

## GE423 Contest/Project

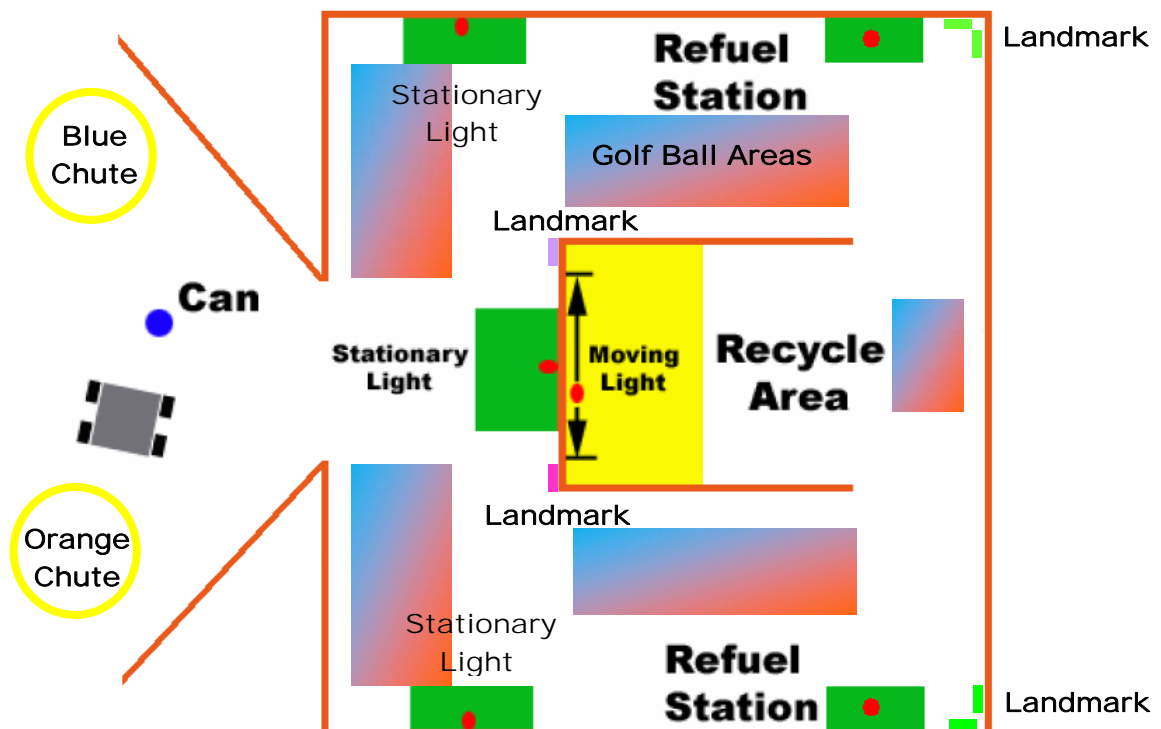
### The Amazing Recycling Robot Contest

#### Contest

This contest has two major themes. The first is to pick up an empty soda can and, while following the lit course directions, place the can in the Recycle Area. The second is (either on the way to the Recycle Area or after) clean the streets of golf balls (trash) and dispose of them in the garbage chute.

As an additional exercise after a successful run, your robot will be picked up and randomly placed anywhere in the 12 by 12 tile course. If your robot can find its way out of the course to the orange golf ball deposit circle, additional seconds will be subtracted from your overall time.

For the first part the goal is to pick up an empty soda-can at the entrance to the course and then deposit the can directly under the pink sign 6 or less inches from the wall in the Recycle Area. You will be able to place your robot in any orientation at the entrance. We will place the soda can somewhere around your robot within 1.5 tiles (or further out if you wish) of the center of your robot. Your robot must find and pick up the can and then enter the course. In the course your robot must first find the center “Stationary Light”. Above this light is an IR sensor that will detect the robot at that light. Once your robot trips that sensor, either the left or right “Stationary Light” will turn on. This indicates which “Refuel Station” you need to visit. The “Refuel Stations” also have IR sensors above them. Once your robot trips the correct “Refuel Station’s” sensor, the “Recycle Area” sign will move. This pink sign moves to a new random position each run. Your robot should find this sign and place the can directly underneath its center. The can should be placed as close to the pink sign as possible. Placement error will be measured vertically (robot’s left/right) on the diagram below. Course completion seconds will be added for each inch of placement error.



