"IOT Applications in Fire safety"

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Abstract:
Change and progress are taking place right now. The world is turning more and more toward technology. The safety of new construction is a problem in the modern day. As the population grows, more and more structures are needed. Accidental fires occur in various types of structures for a number of reasons. If we look at the past several decades, we have seen a number of fatalities brought on by building fires. Every year, our nation suffers financial losses as a result of fire catastrophes. The biggest worry right now is how to prevent these fire incidents in buildings with high ceilings. Traditional fire detection methods are unable to stop such mishaps. Additionally, they are unable to alert owners about fire incidents.
Additionally, they are unable to alert owners about fire incidents. IOT has a significant role to play in this. Internet of things, or IOT. These fire mishaps can be completely prevented or controlled by IOT.
IoT holds one of the leading positions in technological growth across the globe. Following computers, the Internet, and mobile communications, it is another sector of the information economy. Firefighting, fire monitoring, and safety management systems are crucial uses for Internet of Things technology. It talks about the IoT system framework for planning, monitoring, and battling fires.
Building fire accidents can be controlled using an IOT-based fire detection system. An IOT-based system can offer the finest security for tall buildings. The owner, user, alarm, etc. will receive a message alerting them of the fire from an IOT-based fire detection system that can detect temperature, smoke, short circuit, and other factors. In order to take safety precautions, it can also send an alarm message to the local fire department and police system.
Multiple sensors, a communication system (Bluetooth, GSM, NodeMCU), motion planning (manual patrolling), and an Android application for manual system patrolling make up the Fire Detection System. For safety reasons, this fire detection system can be employed in academic institutions, workplaces, and businesses.
In-depth discussions of the IOT, IOT-based fire detection systems, and IOT applications that can be used to improve building fire safety are covered in this article. Additionally, it covers how IoT and wireless sensor network technology might be applied to meet firefighting needs.

Keywords: Information and communications technology (IoT), the National Fire Protection Association (NFPA), Portable Appliance Test (PAT), Building Management Systems (BMS)

1. Introduction

[16]It is a real thing with a tangible Internet connection. It may be a thermostat, lock, appliance, fitness tracker, or even a light bulb.

Imagine having shoes that monitor your heartbeat and alert you to any potential health issues. There are already "smart" shoes on the market, so you don't need to imagine!
The idea behind the Internet of Things is actually rather straightforward: it entails linking all of the world's physical locations and objects to the internet.
In the coming five years, the Internet of Things will bring about significant changes. And even while smart devices are exactly that, the IoT sector still needs to make security improvements on a broad scale. Today's IoT gadgets are frequently hurried to market with little regard for fundamental privacy and security safeguards: "Insecurity by design."
This puts you and everyone else in danger since you could unknowingly be watched, have your data stolen, or even lose the ability to lock your own door. You might even join a botnet that targets the Internet. Millions of other vulnerable webcams, including your own, might be utilised to assault a nation's electrical supply.
The Internet of Things includes everything from dental sensors that can track what a person eats to cat litter that can record a cat's every step. Can you distinguish between the real and fake?

The emergence of the Internet of Things is one of the most rapid and fascinating advances in information and communications technology (IoT). Despite the fact that networking technologies have proliferated over the past 20 years, up until recently they were mostly used to link up traditional end-user devices like mainframes, desktop and laptop computers, and, more recently, smartphones and tablets.

In recent years, a significantly wider variety of devices have been connected to the network. Vehicles, home appliances, medical equipment, energy metres and controllers, street lights, traffic lights, smart TVs, and virtual assistants like Amazon Alexa and Google Home have all been included. Industry analysts predict that by 2020 there will be more than 25 billion of these devices connected to the network, up from an estimated eight billion at present. New use cases for network technologies have been made possible by the growing deployment of these devices. According to some estimates, the IoT might bring in up to US$13 trillion by 2025 [16].

