CPE 470-670 – Autonomous Mobile Robots

Instructor: Monica Nicolescu

Lab 1 – Handout

1. General information

- Lab meeting time and place: SEM 246, Thursday: 9:30am-noon.

2. Textbook

- *Robotic Explorations: An Introduction to Engineering Through Design*, 2001, by Fred G. Martin.

Please have at least one textbook per team with you during the lab sessions, as we will refer to if for numerous design and programming topics.

3. Teammates

During the laboratory sessions you will be working in teams of two students. It is desired that each team contain both graduate and undergraduate students, for an equal distribution of forces ☺. Team members should equally contribute to the lab sessions, reports and final competition.

Each team will be assigned a robotic kit (described below) that will be used for the duration of the semester. Students in each team share the responsibility of maintaining and returning the kits in their original form. Any lost or destroyed pieces must be replaced before returning the kits.

4. Grading, Contests

Your laboratory grade will be composed of two parts, totaling 40% of your overall grade in the class: 20% for the Laboratory Sessions and 20% for the final Project Competition. Each of these grades will be computed based on the following:

Laboratory sessions:

Quizzes	20%
Participation	20%
Cleaning up	10%
Lab reports	15%
Lab results	35%

Result (the behavior of the robot)	65%
Project report	15%
Web page presentation	10%
Code readability	10%

Final Project:

Quizzes: You will have up to 6 quizzes during the duration of the semester. Quizzes will be assigned at the end of a laboratory session and should be turned in, in hardcopy at the start of the next laboratory session. Quizzes are individual for each student.

Participation: Attendance to the laboratory sessions or competitions is mandatory. If you cannot attend one of these sessions you must discuss with the instructor in advance (permission to skip such sessions will only be given for extreme medical emergencies).

Cleaning: Building robots is a lot of fun, but it most always means that lots of tools and robot parts will be scattered around your working area. At the end of each lab session, your team's assigned space should be cleaned and all parts/tools should be placed in order on the desk, such that if needed other students could use the space when you are not there.

Lab reports: for some of the lab sessions each team will be required to write a report that describes the following issues:

- Your hardware and software design
- The problems that you encountered during the implementation
- Your solution to the above problems
- Any unsolved problems and reasons for why you were not able to solve them

Reports should be typed and should be formatted as follows:

- a title page with the names of all the students in the team, the team number and the lab report number
- each report page should be numbered and labeled with the team number
- the pages should be stapled together

Add to the report any additional information that you think could improve your robot evaluation. Lab reports should be turned in at the beginning of the lab session, in the day they are due. No late reports will be accepted (to make sure that you are not spending time during the lab to finish the previous lab's reports).

Lab results: The performance of your robot in the lab contests/assignments throughout the semester will be assessed with respect to how well it achieves the goals of the assigned task.

Final project result: Your score in the final competition will be computed based on your robot individual performance/behavior and its performance relative to that of the other teams.

Project report: This report should address the following topics:

- Introduction (description of the contest, general principles of your chosen design)
- Description of your hardware and software design
- Encountered problems and difficulties, along with your solutions
- Discussion of any unsolved problems
- Result of your robot during the contest
- Conclusions
- Appendix (this must contain the code of your program)

The project report should be submitted electronically (in PDF version) and also be made available on the team web page.

Web page presentation: Each team should design a web page that presents the effort of your team during the final competition. Starting the web page during the initial stages of the competition, and using it to summarize each new stage in your robot design will result in a well structured page that will be also useful for writing the final project report.

Code readability: The code of your program for the final competition **must** be submitted in the appendix of your final report. Your code should be well organized and commented.

5. The robot kit

Each kit consists of the following:

- One Robotics Invention System 2.0
- One HandyBoard System

These will be presented during the first lab session.

6. Prepare the material needed for constructing the Handy Bug

Let's build our first robot: the HandyBug!!

Page 50 in your textbook presents the list of LEGO parts that you will need to build the HandyBug. Following are some changes in the list of items to be used, and modifications on the robot design steps:

Item list changes:

Additional items	Number
Tire hub (large, white)	2
Large, wide tire	2
6-stud long axle	2
Small pulley wheel	2

7. **Build the Handy Bug** (textbook: Chapter 2, Section 2.2.2, pp. 50)

Design changes:

- At step 50: use the two large tire hubs and two large, wide tires instead of the ones described in the book. Follow the same design instructions from step 51.
- Insert the following step before Step 53: use the following components to mount them as the front wheels of the robot: two yellow tire hubs, two large wheels, and two small pulley wheels. The shaft goes into the third hole of the black brick, counting from the back of the robot.

8. **Assigned readings for Lab 2:**

- Chapters 2.1, 4.1, 4.2, 4.5.2, 4.5.3 & Appendix E, HandyBoard manual