International Journal of Research Publication and Reviews, Vol 3, no 10, pp 2194-2207, October 2022

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Smart Attendance System Using Face Recognition: A Survey

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ABSTRACT

The majority of the time allotted to the professors for teaching is spent by noting down the attendance of the pupils who are present in the classroom. This is viewed as a problem because it deprives teachers of time they could use for teaching and interacting with students, as well as because it causes more chaos and a loss of etiquette in the classroom. The presence of proxy attendance further troubles the existing method of manual attendance management. Many automated attendance management systems are proposed which uses the face detection and recognition techniques. Due to the rapid growth and progress and many improvements of deep learning there were vast number of techniques implemented for the purpose of face recognition. In this paper, we give a thorough review of some approaches widely used, that is the deep learning-based automated attendance algorithms. This work also highlights about the most used databases for experimentation like the LFW, YTF, WIDER FACE etc. We examine different restrictions and even current difficulties in this subject and propose future development directions.

Keywords: *Smart Attendance, Face Recognition, Face detection, Deep Learning, Database.*

1. INTRODUCTION

A vital responsibility for measuring student success over the course of a month or a semester is maintaining attendance in all the organizations. Attendance of students has a big impact on their academic progress, regularity in their studies, and likelihood of being rebellious or acting out. Manual attendance keeping is ineffective for the following reasons: requires numerous lecture hours and is vulnerable to proxies. These strategies do, however, have a number of shortcomings. It is inefficient in terms of overhead, which wastes time in the first place. Second, it might not support the accurate counting of pupils, which could result in attendance fraud, particularly in a big class where one student might just record absent for other students.

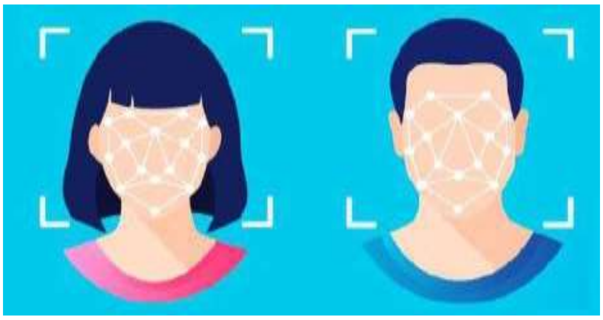


Fig 1. Image Recognition

Automated attendance systems have been anticipated in recent trends in modern businesses by using different identification tactics such as biometric recognitions such as palm vein, fingerprint, and facial recognition to recognize and mark students as present. RFID, barcode, QR code, mobile devices that employ Near Field Communication (NFC), and certain systems created in a portable device like a smartphone were among the other proposed techniques for tracking attendance. Although there is still much to be done in this area, facial recognition technology has made significant strides. In order to overcome the difficulties and constraints of the past, numerous innovative strategies are being proposed. There are both static controllable images and uncontrollable videos in the face recognition systems database. For such systems, this restriction imposes a wide range of technical obstacles in picture processing, analysis, and comprehension. There are many hurdles with facial recognition, such as a vast number of photos and incorrect lighting. To overcome these difficulties, a broad explanation of the challenges might be defined and described, followed by observation. Pre-processing, feature selection, detection, and classification are the four main parts of every face recognition system.

Over the course of their entire lives, people acquire the ability to recognize hundreds of faces, and even after some gap, they are still able to recognize and recall familiar faces. Because this ability and skill are so well suited to people, they are not greatly impacted by the passage of time or other changes in vision brought on by growing, expressions, diversions, and conditions like beards or altered hairstyles and spectacles. Although it is possible to speculate about how humans can infer intelligence or personality traits from a person's face, face recognition is a common task for all people and is an essential and significant part of their ability to perceive the world. Research is still being done on the creation of a system similar to the human perception system. However, it only works well in a limited number of circumstances. Classification concerns, as well as demonstration and representation, must be taken into account in a perfect and improved face recognition method and approach. For many applications, including surveillance equipment, identity authentication, hidden cameras, credit illegal recognition, character identification, people labelling, database inquiry, and ubiquitous computing, face recognition has emerged as a crucial and significant problem. In recent years, a number of algorithms and techniques for facial recognition have been suggested. The focus of these strategies has been on using computers to identify and detect human attributes and characteristics, such as the nose, head outline, eyes, and mouth, as well as to describe the shape and model of a face that use the size, placement, and relationships between these characteristics and features. According to numerous studies, face recognition is highly effective when three dimensional faces are used.

2. Related Work

We learned that face recognition is a two-step process that involves both face detection and face recognition from the literature review we conducted on the topic. When an image is recorded and given for face detection, "Face" and "non-face" portions make up the image area. Numerous research studies have been completed in the streams of face identification and face recognition and some works are still going.

