Smoke Detecting System with Warning Alarm System Using Arduino

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1. Abstract:

The main target of this current attempt is to design, simulate, and implement Smoke Detection System for multiple purposes. This system employs a breadboard, 5v DC power supply, MQ-5 Smoke Sensor, Arduino Uno R3, Active Buzzer 5V, and 5v DC Motor, connecting wires jumpers. At first, all the hardware was connected and then we set up the essential pins. Then we wrote a program in the Arduino IDE for this system. The developed system mainly detects smoke from its surroundings. This circuit triggers the alarm system when smoke leaks are detected. This circuit primarily uses an MQ-5 smoke sensor and an Arduino to detect smoke leaks. This MQ-5 gas sensor is sensitive to detect the presence of risky Smoke leaks in vehicle, service station and storage tank environments. This sensor combines excellent sensitivity with fast response time. This low-level signal is monitored by a microcontroller, which sends a signal to the Sensor & send a message to LCD.

2. Introduction:

In our everyday lives, the environment and its condition are extremely crucial to our health even though those who affect the quality of life for all of Earth's inhabitants. As a consequence, climate and air quality issues in industrial areas are discussed in order to increase climate awareness and accountability for public and worker health.[1]

A smoke detector was designed to help humans in detecting the presence of dangerous smokes within an area in order to avoid catastrophic events from occurring. Nowadays, pressure sensors have been developed into a variety of detection systems, including such infrared thermal imaging and smoke leak detection. [2]

Smoke detector is typically a fire indicator device. It is usually used by commercial, industrial, and mass residential devices. Smoke detector is a device that giving alert when fire is detected (smoke detector). [3]

Fire incidents are common in factories, homes and markets in any country. Increased fatalities and wreckage due to inadequate firefighting equipment, lack of adequate fire alarms and emergency exits. When it comes to security issues, we don't take this for granted. Security is the degree of protection from danger or loss. In today's technology-filled world, people need the help of technology to give early warning signals and have enough time to avoid danger. Smoke Leaks were highlighted as hazards when designing this project. This is because both can lead to major disasters if safety procedures are not taken early. To minimize fire incidents, our project acts as a sentinel controlled from a central console room. A particularly sensitive smoke detector was used for detection. This gives the

microcontroller a high pulse to a pre-programmed input pin for the desired output signal. This project is about creating an alarm warning system. Used to detect the presence of Smoke. In the event of a Smoke, sensors used in the circuit will detect it and Warning Alarm will pop-up. A system that provides real-time notifications increases owner response time. This will provide immediate assistance in realizing the situation.

Keywords: Smoke, Smoke Leakage, Microcontroller, Arduino, Detection, Sensor, Alarm.

3. Objective:

The objective of this project is:

- To automatically detect smoke and make warning.
- To safe human life and resources.
- To provide automatic safety system for residence and working environment.

4. Literature reviews:

In the research by Angayarkanni. K [4], an effective forest detection was used to identify forest fires from spatial data related to forests. For the purpose of detecting fires, this method applies spatial data mining and artificial intelligence approaches. From the spatial data indicating the existence of flames, a fuzzy rule basis is developed for fire detection. To detect the fire zones, the digital images are split and transformed to YCbCr color space. Innovative framework for residential hearth detection was proposed by Lim et al (Lim, Lim et al. 2007). They developed the interval-message-ration (IMR) metric and evaluated their framework using it. They conclude by saying that the framework can be used for other types of disaster recovery in addition to fire detection.

A Fuzzy Rule Based Intelligent Security is demonstrated in another study by Joydeb Roy Chowdhury [5] to detect fires. This study examines the mechanism of the fire-catching process and puts it into practice utilizing hardware with a microprocessor and sophisticated fire-recognition software. A fuzzy rule-based intelligent early fire detection warning system was also used by the author. Without any doubt, an early warning before the defect will help prevent disaster if some preventative steps are taken.

An Author Hasibuan States that, If we set the value of sensor to 60, then its in the safe zone. If in the area of our environment sense any smoke in >=60 then the red light will turn on & in the range of >=160 then red & blue light will turn on & the exhaust fan will turn on start removing the smoke. When the smoke range is <60 then the green light will turn on & red and blue light will be turned off and also the exhaust fan will be turned off. [6]

No	Smoke Level	Green Led	Blue Led	Red Led	Exhaust Fan
1	<60	On	Off	Off	Off
2	>=60	Off	On	On	On

Scorsone and co. suggested Design of a digital nose with eight polymer (CP) conductive fire detectors as its focal point. Fourier transform infrared (FTIR) and gas chromatography-mass spectrometry (GC-MS) spectroscopy To categorize biochemical markers for each category of combustion, four EN54-adapted test flames and tobacco smoke, the primary source of fire threat, were used in fire analyses. [7]

Rappert et al proposed the odor emissions data available from agricultural and pharmaceutical industries via an analysis of odor issues, smell recognition and measurement, and the identification of the factors and processes leading to odor exposures. [8]

Krüll et al proposed A proper mix of various hazard risk screening, region size and personnel presence, appropriate logistical facilities, virtual learning and advanced detonating technologies.

