Fraunhofer
PORTUGAL

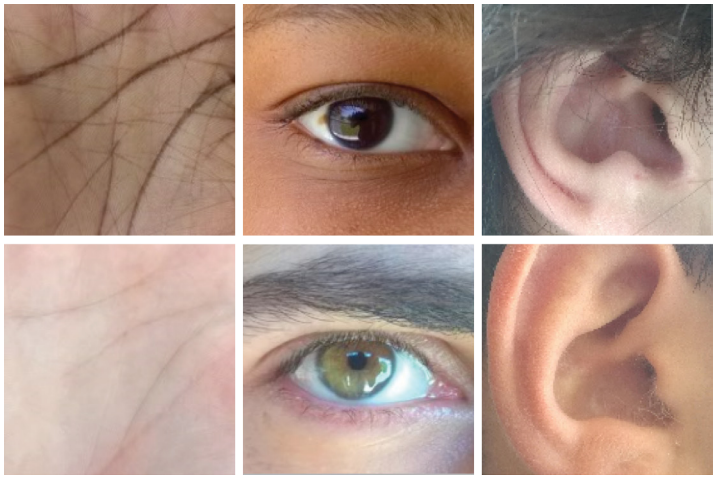

Fig1. MoBIAC dataset samples.

MoBIAC

MOBILE MULTIMODAL BIOMETRIC IDENTIFICATION FOR AFRICAN COMMUNITIES

The main objective of this project is to assess the performance of a given individual recognition algorithm to be applied in the Sub-Saharan African (SSA) context.

Context

In SSA, the lack of official identification promotes poverty and social exclusion for many individuals. This current situation motivates the necessity of conceiving new methods to cover the large identity gap that is pointed out as one of the biggest obstacles to development.

Project Goals

The project consists in developing a biometric system to be implemented in a smartphone, capable of recognizing an individual by taking and analyzing an image of a given physical trait.

To achieve this task the work was divided in four stages:

- Study the impact of mobile setups variations on individual recognition using a periocular region-based algorithm;
- Study of five different descriptors and its performance evaluation when used to analyze images acquired in highly unconstrained scenarios;
- Acquisition of a new database comprising images of the periocular, ear and hand from African and Caucasian individuals;

Contact

Rua Alfredo Allen, 455
4200-135 Porto, Portugal

+351 220 430 300
info@fraunhofer.pt
www.fraunhofer.pt

SIFT

The Scale Invariant Feature Transform detects features with Difference of Gaussians allowing a rotation and scale invariance of the resulting representation.

ULBP

The Uniform Local Binary Pattern labels the pixels of an image by thresholding the 3x3 neighborhood of each pixel with its center value.

HOG

The Histogram of Oriented Gradients divides the image into small cells. For each cell a histogram of gradient directions is computed for the pixels within the cell.

GIST

GIST uses five perceptual dimensions to give a low dimensional and holistic representation of the image.

Future work

- Study the impact of aging over individual life-time
- Achieve multimodality by fusing different traits
- Test and train the system with images acquired from different smartphones
- Evaluation of a novel algorithm's behavior when applied to the previous acquired dataset, especially regarding its multimodality characteristics.

Algorithm Architecture

The algorithm makes use of Gaussian Mixture Model as a Universal Background Model. This model is trained with data from every subject and then it is adapted to each individual, resulting in several individual specific models. New samples are then compared with these models and the best identification (ID) match is found.

Descriptors

Coding the image in order to optimize comparison and achieve a more compact representation of the information is achieved by means of feature descriptors. In this project the image is codified by using five well known descriptors: two variations of HOG, ULBP, SIFT and GIST.

MoBIAC dataset

Images were collected using a smartphone, from 25 Caucasians and 25 Africans subjects, regarding ear, hand and periocular region. The different traits were chosen due to their acceptability and ease of acquisition in the given context.

Images were captured on unconstrained environments with light and pose variations, in order to simulate a real scenario. Given this, there are, for example, ears partially covered by hair and periocular region captured with poor light conditions. These challenges allowed testing the algorithm robustness.

Conclusions

Several conclusions were taken from the development of this work:

By the analysis of the setups it was concluded that good light conditions can greatly improve results while camera resolution is not relevant to the system. The absence of external noise can also be a decisive factor in achieving good performance;

Between the five assessed descriptors, GIST showed outstanding results performing always the highest rank-1 (R1) ratio - highest number of correct matches. Furthermore, GIST also presented the highest decidability (DEC) - highest descriptive power in individual identification;

Hand proved to be the most suitable trait, among the three, to recognize African subjects while the others performed similar in both ethnicities;

The chosen algorithm had surpassed the state of the art results being suitable to be applied in the SSA context in any of the three traits. It is now needed to adapt it into a real smartphone-based system so that it can be assessed in the real context.

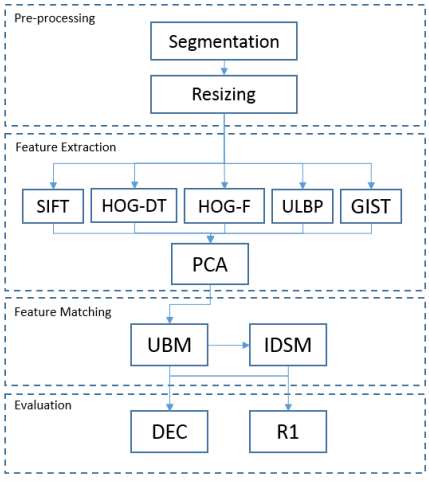

Fig2. Algorithm Architecture.

O NOVO NORTE PROGRAMA OPERACIONAL REGIONAL DO NORTE
QUADRO DE REFERÊNCIA ESTRATÉGICO NACIONAL
UNIÃO EUROPEIA Fundo Europeu de Desenvolvimento Regional