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Fire Alarm Systems

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Abstract: ***The electrical or electronic system that can detect fire-related accidents and can alert or notify peoples, is called a Fire alarm and detection system. The fire alarm system is very important for safety in residential buildings, factories, houses, School/colleges, Hospital etc. Generally, the fire alarm system is installed in a building to detect the fire anywhere in that building. The fire alarm system has two main parts - a detection system and a notification or alarm system. Using the detection system, it senses the fire or fire-related incidents, and using the alarm system it notifies the people. Fire alarm system consists of control panel, smoke detector, MCP and Electronic Sounder. The Brain of fire alarm system is the Fire Alarm Control Panel. It is the central hub for all the detector signal to be wired and provides a status indication to the users.***
Keywords: MCP, Sounder, Sprinkler, Detector, Conventional System, Addressable System etc.

I. INTRODUCTION

The basic working principle of a fire alarm system is that when any fire-related accident happens the initiating devices sense the environmental changes and send signals to the control panel with the location of the accidental place. After receiving the signal, the control panel activates the notification devices to alert people to go far away from that place. Safety officers, supervisors can see the location in the control panel and go to the accidental place and take further actions. The initiating device, notification device, and control panel are the main basic components of a fire panel system.

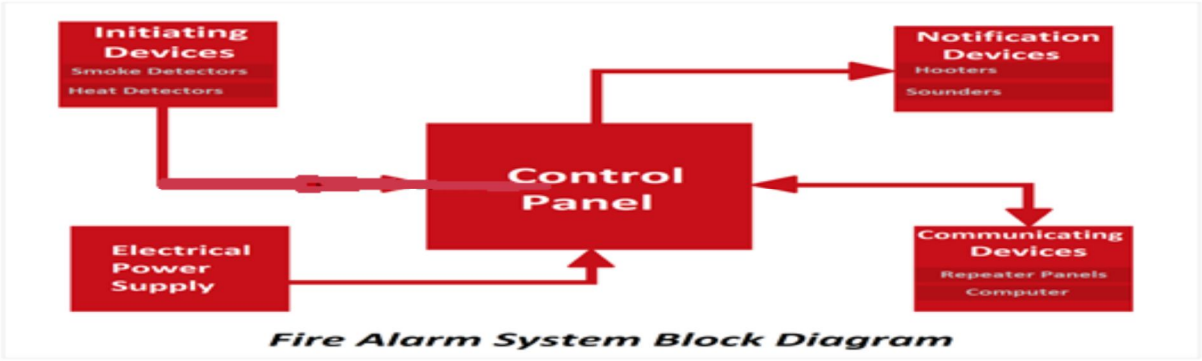


Fig1.Basic block diagram of fire alarm system

Description of components of Basic Fire Alarm System.

A. Communicating Devices

Communicating devices are those through which we can communicate with the control panel of the fire alarm system or take information or data from it. Repeater panel is an example of a communicating device through which we can observe or control the fire alarm system. A modern fire alarm system allows connecting with computers and networks also.

B. Initiating Devices

Initiating devices are those that detect the fire or any environmental changes during fire-related accidents and sends signals to the main control panel. The common examples of initiating devices are Heat Detectors, Smoke Detectors, Dust detectors, carbon monoxide detectors, etc. Here we are defining the following terms.

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1) *Smoke Detector:* Smoke detector/sensor detect the fires by sensing small particles in the air using a couples of different kind of technologies. When smoke detector detects that particle above a certain level, It transmit the signal to fire alarm panel and fire alarm panel activate the sounder. In general we can say that Smoke detector can alert sleeping residents before they become fire victims.
2) *Heat Detector:* Is a device used to detect any significant increase in temperature that may indicate that a fire is about to start. Heat detectors perceive their use when property protection becomes a major examine in your fire alarm system. Heat detectors are ideally suited for protection against high-heat fires, caused by explosions and combustion. As the flames grow higher, the temperature in a room will speedily increase, triggering the heat detector, typically before the fire slow burn enough to trigger the smoke detector. Low-energy fires, ones that smolder, are more easily detected by smoke detectors, making having both on the property key to protecting you from both types of fire.

a) Rate-of-Rise Heat Detectors have a baseline temperature of 70 degrees Fahrenheit. When the heat in the room rises rapidly over 70 degrees, an alarm is then activated. This isn't caused by the temperature merely going above 70 – to account for fluctuations, the detector instead only triggers the alarm if the temperature in the room climbs by about 15 degrees in less than a minute. In a high-heat fire, the temperature of the room increased very quickly, sometimes as fast as 30 degrees in less than a minute, which would trigger any rate-of-rise heat detector.

b) Fixed Temperature Detectors focuses on the rooms actual temperature. Rather than measuring how quickly the temperature is increasing, these heat detectors will instead trigger when they reach a high temperature, usually somewhere around 135 degrees, which will trigger the alarm.

