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Recognizing Individual Faces of Variable Sizes using a Face Recognition Algorithm

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ABSTRACT

Face recognition that uses a person's face to identify or verify their identification is called face recognition. It functions by recognizing and quantifying face features in a picture. Technologies that use facial recognition can identify faces in photos or videos, identify if two faces are of the same person, or look for a particular face in a vast library of previously taken photos. When users enroll or log in, biometric security systems use facial recognition technology to uniquely identify each person. The objective of study is to detect and identify face in coloured images (single or multiple faces) of human. A statistical algorithm based on skin color information, together with the facial features representing holes such as the eye or mouth, was applied. The study involved, among other things, the influence of the type of colored pictures employed in the test was examines, as human images from different races were used. The results confirmed this technology's success in identifying each person's individual face within the group.

Keywords: Face Recognition, Face matching, Image Processing, Correlation Coefficient.

1- INTRODUCTION

face recognition has become one of the leading topics of research in the area of computer vision ,the human-computer interaction applications, With its implementation into security, surveillance, biometric authentication, and human-computer interaction applications,. Despite considerable progress made in recent years, identifying unique faces at varying scales continues to be a challenge [1]. Faces in real-world images or video frames are usually captured at different resolutions due to distance from the camera, different focal lengths at the time of capturing an image or video frame, and environmental conditions. These scale variations may deteriorate the performance of classical face recognition methods since they are most often designed for faces of a fixed or limited size range [2]. This task requires recognizing individual faces across varying scales, making face recognition systems significantly sensitive to any differences in distance, resolution, and quality of the images. This research contributes to the field of this paper in multiple ways: by introducing a face recognition algorithm that can recognize faces of varying sizes up to the knowledge of researchers and Contributing to real-world scenarios by providing an arbitrary scalable solution such as biometrics and surveillance systems where the sizes of faces vary significantly.

2- RELATED WORK

Face recognition has been one of the most widely studied problems in computer vision for decades, and rapid progress has been facilitated by deep learning methods. There was the early approach, for example, some job by Zeina Muhammad [3] a two Algorithms model, also R. A. Abtan [4], but this job integrated a method of two algorithms, CNN and Yolo V 5, to capture face feature and compute correlation confection. Although those methods were computation-efficient, they was very sensitive to variations in illumination, pose and scale. The rise of deep learning (the so-called CNN revolution) has transformed the picture, allowing the automatic extraction of highly discriminative features from raw images. Early research such as Deep Face [5] and FaceNet [6] showed that strengthening the power of deep learning could achieve human-level accuracy in face recognition tasks.

However, face recognition over scale is still a challenging problem. In contrast, traditional face recognition systems have the assumption that images to be processed in a fixed size which is hard to achieve in real-world scenarios. To tackle this, researchers have proposed different approaches to perform scale-invariant feature extraction. A common technique to resolve this issue is the image pyramid, which involves resizing input images to multiple scales and extracting features from each [7]. Although rather robust, this strategy might be costly compared to the need the operate over more scale.

A separate line of work attempts to introduce some kind of scale invariance as a part of the feature extraction process itself. One of the most well-known approaches is Spatial Pyramid Pooling (SPP) [8] and its variants, which enable CNNs to process input images of arbitrary sizes by pooling features at different spatial levels. This motivates the development of techniques such as Feature Pyramid Networks [9] to capture the multi-resolution features hierarchically and detect objects (including faces) of different sizes. While these methods have demonstrated potential for use in object detection tasks, their adoption for face recognition tasks has been limited.

Further investigations have focused on incorporating attention mechanisms and making the features used adaptive for better scale-invariancy. squeeze-and-excitation (SE) networks [10] and deformable convolutions [11] ,which use channel-wise attention to enhance feature representation, which enable the network to flexibly adjust the receptive field according to the input, are examples of such architectures. They have shown superior performance in several tasks where robustness to scale changes is crucial but are not yet fully adopted in face recognition methods.

