Facial Recognition Based on Machine Vision

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***Abstract*—This paper proposes a recognition and face tracking based on computer vision techniques using OpenCV libraries by applying multiple phases in cascade. The algorithm allows for a more robust tracking because it combines face and eye detection. Besides, it detects edges and cuts the region of interest (ROI) where the face is located. After that, the algorithm verifies if there is any face in the ROI passing again the face and eye detector. The identification is done through a comparison of the detected face and a stored database of images.**

***Index Terms*— Robust Face Tracking; Multiple Identification; Face Recognition.**

I. INTRODUCTION

Today, interacting with computing devices has advanced to such an extent that they have become a necessity for human; hence, they cannot live without them. The technology has become so embedded in our daily life that we used it for working, shopping, communicating and even entertaining ourselves [1]. These applications require more and more interaction to use them efficiently, and it is a very lively field of research in recent years. Some parts of body are used to interact with the devices, such as hands, fingers and face. For example, the hand allows communication with devices in a more intuitive way [2]. Other researches focused on facial recognition, and it is one of the fundamental pillars of artificial vision [3], identification and counting people.

In [4], a survey literature of face recognition has been done. An important work has been done by Turk & Plentland who recognize human's face through eigenvalues in [5]. In [6], Ahonen, Hadid & Pietikainen develop a method where the face image is divided into several regions for correct identification.

Face analysis can also be used for a robot that can perform an intellectual conversation with humans. In this case, a research of the method to perceive human emotions was developed in [7].

Facial expressions play an important role in human communication because they carry a lot of information about the feelings of human emotions.

Facial recognition involves computer vision and neural networks. It covers researches in the field of computer science as neuroscientists and psychologists. It could also be considered within the field of object recognition, where the face is a three dimensional object and must be identified based on its 2D projection.

Automatic face recognition system with high precision expression and performance allows human to enjoy smart and transparent communications. Humans interpret facial expressions with no effort, but for a machine, this task is quite difficult as it involves extracting important features, tracking and classifying.

Although much has been achieved, recognizing facial expression remains difficult due to the complexity and variability of facial expressions.

While recognizing facial expression seems simple, it is influenced by a wide variety of lighting conditions, resolution, and orientation pose [8].

The best known model of facial expression was given by Ekman and Friesen [9]. They argued that there is a neutral facial expression and six basic facial expressions for fear, happiness, surprise, anger, sadness and disgust.

This paper is organized as follows: Section II gives a presentation of the phases of the algorithm (in this process both classifier are done). Section III presents the experimental results with a standard database and finally in Section IV concludes this document with the important ideas.

II. EXPERIMENTAL AND RESULTS

The phases of the algorithm are shown in Figure 1.

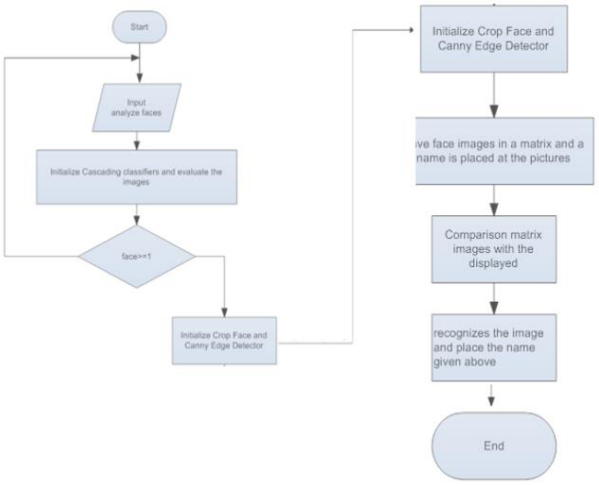


Figure 1: Side view of EBG Unit Cell

A. Recognition of Face

In Figure 2, the scheme used faces recognition with the first sample in the recognition library. This library is based in Haar cascade, and it was chosen because this element is often used in artificial vision applications. The library is called haarcascade_frontalface_alt.xml, which is a good classifier in recognizing faces ([10, 11, 12, 13]).

The tests used a standard database BioID-FaceDatabase-

V1.2. The recognition has an error of 4.5% in 200 photos analyzed. Figure 2 does not recognize all the faces, so another library was increased as presented below.

