Development of an IOT Based Industrial Fault Detection and Diagnosis System

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A

bstract- **This paper has proposed an IoT based industrial fault detection and diagnosis system. The IoT (Internet of things) based industry protection system employing Arduino is intended to safeguard industries from losses brought on by accidents and monitoring the faults. Industrial accidents such as gas leakage causes fire resulting in significant industrial setbacks. Due to furnace explosions, electrical short circuits, or other circumstances, quick fire detection is also required. The proposed system uses flame sensor along with gas sensor to detect fire as well as gas leakage to avoid any industrial mishaps and prevent economic damage. The system consists of temperature detector to detect the high/low temperature, the phase fault detector (either single or three phases), voltage controller (high/low), and frequency monitoring. Flame and Gas sensors are also interfaced with arduino and LCD screen. The sensor data is constantly scanned to record values and check for fire, gas leakage and then this data is transmitted to online. The wifi module is used to achieve internet functionality. GSM module is sent message to specific numbers in case human operators aren't present in online always. IP camera monitor the whole system from anywhere in the world.**

Keywords-automation, fault detection, iot, safety, protection

I. INTRODUCTION

Now a days in industry lots of accident occur. There is a considerable potential of fire hazards in industries like petroleum, chemicals, oil, and gas, which might cause enormous destruction, loss of property, and most importantly, loss of life. It is crucial to have a mechanism in place that can keep the area secure and alert the relevant stakeholders within the allotted time if such an incident occurs. In our country also these types of accident are occurred. This project "Design and Implementation of Industry protection and fault monitoring system" can be reduces the accident and reduces the losses. The Internet of Things (IoT) industry protection system incorporating Arduino is a system created to guard against losses from incidents involving IoT.The system uses an Arduino to accomplish this. The system comprises of temperature, gas, and fire sensors interconnected to an Arduino and an LCD display. In order to capture readings and check for fire, gas leaks, or low/high temperatures, the sensor data is continuously scanned. This data is then provided online. In order to access the functions of internet, the Wi-Fi module is used. To attain the desired outcome, the IOT (internet of things) check server subsequently publishes this data online. By using GSM module if the authority persons are not available in online it will send a SMS of their mobile phone. So that they want to know about the accident. Here we have added the fault monitoring system where check & control the frequency, phase and voltage. Power supply networks are constantly expanding, and their dependability is more crucial than ever. The intricacy of the entire network consists of several components that are prone to phase failure and can disrupt the electricity supply to end users. For the majority of the world's operating industries, low voltage, high voltage, and low frequency all exist.

A. Project objectives

The prime objective of this study was to make sure the industry is accident free and reduce the loss of poverty and human life as well as to provide a healthy environment for the workers to work in. For that, the study also aimed to make the industry protection system wireless and to record defects and report observations and actions taken in relation to a specific defect to anticipated field engineers in order to make sure the fault is adequately removed from the system.

B. Literature Review

BhosaleKiran Uttam and Galande Abhijeet Baspusaheb (June- 2017) in their paper explained about the progress of IOT in Industrial Automation. The Internet of Things (IOT) is a network of tangible items or artifacts that are equipped with sensors, computer software and network connectivity to enable data collection and exchange. The emphasized that most significant criteria of residential and industrial security systems for individuals are safety against fire and raw gas leaks. Because different hazardous gases are processed in industries, it is crucial to focus on the security of the employees who work there. If a gas leak occurs, a standard security system notifies the employers by turning on a warning alarm. Within the internet network, this technology also makes it possible to take certain critical decisions from anywhere on the earth. Between the connected network and the network, Wi-Fi shield serves as a service point. ((Uttam et al., 2017)) Sagar Prem Lalwani, Mehakpreet Kaur Khurana , Swati Jaikumar Khandare , Obaid Ur Rehman Ansari and Dr. Sanjay B. Pokle brief about Monitoring and alerting system for industrial metrics based on IOT in their paper. Our world has become increasingly interlinked than we could have ever anticipated thanks to infrastructure technologies like the smart grid, smart houses, smart water networks, and intelligent transportation. The comprehensive understanding of these systems is typically based on the Internet of Things (IOT), whereby the entire physical infrastructure is closely associated to information and communication technologies through the use of sensors, and where intelligent monitoring and management can be

accomplished through the use of networked embedded devices. To share various forms of data, these equipments will be connected to the internet. ((Prem Lalwani et al., 2018)) These studies ascertain that the researchers controlled the parameters either on basis of IOT or GSM and this control was certainly dependent upon internet connection.

