**PROJECT REPORT**

Project Name**: EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES.**

Team id: **PNT2022TMID03761**

Team members: **VIGNESHWARAN -TEAM LEAD. YUVARAJ R**

**VARSHA R**

**YOGAVIGNES B.M**

1. **INTRODUCTION**
   1. **Project overview**

Wildﬁre, also called forest ﬁre, bush or vegetation ﬁre, can be described as any uncontrolled and non- prescribed combustion or burning of plants in a natural setting such as a forest, grassland, brush land or tundra, which consumes the natural fuels and spreads based on environmental conditions (e.g., wind, topography). Forest ﬁres are a major environmental issue,creating economic and ecological damage while endangering human lives. There are typically about 100,000 wildﬁres in the United States every year.

Over 9 million acres of land have been destroyed due to treacherous wildﬁres. It is diﬃcult to predict and detect Forest Fire in a sparsely populated forest area and 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 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.

This is a huge problem which needs to be tackled and thus through this project we provide away to tackle the issue.

## Purpose

The purpose of the project is to detect the forest ﬁre earlier.

# LITERATURE SURVEY

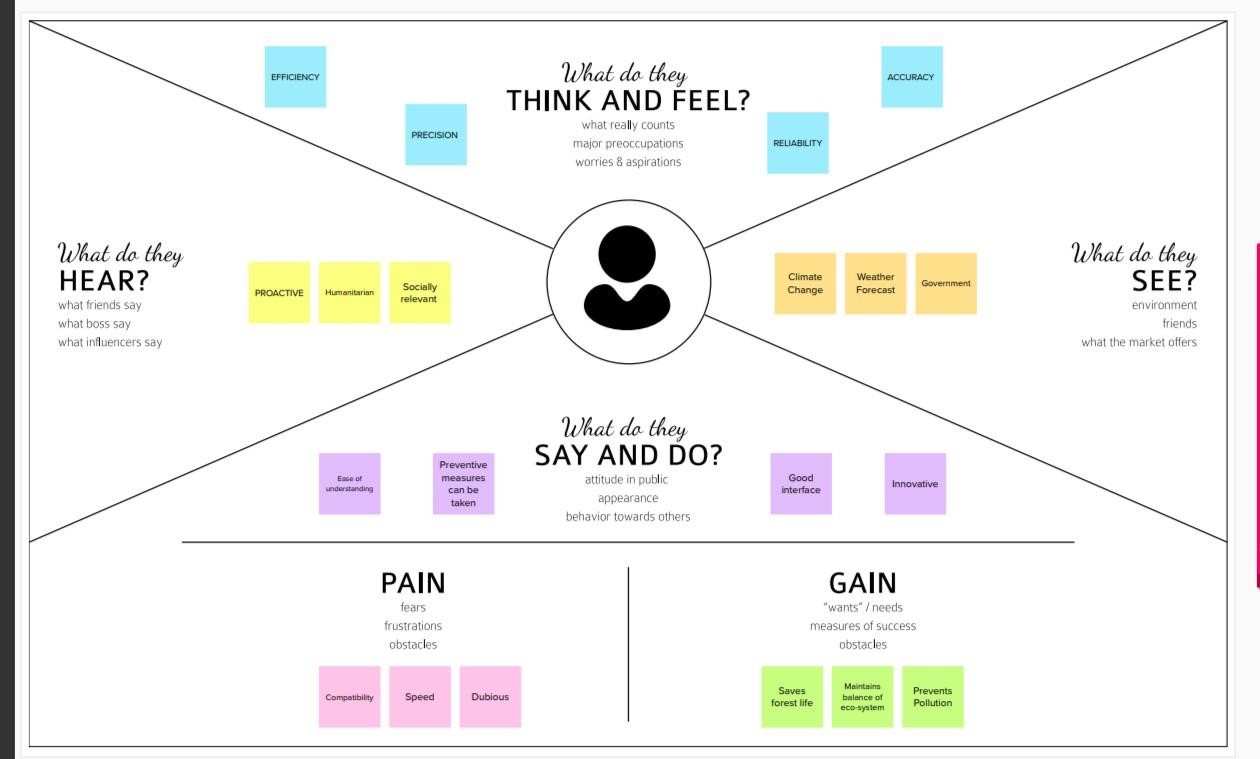
* 1. **Reference**

|  |  |  |  |
| --- | --- | --- | --- |
| **S. NO** | **TITL E** | **AUTHO R** | **YEAR** |
| 1. | Image Processing for Forest Fire Detection. | Priyadharshini | 2016 |
| 2. | Forest ﬁre prediction and detection system. | Faroudja Abid | 2020 |

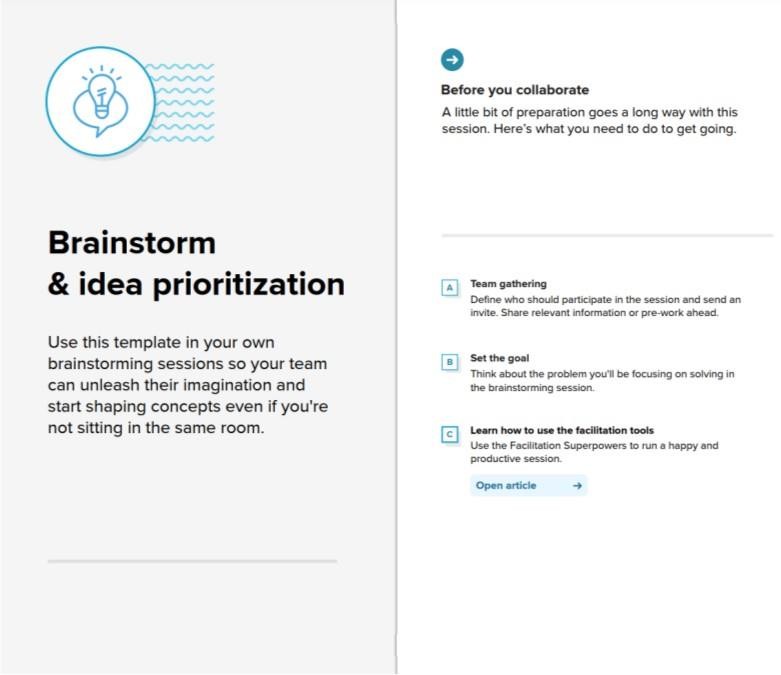
|  |  |  |  |
| --- | --- | --- | --- |
| 3. | systematic approaches in managingforest ﬁres . | [AdityaDhall](https://www.sciencedirect.com/science/article/abs/pii/S0143622818311718#!) | 2020 |

