Environment Monitoring in Factories Using IoT for Employee Safety

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Abstract. One of the most important considerations in the industry, in particular, is employee safety. The value of fresh air for employee satisfaction and health cannot be overestimated. Industrialization in India has led to increased levels of pollution, making it more difficult to maintain adequate air quality. It is necessary to take into account the ongoing economic development and rapid changes in population. All these factors lead to increased air pollution. Hazardous gases such as carbon monoxide not only endanger the health of employees but also prevent them from escaping to the environment. Employees are responsible and want to work at their own risk. We offer a tracking system as a solution to this problem. Through this invention, we oversee the safety aspects essential to this industrial activity and ensure that we are aware of the environmental conditions. Based on a series of events, use surveillance systems to conduct scientific research.

Keywords: Safety, Industry, Monitoring System, Employee, Pollution Control.

1 Introduction

There has been a tremendous growth in the number of factories in all areas across India as a result of rapid industrial development. There are numerous issues that face factory workers who work in hazardous conditions.The Internet of Things is used to monitor the environment with the use of a microcontroller and multiple sensors to track environmental parameters [1]-[5]. It is essential to pay attention to temperature conditions and humidity levels in an environment. Temperatures of between 20 and 27 degrees Celsius and relative humidity of between 35 and 60 percent are ideal for people, as extremes in either can cause suffocation and hinder their efficiency.The majority of enterprises rely on heavy machinery and high-voltage electricity to run. Any deviation from typical operating circumstances could result in a probable health issue. As a result, we must continuously monitor the factory for indicators of

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any hazardous gases leakage. This is accomplished via sensors, which detect the presence of hazardous gases[6]-[8].

2 Problem statement

The existence of potentially hazardous and harmful equipment, as well as the chance of releasing hazardous gases, are all factors that impact workers in a regular workplace.At certain amounts of exposure, airborne pollutants in your facilities can impair your employee's health. It's also possible that poor air quality is affecting your bottom line. In facilities where the air quality is bad, productivity suffers.The Directorate of Industrial Safety and Health (DISH) was unable to assure employee safety on a consistent basis. Employees don't have conscious about their safety at workplace.Inspection conducted by safety department could not able to ensure the employee safety.The circuit diagram of the proposed system is shown in **figure 1.**

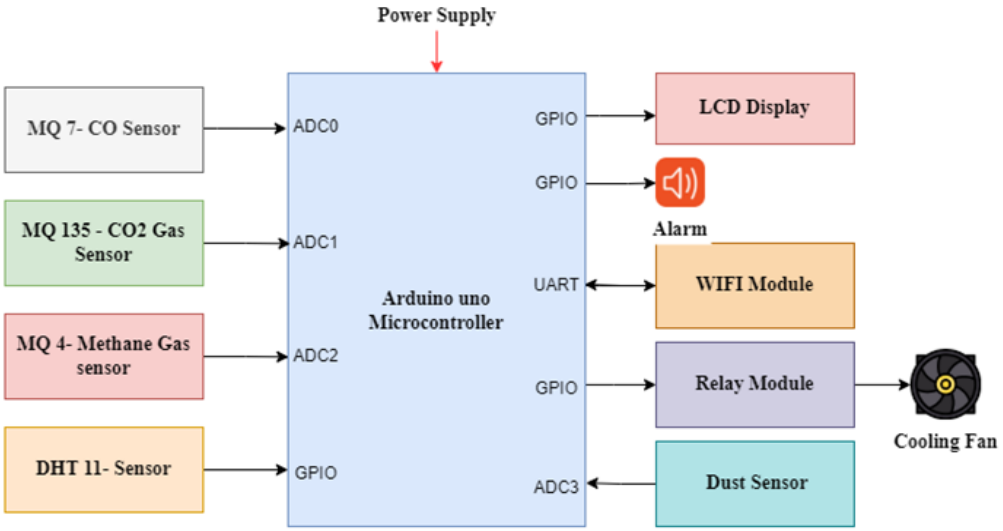

Fig. 1. Circuit diagram

3 Components

- Arduino UNO
- Optical Dust Sensor
- MQ7 – CO Sensor
- MQ135 – CO2 Gas Sensor
- DHT – 11 Sensor
- WIFI Module
- Relay
- LCD
- Power Supply
- Buzzer
- DC Fan

