

EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRE USING DEEP LEARNING

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Importing Keras libraries and ImageDataGenerator from Keras

```
import keras
from keras.preprocessing.image import ImageDataGenerator
```

In [1]:

Define The Parameters /Arguments For ImageDataGenerator Class

```
train_datagen=ImageDataGenerator(rescale=1./255, shear_range=0.2, rotation_range=180, zoom_range=0.2, horizontal_flip=True)
```

In [2]:

```
test_datagen=ImageDataGenerator(rescale=1./255)
```

Applying ImageDataGenerator functionality to trainset.

```
x_train = train_datagen.flow_from_directory(r"D:\Anaconda\Main project\Dataset\train_set", target_size = (128,128), batch_size = 32, class_mode = 'binary')
```

In [3]:

Found 436 images belonging to 2 classes.

Applying ImageDataGenerator functionality to testset.

```
x_test = test_datagen.flow_from_directory(r"D:\Anaconda\Main project\Dataset\test_set", target_size = (128,128), batch_size = 32, class_mode = 'binary')
```

In [4]:

Found 121 images belonging to 2 classes.

Importing Model Building Libraries

In [5]:

```
#import model building libraries...
#To define linear intialisation import sequential
from keras.models import Sequential
#To add layers import Dense
from keras.layers import Dense
#To create convolution kernal 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')
```

initializing the model

In [6]:

```
model = Sequential()
```

Adding CNN Layers

In [7]:

```
model.add
(Convolution2D(32, (3,3), input_shape=(128,128,3), activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())
```

Add Dense layers

In [8]:

```
#add hidden layer
model.add(Dense(150, activation='relu'))
#add output layer
model.add(Dense(1, activation='sigmoid'))
```

In [9]:

```
model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
=====		
conv2d (Conv2D)	(None, 126, 126, 32)	896
max_pooling2d (MaxPooling2D)	(None, 63, 63, 32)	0
flatten (Flatten)	(None, 127008)	0

dense (Dense)	(None, 150)	19051350
dense_1 (Dense)	(None, 1)	151

```
=====
Total params: 19,052,397
Trainable params: 19,052,397
Non-trainable params: 0
=====
```

configure the learning process

```
In [10]:
model.compile(loss = 'binary_crossentropy', optimizer = 'adam', metrics =
["accuracy"])
```

training the model

```
In [11]:
model.fit_generator(x_train, steps_per_epoch=14, epochs=10, validation_data=x_
test, validation_steps=4)

Epoch 1/10
14/14 [=====] - 118s 7s/step - loss: 1.8812 - accu
racy: 0.7110 - val_loss: 0.1588 - val_accuracy: 0.9421
Epoch 2/10
14/14 [=====] - 75s 5s/step - loss: 0.3336 - accur
acy: 0.8761 - val_loss: 0.2790 - val_accuracy: 0.9174
Epoch 3/10
14/14 [=====] - 92s 7s/step - loss: 0.2306 - accur
acy: 0.9014 - val_loss: 0.1209 - val_accuracy: 0.9669
Epoch 4/10
14/14 [=====] - 97s 7s/step - loss: 0.1743 - accur
acy: 0.9243 - val_loss: 0.1087 - val_accuracy: 0.9669
Epoch 5/10
14/14 [=====] - 77s 6s/step - loss: 0.1677 - accur
acy: 0.9427 - val_loss: 0.0905 - val_accuracy: 0.9669
Epoch 6/10
14/14 [=====] - 78s 6s/step - loss: 0.1679 - accur
acy: 0.9266 - val_loss: 0.0592 - val_accuracy: 0.9917
Epoch 7/10
14/14 [=====] - 78s 6s/step - loss: 0.1811 - accur
acy: 0.9266 - val_loss: 0.0593 - val_accuracy: 0.9917
Epoch 8/10
14/14 [=====] - 81s 6s/step - loss: 0.1701 - accur
acy: 0.9335 - val_loss: 0.0638 - val_accuracy: 0.9752
Epoch 9/10
14/14 [=====] - 82s 6s/step - loss: 0.1819 - accur
acy: 0.9243 - val_loss: 0.0567 - val_accuracy: 0.9917
Epoch 10/10
14/14 [=====] - 70s 5s/step - loss: 0.1848 - accur
acy: 0.9083 - val_loss: 0.0850 - val_accuracy: 0.9752
```

Out[11]:

save the model

```
model.save("forest.h5")
```

In [12]:

Predictions

```
#import load_model from keras.model  
from keras.models import load_model  
#import image class from keras  
from tensorflow.keras.preprocessing import image  
#import numpy  
import numpy as np  
#import cv2  
import cv2
```

In [13]:

```
#load the saved model  
model = load_model("forest.h5")
```

In [14]:

```
img=image.load_img(r'D:\Anaconda\Main project\Dataset\train_set\with  
fire\with fire (105).jpg')  
x=image.img_to_array(img)  
res = cv2.resize(x, dsize=(128,128),interpolation=cv2.INTER_CUBIC)  
x=np.expand_dims(res,axis=0)
```

In [15]:

```
img
```

In [16]:



```
pred = model.predict(x)
1/1 [=====] - 4s 4s/step

pred

array([[1.]], dtype=float32)
```

In [18]:

Out[18]:

Open cv for video processing

```
#import opencv library
import cv2
#import numpy
import numpy as np
#import imag and load_model function from keras
from keras.preprocessing import image
from keras.models import load_model
import tensorflow as tf
from tensorflow.keras.preprocessing import image
from PIL import Image
#import Client from twilio API
from twilio.rest import Client
#import playsound package
from playsound import playsound
```

In [19]:

```
#load the saved model
model = load_model(r'forest.h5')
#define video
```

In [20]:

```

video = cv2.VideoCapture(0)
#define the features
name = ['forest','with fire']

```

In [27]:

```

while(True):
    ret,frame=video.read()
    img=image.load_img(r'D:\Anaconda\Main project\Dataset\train_set\with
fire\with fire (105).jpg')
    x=image.img_to_array(img)
    res = cv2.resize(x, dsize=(128,128),interpolation=cv2.INTER_CUBIC)
    x=np.expand_dims(res,axis=0)
    pred = model.predict(x)
    if pred[0]==1:
        #twilio account ssid
        account_sid = 'AC3f73dcc73eb964ff8b6d46f8f57a8d86'
        #twilio account authentication token
        auth_token = 'bd27dc22501d6a933ef5916c2da45abd'
        client = Client(account_sid, auth_token)
        message = client.messages \
            .create(
                body='Forest Fire is detected, stay alert',
                #use twilio free number
                from_=' +13466448645',
                to='+916379947017')
        print(message.sid)
        print('Fire Detected')
        print ('SMS send!')
        playsound(r'D:\Anaconda\Main project\Dataset\Tornado Warning Siren
Sound Effect freesound.mp3')
    else:
        print('No Danger')
        cv2.imshow("image.jpg",frame)
        if cv2.waitKey(2)&0xff == ord('q'):
            break

```

```

video.release()
cv2.destroyAllWindows()

1/1 [=====] - 0s 77ms/step
SM8f657ddb7aa10d8bcfe11c2ec2da69b
Fire Detected
SMS send!
1/1 [=====] - 0s 86ms/step
Error 259 for command:
    play "C:\Users\Hari\AppData\Local\Temp\PSltf105hx.mp3" wait
The driver cannot recognize the specified command parameter.

Error 305 for command:
    close "C:\Users\Hari\AppData\Local\Temp\PSltf105hx.mp3"
Cannot specify extra characters after a string enclosed in quotation ma
rks.
Failed to close the file: "C:\Users\Hari\AppData\Local\Temp\PSltf105hx.mp3"
SM24681efea990b2559cb59ccb77310c69
Fire Detected
SMS send!

```

PlaysoundException

Traceback (most recent call last)

```

Input In [27], in ()
    21     print('Fire Detected')
    22     print ('SMS send!')
--> 23     playsound(r'D:\Anaconda\Main project\Dataset\Tornado Warning Si
ren Sound Effect freesound.mp3')
    24 else:
    25     print('No Danger')

```

File ~\anaconda3\lib\site-packages\playsound.py:44, in _playsoundWin(sound, block)

```

    42 close(fd) # mkstemp opens the file, but it must be closed before M
CI can open it.
    43 try:
--> 44     playsoundWin(tempPath, block)
    45 finally:
    46     remove(tempPath)

```

File ~\anaconda3\lib\site-packages\playsound.py:73, in _playsoundWin(sound, block)

```

    71     logger.debug('Starting')
    72     winCommand(u'open {}'.format(sound))
--> 73     winCommand(u'play {}'.format(sound, ' wait' if block else ''
))
    74     logger.debug('Returning')
    75 finally:

```

File ~\anaconda3\lib\site-packages\playsound.py:64, in _playsoundWin..winCommand(*command)

```

    60     exceptionMessage = ('\n    Error ' + str(errorCode) + ' for com
mand:')
    61         '\n    ' + command.decode('utf-16') +
    62         '\n    ' + errorBuffer.raw.decode('utf-16')
.rstrip('\0'))
    63     logger.error(exceptionMessage)
--> 64     raise PlaysoundException(exceptionMessage)
    65 return buf.value

```

PlaysoundException:

Error 259 for command:

play "C:\Users\Hari\AppData\Local\Temp\PSlutf105hx.mp3" wait

The driver cannot recognize the specified command parameter.