EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES.

NALAIYA THIRAN PROJECT

IBM-Project-29242-1660122517

TEAM ID : PNT2022TMID26744

Submitted by

G.DEEPIKA
R.ABARNA
T.HEMAPRIYA
S.KOHILA

in partial fulfillment for the award of the degree

of

BACHELOR OF

ENGINNERINGIN

COMPUTER SCIENCE AND ENGINEERING

PROJECT REPORT

1. INTRODUCTION

Project Overview

Forests are the savior of earth’s ecological balance. Forest fires usually occur in areas remote from populated places, in order to that their detection at an early stage and timely reports to the competent services are of utmost importance. Forest fires are one among the foremost important and prevalent sort of disasters and that they can create great environmental problems for Nature. it's known that they're detectable and simply preventable. One and possiblythe foremost important method for shielding forests from wildfires is their early detection. The earliest possible detection enables a rapid response to attenuate the spread. 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.

Figure 1. Amazon rainforest wildfire,2019

To reduce the risk and prevent the forest fire they are big offerings to fight it like planes, fire brigade trucks, also extinguishers to small areas which depends upon the severity of the fire andleads to large investment by concerned agencies. Forest fires are highly destructive and are uncontrollable when it starts spreading over the area. Fire causes respiratory problems for livingbeings even they are living several kilometers away. The 2019, Australia wildfires almost 15 million acres have been burned and the fire also killed about one billion animals.

Purpose

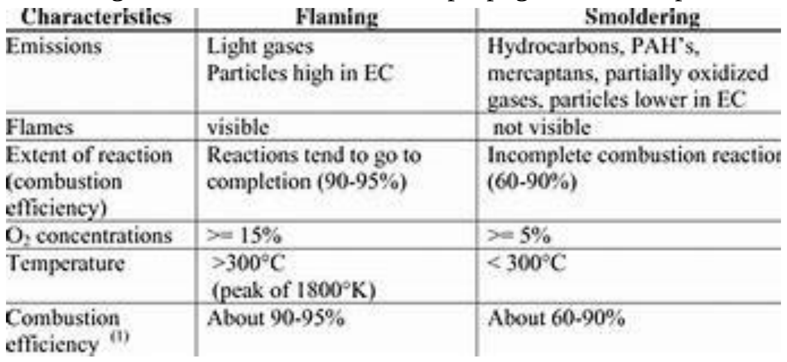
Forest fires as of late have been annihilating both for normal biological system, biodiversity andwoodland economy. With expanding populace weight and change in worldwide atmosphere situation, there is an expansion in level of fires that are a significant reason for declining Indian woodlands. As indicated 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 thewoods 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 backwoodstemperature in specific conditions. It is about the sensors and dynamic checking framework tododge a significant fire and genuine harm to woods.

2. LITERATURE SURVEY

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 toprevent fire is to 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 betweenthe 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 connectedwith 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 focalspot. 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, Maximumpower 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 nodesfrom the physical structure point of view: SNs, to collect data from the environment, and CNs, togather data from the SNs and transmit the information to a Control Centre. The nodes also canbe 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 detectionpurposes but also to environment monitoring to maximize the WSN usage. This environmentaldata can also be employed to firefighting preventive tasks such as vegetation modelling, microclimate studies, and propagation model parametrization.



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

TABLE 1. Comparison of different techniques

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 offire in video streams are indicated by semantic events. Most of the existing systems can only beused 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 hand held devices. It was decried as a global tragedy. Lit by farmers, the fires raged through villages, destroyed ecosystems and pumpedclimate-warming pollution into the atmosphere.

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2.3. Problem Statement Definition

Forest fires lead to destruction of forest wealth and not only that it also destroys the flora and fauna which causes harm to biodiversity. Forest are great resources and to preserve them is a major challenge. As, they are irreparable damage to the ecosystem, so forest fire detection andprevention is utmost important and best way to tackle this problem. But the forest fire early detection and prevention is another major challenge faced all over the world. Several methods for controlling and monitoring of fires have been proposed. In earlier days, manned observationtowers were used but this technique was inefficient and failed. After that satellite and camera imaging technologies were tried but this also proved inefficient and ineffective. For example, cameras were installed at different sites in forest but these provide only line of sight pictures. For a very large areas alert system is required as it is really tedious task to monitor all the images.

3. IDEATION & PROPOSED SOLUTION

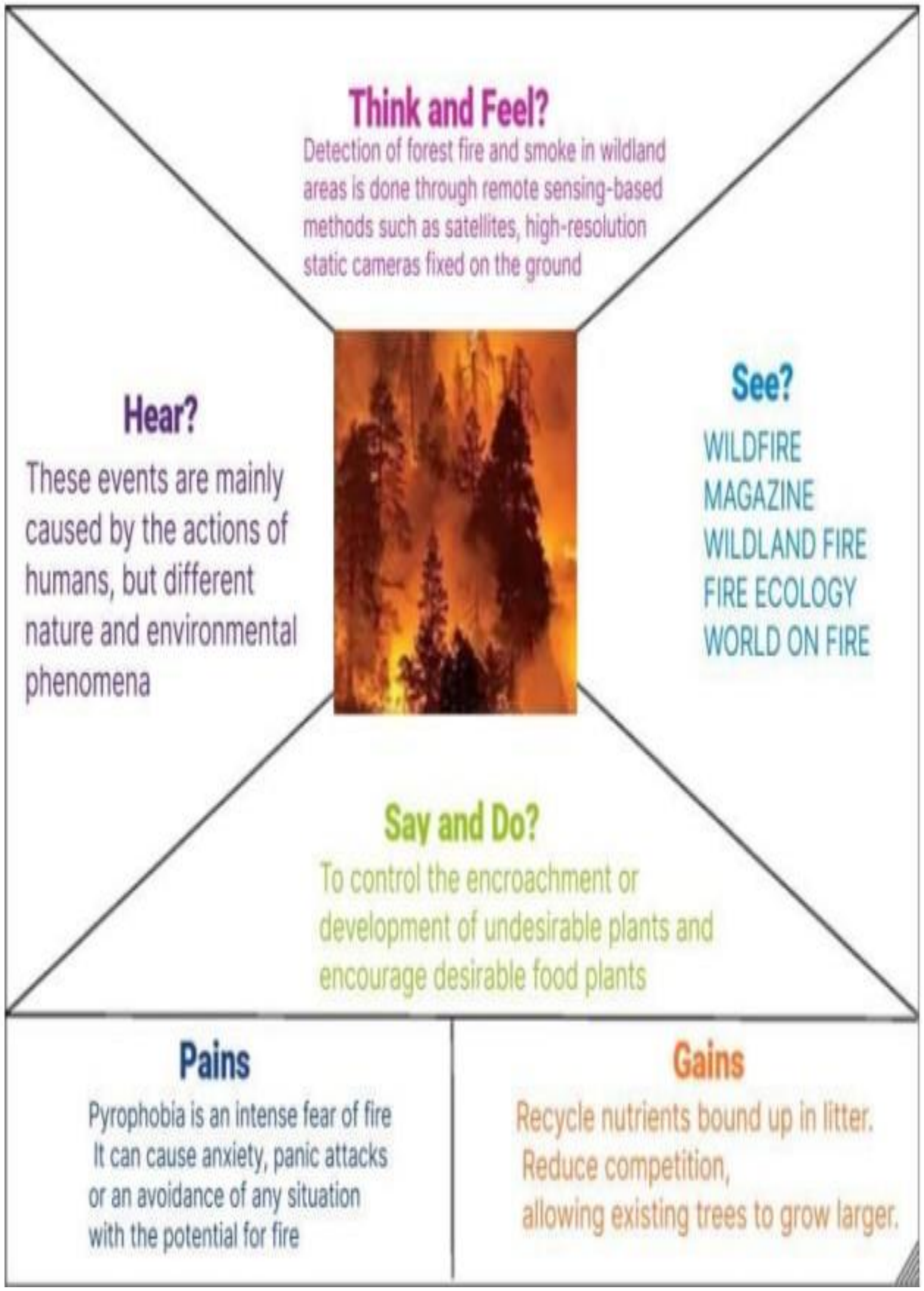
Empathy Map Canvas

1. An empathy map is a collaborative tool teams can use to gain a deeperinsight 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 Grayand has gained much popularity within the agile community.

