An Overview of Face Recognition System

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ABSTRACT: ***Several methods for identifying a person have been developed, including fingerprints, voice recognition systems, and facial recognition systems, among others. These technologies are being used in a variety of locations, depending on the demands and requirements. Face recognition systems have been increasingly popular in recent years due to their accurate ability to recognise people by recording their faces and comparing them to previously recorded data in databases. This study discusses these facial recognition systems, as well as their previous predecessors and the procedures involved in the process. It has a number of advantages, because of which its adoption and demand have skyrocketed in recent years. It communicates individual identity and may thus be used as a key to security solutions in many businesses. It has a high demand and a bright future since it delivers a variety of benefits and makes a variety of chores simpler.***

KEYWORDS: ***Camera, Face Detection, Face Recognition, System, Security.***

1. INTRODUCTION

The most important organ in the human body is the face. According to studies, even a face can communicate and has a variety of expressions for various emotions. It has a vital role to play in dealing with persons in society. It communicates individual identity and may thus be used as a key to security solutions in many businesses. Face Recognition (FR) is fast gaining popularity as a highly safe and trustworthy security solution. Thousands of businesses and government agencies are paying attention because of its high level of security and dependability[1]. Face detection is usually the first step towards many face-related technologies, such as face recognition or verification. However, face detection itself can have very useful applications. The most successful applications of face detection would probably be photo taking. When you take a photo of your friends, the face detection algorithm built into your digital camera detects where the faces are and adjusts the focus accordingly.

Face detection has attracted significant interest in the literature. In general, it constitutes a difficult problem, especially in cases where the background, head pose, and lighting are varying. Some reported systems use traditional image processing techniques for face detection, such as colour segmentation, edge detection, image thresholding, template matching, or motion information in image sequences, taking advantage of the fact that many local facial sub features contain strong edges and are approximately rigid. However, the most widely used techniques follow a statistical modelling approach of face appearance to obtain a binary classification of image regions into the face and non-face classes. Such regions are typically represented as vectors of gray-scale or colour image pixel intensities over normalized rectangles of a predetermined size, often projected onto lower-dimensional spaces, and are defined over a “pyramid” of possible locations, scales, and orientations in the image.

Many methods have been proposed in the field of the face detection. One of them is based on the matching of facial template images. However, the size and pose of the face are limited because it takes terrible computation cost to consider all sizes and poses of the template image. On the other hand, the methods based on a skin colour can detect any sizes and poses of the face. Because it is difficult to detect the face from a skin colour background, the methods use in addition a head shape information or a hair colour information. Moreover it is necessary to make sure that there is a face actually in the region detected by the methods in order to reject the false detection. To make sure whether there is a face actually or not, the approach to extracting facial features such as pupils, a nostril and a mouth is considered. For the facial features extraction, the method based on the geometric face model is proposed. However, the method assumes the nearly frontal face. To extract the facial features of the face whose pose is unknown, we extract the candidates of the facial features by using the colour, shape information, and then match them to the face models of three directions: front, left and right. If there are the facial features in the face candidate region, we regard it as the face region. Otherwise, we eliminate the region.

Face Recognition Technology in which he explained how recently, the multimedia access society has attracted a great deal of attention towards face recognition system. Through facial recognition technologies fields such as security of the network, indexing and retrieval of material, and video compression have gained lot of advantages as , the focus is on 'people' in many videos. Network access control via facial recognition not only

makes it practically impossible for hackers to acquire their "password", but also enhances the usability of the connection between person and computer[2]. For users such as news reporters, political scientists and moviegoers, indexing and/or retrieving video data based on personal appearance are helpful. In addition, the use of facial recognition enables a more effective coding system for the applications of video and teleconferencing. He has introduced this innovative information processing method in this article. The study demonstrates the readers how the facial recognition system is general and what the face recognizer often meets[3].

