FIRE ALARM

A Project Report Submitted in partial fulfillment of the requirement of

DIPLOMA IN

ELECTRICAL ENGINEERING

Submitted By:

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CERTIFICATE

This is to certify that the project report titled “Fire Alarm” submitted by Tacein Ishac (19DPIE119), Mohd Farooq (19DPIE115), Mohd Aquil Khan (19DPIE109) & Zeeshan (19DPIE131) in partial requirements of the degree of the Diploma in Electrical & Instrumentation Engineering is a record of their own hard work carried under my supervision. This project report has not been submitted anywhere else for the award of any other degree or diploma.

Mr. Imtiaz Ahmad Khan,
Assistant Professor,
Electrical Engg. Section,
University Polytechnic,
AMU, Aligarh.

Acknowledgement

It is our privilege to express our sincere regards to our project coordinator, **Mr. Imtiaz Ahmad Khan** for his valuable inputs, able guidance, encouragement, whole-hearted cooperation throughout the duration of our project.

We also express our sincere thanks to **Mr. Imtiaz Ahmad Khan Sir**, our Project Incharge for his help and expert guidance. Help rendered by **Ms. Kaushar Jahan Mam** is also thankfully acknowledged here.

We deeply express our sincere thanks to our Section Incharge, **Mr. Tehzeeb Ahmed Abbasi Sir** for encouraging and allowing us to work in best laboratory environment. We are thankful to the technical staff of the ElectricalEngg. Section for their cooperation and support.

The present project titled "Fire Alarm" could not have been completed without the support and motivation from our families and friends.

We take this opportunity to thank all our teachers who contributed their valuable advice and helped to complete the project successfully.

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INTRODUCTION

A **fire alarm system** warns people when smoke, fire, carbon monoxide or other fire-related emergencies are detected. These alarms may be activated automatically from smoke detectors, and heat detectors or may also be activated via manual fire alarm activation devices such as manual call points or pull stations. Alarms can be either motorized bells or wall mountable sounders or horns. They can also be speaker strobes which sound an alarm, followed by a voice evacuation message which warns people inside the building not to use the elevators. Fire alarm sounders can be set to certain frequencies and different tones including low, medium and high, depending on the country and manufacturer of the device. Most fire alarm systems in Europe sound like a siren with alternating frequencies. Fire alarm electronic devices are known as horns in the United States and Canada, and can be either continuous or set to different codes. Fire alarm warning devices can also be set to different volume levels.

Working principle of fire alarm

A fire alarm system is an active fire protection system that controls all the fire alarm modules in a building. It is composed of alarm initiating devices (smoke detectors and heat sensors), alarm notification appliances (sirens or devices that produce loud noises), fire control units (sprinkler systems or fire extinguisher systems), power supplies and wirings. But how do they work?

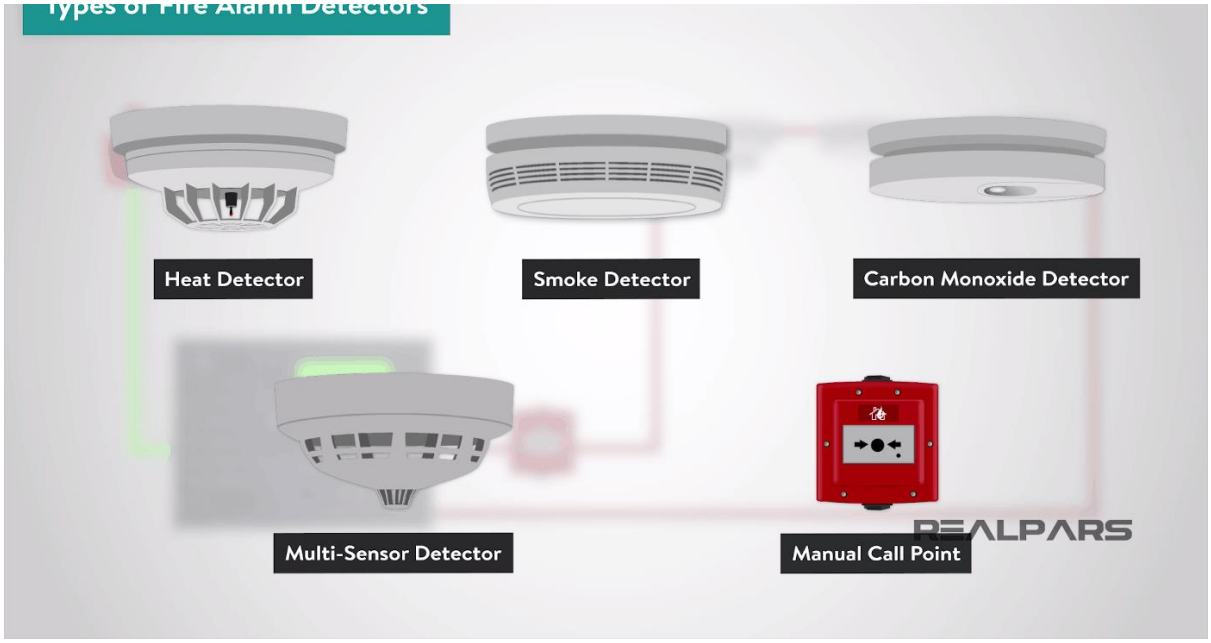
The fire alarm system can be set off automatically by smoke detectors, heat detectors or manually. These sensors are set to detect certain levels of heat or smoke that could be an indication of fire. A loud bell or a siren sometimes accompanied by blinking or flashing lights for individuals who have hearing problems, blasts to alert occupants in the building. To truly understand how a fire alarm system works, let us go further into the components of the fire alarm system. In a fire alarm system there is always a smoke detector to detect smoke or fire.

How does a fire alarm system work by way of smoke sensor? There are two types of smoke detectors. These are the optical detector and the ionization detector. The optical smoke detector detects smoke by using light sensors (infrared LED). When smoke particles pass thru the chamber of the optical detector, it scatters light that triggers the alarm. In the ionization detector, if the smoke particle enters the chamber of the ionization detector it will reduce air ionization inside the chamber of the ionization detector and triggers the alarm.

Different Types of Fire Alarm Detectors

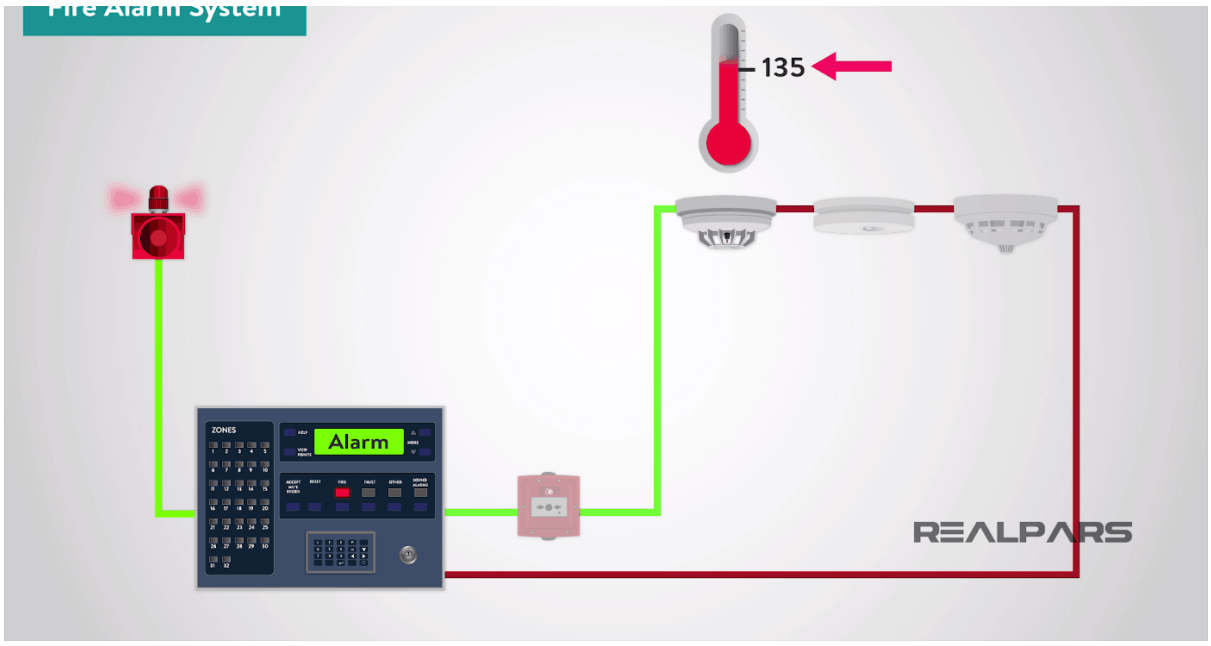
At the core of a fire alarm system are the detection devices, from sophisticated intelligent smoke detectors to simple manually operated break glass units, there are a wide array of different types, but we can divide them into groups including:

– Heat detectors
– Smoke detectors
– Carbon Monoxide detectors
– Multi-sensor detectors
– Manual Call Points

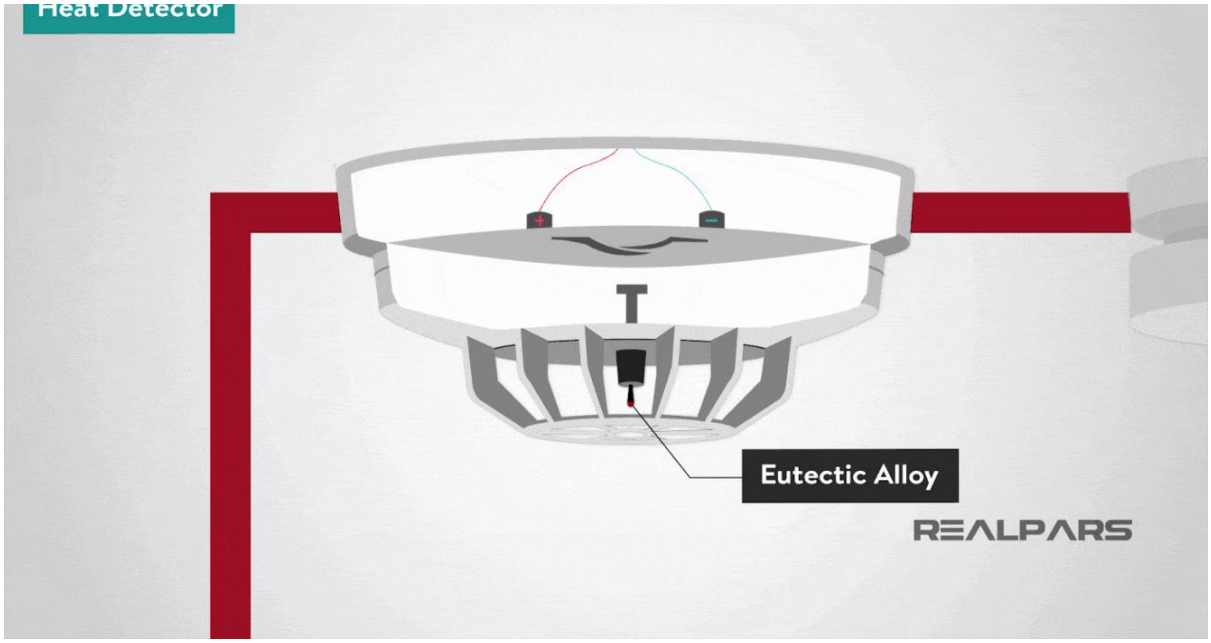


1. Heat Detectors

Heat detector can either work on a fixed temperature basis, where it will trigger an alarm if the temperature exceeds a pre-set value or they can work on the rate of change in temperature.



Commonly Heat detectors work in a similar way to an electrical fuse, the detectors contain a eutectic alloy which is heat sensitive when a certain temperature is reached the alloy turns from a solid to a liquid which in turn triggers the alarm.

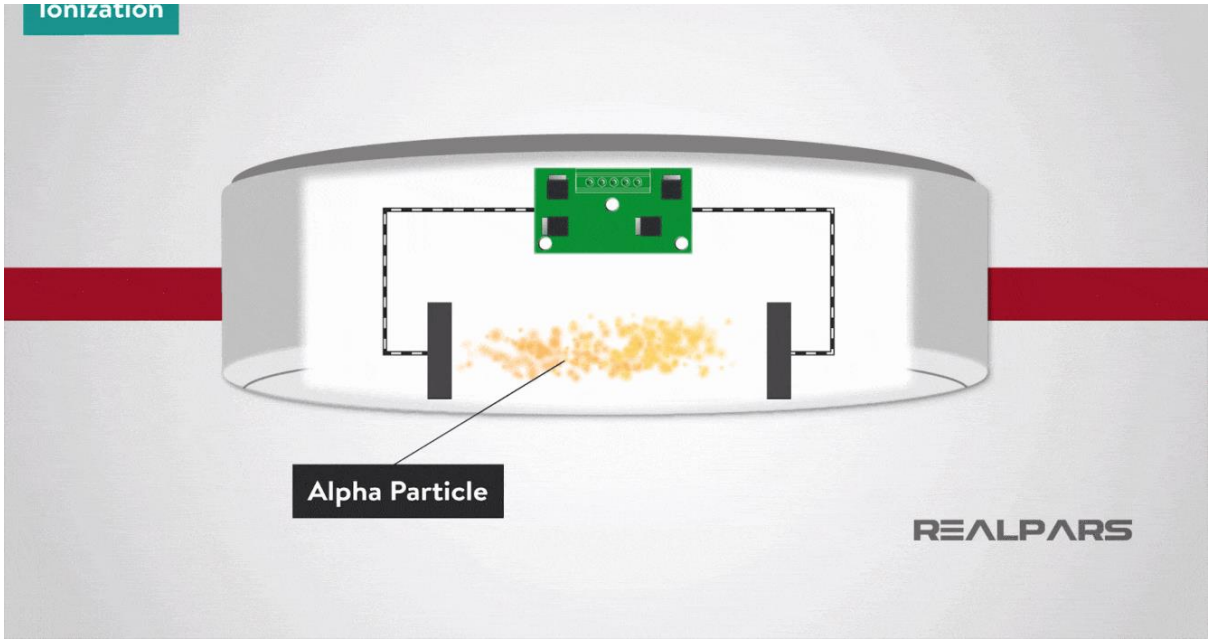


2. Smoke Detectors

There are three basic types of smoke detectors including:
– Ionization
– Light Scattering
– Light Obscuring

