Forest Fire Detection Using Convolutional Neural Network Part I

In this notebook let's see how we can differentiate between an image that shows forest with fire from an image of forrest without fire. To do this I've used CNN. This is part 1, in part 2 we'll see how and what errors occured in the successful execution of this project.

link to dataset: https://www.kaggle.com/datasets/brsdincer/wildfire-detection-image-data

Importing necessary libraries

```
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
```

Making saperate datasets for training and testing

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

train_dataset = train.flow_from_directory("/content/drive/MyDrive/forest_fire/Training and Validation/",
                                          target_size=(150,150),
                                          batch_size = 32,
                                          class_mode = 'binary')

test_dataset = test.flow_from_directory("/content/drive/MyDrive/forest_fire/Testing/",
                                          target_size=(150,150),
                                          batch_size =32,
                                          class_mode = 'binary')
```

```
Found 1410 images belonging to 2 classes.
Found 68 images belonging to 2 classes.
```

```
test_dataset.class_indices
```

```
{'fire': 0, 'nofire': 1}
```

Model Building

```
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'))
```

Compiling the model

```
model.compile(optimizer='adam',loss='binary_crossentropy',metrics=['accuracy'])
```

Fitting the model

```
r = model.fit(train_dataset,
         epochs = 10,
         validation_data = test_dataset)
```

```
Epoch 1/10
45/45 [==============================] - 277s 6s/step - loss: 0.3534 - accuracy: 0.8390 - val_loss: 0.2513 - val_accuracy: 0.9265
Epoch 2/10
45/45 [==============================] - 67s 1s/step - loss: 0.1635 - accuracy: 0.9397 - val_loss: 0.3355 - val_accuracy: 0.8676
Epoch 3/10
45/45 [==============================] - 64s 1s/step - loss: 0.1492 - accuracy: 0.9482 - val_loss: 0.3912 - val_accuracy: 0.8529
Epoch 4/10
45/45 [==============================] - 64s 1s/step - loss: 0.1352 - accuracy: 0.9553 - val_loss: 0.2985 - val_accuracy: 0.8676
Epoch 5/10
45/45 [==============================] - 64s 1s/step - loss: 0.1262 - accuracy: 0.9596 - val_loss: 0.3119 - val_accuracy: 0.8824
Epoch 6/10
45/45 [==============================] - 63s 1s/step - loss: 0.0879 - accuracy: 0.9759 - val_loss: 0.3121 - val_accuracy: 0.9118
Epoch 7/10
45/45 [==============================] - 65s 1s/step - loss: 0.1176 - accuracy: 0.9617 - val_loss: 0.3907 - val_accuracy: 0.8971
Epoch 8/10
45/45 [==============================] - 63s 1s/step - loss: 0.0783 - accuracy: 0.9766 - val_loss: 0.1907 - val_accuracy: 0.9412
Epoch 9/10
45/45 [==============================] - 63s 1s/step - loss: 0.0872 - accuracy: 0.9709 - val_loss: 0.2972 - val_accuracy: 0.9559
Epoch 10/10
45/45 [==============================] - 63s 1s/step - loss: 0.0671 - accuracy: 0.9780 - val_loss: 0.1990 - val_accuracy: 0.9559
```

Predicting on Test Dataset

```
predictions = model.predict(test_dataset)
predictions = np.round(predictions)
```

```
predictions
```

```
array([[1.],
       [1.],
       [1.],
       [0.],
       [1.],
       [0.],
       [1.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [1.],
       [0.],
       [0.],
       [1.],
       [1.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [1.],
       [1.],
       [0.],
       [0.],
       [1.],
       [1.],
       [1.],
       [1.],
       [1.],
       [0.],
       [0.],
       [1.],
       [1.],
       [1.],
       [0.],
       [1.],
       [1.],
       [1.],
       [0.],
       [0.],
       [1.],
       [1.],
       [0.],
       [0.],
         [1.],
         [1.],
         [1.],
         [1.],
         [1.],
         [1.],
         [1.],
         [1.],
         [1.],
```

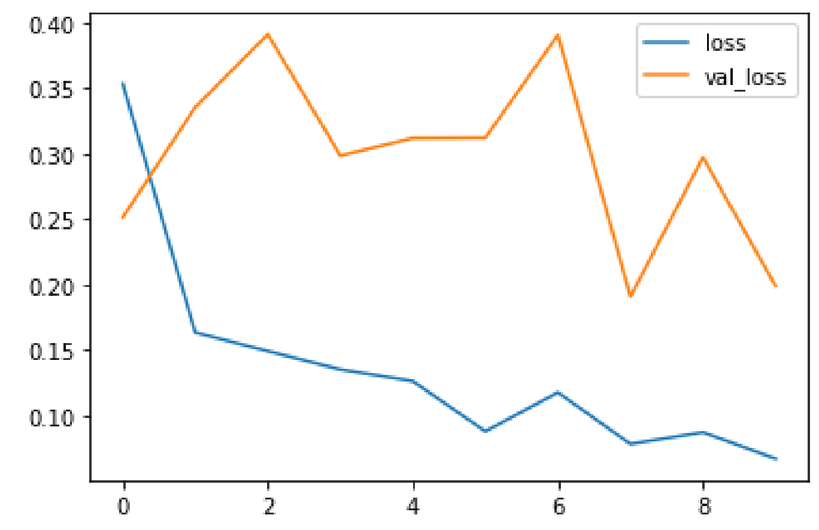
```
print(len(predictions))
```

