IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

An Advanced Features And Classification Model For Covered Face Recognition

[1]Aashaq Rasool,[2]Dr Gurinder Kaur Sodhi,

[1]Research Scholar,[2]Assistant Professor (Head of Department),
[1]Electronics and Communication Engineering,
[1]Desh Bhagat University, Mandi Gobindgarh, Punjab, India

Abstract: Face recognition (FR) is one of the most extensively adopted biometric approach for identity verification. The applications of face recognition can be seen in various sectors such as, army, business, public security etc. However, there systems were not able to detect the faces accurately when covered with scarf and masks, which degrade their overall performance. In this paper, an effective approach is proposed to detect the occluded faces with different head pose angles. To do so, the images are selected from the available dataset or can be taken in real time through camera. These selected input images are then analyzed carefully to detect the various face points such as eye, nose, mouth etc. Once the faces are detected from the input images they are converted to gray scale and HSV color images, so that their statistical features like mean, standard deviation, variance, skewness and kurtosis can be evaluated. These statistical features obtained from gray scale and HSV colored images are then concatenated together to form a single feature matrix. The feature matrix is then given to the CNN model for training and testing purpose. The performance of the proposed CNN model is simulated in the MATLAB environment in terms of various performance factors such as accuracy, sensitivity, specificity, precision, recall and Fscore. The simulation outcomes obtained proved that the proposed CNN model is effective and accurate in identifying the masked faces.

Index Terms - Face recognition system, Artificial intelligence, machine learning, Conventional neural network, etc.

I. INTRODUCTION

The community views face as a non-intrusive form to identify a person because it contains major discriminative traits. The face, unlike iris and fingerprints, may be collected without the consent or knowledge of the subject and is certainly considered a dominant and eminent personal attribute with enormous practical application potential [1]. Biometric recognition is the process that automatically identifies a person on the basis of their behavioral and biological traits ((ISO/IEC JTC1/ SC37) like face, fingerprints, retina, voice, hand geometry, iris, gait, and fingerprints. A set of traits like name, hometown, social security number, driver's license, financial account number, information about health insurance, etc. are required to identify the personal identity of a person [2]. Fig.1 illustrates distinct types of authentic biometric systems.

Face recognition and fingerprints are used more extensively than any standard biometric technique for human recognition and identification. Although, a biometric system based on fingerprints is considered an old approach as it has been utilized for a long time but the system based on facial recognition had become increasingly common since precious twenty years. The system based on face recognition is replacing standard biometric systems because for identity it is considered a natural declaration and makes human verification more convenient due to its non-intrusive nature [3]. To illustrate, in fingerprints-based system need, a person needs to communicate with the system by placing his or her finger under the fingerprint reader, whereas this system requires an expert to validate the outcome. On the other hand, the face recognition system does not need involvement and can be checked by a non-person.

Face recognition

In recent decades, face recognition had become a major topic for research. Face recognition is useful in a variety of sectors like user authentication, smart home access security, homeland security, criminal identification, and small-scale applications for identifying the user. Face recognition's major goal is to minimize the rate of mis-categorization and to detect face it can be employed in several situations where computation would be rigorous [4]. The system based on facial recognition automatically identifies or verifies a person's identity from an image or video by comparing chosen facial traits from the image stored in the facial database. During image processing image factors like quality, light variations, the person's stance, facial expressions, etc. must be considered [5]. It's commonly utilized in security systems, and it's similar to standard biometrics like eye iris recognition or fingerprint systems.

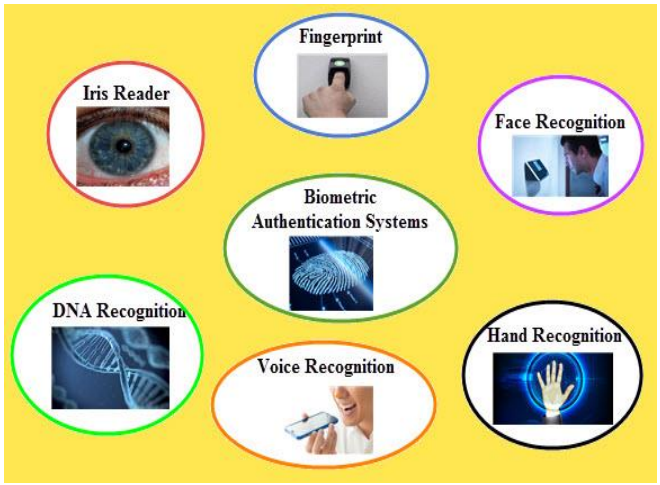

Fig 1. Distinct types of biometric authentication systems

Challenges faced in face recognition

The systems based on face recognition quickly verifies the identity of the person and are secure than standard biometric systems, but the face recognition system faces various challenges that diminish their efficiency like facial expressions, occlusion, head pose, etc. Furthermore, face detection issues arise when face detection systems fail to detect partially obscured faces in various situations, like thieves stealing money from banks with their faces hidden behind a scarf, hospitals, and so on [6]. A lot of techniques were proposed by many researchers in the past to successfully identify individuals accurately which are described in the next section.

