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FAULT MONITORING AND ALERTING SYSTEM FOR OIL AND GAS INDUSTRIES IN OMAN

Dr. Vimalakeerthy Devadoss*[1], Dr. Sivakumar Muthusamy[2], Dr. Muthukumar Selvakannu[3], Dr. Suresh Kumar Arumugam[4], Nanathakumar Chokkalingam[5]

[1]Lecturer, Electrical Engineering University of Technology and Applied Sciences, Nizwa, Sultanate of Oman.

[2]Lecturer, Electrical Engineering University of Technology and Applied Sciences, Nizwa, Sultanate of Oman.

[3]Lecturer, Electrical Engineering University of Technology and Applied Sciences, Nizwa, Sultanate of Oman.

[4]Technician, Electrical Engineering University of Technology and Applied Sciences, Nizwa, Sultanate of Oman.

[5]Technician, Electrical Engineering University of Technology and Applied Sciences, Nizwa, Sultanate of Oman.

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***Corresponding Author**
Dr. Vimalakeerthy Devadoss
Lecturer, Electrical Engineering University of Technology and Applied Sciences, Nizwa, Sultanate of Oman.

ABSTRACT

Oil and gas industries are the most revenue generating industries in Oman. With the presence of plenty of oil resource Oman government continuously concentrates on using new technology for the purpose of increased production and safety measures. Since oil and gas are highly flammable, it is often required to have high quality of safety measures inside the oil and gas processing industries. Therefore, Industrial fault monitoring system is very important to protect against any hazardous situation. In this project, an efficient protection system is proposed to easily identify gas leakage, smoke, increase temperature and flame using intelligent sensors. In addition, the proposed system will have alarming system to alert for safeguarding and protective measures. Arduino is used as the micro controller to get the data from the sensors. Arduino is

programmed to check the data against pre-defined safe levels. Arduino issues alerting through LED and Buzzer to take necessary action.

KEYWORDS: Arduino UNO, Gas sensor, Smoke sensor, Temperature sensor, Flame sensor.

INTRODUCTION

Industrial fault monitoring system is very important because that keep our system work well and staff and people who are working in that industrial in safe side. By this system, it is easier to identify for any gas leakage or smoke and if any temperature is high by alarm and it is possible to see all data signal. In industries, in case of any fault, the total plant will be alerted and the occurrence of accident can be prevented.

Oil and gas industries are the most revenue generating industries in Oman. With the presence of plenty of oil resource Oman government continuously concentrates on using new technology for the purpose of increased production and safety measures. Since oil and gas are highly flammable, it is often required to have high quality of safety measures inside the oil and gas processing industries. Oil is subjected to vaporization if overheated and has the capability of emitting hazardous gas. If sufficient precautions are not taken it well lead to very dangerous accidental situation. Considering the above facts, in this project an efficient security system is proposed that can measure the temperature, gas emissions and smoke emissions of an oil tank that can alert the operator in case of any values going beyond the safer level.

In this research work, Arduino is used as a micro controller to turn buzzer ON when any sensor sense the value above normal value. For sensing various parameters, MQ2 smoke sensor and MG811 gas sensor and DHT11 Temperature, sensors are used. This project is proposed with creation of a model that can measure smoke, gas and temperature, and then the LED and buzzer will turn on depending on the sensors by value.

With the temperature and humidity sensor complex, the DHT11 Temperature and Humidity Sensor, MQ2 smoke sensor and MG811 fuel line sensor offers a calibrated virtual sign output. Its generation gives an excessive stage of dependability and long-time period stability. It is of notable quality, blessings consist of brief reaction, anti-interference capability, and excessive fee overall performance.

