



EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES



NALAIYA THIRAN PROJECT BASED LEARNING ON PROFESSIONAL READLINESS FOR INNOVATION, EMPLOYNMENT AND ENTERPRENEURSHIP.

A PROJECT REPORT SUBMITTED BY ,

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PROJECT REPORT:

1. INTRODUCTION

- a. Project Overview
- b. Purpose

2. LITERATURE SURVEY

- a. Existing problem
- b. References
- c. Problem Statement Definition

3. IDEATION & PROPOSED SOLUTION

- a. Empathy Map Canvas
- b. Proposed Solution
- c. Problem Solution fit

4. REQUIREMENT ANALYSIS

- a. Functional requirement
- b. Non-Functional requirements

5. PROJECT DESIGN

- a. Data Flow Diagrams
- b. Solution & Technical Architecture
- c. User Stories

6. PROJECT PLANNING & SCHEDULING

- a. Sprint Planning & Estimation
- b. Sprint Delivery Schedule
- c. Reports from JIRA

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

- a. Feature 1
- b. Feature 2
- c. Database Schema (if Applicable)

8. TESTING

- a. Test Cases
- b. User Acceptance Testing

9. RESULTS

- a. Performance Metrics

10. ADVANTAGES & DISADVANTAGES

11. CONCLUSION

12. FUTURE SCOPE

13. APPENDIX

Source Code

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 the fire drill in every occurrence of months to protect their employees from 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. But 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.

a. Purpose

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

2. LITERATURE SURVEY:

2.1 Existing Problem:

1. **Surapong Surit, Watchara Chatwiriya** proposed a method to detect fire by smokedetection in video. This approach is based on digital image processing approach with static and dynamic characteristic analysis. The proposed method is composed of following steps, the first is to detect the area of change in the current input frame in comparison with the background image, the second step is to locate regions of interest (ROIs) by connected component algorithm, the area of ROI is calculated by convex hull algorithm and segments the area of change from image, the third step is to calculate static and dynamic characteristics, using this result we decide whether the object detected is the smoke or not. The result shows that this method accurately detects fire smoke.

2. P. Piccinini, S. Calderara, and R. Cucchiara proposed a method based on the wavelet model and a color model of the smoke. The proposed method exploits two features: the variation of energy in wavelet model and a color model of the smoke. Smoke is detected based on the decrease of energy ratio in wavelet domain between background and current. The deviation of the current pixel color is measured by the color model. Bayesian classifier is used to combine these two features to detect smoke.

3. R. Gonzalez proposed a method to detect fire based on Wavelet Transform. Stationary Wavelet Transform is used to detect Region of Interest. This method involves three steps preprocessing, SWT, histogram analysis. In preprocessing unwanted distortions are removed and image is resized and transformation of resized image is performed. High frequencies of an image are eliminated using SWT and the reconstruction of image is done by inverse SWT. Image indexation is performed to group the intensity colors that are closed to each other. Histogram analysis is used to determine the various levels of indexation. After analysis a comparison is made with non-smoke frame and non-smoke images are eliminated. These three are combined and fire is detected.

4. Osman Gunay and Habiboglu proposed a system based on Covariance Descriptors, Color Models, and SVM Classifier. This system uses video data. Spatio-temporal Covariance Matrix (2011) [13] is used in this system which divides the video data into temporal blocks and computes covariance features. The fire is detected using this feature. SVM Classifier is used to filter fire and fire-like regions. This system supports only for clear data not for blur data.

5. Dimitropoulos (2015) proposed an algorithm where a computer vision approach for fire-flame detection is used to detect fire at an early stage. Initially, background subtraction and color analysis is used to define candidate fire regions in a frame and this approach is a non-parametric model. Following this,

the fire behavior is modeled by employing various Spatiotemporal features such as color probability, flickering, spatial and spatiotemporal energy. After flame modeling the dynamic texture analysis is applied in each candidate .

6. Histogram and Mediods. LDS is used to increase the robustness of the algorithm by analyzing temporal evolution of pixel intensities. Preprocessing is done after this to filter non-candidate regions. Spatio-temporal analysis is done to increase the reliability of the algorithm. The consistency of each candidate fire region is estimated to determine the existence of fire in neighboring blocks from the current and previous video frames. Finally, a two-class SVM classifier is used to classify the fire and no fire regions.

7. Hamed Adab proposed another system which is based on Indexing. GIS techniques and remote sensing [10] provides further assistance. The indexing may be structural fire index, Fire risk index, Hybrid fire index. Depending on the geographical condition of the area the indexing differs. Validations of indices are based on hot spot data. Structural fire indices show static information and it does not change over short time span and used to predict the risk in advance. Fire risk index changes as the vegetation or climate changes. Hybrid index is a combination of Structure and Fire index. The disadvantage of this indexing is that way of combining.