3- FACE RECOGNITION

The image of the face is then examined by the facial recognition system. It recognizes facial emotions and maps the form of the face. It recognizes the essential facial characteristics that set one face apart from another. Generally, face recognition software searches for [3]:

The depth of the eye socket;

• The form of the cheekbones.

• The lips, ears, and chin contours.

• The distance between the eyes.

• The distance between the forehead and chin.

• The distance between the mouth and nose.

The algorithm now transforms the facial recognition data into a face print, which is a set of dots or numbers . Each person has a unique facial print, similar to a fingerprint, just as each person's skin microstructure is unique. It is also possible to reverse such a facial recognition system in order to digitally rebuild the user's facial information [7,11].

Face recognition is a technique for identifying or verifying a person from a digital image or a video frame from a video source. Facial recognition systems can identify people in photographs, videos and in real time. Facial recognition falls under the category of biometric security. Additional types of biometric technology include voice recognition, fingerprint recognition, and retinal or iris recognition[5]. The most common ICT surveillance application today focuses on security and law enforcement, but other use cases are gaining momentum[12,13]. Facial detection since 2000 has been a growing topic, and a lot of algorithms and methods came with that, with the most famous ones being.

- Currently, Convolutional Neural Networks (CNNs): CNN is the most used neural network that is well known for numerical data, especially in image recognition.
- An algorithm that uses support data from previously trained data, Support Vector Machines (SVMs) is used mainly in image classification.
- Random Forests (RF): a primary algorithm, that mostly relies on random trees, which allows utilization of several trees to classify images.

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- Deep Belief Networks (DBNs) is an image recognition algorithm based on deep neural networks from which information is extracted about images.
- KNN- K-Nearest Neighbor (KNN) is an algorithm based on calculating nearby pixel values, this algorithm is mainly used for image recognition.

Face recognition development steps are as follow:-

1- Detection: The picture can be acquired by scanning an existing photograph digitally (2D) or by capturing a live image of the subject .

2- Alignment: The position, size, and shape of the head are determined after the face has been identified. The head must be pointing at least 35 degrees in the direction of the camera in order to be in 2D mode.

3- Measurement: To determine the model, the second stage in an endeavor is to measure every contour of the face on a scale smaller than a millimeter.

4. Encoding or representation: The encoder converts the template into a distinct code. In this manner, each template will be stored in a collection of integers that correspond to the characteristics of the subject's face throughout algorithm training.

5. Matching: If the image is 3D and the database has 3D images, the image is matched without any modifications. However, databases that are still in 2D images are currently encountering a problem. It offers a dynamic, moving topic that is contrasted with a still, flat image. This problem is solved with new technologies. There are various points—typically three—when capturing a 3D image.

They are recognized. For instance, the nose tip, the inside of the eye, and the exterior of the eye are all measured. The image will be transformed into a 2D image by applying an algorithm (a methodical process) after these measurements are taken. Following conversion, the program will look for possible matches by comparing the image with 2D images stored in the database.

6- Verification or Identification: In verification, an image is compared to a single image in the database, as illustrated in Figure (1:1). If identification is the aim, a captured image of a subject may be compared to a database image of the image, after which the image is compared to every image in the database, yielding a result for each match.

