Journal of Analysis and Computation (JAC)
(An International Peer Reviewed Journal), www.ijaconline.com, ISSN 0973-2861
Volume XVIII, Issue II, July-December 2024

FACE RECOGNITION USING NEURAL NETWORK

[1]Brijesh Kumar Singh, [2]Prabal Jain, [3]Pintu Suman, [4]Tanuja

[1] Assistant Professor, Department of Information Technology, JECRC College
[2]B.Tech Student, Department of Information Technology, JECRC College
[3]B.Tech Student, Department of Information Technology, JECRC College
[4]B.Tech Student, Department of Information Technology, JECRC College

prabaljain.it24@jecrc.ac.in
pintusuman@jecrc.ac.in
brijeshkumarsingh.it@jecrc.ac.in

ABSTRACT:

Facial recognition technology has garnered significant attention due to its wide-ranging applications in security, surveillance, and personal identification systems. This paper proposes a novel approach to face recognition utilizing neural networks. Traditional methods of face recognition often rely on feature extraction techniques, such as Eigenfaces or Local Binary Patterns, followed by classification using techniques like Support Vector Machines or k-Nearest Neighbors. However, these methods may struggle with variations in lighting conditions, facial expressions, and occlusions. Overall, our study showcases the potential of neural networks, particularly CNNs, in advancing the field of facial recognition, paving the way for enhanced security systems, personalized user experiences, and improved human-computer interaction.

Keywords- Face Recognition, Convolutional Neural Network (CNN), Image Processing, NeuralNetworks, Classifications.

[1] INTRODUCTION

The human ability to recognize faces is quite remarkable and to infer intelligence or character from facial appearance is suspect. The face is the focus of first attention to recognize a person. We can recognize thousands of faces learned throughout our lifetime and recognize familiar faces at a glance even after years of separation. But this skill is not useful despite if there is a change in the faces due to viewing conditions, expression, aging, and distractions such as glasses, beards or changes in hair style. Face recognition has become an important issue in many applications such as security systems, credit card verification and criminal identification. Although it is clear that people are good at face recognition, it is not at all obvious how faces are encoded or decoded by the human brain. Researchers are working for a long time to develop a computer system which can act as a human being. The system will perform visual sensing like identifying objects such home, office, motor car, faces of people, handwriting and printed words and aural sensing like voices recognition. But the computers can perform repetitive actions like calculating the sum of few hundred digit numbers and poorer at the task of processing the vast quantities of different types of data a vision system requires. Instead of these difficulties the researchers are still working for systems that are artificially intelligent in any general sense that would recognize. Human face recognition by computer system has been studied for more than twenty years. Unfortunately developing a computational model of face recognition is quite difficult, because faces are complex, multi-dimensional visual stimuli. Therefore, face recognition is a very high level computer vision task, in which many early vision techniques can be involved. So, we develop an automatic system to find neutral faces in images for face recognition. A neutral face is a relaxed face without contraction of facial muscles and facial movements. It is the states of a person's face most of the time, i.e. it is the facial appearance without any expression.

[2] BACKGROUND STUDY

Stefan Wiegand, Christian Igel, Uwe Handmann has proposed evolutionary optimization of Neural Network approach for detecting face[1]. This approach has recognized face from video streams which speed up the accuracy. Here they describe the optimization of such a network by a hybrid algorithm combining evolutionary computation and gradient-based learning. In the efficient and hardware-friendly implementation of the face detection neural network within Viisage-FaceFINDER the speed of the classification scales approximately linearly with the number of hidden neurons and not with the number of connections[2]. With every hidden neuron that is saved detection costs are reduced by approximately one percentage point. Hence, the goal of the optimization is to reduce the number of hidden nodes of the detection network under the constraint that the classification error does not increase[3]. He has decided to increase the number of connections as long the number of neurons decreases. Author has initialized his optimization algorithm and compares our results with the expert designed architecture of the reference topology. This network has been implemented to the face detection task and has become a standard reference for neural network based face detection. Evolutionary algorithms are an established method for the optimization of the topology of neural networks. Its basic concept might be used as a canonical evolutionary network optimization method using direct encoding, nested learning, and Lamarckian inheritance. However, there are some special features described in the

