PROJECT REPORT

Emerging Methods for Early Detection of Forest Fires

SUBMITED BY

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TABLE OF CONTENTS

CHAPTER 1
INTRODUCTI
ON

1.1 PROJECT OVERVIEW

Machine learning and deep learning play an important role in computer technology and artificial intelligence. With the use of deep learning and machine learning, human effort can be reduced in recognizing, learning, predictions and in many more areas.

Forest fire detection is the ability of computer systems to recognise Fire from various region of forest , such as fire, smoke, and so on. This

project aims to let users take advantage of machine learning to reduce manual tasks in Detecting the forest fire.

1.2 PURPOSE

The main aim of our project is detection and monitoring the forest fire To minimize the effect of fire breakout by controlling in its early stage also to protect Domestic by informing about the breakout to the respective forest department as early as possible . We have implemented the IOT technology to achieve our objective.

CHAPTER 2
LITERATURE SURVEY

2.1 EXISTING PROBLEM

Some of the relevant literary works in this field are briefed below:
The one fourth area of Karnataka is covered by forest, the forest and bio-diversity of the India are at the considerable chance and beneath enormous pressure. General causes of forest fire are extreme hot and aired weather, lightning and human carelessness. In order to protect these huge stretches of forest land, there need
to be taken early caution measures to control of spreading fire

2.2 REFERENCES

1. **A Review on Early Forest Fire Detection Systems Using Optical Remote Sensing**

- P. Barmpoutis, P. Papaioannou, K. Dimitropoulos, N. Grammalidis
- Environmental Science
- Sensors
- 2020

An overview of the optical remote sensing technologies used in early fire warning systems is presented and an extensive survey on both flame and smoke detection algorithms employed by each technology is provided.

2. Forest Fire Detection System using LoRa Technology

- N. Gaitan, Paula Hojbota
- Environmental Science
- 2020

This paper proposes a system capable of quickly detecting forest fires on long wide distance using LoRa (Long Range) technology based on LoRaWAN (Long Range Wide Area Network) protocol which is capable to connect low power devices distributed on large geographical areas.

3. **Low Cost LoRa based Network for Forest Fire Detection**

- Roberto Vega-Rodríguez, Sandra Sendra, Jaime Lloret, Pablo Romero-Díaz, José Luis García-Navas
- Computer Science, Environmental Science

  2019 Sixth International Conference on Internet of Things: Systems, Management and Security (IOTSMS)
- 2019

A low cost Long Range (LoRa) based network able to evaluate level of fire risk and the presence of a forest fire and the evaluation algorithm is based on the 3030-30 rule.

4. A Survey of Machine Learning Algorithms Based Forest Fires Prediction and Detection Systems

- F. Abid
- Environmental Science, Computer Science
- Fire Technology
- 2020

A comprehensive survey of the machine learning algorithms based forest fires prediction and detection systems is presented, highlighting the main issues and outcomes within each study.

2.3 PROBLEM STATEMENT DEFINITION

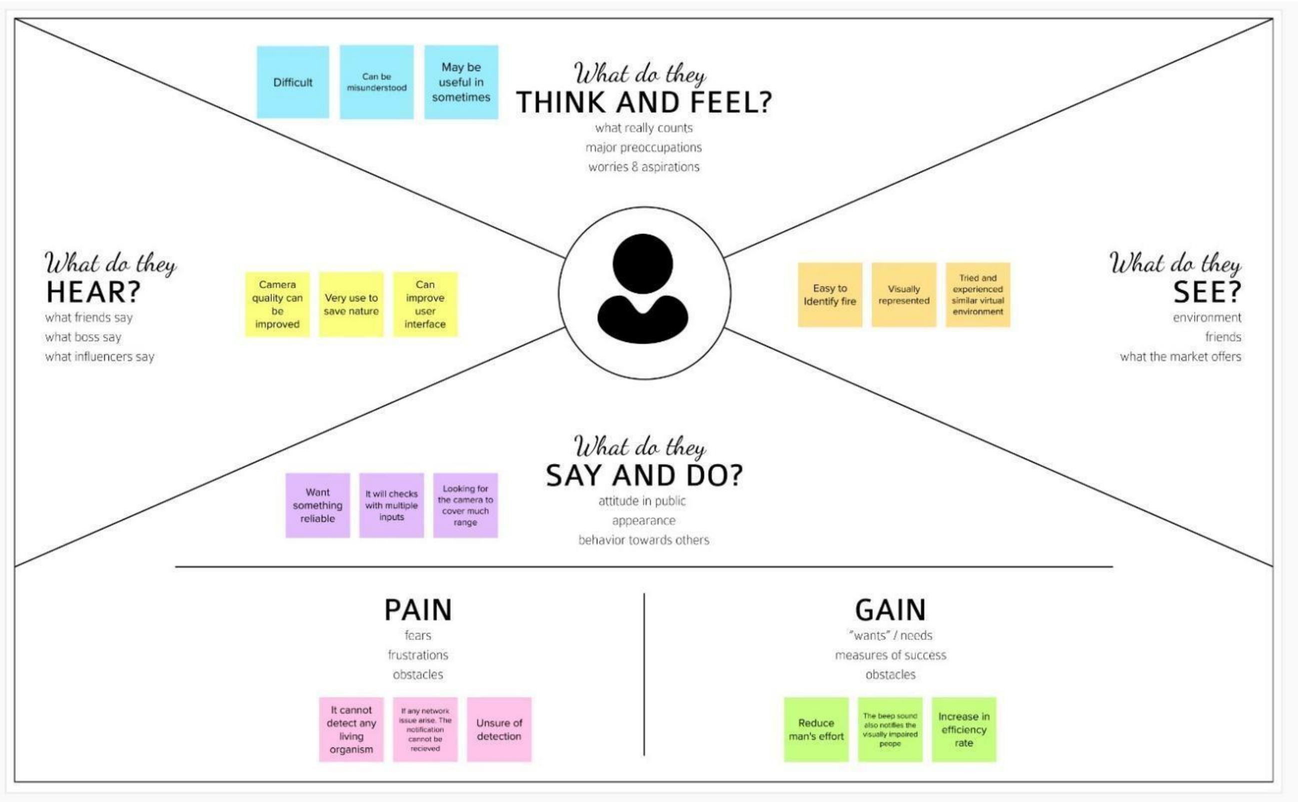
Some people know about the current issues are the most important ones because it is mostly a lot in the news but sometimes other big issues that change our lives are not mentioned in the news because they are issues that can hurt us in the long run or not really important for the modern public. One issue

