Lab 1: Introduction to your kit and NXC

Lab objectives

This lab is to familiarize you with the equipment you will be working with in the course. By the end of this lab you should have:

1. Verified that your kit has all its components, and that they are in working order.
2. Be able to write, compile and run simple programs for the NXT brick using NXC and the BrixCC IDE
3. Have a rough idea what kind of values to expect from each sensor.
4. Construct the tribot, a roving bot platform that will be used repeatedly in the labs
5. Have written a simple program for the tribot.

Step By Step

1. Check that you have received all of your kit
   a. You should have received
      i. Lego NXT manual
      ii. Plastic building pieces
      iii. Electronic building pieces
   b. There is an inventory of the plastic building pieces which should be present in your kit on p. 48 of the Lego Manual. You are responsible for these items, so take the time to sort and check that they are all present.
   c. In addition to the building pieces, the core of the kit is its electronic components. These consist of
      i. The NXT programmable brick
      ii. 3 motors
      iii. A touch sensor
      iv. A microphone sensor
      v. A light sensor
      vi. An ultrasonic sensor
      vii. 7 cables to connect NXT parts
      viii. 1 cable to connect the NXT to the USB port of the computer
2. We will now test each component in turn. Connect all the sensors and motors as shown (pp 6-7, manual). Put an axle and a tire through each motors drive wheel, so that you can turn it by hand. Put batteries in the brick.

   a. Power up the NXT brick by pressing the orange button. A number of settings can be changed from the main menu of the brick
      i. Turn down the volume setting
         1. Turn on the NXT by pressing the orange button.
         2. Using the arrow keys, scroll until the "Settings" option appears.
         3. Select this option by pressing the orange button
         4. Using the arrow keys, scroll until the "Volume" option appears, select it with the orange button
         5. Set the volume to 1 with the arrow keys– this will keep it relatively quiet so we can work without disturbing each other. Once set to 1, press the orange button to accept.
   b. There is a function to view the output from each sensor, we will now view the output to verify if the sensors are working, and to get an idea of typical values. From the main NXT menu, select the "View" option using the left-right buttons. This will let you inspect the output coming from each sensor. In each case you select the type of sensor, and then the port that it is connected to. You will have to hand in the range, units and typical values from these sensors, see, below.
      i. Sound dB, and sound dBa are both appropriate for the microphone sensor. Select the sound dB option, and then select port 2, which is where the microphone is connected. Try whistling, clapping, etc and report typical values of the output. (A clap ->100%, typical quiet 5%,)
      ii. The light bulb "Reflected Light" option causes the light sensor to emit light, and measure the amount reflected. Try blocking the light with your finger, and holding something reflective to it.
      iii. The dark light bulb "Ambient Light option" causes the light sensor to turn its own light off, and measure the light coming from the room. Now try blocking it with your finger, and holding it pointing right at the light.
      iv. Try the "motor rotations" in both degrees and rotations
      v. Try the touch sensor
      vi. The Ultrasonic sensor senses the distance to an object that reflects sound. With this sensor investigate several questions. What is its range? How small an object can it detect? Does the texture of the object being detected, and or the angle it makes to the ultrasonic beam have an effect on the results? Try detecting the wall, a book, your clothing– report range relative to the wall, a person, a book, your hand. Measure its accuracy relative to the wall, looking straight on.
      vii. The "Light Sensor *", rotation sensor and temperature sensors can be ignored, since we don't have them.
3. Programming. In this step you will compile and run a simple NXC program using the BricxCC IDE.
   a. Decide on a place in your account to keep files related to the course.
   b. Start Bricxcc
   c. Copy the file lab1program1.nxc into your workspace and open it in Bricxcc
   d. Compile and run the program, describe its behavior (to hand in, below)

4. Building the Tribot. Start the LEGO NXT software. Instructions are provided on how to build and test the "Tribot" a simple mobile robot. Work through these instructions to build the Tribot..
5. Design a program to make the Tribot
   a. Wait for a button to be pressed, then,
   b. Drive in some pattern on the floor (something more complex than a straight line), all the while reporting the values of its sensors, in a labeled, readable way, and the motor tachometer values on its screen, until,
   c. Another button is pressed, in which case it goes back into a paused mode, and this cycle can be repeated again

This program MUST be designed in a modular way, so that the sensor reading and display, the button sensing, and the motor control all run in separate threads. You are encouraged to put tasks which will be reusable, such as "Turn left" or "Write value on screen" into separate functions or macros.

To hand in

1. a) What are the ranges and precisions of each sensor (a-f in part 1 e above) Marking scheme: Touch, sound (2 options), light (2 options), motor turns (2 options) – (7 points).
   b) What is the range and precision of the ultrasonic sensor. How big a target can it see, and how does it react to different kinds of targets? What is its accuracy, using the wall as a target? - (7 marks)
2. From steps 3 and 5 above
   a. Description of the programs behavior (1 mark)
   b. Your program (10 marks)
   c. You must demonstrate your program to a TA. (10 marks)