# PROJECT REPORT

**PROJECT TITLE:** *Industry Specific Intelligent Fire Management System*

**TEAM ID:** PNT2022TMID20364

**TEAM MEMBERS:** NAVEENA (TEAM LEAD)

SUVA LAKSHMI

SANKAR

NAVANEETHA KRISHNA

# 1.INTRODUCTION

## Project overview

Fire, explosion and toxic release are the three major hazards in the process industry, while fire is the most common one. Increasing number of fire incidents coupled with loss of property has enhanced the demand for automatic intelligent fire alarm systems in residential and commercial buildings. An intelligent fire alarm system is specifically designed to provide advantages such as identification of the fire location, locate any fault in the alarm system wiring, and ensure easier maintenance. This system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment. Based on the temperature readings and if any Gases are present the exhaust fans are powered ON. If any flame is detected the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and Fire station. Moreover, these modern intelligent fire alarm systems are more sensitive as compared to the classic models and are competent to detect false alarms.

## Purpose

The primary purpose of fire alarm system is to provide an early warning of fire so that people can be evacuated & immediate action can be taken to stop or eliminate the fire effect as soon as possible.

# 2.LITERATURE SURVEY

## Existing problem

Fire monitoring systems have usually been based on a single sensor such as smoke or flame. These single sensor systems have been unable to distinguish between true and false presence of fire . Consuming energy all day long and being dependent on one sensor that might end with false alert is not efficient and environmentally friendly. We need a system that is efficient not only in sensing fire accurately, but we also need a solution which is smart. In order to improve upon the results of existing single sensor systems , the smart fire management system includes a Gas sensor, Flame sensor and a temperature sensor . This system also requires a proper network with individual smart devices connected to various panels .

**References**

[1]N N Mahzan, N I M Enzai, N M Zin and K S S K M Noh, ”Design of an Arduino-based home fire alarm system with gSM module”, 1st International conference on green and Sustainable computing (ICoGeS), 2017.

[2] ZHANG Ying-Cong, YU Jing, “Study on the Fire IOT Development Strategy”, Shenyang Fire Research Institute --Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling, US: ANSI/FMRC, pp. FM3260-2004.

[3] Public Security, Shenyang 110034, China Shenyang Institute of Engineering, Shenyang 110136, China, 2019. Liu Yunhong Qi Meini,"The Design of Building Fire Monitoring System Based on ZigBee-WiFi Networks", Eighth International Conference on Measuring Technology and Mechatronics Automation, IEEE, 2016, pp-733-735.

