A project report on

INDUSTRY SPECIFIC – INTELLIGENT FIRE MANAGEMENT

By

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INTRODUCTION

OVERVIEW :

A fire alarm system is a mechanism of different interconnected devices and components used to alert us in case of emergency especially fire to protect the staff and general public by taking appropriate actions.

Fire alarm system is the combination of different components such as smoke detector, heat detector, carbon monoxide detector, multi sensor detector, call points, sounders, bells, relay module, repeater, annunciator, fire control panel and other related and optional security devices designed for fire alarm control system.Like a CPU (central processing unit) in a computer system, the fire alarm control panel is the brain of fire alarm system which sends a status indication and notification to

the connected detectors and sounders in case of manual or automatic operation.

In an intelligent fire alarm system, each device has the ability to analyse the environment around it and communicate the central control panel to take further action(s) in case of fault, fire or the device needs cleaning or scheduled maintenance of the detectors.

As compared to the traditional fire alarm systems, they only provide single signal of info i.e. no matter if it is a fire, or other uncertainties such as fault, temperature, smoke particle or barometric pressure etc, it will trigger the alarm system which is considered as false positives. This misleading information can affect different phenomena such as reporting, omission etc.

Similarly to the addressable fire control system, the devices are connected in loops in

intelligent system which is available in two, four and eight loops system. A single loop can be extended up to 3.3km and up to 99 devices (such as sounders, detectors and call points) can be connected in a single loop. This way, a large area can be controlled and monitored from single control panel.

PURPOSE:

- **Industrial fire protection is a set of measures to prevent or reduce accidents and losses that may result from fire. These policies ensure the safety of lives and property at the workplace. Read on to learn why fire safety is essential in the workplace.**
- **You can prevent the hazards by, at a minimum, correctly disposing of waste, especially the flammable ones. Electrical equipment and machines should undergo**

regular inspection and replacement of faulty ones.

- **Fire protection at the workplace ensures that your employees will be safe in the event of a fire breaking out. Educating the employees on being ready in case of a fire accident helps them learn vital life-saving tip.**
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- **Apart from ensuring safety to staff, your customers' lives are safe too. People may not suffer burns but may inhale smoke due to the fire. Smoke inhalation can cause**

severe and irreparable damage, and having a protection plan can save you all this agony.

- **If a fire breaks out and burns down a building, the losses are massive. It will be costly to put up the property and purchase the equipment that was razed down. Having a fire safety plan protects your premises from damage and losses you would incur to rebuild them. Apart from the direct damage that a fire causes to a property, it can cause secondary harm to your surroundings. If the fire spreads further, it destroys trees, grass, and fences, opening the area to vandalism, human or animal trespass, and weed growth.**

LITERATURE SURVEY:

Fire risk assessment is the process in which the probability of an undesired event and the consequences of it are evaluated in a safety

perspective. The correct adoption of safety measures will decrease risk. In this particular aspect, fire risk depends on all preventive and protective measures installed, affecting the probability of occurrence and the severity, respectively. However, it Is fundamental to assure that these measures remain operational throughout the time. Related to this concern Fontana et al.1 refer a study carried out in Switzerland for a period of about 10 years reporting around 335000 fires in buildings. Only in Berna's canton occurred 1538 fires in industrial buildings corresponding to 45070million dollars in damage. Another study performed in the Great Britain refers that around 800 persons die and around 15000 are injured per year due to fire incidents. These and other testimonials are sufficient to understand the impact of fire safety and the existence of a fire risk assessment.

EXISTING PROBLEM:

As previously stated, fire safety systems are usually well designed and properly installed. However the problem appears after this stage, where it is frequent to observe a complete disregarding for the accomplishment of maintenance and test planning. Dieken states that when facing a fire about one third of the safety systems do not work properly just because of the lack of inspection, test or maintenance of such systems. The author also refers that due to improper maintenance around 49% of the fire extinguishing systems installed failed causing property damages around 15.9million dollars per year. Unfortunately, this type of hidden failures is

only revealed when a fire occurs and the system is required.

REFERENCE:

https://medcraveonline.com/MOJCE/fire-safety-systems-in-buildings-problems-and-concerns-beyond-the-project.html

https://ijariie.com

https://www.orrprotection.com

https://www.orrprotection.com/mcfp/top-causes-of-fire-detection-system-failure

PROBLEM STATEMENT AND DEFINITION:

Safety is a crucial consideration in the design of residential and commercial buildings to safeguard against the loss of life

and damage to property. The existing fire alarm system on market nowadays is too complex in terms of its design and

structure. Since the system is too complex, it needs regular maintenance to be carried out to make sure the system operates

