

Unit 1 Introduction to Robotics Systems

Overview

Purpose

The purpose this unit is to provide students with an introduction to robotics systems by first discussing the fundamental concepts of Technology Education. Students will discuss the development of robotics and discuss the impact of these technologies on society. This unit is organized using the following topics.

Topic 1: Introduction to Technological Systems and Subsystems

Topic 2: Robotics Overview

Topic 3: Introduction to Robotics Systems

Profile

This unit provides a context for the study of robotics systems. Students will explore the fundamentals of Technology Education as the purposeful study of humans' efforts to develop products that help them in their everyday lives. Students will explore the basics of systems and subsystems and the components that make up systems and subsystems. In addition, this unit, will have students exploring the basic components that are common to most robots.

Implementation

This unit is intended to help students develop a context or a broad knowledge of concepts that will follow in the course. It provides an opportunity to spark the students interest in robotics before they get into the more advanced units. This unit should be completed in not more than 10 hours of class

time. Consideration should be given to integrating parts of this unit with other units in the course

Evaluation

Evaluation

Evaluation will focus primarily on students' understanding of the information contained in the unit. Although activities and evaluation suggestions are offered with each topic, it is not intended that significant detail be covered, or that students engage in any great depth of treatment. Unit 1 should account for 10% of the evaluation for Robotic Systems Technology 3205

Outcomes and Strategies

Topic 1: Introduction to Technological Systems and Subsystems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.1.1 differentiate between science and technology. [3.402,3.403]

Suggested Teaching and Learning Strategies

For the Teacher

The purpose of this outcome is to help students understand the difference between science and technology and how science impacts the study of technology.

Points to Emphasize

- Science is the study of naturally occurring phenomena with a view to gaining more knowledge about the universe.
- Technology is human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities.
- Technology education is a study of technology, which provides an opportunity for students to learn about the processes and knowledge related to technologies that are needed to solve problems and extend human capabilities.
- The study of technology relies heavily on the application of scientific principles.

For the Student

Break the class into teams. Provide each team with an artifact

Have each group discuss:

- the underlying scientific principles
- process from which the artifact was created
- its ability to solve a technological problem

Have each team present their findings to the class.

Artifacts Could include:

- a travel coffee mug.
- a tool box.
- a desktop fan
- a swivel chair

Topic 1: Introduction to Technological Systems and Subsystems

Suggested Assessment and Evaluation Strategies

Presentation

Students could be given an artifact of technology and asked to present to the class the underlying scientific principles, processes by which the artifact was created and the technological problem it solves.

Pencil and Paper

Write a definition of the terms science and technology and differentiate between the two.

Journal

- Differentiate between science and technology and give examples of each demonstrating how they are similar and different.
- Provide several objects and have the students **journal** about why each object is categorized as either science or technology.

Resources

www.cdli.ca:

Integrated Systems 1205

Unit 1 - ILO 1-3

Topic 1: Introduction to Technological Systems and Subsystems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.1.2 analyze examples of technology as a process and technology as a product. [3.403, 3.402]

Suggested Teaching and Learning Strategies

For the Teacher

The purpose of this outcome is to help students explore the relationship between the technological process and technology as an outcome of that process.

Points to Emphasize

- The process component, which includes designing, developing the solution, testing and evaluating, redesigning, testing and implementing technological solutions to problems, is the major element of Technology Education. It involves different kinds of knowledge and the development of a wide variety of technical skills and capabilities.
- The product component, which many people consider to be technology, occurs only as a consequence of technological activity. Technological products, sometimes called artifacts and other times called goods and services, are the obvious and visible components of technology.
- It is the process component that solves the problems, uses the resources, creates and solves human, social, and environmental problems.

For the Student

Have the students refer to the artifact from 1.101 and outline the process and product components.

Topic 1: Introduction to Technological Systems and Subsystems

Suggested Assessment and Evaluation Strategies

Presentation

Have students select a technology product, research this product, including the history of how the product evolved over time, what process are involved in producing this product. Present their findings to the class.

Journal

Students could write about a number of technological artifacts they encounter in their everyday lives and state the product and process component of each.