Why IoT Matters

[23]When something is connected to the internet, it can send, receive, or do both when it comes to information. Things become "smart" due to their ability to send and/or receive information.
Let's use smart phones as an illustration once more. You can listen to almost every music in the world right now, but it doesn't mean that your phone truly has every song ever recorded on it. The reason for this is because while your phone can communicate information, every song in the world is kept somewhere else.
(asking for that song) and getting the answer (streaming that song on your phone). A item only needs access to information in order to be intelligent; it is not necessary for it to contain super storage or a super computer. Connecting to super storage or a super computer is all that is

required of a thing. All devices connected to the internet fall into one of three categories in the Internet of Things:

1. Devices that gather data and transmit it.
2. Things that behave after receiving information.
3. Things that do both functions.

And each of these three has tremendous advantages that build on one another.

1.1. Collecting and Sending Information

You can use any type of sensor, including temperature, motion, moisture, air quality, and light sensors. These sensors, when combined with a connection, enable us to automatically gather environmental data, which then enables us to make better informed judgments.

On a farm, automatically gathering data on the soil moisture can help farmers determine when to irrigate their crops. Instead of using irrigation systems excessively (which might be costly) or watering too little (which can be an expensive loss of crops),

The farmer can control how much water is applied to the crops. Farmers can do this to boost crop productivity while cutting costs related to it.

The same senses that humans use to make sense of the world—sight, hearing, smell, touch, and taste—help robots (and the people who oversee them) do the same.

1.2. Receiving and Acting on Information

Machines that gather data and take action are something we're all extremely accustomed to. A document is sent to your printer, who prints it. Your automobile's doors unlock when your car keys send a signal. There are countless examples.

We know that we can instruct machines from a distance, whether it be as basic as sending the command "turn on" or as complex as sending a 3D model to a 3D printer. Then what?

When objects are capable of both of the aforementioned, the Internet of Things reaches its full potential. Things that gather data, send it, as well as receive data and act on it.

1.3. Doing Both: The Goal of an IoT System

Let's fast return to the farming illustration. You don't actually need a farmer; the sensors can gather data about soil moisture to advise the farmer on how much to irrigate the crops. Instead, depending on how much moisture is in the soil, the irrigation system can automatically activate as needed.

You can go even further with it. If the irrigation system receives weather data from its internet connection, it may also be able to predict when it will rain and decide not to water the crops today as the rain would take care of it.

Furthermore, it goes beyond! It is possible to gather and send data on the soil moisture, the amount of irrigation watering, and the actual growth of the crops to supercomputers that can process the data using incredible algorithms.

That's only one type of sensor, by the way. These algorithms can learn considerably more when other sensors, such as those for light, temperature, and air quality, are included. These algorithms can produce amazing insights into how to make crops grow the best, contributing to the world's food supply, with dozens, hundreds, and thousands of farms gathering this data.
And among the countless IoT uses, agriculture is just one...[23]

2. Main components used in IoT:

[20]• Low-power embedded systems: Less battery usage coupled with high performance are the opposing factors that are crucial in the development of electronic systems.

• **Sensors:** A sensor is a critical component of any IoT application. It is a physical device that measures and detects a physical quantity and converts it into a signal that may be provided as an input to a processing or control unit for analytical purposes.

1. Different types of Sensors :
2. Temperature Sensors
3. Image Sensors
4. Gyro Sensors
5. Obstacle Sensors
6. RF Sensor
7. IR Sensor
8. MQ-02/05 Gas Sensor
9. LDR Sensor
10. Ultrasonic Distance Sensor

2.1. Modern Applications:

1. Smart Grids and energy saving
2. Smart cities
3. Smart homes/Home automation
4. Healthcare
5. Earthquake detection
6. Radiation detection/hazardous gas detection
7. Smartphone detection
8. Water flow monitoring
9. Traffic monitoring
10. Wearables
11. Smart door lock protection system

12. Robots and Drones
13. Healthcare and Hospitals, Telemedicine applications
14. Security
15. Biochip Transponders(For animals in farms)
16. Heart monitoring implants (Example Pacemaker, ECG real time tracking)[20].

3. Leading Causes of House Fires

[17]Several of the most frequent reasons for house fires have been recognised by the National Fire Protection Association (NFPA). The following are some of them.

1. Appliances and Equipment

Any appliance that produces heat (such as heaters, clothes dryers, and computers) or warms up over time (such as fans and computers) poses a risk of catching fire. Unattended cooking equipment is a common source of preventable fires.