C. Methodlogy

The ultimate aim of our project is to give the risk-free environment of industry. In this project we will detect the Fire Gas and Temperature. Here we monitoring fault also where included phase failure, voltage up and down and frequency changing high or low. If any fault is detecting then it will give indicate by alarm and give information in online throw the server where all can know about the incident from anywhere in the world. In the mean-time the power will be shut down until recovering these problems.

1) Arduino

The ATmega328p (Arduino Nano V3.x) / Atmega168-based The Italian company Arduino.cc developed the Arduino Nano, a compact, adaptable, and breadboard-friendly microcontroller board. It is significantly smaller than the Arduino UNO despite having exactly the same functionalities. Even though this device's operating voltage is 5V, its input voltage spans from 7 to 12V. The Arduino Nano has 14 digital pins, 8 analog pins, 2 reset pins, and 6 power pins. Although each of these Digital & Analog Pins has been given a multitude of activities, its principal purpose is to be set as an input or output.

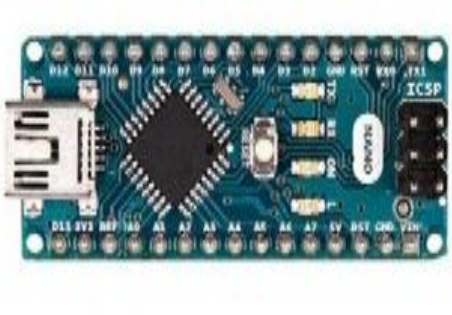

Fig. 1. Arduino Nano

2) Flame Sensor

A flame sensor is the sort of sensor that responds most strongly to ambient light. For that reason, flame alarms employ this sensor module. When the light source's wavelength is between 760 and 1100 nanometers, this sensor can detect flames. High temperatures have the potential to severely harm this sensor. So, a specific distance from the flame may be specified for this sensor's placement. With a detection angle of 600 degrees, the flame may be detected from a distance of 100 cm. The output of this sensor is an analog signal or digital signal. These sensors serve as a flame alert in fire-fighting robots. The operating voltage is 3.3V to 5V. An electronic circuit may be used to construct this sensor/detector employing an electromagnetic radiation receiver. This sensor employs an infrared flame flash technique, which enables it to penetrate ice, water vapor, dust, and other coatings.

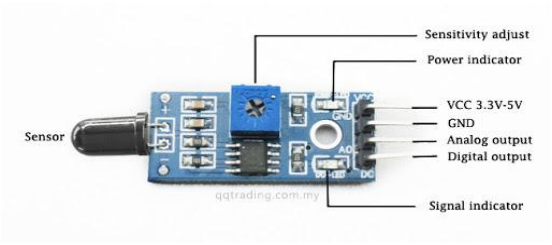

Fig. 2. Flame Sensor

MQ-2 Gas Sensor

One of the gas sensors from the MQ sensor family that is used most frequently, is the MQ2. As the detection is reliant on a transition in the resistance of the detecting element when the Gas and the material are in close proximity, it is known as Chemiresistors or Metal Oxide Semiconductor (MOS) type Gas Sensor. Concentrations of gas may be determined using a simplistic voltage divider network. This sensor consumes around 800mW and operates at 5V DC. It can detect **LPG**, **Smoke**, **Alcohol**, **Propane**, **Hydrogen**, **Methane** and **Carbon Monoxide** concentrations anywhere from 200 to 10000ppm. It is economical and appropriate for a variety of uses. This sensor responds to smoke and combustible gases. The smoke sensor is powered by 5 volts.

Fig. 3. MQ-2 Gas Sensor

3) Temperature Sensor (LM35)

LM35 is defined as a precession Integrated circuit Temperature sensor, whose output voltage fluctuates according to the ambient temperature. It has a privilege over linear temperature sensors calibrated in kelvin since the user is not needed to deduct a significant constant voltage from the output in order to attain effortless centigrade scaling. It is a tiny, affordable IC that can detect temperatures between -55°C and 150°C. It doesn't require any external calibration or trimming to provide typical accuracies of °C. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. LM35 can be operated from a 5V supply and the stand by current is less than 60uA. Any microcontroller featuring an ADC function or any type of development platform, such as Arduino, may effectively be interfaced with it.