Resources

www.cdli.ca:

Integrated Systems 1205

Unit 1 - ILO 1-3

Topic 1: Introduction to Technological Systems and Subsystems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.1.3 describe the Universal Systems Model. [3.401, 3.402]

Delineation:

Systems

Subsystems

Feedback

Outcomes

Suggested Teaching and Learning Strategies

For the Teacher

The purpose of this outcome is to introduce students to the idea that all technological systems can be described in general terms by the Universal Systems Model.

Points to Emphasize

- A system is a collection of parts which can do something together that none of the parts can do independently. Systems are made for a purpose.
- There is a simple model which describes in very general terms how all systems work. That model is the Universal Systems Model.
- This model consists of input, process, output, and feedback. Input is what is put into the system process is how the system does it; output is what the system does; feedback provides information to the system so that adjustments can be made to input and/or the process.
- Outcomes are the consequences of using the system (i.e. desired, undesired expected, unexpected)

For the Student

Set up a role play so that each team of students takes on a different component of the Universal Systems Model. Have them act out the input, process, output, and feedback components.

Topic 1: Introduction to Technological Systems and Subsystems

Suggested Assessment and Evaluation Strategies

Performance

Have students create a one act play demonstrating an example of the universal systems model.

Pencil and Paper

Select a system or subsystem, sketch a diagram of the universal systems model and explain the parts of the model.

Journal

Select a complex system, from everyday life and write about its subsystems of this system.

Resources

www.cdli.ca:

Integrated Systems 1205:
Unit 1 - ILO 1-3

Topic 2: Robotics Overview

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.2.1 develop a definition for robotics systems.

Suggested Teaching and Learning Strategies

For the Teacher

Robotics is the science and technology of robots. This is almost a circular definition. The more important question becomes, “what is a robot?”

Points to Emphasize

A robot has several but not necessarily all of the following features. It:

- Moves
- Senses
- Reacts
- Can be Programmed
- Is under human control

There are a variety of definitions available both online and in texts, but these functions encompass most.

A discussion of how different types of robots relate to the definition of robotic systems will occur later in the course.

For the Student

Students could research a variety of definitions of robot and robotics. These should be placed in a chart for comparison purposes. Once completed students could take the common elements of each definition to try and create a definition of their own.

Topic 2: Robotics Overview

Suggested Assessment and Evaluation Strategies

Presentation (Covers outcomes: 1.2.1, 1.2.2, 1.2.3, 1.2.4)

Create an electronic presentation that covers the following topics:

- Definition a robot
- Two examples of industries that use robots at the local, national and international level.
- Take one of the researched robots and describe the series of tasks that the robot commonly performs.
- List a career associated with this industry and the duties this person performs.

Create a collage of robotic images from the past present and future illustrating the features of robots.

Pencil and Paper

Create a concept map illustrating the features required to be a robot.

Using the internet, research a variety of definitions of robotics and identify the common elements of each.

Resources

Authorized Resource:

Robot Builders Bonanza p. 10

Topic 2: Robotics Overview

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.2.2 identify examples of industries that use robotics systems.

Delineation:

Local
National
International

Suggested Teaching and Learning Strategies

For the Teacher

This outcome is intended to insure that students have a chance to develop a real world context for robotics in industry. Local industries should be highlighted as much as possible.

Points to Emphasize

The main areas in industry that use robotics heavily are manufacturing and fabrication. The number of robots in the entertainment/service area far outweigh any of the other sectors. The common tasks undertaken by robots, and their capabilities dictate the specific industries that would use them.

For the Student

Students could brainstorm the different industries that use robots. Specifically identifying industries in Newfoundland and Labrador.

As an extension, students could envision what future robots could be doing to support industries in which they are not currently used.

Topic 2: Robotics Overview

Suggested Assessment and Evaluation Strategies

Presentation (Covers outcomes: 1.2.1, 1.2.2, 1.2.3, 1.2.4)

Create an electronic presentation that covers the following topics:

- Definition a robot
- Two examples of industries that use robots at the local, national and international level.
- Take one of the researched robots and describe the series of tasks that the robot commonly performs.
- List a career associated with this industry and the duties this person performs.

Create a collage of robotic images from the past, present and future illustrating the features of robots.