To detect faces, which is regarded as the first stage of the classification process, many CNN-based networks are suggested. The small size of faces was one of the difficulties encountered in the detection of faces. [1] proposes a faster face detection framework which uses diverse scales based on R-CNN to increase the detection accuracy in faces of small size. Cascaded Convolutional Neural Networks are utilized for face detection, and [2] emphasizes that they support and offer a greater range of accuracy when faces are medium in size. In order to detect faces of varied sizes, as indicated in [3], a new architecture using depth-wise convolutions is provided. A variation of single shot face detector which uses Deep Pyramid technique is a revolutionary face detector that works best on medium and small-sized faces, is recommended. It works quickly and can recognize faces with extreme scale changes. A small faces attention detector was proposed as in [18], which introduced a multi-branch face detection architecture that plays a critical role in identifying small faces, addressing the challenge of small face detection.

A double-branch centre face detector in the pure convolutional neural net described in [17] makes the process of detecting faces easier and increases the speed of detection. According to [5], a refined face detector which just scans the given input image in a single turn called RefineFace is suggested to acquire performance at higher rates. More advancements are been done and even there was a focus on the hardware architectures too. Object tracking applications are gaining more importance day by day, [12] presents tracking using a drone-mounted camera recording an object movement. It was constructed using the fundamental Deep SORT algorithm and a hybrid of YOLOv3 and RetinaNet to generate detections in each frame of the recorded video. Haarcascade frontal face alt feature parameter of OpenCV is integrated with a hardware architecture as mentioned in [29] which receives pixel data and stores the frames and process them. Face detection in crowded places, change in poses, variations in brightness, distortions, variations in expressions, blurred part of images and low resolution of images are some challenging tasks. [16] addressed the challenges and proposed a technique called Normalized Pixel Difference (NPD). Detection can be done based on the skin colour; one such approach is described in [28] following a segmentation of the image into a skin-like zone and a non-skin region in the YCgCr color space, the developed face predictor is employed to locate the face in the skin region.

Face detection has a vast number of applications, it is mostly used in video surveillance systems. Face detection which is present in security surveillance based on advanced information retrieval technology is a common practice. [19] stated a video-oriented cascaded sophisticated facial recognition software, that constructs an artificial neural network by combining multiple features, such as edge characteristics, curve attributes, feature points to descriptors, etc. by collecting the images and video stream containing faces, and automatically detects and tracks the faces in image, and then carries out further analysis.

Face recognition comes after detection as the second step in the categorization process. It is among the most crucial actions, where the accuracy and other factors mostly depend on. There were many face recognition techniques proposed improving the limitations of the existing approaches. In the beginning, RFID technology is mostly used for recording the student attendance. An RFID device and an Arduino UNO microcontroller board are used to create the hardware system which is capable of recognizing the distinctive student ID and printing the student's data on the system's LCD panel as stated in [14]. But, later on there were many advancements done on using approaches based on deep learning for facial recognition which uses less resources and provides an efficient means of identification. By combining Wavelet Transforms and Cosine Transforms in a discrete form rather than continuous to extract the features of the student's face and then applying Radial Basis Function (RBF) to classify the facial objects, [6] proposed a method for student attendance system in the classroom using face recognition technique. RFIDs are even integrated with OpenCV for better performance and working which even promises a less hardware cost as mentioned in [24].

The administration of attendance is still hampered by some problems, such as the light intensity issue and the head position issue. [7] introduced a number of techniques like illumination invariant, the Viola and Jones algorithm, and principal component analysis to work better in any lighting circumstances and head orientations. The region of interest concept and machine learning approaches are the foundation of PCA and Eigen face techniques. The fundamental purpose of the Illumination Invariant algorithm, according to [7], is to correctly recognise faces in poor lighting. The Eigen face approach for head orientations allows for a wide range of possible postures. According to [8], which can produce a Deep Facial representation which is a face representation derived from a deep neural network made up of nine layers. This work makes a valuable contribution to the development of an effective Deep Neural Net (DNN) architecture and learning mechanism for the purpose of producing a face representation that generalises well to other datasets. Conv Net -based end-to-end learning for face recognition is established in [9], allowing one to negotiate the difficulties of deep neural network training and face recognition to offer methodologies and procedures to attain comparable standard results.

Face Recognition using OpenCV gained a huge popularity and used in many applications. Automated attendance system using OpenCV which was created with the intention of giving college and university students access to Attendance. Detection of face is done using OpenCV as in [10] that uses Haarcascade features and for face recognition, Local Binary Pattern Histogram (LBPH) is used. To achieve even higher performance than this, the extracted features are again processed. In [23], the existing literature is improvised using Principal Component Analysis (PCA). Haar algorithm is applied on the captured images to detect individual faces. In feature extraction Local Binary Pattern Histogram (LBPH)-based enhanced actual time Identification was made using face recognition. in low and high-level images and Principal Component Analysis (PCA) are used to acquire important features from images.

