AUTOMATED ATTENDANCE MARKER

A

PROJECT REPORT

SUBMITTED FOR PARTIAL FULFILMENT

OF BTECH DEGREE

In

INFORMATION TECHNOLOGY

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Declaration

We therefore declare that this post is our work and that, in our opinion and knowledge, it does not contain anything previously published or written by another person or property who has received a serious error for the benefit of any degree or diploma of any other higher education institution, unless acknowledgment has been made in writing.
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CERTIFICATE

This is to certify that the project report entitled “AUTOMATED ATTENDANCE MARKER” presented by Riyansh Pal, Kushagra Srivastava and Mohammad Kashif Khan in the partial fulfillment for the award of Bachelor of Technology in Information Technology, is a record of work carried out by them under my supervision and guidance at the Department of Computer Science and Engineeringat Institute of Engineering and Technology, Lucknow.

It is also certified that this project has not been submitted at any other Institute for the award of any other degrees to the best of my knowledge.

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ABSTRACT

In today's era, face detection and recognition from an image or video is a popular topic in biometric research. The growing interest in computer vision over the past decade brings new technologies like face detection and recognition, which grabs the attention of today's IT professionals. Face detection and recognition is a popular area of research in computer vision, especially in image analysis and algorithm-based understanding. Face recognition technology is widely used in real-time video surveillance systems. Our main aim is to detect and recognize human faces and further extend that idea into an automated attendance system. It will add the student attendance in the excel sheet automatically once his/her face is recognized. In this paper, we represent a methodology of how our projects work. For that, we will use some of the basic python libraries like OpenCV, NumPy and we are also going to use a Haar-like classifier and local binary pattern histogram algorithm to extract the facial features from digital images.

Maintaining the attendance records with day-to-day activities is a challenging task. Traditionally, in schools and colleges, the attendance is taken manually by using an attendance sheet, which is time-consuming and will add the extra workload on the teacher. Moreover, it is challenging to verify one by one student in a large classroom whether the authenticated students are actually responding or not. The use of face recognition for the purpose of attendance marking is the intelligent way of an attendance management system. Face recognition is a more accurate and faster technique among other techniques and reduces the chance of proxy attendance.

The face of a human being conveys a lot of information about identity and emotional state of the person. Face recognition is an interesting and challenging problem, and impacts important applications in many areas such as identification for law enforcement, authentication for banking and security system access, and personal identification among others. In our research work mainly consists of three parts, namely face representation, feature extraction and classification. Face representation represents how to model a face and determines the successive algorithms of detection and recognition. The most useful and unique features of the face image are extracted in the feature extraction phase. In the classification the face image is compared with the images from the database. In our research work, we empirically evaluate face recognition which considers both shape and texture information to represent face images based on Local Binary Patterns for person-independent face recognition. The face area is first divided into small regions from which Local Binary Patterns (LBP), histograms are extracted and concatenated into a single feature vector. This feature vector forms an efficient representation of the face and is used to measure similarities between images.

LIST OF FIGURES AND TABLES

CHAPTER- 1

INTRODUCTION

Facial recognition is the method by which the identity of a human being can be identified using an individual face. The art of recognizing the human face is quite challenging because of the human face expression, age, change in hairstyle, etc. Although there will be many methods, have been proposed to recognize the human face, but in this project, we will use the OpenCV library, which is developed explicitly for real-time computer vision applications. This system contains three modules which are face detection, training, and recognition, by applying various algorithms. This method is helpful in many fields such as the military, security, schools, colleges and universities, airlines, banking, online web applications, gaming, etc. this system uses a robust python algorithm through which the detection and recognition of face are straightforward and efficient.

Maintaining the attendance records with day-to-day activities is a challenging task. Traditionally, in schools and colleges, the attendance is taken manually by using an attendance sheet, which is time-consuming and will add the extra workload on the teacher. Moreover, it is challenging to verify one by one student in a large classroom whether the authenticated students are actually responding or not. The use of face recognition for the purpose of attendance marking is the intelligent way of an attendance management system. Face recognition is a more accurate and faster technique among other techniques and reduces the chance of proxy attendance.

Face Detection: Face detection is an artificial intelligence-based computer technology used to identify only human faces in digital images. It simply means that the face detection system can identify human face is present or not- it cannot identify that particular person. There will be other objects presents in an image like road, trees, bungalow, etc., but the primary aim of face detection algorithms is to determine whether there is any human face in an image or not.

How does face detection works?

There are various libraries, algorithms that helps to identify a human face in an image. Typically, the first thing that the face detection algorithm will look for is the eyes because eyes are the most accessible features to identify. Once eyes are detected, the algorithm might attempt to detect facial regions, including eyebrows, the mouth, nose, etc.

Face Recognition: Facial recognition is the process of identifying or confirming an individual's identity using their face. It can be used to identify people in photos, videos, or in real-time. So, face recognition is the task of identifying an already detected face as a known or unknown face, and in more advanced cases, telling exactly whose face it is.

Face detection is a computer technology used to identify the locations and sizes of human faces in arbitrary images. It will only detect facial features and ignores everything else like roads, trees, bungalows, etc. So, face detection can be performed by using the classifier. Classifier means algorithm, which helps us to distinguish whether the given image has a face or not. OpenCV provides some pre-trained classifiers such as Haar Cascade, LBP (Local Binary Pattern), PCA (Principal Component Analysis), etc. Here, we will use Haar cascade and LBP classifier to detect and recognize the human face easily

It has two sets of tasks:

1. **Face Identification:** Given a face image that belongs to a person in a database and we need to tell whose image it is or specifically recognize a face in an image and give decision whether the face is correctly recognize or not.

2. **Face Verification:** Given Face image that might not belong to database and we need to authenticate whether a correct face is subjected to the database or not.

Facial expression is one of the most powerful, natural and immediate means for human beings to communicate their emotions and intensions. Face recognition is an interesting and challenging problem, and impacts important applications in many areas such as identification for law enforcement, authentication for banking and security system access, and also personal identification among others. The face plays a major role in our social intercourse in conveying identity and emotion. The human ability to recognize faces is remarkable. Modern Civilization heavily depends on person authentication for several purposes. Face recognition has always a major focus of research because of its noninvasive nature and because it is people's primary method of person identification. [1]

Face recognition is an important research problem spanning numerous fields and disciplines. It is because of face recognition, in additional to having numerous practical applications such as bankcard identification, access control, Mug shots searching, security monitoring, and surveillance system, is a fundamental human behavior that is essential for effective communications and interactions among people.

A formal method of classifying faces was first proposed in [1]. The author proposed collecting facial profiles as curves, finding their norm, and then classifying other profiles by their deviations from the norm. This classification is multi-modal, i.e., resulting in a vector of independent measures that could be compared with other vectors in a database.

Progress has advanced to the point that face recognition systems are being demonstrated in real-world settings. The rapid development of face recognition is due to a combination of factors: active development of algorithms, the availability of a large databases of facial images, and a method for evaluating the performance of face recognition algorithms.