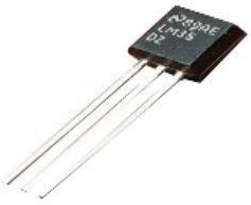

Fig. 4. Temperature Sensor (LM35)

4) Wi-Fi Module (ESP-8266)

With its comprehensive and self-contained Wi-Fi networking solve, either the ESP8266 hosts the applications or another application processor takes over all Wi-Fi networking functions. Wi-Fi networking operations to another application processor. When the ESP8266 acts as the sole application processor in the device and is hosting the program, it may initialize instantly from a source of external flash. To enhance system performance in certain programs and reduce memory needs, it incorporates an integrated cache. The ESP8266 is a highly accessible and economical tool for providing accessibility of the venture to the internet. The module may perform the functions of a station (connect to Wi-Fi) as well as an access point (generating hotspots), making retrieving and publishing data to the internet effortless and consequently making the Internet of Things as simple as feasible. Due to its extensive on-board processing and storage functionalities, this module may be inextricably linked to sensors and other application-specific devices through its GPIOs with the least amount of upfront development and execution-time loading. The ESP8266 features a self-calibrated RF that allows it to operate in all practical circumstances and eliminates the need for any extra RF components. Additionally, APSD for VoIP applications and Bluetooth co-existence interfaces are provided.

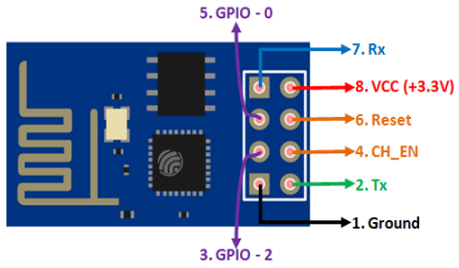

Fig. 5. Wi-Fi module

*5) LCD 16*2*

Liquid Crystal Display is referred to as LCD. It is a particular type of electronic display module employed in a wide array of circuits and devices, including mobile phones, calculators, computers, TVs, and other electronics. Seven segments and multi-segment Light-Emitting Diodes are the major applications for these displays. The liquid crystal molecule tends to untwist in case of receiving electrical current, which is the basic idea underlying LCDs. As a result, the angle of light travelling through the polarized glass molecules and the angle of the top polarizing filter alter. Consequently, only a little amount of light is permitted to flow through the polarized glass into a specific region of the LCD.

Fig. 6. LCD Display

II. RESULT AND DISCUSSION

After completing all implementation as per design, we turned power on then we confirmed that all the equipment works properly. The full mechanisms and tests are presented in the following sections. In the discussion, the result is analyzed and compared. As we have mentioned earlier that we have practically operated our device in different scenario. The final result was quite satisfactory. Now if we observe the data quality then we can see that the values from the sensors are quite accurate and to be more specific the sensors give us almost 100% accurate values.