Video Surveillance also requires face recognition; hence many techniques have been proposed for video processing. As mentioned in [11] face feature extraction is performed by finding a set of linear transformations that minimise the variation within each category and maximise the variance between classes is done using linear discriminant analysis. The word “Smart Classroom” describes the presence of smart attendance system without any human intervention. [13] proposes a method of transforming the RGB formatted image into a YCbCr formatted image to identify specific attributes from the face which uses the Viola & Jones algorithm. Deep Learning contains many algorithms for detection purposes like R-CNN, Fast R-CNN etc. Even though they perform well for faster output YOLO is recommended as referred in [15]. As YOLO is an algorithm mostly used for object detection and recognition as it scans a image in one scan, hence called single shot which is used in many live applications.

Pose invariance is considered as a significant problem for face recognition algorithms. Therefore, pre-processing is carried out in several approaches in order to align the faces. In order to overcome the variability in class and disturbance created by traditional approaches in the alignment procedure, a technique known as Adaptive Pose Alignment (APA) is implemented in [20]. a feature normalisation technique followed by the APA technique to obtain even more distinct face expressions. In [25], a CNN framework that is based on joint face identification and alignment is created. This framework also includes a technique for hard sample mining online to enhance performance. The Face Augmentation Generative Adversarial Network (FA-GAN), a unique hierarchical disentangled representation learning method, is described in [27]. It has two branches: the Geometric Preserving Module (GPM) and the Face Disentanglement Module (FDM). There had been many instances where we needed to apply the clustering technique to identify common people among the faces. In [21], a unified embedding technique is presented that can optimise the embedding itself and relies on training a large neural network to learn a Euclidean embedding for each image. As described in [26], a novel Dual Variational Generation - face framework that uses the Light CNN pre-trained on MS-Celeb-1M as the feature Extractor to generate Heterogeneous Face Recognition (HFR) performance which is enhanced by massive new paired diverse images from noises that has been developed.

3. Challenges in Face Recognition

It is difficult to identify human faces from pictures and videos. Due to the multiple difficulties this system faces, there are numerous ways to complete this work, but none of them can do it accurately to 100% of the time. Challenges are split into Intrinsic and extrinsic variables are factors. External factors, such as light levels and position changes, are those that cause the look of the face to vary, intrinsic factors are those that affect the system directly, such as the physical features of the human face, including emotional expressions, ageing, and so forth. Aiming the disadvantages of traditional manual attendance, the implementation of a system is done**.**

3.1 ILLUMINATION VARIATION:

The face recognition system is significantly impacted by illumination variance, which has drawn the interest of numerous researchers. It gets increasingly challenging to identify one or more people from still or moving pictures. Images taken in a regulated setting with a uniform background make it simple to extract the desired information; but, in an uncontrolled environment, faces must be recognized against a variety of backgrounds. Shadow variation, overexposure, and underexposure are all included. To solve this problem, researchers have been putting forth a lot of effort. [7][21][23]

Fig 2. An effect of illumination

3.2 OCCLUSION:

Occlusion in an image refers to actual or imagined barriers. Part-based methods, feature-based methods, and fractal-based methods are some of the numerous categories into which approaches to face recognition with partial blockage of faces are divided. Partial occlusion has an impact on several aspects of picture processing, including ear recognition that is obscured by earrings. When people fool a system by covering their faces with objects like sunglasses, scarves, or veils, or by holding their hands or phones in front of their faces, this is known as occlusion. Sometimes additional factors, such as shadows created by strong lighting, also serve as occluding factors. Locally, the problem of partially obstructed faces, which divide the faces into several pieces, is addressed. [23]

Fig 3. Partial Occlusion

3.3 POSE INVARIANCE:

Another obstacle to an effective facial recognition system is pose variance. Every time someone is photographed, they adopt a different pose. There is no typical position that is similar. As a result, it is challenging to separate and identify faces in pictures with different positions. The performance of the facing requirement suffers from pose fluctuations. The majority of systems operate in rigid imaging environments. The approaches dealing with posture variation can be classified into two categories, namely multi-view face recognition and face recognition across pose, depending on the type of gallery photos used. A kind of frontal face recognition called multi-view face recognition takes gallery images of each posture into account. On the other hand, while using face recognition, we take into account faces with poses that the algorithm has never seen before. Pose tolerance and the capacity to recognise various positions should be strong aspects of a solid face recognition method. The absence of perceptible subspace posture variation images is one of several unresolved concerns in this regard. To solve this problem, several researchers are engaged.[7][20][21]