Have students select local, national or international and research how industries use robotics systems and present their findings to the class.

Pencil and Paper

Students could brainstorm the different industries that use robots, looking at the types of manufacturing that may lend itself to this type of robot use.

Resources

ehow.com:

How are Robots Used in Industry

http://www.ehow.com/how-does_4572605_how-robots-used-industry.html

Topic 2: Robotics Overview

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.2.3 list and describe a series of tasks that robots commonly perform in industry.

Suggested Teaching and Learning Strategies

For the Teacher

There is a lot of consistency in the roles robots play in modern industry. This outcome provides an opportunity to explore these roles.

Points to Emphasize

The most common tasks robots perform are:

- dangerous or hazardous
- repetitive
- requiring precision

Bomb disposal and assembly line production are examples of these kinds of tasks. Humans lack the capability, which robots have, to perform the same task, the same way, every time.

For the student

Students could develop a list of tasks that robots undertake in industry. This could be done first as a whole class exercise, with brainstorming, and then developed into a more individualized activity.

Students could also break down the number of industries using robots, and through this discover the types of robots being used around the world

Topic 2: Robotics Overview

Suggested Assessment and Evaluation Strategies

Journal

Students could write about a futuristic industry where robots are performing very high end intelligent tasks.

Presentation (Covers outcomes: 1.2.1, 1.2.2, 1.2.3, 1.2.4)

Create an electronic presentation that covers the following topics:

- A working definition of robotics
- Two examples of industries that use robots at the local, national and international level.
- Take one of the researched robots and describe the series of tasks that the robot commonly performs.
- List a career associated with this industry and the duties this person performs.

Create a collage of robotic images from the past present and future illustrating the features of robots.

Each student should select a real world robot and present the common tasks performed by the robot to the class.

Students could develop a list of tasks that robots undertake in industry. This could be done first as a whole class exercise, with brainstorming, and then developed into a more individualized activity.

Resources

Authorized Resource:

Robot Builders Bonanza pp. 10-22

Topic 2: Robotics Overview

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.2.4 identify careers associated with robotics systems.

Suggested Teaching and Learning Strategies

For the Teacher

Through this outcome students will have the opportunity to explore some of the labor market trends in electronics and control, as it applies to robotics systems.

Points to Emphasize

- Careers in robotics revolve around designing, building, maintaining and operating robots.
- Design elements would entail careers centered on engineering and electronics.
- Building would also entail careers centered on engineering and electronics.
- Maintenance and use of robots are one of the few areas for which specific programs in post-secondary are available. For example, Memorial University of Newfoundland, offers an ROV operator program at the Marine Institute.

For the Student

Students could research post-secondary programs that are specific to and may lead into a career in robotics.

Students could also research the National Occupational Classification list to identify careers specific to robotics. This research could include hire-ability, future outlook and qualifications.

Topic 2: Robotics Overview

Suggested Assessment and Evaluation Strategies

Presentation (Covers outcomes: 1.2.1, 1.2.2, 1.2.3, 1.2.4)

Create an electronic presentation that covers the following topics:

- A working definition of robotics
- Two examples of industries that use robots at the local, national and international level.
- Take one of the researched robots and describe the series of tasks that the robot commonly performs.
- List a career associated with this industry and the duties this person performs.

Create a collage of robotic images from the past present and future illustrating the features of robots.

Pencil and paper

Students could research the National Occupational Classification list to identify careers specific to robotics.

This research could include hire-ability, future outlook and qualifications.

Resources

Government of Canada:

Human Resource and Skills
Development Canada

National Occupational
Classification

<http://www5.hrsdc.gc.ca/noc/english/noc/2006/welcome.aspx>

Topic 2: Robotics Overview

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.2.5 discuss the sustainability of robotics as it applies to economic, social and cultural issues.

Suggested Teaching and Learning Strategies

For the Teacher

This outcome requires students to be able to discuss some of the most fundamental economic, social, and cultural issues relating to the development and use of robots in industry.

Points to Emphasize

Sustainable industries are those that meet the needs of today without comprising the ability of future generations to meet their needs (World Commission on Environment and Development, 1997). In addition to the environment, it is concerned with economic, social and cultural issues.