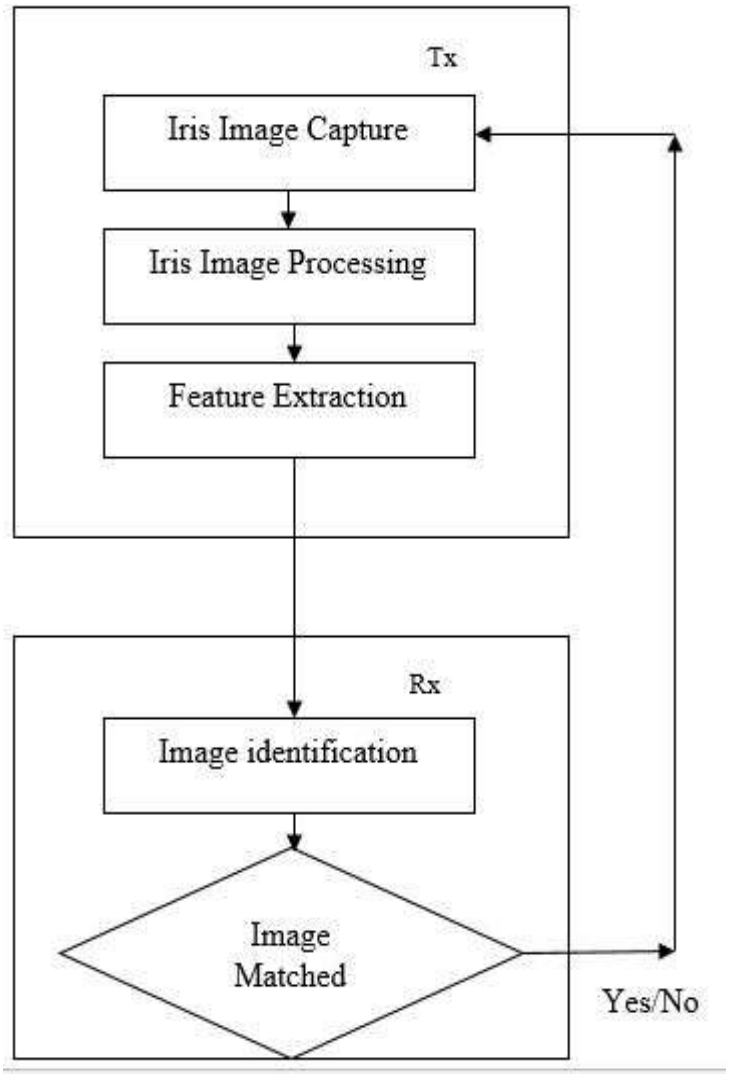

Figure 1: The above diagram is the flowchart of the biometric authentication.

Furthermore, as compared to traditional biometric protections such as palms and fingerprints, the FR system provides significant benefits. It captures biometric measurements of a person from a given distance without engaging with the subject. In criminal dissuasive applications, this approach can help many organisations detect a person with criminal past or other legal issues. This technology is becoming increasingly significant for many residential and commercial constructions[4]. This method is based on human face recognition and a comparison of the different features of a face to previously recorded faces. Figure 1 shows the flowchart of the biometric authentication. There are three methods by which video analytics software can identify real-time face detection within colour images. The software that uses more than one method achieves the greatest accuracy, but the application's purpose is not to identify an individual, but only to recognize that there is a human face to capture. That is the difference between “facial detection” and “facial recognition.” Facial detection software identifies a human face and its location, but the security personnel must identify the target. The first method used by video analytics software detects the human head through an outline analysis. The second uses the colour of skin to first determine that it is a human, then the location of the face.

It is built with user-friendly features and functionalities to incorporate numerous nodal points on the face. One face's nodal points are around 80 to 90. The FR system can assess essential characteristics including eye distance, jaw length, cheekbone shape, and eye depth from these nodal points. These points are calculated by creating a code called a faceprint that represents a person’s face in a computer database[5]. With the advancement of cutting-edge technology, it is now possible to run 2D graphics systems on 3D graphics to

improve the system's accuracy and dependability. Face recognition system in which they explained how Facial recognition is gaining more and more attention as artificial intelligence develops quickly over recent years. Facial recognition offers numerous benefits, including, although limited to non-contact, high competitor and easy to use, compared to standard card recognition, finger print recognition and iris recognition[6]. It has great potential for usage in public, security, e-commerce, retail, education and many other areas. This paper extracted face traits by integrating and comparing various models and then build a deep neural network that forms and builds the combined characteristics. The benefits of several 4 models may therefore be combined to indicate the accuracy of recognition.

