SAHYADRI
COLLEGE OF ENGINEERING & MANAGEMENT
An Autonomous Institution
MANGALURU

Department of Computer Science & Engineering

Mini-Project Synopsis - Academic Year 2023-24

1	**Title of the Project**	Multiple face detection and recognition
2	**Team No**	CS40
3	**Department**	Department of Computer Science and Engineering
4	**Project Area/Domain**	Biometrics
5	**Project Type**	Software
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7	**Name of Guide**	Mr. Harisha A

8. Abstract

With the pervasiveness of monitoring cameras installed in public places, schools, hospitals and homes, video analytics technologies for interpreting the generated video content are becoming more and more relevant to people's lives. Along this context, we develop a human-centric video surveillance system that identifies and tracks people in a given scene. In this mini project, we are going to implement Multiple human face detection and recognition in real time application to detect and recognize the faces in real time using Open CV with the help of Emgu CV. This project focuses on tracking multiple people simultaneously in real time.

Keywords:

- Open CV (Open Source Computer Vision Library): It is a library of programming functions mainly for real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage, then Itseez (which was later acquired by Intel). The library is cross-platform and licensed as free and open-source software under Apache License.
- Emgu CV: It is a cross platform .Net wrapper to the OpenCV image processing library. Allowing OpenCV functions to be called from .NET compatible languages such as C#, VB, VC++, Iron Python etc. The wrapper can be compiled in Mono and run on Windows, Linux, Mac OS X, iPhone, iPad and Android devices.
- Face detection: It is a computer technology being used in a variety of applications that identifies human faces in digital images. Face detection also refers to the psychological process by which humans locate and attend to faces in a visual scene.
- Facial recognition system: It is a technology potentially capable of matching a human face from a digital image or a video frame against a database of faces. Such a system is typically employed to authenticate users through ID verification services, and works by pinpointing and measuring facial features from a given image.
- PCA (Principal component analysis): It is a linear dimensionality reduction technique with applications in exploratory data analysis, visualization and data preprocessing. The data is linearly transformed onto a new coordinate system such that the directions (principal components) capturing the largest variation in the data can be easily identified.

9. Introduction

Face recognition is an important research area in computer vision and has various applications, including security, surveillance, and human-computer interaction. In recent years, there has been a significant increase in the number of face recognition systems that use deep learning techniques. However, the accuracy of these systems is often affected by variations in lighting and camera quality. This makes it challenging to recognize multiple faces in a single frame, particularly in low-quality camera and lighting conditions.

Overview:

The facial recognition has been a problem worked on around the world for many persons; this problem has emerged in multiple fields and sciences, especially in computer science, other fields that are very interested in this technology are: Mechatronic, Robotic, criminalistics, etc. In this project we will work on this topic using Emgu CV cross platform .NET wrapper to the Intel OpenCV image processing library and C# .NET, these libraries allow us to capture and process image of a capture device in real time.

Scope:

- Security and Law Enforcement: Facial recognition is employed for access control systems, surveillance, and public safety. It can help in identifying and tracking individuals of interest, detecting criminals, and preventing unauthorized access.
- Identity Verification: Facial recognition is utilized for identity verification in applications such as unlocking smartphones, accessing secure facilities, and online authentication for banking and e-commerce.
- Personalized Experiences: Facial recognition enables personalized experiences in retail, entertainment, and marketing. It can be used to tailor content, recommendations, or advertisements based on individual preferences and demographics.
- Attendance and Time Tracking: Facial recognition can automate attendance tracking in workplaces, schools, and events. It eliminates the need for manual processes and provides accurate and efficient monitoring.

Motivation:

Multiple face recognition, also known as multi-face recognition, refers to the capability of a system to identify and distinguish between multiple individuals' faces within a single image or across a series of images or frames. There are several motivations behind the development and implementation of multiple face recognition systems:

- Security and Surveillance
- Access Control and Authentication
- Attendance Tracking and Monitoring
- Law Enforcement and Criminal Identification
- Healthcare and Patient Management

10. Literature Survey:

"Dual Attention Network for Scene Segmentation" by Woo et al. (2018): Although not directly focused on facial recognition, this paper introduces a dual attention mechanism that can be applied to handle multiple faces within an image. The attention mechanism allows the model to selectively focus on relevant facial regions, improving recognition accuracy.

"Deep Face Recognition: A Survey" by Zhao et al. (2018): This survey provides a comprehensive overview of deep learning techniques applied to face recognition. It covers various approaches, including multi-task learning, metric learning, and attention mechanisms, that can be utilized for recognizing multiple faces within a single frame.