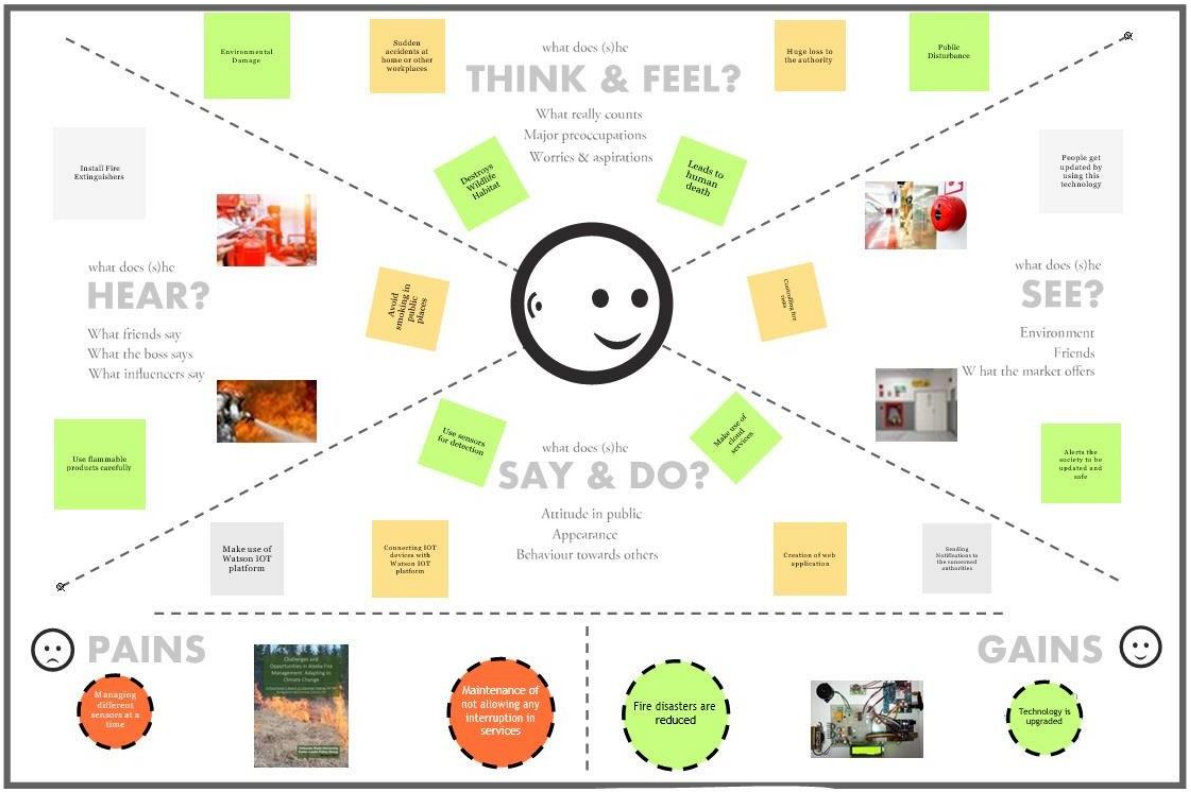
[4] R.A. Sowah, A.R. Ofoli, S.N. Krakani, S.Y. Fiawoo, hardware Design and Web-Based Communication Modules of a Real-Time multisensor Fire Detection and Notification System Using Fuzzy Logic, IEEE Transactions on Industry Applications, 53 (2016) 559-566.

### Problem Statement

Definition Industry Specific Intelligent fire management system are designed to Prevent fire accidents due to Gas leakage and flame in industry.

## 3.IDEATION & PROPOSED SOLUTION

### Empathy Map Canvas




## Ideation &Brainstorming

## 2 Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

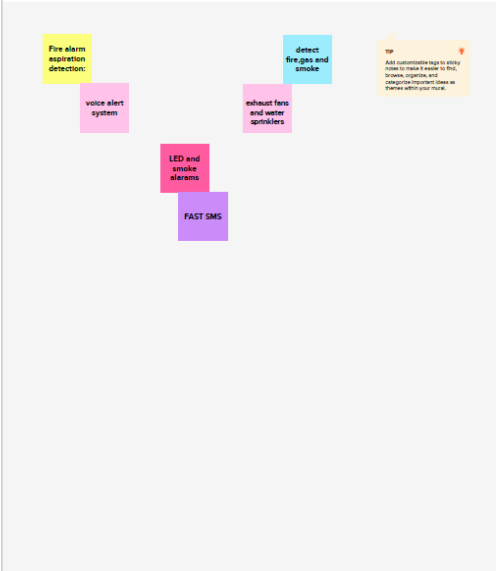
TIP
You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

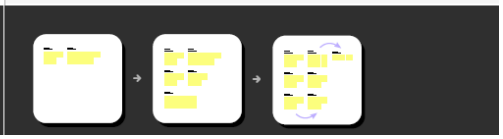
| PELLURU MANASA | POLU TEJASWINI REDDY | DEEPIKA M | CHANDHANA RC |
|---|---|---|---|
| use multiple sensors for detection | Smoke detection system | Voice alert systems | Compact in size |
| Using this techniques the notifications are sended to the fire safety office | prior indication | limit risk with remote monitoring | sprinkler water flow switch |

