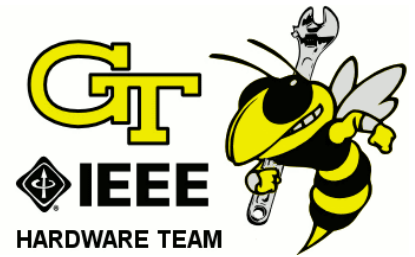




Region 3  
Atlanta Section



## **SoutheastCon 2009 Hardware Competition: The Recycling Robot**



### **I. Introduction**

Athletic stadiums and college campuses are plagued by the issue of trash after tailgating parties, after which there is often an assortment of glass, plastic, and aluminum beverage containers. This is both unsightly and time consuming to clean up, and represents a potentially significant source of untapped recyclable materials. By developing an autonomous robot that can locate, sort, and separately store the different containers, the manpower needed for cleaning can be reduced.

### **II. Objective**

Robots must locate, obtain, sort, and store used beverage products.

All sorting and storage is to be done on the robot. Points are awarded for the collected objects at the end of the round. Some points will be awarded for unsorted items; however, more points will be awarded for correctly sorted items. The winners will be judged on points with run time being the tiebreaker.

### 17 **III. Playing Field**

- 18 **1.** The playing field is a 10'x10' square made of green Astroturf,  
19 with an “invisible dog fence” perimeter, placed underneath  
20 which acts as the boundary. The dog fence transmitter kit will be  
21 provided upon registration. See the appendix for construction  
22 details.
- 23 **2.** A 1-foot square grid of small spray-painted green dots will  
24 indicate potential locations for recyclables. Each recyclable will  
25 be placed on a green dot. The integrity or visibility of the dots  
26 will not be guaranteed and is not intended as a navigational aid.
- 27 **3.** There will be a hard boundary 12” away from the invisible fence  
28 to prevent interaction with other robots on adjacent fields. The  
29 height and material of the boundary will not be specified and is  
30 not intended as a navigational aid. It will be painted green. See  
31 the appendix for construction details.
- 32 **4.** The objects in play consist of Coca-Cola Classic products:  
33 12-ounce aluminum cans, 0.5-liter plastic bottles with the tops  
34 still on (yes, this violates recycling standards), and 8-ounce glass  
35 bottles. The red labels will not be removed. None will contain  
36 liquid, but they may feature minor deformations due to previous  
37 usage.
- 38 **5.** There will be 10 total recyclables in play; 5 aluminum cans, 3  
39 plastic bottles, 2 glass bottles.
- 40 **6.** The containers will be placed on their side in any orientation on  
41 the playing field.

### 42 **IV. Robot**

- 43 **1.** The robot must have a single button labeled “START”.

- 44       **2.** The robot must be able to fit in a 12x12x18 inch (LxWxH) box  
45       at the start of each match.
- 46       **3.** After the beginning of the round, expansion is unrestricted, but  
47       nothing can touch the playing field outside the 12”x12”  
48       footprint. The robot does not have to return to its original size.
- 49       **4.** There is no weight or material restriction. But the robot must be  
50       powered by non-dangerous means (no combustible or hazardous  
51       substances).
- 52       **5.** Gas canisters will be allowed, however the maximum operating  
53       pressure is 100 PSI. We kindly request that all canisters be easily  
54       inspected and that the participants allow extra inspection for  
55       safety. This may include external checks or other acts of  
56       verification. It is advisable to keep any high-pressure system in  
57       an enclosed compartment.
- 58       **6.** Any robot deemed dangerous by competition officials will be  
59       subject to disqualification. This includes any robots using  
60       admissible levels of compressed gas implemented in a dangerous  
61       way.
- 62       **7.** One (1) to three (3) plastic bags may be placed on the robot to  
63       collect recyclables. Each bag must be removable and  
64       replaceable at the end of the round for judging.
- 65       **8.** Prior to the beginning of each round, each bag must be labeled  
66       as to which object type will be stored inside. The team will gain  
67       the extra points for correctly sorted objects only if they are in the  
68       corresponding bag.
- 69       **9.** The bags may not drag on the playing surface
- 70       **10.** See section “Scoring” for additional information on scoring and  
71       point distribution