There are many issues that can be reflected on when exploring the sustainability of the use of robotics in industry.

- If a country has an unskilled labor force and robots are introduced in their labor intensive industries, what happens to the displaced unskilled labor force?
- What are the cultural implications of a large displaced unskilled and uneducated labor force? What does the future of this society hold. If the unskilled displaced workers have no way to feed their families, they may turn to a life of crime to provide the basics of life. What does this do to the society of the country involved?

For the Student

Students could research case studies where robotics have been integrated into industry in developing countries and the developed world.

Topic 2: Robotics Overview

Suggested Assessment and Evaluation Strategies

Performance

In teams students could organize a debate between the industrialists and those concerned with social justice. They could debate the advantages and disadvantages of integrating robotics into industries.

Presentation

Students could be divided into teams. Each team is given a different country. Each team is assigned a scenario of an industry in their particular country introducing robotics. Each team is given the role of CEO of a company and could develop a plan for a sustainable introduction of robotics in their particular company. Each CEO will present their plan to the class.

Journal

Students could **journal** about how their personal perspective on sustainability has broadened since doing this section of the course.

Resources

United Nations Department of Economic and Social Affairs:

Division of Sustainable Development

http://www.un.org/esa/dsd/index.shtml?utm_source=OldRedirect&utm_medium=redirect&utm_content=dsd&utm_campaign=OldRedirect

Topic 2: Robotics Overview

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.2.6 list and describe the milestones of robotics development in history.

Suggested Teaching and Learning Strategies

For the Teacher

This outcome provides students with an opportunity to establish a context for the development of robotics.

Points to Emphasize

Milestones could include but are not limited to:

- Leonardo DaVinci designed and possibly built the first robot in 1495
- Automated machines (first programmed looms, 1801) see also Jacquard loom.
- Development of automated production lines from 1920's-1940's
- First electronic computing machine, 1940
- Transistor developed, 1947
- First programmable robot, 1954
- First industrial robot, 1960
- First microchip, 1961
- First industrial robot on a production line, 1962 (GM)
- Robot arms used on Viking 1 and 11 space probes, 1976
- Microcomputer control introduced to robotics in 1977

Starting in 1980 a new robot company entered the market every month

The microchip has been dubbed one of the most significant discoveries in electronics since the transistor. The milestones ended at 1980, because the development of robotics exploded after the wide scale use of microchips.

For the Student

Students could map these milestones out in a timeline. Students could have a discussion of the various milestones.

Topic 2: Robotics Overview

Suggested Assessment and Evaluation Strategies

Performance

Students could also develop an electronic presentation that would encompass, in greater detail, all of the significant milestones in robotics history.

Presentation

Students could develop a list of milestones for either the microchip or autonomous robotics. This could be presented to the whole class.

Pencil and Paper

Students could map these milestones out in a timeline. A discussion of the importance of each of the milestones should be done within the timeline.

Resources

Bloomberg Business Week Online:

http://www.businessweek.com/magazine/content/01_12/b3724010.htm

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.3.1 explain the principles behind the operation of simple machines.

Delineation:

Inclined plane

Lever

Suggested Teaching and Learning Strategies

For the Teacher

This outcome will have students exploring some of the most basic mechanisms associated with robotics.

Points to emphasize:

- There are two types of simple machines; inclined planes (ramp) and lever.
- Screws and wedges are variations of inclined planes.
- The screw is an inclined plane wrapped around a cylinder.
- The wedge is essentially a pair of inclined planes.
- Pulleys and wheel and axles are variations of levers.
- Gear systems and sprocket and chain systems used in robotic mobility are wheel and axles.
- These simple machines are used in robotics to create more complex machines.

For the Student

Students could describe a series of simple machines used in everyday life. In each case they could specify how the machine aids or has a mechanical advantage.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Performance

Have students select a specific example of a simple machine and create a short video identifying the simple machine and explaining its basic principles of operation.

Presentation

Have each student bring in one example a simple machine and explain its operation to the class.

Pencil and Paper

Students could identify the examples of simple machines present in their classroom.

Journal

Students could describe a series of simple machines used in everyday life. In each case they should specify how the machine aids or has a mechanical advantage.