"Face Detection and Recognition in Real-World Videos" by Jin et al. (2018): The paper presents a framework for simultaneous face detection and recognition in video streams. It utilizes deep learning methods and incorporates temporal information to handle occlusions and variations in appearance across frames.

"DeepID-Net: Multi-Scale Deep Convolutional Neural Networks for Face Alignment and Verification" by Sun et al. (2014): This paper introduces a multi-scale deep neural network architecture for face recognition. The model learns discriminative features at different scales, enabling robust recognition of multiple faces under varying conditions.

"Joint Face Detection and Alignment Using Multitask Cascaded Convolutional Networks" by Zhang et al. (2016): The authors propose a cascaded CNN model for simultaneous face detection and alignment. The model efficiently handles multiple faces in a single frame by performing face detection and facial landmark localization in a unified framework

"Deep Convolutional Neural Networks for Multimodal Parameter Estimation in Facial Recognition" by Sun et al. (2018): This paper proposes a deep convolutional neural network (CNN) model for accurate and efficient recognition of multiple faces in real-world scenarios. The model combines facial image and depth map information to enhance recognition performance.

11. Problem Statement and Description

Facial recognition technology is a biometric application that analyzes and identifies unique facial features to verify or recognize individuals. It has gained significant attention and application in various sectors, including security, law enforcement, and consumer electronics. One of the key problems faced in facial recognition is accuracy. The performance of facial recognition systems heavily relies on the quality of input images or videos. Factors such as lighting conditions, pose variations, occlusions, and image resolution can significantly affect recognition accuracy.

12. Objectives:

- To provide a system to detect people between themselves and the surrounding.
- To check if a person is them or not
- To truly detect potentially dangerous situations while avoiding false alarms (e.g., a family with children or relatives, an elder with their caregivers).
- To provide a system for marking the attendance of students those who are attending the class.

13. Proposed Methodology:

The proposed approach involves two main stages: face detection and recognition. The face detection stage is designed to locate all faces in the image, while the recognition stage is designed to identify each face. We employ a CNN based face detector, which is trained to detect faces in images with low quality camera and lighting competition. The CNN is trained on a large dataset of images with varying lighting conditions and camera qualities to ensure robustness.

Face Recognition: we use a CNN-based face recognition algorithm, which is trained on a large dataset of faces with varying poses, expressions, and lighting conditions. The recognition algorithm takes the detected faces as input and outputs a vector of feature embeddings for each face. The embeddings are then compared using a distance metric to determine if the faces belong to the same person. Facial recognition using AI involves several steps, including face detection, face alignment, feature extraction, and classification. The general process is as follows:

Face Detection: The first step in facial recognition is to locate and isolate the face within an image or video frame. This involves the use of computer vision algorithms to detect the presence of a face and its location within the image. This is typically done using Haar cascades, HOG (Histogram of Oriented Gradients), or deep learning-based object detection methods.

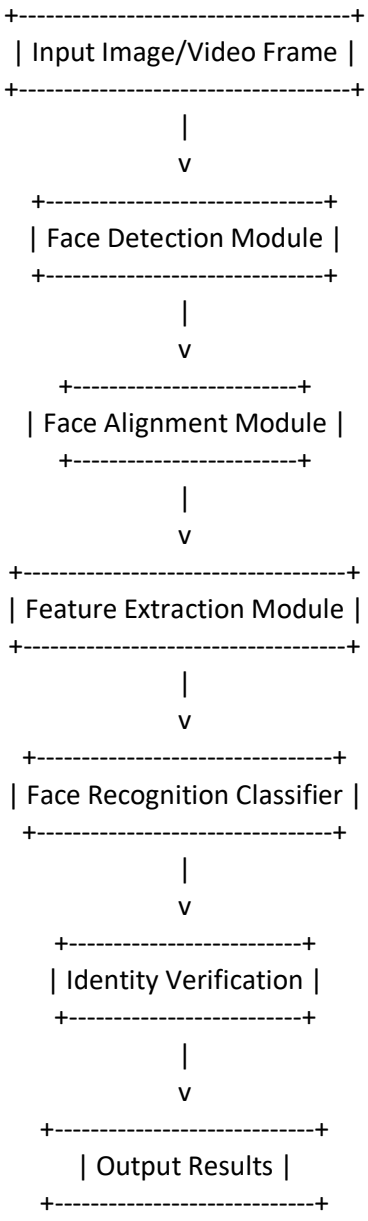
Face Alignment: Once the face has been detected, the next step is to align the face so that it is in a standard position and orientation. This is done to reduce variations caused by differences in head poses, facial expressions, and lighting conditions. This is typically achieved by normalizing the face to a fixed size and orientation.