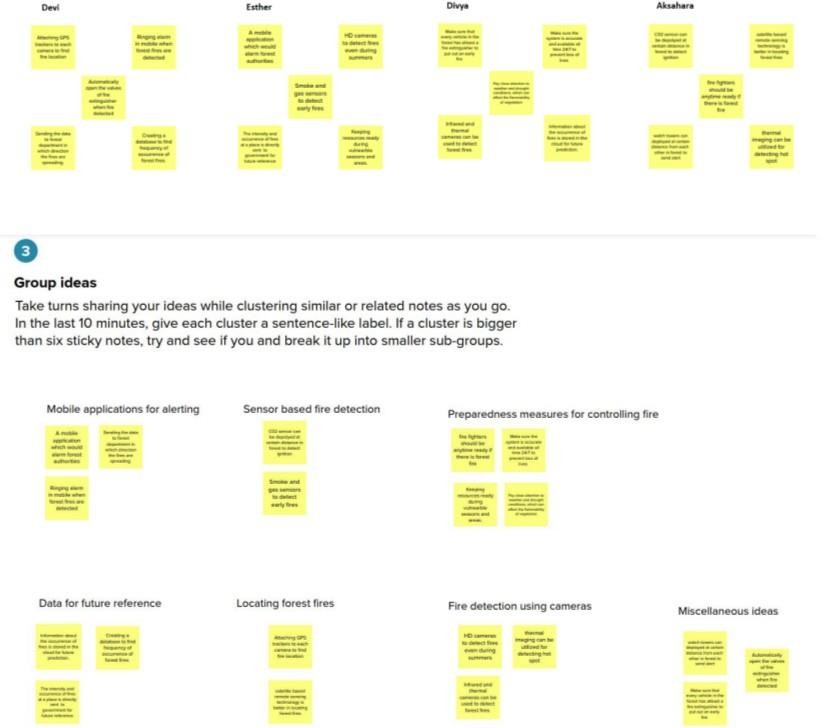
# IDEATION & PROPOSED SOLUTION

## Empathy map



* 1. **Ideation & Brainstorming**





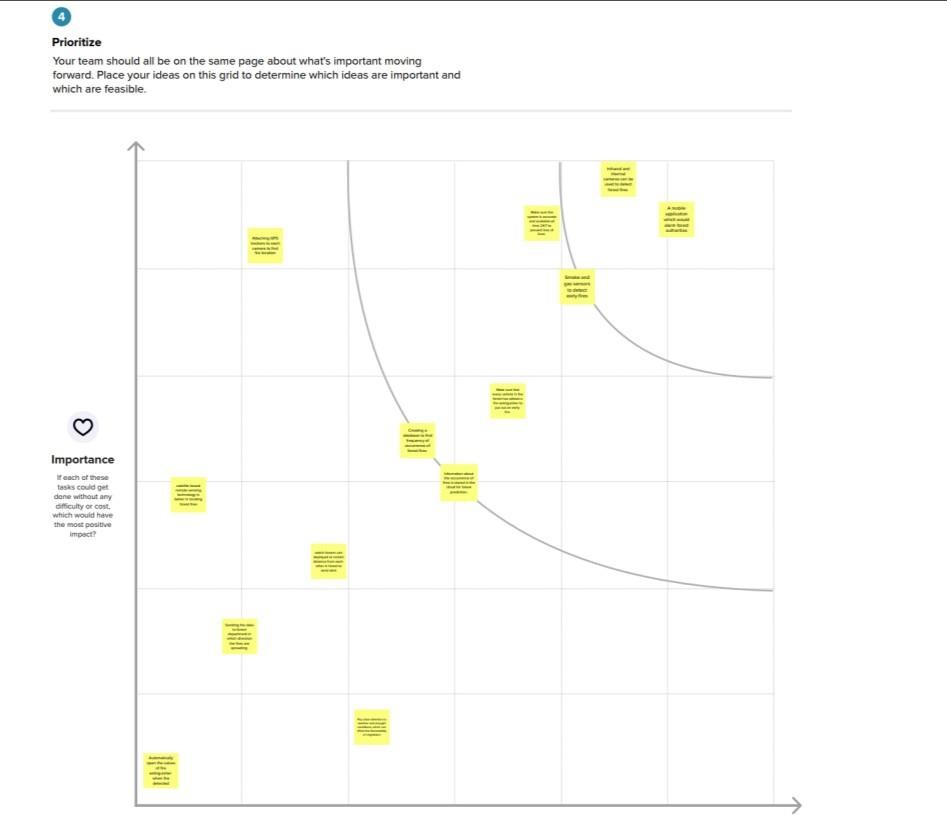
Varsha

YogaVignes

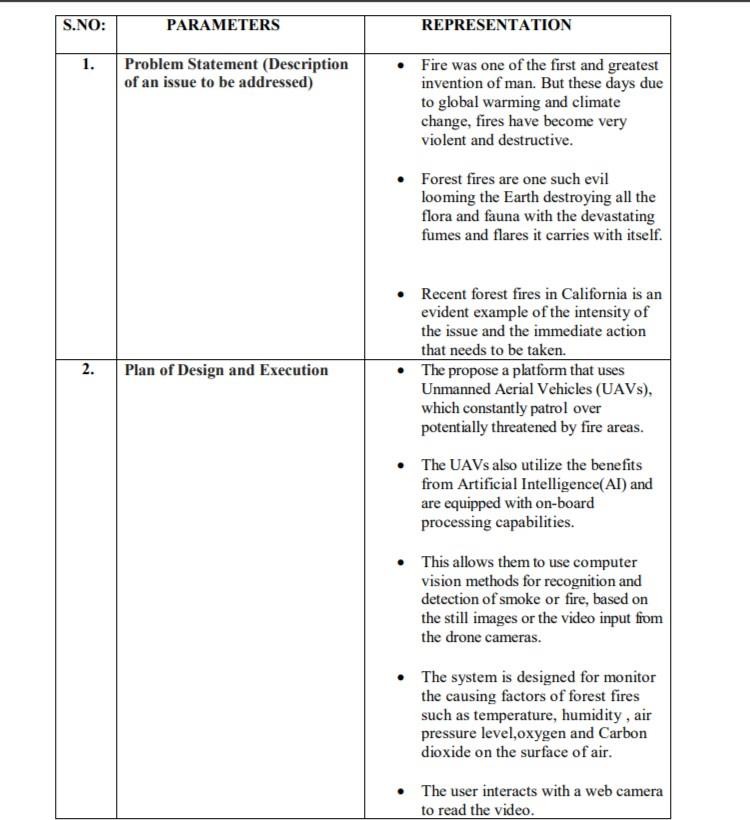
varsha

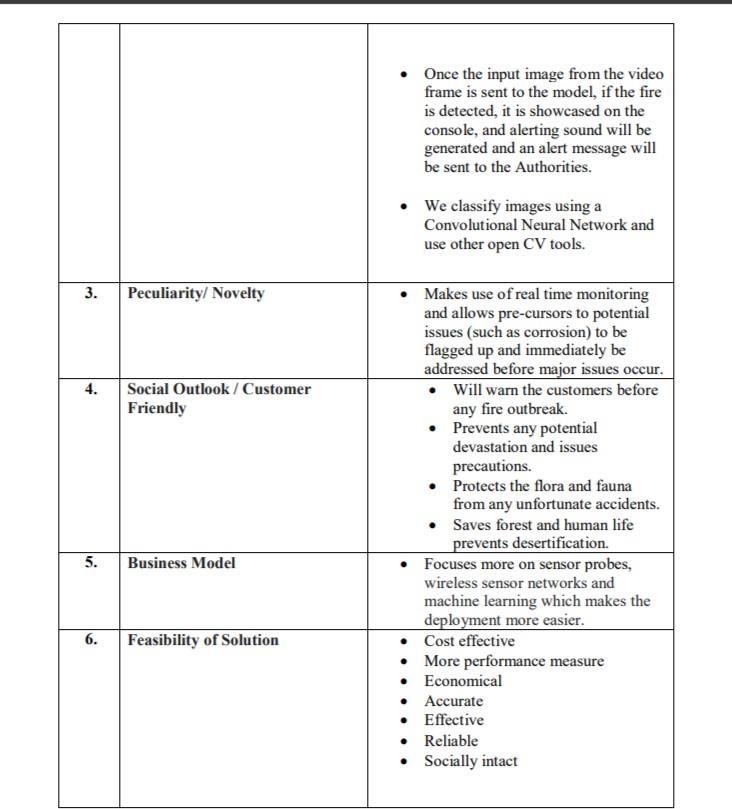
yuvaraj

Vignesh

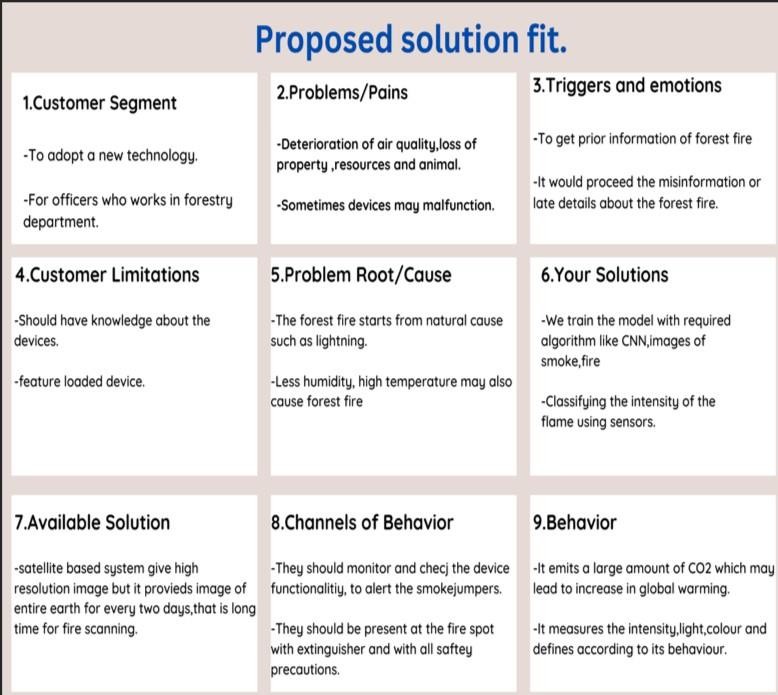


## Proposed solution



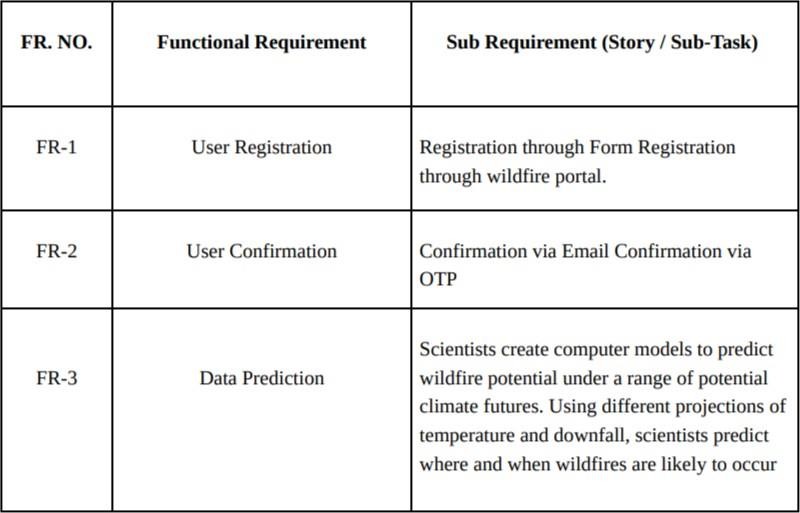


* 1. **Problem solution ﬁt**

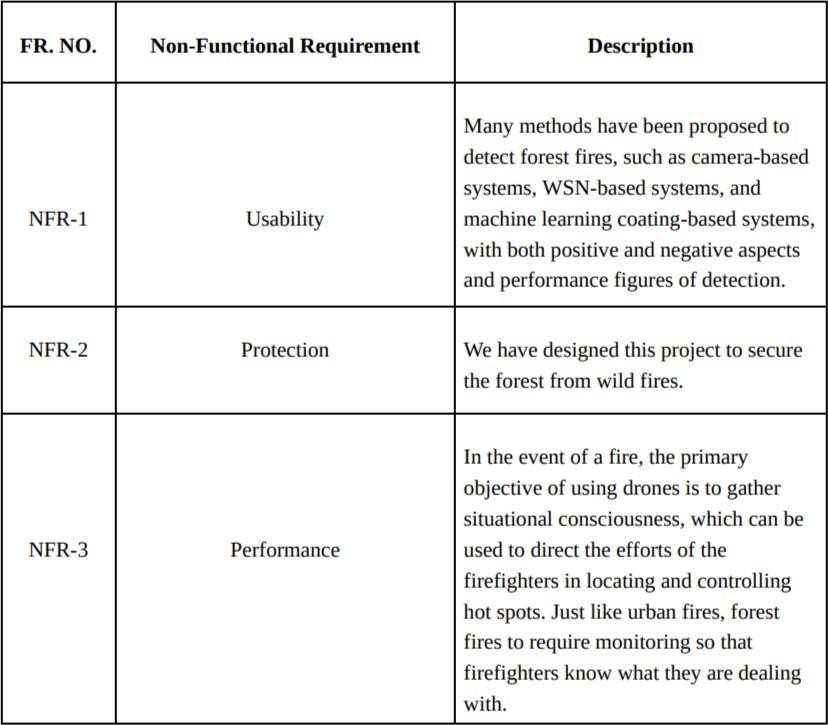


# REQUIREMENT ANALYSIS

## Functional requirement

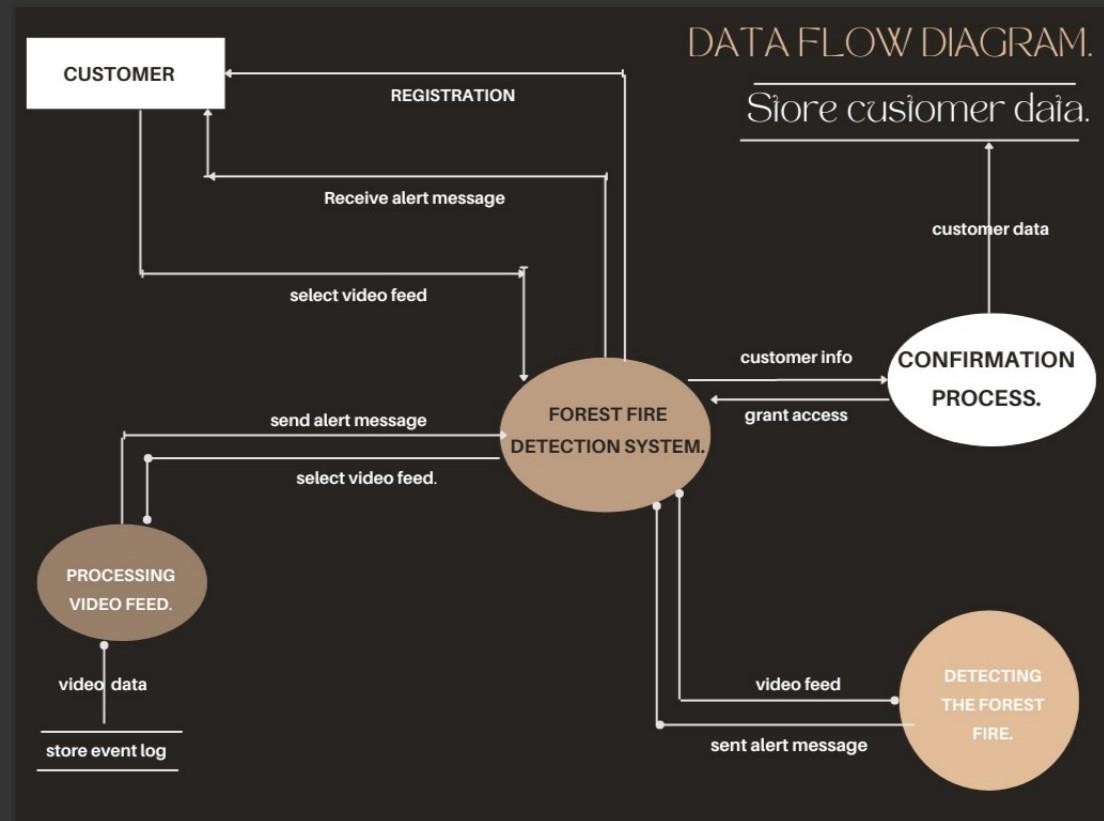


* 1. **Non-Functional requirement**

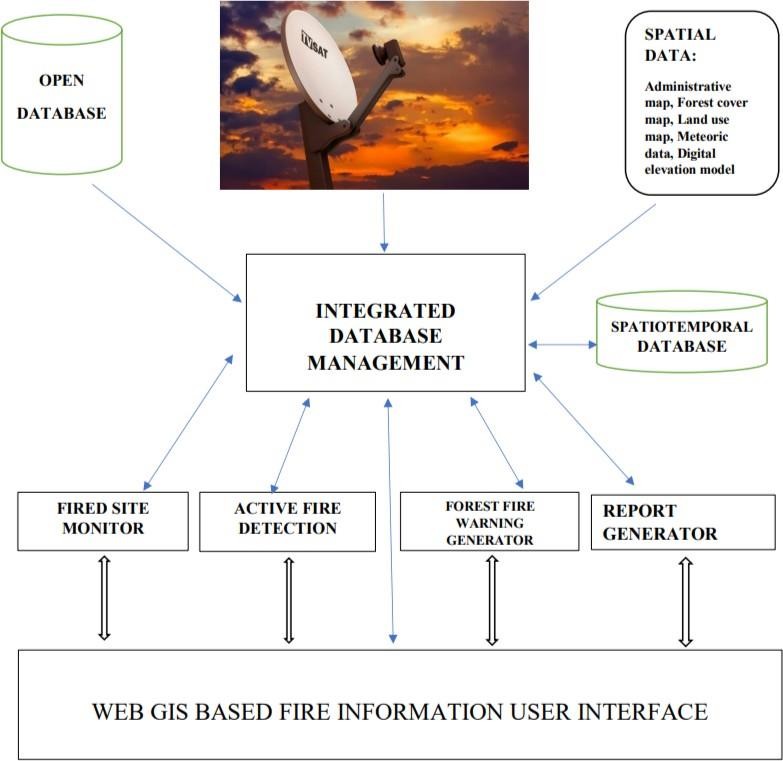


# PROJECT DESIGN

## Data Flow Diagrams

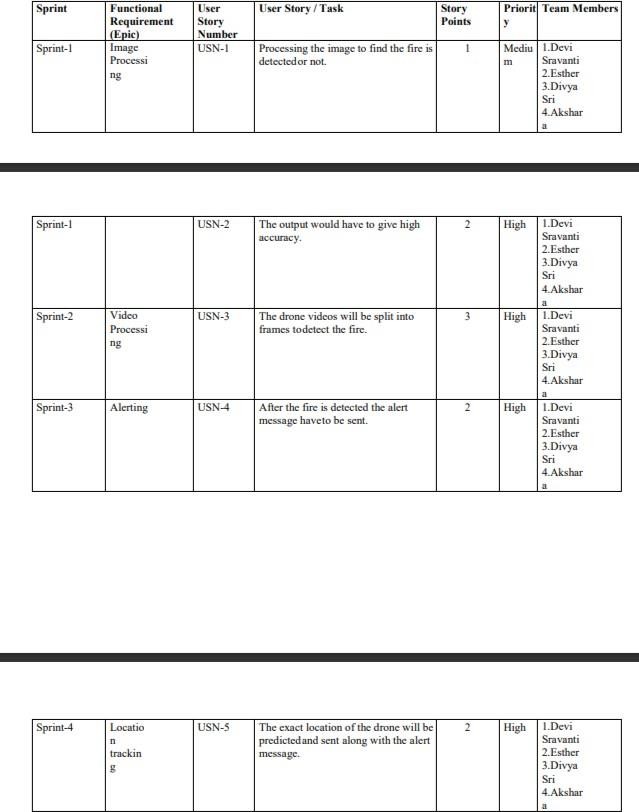


* 1. **Solution Architecture**



# PROJECT PLANNING & SCHEDULING

## Sprint Planning & Estimation



1.vignesh

2.yuvaraj

3.varsha

4.yogavignes

1.vignesh

2.yuvaraj

3.varsha

4.yogavignes

1.vignesh

2.yuvaraj

3.varsha

4.yogavignes

1.vignesh

2.yuvaraj

3.varsha

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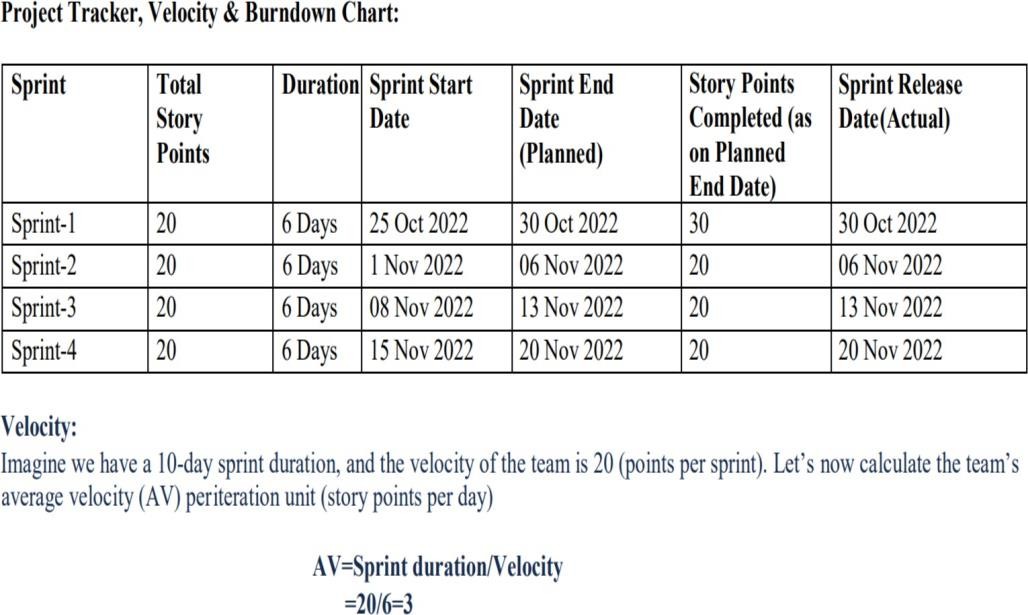
1.vignesh

2.yuvaraj

3.varsha

4.yogavignes

* 1. **Sprint delivery schedule**



## sprint-1



* 1. **Sprint-2**