Resources

www.cdli.ca:

Intermediate Technology
Education - Control

Topic 3 - Mechanical Systems

Gears and Pulleys:

<http://www.technologystudent.com/gears1/geardex1.htm>

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.2 identify the main sub-systems of a robot.

Delineation:

Tools
Motion
Power
Chassis
Sensors
Controller

Suggested Teaching and Learning Strategies

For the Teacher

This outcome is intended to provide students the opportunity to explore the basic subsystems of a robot.

Points to Emphasize

A robot is a system of interconnected components. Each of the sub-systems can collectively act to perform a task. A simple comparison can be made to the human body.

Tools - Hands

Motion - Arms and legs

Power - Heart and lungs

Chassis - Torso

Sensors - Senses

Controller - Brain

Each comparison articulates the six sub-systems and gives a sense of what they do in the whole robot.

For the Student

Students could discuss the different subsystems and in each case debate how each one is or is not included in one of the categories listed above. Students could also further refine the list above by breaking down the larger sub-systems into their smaller components and specifically identify at each point what human body part they most resemble.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Performance

Students could have a robot challenge. Place students in teams with one student blind folded as the robot. The student acting as robot is only allowed to respond to direct commands and must do exactly as instructed. Have the other students give specific instructions to the “robot” to perform some defined task.

Journal

Students could discuss the different sub-systems and in each case define arguments as to why or why not each one can be designated as

- Tools - Hands
- Motion - Arms and legs
- Power - Heart and lungs
- Chassis - Torso
- Sensors - Senses
- Controller - Brain

Resources

Authorized Resource:

Robot Builders Bonanza pp.
10-22

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.3 recognize how tools on a robot are applications of simple machines.

Suggested Teaching and Learning Strategies

For the Teacher

In this outcome, students will apply what they have learned in previous outcomes on simple machines.

Points to Emphasize

There are many applications of simple machines used in the robotics world. A series of specific examples is listed below:

- Gears permit movement at speeds greater or less than the direct application of the motor will allow.
- Wheels and axles give the robot mobility.
- Pulleys change direction of linear forces.
- Levers are involved in all robotic arm movement.

There are many more examples available, and students should be involved in developing this list.

For the student

Students could identify the different parts of the robot that use simple machines. This identification could include the robot part, its purposes, the machine in question and how the use of the machine makes the motion or use possible.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Journal

Reflect back on the student robot challenge and discuss some of the challenges in having the robot complete the tasks.

Performance

Using a presentation software, create a short animation illustrating the use of simple machine in robot tools.

Presentation

Sketch a picture that identifies the different parts of a robot that uses simple machines.

Paper and pencil

Students could identify the different parts of the robot that use simple machines. This identification could include the robot part, its purposes, the machine in question and how the use of the machine makes the motion or use possible.

Resources

Authorized Resource:

Robot Builders Bonanza pp. 10-22

freezeray.com:

<http://www.freezeray.com/technology.htm>

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.4 describe mechanical advantage.

Suggested Teaching and Learning Strategies

For the Teacher

In this outcome students explore the concept of mechanical advantage as it applies to simple machines. Concepts covered in previous outcomes will apply here.

Points to Emphasize

Mechanical advantage is the factor by which a machine multiplies force put into it. All simple machines have a mechanical advantage.

- A lever gains mechanical advantage by moving its fulcrum closer to where the force is needed
- A wheel and axle gains mechanical advantage by changing the ratio between the wheel and axle. The larger the ratio the greater the mechanical advantage
- A pulley system gains mechanical advantage by adding pulleys to its system and thus increasing the number of supporting ropes.

For the student

Students could experiment with a simple lever system. Placing a weight on one end and applying a force on the other. The fulcrum should be moved to either side, sometimes closer to the weight, sometimes closer to the force. Students could also chart the experimental results and try and establish the method of determining the mechanical advantage at each point.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Performance

Students could experiment with a simple lever system. Placing a weight on one end and applying a force on the other. The fulcrum should be moved to either side, sometimes closer to the weight, sometimes closer to the force.

Paper and Pencil

Students could also chart the experimental results and try and establish the method of determining the mechanical advantage at each point.