8. Celik (2007) proposed a generic model for fire and smoke detection without the use of sensors [15]. Fuzzy based approach is used in this system. Color models such as YCbCr, HSV are used for fire and smoke detection. The fire is detected using YCbCr color model samples because it distinguishes luminance and chrominance. Y, Cb, Cr color channels are separated from RGB input image. A pixel is more likely a fire pixel if intensity of Y channel is greater than channel Cb and Cr.

9. Paulo Vinicius Koerich Borges proposed a fire detection method based on probabilistic method and classification. Computer vision based approach is used in this approach. Though this approach is used surveillance it is also used to automatic video classification for retrieval of fire catastrophes in databases of newscast content. There are large variations in fire and background characteristics depending on the video instance. The proposed method observes the frame-to-frame changes of low-level features describing potential fire regions. These features include color, area size, surface coarseness, boundary roughness, and skewness within estimated fire regions.

10. Bayes classifier is used for fire recognition. In addition, apriori knowledge of fire events captured in videos is used to significantly improve the results. The fire region is usually located in image produce satisfying result we now go for fire detection to produce accurate result. Wavelet based smoke detection is used for smoke detection in video sequences of outdoor environment. Covariance method is for flame detection. This method use temporally extended covariance matrices representing all the information together. The method works only well when the fire is clearly visible. If the fire is small and if it is far away from the camera or covered by dense smoke the method fails. Wavelet and Color model combined together and detect smoke earlier. Neural Network produces accurate result as it uses temperature, smoke density and CO concentration. Fuzzy based approach uses YCbCr and HSV model and detects fire at an early stage.

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2.3. Problem Statement Definition

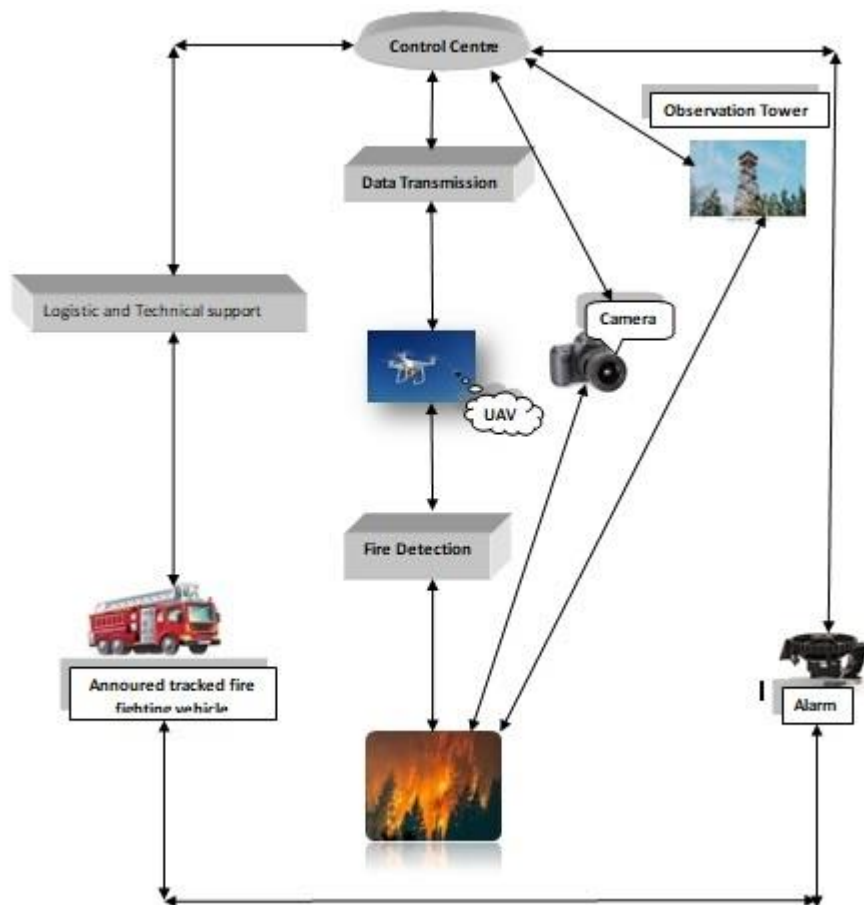
1. In earlier times fires were detected with the help of watching towers or using satellite images.
2. Satellites collect images and send it to the monitoring authority which will decide by seeing images that it is a fire or not.
3. But this approach was very slow as the fire may have spread in the large areas and caused so much damage before the rescue team came.
4. 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.
5. 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.
6. 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.
7. 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:
8. There were mainly two problems in fire detection as discussed:
9. (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.

