**EMERGING METHODS FOR EARLY DETECTION**

**OF FOREST FIRE**

**PROJECT REPORT**

***Submitted by***

**R.Sowmyadevi**

**K.Suvetha**

**J.Sathiyavani**

**J.Janani**

*In partial fulfilment of the requirements for the degree of*

## **BACHELOR OF ENGINEERING**

***in***

**ELECTRONICS AND COMMUNICATION ENGINEERING**

**VIVEKANANDHA COLLEGE OF TECHNOLOGY FOR WOMEN, NAMAKKAL**

**ANNA UNIVERSITY:: CHENNAI 600025**

**APPROVAL AND DECLARATION**

### This project report titled Emerging Methods for Early Detection of Forest Fires was prepared and submitted by SOWMYADEVI.R, SUVETHA.K, SATHIYAVANI.J, JANANI.J and has been found satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the Bachelor of Engineering (Electronics and Communication Engineering) in Vivekananda College of Technology for Women, Tiruchengode.

**Checked and Approved by**

### Mrs.N.Porchelvi

**Project Mentor**

**Assistant Professor**

### Department of Electronics and Communication Engineering

### **Vivekananda College of Technology for Women, Tiruchengode.**

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**1.INTRODUCTION**

The world is burning. As global warming continues to display a statistical rise in global average temperatures and various environmental factors continue to contribute to the rise in forest fires, the need for a wireless detection system to recognize these fire hazards and that can successfully alert the necessary first responders is becoming more and more apparent. Such a detection and alert system would be able to potentially save billions of dollars in property, infrastructure, and environmental costs and damages, preserve wildlife habitats and ecosystems that are directly affected by forest fires, and prevent the displacement of countless families from their homes that neighbor forested areas and regions. Therefore, we have come together as an engineering team to propose and develop a prototype solution to these issues using our acquired technical knowledge as senior electrical engineering students for our senior design project this semester. In summary, we aim to reduce the social, economical and environmental impacts brought by forest fires.

**1.1 Project Overview:**

Fire can make major hazards in this hectic world. All buildings and vehicles used in public transportation have fire prevention and fire protection systems due to the accelerated number in the fire incidents. Also, many of the firms conduct a mock fire drill in every occurrence of months to protect their employees from the fire. This would help them to understand what to do or what not to do when a fire situation happens. Forests are one of the main factors in balancing the ecology. It is very harmful when a fire occurs in a forest. But most of the time, the detection of forest fire happens when it spread over a wide region. Sometimes, it could not be possible to stop the fire. As a result, the damage of the environment is higher than predictable. The emission of large amount of carbon dioxide (CO2) from the forest fire damages the environment. As well as it would lead to complete disappearance of rare species in the world. Also, it can make an impact on the weather, and this make major issues like earthquakes, heavy rains, floods and so on.

A research study shows an automatic fire detection can be divided into three groups: aerial, ground and borne detection. The ground-based systems use several staring black and white video cameras are used in fire detection which detect the smoke and compares it with the natural smoke. The main benefit of using this system is high temporal resolution and spatial resolution. So that, the detection is easier.2But these mechanisms still have some drawbacks in detecting the early stage of the fire. So that, it is highly important to introduce a system to detect the fire early as possible.

Moreover, information regarding the seat of the hearth is invaluable for the rapid deployment of ﬁre- ﬁghters. Therefore, early detection, containment at the primary stages and extinguishment of a ﬁreplace before it spreads are crucial for wildﬁre Management.

# **Purpose:**

Forest ﬁres as of late have been annihilating both for normal biological system, biodiversity and woodland economy. With expanding populace weight and change in worldwide atmosphere situation, there is an expansion in level of ﬁres that are a signiﬁcant reason for declining Indian woodlands. As indicated by woodland study report of India, 50 % of backwoods regions in nation are ﬁre inclined (going from 50 to 90 % in certain conditions of nation). Around 6 % of the woods are inclined to extreme ﬁre harms. The reason for this planned framework is to manufacture a dependable ﬁre location framework so as to know dynamic status of backwoods temperature in speciﬁc conditions. It is about the sensors and dynamic checking framework to dodge a signiﬁcant ﬁre and genuine harm to woods.

**2.LITERATURE SURVEY**

**2.1 Abstract:**

Forest fires are one of the main causes of environmental degradation nowadays. Current surveillance systems for forest fires lack in supporting real-time monitoring of every point of a region at all times and early detection of fire threats. Solution using wireless sensor networks, on the other hand, can gather sensory data values, such as temperature and humidity, from all points of a field continuously, day and night, and, provide fresh and accurate data to the fire-fighting center quickly. However, sensor networks face serious obstacles like limited energy resources and high vulnerability to harsh environmental conditions, that have to be considered carefully. In this paper, we propose a comprehensive framework for the use of wireless sensor networks for forest fire detection and monitoring. Our framework includes proposals for the wireless sensor network architecture, sensor deployment scheme, and clustering and communication protocols. The aim of the framework is to detect a fire threat as early as possible and yet consider the energy consumption of the sensor nodes and the environmental conditions that may affect the required activity level of the network. We implemented a simulator to validate and evaluate our proposed framework. Through extensive simulation experiments, we show that our framework can provide fast reaction to forest fires while also consuming energy efficiently.

**2.1 Existing Method**

Smoke alarms and heat alarms are currently used to detect fire. One module is not enough to monitor all of the potential hot spots for fires, which is the main drawback of smoke sensor alarms and heat sensor alarms. Being overly cautious at the time is the only way to prevent fire. Even if they are deployed in every nook and cranny, it still won't be enough to constantly produce an efficient output. The price will rise by a multiple as the number of smoke sensors required rises. Within seconds of an accident or fire, the suggested method can generate reliable and extremely accurate alarms. One piece of software powers the entire surveillance network, which lowers costs. Data scientists and machine learning experts are actively conducting research in this area. The major difficulty lies in reducing inaccuracy in fire detection and timely alerting. The goal of this research is to create a system using IoT sensors that are randomly distributed throughout the forest and to create a powerful self-organized system between the sensors to cover all of the vast areas in the forest that will be used to keep a safe distance from fire damage whenever possible. The sensor has the ability to detect fire in the included area between time intervals of every 5 to 10 minutes. When a fire is detected, every sensor in the area will become active and be given the instruction to halt their normal duties. The idea is to use an Arduino and various IoT sensors to construct an early fire detector making every effort to create a system that is smarter by linking it to a website and keeping track of the statistics created by the Arduino programming. The use of latest technology can help to prevent the catastrophic accidents in forests. The goal is to early identify a forest fire by taking into account a variety of factors, including smoke, temperature, humidity, and flame. Based on the information we obtain from this programming, the forest department will be able to make an informed decision, and the rescue team will be able to reach the precise location on schedule. Think about it if there is heavy traffic in the area and it produces more carbon monoxide than usual. data scientists and machine learning specialists in this field. The major difficulty lies in reducing inaccuracy in fire detection and timely alerting. The goal of this research is to create a system using IoT sensors that are randomly distributed throughout the forest and to create a powerful self-organized system between the sensors to cover all of the vast areas in the forest that will be used to keep a safe distance from fire damage whenever possible. The sensor has the ability to detect fire in the included area between time intervals of every 5 to 10 minutes. When a fire is detected, every sensor in the area will become active and be given the instruction to halt their normal duties. The idea is to use an Arduino and various IoT sensors to construct an early fire detector. making every effort to create a system that is smarter by linking it to a website and keeping track of the statistics created by the Arduino programming. Utilizing cutting-edge technology can aid in preventing disastrous accidents in forests. The goal is to early identify a forest fire by taking into account a variety of factors, including smoke, temperature, humidity, and flame.

