Project Report

On

Application of Face recognition using ML in Employee Emotion Detection

Submitted as partial fulfillment for the award of

BACHELOR OF TECHNOLOGY

DEGREE

SESSION 2022-2023

in

Computer Science and Engineering

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May, 2023

DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that Project Report entitled **“Application of face recognition using ML in employee emotion Detection”** which is submitted by **Rajat Maurya, Rajat Maurya and Jatin Jain** in partial fulfillment of the requirement for the award of degree B. Tech. in Department of Computer Science & Engineering of Dr. A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

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ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the report of the B. Tech Project undertaken during B. Tech. Final Year. We owe a special debt of gratitude to **Prof. (Dr.) Seema Maitrey**, Department of Computer Science & Engineering, KIET, Ghaziabad, for her constant support and guidance throughout the course of our work. Her sincerity, thoroughness, and perseverance have been a constant source of inspiration for us. Only through her conscious efforts have our endeavors seen the light of day.

We also take the opportunity to acknowledge the contribution of Dr. Vineet Sharma, Head of the Department of Computer Science & Engineering, KIET, Ghaziabad, for his full support and assistance during the development of the project. We also do not like to miss the opportunity to acknowledge the contribution of all the faculty members of the department for their kind assistance and cooperation during the development of our project.

We also do not like to miss the opportunity to acknowledge the contribution, especially to Dr. Dilkeshwar Pandey, of the department for their kind assistance and cooperation during the development of our project. Last, but not the least, we acknowledge our friends for their contribution to the completion of the project.

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ABSTRACT

Employee Emotion Detection using Face Recognition is a technology that is becoming increasingly popular in various industries worldwide. This technology helps in understanding employees' facial expressions and emotions through facial recognition and analysis. It is a computer vision technology that can recognize the subject's facial emotions by analyzing the facial features or patterns. In this report, we will discuss employee emotion detection using face recognition.

In this project we are making a system which is capable of detecting the face by using different facial parts of the face. The system should be able to analyze the facial features and patterns and recognize the emotion of the employee accurately. The programm will be able to recognize the face and detect the emotion on the that face.

Simple methods for differentiating and identifying people include facial recognition. There are two basic stages in the human face recognition process: face detection, which humans can complete quickly unless the item is very close, and face recognition, when a face is identified as belonged to a certain person. Facial image recognition methods, which are extensively researched in the field of biometric technology, have helped researchers reproduce and improve this procedure.

The Eigenface approach and the Fisherface method are now the two most widely used face recognition techniques. A face space (sometimes referred to as Eigenfaces) is created by identifying the eigenvector that corresponds to the biggest eigenvalue of a face picture. Experts have done substantial study and development on this method. Image processing is the subject of this study, which combines face detection and recognition. Matlab is the programme needed to carry out this project.

Keywords: emotion recognition, mental illness, face detection, face recognition, Python, and convolutional neural network.

Extension: This face detection project may be developed to recognise multiple facial components that may be positioned differently and have varied forms, giving opportunities to a large range of software.

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LIST OF ABBREVIATIONS

PCA	Principal Component Analysis
LDA	Linear Discriminate Analysis
ASMs	Active Shape Models
PDM	Point Distribution Model
Einternal	Internal Energy Function
Eexternal	External Energy Function
Ev	Energy due to Valley
Ee	Energy due to Edges
Ep	Energy due to Peak
Ei	Energy due to Images
BPN	Back Propagation Neural network
OCR	Optical character Recognition
SVM	Support Vector Machine
TIFF	Tagged image Title Format
JPEG	Joint Photographic Experts group
GIF	Graphics Interchange Format
BMP	Windows Bitmap
PNG	Portable Network Graphics
RMS	Root-Mean-Square

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION:

A cutting-edge technology called facial recognition can tell whether an object is a known or unknown face. It is crucial in a variety of fields, such as security systems, biometrics, and computer vision. Face recognition uses sophisticated algorithms and machine learning techniques to determine, It is essential to distinguish some similar term. Face recognition drive dipper further by ascribing identification to the observed face, whereas face detection focuses on spotting the existence of a face in an image or video. Understanding the complex procedure involved in correctly identifying people and differentiating them based on their facial traits requires knowledge of this differentiation.

Beyond simple identification, face recognition is important. It has useful applications in a variety of fields, including access control, security for personal devices, surveillance systems, and forensic investigations. Organisations may strengthen security precautions, shave time off the authentication process, and boost productivity by utilising facial recognition technology.

Due to developments in deep learning and neural networks, face recognition has made significant strides in recent years. These developments have resulted in the creation of extremely reliable face recognition algorithms that are capable of overcoming a variety of difficulties, such as changes in lighting, position, expression, and occlusions. Face recognition is becoming an essential tool for preventing identity theft, ensuring seamless user interactions, and providing personalized services.

However, it is crucial to address the ethical issues and privacy concerns related to facial recognition technology. To guarantee that people's privacy rights are maintained while using this technology, it is important to put in place strict data protection procedures, acquire informed permission, and follow legal requirements.

In conclusion, face recognition is a complex operation that requires classifying observed objects as either known or unknown faces and validating those classifications against a database of faces [1]. Its applications cut across a wide range of industries, offering improved security, simplified authentication, and individualized services. Face recognition technology has enormous potential to influence security and human-computer interaction in the future with sustained development and proper use.

1.2 FACE RECOGNITION:

Numerous algorithms were created as researchers dug further into face recognition; three of them were particularly well-researched in the face recognition literature. The first method, referred to as geometric recognition, is based on the geometric connections between and the spatial layout of face landmarks. This technique entails identifying prominent face characteristics like the eyes, nose, and mouth. Then, faces are categorised according to various geometric angles and distances between these traits. Determine the identify of the face using this geometric analysis (Figure 1.3).

The second method, referred to as photometric stereo, uses numerous photos taken in various lighting situations to reconstruct the geometry of an item. By using this technique, a gradient map (Figure 2) is produced, which represents an array of surface normals that determine the geometry of the item [2].

Within the discipline, a number of well-liked recognition algorithms have appeared. The first method uses Eigenfaces and Principal Component Analysis (PCA) to extract the most important characteristics from face photos for use in recognition. Another approach that looks for discriminative characteristics to increase class separability is linear discriminate analysis (LDA). Last but not least, the Fisherface approach combined with the

Elastic Bunch Graph Matching algorithm has acquired a popularity for its capacity to manage changes in facial emotions.

These algorithms are just a small portion of the numerous strategies and approaches created to address the challenging issue of face recognition. They have made a big contribution to the field's developments and have undergone thorough testing to see how well they can identify faces.

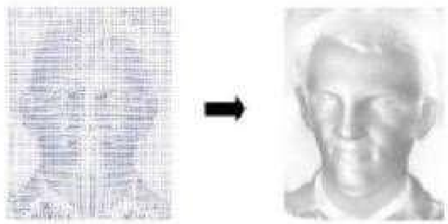

Figure 2 -Photometric stereo image.

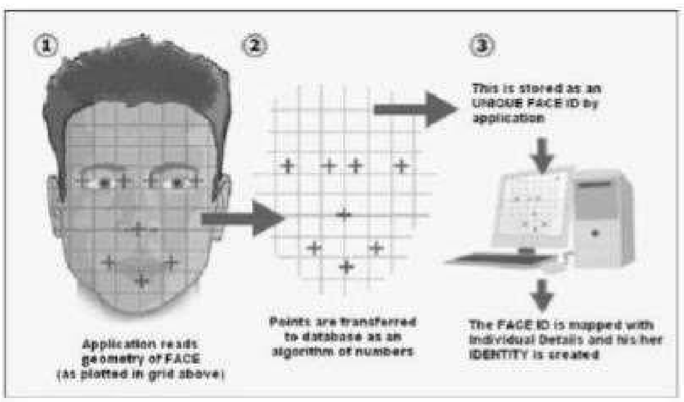

Figure 3 - Geometric facial recognition.

1.3 FACE DETECTION:

Further complicating the issue are elements like various lighting conditions, picture quality, geometries, and recognise faces against any background and in any illumination.

There are two basic phases to the face detection task. In the first phase, classification, a random picture is entered, and the result is a binary value that indicates if there is any image [3]. Next stage is, use of bounding box coordinates (width, and height) to pinpoint the location of a face or faces inside an image.

This technique is further divided into some stages:

1. Pre-Processing: Different features in face is reduced using pre-processing methods before photos are entered into the network. Cropping photographs to concentrate on the frontal aspect of faces allows for the creation of positive examples, such as face images. Utilizing reputable techniques, lighting adjustment is applied to these cropped photos.

2. Classification: Images are classified as either having faces or not using neural networks. The examples gathered are used to perform training. For this, the Matlab neural network toolbox as well as our own implementation of neural networks are both used. To maximize performance, several network topologies are investigated.

3. Localization: When looking for faces in a picture, the trained neural network is used to locate them using bounding boxes if they are found. This approach takes into account a variety of facial attributes, including location, size, orientation, and lighting.

These processes guarantee precise identification and localisation of faces inside pictures throughout the face detection system.

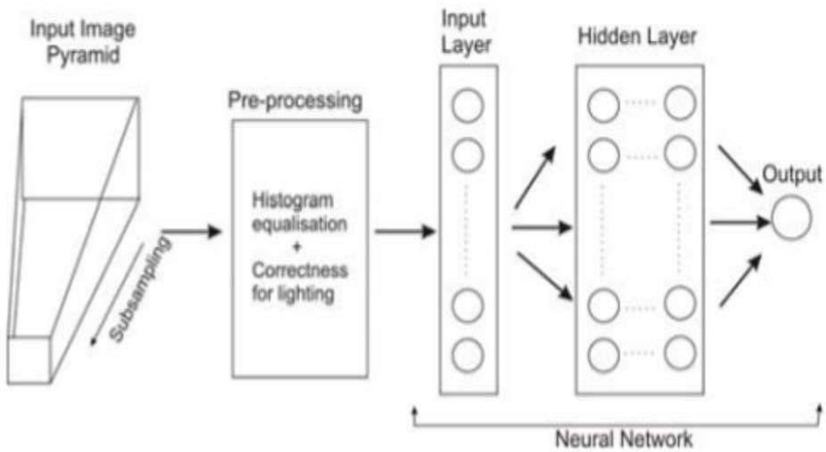

Figure1.1: Face detection algorithm

CHAPTER-2

LITERATURE SURVEY

It uses advanced algorithms to locate and measure human faces precisely inside digital photos. By using this method, the system finds and recognizes face characteristics while ignoring other items like bodies, buildings, and trees that may be present in the image [4]. It essentially entails finding and sizing every item which is an advanced kind of object.