2. An empathy map is an effective visualization template that helps analyze the behavior and emotions of customers and users. Empathy maps not only detect thebehaviors but highlight possible mediums for brands to communicate with their customers in abetter way

3. Empathy maps can also be used to collect data directly from the users. Used alongside user interviews, survey answers, etc., you can also have a user fill in anempathy map themselves. This often reveals aspects of the user that may have remained unsaid or not thought of.

4. Each of the four quadrants comprises a category that helps us delveinto the mind of the user. The four empathy map quadrants look at what the user says, thinks,feels, and does.



Think and Feel?

Detection of forest fire and smoke in wildland areas is done through remote sensing-based methods such as satellites, high-resolution static cameras fixed on the ground

Hear?

These events are mainly caused by the actions of humans, but different nature and environmental phenomena

See?

WILDFIRE
MAGAZINE
WILDLAND FIRE
FIRE ECOLOGY
WORLD ON FIRE

Say and Do?

To control the encroachment or development of undesirable plants and encourage desirable food plants

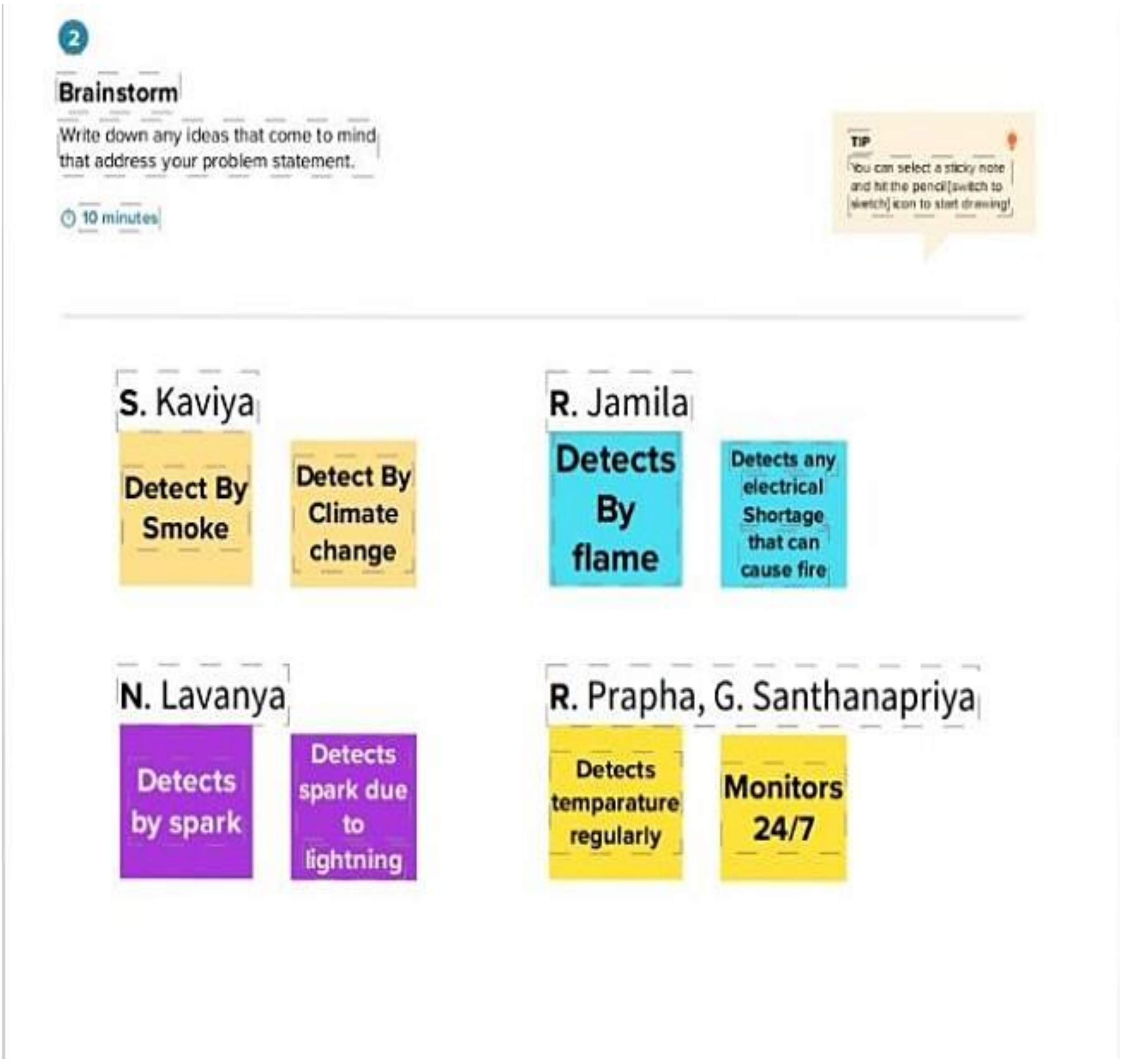
Pains

Pyrophobia is an intense fear of fire
It can cause anxiety, panic attacks or an avoidance of any situation with the potential for fire

Gains

Recycle nutrients bound up in litter.
Reduce competition,
allowing existing trees to grow larger.