## 3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

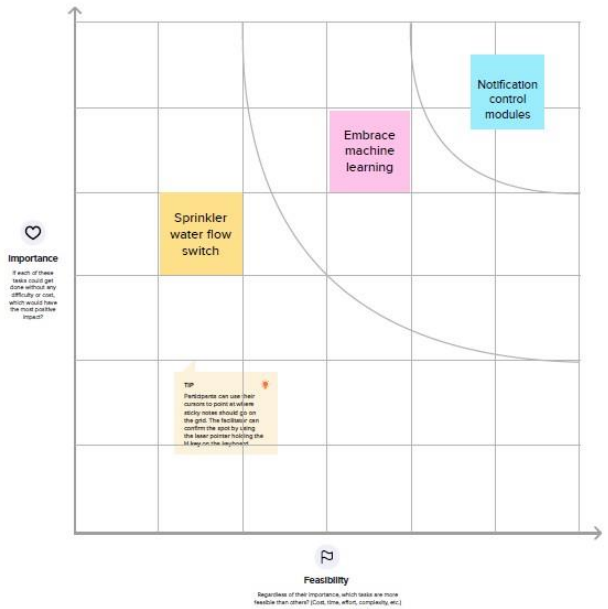


## 4 Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes




## After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

### Quick add-ons

A **Share the mural**
**Share a view link** to the mural with stakeholders to keep them in the loop about the outcomes of the session.

B **Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

### Keep moving forward

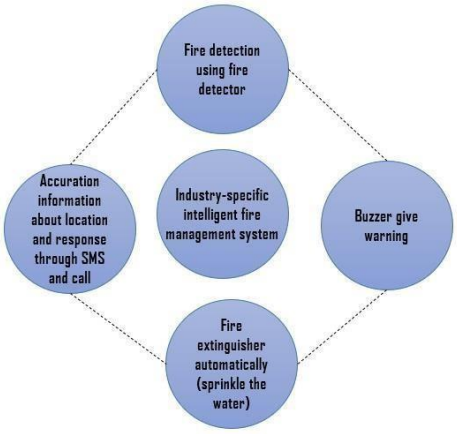
**Strategy blueprint**
Define the components of a new idea or strategy.
Open the template →

**Customer experience journey map**
Understand customer needs, motivations, and obstacles for an experience.
Open the template →

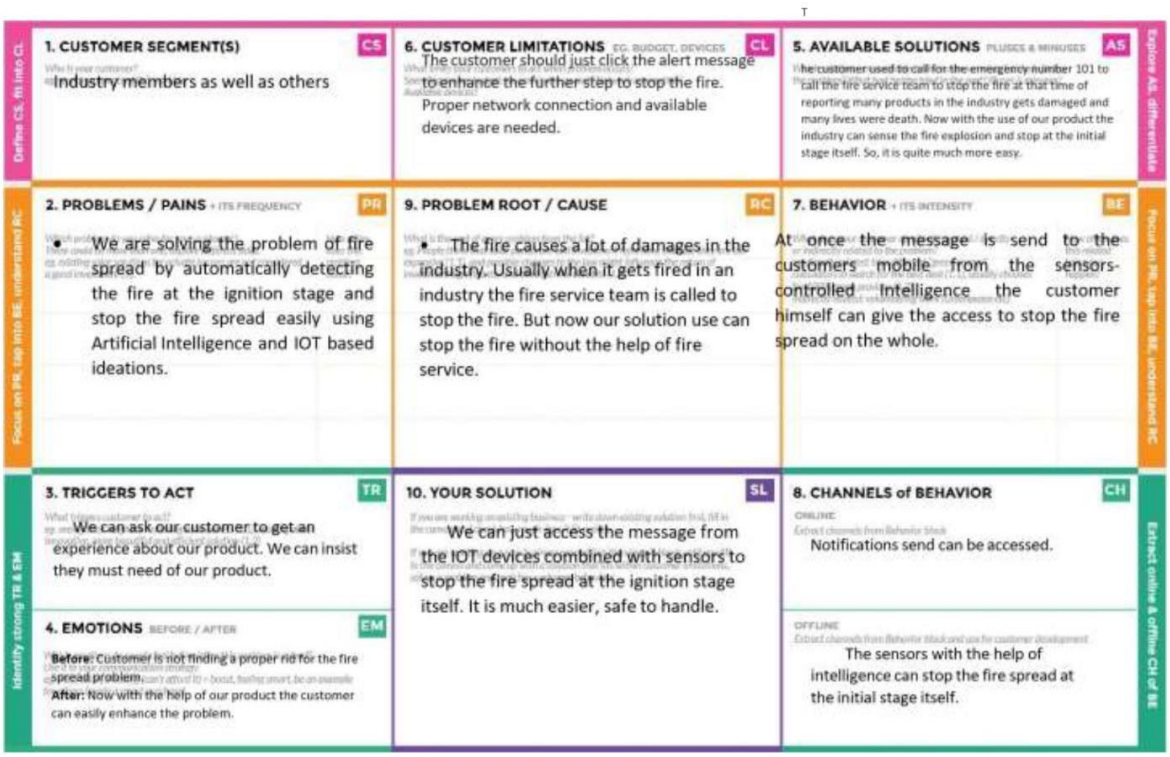
**Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template →