Identify face characteristics in a particular image. In the feature-based technique, pertinent features are extracted from the picture and compared to the database of face traits.

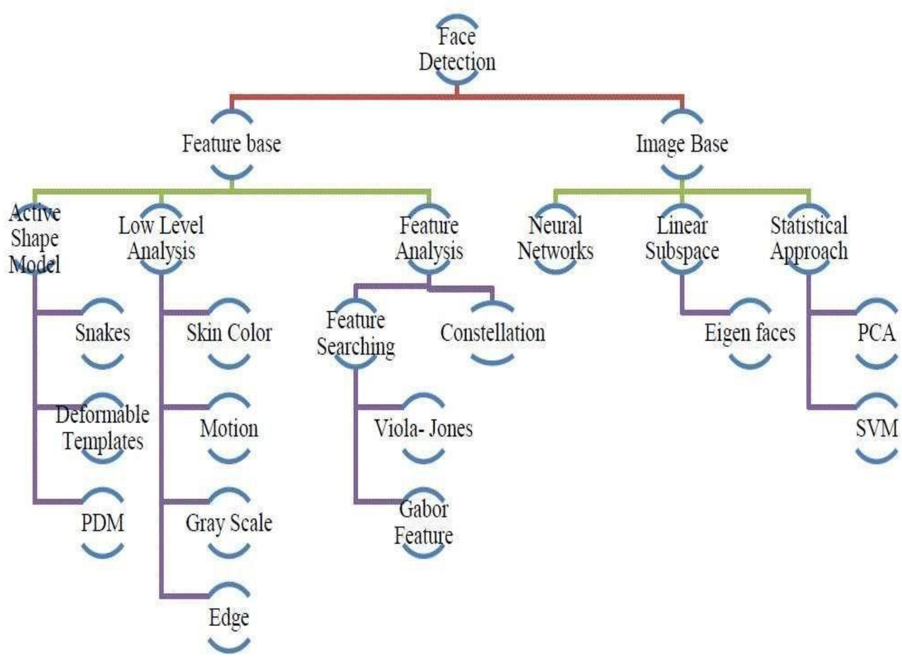

Fig 2.1 detection methods

2.1 FEATURE BASE APPROCH:

a) Face of complex non-rigid objects, notably is defined by landmark points that are automatically located using active shape models (ASMs).

b) ASMs that use the snakes active contour are referred to as ASMs. They are used to define head borders and were first proposed by Kass in 1987. Snakes begin around a head border, lock onto surrounding edges, and progressively take on the head's form. By minimising an energy function that incorporates internal and external energy sources, they are able to evolve. The snake's fundamental qualities have an impact on its internal energy, leading it to naturally contract or extend [5]. The contour can depart from its normal evolution and align with surrounding features thanks to interactions between external energy and picture characteristics. Snakes have drawbacks, including the possibility of becoming stuck on false image features and their unsuitability for result.

2.1.1 Deformable Templates:

Later, Yuille et al. proposed deformable templates as an improvement to snakes, taking into account the past knowledge of face characteristics to boost their performance. It is difficult to organise the local evidence of face edges into a cohesive global structure using generic contours, making the task of determining the limits of facial features complex. Additionally, the process of edge recognition is made more difficult by the existence of low brightness contrast around some areas. Further improvement of the accuracy for the extraction procedure, he extended on the idea of snakes by including global information about the eyeballs.

Deformable templates techniques were created to help with the issue of extracting prominent elements such as the facial border as other areas. These methods make use of deformation based on neighbourhood peak, valley, and brightness signals. Deformable templates' energy function is made up of a number of parts, including internal energy and exterior energies linked to the valley, edges, peak, and picture brightness [6]. In order to accurately extract features for face recognition tasks, the deformation process is guided by the interaction of exterior.

2.1.2 PDM (Point Distribution Model):

Researchers have been working on statistical models of form independently of automated image processing prior to the creation of Active form Models (ASMs). The idea behind these models is to express shapes as vectors so that common statistical techniques may be used. These models capture the legal configurations of form points by learning from training instances and employ primary components to build a program.

Point distribution models does a variety of tasks, including classifying brooches from the Iron Age. Only deformations consistent with the analysed item are allowed by the design of these models [7]. For example, may infer where chin is located. Point Distribution Models were a logical choice as a result, given the need for models that can take into account such occlusions.

The Active Shape Model is the result of the integration of concepts from both image processing and statistical shape modelling. First parametric statistical shape model for picture analysis. Cootes, Taylor, and their associates thereafter published a number of publications that finally served as the basis for the development of what is now referred to as the one of the most famous model.

2.2 DEEP ANALYSIS:

Along with other elements including colour, intensity, edges, and motion, skin tone is an essential low-level visual component in the study of emotion recognition. We can use skin tone, tracking indicator can have various advantages. Comparing colour processing to other face characteristics, it is noticeably faster. Additionally, colour displays orientation invariance in certain illumination scenarios, making motion prediction simpler by simply requiring a translation model. However, using colour for facial tracking comes with certain difficulties. The accuracy of tracking can be affected by the how good the color of image that is captured. Color present in the image have major contribution in the deep dive analysis of the recognition of the faces.

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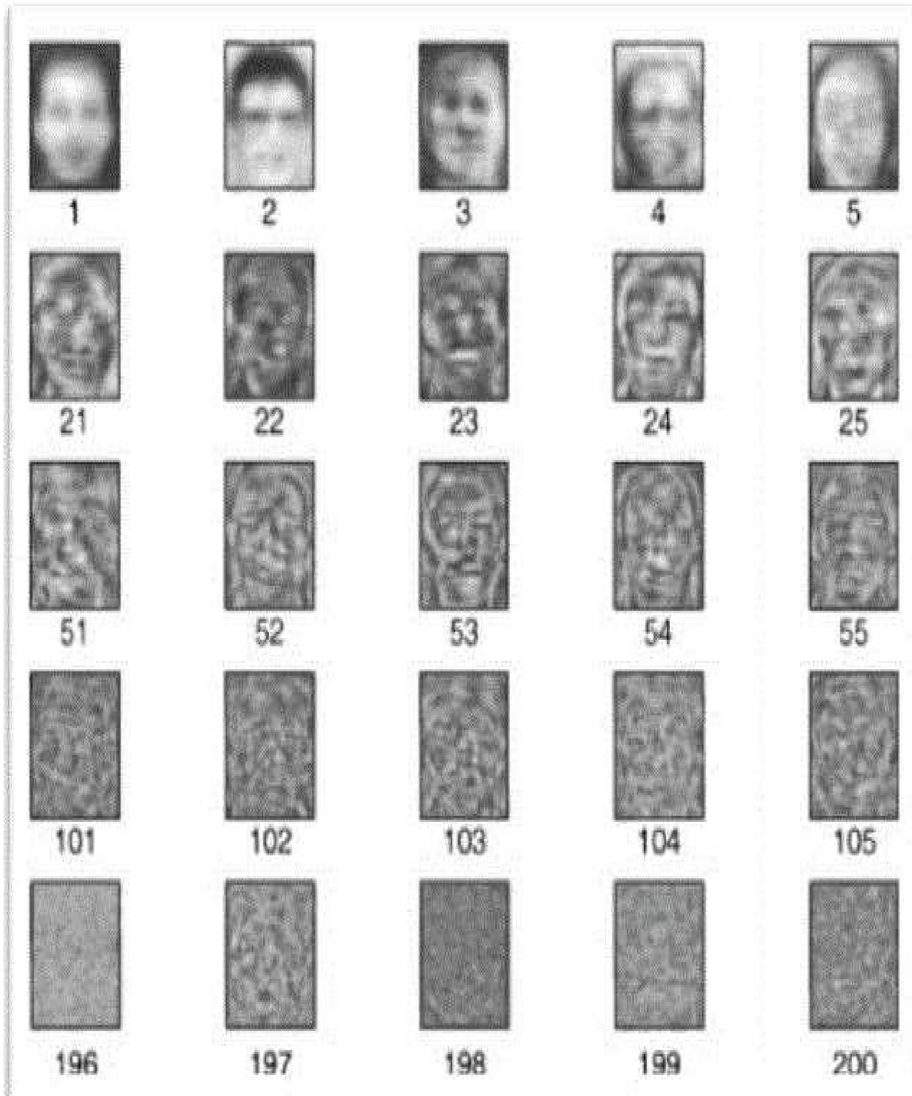

Fig 2.2. Images with different colours

Based on models of the RGB, YCbCr, and HIS colour spaces, there are primarily three main face identification methods available. There are three main phases, namely.

There are many simple face recognition algorithms already made by the scientists which can be used for the recognition of the emotions. They perform even better when there is popper lightning such that pixels present in the images are properly captured.

A normalised colour histogram, which takes intensity variations into account by dividing by brightness, can be used to identify skin patches in a picture. In order to effectively identify skin. However, when faced with additional skin areas like the legs and arms, this algorithm runs into problems. The YCbCr colour space-based skin colour categorization method was developed by Cahi and Ngan [27] as a solution to this problem. According to their investigation, skin-related pixels have identical Cb and Cr values.

The algorithms detects the various skin tones for extracting the different important values which can be used to increase the accuracy. This algorithm's shortcoming is that it only considers the skin area of the face to be present in the image. To distinguish skin areas from the backdrop in the HSV colour space, Kjeldson and Kender developed a color-based criteria. The localised facial picture may be extracted thanks to this distribution. Comparable to the earlier algorithms, this is one of best approaches that can be implemented in the same situations.

2.3 MOTION BASE:

Motion information may be used to recognise moving objects in a video clip. Applying a threshold to cumulative frame differences allows the extraction of moving silhouettes, including faces and body components. Frame differences can be used to locate facial areas as well as to pinpoint specific facial characteristics.

2.3.1 Gray Scale Base:

Considerable face traits may be found in the grey information. Lips, pupils, and other areas of the faces. In recent feature extraction methods, local grey minima are found inside segmented face regions. In order to make dark regions more visible, we can use use approaches which are most viable for the black and white images and does the best analysis for the images in which dark regions are mostly presents [8].