**Construction**

The sensors have an electrolyte covering two of their terminals. The electrodes are traditionally fictitious and are attached to the permeable hydrophobic pia mater by means of a very expensive character. The work(predicate) electrode acquires both the electrolyte and the relaxation information that must be regularly supervised through an open dura mater. The electrodes and housing are typically enclosed in a moldable saddlecloth, which holds a gasoline vestibule concavity for the gasoline and electrical brush. The electrolyte most frequently used is a rock that is acrid.

**Internet of things**

The internet of things (IoT) is defined as the vast array of physical objects, including furniture, vehicles, buildings, and other items, that are outfitted with sensors, software, cobweb connectivity, actuators, and electronics and use these features to collect and exchange data. In its most basic form, Internet of Things (IoT) is a framework that gives individuals, groups, or animals the ability to transmit data to a network that may not support Christian-to-electronic computer (H2C) or humane-to-human interaction (H2H) and unmatched identifiers.

**Data management**

An exact air in the Internet of Things is data charge (IoT). When examining a circle of outcomes that are connected and statically dealing with all styles of education, the scope of the provide data and the activities intricate in thumbing of those notice become wise. When the M2M number, which is also the core technology for the Internet of Things, was released, a usable space for wireless communication device manufacturers emerged (IoT). Free range of applications are hampered by this technology.

The following are some of the most pertinent ideas that help us comprehend the opportunities and difficulties associated with data management:

• Data Collection and Analysis

• Big Data

• Semantic Sensor Networking

• Virtual Sensors

• Complex Event Processing.

**Conclusion**

This project's algorithmic rule for changed sensory parameters has enhanced a system that will lessen error perception and frequently update the deficiency to the expert through IOT landing. In order to identify, complete, and sustain a resilient ecosystem, D2D associations traditionally play a crucial role in the IOT environment. The system as designed is capable of exposing mixture variations, dangerous gases, and fire occurrences via the sensors in a careful manner and capable of updating the complaint to the style expert by the IOT complete secondary MQTT regulation. The revised approach is also applicable to industrial and tenement appliances. However, the aforementioned mechanism is solely intended for news with serious opinions. A future annoyance is the multiple-decision company through the IOT landing. To accomplish this enormous labor, an object is being studied and an exploration is being conducted. It is anticipated that the above practise several-opinion correspondence will also take place in environments with aqiqiy delay due to technological advancements successful in the instant age scenario.

**2.2 Reference**

**[**1] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, “Internet of Things (IoT): A vision, architectural elements, and future directions,” Future Gener. Comput. Syst., vol. 29, no. 7, pp. 1645–1660, Sep. 2013.

[2] J. Buckley, “From RFID to the Internet of Things pervasive networked systems,” Conference Centre Albert Borschette (CCAB), Brussels, Belgium, Mar. 2006. [Online]. Available: ftp://ftp.cordis.europa.eu/pub/ ist/docs/ka4/au\_conf670306\_buckley\_en.pdf

[3] D. Evans, “The Internet of things: How the next evolution of the Internet is changing everything,” Cisco IBSG, San Francisco, CA, USA, Apr. 2011. [Online]. Available: http://www.cisco.com/web/about/ac79/ docs/innov/IoT\_IBSG\_0411FINAL.pdf

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[5] D. Lake, A. Rayes, and M. Morrow, “The Internet of Things,” Internet Protocol J., vol. 15, no. 3, pp. 10–19, Sep. 2012. [Online]. Available: [http://www.cisco.com/web/about/ac123/ac147/archived\_issu es/ipj\_15-3/ 153\_Internet.html](http://www.cisco.com/web/about/ac123/ac147/archived_issu%20es/ipj_15-3/%20153_Internet.html).

**2.3 Problem Statement Definition**

In the past, fires were discovered using watching towers or satellite images, which the monitoring authority would then use to determine whether or not there was a fire. However, this method was very slow because the fire might have spread to large areas and done significant damage before the rescue crew arrived.

In the watching tower system, a man would remain on the tower at all times to watch the area and report any signs of fire.

This approach was also cumbersome because a man must always be present and the fire may have already spread deep within the forest before the man learned of it.

Since it is well known that some regions, particularly forest areas, are vast, it would be nearly difficult to place a man in every area of the forest from where he could keep watch over the area.

In order to minimise the damage caused by fire, both these approaches—watching towers and satellite images—failed to identify fire as soon as possible. Issues with fire detection include: As mentioned, there were primarily two issues with fire detection:

 (a). Evaluation standards for the fire: Edge is predetermined; if worth exceeds edge, there is a fire; otherwise, there is not.

 So, many researchers used machine learning techniques to solve this issue.

Node connections: In older systems, cables were utilised to link the alarm and the detectors.