BLOCK DIAGRAM

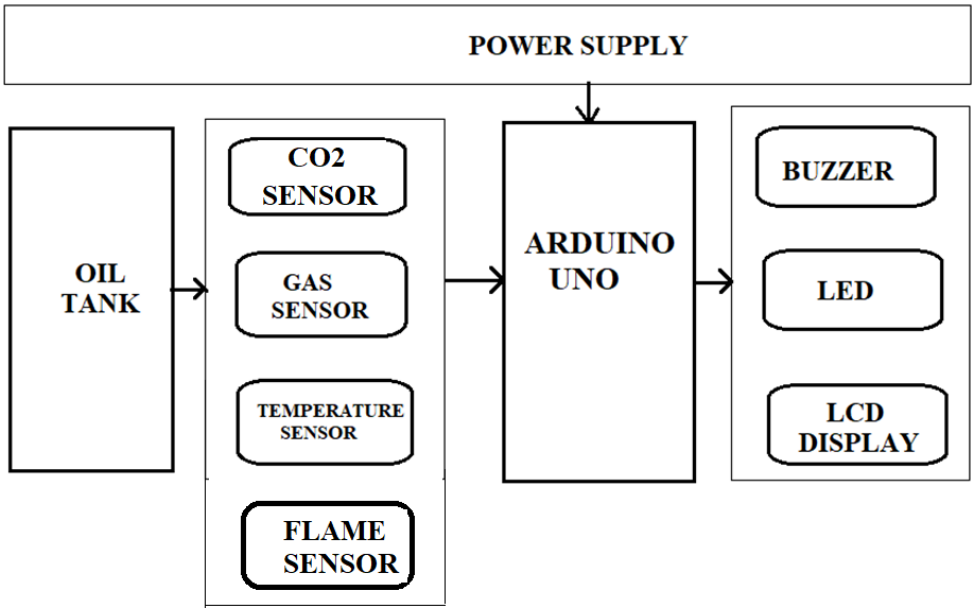

Figure 2.1 Block diagram of the project.

Block Diagram Description

Oil Tank: Oil storage tanks serve as a staging area to collect crude oil in several stages of production. Storage tanks are also used as a holding area for crude oil before the refining process and they hold refined products after it is processed.

Gas Sensor: A gas sensor is a one kind of device which is used to sense the presence of a hazardous LPG gas leak in service station, cars, storage tanks and homes. This sensor is attached to an alarm circuit to give an alert to the operators through a buzzer sound in the area where the gas leak is occurring.

Co2 Sensor: Most of the oils emits CO2 during evaporation. These devices respond to the presence of CO2 in the oil tank. After the device has been activated, it will send a signal to the alarm system to perform the programmed response for that zone.

Flame Sensor: A smoke sensor is a device fitted to smoke alarms. A smoke alarm is designed to detect the presence of smoke in a home to alert the occupants that a fire has broken out. A smoke alarm contains not only a smoke sensor but also a loud audible alarm (85 decibels on average) to alert people in the home.

Buzzer: It is a tiny speaker that you can connect directly to an Arduino. You can make it sound a tone at a frequency you set. The buzzer produces sound based on reverse of the piezoelectric effect.

RGB LED: Visible RGB LEDs are used in many electronic devices as indicator lamps, in automobiles as rear-window and brake lights, and on billboards and signs as alphanumeric displays or even full-color posters.

LCD Display with I2C: A LCD display is a flat panel display that uses an array of light-emitting diodes as pixels for a video display. LCD displays are capable of providing general illumination in addition to visual display, as when used for stage lighting or other decorative purposes.

CIRCUIT DIAGRAM

The circuit diagram of Industrial Fault Monitoring System is is shown as below.