2. Candles

A burning candle should never be left unattended, according to the warning label on every candle. But many candles might burn out of control since they are frequently overlooked. On Christmas Eve, Christmas Day, and New Year's Day, candle fires are most likely to happen.

3. Holiday Decorations

During the winter holiday season, fatal fires aren't just started by candles. The obvious offenders are illuminated holiday decorations and Christmas trees. Live trees that are neglected and allowed to dry out are simple pickings for hot lights to burn down.

5. Electrical Systems and Devices

Any electrically powered device has the potential to cause a fire, but overheated lighting equipment tops the list. Inadequately done electrical work in a home, such as loose wires, poorly grounded circuits, and poorly connected circuits, can also be dangerous.

6. Smoking

The result of careless smoking behaviours is one of the most frequent causes of house fires. Smoking can occasionally cause people to nod off. They run the risk of starting a fire in their couch, bed, or other furniture, which is sometimes fatal. Throwing still-hot ashes into a garbage can, where they could ignite, is another preventable risk.

7. Chemicals and Gasses

Natural gas or propane gas sources can quickly start home fires. A combustible condition can be produced by an accidental spark and a little leak. Combustion can also be caused by improperly combining household chemicals, thus it's crucial to carry out such work outside the home.

8. Lightning

In the summer, when afternoon and early evening storms are at their strongest, lightning fires are most frequent. Homes in densely forested settings are particularly susceptible to lightning strikes that might ignite the surroundings.

9. Children

One of the main causes of house fires is young children playing with fire or matches inadvertently inside the house. Younger children who are aware of the dangers of fire and simply want to watch what happens are just as dangerous. Talking to kids about how reckless conduct around fire can be damaging might help prevent potential disaster, even though it may not be easy to completely quell their interest.

10. BBQ Grill

In comparison to other seasons, the summer is the worst for this. There are a number distinct factors, such as closeness to combustibles like dry grass or a gas leak, that might cause an uncontrolled flame to start on a barbeque grill. Cooking on stone or another flame-resistant material or keeping a close eye on an active grill will reduce the chance of these mishaps. You can also check for gas leaks before lighting the grill.

11. Normal Fires That Go Awry

Sometimes it's impossible to avoid. Fire is famously difficult to manage, even when we do everything right, adhere to all the guidelines, and use common sense. Of course, allowing fires to start in our houses is one of the most frequent reasons for house fires. This is typically not a problem if handled properly, but even a single wayward ember from an active flame might ignite something, like a carpet.

Never leave an interior fireplace alone and practice caution in its vicinity. A log could crack at this moment in such a way as to send embers soaring.[17]

12. Faulty Electrical Equipment

Electrical problems are without a doubt one of the most frequent reasons for workplace fires.

They frequently result from faulty wiring, overloaded sockets or plugs, and outdated, broken equipment that becomes overloaded and sparks, igniting combustible materials.

It's crucial to remember that it is legally required for a workplace to guarantee that all equipment operates and performs as intended, and this includes electrical equipment.

A Portable Appliance Test (PAT) must be performed annually on all electrical equipment in a workplace to make sure it is safe and operating as intended.

All things that pass the PAT test have a sticker on them that lists the date of the test and the result.

13. Equipment Clutter

Office clutter is a typical problem, and if regular cleaning and maintenance are not done, it will eventually raise the risk of a fire starting. The office is filled of flammable items and other potential fire starters. Keeping workspaces in top condition and maintaining a regular cleaning

schedule are essential for lowering fire hazards. The chance of a fire starting will be significantly reduced by actively pushing staff to keep their workspaces as neat and orderly as possible.

14. Combustible Materials

It goes without saying that safety must come first for both employees and the management of such materials if your workplace stores or employs flammable or dangerous products.

If a business is known to use combustible materials, then proper storage, disposal, and handling procedures need to be strictly regulated, and worker safety must come first.
The handling of combustible and flammable materials requires ongoing education and training.

15. Human Error

Basic human mistake is a primary contributor to workplace fires. This is as a result of unintentional occurrences. Burning food in a staff area, spilling flammable liquids, using machinery or equipment improperly and causing it to overheat, and just plain negligence are a few examples of what can go wrong.