C. Notification Devices

Notification devices are those through which the fire alarm system alert peoples. Generally, the notification devices required an additional power supply from the control panel. During any accident or emergency cases, when the control panel receives signals from the initiating devices, it starts to send signals to the notification devices.

II. TYPES OF FIRE ALARM SYSTEM

A. Home Fire Alarm System

Home fire alarm system also known as domestic fire alarm system used in residential buildings, houses, etc. The domestic fire alarms devices are may used as standalone or interconnected to each other. Generally, this type of system is connected to the main power supply of the house or connected to the main distribution board. Also, batteries are used for backup power supplies. Generally, the domestic fire alarm system has not any control panel. Even both of the initiating and notification devices are assembled in the same case. Standalone devices make noise or alert themselves whereas, in the interconnected system, all the devices will be triggered when accidents happen in any one place.

B. Conventional Fire Alarm System

In 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 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 contain bells electronics sounders or other audible devices. It is these devices which sound the alarm when triggered.

C. Addressable Fire Alarm System

The addressable fire alarm system is the latest system than the conventional system. In an addressable fire alarm system, all the initiating devices (smoke detector, heat detector, MCP, etc) and notification devices (sounder, hooter) are connected in a loop wiring system. The Detection principle of an Addressable Fire Alarm 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.

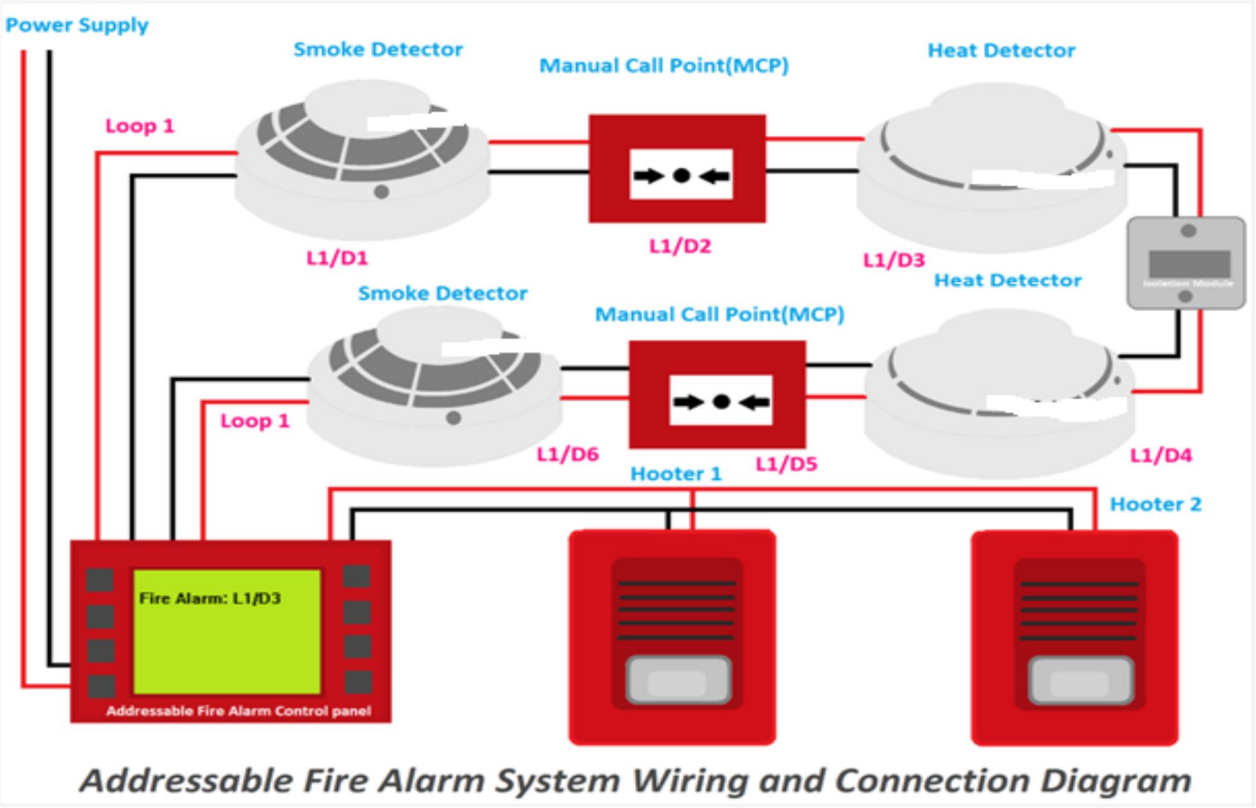


Fig 2. Addressable fire alarm system wiring and connection

The main difference between the conventional fire alarm system and an addressable fire alarm system is that in an addressable fire alarm system the exact location of the device or accident can be find out but in a conventional fire alarm system the exact location of the accidental place cannot be find out from the control panel.

D. Intelligent Fire Alarm system.

