

Mentor Sheet
1st meeting

Agenda for October 11, 2007

1. Introductions, form groups
2. Overview of the NXT, etc.
3. Hello world!
4. Power Levels
5. Gearing















Equipment required:

- Completed taskbot
- Computer with ROBOLAB 2.9
- Kit with additional gears (12 and 20 tooth gears necessary), pieces, and USB connector
- Worksheets for your students
- Ruler

Concepts introduced:

- NXT as a computer
- Input and output ports
- What is a program?
- Velocity
- Modifiers
- Gear Ratios

Icons used:

Begin 	End 	Motor A forward 	Motor B forward 	Wait for 2 sec 
Power level 1	Power level 2	Power Level 3	Power Level 4	Power Level 5
				
Wait for Time 	Stop All Outputs 	“Wait for” menu 	“Modifiers” menu 	

Begin, End, Motor A forward, Motor B forward, and stop all outputs are all found in the main menu. Wait for 2 sec and Wait for Time are both found in the Wait for menu. The Power Levels can be found in the modifier menu.

Ideas for group roles:

Engineer – In charge of modifications to the structure of the robot

Programmer – Primary point person for programming on the computer

Scribe/Historian – Keep track of information in an organized fashion. For this week it will be the various velocity data.

Please remember to have your robot charged!

1. Introductions (approx. 5 min on b)
 - a. Professor Forbes and Chris Bryant will introduce themselves and go over some housekeeping details and ground rules.
 - b. You'll have received your group assignments before we go to DSA, and here you'll meet your group of 3-4 students. Introduce yourselves, figure out the students' names, and do a **brief** ice breaking exercise. My personal favorites are introduce yourself and say an adjective that describes you starting with the same letter as your first name (ex. I'm Chris and I'm cool). I know it's lame, but you'll remember your kids better this way. I did this with my residents when I was an RA, so if college students can do this, middle and high school students can too. Feel free to substitute your own ice breaker.
2. Overview of the NXT, motors, sensors, and connectors (5-10 min)
 - a. By now, you should be able to comfortably describe the NXT-brick as the brain/computer of your robotic creations. Show kids how to turn on the NXT. Make sure to touch on ports A-C as output ports and 1-4 as input ports. Show them the motors, connectors, and briefly show them a couple of sensors
 - b. Questions
 - i. What do you think the difference is between input and output ports?
 - ii. What sort of things would be connected to the input ports?
3. Hello World! (20 minutes)
 - a. The generic first program in any programming language prints "Hello World!" to the screen. We don't really care about printing anything to a screen at this point, so our Hello World! program will make the robot move forward by turning on motors A and B, waiting for 2 seconds, and stopping.
 - b. Making the first program
 - i. Ask students what a program is. Ans: A specific set of ordered operations for a computer to perform. Explain that although a computer is capable of performing an incredible number of calculations and operations in a short amount of time, it can only do as much as you tell it to do.

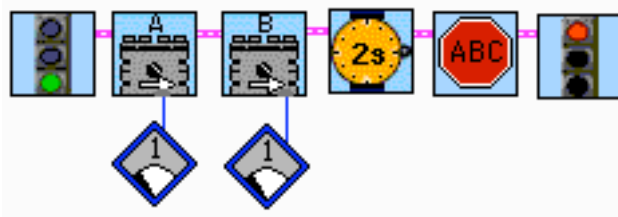
- ii. The programming language we'll be using is called ROBOLAB. It's a graphics based programming language, which means icons take the place of words that would otherwise be used in a text-based language. To make a program, you wire the icons together to form a string of commands read left to right.
- iii. Introduce the Icons we'll be using: The Green and Red lights function as beginnings and ends. Motors A and B are the effectors that enable the robot to move within its environment. The wait for 2 s and the Stop All outputs Icons are the final pieces of the puzzle.
- iv. Put it all together, having the students string the icons together. It may be necessary at this time to introduce the students to the tools palette, specifically the spool and the arrow.
- v. Show them how to transfer the program to the robot, and, if necessary, use the error message part of the run arrow.
- vi. Have them run their program, and congratulate them on their first program.

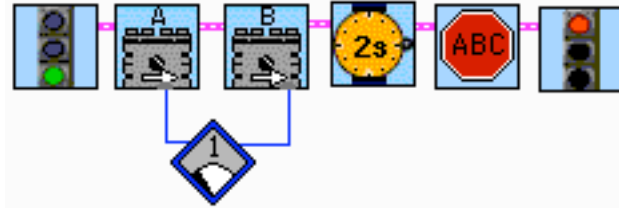


4. Power Levels

- a. The purpose of this exercise is to observe the quantitative and qualitative effect of a change in power levels on the first program. Explain that the default power level is 5, and introduce students to the power level icons in the modifier menu.
- b. Using the same program found in part 3a, change the power levels from 1-5, measuring the distance the robot travels in cm.
 - i. Have one student changing the power levels, another measuring, and if you have 4 another doing something else.
 - ii. To calculate the velocity, which is distance divided by time, have them divide the distance in cm by 2 seconds
 - iii. Ask students about qualitative observations at each power level.

Note: Power levels can be individually wired to each motor or sired together. Wiring multiple motors to the same power level is good programming technique if you are sure you want both to be at the same power level. Examples of both are as follows.





5. Using Gears
 - a. After seeing how changing the power level can affect the speed, ask if they can think of any other way to potentially speed up or slow down their robot. Hopefully someone says gears, if not, say changing the gears
 - b. Your robot has straight gearing (same number of teeth-same number of teeth). What if you put the 12 tooth gears on the engine and the 20 on the wheels? What if the 20 is on the engine and the 12 is on the wheels? Get students hypotheses, and test out on power level three. Compare calculated velocity of the two new gearing scenarios to the original. Also have the students make qualitative observations. If you feel like it, you can repeat on the different power levels.
 - c. Explain gear ratios, but you don't need to belabor the mathematics (ie, torque, angular velocity).
6. Wrap up
 - a. Cleanup should be minimal, but we'll start with 5-7 minutes remaining.
 - b. During or just before cleanup, make sure to ask your group what they learned today, what they liked and didn't like.
7. Going further
 - a. If your group moves through parts 1-5 incredibly quickly, you have 2 choices, depending on time remaining.
 - i. If you have a lot of time, get them to make the fastest robot possible. Gear ratios are important, and an advanced group may want to incorporate gear trains. For a refresher on gear trains, see (<http://auto.howstuffworks.com/gears2.htm>) This will require some disassembly of the robot, so you'll want to make sure you have sufficient time.
 - ii. If you don't have too much time, ask them how they would make a robot travel a certain distance knowing the speed of the robot. Use the "Wait for ?" icon and the calculated velocity data at various motor powers. For example, if I want my robot to travel 3 meters and I calculated a velocity of 15 cm/s at Power level 3, I would make my robot travel for 20 seconds. This can be repeated and tested for various distances and a various power level/gearing settings.
 1. Question: What might cause an error in your calculations? Surface material, charge of the batteries, etc.
 2. Question: How could you get around these problems? Utilizing sensors to deal with a changing, uncertain environment.