3.1 Arduino UNO

The Arduino Uno is based on ATmega328P that has been pre-developedwhich is a microcontroller. It has six ADC interfaces and 14 digital pins, along with six PWM signal pins. It has a crystal oscillator with a frequency of 16 MHZ. It can communicate with I2C, SPI, and UART. The USB connector is used for both power and the programming interface.

3.2 Optical dust sensor

GP2Y1010AU0F is an optical sensor system dust sensor. In this device, an infrared emitting diode and a phototransistor are connected crosswise. It detects dust in the air by sensing reflected light. It is particularly useful for detecting very tiny particles, such as cigarette smoke. It can also tell the difference between smoke and house dust based on the voltage output pulses pattern.

3.3 MQ7 – CO sensor

The MQ-7 sensor is used to detect carbon monoxide. The MQ-7 Sensor is sensitive to the effects of CO and has low-level conductivity in clean air. This is because the Arduino uses the sensor as an input to read and process the sensor data.

3.4 MQ135 – CO2 gas sensor

The MQ135 gas sensor is used to detect carbon dioxide. It has high sensitivity and lower conductivity in clean air. The MQ135 gas sensor module can interface with the Arduino Uno using ADC. It will have a fast speed, a long life, and a low cost of operation. When the modules are connected, they can be placed wherever we desire.

3.5 DHT – 11 sensor

The DHT11sensor measures the temperature and humidity level. The sensor features a separate NTC for temperature measurement and an 8-bit digital serial data output. As a result, no Analog to digital converter is required to detect temperature and humidity sensors. The Arduino Uno can be directly connected to the A DHT11 sensor module through a digital input.

3.6 WIFI module

The ESP8266 WIFI module connects the application to the internet and is also used in Internet of Things applications. It is able to connect to various embedded systems by using the UART interface. It is one of the least expensive products on the market.

3.7 Relay

A relay is an electrical switch that is controlled by another electrical circuit to open and close. The switch is actuated by an electromagnet to open or close one or more sets of contacts in its original configuration. Joseph Henry came up with the idea around 1835. Because a relay can operate a higher voltage circuit than the input signal, it can be thought of as a type of electrical amplifier in a general sense.

3.8 LCD

LCD display is used to show the value of sensor and its dimension is 16x2. It can connect with the Arduino Uno through the parallel interface. The data transfer will be fast when compared to I2C and SPI. It can be used to connect 4-bit or 8-bit microcontrollers.

3.9 Power supply

However, we run an Arduino Uno we want the power supply to run a module. The power supply can be connected to a USB, a power jack, or a battery. It will require 12 volts, and the Arduino Uno board contains an IC7805 regulator that can provide 5 volts and 3.3 volts to external peripherals.

3.10 Buzzer

The buzzer is used to indicate a dangerous situation by the sound of an alarm. It will operate at the minimum DC voltage so that we are directly connected to the digital output. The sensor will work using a pre-program once it reaches a certain level specified in the microcontroller.

3.11 DC fan

Fans are used to cool these components by drawing cooler air over them and pushing warm air away from them. Components must be kept within a certain temperature range to avoid overheating, instability, malfunction, and damage. By using this fan, each ICs heat can be removed. As a result, the component’s lifespan will be reduced.While most components could be cooled by natural convection (passive cooling), many current components require more effective active cooling.

