

Iris Recognition System Using Normal Camera and Deep Neural Network Model With Image Processing Techniques

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ABSTRACT

Iris recognition is a technology used in many security systems. Irises are different among all people every person has a unique iris shape and there is no two irises have the same format. In this paper, a new model is introduced in iris recognition to make this technology easy for anyone to use it. The model depends on the normal camera to collect iris images which will need a strong model that can use these images to make a reasonable iris recognition system. This paper presents an iris recognition system from the beginning of collecting images to the end of recognizing the iris images. This paper also presents a new process to make iris recognition which is a blend between image processing techniques with deep learning to make iris recognition. The iris recognition model is begun by taking images from a normal camera then the eye detection process takes place then the iris detection process detects the iris inside the eyes then iris filter process is responsible for filter iris images and choose suitable images that will be saved in the dataset the last process is training and testing the images using deep neural network model.

INTRODUCTION

Iris recognition plays an important role in many applications It helps in the identification of different persons with high accuracy as each person has unique iris featured ^[1-3].

Iris recognition gives high accuracy more than other human characteristics in user authentication like Fingerprint and handwriting.

This paper introduces iris recognition using a normal or standard camera which will require a model with a lot of filters and conditions to ensure that the right images will be saved in the dataset which will be used by deep neural network models to classify and distinguish between different classes or users ^[4].

In Section 2 overview of the proposed model in Section 3 detailed explanation of each step of the model in Section 4 contain the results and a discussion in Section 5.

MODEL OVERVIEW

The iris recognition model begins by using a normal camera for collecting images then the eye detection process try to find eyes in the images collected by camera then the third process is iris detection in this phase iris inside eyes images are detected the fourth process is iris filter it filter images come from pervious process (iris detection) and save these images to the dataset that will be used in the last process by the deep neural network model to train and test iris images (**Figure 1**).

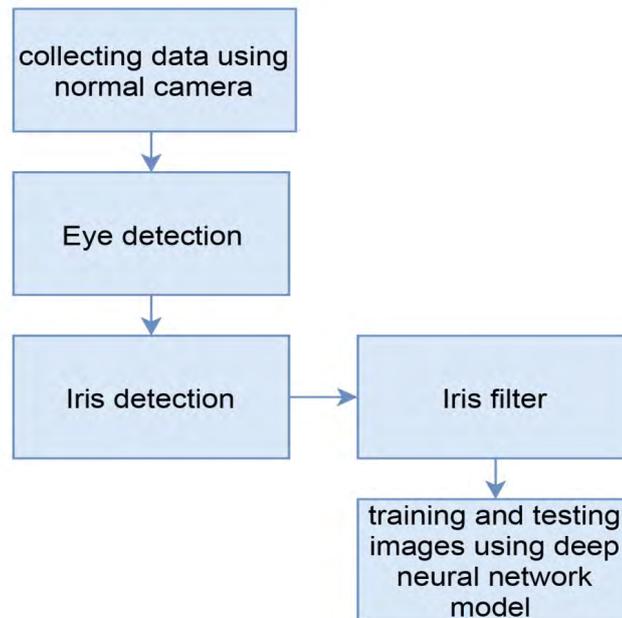


Figure 1. Model Overview.

IRIS RECOGNITION MODEL

Collecting Data Using Normal Camera

Iris recognition systems are done by using sensors specialized in iris imaging [4-6]. In this model normal camera is used to collecting images which are challenging things as the whole model depends on this process [7-9].

The model needs from the images taken from the camera some features so that later in the phase of training the neural network model it can differentiate between different Iris of different people. In this part, the code asks for the user's number so that each user will have a unique number (Figure 2).

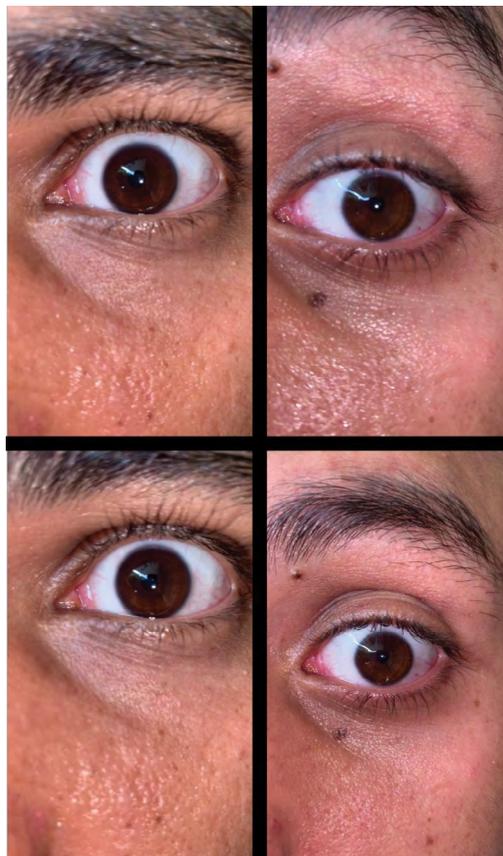


Figure 2. Example of images taken by camera in the first process.