Making sure there are lots of appropriate fire extinguishers placed all over the work area is one way to stop these kinds of events from getting worse.
Additionally, it's critical that every employee receives adequate instruction on how to use a fire extinguisher and that they frequently review and evaluate any potential workplace risks that could arise from human mistake.

16. Negligence

Sadly, there are several potential for fires to start at work as a result of carelessness and incompetence. Shortcuts have been known to be used by some employees in an effort to complete a task more quickly; nevertheless, doing so could put a significant risk to health and safety and fire safety in danger.
Examples include obstructing ventilation spaces, piling paper or cards in combustible places, abusing or storing flammable or combustible items, and improperly operating or overusing equipment.
Regular reviews, retraining, and assessments should be conducted by business owners to ensure quality workmanship and lower the danger of future fires.

Nearly anywhere can catch on fire, although there are some settings where it is a particular danger. These situations include:

- Places of employment that use heavy machinery or industrial equipment. Heavy machinery and industrial equipment both rely on complex electronics to operate, and any

electrical issue can result in a spark or even a flame. In order to prevent this, employers must maintain their equipment.

- Factories that create dust as a byproduct in some form. If there is no active dust removal system in place, facilities that work with wood, paper, or other materials that can produce dust are constantly at risk of a fire accident. In the presence of an open flame, suspended dust, regardless of its composition, can cause an explosive inferno that almost always causes catastrophic injuries.

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4. Factories that create dust as a byproduct in some form. If there is no active dust removal system in place, facilities that work with wood, paper, or other materials that can produce dust are constantly at risk of a fire accident. In the presence of an open flame, suspended dust, regardless of its composition, can cause an explosive inferno that almost always causes catastrophic injuries. Products with flaws that is either combustible or constructed with subpar electronics. Before they are placed on store shelves, clothing and appliances in particular must undergo extensive testing. In fact, safety tests must be performed on every object that is anticipated to be used in close proximity to a flame. However, inferior clothing materials may be highly combustible, while faulty appliance wiring can produce sparks and feed a fire. The makers will be responsible in both situations.Auto accidents, particularly when gasoline or other hazardous liquids are spilled. If a fuel tank ruptures or if a truck transporting hazardous commodities is involved in the incident, a flame may ignite quickly, causing unpredictable casualties and effects.[17]

5. What Is Meant by Fire Safety?

The term "fire safety" refers to the rules and procedures designed to reduce the damage that fire can do. The goal of fire safety measures is to avert fire incidents from happening and to contain the fire once it starts to lessen the damage.

Concerns about Fire Safety in India

• States don't all have the same fire safety laws in place.

• India's fire safety standards are not properly enforced.

• The majority of fire departments in India lack sufficient organizational structure, current equipment, infrastructure, financing for cutting-edge firefighting technologies, and training chances for staff.

• In India, there is a lack of public understanding of fire safety.

• Numerous residential and commercial structures violate fire safety regulations.

• The various buildings' installed fire prevention systems are not properly maintained.

• There are no explicit guidelines for building fire safety audits.

There is no doubting the need to improve fire safety in India. To guarantee that fire safety regulations are strictly followed and adhered to, all parties involved, including the authorities, civic organizations, and the general public, are accountable.

Main Causes of Fire Accidents in India

The following are a few of India's primary fire accident causes:
• Electrical shunt.
• A gas cylinder or stove bursting.
• Human negligence.
• Improper handling and storage of flammable materials.
· Disregarding Indian fire safety regulations.[16]

6. Description of IOT Based Fire Department Alerting System Project

In industries, shops, malls, residential complexes, and parking lots, fire detectors are crucial. They can help save lives by assisting in the early detection of fire or smoke. Commercial fire detection systems typically use a buzzer or siren to signal an alarm. We have created a temperature and smoke sensor-based IOT-based fire alerting system. This project will use IOT to communicate relevant information in addition to signalling the presence of fire in a specific building.

With the aid of sensors, electronics, software, and connection, physical objects can share data through the Internet of Things (IoT), which is essentially a network of "things." There is no need for human involvement with these systems.
In this Arduino fire alarm system using temperature and smoke sensors using the IOT project, we can send LIVE information like Temperature, Smoke Value detected by a particular device to the Fire Department.