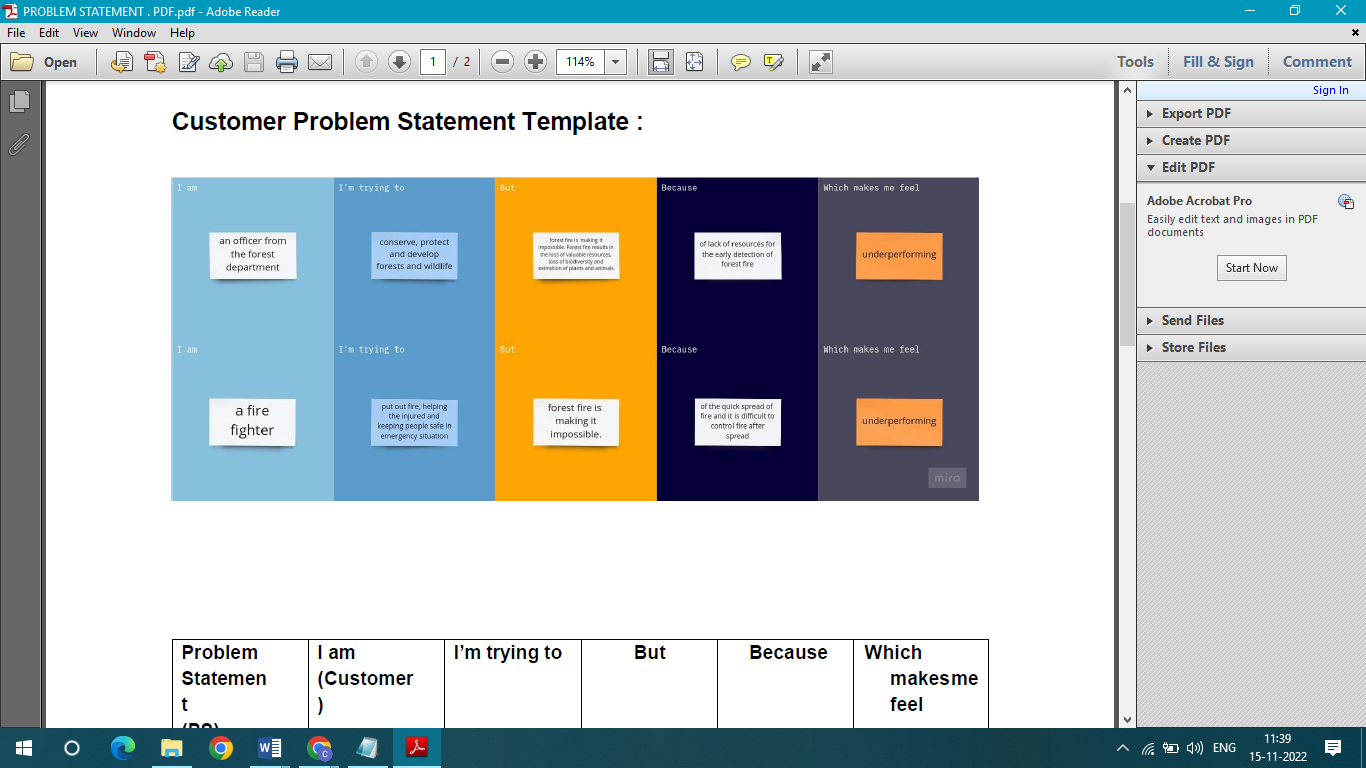
Most cables were made of copper. However, copper cable could be pricey or might have a problem halfway through.

So, employing wireless sensor networks, this issue was solved.

Therefore, with the development of technology, researchers have discovered an effective way to detect forest fires using wireless sensor networks.

By distributing sensor hubs in forested areas that illuminate about fire, fire can be detected.

Conveying sensor hubs in timberland regions entails putting sensors throughout the forest, primarily in high-risk locations where there is a greater chance of a forest fire starting. Using wireless sensor networks, it is now simple to detect.

****

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Problem** **Statement**  (**PS**) | **I am (Customer** | **I’m trying to** | **But** | **Because** | **Which makes me feel** |
| PS-1 | an officer from the forest  department | conserve, protect and develop  forests and  wildlife | forest fire is making it impossible.  Forest fire  results in the loss of valuable resources, loss of biodiversity and extinction of plants and  animals | of lack of resources for the early  detection of  forest fire | underperform ing |
| PS-2 | a fire fighter | put out fire, helping the injured and keeping people safe in emergency  situation | forest fire is making it impossible. | of the quick spread of fire and it is difficult to control fire after spread | underperform ing |

**3.IDEATION AND PROPOSED SOLUTION**

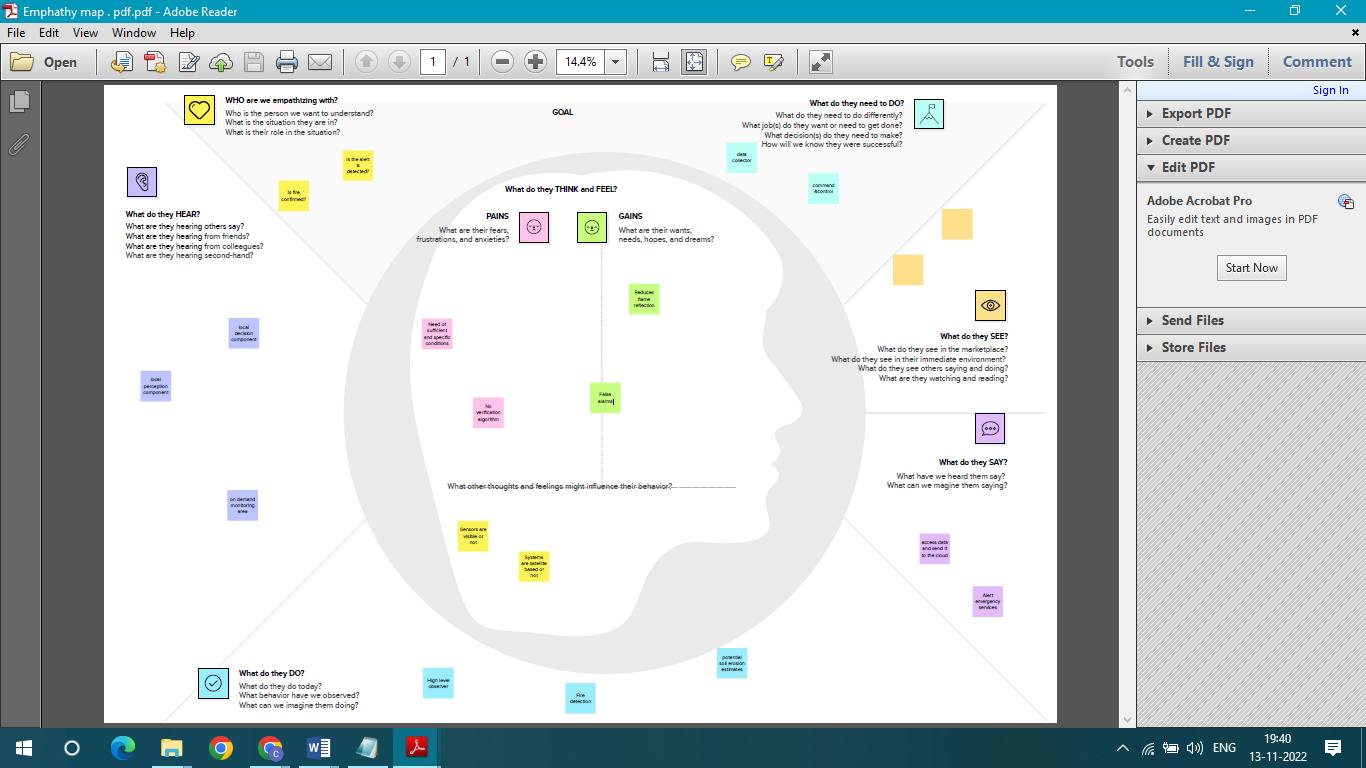
**3.1 Empathy map canvas**

Teams can use an empathy map as a collaborative tool to learn more about their clients. An empathy map can represent a group of users, such as a customer segment, in a manner similar to user personas. The agile community has embraced the empathy map, which was first developed by Dave Gray.