Eye Detection

Eye detection has a lot of different applications. Iris recognition is one of these applications [7]. The model uses haar cascade classifiers to detect eyes as these classifiers are fast, don't need a lot of computational time and give high accuracy [6].

Images that come out from camera pass through haar cascade classifier that detect eyes in these images and

Figure 3 shows the output of this process.

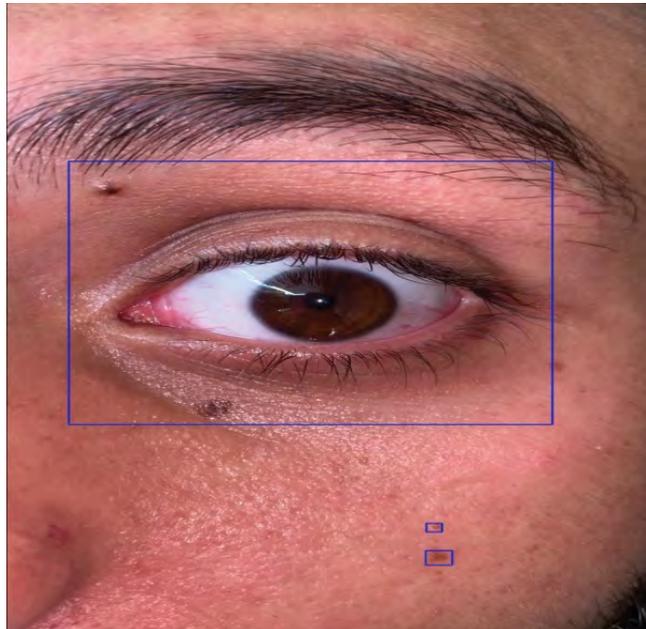


Figure 3. Output of eye detection classifiers.

Iris Detection

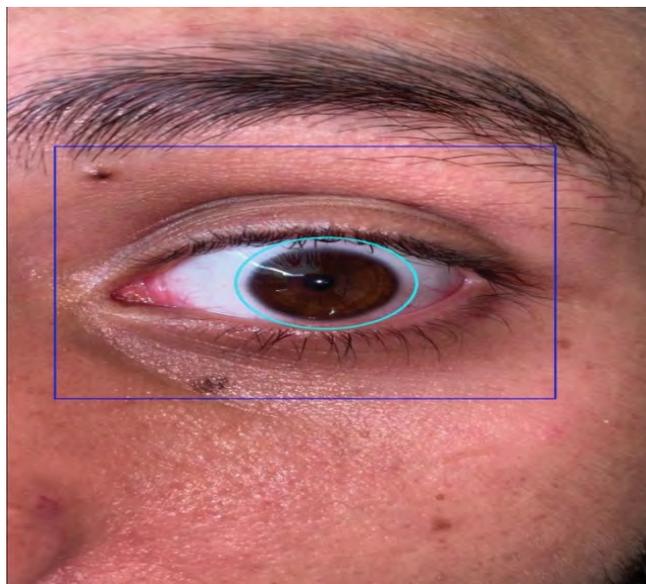


Figure 4. This image come out from the iris detection process.

Iris detection is a very important step in the model as without iris images training deep neural models will be worthless. We can define the iris as it's the region between the pupil and the rest of the eyes [4].

Hough transform has a lot of applications it has been used to detect different patterns for example lines and circles [5].

The model takes the images detected in the last phase and applies Hough transform on these images. The region of interest, in this case, is only the region of eyes that detected in the previous step by eye detection process (**Figure 4**).

Iris Filter

Before using images that come out from Hough transform process in the deep learning model we have to check those

images because the normal camera is used for collecting iris images there are no sensors used so the iris recognition model has another filter to be sure that the iris images can be fitted on the deep learning model ^[10].

The iris filter process takes the images to come out from the iris detection process and for each image, the filter takes some points as in **Figure 5** and compare the values of these points with some threshold and according to this comparison, images are added to the dataset that will be used in the deep learning model or not. Also, the iris filter take only the region of interest of the iris and remove the rest of the image **Figure 6** shows the final images that will be saved in the dataset after applying the iris filter.

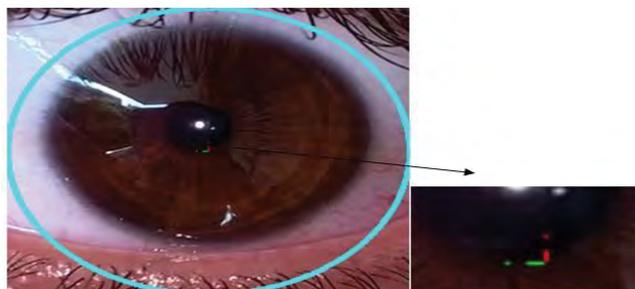


Figure 5. The red and green dots shows iris filter points according to this points the image is accepted or rejected in the dataset.