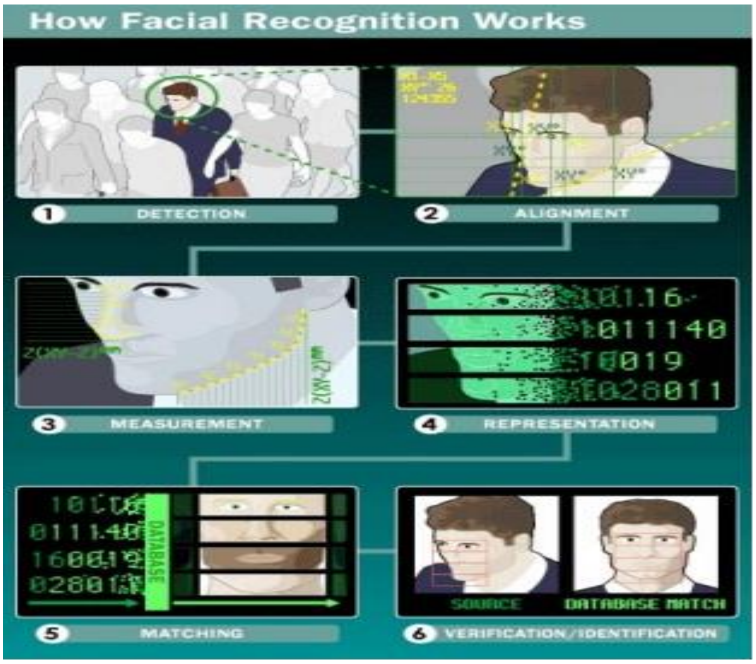

Fig-1- The image is compared to all images in the database

The ability to recognize faces across variable scales is crucial for the practical deployment of face recognition systems. For instance, in surveillance applications, faces may appear small in wide-angle shots or large in close-up

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views. Similarly, in mobile or wearable devices, the distance between the user and the camera can vary significantly, leading to inconsistent face sizes. Existing methods often rely on resizing or cropping input images, which can result in the loss of critical facial features or the introduction of artifacts, ultimately reducing recognition accuracy[5].

4- CORRELATION COEFFICIENT

The correlation coefficient, which ranges from -1 to 1, quantifies how similar or near two photographs are to one another. The two photos are extremely similar, as indicated by the value near (1). provides the correlation between two pixels [2]:

$$CC = \frac{\sum_{x}^{M}\sum_{y}^{N}(I_K(x,y)-\overline{I_K})(G_K(x,y)-\overline{G_K})}{\sqrt{\sum_{x}^{M}\sum_{y}^{N}(I_K(x,y)-\overline{I_K})(G_K(x,y)-\overline{G_K})^2}} \quad (1)$$

where the pixels in images 1 and 2 are denoted by I_K and G_K, respectively. The image's first window's mean value is represented by $\bar{I}_k$, while the image's second window's mean value is represented by $\bar{G}_k$.

5- PROPOSED METHODOLOGY

The proposed methodology addresses the challenge of recognizing individual faces across variable sizes,where a set of images that include a number of people within one image were used,more than one image was taken for the purpose of implementing this program. Where the image of one person from within the group will be distinguished by identifying the face and calculating its highest correlation, the mathlab 2023 program was used in this technique for the purpose of recognizing the face.The following is an explanation of the work algorithm:

1- Reading a single image of the person whose face you want to identify

single = imread(fm);

2- We use the FaceDetect function, which displays only the face image from the full person image that was uploaded in step 1.

BB1=FaceDetect(single);

3- We extract only the face from the image after using the imcrop function.

G=imcrop(single,BB1);

4- We read the image of the group that includes more than one face.

group=imread('Group.jpg');

5- We apply the FaceDetect function, but for each group image, where it displays the faces of all the people in the group and extracts the face of each person, and the program stores them as a database within the program.

group=imread('Group.jpg');

6- We display the pictures of the faces of the people in the group. This is done by placing boxes on the picture of each face in the group and by placing spaces between each picture by placing a threshold of 10 so that one picture does not stick to the other.

imshow(group);hold on

faceDetector.MergeThreshold=10;

7- The program displays blocks that include the faces of the people in the group photo according to the number of people in the photo. If the number of people in the group is 7, the number of blocks that appear will also be 7.

8- The program calculates the strongest correlation between the image uploaded in step number one and step number 7, for the images of the people in the group, image after image until it obtains the highest match.

[maxCorr(i), maxInd(i)] = max(abs(c(:)));

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9- The highest matching we get represents the image we want to distinguish.

