FACE DETECTION & RECOGNITION SYSTEM

ABSTRACT

This study provides a comprehensive literature review to establish the theoretical foundation for the completed project on human face detection and recognition. With the increasing need for secure and efficient authentication systems, face detection has become a critical preprocessing step in a wide range of applications, including surveillance, access control, and human-computer interaction. By examining various research papers, the review highlights challenges posed by both internal (such as facial expressions, glasses, and beards) and external factors (such as lighting, viewpoint, and environmental conditions) that affect detection accuracy. The evolution of methodologies, including neural networks, machine learning, and color-based segmentation, is discussed.

The project focuses on implementing a face detection and recognition system that classifies image segments as either face or non-face (background). The main objective is to overcome the difficulties caused by the variability of human faces under different conditions. Techniques such as Principal Component Analysis (PCA), Local Binary Pattern (LBP), and deep learning with Convolutional Neural Networks (CNN) are explored. The system was trained using a dataset consisting of various angles and lighting conditions to achieve higher accuracy in detecting and recognizing faces. Additionally, the project contributes to improving automated attendance systems by incorporating face recognition technology, which has shown potential in applications such as university attendance management and security systems.

Nowadays increased importance of security and organization, identification and authentication methods have developed into a key technology in various areas: access control for computers in general or for automatic teller machines in particular; entrance control in buildings ; withdrawing money from a bank account . Human face detection is the first step in applications such as human computer interface ,video surveillance, image database management , and face recognition. The main aim of face detection is to classify the segment of image as face or non-face(background of image).

The task of describing the human face is difficult due to the fact that the image varies based on external factors like scale, viewpoint , different individual, lighting, occlusion, environmental conditions and internal factors like facial expression, moustache, beard ,

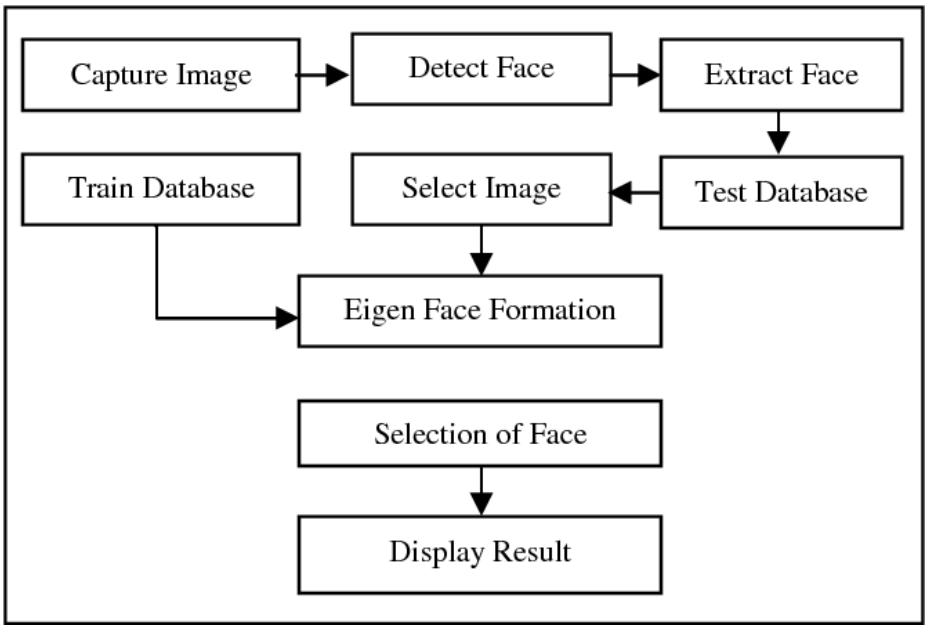
glasses.These approaches[1] utilize techniques such as machine learning , neural networks, (deformable) template matching, motion extraction, Hough transform, and color analysis.

The neural network-based[2] and view-based[3] approaches require a large number of face and non-face training examples, and are designed to find frontal faces in grayscale images. A recent statistical approach[3] extends the detection of frontal faces to profile views by training two separate classifiers. Skin color provides an important cue for face detection. Detection of skin color in color images is a very popular and useful technique for face detection.

