Hand Biometrics Technology

Provided by TryEngineering - www.tryengineering.org

Lesson Focus

Lesson focuses on engineering applications of biometric technologies for identification or security applications. After exploring hand geometry biometrics, students work in teams of "engineers" to evaluate pros and cons of incorporating a hand recognition biometric technology into a new security system for a museum.

Lesson Synopsis

The Hand Biometrics Technology lesson not only explores how engineers incorporate biometrics technologies into products, but also explores the challenges of engineers who must weigh privacy, security and other issues when designing a system. Students explore different biometrics techniques, find their own hand geometry biometrics, then work in teams of "engineers" to design a high-tech security system for a museum.

Age Levels

8-18.

Objectives

- Learn about biometrics technology.
- Learn about engineering product planning and design.
- Learn about meeting the needs of society.
- Learn about teamwork and working in groups.

Anticipated Learner Outcomes

As a result of this activity, students should develop an understanding of:

- biometrics technology
- problem solving
- teamwork

Lesson Activities

Students learn how biometrics technologies have been used worldwide to address security and identification systems. Student teams are then challenged with evaluating and deciding whether a hand geometry-based biometric technology would be the right choice for admitting employees to a museum. Student teams present their recommendations to other teams.

Resources / Materials

- Teacher Resource Document (attached)
- Student Worksheets (attached)
- Student Resource Sheet (attached)

Alignment to Curriculum Frameworks

See attached curriculum alignment sheet.

Internet Connections

- TryEngineering (www.tryengineering.org)
- BBC Interactive Exhibit of Biometric Technology (http://news.bbc.co.uk/2/shared/spl/hi/guides/456900/456993/html/)
- National Biometric Security Project (www.nationalbiometric.org)
- ITEA Standards for Technological Literacy: Content for the Study of Technology (www.iteaconnect.org/TAA)
- National Science Education Standards (www.nsta.org/publications/nses.aspx)

Recommended Reading

- Biometric Technologies and Verification Systems (ISBN: 0750679670)
- Handbook of Multibiometrics (International Series on Biometrics) (ISBN: 0387222960)

Optional Writing Activity

- Write an essay or a paragraph about the ethical implications of introducing biometrics into a school setting, such as for allowing student access to a building, or to tracking lunchroom spending patterns.

Hand Biometrics Technology

For Teachers:
Teacher Resource

◆ Lesson Goal

Lesson focuses on engineering applications of biometric technologies for identification or security applications. After exploring hand geometry biometrics, students work in teams of "engineers" to evaluate pros and cons of incorporating a hand recognition biometric technology into a new security system for a museum.

◆ Lesson Objectives

- Learn about biometrics technology.
- Learn about engineering product planning and design.
- Learn about meeting the needs of society.
- Learn about teamwork and working in groups.

◆ Materials

- Student Resource Sheet
- Student Worksheets
  - One set of materials for each group of students: pencils, blank sheets of paper, ruler, copies of all hand geometry codes for the class.

◆ Procedure

1. Show students the various Student Reference Sheets. These may be read in class, or provided as reading material for the prior night's homework.
2. Have students work in pairs, so each student determines their own personal hand geometry code, then determines the code of their partner.
3. Divide students into groups of 2-3 students, providing a set of materials per group.
4. Explain that students must work in teams of "engineers" to determine the results of the hand geometry code samples in order to determine if a hand recognition biometrics technology system should be used when developing a security system for a museum.
5. Students complete evaluation and reflection sheets, write out their recommendations, and then present their recommendations to the class.

◆ Time Needed

One to two 45 minute sessions.

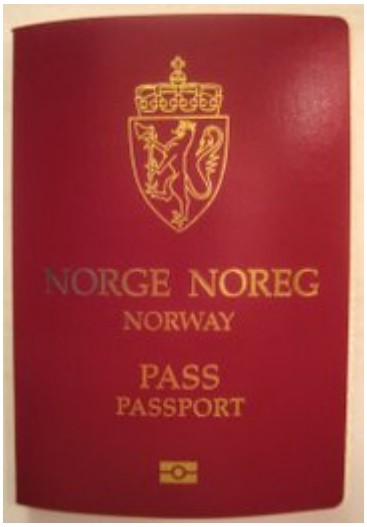
Hand Biometrics Technology

Student Resource:
What is Biometrics?

Biometrics (ancient Greek: bios ="life", metron ="measure") is the study of methods for uniquely recognizing humans based upon one or more intrinsic physical or behavioral traits. In information technology, "biometric authentication" refers to technologies that measure and analyze human physical and behavioral characteristics for authentication purposes. Examples of physical (or physiological or biometric) characteristics include fingerprints, eye retinas and irises, facial patterns and hand measurements, while examples of mostly behavioral characteristics include signature, gait and typing patterns.