Ideation & Brainstorming



2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

S. Kaviya

Detect By Smoke

Detect By Climate change

R. Jamila

Detects By flame

Detects any electrical Shortage that can cause fire

N. Lavanya

Detects by spark

Detects spark due to lightning

R. Prapha, G. Santhanapriya

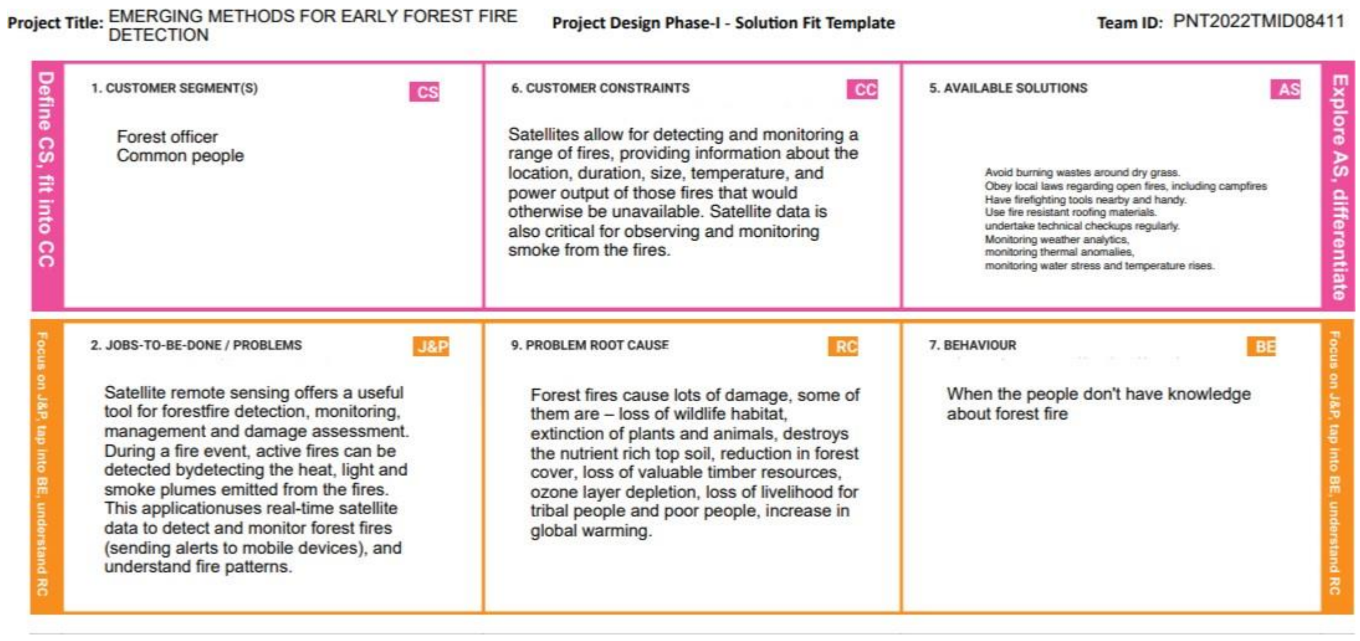
Detects temparature regularly

Monitors 24/7

Proposed Solution

S.No	**Parameter**	**Description**
1.	**Problem Statement (Problem to be solved)**	AI based Emerging methods for early detection of forest fires
2.	**Idea/Solution Description**	A solution is needed that detects fires early by detecting smoke, hydrogen and other gases released by pyrolysis in the early stages of a wildfire, buying firefighters valuable time to extinguish thefire before it spreads out of control. Sensing solutions from Bosch Sensortec can help to reduce wildfires.
3.	**Novelty/ Uniqueness**	Remote sensing Machine learning Wildfire prediction Data mining using Artificial intelligence
4.	**Social Impact/ / Customer Satisfaction**	The most important factors in the fight against the forest fires include the earliestpossible detection of the fire event , the proper categorisation of the fire and fast response from the fire services . Several different types of forest fires are known , including ground fires , surface fires and crown / tree fires . Each of these types of forest fires is specific and the proper counteractions against it must be considered and implemented to successfully fight it . Over the years the detection of forest fires has been conducted in different ways , ranging fromthe use of forest outposts to fully automated solutions .
5.	**Business Model (Revenue Model)**	The annual losses from forest fires in India for the entire country have been moderately estimated at Rs 440 crores (US$ 107

Problem Solution fit



Project Title: EMERGING METHODS FOR EARLY FOREST FIRE DETECTION

Project Design Phase-I - Solution Fit Template

Team ID: PNT2022TMID08411

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Forest officer
Common people

6. CUSTOMER CONSTRAINTS CC

Satellites allow for detecting and monitoring a range of fires, providing information about the location, duration, size, temperature, and power output of those fires that would otherwise be unavailable. Satellite data is also critical for observing and monitoring smoke from the fires.

5. AVAILABLE SOLUTIONS AS

Avoid burning wastes around dry grass.
Obey local laws regarding open fires, including campfires
Have firefighting tools nearby and handy.
Use fire resistant roofing materials.
undertake technical checkups regularly.
Monitoring weather analytics,
monitoring thermal anomalies,
monitoring water stress and temperature rises.

Explore AS, differentiate

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

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

Satellite remote sensing offers a useful tool for forestfire detection, monitoring, management and damage assessment. During a fire event, active fires can be detected bydetecting the heat, light and smoke plumes emitted from the fires. This applicationuses real-time satellite data to detect and monitor forest fires (sending alerts to mobile devices), and understand fire patterns.

9. PROBLEM ROOT CAUSE RC

Forest fires cause lots of damage, some of them are – loss of wildlife habitat, extinction of plants and animals, destroys the nutrient rich top soil, reduction in forest cover, loss of valuable timber resources, ozone layer depletion, loss of livelihood for tribal people and poor people, increase in global warming.

7. BEHAVIOUR BE

When the people don't have knowledge about forest fire

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

4. REQUIREMENT ANALYSIS

Functional Requirement

1. The system shall take training sets of fire images and recognize whether there is a fire or thebeginning 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 imagecontains a fire or not
4. The system shall be able to take images with a variety of sizes and convert it to one fixedimage 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 shouldstart automatically when the computer restarts

Non Functional Requirement

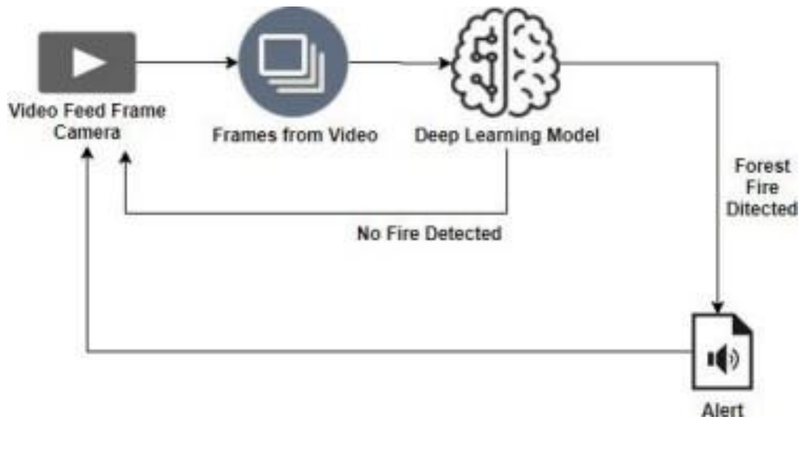
1. The system shall provide following facility that will allow web pages that the useris permitted to access. The system must support the following facility:
   a. Send alert message
   b. Customer data management

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

5. PROJECT DESIGN

Data Flow Diagrams

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 toits reliability and efficiency. The various real-time forest fire detection and prediction approaches, with the goal of informing the local fire authorities



Architecture Diagram

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.