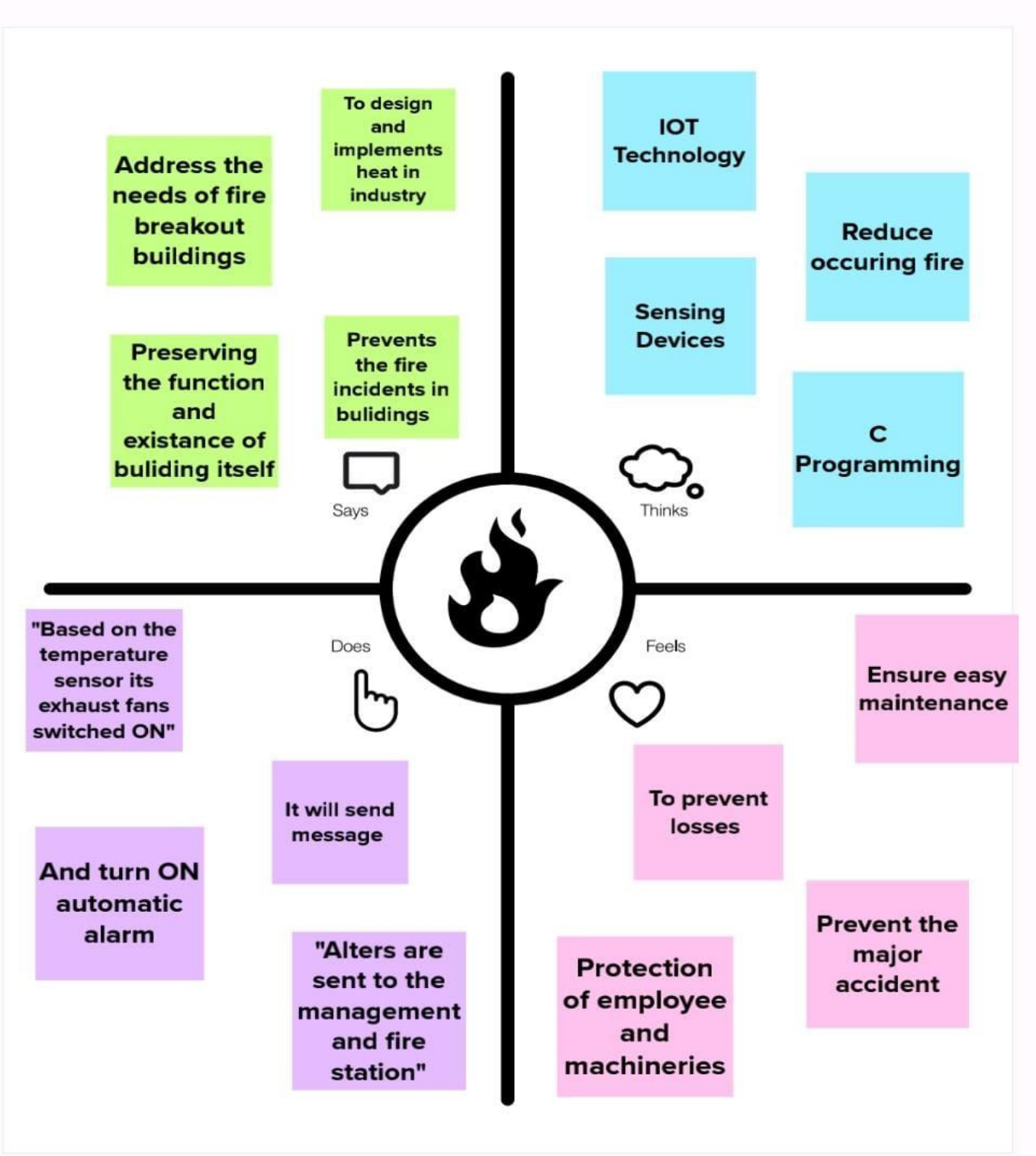
well. Meanwhile, when the maintenance is being done to the existing system, it could raise the cost of the system. Many industries are becoming in fire trouble/hazards where industries loose their entities .To reduce that problem the system for fire

detection and alert in case fire outbreak should be designed and implemented.

IDEATION AND PROSPOSED SOLUTION:

Depending on the type of occupancy or building height, the fire alarm system will be a single stage or two stage system. Single stage fire alarm systems require the full evacuation of a building upon alarm. Two stage fire alarm systems require an alert signal to sound before full evacuation.

EMAPATHY MAP:



PROSPOSED SOLUTION:

Innovation in the fire protection industry can sometimes be slow to move forward as compared to some other industries. Legislation, regulation, and enforcement can all hinder the growth of innovation in the market. But it's important work as the ability to innovate in this industry saves lives.

The growing complexities of today's infrastructure and the demand for more sustainable solutions also fuels the need for innovation. Thankfully there are many companies at the forefront of developing solutions for better, safer, and more efficient ways to prevent and extinguish fires.