**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

**import** matplotlib.pyplot **as** plt

train **=** ImageDataGenerator(rescale**=**1**/**255) test **=** ImageDataGenerator(rescale**=**1**/**255)

train\_dataset **=**

train**.**ﬂow\_from\_directory(r"/content/drive/MyDrive/train\_set",

target\_size**=**(150,150), batch\_size **=** 32, class\_mode **=** 'binary')

test\_dataset **=** test**.**ﬂow\_from\_directory(r"/content/drive/MyDrive/test\_set",

target\_size**=**(150,150), batch\_size **=**32,

class\_mode **=** 'binary')

Found 442 images belonging to 2 classes. Found 121 images belonging to 2 classes.

test\_dataset**.**class\_indices

{'forest': 0, 'with ﬁre': 1}

model **=** keras**.**Sequential() model**.**add(keras**.**layers**.**Conv2D(32,(3,3),activation**=**'relu',input\_shape**=**(150, 150,3)))

model**.**add(keras**.**layers**.**MaxPool2D(2,2)) model**.**add(keras**.**layers**.**Conv2D(64,(3,3),activation**=**'relu')) model**.**add(keras**.**layers**.**MaxPool2D(2,2)) model**.**add(keras**.**layers**.**Conv2D(128,(3,3),activation**=**'relu')) model**.**add(keras**.**layers**.**MaxPool2D(2,2)) model**.**add(keras**.**layers**.**Conv2D(128,(3,3),activation**=**'relu')) model**.**add(keras**.**layers**.**MaxPool2D(2,2)) model**.