A. Circuit Diagram

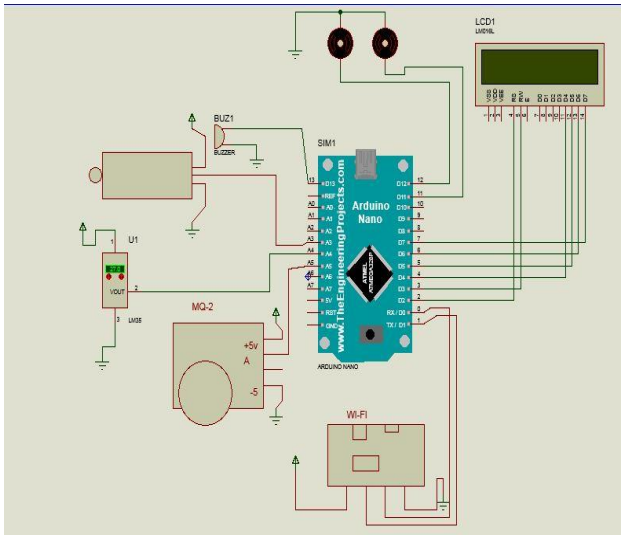

Fig. 7. Circuit Diagram of Industry Protection System

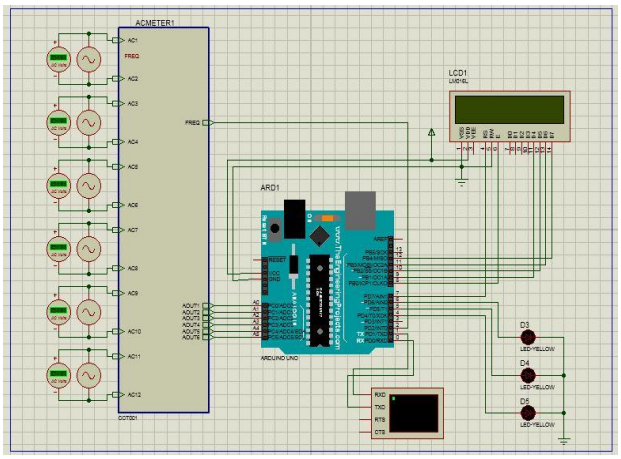

Fig. 8. Circuit Diagram of Fault Monitoring System

B. Working Procedure

First of all, if we consider the temperature, in the display we can see the normal or room temperature. Now we increase the temperature, we can see value of temperature also increasing. When it crosses the limit value then an alarm will be start and, in the server, it will be upload in the meantime the fan switch will start on. Then we consider the fire, when on fire the flame sensor detects the fire and give the alarm and, in the server, it will be upload and the display will show the F=1, in the same time the water pump will be start for extinguish the fire. Now the gas

sensor, in the display we can see the initial value of gas is show, when the gas is leakage in the industry the gas sensor senses the gas and cross the limit value then the alarm will on and, in the server, it will be upload and in the same time the exhaust fan will start. While all the information will upload in the server so anyone can monitor the system. By using the GSM Module, it will send a message some particular people which number will has been set up in the program. In the fault monitoring system, we can consider the phase, in the three-phase system if any phase has problem or the phase sequence have any fault, it will detect and stop the load. In frequency we have set a frequency range suppose in our country the frequency 50HZ. Now in our program we set the lower range is 48HZ and the upper range 52HZ. If the frequency of the system is high or lower than our set frequency then it will detect and stop the load. In the voltage also same first we will give the high voltage 235v and low voltage 190v in the program, if the voltage is high or low from our set voltage then it will detect and shut down the loads. Thus, the fault detection can save all loads of an industry.

1) Fire Detection

In this picture, we see that fire is detecting by flame sensor and in display show that F=1and alarm is on. After detecting fire, the motor is turn on.

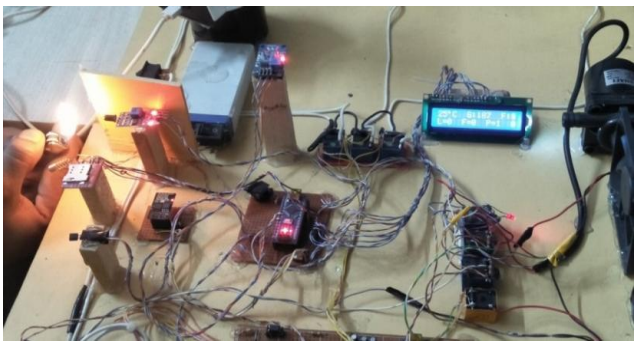

Fig. 9. Fire Detection System

2) Gas Detection

In this picture, we see that gas is detecting by gas sensor (MQ2) and in display show that maximum detecting value of the gas which unit is setup ppm and alarm is on. After detecting gas, the exhaust fan is turn on.

Fig. 10. Gas Detection System

3) Temperature Detection

In this picture, we see that fire is detecting by flame sensor and in display show that T=1 also show that the actual room temperature and alarm is on. After detecting temperature, the cooling fan is turn on.