II. LITERATURE SURVEY

During past decades various methods were proposed by different experts to detect the occluded faces effectively, some of them are defined here; S. Li et al., (2020) [7], established a HGL method to deal with the head pose classification by adopting color texture analysis of images and line portrait. Lu, Y., et al. (2016) [8], proposes the robust and fast algorithms for head pose classification from labeled head pose database by employing deep neural networks (DNNs).G. Giannakak is, et al. (2018) [9], investigates variations in head pose features in response to specific stressors to cover different stress affects. facial landmarks were detected by using 2D Active Appearance Models (AAM) model. Walaa Mohamed et.al., [10], introduced a new face recognition method based on OpenCV face detection technique. The goal of the propose method is to detect faces that exist in the image and trying to locate each face in a previously prepared database using simple variance calculations and Euclidean distance of extracted facial features. The features under consideration are eyes, nose and mouse. Ashok Kumar et al., [11], presented a new technique for human face recognition by using animage-based approach towards artificial intelligence. To remove redundant data from face images through image compression using the two-dimensional discrete cosine transform (2D-DCT).Vinitha.V1 et al. [12], proposed a hybrid model combining deep and classical machine learning to detect masked faces. The author used computer vision and deep learning to identify individual present in an image or video or a live stream was wearing a face mask or not. M. Z. Khan et al. [13], developed an algorithm of face detection and recognition based on CNN that surpasses the previous developed face detection methods in terms of information latency and real-time response. A. Jourabloo and X. Liu [14], proposed developed a technique called face alignment for large-pose face images by combining 3DMM and efficient cascaded CNN regressor techniques. P. Padeleris et al. [15], suggest a scheme for estimating human head pose based on images captured from depth camera. The outcomes received at the end of the established method performed pretty well in terms of effectiveness and occlusion tolerance.

From the literature survey conducted, it is analyzed that a large number of approaches were introduced by a number of researchers in order to identify them asked faces accurately. However, these methods were susceptible to various problems which degraded their overall performance. Moreover, slight variation in lights or head pose angles, the traditional face detection methods were not able to extract face features from images effectively. In addition to this, the major loophole of conventional techniques was related to security issues i.e. these systems were not able to detect the individuals whose faces were covered with scarf or mask. These problems need to be overcome which can be done by upgrading the traditional feature extraction and classification models.

III. PROPOSED WORK

In order to overcome the shortcomings of the traditional methods, this paper suggested an enhanced feature extraction and selection approach that is based on the CNN model. In addition to this, the proposed CNN model extracts the various statistical features such as;

- Mean
- Standard deviation
- Variance
- Skewness
- Kurtosis

By calculating the statistical features of input images, all the crucial and important features are other than color are extracted from the images. This makes the proposed model more efficient and reliable. The main reason of using the CNN classification model in the proposed work is to reduce the complexity, by processing only those features that are important in determining the faces covered under masks. In this work, the images are selected from the dataset that is available online namely; MAFA.

Dataset used

The MAFA dataset is a collection of 30,811 pictures of masked and non-masked people. The dataset is divided into two section in order to train and test the model. Out of the 30,811 pictures that are present in the dataset, we selected only 23,845 pictures in total and out of these 20,845 pictures, 20,139 images are utilized for training the proposed model and remaining 3,706 images are used for testing the proposed model.The detailed description on working of proposed model is described in this section.

Methodology

In order to detect the faces that are covered under masks effectively, the proposed method goes through a number of steps which are mentioned below;

1. The first and the foremost step in the proposed method is to select the images randomly from the dataset that is available online or capture the face from the real world by using camera.

2. Once the images are selected from the available dataset, the next step is to extract the features from these input images. To do so, the proposed model reads the original images carefully to determine different points in face which include masked region, face feature, eye, nose and mouth landmarks etc.

3. After the face detected image is obtained, the next step followed is to convert the selected input RGB image into Gray scale and HSV image to extract their statistical features.The statistical features that needs to be extracted include; mean, standard variation, variance, skewness and kurtosis.The reason for converting the original RBG images into the grey scale and HSV images is because HSV has better color spacing than RBG which makes the features extraction process much easier and ultimately reduces the complexity of the proposed CNN system.