## V. Rules of Play

1. On cue from an official, a team member must press the start button. The robot must operate autonomously thereafter with no interaction from people or electronic sources.
2. A team may not take any action that purposely interferes with the course of play or causes damage to the playing field or competing robots. The penalty for destructive interference is disqualification for that match.
3. A robot may start in any orientation at the discretion of the team, provided that some part of the robot is within 1 foot of the hard boundary on the interior side. The team is responsible for placement, but may not step onto the field.
4. The robot must traverse the play field and gather cans and bottles. Points will be awarded for everything picked up with additional points for correct sorting. This is detailed under the Scoring section.
5. The playing time will be four (4) minutes.
6. The robot is not required to return to any specific zone by the end of the time period.
7. At the end of the time period the robot may stop autonomously or a team member may stop the robot. However, regardless of when the robot is actually deactivated, no additional points may be accumulated. Any objects obtained after the time limit will not be scored.
8. In addition to the time constraint, a team member may call time at any point, ending the round with no penalty. This will be recorded as the runtime for that round in case of a tie-breaker.

- 99           **9.** The robot does not have to return to its original size at the end of  
100 the round (but must do so before the next round).
- 101           **10.** Some damage to the aluminum cans and plastic bottles is  
102 permitted. Damage to the glass bottles, however, is not allowed  
103 for safety reasons.
- 104           **11.** The can and bottle placement on the field (location only) will be  
105 the same for each heat, but may differ between groups and  
106 rounds.
- 107           **12.** All robots in the competing heat will be stored in a staging area  
108 for the duration of the round and unavailable to the teams for  
109 modification.
- 110           **13.** Teams not in the currently competing heat will have full access  
111 to their robots.

## 112 **VI. Competition Format**

### 113 **1. Qualifying Round:**

- 114           a. The robot must move one foot autonomously after the push  
115 of the start button.
- 116           ***b. The time and place of this round to be determined.***

### 117 **2. Preliminary Rounds:**

- 118           a. Qualified teams will be divided evenly into two heats.
- 119           b. There will be three preliminary rounds
- 120           c. The two heats will alternate continuously (Heat A, Heat B,  
121 Heat A, Heat B, Heat A, Heat B)

122 d. The average score of each team for the three preliminary  
123 rounds will be used to determine which teams advance from  
124 the preliminary.

125 e. Eight teams will advance to the finals.

126 1. The top three teams from each heat will advance from  
127 the preliminary.

128 2. The two highest of all the remaining teams (wild  
129 cards) will advance from the preliminary.

### 130 3. Final Rounds:

131 a. One group of eight teams will participate.

132 b. Two final rounds will be held.

133 c. The average of the two final rounds will determine the final  
134 ranking.

## 135 VII. Scoring

136 1. 10 points will be awarded for traveling 1 foot into the playing  
137 field from the starting position.

138 2. Each can or plastic bottle correctly sorted is worth 15 points.  
139 Each glass bottle correctly sorted is worth 30 points.

140 3. Each object incorrectly sorted is worth 5 points.