◆ Sample Applications

1. Since the beginning of the 20th century, Brazilian citizens have used ID cards that incorporate fingerprint-based biometrics.
3. Microsoft has introduced a fingerprint reader that prevents computers from being used by unauthorized people.
2. Some countries have implemented biometric passports that combine paper and electronic identity -- using biometrics to authenticate the citizenship of travelers. The passport's critical information is stored on a tiny RFID computer chip.



The icon to the left is incorporated onto most biometric passports to indicate the technology.

◆ Hand Geometry Biometrics

Hand geometry is a biometric that identifies users by the shape of their hands. Hand geometry readers measure a user's hand along many dimensions and compare those measurements to measurements stored in a file.

Viable hand geometry devices have been manufactured since the early 1980s, making hand geometry the first biometric to find widespread computerized use. It remains popular; common applications include access control and time-and-attendance operations.

Since hand geometry is not thought to be as unique as fingerprints or retinas, fingerprinting and retina scanning remain the preferred technology for high-security applications. Hand geometry is very reliable when combined with other forms of identification, such as identification cards or personal identification numbers. In large populations, hand geometry is not suitable for so-called one-to-many applications, in which a user is identified from his biometric without any other identification.

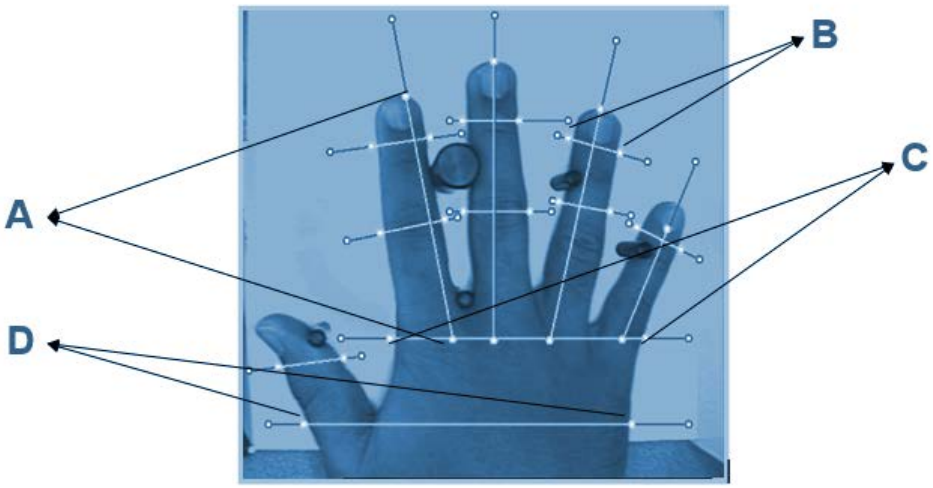
Student Worksheet:
Biometrics and Hand Geometry

◆ Biometrics and Hand Geometry

Biometric templates contain information extracted from biometric traits. The resulting codes can be used for identification in a variety of situations. In this activity, you'll determine your own personal hand geometry code.

Step One:
1. Trace your right hand on a piece of paper, keeping the pencil as close to your skin as possible.
2. Using a ruler, measure the following in centimeters (see diagram below):

A: Distance from index fingertip to bottom knuckle _____cm
B: Width of ring finger, measured across the top knuckle _____cm
C: Width of palm across 4 bottom knuckles _____cm
D: Width of palm from middle knuckle of thumb across hand _____cm



Record the 4 numbers in A, B, C, D order, which is your personal hand geometry code:

____ _____ _____ _____

Step Two:
1. Have someone else in your class trace your right hand, and repeat the measurements above. Record the 4 numbers in A, B, C, D order…are there any differences?

____ _____ _____ _____

(Note: Biometric information on this page is provided by and used with the permission of The National Biometric Security Project (NBSP). Duplication is permitted for educational purposes only.)

Hand Biometrics Technology

Student Worksheet:

You are a team of computer engineers meeting to determine whether personal hand geometry templates or numbers would be unique enough to serve as an element in a new security system for a museum.

◆ Research/Preparation Phase

Each student should determine their own hand geometry template code. A copy of each should be distributed to each team.

◆ Evaluation Phase

As a team, examine the geometry templates you have received. These will represent the codes of staff that need to access the museum during evening hours to check on the security of a group of priceless paintings. Discuss and answer the following questions to help form your plan for incorporating biometrics into the museum's new security system.

1. How similar were the geometry template codes you examined? What did you observe that was most similar? What did your team determine to be different in the group?

2. What problems do you envision an employee might encounter as they placed their hand in the biometric scanning device?

3. Are there any guidelines your engineering team would recommend regarding either capturing the codes from each employee, or in scanning the employee's hand at the entrance to the museum?

4. Do you think that fingerprint scans would be more effective? Why? Why Not?

◆ Presentation

As a team, present the results of your engineering team's evaluations to the rest of your class.