**add(keras**.**layers**.**Flatten()) model**.**add(keras**.**layers**.**Dense(512,activation**=**'relu')) model**.**add(keras**.**layers**.**Dense(1,activation**=**'sigmoid')) model**.**summary()

Model: "sequential"

Layer (type) Output Shape Param #

=================================================================

|  |  |  |
| --- | --- | --- |
| conv2d (Conv2D) | (None, 148, 148, 32) | 896 |
| max\_pooling2d (MaxPooling2D  ) | (None, 74, 74, 32) | 0 |
| conv2d\_1 (Conv2D) | (None, 72, 72, 64) | 18496 |
| max\_pooling2d\_1 (MaxPooling 2D) | (None, 36, 36, 64) | 0 |
| conv2d\_2 (Conv2D) | (None, 34, 34, 128) | 73856 |
| max\_pooling2d\_2 (MaxPooling 2D) | (None, 17, 17, 128) | 0 |
| conv2d\_3 (Conv2D) | (None, 15, 15, 128) | 147584 |

max\_pooling2d\_3 (MaxPooling (None, 7, 7, 128) 0

2D)

|  |  |  |
| --- | --- | --- |
| ﬂatten (Flatten) | (None, 6272) | 0 |
| dense (Dense) | (None, 512) | 3211776 |
| dense\_1 (Dense) | (None, 1) | 513 |

=================================================================

Total params: 3,453,121

Trainable params: 3,453,121

Non-trainable params: 0

model**.**compile(optimizer**=**'adam',loss**=**'binary\_crossentropy',metrics**=**['accura cy'])

r **=** model**.**ﬁt(train\_dataset,

epochs **=** 10,