Feature Extraction: The next step is to extract meaningful features from the aligned face. This involves extracting high-level features that can be used to distinguish between different faces. This is done using deep learning-based feature extraction techniques, such as Convolutional Neural Networks (CNNs), which can automatically learn and extract features from images.

Classification: Once the features have been extracted, the final step is to classify the face based on its features. This involves using machine learning algorithms, such as Support Vector Machines (SVMs) or neural networks, to classify the face into different categories based on the extracted features. The classification algorithm is trained using a dataset of labeled faces to learn the relationship between the extracted features and the identity of the person.

In summary, facial recognition using AI involves the use of computer vision and deep learning techniques to detect, align, extract features, and classify faces within an image or video frame. The process involves several steps, each of which is designed to reduce variations caused by differences in head poses, facial expressions, and lighting conditions, and improve the accuracy of the recognition system.

Architecture:



14. Outcome of the work

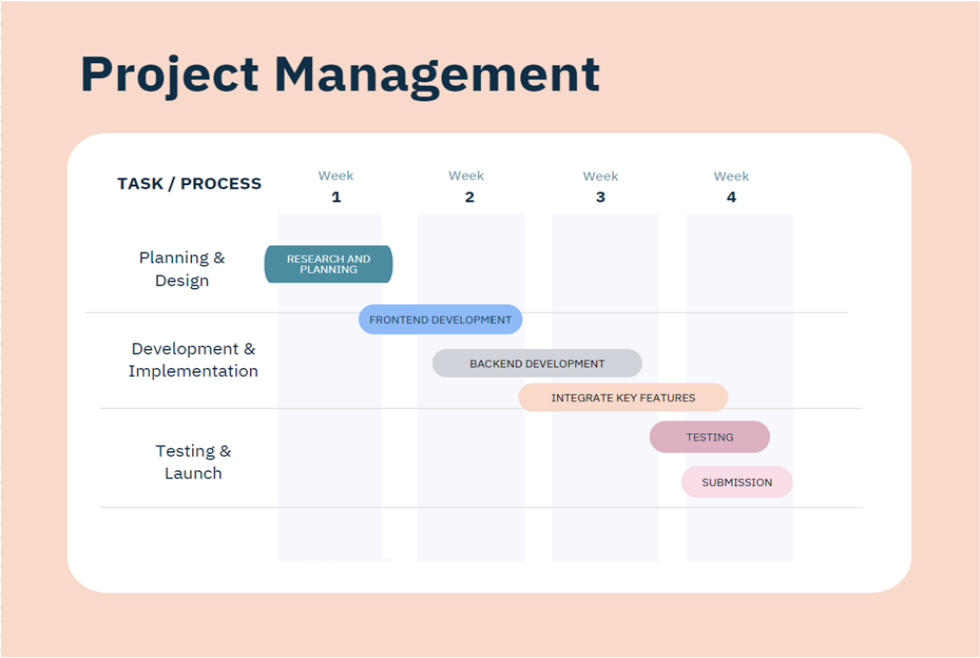
- Enhanced security and safety: Facial recognition technology is already known for high speed, accuracy, and reliability. This makes it ideal for areas where quick and accurate identification is crucial for maintaining a high level of security.

- Fraud Prevention: Face recognition can be used to authenticate customers, reducing the risk of identity theft and fraud. This is especially important in banking and finance.

- Convenience and efficiency: The iPhone X was the first smartphone to introduce face recognition in 2017, also known as Face ID. From simply unlocking the phone to authorizing other types of actions, it became a very convenient feature for end users, prompting other manufacturers to incorporate it by default.

- Personalization: Facial recognition technology can also enable personalization in various situations. For example, driver monitoring can be used to automatically adjust car settings to the preferences of a specific driver or passenger, including lighting, heating, seat position, content recommendations, and more.

15. Work Plan



Conclusion

Face recognition technology has come a long way in the last twenty years. Today, machines are able to automatically verify identity information for secure transactions, for surveillance and security tasks, and for access control to buildings etc. These applications usually work in controlled environments and recognition algorithms can take advantage of the environmental constraints to obtain high recognition accuracy. To achieve this goal computers must be able to reliably identify nearby people in a manner that fits naturally within the pattern of normal human interactions. They must not require special interactions and must conform to human intuitions about when recognition is likely.

References:

- http://en.wikipedia.org/wiki/Facial_recognition_system
- http://www.emgu.com/wiki/index.php/Main_Page
- http://www.shervinemami.info/faceRecognition.html
- http://www.face-rec.org/algorithms/
- https://ieeexplore.ieee.org/document/8659751

16.	**Signature of Students**	
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