Fig 4. Pose Invariance

3.4 FACIAL EXPRESSION:

As it uses expressions to communicate ideas, facial expression is a method of nonverbal communication. However, the face recognition systems become hazy due to expression variance. Numerous face recognition systems have been created, and they all perform well when used with photographs in a controlled setting. Different facial expressions convey a variety of emotions and attitudes as well as alter the geometry of the face, making it challenging for the system to identify a face if there is even a slight alteration in the image. Researchers have worked on face recognition while accounting for facial expression.[15]

Fig 5. Facial Expressions

3.5 AGING:

One of the inherent aspects impacting facial recognition techniques is ageing, which makes the algorithms a mess. Any biological measurement must possess permanence in order to be considered a biometric. The face is made up of bones, muscles, and skin components. Muscle contractions cause the face features to change shape. However, as time goes on, ageing significantly changes a person's facial features, such as their face's texture and contour. The facial recognition technology should be able to meet these criteria. Numerous studies have been conducted with the main goal of addressing this issue. Collecting the data necessary to train the algorithm to handle the ageing component for recognition purposes becomes challenging.[20]

Fig 6. Aging

4. Face Databases

A test of the system is conducted while a face recognition algorithm is being built to determine its recognition rate. A database of faces is needed to test facial recognition software. It is strongly advised to use a common database for testing purposes. There are many standard databases accessible, and the best one should be chosen based on the situation. Here, we cover some of the most well-liked face databases.

4.1 LFW Database:

Face verification, commonly referred to as pair matching, has a public benchmark database called as Labeled Faces in the Wild. A huge database which is a collection of images of faces created with the intention of researching the issue of unrestricted facial recognition. More than 13,000 facial photos gathered from the internet are included in the data collection. Names of the people depicted have been written on each face. 1680 of the individuals depicted had two or more different images included in the database. The size of each of the image is 250 * 250. The fact that these faces were picked up by the Viola-Jones face detector is the only restriction on them. Four sets of photos are provided by LFW, including the original and three varieties of aligned images that can be used to evaluate algorithms in various scenarios. For the purpose of alignment, the dataset uses funneled images (ICCV 2007), LFW-a, and deep funneled images (NIPS 2012). Deep funneled and Most face verification algorithms perform better with LFW-a photos than with filtered or original images. The database shows "typical" diversity in the subjects' postures, illumination, attention, correctness, facial gestures, age, gender, and ethnicity, as well as their accessories, cosmetics, occlusions, backgrounds, and photographic quality. Despite this inconsistency, the database's photos are presented in a straightforward and consistent manner for best usage [8] [20-22].

Fig 7. LFW Database

4.2 YTF Database:

A collection of face videos created with the intention of researching the issue of unrestricted face recognition in videos called the You Tube Face Database. There are 1,595 different people in the 3,425 videos in the data collection. From YouTube, all of the videos were downloaded. Each subject has an average of 2.15 videos available. The shortest visual clip is 48 frames long, the largest is 6,070, and a typical visual clip is 181.3 frames long [8-9] [21].

Fig 8. YTF Database

4.3 WIDER FACE Database:

Images from the freely accessible WIDER dataset were chosen for the WIDER FACE dataset, a benchmark dataset for face detection. We pick 32,203 pictures and classify 393,703 faces that are as seen in the sample images, quite diverse in aspect, placement, and obstruction. Based on 61 event classes, the WIDER FACE dataset is arranged. We choose the data as training, validation, and testing sets in the ratio of 4:1:5 for each event type at random [1-5] [17-18].

Fig 9. WIDER FACE Database

5. Face Detection

Detection of face is the technique of identifying and finding faces in a single image or a collection of photos. Images don't have need to include faces in them, although they sometimes do have intricate backgrounds. Humans can instantly recognize face features and other elements in an image, but computers struggle to do the same. The separation of faces from non-faces is the main goal of face detection [1-3] [16-19]. Some of its uses include surveillance camera systems, telepresence, tracking, face recognition, gender detection, automated cameras, and motion tracking [19]. Face detection serves as a foundation for all of these applications' techniques, particularly face recognition [6–11]. Therefore, the face must first be detected in order to be an input for these systems. Even though all modern photographs are colored, the majority of face recognition methods use grayscale, and only a few methods work with color photographs. And in order to obtain the findings, either window- based or pixel-based techniques are employed by these systems. They can be stated as the main categories of face detection system approaches. The window-based technique is unable to view faces from various angles, while the pixel-based approach struggles to distinguish the face from other skin areas of the human body, such as the hands. Neural Networks [1-3] [17-19] and Adaboost [28] are a few of the most popular face identification methods and approaches among the many ways available.

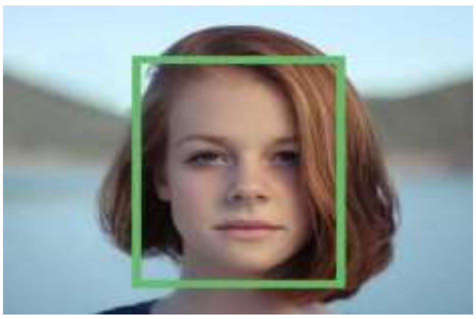


Fig 10. Face Detection

6. Face Recognition

Facial recognition is a technique used to establish or confirm a person's identity using their face. Face-recognition technology allows for the identification of people in both still photos and moving pictures in real time. This section discusses a few of the several methods that are employed to identify faces in photographs.