Like wildfires, vast areas must only be properly controlled by geophysical technology (e.g. video-based systems). [9] Gutmacher et al proposed A range of low capacity gas detectors for fire detecting applications to contrast their efficiency. The test fire situations assessed gas sensitive trigger effect transistors, metal oxide detectors (MOSs) and electrical and chemical cells (EC). In comparison we also concentrated on the dissemination behavior of various gas materials in space and time besides the analysis of the efficiency of the sensors. [10]
Jin and co. suggested An elevated-pressure and long-distance curved pipe spill visualization platform is developed and produced through a comparison analysis with a field distribution pipeline, and embedded leak detection and machine translation model for gas supplies is suggested in order to ensure safety and improve the effectiveness of pipeline minor repairs. [11].

5. Methodology:

The operation of the smoke detection and control system. A 5v DC power supply, MQ-5 Gas & Smoke Sensor, Arduino Uno R3, Active Buzzer 5V, and DC Exhaust Fan. All equipment is connected to the microcontroller. When there is gas or smoke then the system detects and Exhaust Fan is used to control it.

5.3 Descrption of the Components

5.3.1Arduino UNO :

The Arduino Uno R3 is the control unit, which is the brain of this subsection. The Arduino UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with.
Based on the ATmega328, the Arduino Uno is a compact, comprehensive, and breadboard-friendly board.

Figure 1: Ardiuno UNO

5.3.2 DC Power Supply

The DC power supply is a device that converts the outlet's AC power supply into a reliable Direct Current (DC) and supplies it to the device. It serves as a power source for operating electronic circuits or experimenting electronic devices.

5.3.3 Sensor Unit

The sensor unit consists of the various sensors required to detect the presence of smoke that could start a fire in a nearby area. In this system, the MQ-5 Gas serves to detect smoke.

5.3.3.1 MQ-5 Smoke Sensor

Based on its reading, the MQ-5 smoke sensor can detect combustible smoke concentrations in the air and generates an analog voltage. Measurements can be taken as soon as possible due to its high sensitivity and rapid response time. It has a long and stable life. The sensor works at 5 volts and can survive temperatures ranging from -20 to 50 degrees Celsius.

Figure 2: MQ-5 Smoke sensor

5.3.4 Buzzer

The buzzer emits a beeping sound and is used to alert and warn people working nearby of danger. The buzzer is the output of the system. A buzzer will beep to warn of danger.

5.3.5 LCD:

A 16x2 LCD can display 16 characters per line and has 2 different such lines. Each character is displayed in a 5x7 pixel matrix on this LCD. The intelligent alphanumeric dot matrix display does have a pixel density of 16 x 2 and can display 224 different characters and symbols. This LCD includes two registers: Command and Data.

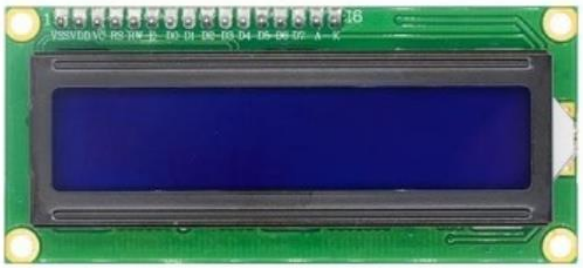

Figure 3: I2C LCD(16x2)

5.3.6 Exhaust Fan

Exhaust fans are installed in rooms such as the kitchen or bathroom to remove sticky, or unclean air. Exhaust fans, as stated previously, purge the air of undesired aromas, dampness, smoke, and other contaminants.

Figure 4: 5V DC fan

5.3.7 LED

A Light Emitting Diode (LED), a semiconductor device, can emit light when an electric current flows through it. Light is produced when p-type semiconductor holes combine with N-type semiconductor electrons.

5.4 Implementation

According to previous study, if the reading value of MQ-5 sensor is 67 then the air is normal according to air to smoke ratio. So, in our system we are considering 70 as initial value. So, if the reading value of MQ-5 sesnor is more then 70 then it will consider that there is smoke. Also if the value is more than 150 then it will turn on the fan to remove the smoke.

In this project smoke detection system is designed and developed using arduino controller.

- The arduino controller act as a main controller of system, smoke sensor(MQ-5) is used to detect the smoke. Buzzer act as an alarm and LED lights ans LCD display is used to create visible communication for warning and showing the level of smoke. Also, 5V DC fan used for removing smoke and blue LED indicates that fan is turned on.
- In normal mode green LED will turned on and LCD display will show normal message.
- Initially smoke sensor will continiously check if smoke is detected.
- The values from this sensor will be given to controller. If smoke is detected and the level is more than 70 then the sensor information is given to controller and controller will give alert by activating buzzer, turning on red led and show an alart message in display. Also show the somke level in display.
- Also the controller will send command to fan to turn on when the smoke level is avobe 150 and blue led will turn on.