```
68
```

Plotting loss per iteration

```
import matplotlib.pyplot as plt
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```

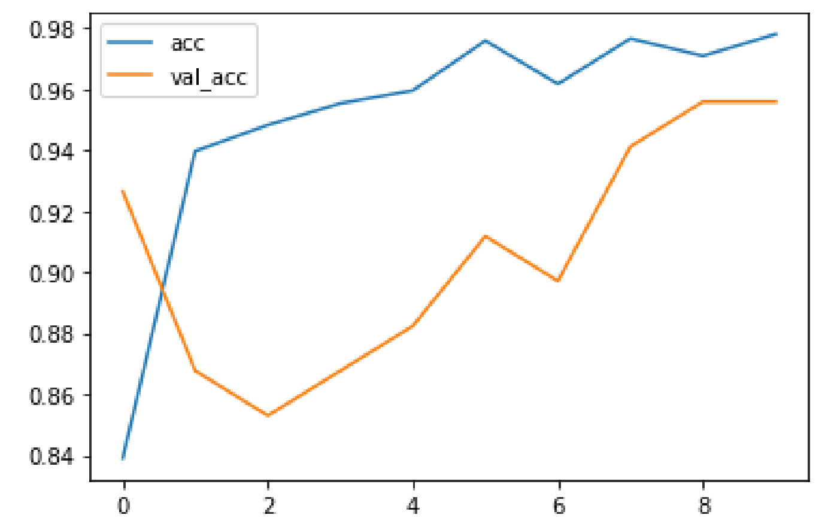
```
<matplotlib.legend.Legend at 0x7f2dcb1ee510>
```



Plotting accuracy per iteration

```
plt.plot(r.history['accuracy'], label='acc')
plt.plot(r.history['val_accuracy'], label='val_acc')
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f2dcace8cd0>
```

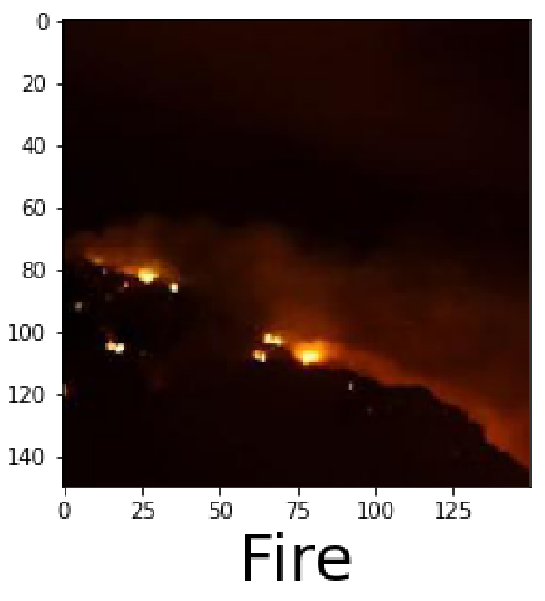


Making a function to see any image from dataset with predicted label

```
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("No Fire",fontsize=30)
    elif val == 0:
        plt.xlabel("Fire",fontsize=30)
```