In order to extract dark areas, low-level gray-scale thresholding is used. Yang and Huang's three-level hierarchical face location system is one technique that makes use of this strategy. While the first level uses an edge detection technique, the top two layers use mosaic photos at various resolutions. In complicated backdrops when the size of the face is uncertain, this method performs especially well and produces reliable results.

2.3.2 Edge Base:

Using line drawings of faces taken from pictures, Sakai et al. developed a face detection technique. They used this method to identify face traits. Craw et al. expanded on their ideas and suggested a hierarchical framework that was centred on tracking the shape of a human skull. Since then, a large number of researchers have significantly advanced this topic. In their study, Anila and Devarajan suggested a quick and easy procedure that attracted notice for its effectiveness.

They provided a three-step structure for doing things. First, a median filter was used to remove noise from the photos, then histogram equalisation was used to improve the contrast. The extracted sub-windows as face or non-facial, they used the Backpropagation Neural Network (BPN) technique. Through the use of picture enhancement, edge detection, and neural network-based classification methods, the suggested method sought to increase the accuracy of face detection.

2.4 FEATURE ANALYSIS

These algorithms seek to discover faces by first identifying structural traits that remain constant regardless of changes in stance, perspective, or illumination. These are one of the best implementations for locating different features of the face.

2.4.1 Feature Search

Viola Jones Method:

An technique to object detection that puts emphasis on both speed and accuracy was presented by Paul Viola and Michael Jones. At the time of its publication, their approach for face identification, which is renowned for its quickness and durability, surpassed alternatives. It was based on the implementation of new picture representations [9]. The

"Integral Image" idea was used to produce faster results, which are faster than most of the algorithms and model that were common used for this purpose. On grayscale pictures, the detector worked in a scanning fashion, enabling window scaling and feature assessment.

Gabor Feature Method:

This method is the used when using the filters based detections. Elastic Bunch Graph Map (EBGM) technique, created by Sharif et al., effectively detects faces using Gabor filters. The technique creates 40 filtered pictures with various angles and orientations by applying 40 distinct Gabor filters on an input image. Then, each filtered image's highest intensity spots are located and designated as fiducial points. Based on how far apart these points are from one another, these are then decreased [10]. The following step includes utilising a distance formula to determine the separations between the decreased fiducial locations. The next step is to check the estimated distances with a database; if a match is made, faces have been successfully spotted in the image. The following gives the Gabor filter equation [40].

$$\psi_{u,v}(z) = \frac{\| k_{u,v} \|^2}{\sigma^2} e^{\left(-\frac{\|k_{u,v}\|^2 \|z\|^2}{2\sigma^2}\right)} \left[e^{i\vec{k}_{u,v} z} - e^{-\frac{\sigma^2}{2}} \right]$$

Where

$$\phi_u = \frac{u\pi}{8}, \quad \phi_u \in [0, \pi) \quad \text{gives the frequency,}$$

Figure 2.3 Gabor Filter equation

2.5 CONSTELLATION METHOD

The earlier approaches have demonstrated the capacity to follow faces, but it is still difficult to find faces in various stances against intricate backdrops. To overcome this, academics have looked at the use of strong modelling techniques, such statistical analysis, to organise facial characteristics into constellations that resemble faces. Using characteristics identified by a multiscale Gaussian derivative filter, Burl et al. presented numerous forms of face constellations based on statistical shape theory. These strategies make use of statistical modelling and image-based methods to enhance face detection in difficult situations [11].

2.5.1 Neural Network

Nueral Network is one of the approaches to soft computing and is used at many places. It is basically based on the functioning of the human brain. Scientists have analyzed the functioning human brain.

Basically, the human brain has neurons as the basic unit of functioning. Neurons are responsible for all the workings of the human brain. So, similarly, neurons nodes are the basis units of the neuron model.

Neural network consists of several levels of the nodes, in which first layer is the input layer and last layer is the output layer and layers between the first and the last layer is the responsible for the processing of the information.

Neural networks have very high usability in this world this is because they work like our brains and produce results like our brains.

Neural networks have very important applications in pattern recognition. It is used for the recognition of the complex patterns. We can also this feature of the Neural networks to find out the pattern in the human faces. And to identify what is the emotion of the human faces.

Overall, by utilizing their capacity to learn complicated patterns and reach probabilistic conclusions, various neural network algorithms have been designed to address face identification.

2.6 LINEAR SUB SPACE METHOD

Eigen faces Method:

Kohonen used algorithm to identify faces aligned and normalised photos, showcasing the power of a simple neural network. Basic approach is that any kind of image of the human face can be converted into the foundation pictures was put out by Kirby and Sirovich. Both Pearson and Hotelling made first proposals for this concept in 1901 and 1933, respectively.

According to experimental findings with a collection of 100 photographs, a facial image with a dimension of 91 by 50 pixels may be efficiently stored with just 50 eigen images [12].

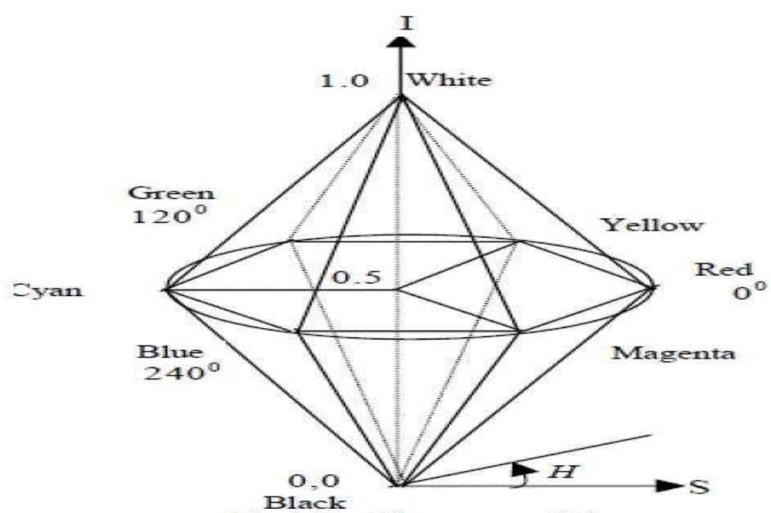

Figure 2.4 Eigen pictures

2.7 STATISTICAL APPROCH

Osuna et al. to propose Support Vector Machines (SVMs) as a technique for facial recognition. SVMs provide a novel method for training classifiers neural networks. To created an effective technique for training SVMs in complicated issues and used it to recognise faces.

This approach reduces the error rate by several amounts, which is highly beneficial for us. In the wavelet domain, SVMs have also been used to identify pedestrians and faces [13].

CHAPTER-3

Image Processing Innovations

3.1 Image Processing Innovations

In this we used pixels to analyse the image. Image processing meaning that instead of normal processing of image through the hardcoded algorithm we will use the machine learning or neural network algorithm to detect the faces.

The spatial coordinates and brightness of the image are discretized to create a digital image that can be processed by a computer [14]. This digital array's constituent components are referred to as image elements or pixels.

Computer image processing is a field that focuses on methods and techniques to extract visual data in a format suitable for computer analysis. It is utilised for activities like product assembly and inspection in a number of sectors, including industrial machine vision. Additionally, it is used in various other fields that call for the automated analysis of visual data by computer algorithms, including automated fingerprint processing, military identification, computerised character recognition, and many others.

An image is a two-dimensional representation of light intensity that can be expressed mathematically. To produce a digital image that a computer can process, the image's brightness and spatial coordinates are discretized.

Basic operations including reading a picture, scaling, rotating, converting RGB to grayscale, histogram equalisation, and more are all included in low-level image processing. A raw picture is produced as a byproduct of low-level processing and is used as the output.

On the other hand, medium-level processing concentrates on removing areas. During this phase, boundaries—often referred to as edges—are identified using the segmentation process.

Beyond these limitations, high-level processing entails adding artificial intelligence to the signals produced by medium-level processing [15]. The goal of this step is to improve the picture or signal being processed with sophisticated computational methods and intelligence.

3.2 FUNDAMENTAL STEPS IN IMAGE PROCESSING

The initial steps for the image processing are give as:

1. Image acquisition: This involves capturing or acquiring a digital image using various devices or techniques.
2. Image pre-processing: This step focuses on improving the acquired image by applying techniques such as noise reduction, contrast enhancement, and image denoising. We have to extract the features in the images that are not visible to the human eye.
3. Image segmentation: This process involves dividing the input image into meaningful regions or segments based on characteristics such as color, texture, or intensity. Segmentation helps identify and isolate different objects or regions within an image.
4. Image normalization: This may include converting color images to grayscale, rescaling pixel values, or normalizing image dimensions.
5. Image feature extraction: This step focuses on extracting relevant features from the segmented or pre-processed image regions [16]. These features can be quantitative measurements or descriptors that capture specific characteristics of the objects or regions in the image.
6. Image recognition: This step involves assigning labels or classifying objects based on the extracted features and a predefined set of classes or categories. It aims to identify and distinguish different objects or patterns within the image based on their characteristic features.
7. These steps collectively form a framework for processing and analyzing digital images, enabling various applications such as object detection, classification, and image understanding.