10. So, this problem was removed by using machine learning techniques by many researchers.
11. (b). Connection of nodes: Traditional systems used cables to connect alarm with the detectors.
12. Cable was mainly of copper. But copper wire may be costly or it can suffer from fault in the mid-way.
13. So, this problem was removed using wireless sensor networks.
14. So, with the advancement in technology researchers find an efficient method to detect forest fire with the help of Wireless Sensor Network.
15. Fire can be identified by conveying sensor hubs in timberland regions by which they illuminate about fire.
16. 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 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.

3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

- i. An empathy map is a collaborative tool teams can use to gain a deeper 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 agile community.
- ii. 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 in a better way
- iii. 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 in an empathy map themselves. This often reveals aspects of the user that may have remained unsaid or not thought of.
- iv. Each of the four quadrants comprises a category that helps us delve into the mind of the user. The four empathy map quadrants look at what the user says, thinks, feels, and does.



b. Proposed Solution

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

S.No	Parameters	Description
•	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.
•	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.
•	Novelty / Uniqueness	Real time computer program detect forest fire in earliest before it spread to larger area.
•	Impact on society	Blocked roads and railway lines, electricity, mobile and land telephone lines cut, destruction of homes and industries.
•	Business Model (Revenue Model)	The proposed method was implemented using the Python programming language on a Core i3 or greater (CPU and 4GB RAM.)
•	Scalability of the Solution	Computer vision models enable land cover classification and smoke detection from satellite and ground cameras

c. 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	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.	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	Explore AS, differentiate
Focus on J&P, tap into BE, understand RC	2. JOBS-TO-BE-DONE / PROBLEMS J&P Which job-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.	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.	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. (save space))	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 neighbour installing solar panels, reading about a more efficient solution in the news.	10. YOUR SOLUTION EM 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 behaviour.	8. PRINCIPLE - EXPLANATION EM 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.	Identify strong TR & EM
	4. EMOTIONS: BEFORE / AFTER EM i.e. lost, insecure > confident, in control - use it in your communication strategy & design.			

4.REQUIREMENT ANALYSIS

a. Functional Requirements

4.1.1.High Priority

1. The system shall take training sets of fire images and recognize whether there is a fire or the beginning of a fire (smoke) or if there is no fire
2. 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 or not
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.
6. 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. Medium Priority

Following facility that will allow web pages that the user is permitted to access. The system must support the following facility:

- a. Send alert message
- b. Customer data management

4.1.3 Low priority:

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

b. Non Functional Requirements

3. Non-Functional Objectives

4.2.1. Reliability

- i. The system shall be completely operational at least x% of the time.
- ii. Down time after a failure shall not exceed x hours.

4.2.2. Usability

- iii. Customer should be able to use the system in his job for x days .
- iv. A user who already knows what camera he is using should be able to connect and view that page in x seconds.

4.2.3. Performance

- v. The system should be able to support x simultaneous users.

vi. The mean time to view a web page over a 56Kbps modem connection shall not exceed x seconds..

4.2.4.Security

vii. The system shall provide password protected access to web pages that are to be viewed only by users.

4.2.5.Supportability

viii. The system should be able to accommodate many camera links.

ix. The system web site shall be viewable from chrome or any browser.

4.2.6.Interfaces

The system must interface with

x. The cloudant db for customer and customer log information

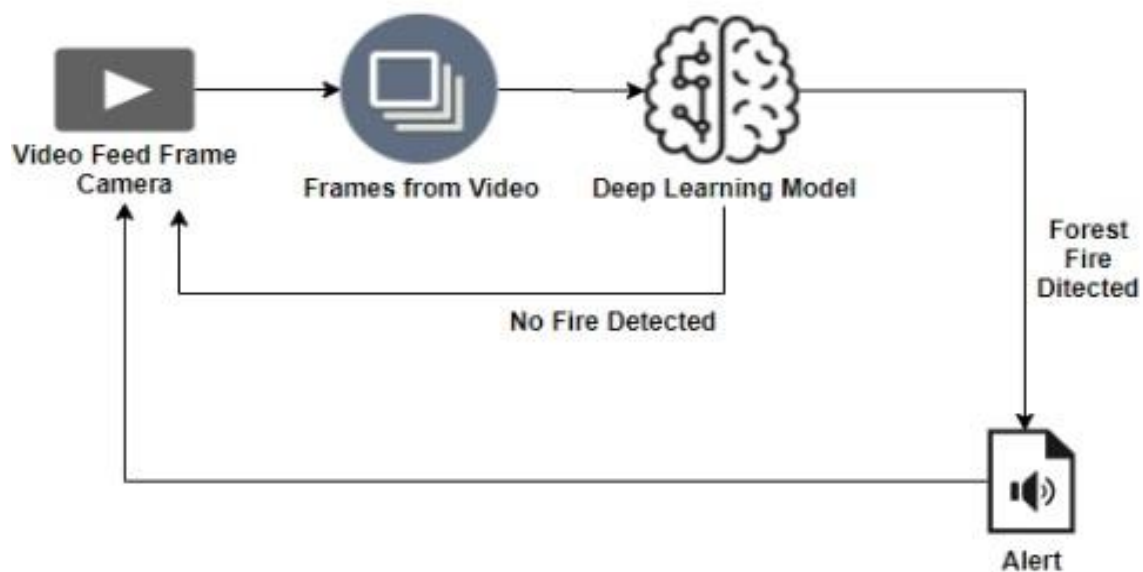
xi. The acquired web site search engine.

