A DISTRIBUTED FACE VERIFICATION SYSTEM BASED ON CORBA ARCHITECTURE.

ANTONIO GUZMÁN FRANCISCO MARTÍN ENRIQUE CABELLO
Universidad Rey Juan Carlos. (ESCET)
Móstoles, 28933, Madrid (SPAIN)

ABSTRACT

Face verification system presented here is based on CORBA communication to obtain a distributed computer vision application. This system is related with VISOR-BASE project. This project is aimed at creating VISOR, a CORBA adaptation to the requirements of digital video monitoring systems applied to the development of observation applications with artificial vision functionality. Sensor detailed in this paper is a face verification system. This project is partially funded by European Union (Project IST-1999-10808 VISOR BASE).

System Architecture

Architecture is split in two parts: sensor core and sensor shell. Sensor shell has been developed by project consortium and encapsulates CORBA functionality's. Sensor core is the computer vision part of the sensor implementing algorithms related to the sensor's functionality. Sensor shell is a set of components with a standard IDL (Interface Description Language), so any third part could developed its own video sensor and integrated in a distributed environment easily. Even more, a set of video sensor has been developed in the project with several functionalities (Licence Plate Recognition, Tracking, People counting, detection and tracking of individuals).

Server-client Architecture.

Visor Architecture is shown in Figure 1 in a client-server architecture. Both systems could be implemented in different platforms with different operating systems. Video sensor could be in server or in client side, depending on system requirements.

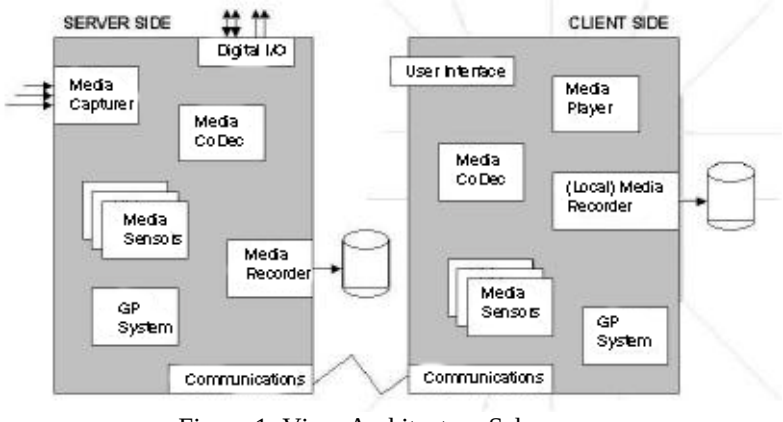

Figure 1: Visor Architecture Scheme.

Face verification Video sensor.

Face verification video sensor scheme is shown in figure 1. Input of sensor is composed by an image containing a face and by a personal identification code. System output is the personal confidence degree (a number between 0 and 100) and indicates degree of matching.

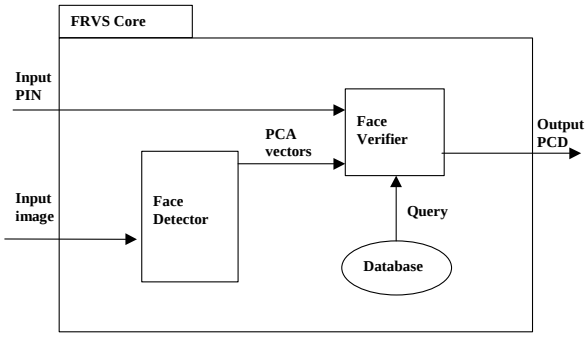

Figure 2: Face verification scheme

Face verification

Face Detector: Video sensor first locates face in the image. To perform this task skin colour levels are used. According with skin HSV values, each pixel of the image is considered to be skin or not. Face Detector module achieves the localization of the face in input image and extraction of the image regions containing main features of face. It also transform face's representation from digital image space to face space defined by Principal Component Analysis (PCA). Once the face is detected, it is resized to 60x60 pixels and from this image, 160 autovalues are considered.

Face verification: Once the face is represented by PCA components, PIN code is used to select an artificial neural network who discriminates if the face in the image correspond with the identity that the code says. Each subject has his own neural net. This allows to change subject database without the needed of recalculate all neural networks. Topology considered for artificial neural network is 160-200-1 and is a multilayer perceptron. During the training, 100 face hypothesis of the correct subject are used and 100 of the rest of the data base; number of epochs is set to 6.000 iterations.

Data base Description and Numerical Results.

It has been captured video sequences of the 32 people. Each sequence takes a time of approximately 9 seconds, and there are about 2 minutes of recording per subject. About 2,000 frames per subject have been extracted. These images have been stored with the colour information, in JPEG format, have a size of 320 x 240 pixels.

Male								Female			
Long hair				Short hair				Long hair		Short hair	
Glasses		No glasses		Glasses		No glasses		Glasses	No glasses	Glasses	No glasses
Beard/ moustache	No beard/ moustache	Beard/ moustache	No beard/ moustache	Beard/ moustache	No beard/ moustache	Beard/ moustache	No beard/ moustache				
1	1			1	3	4	7	3	3	2	7

Following tables show results obtained in three subjects:

	Average value	Standard deviation
Pin 1 Image 1	91.73	0.31
Pin 1 Image 2	22.83	20.36
Pin 1 Image 3	44.58	22.87

Number of images considered: 34 by subject

	Average value	Standard deviation
Pin 2 Image 1	33.68	24.61
Pin 2 Image 2	90.54	15.24
Pin 2 Image 3	37.73	31.44

Number of images considered: 69 by subject

	Average value	Standard deviation
Pin 3 Image 1	45.02	21.27
Pin 3 Image 2	8.24	10.93
Pin 3 Image 3	99.98	0.04

Number of images considered: 34 by subject

Considering a threshold of 68% and using this set of images, results are:

	Number of cases	Percentage
Correct	377	91.72
False Rejection Rate	7	1.7
False Acceptation Rate	27	6.57

If threshold is set to 75% results are:

	Number of cases	Percentage
Correct	378	91.97
False Rejection Rate	11	2.67
False Acceptation Rate	22	5.35

Conclusions

Sensor presented in this paper is a full verification system, including not only face verification but also face location. Excellent results have been achieved with the restrictions that illumination conditions and face pose are similar in test and in training phases.

In normal operation, sensor is very fast but training phase is very time consuming, so this part has to be optimised, selecting best suited neural network architecture to face verification problem.

Also, more techniques has to be implemented in case that conditions are not similar to training ones (for example, using local face characteristics).

CORBA layers offers the opportunity of work with several operating systems and hardware platforms. As an additional advantage, system is more robust that one based on stand-alone products.

An additional advantage of the system is the easy way in which new sensors could be added.