Mx=max(maxCorr(:));

10-Finally, the program displays the person's photo with the group's photo, with a box to identify the person the program has highlighted.

function [bbox] = FaceDetect(ImgIn

bbox = step(faceDetector, ImgIn);

11-End the program.

6 -RESULTS

This section includes a presentation of the most important results that were applied using the Mathlab 2023 program for images with faces of different shapes and sizes and with the JPG extension in the face recognition process, where it is possible to choose any image from the individual images within the group image, as the program searches for all faces in the group image through the face detection algorithm and stores the image of all faces as a database stored within the program until it finds the image of the person required to be searched for by calculating the highest correlation between the required images and the images stored in the database as shown in the results.

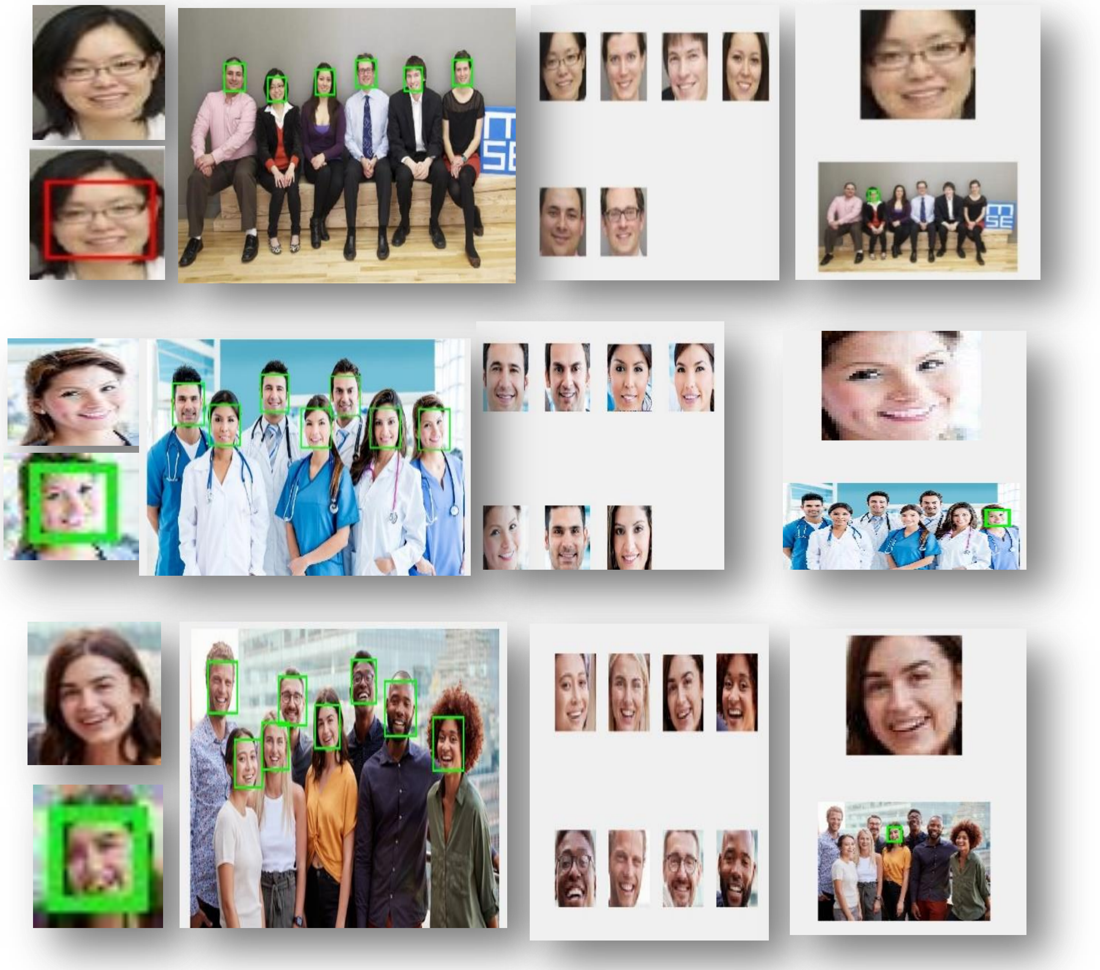

Fig-2- Technique for recognizing individual faces from group image

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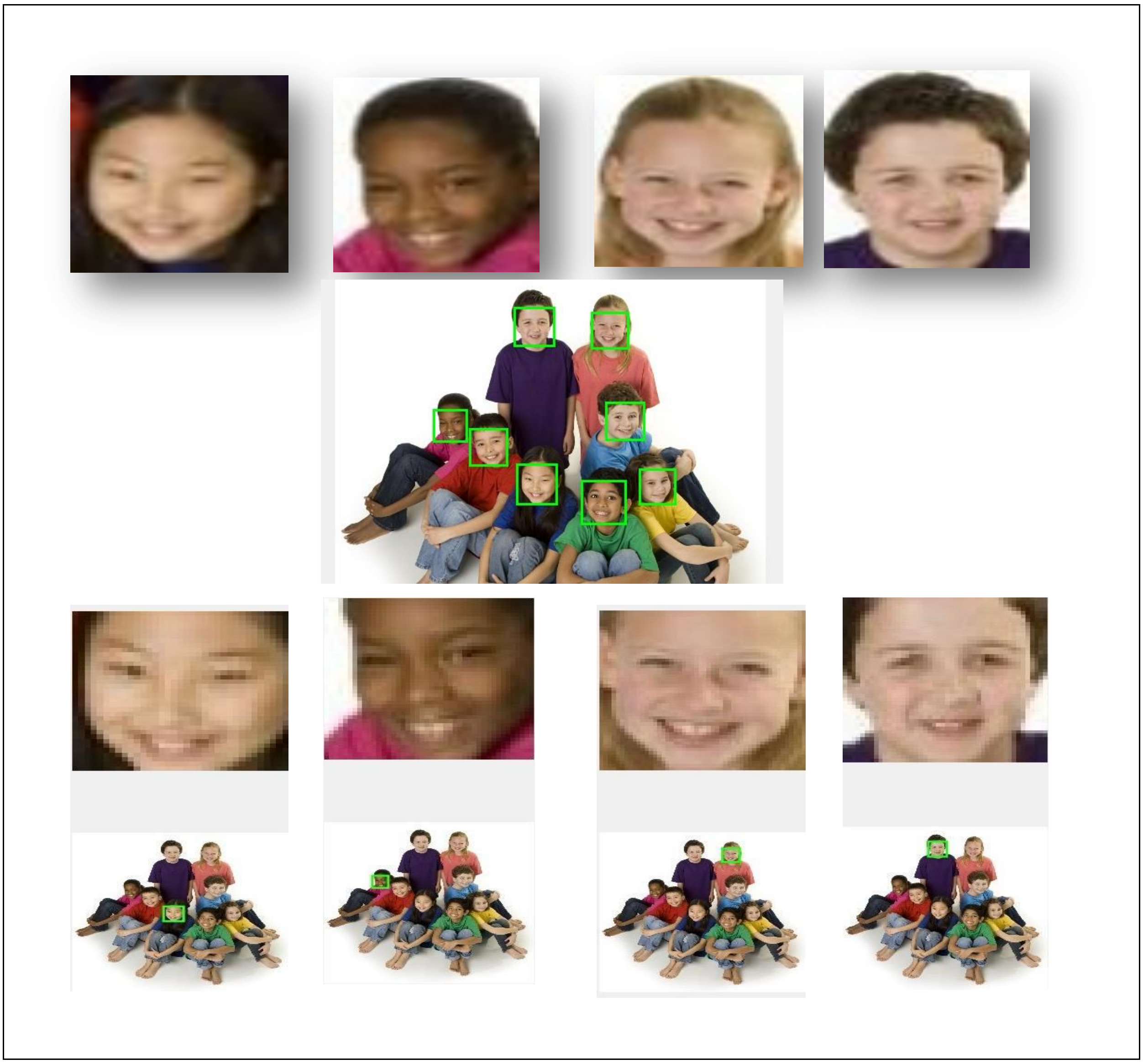

