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Detection Face Parts in Image Using Neural Network Based on MATLAB

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K E Y W O R D S

Convolutional Neural Networks, face detection, MATLAB, eyes, mouth, nose.

A B S T R A C T

Recently, face recognition system (FRS) is implemented in different applications including a range of vital services like airports and banking systems for security purposes. Therefore, deployed surveillance systems have been established which led to the urgent need to develop a vital face recognition system. In this work, a new algorithm was proposed for recognition of the face, personal and color images by training the convolutional neural network using the MATLAB program to build a new program for detection of the face, then building a separate program to discover the lips, nose, and eyes, New methods were explored to analyze the main and independent components to improve face detection, which is considered one of the important techniques in this work using neural networks and implementation through the MATLAB program.

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1. INTRODUCTION

In recent years, the field of face recognition has taken a wide area of research due to the urgent need for security and commercial applications to demonstrate the interaction between humans and computers using measurement analysis. The work in this field varies greatly in terms of face, skin, gender, and color [1]. The difference in the background lighting of the face and facial expressions is a reason that increases the complexity of the problem [2]. Among the many applications in the field of face detection, including recognition and monitoring of the driver's face, face recognition using video surveillance, or image data management, the algorithms for face detection are characterized by complexity. Face detection is complicated [3]. In [4] which it was clarified that the face detection algorithms are divided into two parts, (i) feature (ii) learning, the first is based on simple facial

features without looking at the surrounding light, rotating, or standing. The face position is determined by the vertical projection of the gray level image after the image has been projected for face detection [5]. The role of the neural network appears strongly in the field of facial recognition that has the potential to deal with image data. The neural network technology is multi-layered as it is to design a file containing a recognition system that results in a completely flat structure with inputs that are completely connected to later layers in architecture due to huge interconnecting nodes in addition to the amount of input data that is ignored. This leads to training for all permutations in the input vector [6]. The fields of science and technology have led us to develop rapidly to be able to reach goals that were far from being achieved in the past few decades. Many areas have made life easier, such as machine learning and artificial intelligence, to reach solutions to complex problems in modern science. Computer vision achieves algorithms on the human level in classifying and analyzing images. It was presented YOLO theory to discover things and Fast YOLO, which is the fastest detector is the fastest detector for general-purpose [7]. Face detection was achieved using PCA theory. The network was trained fast [8]. The performance of face detection is evaluated by the false-match rate (FMR), and the false-non-match rate (FNMR) [9]. Viola Jones' method was used to check the number of faces that have been treated and count the number of faces [10]. Modern technology has a role in computer vision at this time when the world is living fighting the emerging coronavirus, the disease pandemic (Covid-19) due to technology, work has been completed from home to adapt to the disease [11]. Facial characteristics such as freckles and hair were identified using a new generator to present data on human faces. the method Kanade Lucas Tomasi (KLT), which is a simple system where it can detect the face and track it where the system can detect the face when the head moves and tilts, with Estimation Geometric Transform (EGT) function and Duration Geometric Transform (DGT) [12,13]. In this work, new and fast algorithms have been proposed that have proven their efficiency through the results in Table (1), and the role of mathematics in dealing with color images and the detection of face parts in different times and place has been highlighted. Finally, the threshold factor and its role in programming MATLAB to reveal the face of images was revealed.

2. PROBLEM DEFINITION

In this work the strategy followed is to develop a high-performance face detection process to reach high-quality results using the face detection system by training a rapid convolutional neural network by programming and putting steps in the MATLAB program that was translated into the proposed algorithm.

I. Materials and Methods

In this work the strategy followed is to develop a high-performance face detection process to achieve high-quality results using the face detection system by training a rapid convolutional neural network by programming and putting steps in the MATLAB program that was translated into the proposed algorithm.

II. Face Detection

Many factors are used in the face detection currency, which contributes to the detection of the face, including distinguishing skin color and facial components, and because of noise, lighting, convexity and invalid space leads to false discoveries.

MATLAB programming in face detection the programming role in the face detection algorithm that is used by Cascade Object Detector is highlighted, which is important in discovering the parts of the face and which is put forward in the proposed algorithm. The nomenclature should be alphabetic (capital letters first, followed by lowercase letters), followed by any Greek symbols, with subscript and superscript last.

III. Convolutional Neural Networks (CNN)

It is the technology that analyzes the color image for classification and detection of objects without the need to compress and split the images.

IV. Mathematical aspects of a Convolutional Neural Network (MCNN)

Large numbers of images are processed through dealing with the computer. After all, it has vision and the ability to deal with countless numbers of images, depending on the convolutional neural network because it deals directly with the color image and reveals the face without resorting to pressure and noise.