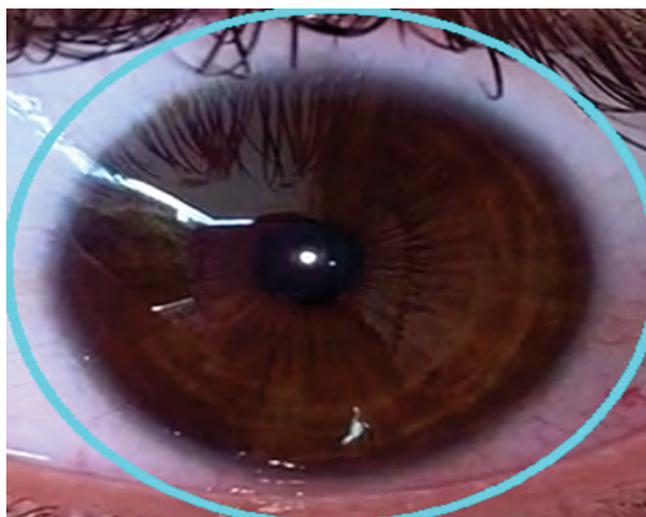


Figure 6. This image is the output that is provided by iris filter.

Training and Testing Images Using Deep Neural Network Model

Deep neural network models have become a very strong tool in many applications. Image classification is one of the applications of deep learning ^[1,2]. The model uses a convolution neural network as it can understand unique features in images^[3]. The model uses a Convolutional Neural Network (CNN) for iris recognition as CNN will differentiate between different classes. The dataset contains three different classes the first class contains images of things other than iris images the two other classes contain iris images of two different people. Each iris class contains 13 images the first-class contains 31 images. Before the images are fitted in the model they converted to grayscale as the colored images have many features the model doesn't need it (**Figure 7**).

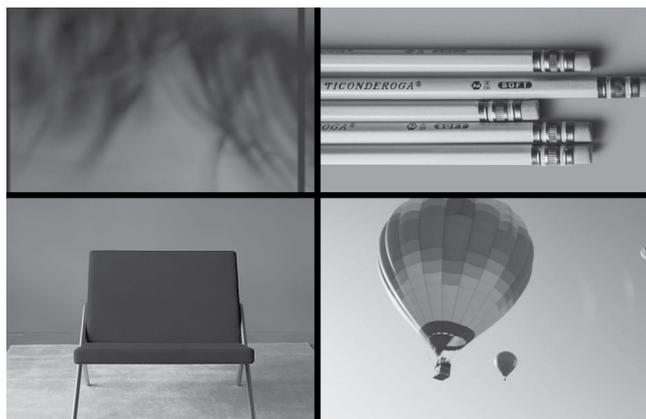


Figure 7. Example of first class of the dataset.

The architecture used in the iris recognition model is presented in Figure 8.

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 89, 89, 600)	87000
activation (Activation)	(None, 89, 89, 600)	0
average_pooling2d (AveragePo	(None, 14, 14, 600)	0
conv2d_1 (Conv2D)	(None, 9, 9, 300)	6480300
activation_1 (Activation)	(None, 9, 9, 300)	0
dropout (Dropout)	(None, 9, 9, 300)	0
conv2d_2 (Conv2D)	(None, 7, 7, 150)	405150
activation_2 (Activation)	(None, 7, 7, 150)	0
average_pooling2d_1 (Average	(None, 3, 3, 150)	0
conv2d_3 (Conv2D)	(None, 1, 1, 100)	135100
activation_3 (Activation)	(None, 1, 1, 100)	0
flatten (Flatten)	(None, 100)	0
dense (Dense)	(None, 100)	10100
dense_1 (Dense)	(None, 30)	3030
dense_2 (Dense)	(None, 3)	93
activation_4 (Activation)	(None, 3)	0
Total params: 7,120,773		
Trainable params: 7,120,773		
Non-trainable params: 0		

Figure 8. Model summary of CNN model.

RESULT

The parameter used to check level of the model in iris recognition is accuracy

$$Accuracy = \frac{\text{number of correct images}}{\text{total number of images}} \times 100$$

The training and test set accuracy=100% the training loss=0.0028 and test loss=0.0526.

CONCLUSION

The architecture of the model uses average pooling layers. The idea of pooling layers was firstly introduced by Hubels Semial paper [10].

Architecture use stochastic gradient descent, learning rate=000005, momentum=0.9 decay=1e-6. The number of epochs=300 and batch size=32. 20% of the data used as test set. Relu used as activation function except in the last layer softmax activation function was used.

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