FIRE DETECTION USING DEEP LEARNING

CECS 553 MACHINE VISION

MENTOR – Dr. BENYAMIN AHMADNIA

GROUP MEMBERS -

AISHWARYA BHAVSAR

ANDREW RAMIREZ

INTRODUCTION

- Having a fire detection system **can significantly reduce damages and maximize fire control efforts**.
- It is also one of the most fundamental steps you can take for **fire safety measures.**
- Even if you are sleeping or busy working, early fire detection **will warn you and help you respond** quickly so you'll be out of danger.
- **Saves life.**
- **Reduces loss of property.**
- **Shorten recovery time.**
- **For insurance discounts.**
- **Keep you code-compliant.**

PROBLEM STATEMENT

- Fires can start randomly, and they can spread quickly, causing major damage before they are noticed.
- Currently, we have fire alarm systems that detect the fire using **smoke sensors.** But they are inefficient, in terms of time and are sometimes are not properly installed. If the owner is away, they may not be around to hear the alarm.
- We need a detection system that can **identify the fire with accuracy** within seconds and notify the user to take further action.
- It can take **just 30 seconds for a small flame** to turn into a major blaze (Department of Homeland Security).
- The top three **causes of fires** in homes are
  - cooking,
  - heating equipment,
  - electrical malfunction.
- An average of **358,500** homes experience a structural fire each year (NFPA).
- More than **3,000 Americans** die in fires each year (FEMA).
- Every day, at least **one child dies** from a fire inside the home (Stanford Children’s Hospital).
- Reference : https://www.thezebra.com/resources/research/house-fire-statistics/

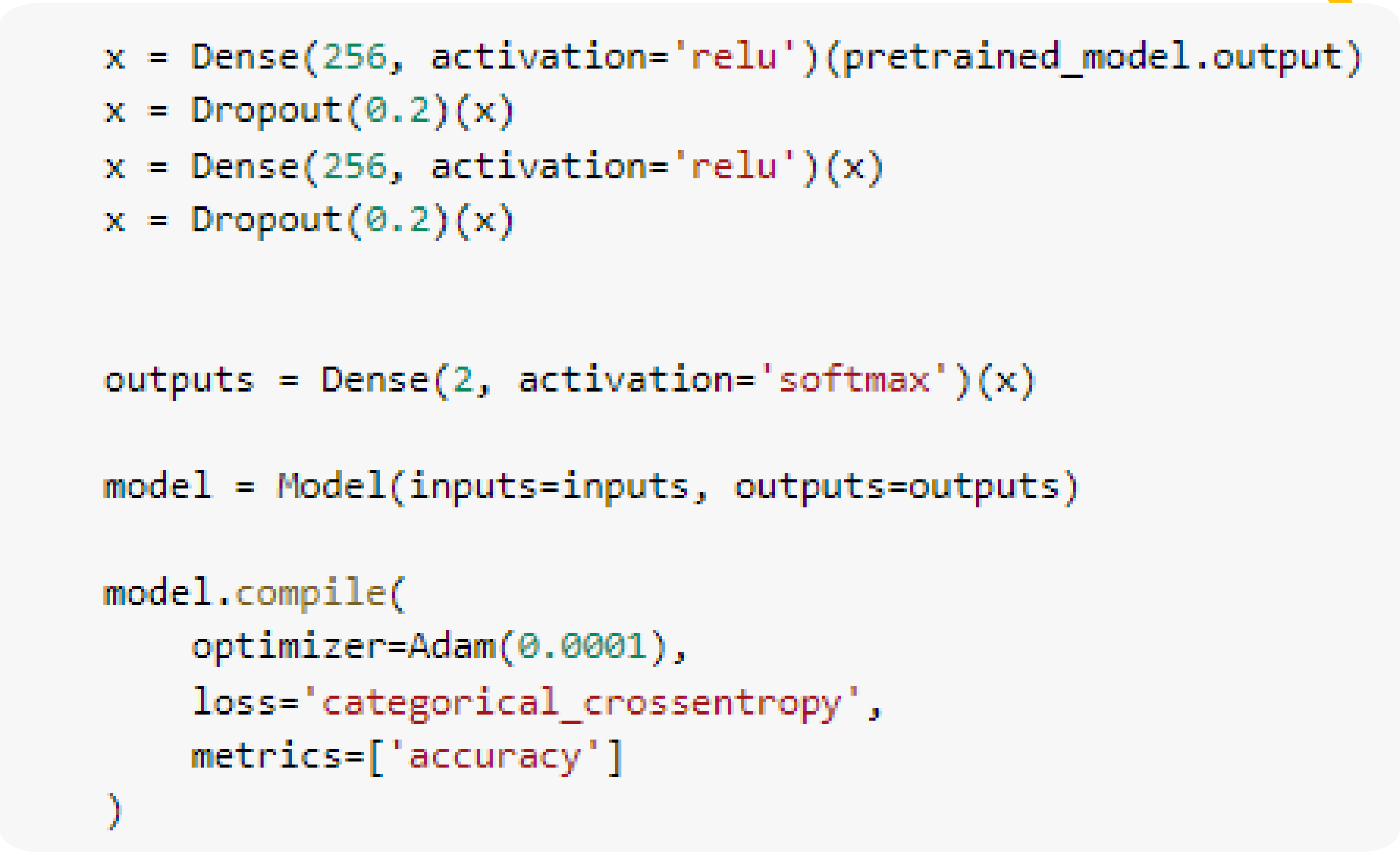
Project Progress :