Name	Year	Author's Name	Key Findings
One-shot Neural Face Reenactment via Finding Directions in GAN's Latent Space	2024	Stella Bounareli, Christos Tzelepis, Vasileios Argyriou, Ioannis Patras	In this paper, we present our framework for neural face/head reenactment whose goal is to transfer the 3D head orientation and expression of a target face to a source face. Previous methods focus on learning embedding networks for identity and head pose/expression disentanglement which proves to be a rather hard task, degrading the quality of the generated images.
Embedding Non-Distortive Cancelable Face Template Generation	2024	Dmytro Zakharov, Oleksandr Kuznetsov, Emanuele Frontoni, Natalia Kryvinska	Biometric authentication systems are crucial for security, but developing them involves various complexities, including privacy, security, and achieving high accuracy without directly storing pure biometric data in storage. We introduce an innovative image distortion technique that makes facial images unrecognizable to the eye but still identifiable by any custom embedding neural network model.
Privacy-Preserving Face Recognition in Hybrid Frequency-Color Domain	2024	Dong Han, Yong Li, Joachim Denzler	Face recognition technology has been deployed in various real-life applications. The most sophisticated deep learning-based face recognition systems rely on training millions of face images through complex deep neural networks to achieve high accuracy. It is quite common for clients to upload face images to the service provider in order to access the model inference.
Dynamic Behaviour of Connectionist Speech Recognition with Strong Latency Constraints	2024	Giampiero Salvi	This paper describes the use of connectionist techniques in phonetic speech recognition with strong latency constraints. The constraints are imposed by the task of deriving the lip movements of a synthetic face in real time from the speech signal, by feeding the phonetic string into an articulatory synthesiser.
CLAPP: Contrastive Language-Audio Pre-training in Passive Underwater Vessel Classification	2024	Zeyu Li, Jingsheng Gao, Tong Yu, Suncheng Xiang, Jiacheng Ruan	Existing research on audio classification faces challenges in recognizing attributes of passive underwater vessel scenarios and lacks well-annotated datasets due to data privacy concerns. In this study, we introduce CLAPP (Contrastive Language-Audio Pre-training in Passive Underwater Vessel Classification), a novel model.
Spikformer V2: Join the High Accuracy Club on ImageNet with an SNN Ticket	2024	Zhaokun Zhou, Kaiwei Che, Wei Fang, Keyu Tian, Yuesheng Zhu	Spiking Neural Networks (SNNs), known for their biologically plausible architecture, face the challenge of limited performance. The self-attention mechanism, which is the cornerstone of the high-performance Transformer and also a biologically inspired structure, is absent in existing SNNs.
Optimizing Convolutional Neural Network Architecture	2023	Luis Balderas, Miguel Lastra, José M. Benítez	Convolutional Neural Networks (CNN) are widely used to face challenging tasks like speech recognition, natural language processing or computer vision. As CNN architectures get larger and more complex, their computational requirements increase, incurring significant energetic costs and challenging their deployment on resource-restricted devices.

following. He has initialized the parent population with 25 individuals that all represent the reference topology[9]. The number of input corresponds to the pixel of the image pattern which is right and left. No hidden neuron is fully connected to the input but to certain receptive fields then the total number of connections portioned into 4 sets train, Val, test, and extern, each parent creates one child per generation by reproduction[10]. The off springs are changed by elemental variation operators. These are chosen randomly for each offspring from a set of operators and are applied sequentially. The process of choosing and applying an operator is repeated n times where n are an individual realization of a Poisson distributed random number with mean 1. A key concept in evolutionary computation is strategy adaptation, i.e., the automatic adjustment of the search strategy during the optimization process. Not all operators might be necessary at all stages of evolution and questions such as when fine-tuning becomes more important than operating on receptive fields[11]. Hence, the application probabilities of the 8 variation operators are adapted using the method described in, which is based on the heuristic that recent beneficial modifications are likely to be also beneficial in the following generations.