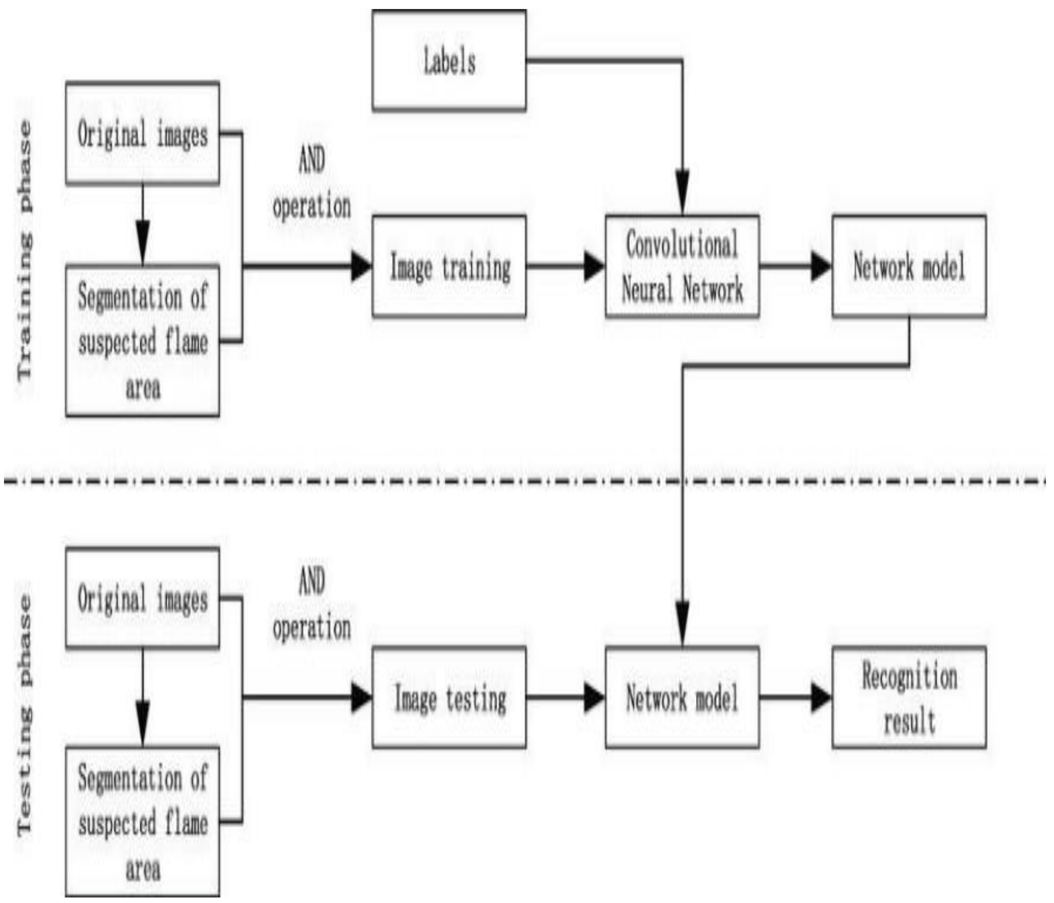
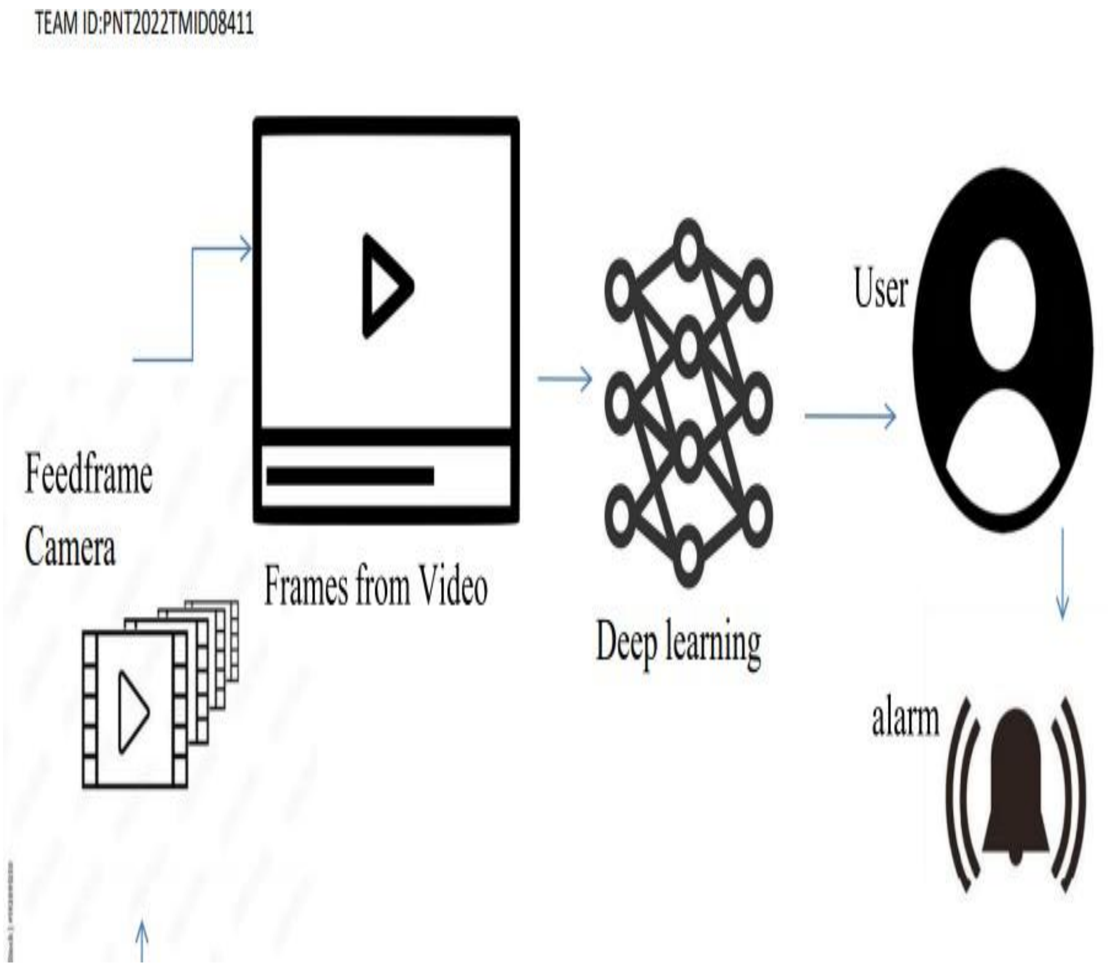