A detailed description of the IOT based Fire Alerting System Project

Temperature and smoke sensors are used in the IOT-based fire alerting system. The analogue signals received at the sensor end are converted to digital using an internal ADC converter in the Arduino. When the temperature and the smoke both reach a predetermined level, the Arduino is programmed to activate the buzzer.
Arduino simultaneously transmits the data to the ESP8266 Wi-Fi module. A chip called ESP8266 is used to link microcontrollers to Wi-Fi networks. The following information will then be sent by the ESP8266 to the IOT website so that authorised individuals can take the necessary actions to put out the fire.

1. Thermostat (in Degree Celsius) Smoke Value
2. (in Percentage)
Device ID 3.
4. Time and Date Stamp

The device ID is a special ID assigned to a device that can be used to obtain information about the location where a fire has been detected.
The Wi-Fi module needs to be connected to a Wi-Fi zone or a hotspot in order for this Internet of Things (IoT)-based fire alarming system to function. Additionally, this project is carried out without the IOT module. The GSM module, which triggers an SMS when the buzzer is turned ON, has been utilised in place of the IOT module.

7. Technical Specifications

The following components are used in the project's IOT-based fire alerting system with temperature and smoke sensors:

1. smoke detector

2. A thermometer

3. Arduino, a microcontroller.

4. LCD Screen

5. ESP8266

6. Buzzer

6.1. How IoT is Changing Fire Safety

Driverless automobiles and household appliances are two of the Internet of Things' (IoT) most well-known uses. However, its most intriguing use in the field of fire safety may be in building sensors. The gathering and use of atmospheric data has the potential to significantly change how we approach putting out fires and saving lives.

6.2. IoT Sensors

IoT sensors are a key component of so-called "smart buildings." Smart buildings are structures that are partially managed by self-contained computer programmes called Building Management Systems (BMS). These sensors can control lighting, keep a certain temperature in various rooms, and perform other functions that benefit from outside information.

The same rules that govern fire safety also apply to fighting flames, which opens up a wide range of possibilities for brand-new approaches. Currently, temperature sensors are only able to detect temperatures within normal limits, although fire temperatures can be detected by special heatproof sensors. In addition to detecting fires before they produce smoke, this could also provide firefighters with information about the intensity of fires, allowing them to adjust their tools and strategy. Another priceless piece of information is the location of the fire in a building. You may currently be aware of the locations where detectors went off or an alarm was pulled, and you may also have access to witness evidence. IoT sensors can prove this beyond a shadow of a doubt by displaying not only the location of a fire's origin but also its rate of spread. Firefighting workers can receive all of this data automatically.

8. Fire Detection Systems

IoT technologies can help maintain crucial fire detection systems better. The fire alarm systems in many large buildings are a patchwork of several alarms from various manufacturers, with manual storage and maintenance procedures depending on the readings from each control panel. IoT can combine data from numerous alarm systems into a single point of contact (such a phone or computer interface), enabling a user to examine maintenance logs and data rapidly.

A smart IoT enabled fire system can deploy various measures to specific rooms, limiting damage to the larger facility, by sensing the exact location of the fire, the type of fire, and whether there are any occupants in the room.

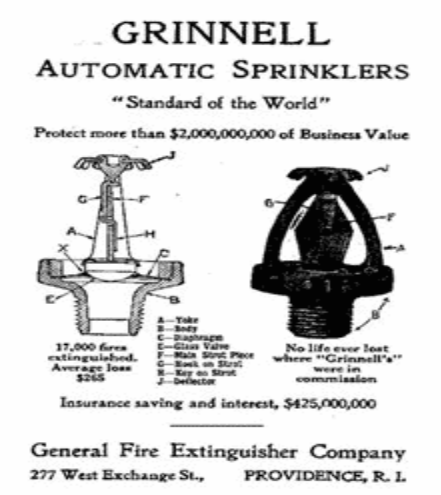
Ensure Safety

New and intelligent systems can integrate information from almost every make of fire alarm systems via the internet, so it can be viewed on mobiles, laptops or tablets from anywhere in the world. This data can also be used for compliance purposes and prove that whoever is responsible has done everything they can to ensure a building is safe.