Figure (1) shows the process of CNN with the image using the filter 3×3 to get the classification as a summation. The result of this process is illustrated by important mathematical equations in this work

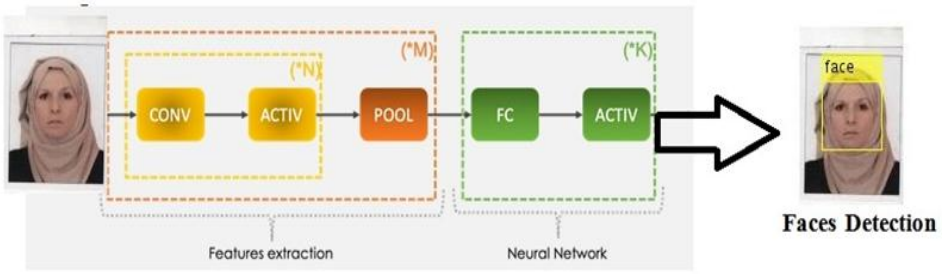

Figure 1: Shows the process of CNN with the image using the filter 3×3 to get the classification as a

V. Mathematical algorithm for Face Detection(MFD)

Input: The color image

Output: The result of the torsion process to determine the face of the color image with basic colors of a RGB that are represented in 3 channels

Step 1: The color image is represented mathematically by the following, height (Mh), width (Mw) and Number of channels (Mc).

Step 2: The filter is treated with the image. Figure (2) shows the process of multiplying the image with the filter, where the filter is individual to mediate each pixel in the filter to contain a kernel N to match the number of channels of the image, in this step, the filter dimensions are calculated using the equation (1)

$$DF=(F,F,Mc) \qquad (1)$$

DF is the domination of filter

Step 3: The mathematical process is done for the convolutional process in equation

$$C(I,N)_{x,y} = \sum_{a=1}^{M_h} \sum_{b=1}^{M_w} \sum_{N=1}^{M_c} N_{a,b-N} I_{x+a-1,y+b-1,N} \qquad (2)$$

$$\dim\big(C(I,N)\big) = \left(\left[\frac{M_h+2P-F}{R}+1\right], \left[\frac{M_w+2P-F}{R}+1\right]\right) \quad S>0; \qquad (3)$$

If $R=1$ equation (3) will be

$$(M_h+2P-F, M_w+2P-F) \qquad (4)$$

Where [x] is the floor function of x P=0 is the valid CNN output size is equal then P=(F-1)/2 is the same CNN , if F=1, this means 1×1 Convolution.

Step 4: The image is distinguished through the process of merging and reducing, which shows its effect on the dimensions M_h, M_w, so that the image information is determined in each channel so that it preserves the number of channels after this step

$$\dim\big(P(I,N)\big) = \left(\left[\frac{M_h+2P-F}{R}+1\right], \left[\frac{M_w+2P-F}{R}+1\right], M_c\right) \quad R>0 \qquad (5)$$

If $R=1$ equation (5) will be

$$(M_h + 2P - F, M_w + 2P - F, M_c) \qquad (6)$$

Step 5: Training process is done in this step helps CNN to reduce the number of layers In Figure 2 and Figure 3 the convolutional process is shown with the color image and reduced in the number of layers

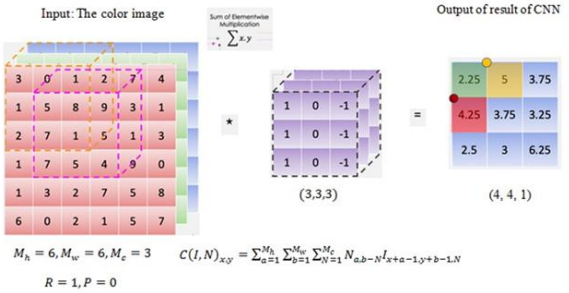

Figure 2: shows the steps of the algorithm MFD

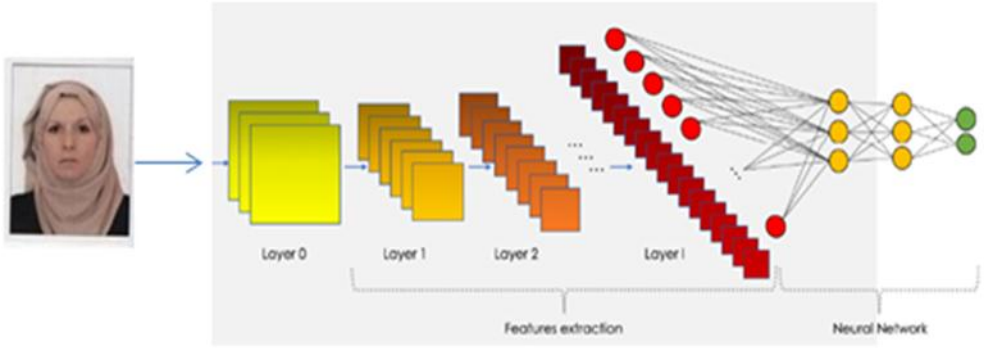

Figure 3: Using the Filter and multiplying it with the color image

VI. Face Part Identification (FPI) Algorithm

Input color image
Output Face Part Identification (FPI)
Step 1: Read the image in the program MATLAB Determine the size of the image and analyses image to 3 layers RGB
Step 2: The image is processed with the filter (3 × 3), the image size is reduced
Step 3: Under the influence of programming the properties of the object are determined
Step 4: In this step, a threshold that directly affects an array of values is determined Bounding Box values which comprise of [x, y, Height, Width] of face
Step 5: The face is determined and by repeating the same steps by controlling the threshold value, the eyes, mouth, and nose are determined respectively