validation\_data **=** test\_dataset) Epoch 1/10

14/14 [==============================] - 140s 10s/step - loss: 0.5568 -

accuracy: 0.7466 - val\_loss: 0.2537 - val\_accuracy: 0.9504 Epoch 2/10

|  |  |  |
| --- | --- | --- |
| 14/14 [==============================] - 37s 3s/step - loss: | 0.2948 | - |
| accuracy: 0.8914 - val\_loss: 0.0443 - val\_accuracy: 0.9835 |  |  |
| Epoch 3/10 |  |  |
| 14/14 [==============================] - 38s 3s/step - loss: | 0.2028 | - |
| accuracy: 0.9231 - val\_loss: 0.1178 - val\_accuracy: 0.9752 |  |  |
| Epoch 4/10 |  |  |
| 14/14 [==============================] - 37s 3s/step - loss: | 0.1618 | - |
| accuracy: 0.9389 - val\_loss: 0.0174 - val\_accuracy: 1.0000 |  |  |
| Epoch 5/10 |  |  |
| 14/14 [==============================] - 35s 3s/step - loss: | 0.2101 | - |
| accuracy: 0.9276 - val\_loss: 0.0741 - val\_accuracy: 0.9835 |  |  |
| Epoch 6/10 |  |  |
| 14/14 [==============================] - 37s 3s/step - loss: | 0.1757 | - |
| accuracy: 0.9367 - val\_loss: 0.1567 - val\_accuracy: 0.9174 |  |  |
| Epoch 7/10 |  |  |
| 14/14 [==============================] - 39s 3s/step - loss: | 0.1656 | - |
| accuracy: 0.9367 - val\_loss: 0.0986 - val\_accuracy: 0.9504 |  |  |
| Epoch 8/10 |  |  |