Share template feedback

## Proposed Solution

| S.No. | Parameter | Description |
|---|---|---|
| 1. | Problem Statement (Problem to be solved) | To improve the safety management system in industries. Improving the safety management system against the fire incidents in industries. |
| 2. | Idea / Solution description | To implement the fire safety management in industry based on IOT using Arduino uno board with fire detection and fire extinguisher system. And using some sensors (Humidity sensor, Flame sensor, smoke sensor) with GPS tracking system. |
| 3. | Novelty / Uniqueness | An Integrated system of temperature monitoring, gas monitoring, fire detection automatically fire extinguisher with accuration of information about locations and response through SMS notification and call. |
| 4. | Social Impact / Customer Satisfaction | ▪ It early prevents the accident cost by fire in industries.<br>▪ Nearby locations so maximum extend more accurate reliability .<br>▪ Compatibility design integrated system. |
| 5. | Business Model (Revenue Model) |  |
| 6. | Scalability of the Solution | ▪ This project can be used more efficiently with accurate information requiring.<br>▪ Easy operability and maintenance.<br>▪ Required low time for maintain<br>▪ Cost is reasonable value. |

## Problem Solution Fit




# 4. REQUIREMENT ANALYSIS

## Functional requirement

Following are the functional requirements of the proposed solution.

| FR No. | Functional Requirement(Epic) | Sub Requirement (Story / Sub-Task) |
|---|---|---|
| FR-1 | User Registration | Registration through website or application Registration through Social medias Registration through LinkedIn |
| FR-2 | User Confirmation | Verification via Emailor OTP |
| FR-3 | User Login | Login through website or App using the respective username and password |
| FR-4 | User Access | Access the app requirements |
| FR-5 | User Upload | User should be able to upload the data |
| FR-6 | User Solution | Data report should be generated and delivered to user for every 24 hours |
| FR-7 | User Data Sync | API interface to increase to invoice system |