4. The statistical features extracted from the gray scale and HSV images are then combined in a single matrix. This features matrix is then passed to the CNN for training purpose. The CNN model is initialized with specific parameters which are given in table 1

Table 1: Specific Parameter Values

Parameter Name	Parameter Value
Max Epochs	30
Learning Rate	0.001
Mini Batch Size	32
Learning drop factor	0.1
Learning drop period	20

5. Finally, the proposed CNN model is tested and the results are obtained. The results obtained are then compared to the traditional models to evaluate the efficiency of the proposed model. The performance of the proposed CNN model is given in detail in the next section.

IV. RESULTS AND DISCUSSIONS

The performance of the proposed CNN model is tested and analyzed in the MATLAB simulation software. Moreover, the performance of the proposed CNN model is compared with the conventional RGB and HGL models in terms of various parameters such as; accuracy, sensitivity, specificity, precision, recall and Fscore.

Performance Evaluation

The performance of the proposed CNN model is evaluated and compared with the conventional RGB and HGL models in terms of accuracy. The accuracy graph obtained is shown in Fig. 2.

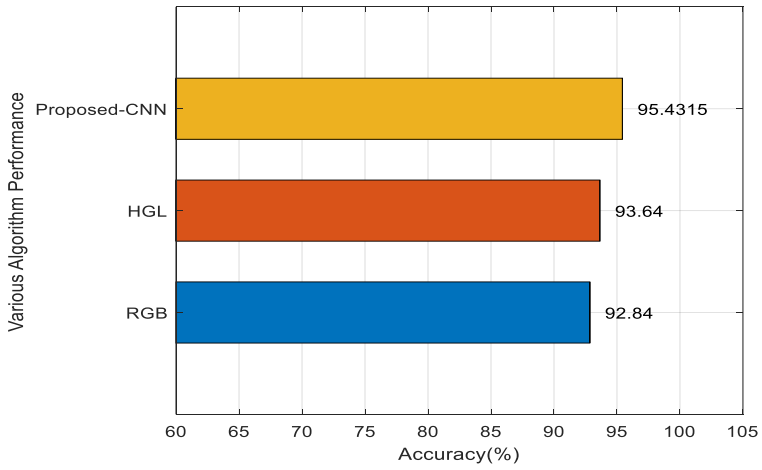

Fig 2. Graph for Accuracy comparison in proposed system

Fig. 2, represents the performance of the proposed CNN model and conventional RGB and HGL model in terms of the accuracy. From the graph, it is observed that the rate of accuracy attained in the proposed CNN model is equal to 95.43%. while as the rate of accuracy attained in the traditional RGB and HGL model came out to be 92.84% and 93.64% respectively. The results

clearly show that the proposed CNN model is more accurate and efficient in detecting the masked faces. The exact values attained by the traditional RGB and HGL and proposed CNN model is given in table 2.

Table 2: Specific values for different algorithms

Technique Name	Parameter Value
RGB	92.8400
HGL	93.6400
Proposed-CNN	95.4315

The performance of the proposed CNN model is analyzed in terms of various dependency factors, which include accuracy, sensitivity, specificity, precision, recall and Fscore, and is shown in Fig 3.

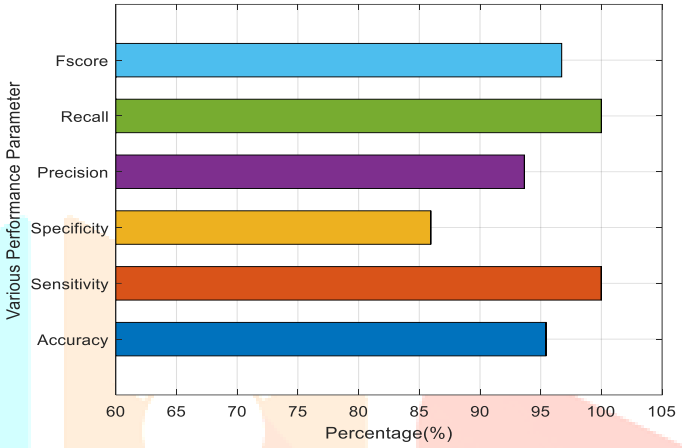

Fig 3. Different performance parameters

Fig 3, demonstrates the performance of the proposed CNN model in terms of various performance parameters. From the graph, it is observed that the value of accuracy achieved is 95.43%. Also, the value of sensitivity and specificity in the proposed CNN model came out to be 100% and 85.93% respectively. In addition to this, the value of precision, recall and Fscore were obtained which came out to be 93.66%, 100% and 96.72% respectively. The exact value of these parameters is given in table 3.

From the graphs and tables, it is observed that the proposed CNN model outperforms the traditional RGB and HGL model in all factors, thus making it the effective and reliable model for detecting occluded faces accurately.