- 1. Obtained Accuracy of the fire dataset by Hyper Tuning the parameters of the CNN model to **98.81 %**
- 2. Real Time Processing Of Fire Video.

Steps To Achieve The Accuracy:

- Step 1 : Obtain Dataset
- Step 2 : Import Libraries (Data Science, TensorFlow, System Libraries)
- Step 3 : Create Helper Functions
- Step 4 : Load & Transform The Data
- Step 5 : Placing Data into Data Frames
- Step 6 : Visualizing Images From Dataset
- Step 7 : Data Pre-processing
- Step 8 : Training The Model
- Step 9 : Model Evaluation
- Step 10 : Visualizing Loss Curves
- Step 11 : Make Predictions on the Test Data
- Step 12 : Plotting Classification Reports & Confusion Matrix

Parameters:

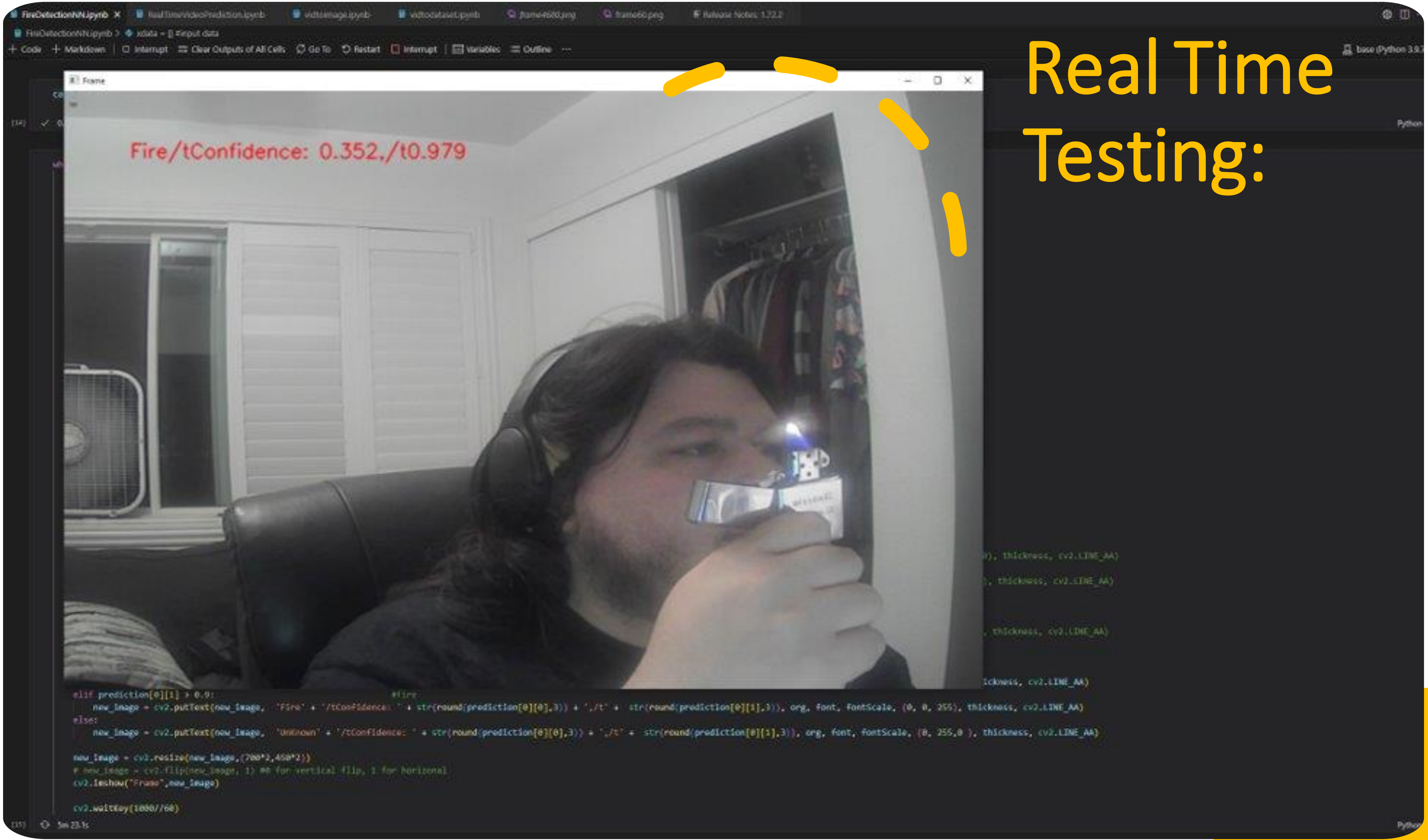


```
x = Dense(256, activation='relu')(pretrained_model.output)
x = Dropout(0.2)(x)
x = Dense(256, activation='relu')(x)
x = Dropout(0.2)(x)


outputs = Dense(2, activation='softmax')(x)

model = Model(inputs=inputs, outputs=outputs)

model.compile(
    optimizer=Adam(0.0001),
    loss='categorical_crossentropy',
    metrics=['accuracy']
)
```

REAL TIME PROCESSING OF FIRE VIDEO:

- Step 1 : OpenCV to get the image
- Step 2 : Create input & target arrays.
- Step 3 : Split the real time video in frames.
- Step 4 : Feed the frames in our CNN model created.
- Step 5: Train the Neural Network.
- Step 6 : Predict the confidence.
