Classroom Activities

These materials are designed to increase students' understanding about what makes a robot a robot, how robots sense, think, and act as well as the uses and limitations of working robots. They can be used to support a visit to an ASIMO demonstration, or as part of a classroom robotics curriculum. By engaging in these activities, students will be encouraged to question their notions about robots and explore some of the science behind robotic operations.

These educational materials were developed by the Carnegie Science Center <http://www.CarnegieScienceCenter.org/>.

Activity #1

Can a robot tie your shoes?

Background

Robots are machines that do specific tasks. Movies are full of robots that can do everything that humans can do and more. However, in reality, there are limits to what robots can do. This activity is designed to help analyze a simple, everyday task from the point of view of a robot. Gloves, blindfolds and pliers are used to limit sensory information, and tongue depressors limit the number of moving joints.

Tying a shoe, an every-day task that seems easy enough for us, is difficult, if not impossible, for a mechanical robot. Robots have limited movement, only a few sensors, and are controlled by computers that must be programmed with instructions for each step required. It is difficult for two people to work together to tie a shoe. Likewise two robots working together is very difficult to coordinate and only recently has been achieved. (A line of robots working sequentially in an assembly plant is different than two robots working together on the same task.)

It is helpful for participants to discuss their experience after each variation.

Materials Needed

- shoes that tie
- tongue depressor
- masking tape
- heavy gloves
- 2 pairs of pliers
- blind folds

What To Do: Try tying your shoes blindfolded. Not too hard! Now, repeat the activity but with heavy gloves on your hands. Then, tape tongue depressors onto your thumbs and forefingers and try again.

And if those activities weren't difficult enough, tie your shoes with pliers. First, use pliers in both hands; then with only one hand; finally with two people – each with one pair of pliers. For fun, these activities can be set up as a race between two people.

Activity #2

Design a robot

Materials Needed

- drawing supplies
- building construction sets or household junk – boxes, rods, tongue depressors, pipe cleaners, etc.

What to Do

Decide on a task for a robot to do, such as catching a ball, digging a hole or washing the dishes. Be creative in your solutions – think about how various animals and machines perform different tasks. Draw or construct a robot to do your task. Use household junk or construction materials. Time or materials can be limited to resemble real engineering challenges.

Write a story about your robot explaining why the robot was needed and how it will accomplish its task.

Activity #3

Robot Factory

Background

Robot arms are used in production lines often with a conveyor belt carrying materials from robot to robot. Each robot performs a different job – the ends of each arm are specially designed for each task. Materials must be delivered to each robot in exactly the same way each time since most robots cannot adjust to different situations without being totally reprogrammed.

What to Do

Participants role-play and become a sandwich-cookie factory. The first row of robots (people) put the bottom cookie on the conveyor belt, the second row squirts the filling, the next puts on the top cookie, and the last puts it in a box.

- Have participants think about their actions.
- Did they use their whole body?
- How far did they need to reach?
- What would happen if one robot worked faster than another?
- Would each robot need to have the same kind of hand ("end effector" in robot language)?
- Robots only have the parts that they need. Many robot arms have joints similar to human arms, but the end effectors are specialized for different tasks.
- Did they get tired? (Robots are great for repetitive tasks, which they can repeat exactly the same over and over with great precision.)
- How would the cookies have to be arranged so that the right side of the cookie was facing up?
- In the past, great effort was required to be sure that parts were fed to the robots in the correct arrangement. In a modern cookie factory, a robot arm has a vision system. The cookies are randomly fed to the robot, and the robot is able to find cookies with the correct side on top. It does this by digitizing visual information from a camera and comparing it to a picture of a correctly positioned cookie. A suction end effector then picks up the cookie and releases it over the correct position on the assembly belt.

ASIMO

Activity #4

Digital Codes

Background

Computers process information using electrical signals to code and interpret information, and to send control signals.

A binary code is used by computers, since a processor is essentially a series of on/off switches or transistors with information either stored or not stored. Information can be transferred using a series of electrical signals – there is electricity flowing or there is no electricity flowing. This causes a motor or a pixel (point of light on a computer screen) to turn on or off or compare the pattern to an image stored in memory.

Materials Needed

- graph paper
- overhead transparency with graph paper grid
- simple pictures

What to Do

To encode sensory information in order to interpret images, computers turn a picture into digital code. To see how this can be accomplished, use a grid to turn a picture into a code of a series of 0's and 1's. Place a transparent grid over a picture. In each square with more than half of the square covered by part of the picture put a 1. If there is less than half of the picture covered, put a 0 in the square. Read the series of 0's and 1's to another person who will fill in a blank grid to recreate the original picture by reversing the code. (Shading squares when a 1 is read.) Images can be transferred back and forth this way.

After information is encoded, computers can analyze the data in different ways. A mobile robot might look for areas with a sharp contrast in order to follow the edge of a road. A sorting robot might compare a picture in its memory with an object in the camera's view.

A picture of a square translates into the following code:

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	1	1	1	1	1	0	0
0	0	1	1	1	1	1	1	0	0
0	0	1	1	1	1	1	1	0	0
0	0	1	1	1	1	1	1	0	0
0	0	1	1	1	1	1	1	0	0
0	0	1	1	1	1	1	1	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0