For the second part of the contest, you need to find golf balls of two different colors and move them to their respective chutes. The garbage chutes are circular areas near the entrance to the course. Tape will be placed on the floor to indicate their positions. The golf balls just need to be dropped off at the garbage chutes. If they roll away after being dropped off, it is the garbage chute workers fault, not yours. There will be 5 golf balls placed randomly inside the course. Your task is to move at least two of them to their chute. Additional golf balls found and disposed of will subtract seconds from your overall contest time, so find as many as you can. There will be at least 2 orange and 2 light blue balls each run. The golf balls will be placed anywhere inside the five “Golf Ball Areas” in the above picture. When you collect a golf ball your robot needs to communicate to your VB application the X, Y position and the color of the golf ball collected. Course completion time will be subtracted from your overall time if the color is correct and the X, Y position is within a 0.5 tile radius of the actual position.

After your robot performs a successful run depositing the can and at least 2 golf balls, it will be physically picked up and placed randomly inside the 12 tile by 12 tile course. From this position (after searching for landmarks, wall following, etc) the robot should use sensor data and landmarks to figure out where it is in the course and correct its (x,y) position. If the discovered (x,y) position is close, then the given LADAR Kalman filter code should start correcting again allowing the robot to successfully drive to the orange deposit circle. The amount of time this procedure takes is not added to the contest run time. If the robot successfully finds its way to the orange deposit circle after being relocated, 40 seconds will be subtracted from the contest runtime.

We are asking you to locate the X, Y position of the golf balls and move these golf balls to a certain X, Y position in the course. For this reason, color landmarks will be located at two far corners to allow your robot to correct its dead reckoned position. Also, the front corners of the middle structure will be color marked for possible landmark recognition.

You are also **required** to use the LADAR sensor in this final project. Use the LADAR to find corners and walls that can be used as landmarks to update your dead reckoned position. Of course you are also encouraged to use the LADAR data for other tasks such as wall following and finding a lost robot. For your final write-up you will be creating a web page to document your work. One part of this write-up will be for you to detail how the LADAR was used in your project: what algorithms did you develop and what algorithms were developed for you. Part of your grade will include the clarity of this explanation.

A working VB application is also required for the contest. It should display the location of the robot throughout the entire course. Your VB application will also be graded in this final project. Points will be given for its appearance, its functionality, and its creativity.

The robots will be scored by the amount of time it takes to recycle the can and bring two golf balls to the Trash Chute. In addition, seconds are added to your time if your robot does not place the soda can directly below the pink sign (**20 seconds added for each inch**). Seconds are subtracted from your time if you bring more than two golf balls to the chute (**20 seconds subtracted for each additional golf ball**). Seconds are also subtracted from your time if your robot is able to transmit to VB the color and X, Y location of each golf ball collected. (**20 seconds subtracted for each correctly identified golf ball**). Finally seconds will be subtracted from your time if your robot is able to find its way out of the course after being placed randomly inside the course. (**40 seconds subtracted for successfully making it to the center (within 0.5 tile radius) of the orange circle**). Groups may try multiple runs to get the lowest score possible, and a tally of scores will be displayed recording each group’s score. *Yes, a negative score could win the contest.*

There will be two checkpoint weeks and a final contest day for this project. More details on what is due when will be given in class, but briefly...

Checkpoint Week #1: Complete the *Can Recycling* part of the contest. VB application should be displaying the robot's position.

Checkpoint Week #2: *Golf ball retrieval and dead reckoning correction*. The robot should be able to find golf balls and drop them off at the Garbage Chutes and be able to "find itself" in the course if moved to a random position. You should be using the LADAR at this point in the project.

Final Contest Day: This is the day and time of your final. Here you will put everything together and compete for the fastest creation-loving robot. An operational VB program is required on contest day.

Final Report: This is due two days after the Final Contest Day. The *Final Report* is a web site that includes at least:

1. A paragraph explaining your group's strategy for the final contest.
2. Pictures and video of your robot in action.
3. All your project source code zipped and downloadable. This includes all your Code Composer project files and all your VB project files.
4. An explanation of the algorithms used with the LADAR's data.
5. Picture/pictures and names of all group members.