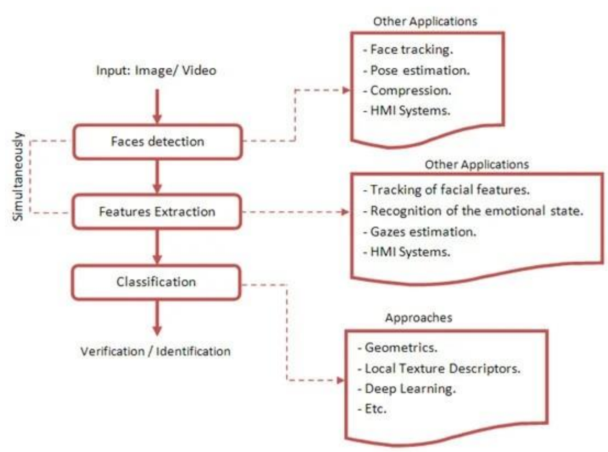

Fig 1: The standard design of face-recognition system.

[3] COMPARATIVE ANALYSIS

A Convolutional Neural Network (CNN) is a type of deep learning algorithm that is particularly well-suited for image recognition and processing tasks. It is made up of multiple layers, including convolutional layers, pooling layers, and fully connected layers.

The convolutional layers are the key component of a CNN, where filters are applied to the input image to extract features such as edges, textures, and shapes[6]. The output of the convolutional layers is then passed through pooling layers, which are used to down-sample the feature maps, reducing the spatial dimensions while retaining the most important information[7]. The output of the pooling layers is then passed through one or more fully connected layers, which are used to make a prediction or classify the image.

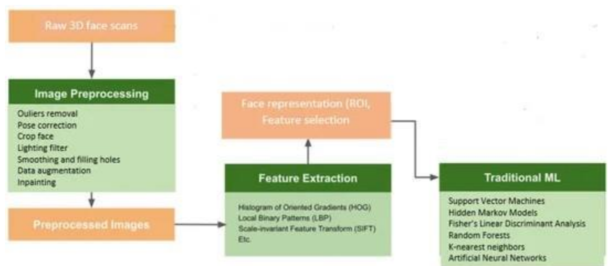

Fig 2: Process of face recognition

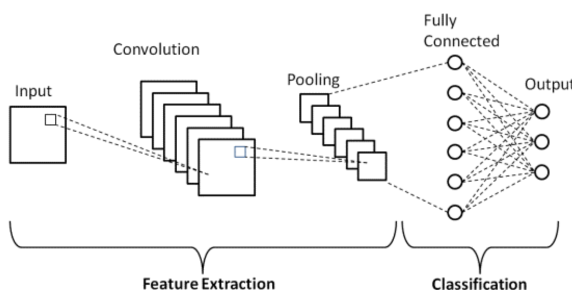

Fig:3 Convolutional neural network

[4] CONCLUSION AND FUTURE SCOPE

There are currently no regulations in the United States expressly covering the biometric data of a person. Facial recognition devices are already being tested or implemented for airport protection, and it is reported that their faceprint has now been produced by more than half the United States populace. Information may be collected and processed by a facial recognition program, and a person does not even recognize it. Then, a hacker might reach the details, and the knowledge of a person would propagate without even realizing it. Government entities or marketers may use this data to monitor individuals too. Worse still, a false positive may include a person for a crime they are not.

Hundreds of companies have embraced face recognition. Integrating and installing is reasonably straightforward, but it has also provided users a feeling of utilizing a system that is more sophisticated and safer than passwords or PINs, thereby increasing user experience[8]. Nonetheless, plenty is often unclear on the road to implementing what many deem the ideal

[1]Brijesh Kumar Singh, [2]Prabal Jain, [3]Pintu Suman, [4]Tanuja

biometric approach, causing several relatively severe blunders along the way.

Facial recognition isn't always ready to coordinate faceprints precisely with the database. Mistakes ordinarily happen because of poor pictures or the absence of data in the database[9]. Poor lighting or low picture quality can make it hard to examine the individual's nodal focuses precisely. The information is affected when the points of the face are clouded. It creates a blunder in the faceprint, making it challenging to coordinate the correct information in the database.

In different cases, the database isn't sufficiently enormous to have a careful counterpart for everybody. Indeed, even the database that the FBI uses, FACE Services, returned 153,636 photographs of obscure individuals between August 2011 and April 2019.

We're now starting to see face-to-face security systems deployed in sectors such as identity protection and banking, but also mainly in combination with other existing solutions such as fingerprint or SMS verification. Yet over the year or two, we'll see big multinational companies adopting increasingly sophisticated face biometrics use state-of-the-art, AI-driven technology to enhance their protection capabilities and better defend customers from identity fraud and data loss. Face authentication with recognition of liveliness would not only have an improved, frictionless user interface, but anybody with a traditional smart app will enjoy unprecedented levels of real-world security[6].