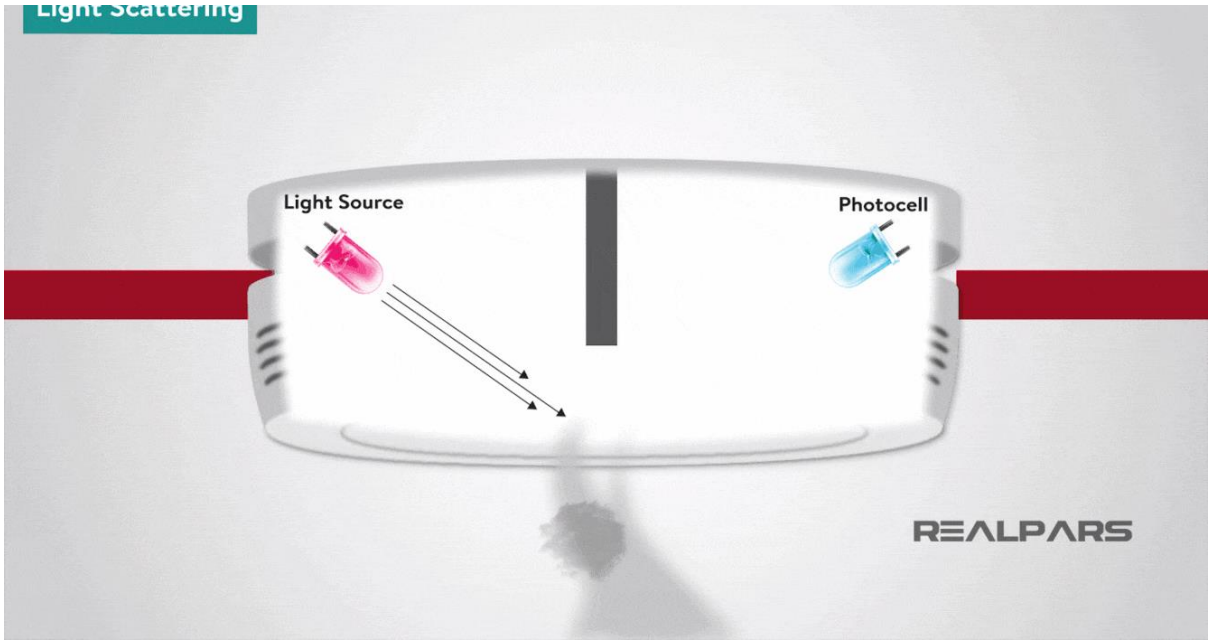
2.1. Ionization Smoke Detector

Ionization Smoke detector generally contains two chambers. The first is used as a reference to compensate for changes in ambient temperature, humidity or pressure.
The second chamber contains a radioactive source, usually alpha particle, which ionizes the air passing through the chamber where a current flows between two electrodes.
When smoke enters the chamber the current flow decreases. This drop in current flow is used to initiate an alarm.



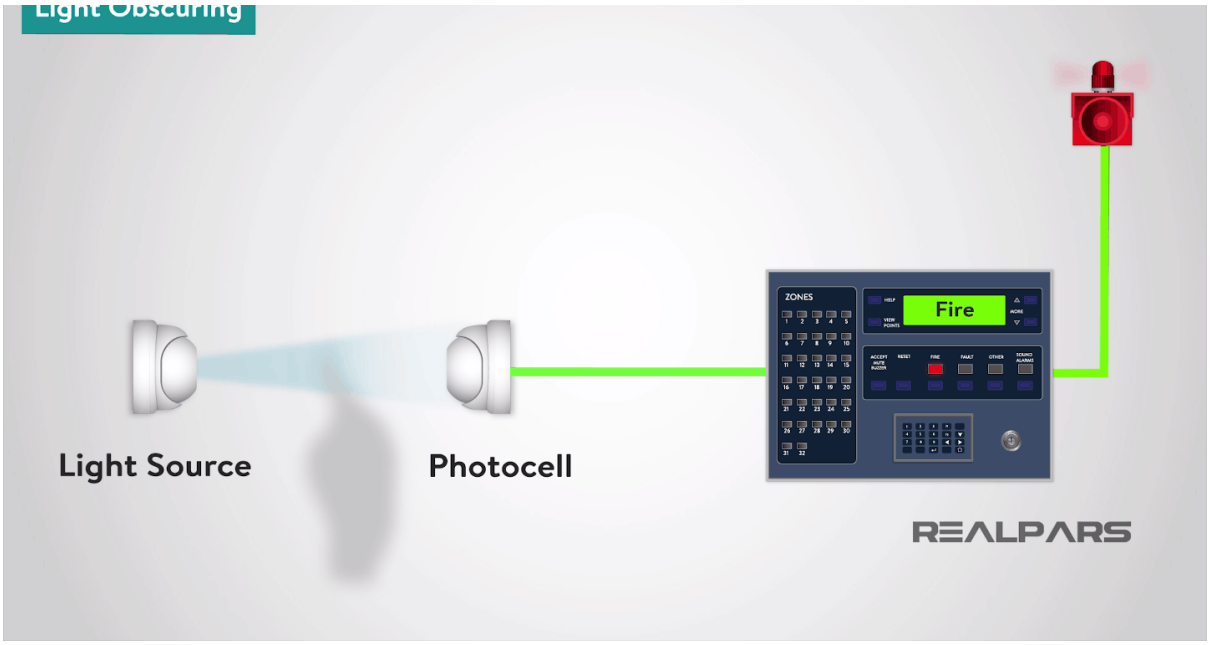
2.2. Light Scattering Smoke Detector

The light scattering smoke detector operates on the Tyndall effect; a photocell and light source are separated from each other by a darkened chamber such that the light source does not fall on the photocell.
The passage of smoke into the chamber causes the light from the source to be scattered and fall on the photocell. The photocell output is being used to initiate an alarm.



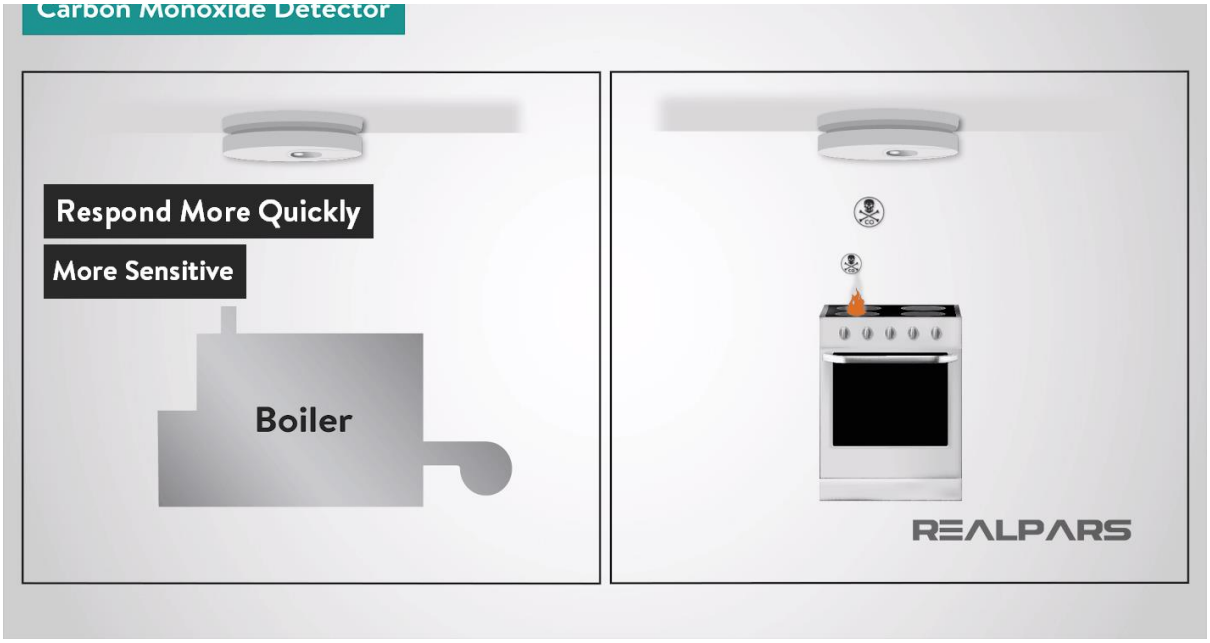
2.3. Light Obscuring Smoke Detector

In the Light obscuring smoke detector, smoke interferes with a light beam between a light source and photocell. The photocell measures the amount of light it receives.
The variation in photocell output, is being used to initiate an alarm.
This type of fire detection equipment can be used to protect large areas with the light source and photocell positioned some distance apart.



3. Carbon Monoxide Detectors

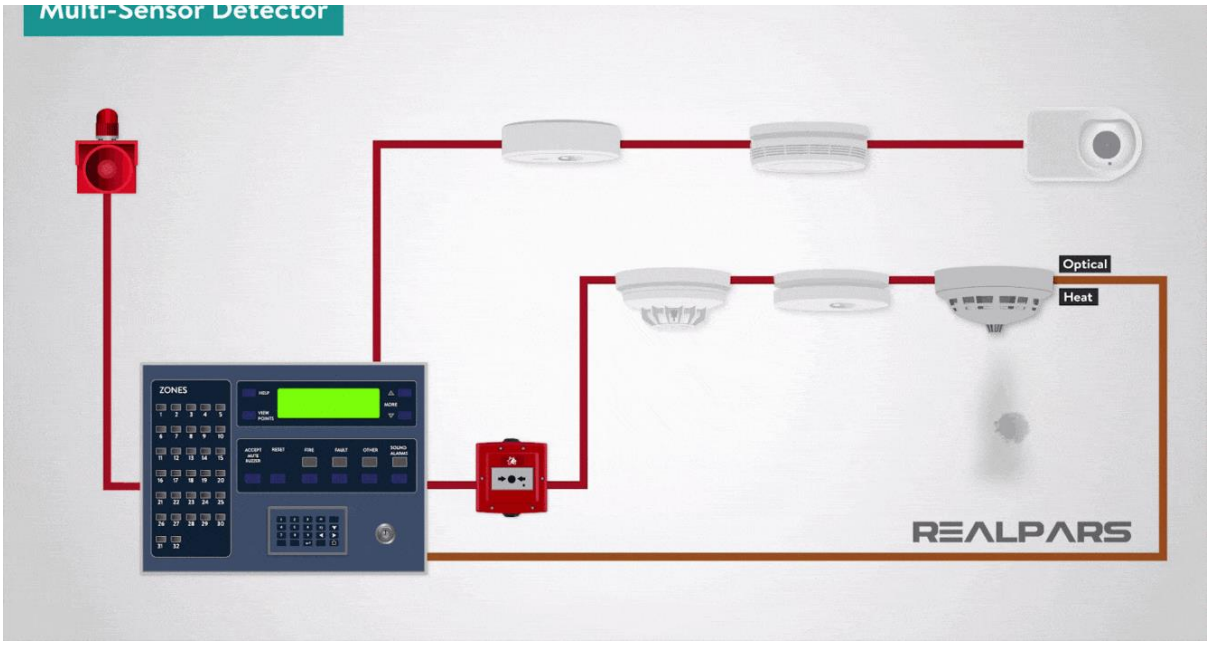
Carbon monoxide detectors are known also as CO fire detectors are electronic detectors used to indicate the outbreak of fire by sensing the level of carbon monoxide in the air.
Carbon monoxide is a poisonous gas produced by combustion.
In this instance, these detectors are not the same as Carbon monoxide detectors used in the home for protecting residents against carbon monoxide produced by incomplete combustion in appliances such as gas fires or boilers.
Carbon Monoxide fire detectors use the same type of sensor as those in the home but are more sensitive and respond more quickly.
Carbon monoxide detectors have an electrochemical cell, which senses carbon monoxide, but not smoke or any other combustion products



4. Multi-Sensor Detectors

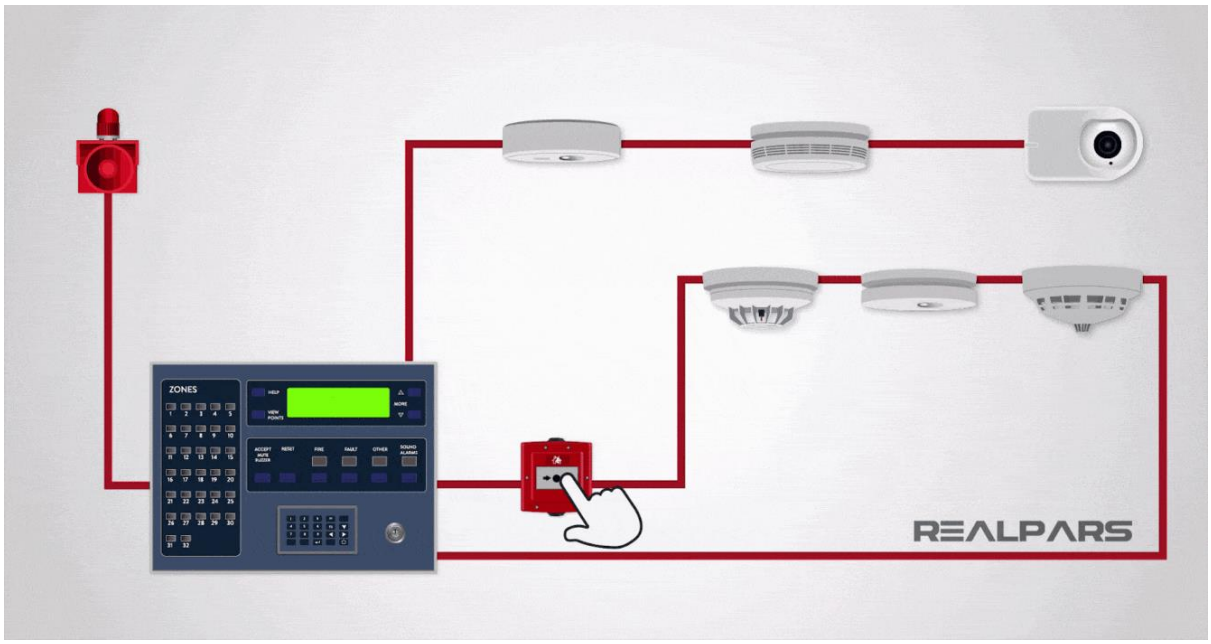
The Multi-sensor detectors combine inputs from both optical and heat sensors and process them using a sophisticated algorithm built into the detector circuitry.

When polled by the control panel the detector returns a value based on the combined responses from both the optical and heat sensors. They are designed to be sensitive to a wide range of fires.



5. Manual Call Points

A Manual Call Point or Break Glass Call Point is a device which enables personnel to raise the alarm by breaking the frangible element on the fascia; this then triggers the alarm.

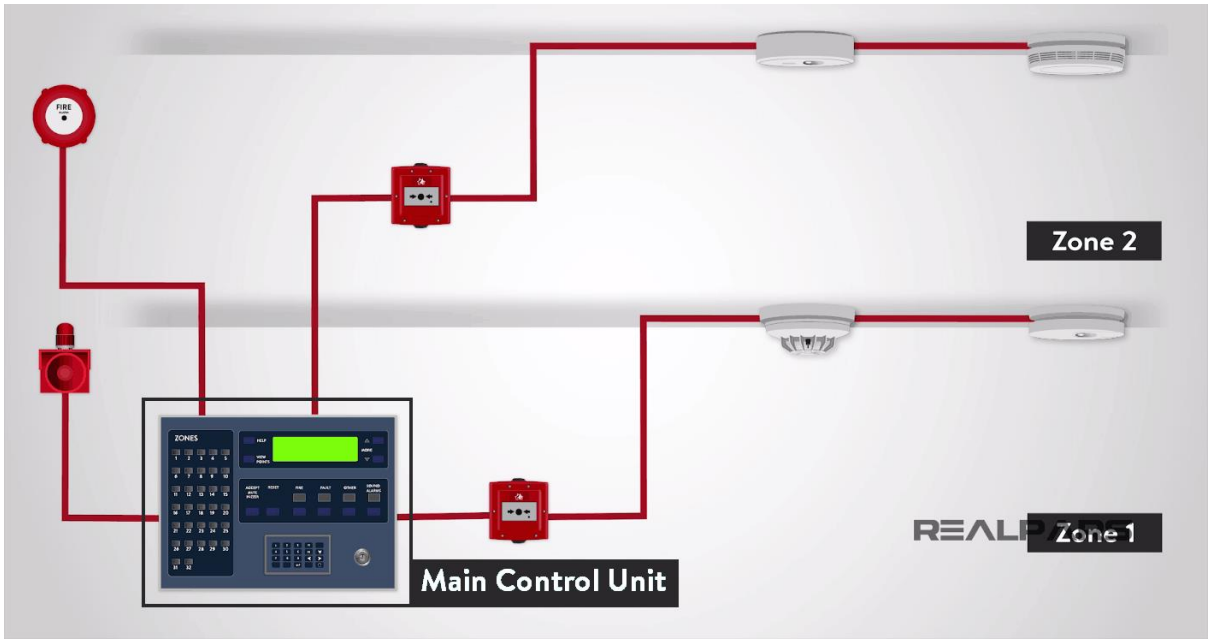


Different Types of Fire Alarm Systems

Fire Alarm Systems can be broken down into four main types;
– Conventional
– Addressable
– Intelligent
– Wireless
Let’s spend some time considering each.

1. Conventional Fire Alarm Systems

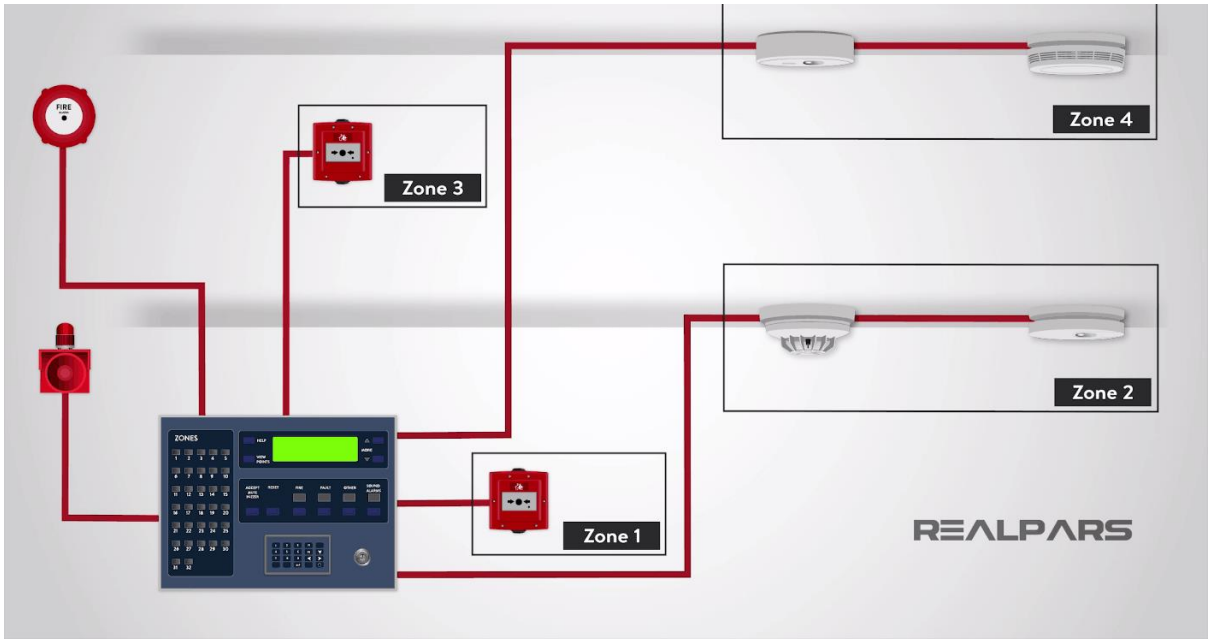
In a Conventional Fire Alarm System, physical cabling is used to interconnect several call points and detectors, the signals from which are wired back to the main control unit.



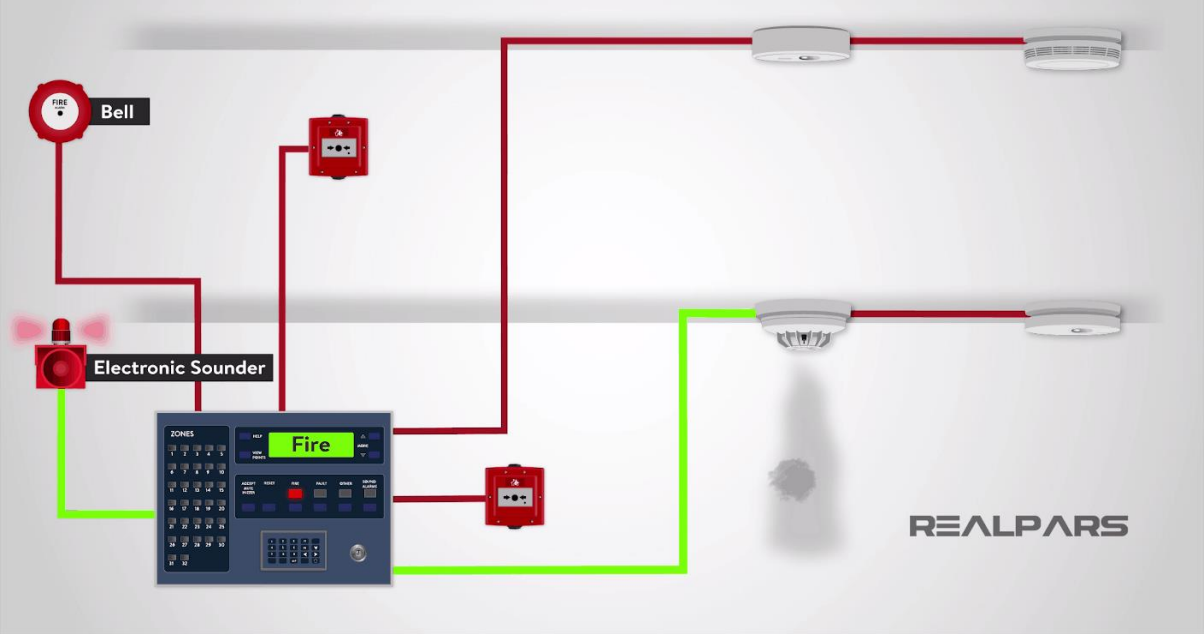
Call points and detectors are arranged in “Zones” to simplify locating the cause of the alarm, this is important for both the fire brigade and general building management.

Each zone is indicated at the Fire Alarm Control Panel either with an indicator lamp, a text display or in some cases both.

It makes sense that the more we can divide a building into zones, the more accurate locating the alarm trigger will be.

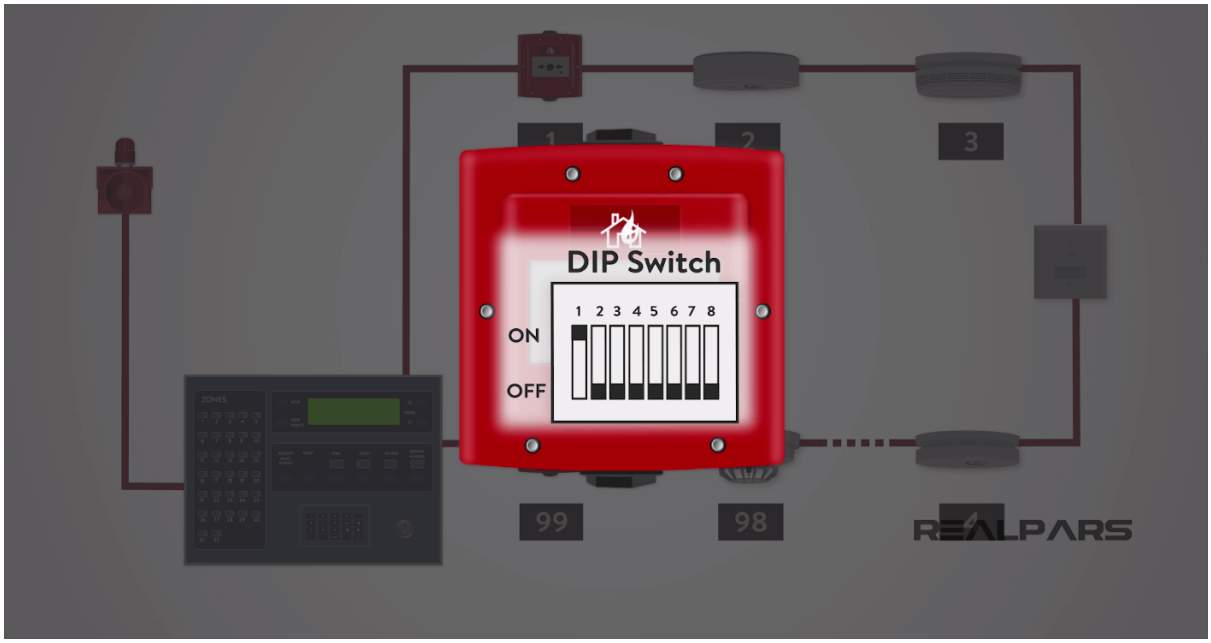


The Control Panel is wired to a minimum of two sounder circuits which could contain bells, electronic sounders or other audible fire alarm devices.
It is these devices which sound the alarm when triggered.



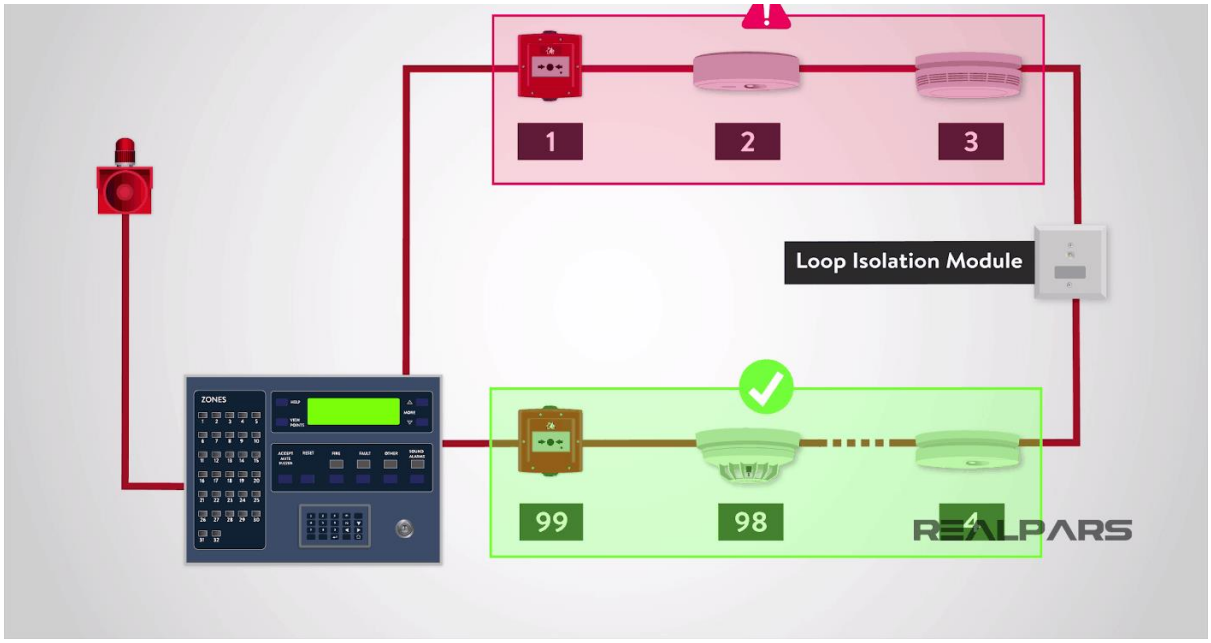
2. Addressable Fire Alarm Systems

The detection principle of an Addressable System is the same as a Conventional System except that each detector is given a set Address (usually by means of a dip-switch) and the Control Panel can then determine exactly which detector or call point has initiated the alarm.



The detection circuit is wired as a loop and up to 99 devices may be connected to each loop.

It is common for the loop to be fitted with Loop Isolation Modules so that the loop is sectioned in order to ensure that a short circuit or single fault will only cause the loss of a small part of the system; allowing the rest of the system to function normally.

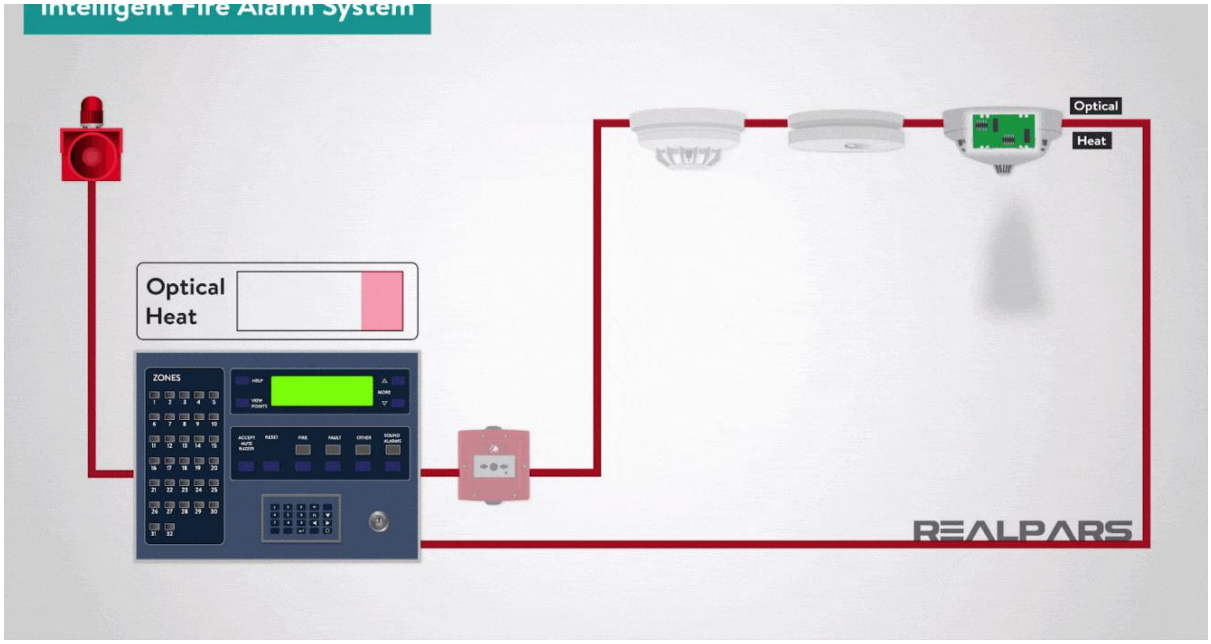


In the previous two systems, the “Conventional Fire Alarm System” and the “Addressable Fire Alarm System” the detectors are not

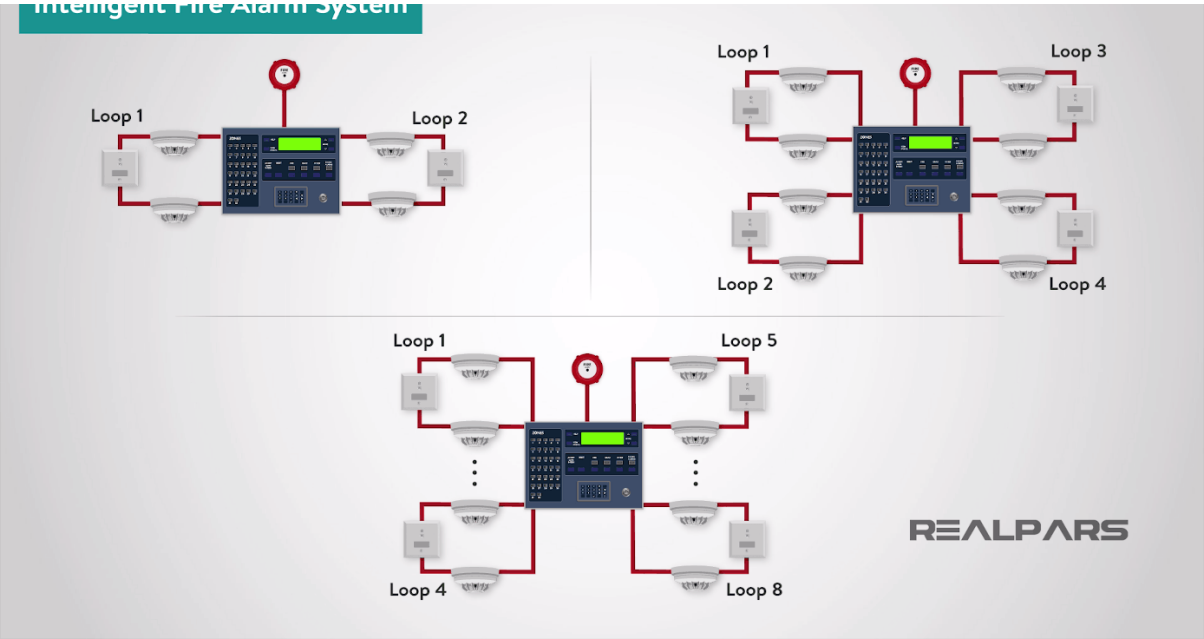
considered “intelligent” as they can only give output signals representing the value of detected phenomena.
It is left up to the Control Unit to decide whether there is a fire, fault, pre-alarm or other.

3. Intelligent Fire Alarm Systems

However, in our next type of System, which is an Intelligent Fire Alarm system, each detector effectively incorporates its own computer which evaluates the environment around it and communicates to the Control Panel whether there is a fire, fault or the detector head needs cleaning. Essentially Intelligent Systems are far more complex and incorporate far more facilities than Conventional or Addressable Systems. Their primary purpose is to help prevent the occurrence of false alarms.



Intelligent Fire Alarm Systems are available in 2, 4, and 8 loop versions which means large premises can be monitored from one single panel.



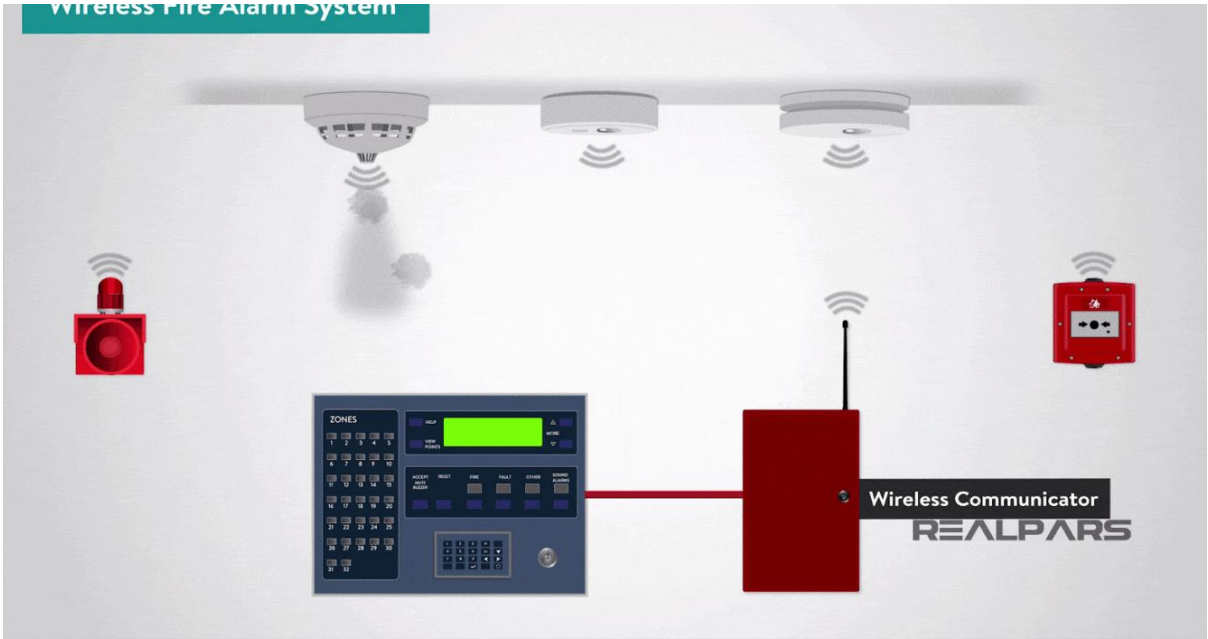
4. Wireless Fire Alarm Systems

The final type of system we will consider is the Wireless Fire Alarm System.

These are an effective alternative to traditional wired fire alarm systems for all applications. They utilize secure, license-free radio communications to interconnect the sensors and devices with the controllers.

It is a simple concept, which provides many unique benefits and is a full intelligent fire detection system without the need for cabling.

In this article, we have learned that Fire Alarm systems are fitted in many buildings we encounter every day and that they are used to warn people within the building of an emergency fire-related situation.



Summary

We discussed the main types of detectors:
– Heat Detectors
– Smoke Detectors
– Carbon Monoxide Detectors
– Multi-Sensor Detectors
– Manual Call points
And finally, we looked at the different types of fire alarm systems:
– Conventional
– Addressable
– Intelligent
– Wireless

Components of fire alarm

1 thermistor 103

2 470 ohm resistance

3 . Transistor (BC547)

4. 1K resistor

5. buzzer

6. Germanium Zener diode 4007

- THERMISTOR

WHAT IS THERMISTOR

- 

The term thermistor comes from “thermal” and “resistor”. A thermistor is a type of resistor whose resistance is reliant on temperature; it’s a resistance thermometer. They’re made from metallic oxide which is moulded into a bead, disk, or cylindrical shape and then enclosed with epoxy or glass.

Thermistors don’t work well with extreme temperatures, but they are perfectly suited for measuring the temperature at a certain point; they’re precise when they’re used within a limited temperature range i.e. within 50 °C of the target temperature; this range is dependent on the base resistance.

Thermistors are easy to use, relatively cheap, and durable. They’re commonly used in digital thermometers, in vehicles to measure oil and coolant temperatures, and in household appliances such as ovens and refrigerators and are preferred for applications that require heating or cooling protection circuits for safe operation.

The thermistor is built in for more complex applications such as laser stabilisation detectors, optical blocks, and charge-coupled devices. For example, a 10 kΩ thermistor is the standard one that's built into laser packages.

How does a thermistor work?

There are two types of thermistors – the most commonly used is the Negative Temperature Coefficient (NTC) thermistor. The NTC's resistance decreases as the temperature increases, and vice versa. With the Positive Temperature Coefficient (PTC) thermistor, the resistance increases as the temperature increases, and vice versa; it's normally used as a fuse.

The type of material used in the thermistor will dictate how much the resistance changes, which is changed with temperature. Thermistors are nonlinear i.e. the connection between resistance and temperature won't form a straight line, it will form a curve on a graph; where the line sits and how much it changes depends on how the thermistor is made.

How is the change in resistance converted to measurable data?

The change in resistance needs to be converted to temperature, which then produces measurable data.

Thermistors versus other sensors

The other types of temperature sensors that are used include the Resistance Temperature Detectors (RTD) and integrated

circuits. Each type of sensor has its pros and cons, and the application will determine the best instrument to use.

1. Thermistor

Advantages:

*KW image

- Durable
- Sensitive
- Small
- Relatively affordable
- Best suited for measuring a single point temperature

Disadvantages:

- Curved output
- Limited temperature range

2. Resistance Temperature Detectors

Advantages

- Extremely accurate
- Linear output
- Wide temperature range

Disadvantages:

- Slow Response time
- Costly

Types of thermistors:

From chip to rod-shaped, there are a variety of shapes available for surface mounting or embedding.

The shape is determined by the type of material that's being monitored i.e. a solid, liquid or gas. They can be enclosed in resin/glass, baked on phenolic or painted depending on the application. For example, thermistor chips are mounted onto circuit boards whereas a bead thermistor can be embedded into a device. Whatever the application, maximum surface contact with the device that's being monitored, and using a thermally

conductive (not electrically conductive) paste or epoxy glue for connection is ideal.

470 ohm resistance

The 470 ohm Resistor color code for 4-band is as shown in the image below:

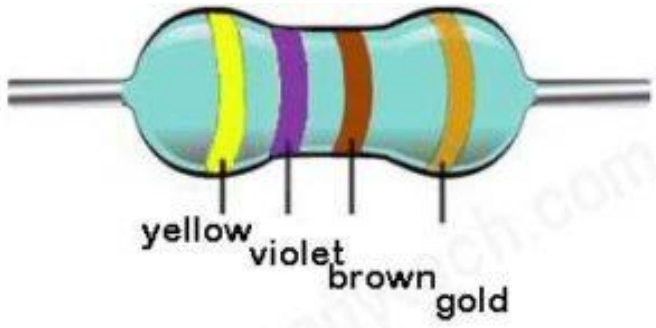


fig. showing the color code of 470 ohm resistor

[Yellow, Violet, Brown, Gold]

Band	Color	Value
1st yellow		4
2nd violet		7
3rd brown		10
4th gold		5%
		470±5% Ω

470 ohm resistor color code for 4-band is calculated as:

- (1st digit) = Yellow = 4
- (2nd digit) = Violet = 7

- (multiplier) = Brown = 1 = 10^1 = 10
- (tolerance) = Gold= ±5%

∴ 47×10±5% –> 470 ohms –> 470 Ω
∴ the real value of **470 Ω resistor** is between **446.5 Ω to 493.5 Ω**

Description: From the resistor code chart we found the color code of resistor with respect to the decimal value of the respective band counted from left to right.

So for 470-ohm resistor, 1st digit is ‘ 4 ‘, ∴ look for colour in a chart with value 4, then it’s your 1st colour (say yellow). The next 2nd digit is ‘ 7 ‘, ∴ look for colour in a chart with value 7, then it’s your 2nd colour (say violet). Next 3rd digit ‘0’ (but value 10^1 = 10) is multiplier ‘ 1 ‘, ∴ look for colour in a chart with value 1, then it’s your 3rd colour band (say brown).

- The last bands in 4 or 5-bands resistors are the indicator of the tolerance value of the resistor. Here, it is Gold indicates a 5% tolerance value. For Silver, its values is 10%, and Brown indicates 1% tolerance. If the 4th band is absent it is considered in 20% tolerance value.

Buck converter

A **buck converter** (**step-down converter**) is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To

reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).[1]

Switching converters (such as buck converters) provide much greater power efficiency as DC-to-DC converters than linear regulators, which are simpler circuits that lower voltages by dissipating power as heat, but do not step up output current.[2]

The efficiency of buck converters can be very high, often over 90%, making them useful for tasks such as converting a computer's main supply voltage, which is usually 12 V, down to lower voltages needed by USB, DRAM and the CPU, which are usually 5, 3.3 or 1.8 V.

Buzzer

A buzzer or beeper is an signaling device, which produces sound. It may be mechanical, electromechanical, or piezoelectric.
This piezo buzzer is 23mm in diameter and has 30mm spaced mount holes. Supplied with a 100mm lead it is designed for 3 – 20V,it produces a 3kHz tone at an 85dB level at 30cm.

Specifications:

1. Operation Voltage: 3-24V DC
2. Current: <15mA
3. SPL: 85dBA/10cm
4. Frequency: 3,300Hz
5. Color: Black
6. Operating Temperature: – 20° to +60°C

Types of buzzers:

Buzzers come in a variety of construction, size, and specifications. Different types and sizes of buzzers are used for different applications. Based on construction, there are the following kinds of buzzers:

1. Piezoelectric buzzers.

2. Magnetic buzzers.
3. Electromagnetic buzzers.
4. Mechanical buzzers.
5. Electromechanical buzzers.

working of Buzzer:

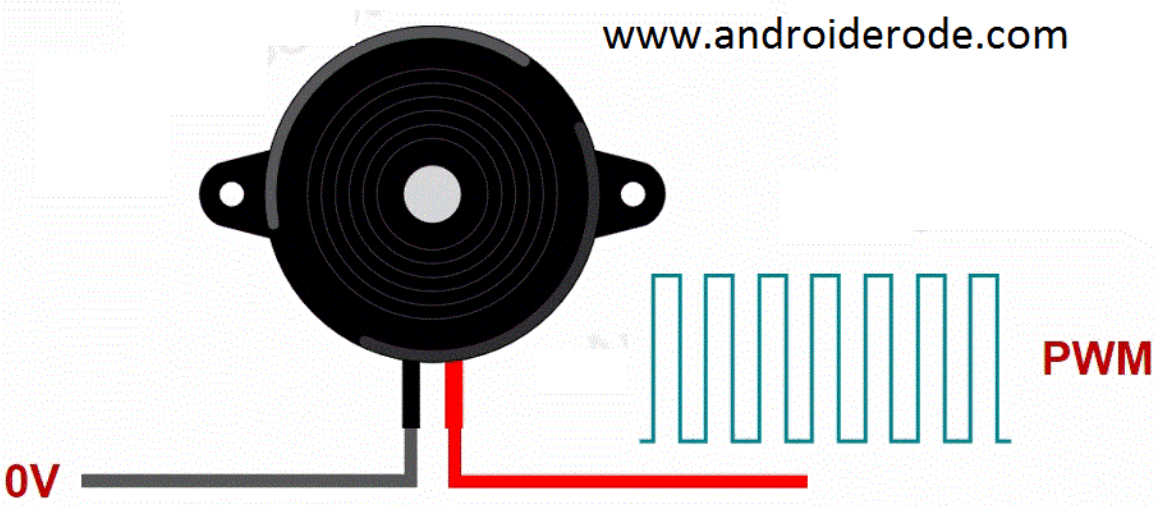
The main working principle is based on the theory that, whenever an electric potential is applied across a piezoelectric material, a pressure variation is generated. A piezo buzzer consists of piezo crystals in between two conductors.

When a potential difference is applied across these crystals, they push one conductor and pull the other conductor by their internal property. The continuous pull and push action generate a sharp sound wave.

How to use a Buzzer:

A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.

There are two types are buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beeeeeeppp.... sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customised with help of other circuits to fit easily in our application.



This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

Applications of Buzzer:

1. Alarming Circuits, where the user has to be alarmed about something.
2. Communication equipment's.
3. Automobile electronics.
4. Portable equipments, due to its compact size.

Piezo buzzers generate a loud & sharp sound. So, they are typically used as an alarm circuit.

Parts

A fire alarm control panel

Fire Alarm Speaker and switch

- Fire alarm control panel (FACP) AKA fire alarm control unit (FACU); This component, the hub of the system, monitors inputs and system integrity, controls outputs and relays information.
- Primary power supply: Commonly the non-switched 120 or 240-volt alternating current source supplied from a commercial power utility. In non-residential applications, a branch circuit is dedicated to the fire alarm system and its constituents. "Dedicated branch circuits" should not be confused with "Individual branch circuits" which supply energy to a single appliance.
- Secondary (backup) power supplies: This component, commonly consisting of sealed lead-acid storage batteries or other emergency sources including generators, is used to supply energy in the event of a primary power failure. The batteries can be either inside

the bottom of the panel or inside a separate battery box installed near the panel.

- Initiating devices: These components act as inputs to the fire alarm control unit and are either manually or automatically activated. Examples would be devices such as pull stations, heat detectors, duct detectors, and smoke detectors. Heat and smoke detectors have different categories of both kinds. Some categories are a beam, photoelectric, ionization, aspiration, and duct.
- Fire alarm notification appliance: This component uses energy supplied from the fire alarm system or other stored energy source, to inform the proximate persons of the need to take action, usually to evacuate. This is done by means of pulsing incandescent light, flashing strobe light, electromechanical horn, siren, electronic horn, chime, bell, speaker, or a combination of these devices. Strobes are either made of a xenon tube (most common) or recently LEDs.
- Building safety interfaces: This interface allows the fire alarm system to control aspects of the built environment, prepare the building for fire, and control the spread of smoke fumes and fire by influencing air movement, lighting, process control, human transport and availability of exits.[1]