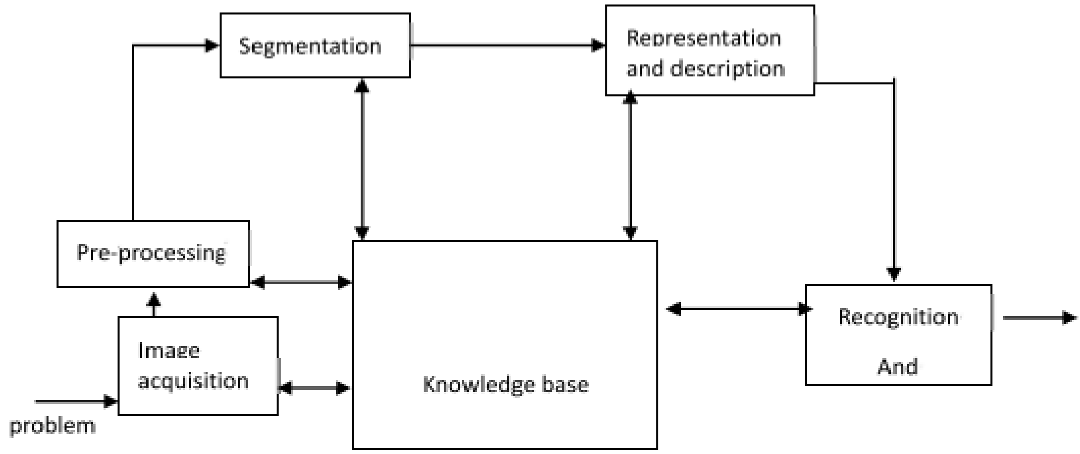

fig.3.1. Initial flow in the Image Processing Innovations

3.3 ELEMENTS OF Image Processing Innovations SYSTEMS

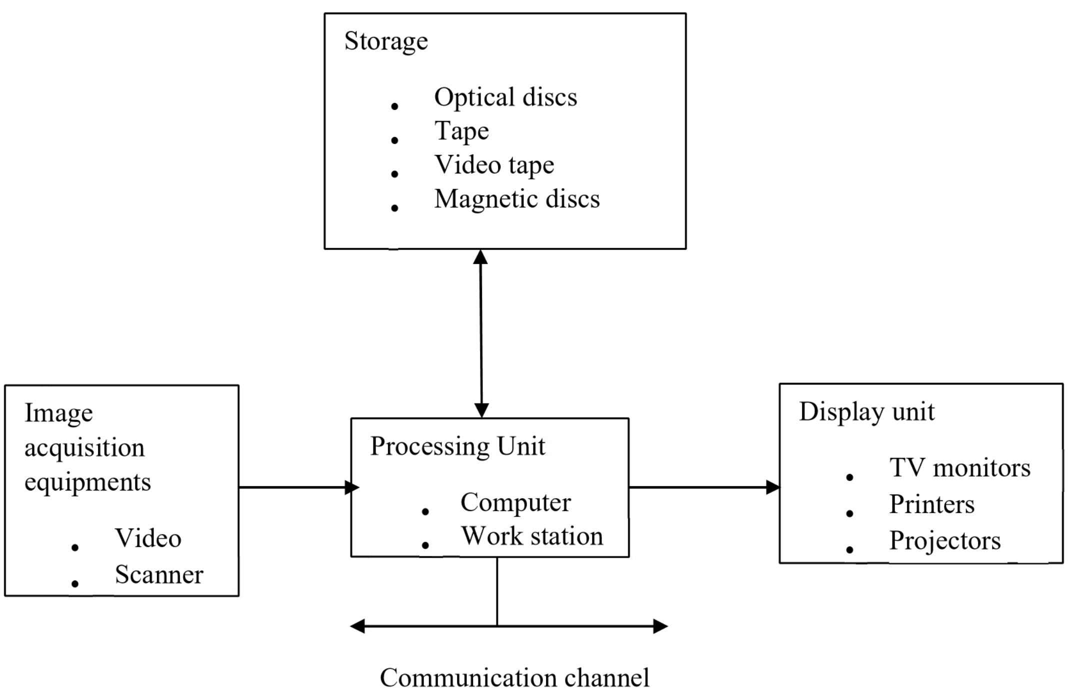

Fig.3.2. Flow of the Image Processing Innovations systems

3.3.1 A simple image formation model

The quantity of light that falls on a scene when we view it or a picture is referred to as incident illumination. The lighting that is reflected by the objects in the scene is known as the reflected illumination. The incident and reflected illuminations are multiplied together to provide the total intensity of the picture we perceive [17]. The values of incident illuminations and reflected illuminations, represent how much light is present across the picture.

Lastly, MATLAB's Image Processing Toolbox supports various image formats for processing and analysis.

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CHAPTER-4

FACE DETECTION

It can surprise researchers who are new to this topic that the main task of face recognition is face detection. Nevertheless, it is essential to precisely detect a face and its distinguishing features in order to perform facial recognition. In practical systems, a lot of time and attention is put into resolving this specific job, which simply includes separating To ensuing recognition phase—which depends on the traits deduced from these face landmarks—is frequently regarded as the process's last, smallest [18].

4.1 FACE DETECTION IN IMAGES

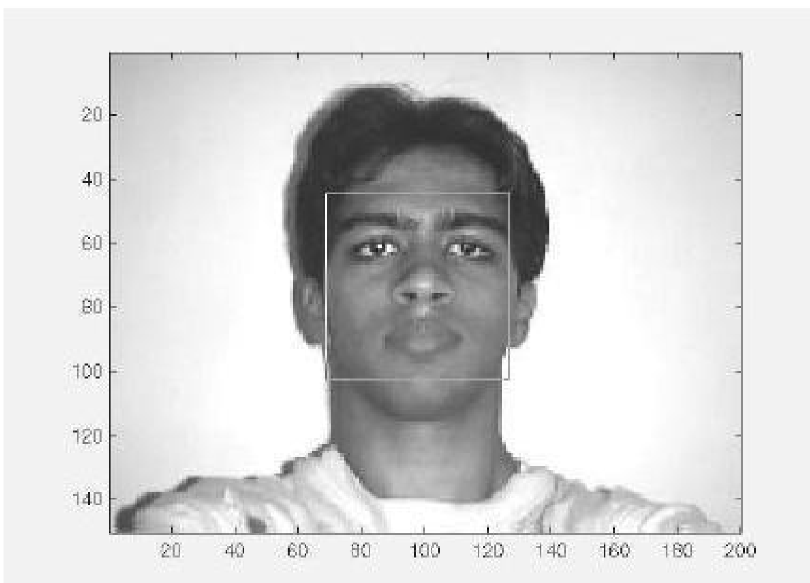


Figure 4.1 This is representation of detection of face.

Similar to a unique ability, face detection enables computers to discover and recognise faces in images or movies, exactly like we can. You know how we can rapidly recognise faces in a group of people? Computers can accomplish that as well, but in a different way.

Let's consider some of the characteristics that set a face unique in order to comprehend how face detection functions. Faces have certain features like eyes, nose, mouth, and sometimes ears [19]. These characteristics are grouped in a certain way that makes a face distinctive and simple to identify.

Computers search for these features in photos using smart algorithms (a collection of instructions). They evaluate the various elements of the picture and look for patterns that correspond to the facial characteristics. For example, they could search for rounded eye forms or a curved lip line.

When the computer identifies these traits, it may determine that the image contains a face. It is even capable of estimating the location of the face and showing us a box around it. Isn't that incredible?

But why is facial recognition crucial? Well, the first step towards a lot of fascinating things that computers can do with faces is face detection. Have you ever used a phone that you can unlock by simply glancing at your face, for instance? The use of facial detection makes that feasible! After locating your face, the computer utilises further algorithms to determine if it is you or someone else.

Emotion recognition is a fascinating new application. Imagine if a machine could analyse your face and infer your emotional state. Are you shocked, glad, or sad? Computers use face detection to locate your face in a picture or video, after which they may determine your emotions by examining the expressions on your face [20].

Video games also employ face detection to design characters that replicate human facial expressions. It's as if the video game characters came to life and behaved just like people.

Face detection, then, is a superpower that aids computers in locating and identifying faces in images and movies. It's the initial step in many fascinating processes, like device unlocking, emotion recognition, and interactive experience creation. Once they locate characteristics like the eyes, nose, and mouth using specialised algorithms, computers may manipulate faces in a variety of fun ways.

4.2 REAL-TIME FACE DETECTION

The use of picture invariants is a method for face detection that is comparable to template matching. This method makes use of the finding that a face's relative brightness distribution holds true under a variety of lighting situations [21]. This attribute is used to create a spatial template that captures facial features based on the typical grayscale intensities of human faces. Therefore, if a picture fulfils the criteria of being "darker than" and "brighter than" specific locations, as described by Sung and Poggio in 1994, it may be said to fit the template. This technique makes use of the intrinsic properties of facial brightness to find faces in images.

Figure 4.2.1: Camera 1

Figure 4.2.2: Camer 2

Figure 4.2.3: filtered image technique

The system examines a series of frames to find alterations that suggest the presence of a face in real-time face detection. Spatio-temporal filtering, which involves comparing successive frames to find regions that have changed, can do this. This method may be used to identify the person within the frame (Wang and Adelson, 1994; Adelson and Bergen, 1986). Furthermore, using simple principles, as shown in the following Figure, it is simple to recognise particular face traits [22].

With the aid of these incredibly basic image processing methods and reasoning rules, real-time face detection is now a manageable problem that is possible even in chaotic and uncontrolled settings.

4.3 FACE DETECTION PROCESS

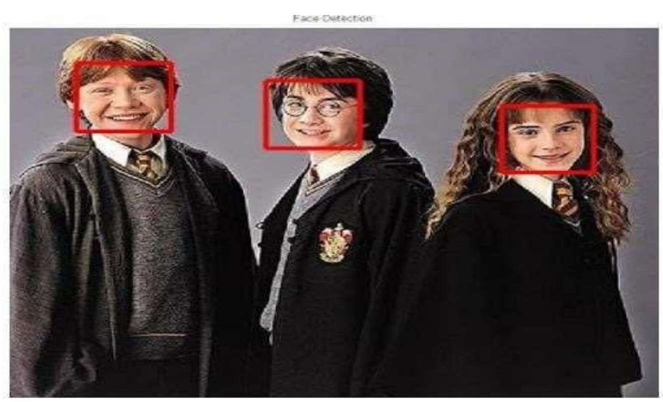
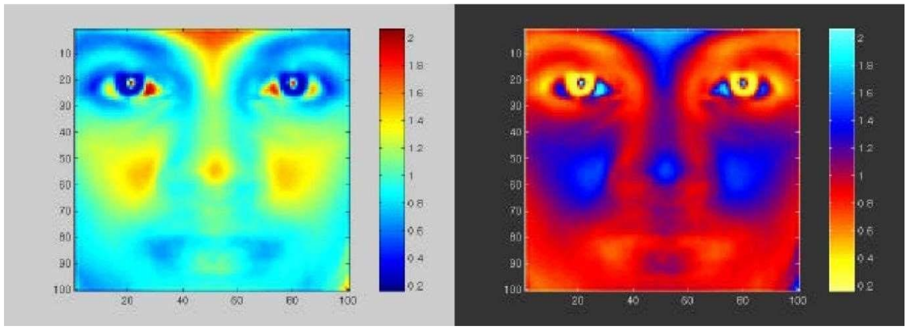


Fig 4.3 Face recognition of from childrens photo

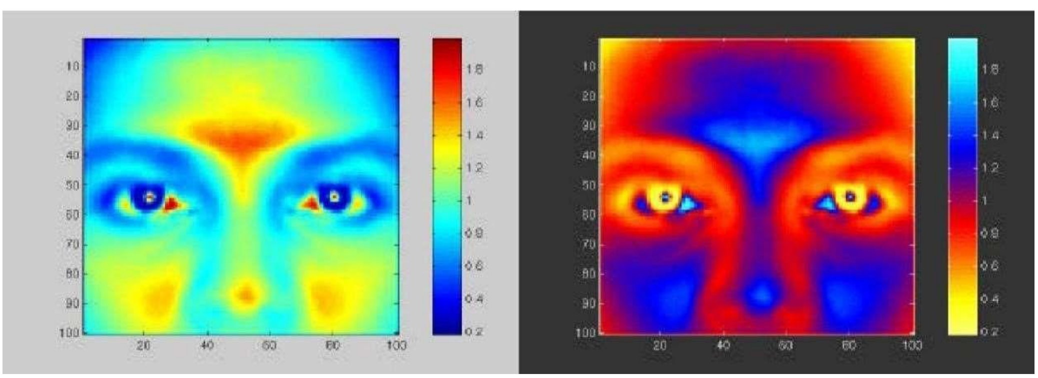
Through picture invariants and MATLAB code, the creator of this research seeks to identify faces in static photographs. Studying the distribution of grayscale intensity in a normal human face is helpful in achieving this. The presented "average human face" is a composite image created from 30 frontal views of people, 12 of whom are female and 18 of whom are male. Using a correctly scaled color map, discrepancies in grayscale intensity have been highlighted.



scaled colormap scaled colormap (negative)

Figure 4.3.1 Image of face of human image.

