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Towards an Intelligent Multimodal Biometric Identification System

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***Abstract*— the goal of this project is to bring together and integrates the work of the laboratory team members in order to get a practical realization of an Intelligent Multimodal Biometric Identification System. This last exploits the vocal and visual properties of a person to carry out, her or his, identification. To improve classification performance, the system will have a virtual character module which can exchange information with the person to be identified according to a random survey (based on information provided previously). Our first objective is to equip our laboratory with a powerful access control system able to identify the members of the lab and follows them where ever they go helping them with all kind of information they may be in need to .**

***Index Terms*—Biometric identification, Multimodal classification, Detection of movements, facial recognition, vocal Identification.**

I. Introduction

Current Research in the field of biometric identification offers practical and effective solutions which make it possible to improve the performances of the traditional safety systems. These improvements are generally the fruit of the use of new sensors (of prints and Iris) powerful but constraining and expensive [1] [2].

In this work we propose the development of a nonconstraining biometric identification system which exploits the vocal and visual properties of a person to carry out his/her identification. In order to improve the classification performances, we propose to equip the system with a virtual character module which is able to exchange information with the person to be identified according to a random questionnaire (established using preliminary provided information).

II. State of the Art

Biometric identification techniques are based in general on the exploitation of certain physiological or behavioral characteristics of a person. These data resulting from biometric sensors form a unique signature which can be stored in a database for later identification. This primary stage is called enrollment phase [3] [4].When an enrolled person has to be identified, a reading and biometric process comparison is used. It consists in comparing the characteristics of the person to be identified with the characteristics recorded initially in of enrollment phase.

The biometric identification techniques can be classified in two great families: morphological techniques and behavioral techniques:

The first family is based on the identification of the physical and particular features of the person. It gathers the techniques based on the use of the fingerprints, the shape of the hand, the face, the retina and the eye iris.

The second family is based on the analysis of certain person behaviors such as for example a signature, the voice print or the way of carrying out certain specific tasks.

In general the powerful biometric identification systems combine several techniques resulting from the two families. It is the multimode approach [3].

In order to humanize the process of identification and to make it less constraining and more effective, we propose to associate to our system a virtual character module which is able to exchange information with the person to be identified according to a random questionnaire (established according to preliminary provided information).

In the next paragraph we will show the structure of our system and we will detail the developed modules.

III. Structure of the System Proposed

The system suggested is composed of three principal modules:

The vocal identification module
The visual identification module
The virtual character module

The structure of the system is presented in figure 1.

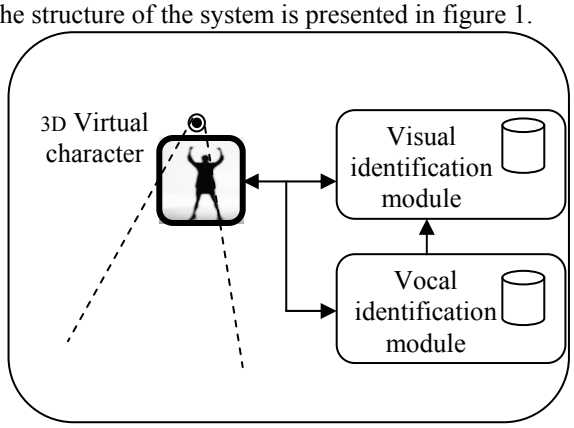

Figure1. System Structure

A) The vocal identification module: This module principal task is the speaker identification. First we acquire the speaker voice using a preliminary questionnaire and then, identify the voice by comparing it to the voices saved in the system database.

B) The visual identification module

This module exploits the results of the vocal identification in order to accelerate the process of visual identification based on the search for similarity between the acquired image

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and those which are in the image database.

C) Virtual character Module: this last module will enable us to work on new human machine interfaces which will be able to engage a series of messages resulting from external events.

