PROJECT REPORT

EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRE

TEAM ID: **PNT2022TMID04190**

submitted by

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CHAPTER 1
INTRODUCTION

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.

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1.2PURPOSE

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.

CHAPTER 2
LITERATURE SURVEY

2.1 EXISTING PROBLEM

The existing system for detecting fire are smoke alarms and heat alarms. The main disadvantage of the smoke sensor alarm and heat sensor alarms are that just one module is not enough to monitor all the potential fire prone places. The only way to prevent fire is too cautious at the time. Even if they are installed in every nook and corner, it just is not sufficient for an efficient output consistently. As the number of smoke sensor requirement increase the cost will also increase to its multiple. The proposed system can produce consistent and highly accurate alerts within seconds of accident of the fire. It reduces cost because only one software is enough to power the entire network of surveillance. Research is active on this field by data scientists and machine learning researchers. The real challenge is to minimize the error in detection of fire and sending alerts at the right time. The idea of this research is to fabricate a system through IoT sensors, which is arbitrarily spread in the forest and to make a self-sorted out powerful system between the sensors to cover all the enormous territories in the forest that will used to maintain a strategic distance from the fire harm whenever. The capacity of the sensor is to identify fire in the inclusion region between the time intermission of each 5-10 minutes. At the point when the fire is recognized the entirety of the sensor in the region will be dynamic and order to stop the normal assignment. The concept is to build early fire detector using Arduino which is connected with different IoT sensors. Putting all efforts to develop a smarter system by connecting it to a webpage and monitoring the developed system statistics controlled by the Arduino programming. The use of latest technology can help to prevent the catastrophic accidents in forests. The aim is to early detect the fireplace in forest by considering the several factor like smoke, temperature, humidity, flame and based on the data we get from this programming, the forest department will be able to take an appropriate decision and the rescue team will be able to arrive on time at exact location. Consider, if it is a large region and it produces more carbon monoxide than the ordinary vehicle traffic. Surveillance of the danger areas and an early detection of fireplace can appreciably shorten the response time and additionally decrease the practicable injury as nicely as the fee of firefighting. Known rule applies here: 1 minute – 1 cup of water, 2 minutes - 100 liters of water, 10 minutes - 1000 liters of water. The goal is to notice the fireplace as quicker as possible, its actual localization and early notification to the fire devices. When fire starts then the flammable texture may likewise issues fuel to the hearth focal spot. The spot at that point will expand and more extensive. The first phase of start is alluded as "surface fire‟ stage. This may feed on abutting bushes and the fire will turn into higher and transforming into "crown fire‟. Generally, at this stage the hearth transforms into wild and injury which end up being extreme that could stay for quite long time while depending on atmosphere conditions and the territory. Forest fire detection using optimized solar–powered ZigBee wireless sensor networks- In this paper, they have developed system for Forest Fire Detection which overcomes the demerits of the Existing technologies of Forest Fire Detection. It can be ensured that the system developed can be implemented on a large scale with its promising results. The system is provided with low-power elements, higher versions of Zigbee, Maximum power point tracking Algorithm is used in order to make the system run for longer periods efficiently. Forest fires are a very serious problem in many countries, and global warming may contribute to make this problem worse. Experts agree that, in order to prevent these tragedies from happening, it is necessary to invest in new technologies and equipment that enable a multifaceted approach. This paper describes a WSN for early detection of forest fires. This network can be easily deployed at areas of special interest or risk. There are two types of nodes from the physical structure point of view: SNs, to collect data from the environment, and CNs, to gather data from the SNs and transmit the information to a Control Centre. The nodes also can be in different functioning modes. This enables a proper and seamless configuration of the network, provides redundancy, and ensures there will be full temporal and geographical coverage in the deployment zone. The information gathered is related not only to early detection purposes but also to environment monitoring to maximize the WSN usage. This environmental data can also be employed to firefighting preventive tasks such as vegetation modelling, microclimate studies, and propagation model parametrization. In this paper, a forest fire detection algorithm is proposed. The algorithm uses YCbCr color space since it effectively separates luminance from chrominance and is able to separate high temperature fire center pixels because the fire at the high temperature center region is white. The final results show that the proposed system has good detection rates and fewer false alarms, which are the main crucial problems of the most existing algorithms. The presences of fire in video streams are indicated by semantic events. Most of the existing systems can only be used for the videos obtained from stationary cameras and videos obtained from the controlled lightening conditions. These existing automatic fire detection systems cannot be used for video streams obtained from mobile phones or any handheld devices. It was decried as a global tragedy. Lit by farmers, the fires raged through villages, destroyed ecosystems and pumped climate-warming pollution into the atmosphere.