Smart technologies for the fire protection industry

Just this past June at the NFPA Conference, there was a lot of talk about Smart Connected

Things (SCoT) in fire protection systems. One session was led by Terry Victor, Johnson Controls, Grinnell Fire Protection Solutions, and co-led by Christina Francis, Procter & Gamble Co. The two looked at these systems as ways to enable both owners and service providers to determine system status and perform some inspection and testing functions remotely. Connected technologies have been a part of our world for years, and now making a strong presence in the fire protection industry.

For example, the use of smart tech can provide more accurate, efficient inspections and testing of systems. This alone can save lives. In an article in which the pair of presenters were interviewed, they describe a fictional scenario of a warehouse fire. If the warehouse is equipped with smart tech to monitor the water pressure and flow rate of the building's sprinkler system, they know how much water has been flowing per minute.

This means they should therefore have control of the fire and can communicate this information to incident command. The ability to monitor water flow in a sprinklered building externally is just one of the ways that smart tech can literally save lives.

Smart technology can also be used to alert building owners to faulty sprinkler systems, frozen pipes, and more.

Advanced smoke detection for homeowners

Kidde has come out with the first ever smoke detector to meet new UL 268 Safety Standards for 2020. The new standards,that were actually announced back in 2016, require that all smoke alarms and detectors meet two important criteria: increased sensitivity to meet the two new polyurethane foam tests and ability to distinguish between smoke aerosols from fire sources and smoke aerosols from cooking sources. More information on

these tests can be found on the UL Safety Standards website.

In short, smoke detectors must be able to detect the differences in materials based on the type of smoke they release when on fire. Detectors must also recognize the difference in smoke from cooking (or a "nuisance" fire) and a true fire.

REQUIREMENT ANALYSIS:

FUNCTIONAL REQUIREMENT:

Fire grows exponentially. Unless a fire is detected and extinguished very quickly, it rapidly spreads out of control. Rapid detection and rapid extinguishing are therefore the two crucial elements to minimizing loss of life and property.

This is common knowledge and is the reason that building interiors have detection systems

and sprinkler systems. Building exteriors should be treated no differently and should be equipped with effective, automatic protection, particularly where the material used on the building's exterior is prone to rapid spreading of fire when it does break out.

When a fire starts on the exterior of a building, the goals are always to quickly detect the flame and quickly aim a high volume stream of water onto the flame to extinguish it. The combined time of these two factors directly determines the severity of damage and whether the fire can be extinguished at all.

Fully automatic, permanently-installed automatic fire detection and extinguishing systems are now available, which are capable of very rapid detection and extinguishing—indeed much faster than is possible to achieve by the traditional means of simply waiting for

someone to notice the fire, call the fire brigade and await their arrival.

The following minimum functions are required of any effective automatic detection and extinguishing system for the protection of high-rise building exteriors:

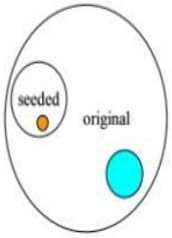
- **Rapid Detection: the system must be able to detect a fire rapidly (within seconds, not minutes).**
- **3D Location: the system must be able to accurately determine the three-dimensional position and volume of the flames in 3-dimensional space.**
- **Automatic, Accurate, Dynamic Aiming: the system must be able to quickly aim a large volume of water directly onto the flames, and it must be able to dynamically follow the flames if the fire grows or spreads.**

- **Multiple Flames: the system must be able to handle multiple fires simultaneously.**
- **Automation and Autonomy: the system must be able to activate and function completely autonomously, without any external network or powerand without any human intervention.**
- **Web Server: the system must have a built in web-server for system monitoring and allow for remote control by designated persons. This provides a number of benefits, including allowing firefighters to remotely control each nozzle, allowing a central command center to activate nozzles on neighboring buildings to self-protect and support extinguishing, and providing personnel with real-time alerts—both to fires detected as well as to any functional errors on the system, should they occur**

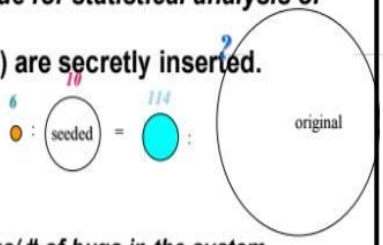
NON FUNCTIONAL REQUIREMENT :

NFRs: Reliability

- Sometimes reliability requirements take the form:
  "The software shall have no more than X bugs/1K LOC"
  But how do we measure bugs at delivery time?



- Bebugging *Process - based on a Monte Carlo technique for statistical analysis of random events.*
  1. before testing, a known number of bugs (seeded bugs) are secretly inserted.
  2. estimate the number of bugs in the system
  3. remove (both known and new) bugs.