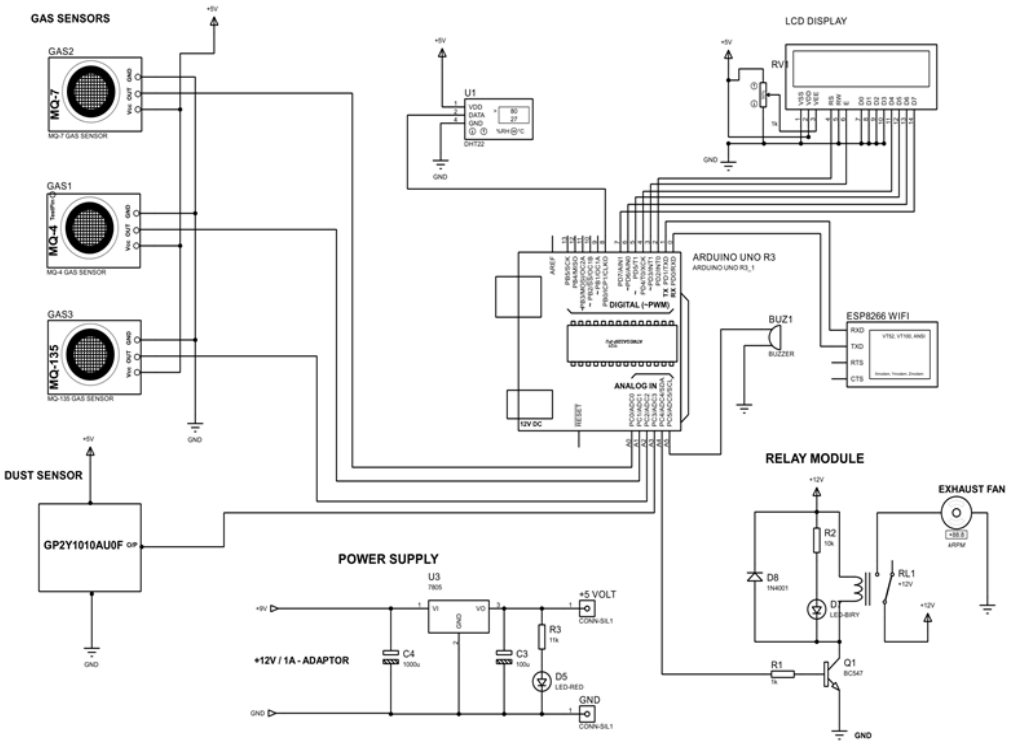

Fig. 2. Circuit diagram

4 Working

The circuit diagram is shown in **figure 2** in which MQ135, MQ4, and MQ7 sensors, as well as the LCD, Dust Sensor, and DHT11, all require 5V DC to operate and are attached to Arduino Uno R3 boards. The A USB port or a 12V converter can be used to power Arduino. The other modules voltage supply and ground pins are linked to the common VCC and ground. As a result, the Arduino board's 5V output powers the rest of the components. The DHT11 sensor employs both the resistive humidity measurement and the NTC temperature measurement components. The LCD on the Vehicle Control Unit is connected to the Arduino Uno 2, 3, 4, 5, 6, and 7 pins in 4-bit mode. The A4 and A5 pins on the Arduino are used to connect the fan and buzzer.