Construction:

The sensors cover two in terminal with an electrolyte. The electrodes are classically fictional by arrangements a highly costly character on to the penetrable hydrophobic pia mater. The at work(predicate) electrode gain both the electrolyte and the chillout information which has to be supervised regularly through a open dura mater. The electrolyte most commonly habit is a rock acrimonious the electrodes and shelter are for the most part in a moldable saddlecloth which restrain a gasoline vestibule concavity for the petrol and electrical brush.

INTERNET OF THINGS:

The internet of things (IoT) can be determine as the mass of material devices, buildings, vehicles and many paragraph that are fixed with sensors, software, cobweb connectivity, actuators, and electronics that suffer these sight for amass and interchanging complaint. In usual Internet of Things (IoT) is a framework that afford animals, aim or community, the capability to emit over data to a netting that may not enjoin the Christian-to-electronic computer (H2C) or the humane-tohuman (H2H) interaction and the unparalleled identifiers.

DATA MANAGEMENT:

Data charge is an exact air in Internet of Things (IoT). The compass of the furnish data and the activities complex in thumbing of those notice come judicious, when examine a circle of end interrelated and statically dealing all style of instruction. An utilizable space came for wireless communications hew makers when M2M number has been emit, which is also the endow technology for Internet of Things (IoT). This technology hobble free row of applications.

Some of the most relevant concepts which enable us to understand the challenges and opportunities of data management are:

- Data Collection and Analysis
- Big Data
- Semantic Sensor Networking
- Virtual Sensors
- Complex Event Processing.

CONCLUSION

In this project changeable sensory parameters algorithmic rule, a system has been improved which will reduce the error perception and updates the deficiency to the expert often through the IOT landing. D2D association conventionality an definite integral part which intercept IOT surrounding to designate, accomplish, and support a endurable ecosystem. The system thus intend is powerful to expose the mixture variations, daring gases and fire event through the sensors in an diligence and powerful to update the complaint to the style expert through the IOT fulfill secondhand MQTT policy. The improved system can be unfold for tenement appliances and in industries also. However, the system above is meant for a sincere opinion news only. As a tomorrow aggravation, several-decision company through the IOT landing is study a object and the exploration is being done to effectuate this enormous toil. It is trust that with the technological advancements profitable in instant age scenario, the above rehearse several-opinion correspondence will also be unfold in aqiqiy delay environments.

2.2 REFERENCES

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2.3 PROBLEM STATEMENT DEFINITION

* In earlier times fires were detected with the help of watching towers or using satellite images.
*Satellites collect images and send it to the monitoring authority which will decide by seeing images that it is a fire or not.
*But this approach was very slow as the fire may have spread in the large areas and caused so much damage before the rescue team came.
*In the watching tower method, there was a man always standing on the tower who would monitor the area and inform if there was fire.
*This method was also slow because before the man got to know about the fire it may have spread in the inner parts of forest, also it always requires a man who must be present there.

*Since, we know that some areas, especially forest areas are large so it is practically impossible to put a man in every part of forest from where they can monitor the forest area.
*So, both these approaches of watching towers and satellite images failed to detect fire as early as possible to reduce the damage done by fire Problems in fire detection:
*There were mainly two problems in fire detection as discussed:

(a). Judging criteria for the fire: Edge is set, on the off chance that the worth is more noteworthy than edge, it is a fire, else not.
So, this problem was removed by using machine learning techniques by many researchers.
(b). Connection of nodes: Traditional systems used cables to connect alarm with the detectors.
*Cable was mainly of copper. But copper wire may be costly or it can suffer from fault in the mid-way.
*So, this problem was removed using wireless sensor networks.