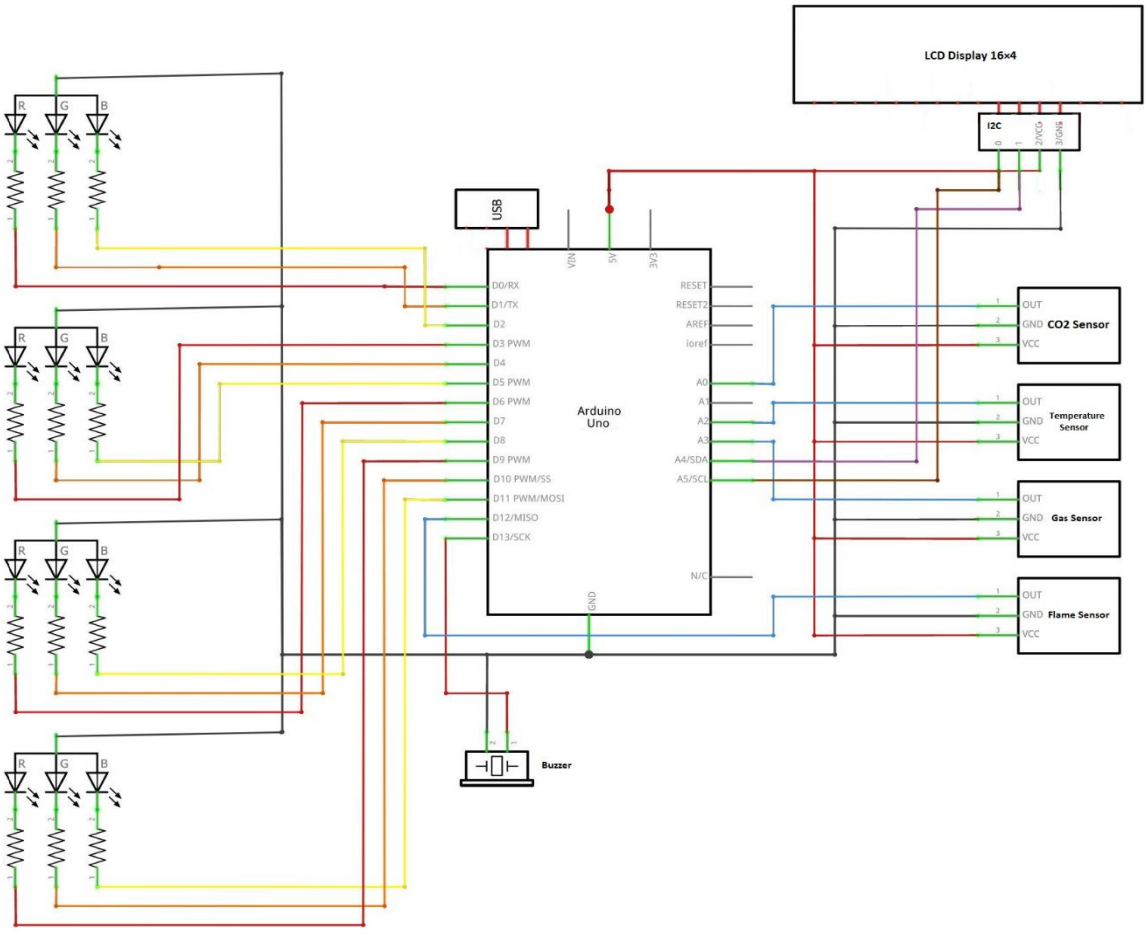

Figure 4.1 Industrial Fault Monitoring System Circuit Diagram.

Power Supply

The main component of the project is Arduino Uno. Arduino Uno can be powered using multiple input options. It can be powered using USB, 5V adapter or by using external battery to Vin pin. Arduino can be powered in the rage of 7 to 12V. Internally Arduino has voltage regulators that limits the operating voltage as 5 Volts.

Sensor Modules

This project is designed to detect the important hazardous levels of gas, Co2, Temperature of vacuum inside the tank and the fire outside the tank. Different intelligent sensors compatible with Arduino are used. Following are the sensor connected in the circuit.

Gas Sensor – MQ2

Co2 Sensor – MG811

Temperature Sensor – DHT11

Flame Sensor - IR Flame sensor module

Micro Controller

Arduino Uno is used as Microcontroller in this project. Arduino is selected due to its flexibility and features like open source programming and easy connectivity. Arduino is the heart of this project that received data from all the sensors and checks the measured date with predefined safe fault values and issues alerting signal to output unit to protect the system

Output Devices

Following are the output devices used in this project to issue alert if the value of measured parameters exceeds the safe level.

1. RGB LED individual for each sensor
2. Buzzer common for all the sensors
3. LCD with I2C to show the measured values and status of sensors

Circuit Operation

Arduino receives power supply (5V) through USB port or 5V adapter. Sensors and output devices are powered using internal supply (5V) present in Arduino. For Sensing Unit, each sensor is connecting to analog pin to sends the data to Arduino. Smoke Sensor (MQ2) use A0 pin, LPG Gas Sensor (MG811) use A2 pin, Temperature Sensor (DHT11) use A3 pin and Flame Sensor use digital pin (D12) to sense the present of fire. Four RGB LEDs and Buzzer are connected in digital pins (from D0 to D13). Arduino will receives data from each sensor.

