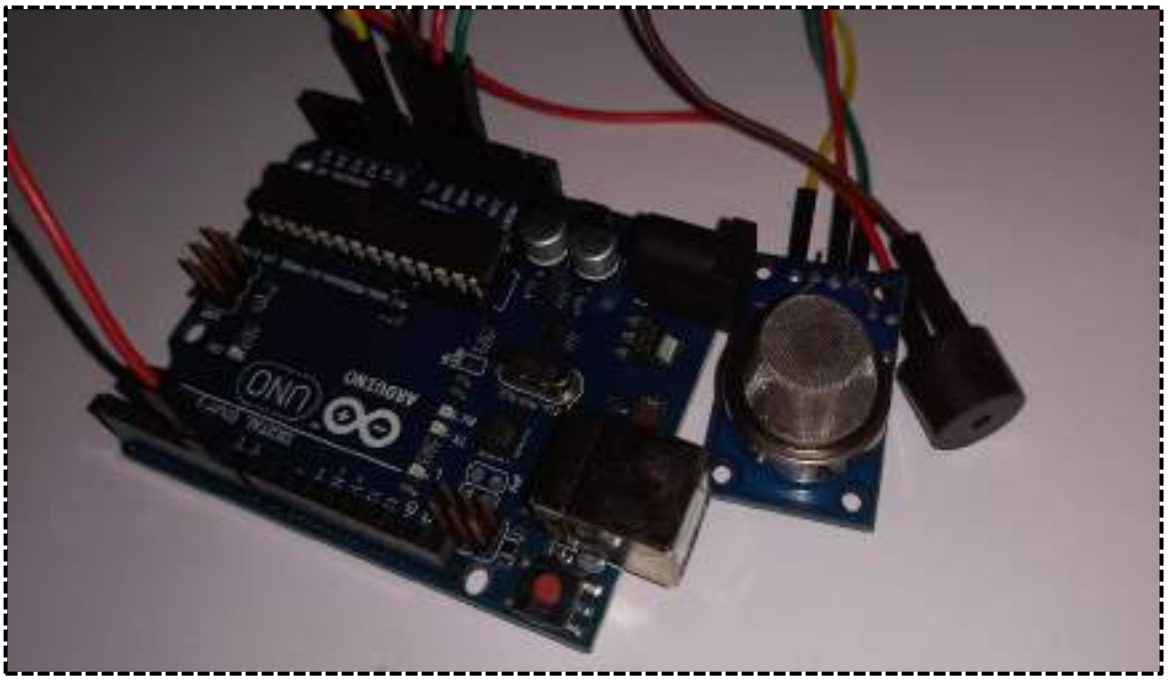

SMOKE DETECTOR ALARM

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Under the guidance of

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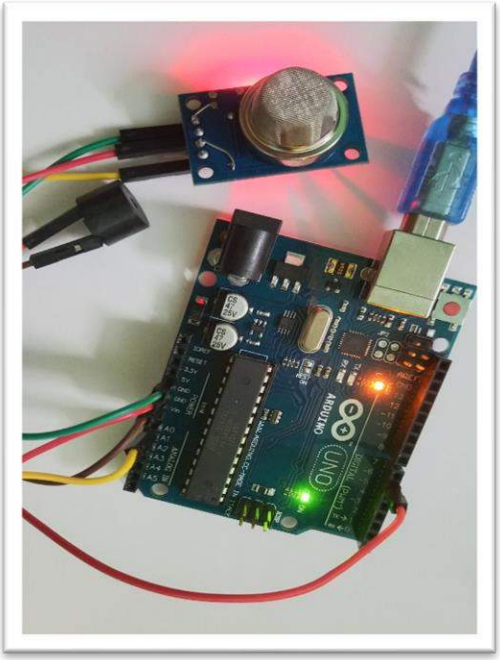


Smoke Detector Alarm

ABSTRACT:

A smoke detector alarm is a fire protection device that automatically detects smoke and gives us warning. In the proposed system, a smoke detector upon senses smoke activates its alarm, sends a low voltage signal to all other smoke detectors in the vicinity. This low voltage signal activates the individual relays in the other smoke detectors causing them to emit a tone that alerts residents that one of the smoke detectors senses smokes. In this system the transmitter and receiver are installed in a unit and the need for a base is eliminated. The individual smoke detectors are equipped with all the electronics required to both send and receive signals. They are battery operated and therefore, they require no external connections. They can be installed by a homeowner just as they would a normal smoke detector. The proposed design is aiming to have Cost efficient system, Compact design, easily expandable, Simple to install, Replaceable components. The system was tested indoor and outdoor with different distance and with the presence of noise. Standard for Safety of Smoke Alarms, to measure the performance of many existing smoke alarms. The standard calls for additional fire tests with smouldering and flaming polyurethane foam as well as a broiling hamburger cooking nuisance test.

