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A REVIEW PAPER ON FACE RECOGNITION USING DEEP LEARNING

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***Abstract*— A person's greatest distinguishing feature is their face. Everyone, including twins, has a unique face. As a result, facial recognition and ID are likely to be distinct. A framework for facial recognition is utilized as validation when a biometric technique is employed to track down a person's identify. Face recognition has became a widely used approach nowadays in a variety of applications, as well as criminal identifying evidence, the telephone open framework, and, shockingly, home security framework. This system is safer because it only needs a facial image instead of other requirements like a key or card. Face discovery and face ID are the two main stages of the human acknowledgment framework. Deep learning is a way to deal with play out the face acknowledgment and is by all accounts a satisfactory technique to do confront acknowledgment because of its high precision. Its applications are wide, going from policing purchaser applications, and industry proficiency and observing arrangements.**

I. INTRODUCTION

Face discovery and recognition are two instances of face recognition in a whole face acknowledgment framework. In general, the biological features and qualities of the face have basic similarities and individual neighbourhood differences. As a result, it is critical to eliminate the key highlights of the face using the face location technique, as well as separate the countenances from the foundation example and face recognition of the isolated appearances. This is a method of extracting standardised face photographs, followed by difference and identifiable evidence, with the goal of recognising the character of the face from the picture. Face acknowledgment has progressed through the first stage from the 1950s to the 1980s, and it is regarded as a general example acknowledgment challenge. The face geometry determines the standard innovation. The second stage was encountered in the nineties of the past century. In this era of accelerated growth in face recognition, there have been various exemplary strategies, such as Eigen Face, Fisher Face, and flexible guide match where the standard innovation rely on face execution modelling. Face recognition is regarded as one of the most successful image analyzing programs [2]. Face recognition can be performed as (I) Face confirmation, also known as Face verification, in which the face is matched against the layout face pictures whose character is to be checked against, or (ii) Face ID, also known as Face acknowledgment, in which the inquiry face is coordinated with all the face pictures saved in the data set.

A face recognition system is composed of four modules:

i. Face Detection/Tracking (in the case of videos)
ii. Face Alignment
iii. Feature Extraction
iv. A comparison between the test face image and the database face image.

II. DEEP LEARNING

Deep learning, a novel research technique, has generated a great deal of concern in the artificial intelligence community with the emergence of machine learning. [4]. Deep neural networks can be successfully trained using the machine learning technique known as deep learning for complex abstract data modeling. "Deep learning allows the computer to perform human behaviors such as seeing, listening, and thinking, allowing for pattern detection and expediting the [5] evolution of artificial intelligence," the New York Times front page said on December 29, 2012. One of the top ten technological advancements in the world in 2013 according to the MIT Technology Review was deep learning. Due to deep learning's explosive progress during the preceding year, both business and academics have committed to both physical and mental deep learning. Artificial intelligence has been identified as the next strategic priority for numerous large companies, including Google, Facebook, Baidu, Alibaba, and many others. Companies like Google, Facebook, Baidu, Microsoft, Amazon, and others have made deep learning frameworks available. Andrew Ng, a leading expert in deep

learning, joined Baidu, Yann LeCun joined Facebook, Li Feifei, a professor at Stanford University, joined Google, and Alex Smola, a pioneer in machine learning and professor at Carnegie Mellon University, joined Amazon. Baidu organized the "Deep" public opening on May 21, 2015. Open source distributed deep learning platform called Deep.

Applications can be categorized into three groups depending on the structures and technologies that emerged from deep learning, which gave rise to a plethora of machine learning technologies and structures:

A. Model of generation

Generating is the process of refactoring from the input data to the hidden layer. This section mostly introduces the deep belief network. Deep belief networks were presented as a deep learning generative model by Geoffrey Hinton in 2006. The restricted Boltzmann machine is a random neural network-like probabilistic graph model. A number of deep learning models, including self-encoders and deep belief networks, may be built using this random undirected graph model. As a representation of the learning process, the deep belief network may be separated into two stages.; the unsupervised greedy layer-by-layer method is used for pre-training. The second step is adjusted using the wake-sleep algorithm. Estimate the generate weights and bias utilizing high repeat rate identify weights and bias during the waking time .Estimate the identify weights and bias utilising the generate weights and create bias repeatedly during the sleep time.