In the literatures, face recognition problem can be formulated as: given static (still) or video images of a scene, identify or verify one or more persons in the scene by comparing with faces stored in a database. [2]

When comparing person verification to face recognition, there are several aspects which differ. First, a client – an authorized user of a personal identification system – is

assumed to be co-operative and makes an identity claim.
Computationally this means that it is not necessary to consult the complete set of database images (denoted model images below) in order to verify a claim. An incoming image (referred to as a probe image) is thus compared to a small number of model images of the person whose identity is claimed and not, as in the recognition scenario, with every image (or some descriptor of an image) in a potentially large database. Second, an automatic authentication system must operate in near-real time to be acceptable to users. Finally, in recognition experiments, only images of people from the training database are presented to the system, whereas the case of an imposter (most likely a previously unseen person) is of utmost importance for authentication.
Face recognition is a biometric approach that employs automated methods to verify or recognize the identity of a living person based on his/her physiological characteristics. In general, a biometric identification system makes use of either physiological characteristics (such as a fingerprint, iris pattern, or face) or behavior patterns (such as hand-writing, voice, or key-stroke pattern) to identify a person. Because of human inherent protectiveness of his/her eyes, some people are reluctant to use eye identification systems. Face recognition has the benefit of being a passive, non-intrusive system to verify personal identity in a “natural” and friendly way.

In general, biometric devices can be explained with a three- step procedure -
1. a sensor takes an observation. The type of sensor and its observation depend on the type of biometric devices used. This observation gives us a “Biometric Signature” of the individual.
2. a computer algorithm “normalizes” the biometric signature so that it is in the same format (size, resolution, view, etc.) as the signatures on the system’s database. The normalization of the biometric signature gives us a “Normalized Signature” of the individual.
3. a matcher compares the normalized signature with the set (or sub-set) of normalized signatures on the system's database and provides a “similarity score” that compares the individual's normalized signature with each signature in the database set (or sub-set).

What is then done with the similarity scores depends on the biometric system’s application?
Face recognition starts with the detection of face patterns in sometimes cluttered scenes, proceeds by normalizing the face images to account for geometrical and illumination changes, possibly using information about the location and appearance of facial landmarks, identifies the faces using appropriate classification algorithms, and post processes the results using model-based schemes and logistic feedback.

The application of face recognition technique can be categorized into two main parts: law enforcement application and commercial application. Face recognition technology is primarily used in law enforcement applications, especially Mug shot albums (static matching) and video surveillance (real-time matching by video image sequences). The commercial applications range from static matching of photographs on credit cards, ATM cards, passports, driver’s licenses, and photo ID to real-time matching with still images or video image sequences for access control. Each application presents different constraints in terms of processing.

Face recognition research still face challenge in some specific domains such as pose and illumination changes. Although numerous methods have been proposed to solve such problems and have demonstrated significant promise, the difficulties still remain. For these reasons, the matching performance in current automatic face recognition is relatively poor compared to that achieved in fingerprint and iris matching, yet it may be the only available measuring tool for an application. Error rates of 2-25% are typical. It is effective if combined with other biometric measurements.

Current systems work very well whenever the test image to be recognized is captured under conditions similar to those of the training images. However, they are not robust enough if there is variation between test and training images. Changes in incident illumination, head pose, facial expression, hairstyle (include facial hair), cosmetics (including eyewear) and age, all confound the best systems today.

As a general rule, we may categorize approaches used to cope with variation in appearance into three kinds: invariant features, canonical forms, and variation- modeling. The first approach seeks to utilize features that are invariant to the changes being studied. For instance, the Quotient Image is (by construction) invariant to illumination and may be used to recognize faces (assumed to be Lambertian).

CHAPTER- 2

LITERATURE REVIEW

This chapter gives an insight into various studies conducted by outstanding researchers' formidable researchers, as well as explained terminology with regards to Face Detection and Face Recognition using Local Binary Pattern Histogram. The chapter also gives a resume of the history and present status of the problem delineated by a concise review of previous studies into closely related problems.

This section gives an overview on the major human face recognition techniques that apply mostly to frontal faces, advantages and disadvantages of each method are also given. The methods considered are eigenfaces (eigenfeatures), neural networks, dynamic link architecture, hidden Markov model, geometrical feature matching, and template matching. The approaches are analyzed in terms of the facial representations they used.

Some of the major terminologies used in the project are listed below-

1. Eigenfaces
2. Neural Network
3. Graph Matching
4. Geometrical Feature Matching
5. Template Matching

1. Eigenfaces

Eigenface is one of the most thoroughly investigated approaches to face recognition. It is also known as Karhunen- Loève expansion, eigenpicture, eigenvector, and principal component. References used principal component analysis to efficiently represent pictures of faces. They argued that any face images could be approximately reconstructed by a small collection of weights for each face and a standard face picture (eigenpicture). The weights describing each face are obtained by projecting the face image onto the eigenpicture. Reference used eigenfaces, which was motivated by the technique of Kirby and Sirovich, for face detection and identification.

In mathematical terms, eigenfaces are the principal components of the distribution of faces, or the eigenvectors of the covariance matrix of the set of face images. The eigenvectors are ordered to represent different amounts of the variation, respectively, among the faces. Each face can be represented exactly by a linear combination of the eigenfaces. It can also be approximated using only the "best" eigenvectors with the largest eigenvalues. The best M eigenfaces construct an M dimensional space, i.e., the "face space". The authors reported 96 percent, 85 percent, and 64 percent correct classifications averaged over lighting, orientation, and size variations, respectively. Their database contained 2,500 images of 16 individuals.

As the images include a large quantity of background area, the above results are influenced by background. The authors explained the robust performance of the system under different lighting conditions by significant correlation between images with changes in illumination. However, [2] showed that the correlation between images of the whole faces is not efficient for satisfactory recognition performance. Illumination normalization is usually necessary for the eigenfaces approach.

Reference [3] proposed a new method to compute the covariance matrix using three images each was taken in different lighting conditions to account for arbitrary illumination effects, if the object is Lambertian. It extended their early work on eigenface to eigenfeatures corresponding to face components, such as eyes, nose, and mouth. They used a modular eigenspace which was composed of the above eigenfeatures (i.e., eigeneyes, eigennose, and eigenmouth). This method would be less sensitive to appearance changes than the standard eigenface method. The system achieved a recognition rate of 95 percent on the FERET database of 7,562 images of approximately 3,000 individuals. In summary, eigenface appears as a fast, simple, and practical method. However, in general, it does not provide invariance over changes in scale and lighting conditions.

Recently, in [3] experiments with ear and face recognition, using the standard principal component analysis approach, showed that the recognition performance is essentially identical using ear images or face images and combining the two for multimodal recognition results in a statistically significant performance improvement. For example, the difference in the rank-one recognition rate for the day variation experiment using the 197-image training sets is 90.9% for the multimodal biometric versus 71.6% for the ear and 70.5% for the face.

There is substantial related work in multimodal biometrics. For example [3] used face and fingerprint in multimodal biometric identification, and used face and voice. However, use of the face and ear in combination seems more relevant to surveillance applications.

2. *Neural Networks*

The attractiveness of using neural networks could be due to its non-linearity in the network. Hence, the feature extraction step may be more efficient than the linear Karhunen-Loève methods. One of the first artificial neural networks (ANN) techniques used for face recognition is a single layer adaptive network called WISARD which contains a separate network for each stored individual. The way in constructing a neural network structure is crucial for successful recognition. It is very much dependent on the intended application. For face detection, multilayer perceptron and convolutional neural network have been applied. [5][6]
For face verification, [6] is a multi-resolution pyramid structure. Reference [7] proposed a hybrid neural network which combines local image sampling, a self-organizing map (SOM) neural network, and a convolutional neural network. The SOM provides a quantization of the image samples into a topological space where inputs that are nearby in the original space are also nearby in the output space, thereby providing dimension reduction and invariance to minor changes in the image sample. The convolutional network extracts successively larger features in a hierarchical set of layers and provides partial invariance to translation, rotation,

scale, and deformation. The authors reported 96.2% correct recognition on ORL database of 400 images of 40 individuals.