5.5 Test/Experimental setup

To develop the system a closed room environment is created. Front side of the setup, in the top there is LCD display for showing information regarding smoke level and middle portion there is a buzzer and in the bottom portion there are 3 LED for indicating different signal.

Figure 5: Setup in no smoke invironment.(Green LED is turned on and no somke is the room.)

Figure 5: Setup in no smokey invironment.(Red LED turned on and LCD showing the smoke level.)

Figure 6: Setup in smokey invironment with fan on.(RED and Blue LED is turned on, LCD showing smoke level is more than 150 and fan is turned on.)

6. Cost analysis

Serial	Equipement list	Cost
01	Arduino UNO	10$
02	LED (3 ps)	0.2$
03	Buzzer	1.3$
04	Resistor (3ps)	0.2$
05	5V DC fan	2$
06	12V battery	2$
07	MQ-5 Smoke Sensor	1.3$
08	I2C LCD display	5$
Total		21$

7. Results and Discussion

Smoke prevention and detection design, implementation, and success. This method has solved the problem of smoke leakages in our surroundings, which resulted in fire incidents and fatalities. This system was created to detect, prevent, and alert us to the presence of smoke in the area. It's also able to detect and alert users when there is smoke in the area. It then uses an exhaust fan system to blow away the smoke from

the area. This system can be used in residential areas, healthcare facilities, offices, and guest houses because it was designed to allow for quick repairs and maintenance in the event that the system malfunctions or breaks down. This system will ensure your safety.

7.1 Simulation

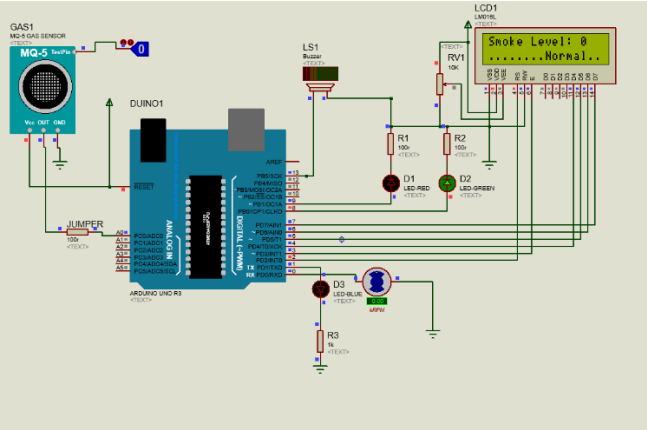

Figure 2: Smoke detecting System (Range<70) [Green Led On] (No Smoke Detected, State=Normal)

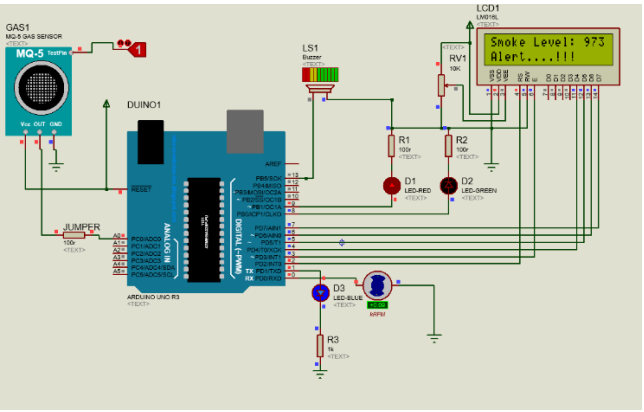

Figure 2.1: Smoke detecting System (Range>=70) [Red & Blue Led on and Exhaust Fan is on] (Smoke is Detected)

7.4 Limitation of the Project

Limitations Arduino-based smoke detecting and warning system are:

- Limited Battery Life: Arduino, Smoke detecting sensor, LCD, Buzzer, LED are dependent on a battery power for coniniously operation. So it is imporant to have power source all the time to maintain all the components operational.
- Limited Sensors: The Arduino-based system used sensor for detecting smoke in the surrounding. This means that it will not be able to detect smoke if it is not in working condition.
- Limited Processing Power: The Arduino board has limited processing power, meaning that in the critical conditon will be unable to process large amounts of data quickly. This could limit its ability to quickly react to its environment and make decisions.

8. Conclusion and future endeavors

8.1

- This system and tool work as expected, and is able to detect Smoke that occur within the detection radius of the MQ-5 sensor which is attached to the system and the device, which is >60cm and placed in a relatively closed.
- With this system and tool, the people or people who use it feel safe and comfortable. In other words, do not worry about the danger if there is a Smoke leak that is unknown to the owner.

8.2 Future Endeavors

In further work,We wanted to upgrade the current system to the IoT-based system so that we can provide a message to the smartphone whenever the sensor detects a Smoke and the message is being sent to the administrator. In those areas where smokes has been detected, in that are the

electrical components will be turned off. The admin can turn off the all electrical components using IOT based android app or from server.

9. References

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