PRML PROJECT REPORT

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Abstract

In this report, we present a comprehensive study on the identification of faces in images by classifying them into one of K given classes using various feature extraction techniques. Specifically, we explore the Local Binary Patterns (LBP), Histogram of Oriented Gradients (HoG), and Convolutional Neural Networks (CNN) methods.

Firstly, we provide an overview of each technique, explaining its underlying principles and how it extracts features from images. Then, we describe our experimental setup, including the dataset used, preprocessing steps, and evaluation metrics.

Subsequently, we present the results of our experiments, comparing the performance of LBP, HoG, and CNN in terms of accuracy, computational efficiency, and robustness.

Finally, we conclude with insights gained from our study and potential avenues for future research in the field of face identification using different feature extraction techniques.

Contents

1 Introduction

Face identification is a fundamental task in computer vision with numerous applications ranging from security and surveillance to human-computer interaction. The ability to accurately classify faces into predefined classes plays a crucial role in various domains, including law enforcement, access control systems, and personal device authentication.

In this report, we address the problem of face identification by exploring three distinct feature extraction techniques: Local Binary Patterns (LBP), Histogram of Oriented Gradients (HoG), and Convolutional Neural Networks (CNN). These techniques have been widely studied and applied in the field of computer vision for their effectiveness in capturing discriminative features from images.

1.1 Figures

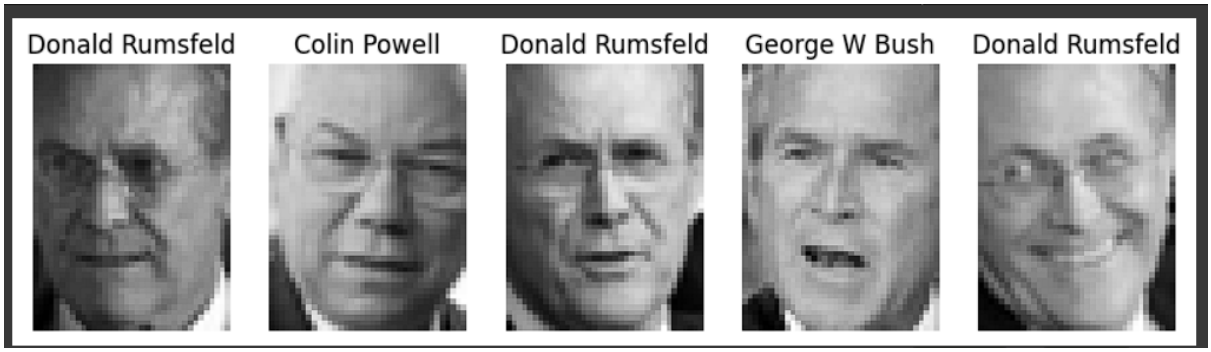


Figure 1: Randomly generated LFW images

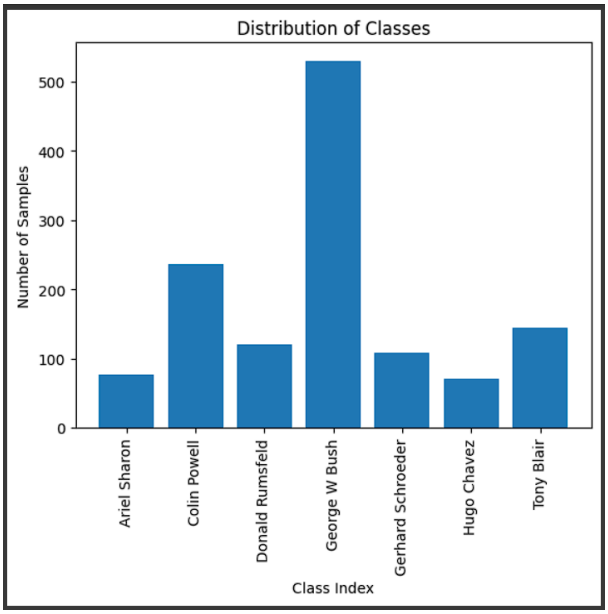


Figure 2: Bar chart representing numbers of samples among different classes

(a) Original Image

(b) LBP Feature Extracted (Scratch)

(c) LBP Feature Extracted (Using scikit-learn)

Figure 3: Comparison of LBP Feature Extraction

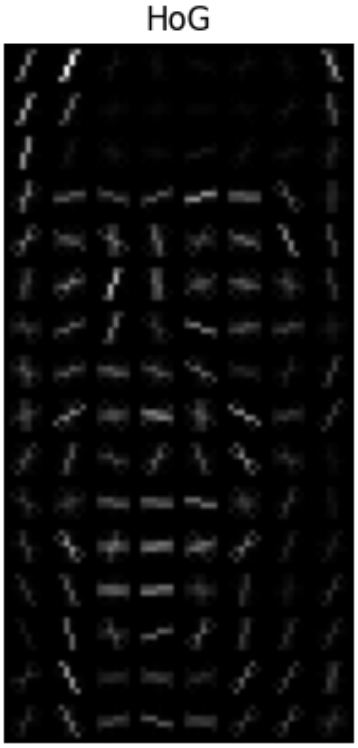
(a) Original Image

(b) vertical Gradient Detection using HOG

(c) Horizontal Gradient Detection using HOG

(d) Representation of mMagnitude of gradient

(e) Representation of angle



(f) Final Histogram of Oriented Gradients Image

Figure 4: HOG feature Extraction

(a) Horizontal edge detection using CNN

(b) Vertical edge detection using CNN

(c) CNN : gabor filter application

Figure 5: Comparison of CNN Feature Extraction

2 Approaches Tried

Exploratory Data Analysis:

- The dataset comprises a total of 1288 images, each of size (50, 37) pixels.
- There are 7 unique classes in the dataset, representing different individuals.
- The distribution of samples among different classes is visualized using a bar chart.

Feature Extraction Techniques:

1. **Local Binary Patterns (LBP) Feature Extraction:**
   - **Implemented from Scratch:**
     - The LBP algorithm is manually implemented to extract texture features from images.
     - LBP is computed for each pixel by comparing its intensity with neighboring pixels.
     - The resulting LBP image encodes texture information.
   - **Using scikit-learn:**
     - Scikit-learn library is utilized to perform LBP feature extraction.
     - Scikit-learn provides optimized implementations for efficient feature extraction.
2. **Histogram of Oriented Gradients (HOG) Feature Extraction:**
   - Computation of horizontal gradient, vertical gradient and magnitude and angle of gradients for each pixel in the image is done manually
   - HOG focuses on capturing the distribution of gradient orientations in images.
   - It divides images into cells and computes histograms of gradient orientations within each cell.
   - HOG features are commonly used in object detection tasks.
3. **Convolutional Neural Network (CNN) for Edge Detection:**
   - A CNN is employed for vertical and horizontal edge detection.
   - The Colvolution function is made from scratch that can be used to detect vertical and horizontal edges in images.

- These edge-detected images provide useful features for characterizing image content.
- The Gabor filter is also applied to images to extract texture features.
- Gabor filters are spatial-frequency filters that are sensitive to textures and edges in images.
- By convolving images with Gabor filters, texture information is extracted to represent image content.

3 Experiments and Results

Write about dataset, experimental setting, compare results

4 Summary

Summerize the project.

References

A Contribution of each member

1. Author1: Implemented baseline1 and baseline2. Prepared project page.(example)
2. Author2: Implemented baseline3 and cleaned the data. Prepared video recording. (example)