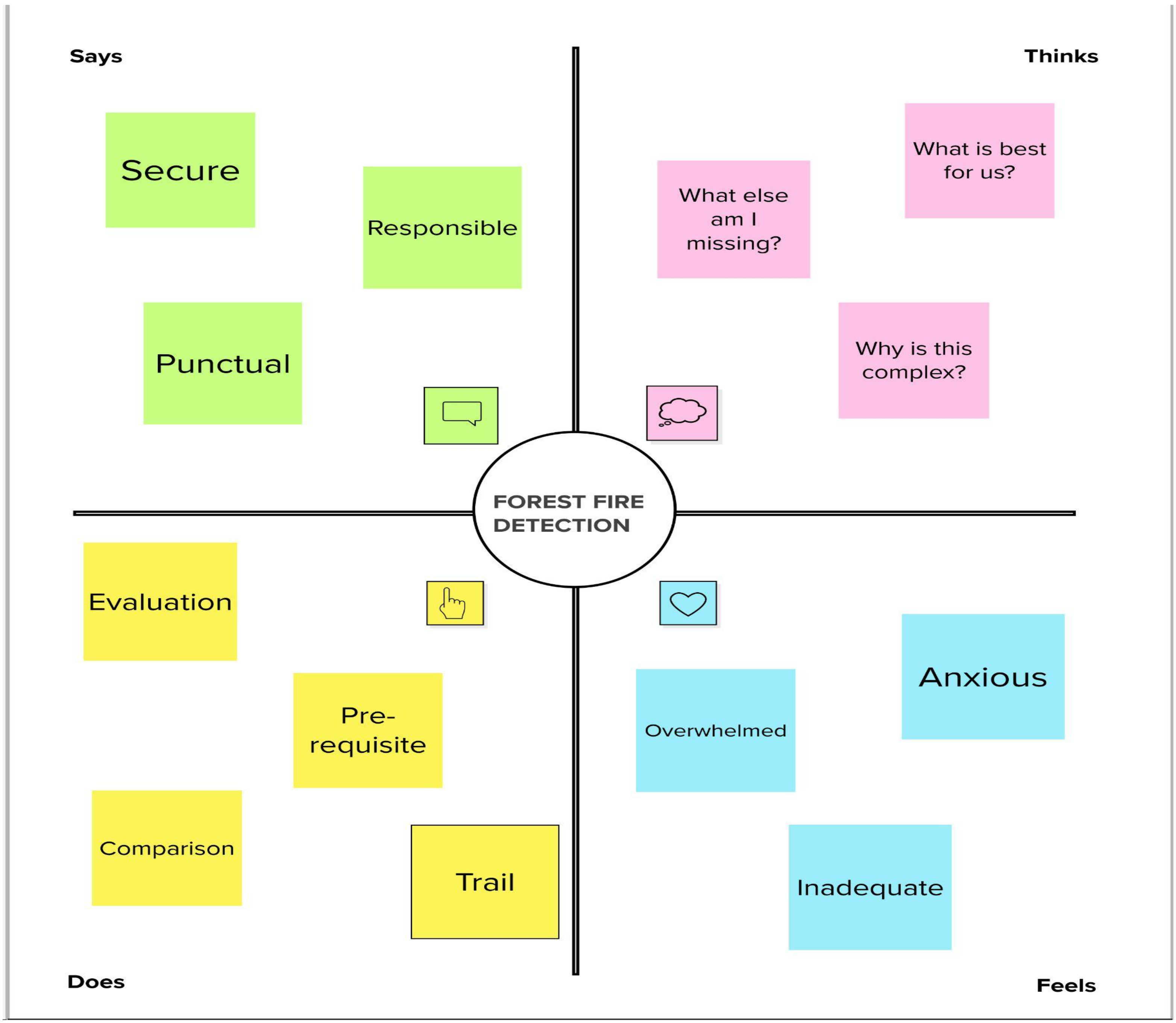
*So, with the advancement in technology researchers find an efficient method to detect forest fire with the help of Wireless Sensor Network.
*Fire can be identified by conveying sensor hubs in timberland regions by which they illuminate about fire.

Conveying sensor hubs in the timberland regions means placing sensors in every part of the forest and mostly in the prone areas where risk of 9 catching fire is more. With the use of wireless sensor networks, now it is easy to detect the fire in large areas as soon as possible.

