

Work in Progress - The Biometric Signal Processing Laboratory at the U.S. Naval Academy

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Abstract – A *biometric* is a distinct, robust, and measurable physical and/or physiological characteristic of a person which can be used to identify, or verify their identity. Additionally, the term *biometrics* refers to the automated recognition of an individual using one or more of these characteristics. The more commonly used biometrics includes fingerprints, face, and iris. Biometrics has proven to be a solution to a number of security-related applications where accurate identification or verification of individuals is required. The technology continues to evolve at a rapid pace, and efforts have been made to incorporate the study of this field into our undergraduate curriculum. To support the education of our undergraduates in biometric theories and technologies, we have developed a biometric signal processing laboratory in the Electrical Engineering department at the United States Naval Academy. This paper summarizes the equipment and activities associated with this lab.

Index Terms – Biometric Signal Processing, Biometrics, Human Identification, Recognition

INTRODUCTION

Biometrics, the use of unique physical, biological or behavioral characteristics to automatically identify or verify identity, continues to evolve in response to numerous critical issues. Where accurate identity is required for access to sensitive facilities or computer networks, in financial transactions where prevention of identity theft is vital, or in surveillance applications where a watchlist is being monitored, biometrics provides a means to enhance security and prevent criminal activity.

With such a critical and developing field of technology, we felt it was important to expose our students, who are future officers in the Navy and Marine Corps, to the latest systems and methods of biometric identification. To achieve this goal, the authors have formed a Center for Biometric Signal Processing. The foundation of this Center is our laboratory, in which major changes and improvements have transpired since its creation in April 2004. This paper documents the progress that has been made over the past year.

BIOMETRIC EQUIPMENT

The U.S. Naval Academy's Biometric Signal Processing Laboratory is equipped with state-of-the-art recognition systems. These systems support student and faculty research,

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courses and visitor familiarity with the latest technologies available. Currently, these systems include iris, face, and fingerprint recognition.

Access to the lab is controlled using the LG IrisAccess 3000 iris recognition system. In addition, an AcSys Veraport two-dimensional face recognition system is installed outside the door. The Veraport is currently only used for demonstrations, but could be reconfigured to control access, possibly in conjunction with the IrisAccess system. Inside the lab, the Veraport camera's video signal is connected to one of the desktop computers to allow surveillance of the lab's entryway. The A4Vision three-dimensional face recognition system is connected to another desktop PC for use in demonstrations. These three systems provide outstanding examples of current biometric technology to our students and visitors to the lab.

All of the lab computers use the SecuGen Hamster or Hamster III fingerprint recognition system for network log on. This is accomplished using the Biogate multimodal biometrics network access control software. In addition, there are six Panasonic Authenticam USB iris recognition systems that are connected to some computers, and could be configured for network log on.

The lab also has a Hitachi KP-F120 camera-link camera for use in iris or face recognition database collection and algorithm development. Its video output is connected to a National Instruments NI-1428 image acquisition board in one of the lab's computers. With a near infrared (NIR) filter, it can be used to collect iris imagery. Other lab hardware includes an Identix DFR-90 fingerprint capture device and an OKI IrisPass iris recognition system, both of which are also capable of collection of raw imagery. The lab is augmented with eight webcams for use in facial recognition.

ACTIVITIES

I. Course Related Activities

The subject of biometrics is addressed in two courses at the Naval Academy. In the fall semester, the digital signal processing course concentrates on voice signal processing and introduces the use of voice signals for speaker recognition. In the spring semester, our biometric signal processing course [1]-[3] is taught. The biometrics lab supports both courses in the following activities:

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• Field trips

Field trips were organized to the Biometric Consortium Conference (September 2004 and 2005, Crystal City, VA), which included research presentations and exhibits. This field trip in the fall semester allowed junior and senior EE students to receive an introduction to biometrics and motivated their interest for future biometric study. Approximately 30 Midshipmen attended each year. A trip to the biometrics lab at the National Security Agency (NSA) has been incorporated as an essential element of the biometric signal processing course, and additional trips are planned for all future offerings of the course. Other sites identified for possible field trips include Unisys and the FBI laboratories.

• Biometric seminars

Experts are invited to give guest lectures about biometric science, technologies, and policies. These seminars are open to students and faculty members, and have included representatives from the National Biometrics Security Project, Northrup-Grumman, the A4Vision Company, the DoD Biometrics Management Office, and the Unisys Corporation.

• Interactive Demos

Equipment demonstrations have proven to be an integral part of student awareness of the field of biometrics. Several demonstrations have been used extensively, including fingerprint log on of lab computers, iris enrollment and identification for lab access, and enrollment and identification using the 3D face recognition system. These demos are used with students taking the biometrics class; they have also been used to introduce high school seniors to the field during the Naval Academy Summer Seminar program [4], and as a part of VIP tours.

II. Research Activities

Along with course-related activities, the lab supports Midshipman and faculty research. A summary of these activities is listed below.

• Student research

There are several programs available for students who are far ahead in their required course requirements to perform independent research. Thus far, two students, under the Naval Academy "Trident Scholar" program (one in 2005, one for 2006), were chosen to spend their senior year performing research into biometric projects. Their particular focus relates to the use of off-axis iris imagery for iris recognition. Their program includes a summer internship with the biometric lab at NSA, and weekly trips there to continue research during their senior year. In addition, a number of seniors in the electrical engineering major have chosen projects in the area of biometrics. These include: developing algorithms for speaker verification, iris recognition, fingerprint recognition, and face recognition. These projects are supported by lab equipment and computers.

• Faculty research

Current faculty research includes the development of a rotation, translation, scale and illumination invariant one-dimensional iris recognition algorithm [5] (patent pending), the effects of image compression on iris recognition, and the

fusion of low-resolution, high resolution and infrared images for facial recognition and tracking.

• Database Collections

An iris database has been collected and is continually expanded each semester. Raw images for the database are collected by taking the video signal from the LG IrisAccess 3000 enrollment station NIR camera and sending it to a Matrox Meteor II card in one of our desktop computers. The camera on the LG IrisAccess 3000 was used as it provides high quality near-infrared iris video imagery (resolution of 640 x 480). The video is connected directly into MATLAB via their Image Acquisition toolbox, and captured using a special graphical user interface (GUI) that was also created in MATLAB [6].

The GUI enables the researcher to assign a subject number to each individual whose iris images are captured, and annotate in the database the date/time, their gender, age, left eye/right eye, whether or not they were wearing glasses or contacts, and whether or not they have had eye surgery. The GUI is set up to enable the researcher to capture video at 10 frames/second for one second. There are currently 65 subjects represented in the iris database, which consists of approximately 3000 images. This database is being used in ongoing iris recognition research at the Naval Academy, and it is planned to collect a fingerprint database using a very similar GUI with the Identix DFR-90 fingerprint capture device.

SUMMARY

The new biometric signal processing lab has enhanced the education of our undergraduate students in the up and coming field of biometrics. The use of state-of-the-art equipment allows a hands-on approach to teaching, and facilitates both student and faculty research.

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