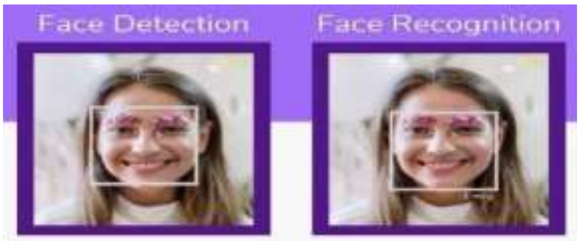


Fig 11. Face Detection Vs Face Recognition

Reference No.	**Year**	**Dataset Used**	**Techniques**	**Accuracy**
[6]	2016	Hand collected dataset of 176 images of 16 students	Discrete Wavelet and Cosine Transforms, Radial basis function neural network	82%
[7]	2015	Hand collected dataset	Illumination invariant, Viola and Jones algorithm, Principal component analysis	-
[8]	2014	Labeled Faces in the Wild (LFW) dataset	Deep Face System (uses Deep Neural Network)	97.35% - LFW
[9]	2020	Customized Dataset	Haarcascade, LBPH (Local Binary Pattern Histogram), KNN (K-Nearest Neighbor)	96%
[11]	2020	Customized Dataset	Basic Face Recognition Algorithm and methods (Geometric feature method, Subspace analysis method, Neural network method, Support Vector Machine (SVM) method)	82%
[13]	2020	Customized Dataset	Haar cascade in the OpenCV library and Convolutional Neural Networks (CNN)	-
[14]	2014	Customized Dataset	Web based development integrated with RFID- Arduino approach	-
[15]	2021	-	YOLO-v3 algorithm	63.40% (mAP)
[16]	2019	IARPA Janus Benchmarks	Deep Pyramid Single Shot Face Detector (DPSSD)	99.50%
[20]	2021	IJB-A, IJB-C, LFW and CPLFW datasets.	Adaptive Pose Alignment (APA)	99.90%

[21]	2014	Labeled Faces in the Wild (LFW) dataset, YouTube Faces (YTF) dataset	FaceNet	LFW – 99.63% YTB – 95.12%
[22]	2016	Labeled Faces in the Wild (LFW) dataset	OpenFace face recognition library	85.70%
[23]	2020	Customized Dataset	Local Binary Pattern (LBP) algorithm along with Contrast Adjustment, Bilateral Filter, Histogram Equalization and Image Blending	95%
[24]	2021	Customized Dataset	RFID and Face Recognition Modules (ArcFace2.0 C# SDK library and OpenCV Sharp library)	99.80%
[25]	2016	FDDB and WIDER FACE datasets	MTCNN (Multi-Task Cascaded Convolutional Neural Network)	-
[26]	2021	IIIT-D Sketch Viewed Database	Dual Variational Generation (DVG-Face) framework	97.21%
[27]	2021	Multi-PIE dataset and the M2FPA dataset	Face Augmentation Generative Adversarial Network (FA-GAN)	99.46%
[38]	2012	Face 95	Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA)	100%

6.1 Radial Basis Function Neural Network (RBFNN):

Radial Basis Function [6] is one of the face recognition methodologies. In the proposed network in [6] all the images are 64*64 pixels. using face recognition technique by combining the wavelet transformation and cosine transformation in its discrete form rather than a continuous form to extract the features of student's face which is followed by applying Radial Basis Function (RBF) for classifying the facial objects [31]. This system is particularly for attendance system which uses people face identification techniques, these are generally used to collect important and useful features through a method called extraction from a person captured during entering into classroom or sitting in his seat in classroom. Therefore, it gives attendance for the student captured face automatically. The following flow is described-

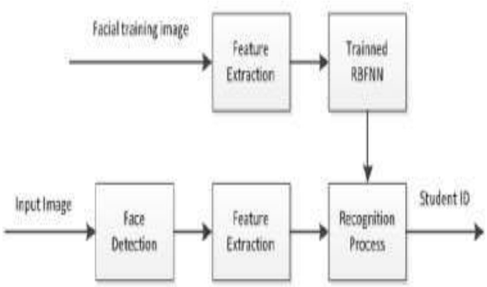


Fig 13. Structure of RBFFN

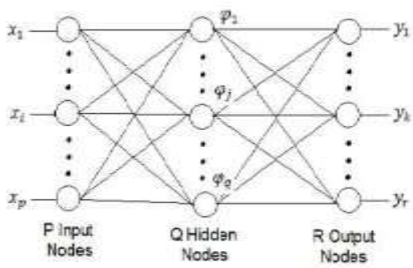


Fig 12. Block Diagram in [6]

DWT is very highly flexible and efficient for the purpose of multi resolution analysis to decompose image into certain values which thereby used as coefficients for the described wavelet functions and scaling functions and De-correlation, resource compactness, range scalability, distinctiveness, and uniformity are a few characteristics of DCT. The main benefit of utilising this is that it is simple to implement and requires less time and resources for computation.