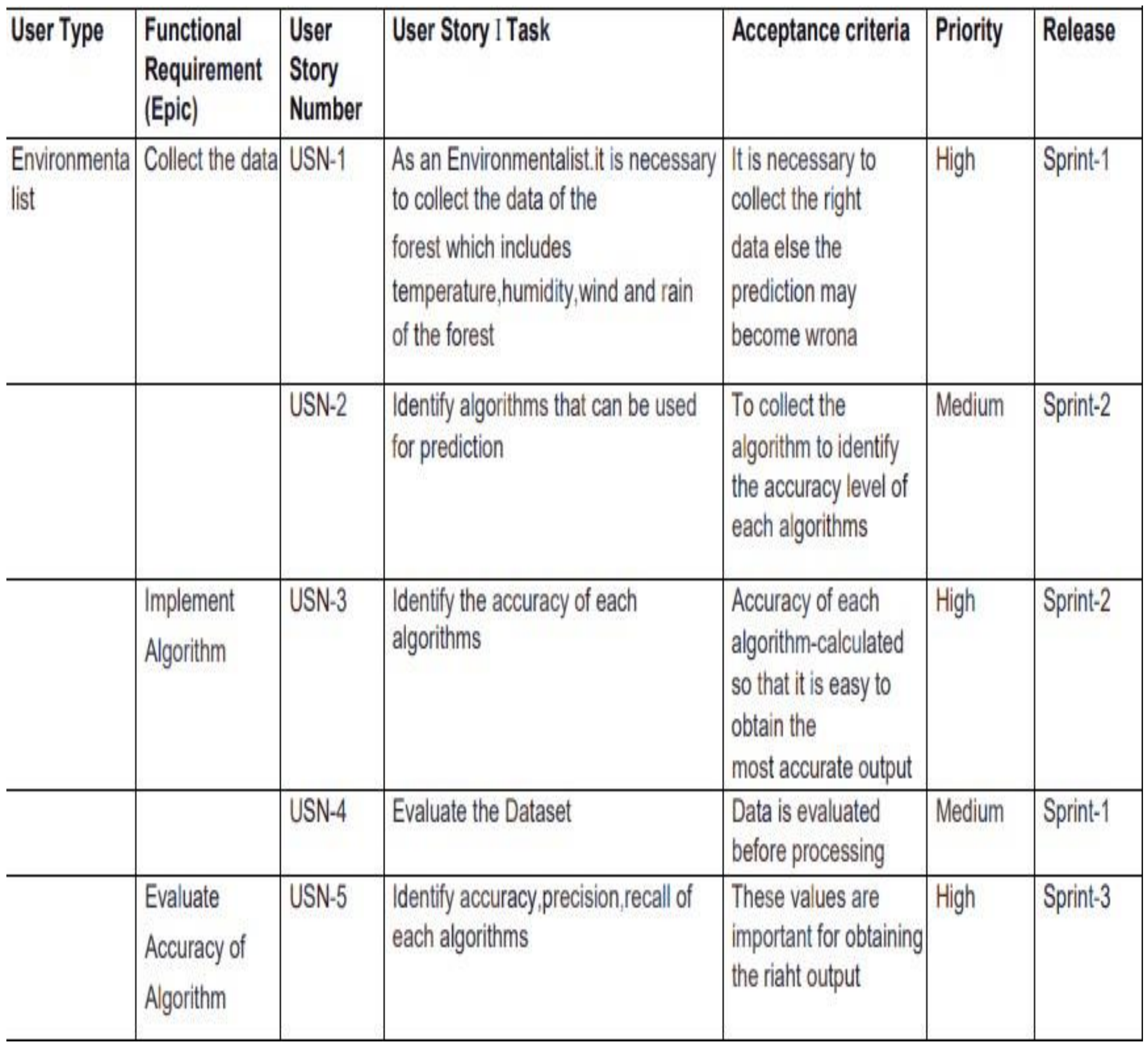
Fig 1. Data Flow Diagrams

Solution & Technical Architecture



Technical Architecture

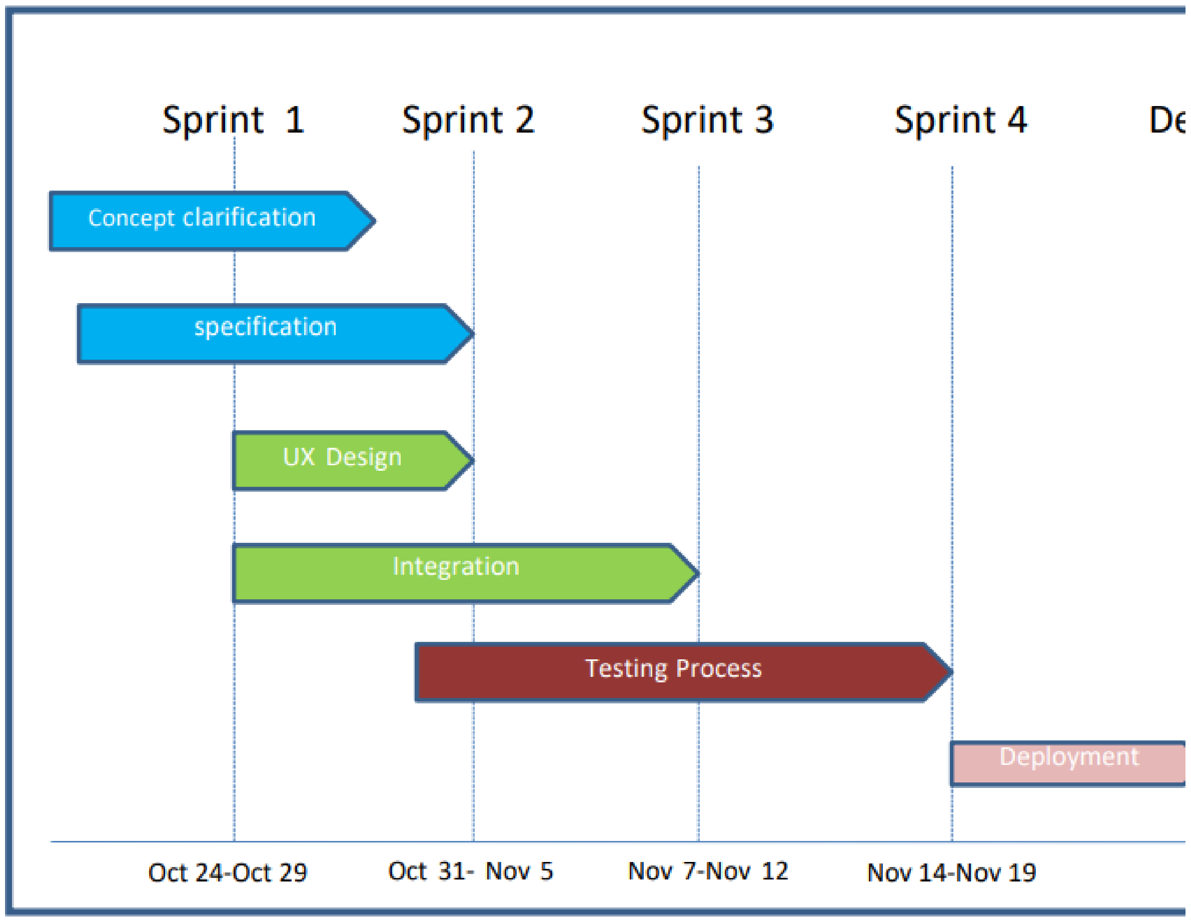
User Stories



User Type	Functional Requirement (Epic)	User Story Number	User Story I Task	Acceptance criteria	Priority	Release
Environmentalist	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 wrona	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 riaht output	High	Sprint-3

6. PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation



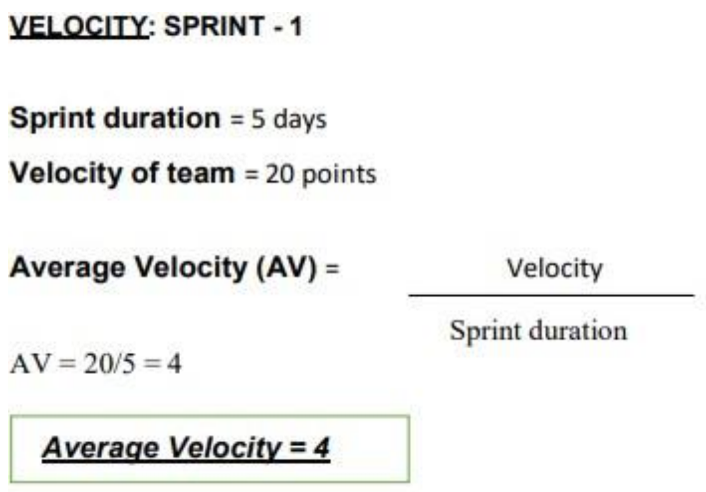
Sprint Delivery Schedule

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

Reports from JIRA

JIRA has categorized reports in four levels, which are –

- Agile
- Issue Analysis
- Forecast & Management
- Others



VELOCITY: SPRINT - 1

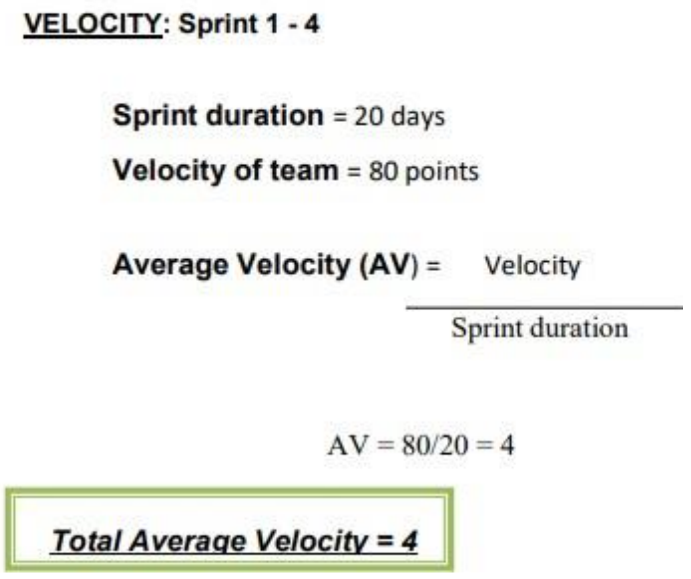
Sprint duration = 5 days

Velocity of team = 20 points

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

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

AV = 80/20 = 4

Total Average Velocity = 4

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

Feature 1

```
import warnings
warnings.filterwarnings("ignore") import
numpy as np
import sys
import tensorflow as tf
from distutils.version import StrictVersion
from collections import defaultdict
from object_detection.utils import ops as utils_ops

##import serial
##ser = serial.Serial(port = "COM7", baudrate = '9600')

# This is needed since the notebook is stored in the object_detection folder.
sys.path.append("..")


if StrictVersion(tf._version__) < StrictVersion('1.9.0'):
  raise ImportError('Please upgrade your TensorFlow installation to v1.9.* or later!')


from utils import label_map_util
from utils import visualization_utils as vis_util

MODEL_NAME = 'inference_graph'
PATH_TO_FROZEN_GRAPH = MODEL_NAME + '/frozen_inference_graph.pb'
PATH_TO_LABELS = 'training/labelmap.pbtxt'

detection_graph = tf.Graph()
with detection_graph.as_default():
  od_graph_def = tf.GraphDef()
  with tf.gfile.GFile(PATH_TO_FROZEN_GRAPH, 'rb') as fid:
    serialized_graph = fid.read()
    od_graph_def.ParseFromString(serialized_graph)
    tf.import_graph_def(od_graph_def, name='')
```

```
category_index = label_map_util.create_category_index_from_labelmap(PATH_TO_LABELS,use_display_name=True)

def run_inference_for_single_image(image, graph):if
    'detection_masks' in tensor_dict:
        # The following processing is only for single image detection_boxes =
        tf.squeeze(tensor_dict['detection_boxes'], [0]) detection_masks =
        tf.squeeze(tensor_dict['detection_masks'], [0])
        # Reframe is required to translate mask from box coordinates to image coordinates and fitthe image
size.
        real_num_detection = tf.cast(tensor_dict['num_detections'][0], tf.int32)
        detection_boxes = tf.slice(detection_boxes, [0, 0], [real_num_detection, -1])
        detection_masks = tf.slice(detection_masks, [0, 0, 0], [real_num_detection, -1, -1])detection_masks_reframed =
        utils_ops.reframe_box_masks_to_image_masks(
            detection_masks, detection_boxes, image.shape[0], image.shape[1])
        detection_masks_reframed = tf.cast(
            tf.greater(detection_masks_reframed, 0.5), tf.uint8)
        # Follow the convention by adding back the batch dimension
        tensor_dict['detection_masks'] = tf.expand_dims(
            detection_masks_reframed, 0)
    image_tensor = tf.get_default_graph().get_tensor_by_name('image_tensor:0')

    # Run inference
    output_dict = sess.run(tensor_dict,
                        feed_dict={image_tensor: np.expand_dims(image, 0)})

    # all outputs are float32 numpy arrays, so convert types as appropriate
    output_dict['num_detections'] = int(output_dict['num_detections'][0])
    output_dict['detection_classes'] = output_dict[
        'detection_classes'][0].astype(np.uint8)

    output_dict['detection_boxes'] = output_dict['detection_boxes'][0]
    output_dict['detection_scores'] = output_dict['detection_scores'][0]if
    'detection_masks' in output_dict:
        output_dict['detection_masks'] = output_dict['detection_masks'][0]
    if output_dict['detection_classes'][0] == 1 and output_dict['detection_scores'][0] > 0.70:
      print('FIRE')
    winsound.Beep(frequency, duration)

  if output_dict['detection_classes'][0] == 2 and output_dict['detection_scores'][0] > 0.70:
      print('FIRE')
```

```
 winsound.Beep(frequency, duration)

   if ((output_dict['detection_classes'][0] == 1 or output_dict['detection_scores'][0] < 0.70) and
(output_dict['detection_classes'][0] == 2 or  output_dict['detection_scores'][0] < 0.70)):
      print('No Fire')

    return output_dict
```

Feature 2

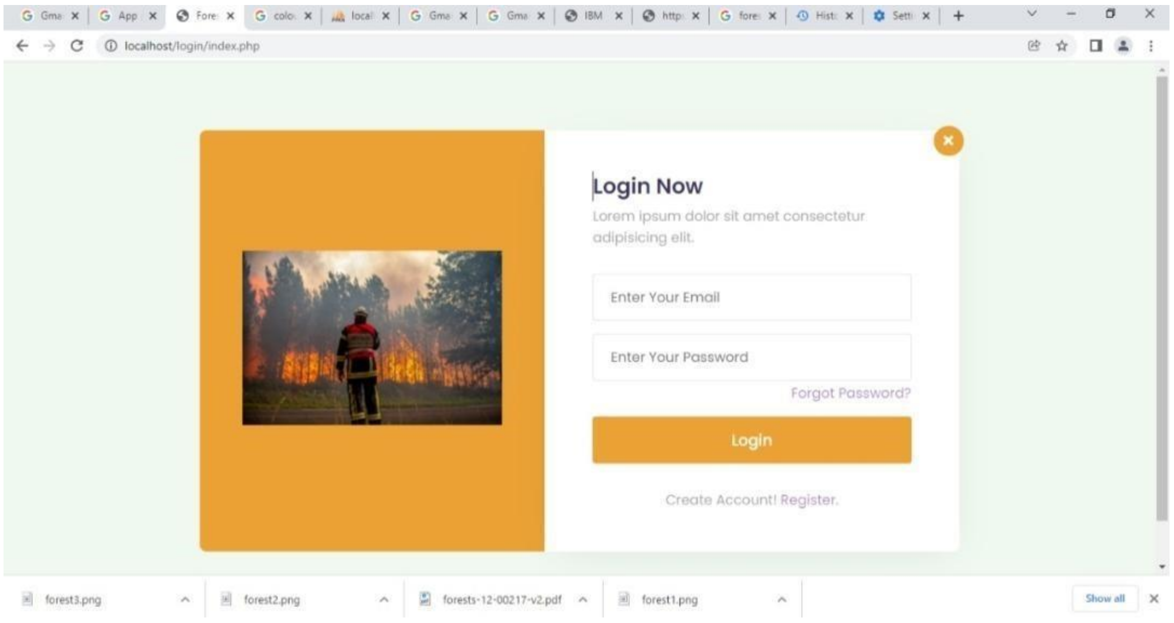
```
import cv2
cap = cv2.VideoCapture(0)

try:
    with detection_graph.as_default():with
        tf.Session() as sess:
                # Get handles to input and output tensors ops =
                tf.get_default_graph().get_operations()
                all_tensor_names = {output.name for op in ops for output in op.outputs}
                tensor_dict = {}
                for key in [
                  'num_detections', 'detection_boxes', 'detection_scores',
                  'detection_classes', 'detection_masks'
                ]:
                    tensor_name = key + ':0'
                    if tensor_name in all_tensor_names:
                        tensor_dict[key] = tf.get_default_graph().get_tensor_by_name(
                      tensor_name)

                while True:
                    ret, image_np = cap.read()
                    # Expand dimensions since the model expects images to have shape: [1, None,
None, 3]
                    image_np_expanded = np.expand_dims(image_np, axis=0)#
                    Actual detection.
                    output_dict = run_inference_for_single_image(image_np, detection_graph)#
                    Visualization of the results of a detection.
                    vis_util.visualize_boxes_and_labels_on_image_array(
                        image_np, output_dict['detection_boxes'],
                        output_dict['detection_classes'],
                        output_dict['detection_scores'],
                        category_index,
                        instance_masks=output_dict.get('detection_masks'),
                        use_normalized_coordinates=True, line_thickness=8)
                    cv2.imshow('Frame',   cv2.resize(image_np,(800,600))) if
                    cv2.waitKey(1) == ord('q'):
                        cap.release()
                        cv2.destroyAllWindows()
                        break
except Exception as e:
    print(e) cap.release()
```

8. TESTING

Test Cases


localhost/login/index.php

Login Now

Lorem ipsum dolor sit amet consectetur adipisicing elit.