This systematic review provides the new state-of-the-art in facial recognition research in a comprehensive manner. Recent advances in this field are clearly stated and prospects for improvement are proposed.

The outcomes of this review show that a substantial boost in this domain's research occurred over the last five years, particularly with the advent of deep learning approach that has outperformed the most popular computer vision methods. In addition, numerous facial databases (public and private) are available for research and commercial purposes and their main characteristics and evaluation protocols are presented. A focus on the labeled faces in the wild (LFW) database in terms of methodology, architecture, metrics, precision, and protocols was necessary to allow researchers to compare their results to this referential database.

The main lessons learnt from this study are that 2D facial recognition is still open to future technical andmaterial developments for the acquisition of images to be analyzed. On the other hand, the attention of researchers is increasingly attracted by 3D facial recognition[1]. The recent development of 3D sensors reveals a new direction for facial recognition that could overcome the main limitations of 2D technologies, e.g., changes in physical appearance, aging factor, pose, changes in light intensity, and more generally by facial expressions, missing data, cosmetics, and occlusions. The geometric information provided by 3D facial data could significantly improve the accuracy of facial recognition in the presence of adverse acquisition conditions. However, the lack of a 3D facial recognition database hinders the exploitation of methods based on deep learning. Also, interpretation of the 3D facial expression, identification under variations in age, and transfer learning are three open challenges that are still in their beginning and requires further researches[8].

Multimodality (voice, iris, fingerprint, ...), soft facial biometrics, infrared imaging, sketches, and deep learning without neglecting conventional machine learning methods are tracks to be considered in the near future[4].

Naturally, these new developments in facial recognition must meet four objectives: always faster (immediate response seen from the user’s point of view), accuracy close to 100%, optimal security, miniaturized, and portable equipment.

In conclusion, the utilization of neural networks, particularly convolutional neural networks (CNNs), presents a promising approach for enhancing face recognition systems. Through the hierarchical learning of features from raw data, CNNs demonstrate remarkable capabilities in handling variations in facial images caused by factors such as pose, illumination, and occlusions.

REFERENCES

[1] Fujitake, M.. DTrOCR: Decoder-only Transformer for Optical Character Recognitio(2024).
[2] Chowdhury, I. J., Mondal, J. J., ... & Noor, J.. Fog-Resilient Bangla Car Plate Recognition Using Dark Channel Prior and YOLO(2024)

[3] D¨opfer, D., & Lee, Y. J. . Computer Vision on the Edge: Individual Cattle Identification in Real-Time With ReadMyCow System.(2024)

[4] Mishra, A., & Jawahar, C. V. . Semantic Labels-Aware Transformer Model for Searching Over a Large Collection of Lecture-Slides. (2024)

[5] L., & Rosati, R.. Enhancing copy-move forgery detection through a novel CNN architecture and comprehensive dataset analysis(2024)

[6] Khoshgoftaar, T. M.. Low-shot learning and class imbalance: a survey. Journal of Big Data, 11(2024)

[7] Algwil, A. M.. A SURVEY ON CAPTCHA: ORIGIN, APPLICATIONS AND CLASSIFICATION(2023)

[8] Yu-Chung Chang, A CAPTCHA Recognition Algorithm Based on Character Segmentation and Random Forest(2023)

[9] Srivastava, D., Singh, D. et al. Multiview deep learning-based attack to break text-CAPTCHAs. Int. J. Mach. Learn. & Cyber.(2023)

[10] Wang Y, Yang D, Bremond F, et al Latent image animator: Learning to animate images via latent space navigation.(2022)

[11] Chen K, Guo D, et al Face2face ρ: Real-time high-resolution one-shot face reenactment(2022).

[12] Gousseau Y, et al (2022a) A style-based gan encoder for high fidelity reconstruction of images and videos.

[13] Yang H, Zhang T, et al General facial representation learning in a visual-linguistic manner.(2022)

[14] Chai M, He M, et al Cross-domain and disentangled face manipulation with 3d guidance(2021)
[15] Mallya A, Liu MY One-shot free-view neural talking-head synthesis for video conferencing.(2021)