This research paper presents a comprehensive study on the design, implementation, and performance evaluation of a smoke detection system developed using an Arduino Uno R3 microcontroller board. The system incorporates an MQ-2 gas sensor for accurate detection of smoke, and a buzzer for immediate audio alarm activation. The project, a collaborative effort by Subhradeep Nath, Alaska, Pradipta Patra, and Sugata Das, aims to provide an effective and affordable solution for enhancing fire safety.

PROBLEM STATEMENT:

Safety is a crucial consideration in design of residential and commercial buildings in order to safeguard against loss of life and damage to property. Fire is a key element in safety considerations. This project therefore seeks to design a microcontroller-based smoke alarm that will continuously monitor the presence of significant amount of smoke and activate an alarm to prompt a safety measure to contain the situation.

When it comes to Fire safety, it's best to have a smoke detector in every bedroom and hall way, as well as on every floor in our home. with so many smokes detector, we can rest assured our home is protected from the unthinkable. Smoke detector is one of the easiest and low costly. Most of industries use it, because it works fatly to protect and most effective.

This system can be of great in domestic as well as industrial settings to detect smoke and alert people on an impending fire since smoke is a precursor for fire, instead of relying on heat/temperature sensors which sounds alarm when the fire has already started. This can go a long way in helping to save human life. This system can also be used to detect and deter smokers in areas where smoking is prohibited.

The cost of implementing this system is relatively low since the components used are relatively cheap and are easily available in the market. The single microcontroller can be used to interface several sensors with alarms located in different locations if more pins are freed for multiple inputs multiple outputs.

This system comes with a power supply that can be directly plugged to the mains (240V AC) source and give the appropriate operating voltage.

Smoke detectors respond faster to fire in its early, smouldering stage (before it breaks into flame). The smoke from the smouldering stage of a fire is typically made up of large combustion particles—between 0.3 and 10.0 μm. Ionization smoke detectors respond faster (typically 30–60 seconds) in the flaming stage of a fire. The smoke from the flaming stage of a fire is typically made up of microscopic combustion particles between 0.01 and 0.3 μm. Also, ionization detectors are weaker in high air-flow environments, and because of this, the photoelectric smoke detector is more reliable for detecting smoke in both the smouldering and flaming stages of a fire.

OBJECTIVES:

Home fire safety and an escape plan will help ensure your family’s safe exit and in the event of a house fire.

INTRODUCTION:

According to, Smoke detector has been reviewed as a fundamental component of active fire detection strategy of modern commercial and residential building. In the 1970's, industries recorded increased use of smoke detectors and this growth was accompanied by several significant research projects that reinforced the life safety protection provided by smoke detectors, thereby providing significant evidence that supported increase in use of smoke detectors. Also, in order to understand the response, working principle of these detectors in the environment, several researches were embarked. Accurate prediction of smoke detector is a very significant way of assessing detector system performance because occupants and fire service notification can be dependent upon smoke detector response. Fire Dynamic Simulator software, can be used to predict the response of smoke detector. Reference stated that "fire loss data reveals that in buildings with automatic sprinklers, 96% were controlled and extinguished by these systems". Once there a fire, the fire detection system activates the alert thereby triggering the automatic sprinkler system. It is very important for fire protection system to be installed in all commercial building. There are concerns associated with automatic smoke detection system arising from inappropriate techniques for quick notification, false noise tolerant and different sensor combinations. Researchers have been studying fire taking place in various places such as residential area and commercial buildings. A smoke alarm is a device that senses smoke, typically as an indicator of fire. It may issue a signal to a fire alarm control panel as part of fire alarm system, especially in commercial security devices or may issue a local audible or visual alarm in the household.
Smoke can be detected either optically (photoelectric) or by physical process(ionization). Detectors may use either or both methods. Smoke detectors have prior detection when compared with heat detectors, hence are preferred for fire detection. They also find application in detecting, and thus deter smoking in premises where it is banned.