Since the early 70's [4], face recognition has drawn the attention of researchers in fields from security, psychology, and image processing, to computer vision. While network security and access control are it most widely discussed applications, face recognition has also proven useful in other multimedia information processing areas.

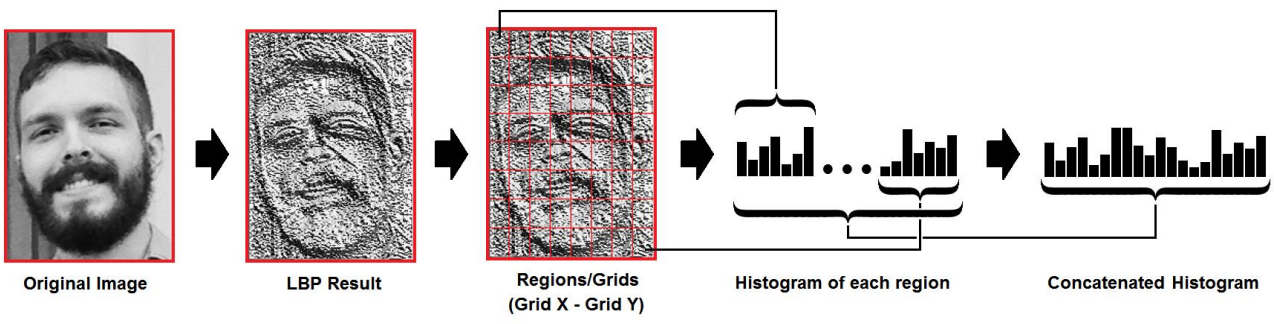
In the beginning of the 1970's, face recognition was treated as a 2D pattern recognition problem [5]. The distances between important points where used to recognize known faces, e.g. measuring the distance between the eyes or other important points or measuring different angles of facial components. But it is necessary that the face recognition systems to be fully automatic. Face recognition is such a challenging yet interesting problem that it has attracted researchers who have different backgrounds: psychology, pattern recognition, neural networks, computer vision, and computer graphics.

Liton Chandra Paul et. al. [6] wrote a paper “Face Recognition Using Principal Component Analysis Method”. This paper mainly addressed the building of face recognition system by using Principal Component Analysis (PCA). PCA is a statistical approach used for reducing the number of variables in face recognition. In PCA, every image in the training set is represented as a linear combination of weighted eigenvectors called eigenfaces. These eigenvectors are obtained from covariance matrix of a training image set. The weights are found out after selecting a set of most relevant Eigenfaces. Recognition is performed by projecting a test image onto the subspace spanned by the eigenfaces and then classification is done by measuring minimum Euclidean distance.



Divyarajsinh N. Parmar et. al. [7] wrote a paper "Face Recognition Methods & Applications". They described that Face Recognition system is used in security. Face recognition system should be able to automatically detect a face in an image. This involves extracts its features and then recognize it, regardless of lighting, expression, illumination, ageing, transformations (translate, rotate and scale image) and pose, which is a difficult task. This paper contains three sections. The first section describes the common methods like holistic matching method, feature extraction method and hybrid methods. The second section describes applications with examples and finally third section describes the future research directions of face recognition.

Sarabjit Singh et. al. [8] wrote a paper "A Face Recognition Technique using Local Binary Pattern Method". In this paper they described that LBP is really a very powerful method to explain the texture and model of a digital image. Therefore it was ideal for feature extraction in face recognition systems. A face image is first split into small regions that LBP histograms are extracted and then concatenated in to a single feature vector. This vector forms an efficient representation of the face area and can be used to measure similarities between images. Automatic facial expression analysis is a fascinating and challenging problem, and impacts important applications in several areas such as human–computer interaction and data-driven animation.