Journal

Students could write an entry indicating how they use mechanical advantage in everyday life.

Resources

Math and Science Activity Center:

http://www.edinformatics.com/math_science/simple_machines/mechanical_advantage.htm

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.5 demonstrate mechanical advantage as it applies to the motion and/or force of a robot.

Delineation

Torque vs. Speed

Suggested Teaching and Learning Strategies

For the teacher

This outcome insures that students can apply the principles of mechanical advantage in the context of motion and force.

Points to Emphasize

- A simple machine multiplies the amount of force put into it, at a factor of its mechanical advantage. The specific machine used in the mobility of a robot is the wheel and axle. This could take the form of sprocket and chain, gears or pulleys and belts.
- A motor outputs a certain amount of rotational force; known as torque. By using different mechanical advantages a motor can provide either a higher speed with a lower torque, or a lower speed with a higher torque.
- The amount of speed and the amount of torque needed will be determined by a specific task. For example in a chain and sprocket drive arrangement, if more speed is required, the sprocket on the drive motor should be larger than the sprocket on the wheel axle. If more torque is needed, to climb an incline, then the sprocket on the drive motor should be smaller than the sprocket on the wheel axle.
- Commonly the different mechanical advantages are referred to as gear ratios.
- Motor use of this type in robots is for arm movement and movement of the robot as a whole.

For the Student

Students could measure and calculate the mechanical advantage of two sprockets of different size when used on a drive motor and wheel axle.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Performance

Create a short animation illustrating the concept of mechanical advantage applied to speed and torque

Pencil and Paper

Students could measure and calculate the mechanical advantage of two sprockets of different sizes when used on a drive motor and wheel axle.

Resources

freezeray.com:

<http://www.freezeray.com/technology.htm>

Math and Science Activity Center:

http://www.edinformatics.com/math_science/simple_machines/mechanical_advantage.htm

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.6 identify common sensor types utilized in robotics.

Delineation:

Temperature
Voltage
Current
Distance
Position
Force
Pressure
Humidity
Light
PH
Contact
Sound
Infrared

Suggested Teaching and Learning Strategies

For the Teacher

This outcome sets out to insure that students can identify common sensor types. Later in the course students will be required to use these sensors in an operational robot.

Points to Emphasize

There are many different types of sensors. Sensors react to some physical phenomena and produce an electrical signal (varying a voltage or current) which is related to the change in the phenomena.

- Sensors are used to collect external data from the robot environment
- Each sensor is designed to detect specific kinds of data
- Provides the hardware required to give the robot human like senses
- Allows the robot to react to its environment

For the Student

Students could rotate through stations around the room. At each station teams of students will record the basic characteristics of each sensor and describe which human senses it represents.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Performance

Students could create a short drama where each team of students develops a character around a specific analog sensor. The team then has to act out the characteristics of that particular sensor and the rest of the class has to guess which one is being demonstrated.

Journal

Identify the application of analog sensors in your home, school and industry.

Paper and Pencil

Students could compare each analog sensor to the human sense it represents.

Resources

Authorized Resource:

Robot Builders Bonanza,
Chapter 5

Robot Builders Bonanza, p.
193

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.7 identify the two main types of actuators.

Delineation:

Linear

Rotational

Suggested Teaching and Learning Strategies

For the Teacher

The previous outcome had students exploring the components that give robot human like senses. These are the components that provide input of some sort. This outcome explores the output components or the components that allow the robot to do its job based on the sensing of external phenomena.

Points to Emphasize

Actuators are devices that cause movement. In robotics there are two main types of actuators; linear and rotational. As the names might suggest, the basic difference is that linear actuators (such as pneumatic cylinders and solenoids) cause movement in a straight line and rotational actuators (such as a basic DC drive motor) cause movement in a circular path.

For the Student

Students could identify the most appropriate applications for each type of actuator. A list should be generated and comparisons made between groups.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Performance

Student could create a short drama to demonstrate the difference between linear and rotational actuators.

Presentation

Students could do research to identify the most appropriate applications for each type of actuator. A list should be generated and presented to the class for comparisons between the types of actuators.