Table 3: Specific parameter values

Parameters	Value
Accuracy	95.4315
Sensitivity	100.0000
Specificity	85.9375
Precision	93.6620
Recall	100.0000
Fscore	96.7273

V. CONCLUSION

The proposed CNN model acts as an effective solution to overcome the various security related issues like detecting occluded faces. The performance of the proposed CNN model is analyzed and compared with traditional RGB and HGL models in the MATLAB simulation software. The results were obtained in terms of various performance dependency factors, these are; accuracy, precision, sensitivity, specificity, recall and Fscore. The simulation outcomes obtained in the conventional RGB and HGL approaches in terms of accuracy came out to be 92.8400% and 93.6400% respectively. On the other hand, when the rate of accuracy for proposed CNN model is evaluated, it came out to be 95.4315%. This increased accuracy rate makes our model efficient and effective. In addition to this, the value of sensitivity, specificity, precision, recall and Fscore is determined for the proposed CNN model whose values are 100%, 85.9375%, 93.6620%, 100% and 96.7273% respectively. These results prove that the proposed CNN model is more efficient, reliable and accurate in determining the occluded faces with different head pose angles.

REFERENCES

[1]Arachchilage, S. W., &Izquierdo, E. (2019). A Framework for Real-Time Face-Recognition. 2019 IEEE Visual Communications and Image Processing (VCIP).

[2] D. Bhattacharyya, R. Ranjan, P. Das, T. Kim and S. K. Bandyopadhyay, "Biometric Authentication Techniques and its Future Possibilities," 2009 Second International Conference on Computer and Electrical Engineering, 2009, pp. 652-655,

[3] Tsalakanidou F., Malassiotis S., Strintzis M.G. (2008) Face Recognition. In: Furht B. (eds) Encyclopedia of Multimedia. Springer, Boston, MA, pp. 239-244

[4] Sharmila, Sharma, R., Kumar, D., Puranik, V., & Gautham, K. (2019). Performance Analysis of Human Face Recognition Techniques. 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU).

[5] Subban R., Mankame D.P. (2014) Human Face Recognition Biometric Techniques: Analysis and Review. In: Thampi S., Abraham A., Pal S., Rodriguez J. (eds) Recent Advances in Intelligent Informatics. Advances in Intelligent Systems and Computing, vol 235, pp. 455-463 Springer, Cham

[6] Alafif, T., Hailat, Z., Aslan, M., & Chen, X. (2017). On Detecting Partially Occluded Faces with Pose Variations. 2017 14th International Symposium on Pervasive Systems, Algorithms and Networks & 2017 11th International Conference on Frontier of Computer Science and Technology & 2017 Third International Symposium of Creative Computing (ISPAN-FCST-ISCC).

[7] S. Li et al., "Multi-angle Head Pose Classification when Wearing the Mask for Face Recognition under the COVID-19 Coronavirus Epidemic," 2020 International Conference on High Performance Big Data and Intelligent Systems (HPBD&IS), Shenzhen, China, 2020, pp. 1-5

[8] Lu, Y., Yi, S., Hou, N., Zhu, J., & Ma, T. (2016). Deep neural networks for head pose classification. 2016 12th World Congress on Intelligent Control and Automation (WCICA).

[9] G. Giannakakis, D. Manousos, V. Chaniotakis and M. Tsiknakis, "Evaluation of head pose features for stress detection and classification," 2018 IEEE EMBS International Conference on Biomedical & Health Informatics (BHI), Las Vegas, NV, 2018, pp. 406-409.

[10] Walaa Mohamed Et Al, “A New Method for Face Recognition Using Variance Estimation and Feature Extraction”, IJETTCS, Vol. 2, No. 2, Pp. 134-141, April 2013.

[11] Ashok Kumar et al, “A MATLAB based Face Recognition System using Image Processing and Neural Networks”, IJARCSSE, Vol. 6, No. 4, Pp. 871-875, April 2016.

[12] Vinitha.V1, Velantina.V2, “COVID-19 facemask detection with deep learning and computer vision”, International Research Journal of Engineering and Technology (IRJET), vol.07, ISSN. 08, pp. 3127-3132, 2020.

[13] M. Z. Khan, S. Harous, S. U. Hassan, M. U. Ghani Khan, R. Iqbal and S. Mumtaz, "Deep Unified Model For Face Recognition Based on Convolution Neural Network and Edge Computing," in IEEE Access, vol. 7, pp. 72622-72633, 2019.

[14] A. Jourabloo and X. Liu, "Large-Pose Face Alignment via CNN-Based Dense 3D Model Fitting," 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 4188-4196,2016.

[15] P. Padeleris, X. Zabulis and A. A. Argyros, "Head pose estimation on depth data based on Particle Swarm Optimization," 2012 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, Providence, pp. 42-49, 2012.