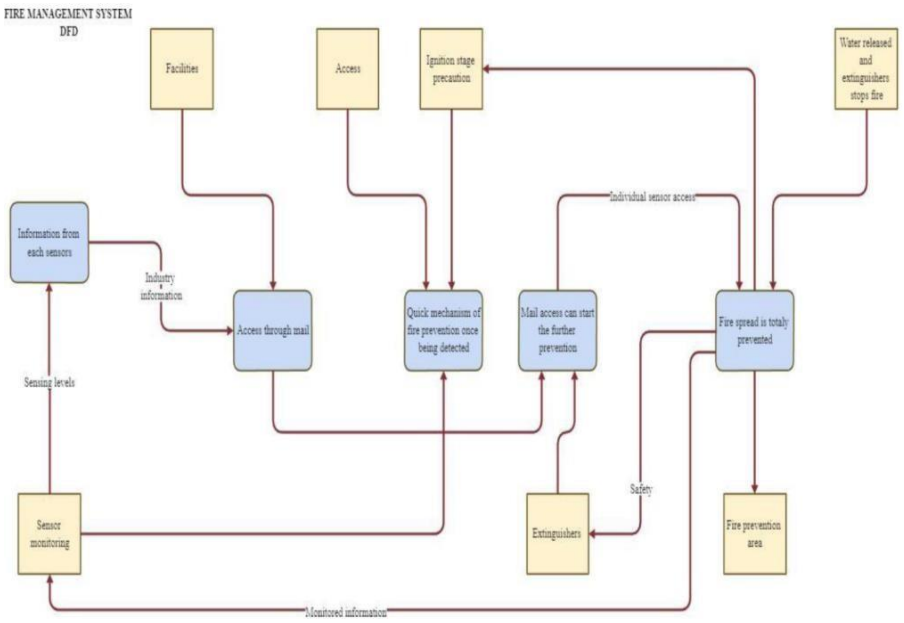
## Non-Functional requirement

| FR No. | Non-Functional Requirement | Description |
|---|---|---|

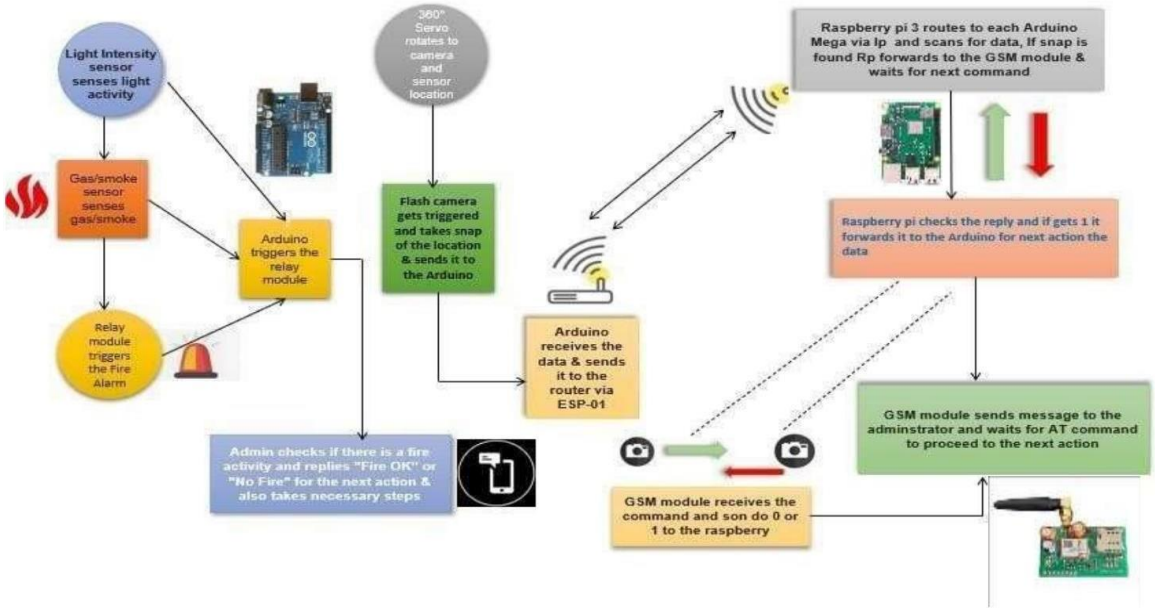
| | | |
|---|---|---|
| NFR-1 | **Usability** | Usability requirements includes language barriers and localization tasks. Usability can be assessed by Efficiency of use. |
| NFR-2 | **Security** | Access permissions for the particular system information may only be changed by the system's data administrator. |
| NFR-3 | **Reliability** | The database update process must roll back all related updates when any update fails. |
| NFR-4 | **Performance** | The front-page load time must be no more than2 seconds for users that access the website using an VoLTE mobile connection. |
| NFR-5 | **Availability** | New module deployment must not impact front page, product pages, and check out pages availability and mustn't take longer than one hour. |
| NFR-6 | **Scalability** | We can increase scalability by adding memory, servers, or disk space. On the other hand, we can compress data, use optimizing algorithms. |

## 5. PROJECT DESIGN

### Data Flow Diagram



## Solution Architecture




## User Stories

| User Type | Functional requirement | User story number | User story/task | Acceptance criteria | Priority | Release |
|---|---|---|---|---|---|---|
| Customer (Mobile user, Web user, Care executive, Administrator) | Registration | USN-1 | As a user, I can register for the application by entering my mail, password, and confirming my password | I can access my account/ dashboard | High | Sprint-1 |
| | | USN-2 | As a user, I will receive confirmation email once I have registered for the application | I can receive confirmation email & click confirm | High | Sprint-1 |
| | Dashboard | USN-3 | As a user, I can register for the | I can register & access the dashboard | Low | Sprint-2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | application through internet | with Internet login | | |
| | | USN-4 | As a user, I can register for the application through Gmail | I can confirm the registration in Gmail | Medium | Sprint-1 |
| | Logi n | USN-5 | As a user, I can log into the application by entering email & password | I can login with my id and password | High | Sprint-1 |