1.PROJECT DESIGN

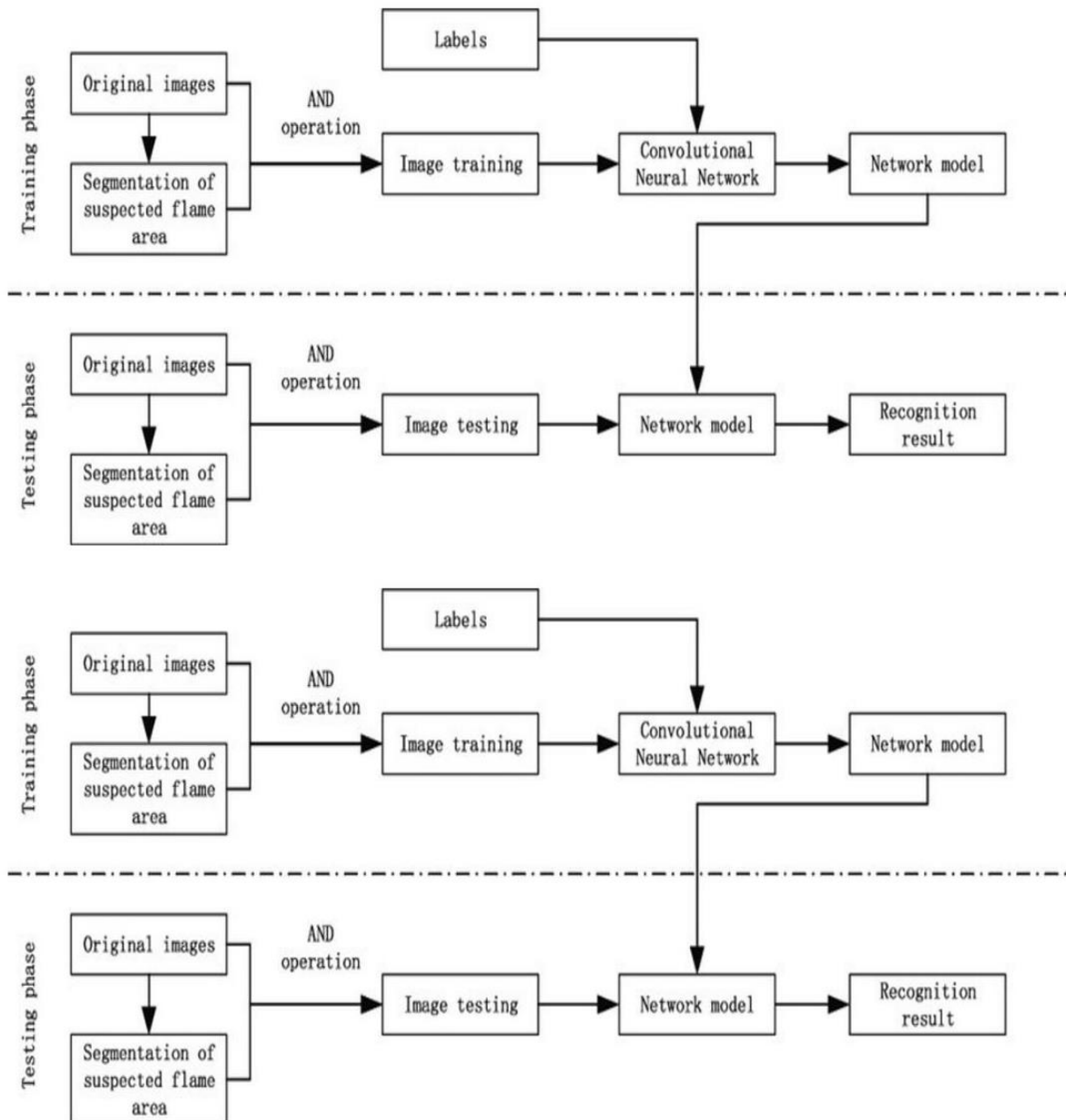
a. Data Flow Diagrams

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 .