Fig 1. Login page

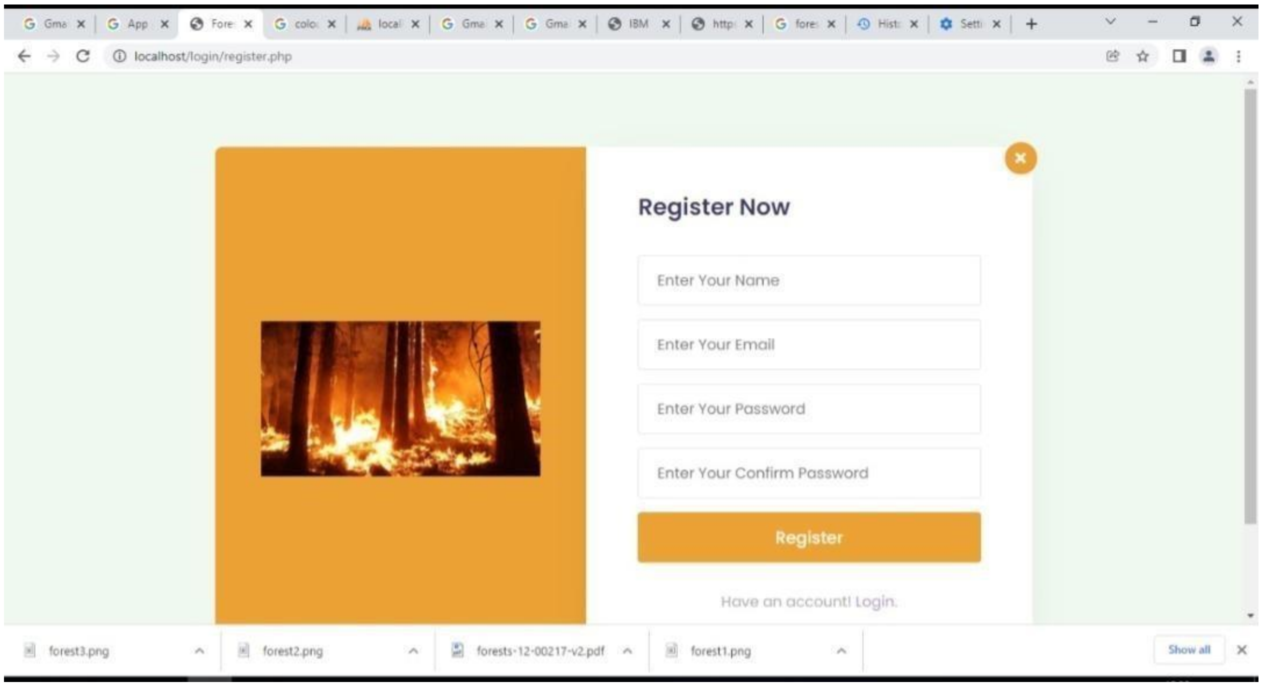


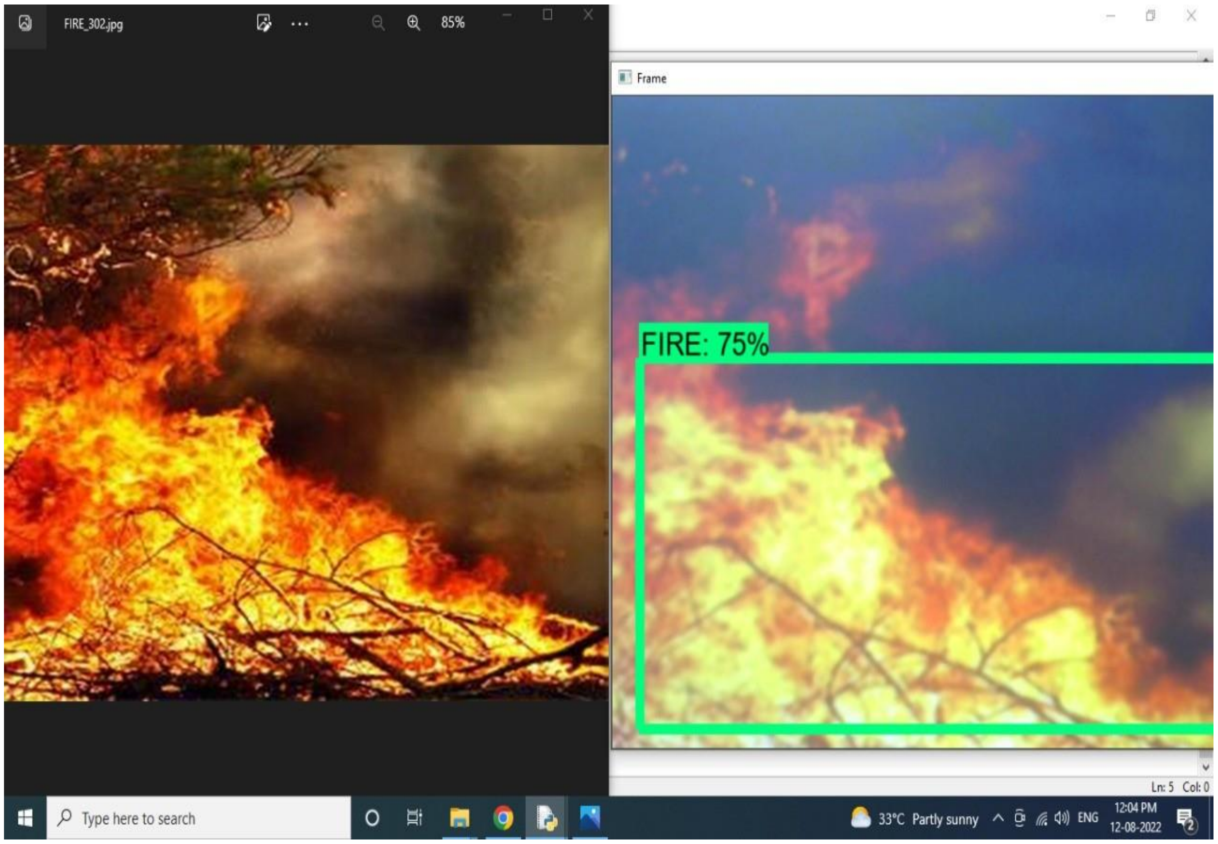
Fig 2. Register Page

User Acceptance Testing

1. This sort of testing is carried out by users, clients, or other authorised bodies toidentify the requirements and operational procedures of an application or piece of software.
2. The most crucial stage of testing is acceptance testing since it determineswhether or not the customer will accept the application or programmer.
3. It could entail the application's U.I., performance, usability, and usefulness. It isalso referred to as end-user testing, operational acceptance testing, and user acceptance testing (UAT).

9. RESULT

Performance Metrics



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 sensorvalue.Above image is result obtained from the trained ML model showing count for damaged and intact homes.

10. ADVANTAGES & DISADVANTAGES

Advantages:

1. **It refreshes the habitat zones:** Fire 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 anew 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 ofthe forest when it occurs. The end result is a clearing of the ground floor of the forest while thetrees 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 smallforest 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 andthe 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 afire occurs. Sometimes it is the firefighters who are tasked with stopping the fire. It could beanimals 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 toreach. 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.

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 whichovercomes 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.

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 updatingthe 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.