I can tell you about is the forest fires. Sometimes people don 't notice or now about the forest fires until it is talk in the news and it 's mostly because it has done a great damage.

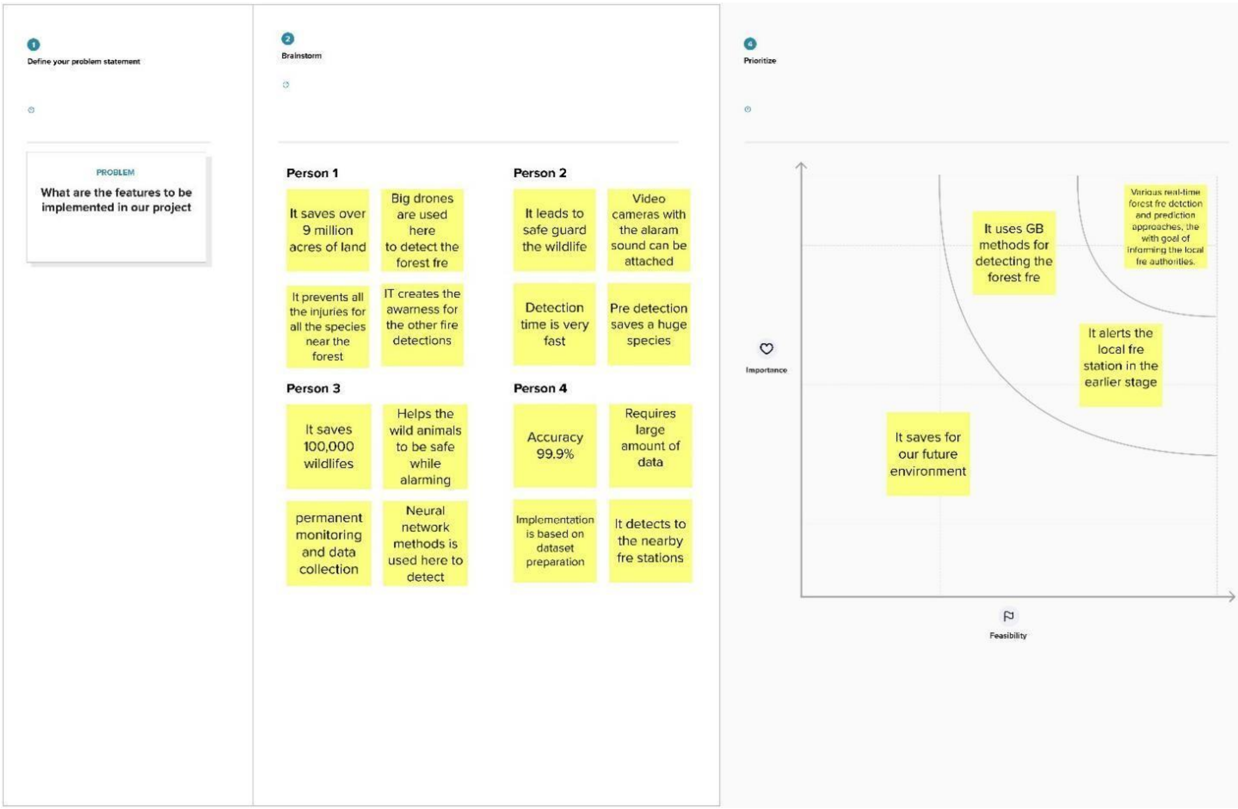
CHAPTER 3

IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION & BRAINSTORMING



3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To find emerging methods for early detection of forest fires using artificial intelligence.
2.	Idea / Solution description	In case of forest fire detection the burning substances are primarily identified as sceptical flame regions using a division strategy to expel the non-fire structures and results are verified by a deep learning model.
3.	Novelty / Uniqueness	Accurate and reliable recognition of sceptical flame regions by means of using YOLO v3 algorithm.
4.	Social Impact / Customer Satisfaction	1. By using this method we can save environmental damage and lives of living beings. 2. It is fast and accurate method to detect the fire easily and give an alert to the forest fire department simultaneously when the fire is detected.
5.	Business Model (Revenue Model)	The software platform to provide the fully autonomous processing of data received from the camera of UAV to obtain live feed in web App.
6.	Scalability of the Solution	It is mainly developed for detecting the forest fire across the world and useful in surveillance the different sections of the forest.

3.4 PROBLEM SOLUTION FIT

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

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

The forest resources which plays a vital role in sustaining lives on the earth, therefore to preserve them from unexpected outbreak of fire and smoke. The forest management team do need this device in fire prone areas.

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.

Climatic changes and the greenhouses gases arethe reasons behind the destruction. Along with this the human factor to greedily use resources also play a vital reason for the forest fires.

5. AVAILABLE SOLUTIONS AS

Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking

Existing systems uses optical sensors for detectingforest fires. As fire is detected the sensors sends signal to the office of forest management. Among with that satellites are used to detect IR rays spotted in forest lands.

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.

The main problem that exists is weather and climate by releasing large number of carbon dioxide, carbon monoxide and fine particulate matter into the atmosphere.

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.

The reasons possible are:

1. Due to natural causes- Lightning
2. Man-made causes- Naked flame, cigarette, electric spark

Thus, contineous care and monitoring is needed to preserve natural resources to save lives.