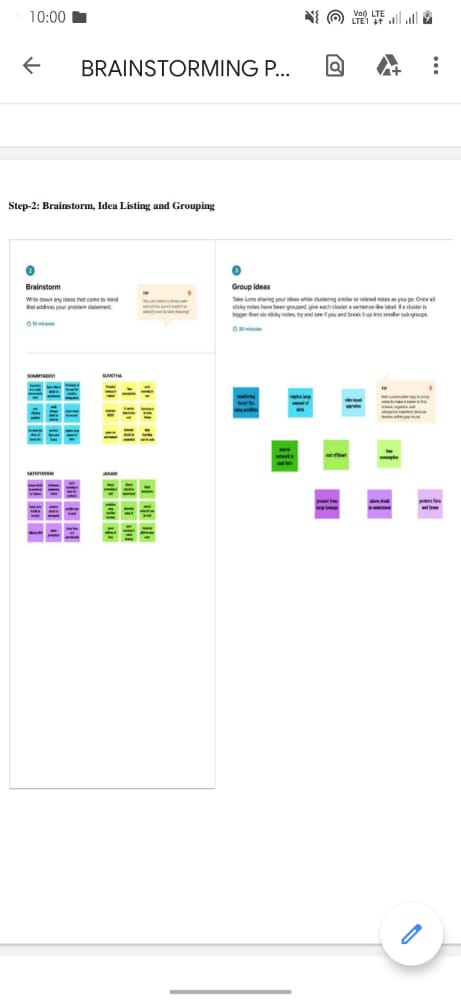
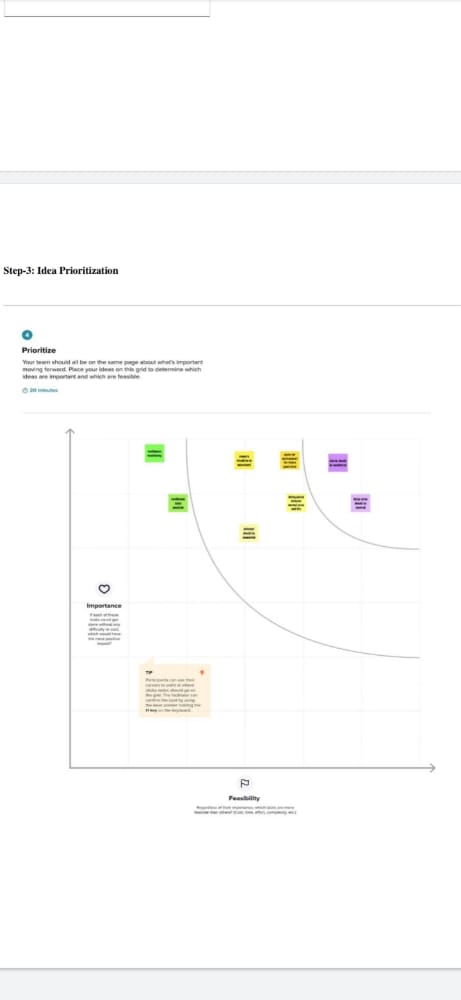
• An empathy map is a useful visualisation template that aids in the analysis of user and customer behaviour and emotions. Empathy maps not only identify behaviours but also point out potential channels for brands to interact with consumers more effectively.

• Data can be directly gathered from users using empathy maps. You can also ask a user to complete an empathy map themselves when combined with user interviews, survey responses, etc. This frequently reveals aspects of the user that may have gone unspoken or unconsidered.

• A category is included in each of the four quadrants to aid in our understanding of the user's perspective. The four empathy map quadrants examine the user's actions, thoughts, and feelings.



