



Multilingual Behavioral Biometric Identification/Verification

eINTERFACE

The SIMILAR NoE Summer Workshop on Multimodal Interfaces

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Faculte Polytechnique de Mons, Belgium

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Abstract:

This project will involve the recording of a multilingual database with behavioral biometric modalities like speech and signatures, the development of fusion algorithms for speech and handwriting data, and building a robust individual identification/verification system. The target application will be the electronic document authentication. On site, tests will be conducted under various scenarios of fusion between different modalities and noise conditions.

1. Project objective

The main goal of the project is to use speech and handwriting – especially signatures – for the identification and/or verification of the identity of the participants in the eNTERFACE workshop. To accomplish this we will need:

1. Record a database with speech signals and signatures from the participants of the workshop.
2. Develop algorithms for fusion of these two modalities
3. Define and implement a Human-Computer Interaction system with the task to fill out a selected document (maybe provided by the organizers of the workshop) and sign it with voice and signature.
4. Repeatedly test the system, communicate results to the fusion team.

2. Background Information

Speech and handwritten signature are considered as two important behavioral biometric modalities commonly used today by humans for the identification and verification of an individual. With the increasing use of new mobile devices such as PDAs and tablet PCs, there is emergence of new capabilities for applications like the authentication of electronic documents (e.g., confidential financial transactions). Also for security reasons, identification (associating an unknown biometric - voice and signature - with biometrics from enrolled person in a database) or verification (determining whether an unknown biometric is produced by a particular person in the database) is very important.

For building a robust system for individual identification and/or verification the magic word is “fusion”. Even in one modality like speech, researchers are looking for the fusion of high and low-level features to accomplish their task [1]. Fusion of physiological biometrics like iris, fingerprints, hand geometry, and face or behavioral biometrics like handwriting and speech are also used [2][3]. Although a high number of modalities are currently used, the fusion of these modalities is still an open research problem. The task of many Work Packages in SIMILAR is to establish the theory of fusion using information theoretic arguments and implement and test various algorithms of fusion for different modalities. Our task during this workshop will be to advance our knowledge on how to fuse human voice with signatures for the task of human identification and verification.

3. Detailed Technical Description

Technical description

The project will be divided in three major parts:

The first part concerns the data collection, which means recordings of voices and signatures from the participants –after obtained their permission- of the workshop. Actually this part will continue until the end of the Workshop. The database should be organized in such a way that is

easily accessed, managed, and updated. As more information becomes available.

In the same part we will need to build the probabilistic models that describe better a person. We will mainly use Gaussian Mixture Model for both voice [4] and signatures [5]. Although for speech the mel frequency cepstrum coefficients (mfcc) have proven to be quite robust for this task, it is not obvious what will be the features for the signature signals.

The second part of the project consists of the fusion of two modalities. Two major approaches will be implemented and tested. An *early* fusion and a *late* fusion approach. In the first case, models will be developed on the space generated by the combination of computed feature from the two modalities. In the second case, the decision will be based on the combination of decisions taken by the individual recognition agents (one for speech and another for signature).

The third part of the project concerns the development of a real application that of authentication of an electronic document that the organizer of the Workshop will provide us. Results from the tests will be analyzed and optimizations of the identification/verification system will be proposed and implemented in the system.

The performance of the final system will be compared to the performance using only one modality for the same task. We will also monitor the performance of the system for various fusion strategies.

Resources needed: facility, equipment software, staff, etc...

1. Equipment:
 - a. Headphones, microphones (Univ of Crete will provide two cheap devices).
 - b. Tablet-PC
 - c. PC
2. Facility: a large room, with network, table, chairs and white (or black) boards.
3. Software: Matlab, C and C++ compilers

Project Management

- July 18th – August 2nd : Yannis Stylianou
- August 2nd – August 12 : Thanassis Valsamakis

4. Work Plan and implementation schedule

First week: Start the collection of data and develop the individual probabilistic descriptions of the data (one for speech and another for signatures, using GMM). Check normalization issues for features obtained by the two modalities as a first step to build a GMM system on the fusion of features (early fusion).

Second week: Continue the collection of data. Conduct first tests and collection of identification scores for speech and signatures. Start comparisons between the two fusion strategies (late and early fusion). Start using the electronic document among the participants of this project.

Third week: Continue the collection of data and let people to sign the electronic document. The electronic document will be filled out in testing (inside the room where we will work) and in real-testing conditions (at other places where we expect to have noise from devices, cross-talking etc.)

Fourth week: Collection of last data, final tests. Write a report on the obtained results and a detailed report on the collected database. Refine software tools for easy access to the database.

An internal website should be established in the first place where results and progress will be reported during the workshop. At the end, this website will contain the list of achieved results, the database, tools to access the database, and links to the software used and developed during the workshop.

5. Benefits of the research

We see three major benefits of this research:

- a. A multilingual database with speech and signatures. The database will be available after the end of the workshop to the participants and to the SIMILAR community (if there is such permission).
- b. Test various fusion strategies for speech and signature signals.
- c. Target a real application: electronic document authentication.

6. Profile of team

Yannis Stylianou is Associate Professor at University of Crete, Department of Computer Science. He received the Diploma of Electrical Engineering from the National Technical University, NTUA, of Athens in 1991 and the M.Sc. and Ph.D. degrees in Signal Processing from the Ecole National Supérieure des Telecommunications, ENST, Paris, France in 1992 and 1996, respectively. From 1996 until 2001 he was with AT&T Labs Research (Murray Hill and Florham Park, NJ, USA) as a Senior Technical Staff Member. In 2001 he joined Bell-Labs Lucent Technologies, in Murray Hill, NJ, USA. Since 2002 he is with the Computer Science Department at the University of Crete.

He was Associate Editor for the IEEE Signal Processing Letters and since 2004 he serves on the Management Committee for the COST Action 277: "Nonlinear Speech Processing". Prof. Stylianou participates in the SIMILAR Network of Excellence (6th FP) coordinating the task on the fusion of speech and handwriting modalities.

7. References

1. SuperID Project: <http://www.clsp.jhu.edu/ws2002/groups/supersid/>
2. Sanderson, C. Paliwal, K.K., : "Identity verification using speech and face information", Digital Signal Processing 14 (2004) 449-480, Elsevier.
3. Biometric Consortium: <http://www.biometric.org>
4. D. Reynolds, T.Quatieri, and R.Dunn. "Speaker verification using adapted Gaussian Mixture Models", Digital Signal Processing 10(2000) 19-41, Elsevier.
5. J.Richiardi, A. Drygajlo, "Gaussian Mixture Models for On-line Signature Verification", WBMA'03, Berkeley, California, USA.