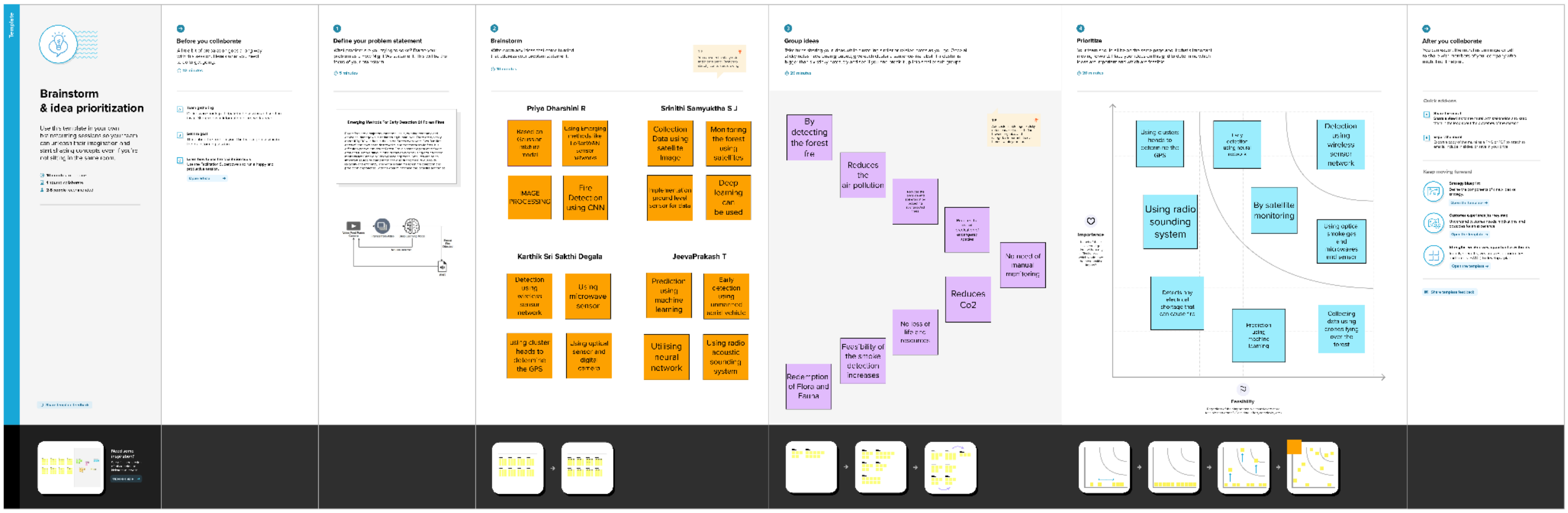
CHAPTER 3

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)	A forest fire risk prediction algorithm, based on support vector machines, is presented. The algorithm depends on previous weather conditions in order to predict the fire hazard level of a day.
2.	Idea / Solution description	Use computer vision methods for recognition and detection of smoke or fire, based on the still images or the video input from the drone cameras.
3.	Novelty / Uniqueness	Real time computer program detect forest fire in earliest before it spread to larger area.
4.	Social Impact / Customer Satisfaction	Blocked roads and railway lines, electricity, mobile and land telephone lines cut, destruction of homes and industries.
5.	Business Model (Revenue Model)	The proposed method was implemented using the Python programming language on a Core i3 or greater (CPU and 4GB RAM.)
6.	Scalability of the Solution	Computer vision models enable land cover classification and smoke detection from satellite and ground cameras.

3.4 PROBLEM SOLUTION FIT

Project Title: Emerging Methods for Early Detection of Forest Fires

Project Design Phase-I - Solution Fit Template

Team ID: PNT2022TMID04190

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

This product can be used by a corporation or a government to monitor huge reserve forests and environment

6. CUSTOMER CONSTRAINTS CC

This product has huge social and biological impact as prevention of forest fire can save countless acres of forest land and wild lives. Forest fire also increases the amount of car in the atmosphere. So prevention of forest fire can also reduce global warming.

5. AVAILABLE SOLUTIONS AS

Forest surveillance video cameras can be used to monitor the forest areas and they can alert the forest department if there is any symptoms of forest fire or any other suspicious activities.

Explore AS, differentiate

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

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

forest fires have become a frequent and most dangerous natural disaster as a result of climate change and due to human errors

9. PROBLEM ROOT CAUSE RC

Forest fires are the one of the random natural disaster that is too hard to identify even with the existing state of the art technology. The fact that more than 20% of complete world CO_2 emissions comes from forest fire and human negligence has caused these type of disasters too

7. BEHAVIOUR BE

The sudden climate change makes the weather unpredictable and disasters like bush fire and forest fire becomes common and human ignorance of playing with fire

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

Identify strong TR & EM

3. TRIGGERS TR

Human caused errors such as unattended campfires, discarding of cigars, burning of debris

4. EMOTIONS: BEFORE / AFTER EM

BEFORE : Tribal People and wildlife survival in the forest has becoming challenging because of forest fires.

AFTER : Forest surveillance video cameras can be used to monitor the forest areas so that we can prevent the people and wild lives

10. YOUR SOLUTION SL

Forest surveillance video cameras can be used to monitor the forest areas and they can alert the forest department if there is any symptoms of forest fire or any other suspicious activities.

