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Intelligent Fingerprint Recognition System Using Artificial Neural Network (ANN)

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A B S T R A C T

In this paper, a smart system was created to identify handprints. Where the initial processing was done on the input image by converting it into a binary digital array, then the initial processing process begins, which is removing noise from the image using the average filter and then slimming the fingerprint image in order to make it suitable in order to obtain the least input to the neural network after calculating the distinctive value (egin value) of that image as a method for extracting properties, where the algorithm adopted in this research included two stages: the first was to adopt samples for thirty fingerprint images, and then calculate the value of the distinctive value of those samples as a way to extract the properties of the image in order to build a database with the distinctive values of those samples in order to rely on them as input To train the neural network. The second stage, in which a fingerprint image is tested, from which we extract the same characteristics adopted in building the database, which is calculating the distinctive value to be then entered into the previously trained neural network in order to check the fingerprint whether it is within the stored database or not. The network used in this research in order to distinguish is the Back Propagation network, where the back propagation network was trained on 75 images of different sizes and the network was tested on 25 images of all these fingerprints. Where the discrimination rate was approximately 88%.

Keywords*: fingerprint, edge detection, back propagation neural network, pattern averaging*

1. Introduction

The science of artificial intelligence started and focused on how we can simulate the human mind, how devices have the ability to distinguish, how we can make that device that has the ability to simulate the human mind. Computers, despite their high speed and ability to process millions of data in fractions of a second, could not do many of the things that humans do. For example, if a small ten-year-old child was shown a set of pictures, this child would simply know the picture like a cat picture. , knows the image of the tree and others. Scientists have studied the cells of human neural networks, and tried to simulate them by means of a computer, so that we can build a network that works on the same principle, and thus we can get that smart computer that is capable of excellence, and from here the idea of Artificial Neural Networks (ANN) began. Neural networks are considered more complex in the use of parallel computing methods and processing, which is one of the reasons that the human brain performs in its ability to process data with more than one group of neurons entering the same moment in parallel, computers today and simulate this process in what is called parallel computing, Despite the high speed resulting from this technique, it lacks the ability to be independent in solving the problem, meaning that the system is unable to solve the problem using the input data.

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2. Methodology

2.1 Image processing

In this paper we use image processing techniques, which have a wide scope. It is considered one of the most important programs used in the computer, the types of image processing are: image enhancement, cropping important parts of the image, extracting features. Converting the image of the entered number to grayscale is the first image processing technique in this paper**.**

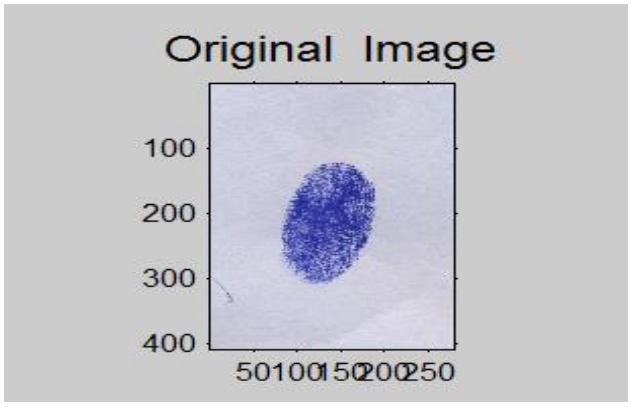

Fig 1. Original image

2.1.1 Gray Scale

Grayscale is a group of monochromatic (gray) shades, which range from pure white on the lighter end to pure black on the opposite end. Grayscale contains only luminance (brightness) information and no color information; this is why the maximum luminance is white while the zero light level is black. Everything in between is shades of grey. This is why grayscale images contain only shades of gray. A digital image usually contains both color and lighting or grayscale information. If you remove the color information, you will be left with a grayscale, resulting in a black and white image. Grayscale is an important aspect of images, and it's the only part that hasn't been removed; otherwise, a pure black image may result regardless of the existing color information.

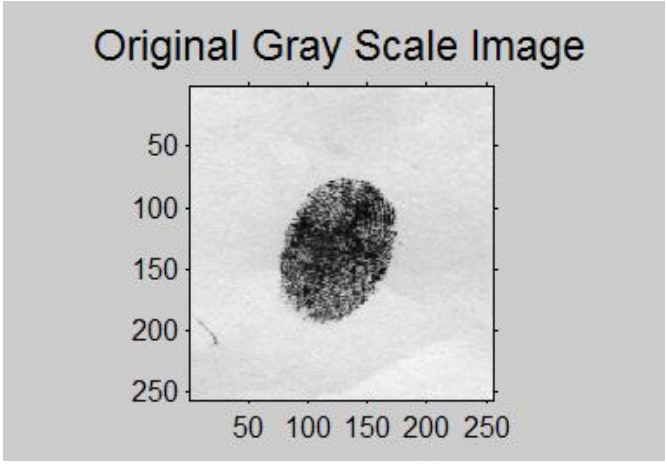

Fig 2. Gray Scale image

2.1.2 Laplace filter

The Laplace filter or discrete Laplace administrator is a channel for edge identification that approximates the Laplace operator.

