

Work in Progress - On the Development of a Biometrics Course and its Relationship with STEM Curricula

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Abstract - In this paper, we describe a biometrics course developed at a four year college. The impact of the Biometrics course to STEM (Science, Technology, Engineering and Mathematics) fields will be the focal point. Also included is the description of weekly lab sessions developed as an integrated part of the biometrics course.

Index Terms - Biometrics, Computer Science and Computer Engineering Education, STEM

INTRODUCTION

From the name of Biometrics, one can easily imagine that Biometrics has its root in Biology. Indeed, biometrics was a subject within biostatistics in history and it referred to the collection, storage and analysis of biological data regarding human beings. In the field of information technology, however, biometrics means hardware and software that can be used to measure and analyze characteristics of our body. Fingerprint has been the most commonly used characteristic. The other characteristics include Iris, facial, hand geometry, handwriting and voice pattern, etc.

For mathematicians, biometrics may be a subject in statistics. Biometrics applications take a sample, deriving a score, registering the derived score, deriving the new score when a user wants to get authenticated, and deciding if there is a match.

For engineers, biometrics means how to design a biometrics device. Before any biometrics application can be put into use, there must be certain types of biometrics devices, such as fingerprint scanners, facial recognition cameras, or voice recording devices. In addition, the companion software, including device drivers, SDK and applications, must be made available. It is therefore evident that biometrics is a comprehensive subject requiring solid background in STEM fields.

The Department of Computer Science, Mathematics and Engineering (CME) at Shepherd University have recently proposed and developed a Biometrics and Security concentration. The CME Department offers four year degrees programs in the area of Computer Science, Computer Engineering, Information Technology,

Mathematics, and Engineering. With great combination of academic background and industry experience, we are confident that we have sufficient skill set to develop a degree program in the field of Biometrics. We are confident that this program would be a popular concentration with great interest from students from the Eastern Panhandle of West Virginia and other neighboring states. Nevertheless, it has been challenging to develop Biometrics courses to cover subjects ranging from biology, computer science, technology, engineering and mathematics.

After interviewing with and consulting our potential employers, students with interest in biometrics, and biometrics experts, we have successfully developed a Biometrics and Information Security degree program. The highlight of our degree proposal would be the course plan for the core course titled as Introduction to Biometrics. In this paper, we will describe our experience and lessons learned from developing this course.

The following sections are organized as follows. The next section will describe the course coverage in general. After that, we will discuss the possible impacts that our biometrics course may have on each of the STEM fields. Later than that, we will describe our lab settings to support this course and lab assignments we plan to have for student teams. Finally we summarize our ongoing efforts.

COURSE DESCRIPTION

CIS 361, Introduction to Biometrics, is a course developed for junior or senior students in Computer and Information Sciences (CIS) or Computer Information Technology (CIT) majors. This course is intended to teach fundamental concepts and theoretical background in biometrics and its applications. A lab session is also included in this 3-credit course to give students hands-on experiences in biometrics hardware and software.

This is the core course for students in the special track of Biometrics and Information Security. Students in other tracks in the CIS/CIT can take it as an elective course. This course is developed as an introductory course to cover the basics of biometrics and the mainstream biometric technologies. The underlying image processing concepts required to understand biometric techniques are also

discussed. Other covered subjects are ethics, privacy concerns, and the future of biometric technologies.

In short, the following topics will be covered:

- Taxonomies of Biometrics Devices and Applications
- Basic Probability and Statistical Testing Methods
- Biometrics devices: finger printing, voice recognition, facial recognition, and iris scanning
- Biometrics and information security
- Social, Legal, and Ethical Concerns

Upon completion of this course, students are expected to be exposed to basic concepts of biometrics such as the fundamentals of fingerprinting, iris scanning, speaker verification, and hand geometry. In addition, students must also understand the underlying technologies behind biometrics, such as statistics and image processing, pattern recognition etc. A weekly lab is also designed for the provision of hands-on experience to students.

I. Prerequisite

The pre-requisite for this course is MATH 314: Statistics, and CIS 104: Introduction to Computer and Information Sciences, or permission from the instructor. Students from non-computing majors may not have taken CIS 104 but may have sufficient computing background. These students will grant permission to take this course. We anticipate a diverse group of students will be in this class. For example, students from biology program may be interested in this course. This would benefit the entire class as students from different background can form teams and work on term papers and projects together.

