system and recording of results. The system can be further improvised by Industrial automation

The Industrial based intelligent emergency response system can reduce the casualties of the disaster in industries to prevent the employees, industrial machines and infrastructure by providing appropriate evacuation guidance. The system can also aid disaster fighting with the help of water sprinklers because it allows for a quick assessment of the disaster with decentralized control that can intelligently guide evacuees based on the detection of humans. Integration of existing industries need modifications in process layout. It could integrate and work along with the existing systems such as CCTV cameras and fire suppression systems. It could support further enhancement with image processing.

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