# of detected seeded bugs/ # of seeded bugs = # of detected bugs/ # of bugs in the system
# of bugs in the system = # of seeded bugs x # of detected bugs /# of detected seeded bugs

Example: *secretely seed 10 bugs*
an independent test team detects 120 bugs (6 for the seeded)
# of bugs in the system = 10 x 120/6 = 200
# of bugs in the system after removal = 200 - 120 - 4 = 76

- But, deadly bugs vs. insignifant ones; not all bugs are equally detectable; (Suggestion [Musa87]:
  "No more than X bugs/1K LOC may be detected during testing"
  "No more than X bugs/1K LOC may be remain after delivery

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Dependability

- **Dimensions of Dependability**
  - Availability - The ability of the system to deliver services when requested
  - Reliability - The ability of the system to deliver services as specified
  - Safety - The ability of the system to operate without catastrophic failure
  - Security - The ability of the system to protect itself against accidental or deliberate intrusion
- **Cost of development** - Geometric rise in cost from low dependability to highest
- **Effects of low dependability**
  - Often unused
  - Failure recovery costs may be high
  - Difficult to retrofit dependability
  - Loss of information
- **Repeatable improvement process** helps
  - CMM -SEI
  - More later

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- Critical Systems
  - Safety critical
  - Mission critical
  - Business critical
- Dependability a key aspect
  - A system failure causes
    - Significant economic loss
    - Physical damage
    - Threat to or loss of human life

NFRs: Portability

- The degree to which software running on one platform can easily be converted to run on another platform
- E.g., number of target statements (e.g., from Unix to Windows)
- Hard to quantify, since it is hard to predict what a "next generation" platform might be like
- Can be enhanced by using languages, OSs and tools that are universally available and standardized.

  E.g., C/C++/C#/Java J2EE/J2ME/.NET

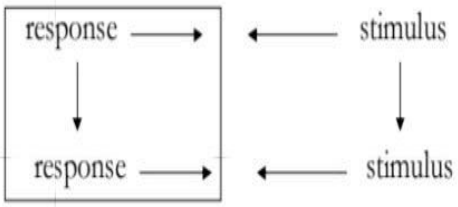
NFRs: Efficiency

- refers to the level at which a software system uses scarce computational resources, such as CPU cycles, memory, disk space, buffers and communication channels

- can be characterized along a number of dimensions:
  Capacity: maximum number of users/terminals/transactions ...

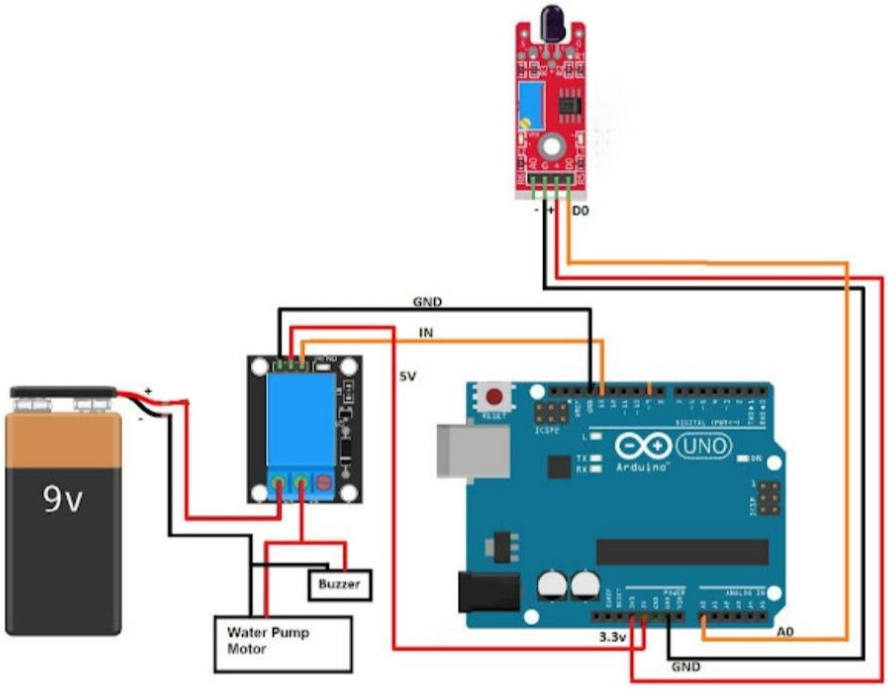
  Degradation of service: what happens when a system with capacity X widgets per time unit receives X+1 widgets?
  - Let the system handle the load, perhaps with degraded performance
  - Let the system crash

  Timing constraints: Let stimulus refer to an action performed by the user/environment, and response refer to an action generated by the system.