It is the advanced technology from the addressable fire alarm system. In the intelligent fire alarm system, all the detector devices have their own programming or computing devices. So they not only send the signal during the accident even send the status of the current environmental status around them such as dust that needs to be cleaned, faults, moisture, etc. This system prevents the occurrence of false fire alarms. Also in this system, the control panel can be connected to the multiple loops of wirings. An intelligent fire alarm system helps to monitor a large area from a single panel even they allow remote control and other extra functions. The intelligent fire alarm system is more efficient and advanced technology than the addressable fire alarm system. Nowadays intelligent fire alarm system comes with single standalone devices to large housing installation. This system also helps to find out the exact location of the detector or the accidental place.

This system provides a lot of features and advantages over other types of fire alarm systems. In this system also, all the detectors are connected in a loop wiring procedure. This system supports all types of detectors including multi-sensor detectors. The additional feature of this system is that it can support connecting multiple loops. The detectors of an intelligent fire alarm system have their own programming device or minicomputer. So, they not only send the signal when a fire happens, but they send another status also such as whether cleaning is required, moisture, internal faults, etc. In this fire alarm system, the fire alarm control panel can communicate with each detector individually.In this fire alarm system, a very large building or area can be monitored from a single control panel. An intelligent fire alarm system works with digital signals. Also, it allows connecting additional panels (repeater panel), computers, or other networks for remote control.

The intelligent fire alarm system is more complex than other systems. Its control panel records all the data from each loop and each detector separately. Also they are capable to store everything such as event history, scheduling, timing, etc. Also, it can help to check all the detectors individually whether they are functioning normally or not.

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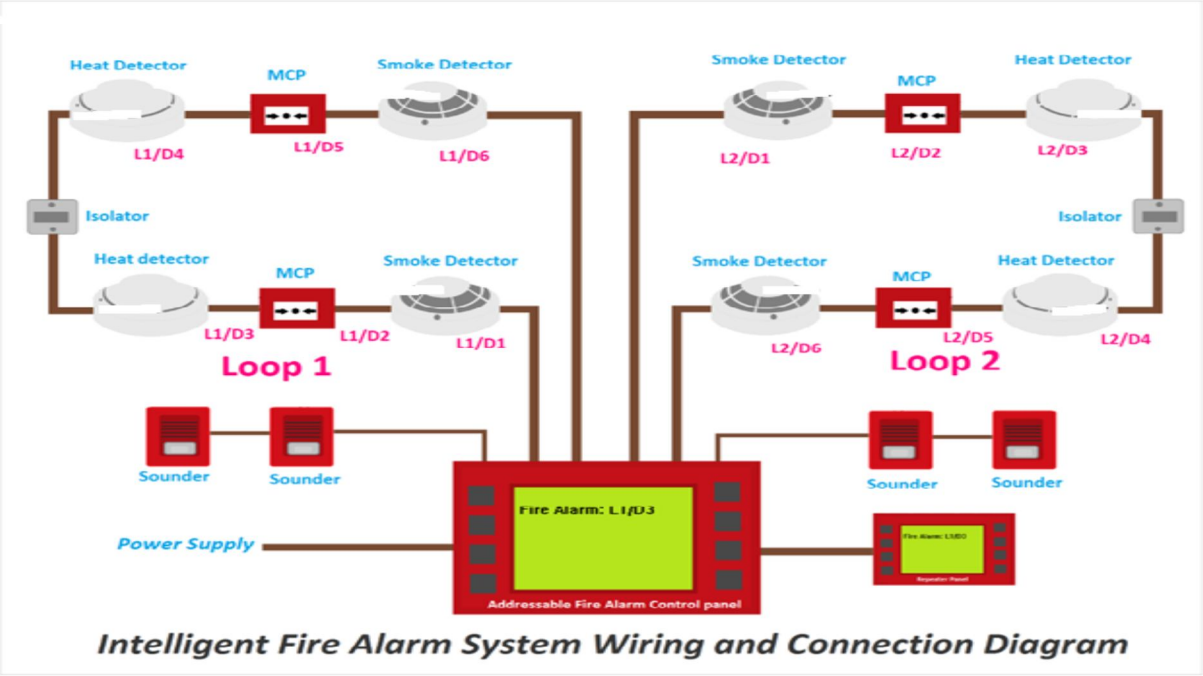


