SMOKE DETECTOR ALARM

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Abstract

A smoke detector alarm is a fire protection device that automatically detects smoke and also 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 smoke. 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 a large number of existing smoke alarms. The standard calls for additional fire tests with smoldering and flaming polyurethane foam as well as a broiling hamburgers cooking nuisance test. The research included 45 distinct smoke alarm models. Analysis of the results showed that no current smoke alarm model would likely meet the new test performance levels required in ANSI/UL 217-2015.

Keywords: smoke detector alarm , Fire detector , Arduino , MQ2 Smoke sensor

1. 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 these 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 was 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’s 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.

2. Literature Survey

The A smoke detector is a device that senses smoke typically as an indicator of fire or non smoking zone. In order to ensure human safety and safeguard property against fire in both domestic and commercial settings, different solutions for smoke detection have been developed. These designs vary depending on the method of smoke detection. However, the different designs are derived.

the two basic types of smoke detectors, namely:
1. The photoelectric smoke detector
2. The ionization chamber smoke detector (ICSD)

The photoelectric smoke detector uses an optical beam to search for smoke. When smoke particles cloud the beam, a photoelectric cell senses the decrease in light intensity and triggers an alarm. This type of smoke detector reacts most quickly to smoldering fires that release relatively large amounts of smoke. On the other hand, the ionization chamber smoke detector is quicker at sensing flaming fires that produce little smoke. It employs a radioactive material to ionize the air in a sensing chamber; the presence of smoke affects the flow of the ions between a pair of electrodes, which triggers the alarm.
In a typical system, the radioactive material emits alpha particles that strip electrons from the air molecules, creating positive oxygen and nitrogen ions. The electrons attach themselves to other air molecules, forming negative oxygen and nitrogen ions. Two oppositely charged electrodes within the sensing chamber attract the positive and negative ions, setting up a small flow of current in the air space between the electrodes, but when the smoke particles enter the chamber, they attract some of the ions, disrupting the current flow.

3. 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 come 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 smoke 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 work 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, 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 smoldering and flaming stages of a fire.
4. Block Diagram of smoke detector alarm:

**BLOCK DIAGRAM**

![Block Diagram of proposed system](image)

5. Hardware Design and compounds:

**SCHEMATIC DIAGRAM**:

![Schematic Diagram of Smoke Detector Alarm Circuit Using Arduino](image)

Fig 5 (a): Schematic Diagram of Smoke Detector Alarm Circuit Using Arduino Circuit diagram.
TYPE OF COMPONENTS:

Fig 5(b) : Hardware components

The Basic Components of the smoke detector alarm

a) Arduino uno
b) PCB design
c) MQ2 sensor
d) LED light
e) Buzzer
f) power supply (9v battery)
g) Resistor
h) Male to Female Jumper Wires

a) Arduino Uno:

Fig : 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 a 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.
b) **PCB:**

![Image of PCB](image)

Fig: PCB

A printed circuit board (PCB) mechanically supports and electrically connects electronic components or electrical components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate. Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it. Printed circuit boards are used in all but the simplest electronic products. They are also used in some electrical products, such as passive switch boxes.

PCBs can be single-sided (one copper layer), double-sided (two copper layers on both sides of one substrate layer), or multi-layer (outer and inner layers of copper, alternating with layers of substrate). Multi-layer PCBs allow for much higher component density, because circuit traces on the inner layers would otherwise take up surface space between components. The rise in popularity of multilayer PCBs with more than two, and especially with more than four, copper planes was concurrent with the adoption of surface mount technology. However, multilayer PCBs make repair, analysis, and field modification of circuits much more difficult and usually impractical.

c) **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

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.

**Fig : MQ2 SENSOR**

**Fig : MQ2 SENSOR PIN OUT**

**DETAILS**

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.

d) **LED LIGHT:**

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

**Fig : Parts of an LED**
e) BUZZER:
A buzzer is an audio signalling device which may be used in alarm devices, timers and other forms of alerts. They may be mechanical, electromechanical, or piezoelectric.

![Buzzer Image]

Electromechanical buzzers use a relay connected to interrupt its own actuating current, causing the contacts to buzz. Mechanical buzzers are purely mechanical and require drivers. Piezoelectric elements are driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. For this project, the buzzer used is the compact, pin terminal type electromagnetic buzzer with 2048 Hz output. Pin type terminal construction enables direct mounting onto printed circuit boards.

6. RESULT

OVERALL VIEW OF THE KIT:

![Overall Kit Image]

WORKING OF SMOKE DETECTOR ALARM:
The voltage that the sensor outputs changes accordingly to the smoke/gas level that exists in the atmosphere. The sensor outputs a voltage that is proportional to the concentration of smoke/gas. In other words, the relationship between voltage and gas concentration is the following:
- The greater the gas concentration, the greater the output voltage
The lower the gas concentration, the lower the output voltage

Fig 6(b): Working mechanism of Smoke Detector MQ2 Sensor

Installation and placement:

The installation of smoke detectors vary 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 are more practical in new construction than for existing buildings.
Fig 6(C) : INSTALLTION AND PLACEMENT OF SMOKE DETECTORS ON HOME

Conclusion

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 smoke detectors, 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 work 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. We can use the project fire accidents can be controlled to a great extent in a place such as forests, home, colleges, industries, trains and some other public places. Fire accidents leads to deaths of excess of people. By using this technique we can save those life's easily. To detects the chain smokers (which are hazardous to health)

PROGRAM:

```c
int redLed = 12;
int greenLed = 11;
int buzzer = 10;
int smokeA0 = A5;
// Your threshold value
int sensorThres = 400;
```
void setup() {
  pinMode(redLed, OUTPUT);
  pinMode(greenLed, OUTPUT);
  pinMode(buzzer, OUTPUT);
  pinMode(smokeA0, INPUT);
  Serial.begin(9600);
}

void loop() {
  int analogSensor = analogRead(smokeA0);

  Serial.print("Pin A0: ");
  Serial.println(analogSensor);
  // Checks if it has reached the threshold value
  if (analogSensor > sensorThres) {
    digitalWrite(redLed, HIGH);
    digitalWrite(greenLed, LOW);
    tone(buzzer, 1000, 200);
  } else {
    digitalWrite(redLed, LOW);
    digitalWrite(greenLed, HIGH);
    noTone(buzzer);
  }
  delay(100);
}

References