6.2 Eigen Face:

One of the facial recognition techniques is the Eigen face method [7]. Principal Component Analysis or Eigen Vector are other names for this technique. Eigen Vectors are used to assess the variability between many faces. The covariance matrix is used to compute these Eigen Vectors. The features are extracted using PCA, by representing everything in a two- dimensional matrix format. Based on that the covariance matrix is found, this computed matrix helps in the calculation of the eigen values and thereby corresponding eigen vectors. These eigenfaces are computed by measuring the distance between key features of the human faces. These distinguishing characteristics include the corners of the mouth, eyes, and chin.

Fig 14. Eigen Faces

To lessen the impact of illumination, the image must be pre-processed. Face recognition systems that use the eigen face approach normally perform well on photos of the frontal face, but some researchers have also identified faces in other positions [33]. It is also possible to employ a hybrid strategy for face recognition that combines ANN with eigenfaces [34], which can produce effective results. The effectiveness of the face recognition system employing eigenfaces can be changed and greatly modified by using an optimum value that can be basis for a classification for recognising the faces as a threshold value.

Reference	**Year**	**Database**	**Methods**	**Accuracy**
[34]	2010	Olivetti Face Database	PCA, Feed Forward Back Propagation NN	97.018%
[35]	2010	ORL Face Database	Eigen Face	97%
[36]	2010	RICE Face Database	Multiple Eigenface Subspaces	94.8%
[37]	2013	FRAV Face Database	Eigen Face	96%

6.3 Deep Neural Networks:

Face recognition is important in many fields; hence several techniques are employed to complete this task. NN is made up of a few straightforward components that work in parallel. Gender classification and facial emotion classification are other applications for NN. NN are employed because they simplify the problem. The accuracy of the neural network increases as it gains experience and performs well on photographs with different illumination. The neural network's main drawback is the lengthy training period that is necessary.

Neural Network can solve many challenges in the face recognition. One major challenge is the face alignment [8] presents a Deep Face algorithm for aligning the faces in a proper direction using 3D- modeling. By using explicit 3D face modelling to apply a piecewise affine transformation, changing both the alignment stage and the representation step, then a face representation using a deep neural network composed of nine convolutional linked layers is derived. Instead of the conventional convolutional layers, this deep network uses many locally linked layers without weight sharing and more than 120 million parameters. In this network, a 3-channel system is maintained which takes the image inputs of height 152 pixels and width of 152 pixels present in the RGB format. This taken image will be given as an input to the first convolutional layer

– C1 which has the dimensions as 11*11*3 with 32 filters. As 32 filters are used, 32 feature maps will get generated and sent to the max-pooling layer – M2 which uses 3*3 filters and a stride of 2 on each of the channel present. Another convolutional layer – C3 is followed with dimensions 9*9*16 with 16 filters being used. These three layers serve to retrieve poor features, such as straightforward edges and texture. The outcome of convolution networks is more resilient to local translations when max-pooling layers are used. They increase the network's resistance to minor registration mistakes when used with aligned facial images.

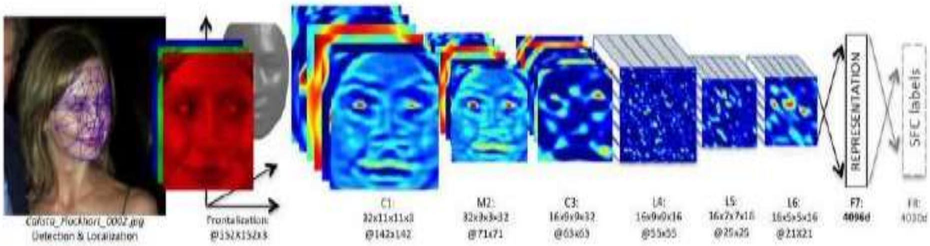
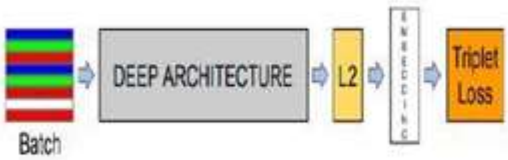


Fig 15. Deep Face architecture

The FaceNet system [21], in this study, in a compact Vector space, where distances are closely associated to a scale of face similarity, the model immediately learns a projection from face pictures. FaceNet embeddings can be leveraged as feature vectors to accomplish work like face recognition, validation, and grouping once this space has been constructed. In contrast to prior deep learning techniques, it directly optimizes the embedding itself using a deep convolutional network, as opposed to using an intermediary bottleneck layer. Utilizing an innovative online triplet mining technique, for training, there have been produced triplets of generally aligned matching and non-matching face patches.