- Step 7 : Conclude whether "Fire Detected" or "Non - Fire".

Real Time Testing:



```
Fire/tConfidence: 0.352./t0.979
```

```
...), thickness, cv2.LINE_AA)
..., thickness, cv2.LINE_AA)
..., thickness, cv2.LINE_AA)
...ickness, cv2.LINE_AA)
elif prediction[0][1] > 0.9:                        #fire
    new_image = cv2.putText(new_image,  'Fire' + '/tConfidence: ' + str(round(prediction[0][0],3)) + './t' +  str(round(prediction[0][1],3)), org, font, fontScale, (0, 0, 255), thickness, cv2.LINE_AA)
else:
    new_image = cv2.putText(new_image,  'Unknown' + '/tConfidence: ' + str(round(prediction[0][0],3)) + './t' +  str(round(prediction[0][1],3)), org, font, fontScale, (0, 255,0 ), thickness, cv2.LINE_AA)

new_image = cv2.resize(new_image,(700*2,450*2))
# new_image = cv2.flip(new_image, 1) #0 for vertical flip, 1 for horizonal
cv2.imshow("Frame",new_image)

cv2.waitKey(1000//60)
```

FUTURE SCOPE

1. Future studies may focus on deploying the model into **raspberry pi** and using necessary support packages to detect the real time fire by making challenging and **specific scene understanding datasets for fire** detection methods and detailed experiments.

2. We can also expect better deep learning **architectures** to emerge in the future, offering better feature extraction.

3. **CNN can be clubbed with R-CNN LSTM.**

THANK YOU