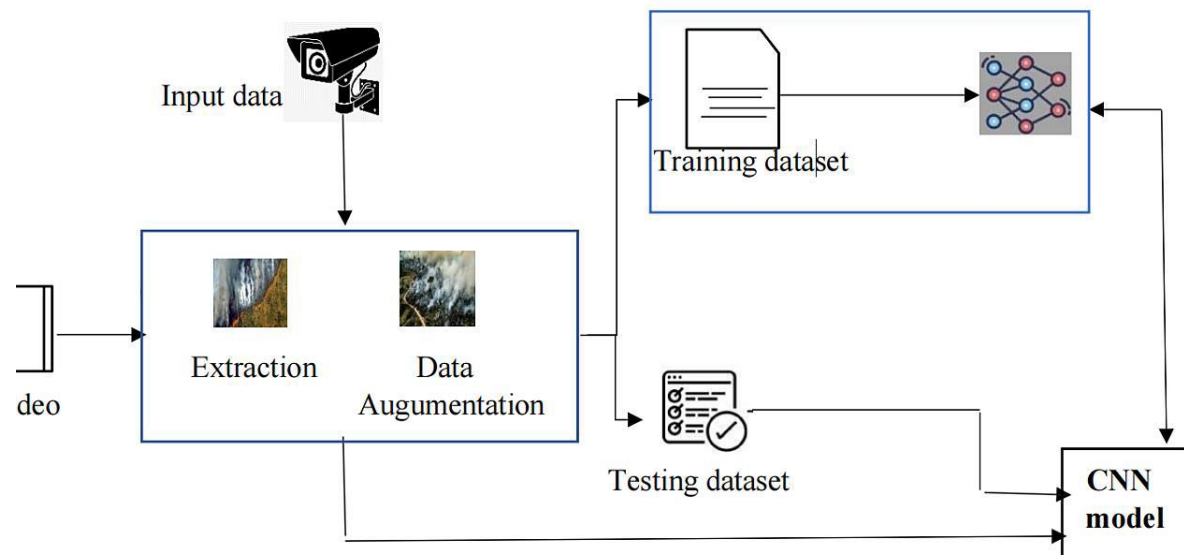


b. Solution & Technical Architecture

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

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

- Provide specifications according to which the solution is defined, managed, and delivered.



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

User Type	Functional Requirement (Epic)	User Story Number	User Story I 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

PROJECT PLANNING & SCHEDULING :

a. Sprint Planning & Estimation :