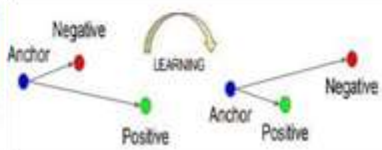
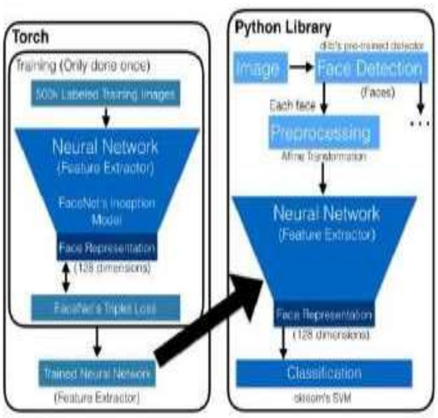


Fig 16. Model Structure [21] Fig 17. Triplet Loss [21]

OpenFace [22] provides low dimensionality representation for faces in an image. A predefined face detector which performs better than OpenCV is used. Pre-processing is done to align the faces into a specific direction for accurate detection and that transformation is named as the affine transformation.



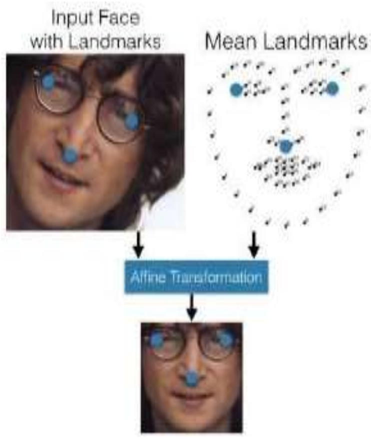


Fig 18. OpenFace work structure [22] Fig 19. Affine Transformation [22]

[25] implements a broad cascaded multi-task framework that incorporates advantage of the natural correlation to improve performance. A lighter weight CNN architecture for joint face identification and alignment is devised using cascaded CNNs.

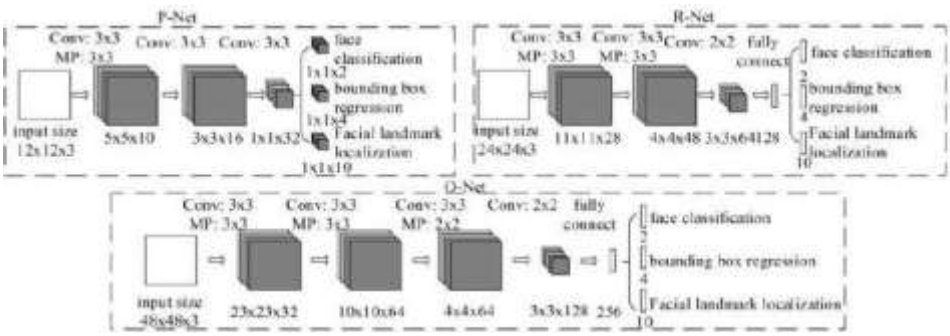


Fig 20. Architecture proposed in [25]

The pipeline consists of a fully conventional network called as the proposal network which uses a network to get windows and calculate the boundary box extrapolation vectors. On boxes with high overlap, non-maximum suppression is used. The obtained objects are passed to a CNN called refine network. It is again fed to a third stage to output the facial landmark positions.

6.4 OpenCV:

The complete work is divided into two phases namely the face detection and the face recognition. Face Detection is carried out Haarcascade and recognition using LBPH (Local Binary Pattern Histogram) [10]. Fourier analysis is extremely similar to Haar-wavelet, which is a series of scaling square-shaped functions. The Haar feature includes a four-rectangle feature in addition to three faces that are edge features that can detect edges and lines pretty successfully. Real images, which are composed of grey scale images with each pixel having a value between 0 and 255, hence, have white pixels and black pixels.

Fig 21. Real time face detection with Haar Features

LBPH - In open computer vision, the LBPH (Local Binary Pattern Histogram) concept is one of the finest for face recognition. The local structure of an image or frame is assembled using LBPH with each pixel's neighboring frames. Its thresholds against other pixels using a certain pixel as its Centre. If the quality of the pixels is higher than that of the neighboring pixels, "1" will be returned; otherwise, "null." We thus obtain local binary numbers or local codes from neighboring pixel combinations. For more efficiency, [23] described an improvised LBPH exploiting the In order to achieve the best quality photos that will reveal greater characteristics of visual features for more precise feature extraction and comparison, consider the following image quality aspects of the source and reference face images: brightness, sharpness, chaos, resolution, dimension, and stance.