Pencil and Paper

Students could develop a flow chart or a thought web that uses linear and rotational actuators as its starting point. They can then populate the web with examples and related technologies.

Resources

Authorized Resource:

Robot Builders Bonanza, pp. 17-20

Robot Builders Bonanza, pp. 305 – 322

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

- 1.3.8 define the term “degrees of freedom” with respect to robotic movement.

Suggested Teaching and Learning Strategies

For the Teacher

Through the completion of this outcome students will explore another fundamental concept of robotics. Degrees of freedom is a major consideration in robotic design. It is a crucial element in the robot’s ability to do the job it was designed to do.

Points to emphasize

- Degrees of freedom are simply an axis in which a robot is able to rotate. A robot arm able to move in three full dimensions would have three degrees of freedom.
- Robots would have various degrees of freedom based on the task it is designed to do.
- Degrees of freedom is very resource intensive in robotics. In other words, adding a degree of freedom to a robot requires additional motors, fabrication and drive components.

For the Student

Students could identify the total degrees of freedom available in the human arm. Starting at the shoulder, through the elbow and wrist but not including the fingers.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Presentation

Student could create a poster of a selected robot indicating the location of axis and the degrees of freedom of the chosen robot.

Performance

Students could identify the total degrees of freedom available in the human arm. Starting at the shoulder, through the elbow and wrist but not including the fingers.

Resources

Authorized Resource:

Robot Builders Bonanza, pp. 404, 466, 471, 496

Applied Control Systems:

http://www.t4.ie/Professional_Development/RD8_Technology/Robotics/Applied%20Control%20%20Systems.ppt

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.9 identify motor types
typically used in robotics

Delineation:

Stepper
Basic DC Drive
Servo

Suggested Teaching and Learning Strategies

For the teacher

Stepper, basic DC drives and servo motors are typically used in robotics for different purposes.

Points to Emphasize

A stepper motor:

- moves from one location to another in precise steps
- usually does not have a high rotational speed
- needs a driver circuit to be accurately positioned
- is commonly used in printers, CNC routers, conveyor belts and telescopes.

A DC drive motor:

- can have continuous rotation
- can be geared to increase torque
- can rotate forward and reverse
- can have speed control
- can be used in propulsion, winch and pulley systems.

A servo motor

- has limited rotation that usually, depends on the controller (some have mechanical stops)
- consists of a geared DC motor with position feedback (electronic sensor)
- is used in control surface positioning (ailerons, rudder, steering).

For the Students

In teams, students could rotate around the room to various stations with different types of motors. Students could record the physical characteristics of the motor and suggest some of its uses.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Performance

Students could use a audio editing software to create commercials with the intent to promote the use of one of the motor types.

Presentation

Create a short animation illustrating motor types typically used in robotics.

Pencil and Paper

Students could complete a lab activity where they are required to collect information on the characteristics and uses of the various motor types.

Resources

Authorized Resource:

Robot Builders Bonanza, Ch. 19, 20, 21,22

Applied Control System

http://www.t4.ie/Professional_Development/RD8_Technology/Robotics/Applied%20Control%20%20Systems.ppt

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.10 identify drive train systems available for robot mobility.

Delineation:

Direct drive
Belt drive
Chain drive
Geared drive

Suggested Teaching and Learning Strategies

For the Teacher

After completing this outcome students will be able to identify different types of drive train systems that are available for robot mobility.

Points to Emphasize

Direct drive systems have one motor for each motive device on the robot. There is no energy transference system, as the motor is directly connected.

Belt drive uses wheels with a groove on the edge. Belts fit into the groove and friction turns the belt when the pulley is rotated (some belts have teeth that fit into lateral grooves in the wheel). Typically, two wheels are connected by a belt in this fashion. One wheel is connected to the drive motor and the second wheel is attached to the axle. The mechanical advantage results from the ratio of the different diameters of the wheels.

Chain drives are similar to belt drives. The difference lies in the use of a sprocket (toothed wheel) instead of grooved wheel and the use of a chain instead of a belt. As in the belt drive two wheels are connected by a chain, and the mechanical advantage results from the ratio of the different diameters or the ratio of the different numbers of teeth on the sprockets.