Fig 3. Intelligent fire alarm system wiring and connection design

The control panel for the intelligent fire alarm system comes with 2 loops, 4 loops, and other multiple loop specifications. In the above diagram, a 2 loop system is shown. You can see, both loops have six detectors but it can be more. All the detectors have separate identification such as L1/D1 or L2/D2. Here, L1 means Loop 1 and D1 means detector 1. Similarly, L2 means loop 2, and D2 means detector 2. If the control panel shows an alarm regarding L1/D3. It means the accident happened near to the detector 3 in the loop 1.

Here you can see a repeater panel is connected to the main control panel. The repeater panel is the sub-panel that shows all the data of the control panel. Even they can control the whole system. The repeater panel that only shows the data same as the main control panel, but cannot control anything is called a passive repeater panel. On the other hand, the repeater panel shows data and can control the system is called an active repeater panel. The repeater panel is only connected to the main control panel. No initiating or notification devices are connected to the repeater panel.

E. Wireless Fire Alarm System

In the wireless communication system, all the detection devices are connected to the control panel wirelessly using a license-free radio communication system. So the cost of cabling is eliminated. The detector communicates with the control panel by transmitting the radio signal. The wireless fire alarm system is easy to install in a very short time with a low installation cost.

III. ADVANTAGES TO INSTALL A FIRE ALARM

According to the National Fire Protection Association (NFPA), over 113,000 non-residential fires broke out in the U.S. in 2015, killing 90 civilians, injuring 1,425 others, and causing $3.1 billion in property damage. Mitigate these risks with a fire alarm.

1) *Fire Alarms Save Lives:* The number one reason to install a fire alarm is to make the building safe for your employees, customers, and tenants. A combination of smoke and heat detectors, sirens and bells, and strobe lights detect fires and alert building occupants, giving them ample time to evacuate in an orderly fashion.
2) *Fire Alarms Reduce Property Loss:* While strobe lights and sirens don't actively put out fires, they alert the people who can. The fire control process begins when trained personnel attack a small fire with an extinguisher and bystanders, guests, or employees call the fire department. Monitored fire alarm systems automatically notify emergency responders and fire trucks dispatch to your location without delay. The faster these responses happen, the sooner the fire is extinguished and the less damage your building sustains.