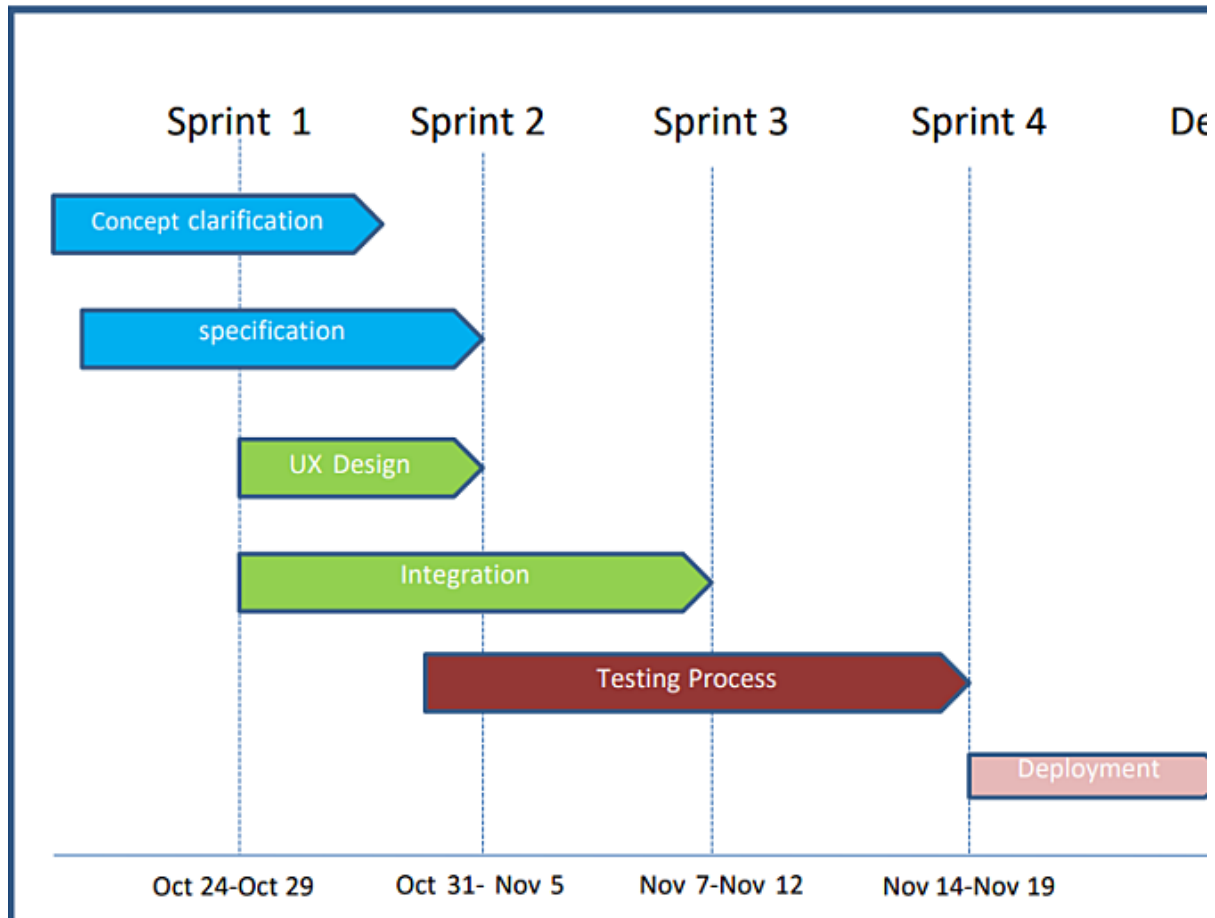
Milestone Name	Milestone Number	Description	Mandatory	Optional
Project Objectives	M-001	We will be able to learn to prepare dataset, image processing, working with CNN layers, read images using OpenCV and CNN for computer vision AI	Yes	-
Project Flow	M-002	A project management process flowchart is a graphical aid, designed to visualize the sequence of steps to be followed throughout the project management process	Yes	
Pre-Requisites	M-003	To complete this project we should have known following project such as Keras, Tensorflow, Python ,Anaconda, OpenCV, Flask, Scikit-learn etc....	Yes	
Prior Knowledge	M-004	One should have knowledge on the Supervised Learning ,CNN and Regression Classification and Clustering, ANN	Yes	
Data collection	M-005	We can collect dataset from different open sources like kaggle.com, UCI machine learning etc	Yes	
Image Preprocessing	M-006	Importing the ImageDataGenerator libraries, Define Parameters/Arguments for ImageDataGenerator class, Applying Image Data Generator Functionality to trainset and testset	Yes	
Model Building	M-007	Importing the model building libraries, Initializing the model, Adding CNN layers, Adding Dense layers, Configuring the learning Process,Train the model,Save the model,Predictions.	Yes	
Video Analysis	M-008	Opencv for video processing, creating an account in twilio service and sending alert message	Yes	
Train CNN model	M-009	Register for IBM Cloud and train Image Classification Model	Yes	
Ideation Phase	M-010	Prepare Literature Survey on the selected Project and Information Gathering, empathy map and ideation	Yes	
Project Design Phase-I	M-011	Prepare Proposed solution , problem-solution fit and Solution Architecture	Yes	
Project Design Phase-II	M-012	Prepare Customer journey ,functional requirements,Data flow diagram and Technology Architecture	Yes	
Project Planning Phase	M-013	Prepare Milestone list , Activity list and Sprint Delivery Plan	Yes	
Project DevelopmentPhase	M-014	Project Development delivery of Sprint 1, Sprint 2, Sprint 3, Sprint 4	Yes	

Activity Number	Activity Name	Detailed Activity Description
1.1	Access Resources	Access the resources (courses) in project dashboard.
1.2	Rocket chat registration	Join the mentoring channel via platform & rocket-chat mobile app.
1.3	Access workspace	Access the guided project workspace.
1.4	IBM Cloud registration	Register on IBM Academic Initiative & Apply Feature code for IBM Cloud Credits.
1.5	Project Repository Creation	Create GitHub account & collaborate with Project Repository in project workspace.
1.6	Environment Setup	Set-up the Laptop / Computers based on the pre-requisites for each technology track.
2.1	Literature survey	Literature survey on the selected project & Information Gathering.
2.2	Technology Training	Attend the technology trainings as per the training Calendar.
2.3	Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements
2.4	Technology Training	Attend the technology trainings as per the training Calendar.
2.5	Brainstorming	List the ideas (at least 4 per each team member) by

		organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.
2.6	Technology Training	Attend the technology trainings as per the training Calendar.
3.1	Proposed Solution Document	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.
3.2	Technology Training	Attend the technology trainings as per the training Calendar.
3.3	Problem - Solution fit & Solution Architecture	Prepare problem - solution fit document & Solution Architecture.
3.4	Technology Training	Attend the technology trainings as per the training Calendar.
4.1	Customer Journey Map	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).
4.2	Technology Training	Attend the technology trainings as per the training Calendar.
4.3	Functional Requirements & Data Flow Diagrams	Prepare the Functional Requirement Document & Data-Flow Diagrams.
4.4	Technology Architecture	Prepare Technology Architecture of the solution.
4.5	Technology Training	Attend the technology trainings as per the training Calendar.
5.1	Milestone & Activity List	Prepare Milestone & Activity List.
5.2	Sprint Delivery Plan	Prepare Sprint Delivery Plan.