All faces in the sample have the same consistent grey-scale differences, which are plainly discernible. Notably, regularly display brilliant whereas area constantly displays dark intensity (low) grey-levels. Through thorough testing, the researcher was able to pinpoint particular facial features that are ideal for a face identification system that makes use of picture [23].



scaled colormap scaled colormap (negative)

Figure 4.3.2 Area chosen for face detection (indicated on average human face in gray scale)

Due to the clear boundaries produced by the intersection of the dark intensity invariant areas and the bright intensity invariant area, the aforementioned facial region proves to be a solid base for a face template. Specific regions of interest can be segregated based on the proportions seen in the typical human face once the face identification algorithm has located this pixel area. The following templates were found by the author to be acceptable for identifying dark intensity and brilliant intensity sensitive regions after carefully examining the accompanying photographs [24]. Additionally, a reference point is provided by a pixel region that is 33.3% lower than the discovered location.

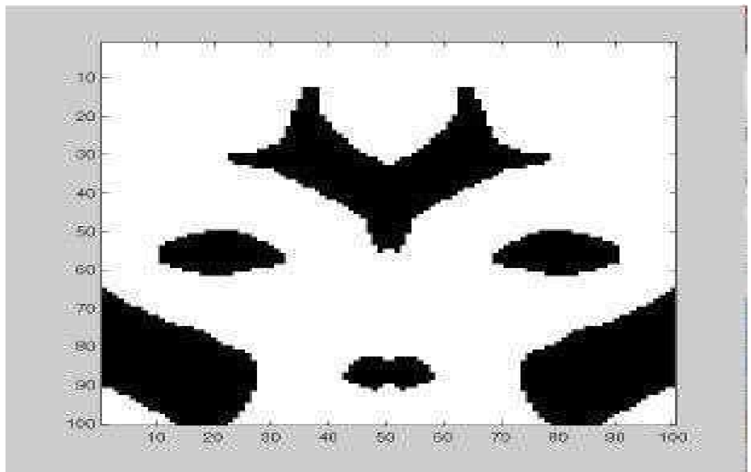


Figure 4.3.3: Basis for a bright intensity invariant sensitive template.

Compare Figures 3.4 and 3.2 to see the small changes made to the template responsive to bright intensity invariants. These modifications were required as a result of the pre-processing procedures the system used to account for varying lighting conditions, as discussed in chapter six [25]. The next stage is to create a computational model that can assign neurons to the presented distributions, basically establishing units for a perceptron, after choosing suitable templates for dark and brilliant intensity invariants.