Biometrics refers to the science and technology of measuring and analysing biological data. They are quantifiable behavioural and/or physiological features that may be used to verify a person's identity. To authenticate each individual, a single biometric might be utilised. Biometric technologies are increasingly being used in areas such as jail security, secure access, and forensics. People recognise biometric systems by using a variety of biological characteristics such as the face, hand form, iris, retina, and fingerprints. The FR system is a more biometrically varied and natural information process[7]. Real-time implementation of face recognition system in which discussed how the capacity to identify and recognise an individual by his/her faces called face recognition. Face recognition is multidimensional, thus many mathematical calculations are required. Face recognition system is vital and crucial to ensure security, mug shoot matching, law enforcement applications, user verification, user access management, etc. An effective face recognition system is required for all applications[8]. The main research objective was to build face recognition systems with better accuracy and better facial recognition time. Their study proposed to combine two facial recognition approaches by merging the Linear Discriminant Analysis Component (LDA) Principle (PCA) with a hybrid facial reconciliation algorithm. The Jacobi technique for computing PCA and LDA algorithms is used to calculate the Eigenvector. On the Embedded System Raspberry pi 3 board, the Face Recognition system has been built.

The major objectives of this paper are the construction of a deep FR system using fog-computing transfer learning. This method is based on contemporary approaches for the development of deeply convoluted neural systems (DCNN) and machine education. The approaches described may record a person's biometrical measures at a particular distance without engaging with him for criminal dissuasive reasons[9]. This allows numerous companies to identify a person with any type of criminal record or other legal concerns with the methods given.

1.1 Steps in Face Recognition:

Figure 2 represents steps involved in face recognition system. The development of a strong face recognition system includes three fundamental steps: first, is face detection, next is feature extraction, and last is face recognition. The face detection stage is utilised to detect and find the picture of the human face that the system generates. In order to extract vectors for any human face in the first phase, the characteristic removal step is used. Finally, the face identifier comprises the features retrieved from the human face to match it with every template face database in order to determine the identification of the human face[10].