IV. Interaction With Eternal environment

In order to make the system autonomous, a movement detector is used. Once a person enters the view field of the camera, the system starts the identification process by the following:

- Making a greeting by the virtual character, which asks the intruder to identify himself? An example of a message made by the virtual character is as follows: "Hello, What is your full name?"
- In parallel, the vocal and visual identification processes are switched on.
- When identified the person is allowed to enter and some information are kept in the data base concerning the person identified (such as the checking time etc...), otherwise it will be invited to leave. When in the lab, the person is followed and helped for what ever he needs.

V. The Vocal Identification Module

This module is based on two voice recognition systems:

1. A speaker recognition system allowing his/her identification [12].
2. A voice recognition system RAP associated with the virtual character module, allowing the confirmation of the identity of this speaker by a preliminary questionnaire as stated earlier.¶

The first system is to determine, among a set of N speakers, one corresponding voice recording.

Figure 2. illustrates this system.

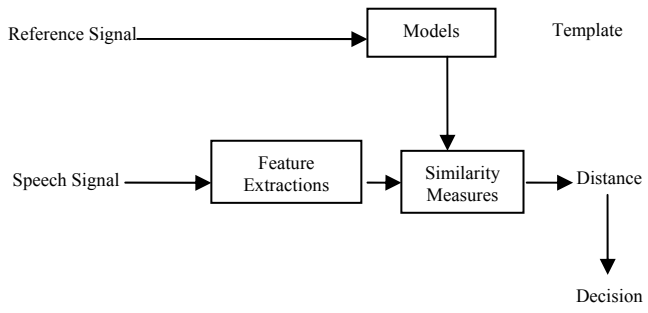

Figure 2.Speaker Recognition System

According to figure 3, the voice presents major differences with the fingerprints [2].

This can be interpreted as follows:

The voice changes over time even in the short, medium and long-term, and depending on the health or emotional state.

The voice can be voluntarily modified (or imitated) and falsified, with the existing techniques.

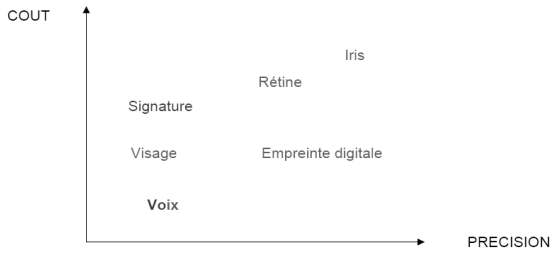

Figure 3. Comparison between various biometric techniques

In order to remedy this problem, the second system is conceived to ensure the proper identity of the speaker.

This system detects the human words and analyzes it in order to generate a string of words or phonemes representing the answers to the questionnaire of the virtual character, pronounced by the speaker.

Such system can be described according to the following axes [6]:

- Dependence or not of the speaker
- The mode of speech: isolated words or continuous speech.
- The complexity of the authorized language: size of the vocabulary and the difficulty of the grammar.
- The robustness to the conditions of recording: systems requiring high quality of speech or operating in noisy environment.

One of the ASR problems is the great variability of the characteristics of the word signal [6] [7]. To overcome this problem, many mathematical models and methods were developed, among which one can quote: the dynamic comparison, neurons networks, Markov stochastic models and in particular Markov hidden models HMM [8].

VI. Visual Identification Module

Before carrying out the visual identification of the intruder, the system carries out the localization of its face. For that several approaches were proposed to follow and locate the face.

According to Ahuja et al...In [4], four categories of approaches can be distinguished:

- Methods based on our intuitive representation of the face (presence of the mouth, the eyes and the nose).
- Methods based on the features of the face which do not change, such as for example the color of the skin.
- Methods based on a parametric representation of the face which constitutes a model (*template matching*).
- Methods based on appearance.

The process of visual identification is carried out in two stages: The first One locates the face then the other one identifies it.

VII. Face Localisation

For this application we developed an operator of localization and follow-up of the face in real time based on the techniques of detection of movements [4].This last uses three successive images for the extraction of the movement in a video sequence. The mathematical expression of this

operator is as follows:

$$\forall\ x,y \qquad M_n(x,y) = \max\ [(|C_n(x,y) - C_{n-1}(x,y)|)\ ,\ (|C_n(x,y) - C_{n+1}(x,y)|)\ ]$$

With Cn_{-1}, Cn and Cn_{+1} are the respective contours of the successive images In_{-1}, and $_{+1}$.