13. APPENDI

XSource Code:

```
import warnings
warnings.filterwarnings("ignore")
import numpy as np
import sys
import tensorflow as tf
from distutils.version import StrictVersionfrom
collections import defaultdict
from object_detection.utils import ops as utils_ops

##import serial
##ser = serial.Serial(port = "COM7", baudrate = '9600')

# This is needed since the notebook is stored in the object_detection folder.
sys.path.append("..")


if StrictVersion(tf.__version__) < StrictVersion('1.9.0'):
  raise ImportError('Please upgrade your TensorFlow installation to v1.9.* orlater!')
```

```
from utils import label_map_util
from utils import visualization_utils as vis_util

MODEL_NAME = 'inference_graph'
PATH_TO_FROZEN_GRAPH = MODEL_NAME + '/frozen_inference_graph.pb'
PATH_TO_LABELS = 'training/labelmap.pbtxt'

detection_graph = tf.Graph()
with detection_graph.as_default():
  od_graph_def = tf.GraphDef()
  with tf.gfile.GFile(PATH_TO_FROZEN_GRAPH, 'rb') as fid:
    serialized_graph = fid.read()
    od_graph_def.ParseFromString(serialized_graph)
    tf.import_graph_def(od_graph_def, name='')

category_index = label_map_util.create_category_index_from_labelmap(PATH_TO_LABELS,
use_display_name=True)

def run_inference_for_single_image(image, graph):if
    'detection_masks' in tensor_dict:
        # The following processing is only for single image detection_boxes =
        tf.squeeze(tensor_dict['detection_boxes'], [0]) detection_masks =
        tf.squeeze(tensor_dict['detection_masks'], [0])
        # Reframe is required to translate mask from box coordinates to image
coordinates and fit the image size.
        real_num_detection = tf.cast(tensor_dict['num_detections'][0], tf.int32)
        detection_boxes = tf.slice(detection_boxes, [0, 0], [real_num_detection,
-1])
        detection_masks = tf.slice(detection_masks, [0, 0, 0],
[real_num_detection, -1, -1]) detection_masks_reframed
        =
utils_ops.reframe_box_masks_to_image_masks(
            detection_masks, detection_boxes, image.shape[0], image.shape[1])
        detection_masks_reframed = tf.cast(
            tf.greater(detection_masks_reframed, 0.5), tf.uint8)
        # Follow the convention by adding back the batch dimension
        tensor_dict['detection_masks'] = tf.expand_dims(
            detection_masks_reframed, 0)
    image_tensor =
tf.get_default_graph().get_tensor_by_name('image_tensor:0')

    # Run inference
    output_dict = sess.run(tensor_dict,
                            feed_dict={image_tensor: np.expand_dims(image, 0)})

    # all outputs are float32 numpy arrays, so convert types as appropriate
    output_dict['num_detections'] = int(output_dict['num_detections'][0])
    output_dict['detection_classes'] = output_dict[
        'detection_classes'][0].astype(np.uint8)

    output_dict['detection_boxes'] = output_dict['detection_boxes'][0]
    output_dict['detection_scores'] =  output_dict['detection_scores'][0]if
    'detection_masks' in output_dict:
        output_dict['detection_masks'] =  output_dict['detection_masks'][0]if
    output_dict['detection_classes'][0] == 1 and
output_dict['detection_scores'][0] > 0.70:
      print('FIRE')

    if output_dict['detection_classes'][0] == 2 and
output_dict['detection_scores'][0] > 0.70:
      print('FIRE')
    if ((output_dict['detection_classes'][0] == 1 or
output_dict['detection_scores'][0] < 0.70) and
(output_dict['detection_classes'][0] == 2 or
output_dict['detection_scores'][0] < 0.70)):
      print('No Fire')

    return  output_dict




import cv2
cap = cv2.VideoCapture(0)

try:
    with detection_graph.as_default():with
        tf.Session() as sess:
                # Get handles to input and output tensors ops =
                tf.get_default_graph().get_operations()
                all_tensor_names = {output.name for op in ops for output in
op.outputs}
                tensor_dict = {}
                for key in [
                  'num_detections', 'detection_boxes', 'detection_scores','detection_classes',
                  'detection_masks'
                ]:
                    tensor_name = key + ':0'
                    if tensor_name in all_tensor_names:
                        tensor_dict[key] = tf.get_default_graph().get_tensor_by_name(tensor_name)

                while True:
                    ret, image_np = cap.read()
                    # Expand dimensions since the model expects images to haveshape:
[1, None, None, 3]
                    image_np_expanded = np.expand_dims(image_np,  axis=0)#
                    Actual detection.
                    output_dict = run_inference_for_single_image(image_np,
detection_graph)
                    # Visualization of the results of a detection.
                    vis_util.visualize_boxes_and_labels_on_image_array(
                        image_np, output_dict['detection_boxes'],
                        output_dict['detection_classes'],
                        output_dict['detection_scores'],
                        category_index,
                        instance_masks=output_dict.get('detection_masks'),
                        use_normalized_coordinates=True, line_thickness=8)
                    cv2.imshow('Frame',   cv2.resize(image_np,(800,600))) if
                    cv2.waitKey(1) == ord('q'):
                        cap.release()
                        cv2.destroyAllWindows()
                        break
except Exception as e:
    print(e) cap.release()
```

MODEL MAIN:

```
from__future___import absolute_import
from__future___import division
from__future___import print_function
```

```
from absl import flags

import tensorflow as tf

from object_detection import model_hparamsfrom
object_detection import model_lib

flags.DEFINE_string(
   'model_dir', None, 'Path to output model directory '
   'where event and checkpoint files will be written.')
flags.DEFINE_string('pipeline_config_path', None, 'Path to pipeline config ''file.')
flags.DEFINE_integer('num_train_steps', None, 'Number of train steps.')
flags.DEFINE_boolean('eval_training_data', False,
                'If training data should be evaluated for this job. Note ''that
                one call only use this in eval-only mode, and '
                '`checkpoint_dir` must be supplied.')
flags.DEFINE_integer('sample_1_of_n_eval_examples', 1, 'Will sample one of'
                'every n eval input examples, where n is provided.')
flags.DEFINE_integer('sample_1_of_n_eval_on_train_examples', 5, 'Willsample '
                'one of every n train input examples for evaluation, '
                'where n is provided. This is only used if '
                '`eval_training_data` is True.')
flags.DEFINE_string(
   'hparams_overrides', None, 'Hyperparameter overrides, ''represented as a
   string containing comma-separated ' 'hparam_name=value pairs.')
flags.DEFINE_string(
   'checkpoint_dir', None, 'Path to directory holding a checkpoint. If '
   '`checkpoint_dir` is provided, this binary operates in eval-only mode, '
```

```
    'writing resulting metrics to `model_dir`.')
flags.DEFINE_boolean(
    'run_once', False, 'If running in eval-only mode, whether to run just ''one
    round of eval vs running continuously (default).'
)
FLAGS = flags.FLAGS


def main(unused_argv): flags.mark_flag_as_required('model_dir')
  flags.mark_flag_as_required('pipeline_config_path')
  config = tf.estimator.RunConfig(model_dir=FLAGS.model_dir)

  train_and_eval_dict = model_lib.create_estimator_and_inputs(
      run_config=config,
      hparams=model_hparams.create_hparams(FLAGS.hparams_overrides),
      pipeline_config_path=FLAGS.pipeline_config_path,
      train_steps=FLAGS.num_train_steps,
      sample_1_of_n_eval_examples=FLAGS.sample_1_of_n_eval_examples,
      sample_1_of_n_eval_on_train_examples=(
          FLAGS.sample_1_of_n_eval_on_train_examples))
  estimator = train_and_eval_dict['estimator'] train_input_fn =
  train_and_eval_dict['train_input_fn'] eval_input_fns =
  train_and_eval_dict['eval_input_fns']
  eval_on_train_input_fn = train_and_eval_dict['eval_on_train_input_fn']
  predict_input_fn = train_and_eval_dict['predict_input_fn']
  train_steps = train_and_eval_dict['train_steps']

  if FLAGS.checkpoint_dir:
    if FLAGS.eval_training_data:
      name = 'training_data'
      input_fn = eval_on_train_input_fn
    else:
      name = 'validation_data'
      # The first eval input will be evaluated.
      input_fn = eval_input_fns[0]
    if FLAGS.run_once:
      estimator.evaluate(input_fn,
                         num_eval_steps=None, checkpoint_path=tf.train.latest_checkpoint(
                             FLAGS.checkpoint_dir))
    else:
      model_lib.continuous_eval(estimator, FLAGS.checkpoint_dir, input_fn,
                                train_steps, name)
  else:
    train_spec, eval_specs = model_lib.create_train_and_eval_specs(train_input_fn,
        eval_input_fns,
        eval_on_train_input_fn,
        predict_input_fn,
        train_steps,
        eval_on_train_data=False)

    # Currently only a single Eval Spec is allowed. tf.estimator.train_and_evaluate(estimator,
    train_spec,  eval_specs[0])


if __name__ == '__main__':
  tf.app.run()
```