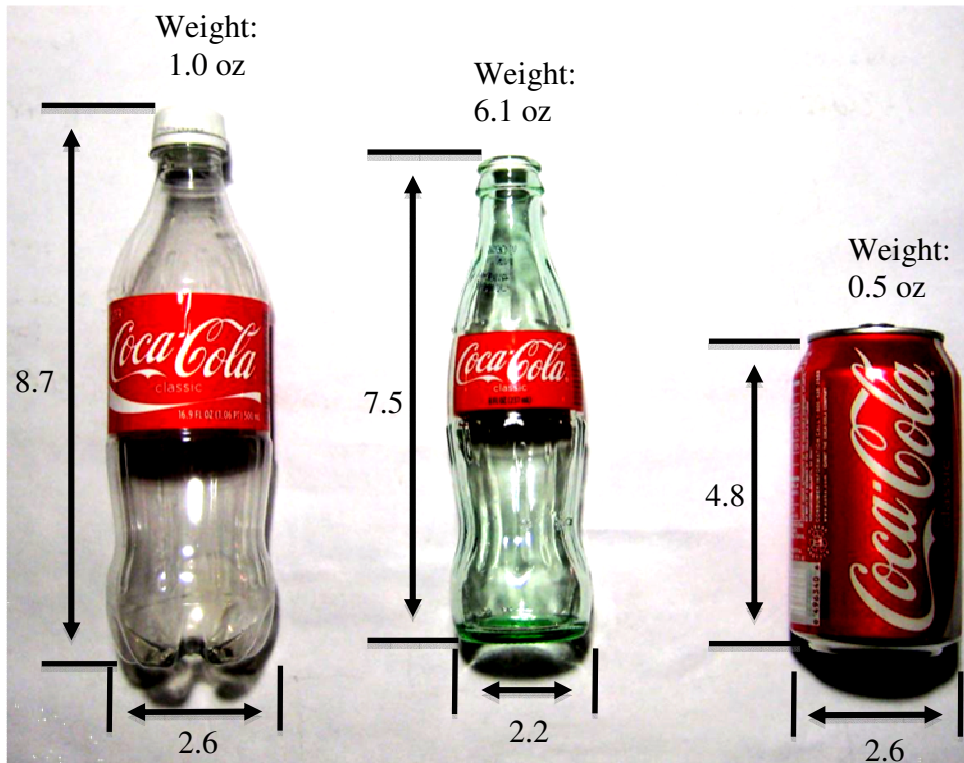
141 4. Points will be calculated after the end of the round by the judges  
142 by assessing the number of sorted and unsorted objects.

143 5. A penalty is assessed whenever a team either impacts the hard  
144 stop surrounding the playing field, or an extremity of the robot  
145 passes beyond the 10'x10' edge of the board.

- 146  
147  
148
6. The degree of the penalty is  $2^{n-1}$  points per violation where n is the total number of violations that have taken place during that round.
- 149
7. The penalty per violation will not increase past  $2^5$  points.
- 150
8. A line judge will be present to judge violations.
- 151
9. The team is encouraged to observe the point calculation and propose an objection, but only before the score is officially recorded. It is the team's responsibility to be present at the calculation (which will directly follow the round and will be done off to the side) and the team may not request a delay in the calculation.
- 152  
153  
154  
155  
156
10. Other awards will be given out to acknowledge outstanding achievement in the following areas:
- 157  
158
- 159 \* Most Aesthetically pleasing
  - 160 \* Most entertaining
  - 161 \* Best use of recyclable/recycled materials
  - 162 \* Best mechanical design/implementation
  - 163 \* Best electrical design/implementation
  - 164

165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191

## Appendix A: Recyclables



All dimensions are the maximum outer dimensions in decimal inches with a 0.1 inch tolerance.  
The weights have a 0.05 oz tolerance.