## 6.PROJECT PLANNING &SCHEDULING

## Sprint Planning & Estimation

| Sprint | Functional Requirement (Epic) | User Story Numbe r | User Story / Task | Story Points | Priority | Team Members |
|---|---|---|---|---|---|---|
| Sprint-1 | Sensing | USN-1 | Sensing the environment using thesensors. | 3 | High | Pelluru Manasa Polu Tejaswini M Deepika RC Chandhana |
| | Operating | USN-2 | Turning on the exhaust fan as well asthe fire sprinkler system in cause of fire and gas leakage. | 3 | Medium | Pelluru Manasa Polu Tejaswini M Deepika RC Chandhana |
| Sprint-2 | Sending collected data tothe IBM Watson platform | USN-3 | Sending the data of the Sensors to the IBM Watson. | 3 | High | Pelluru Manasa Polu Tejaswini M Deepika RC Chandhana |

## 7.CODING & SOLUTIONING

## Feature 1

- IoT device
- IBM Watson Platform
- Node red

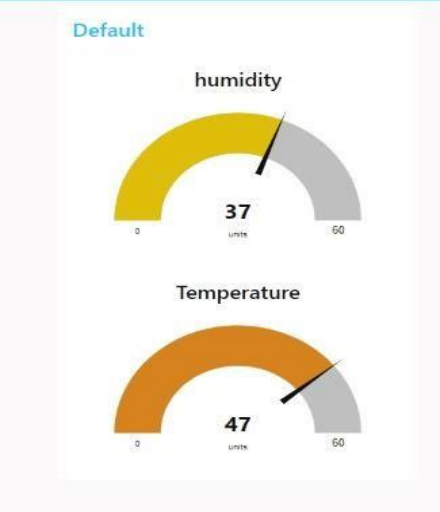
- Cloudant DB
- Web UI
- MIT App Inventor
- Python code

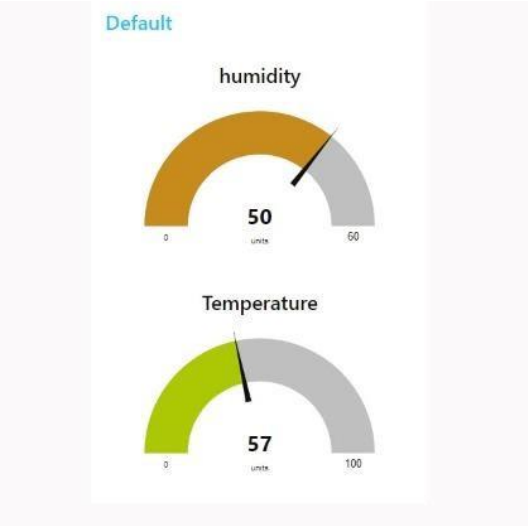
### 7.2 Feature 2

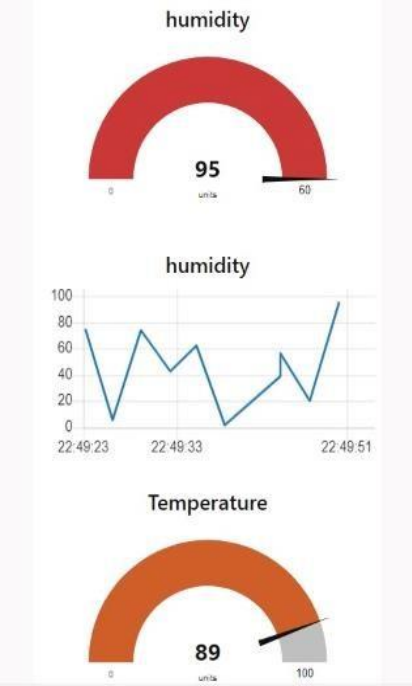
- Login
- Wokwi

## 8. TESTING AND RESULTS

### Test Cases






## 9. ADVANTAGES

- Reduced installation cost.
- They monitor 24/7.
- Improved security in homes, industries and Offices.
- It pin points location of the fire.