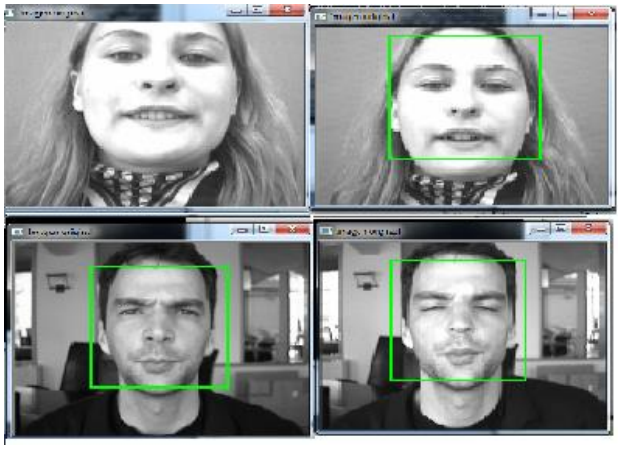


Figure 2: Recognition with haarcascade_frontalface_alt.xml

B. Eyes Recognition (Second Stage)

For this second stage, as shown in Figure 3, eyes recognition have been added to get more certainty that it is a face.

Figure 3: Recognition with haarcascade_eye_tree_eyeglasses.xml

We used haarcascade_eye_tree_eyeglasses.xml that is an OpenCV classifier. The second stage reduced the errors to the value of 1.5%. The errors were due to the environment surrounding the person. Minor errors occurred because eye Library captured the eye as the mouth or nose.

C. Edge Detection

The region of interest was cropped (with OpenCV method called cropface) through an edge detection (Figure 4) using Canny that changes the color image to black and white and allows us to detect the edges of the face.

D. Recognition

Different Images were stored in a virtual database (Mat), then, a name was given to the group. However, the mentioned above classifiers were used to prove that, the image is a face. Then, a name is positioned on the photos to have a description of the photo (Figure 5).

E. Facial Recognition

The training method called Face Recognizer allows to distinguish the image of the person more clearly (Figure 6).

Figure 4: Canny algorithm

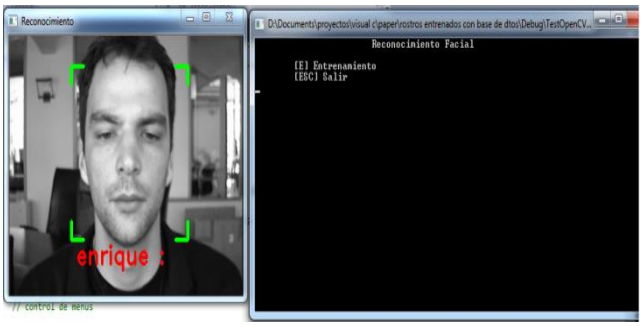


Figure 5: Assignment name

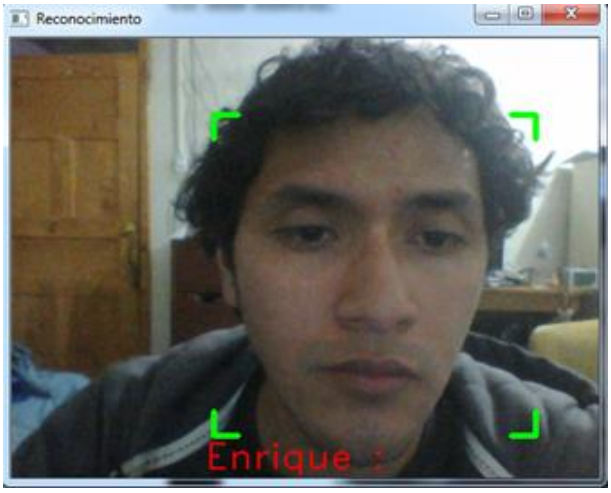
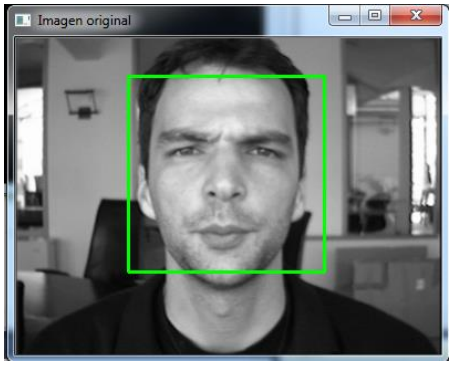