14/14 [==============================] - 38s 3s/step - loss: 0.1422 -

accuracy: 0.9502 - val\_loss: 0.0220 - val\_accuracy: 1.0000 Epoch 9/10

14/14 [==============================] - 38s 3s/step - loss: 0.1242 -

accuracy: 0.9615 - val\_loss: 0.0337 - val\_accuracy: 1.0000 Epoch 10/10

14/14 [==============================] - 38s 3s/step - loss: 0.0923 -

accuracy: 0.9706 - val\_loss: 0.0392 - val\_accuracy: 0.9669 model**.**save("forest1.h5")

predictions **=** model**.**predict(test\_dataset)

predictions **=** np**.**round(predictions)

4/4 [==============================] - 6s 1s/step

predictions array([[1.],

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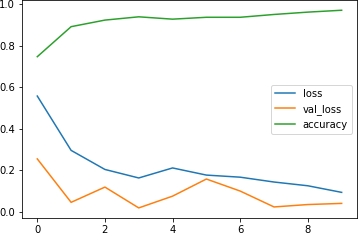
[0.],

[0.],

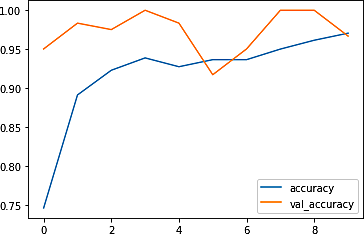
[1.]], dtype=ﬂoat32)

print(len(predictions)) 121

**import** matplotlib.pyplot **as** plt plt**.**plot(r**.**history['loss'], label**=**'loss') plt**.**plot(r**.**history['val\_loss'], label**=**'val\_loss') plt**.**plot(r**.**history['accuracy'], label**=**'accuracy') plt**.**legend()



plt**.**plot(r**.**history['accuracy'], label**=**'accuracy') plt**.**plot(r**.**history['val\_accuracy'], label**=**'val\_accuracy') plt**.**legend()



**def** predictImage(ﬁlename):

img1 **=** image**.**load\_img(ﬁlename,target\_size**=**(150,150)) plt**.**imshow(img1)

Y **=** image**.**img\_to\_array(img1) X **=** np**.**expand\_dims(Y,axis**=**0) val **=** model**.**predict(X) print(val)

**if** val **==** 1:

plt**.**xlabel("Fire")

**elif** val **==** 0: plt**.**xlabel("No Fire")

## Sprint-3

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"Requirement already satisﬁed: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist- packages (from requests<3,>=2.21.0->tensorboard<2.10,>=2.9->tensorﬂow) (3.0.4)\n",

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"Requirement already satisﬁed: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in

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>tensorﬂow) (1.24.3)\n",

"Requirement already satisﬁed: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests<3,>=2.21.0->tensorboard<2.10,>=2.9->tensorﬂow) (2.10)\n",

"Requirement already satisﬁed: oauthlib>=3.0.0 in /usr/local/lib/python3.7/dist-packages(from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.10,>=2.9-

>tensorﬂow) (3.2.2)\n",

"Requirement already satisﬁed: pyparsing!=3.0.5,>=2.0.2 in /usr/local/lib/python3.7/dist- packages (from packaging->tensorﬂow) (3.0.9)\n",

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python) (1.21.6)\n"

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"from keras.models import Sequential\n", "from keras.layers import Dense\n",

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"test = ImageDataGenerator(rescale=1/255)"

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" batch\_size = 32,\n",

" class\_mode = 'binary')\n",

"x\_test = test\_dataset = test.ﬂow\_from\_directory(\"/content/drive/MyDrive/test\_set\",\n", " target\_size= (64,64),\n",

" batch\_size = 32,\n",

" class\_mode = 'binary')"

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"Found 442 images belonging to 2 classes.\n", "Found 121 images belonging to 2 classes.\n"

]

}

]

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"{'forest': 0, 'with ﬁre': 1}"

]

},

"metadata": {}, "execution\_count": 11

}

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"model = Sequential()"

],

"metadata": {

"id": "qyQ20wPg0XZg"

},

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},

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"model.add(Convolution2D(32,(3,3),activation='relu',input\_shape=(64,64,3)))"

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"model.add(MaxPooling2D(2,2))"

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,epochs=10,validation\_data=x\_test,validation\_steps=4)"

],

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"14/14 [==============================] - 157s 11s/step - loss: 3.7764 - accuracy:

0.5928 - val\_loss: 0.3833 - val\_accuracy: 0.8182\n","Epoch 2/10\n",

"14/14 [==============================] - 22s 2s/step - loss: 1.0376 - accuracy:

0.6855 - val\_loss: 0.1756 - val\_accuracy: 0.9339\n","Epoch 3/10\n",

"14/14 [==============================] - 21s 1s/step - loss: 0.2968 - accuracy:

0.8688 - val\_loss: 0.1248 - val\_accuracy: 0.9835\n","Epoch 4/10\n",

"14/14 [==============================] - 21s 2s/step - loss: 0.2413 - accuracy:

0.9072 - val\_loss: 0.1233 - val\_accuracy: 0.9504\n","Epoch 5/10\n",

"14/14 [==============================] - 21s 2s/step - loss: 0.1790 - accuracy:

0.9321 - val\_loss: 0.0887 - val\_accuracy: 0.9669\n","Epoch 6/10\n",

"14/14 [==============================] - 21s 2s/step - loss: 0.1427 - accuracy:

0.9457 - val\_loss: 0.0762 - val\_accuracy: 0.9752\n","Epoch 7/10\n",

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0.9706 - val\_loss: 0.0514 - val\_accuracy: 0.9917\n","Epoch 8/10\n",

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0.9774 - val\_loss: 0.0272 - val\_accuracy: 1.0000\n","Epoch 9/10\n",

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0.9774 - val\_loss: 0.0266 - val\_accuracy: 0.9917\n","Epoch 10/10\n",

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]

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],

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],

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packages (from watson-machine-learning-client) (2.23.0)\n",

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requests->watson-machine-learning-client) (2.10)\n",

"Requirement already satisﬁed: pytz>=2017.3 in /usr/local/lib/python3.7/dist-packages (from pandas-

>watson-machine-learning-client) (2022.6)\n",

"Requirement already satisﬁed: numpy>=1.17.3 in /usr/local/lib/python3.7/dist-packages(from pandas-

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" Building wheel for ibm-cos-sdk-s3transfer (setup.py) ...