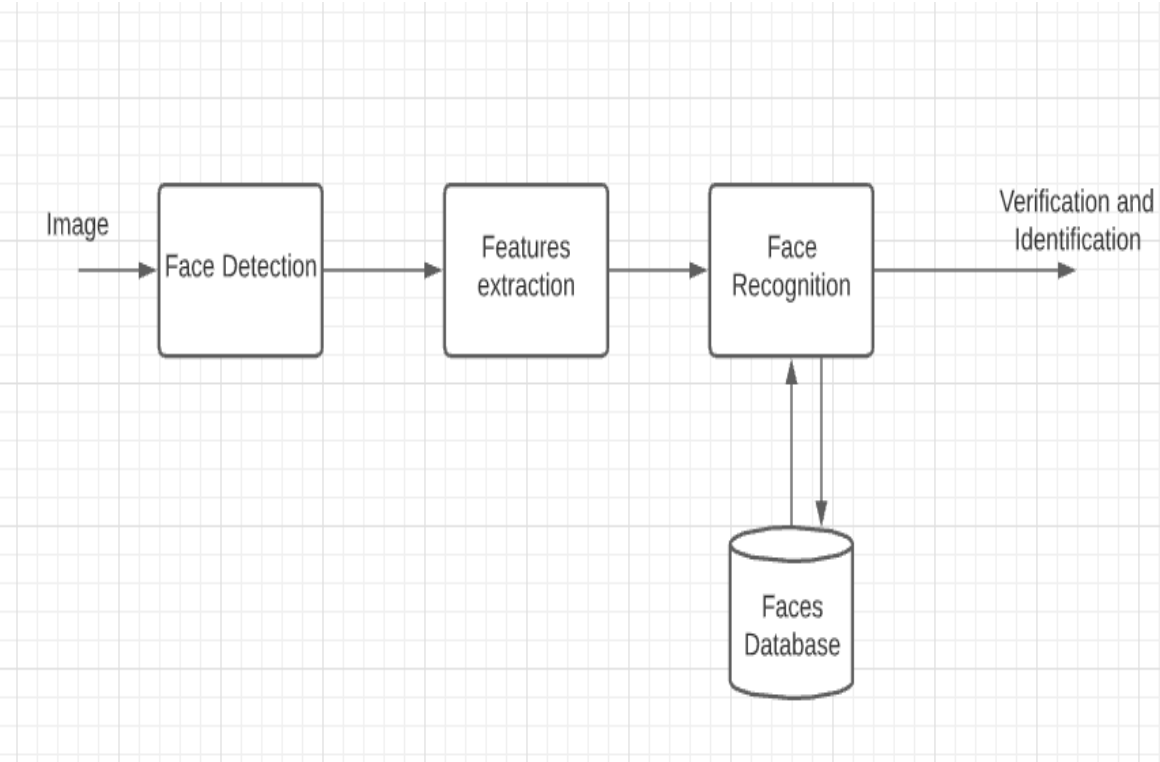

Figure 2: Representation of steps involved in face recognition system.

1.1.1 Face Detection:

The process of facial recognition starts by locating the human faces in a certain image. This phase is intended to assess whether or not the incoming image contains human faces. The lighting and facial expression changes might hinder accurate facial detection. Pre-processing procedures are done to help the design and robustness of another face recognition system. Many approaches are employed in the detection and location of the human face picture, such as Viola–Jones detector.

1.1.2 Feature extraction:

This stage mainly involves extracting the characteristics of the facial pictures that are discovered during detection. This stage depicts a face with a collection of characteristics known as a "signature" with a geometrically significant aspect of the face picture such as mouth, nose, and eyes. The structure, size and form of each face are characteristic that allow it to be recognised. Multiple procedures involve mouth, eye or nose extraction for the size and distance of the face. Scale Invarian Transform Functions (SIFT), Gabor Filter, Locals Phased Quantification, Haar Wavelets, Fourier Transformation and Local Binary Pattern (LBP) techniques for extracting facial characteristics are widely employed.

1.1.3 Face Recognition:

This phase takes the characteristics extracted from the background during the extraction of a feature in a particular database and compares them with known faces. There are two general facial recognition applications: one is termed identification and another is called verification. The test face is compared with a set of faces to identify the most probable match in the identification stage. In order to take a judgement on acceptance or rejection, a test face will be compared to a known face on the database during the identification stage. Correlation filters, CNN (convolutional neural network), and K-nearest neighbours (K-NN) are known to solve this issue successfully.

1.2 Working Procedure:

Figure 3 represents working procedure of face recognition system. As soon as the camera detects the person's image is captured and passed to the face detector, which compares the image with faces, which are already stored in face database. This determines face angle/scale and passes the data to the eye localizer. The eye localizer compares the eyes of the received image with the eyes already stored in the eye database. It passes data related to location of both eyes to facial features extractor, which extract the facial features and passes it to the face recognizer, which compares all the data received from all the detectors with the person's database already stored. Depending upon that if all features are matched it recognizes the person otherwise if any of the features is not matched it rejects it.