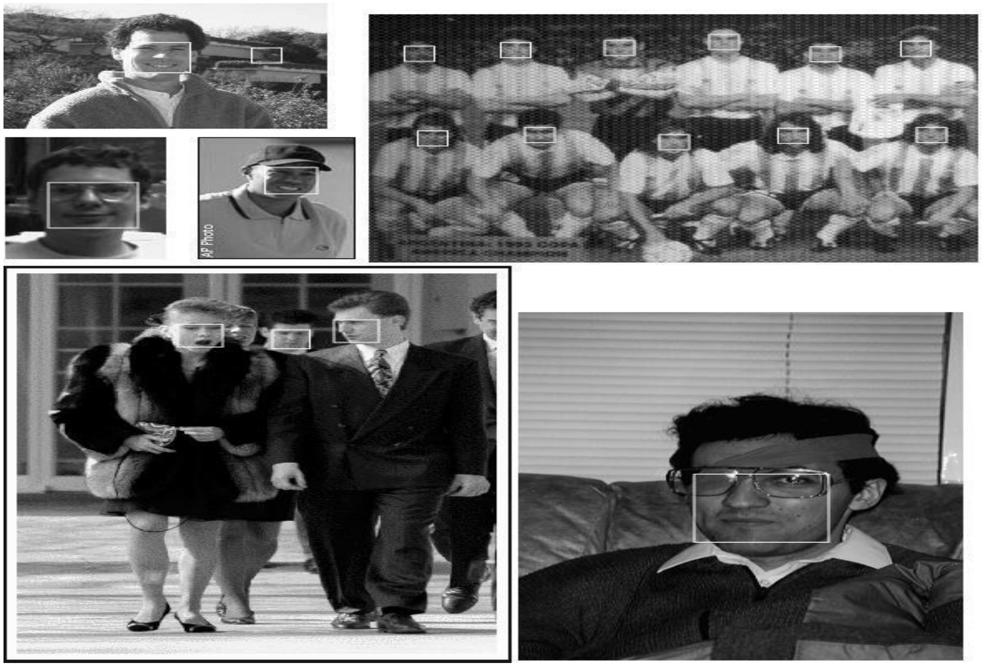


Fig 4.3.4 Scanned image detection

4.4 FACE DETECTION ALGORITHM

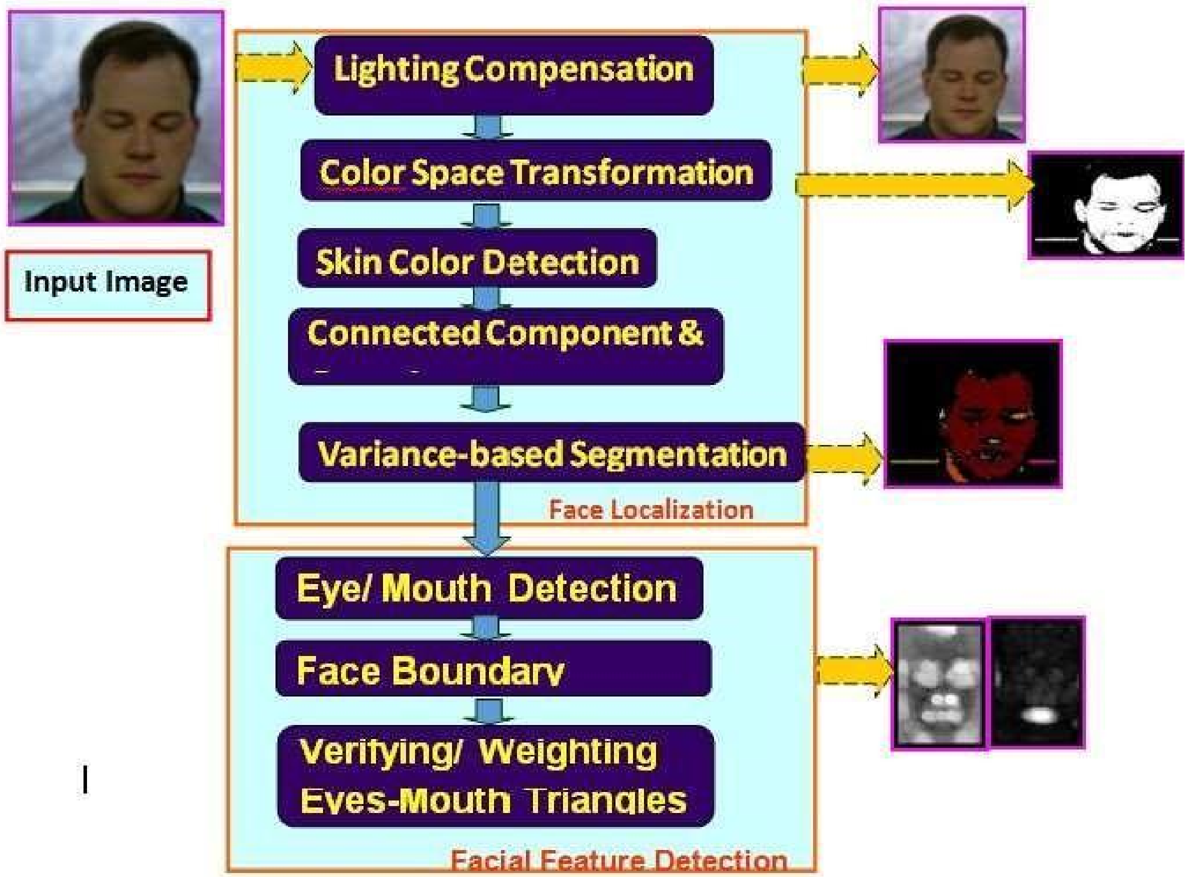


Fig 4.4 Face detection algorithm

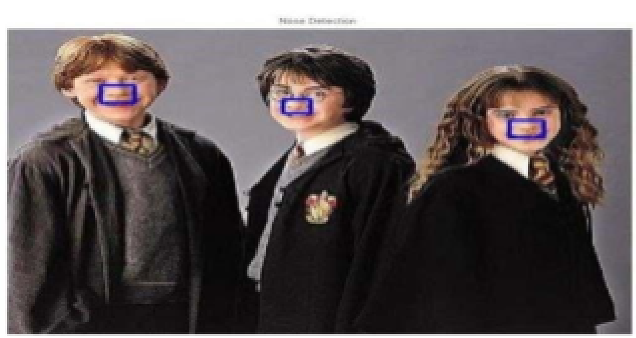


Fig 4.4.1 mouth detection

Fig 4.4.2 Nose detection

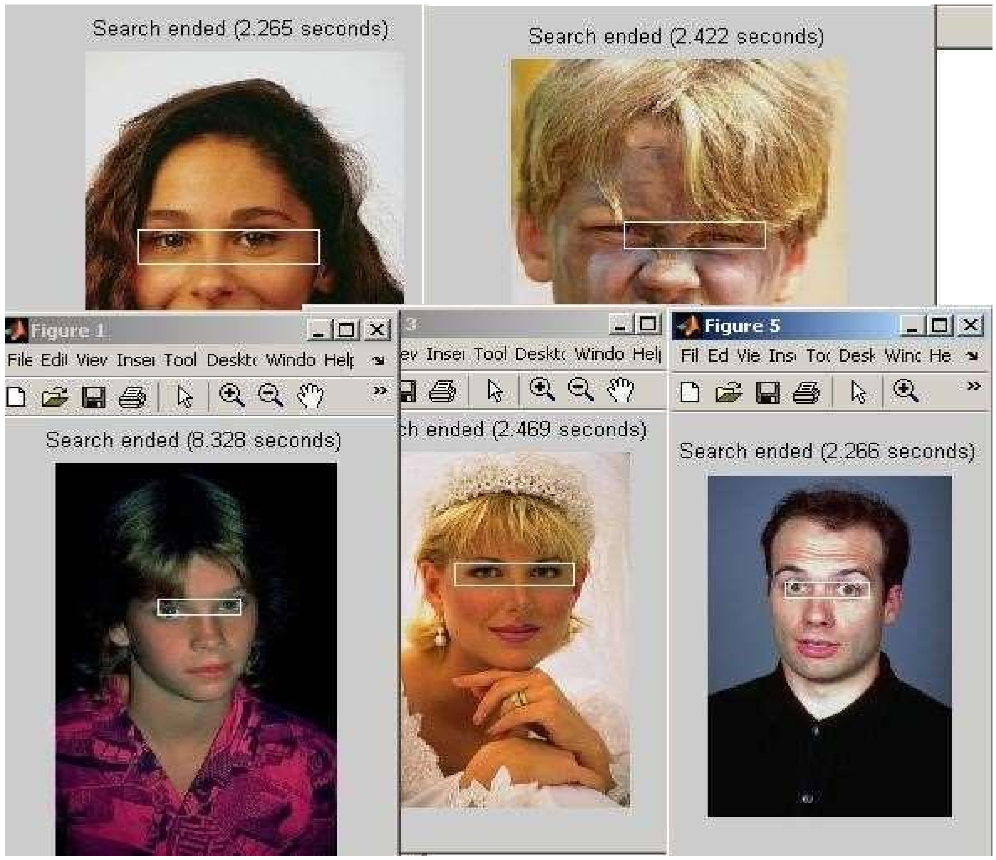


Fig 4.4.3 Eye detection

4.5. METHODOLOGY

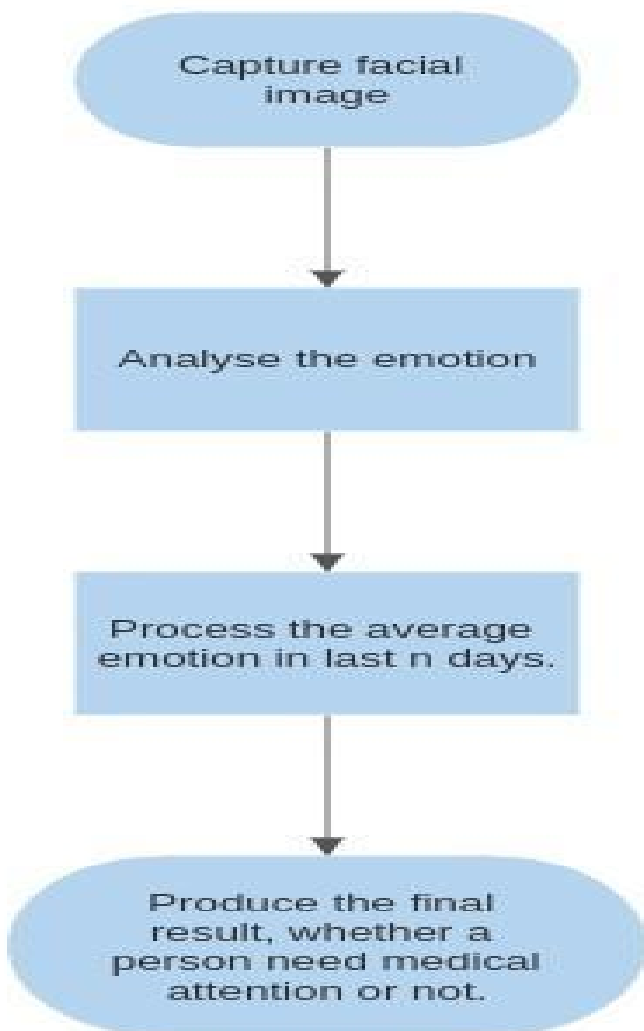
Understanding the method used to identify emotions is crucial when talking about this topic. In this instance, a convolutional neural network (CNN) will be used to identify and analyse key face traits. Utilising a CNN has the benefit of eliminating the need for manual input by automatically identifying pertinent face characteristics.

Let's first examine the project's high-level implementation before getting into the detailed face identification technique. Establishing an interface to periodically take pictures of staff is the first step. There are two options available: using the webcams built into laptops or the office's public cameras [26]. The latter is the better choice since it produces more accurate pictures and raises the likelihood of capturing facial features effectively.

Therefore, we need a software interface that reliably takes pictures of employees at regular intervals. Either a native software programme or a web application may be created to do this.

The programme will be set up to start automatically when the computer turns on and to start taking pictures of the employees throughout business hours. To collect the required data, it will be installed on all corporate employees' laptops or desktops.

In this project, we've chosen to build the programme and take periodic facial snapshots using a simple HTML and JavaScript combo. The structure of a web page is built using HTML as a base, and JavaScript is used as the programming language.



In our system, MongoDB will serve as the database for storing captured image information and processing results. It will maintain a record of the images we capture and the corresponding emotion analysis outcomes.

To enhance the user experience, we will utilize CSS for styling the software interface, making it visually appealing and user-friendly. Within the interface, users will be able to view the overall emotions for the current day, as well as the emotions over the past week and month. This feature enables users to self-analyze and identify areas of improvement or positive changes.

We will develop an API using Python to facilitate communication between the frontend interface and the backend. One API will receive images from the frontend, process them using the convolutional neural network (CNN), and provide an emotion response. The API will also store the emotion information, along with a timestamp, in the respective user's collection.

Another API will handle requests for obtaining average emotion information for users. This API will respond with the relevant details to be displayed to the user.

Furthermore, an admin user will have a separate API and user interface specifically designed for monitoring all employees. The admin user will have access to comprehensive employee details and can strategize employee benefits based on their emotions. For instance, if the organization's average emotion becomes consistently negative after a specific change, it indicates employee dissatisfaction. The admin can then investigate and address the concerns accordingly [27].

The application workflow involves two interfaces: one for regular employees accessed via username and password, and another exclusive admin interface accessible only by authorized personnel. When employees start their laptops in the morning, the software will automatically launch, rendering the web page in their browser. The webcam will capture images of their faces at regular intervals using a JavaScript set timeout function. After capturing the images, a request will be made to the backend API with the facial image. The API will detect the emotion, store the information in the database for the respective user, and send the emotion state to the frontend for display.

At the end of each day, a cron job will execute and calculate the average emotions. If the emotional state is concerning, an email notification will be sent to both the admin user and the respective employee. Meetings can be scheduled based on the average emotional states to address any issues or concerns [28]. The company can provide counseling or support to employees experiencing emotional stress, ensuring they have the necessary guidance and resources. Additionally, this system allows the company to evaluate the impact of its decisions on employee well-being.

To maintain employee privacy, additional steps can be implemented, such as a robust authentication system with 2-step verification. These measures will ensure the security and confidentiality of employee data within the organization.

And we can also anonymize the data of employees on a daily basis which can enable the admin user to not see the day-today information about the employee. We can also automate the counseling process for emotionally imbalanced employees by setting up automated counselling with the counselors. By doing that, we can save a lot of time [29].

CHAPTER-5

FACE RECOGNITION

Many different facial recognition systems have been proposed in recent years. Despite the limited effectiveness of early computer vision techniques, most current facial recognition techniques have showed promise. In their study, Brunelli and Poggio (1993), they divided all methods for identifying human faces into two categories:

5.1 FACE RECOGNITION USING GEOMETRICAL FEATURES

In face recognition, there is a method called geometric-based face recognition. This method involves analyzing the shape and size of different facial features in an image to recognize and identify a person's face. The geometric properties that are considered include measurements like nose width and length, the location of the mouth, the shape of the chin, and other similar characteristics [30].

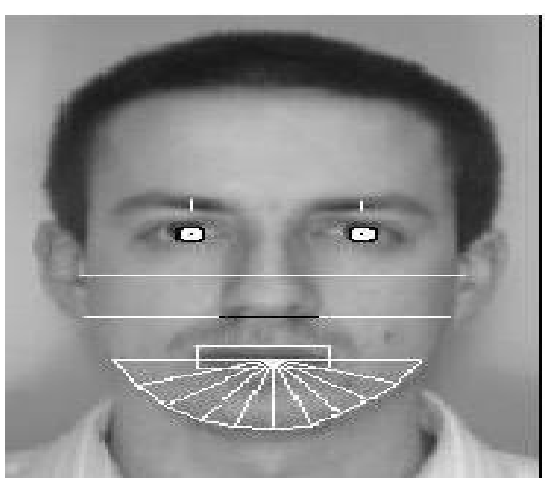


Figure 5.1 Geometrical features (white) which could be used for face recognition

This method has several benefits, such as the capacity to recognise faces even in noisy and low-resolution pictures. The general geometric layout can nevertheless be derived for identification purposes despite the reduced visibility of face features [31]. The challenge of mechanically extracting these geometric traits is a significant downside, though. According to the findings of Kanade, who obtained a good amount of accuracy in the detection of the face, automated recognition based on geometric feature extraction is likewise very sensitive to changes in face scaling and rotation within the picture plane [32].

