Exploring Facial Recognition Techniques:
LBP versus Deep Learning on LFW Dataset

M.Sc. of Cybersecurity

Eleonora Fornaro 1836820

Michela Giampaolo 1838257

Damiano Gualandri 1892871

Academic Year 2023/2024

SAPIENZA
UNIVERSITÀ DI ROMA

Table of Contents

Objective

1 Introduction

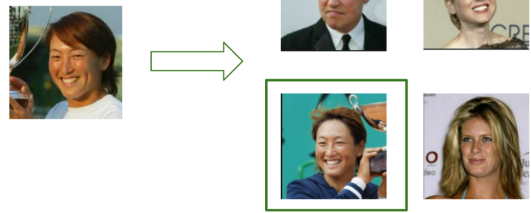
- **Local Binary Pattern**
  - captures pixel-wise patterns and transitions within small regions
  - computationally efficient for facial recognition
- **Deep learning**
  - Deep neural networks for the extraction of facial features
  - Raise the level of accuracy in face recognition

- **Main aim**:
  - Highlights differences between Face detection and Recognition with LBP and Deep Learning
  - Use an unconstrained dataset like **LFW**.

Identification Open Set

1 Introduction

- **Tasks**
  - Determine whether a probe's biometric signature matches someone's in the gallery
- **Threshold settings**
  - customized to achieve ideal rates according to application purpose



Dataset

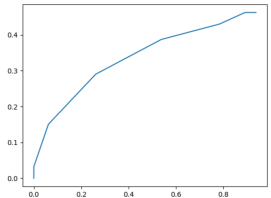
1 Introduction

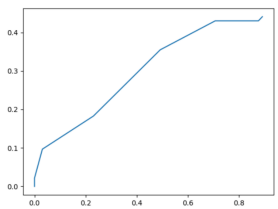
- **Labeled Faces in the Wild**
  - Images captured under uncontrolled conditions
  - Variations in terms of PIE (Pose, Illumination and Expression)
  - Partial Occlusion

Table of Contents

Local Binary Pattern

2 Project Implementation





- **Face Detection** carried out with the *face_detect()* function in which we could use either **Haar Classifier** or **LBP Classifier**
- **Haar Cascade Classifier**
  - Effective and highly accurate for detection in various scenarios but require significant memory resources and may struggle with image variations.
- **LBP Classifier**
  - Efficient and faster but sensitive to noise in the data, leading to false positives or decreased accuracy

Local Binary Pattern

2 Project Implementation

- **Create Face recognizer**
- **Face Recognition** The face Recognition happens inside the predict function
- **Label** is tha label predicted that is inside the gallery while **the confidence** is a measure of distance.

```
#create the LBP face recognizer
face_recognizer = cv2.face.LBPHFaceRecognizer_create()
```

```
label, confidence = face_recognizer.predict(face)
```

Local Binary Pattern

2 Project Implementation

- **Rates**
  - Confidence is the value to compare to the threshold in order to increment **GA**, **FR**, **FA**, **GR**.

```
def calculate_metrics(t, test_img, subfolder, predicted_img, subjects, DI, FR, FA, GR):
    (label_pred, predicted, confidence) = predict(test_img)
    if predicted is not None:
        if confidence <= t:
            if label_pred == subfolder:
                predicted_img.append((label_pred,predicted))
                DI += 1
            else:
                if subfolder not in subjects:
                    FA+=1
        else:
            if label_pred != subfolder:
                GR+=1
    else:
        GR+=1

    return (DI,FR,FA,GR)
```

Deep Learning

2 Project Implementation

- **Deep Face**
  - **Find** function
  - VGG model as recognition model
  - OpenCV for face detection
  - Thresholds varies from 0.01 to 0.99

For deep learning we used the same logic to calculate rates.

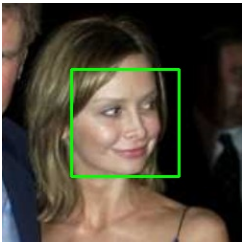
- **Cosine Similarity**
  - used to measure the or similarity or distance between two face embedding, treated as vectors, calculating the cosine of the angle between them.

Deep Learning

2 Project Implementation

- **Deep Face**
  - Organization of probes and gallery is the same used for LBP
  - Only variation in reprocessing: ***find*** function, which search for the identity in the gallery and return list of pandas data frame
  - Calculate the number of GA, FR, FA and GR

- Due to the different nature of DeepFace, we're now able to correctly detect the face of Calista



Performance Evaluations

2 Project Implementation

- **Assessment**
  - Calculate the following rates:
    - Detection and Identification Rate DIR(t,1): rank k is 1 for both LBP and DF
    - False Acceptance Rate (FAR)
    - False Rejection Rate (FRR)
    - Equal Error Rate (ERR)

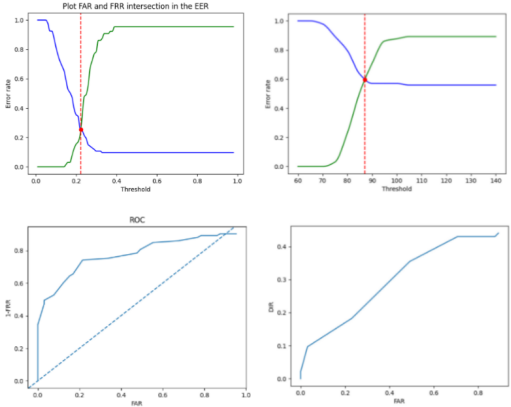


Table of Contents

Considerations

3 Conclusion

- **Deep Face vs LBP**
  - LBP ability to address complex variations may be limited, especially with diverse lighting and angles
  - Deep Learning excelled in flexibility even with complex patterns
  - LBP approach is faster computational cheaper

- **Future Works**
  - Multi biometric system by combining scores (normalization of scores since we have different ranges)
  - Live Detection

Exploring Facial Recognition Techniques:

Thank you for listening!

Any questions?