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 fire is detected the system which is implementedto monitor the forests sets the alarm to ring, that is it gives the signal through which fire management team and the forest committee tries to call off the fire. Thus, the aim is to recognize the fire as early as possible to prevent spread of fire which will cause further damage to control.

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

Identify strong TR & EM

3. TRIGGERS TR

What triggers customers to act? i.e. seeing their neighbor installing solar panels, reading about a more efficient solution in the news.

The unconsious behavior towards burned cigarette left, chances of leaving the campfire remained burnt and electric supply being disrupted

4. EMOTIONS: BEFORE / AFTER EM

How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.

Wildfires can cause lot of stress since the factor that influence their direction and intensity are unpredictable and can change at anytime. People who have lived through wildfires can face dramatic mood swings, anxiety and mood-swings.

10. YOUR SOLUTION SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behavior.

To minimize these loses, we have proposed a solution to detect early detection of forest fires by using CCTV camera surveillance, which can detect fire in indoor and outdoor activities. Thus instant alerts has to be sent to the forest management office so that they can take further actions to disrupt the damage caused by the fire.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7

8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

Online Detection: Thus the chatbot or the API canconnect through internet to feed you with the current status of the forest.

Offline Detection: Thus, the forest management cansend notice to the nearby residential areas or the media can bring the awareness through news, radio.

Identify strong TR & EM

CHAPTER 4
REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

FUNCTIONALREQUIREMENTS:

-Following are the functional requirements of the proposed solution

Sn. No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
1.	User Registration	Registration through G-mail.
2.	User Confirmation	Confirmation through OTP. Confirmation through mail.
3.	User Login	Can login through credentials.
4.	User Feed	The live update of the forestcover is sent to user if there is any detection of fire
5.	User Profile	The workers profile created to give the forest management live track of the forest.
6.	User Alert	The user receives thequick response through alert sound or Messages,if any fire is detected.
7.	User Application	Along with the forest management team the citizens residing nearby forest can also download the application for alerts.