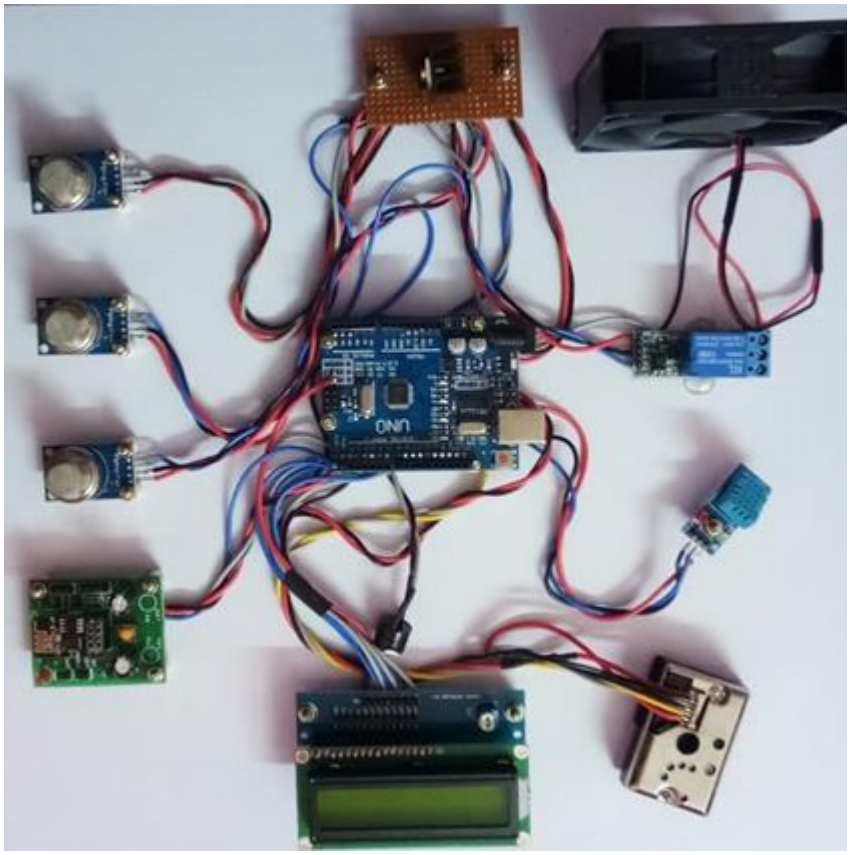

Fig. 3. Prototype.

Because it uses the Serial Port Protocol, the ESP8266 WIFI module must be connected to a microcontroller's UART (SPP). With +5V, connect the Rx pin of module to the MCU's Tx and the Tx pin of module to the MCU's Rx. The system's WIFI module is used to send data over TCP to an online server in order to monitor factory environmental parameters, which may be displayed as tables and graphs. When any of the above-mentioned monitoring parameters reaches a dangerous level, the system sends out an alarm and turns on the exhaust, giving personnel enough time to leave the hazardous area. The prototype model developed is shown in **figure 3**.

5 Results and Conclusion

The DHT11 is a single-wire digital humidity and temperature sensor that outputs humidity and temperature values via a one-wire protocol and reads temperature and humidity measurements via the Arduino's second port. Temperature, Humidity, Air Quality Index, Dust Density, Carbon Dioxide, Carbon Monoxide, and Methane ppm Levels are all displayed on the LCD display. The level will be monitored, and if it reaches a dangerous level, the system will send out an alarm and activate the buzzer. The buzzer will sound until the atmosphere returns to

normal. The system's WIFI module is used to send data through TCP to an online server *http://dreampixelz.in/22/iot3/* in order to monitor factory environmental parameters, which may be viewed as a table or in graphical representations.The web page data is shown in **figure 4 and figure 5.**