5.1.1 Face recognition using template matching

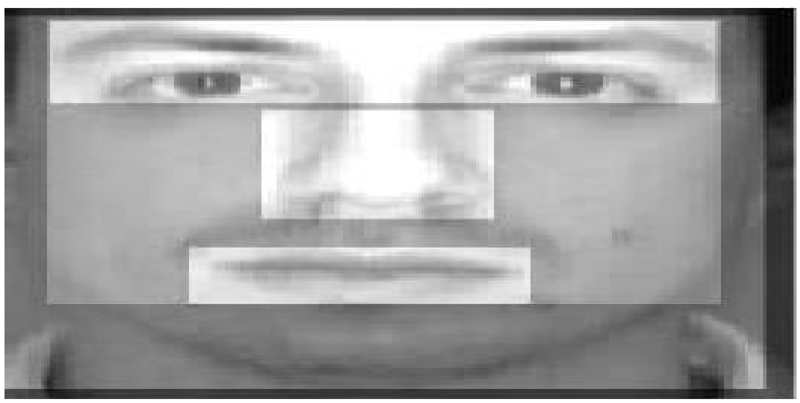


Figure .5.1.1 Face recognition using template matching

Benefits of using geometrical traits as the foundation for face recognition include the ability to distinguish faces even in noisy and low-resolution images [32]. Despite the reduced visibility of face characteristics, the overall geometric arrangement may still be determined for identifying purposes. A key drawback is the difficulty of automatically extracting these geometric features. Automated recognition based on geometric feature extraction is also particularly sensitive to changes in face scaling and rotation inside the image plane, according to Kanade's findings, who reported a recognition rate of 45-75% using a small database of 20 persons. However, as demonstrated in the old works, acceptable results might be attained by manually removing these traits.

For instance, the eigenfaces technique, also known as Principal Component Analysis, was used by Turk and Pentland to preprocess the grey levels. Elastic Graphs encoded with Gabor filters were also used by Wiskott et al. to preprocess the retrieved areas.

5.2 PROBLEM SCOPE AND SYSTEM SPECIFICATION

After a thorough analysis of the face detection and face recognition literature, as well as taking into account many real-world circumstances where these systems might be advantageous. The following system requirements were determined based on this investigation.

First of all, we need a program that can show or view faces in a still picture. After after there may be cases where we might be after to investigate further and find out that we only need the front face view of any image. There might be some cases where the image shown will not be of the face. To tackle these types of issues, we have to specifically determine if the front face view is present or not.

However, it is important to acknowledge that strict adherence to the specified conditions in real-world system implementation may pose challenges.

5.3 BRIEF OUT LINE OF THE IMPLEMENTED SYSTEM

The implementation of a this approach is for completely automated face detection of frontal view faces. Due to the large training data needs and significant computer resource requirements, this strategy was chosen over a neural-network based model. It is hard to find an algorithm which work work perfectly that is were the main difficulties faced during the use of the deformable template technology.

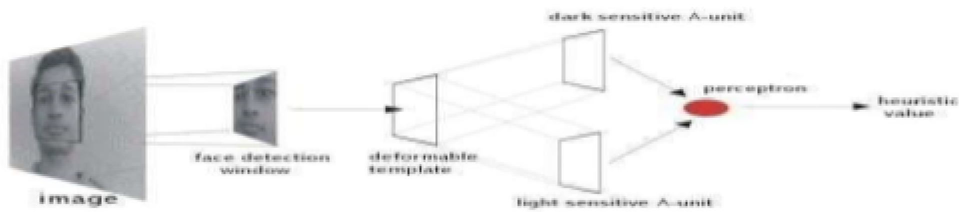


Figure 5.3 Complete Model for face detection.

In order to create a manual face detection system, data from 30 test individuals were used to analyse the average face's facial dimensions. An region of the image would be segmented for further analysis in this system after a human operator identified.

An method called template matching was used for facial recognition. This choice was driven by template matching's superior accuracy when compared to methods based on geometrical characteristics. Additionally, a geometrical features-based automated method would have required time-consuming feature discovery preprocessing.

Due to its shown resilience, one of the several template matching approaches available, was chosen. Even though the author was interested in developing a strategy based on elastic graphs, the project's time constraints prohibited it from being done because there wasn't enough research on the model.

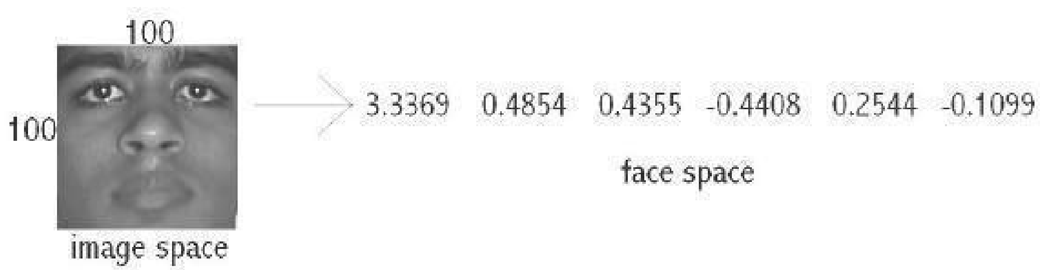


Figure 5.3.1:Main component while the analysis of the face.

Imagine that we have a unique approach to identify faces using the Principal Component Analysis (PCA) technique. With the use of this technique, we may change the images of the faces we wish to recognise into a new representation known as "face space." It's similar to transforming the faces into a unique language that computers can better comprehend.

We have a database of several faces that we wish to identify in our computer system. To make things equal, we also translate those faces into face space using the same transformation that we did for the test image.

Currently, we first use PCA to transform a fresh face into face space before attempting to recognise it. Then, we contrast this altered face with the earlier-transformed vectors from the faces in our database.

We search the database for the vector that most closely resembles the test image. It's like discovering the last missing piece of a puzzle. If a fairly close match is made, we can conclude that the test image and the vector in the database both depict the same individual.

Fig. 5.3.2 Face Recognition

5.4 FACE RECOGNITION DIFFICULTIES

5.4.1 Inter - class similarity:

✧ In this huge world, there might be some possibility when two person have similarly in different faces.

Fig 5.4 Face recognition twins and other and Son

Preprocessing is done on face pictures before they are entered into the network in order to manage the variances that are present in them. By just include the frontal aspect of faces in photographs, this entails extracting good samples. Standard algorithms are also used to adjust the cropped photos for differences in illumination.

5.4.2 Inter – class variability

Due to changes in stance, lighting, emotion, accessories, colour, occlusions, and brightness, faces might vary even within the same subject.

5.5 PRINCIPAL COMPONENT ANALYSIS (PCA)

Due to its capacity to capture the underlying variability found in human faces, which may not always be obvious, successful method for face identification. Instead than focusing on more conventional physical distinctions like, PCA examines, pinpoint the major factors that influence the overall variety in appearances.

When visualised, these variables, known as eigenfaces, remarkably resemble real human faces. Although PCA has been used for statistical analysis for a while, its use in pattern recognition for categorization is a more recent development.

Principal component analysis (PCA), as described by Johnson and Wichern (1992), uses a limited represent the underlying structure of variance and covariance in a dataset. The ability of PCA to reduce and analyse data is one of its main benefits. For instance, just 40 eigenvalues are required to adequately depict a face area with a size of 100x100 pixels. Within each picture, each eigenvalue represents the size of the corresponding eigenface. As a result, activities like recognition may be carried out merely using these 40 eigenvalues, negating the need to deal with the 10,000 values included in a 100x100 image.

By doing so, the computational complexity is decreased and a much smaller number of values represent the important information.

5.6 UNDERSTANDING EIGENFACES

I(x, y) is a representation of a black-and-white image of a face that may be thought of as a lengthy list of integers. The brightness of each number corresponds to a particular pixel in the picture. Since the picture we're considering in this situation is 100 by 100 pixels, our list contains 10,000 numbers in total.

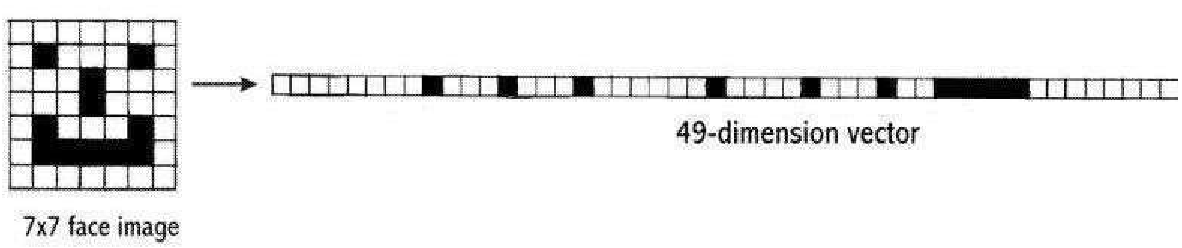
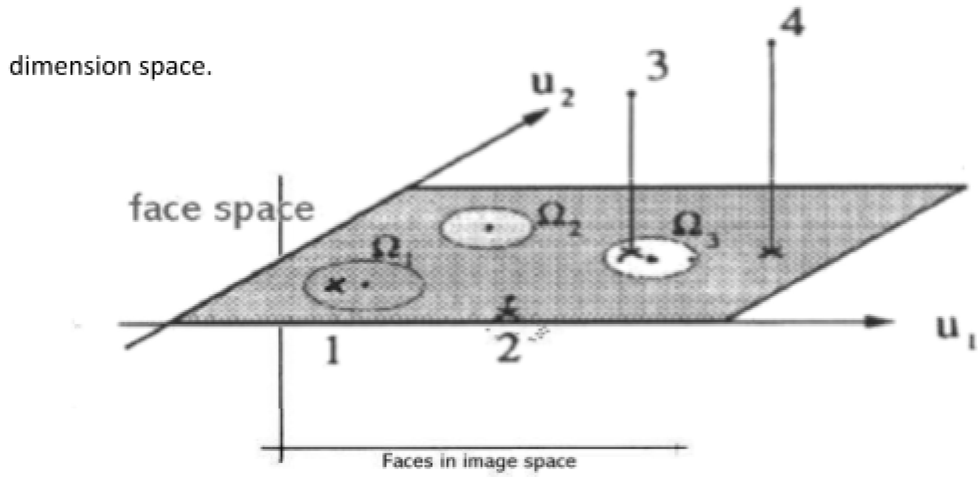


Figure 5.6.1 This is image that is transformed into vector.

Alternatively, we might think of this collection of integers. Each face that we wish to identify may be represented as a dot in this 10,000-dimensional space.



