EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

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NALAIYA THIRAN
PROJECTBASED LEARNING ON
PROFESSIONAL READLINESS
FOR INNOVATION,
EMPLOYNMENT AND
ENTERPRENEURSHIP

A PROJECT REPORT

Submitted

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PROJECT REPORT

1. INTRODUCTION

1.1 Project overview:

In this busy society, fire can pose serious risks. Due to the increased frequency of fire occurrences, fire prevention and fire protection systems are installed in all buildings and vehicles used for public transportation. Additionally, many businesses run simulated fire drills once a month to protect their staff against fires. They would gain a better understanding of what to do and what not to do in the event of a fire thanks to this. One of the key elements in keeping the ecological in balance is forests. When a fire breaks out in a forest, it can be very dangerous. However, a forest fire is typically discovered after it has spread across a significant area. It might not always be able to put out the fire.
According to a study, there are three categories of automatic fire detection: airborne, ground, and borne detection. The ground-based devices use a number of stationary black-and-white video cameras to identify smoke from fires and compare it to ambient smoke. High spatial and temporal resolution is the key advantage of this system. such that it is simpler to identify. 2 However, there are still some issues with these methods in terms of spotting a fire in its early stages. Therefore, it is crucial to implement a system to identify fires as soon as possible.
Additionally, knowing where the hearth is located is essential for the quick deployment of fire fighters. Early detection, primary containment, and extinguishment of a fireplace before it spreads are therefore essential for wildfire management.

1.2Purpose

Recent forest fires have destroyed both the natural biological system, biodiversity, and the woodland economy. An important factor in the decline of Indian forests is an increase in the number of fires due to a rising population and changes in the global climate. According to an Indian woodland study report, 50% of the country's backwoods regions are fire-prone (the percentage rises to 90% in other locations). Approximately 6% of the forest is predisposed to severe fire damage. This planned structure was created to build a reliable fire placement system to track the backcountry temperature dynamically under certain circumstances. It involves using sensors and a dynamic checking system to prevent a major fire and actual damage to the woods.

2. LITERATURE SURVEY

2.1Existing problem

Smoke alarms and heat alarms are being used to detect fires. One module is not enough to monitor all of the potential hot spots for fires, which is the fundamental drawback of smoke sensor alarms and heat sensor alarms. Being vigilant at the time is the only way to avoid a fire. Even if they are put in every corner and cranny corner, it simply isn't enough to continuously produce an efficient result. 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 key problem is reducing inaccuracy in fire detection and issuing notifications at the appropriate time.

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 technologies can aid in preventing disastrous incidents 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 a vast area that creates more carbon monoxide than regular vehicle traffic. Monitoring high-risk locations and early fire detection can significantly reduce reaction times, as well as the amount of potential damage and firefighting costs.

This situation fits a well-known rule: One cup of water in one minute, 100 litres in two minutes, and 1,000 litres in ten minutes. The objective is to locate the fireplace as quickly as possible, identify its actual location, and alert the fire apparatus as soon as feasible. The flammable texture may also supply fuel to the hearth focal point when a fire starts. At that time, the location will get larger. The beginning stage is related to "stage of a surface fire This could consume nearby shrubs, causing the fire to grow larger and evolve into "crownfire‟. In general, at this point, the earth turns into a dangerous place with severe injury that, depending on the terrain and the atmosphere, may last for a considerable amount of time. Utilizing solar-powered ZigBee wireless sensor networks for forest fire detection - In this paper, a method for detecting forest fires has been devised that addresses the drawbacks of earlier approaches. With its promising outcomes, it is certain that the system devised can be applied on a large scale. The system is equipped with low-power components, more recent Zigbee versions, and a Maximum Power Point Tracking Algorithm to enable longer-lasting and more effective operation. In many nations, forest fires are a very serious problem, and global warming may make them worse. Experts concur that it is essential to invest in new technology and equipment that enable a diverse approach in order to avoid similar tragedies from occurring. In this study, a WSN for early forest fire detection is described. This network is simply deployable in high-risk or special-interest locations. From the standpoint of the physical structure, there are two different types of nodes: SNs, which collect data from the environment, and CNs, which collect data from SNs and transfer the information to a Control Center. The nodes may also operate in various modes. This permits accurate and seamless network configuration, offers redundancy, and guarantees complete temporal and geographic coverage in the deployment zone. In order to make the most of the WSN, the information acquired is relevant for both early detection and environmental monitoring. This environmental data can also be used for fire prevention tasks like vegetation modeling, microclimate research, and parametrization of propagation models.

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Characteristics	Flaming	Smoldering
Emissions	Light gases Particles high in EC	Hydrocarbons, PAH's, mercaptans, partially oxidized gases, particles lower in EC
Flames	visible	not visible
Extent of reaction (combustion efficiency)	Reactions tend to go to completion (90-95%)	Incomplete combustion reactio (60-90%)
O_2 concentrations	>= 15%	>= 5%
Temperature	>300°C (peak of 1800°K)	< 300°C
Combustion efficiency [1]	About 90-95%	About 60-90%

TABLE 1. Comparison of different techniques

A forest fire detection algorithm is suggested in this study. The algorithm employs the YCbCr colour space because it successfully separates luminance from chrominance and can distinguish between pixels with high temperature fire in the centre since the fire there is white. The final results demonstrate that the suggested system has strong detection rates and fewer false alarms—two key issues with the majority of existing algorithms. Semantic events serve as indicators of the existence of fire in video streams. The majority of the solutions currently in use can only be used for videos taken with stationary cameras and videos taken under regulated lighting circumstances. Video cannot be used with the already installed automatic fire detection systems.

streams acquired from handheld devices, such smartphones. It was hailed as an international catastrophe. Farmers started the fires, which tore through villages, destroyed ecosystems, and released pollution that warmed the atmosphere..

2.2References

1. Abdullah S, Bertalan S, Coskun A, Kale I (2017) A wireless sensor network for early forest fire detection and monitoring as a decision factor in the context of a complex integrated emergency response system. IEEE Workshop on

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2. 2. Alkhatib AAA (2014) A Review on Forest Fire Detection Techniques. International Journal of Distributed Sensor Networks, IEEE, pp. 521. Bolourchi P, Uysal S (2013) Forest Fire Detection in Wireless Sensor Network Using Fuzzy Logic. 5th International Conference on Computational Intelligence, Communication Systems and Networks, Madrid, pp. 83-87.

3. Bouabdellaha K, Noureddine H, Larbi S (2013) Using Wireless Sensor Networks for Reliable Forest Fires Detection. Laboratory of Industrial Computing and Networking, Faculty of Sciences, Oran University. The 3rd Internationa conference on Sustainable Energy Information Technology, pp. 794 – 801.

4.Cantuña JG, Bastidas D, Solorzano S, Clairand J-M (2017) Design and implementation of a Wireless Sensor Network to detect forest fires. Fourth International Conference on eDemocracy & eGovernment (ICEDEG), IEEE.

5.Diaz-Ramireza A, Tafoyaa LA, Atempaa JA, Mejia-Alvarez P (2012) Wireless Sensor Networks and Fusion Information Methods for Forest Fire Detection. Iberoamerican Conference on Electronics Engineering and Computer Science, Elsevier, Procedia technology 3: 69-79.

7. Douglass R (2010) Quantification of the health impacts associated with fin particulate matter due to wildfires. Nicholas School of the Environment and Earth Sciences of DukeUniversity.

8. Huh Y, Lee JK (2017) Enhanced contextual forest fire detection with prediction interval analysis of surface temperature using vegetation amount. International journal of Remote Sensing, Taylor & Francis, pp. 3375- 3393.

2.3. Problem Statement Definition

Inearliertimesfiresweredetectedwiththehelpofwatchingtowersorusingsatelliteimages. Satellites gather imagesandtransmit them to the monitoring agency, which uses the photographs to determine whether or not there is a fire. However, this strategy was quite slow because the fire may have spread quickly and caused significant damage before the rescue squad arrived In the watching tower system, a man was stationed atop the tower at all times to watch the area and report any fires.

This method was also cumbersome because a man had to always be present and the fire might have already spread deep inside the forest by the time he learned about it.

Because some regions, especially forest areas, are so big, it is nearly difficult to station a person in every corner of the forest from a vantage point from which to monitor the forest area.
In order to minimise the impact of fire, both these approaches—watching towers and satellite images—failed to detect fire as soon as possible.

Cablewasmainlyofcopper. But copper cable could be expensive or it might have a mid-section defect. Consequently, wireless sensor networks were used to solve this issue.
As a result, researchers have discovered an effective way to detect forest fire using a wireless sensor network thanks to technological advancements.

By conveying sensor hubs in timberland regions, which illuminate about fire, fire can be discovered. Conveying sensor hubs in timberland regions entails planting sensors in every section of the forest, primarily in high-risk locations where they are more likely to catch fire. Now that wireless sensor networks are being used, it is simple to find a fire in a big region as quickly as feasible.
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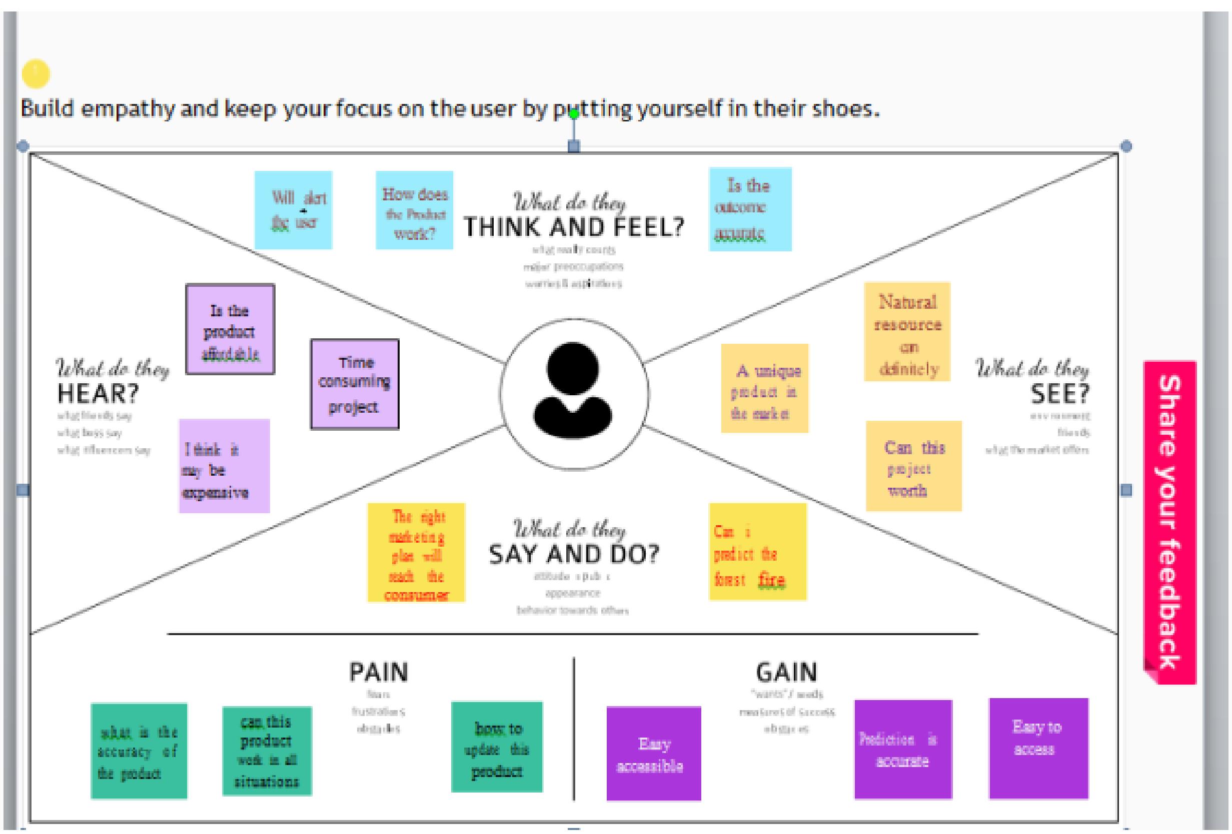
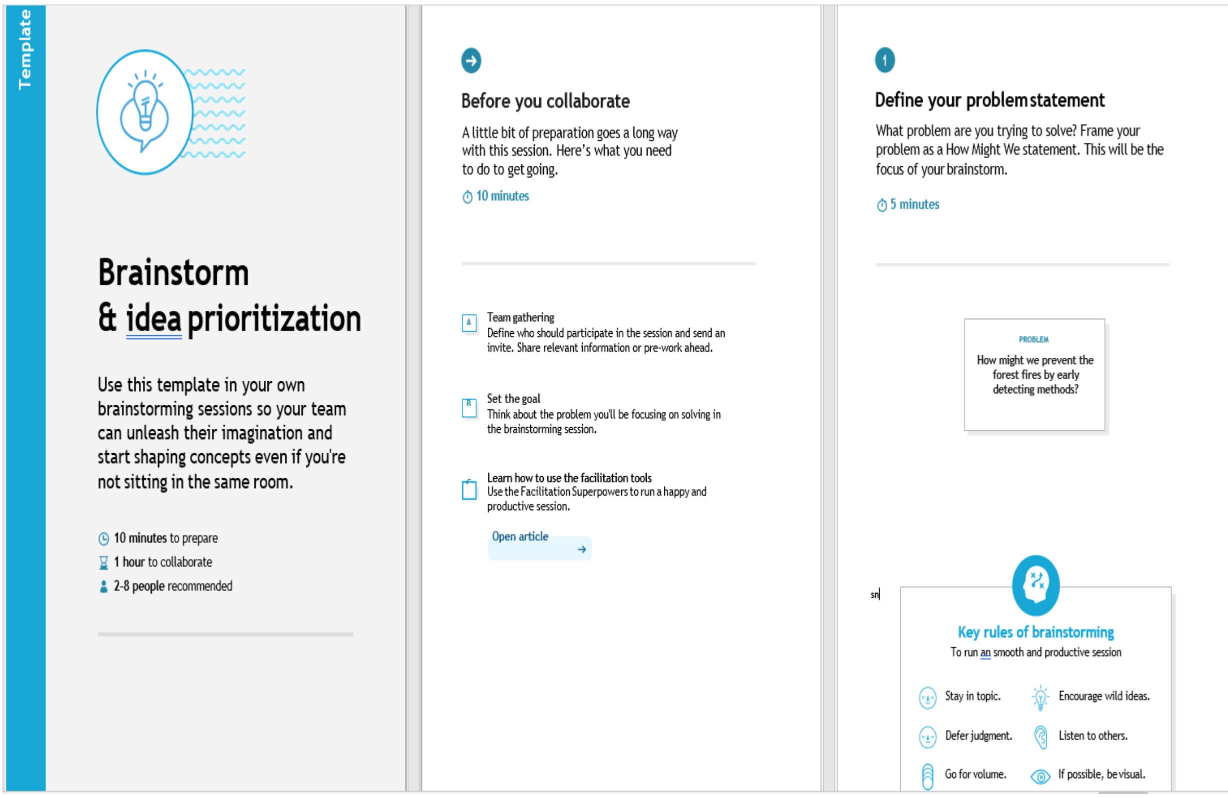
3.IDEATION & PROPOSED SOLUTION

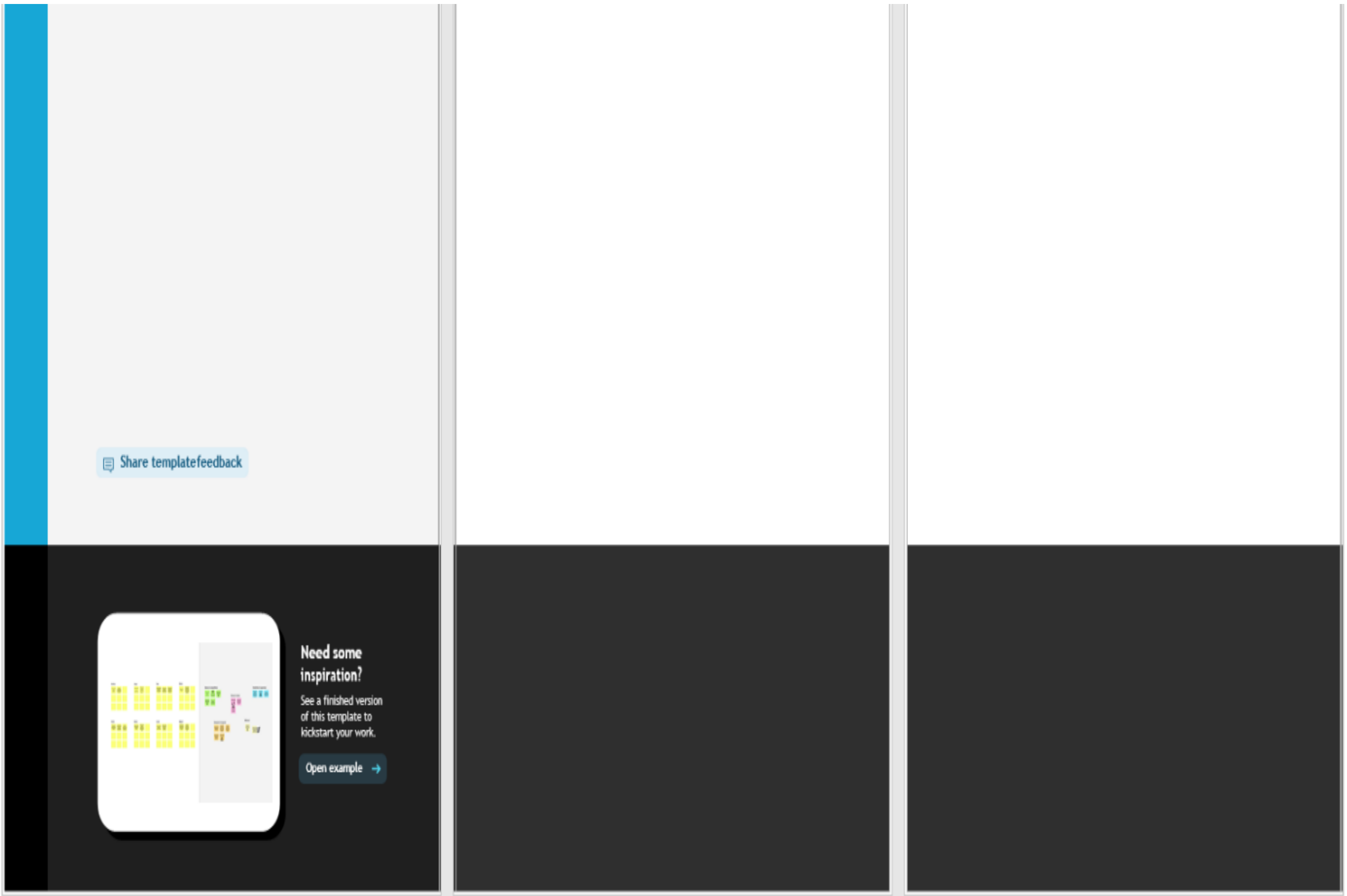
3.1 Empathy Map Canvas

1. An empathy map is a collaborative tool teams can use to gain adeeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agilecommunity.
2. An empathy map is an effective visualization template that helps analyze the behavior and emotions of customers and users. Empathy maps not only detect the behaviors but highlight possible mediums for brands to communicate with their customers ina betterway
3. Empathy maps can also be used to collect data directly from the users. Used alongside user interviews, survey answers, etc., you can also have a user fill inan empathy map themselves. This often reveals aspects of the user that may have remained unsaid or not thoughtof.
4. Each of the four quadrants comprises a category that helps usdelve into the mind of the user. The four empathy map quadrants look at what the user says,thinks, feels, anddoes.



Ideation &Brainstorming




Share template feedback
Need some inspiration?
See a finished version of this template to kickstart your work.
Open example


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!
Nalina
Detect by smoke
Detects by climate changes
Detects intentional acts of arson
Powerful CCTV and HD cameras are used
Yamunadevi
Detects by flame
Detects any electrical shortage that can cause fire
IR flame detectors are used
Regularly removes dry leaves
Jayasakthi
Detects by spark
Detects spark due to lightning
Install and maintain the smoke alarms
By satellite monitoring
Santhanalakshmi
Detects by temperature regularly
detects the forest fire using CO2
Checks the humidity level
Monitors 24/7

3

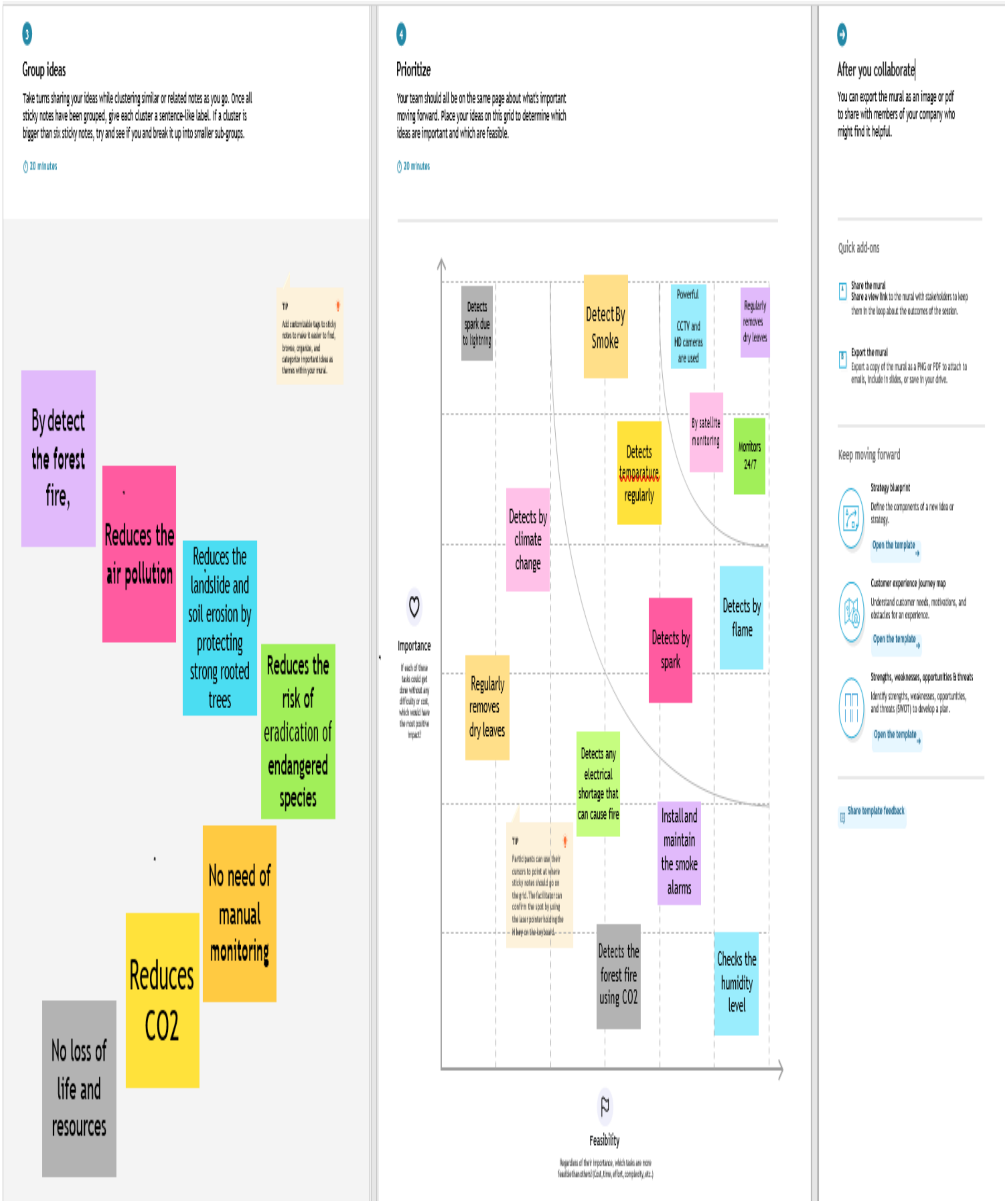
Group ideas

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

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.



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
By detect the forest fire,
Reduces the air pollution
Reduces the landslide and soil erosion by protecting strong rooted trees
Reduces the risk of eradication of endangered species
No need of manual monitoring
Reduces CO2
No loss of life and resources
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
Detects spark due to lightning
Detect By Smoke
Powerful CCTV and HD cameras are used
Regularly removes dry leaves
By satellite monitoring
Detects temparature regularly
Monitors 24/7
Detects by climate change
Detects by flame
Detects by spark
Regularly removes dry leaves
Detects any electrical shortage that can cause fire
Install and maintain the smoke alarms
Detects the forest fire using CO2
Checks the humidity level
Importance
Feasibility
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
Share the mural
Export the mural
Keep moving forward
Strategy blueprint
Open the template
Customer experience journey map
Open the template
Strengths, weaknesses, opportunities & threats
Open the template
Share template feedback

.2ProposedSolution

Project team shall fill the following information in proposed solution template.

	Parameter	Description
	Problem Statement (Problem to be solved)	A support vector machine-based system for predicting the risk of forest fires is provided. The system uses historical weather data to forecast
	Idea / Solution description	Based on the still images or the video input from the drone cameras, use computer vision techniques for the recognition and detection of smoke or fire.
	Novelty / Uniqueness	An early detection of a forest fire by a real-time computer programme prevents it from spreading to a larger area
	Impact on society	Destroyed homes and businesses, cut electricity, mobile and land telephone lines, and blocked roads and railway lines.
	Business Model (Revenue Model)	Python programming was used to accomplish the suggested technique on a Core i3 processor or higher (CPU and 4GB RAM.)
	Scalability of the Solution	Smoke detection from satellite and ground cameras is made possible by computer vision models.

3.2 Problem Solutionfit

ProjectTitle: EMERGING METHODS FOR EARLY FOREST FIRE DETECTION

Project Design Phase-I - SolutionFitTemplate

Team ID:PNT2022TMID12327

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer?
i.e. working parents of 0-5 y.o. kids

Forest officer
Regular citizens

6. CUSTOMER CONSTRAINTS CC

What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.

Satellites make it possible to identify and keep an eye on a variety of flames, providing information that would not otherwise be available regarding their location, size, temperature, and power production. Additionally important for viewing and tracking fire smoke is satellite data..

5. AVAILABLE SOLUTIONS AS

Stay away from burning trash near dry grass.
Respect local regulations regulating campfires and other open fires and have firefighting equipment close at hand.
Make use of fireproof roofing materials. perform routine technical inspections. monitoring thermal abnormalities, monitoring weather analytics keeping an eye on temperature increases and water stress.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

For the discovery, monitoring, control, and assessment of forestfire damage, satellite remote sensing is a useful tool. Active fires can be located during a fire occurrence by observing the heat, light, and smoke plumes they produce.This application uses real-time satellite data to identify forest fires, monitor them (by delivering notifications to mobile devices), and analyse their behaviour..

9. PROBLEM ROOT CAUSE RC

What is the real reason that this problem exists?
What is the back story behind the need to do this job?
i.e. customers have to do it because of the change in regulations.

Loss of wildlife habitat, extinction of plants and animals, destruction of the nutrient-rich top soil, reduction in forest cover, loss of valuable timber resources, ozone layer depletion, loss of livelihood for tribal people and the poor, and an increase in global warming are just a few of the harms caused by forest fires.

7. BEHAVIOUR BE

What does your customer do to address the problem and get the job done?
i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

When people known Nothing about forest fires

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TR

Manmadefiresarecausedbyunattendedcampfires,burningdebris,equipmentuseandfailure,carelesslydiscardedcigarettes,andintentionalarson.

4. EMOTIONS: BEFORE/AFTER EM

Before : unsafe and worries about lives and belongings

After : safety and relief

10.YOURSOLUTION SL

Inthisissue,imageprocessingandvideoanalyticscanbeusedtodetectfiresearlythroughsatelliteimagingandpreventthemfromspreadingwithinforests.ThismodelisprimarilybuiltusingCNNandmachinelearninganddeeplearning.

8.CHANNELSofBEHAVIOUR CH

ONLINE: FIRE ALERT SENSOR

OFFLINE: Fire awareness program

Identify strong TR & EM

4.REQUIREMENTANALYSIS

4.1 FunctionalRequirements

4.1.1.HighPriority

1. The system shall take training sets of fire images and recognize whether there is a fire or the
2. beginning of a fire (smoke) or if there is no fire
3. The system shall send a notification to the admin when it recognizes a fire in the image given

3.The system shall take real inputs of camera images and determine whether the image contains a fire

4.The system shall be able to take images with a variety of sizes and convert it to one fixed image to be used throughout the application.

5.The system shall run as a service on either a Windows or Linux operating system.

In the event that the computer on which the system is running shuts down, the system service should start automatically when the computer restarts

4.1.2.MediumPriority

1. The system shall provide following facility that will allow web pages that the user is permitted
2. to access. The system must support the following facility:
   a. Send alert message
   b. Customer data management

4.1.3.LowPriority

1. The system shall allow the user's status to be stored for the next time he returns to the web site.
2. This will save the user x minutes per visit by not having to reenter already supplied data.
3. The system shall provide information about event log of forest.

4.2 Non FunctionalRequirements

4. Non-FunctionalObjectives

4.2.1.Reliability

- Thesystemshallbecompletelyoperationalatleastx%ofthetime.
- Downtimeafterafailureshallnotexceedxhours.

4.2.2.Usability

- Customershouldbeabletousethesysteminhisjobforxdays.
- Auserwhoalreadyknowswhatcameraheisusingshouldbeabletoconnectandview thatpageinxseconds.

4.2.3.Performance

- Thesystemshouldbeabletosupportxsimultaneoususers.
- Themeantimetoviewawebpageovera56Kbpsmodemconnectionshallnotexceedx seconds..

4.2.4.Security

- Thesystemshallprovidepasswordprotectedaccesstowebpagesthataretobeviewed only byusers.

4.2.5.Supportability

- Thesystemshouldbeabletoaccommodatemanycameralinks.
- Thesystemwebsiteshallbeviewablefromchromeoranybrowser.

4.2.6.Interfaces

The system must interface with

- Thecloudantdbforcustomerandcustomerloginformation
- Theacquiredwebsitesearchengine.

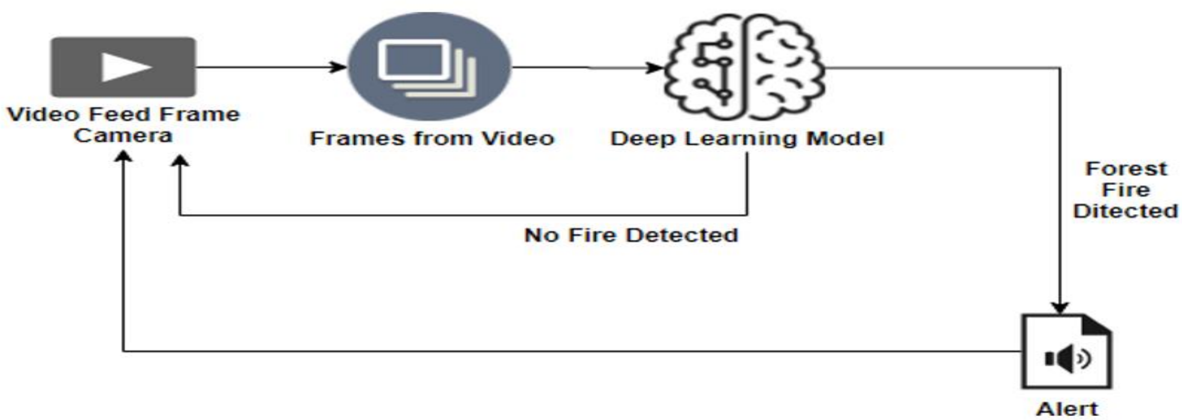
5.PROJECTDESIGN

5.1. Data FlowDiagrams

A Data Flow Diagram (DFD) 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. It shows how data enters and leaves the system, what changes the information, and where data is stored. Example:

FLOW

- It is difficult to predict and detect Forest Fire in a sparsely populated forest area.
- It is more difficult if the prediction is done using ground-based methods like Camera.



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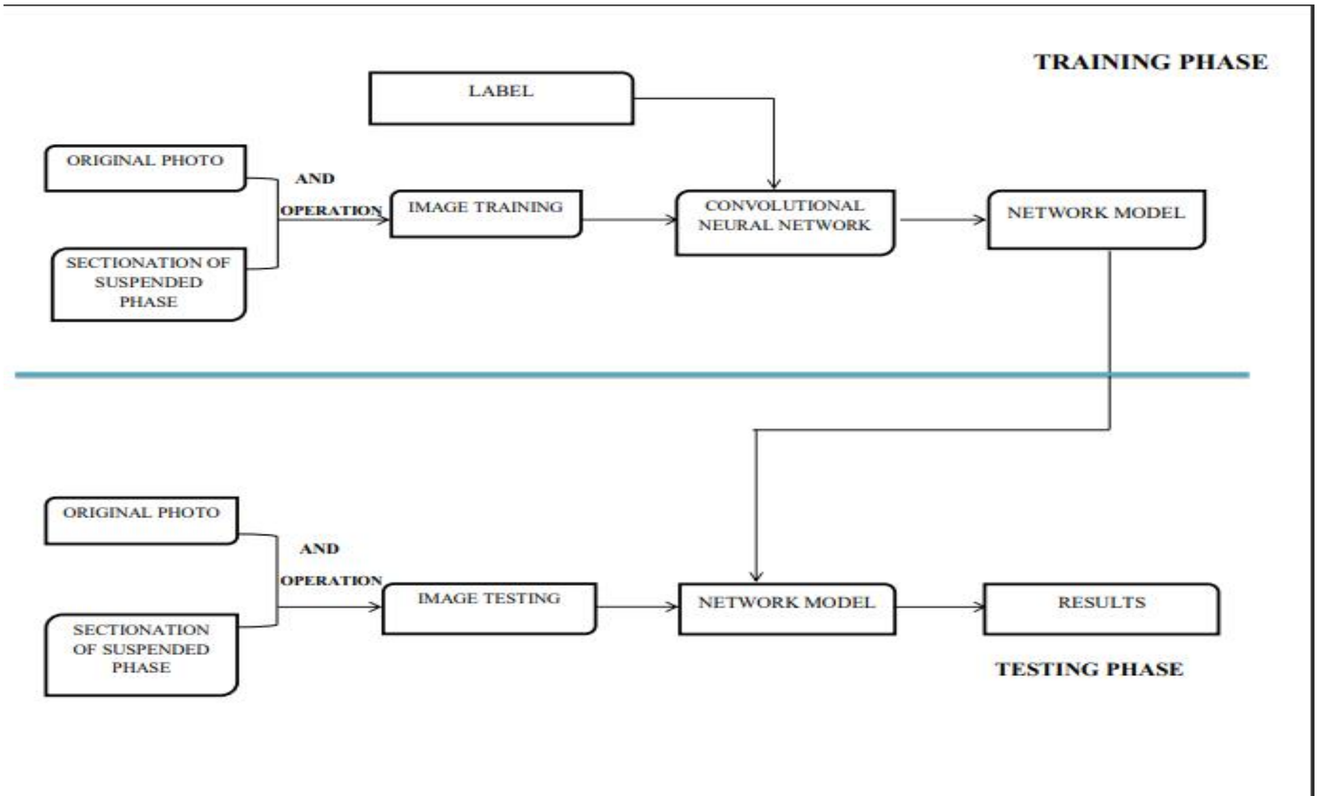
- Satellites can be an important source of data prior to and also during the Fire due to its reliability and efficiency.
- The various real-time forest fire detection and prediction approaches, with the goal of informing the local fire authorities.
- If the fire is not detected ,it will send the result to the frame camera.if the forest fire will detected the alert will go to the video feed frame camera.

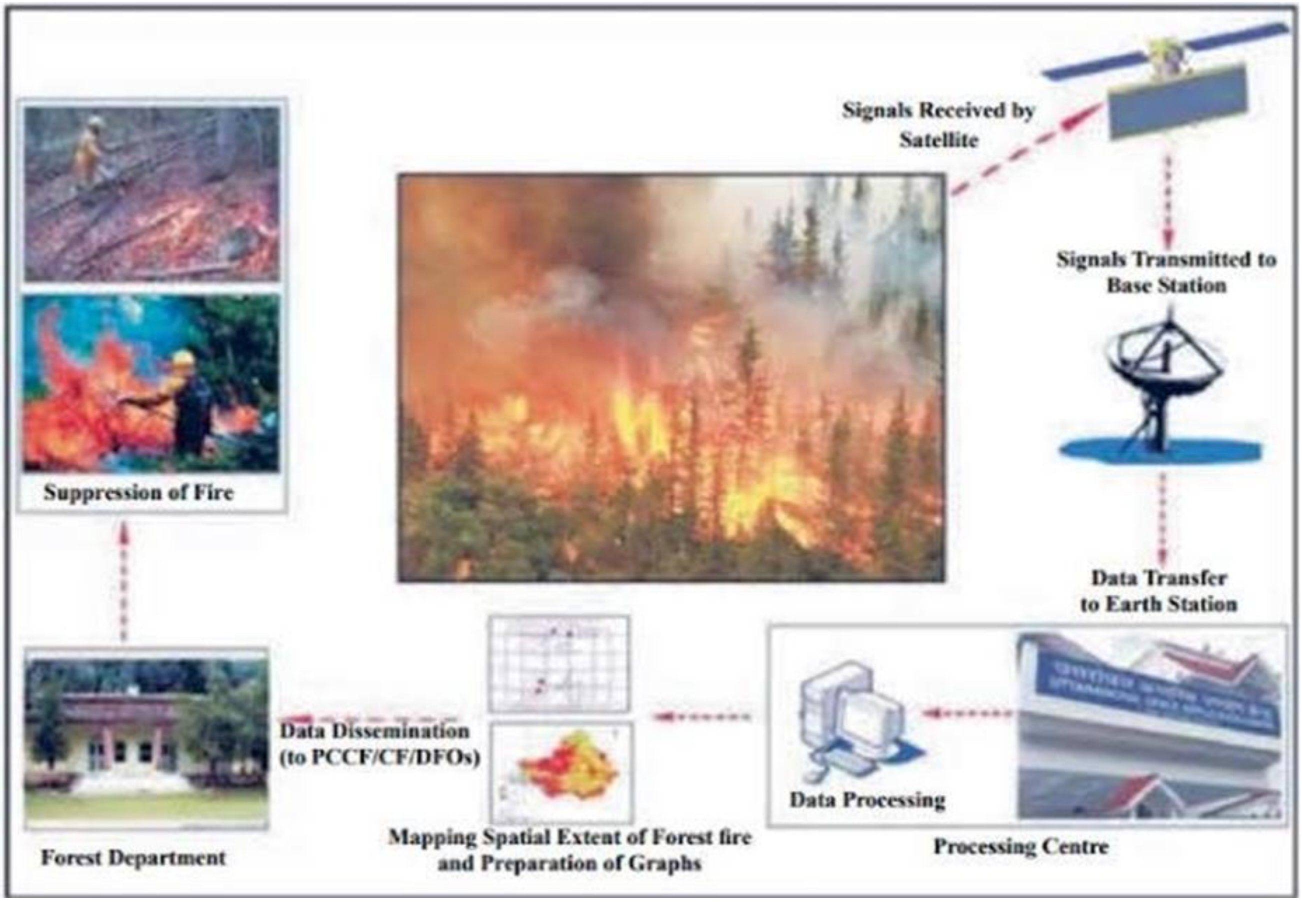


5.2.Solution & TechnicalArchitecture

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 businessproblems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solutionrequirements.
- Provide specifications according to which the solution is defined, managed, anddelivered.

5.3. UserStories



5.3 UserStories

Use the below template to list all the user stories for the product

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Environmentalist	Collect the data	USN-1	As an environmentalist, you must gather information about the forest's temperature, humidity, wind, and rainfall.	The relevant data must be gathered in order to avoid having the prediction be incorrect.	High	Sprint-1
		USN-2	Identify potential prediction-based algorithms.	To gather the algorithms and determine each algorithm's accuracy level	Medium	Sprint-2
		USN-3	Determine each algorithm's accuracy	Each algorithm's calculated accuracy, making it simple to obtain the most accurate output	High	Sprint-2
		USN-4	Review the Dataset.	Information is assessed before processing.	Medium	Sprint-1
		USN-5	Determine the precision, accuracy, and recall of each algorithm.	These settings are crucial for getting the desired result.	High	Sprint-3
		USN-6	Each algorithm generates outputs.	It is widely used to foresee effects and take preventative steps..	High	Sprint-4

6. PROJECT PLANNING &SCHEDULING

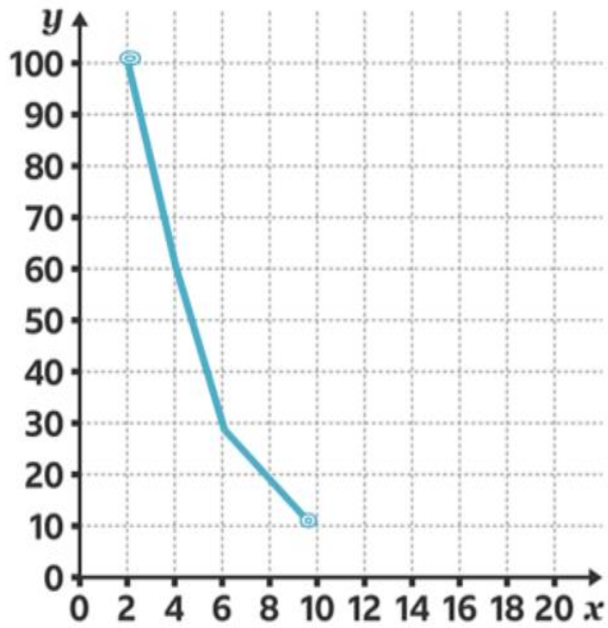
6.`Sprint DeliverySchedule

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	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Sprint deleviery plan

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodolog as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



6.3 Reports fromJIRA

JIRA has categorized reports in four levels, which are −

1.6.1. Agile
1.6.2. Issue Analysis
1.6.3. Forecast & Management
1.6.4. Others

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

1. Feature 1

```
!pip install tensorflow
!pip install opencv-python
!pip install opencv-contrib-python
import tensorflow as tf
import numpy as np
from tensorflow import keras
import os
import cv2
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.preprocessing import image
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)
train_dataset = train.flow_from_directory("/content/drive/MyDrive/Dataset/
train_set",
                                           target_size=(128,128),
                                           batch_size = 32,
                                           class_mode = 'binary' )
test_dataset = test.flow_from_directory("/content/drive/MyDrive/Dataset/te
st_set",
                                           target_size=(128,128),
                                           batch_size = 32,
                                           class_mode = 'binary' )
test_dataset.class_indices
#to define linear initialisation import sequential
from keras.models import Sequential
#to add layer import Dense
from keras.layers import Dense
#to create convolution 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 warnings
warnings.filterwarnings('ignore')
model =Sequential()
#add convolutional layer
```

```
model.add(Convolution2D(32,(3,3),input_shape=(128,128,3),activation='relu'
))
#add maxpooling layer
model.add(MaxPooling2D(pool_size=(2,2)))
#add flatten layer
model.add(Flatten())
model.add(Dense(150,activation='relu'))

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=4)
model.save("/content/drive/MyDrive/archive(1)/forest1.h5")
predictions = model.predict(test_dataset)
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
import cv2
#load the saved model
model = load_model("/content/drive/MyDrive/archive(1)/forest1.h5")
def predictImage(filename):
  img1 = image.load_img(filename,target_size=(128,128))
  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/Dataset/test_set/with fire/19464620_4
01.jpg")
```

2. Feature 2

```
!pip install tensorflow
```

PNT2022TMID12327

```
!pip install opencv-python
!pip install opencv-contrib-python
import tensorflow as tf
import numpy as np
from tensorflow import keras
import os
import cv2
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.preprocessing import image
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)
train_dataset = train.flow_from_directory("/content/drive/MyDrive/Datas
et/train_set",
                                          target_size=(128,128),
                                          batch_size = 32,
                                          class_mode = 'binary' )
test_dataset = test.flow_from_directory("/content/drive/MyDrive/Dataset/
test_set",
                                          target_size=(128,128),
                                          batch_size = 32,
                                          class_mode = 'binary' )
test_dataset.class_indices
#to define linear initialisation import sequential
from keras.models import Sequential
#to add layer import Dense
from keras.layers import Dense
#to create convolution 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 warnings
warnings.filterwarnings('ignore')
model =Sequential()
#add convolutional layer
model.add(Convolution2D(32,(3,3),input_shape=(128,128,3),activation='rel
u'))
#add maxpooling layer
model.add(MaxPooling2D(pool_size=(2,2)))
#add flatten layer
model.add(Flatten())
model.add(Dense(150,activation='relu'))
```

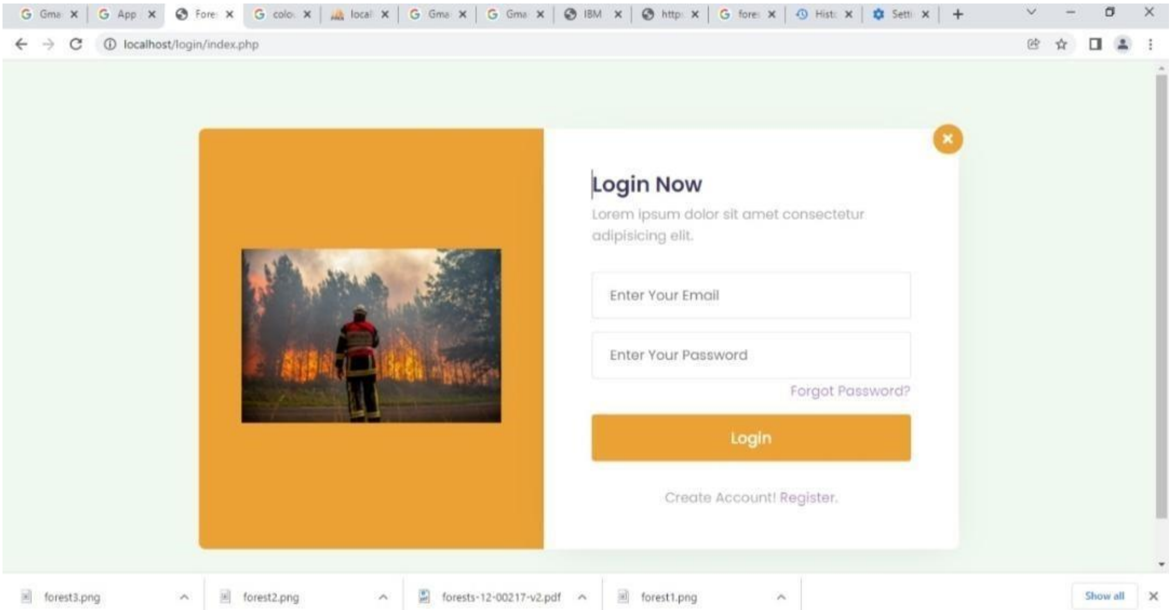
```
model.add(Dense(1,activation='sigmoid'))
model.compile(loss = 'binary_crossentropy',
              optimizer = "adam",
              metrics = ["accuracy"])
model.fit_generator(x_train,steps_per_epoch=14,epochs=5,validation_data=
x_test,validation_steps=4)
model.save("/content/drive/MyDrive/archive(1)/forest1.h5")
predictions = model.predict(test_dataset)
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
import cv2
#load the saved model
model = load_model("/content/drive/MyDrive/archive(1)/forest1.h5")
def predictImage(filename):
  img1 = image.load_img(filename,target_size=(128,128))
  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/Dataset/test_set/with fire/19464620
_401.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
```