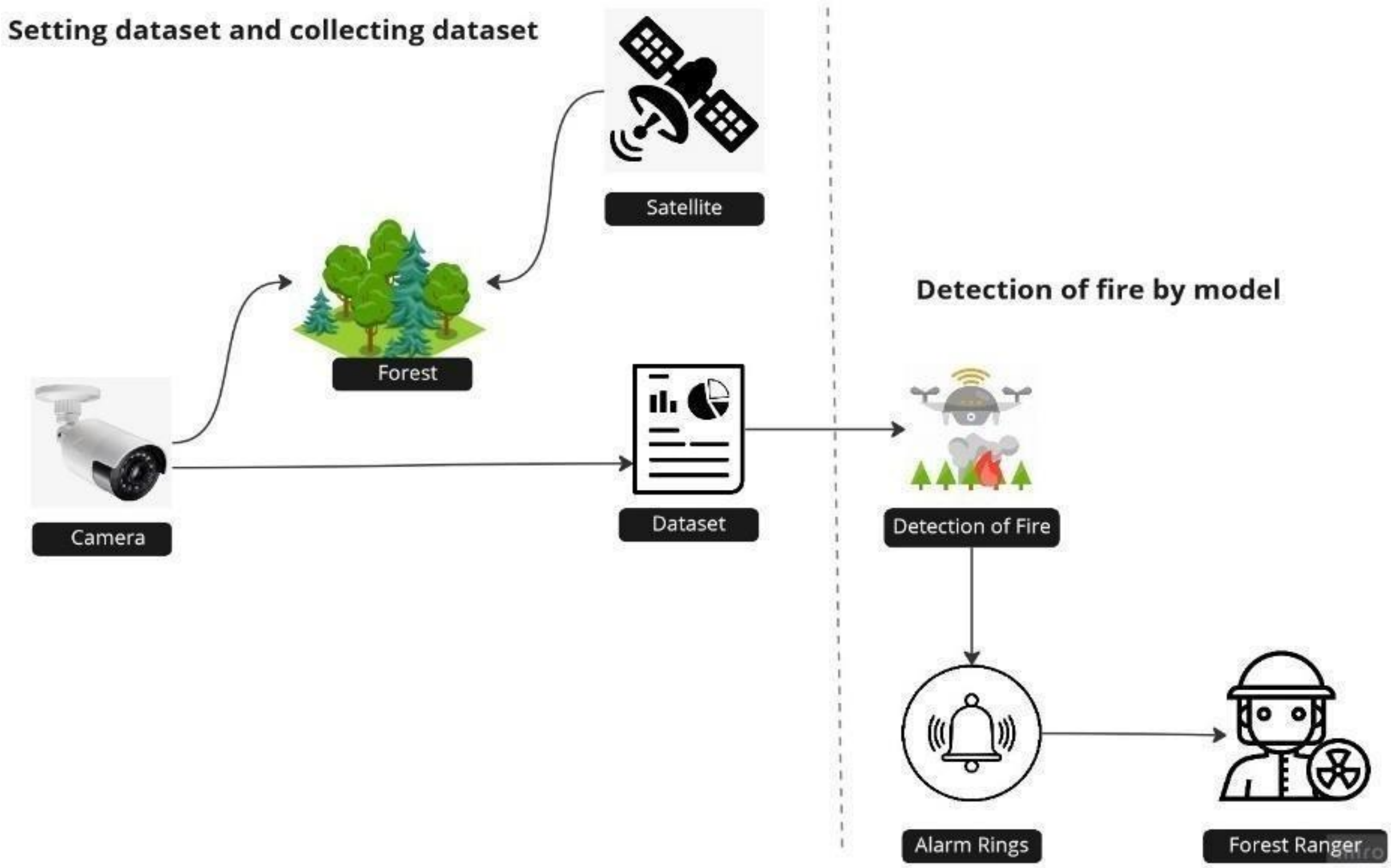
NON-FUNCTIONALREQUIREMENTS:

-Following are the non-functional requirements of the proposed solution.