The classification time is less than 0.5 second, but the training time is as long as 4 hours. Reference [8] used probabilistic decision-based neural network (PDBNN) which inherited the modular structure from its predecessor, a decision based neural network (DBNN). The PDBNN can be applied effectively to

1. face detector: which finds the location of a human face in a cluttered image,
2. eye localizer: which determines the positions of both eyes in order to generate meaningful feature vectors,
3. face recognizer. PDNN does not have a fully connected network topology. Instead, it divides the network into K subnets. Each subset is dedicated to recognize one person in the database.

PDNN uses the Gaussian activation function for its neurons, and the output of each "face subnet" is the weighted summation of the neuron outputs. In other words, the face subnet estimates the likelihood density using the popular mixture-of-Gaussian model. Compared to the AWGN scheme, mixture of Gaussian provides a much more flexible and complex model for approximating the time likelihood densities in the face space.

The learning scheme of the PDNN consists of two phases, in the first phase; each subnet is trained by its own face images. In the second phase, called the decision-based learning, the subnet parameters may be trained by some particular samples from other face classes. The decision-based learning scheme does not use all the training samples for the training. Only misclassified patterns are used. If the sample is misclassified to the wrong subnet, the rightful subnet will tune its parameters so that its decision-region can be moved closer to the misclassified sample.

PDBNN-based biometric identification system has the merits of both neural networks and statistical approaches, and its distributed computing principle is relatively easy to implement on parallel computer. In [3], it was reported that PDBNN face recognizer had the capability of recognizing up to 200 people and could achieve up to 96% correct recognition rate in approximately 1 second. However, when the number of persons increases, the computing expense will become more demanding. In general, neural network approaches encounter problems when the number of classes (i.e., individuals) increases. Moreover, they are not suitable for a single model image recognition test because multiple model images per person are necessary in order for training the systems to "optimal" parameter setting.

3. *Graph Matching*

Graph matching is another approach to face recognition. Reference [4] presented a dynamic link structure for distortion invariant object recognition which employed elastic graph matching to find the closest stored graph. Dynamic link architecture is an extension to classical artificial neural networks. Memorized objects are represented by sparse graphs, whose vertices are labeled with a multiresolution description in terms of a local power spectrum and whose edges are labeled with geometrical distance vectors. Object recognition can be formulated as elastic graph matching which is performed by stochastic optimization of a matching cost function. They reported good results on a database of 87 people and a small set of office items comprising different expressions with a rotation of 15 degrees.

The matching process is computationally expensive, taking about 25 seconds to compare with 87 stored objects on a parallel machine with 23 transputers. Reference [5] extended the technique and matched human faces against a gallery of 112 neutral frontal view faces. Probe images were distorted due to rotation in depth and changing facial expression. Encouraging results on faces with large rotation angles were obtained. They reported recognition rates of 86.5% and 66.4% for the matching tests of 111 faces of 15-degree rotation and 110 faces of 30-degree rotation to a gallery of 112 neutral frontal views. In general, dynamic link architecture is superior to other face recognition techniques in terms of rotation invariance; however, the matching process is computationally expensive.

4. *Geometrical Feature Matching*

Geometrical feature matching techniques are based on the computation of a set of geometrical features from the picture of a face. The fact that face recognition is possible even at coarse resolution as low as 8x6 pixels when the single facial features are hardly revealed in detail, implies that the overall geometrical configuration of the face features is sufficient for recognition. The overall configuration can be described by a vector representing the position and size of the main facial features, such as eyes and eyebrows, nose, mouth, and the shape of face outline. [4]

One of the pioneering works on automated face recognition by using geometrical features was done by [6] in 1973. Their system achieved a peak performance of 75% recognition rate on a database of 20 people using two images per person, one as the model and the other as the test image. References [7,8] showed that a face recognition program provided with features extracted manually could perform recognition apparently with satisfactory results. Reference [9] automatically extracted a set of geometrical features from the picture of a face, such as nose width and length, mouth position, and chin shape. There were 35 features extracted form a 35-dimensional vector. The recognition was then performed with a Bayes classifier. They reported a recognition rate of 90% on a database of 47 people.

Reference [5] introduced a mixture-distance technique which achieved 95% recognition rate on a query database of 685 individuals. Each face was represented by 30 manually extracted distances. It used Gabor wavelet decomposition to detect feature points for each face image which greatly reduced the storage requirement for the database. Typically, 35-45 feature points per face were generated. The matching process utilized the information presented in a topological graphic representation of the feature points. After compensating for different centroid location, two cost values, the topological cost, and similarity cost, were evaluated. The recognition accuracy in terms of the best match to the right person was 86% and 94% of the correct person's faces was in the top three candidate matches.

In summary, geometrical feature matching based on precisely measured distances between features may be most useful for finding possible matches in a large database such as a Mug shot album. However, it will be dependent on the accuracy of the feature location algorithms. Current automated face feature location algorithms do not provide a high degree of accuracy and require considerable computational time.

5. Template Matching

A simple version of template matching is that a test image represented as a two-dimensional array of intensity values is compared using a suitable metric, such as the Euclidean distance, with a single template representing the whole face. There are several other more sophisticated versions of template matching on face recognition. One can use more than one face template from different viewpoints to represent an individual's face.

A face from a single viewpoint can also be represented by a set of multiple distinctive smaller templates. The face image of gray levels may also be properly processed before matching. In [9], Bruneli and Poggio automatically selected a set of four features templates, i.e., the eyes, nose, mouth, and the whole face, for all of the available faces. They compared the performance of their geometrical matching algorithm and template matching algorithm on the same database of faces which contains 188 images of 47 individuals. The template matching was superior in recognition (100 percent recognition rate) to geometrical matching (90 percent recognition rate) and was also simpler. Since the principal components (also known as eigenfaces or eigenfeatures) are linear combinations of the templates in the data basis, the technique cannot achieve better results than correlation [9], but it may be less computationally expensive. One drawback of template matching is its computational complexity. Another problem lies in the description of these templates. Since the recognition system has to be tolerant to certain discrepancies between the template and the test image, this tolerance might average out the differences that make individual faces unique.

In general, template-based approaches compared to feature matching are a more logical approach. In summary, no existing technique is free from limitations. Further efforts are required to improve the performances of face recognition techniques, especially in the wide range of environments encountered in real world.

CHAPTER- 3

METHODOLOGY

There are mainly five steps for face recognition.

1. Image Acquisition
2. Image Processing
3. Face detection
4. Feature Extraction
5. Recognize face

This is the actual block diagram of our system, which shows how the actual process flow works—starting from the high-quality camera that captures an image of a person and converts that image from RGB to grayscale. The next step is to apply the various algorithms to extract the facial features from that grayscale image, and then it will be compared with the known database faces by using a unique student ID, and once the match is found, the attendance is automatically marked in the excel sheet.