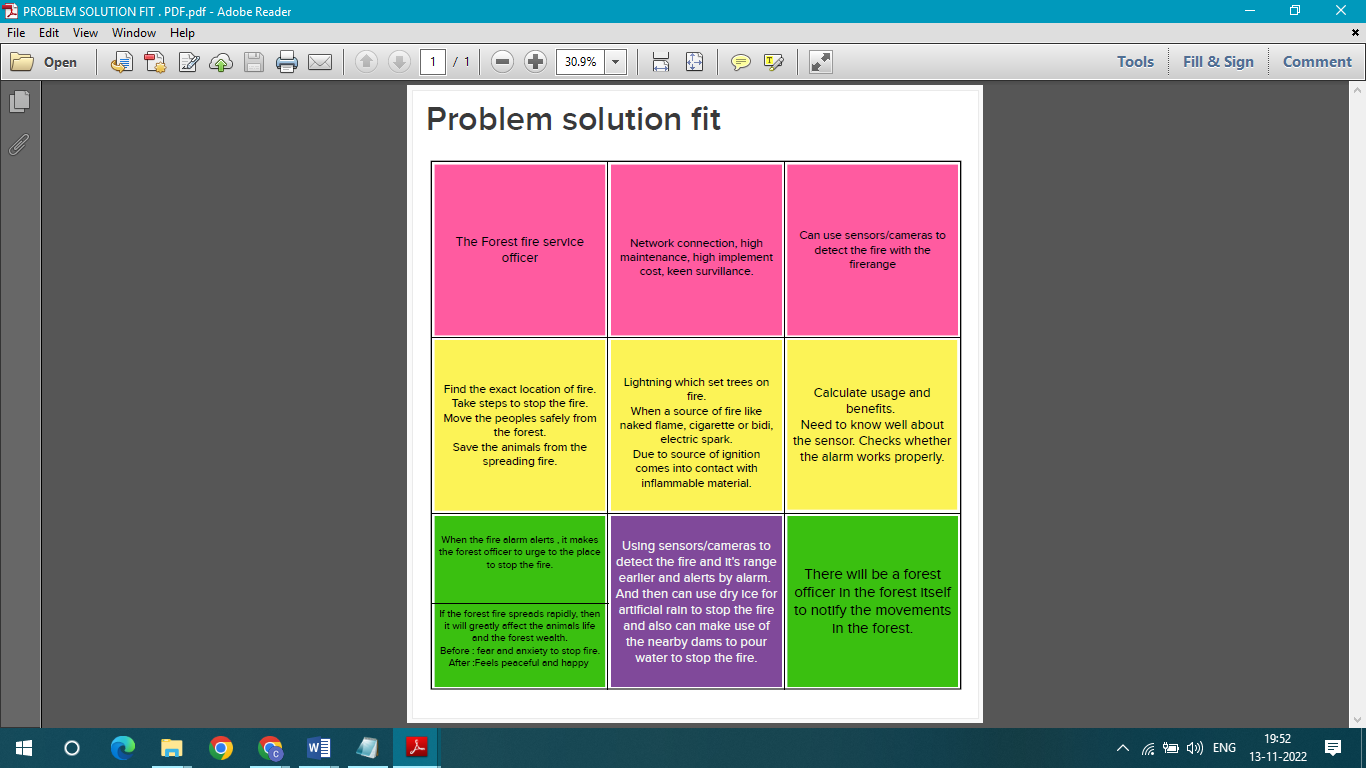
**3.2 Ideation and Brainstroming**

****

**3.3 Proposed solution**

|  |  |  |
| --- | --- | --- |
| **S** **.No.** | **Parameter** | **Description** |
| 1 | Problem Statement (Problem to be solved) | For many nations around the world, forest and urban fires  are major issues. Forest fires harm the economy, and the ecosystem, and put people in danger. In the United States, there areabout 100,000 wildfires per year. Dangerous flames have burned more than 9 million acresof land. |
| 2 | Idea / Solution description | It is even more challenging if the prediction is made using  ground-based techniques like a camera or video-based approaches. Due to theirdependability and effectiveness, satellites can be a valuable source of data both before and during the Fire. the many methods for predicting and detecting forest fires in real time, with the aim of informing the local fire authority. |
| 3 | Novelty / Uniqueness | Continuous monitoring, data gathering, and analysis. detect forest fires earlier before they spread to a large  area. |
| 4 | Social Impact / Customer Satisfaction | Instant detection of forest fires and sending an early  warning message to reduce the damage. it helps to save the lives of people, animals, and trees. |
| 5 | Business Model (Revenue Model) | Forest plays an important role in the economy.It is used  for commercial and medicine. |
| 6 | Scalability of the Solution | The development of a forest fire is influenced bya  number of factors. It is common knowledge that wind is one of the most important factors in determining how a forest fire spreads. It makes sense that the main direction a forestfire will spread will be determined by the meteorological wind speed. Smoke detection from  satellite and ground cameras is made possible by computer vision models. |

**3.4 Problem Solution Fit**



**4.REQUIREMENT ANALYSIS**

**4.1. FUNCTIONAL REQUIREMENT:**

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Functional Requirement (Epic)** | **Sub Requirement (Story / Sub-Task)** |
| FR-1 | User Registration | Registration through Form  Registration through Gmail |
| FR-2 | User Confirmation | Confirmation via Email  Confirmation via OTP |
| FR-3 | |  | | --- | | Accurate model | | |  | | --- | | The model gives accurate results for detection of forest fires. | |
| FR-4 | |  | | --- | | Good hardware | | |  | | --- | | To obtain high quality images to perform real time detection | |
| FR-5 | cloud   |  | | --- | |  | | We need cloud for storage and deploying the application   |  | | --- | |  | |
| FR-6 | Website   |  | | --- | |  | | |  | | --- | | Easy to use and navigate website that send alerts to authorities when forest fire is detected. | |

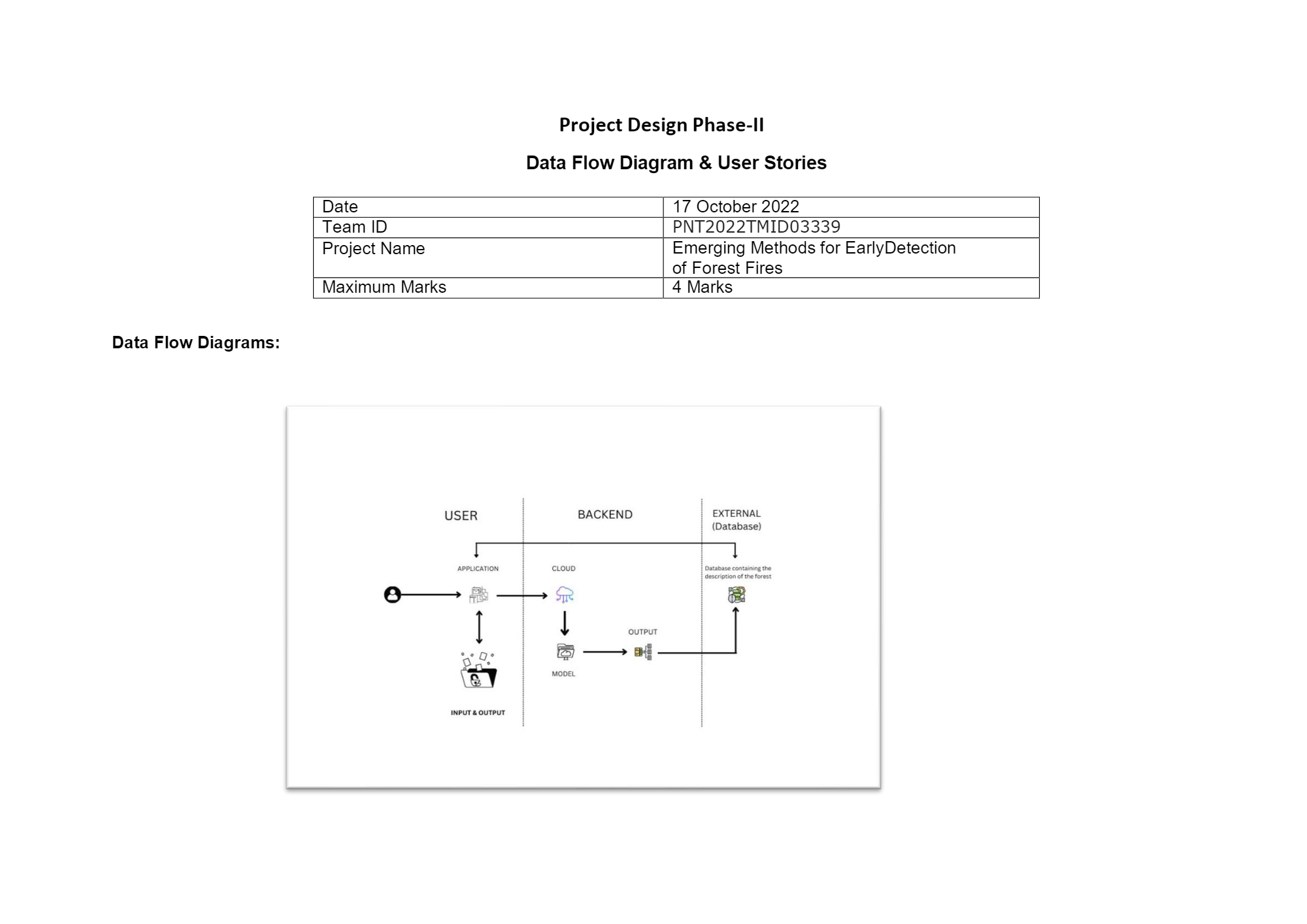
**4.2 Non-Functional requirements:**

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Non-Functional Requirement** | **Description** |
| NFR-1 | **Usability** | |  | | --- | | The interface will be easy to use and very user friendly and can be used by anyone. | |
| NFR-2 | **Security** | The application will be secure and safe to use.   |  | | --- | |  | |
| NFR-3 | **Reliability** | It will be taken care such that the application only produces highly accurate results and will accurately detect forest fires.   |  | | --- | |  | |
| NFR-4 | **Performance** | The model will perform detection in few seconds.   |  | | --- | |  | |
| NFR-5 | **Availability** | It will be available 24/7 will minimal downtime to continuously monitor   |  | | --- | |  | |
| NFR-6 | **Scalability** | The project is highly scalable and can be scaled up to monitor and detect forest fires in large forest or can also be scaled down to monitor and detect forest fires in particular areas alone |