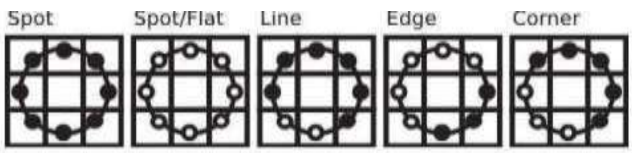
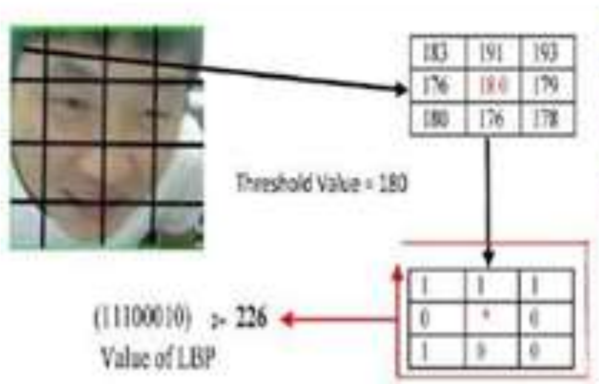


Fig 22. Local Representation for face features [10]



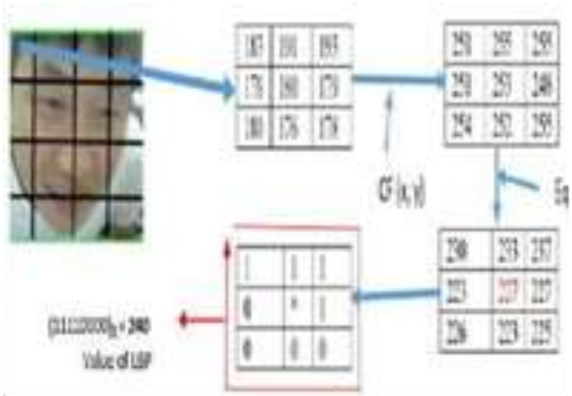


Fig 23. Original LBP Operator [23]

Fig 24. Modified LBP operator [23]

7. Future Scope

Many approaches being proposed, each new proposed model focused on an advancement and improvement of the other. Even though, there were many challenges in this field of face recognition. This led to a scope for many future works.

Small Faces:

It is difficult to detect and classify when the size of the faces is small, since we cannot extract the features from it. Therefore, small faces detection has a future scope and various methods can come into existence [18].

Improving Efficiency:

More attention needs to be paid on the use of various methods to extract the features and recognize various faces. The main aim is to make the complete process a robust one [6].

Intensity of Light:

All the photos taken need not have enough brightness and the light may not be uniform throughout the image. Due to that, faces cannot be detected easily and was inefficient. Hence, to overcome this problem Illumination Invariant algorithm is used [7]. Contrast adjustments are done to improve accuracy so that faces can be identified [13].

Head Pose:

In the input picture taken all the faces need not be aligned and new techniques should be proposed to align faces in a single direction [7]. A technique is proposed in [8] which overcomes the challenges of pose invariance using three dimensional models. [20] states a technique of pose alignment which can overcome this issue.

Computation Time:

Deep learning models usually take more time and resources. There is a future direction to propose models which can use less power [8]. For faster rate processing and execution techniques like YOLO are used as mentioned in [15]. There is a scope for future advancements where models can use faster training techniques as stated in [4].

Hyper tune parameters:

There can be variations employed for better performance making few changes in the existing work and thereby can upgrade its performance [21]. The interdependence between various parameters should be analyzed and the efficiency need to be improved [25]. Trackers which were used for attendance marking should be investigated both online and offline by tuning the initial parameters [12]. [5] shown a way of implementing light weight architectures using auto ML.

Occlusion:

[23] have introduced many image preprocessing techniques but could not address the problem of Occlusion and masked face recognition.

Others:

The proposed application can be even extended to other applications and this can be a future scope [16]. The detection of face usually uses a rectangular box, future extensions can be done on other shapes, so that some other features cannot be missed [3].

8. Conclusion

The construction of a system for an automatic attendance system based on facial recognition is done in an effort to counter the drawbacks of traditional manual attendance. can serve as an access control system by enrolling students with their faces, recognizing them afterwards, and recording attendance. As facial recognition is a topic of ongoing research because of its many advantages, an effort is being made to review it in this survey. Reviewing a significant number of researchers provides an overview of recent developments in the stream of face recognition. Researchers are working hard in this field, and encouraging advancements are being made as a result. However, more work needs to be done to create facial recognition systems that can deliver trustworthy findings in a variety of settings. Some researchers used a specific strategy, whereas others used mixed methods to develop a face recognition system with a 100% detection accuracy.

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