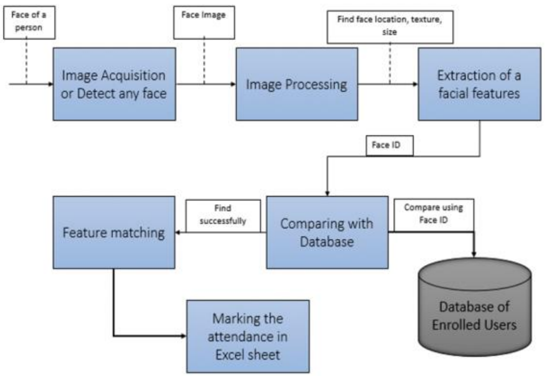

Figure 3.1

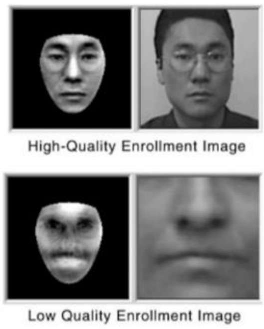

Figure 3.2

1. Image Acquisition

As the name suggests, Acquisition means to acquire or capture anything. Image acquisition can be accomplished by capturing real-time images of any object using a high-optical camera and generates images of sufficient quality and resolution. Image acquisition can be made by digitally scanning an existing photograph or by using high-quality sensors like the camera to capture a live picture of a subject. Here, it is one condition that the person's face should be at the perfect angle; no various poses or expressions are allowed while capturing the image. With increasing of the pose angle, the recognition rate decreases, and it will be challenging to recognize the human face. A high-quality image is necessary for detecting any facial characteristics, which can be used in the further face recognition process.

2. Image Processing

Image processing is the process of performing certain operations on an image to improve its quality or to extract features of that image. This can be used for further analysis and decision-making; when the camera detects any face and converts it into an image, then that image will be first cropped and converted from RGB to grayscale because it is very easy to detect faces in grayscale images.

3. Face Detection

Face detection is a computer technology used to identify the locations and sizes of human faces in arbitrary images. It will only detect facial features and ignores everything else like roads, trees, bungalows, etc. So, face detection can be performed by using the classifier. Classifier means algorithm, which helps us to distinguish whether the given image has a face or not. OpenCV provides some pre-trained classifiers such as Haar Cascade, LBP (Local Binary Pattern), PCA (Principal Component Analysis), etc. Here, we will use Haar cascade and LBP classifier to detect and recognize the human face easily.

4. Feature Extraction

So, the main goal of this module is to extracting some relevant feature that is well enough to identify as the face. To recognize any human face, software defines nodal points. There are about 80 nodal points on a human face. So, with the help of the nodal points, software identify that the particular image has a human face or not. Here are some nodal points:

Distance between the eyes
Width of the nose
Length of Jaw line
Chin

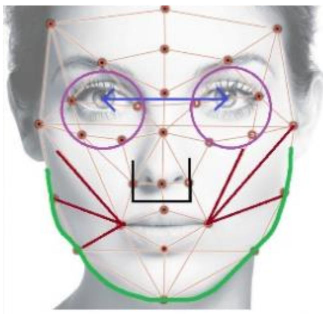

Figure 3.3

5. Face Matching

When the facial feature is extracted and landmarks, face position is fed into the software, the software generates a unique feature vector for each face in the numeric form. The feature vector is used to search through the entire database of enrolled users during the face-recognizing process. Once the matching face is found, then the particular student attendance is automatically marked in the excel sheet.

In the automatic attendance system, registered student faces are trained and stored in the database. Therefore, when the camera captures the face of any student, it will compare it with the known face database by using the unique student ID, and this process will return matches or potential matches close to the image in the database.

Then, the attendance is automatically marked in the excel worksheet.

LOCAL BINARY PATTERN

There exist several methods for extracting the most useful features from (preprocessed) face images to perform face recognition. One of these feature extraction methods is the Local Binary Pattern (LBP) method. This relative new approach was introduced in 1996 by Ojala et al. [5]. With LBP it is possible to describe the texture and shape of a digital image. This is done by dividing an image into several small regions from which the features are extracted (Figure 3.4).

Figure 3.4: A preprocessed image divided into 64 regions

These features consist of binary patterns that describe the surroundings of pixels in the regions. The obtained features from the regions are concatenated into a single feature histogram, which forms a representation of the image. Images can then be compared by measuring the similarity (distance) between their histograms. According to several studies [2, 3, 4] face recognition using the LBP method provides very good results, both in terms of speed and discrimination performance. Because of the way the texture and shape of images is described, the method seems to be quite robust against face images with different facial expressions, different lightening conditions, image rotation and aging of persons.

PRINCIPLES OF LOCAL BINARY PATTERN

The original LBP operator was introduced by Ojala et al. This operator works with the eight neighbors of a pixel, using the value of this center pixel as a threshold. If a neighbor pixel has a higher gray value than the center pixel (or the et al. same gray value) than a one is assigned to that pixel, else it gets a zero. The LBP code for the center pixel is then produced by concatenating the eight ones or zeros to a binary code (Figure 3.5).

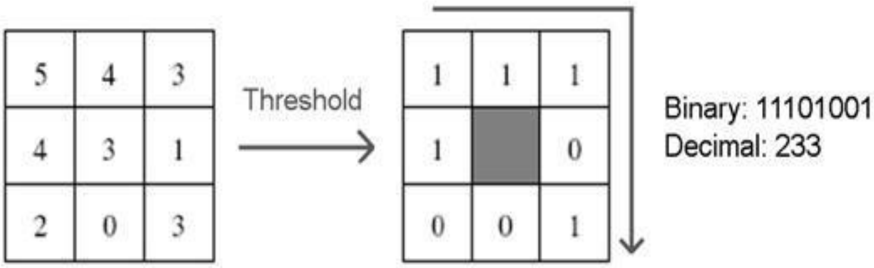

Figure 3.5: The Original LBP Operator

Later the LBP operator was extended to use neighborhoods of different sizes. In this case a circle is made with radius R from the center pixel. P sampling points on the edge of this circle are taken and compared with the value of the center pixel. To get the values of all sampling points in the neighborhood for any radius and any number of pixels, (bilinear) interpolation is necessary. For neighborhoods the notation (P, R) is used. Figure 3.6 illustrates three neighbor-sets for different values of P and R.

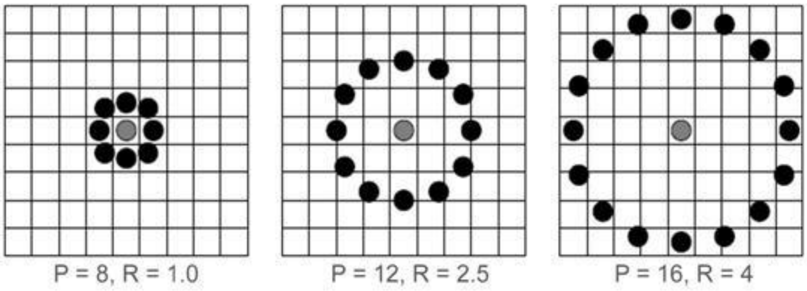

Figure 3.6: Circularly neighbor-sets for three different values of P and R

If the coordinates of the center pixel are (xc, yc) then the coordinates of his P neighbors (xp, yp) on the edge of the circle with radius R can be calculated with the sinus and cosines:

$xp = xc + R\cos(2\pi p/P)$ ……….(1)

$yp = yc + R\sin(2\pi p/P)$ ……….(2)

If the gray value of the center pixel is gc and the gray values of his neighbors are gp, with p = 0, ..., P − 1, then the texture T in the local neighborhood of pixel (xc, yc) can be defined as:

$T = t\ (gc,\ g0,\ .\ .\ .,\ gP{-}1)$ ……….(3)

Once these values of the points are obtained is it also possible do describe the texture in another way. This is done by subtracting the value of the center pixel from the values of the points on the circle. On this way the local texture is represented as a joint distribution of the value of the center pixel and the differences:

$T = t\ (gc,\ g0 - gc,\ .\ .\ .,\ gP{-}1 - gc)$ ……….(4)

Since t(gc) describes the overall luminance of an image, which is unrelated to the local image texture, it does not provide useful information for texture analysis. Therefore, much of the information about the textural characteristics in the original joint distribution (Eq. 3) is preserved in the joint difference distribution (Ojala et al. 2001):

$T\ \ (g0 - gc,\ .\ .\ .,\ gP{-}1 - gc)$ ……….(5)

Although invariant against gray scale shifts, the differences are affected by scaling. To achieve invariance with respect to any monotonic transformation of the gray scale, only the signs of the differences are considered. This means that in the case a point on the circle has a higher gray value than the center pixel (or the same value), a one is assigned to that point, and else it gets a zero:

$T\ \ \ (s\ (g0 - gc),\ .\ .\ .,\ s\ (gP{-}1 - gc)$ ……….(6)

Where,

In the last step to produce the LBP for pixel (xc, yc) a binomial weight 2p is assigned to each sign s (gp − gc). These binomial weights are summed:

$LBPP.R(xc\ ,\ yc\ ) = \sum p-1\ s(\ gp - gc)2p$ ……….(7)

The Local Binary Pattern characterizes the local image texture around (xc, yc). The original LBP operator in figure 3.6 is very similar to this operator with P = 8 and R = 1, thus LBP8,1. The main difference between these operators is that in LBP8,1 the pixels first need to be interpolated to get the values of the points on the circle.

Face Recognition Using Local Binary Pattern Histogram

We explained how the LBP-method can be applied on images (of faces) to extract features which can be used to get a measure for the similarity between these images. The main idea is that for every pixel of an image the LBP-code is calculated. The occurrence of each possible pattern in the image is kept up. The histogram of these patterns, also called labels, forms a feature vector, and is thus a representation for the texture of the image. These histograms can then be used to measure the similarity between the images, by calculating the distance between the histograms.

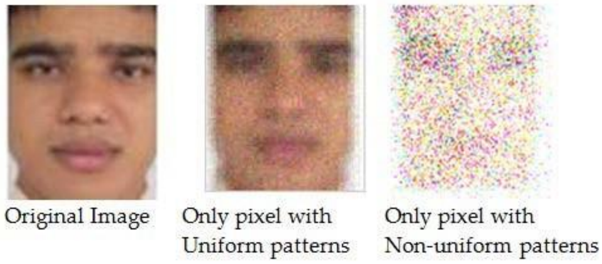

Figure 3.7: Face image split in an image with only pixels with uniform patterns and in an image with onlynon-uniform patterns, by using LBP^{u2}

Figure 3.7 shows an image which is split in an image with only pixels with uniform patterns and in an image with only non-uniform patterns. These images are created by using the $LBPu2$ operator. It occurs that the image with only pixels with uniform patterns still contains a considerable number of pixels, namely 99 % of the original image. So, 99% of the pixels of the image have uniform patterns (with LBP this is even 99 %). Another striking thing is the fact that, by taking only the pixels with uniform patterns, the background is also preserved. This is because the background pixels all have the same color (same gray value) and thus their patterns contain zero transitions. It also seems that much of the pixels around the mouth, the noise and the eyes (especially the eyebrows) have uniform patterns.

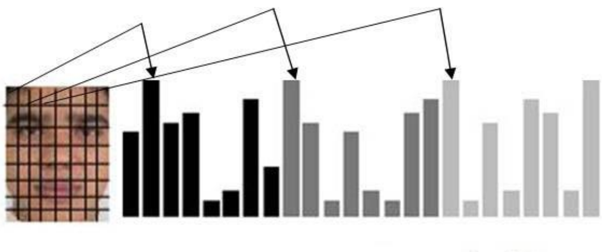

Figure 3.8: Face Image divided into 64 regions, with every region having its own histogram

Once the Local Binary Pattern for every pixel is calculated, the feature vector of the image can be constructed [10]. For an efficient representation of the face, first the image is divided into K2 regions. In figure 3.8 a face image is divided into 82 = 64 regions. For every region a histogram with all possible labels is constructed. This means that every bin in a histogram represents a pattern and contains the number of its appearance in the region. The feature vector is then constructed by concatenating the regional histograms to one big histogram.

Face Recognition Algorithm

To implement the face recognition in this research work, we proposed the Local Binary patterns methodology. Local Binary Pattern works on local features that uses LBP operator which summarizes the local special structure of a face image [11].
LBP is defined as an ordered set of binary comparisons of pixels intensities between the center pixels and its eight surrounding pixels. Local Binary Pattern do this comparison by applying the following formula:
$LBP\ (xc\ ,\ yc\ )\ =\ \sum 7s(iin\ \ -\ iic)2$

Where ic corresponds to the value of the center pixel ($xc\ ,\ yc$), in to the value of eight surrounding pixels. It is used to determine the local features in the face and also works by using basic LBP operator. Feature extracted matrix originally of size 3 x 3, the values are compared by the value of the center pixel, then binary pattern code is produced and also LBP code is obtained by converting the binary code into decimal one.

Algorithm

Input: Training Image set.
Output: Feature extracted from face image and compared with center pixel and recognition with unknown face image.

1.Initialize temp = 0
2.FOR each image I in the training image set
3.Initialize the pattern histogram, H = 0
4.FOR each center pixel tc C I
5.Compute the pattern label of tc, LBP (1)
6.Increase the corresponding bin by 1.
7.END FOR
8.Find the highest LBP feature for each face image and combined into single vector.
9.Compare with test face image.
10.If it matches its most similar face in database then the face is successfully recognized.

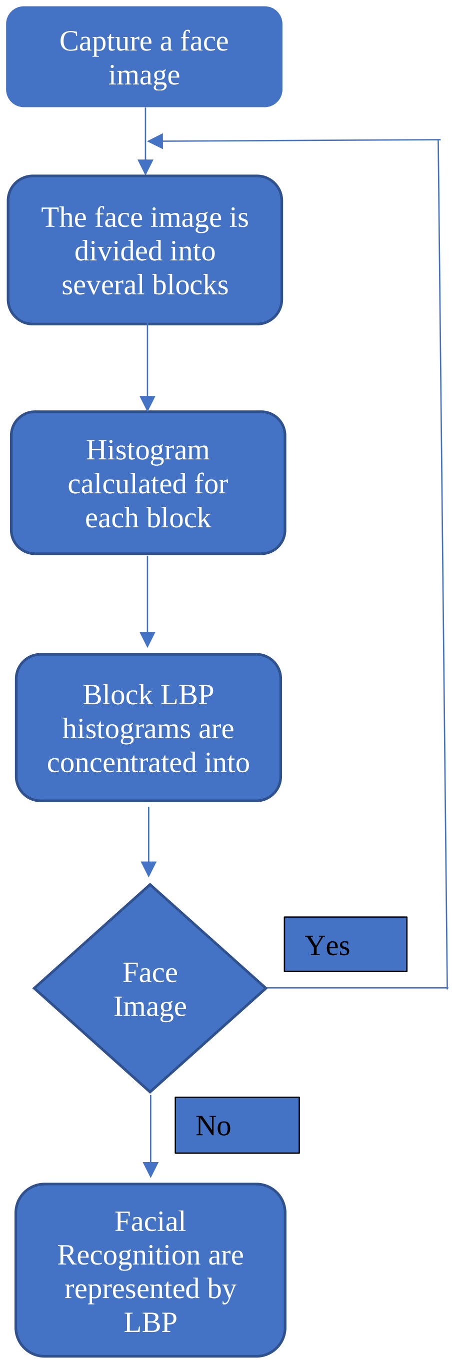

Figure 3.9: LBPH Flowchart

Computational steps in LBPH

- The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics.