**5.PROJECT DESIGN**

**5.1Data Flow Diagrams**

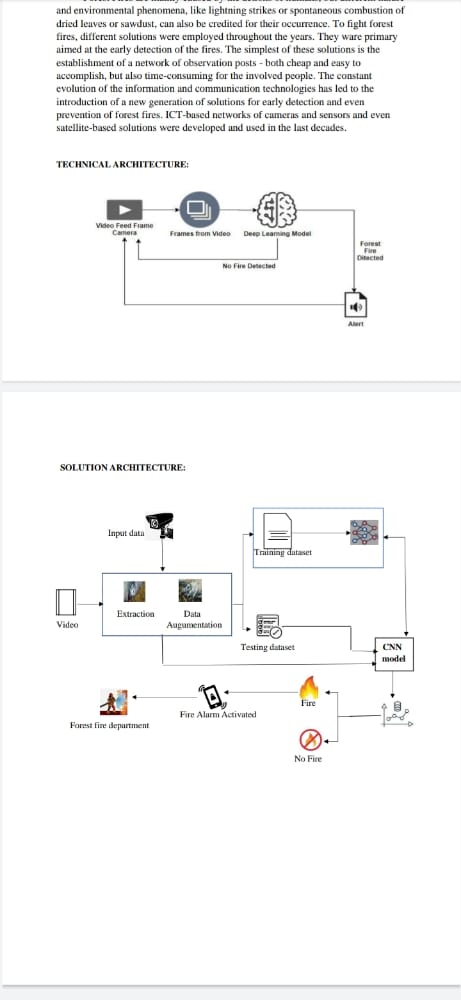
It is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically.

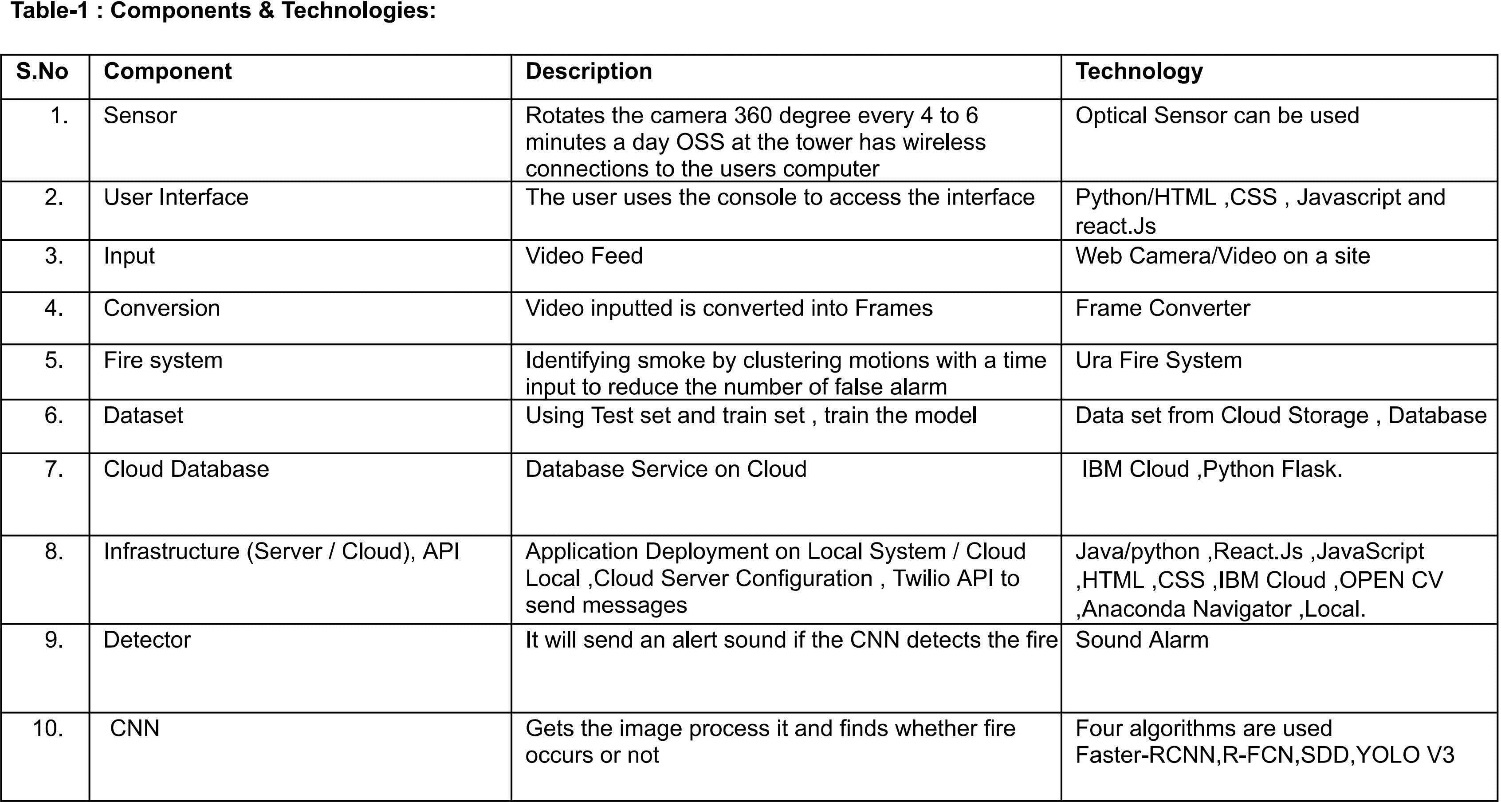
****

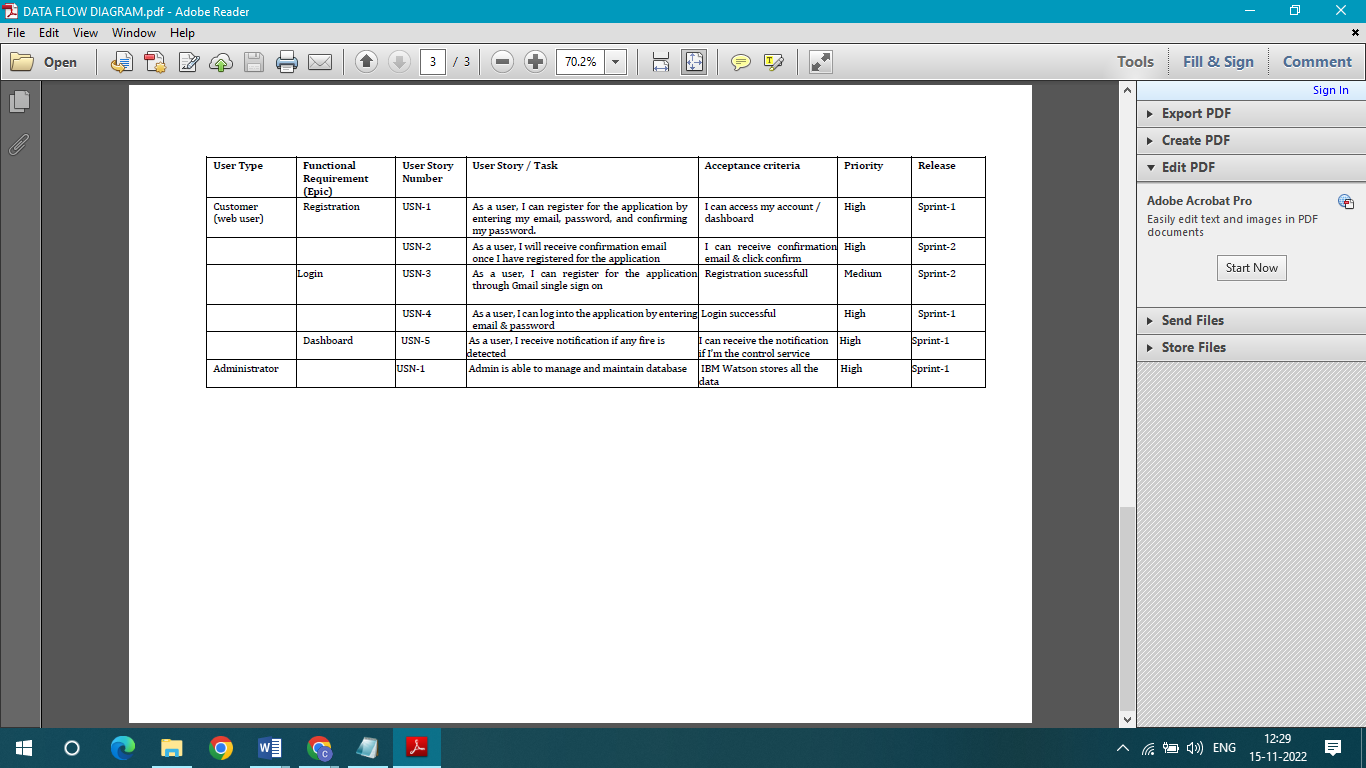
**5.2Solution & Technical Architecture:**

Solution architecture is a complex process – with many sub-processes that bridges the gap between business problems and technology solutions. Its goals are to:

* Find the best tech solution to solve existing business problems.
* Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
* Define features, development phases, and solution requirements.

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**5. 3 User Stories**

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**6.PROJECT PLANNING & SCHEDULING**

**6.1 Sprint Planning & Estimation**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Functional Requirements**  **(Epic)** | **User Story Number** | **User Story/Tasks** | **Story points** | **Priority** | **Team Members** |
| Sprint-1 | Image Processing | USN-1 | Processing the image to find the fire is detected or not | 1 | Medium | 1.Sowmyadevi  2.Suvetha  3.Sathiyavani  4.Janani |
| Sprint-1 |  | USN-2 | The output would have to give high accuracy | 2 | High | 1.Sowmyadevi  2.Suvetha  3.Sathiyavani  4.Janani |
| Sprint-2 | Video Processing | USN-3 | The drone videos will be split into frames to detect the fire | 3 | High | 1.Sowmyadevi  2.Suvetha  3.Sathiyavani  4.Janani |
| Sprint-3 | Alerting | USN-4 | After the fire is detected the alert message have to be sent. | 2 | High | 1.Sowmyadevi  2.Suvetha  3.Sathiyavani  4.Janani |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sprint-4 | Location Tracking | USN-5 | The exact location of the drone will be predicted and sent along with the alert message. | 2 | High | 1.Sowmyadevi  2.Suvetha  3.Sathiyavani  4.Janani |

# **6.2 Sprint Delivery Tracker**

# **Project Tracker, Velocity & Burndown Chart:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Total Story points** | **Duration** | **Sprint Start Date** | **Sprint End Date (Planned)** | **Story Points Completed(as on Planned End Date)** | **Sprint Release Date (Actual)** |
| Sprint-1 | 20 | 6 Days | 25 Oct 2022 | 30 Oct 2022 | 30 | 30 Oct 2022 |
| Sprint-2 | 20 | 6 Days | 01 Nov 2022 | 06 Nov 2022 | 20 | 06 Nov 2022 |
| Sprint-3 | 20 | 6 Days | 08 Nov 2022 | 13 Nov 2022 | 20 | 13 Nov 2022 |
| Sprint-4 | 20 | 6 Days | 15 Nov 2022 | 20 Nov 2022 | 20 | 20 Nov 2022 |

# **Velocity:**

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let’s now calculate the team’s average velocity (AV) per iteration unit (story points per day)

# AV=Sprint duration/Velocity

**=20/6=3**

**7. CODING & SOLUTIONING**

**7.1 Coding**

import keras

from matplotlib import pyplot as plt

from keras.preprocessing.image import ImageDataGenerator

#define the parameters

train=ImageDataGenerator(rescale=1./255,

                                 shear\_range=0.2,

                                 rotation\_range=180,

                                 zoom\_range=0.2,

                                 horizontal\_flip=True)

train = ImageDataGenerator(rescale=1/255)

test = ImageDataGenerator(rescale=1/255)

x\_train = train.flow\_from\_directory("/content/drive/MyDrive/forest fire/Dataset/Dataset/train\_set",

                                          target\_size=(64,64),

                                          batch\_size = 32,

                                          class\_mode = 'binary' )

x\_test = test.flow\_from\_directory("/content/drive/MyDrive/forest fire/Dataset/Dataset/test\_set",