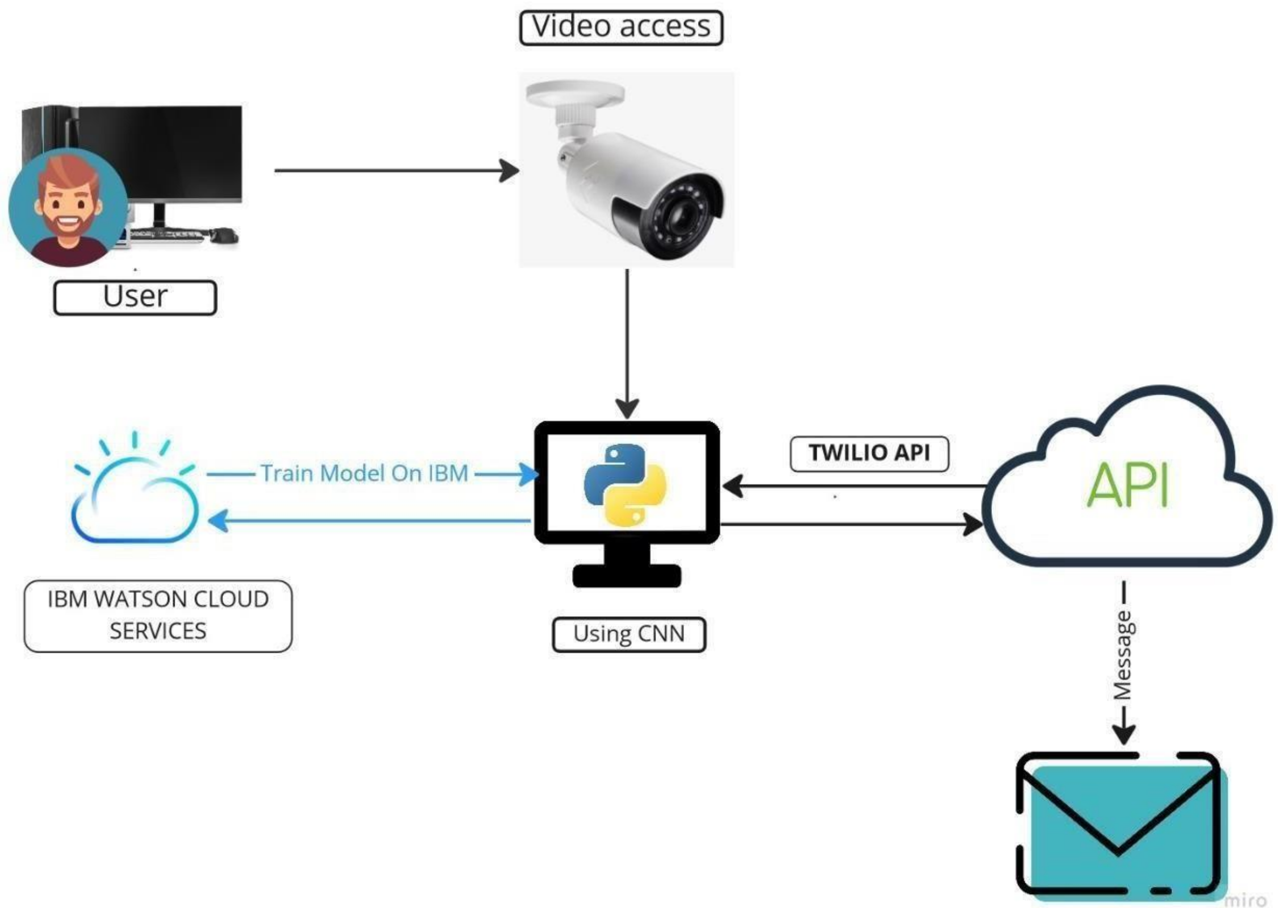
Sn. No.	**Non-Functional Requirement**	**Description**
1.	Usability	Monitoring possible danger areas and early fire detection can greatly reduce the response time and potential damage.
2.	Security	The environment is more secure.
3.	Reliability	The installment of model is safe.
4.	Performance	Model will achieve high accuracy.
5.	Availability	Build model is available all the time.
6.	Scalability	The instant alerts received by the forest team is ensured.

CHAPTER 5
PROJECT
DESIGN

Data Flow Diagram



5.2 SOLUTION & TECHNICAL ARCHITECTURE



5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Forest Management Team	Setting up a camera	USN-1	As a user, the forest management team has to survey the forest by adding camera to the fire prone areas.	The live video captured can be monitored	High	Sprint-1
		USN-2	As a user, the forest management team can get video feed which is used for processing	The camera sends video or image to the forest centre	High	Sprint-2
		USN-3	Along with forest team, the NGO can also get access of the video to take some early measurement of forest fires.	They can also get the view of the live monitoring of forest	Low	Sprint-1
Technical Team	Image Classification	USN-4	By using CNN Model, the images captured by the camera is classified accordingly by testing & training the model	The model should be able to identify the difference between fire and a normal smoke	Medium	Sprint-2
	Using Open CV	USN-5	The recorded video is under monitoring continuously to determine the detection of early video	Therefore, by using CNN we can determine the input layer, classify the hidden layers and send warnings through output layer	High	Sprint-2
Alert Team	Dashboard	USN-6	Thus, after successful detection of fire by processing images. This, API sends the alert by buzzing the alarm and sends messages through chatbot	Thus, the immediate response which is required for earlier determination through sending quick responses	High	Sprint-2

Fire Management	Twilio API		They play the most important role to cool the	They take the following measures to	High	Sprint-2

			fire and manage the excess spread of fire further	stop fire from spreading		
User Type	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Acceptance criteria**	**Priority**	**Release**
Media & Nearby Residing People	News, Radio, Alerts,	USN-7	Protecting wildlife, human from the disaster caused	Thus, helping unit should be sent to protect lives	Medium	Sprint-2