Geared drives are similar again, using toothed wheels, but direct connection between the wheels occurs. The mechanical advantage is calculated from the ratio of the different numbers of teeth on the gears. This is called the gear ratio introduced early in this topic.

For the Student

Students could prepare a presentation underlying the differences between the drive train systems. This should include the different ways that the drive train systems transfer energy, and how these make them applicable for different situations.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Presentation

Students could prepare a report identifying the differences between the drive train systems. This should include the different ways that the drive train systems transfer energy, and how these make them applicable for different situations.

Pencil and Paper

Students could sketch and label diagrams of common drive train systems.

Journal

Students could identify some drive trains that they see in their own homes.

Resources

Authorized Resource:

Robot Builders Bonanza, Ch 18
and pp. 17 – 18

IKA Logic: Small Robot Drive Trains:

http://www.ikalogic.com/tut_mech_1.php

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.11 identify common power sources used in robotics

Delineation:

Batteries

AC\DC power supplies

Suggested Teaching and Learning Strategies

For the Teacher

The most common power source for robotics is electrical. In mobile robotics it is direct current (DC) electrical power, and in stationary robotics it is typically alternating current (AC) electrical power.

Points to Emphasize

- Some power sources are internal to the robot and some are external. In the case of external an example would be some sort of tethered robot.
- Hydraulics and pneumatics can be used as power sources as well, but in fact they require electrical energy to run a pump or compressor. They are in effect an energy storage system, storing potential energy for use later.

For the Student

Students could identify common power sources used in robotics. These can be categorized by their current type, how the energy is stored and under what applications each power source is used. A discussion of tethered robotics could occur at this point, as power source is one of the differentiating factors in this area.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Presentation

Students could identify common power sources used in robotics. These can be categorized by their current type, how the energy is stored and under what applications each power source is used. A discussion of tethered robotics could occur at this point, as power source is one of the differentiating factors in this area.

Pencil and Paper

Students could complete a lab activity where they are required to investigate the common sources of power used in robotics. This could be done using a rotation setup in the classroom with a different power sources at each rotation.

Journal

Students could reflect on the types of power sources they use in their household appliances and electronics.

Resources

Authorized Resource

Robot Builders Bonanza, Ch.
17

Topic 3: Introduction to Robotics Systems

Specific Curriculum Outcomes

Robotic Systems Technology 3205

Students will be expected to:

1.3.12 differentiate between
methods of energy transfer
within robotics systems

Delineation:

Hydraulics
Pneumatics
Electromagnetic

Suggested Teaching and Learning Strategies

For the teacher

Upon completion of this outcome the student will have the ability to distinguish the various methods of energy transfer in a robotic system.

Points to Emphasize

Hydraulics is the use of a pressurized liquid to transfer energy. It is a closed system that requires a pump to maintain pressure. One advantage of hydraulics is that due to the incompressibility of the liquid it is a more efficient mode of transferring energy.

Pneumatics is the use of pressurized air to transfer energy. It is not a closed system, as waste air is vented to the atmosphere and replaced with new air pressurized by a compressor. The compressibility of the fluid (air) means that a more delicate touch in energy transference is possible. The main advantage for pneumatics is that leakage only leaks air, not a potential fluid hazard as in hydraulics.

Electromagnetic energy transfer refers to the use of electricity interacting with a magnetic fields to produce motion as in electric motors

For the student

Students could investigate the uses of hydraulics and pneumatics in robotics. This investigation should include:

- identification of areas where the two are used and;
- reasons for their selections.

Topic 3: Introduction to Robotics Systems

Suggested Assessment and Evaluation Strategies

Presentation

Students could be divided into groups and asked to investigate methods of energy transfer within robotics systems and present their findings to the class. This investigation should include: identification of areas where the method was used and reasons for the selection of that method in that instance.

Pencil and Paper

Draw and label a diagram of the common types of energy transfer subsystems in a robotics system

Resources

Intro To Pneumatics:

<http://www.mvrt.com/notes/Pneumatics.ppt>

Hydraulic Fundamentals:

<http://virtual.yosemite.cc.ca.us/agents/instruction/Conrado/AGM%20280%20Lectures/Hydraulic%20Fundamentals.ppt>