8. CHANNELS of BEHAVIOUR CH

ONLINE: fire sensor alert

OFFLINE: fire awareness program

Identify strong TR & EM

CHAPTER 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	Overall Surveillance Report	Helps to understand the current scenario in the forest by giving report as “no fire” or “negative”
FR-4	Cloud Server Access	To save and run the model from the camera footage
FR-5	5 Live Camera Feed	Real-time monitoring by the forest authorities
FR-6	GSM Module	Warn the nearest forestry manager and local residents fire station

4.2 Non-Functional requirement

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	This project-as-a-service can be used by governments for managing protected forests, large corporations managing large tracts of land where trees are grown for commercial purposes, and NGOs seeking to protect forests. Authorities are used to monitor the behavior of endangered animals.
NFR-2	**Security**	To ensure the security of the monitoring process, the server is used as IBM Cloud with very good encryption standards. These files are only accessible to corporate government officials. Another security check is made by the OTP for verification. Backup videos are stored on IBM Cloud servers.
NFR-3	**Reliability**	The project is very reliable compared to its predecessor. A generational open source forest monitoring system that is very robust due to its easy manipulation of data, low maintenance costs and
NFR-4	**Performance**	This project outperforms other wildfire detection methods such as using satellite surveillance, IOT sensors, or IR sensor-based cameras. The accuracy of this model also improves over time.
NFR-5	**Availability**	This data can be only accessed by the officials as this is very sensitive information regarding thousands of acres of forest lands. So this can be opened anywhere by the authorized person as the AI model is connected in IBM server.
NFR-6	**Scalability**	Initial costs to set up are high compared to other methods, but there are little to no maintenance costs, and the costs to combat wildfires, pollution, and wildlife loss are very high relative to initial set-up costs. increase. Projects are much easier to implement and therefore easily scale to larger parts of the forest.

CHAPTER 5
PROJECT DESIGN

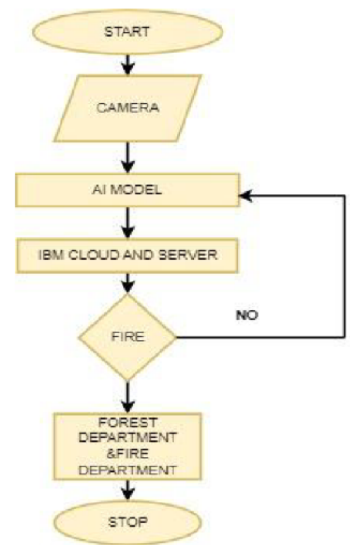
5.1 DATA FLOW DIAGRAM

Data Flow Diagrams:

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:

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 or Video-Based approach.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 & TECHNICAL ARCHITECTURE