                                          target\_size=(64,64),

                                          batch\_size = 32,

                                          class\_mode = 'binary' )

x\_test.class\_indices

x\_test.class\_indices

#to define the linear Initialisation import sequential

from keras.models import Sequential

#to add layers import Dense

from keras.layers import Dense

#to create Convolutional kernel import convolution2D

from keras.layers import Convolution2D

#import Maxpooling layer

from keras.layers import MaxPooling2D

#import flatten layer

from keras.layers import Flatten

import numpy as np

import warnings

warnings.filterwarnings('ignore')

model =Sequential()

model.add(Convolution2D(32,(3,3),input\_shape=(64,64,3),activation='relu'))

#add maxpooling layers

model.add(MaxPooling2D(pool\_size=(2,2)))

#add faltten layer

model.add(Flatten())

#add hidden layers

model.add(Dense(150,activation='relu'))

#add output layer

model.add(Dense(1,activation='sigmoid'))

model.compile(loss = 'binary\_crossentropy',

              optimizer = "adam",

              metrics = ["accuracy"])

model.fit\_generator(x\_train,steps\_per\_epoch=14,epochs=5,validation\_data=x\_test,validation\_steps=20)

model.save("forest1.h5")

predictions = model.predict(x\_test)

predictions = np.round(predictions)

predictions

print(len(predictions))

#import load\_model from keras.model

from keras.models import load\_model

#import image class from keras

import tensorflow as tf

from tensorflow.keras.preprocessing import image

#import numpy

import numpy as np

#import cv2

#load the saved model

model = load\_model("forest1.h5")

def predictImage(filename):

  img1 = image.load\_img(filename,target\_size=(64,64))

  Y = image.img\_to\_array(img1)

  X = np.expand\_dims(Y,axis=0)

  val = model.predict(X)

  print(val)

  if val == 1:

    print(" fire")

  elif val == 0:

      print("no fire")

predictImage("/content/drive/MyDrive/forest fire/Dataset/Dataset/test\_set/with fire/FORESTFIRE (1).jpg")

pip install twilio

pip install playsound

#import opencv librariy

#import cv2

#import numpy

import numpy as np

#import image function from keras

from keras.preprocessing import image

#import load\_model from keras

from keras.models import load\_model

#import client from twilio API

from twilio.rest import Client

#imort playsound package

from playsound import playsound

#load the saved model

model = load\_model(r'forest1.h5')

#define the features

name = ['forest','with forest']

account\_sid='ACcd50918435afdf4a48f0b5b00c086b25'

auth\_token='5ca3f7bf591627441cefd46af0a4e746'

client=Client(account\_sid,auth\_token)

message=client.messages \

.create(

    body='forest fire is detected,stay alert',

#use twilio free number

    from\_='+14635832381',

#to number

    to='+919025868474')

print(message.sid)

pip install pygobjectdef message(val):

  if val==1:

    from twilio.rest import Client

    print('Forest fire')

    account\_sid='ACcd50918435afdf4a48f0b5b00c086b25'

    auth\_token='5ca3f7bf591627441cefd46af0a4e746'

    client=Client(account\_sid,auth\_token)

    message=client.messages \

     .create(

        body='forest fire is detected, stay alert',

        #use twilio free number

        from\_='+14635832381',

        #to number

        to='+919025868474')

    print(message.sid)

    print("Fire detected")

    print("SMS Sent!")

  elif val==0:

    print('No Fire')

from matplotlib import pyplot as plt

#import load model from keras.model

from keras.models import load\_model

#import image from keras

from tensorflow.keras.preprocessing import image

img1 = image.load\_img('/content/drive/MyDrive/forest fire/Dataset/Dataset/test\_set/with fire/19464620\_401.jpg',target\_size=(64,64))

Y = image.img\_to\_array(img1)

x = np.expand\_dims(Y,axis=0)

val = model.predict(x)

plt.imshow(img1)

plt.show()

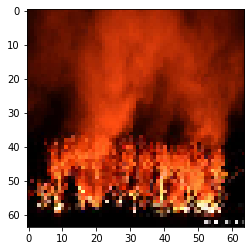
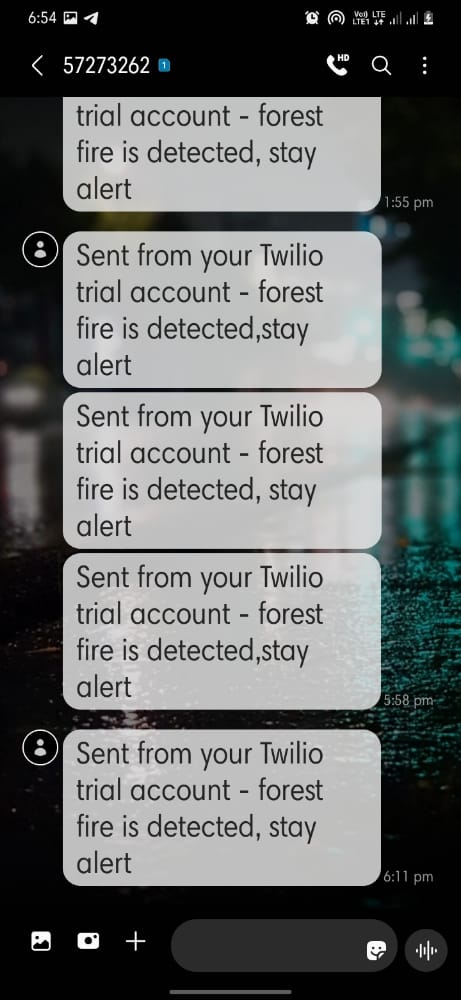
message(val)

**8.TESTING & RESULT**

Test cases help guide the tester through a sequence of steps to validate whether

a software application is free of bugs, and working as required by the end-user. Learning how to write test cases for software requires basic writing skills, an attention to detail, and a good understanding of the application under test (AUT).

**8.1 Performance metrics**

****

**9.ADVANTAGES & DISADVANTAGES**

**9.1 Advantages:**

* Avoid Smoke Inhalation. The most important reason is perhaps the only one you really need.
* Early Detection. The earlier a fire is detected, the faster it will be that firefighters will respond.

**9.2 Disadvantages:**

* 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 business owners to always remember to keep the batteries fresh so the system operates properly when you need it most.

**10.CONCLUSION**

This project will help in early detection of forest ﬁre and the prevention. It also involves the risk factor of analyzing the drone images of affected areas using machine learning algorithm which overcomes the existing project. This system detects the ﬁre conditions in a short time before any ﬁre accidents spreads over the forest area. The scope of using video frames in the detection of ﬁre using machine learning is challenging as well as innovative. If this system with less error rate can be implemented at a large scale like in big factories, houses, forests, it is possible to prevent damage and loss due to random ﬁre accidents by making use of the Surveillance System.

**11.APPENDIX**

**Github Link :**

[**https://github.com/IBM-EPBL/IBM-Project-15916-1659606147**](https://github.com/IBM-EPBL/IBM-Project-15916-1659606147)

**Demo Link:**

<https://photos.app.goo.gl/jUTqypCYH6WLcMQR8>