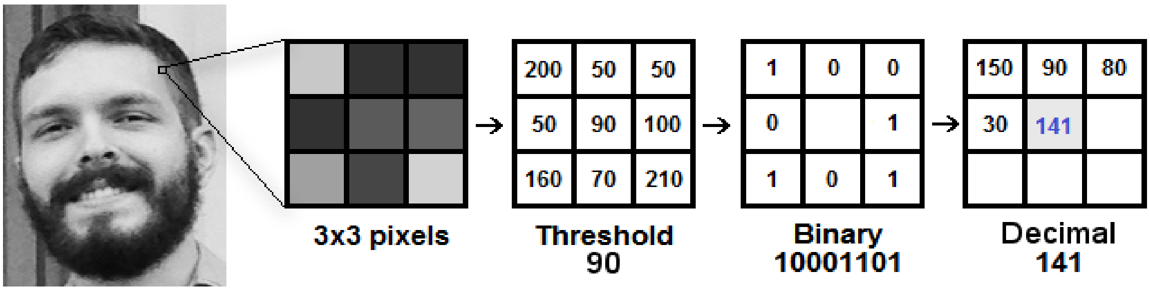

Figure 3.10

- For each neighbours, condition is:
  put 1 when central value <= neighbour value
  put 0 when central value > neighbour value

- The matrix will contain only binary values and convert that binary value into a decimal value as a clockwise direction.

- The decimal value we get is set to the central value of the matrix, which is actually a pixel from the original image.

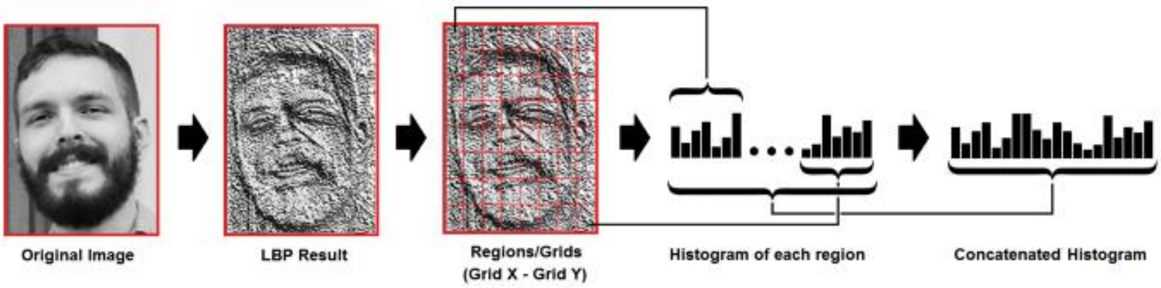

Figure 3.11

- Now using that image, we use grind x and grind y parameters to divide the image into multiple grids.

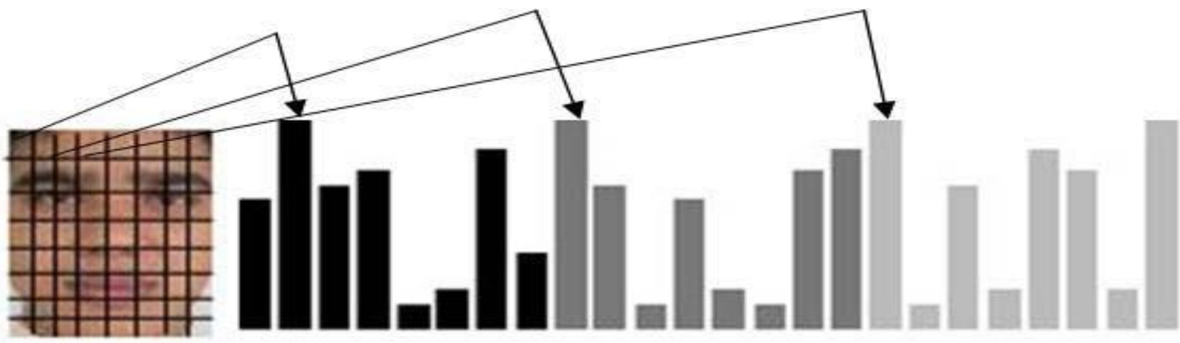

Figure 3.12. Face image divided into 64 regions, with for every region a histogram

Why LBPH ?

Through the graphs given below, we can understand why LBPH is superior compared to other face recognition algorithms on the basis of correct output, wrong output and accuracy.

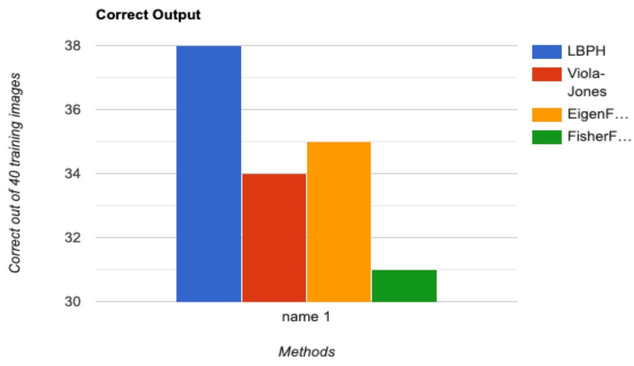

Figure 3.13

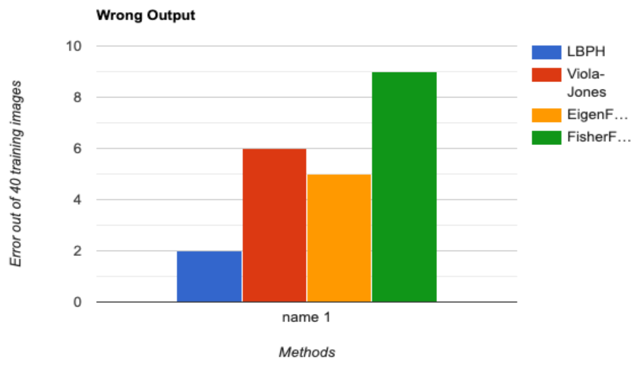

Figure 3.14

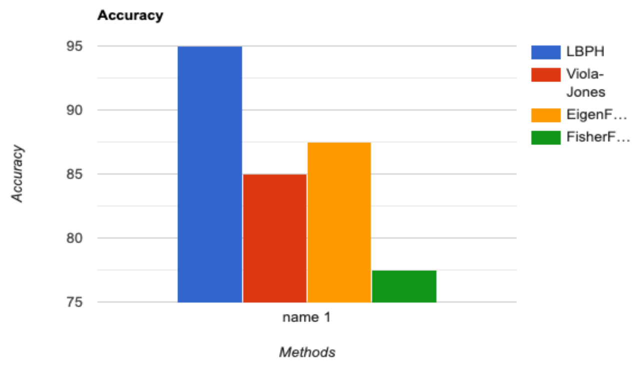

Figure 3.15

CHAPTER- 4

EXPERIMENTAL RESULTS

We have tested our model for multiple datasets and listed a few of the outputs generated with their corresponding inputs.