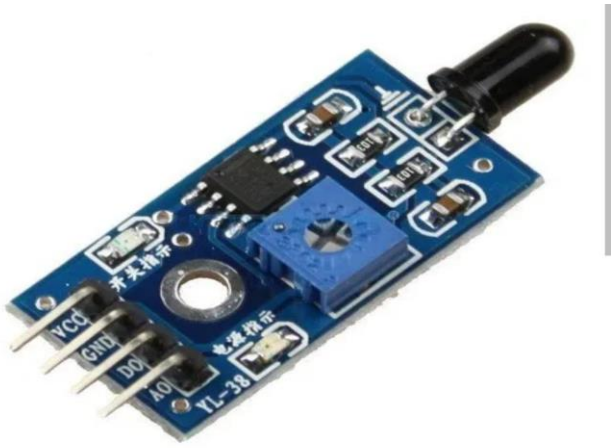


- **stimulus-response**: e.g., "the system will generate a dial tone within 10 secs from the time the phone is picked up"
- **response-response**: e.g., "the system will record that the phone is in use no later than 1 micro-second after it had generated a dial tone"
- **stimulus-stimulus**: e.g., "the user will type her password within 15 secs from typing her login name"
- **response-stimulus**: e.g., "the user will start dialing the phone number within 1 minute from getting the dial tone"

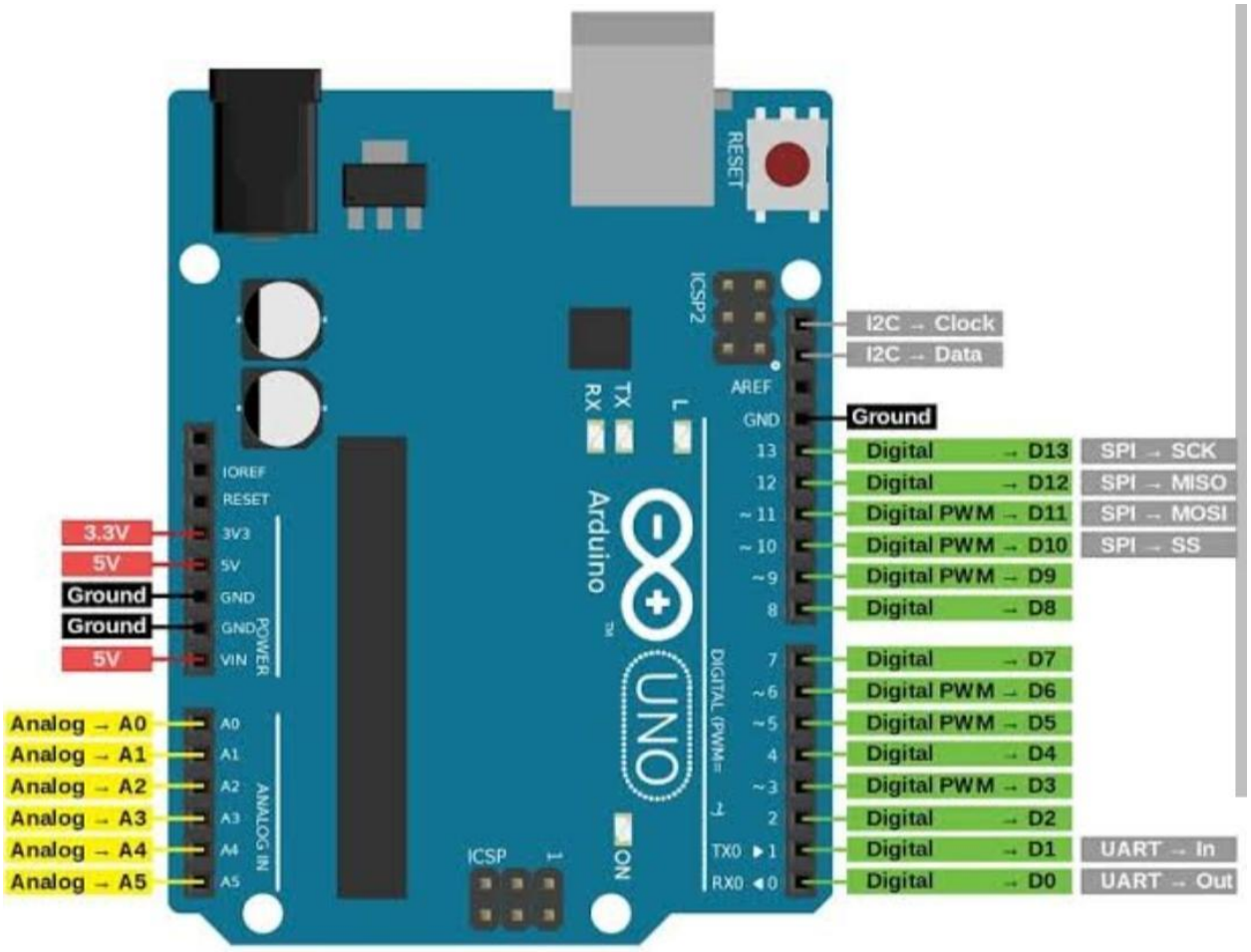
TECHNICAL ARCHITECTURE:



Flame sensor :