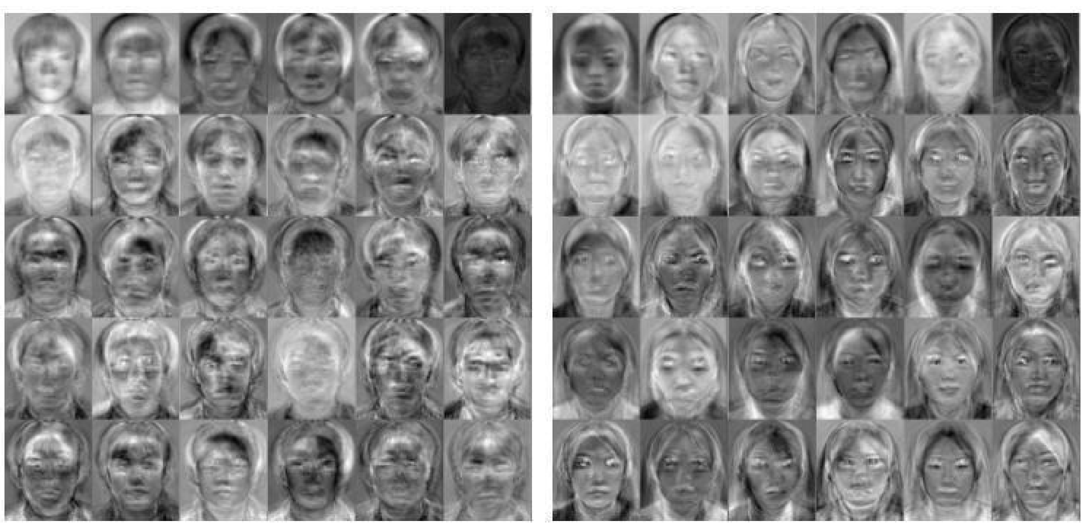


Fig 5.6.3 Eigenfaces

By simply multiplying matrices, we may transform an image that is initial a normal image consist of noise, to an image which consists of only face. This technique makes use of an average face image (A) and a matrix (U) that is made up of the eigenfaces we previously collected.

$$f = U * (I - A)$$

This procedure is carried out on each and every face image kept in our database, including the picture of the individual that has to be identified. The accompanying picture visually illustrates the possibilities that come from when a face is shown.

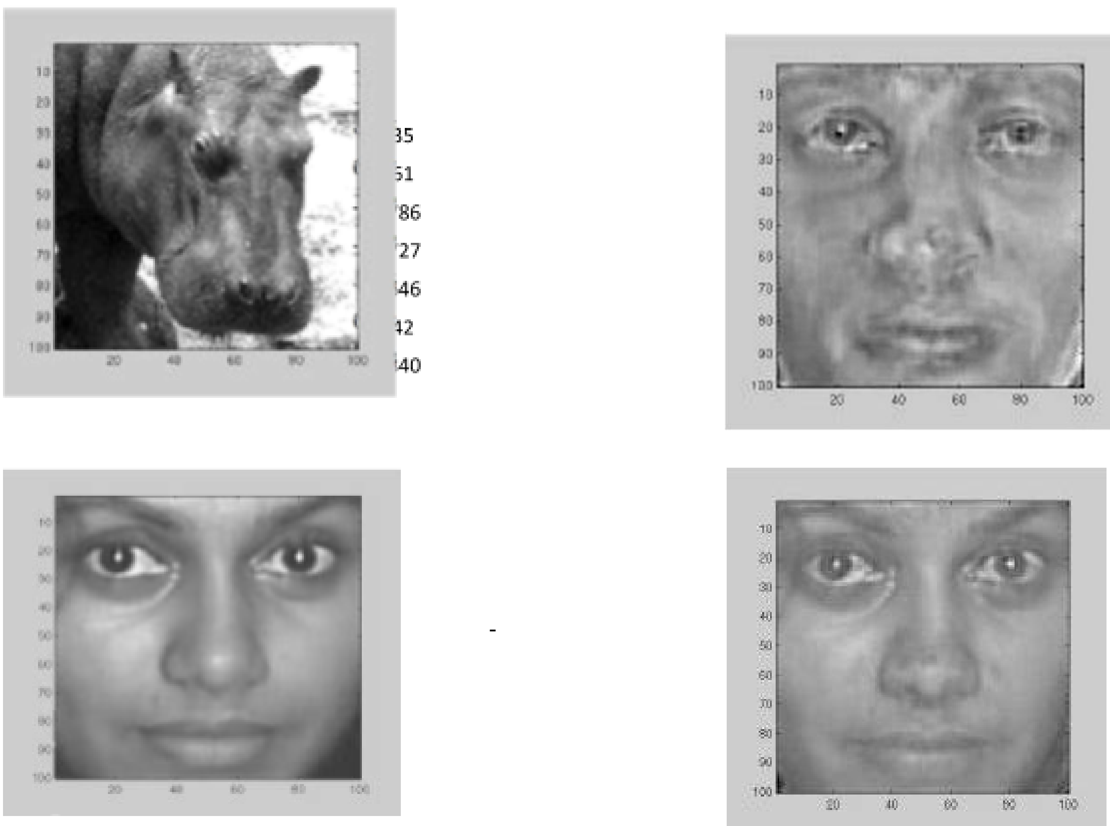


Figure 5.6.4 Images and there reconstruction.

5.7 IMPROVING FACE DETECTION USING RECONSTRUCTION

The practical implementation of reconstruction for real-time face detection is hindered by the computational complexity arising from the need to resize the face detection window and perform computationally-intensive matrix multiplications.

By comparing the reconstructed image with the contents of the face detection window, it becomes possible to discern the presence of a face within the window. Significant dissimilarity between the reconstructed image and the face detection window serves as an indicator that the window does not contain a face.

This approach offers notable advantages by addressing scenarios where the deformable template algorithm identifies a location with the highest 'faceness' score that may not align with the optimal frontal view of the face.

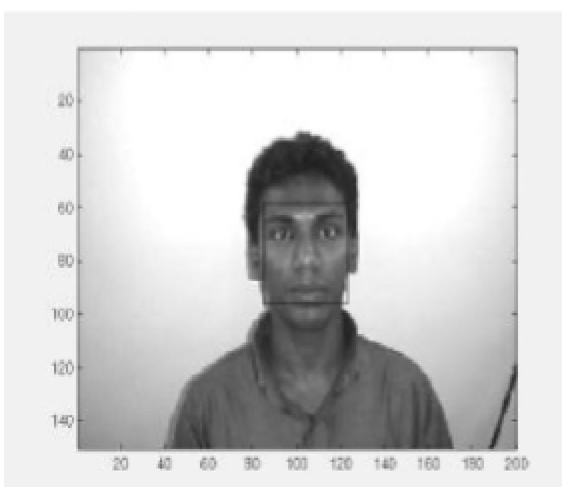


Fig 5.7, These locations are regions in above picture which contain face

By highlighting most promising alternatives, the deformable template algorithm effectively reduces the search space for probable face positions. To ascertain if a face is present, more investigation is done at these places. The original picture and the reconstructed image are compared using a threshold level that establishes the largest permissible difference between the two before a spot is accepted as a legitimate face.

There are a number of speed and accuracy trade-offs that may be taken into account while optimising the face identification process. For instance, changing the face detection system's output so that it includes both the best face locations so far as well as any other places with 'faceness' values over a certain threshold, such as 0.9 times the best heuristic value. The number of probable face locations that can be confirmed via reconstruction grows as a result of this strategy.

Making judgements on speed and accuracy while creating such a system requires careful consideration of the constraints and needs of the platform or device on which the system will run.

A face is probably present in areas of interest that show a significant association. To differentiate between faces and objects without faces, a threshold value must be established.

5.8 POSE INVARIANT FACE RECOGNITION

Imagine you have a unique system that can identify faces of individuals. Typically, it works best when the subject is directly facing the camera. But what if the person's head is slightly inclined or turned to the side. We can help the system recognise faces even when they are not facing it straight on by making a few modifications.

We need to save several images of each person in our system in order to do this. For instance, we can photograph each person's face numerous times from various perspectives. The system can then accurately identify that individual even if we have a new image of them taken at a slightly different angle as long as it falls inside a specific range.

Below is image of a person with different facial images.

Image of individual to identify the face.

Fig: 5.8 Pose invariant face recognition.

Principal Component Analysis (PCA)'s impressive generalisation power is demonstrated via pose invariant face recognition. This means that even if a person's frontal view and a 30-degree left view are all that are known about them, the algorithm can still properly identify them in a 15-degree left view.

CHAPTER-6
CONCLUSION AND FUTURE SCOPE

The trustworthiness of the computational models chosen for this project has been confirmed by their performance throughout testing, which was carefully picked based on thorough study. The system's performance in real-world circumstances is anticipated to show considerable improvements over the first evaluation provided by the rigorously controlled experimental investigation.

This was principally caused by the face recognition subsystem's lack of scale, rotation, and shift invariance, as was noted in section 2.3 of the system requirements. However, the performance may be improved to a level that is equivalent to the manual face detection and identification system by combining additional processing techniques, such as an eye detection approach.

The success of all other systems that were put into use demonstrated the value of the deformable template and different techniques. Recognition technologies are particularly well suited for surveillance and mugshot matching when considering real-world applications. It might significantly help law enforcement organisations find and monitor suspects if broadly used.

Potential applications for the completely identification system,, include basic surveillance scenarios like ATM user security. As opposed to the findings from this study, which was done under difficult circumstances, the manual face identification and automatic recognition method outperforms in mugshot matching, where controlled settings enable better recognition accuracy.

It's also crucial to keep in mind that didn't maintain themselves while their photographs were taken. This makes sense given that people's cooperation may vary when a police officer takes their mugshot. It is not strictly necessary to achieve 100% identification accuracy or an exact match in mugshot matching applications. The practicality and effectiveness of law enforcement activities would be considerably improved if a face recognition technology could successfully cut down on the amount of photographs that a human operator has to manually sift through.

It is important to note that created and used for some time, matching the effectiveness or durability of the natural face recognition abilities.

In future, there will always be need of these kinds of technologies to detection our emotions and tell us how we should live our lives. It has always been seen that people live a better life when they are stress free.

Even though, technology is growing faster, the mental health of any being is very necessary for the well being of our society. There are many people in this world who enjoy their life without enough wealth, that is only because they are stress free and have healthy mental condition.

In future, there is high possibility that complex and powerful artificial intelligence tools will be developed with same idea.

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