CHAPTER 6
PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Import the Required, Collecting the Dataset	USN-1	To analyse the fire prone areas and to set the surveillance camera to collect and observe the region continuously for early detection.	2	High	Nakul Anand C Vasanth K Deepak K Santhosh S
Sprint-2	Training & Testing of model	USN-2	The collected data are categorized on the basis of parameters set to identify. To train the model, CNN is used to test repeatedly by storing the datasets in server.	1	High	Nakul Anand C Vasanth K Deepak K Santhosh S
Sprint-3	Model Building, Reviewing the model	USN-3	The main task is to check that the model is efficient to work in real time. Therefore, smallest of error decoded needed to be corrected to avoid future lags	1	Medium	Nakul Anand C Vasanth K Deepak K Santhosh S
Sprint-4	Implementing the model	USN-4	The model after testing all it's functionalities is been implemented at forest management offices to get quick responses from the model.	2	High	Nakul Anand C Vasanth K Deepak K Santhosh S
Sprint-4	Connecting it with API	USN-5	The model should connect with API named Twilio, which receives & sends the management with messages.	2	High	Nakul Anand C Vasanth K Deepak K Santhosh S

6.2 SPRINT DELIVERY SCHEDULE

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	15	06 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	10	14 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	5	20 Nov 2022

CHAPTER 7

CODING & SOLUTIONING

```python
import cv2
import numpy as np
from tensorflow.keras.preprocessing import image
from tensorflow.keras.models import load_model
from twilio.rest import Client
from playsound import playsound
from decouple import config


message_sent = False

model = load_model("./model.h5")

video = cv2.VideoCapture("fire.mp4")

name = ["No fire", "Fire Detected"]


def send_message():
    account_sid = config("ACCOUNT_SID")
    auth_token = config("AUTH_TOKEN")

    client = Client(account_sid, auth_token)
    message = client.messages.create(
        body="Forest Fire detected , Stay safe!!!",
        from_=config("FROM"),
        to=config("TO")
    )
    print(message.sid)
    print("Fire Detected")
    print("SMS Sent!")

playsound("./beep.mp3")
```

```python
while True:
    success, frame = video.read()
    cv2.imwrite("image.jpg", frame)
    img = image.load_img("image.jpg", target_size=(128, 128))
    x = image.img_to_array(img)
    x = np.expand_dims(x, axis=0)
    pred = model.predict(x)
    p = int(pred[0][0])
    cv2.putText(frame, str(name[p]), (100, 100), cv2.FONT_HERSHEY_SIMPLEX, 1, (0, 0, 0), 1)

    if p == 1:
        if not message_sent:
            send_message()
            message_sent = True
        print("Fire Detected , stay safe!!!")
    else:
        print("No Fire Detected")

    cv2.imshow("Image", frame)

    if cv2.waitKey(1) & 0xFF == ord('x'):
        break

video.release()
cv2.destroyAllWindows()
```

CHAPTE R 8

TESTING

8.1 TEST CASES

Test case ID	Feature Type	Component	Test Scenario	Steps To Execute	Test Data	Expected Result	Actual Result	Status	BUG ID	Executed By
OP_RT_001	Functional	Page	Check if user can upload their file	The sensor senses the fire	Sample 1.png	The input image should be uploaded to the application successfully	Working as expected	PASS		NAKUL ANAND C SANTHOSH S
OP_RT_002	Functional	Page	Check if user cannot upload unsupported files	1) The sensor senses the fire 2)checks with the pre-uploads images	installer.exe	The application should not allow user to select a non image file	User is able to upload any file	FAIL	BUG_HP_002	VASANTH K DEEPAK K
OP_RT_003	Functional	Page	Checks whether the page redirects to the result page to the given output	1) The sensor senses the fire 2)checks with the pre-uploaded images 3)checks if there is fire detection	Sample 1.png	The page should redirect to the results page	Working as expected	PASS		DEEPAK K SANTHOSH S
MB_RT_001	Functional	Backend	Checks if all the routes are working properly	1) The sensor senses the fire 2)checks with the pre-uploaded images 3)checks if there is fire detection	Sample 1.png	All the routes should properly work	Working as expected	PASS		DEEPAK K VASANTH K
N_DC_001	Functional	Model	Checks whether the model can handle various image sizes	1) Open the page in a specific device 2) Upload the input image 3) Repeat the above steps with different input	Sample 1.png Sample 1 XS.png Sample 1 XL.png	The model should rescale the image and predict the results	Working as expected	PASS		NAKULANAND C VASANTH K
N_DC_002	Functional	Model	Check if the model predicts the digit	1) Open the page 2) Select the input images	Sample 1.png	The model should predict the number	Working as expected	PASS		NAKULANAND C VASANTH K
N_DC_003	Functional	Model	Check if the model can handle complex input image	1) Open the page 2) Select the input images 3) Check the results	Complex Sample.png	The model should predict the number in the compex image	The model fails to identify the digit since the model is not built to handle such data	FAIL	BUG_M_001	SANTHOSH S DEEPAK K
RL_DC_001	Functional	Result Page	Verify the elements	1) Open the page 2) Select the input image 3) Check if all the UI elements are displayed properly	Sample 1.png	The Result page must be displayed properly	Working as expected	PASS		NAKUL ANAND C SANTHOSH S
RL_DC_002	Functional	Result Page	Check if that image is displayed properly	1) Open the page 2) Select the input image 3) Check if the input image are displayed	Sample 1.png	The input image should be displayed properly	The size of the input image exceeds the display container	FAIL	BUG_RP_001	VASANTH K DEEPAK K
RL_DC_003	Functional	Result Page	Checks whether the displayed prediction is accurate	1) Open the page 2) Select the input image 3) Check if all the other predictions are displayed	Sample 1.png	The other predictions should be displayed properly	Working as expected	PASS		NAKUL ANAND C DEEPAK K