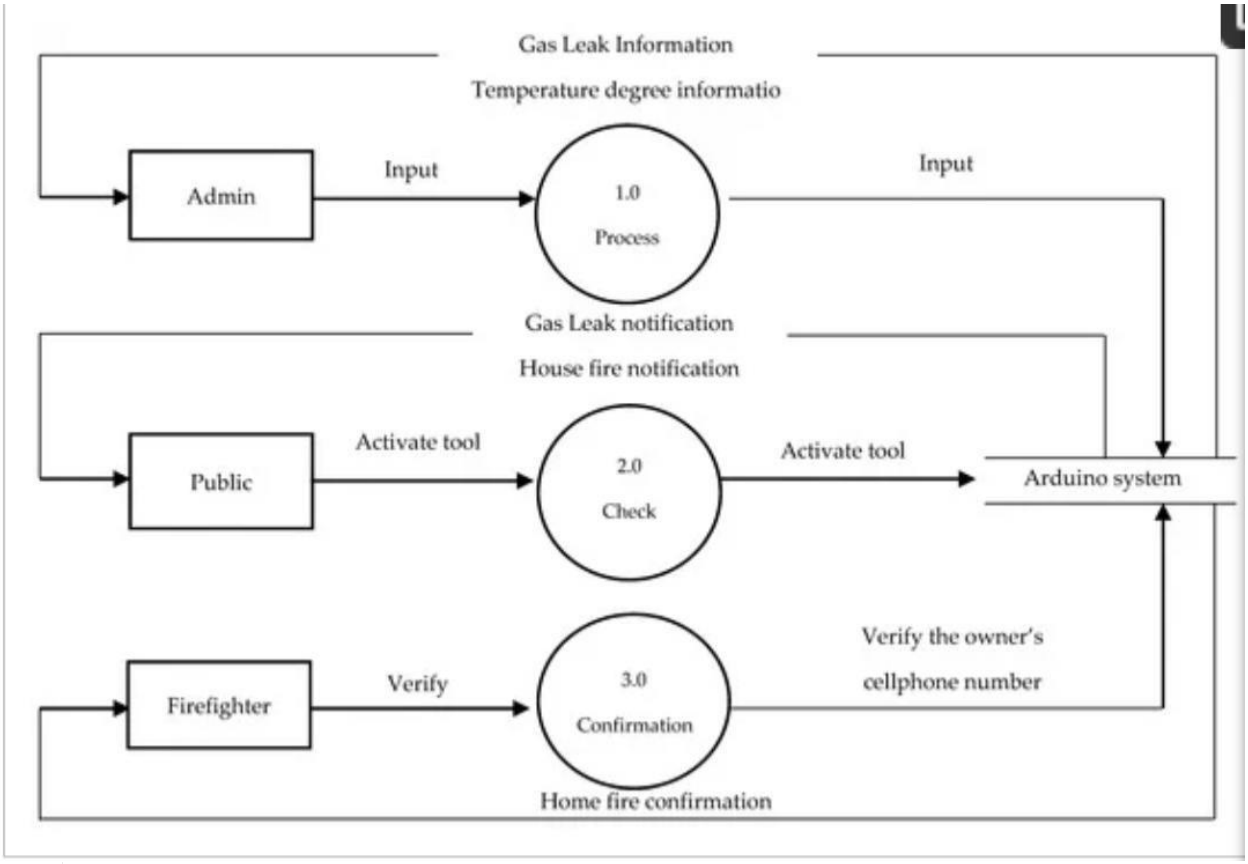
Ardino pin daigram:



PROJECT DESIGN:

DATA FLOW DAIGRAM:

<u>Program flow design:</u> The program flow plan that has been performed on the design of a



home fire detection system and the SMS gateway is more detailed, as follows:

<u>Stage</u> 1: Microcontroller initialization.
The first stage is the step when the home fire detection system and SMS gateway are

operated. In this stage, when the Arduino system is ON, it will proceed to the next stage.

Stage 2: Initialization of DS18B20 and MQ2 sensors

In this step, a prototype of a home fire detection system and an SMS gateway will discover room temperature and LPG gas in a room initialized on an Arduino device. Both of these devices will be available and set for the next stage.

Stage 3: GSM module initialization

In the third stage, the system will initialize the GSM module on the Arduino device, which transfers short messages.

Stage 4: Buzzer initialization

In this step, the system will initialize the buzzer on the Arduino device, which will be applied for home fire detection and SMS gateway that functions as an alarm in the case of a fire.

Stage 5: Room temperature identification

The fifth step is the DS18B20 sensor interpreting process when the detection system is on.