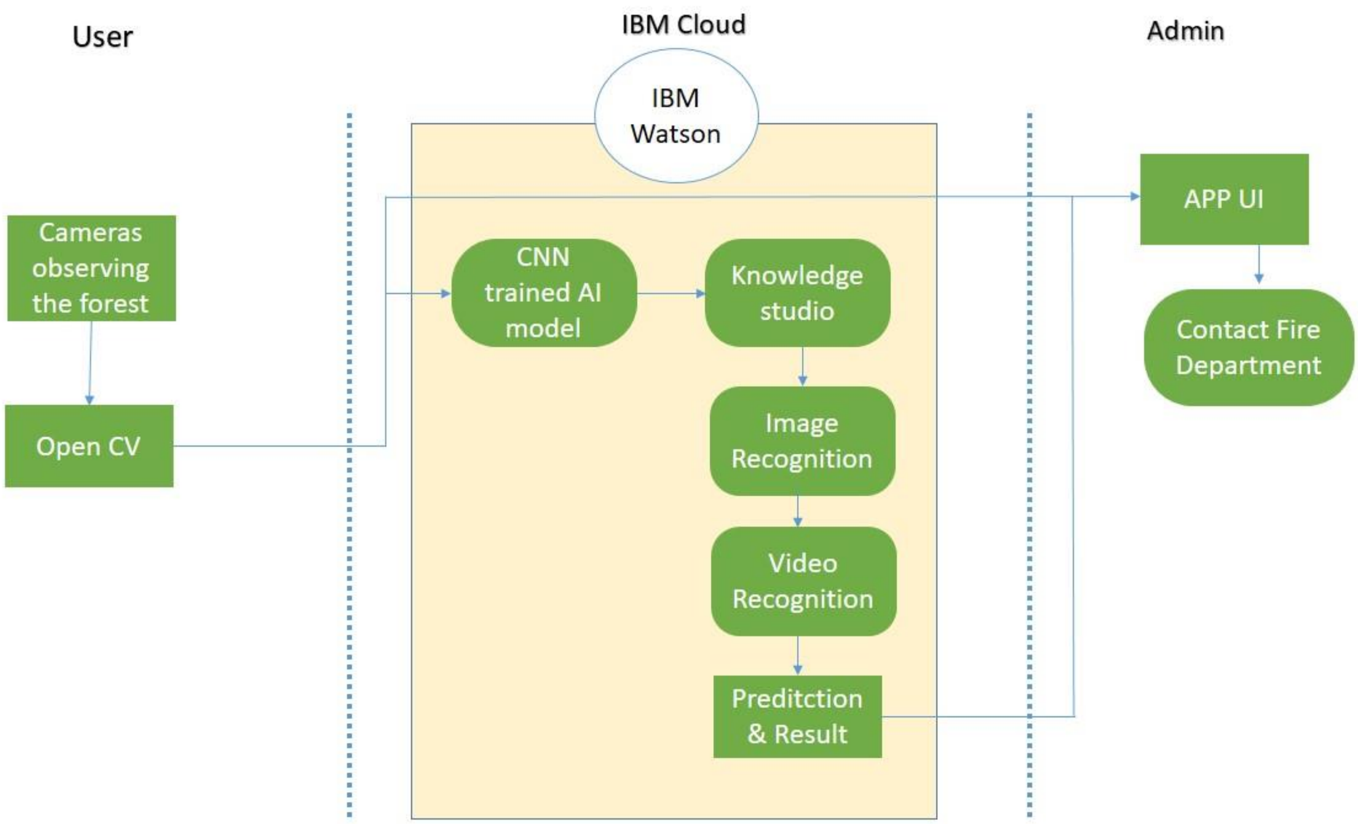


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Helps the user to interact with the application and to observe the videos	HMTL, CSS, JavaScript, Python-Flask, Angular
2.	Training a Model	To train a model to find if there is any fire or not	Python (Tensorflow, Pandas, Scipy)
3.	Computer Vision	Helps the cameras to understand and process images and videos	Open CV, YOLOv3
4.	Database	To have a small dataset for further training and testing of the model	MySQL,

5.	Cloud Database	Database Services on Cloud for AI model to train and predict	IBM DB2
6.	Mobile number security verification	To verify that the user is an authorized person who can access these information	GSM Module, WebOTP API

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Open-Source frameworks used in building a model, training them, implementing them in real-time, computer vision and neural networks.	Python (Tensorflow, Keras, Pandas, Pytorch, Numpy, MatPlotlib, Scipy), Open CV, Open Vino.
2.	Security Implementations	The surveillance camera in forests pose a security threat as they are very sensitive data which in the wrong hand can be able to monitor and manipulate them.	AES Encryptions, Two-Factor Authentication, OTP confirmation
3.	Scalable Architecture	The project can be scaled into large acres of forests as they are much easier to scale in its size. The only consideration would be the size of the cloud server and the availability of cameras	IBM Cloud
4.	Availability	This can be accessed by officials all around the globe as they are live-streamed in IBM Cloud Server through internet. So officials can access through the UI portal using their credentials.	IBM Cloud Server, WebOTP API,
5.	Performance	The performance of this project can be increased overtime as we are using Convoluted Neural Networks with Deep Learning techniques so the accuracy increases over-time. The performance can also be increased when the Cloud server's physical memory increases.	Support Vector Machine, Recurrent Neural Networks, Naïve-Bayer Classifier, Restricted Boltzmann machine, IBM Cloud

5.3 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story Task	Acceptance criteria	Priority	Release
Environmental list	Collect the data	USN-1	As an Environmentalist.it is necessary to collect the data of the forest which includes temperature,humidity,wind and rain of the forest	It is necessary to collect the right data else the prediction may become wrong.	High	Sprint-1
		USN-2	Identify algorithms that can be used for prediction	To collect the algorithm to identify the accuracy level of each algorithms	Medium	Sprint-2
	Implement Algorithm	USN-3	Identify the accuracy of each algorithms	Accuracy of each algorithm-calculated so that it is easy to obtain the most accurate output	High	Sprint-2
		USN-4	Evaluate the Dataset	Data is evaluated before processing	Medium	Sprint-1
	Evaluate Accuracy of Algorithm	USN-5	Identify accuracy,precision,recall of each algorithms	These values are important for obtaining the right output	High	Sprint-3

CHAPTER 6
PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User story/ Task	Story Points	Priority	Team members
Sprint-1	Registration	USN-1	As a user, I should be able to register myself in the application by giving my email ID, phone number, username and password	5	High	Karthik Sri Sakthi Degala
Sprint-1	Login	USN-2	As a user, I should be able to access my account using my username and password	5	High	Karthik Sri Sakthi Degala
Sprint-1	Data Collection	USN-3	Collection of data (images) for testing and training data	4	High	Jeevaprakash T
Sprint-1	Data preprocessing	USN-4	Image preprocessing and image segregation for the ease of training AI model and helps to classify images.	6	Medium	Jeevaprakash T
Sprint-2	Model Training	USN-1	Training an AI model using the preprocessed data using AI techniques like CNN, RNN, and YOLO Algorithms.	10	Medium	Srinithi Samyuktha S J