Figure 6: Recognition

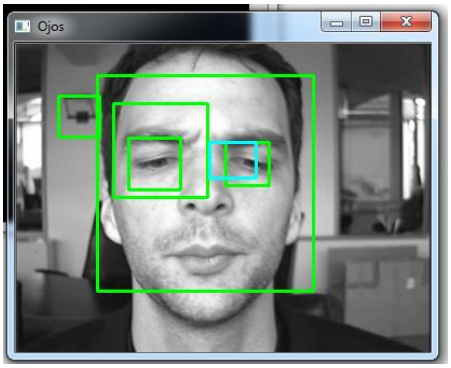
III. Results And Discussion

We developed an algorithm that allows for a robust face tracking color: The phases are in Figure 6.

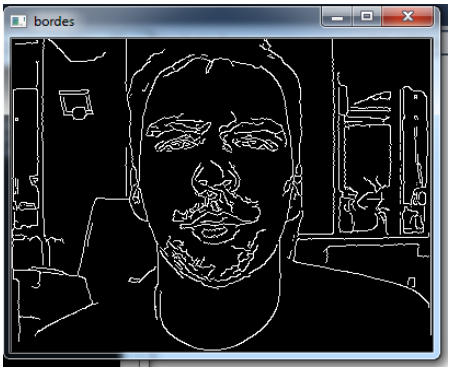
Face recognition alone, as conducted in phase one algorithm has an error of 4.5% in 200 samples. The combination with the eye method minimizes this error. By adding the image trimming method and detecting the edge of the face, the environment surrounding the images is removed and mistakes in recognition is avoided. Recognition is fast and efficient, and it reduces errors to a minimum despite the processing involves several filters.



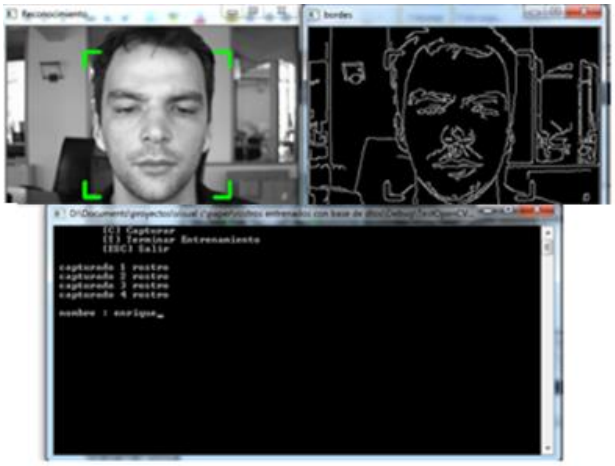
a) First phase: Face recognition



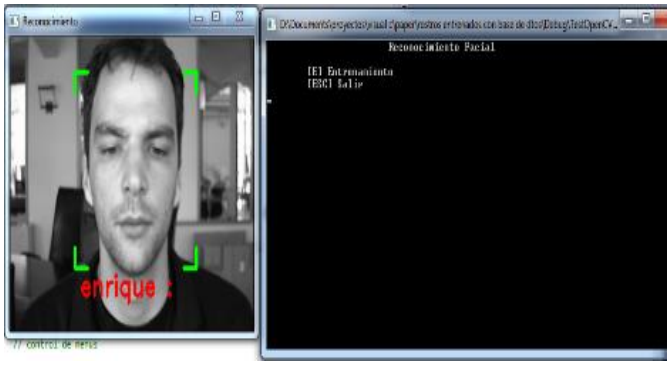
b) Second Phase: Eye recognition



c) Edge detection



d) Comparison the input image with the database



e) Final Phase: Face Recognition

Figure 7: Phases of algorithm

IV. CONCLUSION

A robust face recognition was implemented. When these classifiers (face and eyes) work together, they increase the certainty and veracity of training. The first classifier can be wrong, but with the second classifier it has a better recognition and support. The database allows for a backup for training to use artificial vision; hence, variations in the face can be learned successfully.

As in other facial recognition processes, this work deconstructs the recognition process with some phases in cascade.

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