6	Data Collection	Collect datasets from different open sources like kaggle.com, data.gov, UCI machine learning repository, etc.
7.1	Image Preprocessing	Importing the ImageDataGenerator Library
7.2	Image Preprocessing	Define the parameters/arguments for ImageDataGenerator class.
7.3	Image Preprocessing	Applying ImageDataGenerator functionality to trainset and test set.
8.1	Model Building	Importing the model building libraries.
8.2	Model Building	Initializing the model.
8.3	Model Building	Adding CNN Layers.
8.4	Model Building	Adding Dense Layers
8.5	Model Building	Configuring the learning process
8.6	Model Building	Training the Model
8.7	Model Building	Save the model
8.8	Model Building	Predictions
9.1	Video Analysis	OpenCV for video processing.
9.2	Video Analysis	Creating an account in Twilio service.
9.3	Video Analysis	Sending alert message.
10.1	Train CNN Model on IBM	Register for IBM Cloud
10.2	Train CNN Model on IBM	Train Image Classification Model

6.2 Sprint Delivery Schedule SPRINT DELIVERY PLAN



a. Reports from JIRA

JIRA has categorized reports in four levels, which are –

- i. Agile
- ii. Issue Analysis
- iii. Forecast & Management
- iv. Others

VELOCITY: SPRINT - 1

Sprint duration = 5 days

Velocity of team = 20 points

$$\text{Average Velocity (AV)} = \frac{\text{Velocity}}{\text{Sprint duration}}$$

$$AV = 20/5 = 4$$

Average Velocity = 4

VELOCITY: Sprint 1 - 4

Sprint duration = 20 days

Velocity of team = 80 points

$$\text{Average Velocity (AV)} = \frac{\text{Velocity}}{\text{Sprint duration}}$$

$$AV = 80/20 = 4$$

Total Average Velocity = 4

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

a. Feature

```
!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_t
est,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")

```

```

metrics = ["accuracy"])
model.fit_generator(x_train,steps_per_epoch=14,epochs=5,validation_data=x_t
est,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")

```

b. 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_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

```

```

#import 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

```

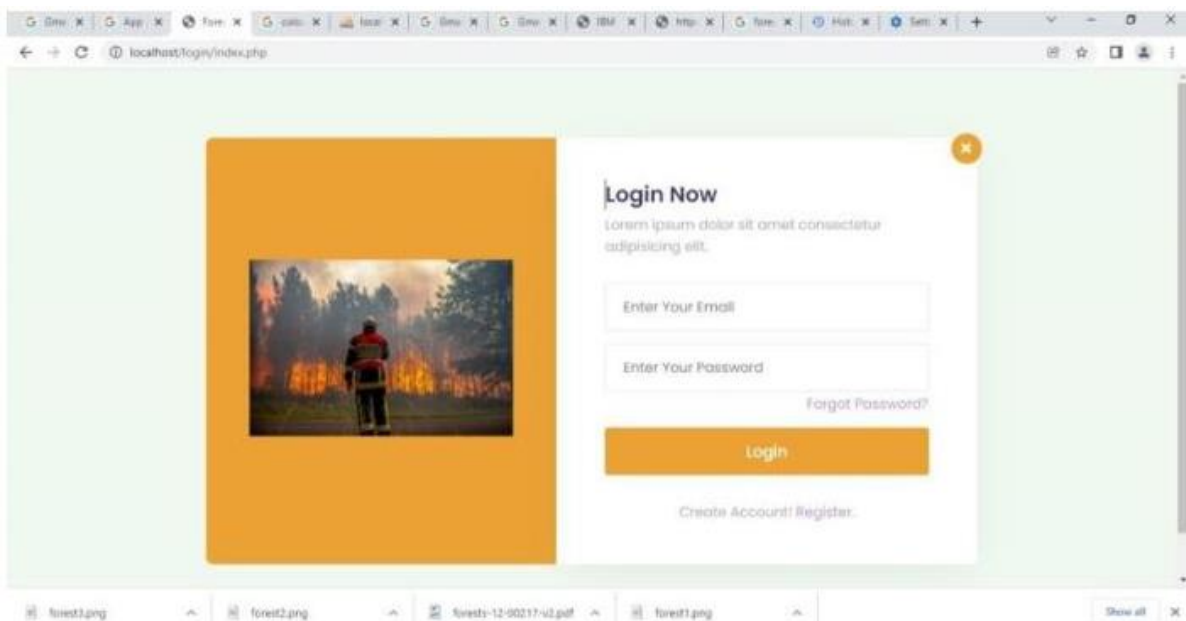
```