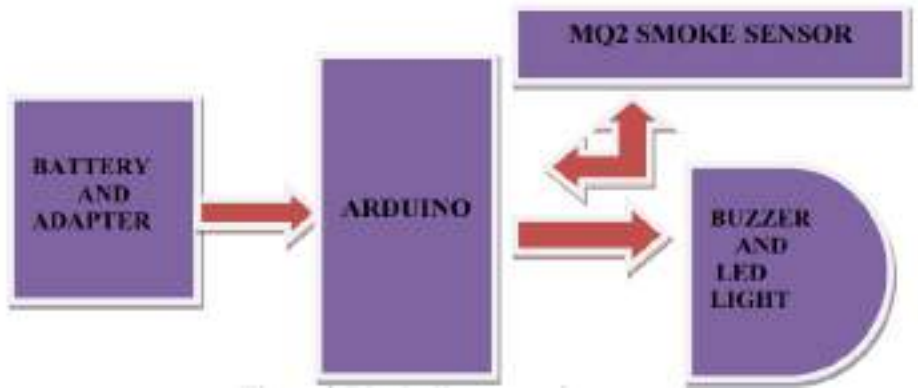
Smoke detection plays a vital role in preventing fire incidents and ensuring the safety of individuals. This research paper presents the development of a smoke detection system using Arduino Uno R3, which offers a cost-effective and versatile platform for real-time monitoring. The study focuses on the design principles, implementation details, and performance evaluation of the system.

THEORY:

Safety is a crucial consideration in design of residential and commercial buildings in order to safeguard against loss of life and damage to property. This project therefore seeks to design a microcontroller-based smoke alarm that will continuously monitor the presence of significant amount of smoke and activate an alarm to prompt a safety measure to contain the situation. Smoke detector is one of the easiest and low costly. Most of industries use it, because it works fatly to protect and most effective This system can be of great in domestic as well as industrial settings to detect smoke and alert people on an impending fire since smoke is a precursor for fire, instead of relying on heat/temperature sensors which sounds alarm when the fire has already started. This can go a long way in helping to save human life. This system can also be used to detect and deter smokers in areas where smoking is

prohibited. The cost of implementing this system is relatively low since the components used are relatively cheap and are easily available in the market. The single microcontroller can be used to interface several sensors with alarms located in different locations as long as more pins are freed for multiple inputs multiple outputs. This system comes with a power supply that can be directly plugged to the mains (240V AC) source and give the appropriate operating voltage. smoke detectors respond faster to fire in its early, smoldering stage (before it breaks into flame). The smoke from the smoldering stage of a fire is typically made up of large combustion particles—between 0.3 and 10.0 μm. Ionization smoke detectors respond faster (typically 30–60 seconds) in the flaming stage of a fire. The smoke from the flaming stage of a fire is typically made up of microscopic combustion particles between 0.01 and 0.3 μm. Also, ionization detectors are weaker in high air-flow environments, and because of this, the photoelectric smoke detector is more reliable for detecting smoke in both the smoldering and flaming stages of a fire.

BLOCK DIAGRAM:



Block Diagram for Smoke Detector Alarm

COMPONENTS USED:

1. Arduino Uno R3
2. Buzzer
3. Gas Sensor -MQ2
4. Male to Female Jumper wires
5. Female to Male Jumper wires
6. Battery- 9v

The hardware components are connected following the system design, and the Arduino Uno R3 is programmed using the Arduino IDE. The code facilitates continuous monitoring of the sensor values, real-time analysis, and activation of the buzzer when smoke is detected.

ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB to- serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Applications:

- Prototyping of Electronics Products and Systems
- Multiple DIY Projects.
- Easy to use for beginner level DIYers and makers.
- Projects requiring Multiple I/O interfaces and communications.

BUZZER:

The buzzer consists of an outside case with two pins to attach it to power and ground. ... When current is applied to the buzzer it causes the ceramic disk to contract or expand. Changing the This then causes the surrounding disc to vibrate. That is the sound that you hear. PUI has theAI-3035, a piezoelectric buzzer rated for 2-5 Volt operation, nominal 3 Volts, and with a maximum current requirement of 9 mA. The dimensions are 30 mm diameter, 20.5 mm height excluding leads. To reduce the sound of the buzzer, measure the resistance of the buzzer, then place a resistor the same value as the buzzer in series with it, see how much this drops the volume. The more resistance to quieter the buzzer should be. If the buzzer does not work with half the value try a value lower in resistance. The purpose of the buzzer test is to test functions of the buzzers installed in a computer. Typically, the buzzer test is done by controlling the buzzer to sound a continuous buzzing sound while a test engineer listens to the buzzer with ears to determine if the buzzer is inworking condition. Sensor-Buzzer is a passive buzzer. Like a magnetic speaker, it needs voltage with different frequency so that it can make sound accordingly. The pitch becomes louder when the frequency gets higher. All buzzers with internal oscillators have polarity because they have small circuit built into them while the buzzers with only Piezo disks can be operated both ways.