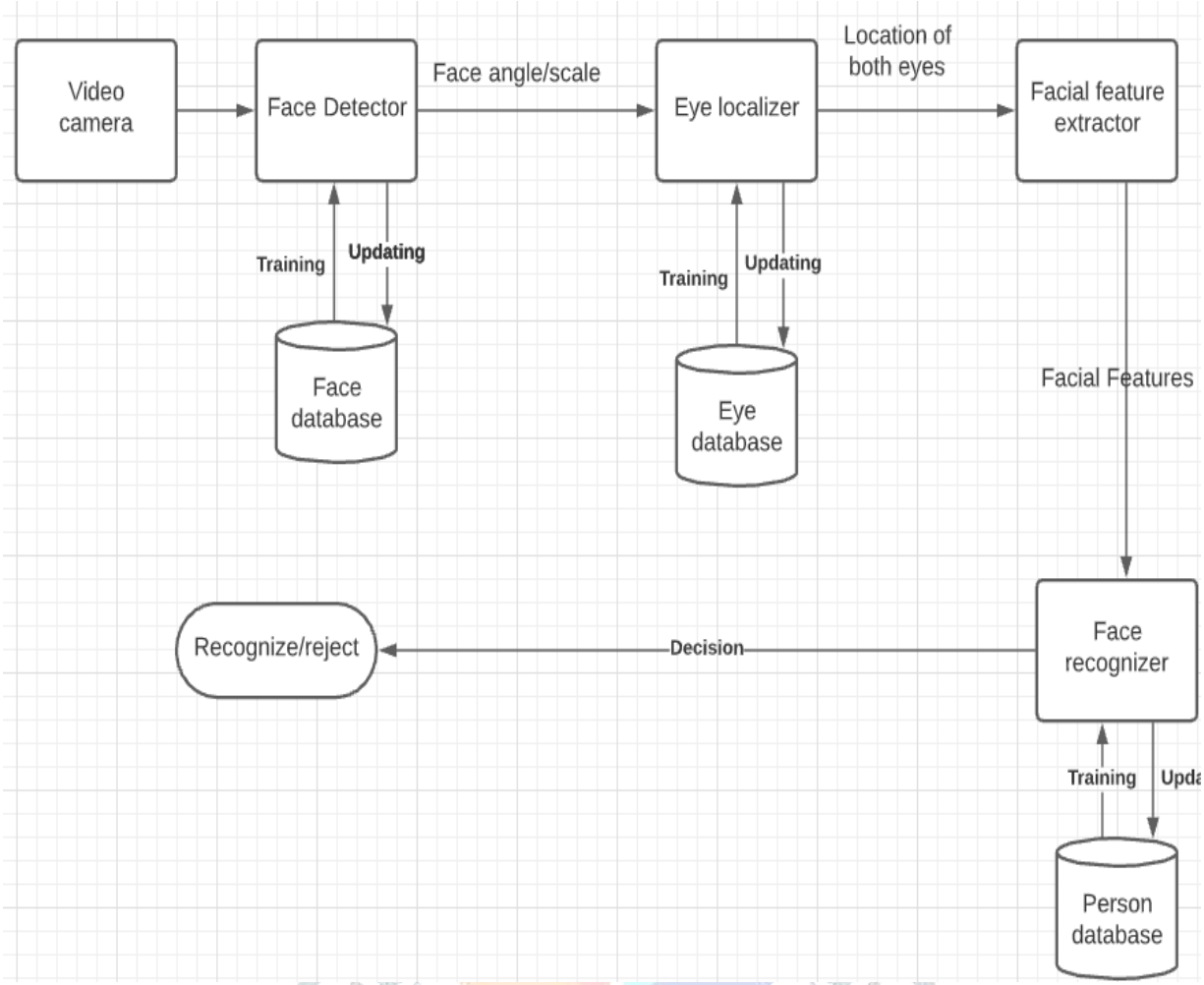

Figure 3: Representation of working procedure of face recognition system.

2. DISCUSSION

Face recognition system has been trending on a very large scale in several countries worldwide because of its capability to very precisely determine a person's face. It is a technique that allows a subject to be identified or verified using an image, video or audio-visual aspect of his face[11]. Generally, the programme, system or service may be accessed by using this identifier. It is a biometric identification approach, which employs body measurements to check a person's identity, face and head, through its data. The system captures a number of unique biometric data about each individual's face to identify, verify and/or authenticate a person. This paper also discusses the same concept of face recognition system along with its working and the processes involved in it.

It collects biometric dimensions of a person from a certain distance without engaging with the individual. This method can assist many organisations identify a person with a criminal record or other legal concerns in criminal dissuasive applications. For many residential structures and business entities, this technology becomes important. This approach is based on a human face recognition and comparison with the previously recorded faces between the different characteristics of a face.