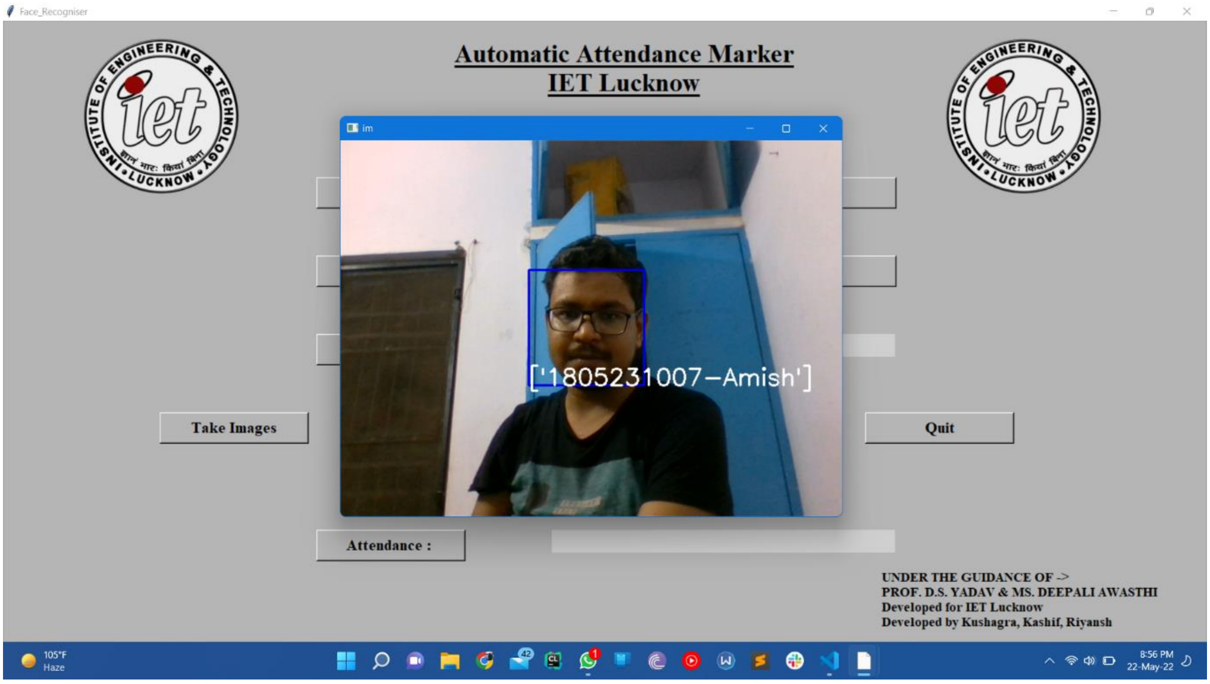

Figure 4.1: Detecting Face

	A	B	C	D
1	Id	Name	Date	Time
2	1805231007	['Amish']	22-05-22	20:54:59
3				
4				
5				