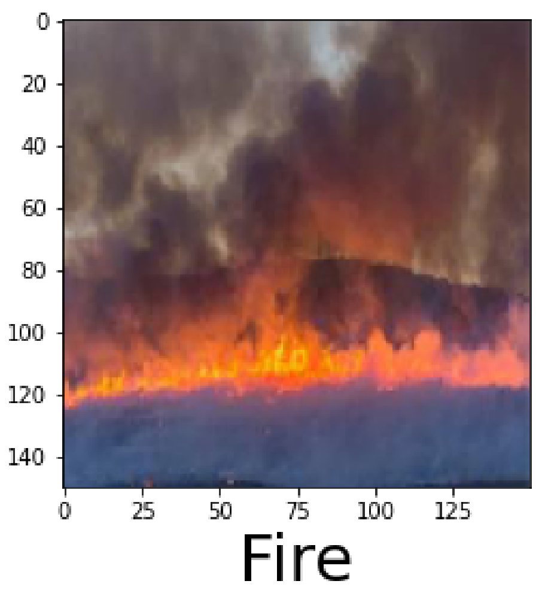
```
predictImage("/content/drive/MyDrive/forest_fire/Testing/fire/abc172.jpg")
```

```
[[0.]]
```



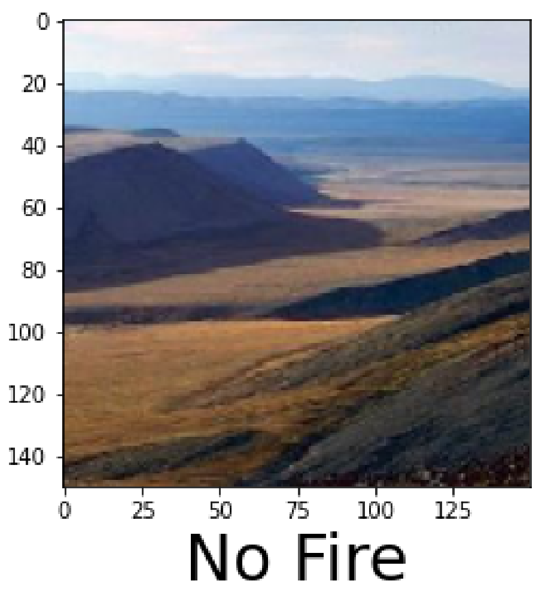
```
predictImage('/content/drive/MyDrive/forest_fire/Testing/fire/abc178.jpg')
```

```
[[0.]]
```



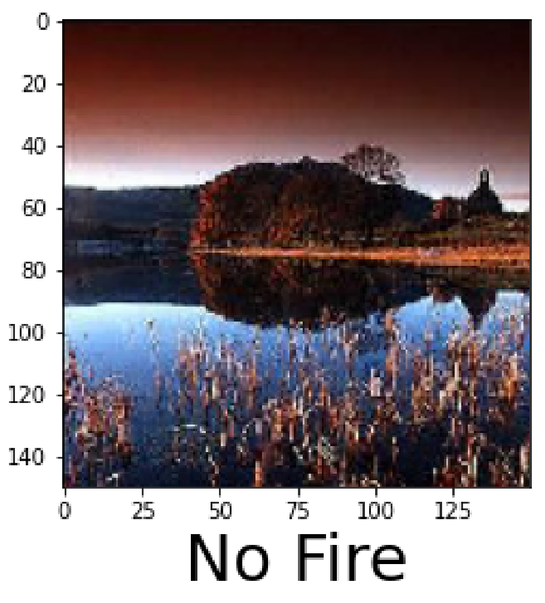
```
predictImage('/content/drive/MyDrive/forest_fire/Testing/nofire/abc347.jpg')
```

```
[[1.]]
```



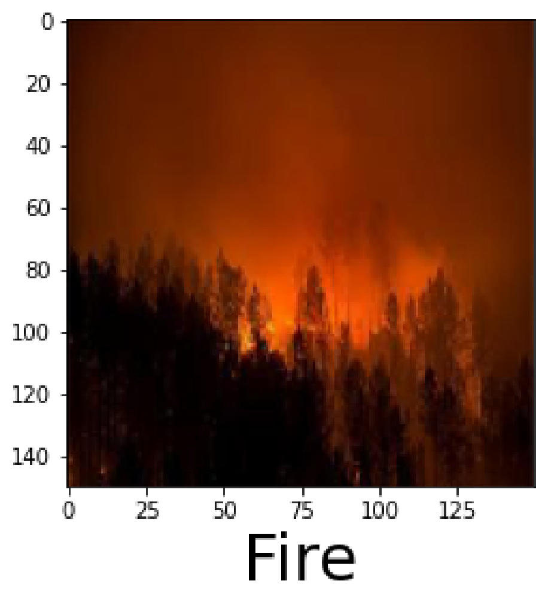
```
predictImage('/content/drive/MyDrive/forest_fire/Testing/nofire/abc367.jpg')
```

```
[[1.]]
```



```
predictImage('/content/drive/MyDrive/forest_fire/Training and Validation/fire/abc012.jpg')
```

```
[[0.]]
```