## 10. DISADVANTAGES

- Heat detectors are not considered as life saving devices because they are sensitive only to heat.
- High battery or current consumption will need for these detectors.
- Control pannel may need to be replaced if it becomes damaged**.**

## 11. CONCLUSION

This gas leakage system can be applied for household safety and many other applications in the industry . Gas leakages and fire outbreaks in industries as well as houses have lead to wide destruction and losses in the past. Gas leakages and fire outbreaks both spread widely and lead to even greater loss of life and property if proper action is not taken on time. So here we proposed a system that detects gas as well as fire outbreaks and alert us accordingly so that proper action may be taken to control it.

## 12. FUTURE SCOPE

Smoke detectors and alarms are migrating from just the detection of smoke, to combination detectors and multicriteria detector. The future will be with multicriteria 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 dioxide in addition to heat and particulate matter. 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.

## 13. APPENDIX

### Source Code:

```
import pandas as pd
import ipywidgets as widgets
import plotly.express as px

while True:
    try:
        amb_temp = float(input('Enter ambient room temperature (°C): '))
        rad_distance = float(input('Enter the horizontal distance between
the fire and sprinkler head (m): '))
        height_above_fire = float(input('Enter the vertical distance
between the fire and sprinkler head (m): '))
        RTI = float(input('Enter RTI value of the sprinkler head: '))
        c = float(input('Enter conduction value of the sprinkler head: '))
        activation = float(input('Enter sprinkler activation temperature
(°C): '))
        break
    except ValueError as e:
        print('Error: Enter a valid number')

t_sq_list = ["slow", "medium", "fast", "ultra-fast"]
t_sq  = None

while t_sq not in t_sq_list:
    t_sq = input('Enter fire t² growth rate. Select from the list [slow,
medium, fast, ultra-fast]: ').lower().strip()

if t_sq == 'slow':
    growth = 0.00293
elif t_sq == 'medium':
    growth = 0.01172
elif t_sq == 'fast':
    growth = 0.0469
else:
    growth = 0.1876

index = pd.RangeIndex(0, 1308, 1) # a slow t² fire will take 1307 seconds
```

```
to reach 5 MW
columns = ['Time', 'HRR', 'Gas Temp 1', 'Gas Temp 2', 'Gas Vel 1', 'Gas Vel
2', 'Gas Temp', 'Temp Sprinkler']

df = pd.DataFrame(index=index, columns=columns)
df = df.fillna(0) # with 0s rather than NaNs

df['Time'] = df.index
df['HRR'] = df['Time']*df['Time']*growth

if rad_distance/height_above_fire > 0.18:
    df['Gas Temp 1'] =
(5.38*(df['HRR']/rad_distance)**(2/3))/(height_above_fire)
    df['Gas Temp'] = df['Gas Temp 1'] + amb_temp
    a = 'one'
else:
    df['Gas Temp 2'] = (16.9*(df['HRR'])**(1/3))/height_above_fire**(5/3)
    df['Gas Temp'] = df['Gas Temp 2'] + amb_temp
    a = 'two'

if rad_distance/height_above_fire > 0.15:
    df['Gas Vel 1'] =
(0.2*df['HRR']**(1/3)*height_above_fire**(1/2))/(rad_distance**(5/6))
    b = 'one'
else:
    df['Gas Vel 2'] = 0.95*((df['HRR']/height_above_fire)**(1/3))
    b= 'two'

x = 2

# initialise row 0
df.loc[0, 'Temp Sprinkler'] = amb_temp
if (a == 'one') & (b == 'one'):
    # initialise row 1