B. Discriminative model

Discriminative models serve as the protocol that links input data to the hidden layer. Discriminative models are frequently employed to classify the underlying structure of data or to describe the posterior distribution of data. Convolutional neural networks will be a major topic of discussion. An example of a specific feed-forward neural network model is the standard convolution neural network. In the same layer, individual neurons share connection weights, although connections between neighboring neurons are not always connected. Typical layers include the input layer, the convolutional layer (also called the detection layer), the subsampling layer (sometimes called the pooling layer), the fully-connected layer, and the output layer.

C. Mixed model

Deep learning generates a multitude of mixed models by combining the standard model with the variance model, as well as other approaches [8]. What precisely does "mixed" mean? The term "mixed" can be interpreted in two ways:

- Structure Of The Ingredients: The deep-framework that connects the many model components. In this perspective, there are four deep mixed structures:

1) Deep belief network mixed models and the hidden Markov model DBN-HMM are examples of generative +generative mixed models.
2) MLP-SVM [multilayer perceptron + support vector machine] is a discriminative + discriminative mixed model.
3) CNN and recurrent neural network-CNN-RNN mix-up models are examples of discriminative +generative mixed models.
4) Examples of generative + discriminative mixed models are deep convolutional neural networking and conditional random domains. DBN-CRF.

- Face Recognition Based On Deep Learning: An adaptive single-layer network was the first artificial neural network to be utilized for facial recognition.

On the other hand, it cannot increase its resistance to interference variables including feelings, gestures, backdrops, and shelters.. Deep learning addresses this difficulty by assuring both the algorithm's robustness and accuracy. G. Hinton and colleagues train DBNs using the greedy layer-by-layer methodology to enhance the Lower bound of the data's logarithmic likelihood function; this approach may also be used for facial recognition. As the front end of DBNs, Marc Aurelio Ranzato uses the gated Markov random field (MRF) to train a deep generation model of face pictures that can recognize facial expressions and is more durable .Convolution neural networks are used by Osadchy M. for face identification and attitude evaluation. Huang.G. B learns multi-level features using a convolution deep belief network (CDBN). Sun. Y constructs a hierarchical regression structure using a three-layer convolution neural network [10], it suggests a network model that combines a constrained Boltzmann machine with a mixed CNN (ConvNet) (RBM).To extract the face image's Local relevant information, the technique use a deep convolution neural network. Lin M suggests using a deep belief network to solve non-linear difficulties induced by various postures. Brain Cheung suggested using convolution neural networks to train to discriminate between natural and computer-generated facial photos [11]. Chen separates the image into non-overlapping blocks, trains a deep neural network (DNN) on each block, then links the local features of the training to identify in order to address the issue of picture size. By reaching 87 percent recognition using unsupervised feature learning techniques, the Rennes Miller team took the lead in learning face recognition for the LFW (labelled face in the wild) database in 2012. The present deep learning algorithm has a recognition rate of 99.47 percent compared to the classic face recognition approach Eigen face in LFW's identification rate of just 60%. percent, which is higher than the recognition rate of the human retina [12]. Many multinational initiatives, such as Deep Facial, Deep-ID, Face-Net, and others, have effectively utilised deep learning to face recognition in recent years.

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III. LITERATURE REVIEW

Ahmad Alzu'bi at el. (2021) In the study "Masked Face Recognition Using Deep Learning: A Review," which provides insights and a thorough overview of the MFR system development process, new works done for MFR using deep learning techniques are highlighted. The properties of deep network topologies and deep feature extraction techniques are used to introduce cutting-edge approaches. The very often utilised benchmarking datasets and assessment measures in the field of MFR are also reviewed.