192



193

194

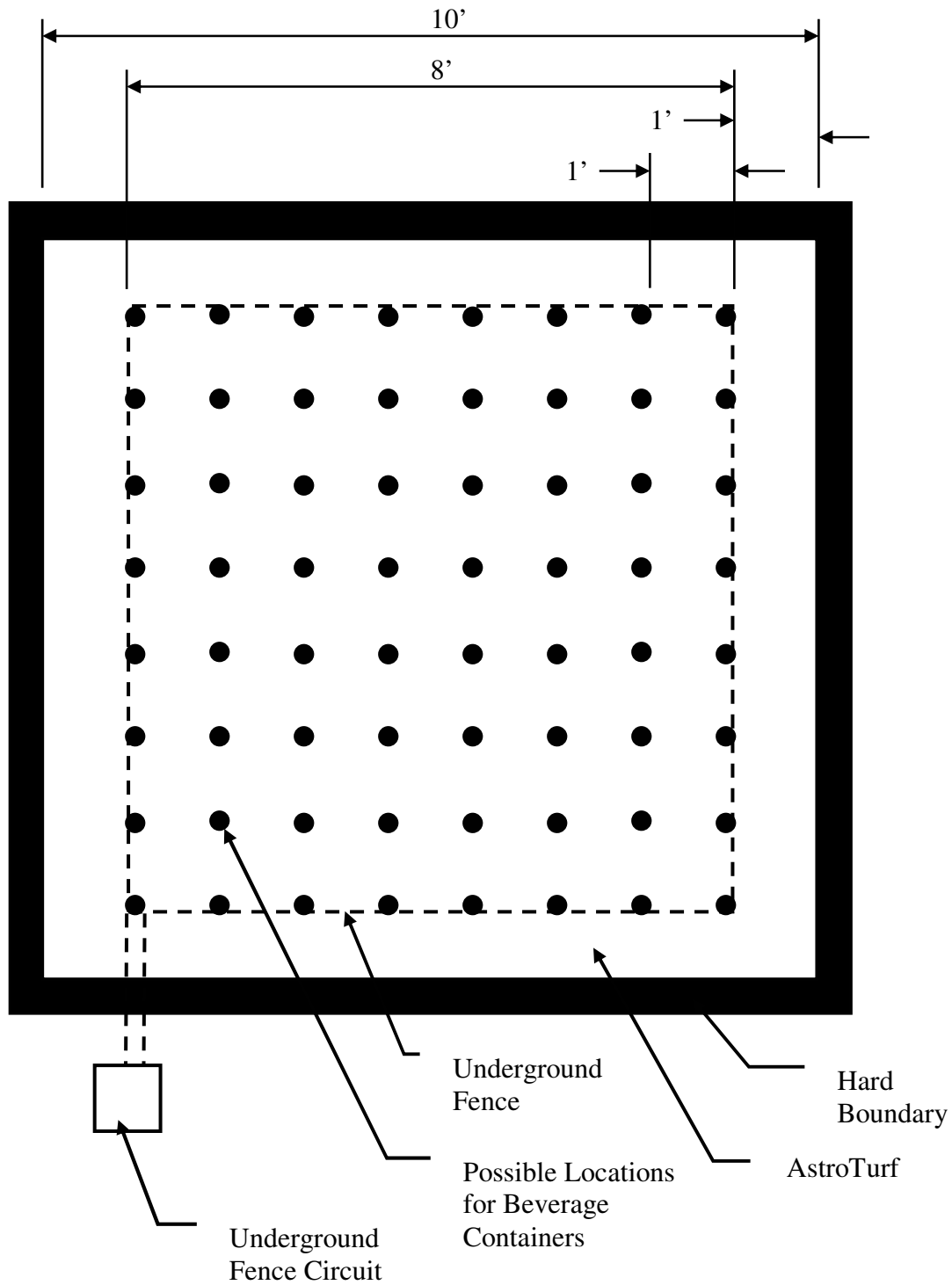
## Appendix B: Board Construction

Item	Description	Part Number	Construction note
Underground "invisible" fence	Custom circuit board and parts kit (including the wire) will be provided upon registration.	N/A	The wire will be attached to the underside of the AstroTurf using duct tape.
AsroTurf - like Carpet	This is a green plastic carpet-like material that will represent grass.	Lowes #234774	It costs \$0.44 per square foot (at our Lowes). It is sold in 12' widths, so you will need to buy a 12'X10' piece and cut off 2' of it. It is easy to roll up and transport in a normal car trunk.
Hard boundary	This is not intended as a navigational aid and is only there to keep the robot from leaving the field. For testing purposes, a painted green "2x4" on its side can be used but will be different than the boundary used in the competition.	Lowes #98653 for the paint  Any wooden 2"x4"x10' will work	The 2x4s should be painted green and placed on its side (so it is only 2" high) along the 10' outer boundary. The boards are not connected together at the ends, and thus so that they and the AstroTurf can be rolled up and transported easily.
Possible beverage location markers	These will consist of green spray painted dots. They indicate the possible location of beverage containers and are not intended for navigational aid.	Lowes #98653	The dots are in a 1' grid as shown in the board diagram and are no larger than 1" in diameter.

195

196

### Board Diagram



Note 1: The board is symmetric so all dimensions on the top also apply to the side.

Note 2: The hard boundary will be slightly different at the competition to discourage its use as a navigational aid.