9. IoT Applications in the Fire Safety

[22]By gaining more value from a product that is required in the majority of homes and buildings, the fire sprinkler, IoT might revolutionise the fire safety sector. With additional sensors, smart sprinklers become smart safety systems that reduce hazards, help with insurance claims, and safeguard people and their property. Since the creation of the first usable sprinkler by Frederick Grinnell in 1882, the automatic fire sprinkler has essentially stayed constant. He created the glass disc sprinkler in 1890, which is essentially the kind that is still in use today. However, the fire industry's conservative mentality, which is understandable given the dire implications of failure, has contributed to the dearth of innovation in fire sprinkler design since its conception.

The New Fire Sprinkler



The installation of automated fire sprinklers in new residential construction is becoming a requirement in many parts of the world. Unquestionably, fire sprinkler systems can save lives, but according to several studies, their efficiency might range from about 70% to 93 percent. Despite being an admirable figure, there is still much space for improvement when compared to another type of life safety equipment, like an airbag, which has a 99.9 percent efficiency rate.

However, sprinkler success rates drastically decline in homes, where they fail 1 in 10 times. This is largely because sprinklers are disregarded and made to blend in and be forgotten. The system being turned off is the primary cause of 64% of failures, with lack of maintenance coming in second.

It can be challenging to address problems with home sprinkler systems, such as poor maintenance and leaks, particularly in a sector where adopting new ideas is culturally frowned upon. Change is conceivable, though; understanding how the insurance sector underwent structural change can give context for how comparable change will occur in the fire safety sector.

Fire Safety IoT Applications

A small number of fire industry businesses have already started designing their products to be IoT ready in an effort to solve the issue of neglect that leads to traditional sprinkler failures.

We can advance the fire sprinkler's functioning by creating a more clever approach that isn't only used in emergency situations. Future sprinklers might include features that appeal to homeowners and provide benefits and services outside of an emergency, which would complement device maintenance. Sprinkler systems will also receive additional sensors to transform them into home safety systems. These sprinklers may immediately offer a smart safety system for homes and buildings once they are connected to the cloud.

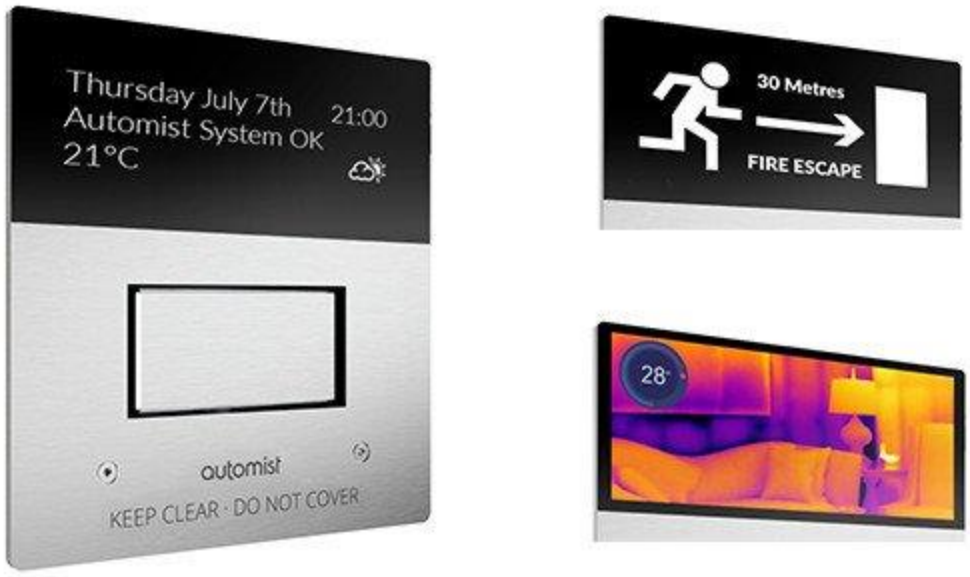


Image Credit: Plumis Ltd

Smart sprinklers can also assist with the cleanup after a fire; some businesses are adopting cutting-edge sprinkler systems to communicate with the insurance sector. These sprinklers have the capability of reporting fire-related behaviour that is then recorded in a "black box," giving the opportunity to assess the extent and origin of the damage while also considering potential future preventive measures. All parties can file insurance claims more quickly and affordably as a result. By analysing the number of "near calls" involving the activation of the suppression system, technology of this kind might also assess relative customer risk and propensity to have a fire.