Raktim Ranjan Nath at el. (2021) The paper "Face Detection and Recognition Using Machine Learning Algorithm" describes a face detector based on HOG (Histogram of Oriented Gradient), which produces results that are more accurate than those of other machine learning methods like Haar Cascade**.** It also uses CLAHE (Contrast Limited Adaptive Histogram Equalization) for pre-processing instead of HOG, which is a common method for feature extraction. HOG characteristics are derived from both the test and training images. Finally, SVM was used to categorise data (support vector machine). SVM will be used to classify the HOG features. Pre-processing is used to eliminate noise, boost contrast, and even out illumination.

KH Teoh at el. (2020) The paper "Face Recognition and Identification Using Deep Learning Approach" shows how to build and create a face recognition system using deep learning in Python using Open-CV. Deep learning looks to be an effective technology for facial recognition due to its high accuracy.

Pooja G Nair and Sneha R (2020) In the article "A Review: Face Recognition Using Machine Learning," a facial recognition system that can confirm or identify a person based on video or a digital image is discussed. It serves many purposes in security systems. Due to its non-intrusive and contactless qualities, this method is frequently utilized despite having a lower level of biometric technology accuracy than iris and fingerprint recognition. As a retail and marketing tool, it has recently gained in favor. Finding missing people or criminals is another another use for video surveillance. The medical industry is seeing an increase in its use.

S. Meenakshi at el. (2019) the paper "Face Identification Using DNN (Deep Neural Network) across variations in pose and illumination" offers a deep neural network design for face recognition. To detect facial pictures, a convolutional neural network is trained. The created approach is tested on the ORL database using different feature maps to determine the optimum architecture.

Andrew Jason Shepley (2019) the paper "Deep Learning for Face Recognition: A Comprehensive Review" offers a critical evaluation of modern, state-of-the-art methods, together with associated advantages and disadvantages. It includes both in-depth and surface-level solutions, but also topics that need additional research and development. This study intends to promote scientists' and engineers' research into fresh ways and the advancement of present methodology, while also offering end users in business, government, and consumer settings with an informed and analytical viewpoint on already accessible solutions.

Rajeshwar Moghekar and Sachin Ahuja (2019) The study "Face Recognition: Literature Review with Emphasis on Deep Learning" explains some of the strategies researchers have taken to get around problems including postural fluctuation, limited resolution, and occlusion in an open environment. This research also investigates the use of deep DL for facial recognition to achieve classification accuracy on par with that of humans.

Xiao Han and Qingdong Du (2018) The paper "Research on Face Recognition Based on Deep Learning" outlines the research areas for face recognition based on deep learning in the biometrics field, including relevant theories and practice for face recognition technology and DL, together with the sequence of biometric authentication and length learning application to start research.

Othman. I. Hammadi at el. (2018) The publication "Face recognition using deep learning methods a review" provides a review of the literature on current improvements in machine learning research for face recognition, as well as experimental findings on publically accessible datasets. It looked into many aspects such as algorithm complexity and experimental outcomes on benchmark datasets.

Arun Alvappillai and Peter Neal Barrina (2017) A machine learning-based face identification system, namely support vector machines, has been proposed in a study titled "Face Recognition Using Machine Learning" (SVM). The first stage is to recognise faces, which we accomplish using a well-known method known as the Viola-Jones algorithm. The Viola-Jones approach is much desired due to its high detection rate and quick processing time. After recognising the face, feature extraction is performed on it using a histogram of oriented gradients (HOG), which successfully stores the face's edges as well as the directionality of those edges. HOG is a helpful feature extraction approach because to its high efficacy in levelling local contrast. Finally, a multi-class SVM is used to train and classify facial datasets, with each unique face in the database acting as a class.

M. Arsenovic at el. (2017) An original DL-based facial recognition attendance-system is presented in the paper "Face-Time - Deep learning based face recognition attendance system." This model consists of several essential procedures that were developed using state-of-the-art tools including CNN cascade for face recognition and CNN for face embeddings. Applying advanced deep learning algorithms to facial recognition problems was the main goal of this work. Because CNNs work better on bigger datasets, which are not available in production, adapting these approaches to smaller datasets was the key problem. A novel picture enhancement technique for face recognition applications is suggested. A tiny collection of actual facial photographs of employees in a real-time scenario yielded a total accuracy of 95.02 percent.