    df.loc[1, 'Temp Sprinkler'] = amb_temp + ((df.loc[1,'Gas Vel
1']**0.5)/RTI)*((df.loc[1,'Gas Temp']-amb_temp)-((1+(c/df.loc[1,'Gas Vel
1']**0.5)))*(df.loc[0,'Temp Sprinkler']-amb_temp))
    # initialise remaining rows
    while x < 1308:
        df.loc[x,'Temp Sprinkler'] = df.loc[x-1, 'Temp Sprinkler'] +
((df.loc[x-1, 'Gas Vel 1']**0.5)/RTI)*((df.loc[x-1, 'Gas Temp']-amb_temp)-
((1+(c/df.loc[x-1, 'Gas Vel 1']**0.5)))*(df.loc[x-1, 'Temp Sprinkler']-
amb_temp))
        x = x+1
elif (a == 'one') & (b == 'two'):
    df.loc[1, 'Temp Sprinkler'] = amb_temp + ((df.loc[1,'Gas Vel
2']**0.5)/RTI)*((df.loc[1,'Gas Temp']-amb_temp)-((1+(c/df.loc[1,'Gas Vel
2']**0.5)))*(df.loc[0,'Temp Sprinkler']-amb_temp))
    while x < 1308:
        df.loc[x,'Temp Sprinkler'] = df.loc[x-1, 'Temp Sprinkler'] +
((df.loc[x-1, 'Gas Vel 2']**0.5)/RTI)*((df.loc[x-1, 'Gas Temp']-amb_temp)-
((1+(c/df.loc[x-1, 'Gas Vel 2']**0.5)))*(df.loc[x-1, 'Temp Sprinkler']-
amb_temp))
        x = x+1
elif (a == 'two') & (b == 'one'):
    df.loc[1, 'Temp Sprinkler'] = amb_temp + ((df.loc[1,'Gas Vel
1']**0.5)/RTI)*((df.loc[1,'Gas Temp']-amb_temp)-((1+(c/df.loc[1,'Gas Vel
1']**0.5)))*(df.loc[0,'Temp Sprinkler']-amb_temp))
    while x < 1308:
        df.loc[x,'Temp Sprinkler'] = df.loc[x-1, 'Temp Sprinkler'] +
((df.loc[x-1, 'Gas Vel 1']**0.5)/RTI)*((df.loc[x-1, 'Gas Temp']-amb_temp)-
```

```
((1+(c/df.loc[x-1, 'Gas Vel 1']**0.5)))*(df.loc[x-1, 'Temp Sprinkler']-
amb_temp))
        x = x+1
else:
    df.loc[1, 'Temp Sprinkler'] = amb_temp + ((df.loc[1,'Gas Vel
2']**0.5)/RTI)*((df.loc[1,'Gas Temp']-amb_temp)-((1+(c/df.loc[1,'Gas Vel
2']**0.5)))*(df.loc[0,'Temp Sprinkler']-amb_temp))
    while x < 1308:
        df.loc[x,'Temp Sprinkler'] = df.loc[x-1, 'Temp Sprinkler'] +
((df.loc[x-1, 'Gas Vel 2']**0.5)/RTI)*((df.loc[x-1, 'Gas Temp']-amb_temp)-
((1+(c/df.loc[x-1, 'Gas Vel 2']**0.5)))*(df.loc[x-1, 'Temp Sprinkler']-
amb_temp))
        x = x+1

try:
    act_time = df.loc[df['Temp Sprinkler']>activation, 'Time'].iloc[0]
except:
    print('The sprinkler does not activate')

try:
    act_hrr = round(df.loc[df['Temp Sprinkler'] > activation,
'HRR'].iloc[0],1)
except:
    print('The sprinkler does not activate')

act_time_text = 'Sprinkler activates at ' + str(act_time) + ' s.' + '\n'+ '
Fire size: ' + str(act_hrr) + ' kW'
act_temp_text = 'Activation temperature: ' + str(activation) + ' °C'

fig = px.line(df, x="Time", y="Temp Sprinkler", title="Sprinkler Activation
Time (" + t_sq +' t² fire)', template = 'none')

fig.update_layout(
    autosize=False,
    width=600,
    height=500,
    yaxis=dict(
       title_text="Temperature (°C)",
        titlefont=dict(size=12),
    ),
    xaxis=dict(
       title_text="Time (s)",
        titlefont=dict(size=12),
    )
)


fig.update_layout(
    title={
        'y':0.9,
        'x':0.5,
        'xanchor': 'center',
        'yanchor': 'top'})

fig.update_layout(
    xaxis = dict(
        tickmode = 'linear',
        tick0 = 0,
        dtick = 250
    )
)
```

```
fig.add_hline(y=activation, line_width=1, line_dash="dash",
line_color="green", annotation_text = act_temp_text)
fig.add_vline(x=act_time, line_width=1, line_dash="dash",
line_color="green",  annotation_text = act_time_text)

fig.update_annotations(font_size=10, font_color = 'darkblue')


fig.show()
```

## OUTPUT: