

# **INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM**

(TEAM ID:PNT2022TMID18894)

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# INTRODUCTION

## 1.1 Project Overview

The objective of the Industry Specific Fire Management System is to provide the early detection of fire. This project targets to turn on the sprinkler and turn on the alarm when any flame or gas is detected. The smart fire management system includes a gas sensor, flame sensor and temperature sensors to detect any changes in the environment. If the temperature value, gas value exceeded beyond a certain value or if flame is detected the sprinklers will be turned on immediately and alarm will be turned on if the temperature value or the gas value is exceeded beyond a certain value, or if flame is detected. This project also provides a facility where the authorities and the management can monitor the temperature values, gas values and if any flame values remotely using the mobile application.

## 1.2 Purpose

The Primary purpose of the Industry Specific Intelligent Fire Management System is to design, manage, plan and co-ordinate appropriate fire safety procedures to reduce the risk of fire in industries and to ensure the safety of building occupants. A complete fire management system ensures legal compliance and protection of lives and assets. This fire management system aims to save the lives of the employees, properties of the management. The primary purpose of fire alarm system is to provide an early warning of fire so that people can be evacuated and immediate action can be taken to stop or eliminate of the fire effect as soon as possible. Another important purpose of the fire management system is to reduce the financial loss happens to the industry.

# 2. LITERATURE SURVEY

## 2.1 Existing problem

In cracker industries the chemicals used for manufacturing fireworks are highly sensitive to friction, impact, heat and static electricity. These friction and impact causes fire accidents. The fire accidents or blasts also occur in god owns

either due to sparks from electrical fittings or from the impact stimuli generated during loading and unloading of boxes containing fireworks. These fire accidents cause great loss to the industry and also to the lives of the people working in the industries. So, to overcome this problem we have proposed a solution that uses sensors to detect the fire before it causes damage, sprinklers are used to control the fire and a fire alarm is used to alert the workers about the fire breakage.

### Developed Intelligent Fire alarm system.

[Hussam Elbehiery. J Am Sci2012;8(8):1016-1024].

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 of the fire effect as soon as possible. Alarm can be triggered by using detectors or by manual call point (Remotely). To alert/evacuate the occupants siren are used. With the Intelligent Building of the rapid development of technology applications, commercial fire alarm market demand growth, the key is to use the bus system intelligent distributed computer system fire alarm system, although installation in the system much easier than in the past, but still cannot meet the modern needs, the installation costs of equipment costs about 33% 70. The suggested technique in Fire alarm system used the addressable detectors units besides using the wireless connection between the detector in zones as a slave units and the main control unit as the master unit. The system shall include a control panel, alarm initiating devices, notification appliances, and the accessory equipment necessary for a complete functioning fire alarm system. In the wireless fire alarm, individual units are powered by primary & secondary batteries for the communication.

### Research on Fire Alarm Computer Monitoring System in Fire Engineering

Xiyang Feng and Chaofei Wang 2021 J. Phys.: Conf. Ser. 1915 042061

With the in-depth development and application of computer technology, the fire alarm computer monitoring system in fire protection engineering has become more and more essential equipment in modern life. With the support of network technology, the fire alarm monitoring system of fire protection engineering has formed a complete system, including alarm monitoring, automatic fire control, fire linkage control, and fire data monitoring and analysis modules. This article mainly analyzes the fire alarm computer monitoring system in fire engineering.

Hamood Alqourabah, Amgad Muneer, Suliman Mohamed Fati in the paper titled "A Smart Fire Detection using IoT Technology with Automatic Water Sprinkler", which employs different integrated detectors, such as heat, smoke, and flame. The signals from those detectors go through the system algorithm to check the fire's potentiality and then broadcast the predicted result to various parties using GSM modem associated with the system. To get real-life data without putting human lives in danger, an IoT technology has been implemented to provide the fire department with the necessary data. Finally, the main feature of the proposed system is to minimize false alarms, which, in turn, makes this system more reliable. The experimental results showed the superiority of our model in terms of affordability, effectiveness, and responsiveness as the system uses the Ubidots platform, which makes the data exchange faster and reliable.

Poonam Sonsale, Rutika Gawas, Siddhi Pise, Anuj Kaldate in the paper "Intelligent Fire Extinguisher System" which proposes an adaptive fusion algorithm for fire detection, and uses a smoke sensor, flame sensor, and temperature sensor to detect fire incident. In reality, the phenomenon of the fire incident may have smoke, flame, and high temperature situations. However, these signals may happen simultaneously or sequentially. We develop an intelligent multi sensor based security system that contains a fire fighting system in our daily life. The security system can detect abnormal and dangerous situation and notify us. First, we design a firefighting system with extinguisher for the intelligent building. We design the fire detection system using sensors in the fire fighting system, and program the fire detection and fighting procedure using sensor based method. Finally, we implement the fire detection system using fire fighting system.

GPS-based fire detection system (Global Positioning System) and SMS Gateway .A Aryanti, I Mekongga and R S Dewi et al 2021 IOP Conf. Ser.: Mater. Sci. Eng. 1108 012023 This research aims to produce a GPS-based fire detection system (Global Positioning System) and SMS Gateway. The benefits of this detection system can detect early fire occurrence based on the detection of temperature conditions by accommodating the nature of the fire and able to detect any rise in temperature caused by the existence of the fire. This detection system must also be able to read any smoke produced by a fire. To realize the system, required sensors capable of reading the temperature and

smoke. The Arduino Uno microcontroller is the brain control system of the system. At a temperature of  $> 35^{\circ}\text{C}$ , the system will activate the DHT 11 and MQ 2 sensors that detect smoke  $> 50$  ppm from fire. The system will activate Buzzer as a warning in the form of the next alarm sound. Global Positioning System (GPS) will provide information in the form of coordinates of the location of the point of fire through GSM SIM900 Module Short Message Service (SMS) to the user. The results obtained  $\text{mq2} = 128$  ppm and temperature value  $= 38^{\circ}\text{C}$  and GPS data with latitude of  $-3.04798388$  and a longitude of  $104.78263092$ . From the data it is seen that the mq2 value reaches  $> 50$  ppm and the temperature value reaches  $> 35^{\circ}\text{C}$ , and the detector outputs buzzer sound and warning notification of coordinate point in the form of SMS containing the message "FIRE available" with the coordinates of the location of the fire detected by GPS.

### 10T Based Fire Detection System Using Machine Intelligence

4 authors, including Arun Rajesh DOI: 10.13140/RG.2.2.18979.99365 Fire alarms play an important role in residential safety work. While the Fire Services are the first line of defence against fire accidents, they are heavily underresourced and lack adequate manpower. After analysing the needs of the Indian Fire Department, this paper proposed a 10T architecture based fire alarm system that alerts the owner and fire station of a fire outbreak. This paper also uncovers the ideal conditions to set off the fire alarm based on the temperature, humidity and the nature of gases present in the environment using the decision tree algorithm. Several cases are recorded for experimentation and training. Results show 91.15% accuracy in detecting fire.

### IOT Based Fire Detection System

Rashmi Vinod Patil, Sayali Fakira Jadhav, Kaveri Sitaram Kapse, Prof. M. B. Thombare, Prof. S. A. Talekar Article • July 2021 DOI: 10.48175/1JAR SCT1681 Fire Detection Systems are now widely used in various safety and security applications. The major amount of fire starts due to the electric short circuit. It leads to damage to property and also loss of life. To avoid that or to minimize the damage caused by fire outbreaks due to electric short circuits an IOT technology is used to control such a kind of risk. Traditional fire detection systems are not that effective and quick to alert the owner about fire, in case no one is present on the location. To overcome this problem in this paper we present the design and

development of 10T based Fire Detection System. A system that combines qualities for fire, temperature and smoke detection, sending alert Text Message about the fire to the user along with onsite alarm(buzzer), updating temperature, humidity and smoke on ThingSpeak cloud every 15 seconds, and it also moves manually with the help of Android Application. The Fire Detection System consists of four main parts: Multiple sensors, communication system (Bluetooth, GSM, NodeMCU), motion planning (Manual patrolling), and Android application for manual patrolling of the system. This Fire Detection system can be used in college, school, office, and industry for safety purposes.

### GSM based smart fire and high-temperature detection system

Ravindra Koggalage, Manjula Welihinda and Hasitha Nuwan Article in ITEGAM- Journal of Engineering and Technology for Industrial Applications (ITEGAM JETIA) • January 2021

This research refers to an Arduino and Global System for Mobile (GSM) based system for efficient detection of fire hazards. This project's purpose is industrial and domestic safety, and the primary concern is to avoid the fire hazards that occur to the employees and the properties inside the buildings. As a solution, a smart fire and high-temperature detection system is design using GSM technology, smoke/temperature sensors, and Arduino technology. A smoke sensor is used to detect the smoke from the fire and a temperature sensor is used to detect temperature increase inside the building. In event of a fire, an alert message will be sent to the user via short message service (SMS) via the GSM module. Furthermore, when a fire is detected, a signal will be sent to the main power supply circuit breaker via a microcontroller and then the power supply of the particular building will shut down. Results from the test are documented and discussed in this paper. This system helps users to respond immediately to the situation and so improve their safety by protecting their lives and the properties from a disaster.

## 2.2 References

1. Developed Intelligent Fire alarm system. [Hussam Elbehieri. J Am Sci 2012;8(8):1016- 1024].
2. Research on Fire Alarm Computer Monitoring System in Fire



Engineering Xiyang Feng and Chaoferi Wang 2021 J. Phys.: Conf. Ser. 1915 042061

3. Hamood Alqourabah, Amgad Muneer, Suliman Mohamed Fati in the paper titled "A Smart Fire Detection using IoT Technology with Automatic Water Sprinkler"

4. Poonam Sonsale, Rutika Gawas, Siddhi Pise, Anuj Kaldade in the paper "Intelligent Fire Extinguisher System"

5. GPS-based fire detection system (Global Positioning System) and

SMS Gateway A Aryanti, I Mekongga and R S Dewi et al 2021 IOP Conf. Ser.: Mater. Sci. Eng. 1108 012023

6. IoT Based Fire Detection System Using Machine Intelligence 4 authors, including Arun Rajesh DOI: 10.13140/RG.2.2.18979.99365

7. IOT Based Fire Detection System Rashmi Vinod Patil, Sayali Fakira

Jadhav, Kaveri Sitaram Kapse, Prof. M. B. Thombare, Prof. S. A. Talekar

Article • July 2021 DOI: 10.48175/IJARSC-1681

8. GSM based smart fire and high-temperature detection system Ravindra Koggalage, Manjula Welihinda and Hasitha Nuwan Article in ITEGAM- Journal of Engineering and Technology for Industrial Applications (ITEGAM-JETIA) January 2021

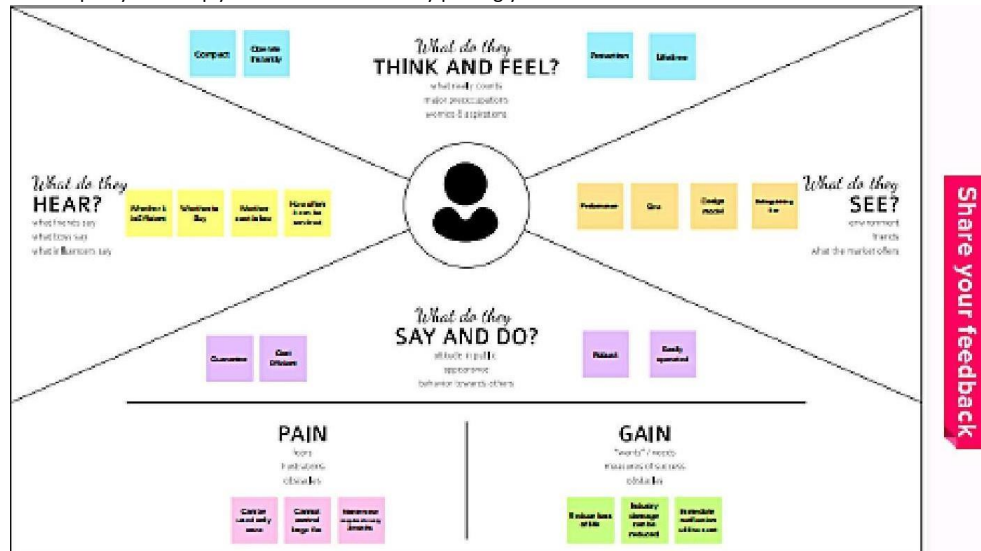
## 2.3 Problem Statement Definition

A fire detection system uses a smoke detector to detect a fire before it actually starts. An effective fire detection system eliminates damage by ensuring that a fire can be prevented before it even starts. A fire detector may also have a direct connection to an alarm monitoring centre. The smart fire management 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 then the alarm is triggered. If any flame is detected the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and fire station.

### 3. IDEATION & PROPOSED SOLUTION

#### 3.1 Empathy Map

Build empathy and keep your focus on the user by putting yourself in their shoes-



#### 3.2 Ideation & Brainstorming



#### 3.3 Proposed Solution

| s.NO. | Parameter | Description |
|-------|-----------|-------------|
|-------|-----------|-------------|

|    |   |  |
|----|---|--|
| 1. | <p>Problem Statement<br/>(Problem to be solved)</p> | <p>On October 20, 2016 in Tamilnadu a major fire broke out in the huge cracker manufacturing hub in Sivakasi. Many people lost their lives in this accident.</p> <p>In cracker industries the chemicals used for manufacturing fireworks are highly sensitive to friction, impact, heat and static electricity.</p> <p>These friction and impact causes fire accidents. The fire accidents or blasts also occur in godowns either due to sparks from electrical fittings or from the impact stimuli generated during loading and unloading of boxes containing fireworks. These fire accidents cause great loss to the</p> |
|    |   | <p>industry and also to the lives of the people working in the industries.</p> <p>So, to overcome this problem we have proposed a solution that uses sensors to detect the fire before it causes damage, sprinklers are used to control the fire and a fire alarm is used to alert the workers about the fire breakage. This can also be used in all the other industries like textile industries, mining industries etc.,</p>   |

|    |                             |   |
|----|-----------------------------|---|
| 2. | Idea / Solution description | <p>In the proposed model, a gas sensor, flame sensor and temperature sensors are used for the detection of fire.</p> <p><b>Gas Sensor</b></p> <p>Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gasses. They are commonly used to detect toxic or explosive gasses and measure gas concentration. Gas sensors are employed in factories and manufacturing facilities to identify gas leaks, and to detect smoke and carbon monoxide in homes. Gas sensors vary widely in size (portable and fixed), range, and sensing ability. They are often part of a large Embedded systems, such as hazmat and security systems, and they are normally connected to an audible alarm or interface. Because gas sensors are constantly interacting with air and other gasses, they have to be calibrated more often than many other types of sensors. In general gas sensors have the potential to detect all fires because every fire is</p> |
|----|-----------------------------|---|

|  |  |  |
|--|--|--|
|  |  | <p>emitting gas and an according fire detector is not dependent from the release of heat or smoke.</p> <p><b>Flame sensor</b></p> <p>The flame sensor detects the presence of fire or flame based on the Infrared (IR) wavelength emitted by the flame. It gives logic 1 as output if a flame is detected, otherwise, it gives logic 0 as output.</p> <p>Arduino Uno checks the logic level on the output pin of the sensor and performs further tasks such as activating the buzzer, sending an alert message.</p> <p><b>Temperature sensor</b></p> <p>A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes. The alarm is triggered when the temperature exceeds a particular value.</p> <p><b>Fire alarm</b></p> <p>A fire alarm system warns people when smoke, fire, carbon monoxide or other fire-related emergencies are detected. These alarms may be activated automatically from temperature sensors and gas sensors. If fire is detected by using flame sensors, then the sprinklers will be turned on.</p> <p><b>Sprinklers</b></p> <p>A fire sprinkler system is an active fire protection method, consisting of a water supply system, providing adequate</p> |
|--|--|--|



|  |  |   |
|--|--|---|
|  |  | <p>pressure and flowrate to a water distribution piping system, onto which fire sprinklers are connected.</p> <p>Fire sprinkler systems are extensively used worldwide, with over 40 million sprinkler heads fitted each year. Even though Fire Sprinkler Systems are a Life Saving System and are not designed to protect the building, 96% of buildings that had fires and were completely protected by fire sprinkler systems were controlled by the fire sprinklers alone.</p> <p><b>Arduino</b></p> <p>Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.</p> <p><b>10T</b></p> <p>The Internet of Things (IOT) is the ability to have devices communicate with one another via the internet or other networks, remotely tracking information to provide feedback to assist with decision making for commercial, industrial and residential purposes. This is commonly done using sensors connecting to a back-to-base system.</p> <p>The internet of things, or IOT, is a system</p> |
|--|--|---|





|  |  |   |
|--|--|---|
|  |  | <p>of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.</p> <p>How does 10T work?</p> <p>An 10T ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. 10T devices share the sensor data they collect by connecting to an 10T gateway or other edge device where data is either sent to the cloud to be analysed or analysed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices - for instance, to set them up, give them instructions or access the data. In addition, the Cloud Server application supports notification management, i.e., the automated and manual ability to communicate with all occupants connected with the affected property areas to guide them through the event. This communication can occur through App notifications, emails, SMS and PA systems. These communication tools can be</p> |
|--|--|---|

|    |                      |   |
|----|----------------------|---|
|    |                      | <p>engaged by the administrators of the application based on how the emergency situation or event evolves.</p> <p><b>Cloudant DB</b></p> <p>Cloudant is an IBM software product, which is primarily delivered as a cloud based service. Cloudant is a non-relational, distributed database service of the same name. Cloudant is based on the Apache backed CouchDB project and the open source BigCouch project.</p> <p>Cloudant's service provides integrated data management, search, and analytics engine designed for web applications.</p>  |
| 3. | Novelty / Uniqueness | <p>A fire detection system uses a smoke detector to detect a fire before it actually starts. An effective fire detection system eliminates damage by ensuring that a fire can be prevented before it even starts. A fire detector may also have a direct connection to an alarm monitoring centre. The smart fire management 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 then the alarm is triggered. If any flame is detected the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and fire station.</p> |

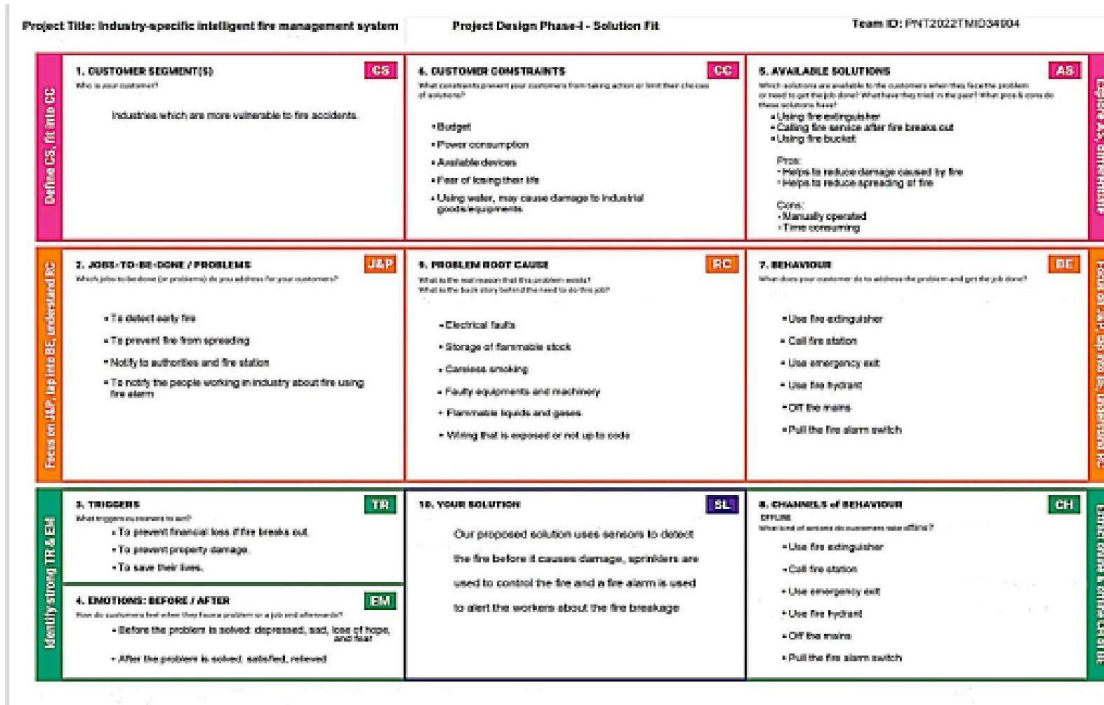
|    |  |  |
|----|--|--|
| 4. | Social Impact /<br>Customer Satisfaction | Fire management system provides an early warning of fire so that people can be evacuated and immediate action can be |
|----|--|--|

|  |  |   |
|--|--|---|
|  |  | <p>taken to stop or eliminate the fire effect as soon as possible. If fire is detected immediate notification will be sent to authorities and fire stations.</p> <p>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</p> <p>fashion. Using automatic fire sprinklers protects the environment while further verifying that they reduce property damage and protect lives. It reduces financial loss in industries.</p> |
|--|--|---|

|    |                                   |  |
|----|-----------------------------------|--|
| 5. | Business Model<br>(Revenue Model) | <p>Customer segment</p> <p>This alarm system is designed for industries. Its purpose is industrial safety, and the primary concern is to avoid the fire hazards that occur to the employees and the properties inside the buildings. Industrial buildings shall include any building in which products or materials of all kinds and properties are fabricated, assembled, manufactured or processed, for example, assembly plants, industrial laboratories, dry cleaning plants, power plants, generating units, pumping stations, laundries, buildings or structures in gas plants, refineries, dairies and saw mills etc.</p> <p>Customer relationship</p> <p>The industry premises will be inspected</p> |
|----|-----------------------------------|--|

|    |                             |  |
|----|-----------------------------|--|
|    |                             | <p>and after a full assessment, recommendations will be made for the location specifically to ensure maximum safety without excess cost to the business. After installation the following will be provided in the premises.</p> <ul style="list-style-type: none"> <li>• Owner's manual and manufacturer's instructions covering all system equipment.</li> <li>• Operator instructions for basic system operations.</li> <li>• A detailed description of routine maintenance and testing as required and recommended, including: Listing of the individual system components that require periodic testing and maintenance.</li> <li>• Step-by-step instructions detailing the requisite testing and maintenance procedures, and the intervals at which these procedures need to be performed, for each type of device installed.</li> <li>• A testing and maintenance schedule.</li> <li>• Detailed troubleshooting instructions.</li> <li>• A service directory that includes a list of the names and telephone numbers of those who provide service for the system.</li> </ul> |
| 6. | Scalability of the Solution | The proposed model can be used in textile industries, paper industries, automobile industries, mining industries, cracker industries, cement industries etc.   |

### 3.4 Problem Solution fit



## 4. REQUIREMENT ANALYSIS

### 4.1 Functional requirement

| FR No. | Functional Requirement (Epic)       | Sub Requirement (Story / Sub-Task)   |
|--------|-------------------------------------|--|
| FR-I   | Rapid Detection of fire             | The system must be able to detect fire rapidly.  |
| FR-2   | 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 . |
| FR-3   | 3D location                         | The system must be able to accurately determine the three-dimensional position and volume of the flames in 3-dimensional space .   |

|      |                         |  |
|------|-------------------------|--|
| FR-4 | Automation and Autonomy | The system must be able to activate and function completely autonomously, without any external network or power and any human intervention.  |
| FR-5 | Web server              | The system must have a web server for system monitoring and allow for remote control by designated persons .   |
| FR-6 | Cloud server            | Cloud servers allows us to store information on the cloud and access this information using an internet connection. As the cloud provider is responsible for providing security, so they offer various backup recovery application for retrieving the lost data. |

#### 4.2 Non-Functional requirements

| FR No. | Non-Functional Requirement (Epic) | Description   |
|--------|-----------------------------------|---|
| NFR-I  | Usability                         | It is completely automated. No need to manually remove any pin like a fire extinguisher. Instead, when the flame is detected, the sprinkler is turned on immediately and when a gas sensor detects any gases, an alarm is sent immediately and notifications are sent to the authorities. It is easier to use the fire management system. |
| NFR-2  | Security                          | According to the testing and maintenance schedule, frequent   |

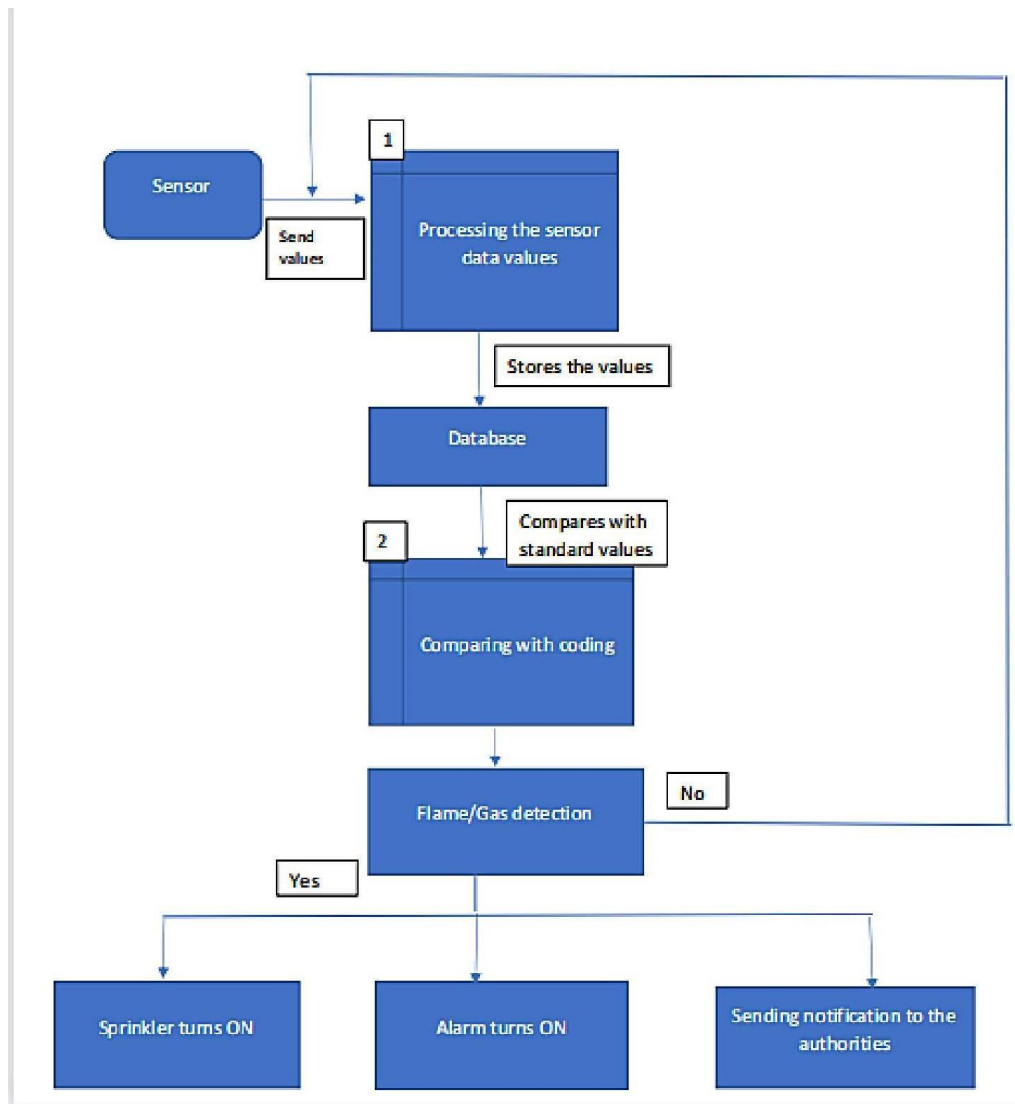
|       |             |  |
|-------|-------------|--|
|       |             | <p>tests are done to secure the fire management system. Fire management systems should be discharged, disassembled, and inspected annually. Mock drills should be conducted periodically. It should be checked whether it includes all the fire safety standards.</p>  |
| NFR-3 | Reliability | <p>This is the highest quality and most innovative fire sprinklers and special systems on the market; distributes a full line of best-in-class system components; and backs it up with premier customer service</p>  |
| NFR-4 | Performance | <p>All the minimum durations of operations are here decided for every fire management system, according to the value of the flame sensor, gas, and temperature sensor. The emission of sprinklers shall start within a few seconds since the flame is detected and in case of any gas is detected, an alarm is turned on within a few seconds.</p> |



|       |              |   |
|-------|--------------|---|
| NFR-5 | Availability | The fire management systems were effective in extinguishing fires 95% of the time. A new installation of the system shall be available for first-time use within 24 hours of the start of the |
|       |              | installation.   |
| NFR-6 | Scalability  | This model is not only used for small industries but it can also be used in large industries and buildings with proper infrastructure and technology.   |

## 5. PROJECT DESIGN

### 5.1 Data Flow Diagrams



### 5.3 User Stories

| User Type                  | Functional Requirement (Epic) | User Story Number | User Story Number                    | Acceptance criteria                         | Priority | Release  |
|----------------------------|-------------------------------|-------------------|--------------------------------------|---|----------|----------|
| Customer (Industrial user) | Rapid Detection of fire       | USN-I             | user, I need rapid detection of fire | I can safeguard my properties and employees | High     | Sprint-I |

|                               |                                     |       |   |  |        |          |
|-------------------------------|-------------------------------------|-------|---|--|--------|----------|
| Customer<br>(Industrial user) | 3D location                         | USN-2 | As a user, I require a 3D location        | Fire can be detected accurately                                  | Medium | Sprint-I |
| Customer<br>(Industrial user) | Automation and autonomy             | USN-3 | As a user, I need automation and autonomy | Human interaction can be avoided                                 | High   | Sprint-2 |
| Customer<br>(Industrial user) | Web server                          | USN-4 | user, it's essential to have a web server | I can monitor and allow for remote control by designated persons | Medium | Sprint-4 |
| Customer<br>(Industrial user) | Automatic, Accurate, Dynamic Aiming | USN-5 | As a user, I require automatic            | Aim a large volume of water directly at the flames, and          | High   | Sprint-2 |

|  |  |  |                                 |   |  |  |
|--|--|--|---------------------------------|---|--|--|
|  |  |  | c, accurate, and dynamic aiming | dynamically follow the flames if the fire grows |  |  |
|--|--|--|---------------------------------|---|--|--|

|                               |              |       |  |   |      |          |
|-------------------------------|--------------|-------|--|---|------|----------|
| Customer<br>(Industrial user) | Cloud server | USN-6 | As a user, I need a cloud server           | I can store the data securely             | Low  | Sprint-3 |
| Customer<br>(Industrial user) | Alarm        | USN-7 | As a user, I need an alarm                 | I can be safe before the fire spreads     | High | Sprint-2 |
| Customer<br>(Fire station)    | Notification | USN-8 | user, I need a notification about the fire | I can know about the nearby fire breakage | Low  | Sprint-3 |

## 6. PROJECT PLANNING & SCHEDULING

### 6.1 Sprint Planning & Estimation

| Sprint   | Functional Requirement (Epic) | User Story Number | User Story/ Task                                | Story Points | Priority | Team Members                      |
|----------|-------------------------------|-------------------|---|--------------|----------|-----------------------------------|
| Sprint-I | Sensing the values            | USN-I             | As a user, I want to see the temperature values | 3            | High     | Fershia G Geona,<br>Reshma Xavier |
| Sprint-I | Sensing the values            | USN-2             | As a user, I want to see gas values             | 2            | High     | Fershia G Geona,<br>Reshma Xavier |

|          |                              |       |  |   |        |                                   |
|----------|------------------------------|-------|--|---|--------|-----------------------------------|
| Sprint-I | Sensing the values           | USN-3 | As a user, I want to see if flame is present                 | 2 | High   | Godsy D,<br>Aswini A              |
| Sprint-2 | Displaying temperature value | USN-4 | As a user, I want to see the temperature values in dashboard | 2 | Medium | Fershia G Geona,<br>Reshma Xavier |
| Sprint-2 | Displaying gas value         | USN-5 | user, I want to see the gas values in dash board             | 2 | Medium | Fershia G Geona,<br>Reshma Xavier |

| Sprint   | Functional Requirement (Epic) | User Story Number | User Story / Task                                  | Story Points | Priority | Team Members         |
|----------|-------------------------------|-------------------|--|--------------|----------|----------------------|
| Sprint-2 | Displaying flame value        | USN-6             | As a user, I want to see flame values in dashboard | 2            | Medium   | Godsy D,<br>Aswini A |

|          |              |       |  |   |      |                                   |
|----------|--------------|-------|--|---|------|-----------------------------------|
| Sprint-3 | Alarm On     | USN-7 | As a user, the alarm should be turned on immediately if temperature, gas, flame values exceeds a particular threshold in web application     | 3 | High | Fershia G Geona,<br>Reshma Xavier |
| Sprint-3 | Alarm Off    | USN-8 | As a user, I need to turn off alarm in web application   | 2 | Low  | Fershia G Geona,<br>Reshma Xavier |
| Sprint-3 | Sprinkler On | USN-9 | As a user, the sprinkler should be turned on immediately if temperature, gas, flame values exceeds a particular threshold in web application | 3 | High | Godsy D,<br>Aswini A              |

|          |               |        |  |   |     |                      |
|----------|---------------|--------|--|---|-----|----------------------|
| Sprint-3 | Sprinkler Off | USN-IO | As a user, I need to turn off sprinkler in web application | 2 | Low | Godsy D,<br>Aswini A |
|----------|---------------|--------|--|---|-----|----------------------|

|          |                          |        |  |   |      |                                |
|----------|--------------------------|--------|--|---|------|--------------------------------|
| Sprint-4 | Registration             | USN-II | As a user, I can register for the application by entering email, password, and confirming my password  | 3 | High | Fershia G Geona                |
| Sprint-4 | Displaying sensor values | USN-12 | Displaying gas, flame and temperature sensor values  | 3 | High | Reshma Xavier                  |
| Sprint-4 | Alarm On                 | USN-13 | As a user, the alarm should be turned on immediately if temperature, gas, flame values exceeds a particular threshold using mobile application | 3 | High | Fershia G Geona, Reshma Xavier |
| Sprint-4 | Alarm Off                | USN-14 | As a user, I need to turn off alarm using mobile application   | 2 | Low  | Fershia G Geona, Reshma Xavier |

|          |               |        |  |   |      |                   |
|----------|---------------|--------|--|---|------|-------------------|
| Sprint-4 | Sprinkler On  | USN-15 | As a user, the sprinkler should be turned on immediately if temperature, gas, flame values exceeds a particular threshold using mobile application | 3 | High | Godsy D, Aswini A |
| Sprint-4 | Sprinkler Off | USN-16 | As a user, I need to turn off sprinkler using mobile application   | 2 | Low  | Godsy D, Aswini A |

## 6.2 Sprint Delivery Schedule

| TITLE  | DESCRIPTION  | COMPLETED DATE      |
|--|--|---------------------|
| Literature survey on the project and Information Gathering | Collect the relevant information on project use case, refer the existing solutions, technical papers, research publications etc. | 19th September 2022 |
| Prepare Empathy Maps                                       | Prepare the empathy map canvas to capture the user pains and gains, Prepare list of problem statements.                          | 19th September 2022 |
| Ideation   | List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the                               | 19th September 2022 |



|                        |   |                     |
|------------------------|---|---------------------|
|                        | feasibility and importance.   |                     |
| Proposed Solution      | Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc. | 24th September 2022 |
| Problem Solution Fit   | Prepare solution fit document   | 01st October 2022   |
| Solution Architecture  | Prepare solution architecture document  | 01st October 2022   |
| Customer Journey       | Prepare the customer journey maps to understand the user interactions & experiences with the application  | 08th October 2022   |
| Functional Requirement | Prepare the functional requirement document   | 15th October 2022   |

- CODING & SOLUTIONING (Explain the features added in the project along with code)

## CODING

```
#include <WiFi.h>

#include

<PubSubClient.h>

#include "DHT.h"

#define DHTPIN 15

#define DHTTYPE DHT22
```

```

#define LED 2

DHT dht (DHTPIN, DHTTYPE), void callback(char*
subscribetopic, byte* payload, unsigned int payloadLength);

//-----credentials of IBM Accounts-----#define

ORG "zbgr67"

#define DEVICE TYPE "fershidevicetype"

#define DEVICE ID "fershideviceid"

#define TOKEN "fershiageona"

String data3;

float t;

//-----Customise the above values -----char server[] = ORG
".messaging.internetofthings.ibmcloud.com"; char publishTopic[]
— "iot-2/evt/Data/fmt/json"; char subscribetopic[] "iot-
2/cmd/command/fmt/String" ; char authMethod[] = "use-token-
auth"; char token[] = TOKEN; char clientId[] = "d:" ORG ' '
DEVICE TYPE ' ' DEVICE ID

```

---

```

WiFiClient wifiClient;

PubSubClient client(server, 1883, callback ,wifiClient);

void setup()

Serial.begin(115200);

dht.begin();

pinMode(LED,OUTPUT);

delay(10);

Serial.println();

```

```
wificonnect();  
mqttconnect();
```

```
void loop()// Recursive Function
```

```
t = dht.readTemperature();  
Serial.print("temperature:");  
Serial.println(t);  
PublishData(t);  
delay(1000); if  
(!client.loop()) {  
mqttconnect();
```

```
/* .....retrieving to Cloud .....*/  
void PublishData(float temp) {  
mqttconnect();
```

creating the String in in form JSon to update the data to ibm cloud

```
String payload = "{\"temperature\":";  
payload += temp;  
payload += "}";  
  
Serial.print("Sending payload: ");  
  
Serial.println(payload); if (client.publish(publishTopic,  
(char*) payload.c_str())) {
```

```
    Serial.println("Publish ok"); }  
else {  
    Serial.println("Publish failed");
```

```
void mqttconnect() { if  
    (!client.connected()) {  
    Serial.print("Reconnecting client to");  
    Serial.println(server); while (! !  
        !client.connect(clientId, authMethod, token)) {  
        Serial.print( ".");  
        delay(500);  
  
        initManagedDevice();  
        Serial.println();  
void wificonnect()  
  
    Serial.println();  
    Serial.print("Connecting to ");  
    WiFi.begin("Wokwi-GUEST", "",6);  
    while (WiFi.status() != WL_CONNECTED) { delay(500);  
        Serial.print( ".");  
  
    Serial.println("");  
    Serial.println("WiFi connected");  
    Serial.println("IP address: ");  
    Serial.println(WiFi.localIP());
```

```

void initManagedDevice() { if
  (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd FAILED");
  }
}

```

```

void callback(char* subscribetopic, byte* payload, unsigned int
payloadLength)
  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic); for (int i = 0;
i < payloadLength; i++) {
  //Serial.print((char)payload[i]); data3 +=
(char)payload[i];

  Serial.println("data: "+ data3); if(data3==—
"lighton")

```

```

  Serial.println(data3);
  digitalWrite(LED,HIGH);

```

```

  else

```

```

  Serial.println(data3);
  digitalWrite(LED,LOW);

```

## TESTING

## 8.1 Test Cases Report

| Test case ID            | Feature Type | Component | Test Scenario  | Pre-Req | Steps To Execute  | Test Data   | Expected Result                                   | Actual Result       | Status | Comments | TC for Automation(Y/N) |
|-------------------------|--------------|-----------|--|---------|---|---|---|---------------------|--------|----------|------------------------|
| RegistrationPage_TC_001 | UI           | Home Page | Verify user is able to see the username textbox                            |         | 1.Click the link and download the application<br>2.Verify username text box is displayed  | <a href="http://a2.apptinventor.mil.edu/b/2.nsf/">http://a2.apptinventor.mil.edu/b/2.nsf/</a>                   | Application should show username text box         | Working as expected | Pass   |          | No                     |
| RegistrationPage_TC_002 | UI           | Home Page | Verify user is able to see the E-mail textbox                              |         | 1.Click the link and download the application<br>2.Verify email text box is displayed   | <a href="http://a2.apptinventor.mil.edu/b/2.nsf/">http://a2.apptinventor.mil.edu/b/2.nsf/</a>                   | Application should show email text box            | Working as expected | Pass   |          | No                     |
| RegistrationPage_TC_003 | UI           | Home page | Verify user is able to see the Password textbox                            |         | 1.Click the link and download the application<br>2.Verify password textbox is displayed   | <a href="http://a2.apptinventor.mil.edu/b/2.nsf/">http://a2.apptinventor.mil.edu/b/2.nsf/</a>                   | Application should show password text box         | Working as expected | Pass   |          | No                     |
| RegistrationPage_TC_004 | UI           | Home page | Verify user is able to see the confirm password textbox                    |         | 1.Click the link and download the application<br>2.Verify confirm password text box is displayed  | <a href="http://a2.apptinventor.mil.edu/b/2.nsf/">http://a2.apptinventor.mil.edu/b/2.nsf/</a>                   | Application should show confirm password text box | Working as expected | Pass   |          | No                     |
| RegistrationPage_TC_005 | UI           | Home page | Verify user is able to see the submit button                               |         | 1.Click the link and download the application<br>2.Verify submit text box is displayed  | <a href="http://a2.apptinventor.mil.edu/b/2.nsf/">http://a2.apptinventor.mil.edu/b/2.nsf/</a>                   | Application should show submit text box           | Working as expected | Pass   |          | No                     |
| RegistrationPage_TC_006 | Functional   | Home page | Verify user is able to register to the application using valid credentials |         | 1.Click the link and download the application<br>2.Enter valid username in username text box<br>3.Enter valid email in email text box<br>4.Enter valid password in password text box<br>5.Enter valid confirm password in confirm password textbox<br>6.Enter submit button | Username: firestation<br>E-mail: firestation987@gmail.com<br>Password: cdtpro@12<br>Confirm Password:stdtpro@12 | User should navigate to user account page         | Working as expected | Pass   |          | No                     |
| RegistrationPage_TC_007 | Functional   | Home Page | Verify user is able to log into application with invalid email             |         | 1.Click the link and download the application<br>2.Enter invalid email in email text box<br>3.Click on submit button  | E-mail: firestation@gmail.com   | Application should show "invalid E-mail"          | Working as expected | Pass   |          | No                     |

[illegible]

[illegible]

## 9. RESULTS

## Performance Metrics

| NFT - Risk Assessment    |   |                       |                             |  |                    |  |   |                                 |
|--------------------------|---|-----------------------|-----------------------------|--|--------------------|--|---|---------------------------------|
| S.No                     | Project Name                                      | Scope/Testure         | Functional Changes          | Hardware Changes   | Software Changes   | Load/Volumen Changes                                       | Risk Score  |                                 |
| 1                        | Industry Based Intelligent Fire Management System | None                  | Low                         | No Changes   | Low                | No Changes   | ORANGE  |                                 |
|                          |   | Sending the values    |                             |  |                    |  |   |                                 |
|                          |   | Displaying the values |                             |  | Connection failure |  |   |                                 |
|                          |   | Registration          |                             |  | Crashing of server |  |   |                                 |
|                          |   | Alarm                 | Overloading of data         |  |                    |  |   |                                 |
|                          |   | Subscription          |                             |  |                    |  |   |                                 |
|                          |   |                       |                             |  |                    |  |   |                                 |
| NFT - Detailed Test Plan |   |                       |                             |  |                    |  |   |                                 |
| S.No                     | Project Overview                                  |                       |                             |  | NFT Test approach  | Approvals/Sign Off   |   |                                 |
| 1                        | Industry Based Intelligent Fire Management System |                       |                             |  | Stress testing     | As there may be crashing of server ,stress testing is used |   |                                 |
|                          |   |                       |                             |  | Load testing       | Overloading of data to alarm                               |   |                                 |
|                          |   |                       |                             |  |                    |  |   |                                 |
| End Of Test Report       |   |                       |                             |  |                    |  |   |                                 |
| S.No                     | Project Overview                                  | NFT Test approach     | NFR - Met                   | Test Outcome   |                    | GO/NO-GO decision  | Identified Defects [Detected/Closed/Open]                     | Approvals/Sign Off              |
| 1                        | Industry Based Intelligent Fire Management System | Stress testing        | Registration - Met          | 3 pages requested per second and 3 pages got loaded                    |                    | GO Decision  | No defects  | Good                            |
|                          |   |                       | Displaying the values - Met | Due to connection failure, there can be delay in displaying the values |                    | GO Decision  | Connection failure due to over load only less number of times | Failure of connection sometimes |
|                          |   | Load testing          | Alarm - Met                 | Due to overloading, there can be false alarms                          |                    | GO Decision  | False alarm   | Chaotic environment             |

## 10. ADVANTAGES & DISADVANTAGES

## 10.1 ADVANTAGES

- It saves the lives of the employees.
- It prevents property damages.
- It saves immense financial losses.
- It reduces manual work.
- It provides low cost infrastructure for fire management system.
- It detects the early fire.
- It prevents fire from spreading.

## 10.2

### DISADVANTAGES

- Frequent maintenance and services are required.

### • CONCLUSION

We conclude that the system protects the industry from huge loss of lives of the employees and the immense financial loss caused by the fire. It provides a low cost infrastructure for managing the fire. It also saves manual work. It is highly useful in early detection of fire.

## 12. FUTURE SCOPE

This model is not only used for small industries but it can also be used in large industries and buildings with proper infrastructure and technology.

## 13. APPENDIX

### 13.1 Source Code

```
#include <WiFi.h>

#include

<PubSubClient.h>

#include "DHT.h"
```



```

#define DHTPIN 15

#define DHTTYPE
DHT22

#define LED 2

DHT dht (DHTPIN, DHTTYPE); void callback(char*
subscribetopic, byte* payload, unsigned int payloadLength);

//-----credentials of IBM Accounts-----#define
ORG "zbgr67"

#define DEVICE TYPE "fershidevicetype"

#define DEVICE ID "fershideviceid"

#define TOKEN "fershiageona"

String data3;

float t;

//-----Customise the above values -----char server[] = ORG
".messaging.internetofthings.ibmcloud.com"; char publishTopic[]
— "iot-2/evt/Data/fmt/json";

char subscribetopic[] — "iot-2/cmd/command/fmt/String"; char
authMethod[] = "use-token-auth"; char token[] = TOKEN; char
clientId[] = "d:" ORG ' ' DEVICE TYPE ' ' DEVICE ID

_____

WiFiClient wifiClient;

PubSubClient client(server, 1883, callback ,wifiClient);

void setup()

Serial.begin(115200);

dht.begin();

```

```
pinMode(LED,OUTPUT);
```

```
delay(10);
```

```
Serial.println();
```

```
wificonnect();
```

```
mqttconnect();
```

```
void loop()// Recursive Function
```

```
t = dht.readTemperature();
```

```
Serial.print("temperature:");
```

```
Serial.println(t);
```

```
PublishData(t);
```

```
delay(1000); if
```

```
(!client.loop()) {
```

```
mqttconnect();
```

```
/* .....
```

```
retrieving to
```

```
Cloud
```

```
.....*/
```

```
void
```

```
PublishData(float
```

```
temp) {
```

```
mqttconnect();
```

creating the String in in form JSon to update the data to ibm cloud

```
String payload = "{\\"temperature\ .";
payload += temp;
payload += "}";

Serial.print("Sending payload: ");

Serial.println(payload); if (client.publish(publishTopic,
(char*) payload.c_str())) {
    Serial.println("Publish ok");
} else {
    Serial.println("Publish failed");
```

```
void mqttconnect() { if
(!client.connected()) {
Serial.print("Reconnecting client to");

Serial.println(server); while (!
!client.connect(clientId, authMethod, token)) {
    Serial.print(".");
    delay(500);
```

```
initManagedDevice();

Serial.println();
```

```
void wificonnect()
```

```
Serial.println();

Serial.print("Connecting to ");
```

```

WiFi.begin("Wokwi-GUEST", "", 6);

while (WiFi.status() == WL_CONNECTED) {
    delay(500); Serial.print(".");

    Serial.println("");
    Serial.println("WiFi connected");
    Serial.println("IP address: ");
    Serial.println(WiFi.localIP());

    void initManagedDevice() { if
        (client.subscribe(subscribetopic)) {
            Serial.println(subscribetopic);

            Serial.println("subscribe to cmd OK");

        } else {
            Serial.println("subscribe to cmd FAILED"); void callback(char*
                subscribetopic, byte* payload, unsigned int payloadLength)

                Serial.print("callback invoked for topic: ");
                Serial.println(subscribetopic); for (int i = 0;
                i < payloadLength; i++) {
                    //Serial.print((char)payload[i]);

                    data3 += (char)payload[i];

                    Serial.println("data: "+ data3); if(data3=="
                        "lighton")

                        Serial.println(data3);

```

```
digitalWrite(LED,HIGH);
```

```
else
```

```
Serial.println(data3);  
digitalWrite(LED,LOW);
```

```
data3=millis();
```