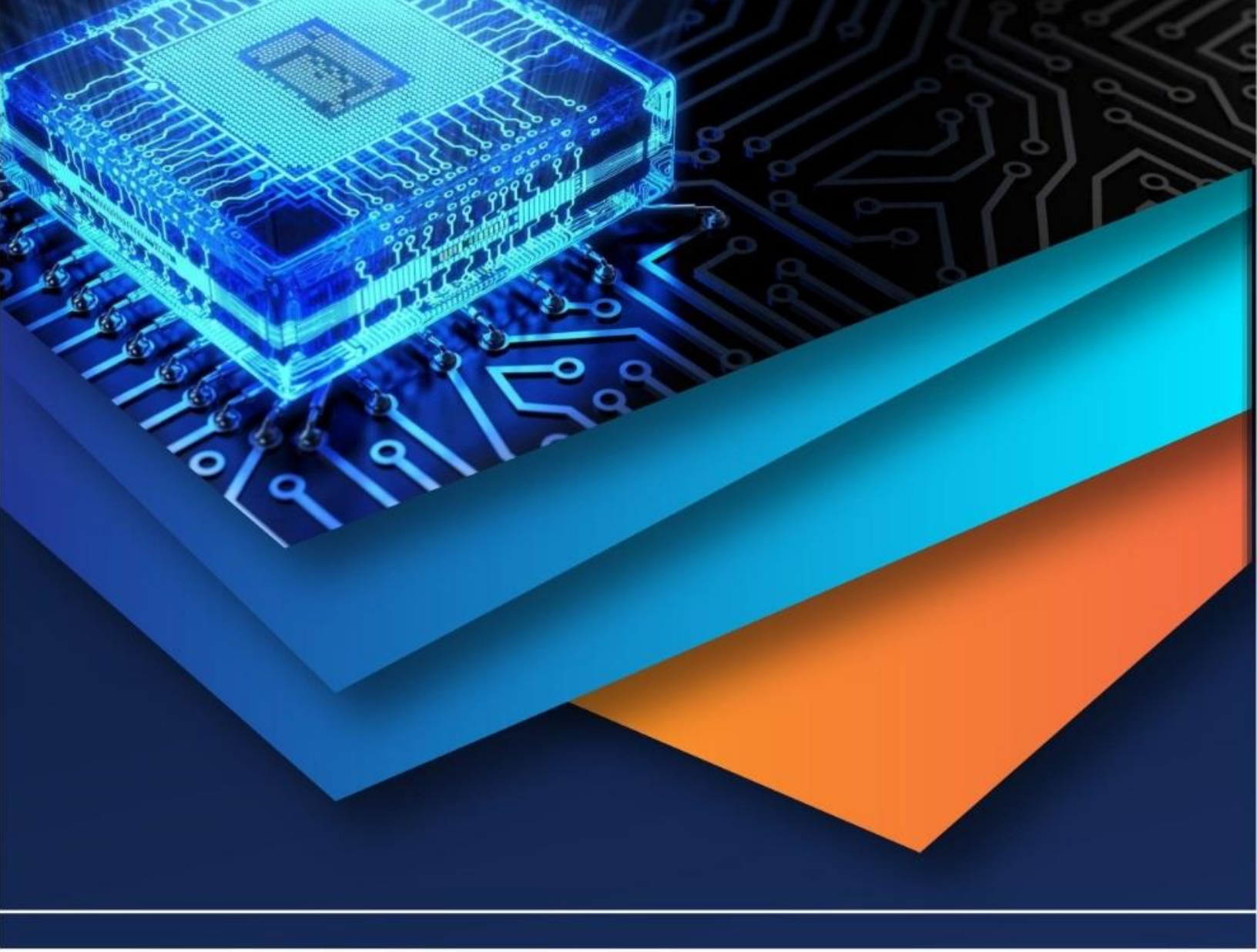
3) *Fire Alarms Shorten Your Recovery Time:* Less building damage means shorter downtime until you can reopen for business. This cuts your losses from the fire even more, allowing you to return to business as usual before long.
4) *Fire Alarms May Qualify You For Insurance Discounts:* Most insurance carriers offer discounted rates on business insurance policy premiums if you have a code-compliant fire alarm system. In fact, some providers require you to install a fire alarm before they will insure your business.
5) *Fire Alarms Keep You Code-Compliant:* If you want to avoid fees and embarrassing PR problems, avoid getting caught up in code-compliance issues. One way to do this is to install a fire alarm in your commercial building.

IV. CONCLUSION

Fire alarms System save lives. The number one reason to install a fire alarm is to make the building safe for your employees, customers, and tenants. Fire alarms reduce the property losses. In Fire alarm system, Firstly fire sensor (smoke detector, heat detector) sense the smoke and automatic transmit the signal to the fire alarm panel. In wireless systems, the signal from the fire sensor/detector to the control panel is transmitted with radio frequency. The fire alarm panel activates the flashers or the sounders, turns on sprinklers (or they can be activated along with the detector), or makes a call to the authorities or to the occupants. If the fire alarm system is addressable, the source of the occurrence will be pointed on the control panel. Users on separate floors or in connected buildings can be notified in several ways: by horns, gongs and loudspeaker messages advising appropriate action for each department. In General we can say that fire alarm system alert us about the fire and any person can leave that campus timely without become the victim of fire incident.

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