The fire sprinkler is particularly intriguing because, unlike other smart home gadgets that rely on consumer buy-in, it is a one-time, sunk expense in many homes. In many places, you must have a fire sprinkler to comply with building codes, and 2999 out of 3000 households that don't experience a serious fire each year receive little benefit from their sprinkler systems other than peace of mind. Although there is more value to be had from sprinklers with the advent of fire safety IoT applications, fires are still more common in higher risk demographics and building categories. **[22]**

9.1. Fire Technology in Smart Cities and Beyond: How IoT Helps Fight Fires

[18]The First Responder Network Authority (FirstNet) public safety broadband network and other recent improvements in safety technology, such as Next Generation 911, are helping first responders.

Another technological advancement that is having an impact on a crucial aspect of public safety is the Internet of Things: firefighting. Fire departments gain many advantages from IoT solutions, which are supported by evolving fire technology.
IoT sensors and devices can improve building monitoring in smart cities to detect fires more quickly, give incident command centres more information, improve computer-aided dispatch, improve situational awareness for firefighters once they arrive at the scene of a fire, and aid in fire suppression through the use of smart sprinklers.

"Rapid access to information is crucial for first responders, including fire departments, emergency medical services, police departments, and others, who frequently find themselves in hazardous situations," "IoT solutions enable the intelligent networking of emergency vehicles, supplying first responders with precise and timely information about an emergency as they approach the scene, allowing them to cut down on response time and enable them to arrive ready to react swiftly to developing situations," says the company.

9.2. What Are Applications of IoT for Fire Departments?

IoT has a wide range of uses in the field of fire safety. According to Analytics Insight, wireless cellular networks or low-power wide area networks can send a variety of data from IoT sensors to help with fire prevention and response.

According to the article, IoT sensors can be integrated with "items such as alarms, personal safety gadgets, and fire suit technologies." Additionally, they can be used to track firefighters and provide incident commanders with more situational awareness and visibility into where specific firefighters are when they are putting out a fire. Radio-frequency identification trackers, which may be incorporated into firefighter gear, can provide real-time information on the whereabouts of firemen.
Additionally, information can be provided through wirelessly connected sensors to incident commanders and emergency command centres.

According to a blog post by BehrTech, a software firm that creates a wireless IoT connectivity platform, "Heat-proof sensors can indicate where the fire starts off, its strength, type, and spreading patterns, as well as whether there are any people in the fire zone." Real-time information about the situation on the ground allows for more efficient firefighting and evacuation efforts, which reduces damage and casualties.
According to a blog from ESO, a developer of electronic patient care software, the personal alert safety system gadget, which can detect firefighter motion, is another IoT application in firefighting.

According to the site, the apparatus also features a "acoustic transmitter that works as a beacon" to help locate the fireman when sensors notice they haven't moved for a predetermined amount of time.
According to ESO, such monitoring devices "may also contain sensors to measure oxygen and carbon dioxide partial pressure, volume flow rate, heart rate, gas pressure, body temperature, and exposure to hazardous auditory environments that may damage hearing" in the near future.

9.3. How IoT Supports Smart Building Fire Safety

IoT technologies can assist make buildings themselves smarter and safer in addition to safeguarding firemen and giving them additional information.
According to the BehrTech blog, "IoT sensors can be used to continuously monitor electrical systems and identify any active heat sources that are unseen to the naked eye." In order to prevent potential disasters, an alarm is promptly dispatched whenever a temperature spike is discovered. IoT temperature sensors are superior to conventional smoke detectors because they can identify lit fires even before they start to release smoke. The sooner an alarm is activated in an emergency when every second counts, the more the consequences can be reduced.
According to Analytics Insight, IoT sensors can also detect smoke or carbon monoxide in buildings, potentially turning off ignition sources. According to the website, "IoT enables a more targeted firefighting capability, effectively cutting off tiny flames." "Different procedures might be deployed for particular rooms using a smart IoT-enabled fire system to limit the damage."