8.2 USER ACCEPTANCE TESTING

8.2.1 DEFECT ANALYSIS

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Total
By Design	1	1	1	0	3
Duplicate	0	0	0	0	0
External	0	0	2	0	2
Fixed	3	1	0	1	5
Not Reproduced	0	0	0	1	1
Skipped	1	0	1	0	2
Won't Fix	1	0	0	0	1
Total	6	3	4	3	14

8.2.2 TEST CASE ANALYSIS

Section	Total Cases	Not Tested	Fail	Pass
Client Application	10	0	2	8
Security	3	0	2	2
Performance	2	0	1	1
Exception Reporting	3	0	0	3

CHAPTER

9

RESULTS

9.1 PERFORMANCE METRICS

Locust Test Report

During: 13/12/2022, 7:05:40 AM - 13/12/2022, 7:14:47 AM

Target Host: http://127.0.0.1:5000/

Script: locust.py

Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	//	1044	0	14	4	292	1080	2.2	0.0
GET	//predict	1007	0	39649	387	59814	2670	1.8	0.0
	Aggregated	2050	**0**	19464	**4**	**59814**	**1859**	4.0	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	//	11	12	13	15	20	22	64	290
GET	//predict	44000	46000	47000	48000	50000	52000	55000	60000
	Aggregated	37	37000	**43000**	**45000**	49000	**50000**	56000	**60000**


Charts
Total Requests per Second
RPS
Failures/s
6
5
4
3
2
1
0
7:05:43 AM
7:06:38 AM
7:07:33 AM
7:08:28 AM
7:09:23 AM
7:10:18 AM
7:11:13 AM
7:12:08 AM
7:13:03 AM
7:13:58 AM
Response Times (ms)
Median Response Time
95% percentile
60,000
50,000
40,000
30,000
20,000
10,000
0
7:05:43 AM
7:06:38 AM
7:07:33 AM
7:08:28 AM
7:09:23 AM
7:10:18 AM
7:11:13 AM
7:12:08 AM
7:13:03 AM
7:13:58 AM
Number of Users
Users
120
100
80
60
40
20
0
7:05:43 AM
7:06:38 AM
7:07:33 AM
7:08:28 AM
7:09:23 AM
7:10:18 AM
7:11:13 AM
7:12:08 AM
7:13:03 AM
7:13:58 AM

CHAPTER 10

ADVANTAGES & DISADVANTAGES

ADVANTAGES

The proposed system detects the forest fire at a faster rate compared to existing system. It has enhanced data collection feature. The major aspect is that it reduces false alarm and also has accuracy due to various sensors present. It minimizes the human effort as it works automatically. This is very affordable due to which can be easily accessed. The main objective of our project is to receive an alert message through an app to the respective user.

DISADVANTAGES

The electrical interference diminishes the effectiveness of radio receiver. The main drawback is that it has less coverage range areas.

CHAPTER 11 CONCLUSION

This type of system is the first of its kind to ensure no further damage is then to forests when there is fire breakout and immediately a message is sent to the user through the App. Immediate response or early warning to a fire breakout is mostly the only ways to avoid losses and environmental, cultural heritage damages to a great extent. Therefore the most important goals in fire surveillance are quick and reliable detection of fire. It is so much easier to suppress fire while it is in its early stages. Information about progress of fire is highly valuable for managing fire during all its stages. Based on this information the firefighting staff can be guidedon target to block fire before it reaches cultural heritage sites and to suppress it quickly by utilizing required firefighting equipment and vehicles. With further research and innovation, thisproject can be implemented in various forest areas so that we can save our forests and maintaingreat environment.

CHAPTER 12

FUTURE

SCOPE

This project is far from complete and there is a lot of room for improvement. Some of the improvements that can be made to this project are as follows:

Additional pump can be added so that it automatically sends water when there is a fire breakout. Also industrial sensors can be used for better ranging and accuracy.

- ➔ This project has endless potential and can always be enhanced to become better. Implementing this concept in the real world will benefit several industries and reduce the workload on many workers, enhancing overall work efficiency.