Fig-2- Technique for recognizing individual faces from group image

Fig-3- Technique for recognizing individual faces from group image

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7 DISCUSSION

The experimental findings show that the suggested methodology performs better at identifying faces of different sizes than the most advanced techniques. The following are the main causes of this success:

Multi-Scale Feature Extraction: By processing faces at multiple resolutions, the algorithm captures both fine-grained details and contextual information, improving recognition accuracy and reducing the impact of scale-related distortions.where The proposed method is particularly effective in challenging scenarios, such as surveillance and mobile applications, where face sizes vary significantly.

8 CONCLUSION

The proposed methodology provides a robust and scalable solution for recognizing faces of variable sizes. By integrating a preprocessing pipeline, multi-scale feature extraction, and an attention mechanism, the algorithm achieves state-of-the-art performance while maintaining computational efficiency. Future work will focus on further reducing computational costs and improving robustness to occlusions and extreme lighting conditions.

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REFERENCES

1- Zainab hashim., hanaa mohsin., ahmed alkhayyat.," Handwritten Signature Identification Based on Hybrid Features and Machine Learning Algorithms"., volume 24, issue 1 , march 2024 ., page 43-56 .

2- Minchul Kim, Anil K. Jain, and Xiaoming Liu.,"AdaFace: Quality Adaptive Margin for Face Recognition" ,CVPR. ,2022.

3- Zeena Mohammed1 and Dr. Hayder Hassan Safi2.," A New Technology to detection face by using two Algorithms model ",Vol.29 , Computer Integrated Manufacturing Systems , 2023 .

4- Awad, R., Al-Zuky, A.A., Al-Saleh, A.H., Mohamad, H.J.," Built background image using correlation method"., Mustansiriya University, 2017 Annual Conference on New Trends in Information and Communications Technology Applications, NTICT 2017, 2017, pp. 116–121, 7976102>

5- Taigman, Y., Yang, M., Ranzato, M., & Wolf, L. (2014). DeepFace: Closing the gap to human-level performance in face verification. *CVPR*.

6- Schroff, F., Kalenichenko, D., & Philbin, J. (2015). FaceNet: A unified embedding for face recognition and clustering. *CVPR*.

7- Lowe, D. G. (2004). Distinctive image features from scale-invariant keypoints. *International Journal of Computer Vision*.

8- He, K., Zhang, X., Ren, S., & Sun, J. (2015). Spatial pyramid pooling in deep convolutional networks for visual recognition. *IEEE Transactions on Pattern Analysis and Machine Intelligence*.

9- Lin, T.-Y., Dollár, P., Girshick, R., He, K., Hariharan, B., & Belongie, S. (2017). Feature pyramid networks for object detection. *CVPR*.

10- Hu, J., Shen, L., & Sun, G. (2018). Squeeze-and-excitation networks. *CVPR*.

11- Dai, J., Qi, H., Xiong, Y., Li, Y., Zhang, G., Hu, H., & Wei, Y. (2017). Deformable convolutional networks. *ICCV*.

12- Deng, J., Guo, J., Xue, N., & Zafeiriou, S. (2019). ArcFace: Additive angular margin loss for deep face recognition. CVPR.

13- Awad, R., Al-Zuky, A.A., Al-Saleh, A.H., Mohamad, H.J., "Numerals Recognition System using Feature Extraction and Minimum Distance Technique"., college of basic education, computer department , 3 Aug 2020.

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