VII. Application of the algorithm (FPI)

Using the MATLAB program and using the convolutional neural network (CNN) training process, samples of the same person are used with changing time and state and by the influence of the threshold factor. Figure 4 illustrates the process of identifying the face, eyes, mouth, and nose

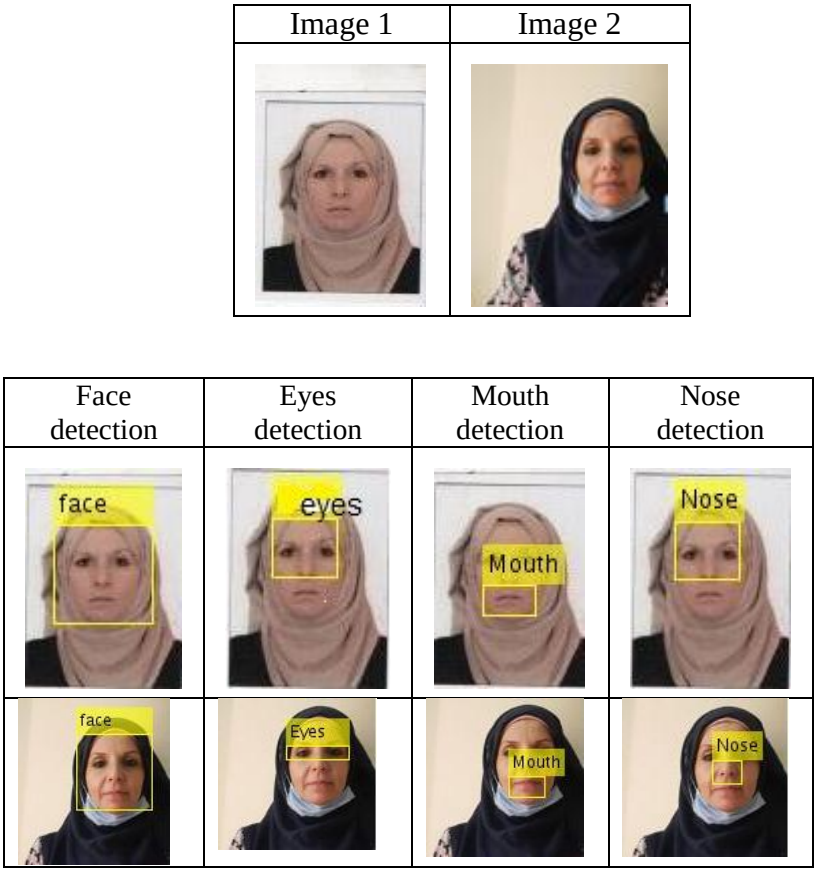

Figure 4: Illustrates the process of identifying the face, eyes, mouth, and nose

3. Results and Discussion

I. Aim

Display the results obtained for the correct rate of detection of the face and its parts. The new algorithm proved its correctness by showing the results obtained. In this work, a modern version of MATLAB was used to design a program of parts of the face with the effect of the threshold factor. After training the convolutional neural network, the effect of the threshold was proven on the matrix (Bounding Box) Table (1) shows the efficiency and validity of the new algorithm In this work, new and fast algorithms have been proposed that have proven their efficiency through the results in Table (1), and the role of mathematics in dealing with color images and the detection of face parts in different time and place has been highlighted. Finally, the threshold factor and its role in programming MATLAB to reveal the face of images was revealed Boxing Faces and Table (1) shows the values that consist of [x, y, height, width] of the faces whose parts are to be revealed.

TABLE I: Shows the Values that consist of BB box of the Faces whose parts are to be revealed.

Image	Face	Eyes	Mouth	Nose
threshold	11	[1,6]	7,8,…	9,10
threshold	[19,40,50,50]	[26,43,33,28]	[]	[30,71,27,16]
BB box	Face detection	Eyes detection		Mouth detection
Image 2	11	1,2,3	4,5,….	10
BB box	[74,103,58,58]	[79,120,47,11	[ ]	[90, 143, 27, 16]

4. CONCLUSIONS

In this paper, a new algorithm was built for face detection technology by segmenting the color image into RGB in which a neural network is used, where the face area of a person was detected through a comparison between the input and output image with the implementation of the algorithm in the MATLAB program, good results were obtained for the indications of the algorithm a new technique for identifying the face of color images was presented after analyzing the image and dividing it into three layers resulting from the neural network that helps to detect the features of the face, and by using the MATLAB program, a classification technique is applied to detect the face, which satisfactory results were obtained after using the basic equations.

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