MAE 1170 Introduction to Mechanical Engineering

Fall 2009

Lego Mindstorms Laboratory Session #1
Introduction to Mindstorms and Robolab

The design, analysis, and control of robots and robotic actuators is a major field of modern engineering called mechatronics. Incorporating several disciplines of mechanical engineering, mechatronics includes rigid body dynamics, kinematics, and feedback control.

In this lab, you will build and program a small robot to accomplish a specific task. You will use Lego Mindstorms kit to build the robot, as well as Robolab, a virtual interface (VI) program to command the robot. The goal of this lab is for you to become acquainted with the Lego Mindstorms kit, and the Robolab software that accompanies it.

Procedure:

1) Design and build a robot that can move forward or backward in one direction, and rotate about the z axis (pointing up). This gives the robot two degrees of freedom (DOF).

2) Once you have built your robot, open Robolab and complete the tutorial.

3) Make a program that tells the robot to move forward for several seconds, stop, and then return to its original position. Download the program to the RCX unit and run the program. Demonstrate this to your TA.

4) Make your robot move in a circle. The circle can be any size, and does not have to be perfectly smooth (If you attached a pencil to your robot, the path it traced should approximate a circle). Try changing some constants to see what the effect is on the smoothness of the circular path. You can make a new program, or modify your old one. Demonstrate this to your TA.

5) Attach a light sensor to your robot. Attach the sensor so that it is looking down and is as close as possible to the ground. Try programming the robot to perform a function (go in reverse, turn 90 degrees, stop, etc.) when the light sensor “sees” a black line. Modify your old program, or make a new one. Demonstrate this to your TA.

6) Use a loop function to have your robot follow the black line on the paper track. Your robot only needs to be able to navigate the black line in one direction (counter clockwise or

clockwise around the track). Start by using slow motor speeds. Modify your old program, or make a new one.

Once your robot can navigate the line successfully, try making it faster. Note that this may require significant modification to the robot itself, in addition to the program. Demonstrate this to your TA.

7) Experiment with the Lego Mindstorms and Robolab.

Make you robot do something cool and show your TA. Here are a few ideas:

a. Use the touch sensor to build a robot that will turn 90 degrees when it hits a wall.
b. Attach a pencil or pen to your robot and program it to spell out MAE117.
c. Make a robot that senses when it is dark in a room, and automatically turns on its headlights.
d. Program a nice melody and have the robot roam around the room serenading the classroom.
e. Incorporate different sensors or controls into something cool.
f. Surprise or impress your TA with something novel or complicated.

LAB REPORT:

Write a 1-2 page report that includes/discusses:
Introduction & conclusion discussing the following:

i. What was the lab?
ii. Why did we have you do the lab (big picture)?
iii. What did you do in the lab?
iv. The general algorithms that you used for each task (you can use pseudocode)
v. What you learned in the lab:
vi. What new concepts and ideas did you learn?
vii. What mechanical design difficulties did you encounter when building and operating the Lego robot? How did you overcome these difficulties?
viii. What algorithmic difficulties did you encounter when trying to code the robot? How did you overcome these difficulties?