The operator proposed allows detecting the least movement in the filmed scene and gives a null result only if the scene is static.

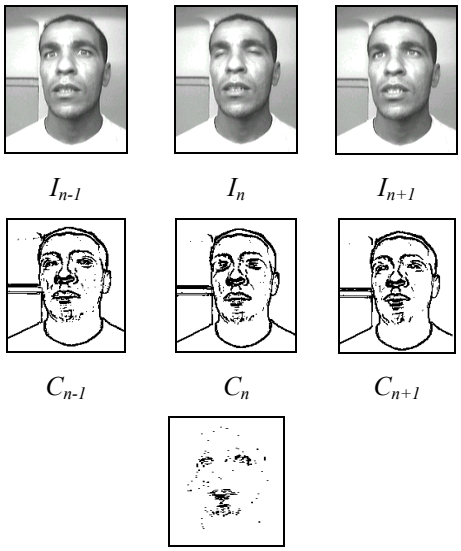

Figure 4. Obtained Result by the proposed Operator

It is significant to note that the request stage of the intruder identity by the virtual character will oblige the person to identify to mainly move his lips and his eyes. This will enable us to carry out a good localization and extraction of the face. Once the face extracted we pass to the recognition phase.

VIII. Face Identification

After detection and standardization, the faces are normally forwarded to an algorithm of recognition. We used a hybrid method [11] combining two global methods PCA [9] and DCT [10]. Figure 5 presents the stages of an algorithm of recognition. A data base of images, BBAFaces figure 6, was created at the university center of Bordj-Bou-Arréridj in order to test the performances of the developed system.

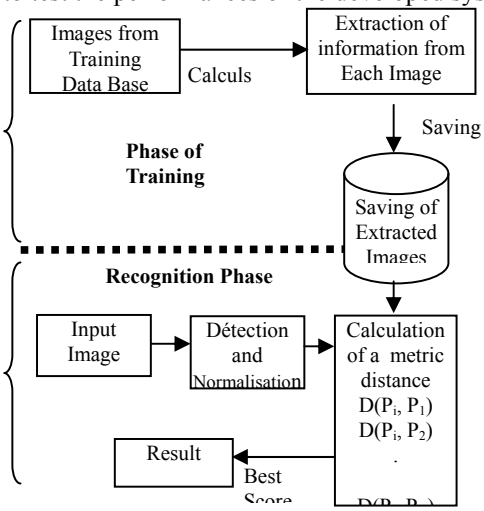

Figure 5. Recognition Algorithm Stages

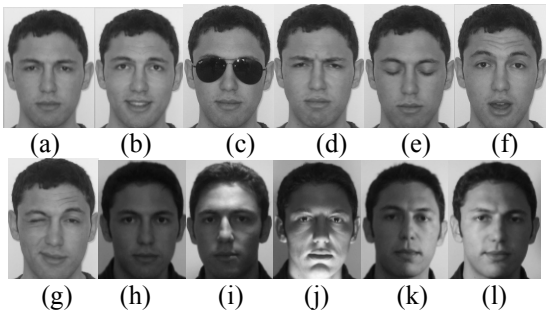

Figure 6. : BBAFaces Database Example (a): normal, (b): happy, (c): glasses, (d): sad, (e): sleepy, (f): surprised, (g): wink, (h): dark, (i): top light, (j): bottom light, (k): left light, (l): right light.

The combined use of PCA and DCT is nothing but the transformation of each image (for training and for recognition) via DCT method before using it as input for the PCA. This technique, although needing more calculation time-consuming, offers a higher recognition rate than PCA or DCT method used alone. Its other advantage is that it consumes less memory space than PCA.

IX. Conclusion

In this project we have set a common goal to bring together the work of our team members on a practical application in the field of biometric identification. Besides the virtual character module, the main components of the systems which include: visual and voice identifying were developed. The proposal of a random survey will enable us to increase the system performances. It remains to combine the methods and work on the interactive side of the system with the external environment

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