N. K. Balcoh at el. (2012) the article "Algorithm for Efficient Attendance Management: Face Recognition Based Approach" provides a useful means of automatically recording attendance without requiring human interaction. The attendance is tracked by putting a camera in front of the class-room and photographing the pupils continually, recognising faces in the photographs, comparing the identified faces to a database, and marking the attendance.

Zhaoqing at el. (2010) The paper "Face Images Identification Research Based on Smooth Filter and Support Vector Machine" describes the development of an integrated system for human face recognition, which includes pre-processing, characteristic extraction, classification, and recognition. The processing effects of Gauss flatness, median filter, and neighboring area average are compared, along with pre-processing methods for smooth filters. The Least Square Support Vector Machine is used to recognize human faces in experiments that involve face recognition.

IV. COMPARITIVE ANALYSIS

AUTHORS' NAME	TECHNOLOGY	CONCLUSION
Ahmad Alzu'bi, Firas Albalas, Tawfik AL-Hadhrami, Lojin Bani Younis and Amjad Bashayreh	Deep learning models	This article offered a comprehensive evaluation of recent deep learning-based MFR initiatives. This article looked at the entire MFR pipeline that has been put in place recently, as well as the most recent changes that have helped MFR procedures perform better.
Raktim Ranjan Nath, Kaberi Kakoty, Dibya Jyoti Bora	Histogram of oriented Gradient	CLAHE, HOG features, and an SVM classifier-based face recognition system are introduced in this study. Face recognition algorithms based on HOG features and SVM classifiers are compared to the proposed technique.
KH Teoh, RC Ismail, SZM Naziri, R Hussin, MNM	Deep learning using Open-CV in python	A face identification and recognition system is built

Isa and MSSM Basir		and developed in this work using a deep learning technique. Throughout the development of this facial recognition system, from data training through face recognition using the CNN approach, is described.
Pooja G Nair, Sneha R	Convolutional Neural Network	The emphasis has been on how ML has quickly taken control of the field of AI, where DL and a wide range of algorithms and notions, including Support Vector Machine, Neural Networks, CNN, Ensemble of Classifiers, and Extreme Learning Machine, have been used to exploit the constantly growing potential of facial recognition (E.L.M.).
S. Meenakshi, M. Siva Jothi, D. Murugan	Convolutional Neural Network using ORL database	Three convolutional layers plus a subsampling layer make up a CNN. C1's first convolution layer is used to identify edges in a facial picture. Using the edge characteristics

		created from the convolution of the first layer, the second layer, C2,finds the basic shapes. The third convolution layer extracts higher level characteristics.
ANDREW JASON SHEPLEY	Modern state-of-the-art approaches are critically analyzed and compared, along with the advantages and drawbacks of each.	Additionally, it included a comparison of the existing datasets and associated standards. It emphasised the weaknesses of cutting-edge approaches and assessed solutions intended to overcome these drawbacks, highlighting unresolved problems that still need to be resolved. It also compared the datasets that were already available and the standards that went along with them. It stressed the flaws in cutting-edge methods and evaluated ways to get around them, highlighting issues that remain unresolved and need to be fixed. The non-linearity of deep feature representations

		allows us to deduce that, spite of substantial improvements in accuracy of representations, there really is no proven similar facial feature that is durable enough for face recognition in uncontrolled scenarios.
RAJESHWAR MOGHEKAR, SACHIN AHUJA	An updated review of facial recognition methods is provided in this publication..	It has demonstrated the research that has been done to address ace identification in real world applications is difficult because to problems such location fluctuation, occlusion, as well as low resolution. Since DL achieves outcomes that are comparable to those of humans in picture classification tasks, we now include academicians' discoveries to face recognition using DL.
Xiao Han & Qingdong Du	It concentrates on the face recognition effective and interesting in the biometrics sector based upon depth learning, together including previous literature and	In comparison to other facial recognition methods, deep learning offers a significant benefit. First, essentially no processed raw data can be used to learn low-