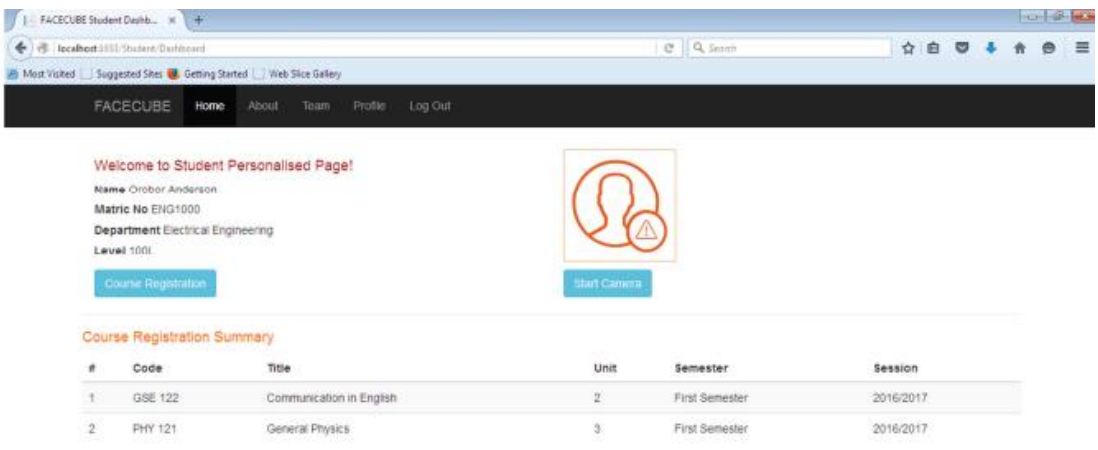


Automatic Attendance System for University Student Using Face Recognition Based on Deep Learning[9] : Student attendance is an essential aspect of the learning process on the university. By attending class, student able to get valuable information from the lecturer, so that the student able to improve knowledge and understanding towards a particular field or even some skills [10]. Each university is implementing its attendance system to make record student's presence for tracking and administration purpose .Convolutional Neural Network used in this study. Convolutional Neural Network is a computational processing system similar to the Artificial Neural Network, inspired by the work of the human brain. CNN consists of neurons that can be optimised through training. The difference between CNN and Artificial Neural Networks is that CNN is primarily used in the field of pattern recognition in pictures [11]. To achieve a student attendance system based on face recognition, the computer must be able detect student's face from the input image; then it will identify the student, and save the student's data, which is his or her student ID number, date, and time. Preparing Student photo stage is done to prepare a dataset for training the neural network and classify student based on his or her face. In this test, three students' photo was taken, with five photos each. The photos used have a size of 600 px x 800 px. The photos are taken from the frontal side, ±30° to the right, ±60° to the right, ±30° to the left, and ±60° to the left. This is done in order to achieve higher accuracy.

To find out the accuracy level of face recognition used in this system, a photo of a student whose face has been trained is taken. The size of the photo taken by the Raspberry Pi camera is 320 px × 240 px. This is done to make the face recognition process can be accomplished faster, because the more significant the image size, the time needed to recognize the student's face becomes longer. The below figure shows the facial recognition result from one of the student's face. A box with the student's ID number is shown as evidence that the system successfully recognises the student.

This system makes the student attendance process done automatically and is expected to be able to replace the old manual attendance process, which is currently used.

Now , we will now focus on another study about.attendance management system .This research is aimed at developing a less intrusive, cost effective and more efficient automated student attendance management system using face recognition that leverages on cloud computing (CC) infrastructure called FACECUBE. FACECUBE takes attendance by using IP camera mounted in front of a classroom, to acquire images of the entire class. It detect the faces in the image and compares it with the enrolled faces in the database. On identification of a registered face on the acquired image collections, the attendance register is marked as present otherwise absent. The system is developed on Open Source image processing library hence, it is not vendor hardware nor software dependent. Faces are highly challenging and dynamic objects that are employed as biometric evidence, in identity verification. Biometrics systems have proven to be an essential security tool, in which bulk matching of enrolled



people and watch lists is performed every day [13]. FACECUBE window service component is a lightweight application that runs on the background of the on-premise local server. It is responsible for listening to attendance request, starting IP cameras irrespective of their location on the Campus Area Network (CAN) and continuous acquisition of images from the IP cameras mounted in front of the classrooms. The service sends all acquired images to the cloud web server for storage through web service mechanism where they are processed.

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