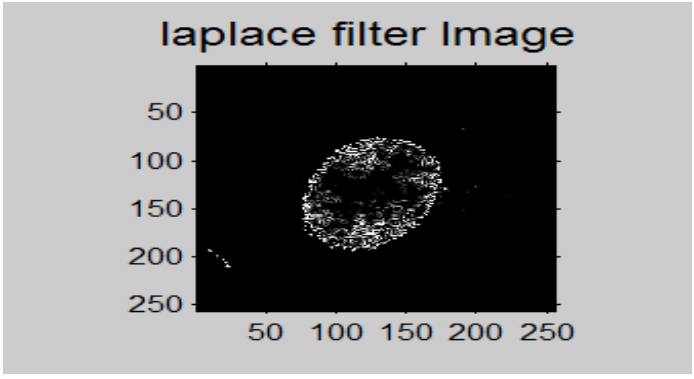

Fig 3. Laplace filter

2.2.3 Canny edge detection

Canny edge detection is a procedure to extricate helpful underlying data from various vision objects and drastically lessen the measure of information to be handled. It has been broadly applied in different PC vision frameworks. Vigilant has observed that the prerequisites for the use of edge discovery on different vision frameworks are moderately comparable.

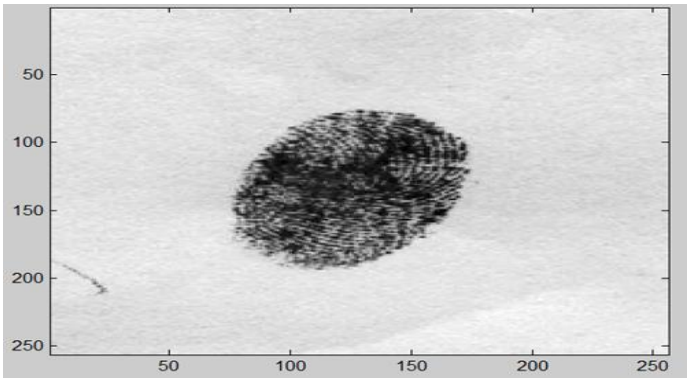

Fig 4. Canny edge detection

2.2.4 Pattern averaging

After the division cycle utilizing the vigilant edge recognition, the pictures size ought to be decreased to be taken care of to the neural organization. To diminish the size of pictures while keeping the valuable and required elements removed by the recently utilized strategies, we utilized pattern averaging. This method is characterized as the averaging of the characterized sections

3. Recognition phrase

In this paper, we created a back propagation neural network (BPNN), which is considered one of the most used networks. This network recognizes the input fingerprints. We used 20 images of one hand, 15 images as training for the network, and five images in the process of network testing. Where all images have been scaled to become a matrix of dimension 20 * 20, so the network input layer has become 400 neurons, and the processing layer consists of 10 neurons, and the output layer of the network consists of 228 neurons, as shown in the figure

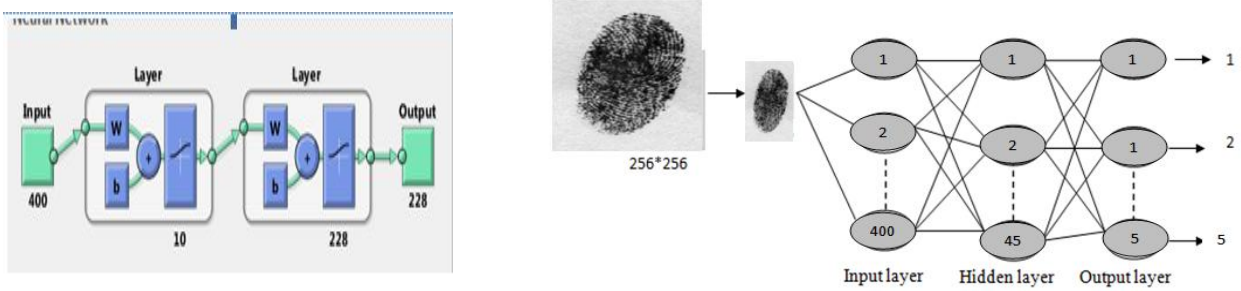

Fig 5. PBNN

Table 1: Network Parameters

Parameters	Number
Input neurons	400
Hidden layer	1
Hidden neurons	45
Learning rate	0.27
Error	0.001
Momentum rate	0.05

4. Testing and Result

At this stage, the network was tested by 25 samples of fingerprints, 5 samples from each person. Through the tests conducted on the network, the network proved to be very effective for recognition, as the recognition ability was calculated through the following table

Table 2: PBNN Results

ANN	Recognition Rate	Percentage
BPNN	22/25=0.88	88%

Through the previous table, it was found that the identification rate was 0.88, meaning that the network's ability to identify was (88%).

5. Conclusion

In this paper, we have created an intelligent system to identify handprints using a back-propagation neural network, where we collected fingerprints for counting 5 people with four fingerprints for each finger, where the total fingerprints for each person was 20 and the total was 100 fingerprints, where these were divided The fingerprints consisted of 75 fingerprints as training for the network and 25 fingerprints as a test, and we performed processing of fingerprint images before entering them into the network and we reduced the size of the image using (pattern averaging), where the results showed that the network recognition rate was 88%, which is considered very good.

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