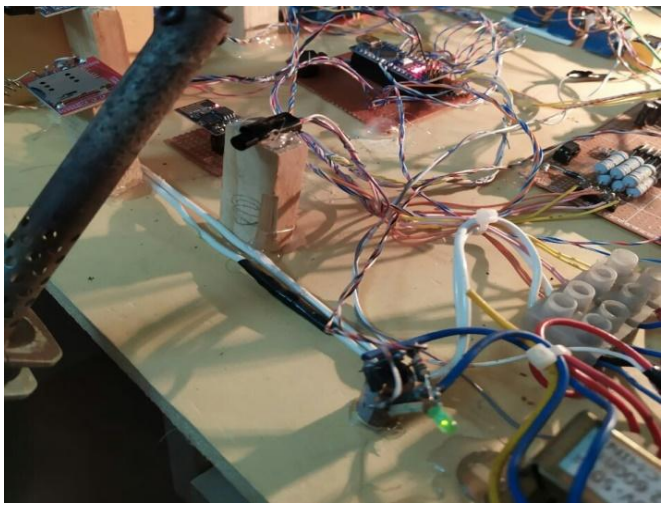

Fig. 11. Temperature Detection System

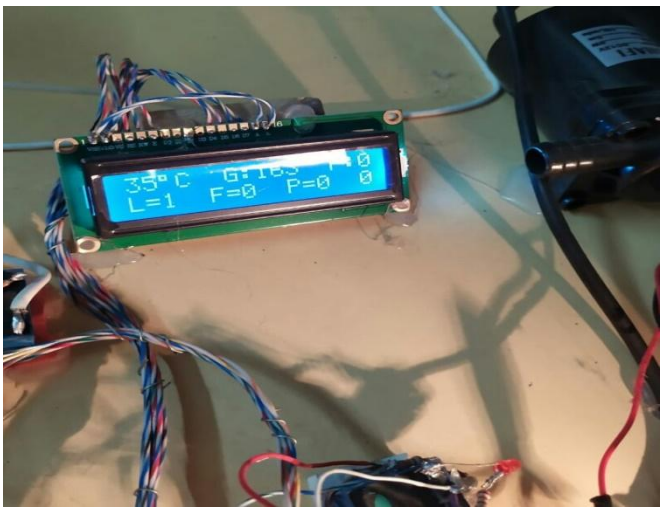

Fig. 12. Display Show the Rising Temperature

4) Fault Detection

At this picture, we are removing one phase, after outing the phase display show that the phase sequence error. After detecting this type of error all the load of the industry is turned off.

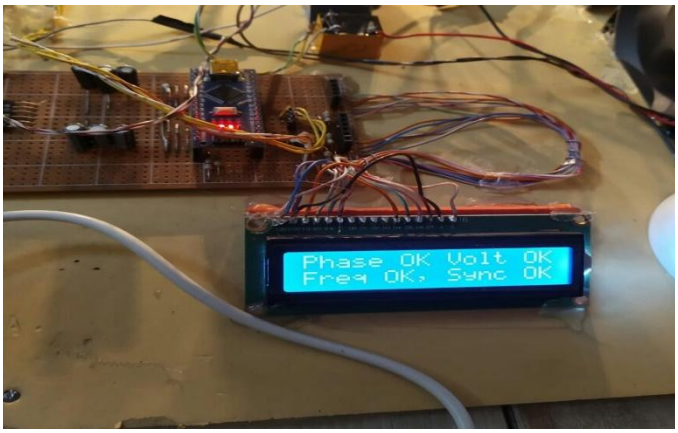

Fig. 13. Display Fault detecting system

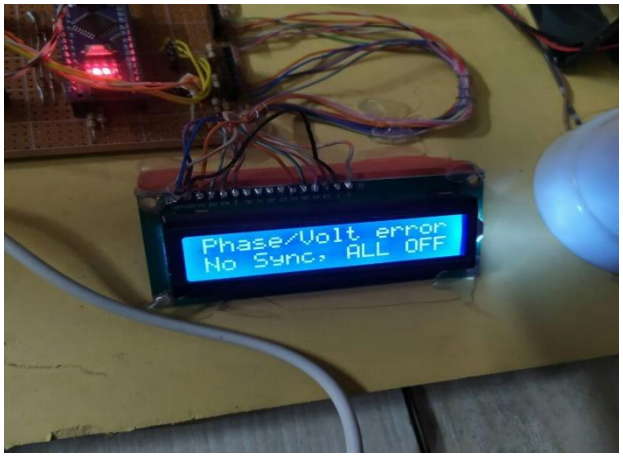

Fig. 14. After take out one phase display show the error and all load has been off

Fig. 15. Full Project

III. CONCLUSION

Industry is the main earning source of a developing country. But if the Industries are not safe and protected, peoples can't get more benefits from its. By using this protection system industry can be more secure. By using this system peoples can monitor protection from anywhere in the world, and if occurs any accident they can take action immediately. More over the owners of the industry can recheck the causes of occurs accident, what are the false and how it was happen. They can act on it and in future it doesn't happen again they can solve all the problems.

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