***CODING AND SOLUTIONING*:**

int flame=0;// select analog pin 0 for the sensor

Int Beep=9;// select digital pin 9 for the buzzer

Int val=0;// initialize variable

Int relay= 13;

```
/* The setup() function is called when a sketch
starts. It is used to initialize variables, pin
modes, start using libraries, etc. This function
will only run once, after each power up or
reset of the Arduino board. */



Void setup()

{

 pinMode(Beep,OUTPUT);// set buzzer pin as
“output”

pinMode(relay,OUTPUT);// set LED pin as
“output”
```

```
pinMode(flame,INPUT);// set flame pin as
“input”

Serial.begin(9600);// set baud rate at “9600”

}



/* The loop() function executes the program
repeatedly until Specified. */



Void loop()
```

```
{

Val=analogRead(flame);// read the analog value of the sensor

Serial.println(val);// output and display the analog value

If(val>=500)// when the analog value is larger than 600, the buzzer will buzz

 {

 digitalWrite(Beep,HIGH);

 digitalWrite(relay,HIGH);

 }else
```

```
{

digitalwrite(beep, Low) ;

digitalWrite(relay,LOW);

}

Delay(500);

}
```

TESTING:

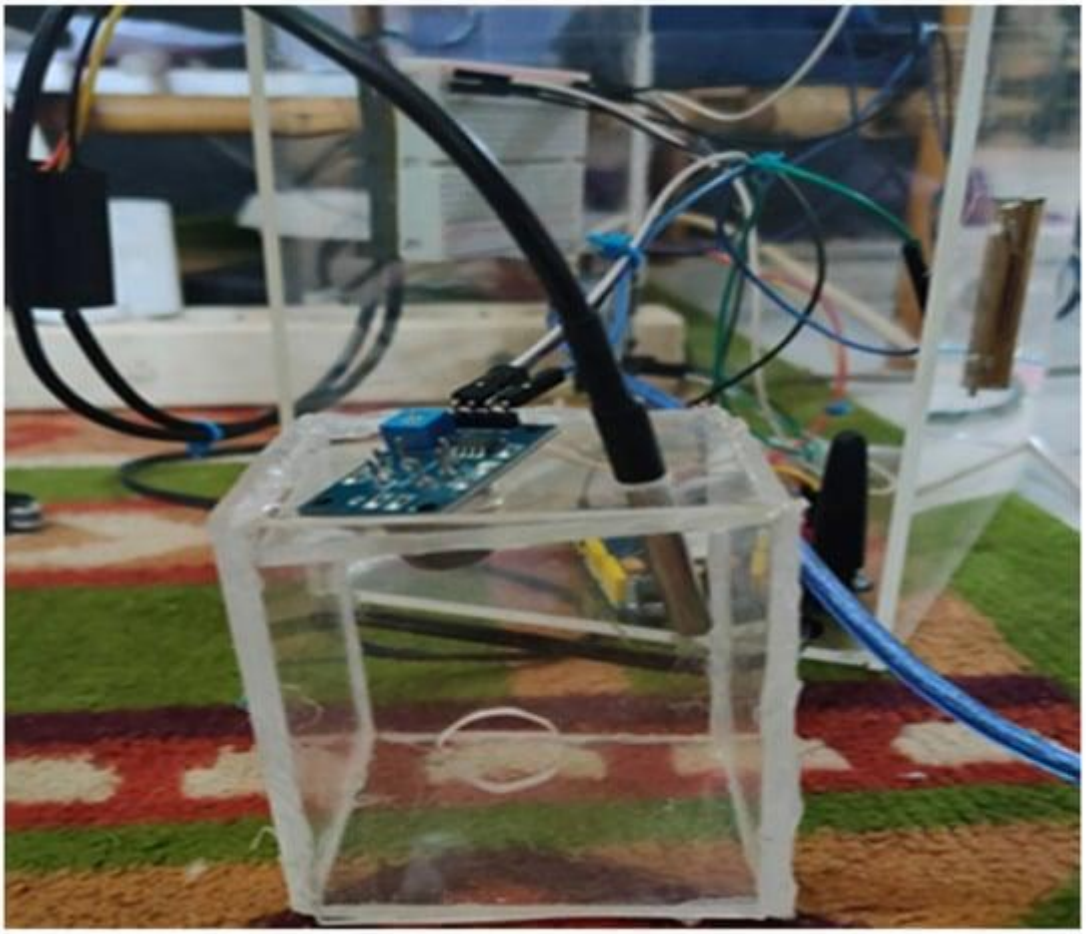
Sensor calibration test

- **Sensor calibration is the process of checking and adjusting the accuracy of the measuring instrument needed to ensure that the measurement results are carried out and are consistent with other tools. The calibration process is carried out to test for gas leaks using 3 (three) test scenarios based on the room/box comparison scale used to test the system.The first scenario testing is on a scale of 1 to 75.**
- **MQ2 sensor calibration is sensor calibration with a gas lighter tool. This test was carried out with a room size of 4 cm wide, 4 cm long, and 5.3 cm high with a scale ratio of 1 to 75 from the original size. Tests at this scale will send a short message warning at a gas level of 270 ppm, which refers to the gas volume**

scheme in Table 2. When checking the DS18B20 sensor with a scale of 1 to 75, the system will immediately send an SMS because the standard room temperature ranges from 30.12 to 31.56 degrees.