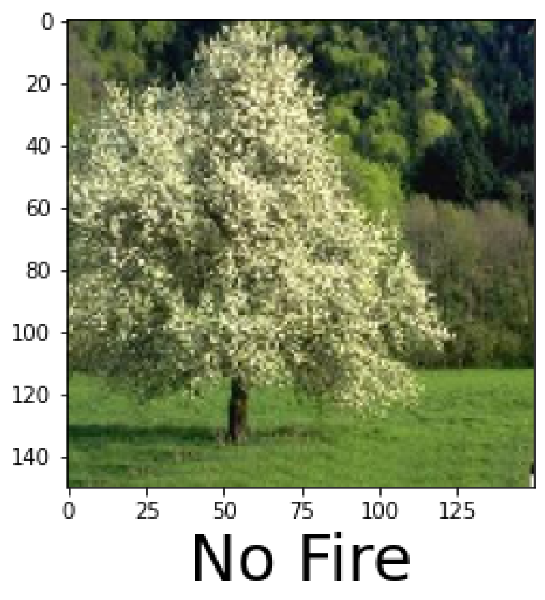


```
predictImage('/content/drive/MyDrive/forest_fire/Training and Validation/fire/abc051.jpg')
```

```
[[0.]]
```

```
predictImage('/content/drive/MyDrive/forest_fire/Training and Validation/nofire/abc218.jpg')
```

```
[[1.]]
```



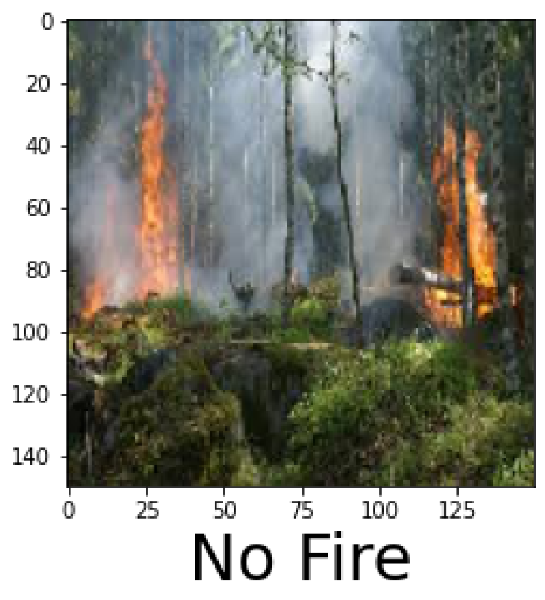
predicting images from google

```
predictImage('/content/drive/MyDrive/download.jfif')
```

```
[[1.]]
```

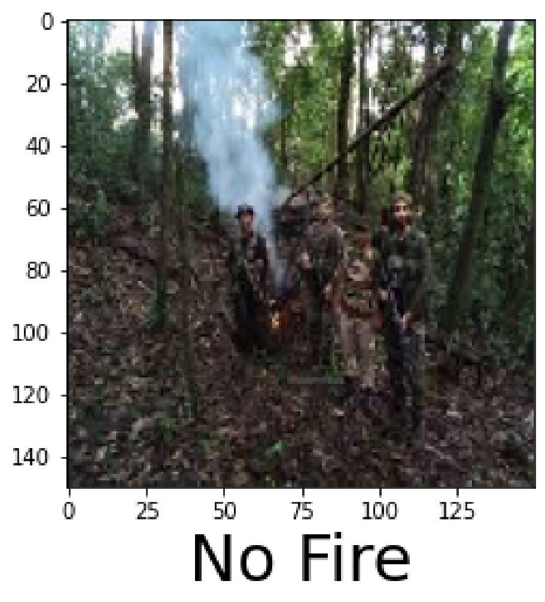
```
predictImage('/content/drive/MyDrive/images (1).jfif')
```

```
[[1.]]
```



```
predictImage('/content/drive/MyDrive/images.jfif')
```

```
[[1.]]
```



Final Thoughts

1. Model is well performing in testing.
2. It has failed to predict the second last image downloaded from web.
3. The model can be improved further more as the graphs showing accuracy and loss are bit messy.
4. Transfer Learning can be used to reduce the learning/training time significantly.