APPENDIX

SOURCE CODE

Import the neccessary libraries

```python
import keras
import tensorflow

from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

1m 18.2s Python

```python
import tensorflow

from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

Python

```python
train_datagen = ImageDataGenerator(rescale=1./255,
                                   shear_range=0.2,
                                   rotation_range=180,
                                   zoom_range=0.2,
                                   horizontal_flip=True)

test_datagen = ImageDataGenerator(rescale=1./255)
```

0.1s Python

```python
x_train = train_datagen.flow_from_directory(r'./Dataset/train_set/',
                                            target_size=(128, 128),
                                            batch_size=32,
                                            class_mode='binary')
```

0.6s Python

```
Found 436 images belonging to 2 classes.
```

```python
x_test = train_datagen.flow_from_directory(r'./Dataset/test_set/',
                                           target_size=(128, 128),
                                           batch_size=32,
                                           class_mode='binary')
```

0.1s Python

```
Found 121 images belonging to 2 classes.
```

```python
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Convolution2D, MaxPooling2D, Flatten
```

0.1s Python

```
movie1    Se o. uenI la I()
g  Set.add(cofivoLuthon2D    ,          ,                          ,       ,      ,

model.add(F'atten )
‹rodel.add(0e,se
modeladdDe›ve   ,
```

```
model.fit(x_train, steps_per_epoch=14, epochs=10, validation_data=x_test, validation_steps=4)
```

```
Epoch 1/10
14/14 [==============================] - 64s 4s/step - loss: 3.5440 - accuracy: 0.5665 - val_loss: 0.4052 - val_accuracy: 0.8430
Epoch 2/10
14/14 [==============================] - 23s 2s/step - loss: 0.5222 - accuracy: 0.7431 - val_loss: 0.2283 - val_accuracy: 0.9669
Epoch 3/10
14/14 [==============================] - 23s 2s/step - loss: 0.3097 - accuracy: 0.8647 - val_loss: 0.1622 - val_accuracy: 0.9504
Epoch 4/10
14/14 [==============================] - 22s 2s/step - loss: 0.2392 - accuracy: 0.8945 - val_loss: 0.1137 - val_accuracy: 0.9669
Epoch 5/10
14/14 [==============================] - 23s 2s/step - loss: 0.2125 - accuracy: 0.8968 - val_loss: 0.1337 - val_accuracy: 0.9504
Epoch 6/10
14/14 [==============================] - 23s 2s/step - loss: 0.1922 - accuracy: 0.9243 - val_loss: 0.0887 - val_accuracy: 0.9669
Epoch 7/10
14/14 [==============================] - 23s 2s/step - loss: 0.1773 - accuracy: 0.9266 - val_loss: 0.1454 - val_accuracy: 0.9339
Epoch 8/10
14/14 [==============================] - 21s 2s/step - loss: 0.1678 - accuracy: 0.9427 - val_loss: 0.0835 - val_accuracy: 0.9752
Epoch 9/10
14/14 [==============================] - 24s 2s/step - loss: 0.1733 - accuracy: 0.9243 - val_loss: 0.1079 - val_accuracy: 0.9669
Epoch 10/10
14/14 [==============================] - 25s 2s/step - loss: 0.1647 - accuracy: 0.9335 - val_loss: 0.0716 - val_accuracy: 0.9752

<keras.callbacks.History at 0x1920c974be0>
```

Save the model

```
model.save("model.h5")
```

Prediction

```python
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
import numpy as np
import cv2
```

Python

```python
model = load_model("model.h5")
```

Python

Reviewing the model

```python
img = image.load_img("forest-fire.jpg")
x = image.img_to_array(img)
res = cv2.resize(x, dsize=(128, 128), interpolation=cv2.INTER_CUBIC)
x = np.expand_dims(res, axis=0)
```

Python

```python
pred = model.predict(x)
pred = int(pred[0][0])
pred
```

Python

```
1/1 [==============================] - 1s 524ms/step

0
```

Fire.py (Main file)

```python
import cv2
import numpy as np
from tensorflow.keras.preprocessing import image
from tensorflow.keras.models import load_model
from twilio.rest import Client
from playsound import playsound
from decouple import config


message_sent = False

model = load_model("./model.h5")

video = cv2.VideoCapture("fire.mp4")

name = ["No fire", "Fire Detected"]


def send_message():
    account_sid = config("ACCOUNT_SID")
    auth_token = config("AUTH_TOKEN")

    client = Client(account_sid, auth_token)
    message = client.messages.create(
        body="Forest Fire detected , Stay safe!!!",
        from_=config("FROM"),
        to=config("TO")
    )
    print(message.sid)
    print("Fire Detected")
    print("SMS Sent!")

playsound("./beep.mp3")
```

```
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    p     :
        message_sent:
                    ()
        message_sent
        print("Fire Detected , stay safe!!!")
    :
        print("No Fire Detected")
```

GITHUB

https://github.com/IBM-EPBL/IBM-Project-10066-1659090285

PROJECT DEMO

https://drive.google.com/file/d/19UO-dEVqceL_yKPD6GxqcGaZy-_Z7iks/view?usp=sharing