PATHWAY: Manufacturing

COURSE: Robotics and Automated Systems

UNIT: 7-Sensors

INTRODUCTION

Annotation:

In this unit students will discover the various methods of providing inputs to the micro controller, allowing the robot to react to stimuli.

Grade(s):

	9th
X	10th
X	11th
X	12th

Time:

5 hours

Author:

Emil L. Decker

Additional Author(s):

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

FOCUS STANDARDS

GPS Focus Standards:

ENGR-RAS-1. Students will explain the history of automated systems and the benefits of those systems to manufacturing in a global society.
ENGR-STEM-1. Students will recognize the systems, components, and processes of a technological system.
ENGR-STEM-6. Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

GPS Academic Standards:

SCSh7. Students will analyze how scientific knowledge is developed.
SCSh3. Students will identify and investigate problems scientifically.
SCSh6. Students will communicate scientific investigations and information clearly.
MM3P3. Students will communicate mathematically.
MM3P4. Students will make connections among mathematical ideas and to other disciplines.

National / Local Standards / Industry / ISTE:

UNDERSTANDINGS & GOALS

Enduring Understandings:

- Students will discover the various methods of providing inputs to the micro controller, allowing the robot to react to stimuli. Sensors include optical, tactile, ultrasonic, and sound devices.

Essential Questions:

- What is the purpose of sensors in robotics?
- What sensor would be best used for a given robotic task?
- Give 4 examples of sensors used in robotics.
- Describe the process through which a sensor is installed, adjusted, and programmed.

Knowledge from this Unit:

- Students will be able to identify the major types of sensors used in robotics
- Students will be able to describe how to install and adjust sensors on the robot
- Students will be able to describe how to program specific sensors to perform a task

Skills from this Unit:

- Students will develop their critical thinking skills while completing this unit.

ASSESSMENT(S)

Assessment Method Type: Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

__X__ Pre-test
__X__ Objective assessment - multiple-choice, true- false, etc.
  __ Quizzes/Tests
  _x_ Unit test
__X__ Group project
__X__ Individual project
_____ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
  _x_ Self-check rubrics
  __ Self-check during writing/planning process
  __ Journal reflections on concepts, personal experiences and impact on one's life
  __ Reflect on evaluations of work from teachers, business partners, and competition judges
  __ Academic prompts
  _x_ Practice quizzes/tests
_____ Subjective assessment/Informal observations
  __ Essay tests
  _x_ Observe students working with partners
  __ Observe students role playing
_____ Peer-assessment
  __ Peer editing & commentary of products/projects/presentations using rubrics
  __ Peer editing and/or critiquing
_____ Dialogue and Discussion
  __ Student/teacher conferences
  _x_ Partner and small group discussions
  __ Whole group discussions
  __ Interaction with/feedback from community members/speakers and business partners
_____ Constructed Responses
  __ Chart good reading/writing/listening/speaking habits
  __ Application of skills to real-life situations/scenarios
__x__ Post-test

Assessment(s) Title:

Sensor Based Feedback Systems

Assessment(s) Description/Directions:

Assessment will provide students with the opportunity to select appropriate sensors for robotic systems, describe installation methods, and programming scenarios.

Attachments for Assessment(s):

http://www.robotshop.ca/sensors.html
http://www.robotstorehk.com/index.html
http://www.handyboard.com

LEARNING EXPERIENCES

Sequence of Instruction

1. **Identify the Standards. Standards should be posted in the classroom for each lesson.**
2. **Review Essential Questions.**
3. **Identify and review the unit vocabulary.**
4. **Assessment Activity.**

   Step 1:
   Discuss the types of sensors and uses of those sensors in manufacturing. Show the presentation on sensors. (*see Robot Sensors.ppt & Robotic Sensors.doc)*

   Step 2:
   Use sensors from the robotics training resources available to your district to install a sensor system on a robot. *(see Sensor Practical Exam.doc)*

   Step 3:
   Review vocabulary associated with sensors. *(see Sensor Crossword.doc)*

   Step 4:
   Take Unit exam. *(see Sensor Based Feedback System.rtf)*

Attachments for Learning Experiences:

Notes & Reflections:

Sensors are often the last item purchased when procuring robotic training systems. Tele-operations, or simple programming for motor manipulation via time on/off is often as far as the money goes. If the funding exists, sensors are a great option. Sensors are available for the major systems, (i.e. LEGO, VEX, TETRIX, etc.) Generic sensors are also available from vendors.

http://www.robotshop.ca/sensors.html Contains LEGO, VEX, INEX, PHIGETS, and a slew of other custom components for robot construction.

http://www.robotstorehk.com/index.html Another supplier of parts. Authorized distributor for the MIT Handy Board.
http://www.handyboard.com/ Handy Board is a stripped down (cheaper) version of the early RCX Lego controller, minus the case. Programs in a version of LOGO. Great for custom robotic projects.

Negotiating a maze using ultrasonic, line tracker, or bump sensors is a common goal that can be challenging, but not impossible. A maze can be constructed of 2 x 4's, and a plywood base.

Lines can be taped on the floor for line following robots. A piece of white shower board from a building supply store can have lines drawn, erased, and redrawn using expo marker board pens. Schools fortunate enough to have the rubber tiles used in VEX and FTC competitions can use the gray side, with white lines taped on them.

A simple use of a sensor is to install two touch sensors on either end of a robot. It will run till it bumps into something. Then have it reverse directions, and run till it bumps into something else.

The same concept is applied when you use an ultrasonic sensor. When the robot senses that it is about to run into an object, program it to turn and go a different direction.

Numerous books have been written about programming the LEGO sensors. I cannot recommend one over the other, but they can be found on Amazon, and in bookstores everywhere.

Information on sensors can possibly be found on forums dedicated to robotics, such as www.chiefdelphi.com, http://www.vexfan.com/ , and http://www.vexforum.com/ . Many folks on these forums are willing to help you solve problems and give advice. You may have to register and become a member, but it is free.

Check into communities that promote and participate in the FLL, First Lego League competitions for elementary and middle schools. There are often workshops held to help train the teacher / sponsor during the summer, as well as robotic institutes and academies from colleges such as Carnegie Mellon http://www.education.rec.ri.cmu.edu/ and possibly other locations during the summer. Request and encourage your professional educators associations (GETEA) to provide workshops and training.

Chapter 7 Sensor Exam is available as an Exam Pro document, an RTF, and Zipped for inclusion in blackboard, angel, or CT Web (may or may not import).

CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Design a Feedback System

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Students will design a feedback system using a sensor on a robot of their design. Based on the robotic kits available within the school system, this sensor based configuration may be as simple as a bump switch to turn off a robot when it hits an object such as a wall, to a more sophisticated design such as a line tracking robot.

Attachments for Culminating Performance Task:

(See Sensor Practical Exam documents.)

UNIT RESOURCES

Web Resources:

Attachment(s):

Materials & Equipment:

What 21st Century Technology was used in this unit:

x	Slide Show Software		Graphing Software		Audio File(s)
	Interactive Whiteboard		Calculator		Graphic Organizer
	Student Response System		Desktop Publishing		Image File(s)
	Web Design Software		Blog	x	Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email	x	Website		