3. CONCLUSION

This paper solely focuses on face recognition system, which has been very popular nowadays because of the several advantages it provides. Face acknowledgement facilitates tracking of burghers, thefts and offenders. It analyses the private and public feed networks of CCTV cameras. The technology is not limited to tracking down criminals. For example, finding lost children and elderly people might potentially be made easier. Face recognition may reduce the intrusion of passenger safety checks at airports. This paper also discusses same technology in detail. It discusses represents steps involved in face recognition system. The development of a strong face recognition system includes three fundamental steps: first, is face detection, next is feature extraction, and last is face recognition. The face detection stage is utilised to detect and find the picture of the human face that the system generates. In order to extract vectors for any human face in the first phase, the

characteristic removal step is used. Finally, the face identifier comprises the features retrieved from the human face to match it with every template face database in order to determine the identification of the human face.

It discusses working of the face detection system. It explains how procedure of face detection system works. As soon as the camera detects the person image is captured and passed to the face detector, which compares the image with faces, which are already stored in face database. This determines face angle/scale and passes the data to the eye localizer. The eye localizer compares the eyes of the received image with the eyes already stored in the eye database. It passes data related to location of both eyes to facial features extractor, which extract the facial feature. Passes it to the face recognizer which compares all the data received from all the detectors with the person's database already stored and depending upon that if all features are matched it recognizes the person otherwise if any of the features is not matched it rejects it. As it provides several benefits and have made several tasks easier, it has high demand and bright future.

REFERENCES

[1] J. B. Wilmer, "Individual Differences in Face Recognition: A Decade of Discovery," *Curr. Dir. Psychol. Sci.*, vol. 26, no. 3, pp. 225–230, 2017, doi: 10.1177/0963721417710693.

[2] J. B. Wilmer *et al.*, "Human face recognition ability is specific and highly heritable," *Proc. Natl. Acad. Sci. U. S. A.*, vol. 107, no. 11, pp. 5238–5241, 2010, doi: 10.1073/pnas.0913053107.

[3] S. Zhou and S. Xiao, "3D face recognition: a survey," *Human-centric Comput. Inf. Sci.*, vol. 8, no. 1, 2018, doi: 10.1186/s13673-018-0157-2.

[4] M. Lal, K. Kumar, R. H. Arain, A. Maitlo, S. A. Ruk, and H. Shaikh, "Study of face recognition techniques: A survey," *Int. J. Adv. Comput. Sci. Appl.*, vol. 9, no. 6, pp. 42–49, 2018, doi: 10.14569/IJACSA.2018.090606.

[5] J. W. Tanaka and D. Simonyi, "The 'parts and wholes' of face recognition: A review of the literature," *Q. J. Exp. Psychol.*, 2016, doi: 10.1080/17470218.2016.1146780.

[6] C. L. Witham, "Automated face recognition of rhesus macaques," *J. Neurosci. Methods*, 2018, doi: 10.1016/j.jneumeth.2017.07.020.

[7] W. Zhao, R. Chellappa, P. J. Phillips, and A. Rosenfeld, "Face recognition: A literature survey," *ACM Computing Surveys*. 2003, doi: 10.1145/954339.954342.

[8] A. W. Young and A. M. Burton, "The Limits of Expertise in Face Recognition: Response to Sunday and Gauthier's 'Face Expertise for Unfamiliar Faces: A Commentary on Young and Burton's "Are We Face Experts?,"'" *J. Expert.*, 2018.

[9] S. Z. Gilani and A. Mian, "Learning from Millions of 3D Scans for Large-scale 3D Face Recognition (This the preprint of the paper published in CVPR 2018)," *Cvpr*, 2018.

[10] S. Chen, D. Yan, and Y. Yan, "Directional Correlation Filter Bank for Robust Head Pose Estimation and Face Recognition," *Math. Probl. Eng.*, 2018, doi: 10.1155/2018/1923063.

[11] K. Raju and Y. Srinivasa Rao, "Real time implementation of face recognition system on Raspberry Pi," *Int. J. Eng. Technol.*, 2018, doi: 10.14419/ijet.v7i2.17.11564.