Figure 4.2 Updating Attendance

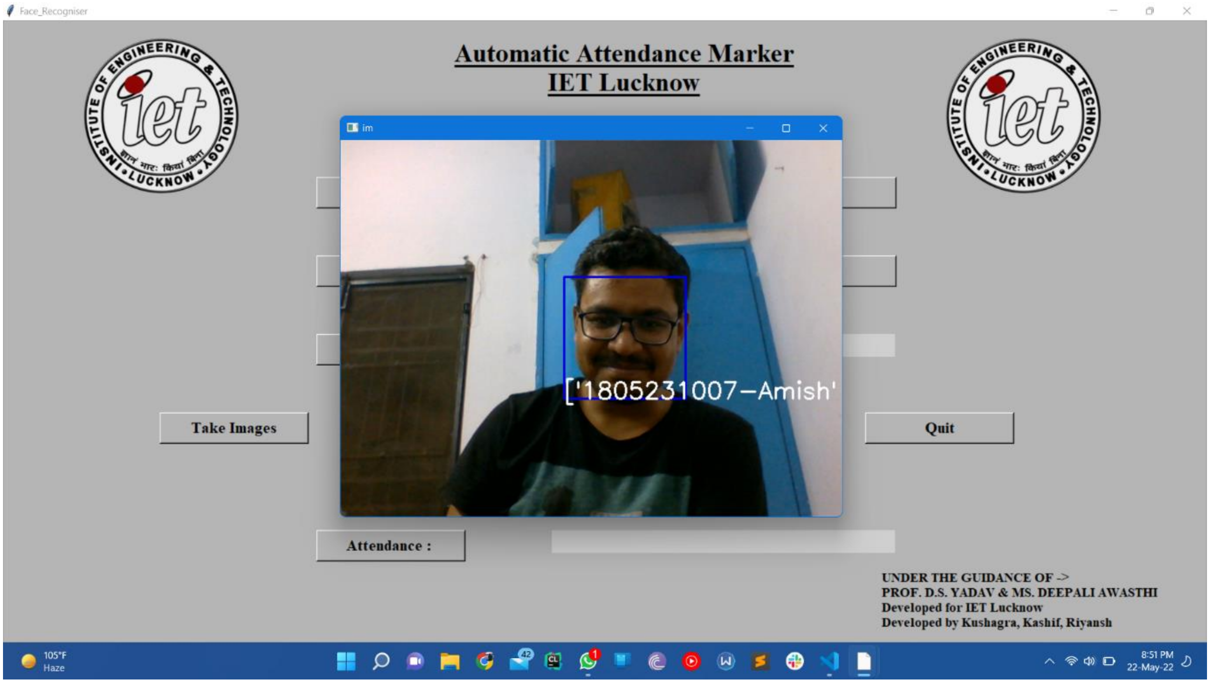

Figure 4.3: Detecting Face with expressions

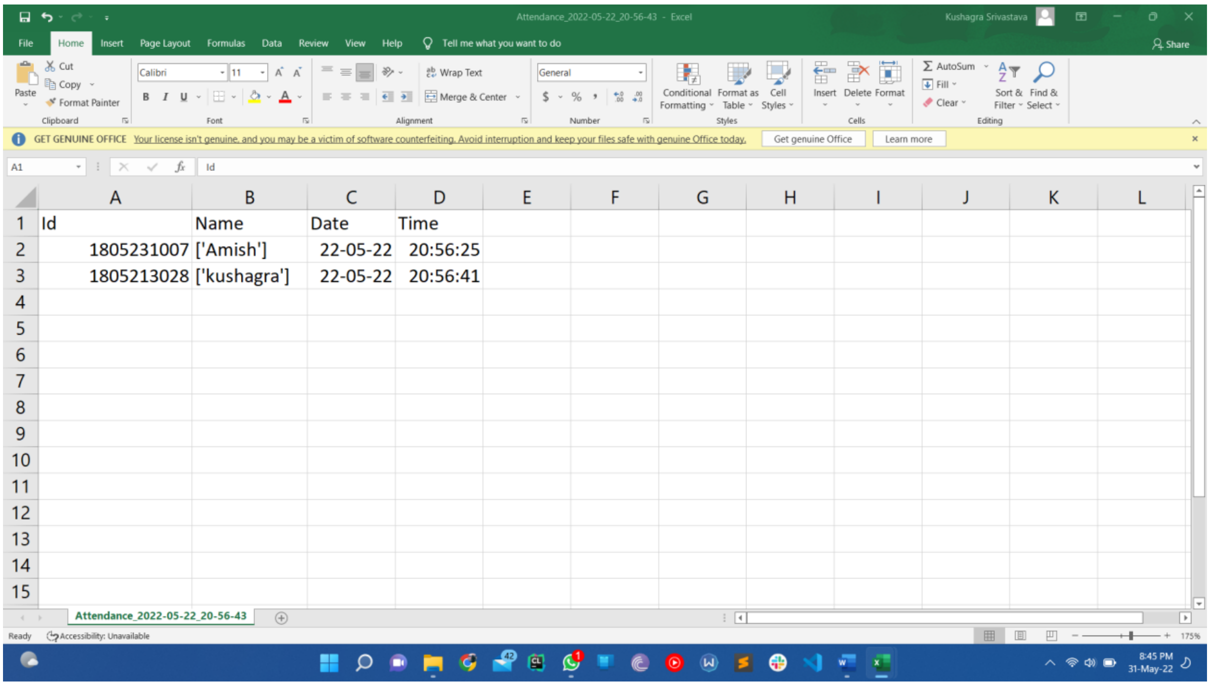

Figure 4.4: Marking Attendance in Excel Sheet

This implementation is used to test the performance of the LBP-method on different kind of face images. Several parameters, like the LBP operator (P and R), non-weighted or weighted regions and the dividing of the regions, are varied to see the influence of these parameters on the performance. For this experiment we have collected lots of face images, some of them are collected from photographs taken with our laptop cameras. And also collected face images from the face database. In the algorithms which we have used, different types of face images have been detected and recognized. Based on algorithm, the face image of an unknown identity is compared with the face of our classroom individuals whose faces have already been stored in our databases in excel sheets.

ADVANTAGES AND DISADVANTAGES

The advantages of a face recognition system include public security, fast processing speed, best result, automation of identification, real-time face recognition in schools, colleges, offices, smartphone unlock, and many more in our day-to-day life.

Few disadvantages in this system include the funding, high-quality cameras are required, poor image quality may create problems while recognizing any face, perfect size of the image is necessary because it becomes difficult to identify the face in small images. Moreover, various facial expressions, face angles can limit this system.

CHAPTER- 5

CONCLUSION AND FUTURE WORKS

Conclusion

In this project it has been done to the performance of a face recognition system by making use of feature extraction with Local Binary Patterns. It mainly consists of three parts, namely face representation, feature extraction and classification. Face representation represents how to model a face and determines the successive algorithms of detection and recognition. The most useful and unique features of the face image are extracted in the feature extraction phase. In the classification the face image is compared with the images from the database. This method represents the local feature of the face and matches it with the most similar face image in database. The accuracy of the system is above 100% by the Local Binary Patterns algorithm.

In this project, we have developed an automated attendance system by face detection and recognition using OpenCV. Face recognition system is currently associated with many top companies and industries making their employees attendance. With the use of python programming and OpenCV, it becomes easy to detect and recognize human faces. This system is used to detect and recognize human faces. The images of a person which we have to recognize will be already stored in databased and trained by using the LBPH algorithm. Moreover, we used the Haar cascade classifier to detect facial features from an image easily. This project contains a detailed discussion about how LBPH and Haar cascade algorithm works in detecting and recognizing any human face.

Future Works and Improvements

It is obvious that the result of this face recognition system is good but there is scope for future improvement. Due to time constraints, we were not able to implement some objectives that should have made the research work a better proposition. The main improvement will pursue the performances, recognizes the real-time face recognition. We would like to improve our code for face image recognition as well as clean up the code in order to improve performance.

Many difficulties have been faced when we recognize face images from database such as pose and lighting variations, expression variations, age variations, and facial occlusions. In future to improve the pose correction, quality-based frame selection, aging correction, and mark based matching techniques can be combined to build a unified system for video-based face recognition.

REFERENCES

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   Proposed a 3D aging modeling technique and show how it can be used to compensate for the age variations to improve the face recognition performance. The aging modeling technique adapts view-invariant 3D face models to the given 2D face aging database. The proposed approach is evaluated on three different databases (i.e., FG-NET, MORPH, and BROWNS) using FaceVACS, a state-of-the-art commercial face recognition engine.

2. T. Chen, Y. Wotao, S. Z. Xiang, D. Comaniciu, and T. S. Huang, “Total variation models for variable lighting face recognition” IEEE Transactions on Pattern Analysis and Machine Intelligence, 2016.

   Proposed a strictly convex functional in which the regular term consists of the total variation term and an adaptive logarithm based convex modification term. We prove the existence and uniqueness of the minimizer for the proposed variational problem. The existence, uniqueness, and long-time behavior of the solution of the associated evolution system is also established. Finally, we present experimental results to illustrate the effectiveness of the model in noise reduction, and a comparison is made in relation to the more classical methods of the traditional total variation (TV), the Perona-Malik (PM), and the more recent D-α-PM method. Additional distinction from the other methods is that the parameters, for manual manipulation, in the proposed algorithm are reduced to basically only one.

3. T. Ahonen, A. Hadid and M. Pietikainen, “Face description with Local Binary Patterns”, Application to Face Recognition. Machine Vision Group, University of Oulu, Finland, 2006.

   This paper provides efficient and robust algorithms for real-time face detection and recognition in complex backgrounds. The algorithms are implemented using a series of signal processing methods including Ada Boost, cascade classifier, Local Binary Pattern (LBP), Haar-like feature, facial image pre-processing and Principal Component Analysis (PCA).

4. T. Ahonen, A. Hadid, M. Pietikainen and T. M Aenpaa. “Face recognition based on the appearance of local regions”, In Proceedings of the 17th International Conference on Pattern Recognition, 2004.

5. T. Ojala, M. Pietikainen and D. Harwood, “A comparative study of texture measures with classification based on feature distributions” Pattern Recognition vol. 29, 2015.

   This paper evaluates the performance both of some texture measures which have been successfully used in various applications and of some new promising approaches proposed recently. For classification a method based on Kullback discrimination of sample and prototype distributions is used. The classification results for single features with one-dimensional feature value distributions and for pairs of complementary features with two-dimensional distributions are presented

6. M. Turk and A. Pentland, “Eigenfaces for recognition”, Cognitive Neuroscience, 3:72{86, 1991.

   Developed a near-real-time computer system that can locate and track a subject's head, and then recognize the person by comparing characteristics of the face to those of known individuals. The computational approach taken in this system is motivated by both physiology and information theory, as well as by the practical requirements of near-real-time performance and accuracy. Our approach treats the face recognition problem as an intrinsically two-dimensional (2-D) recognition problem rather than requiring recovery of three-dimensional geometry, taking advantage of the fact that faces are normally upright and thus may be described by a small set of 2-D characteristic views.

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8. W. Zhao, R. Chellappa, P. J. Phillips, and A. Rosenfeld, “Face recognition: A literature survey” ACM Computing Surveys (CSUR), 35(4):399{458, 2009}.

   This paper provides an up-to-date critical survey of still- and video-based face recognition research. There are two underlying motivations for us to write this survey paper: the first is to provide an up-to-date review of the existing literature, and the second is to offer some insights into the studies of machine recognition of faces. To provide a comprehensive survey, we not only categorize existing recognition techniques but also present detailed descriptions of representative methods within each category. In addition, relevant topics such as psychophysical studies, system evaluation, and issues of illumination and pose variation are covered.

9. S. Z. Li and A. K. Jain (eds.), “Handbook of Face Recognition” Springer-Verlag, Secaucus, NJ, 2005.

10. W. Zhao and R. Chellappa “Robust face recognition using symmetric shape from-shading” Technical Report, Center for Automation Research, University of Maryland, 1999.

11. M. Grudin, “On internal representation in face recognition systems”. Pattern Recognition, 33(7):1161 1177, 2008.