\u001b[?25l\u001b[?25hdone\n",

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" Stored in directory:

/root/.cache/pip/wheels/57/79/6a/ffe3370ed7ebc00604f9f76766e1e0348dcdcad2b2e32df9e1

\n",

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" Successfully uninstalled requests-2.23.0\n",

"Successfully installed boto3-1.26.11 botocore-1.29.11 ibm-cos-sdk-2.12.0 ibm-cos-sdk- core-2.12.0 ibm-cos-sdk-s3transfer-2.12.0 jmespath-0.10.0 lomond-0.3.3 requests-2.28.1 s3transfer-0.6.0 urllib3-

1.26.12 watson-machine-learning-client-1.0.391\n"

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"def guid\_from\_space\_name(client, space\_name):\n"," space = client.spaces.get\_details()\n",

" #print(space)\n",

" return(next(item for item in space['resources']if item['entity'][\"name\"] == space\_name)['metadata']['id'])"

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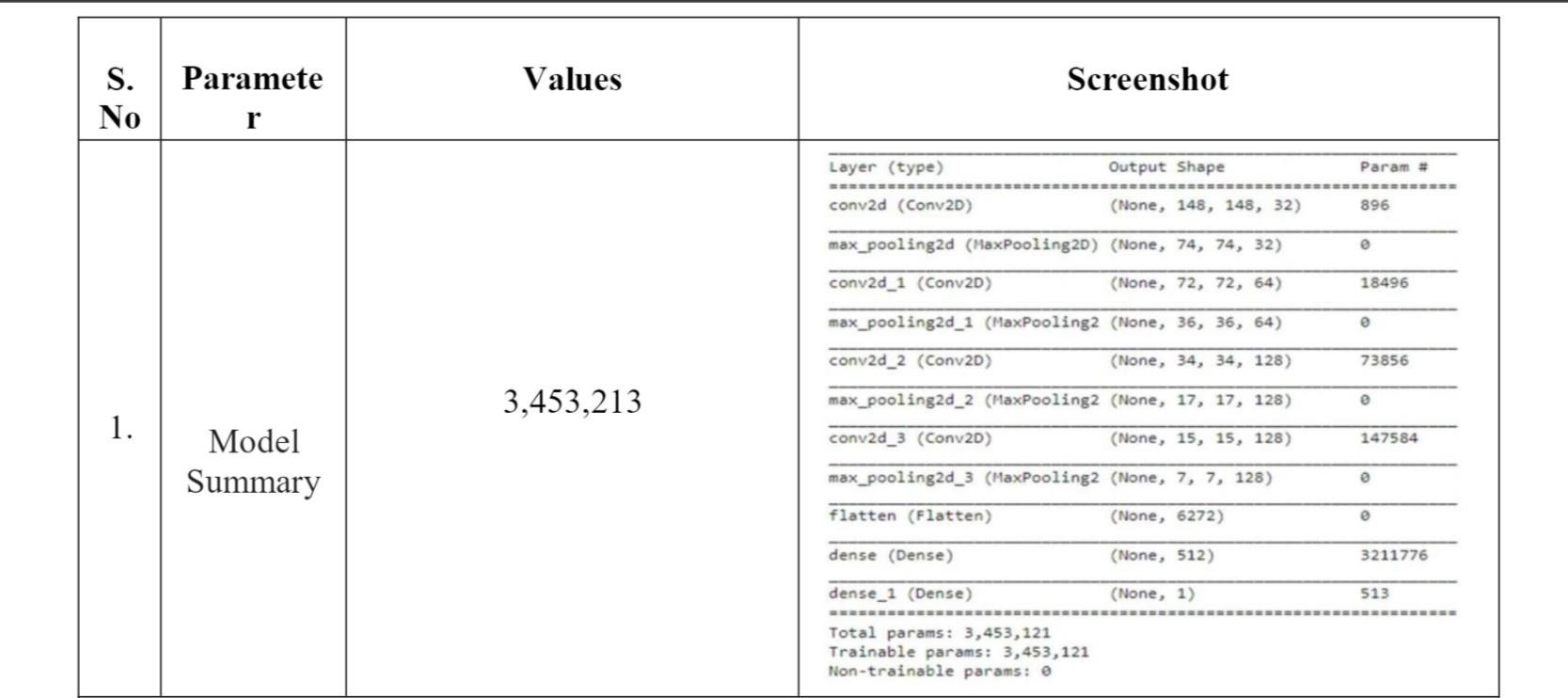
}

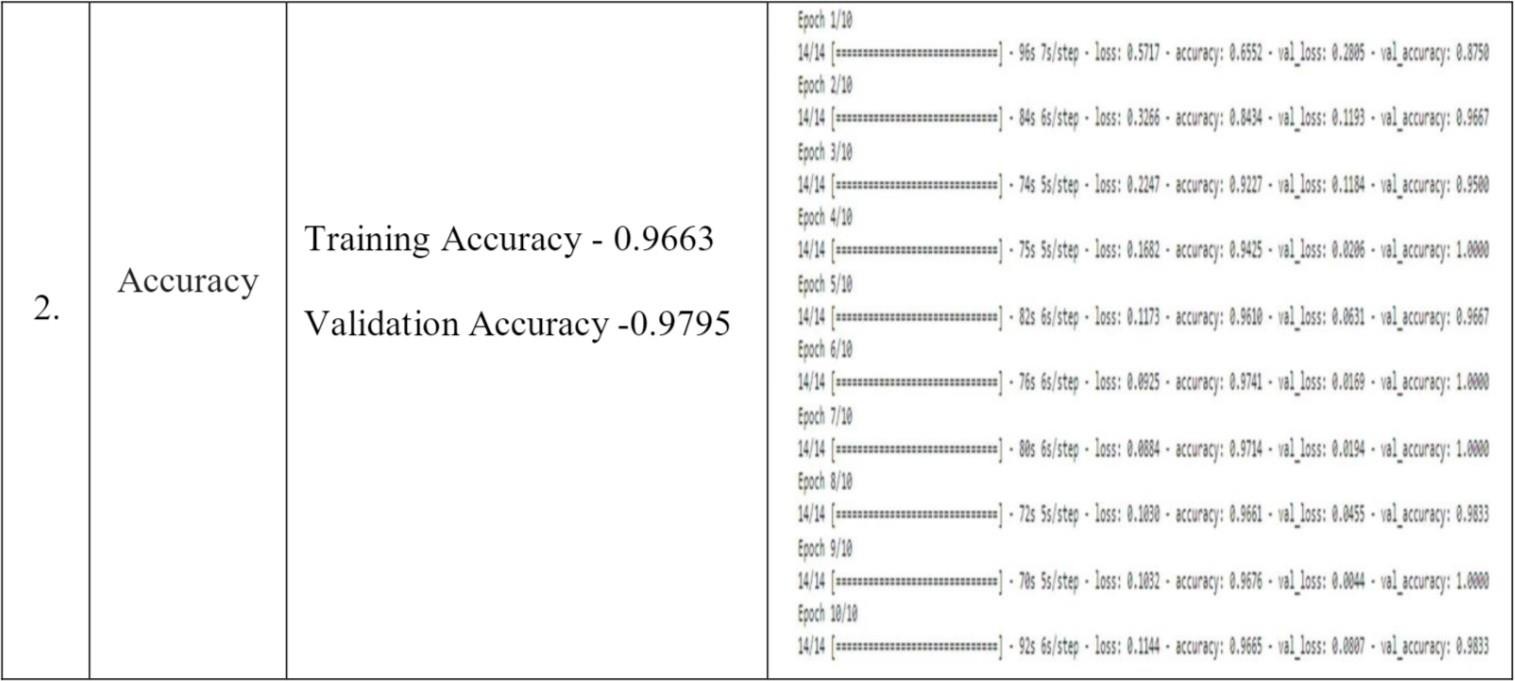
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}

