Wireless Technology in Robotics

Purpose: The objective of this activity is to introduce students to the use of wireless technology to control robots.

Overview: Robots can be found in most industries. Robots perform routine, and redundant tasks that are either too expensive to be performed by human labor, or too tedious to motivate human workers to perform. Robots also perform those tasks that are too dangerous for humans to perform. Robots are usually controlled by computer; computers are nothing more than simple adding machines (they just add incredibly fast). In order for the computer to operate the robot, they must be programmed, but they also need to be able to sense the environment and provide that sensory information to the program so that pre-programmed decisions and movements can be sent to the robot in response.

Wireless technology is one means that can be employed in robotics to allow the robot to sense (see) and respond to its environment. This activity uses a simple robot that has two infrared transmitters that send out a beam of infrared light forward of the robot. The infrared light then reflects off of any obstacles in the robot' s path of movement. The reflected infrared light is detected by sensors onboard the robot and the output of the sensors is relayed to a small onboard computer that is controlling the robot' s movements.

Time: One class period to explain the mechanics of the robot. One class period to explain the infrared transmitters and receivers. One class period for the students to build the sensors on the robot and upload the programming into the computer. One class period to have student demonstration of their infrared sensor avoidance robots.

Skills Required:

- Listening
- Observation
- Critical Thinking
- Writing and expression

Materials and Tools:

- Parallax BOE-Bot (Board of Education-Robot), one for each group
- Computer with serial interface cable to connect to BOE-Bot computer with software.

Preparation:

1. Review with the students the basics or robotics.

2. Review with the students the concept of sensing and remote sensing.

3. Review with the students the material presented in the Parallax curriculum materials for the BOE-Bot.

Background:

Parallax provides exceptional educational support for the BOE-Bot. This web site has the instructional materials required for this activity:

http://www.parallax.com/Downloads/Documentation/edu/Robotics.pdf

Chapters 2 and 5 contain the relevant material for this activity

What to do and how to do it:

1. Instruct students on interpreting the simple circuit diagram for the infrared circuit that is to be wired on the BOE-Bot proto board. Have both the circuit diagram and pictorial drawing of the proto board wiring so that students can see the connection between a circuit diagram and actual wiring of the board.

2. Develop a simple program that will check the individual components of the BOE-Bot wiring to help troubleshoot wiring difficulties. A program is attached to check the sensor wiring alone before it is tied into the wheel control circuitry. If the BOE-Bot construction manual has been followed, the wheel control circuitry has already been wired and tested.

3. Set up a simple maze that the BOE-Bots need to navigate. Individual test runs by the student groups will ensure their BOE-Bots are wired correctly. Then timed completions can be performed to see which group' s BOE-Bot can navigate the maze the fastest or most accurately (not hitting a wall).

4. Encourage the students to exploring modifying the basic BOE-Bot circuit to improve the performance of the system.

Data Analysis:

Student groups should be able to successfully construct a BOE-Bot that will navigate a simple maze using infrared sensors to avoid collision with the maze walls.

Activity questions:

1. What is the infrared spectrum of light more desirable for use in wireless technology than visible light? Are there appliances in your home or in the classroom that use infrared wireless technology?

2. Explain why wire controlled BOE-Bots are not as desirable as the wireless controlled robot. Could wires be used? What type of controller would have to be developed to make wire usable?

3. Explain why the infrared sensors are arranged the way they are. Can you develop an alternative arrangement that would provide better coverage and more accurate navigation?

4. Can you develop another wireless technology method that could be used to navigate the maze? What are some of the advantages and disadvantages of your system?

5. Can you develop a wireless technology method that would allow you to monitor the robot's activities without physically being present in the room? Could this type of system be used for planetary exploration? What are some of the factors that you might need to consider if your were going to build a robot that would operate on a distant planet?

6. How might this technology be used around your classroom or home?

7. How might this technology be used to help people with physical handicaps?

Adaptations for special needs: There may have to be some accommodations for those students who are visually impaired in constructing the BOE-Bot, but they should not be excluded from actively participating because of their handicap. The program can be modified to provide more sound effects that are indicative of the BOE-Bot's proximity to the maze wall. As the suggested program is written, there are distinctive sound effects that indicate commanded directions of movement. These sound effects can certainly be improved to provide more information aurally (but with the sacrifice of speed of movement). This could actually provide an excellent programming challenge for some students.

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'{$STAMP BS2}
'use this program to check that the students have wired the BOE-Bot board
'and the IR sensors correctly.  While the program is running, position a
'hand or other obsticle near the sensors.  The computer should display that
'the appropriate sensor has detected the presence of the hand

'variables

left_IR_det var   bit
right_IR_det      var   bit


'initialized pins
output 2
output 7
output 1

main:

freqout 7,1,38500              'moduates the left IR transmitter at the proper
                               'frequency.  Modulation is required to prevent
                               'triggering of the sensor by ambient
conditions
left_IR_det=in8                'reads if the sensor detects the reflected light
                               'a zero reading means the reflected light is
                               'detected

freqout 1,1,38500
right_IR_det=in0

debug home, "left=", bin1 left_IR_det      'prints sensor output to screen
pause 20
debug " right= ", bin1 right_IR_det
pause 20
                               'simulates sending appropriate avoidance commands
                               'to the BOE-Bot motor control routines, instead
                               'only audio feedback indicates the avoidance
                               'commands

if (left_IR_det=0) and (right_IR_det=0) then back_up
if left_IR_det=0 then turn_right
if right_IR_det=0 then turn_left

goto main

back_up:                       'backup command has two tones
freqout 2,100,2000
freqout 2,100, 2500
goto main

turn_right:                    'right and left commands have single but different
freqout 2,200,2000             'tones

goto main

turn_left:
freqout 2,200,2500

goto main
```

```
      pulsout left_servo, 750-speed
      pulsout right_servo,750+speed
      pause 20
next
goto sense

left:                   'moves the BOE_Bot left with tones

freqout 2,200,2500

for x=1 to delay*1
      pulsout left_servo, 750-speed
      pulsout right_servo,750-speed
      pause 20
next
goto sense

right:                  'moves the BOE_Bot right with tones

freqout 2,200,2000

for x=1 to delay*1
      pulsout left_servo, 750+speed
      pulsout right_servo,750+speed
      pause 20
next
goto sense
```