MQ2 SENSOR:

The MQ2 sensor module was selected to serve the purpose of sensing smoke. It has the capability of sensing smoke and other combustible gases. The following are the reasons as to why it was selected:

- Wide detecting scope
- Fast response & high sensitivity
- Stable and long life
- Simple drive circuit

Fig: MQ2 SENSOR

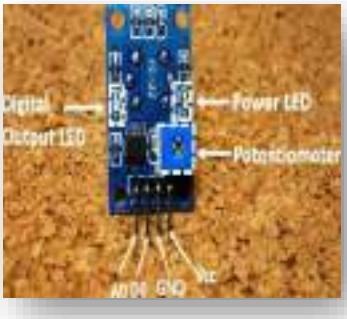


Fig: MQ2 SENSOR PIN OUT

The MQ-2 smoke sensor is sensitive to smoke and to the following flammable gases:
LPG
Butane
Propane
Methane
Alcohol
Hydrogen
The resistance of the sensor is different depending on the type of the gas.
The smoke sensor has a built-in potentiometer that allows you to adjust the sensor sensitivity according to how accurate you want to detect gas
The sensor can detect smoke in the range of 300-10,000 rpm, giving an analog output voltage of between 0v to 5v depending on the quantity of smoke detected. The sensitive material used is SnO2, whose conductivity is lower in clean air. Its conductivity increases as the concentration of combustible gases increases, hence generating a corresponding analog voltage at the output.

CONNECTING WIRES:

- These are used to connect the components in the circuit.
- These are used to allow current through them.
- These are made up of copper, since copper is a good conductor of electricity

9V POWER SUPPLY:

For this we use a 9v battery

EXPERIMENTAL RESULTS:

The developed smoke detection system undergoes rigorous testing to assess its performance. The evaluation includes determining the accuracy, sensitivity, response time, and reliability of the system under various smoke concentrations and environmental conditions. The obtained results demonstrate the system's effectiveness in detecting smoke and promptly activating the alarm.

Installation and placement:

The installation of smoke detectors varies depending on the locality. However, some rules and guidelines for existing homes are relatively consistent throughout the developed world. For example, Canada and Australia require a building to have a working smoke detector on every level. The United States NFPA code cited in the previous paragraph requires smoke detectors on every habitable level and within the vicinity of all bedrooms. Habitable levels include attics that are tall enough to allow access. Many other countries have comparable requirements. In new construction, minimum requirements are typically more stringent. All smoke detectors must be hooked directly to the electrical wiring, be interconnected, and have a battery backup. In addition, smoke detectors are required either inside or outside every bedroom, depending on local codes. Smoke detectors on the outside will detect fires more quickly, assuming the fire does not begin in the bedroom, but the sound of the alarm will be reduced and may not wake some people. Some areas also require smoke detectors in stairways, main hallways, and garages. A dozen or more detectors may be connected via wiring or wirelessly such that if one detects smoke, the alarms will sound on all the detectors in the network, improving the likelihood that occupants will be alerted even if smoke is detected far from their location. Wired interconnection is more practical in new construction than for existing buildings.

PROGRAM:

```
# define mq2 (0)
int a=6;
void setup()
{
 // initialize serial communication at 9600 bits per second:
 delay(4000);
 Serial.begin(9600);
}

// the loop routine runs repeatedly forever:
void loop()
{
 // read the input on analog pin 0:
 int sensorValue = analogRead(mq2);
 pinMode(6,OUTPUT);
 if(sensorValue>=210&&sensorValue<250)
 {
  Serial.println(sensorValue);
  digitalWrite(6,HIGH);
  delay(400);
  digitalWrite(6,LOW);
  delay(200);
```

```
  }
  else if(sensorValue>=250)
  {
    Serial.println(sensorValue);
    digitalWrite(6,HIGH);
    delay(400);
    digitalWrite(6,LOW);
    delay(100);
  }
  // print out the value you read:
  delay(20);        // delay in between reads for stability
}
```

CONCLUSION:

The first conclusion to be drawn from the data collection is that consumers care about the performance of a smoke alarm in a fire, but it is not at the front of their minds when they are purchasing a smoke alarm. This can be seen in the differences in responses between the interviews and surveys from our first round of data collection. When given a predetermined list of features to choose from, consumers valued detection time as the most important factor to them on the most consistent basis. However, when asked during our interviews "What features would you look for when purchasing a smoke alarm?" consumers generally listed detection time less often than optional features and qualities of the smoke alarm. What is important to note is the fact that the answers we received during the interview were completely derived from the thoughts that first came to mind, which are generally considered as the ones most important or prevalent to them. Finally, when asked during the interview "Were you aware that some smoke alarms respond faster to certain types of fire?" 85 percent of consumers did not know that there was a difference. Some consumers even went as far as to ask: "There is a difference between smoke alarms?" The juxtaposition of the survey findings and the answers to these interview questions is telling about the process by which consumers choose a smoke alarm. It shows that while consumers care about detection, when it comes time to purchase a smoke alarm, they bypass performance. This could be for two reasons:

- being unaware of the variation in smoke alarm detection capabilities; and
- performance differences are not presented on packaging. It is because of these reasons that consumers are more likely to focus on other features of the alarm when deciding on which smoke alarm to purchase.

The next conclusion drawn from the data is that consumers want information on performance and will use it when it is given. This idea is supported by the data collected during the second consumer survey. When shown 3 separate smoke alarm packages and told to select the smoke alarm they would be most likely to purchase, 80% of those surveyed indicated that their first choice would be a smoke alarm with a rating system or list of features included. The survey results provide insight into how the consumer values additional information on smoke alarms. Many consumers stated that their choice was based on wanting more information. Another conclusion to make is that consumers will choose performance over price. This is supported by the findings in Survey Question 2 & 3, where 82% of those surveyed selected the higher rated alarm over the lower cost option. The information provided by this question shows that consumers are aware of the importance of the performance of a smoke alarm, and believe that it is worth the extra money to purchase a better rated smoke alarm. Sections 2 and 3 of the Consumer Packaging Survey indicate that consumers mostly understand the tested rating systems, but there are still improvements that could be made. Over 90% of consumers understood both the icon and text-based rating systems used, however that proportion dropped significantly in the nuisance resistance category.

REFERENCES:

- "How smoke detector is made". MadeHow.com. Archived from the original on 7 June 2014. Retrieved 9 June 2014.
- "How smoke detector is made". MadeHow.com. Advameg. Archived from the original on 7 June 2014. Retrieved 9 June 2014.
- "Backgrounder on Smoke Detectors". NRC Library. U.S. Nuclear Regulatory Commission. Retrieved 24 September 2022.
- "Smoke Alarms in U.S. Home Fires". nfpa.org. September 2015. Archived from the original on 2017-07-29. Retrieved 2017-07-28.
- "Ionization Smoke Alarms Are DEADLY". The World Fire Safety Foundation. Archived from the original on 2014-04-16. Retrieved 2001-06-27.
- "Alarm concern from the Hearing Loss Association of America". hearingloss.org. Archived from the original on 27 September 2007. Retrieved 8 May 2018.
- Fleming, Jay. "Smoke Detector Technology Research" Archived 2016-04-20 at the Way back Machine, retrieved 2011-11-07
- "Safe disposal of smoke alarms - Fire and Rescue NSW". NSW Government. 26 November 2012. Archived from the original on 20 April 2013. Retrieved 2013-06-26.
- "Contaminated (dirty) Smoke Detectors". Firewize.com. Firewise Holdings Pty. 2012. Archived from the original on 29 July 2014. Retrieved 6 June 2014
- C.-C. Ho and T.-H. Kuo, "Real-time video-based fire smoke detection system," in Advanced Intelligent Mechatronics, 2009. AIM 2009. IEEE/ASME International Conference on, 2009, pp. 1845–1850.Internationa l Journal of Scientific and Research Publications, Volume 4, Issue 7, July 2014 5 ISSN 2250-3153 www.ijsrp.org
- "Smoke Alarms in U.S. Home Fires". nfpa.org. September 2015. Archived from the original on 2017-07-29. Retrieved 2017-07-28.
- "Smoke Alarm Myths Explained". The World Fire Safety Foundation. Archived from the original on 2014-10-06. Retrieved 2014-09-03.
- Residential Smoke Alarm Performance, Thomas Cleary, Building and Fire Research Laboratory, National Institute of Standards and Technology, UL Smoke and Fire Dynamics Seminar. November, 2007.
- "SMOKE ALARM SAFETY TIPS". Safety Information. National Fire Protection Association. Archived from the original on 2009-08-21. Retrieved 2009-05-17.
- "Smoke Alarms". Hansard - Mr. Christopher Gulati's MP, Private Member's Statements, New South Wales Parliamentary Debates, Legislative Assembly, New South