9.4. Smart Sprinkler Systems Aid Firefighting

IoT sensors on smart sprinklers can simplify fire suppression in smart buildings.

A dry sprinkler valve can be made "smart" by adding several sensor components, claims the NFPA Journal, the periodical of the National Fire Protection Association.
The journal states that "two pressure sensors attached below the valve's gauges continuously collect data on air and water pressure." Cables link the sensors to an interface device that is attached to the valve's pipe and wirelessly transmits the data to a database where it can be used by facility managers, inspectors, and others to spot potential issues.

We may inform incident command that the fire should be under control if we know that 500 gallons of water per minute have been flowing on it for the past 30 minutes, according to Francis. One of our major "aha" moments as a company was the ability to externally monitor water flow in a sprinklered structure. We came to the conclusion that deploying firefighters inside would not be necessary. We are able to wait and enter the area later before using a fire hose for final extinguishment thanks to laboratory research and testing.

9.5. IoT's Role in Computer-Aided Dispatch

Additionally, IoT can be utilised to improve computer-assisted dispatch systems.

As an illustration, in 2018 AT&T and Rapid Deploy jointly announced a deal in which AT&T will grant PSAPs access to Rapid Deploy's cloud-based CAD platform.
The platform can be integrated with data-rich sources to enhance the situational awareness of a fire department or emergency operations centre. In a press release, it is stated that dispatchers "can access near real-time information, like closed-caption video streams or data from Internet of Things devices." They can improve their decision-making and gain a better understanding of the required response with the aid of these tools.

In a news statement, Northrop Grumman noted that the system gives PSAPs "access to enhanced location information and other data from smart devices such as phones, wearables, connected cars and houses, as well as popular apps for navigation and transportation services."
Firefighters may respond more effectively and safely if they have more knowledge. Imagine being a firefighter and getting computer-aided dispatch (CAD) data on your smartphone that includes the address, location of the fire, environmental conditions, location of people who are trapped, and video, according to the publication Firehouse. "Then, as firefighters arrive, incident command (IC) staff may monitor their location as they travel to that in need." [18].

10. Research Methodology:

Review literature as well as qualitative research methodology is used.
A literature review is a comprehensive summary of previous research on a topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research. The review should enumerate, describe, summarize, objectively evaluate and clarify this previous research. It should give a theoretical base for the research and help you (the author) determine the nature of your research. The literature review acknowledges the work of previous researchers, and in so doing, assures the reader that your work has been well conceived. It is assumed that by mentioning a previous work in the field of study, that the author has read, evaluated, and assimiliated that work into the work at hand.
Qualitative research involves collecting and analyzing non-numerical data (e.g., text, video, or audio) to understand concepts, opinions, or experiences. It can be used to gather in-depth insights into a problem or generate new ideas for research.
Qualitative research is the opposite of quantitative research, which involves collecting and analyzing numerical data for statistical analysis.
Qualitative research is commonly used in the humanities and social sciences, in subjects such as anthropology, sociology, education, health sciences, history, etc.

11. Paper Analysis:

Analysis of this research paper says that IOT (Internet of things) is a unique field which has many applications in many fields like defense, health, education etc. It has many applications in fire safety also as explained in this paper. It protects building from any fire accident as well as any miss happening. In this paper all applications related with fire safety of buildings explained.

In this paper IOT based fire alerting system is also explained. All equipments functioning during fire accidents are also explained. Role of IOT in fire safety is fully explained.

12.Conclusion

The fire sprinkler, which is a device that is a legal and/or insurance requirement in all buildings and houses, can be used by IoT to alter the fire safety business. The well-worn product first developed in the 1800s will have to adapt as a result of these changes, but maybe we'll come up with a better solution tailored to the demands and requirements of contemporary homes and people. As new products in the fire safety sector help reduce risks, assist with insurance claims, and carry out additional duties to safeguard people and their property, this gets more and more interesting.

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