Hand Biometrics Technology

Student Worksheet: Reflection

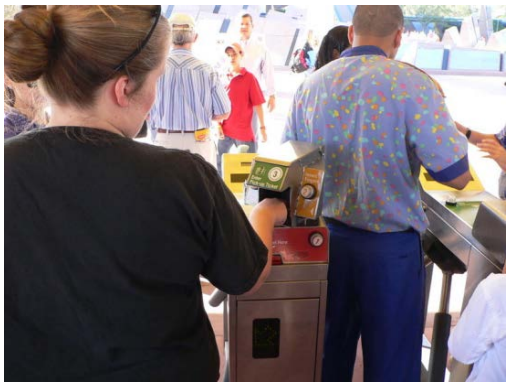
Biometrics can be applied to many situations, such as computer login security, employee recognition, time or attendance record systems, and voter identification. As a team of "engineers" describe three other situations where you think engineers should consider incorporating biometrics technology to solve problems. Please indicate whether any of these situations might warrant at two-level system, where hand biometrics is one of the two levels of verification:

1.

2.

3.

At Walt Disney World, biometric measurements are taken from the fingers of guests to ensure that the person's ticket is used by the same person from day to day. Do you have privacy concerns about this? Why? Why not? If you were part of the engineering team on this project, what would you do to ensure privacy?



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For Teachers: Alignment to Curriculum Frameworks

Note: Lesson plans in this series are aligned to one or more of the following sets of standards:

- U.S. Science Education Standards (http://www.nap.edu/catalog.php?record_id=4962)
- U.S. Next Generation Science Standards (http://www.nextgenscience.org/)
- International Technology Education Association's Standards for Technological Literacy (http://www.iteea.org/TAA/PDFs/xstnd.pdf)
- U.S. National Council of Teachers of Mathematics' Principles and Standards for School Mathematics (http://www.nctm.org/standards/content.aspx?id=16909)
- U.S. Common Core State Standards for Mathematics (http://www.corestandards.org/Math)
- Computer Science Teachers Association K-12 Computer Science Standards (http://csta.acm.org/Curriculum/sub/K12Standards.html)

◆National Science Education Standards Grades K-4 (ages 4 - 9)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- ✦ Abilities necessary to do scientific inquiry
- ✦ Understanding about scientific inquiry

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- ✦ Abilities of technological design
- ✦ Understanding about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop understanding of

- ✦ Science and technology in local challenges

◆National Science Education Standards Grades 5-8 (ages 10 - 14)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- ✦ Abilities necessary to do scientific inquiry
- ✦ Understandings about scientific inquiry

CONTENT STANDARD E: Science and Technology

As a result of activities in grades 5-8, all students should develop

- ✦ Abilities of technological design
- ✦ Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop understanding of

- ✦ Risks and benefits
- ✦ Science and technology in society

◆National Science Education Standards Grades 9-12 (ages 14-18)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- ✦ Abilities necessary to do scientific inquiry
- ✦ Understandings about scientific inquiry

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- ✦ Abilities of technological design
- ✦ Understandings about science and technology

For Teachers:
Alignment to Curriculum Frameworks (continued)

◆National Science Education Standards Grades 9-12 (ages 14-18)

CONTENT STANDARD F: Science in Personal and Social Perspectives

As a result of activities, all students should develop understanding of

- Science and technology in local, national, and global challenges

CONTENT STANDARD G: History and Nature of Science

As a result of activities, all students should develop understanding of

- Historical perspectives

◆Next Generation Science Standards Grades 3-5 (Ages 8-11)

Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

- 4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.

Engineering Design

Students who demonstrate understanding can:

- 3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2.Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

◆Next Generation Science Standards Grades 6-8 (Ages 11-14)

Engineering Design

Students who demonstrate understanding can:

- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

◆Principles and Standards for School Mathematics

Number and Operations Standard

As a result of activities, all students should develop

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
- Compute fluently and make reasonable estimates.

Connections Standard

As a result of activities, all students should develop

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- Recognize and apply mathematics in contexts outside of mathematics.

◆ Common Core State Standards for School Mathematics Grades 2-8 (ages 7-14)

Measurement and data

- Measure and estimate lengths in standard units.

- CCSS.Math.Content.2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
- CCSS.Math.Content.2.MD.A.3 Estimate lengths using units of inches, feet, centimeters, and meters.

For Teachers:
Alignment to Curriculum Frameworks (continued)

◆Standards for Technological Literacy - All Ages

The Nature of Technology

- Standard 1: Students will develop an understanding of the characteristics and scope of technology.
- Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Technology and Society

- Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.
- Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

Design

- Standard 8: Students will develop an understanding of the attributes of design.
- Standard 9: Students will develop an understanding of engineering design.
- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Abilities for a Technological World

- Standard 11: Students will develop abilities to apply the design process.
- Standard 13: Students will develop abilities to assess the impact of products and systems.

The Designed World

- Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
- Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.