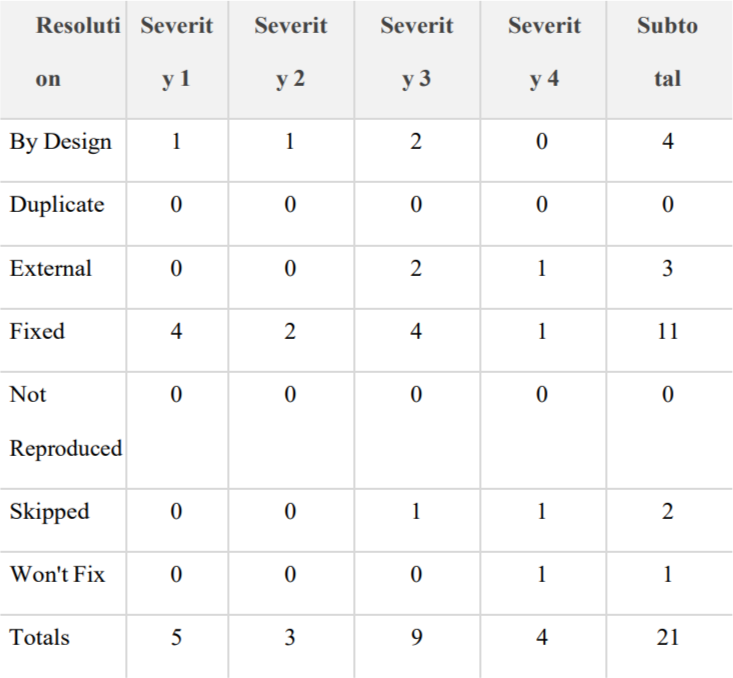
# TESTING AND RESULTS

## Performance Testing

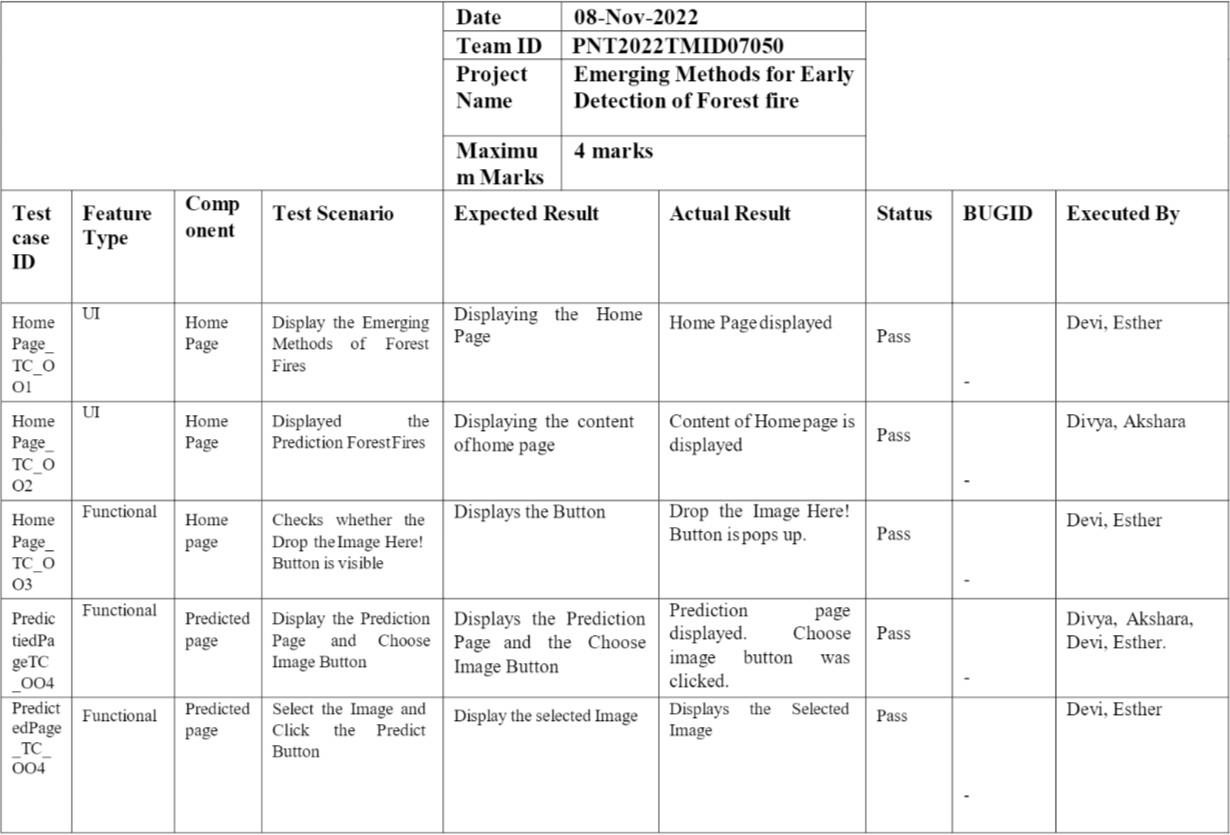




* 1. **User acceptance testing**



## Test case



Vignesh,

yogavignes

yogavignes,

yuvaraj

Vignesh,

varsha

Varsha,

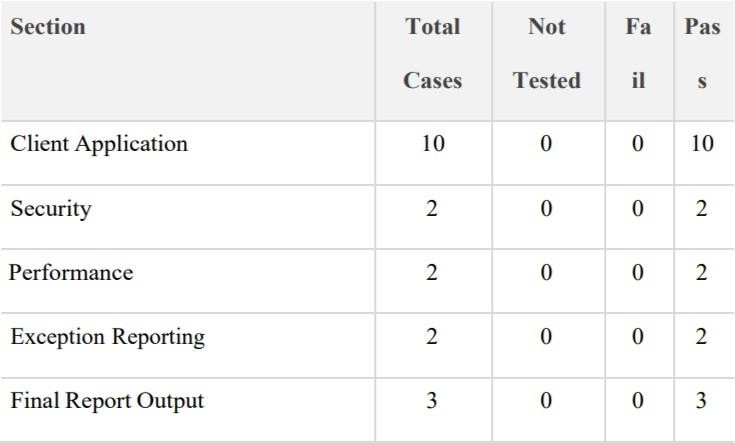
yogavignes

Vignesh,

yuvaraj

PNT2022TMID03761

* 1. **Test case analysis**



# ADVANTAGES & DISADVANTAGES

## ADVANTAGES:

* The proposed system detects the forest ﬁre at a faster rate compared to existing system. It has enhanced data collection feature.
* The major aspect is that it reduces false alarm and also has accuracy due to various sensorspresent.
* It minimize the human effort as it works automatically. This is meagre -cost due to whichcan be easily accessed.
* The main objective of our project is to receive an alert message through an app to therespective user.

## DISADVANTAGES:

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

# CONCULSION

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

# FUTURE SCOPE

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

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

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

**GitHub :**

<https://github.com/IBM-EPBL/IBM-Project-15477-1659599109>