BIOMETRICS AND STEM FIELDS

In this section we briefly describe the relationship between biometrics to each of these STEM fields: science, technology, engineering and mathematics.

I. Biometrics and Science

Biometrics has close relationship with biology, and thus background in biology will certainly be helpful for students to grasp biometrics concepts. In fact, the essence of biometrics is the translation from biological information to a series of numbers that can be stored in database. As a university with liberal art tradition, Shepherd University requires students take 46 General Studies credits. Among these 46 credits, 8 of them could be in biology.

We encourage students who are interested in Biometrics and Information Security degree program to take biology as part of their general studies credits. Meanwhile, biology students are welcome to take this course even if they haven't taken the pre-requisite. We envision most students in CIS 361 would have certain biology background.

II. Biometrics and Technology

Pittsburgh, PA

Biometrics has been used in security for a long time. Since 2004, the US Homeland security and FBI have started to fingerprint visitors and immigrants in the international airports. European Union and Japan also want to follow.

In the information security area, biometrics is commonly used to enforce authentication. That is, biometrics is widely used to confirm an entity as it claims to be. The biometrics can be used to confirm the message origin, to verify the integrity of the message, and to ascertain the receiver is intended receiver.

Information Security, Database Management System, Artificial Intelligence and Computer Graphics have been consistently offered at CME department, and the topics in these courses are also briefly described in Introduction to Computer and Information Sciences course (which is the pre-requisite for Biometrics course). Decent understanding to materials in these courses will certainly set the stage for the Biometrics course. On the other hand, Biometrics course will also be used as a course for students to reinforce their knowledge and concepts in Information Technology courses.

III. Biometrics and Engineering

Biometrics application relies on the success of physics, engineering and engineering technology. We can take fingerprinting (and related applications) as an example. At first, fingerprint scanners have to be envisioned and developed, which demands optics knowledge from physicists. Second, it requires engineers to have fingerprint scanners be manufactured. At last, engineers, engineering technologists, and IT professionals will work together to develop a full-featured biometrics system used in airport, banks, and Homeland security agencies.

We plan to encourage engineering students in our department to get involved in Biometrics course. Engineering students will be able to get chance to work with other students on Robotics projects using biometrics sensing systems, or other value-added biometrics system, such as biometrics based Sign-on/Sign-out systems that are used in human resource applications.

IV. Biometrics and Mathematics

Biometrics requires certain background in probability and statistics. Background in sampling theory, regression analysis, nonparametric statistics and generalized linear models are essential to understanding the fundamentals of biometry and biometrics. Students in our industrial mathematics program would find Biometrics course beneficial. These students may also work on their capstone projects in biometrics area.

LABORATORY SETTINGS

Department of Computer Science, Mathematics and Engineering has a PC lab dedicated to networking and

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security. We plan to equip this lab with essential biometrics devices for students to conduct hands-on lab in biometrics. We have set aside departmental budget for the following software and hardware for biometrics lab sessions.

- MegaMatcher Software Development Kit. Including 1 Cluster Server, 2 Cluster Nodes, 1 MegaMatcher Server and 2 Client licenses.
- MegaMatcher additional Client License
- Futronic FS80 2.0 Pro USB Fingerprint scanners
- Security camera

A semester long lab project will be assigned to each student team to develop a full-featured biometrics application consisting of biometrics devices, computing hardware and software applications. Student teams will have flexibility to choose the team projects, ranging from blood vessel authentication system, biometrics enhanced distance learning community, to a human resource management system that requests employees to use hand geometry or fingerprint to sign on when they arrive to work and sign out when they are ready to go home.

SUMMARY AND FUTURE WORK

This paper describes a biometrics course that is designed for students in Biometrics and Security degree program and those in general STEM (Science, Technology, Engineering and Mathematics) programs. We believe the Biometrics course we developed would provide valuable reference for educators in Computer Science, Computer Engineering, and Information Technology areas.

The course development is still an ongoing effort. We plan to have the course officially offered in 2010-2011 academic year. However, some experiments are being conducted in other courses already. For example, the biometrics lab components are being used in Network Security class in Spring 2010. We plan to demonstrate our result in using biometrics in network security class in the section conference.

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