PNT2022TMID12327

```
from playsound import playsound
#load the saved model
model = load_model(r'/content/drive/MyDrive/archive(1)/forest1.h5')
#define video
video = cv2.VideoCapture('/content/Fighting Fire with Fire _ Explained in 
30 Seconds.mp4')
#define the features
name = ['forest','with forest']
account_sid='ACfb4e6d0e7b0d25def63044919f1b96e3'
auth_token='f9ae4fc4a617a527da8672e97eefb2d8'
client=Client(account_sid,auth_token)
message=client.messages \
.create(
      body='Forest Fire is detected, stay alert',
      from_='+1 302 248 4366',
      to='+91 99400 12164'
)
print(message.sid)
pip install pygobject
def message(val):
  if val==1:
    from twilio.rest import Client
    print('Forest fire')
    account_sid='ACfb4e6d0e7b0d25def63044919f1b96e3'
    auth_token='f9ae4fc4a617a527da8672e97eefb2d8'
    client=Client(account_sid,auth_token)
    message=client.messages \
     .create(
        body='forest fire is detected, stay alert',
        #use twilio free number
        from_='+1 302 248 4366',
        #to number
        to='+91 99400 12164')
    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/Dataset/test_set/with fire/W
ild_fires.jpg',target_size=(128,128))
Y = image.img_to_array(img1)
x = np.expand_dims(Y,axis=0)
val = model.predict(x)
```

```
plt.imshow(img1)
plt.show()
message(val)
img2 = image.load_img('/content/drive/MyDrive/Dataset/test_set/forest/1200
px_Mountainarea.jpg',target_size=(128,128))
Y = image.img_to_array(img2)
x = np.expand_dims(Y,axis=0)
val = model.predict(x)
plt.imshow(img2)
plt.show()
message(val)
```

8.TESTING



9. RESULTS

9.1. Performance Metrics

S.No.	Parameter	Values
1.	Model Summary	As a threat of forest fire increases due to climate changes, the need for finding a detection system increases .The proposed Deep Learning-based model to predict early detection of forest fire. The Proposed model successfully classifies the images into fire and no fire, and sends an alert messages in case of fire. Thus, the Deep Learning algorithms proved their efficiency in detecting different objects.
2.	Accuracy	Training Accuracy - 98% Validation Accuracy - 95%

Value obtained from three sensor, if any Infrared ray detected, it gives output as IR detected, Sensor activated! Similarly, if there is any temperature change it will show Abnormal temperature and its intensity. For any smoke detection it output as Smoke detected and sensor value.Above image is result obtained from the trained ML model showing count for damaged and intact homes.

10. ADVANTAGES &DISADVANTAGES

Advantages:

1. It refreshes the habitat zones: Fire destroys vegetation and trees, releasing more natural resources for the ecosystem. The surviving plants and animals that inhabit the area will have better access to water as there will be less trees in the area. Many animals also find food in newly sprung grass and bushes. A regrowth of ground cover following a fire creates a new microhabitat. With a fire, everything gets revitalised**.**

2. Low-intensity fires don't usually harm trees: A tree's bark acts as an armoured shell to protect it from things like fire, bugs, and other potential hazards. When conditions are ideal, most forest fires burn at moderate temperatures, which results in little harm to the forest's trees. As a result, the forest's understory is cleared, but the beautiful trees can still be seen standing tall.

3. Decreases the Wastes on Forests: Wildfires can be sparked by the large amount of garbage that accumulates in forests over time. We may not be able to comprehend the extent of the devastation caused by a huge wildfire if it spreads for several weeks.

Dead leaves on the ground are a good source of waste for wildfires to consume, and tiny forest fires simply dispose of these wastes effectively without spreading.

Disadvantages:

1. A forest fire sets up the potential for soil erosion to occur: Forest fires remove the underbrush and promote new growth, however there is a window of vulnerability for the forest between the fire and the new growth.

2. Forest fires always bring death in some formForest fires remove the underbrush and promote new growth, however there is a window of vulnerability for the forest between the fire and the new growth.

3. Uncontrolled fires can cause localized air pollution: Despite the extent of global development, many forests remain inaccessible or extremely difficult to reach. When fires are allowed to burn out of control in certain places, air pollution is produced, which can have an adverse effect on the surrounding environment and make breathing difficult.

11. CONCLUSION

This research will aid in the early detection and prevention of forest fires. Additionally, it contains the potential risk of overturning the current project by utilising a machine learning system to analyse drone photographs of the affected areas. Prior to any fire mishaps spreading throughout the forest region, this technology quickly detects the fire conditions. It is both novel and tough to use video frames to detect fire using machine learning. It is possible to prevent loss and damage from random fire accidents by using the surveillance system if this system with a low mistake rate can be deployed on a broad scale, such as in major companies, homes, or forests.

12. FUTURESCOPE

Future Plans In order to make it easier for firefighters and resources to access dense forest, we intend to construct smart water tank systems there in the future. In addition, we will update the system to add greater functionality and dependability. Additionally, a loud sound system will be used to keep animals away from the fire location. By combining wireless sensors with CCTV, the proposed system can be upgraded to a more precise and protective system. The algorithm has a lot of potential for adjusting to different environments..

13. Appendix

Github and Demo Link:

Github repository link: https://github.com/IBM-EPBL/IBM-Project-18136-1659679822

Demo Link: https://youtu.be/UIrG-9IGqXU