#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_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/1200px_Mount
ainarea.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)

```

1. TESTING

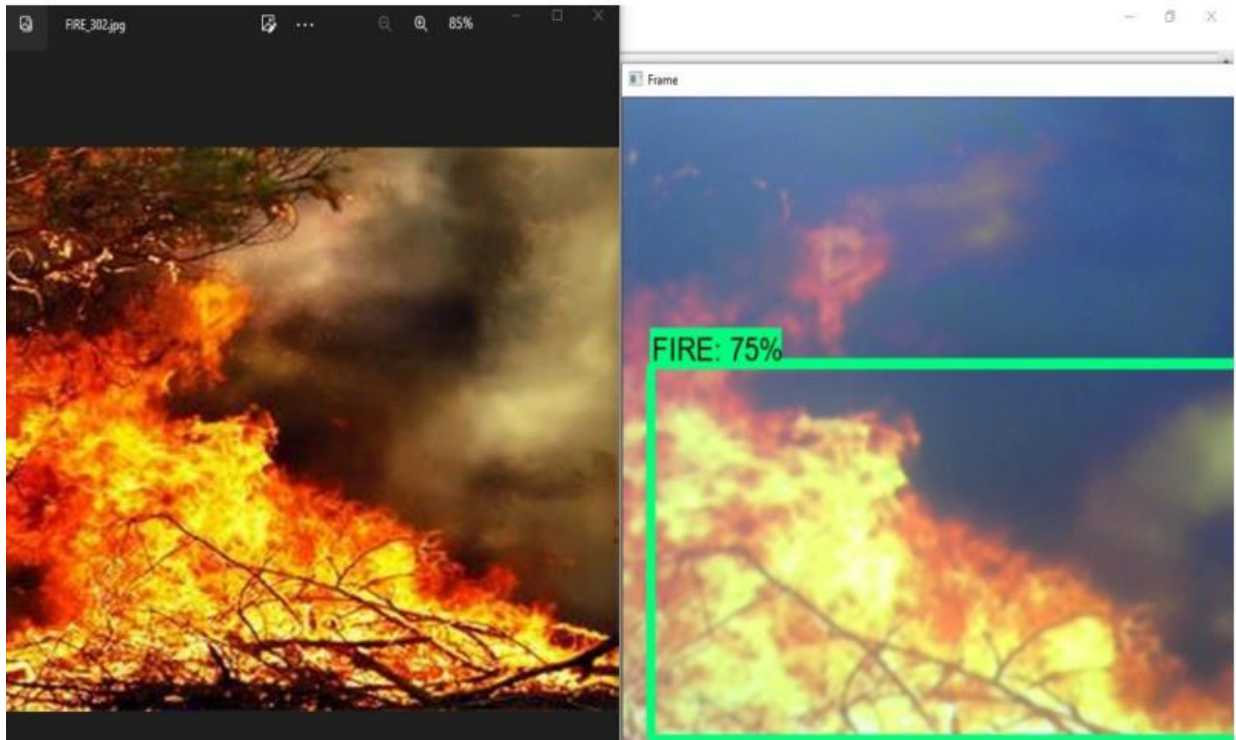
a. Test Cases



1. RESULTS

a. Performance

METRIXS



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.

1.ADVANTAGES & DISADVANTAGES

ADVANTAGE:



1. It refreshes the habitat zones: Fire clears out plants and trees to make more natural resources available to the habitat. Fewer trees mean more water becomes available for the remaining plants and animals that call the area their home. New grass and shrubs are food sources for a number of animals as well. A ground cover that comes back after a fire becomes a new micro-habitat. Everything is refreshed with a fire.

2. Low-intensity fires don't usually harm trees: The bark of a tree is like an armored shell against fire, pests, and other things that could damage them. Most forest fires burn at low- temperature levels when conditions are optimal and this causes minimal damage to the trees of the forest when it occurs. The end result is a clearing of the ground floor of the forest while the trees are able to continue standing majestically.

3. Decreases the Wastes on Forests: Forests have a lot of waste that ends up building up over time and these wastes can help create wildfires. If a large wildfire breaks out it might take weeks to control it and the damage it can cause is just too extensive to understand for us. Waste such as dead leaves on the ground can be pretty useful for wildfires to feed on and small forest fires just deal with these wastes properly without going out of control.

Disadvantages:

1. A forest fire sets up the potential for soil erosion to occur: Forest fires clear the underbrush away and encourage new growth, but there is a period of time between the fire and the new growth where the forest is vulnerable.

2. Forest fires always bring death in some form: Maybe it's just the weak plants of the forest that are killed during a fire, but there is always some sort of death that happens when a fire occurs.

Sometimes it is the firefighters who are tasked with stopping the fire. It could be animals or pets.

3. Uncontrolled fires can cause localized air pollution: Despite the amount of global development that has occurred, there are many forests that are difficult or nearly impossible to reach. Fires in these areas are left to burn in an uncontrolled fashion and this creates air pollution which can affect the local environment and make it difficult to breathe.

1.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.

2.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.

Demo Link:

<https://youtu.be/ufPM-ygA9P0>