A program is written in Arduino software. In that, Arduino program will compares the actual data from sensor with pre-defined safe levels for each sensor. According to that LCD display will show if the seniors is normal or not with the data. If anything is above normal value then the Arduino sends signal to buzzer to alert and LED will change from green to red. Buzzer will turn of and LED change from red to green if the sensing value back to the safe value.

Initial Checking

Arduino is programmed to initially assign the safe values of the oil used. These values can be adjusted based on the oil used, atmospheric conditions and safety levels of that particular oil. Before reading the actual values Arduino sets all the RGB LEDs to green state and buzzer is maintained in OFF state.

Co2 Sensor

Arduino program initially checks the level of C02 present inside the oil tank using MG811 sensor. If the sensor value read from the sensor exceeds the safe value of 400 then the RGB LED alerts the operator by glowing RED. In addition, buzzer is turned on alerting the working place. LCD displays the value obtained from the sensor. The level of Co2 can be controlled if the measured values are known.

Temperature Sensor

It is very important to measure the temperature of air space inside the oil tank. Due to emissions and evaporations sometimes, excess of pressure may be created in vacuum space that can heat the oil inside the tank. DHT11 sensor measures the temperature of the vacuum. If the temperature exceeds the safe level of 28 then the RGB LED turns to RED, buzzer will be turned on and the LCD display gives the actual temperature measured.

Gas Sensor

Following the temperature sensor Arduino senses the level of the gas inside the oil tank using MQ2 Sensor. If the level of the gas measured is more than 600 then the RGB LED turns to RED, buzzer will be turned on and the LCD display gives the actual value taken using the sensor.

Flame Sensor

Oil is always subjected to explosion when is exposed to fire. Hence, flame sensor is introduced to detect any fire around the tank for safety. IR based fire sensor is used to detect

the flame level. In case of any small flame them RGB LED turns RED, buzzer turns ON and the LCD display shows the presence of flame around the tank.

RESULTS AND DISCUSSION

The project is tested for the working and accuracy of operation under different fault conditions. Different inputs are given under different conditions. The overall operation of the sensors and the alerting system is illustrated in the following table. As the Arduino is easy to program this project can be tested in different working conditions and with different oils. In the program, the safe values can also be adjusted according to the safe level of that particular oil and environment.

Table 1.0 Industrial Fault Detection Testing.

S.No		**CO2 Sensor ANALOG (Safe Value 400)**	**Temperature Sensor ANALOG (Safe Value 28)**	**Gas Sensor ANALOG (Safe Value 600)**	**Flame Sensor DIGITAL (Immediate)**
INITIAL CONDITON		0	0	0	LOW
RGB LED		GREEN	GREEN	GREEN	GREEN
BUZZER STATE		OFF	OFF	OFF	OFF
Within Safe Limit	**RGB LED**	GREEN	GREEN	GREEN	GREEN
	BUZZER	OFF	OFF	OFF	OFF
Exceeding Safe Limit	**RGB LED**	RED	RED	RED	RED
	BUZZER	ON	ON	ON	ON

CONCLUSION AND FUTURE SCOPE

Oman is well known for oil and gas industries. Oil and gas sector contributes the maximum revenue to Oman. As Oil is flammable, it is mandatory to have high security systems to avoid explosion and fire. In this project, an intelligent industrial fault monitoring system was designed and a mini working model is developed. In this project, selected parameters like Gas level, Co2 level, Temperature and flame outside the tank are considered and suitable sensors were used to measure the real time value. Arduino was used as a microcontroller that receives the real time information from the sensors, compares with prefixed safe values and issues alert signal to the output devices. To alert the fault levels, individual RGB LEDs are used that changes their colour from Green while normal function to Red during the fault

level. Buzzer was added, as the sound alerting device to take immediate action even the operator does not notice the LED signal. In addition, LCD display was also used to show the real values of the sensors to notify the values and status of the sensors. The designed project is found to be efficient in the operation and works effectively as per the design idea. This project is cost effective as Arduino is open source, easy to connect and program. This project can be used in any real-time environment by adjusting the safe levels as per the conditions of the industry and oil used.

Future Scope

The project is currently designed with the objective to be monitored by the operator to take safety precautions in case of any fault identification signal issued by the output components. This project can be extended to IOT to make the fault detection remote and can add precaution or protection systems to control the fault.

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