Sprint-2		USN-2	Computer Vision (OpenCV) for video processing and techniques like frame-to-frame segmentation, image interpolation.	10	Medium	Srinithi Samyuktha S J
Sprint-3	Local Implementation	USN-1	Integration of the AI model and the webpage for user interface	10	Medium	Priya Dharshini R
Sprint-3		USN-2	Activation of Twilio account and integration of Twilio account with Open CV and the previously integrated AI model	3	High	Priya Dharshini R
Sprint-3		USN-3	Testing of SMS alert by implementing the entire model locally using Python-Flask	7	Medium	Jeevaprakash T
Sprint-4	Cloud Deployment	USN-1	Creation of the IBM Cloud services which are being used in this project.	6	High	Karthik Sri Sakthi Degala
Sprint-4		USN-2	Configuration of the IBM Cloud depending on the project	2	Medium	Karthik Sri Sakthi Degala
Sprint-4		USN-3	Training of the AI model in the cloud with the preprocessed data and saving them.	2	High	Srinithi Samyuktha S J
Sprint-4		USN-4	Integrating the cloud trained AI model with webpage, OpenCV and Twilio API services.	4	High	Srinithi Samyuktha S J
Sprint-4		USN-5	Final deployment of the entire integrated model	6	High	Karthik Sri Sakthi Degala, Jeevaprakash T, Srinithi Samyuktha S J, Priya Dharshini R

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	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

CHAPTER 7

CODING & SOLUTIONING

7.1 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/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='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_step
s=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")
```

7.2 Feature 2

```
!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/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='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_s
teps=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)
```

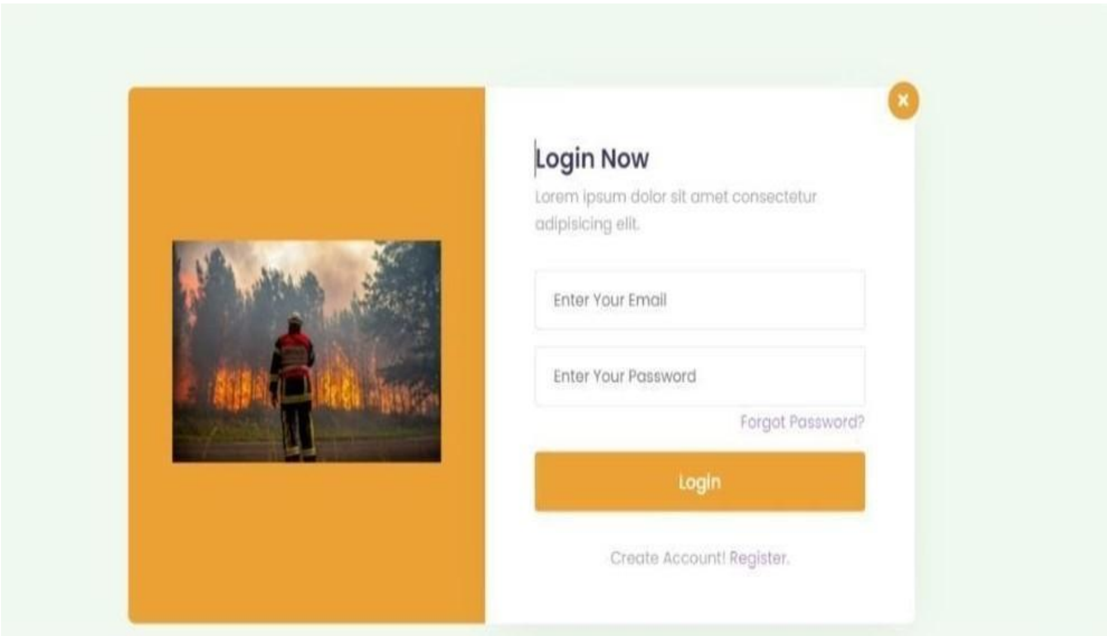
```
    if val == 1:
      print(" fire")
    elif val == 0:
        print("no fire")
  predictImage("/content/drive/MyDrive/Dataset/test_set/with fire/19464620_401.jpg")
pip install twilio
pip install playsound
#import opencv librariy
import cv2
#import numpy
import numpy as np
#import image function 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
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/Wild_fires.jpg',target_s
ize=(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/1200px_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)
```

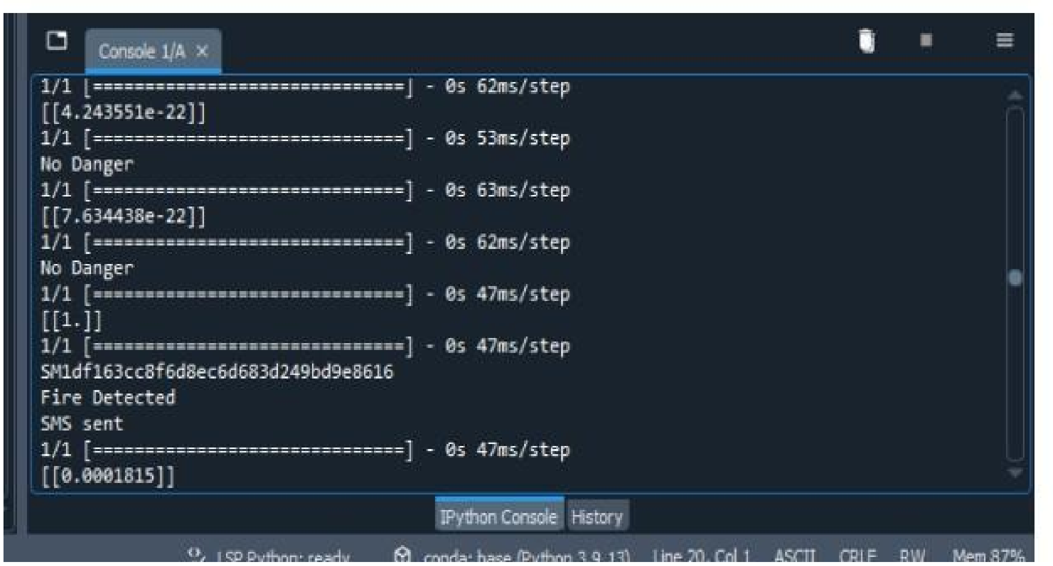
CHAPTER 8
TESTING

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 TEST CASES



8.2 User Acceptance Testing:



CHAPTER 9
RESULTS

9.1 Performance Metrics:

CHAPTER 10

ADVANTAGES & DISADVANTAGES

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.
- Insurance Discounts.
- 24/7 Monitoring.
- Easy & Affordable

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.

CHAPTER 11

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.

CHAPTER 12

FUTURE SCOPE

Future Scope In future, we are planning to install smart water tank system in dense forest where reachability of resources and firefighters is difficult. In addition to that we will be updating the system with more features and reliability. We will also include a high pitch sound system that will keep away the animals from the site of fire.The proposed system can be developed to more advanced system by integrating wireless sensors with CCTV for added protection and precision. The algorithm shows great promise in adapting to various environment.

APPENDIX

Source Code:

```
#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 video
video = cv2.VideoCapture(0)
#define the features
name = ['forest','with forest']
account_sid = 'AC557b4c7a685d072baa73125f61031af3'
auth_token = 'a59cd5e5fdfddcc9ab008273557f8f78'
client = Client(account_sid, auth_token)
message = client.messages \
.create(
body='Forest fire is detected , stay alert',
from_='+14247991869',
to='+918940722793'
)
print(message.sid)
#import opencv library
import cv2
```

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```
#import numpy
```

```
import numpy as np
#import images and load_model function from keras
from keras_preprocessing import image
from keras.models import load_model
#import client from twilio API
from twilio.rest import Client
#import playsound package
from playsound import playsound
#load the saved model
model = load_model(r'forest1.h5')
video = cv2.VideoCapture(0)
name = ['forest','with fire']
while(1):

success, frame=video.read()
cv2.imwrite("image.jpg",frame)
img=image.load_img("image.jpg",target_size=(128,128,3))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=model.predict(x)
p=pred[0]
print(pred)
##cv2.putText(frame,"predicted class= "+str(name[p]), (100,100),
## cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,0), 1)
pred=model.predict(x)

if pred[0]==1:

account_sid = 'AC557b4c7a685d072baa73125f61031af3'
auth_token = 'a59cd5e5fdfddcc9ab008273557f8f78'
client = Client(account_sid, auth_token)
message=client.messages\
.create(

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body='Forest Fire is Detected, stay alert',
from_='+14247991869',to='+918940722793')
print(message.sid)
print('Fire Detected')
print('SMS sent')
```

```
playsound(r'C:\Users\My\Downloads\buzzer.mp3')
else:
print("No Danger")
cv2.imshow("image",frame)
if cv2.waitKey(1) & 0xFF ==ord('a'):
break
video.release()
cv2.destroyAllWindows()
```

GITHUB

https://github.com/IBM-EPBL/IBM-Project-14233-1659546538

PROJECT DEMO

https://drive.google.com/drive/folders/12eRdGd7rbR8L_V3kRFJ1wIx1QLsfmzd6