	depth learning techniques, face recognition technology, along the depth learning order, and application for face recognition to start research.	level characteristics. Second, the traits may be used to identify complicated interactions. As a result, deep learning may be used to create more accurate models in addition to learning how to obtain more usable data.
Othman. I. Hammadi ,Abdulkarim Dawah Abas , Khaled Hammad Ayed	a review of the current findings in machine learning for facial recognition research, including experimental data from online databases.	In order to provide readers a solid understanding of the successful development of deep learning in the field of face recognition, this article has evaluated the most recent works.
Arun Alvappillai, Peter Neal Barrina	A face recognition system uses support vector machines and machine learning (SVM). It focuses on the face recognition research hotspots in the biometrics field based on depth learning, together With the aid of the pertinent theory, depth learning techniques, face recognition software, and depth learning applications, research can be initiated.	It created a facial recognition system based on a global feature extraction method and a histogram-oriented gradient.
Marko	CNN for face	It is thoroughly

Arsenovic, Srdjan Sladojevic, Andras Anderla, Darko Stefanovic	detection and CNN for creating face embeddings	described how to develop a face recognition component utilising cutting-edge methods and deep learning innovations. It has been noted that high accuracy (95.02 percent overall) may be attained with fewer face photos and the advised enhancement strategy.
Naveed Khan Balcoh, M. Haroon Yousaf, Waqar Ahmad and M. Iram Baig	This study suggests a practical method for automatically recording attendance without human involvement.	This study suggests replacing the outdated manual techniques with a quick and accurate system for tracking attendance in classes. The system may be used in the classroom with minimal hardware requirements. It might be created using a computer and a camera. To speed up the system, some algorithms that can recognise faces via a mask must be used.
Zhaoqing Song; Su Zheng; Zhicheng Li	smooth filter and Support Vector Machine	Human faces are recognised through pre-processing, characteristic extraction, classification, and recognition in an integrated

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		system that has been developed. Pre-processing methods using smooth filters are investigated, and the processing effects of Gauss flatness, median filter, and neighbouring area average are all contrasted.

V. DESIGN METHODOLOGY

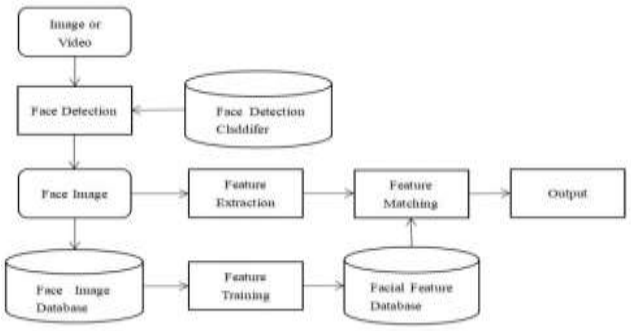

Figure1: Flow chart of face recognition.

VI. CONCLUSION

Fake insights are appearing in our field of view more frequently as science and technology evolve, and facial recognition has also developed into a vital technique for radically altering individuals. For other face recognition techniques, profound learning has a significant advantage over AI. The first thing that can be obtained from raw data with little to no treatment is low-level highlights. Second, the traits may be used to identify complicated communications. Therefore, deep learning can't just figure out how to gather more usable data; it also needs to figure out how to create more accurate models. There are still a lot of problems waiting for us to solve with the continuous improvement pattern, especially since deep learning face recognition will be an improvement pattern. For instance, Inside the case of a convolutional neural network, how to separate a higher request image feature, how to optimize the picture acknowledgment rate and resilience, and in the case of a sub layer in light of face recognition, parameter choices still require additional investigation. are problems that need to be resolved. In order to resolve annoying difficulties, we should condense the material. We should also work on the presentation to advance it.

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