**PUNE INSTITUTE OF COMPUTER TECHNOLOGY**

**Department of Computer Engineering**

**(2022-2023)**

**LP-5**

**Batch:- R2**

**Human Face Recognition**

Under the guidance of

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**DEPARTMENT OF COMPUTER ENGINEERING**

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**CERTIFICATE**

This is to certify that the SPPU Curriculum-based mini-project report entitled “Human Face Recognition” submitted by Aditya Magdum (41251) has satisfactorily completed the curriculum-based mini-project under the guidance of Prof. A. A. Chandorkar towards the partial fulfillment of third year Computer Engineering Semester VIII, Academic Year 2023-24 of Savitribai Phule Pune University.

Date: April 2024 Prof. P. R. Patil

Place: Pune Subject Coordinator

**Table of Contents: -**

|  |  |  |
| --- | --- | --- |
| **Sr.no** | **Title** | **Page no.** |
| **1** | **Problem Statement** | **3** |
| **2** | **Motivation** | **3** |
| **3** | **Scope** | **3** |
| **4** | **Objective** | **3** |
| **5** | **Outcomes** | **3** |
| **6** | **Software and Hardware**  **Requirements** | **3** |
| **7** | **Theory** | **4** |
| **8** | **Conclusion** | **5** |

1. **Problem Statement:**

To build a system that can accurately recognize an individual using their facial features extracted from an image.

1. **Motivation:**

The motivation behind face recognition is to accurately identify and verify the identity of an individual based on their facial features. This has many practical applications, including security and surveillance, access control, human-computer interaction, and personalized services. Face recognition technology offers a non-invasive and reliable method for identifying individuals, which has many benefits, such as improving public safety, preventing fraud, enhancing user experience, and reducing the risk of identity theft. The motivation behind face recognition also includes the desire to develop more advanced and intelligent systems that can operate in real-world scenarios with high accuracy and efficiency.

1. **Problem Scope:**

Human face recognition is a field of computer vision and artificial intelligence that deals with identifying and verifying the identity of an individual based on their facial features. It has a wide range of applications in security, surveillance, access control, and human-computer interaction.

1. **Objectives:**

The objective of this report is to provide an overview of human face recognition, including its theory, hardware and software requirements, outcomes, and future prospects. The report aims to explain how the technology works, what are its limitations and challenges, and how it can be applied to real-world problems.

1. **Outcomes:**

The expected outcomes of this report are:

* An understanding of the fundamental principles of human face recognition.
* An awareness of the hardware and software requirements for implementing a face recognition system.
* An appreciation of the advantages and limitations of face recognition technology.
* An insight into the ethical and social implications of using face recognition in different contexts.

1. **Hardware and Software Requirements**
2. **Hardware Requirements**

* CPU
* Windows 11, 64bit
* GPU (Nvidia)
* 8GB RAM

1. **Software Requirements**

* Python 3.0
* Jupyter Notebook IDE
* Facebook’s Deepface
* Histogram of Gradients

1. **Theory:**

Human face recognition is based on the idea that each person has unique facial features that can be used to distinguish them from others. These features can include the shape and size of the eyes, nose, mouth, and jawline, as well as the skin texture and color. Face recognition algorithms typically work in three main steps: face detection, face alignment, and face encoding.

1. **Face detection**

It is the process of identifying the presence and location of a face in an image or a video stream. This is typically done using machine learning models that can classify whether a given region of the image contains a face or not.

1. **Face alignment**

It is the process of normalizing the position and orientation of the detected face to a standard pose. This is necessary to ensure that the facial features are aligned and consistent across different images.

1. **Face encoding**

It is the process of extracting a set of numerical features that represent the unique characteristics of the face. This is typically done using deep learning models that can learn to encode the face features in a high-dimensional space.

1. **Procedure**
2. In this project, we use HOG or Histogram of Gradients to detect faces in an image.
3. We then use Open CV to preprocess the image and crop the image such that the new image only has the persons face in it.
4. After cropping the face, we use Facebook’s DeepFace model to extract face embeddings from the cropped image.
5. We then compare these face embeddings to the ones in our database using cosine similarity and euclidean distance.
6. Then we assume that the face with the highest cosine similarity is the person given in the input.
7. **Code**

Face detection function:

def detect\_faces(grp\_img):  
 face\_locations = face\_recognition.face\_locations(grp\_img)  
 images\_array = []  
 for face\_location in face\_locations:  
 top, right, bottom, left = face\_location  
 face\_array = grp\_img[top-100:bottom+100, left-100:right+100]  
 images\_array.append(face\_array)  
 return images\_array

Face recognition:

def find\_embeds(image\_arr):  
 embed\_arr = []  
 for i in range(len(image\_arr)):  
 result = DeepFace.represent(img\_path=image\_arr[i], model\_name="Dlib", enforce\_detection=False)  
 embed\_arr.append(result)  
 return embed\_arr

Cross-referencing faces:

def is\_same\_person(img1, img2):  
 em1 = np.array(img1)  
 em2 = np.array(img2)  
 a = np.matmul(np.transpose(em1), em2)  
 b = np.sum(np.multiply(em1, em1))  
 c = np.sum(np.multiply(em2, em2))  
 score = 1 - (a / (np.sqrt(b) \* np.sqrt(c)))  
 return score

1. **Conclusion**

Human face recognition is a rapidly growing field that has many practical applications and significant social implications. While the technology has made great strides in recent years, there are still many challenges and limitations that need to be addressed, such as privacy concerns, algorithmic bias, and robustness to variations in lighting and pose. Nevertheless, face recognition has the potential to revolutionize many aspects of our lives and improve our safety, security, and well-being.