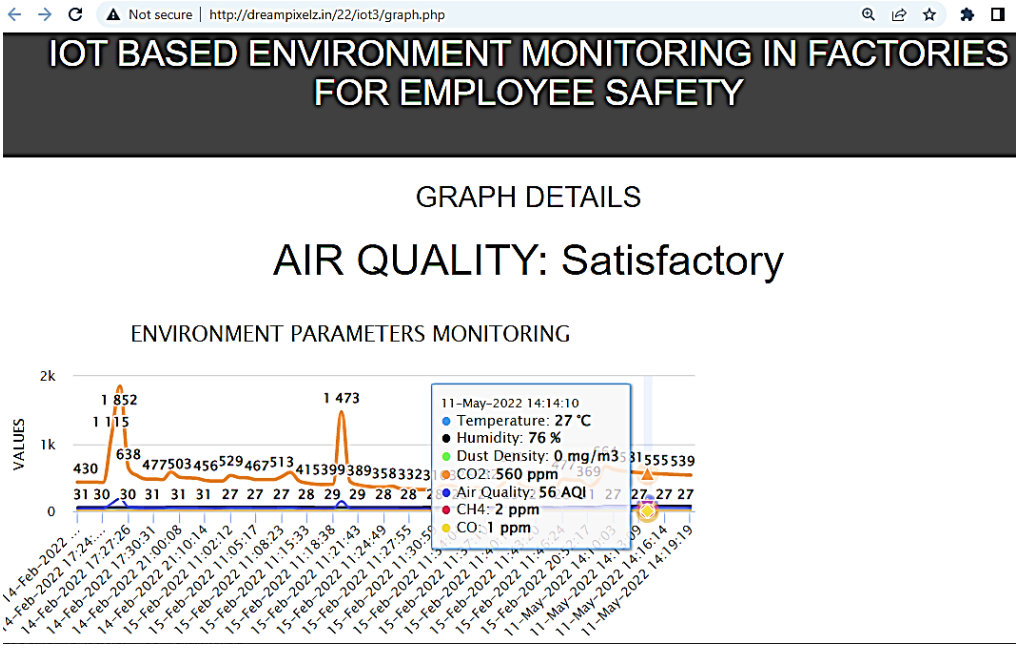

Fig. 4. Web page data

Through this analysis, we send the data to the server using IoT and used for further reference. The data is available for industrial purpose to monitor the environment safety of employees. The data from the cloud are fetched and represented in the tabular view and sketched with the linear graphs. These graphs help to identify the peak and drop of levels at a particular time period. The system's ultimate aim to maintain the atmospheric Air Quality Level in the environment.

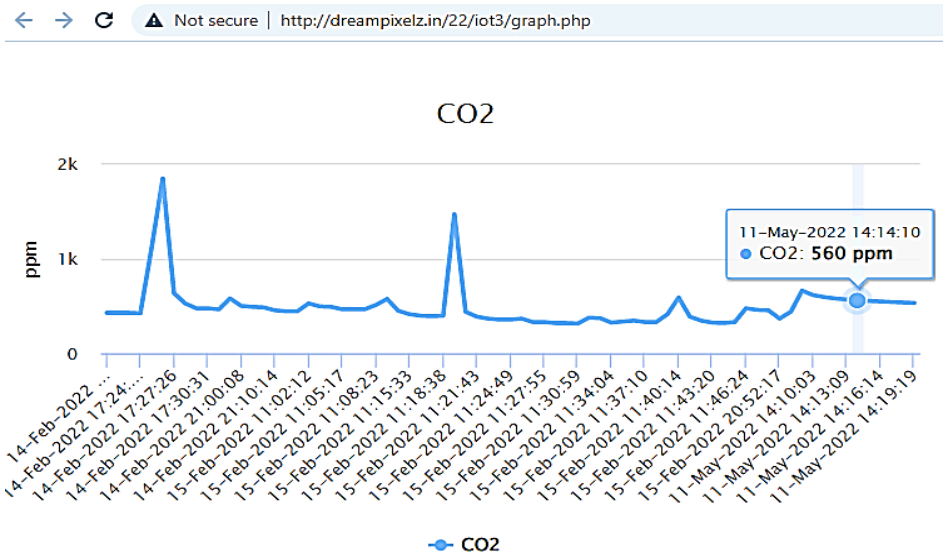

Fig. 5. Web page data

7 Future Enhancement

It can be upgraded to online monitoring and can be used to develop a model using Artificial Intelligence. The data will be collected from multiple industries and will store in cloud, it can be monitored by government as well as industry. It helps to Directorate of Industrial Safety and Health department (DISH). Admin access given to respective DISH officers and User access given to industrial people who regularly monitors the level.Cloud data are helpful for research purpose and able to predict the future using some algorithms.

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