- Testing the second scenario with a scale of 1 to 50

This test is carried out with a room size of 6 cm wide, 6 cm long, and 8 cm high with a scale ratio of 1 to 50 from the original size, as shown . In this test, the system will send a short warning message at a gas level of 400 ppm, which refers to the gas volume scheme in Table 3. When checking the DS18B20 sensor with a scale of 1 to 50, the system will immediately send a short message because the standard room temperature ranges from 30.12 to 31.56 degrees.



ADVANTAGES :

As far as fire alarm installers go, a wireless system is ideal because they are much easier to install. A wireless system essentially involves mounting the devices to the

appropriate locations around a building or room, setting up the actual system and syncing it to WiFi. Compare this to a wired system, which requires fire alarm installers to connect the system to power supplies and ensure cables are connected properly.Another great advantage of a wireless fire alarm system is it operates off of a battery. This frees up a wall outlet and you can feel safe knowing the system will still work in the event of a power outage. And adding a second or subsequent wireless device is easy if you add on to your home or office

DISADVANTAGES :

The one thing most fire alarm system inspectors caution against with wireless systems is having to replace the battery. The system is essentially useless if the batteries aren't charged, since it won't work properly. There is a bit of a burden to homeowners or business owners to always remember to keep the batteries fresh so the system operates properly when you need it most.

A couple other disadvantages fire alarm system inspectors point out is wireless systems have limited range and don't have centralized monitoring. Range can be a problem for large offices or homes, since a weak wireless connection may cause the system to not operate reliably. Wireless fire alarm systems also don't connect directly to the telephone lines, which are linked to the fire departments, so the response to an emergency could be slower as a result.The best fire alarm system is the one that works specifically to suit your needs. And finding the

right one starts with getting connected with the best fire alarm installers. They will evaluate your space to determine whether a wireless system offers more benefits than disadvantages, so you can make the best decision from cost, convenience and reliability perspectives.

FUTURE SCOPE:

Upcoming Technologies

Sensor assisted fire fighting:

The way firefighters put out fires in a burning building changes once there are smart sensors installed inside. Connected to the internet, these sensors allow firefighters to get a live feed into the progress of the fire, thereby helping them strategize the best way to handle the situation. Using building

schematics and rendered computer models from the sensor technology, firefighters are much more prepared to act effectively and safely

<u>High pressure water mist:</u>

A significant apprehension that consumers have towards commercial fire systems is having a thousand gallons of water spewed all over their electronics. Although water is one of the most effective agents in fighting fires, it can cause a lot of damage to the buildings, often rendering it unusable after it has done its job. High-pressure mist effectively blocks radiant heat and oxygen from reaching the fire, effectively isolating problem areas while protecting others.

<u>Drones:</u>

Teams in the USA and even Australia are deploying drones that help firefighters identify hotspots by sending them real-time

data, including images and video. Other drone models are used to provide aerial vision, among other things, to those directing the firefighting process. Providing unique insight to those who would typically require expensive helicopters to do the same work. Better yet, more advanced, and expensive, drones are being developed to fly up to 900 feet to spray water that would be typically unreachable by truck-mounted ladders.

- ***Since the first generation of smoke detectors were released, there have been a number of advancements to both decrease the time of detection while at the same time decrease the activation of the detector when the products of combustion are not present. Smoke detectors and alarms are migrating from just the***

detection of smoke, to combination detectors and multicriteria detectors.

- **The** ***future will be with multicritirea detection In which the detector will be more of a sensor, with the detection more for the products of combustion, such as carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxides in addition to heat and particulate matter.***

- ***Sensors will also have the ability to sense or track when a room is occupied or not and have the ability to be integrated with occupant notification and evacuation. The development of more advanced algorithms and artificial intelligence, both within the sensor itself and the front end control unit***

will decrease the time from the beginning of an event to the notification of the event.

- *It Is not improbable that detection technology will be able to detect an incipient fire at that stage rather than at the flaming stage. This at the same time could reduce the likelihood of an unwanted activation from occurring.*

- *Within the next decade, video image detection (VID) will become more mainstream in which, through analytics, the image of either smoke or flame will be able to be isolated and detected from within a room or space. The VID system would also be able to detect if an individual is within the space and through*

the Integration with the notification appliances, provide a path of exit.

CONCLUSION:

Fire alarm systems can seem straightforward when you consider the ease of installation, but it can present some complex moral, operational and legal responsibility. There have also been some recent updates to the technology over the last few years worth noting. The underlying principles remain the same. Alarm sounders will give off an audible sound when smoke is picked up by a smoke detector or when a person operates a manual call point and the ultimate goal is to warn other people in the building that there may be a fire and to evacuate immediately. Increasingly, fire alarm systems incorporate remote signalling equipment which would

alert the fire brigade or other available emergency response services.

Every building needs a fire alarm system. Lives and valuable assets have been saved because of the early warning benefits of fire alarm systems. They are affordable and, when used properly and maintained regularly, are very reliable.