APSC 100/101 Module 5

Design Project - Rules and Scoring   January, 2017

Overview

This document outlines the competition rules and scoring for the Module 5 Claw Retrieval project.

Teams will suspend their Claw Retrieval System from the crane system, which will rest on the work benches (see Figure 1).   One or two team members will have full control of the position of the crane from behind the workbench during the competition, including raising and lowering, such that they will not be able to see the actual claw or objects to be picked up. Other team members will give verbal commands or hand signals to the operators to raise and lower the claw, and the Claw Retrieval System will have to autonomously open and close to grasp objects. For the first two rounds of the competition, **each team member must assume a different role**.

Teams may bring two different claws to use during the different rounds, however will not be given any additional time (for swapping, adjustments, etc.) during the competition, so teams should be proficient at swapping.
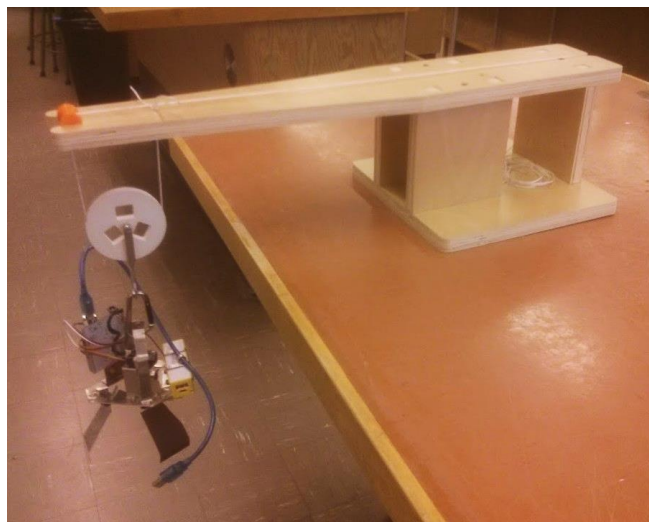
Figure 1: Image of crane system, with prototype Claw Retrieval System attached.

Objects will need to be grasped, lifted, carried over a threshold, and released into a "retrieval zone." Team members will be responsible for positioning the items before clearing the competition area.

The Claw Retrieval Systems will be evaluated on three related objectives:

- Variety Round: pick up and transport as many unique objects in a 4 minute time limit.

- Bulk Round: pick up and transport as much weight as possible from a container of uniform items, with a maximum time limit of 2 minutes.
- Cooperation Round: all teams of studio section will work together for 12 minutes to pick up large items for bonus points.

List of Items

Pictured and listed below are the items you will have available to pick up during the Variety Round of the competition. For the Bulk Round, you will pick up from a container full of wooden beads (Item #9).

1. Shoelace (~20 cm long, lying extended)
2. Badminton shuttlecock
3. Balloon (inflated to ~8 cm diameter)
4. Golf ball
5. Ping pong ball
6. Small alien
7. Plastic jewel
8. Six-sided die
9. Wooden bead (1x bulk item)
10. Red plastic drinking cup
11. Small can of tomato paste (full)
12. Kitchen cleaning sponge
13. Flat foam sea creature (can be balanced on edge to start, no bending)
14. Wood dowel rod (~30 cm long, ~1 cm diameter)
15. Dish cloth (must be lying flat, as pictured, to start)

For Round 3 (cooperative round), the items available for pick up are shown below.

1. 1 m of rope

2. Broomstick
3. Baseball bat
4. Swimming pool noodle
5. 2 m PVC piping
6. Plastic chain

*Note: all items subject to change

Rules

The following rules apply to the competition. The goal is to keep the competition fun and fair for everyone – in this regard, the teaching team reserves the right to modify these rules if necessary. If you have a question or would like clarification on the rules, please post it to the discussion forum on Connect. If you think your team might have identified a loophole in the rules, speak to an instructor as soon possible for clarification (and to avoid being caught by a possible rule change later).

1. **Construction**:
    a. Teams are allowed to use two different claw mechanisms on competition day (i.e. claws can be tailored to specific rounds), but are also permitted to use the same claw for all rounds.
    b. Teams are only allowed to use materials/consumables provided in the studio (including tape, string, cardboard etc.).
    c. Teams are only allowed to use major parts from one Arduino kit per claw (i.e. only one servo and one sonar per claw).
2. **Operators, Other Team Members, and Rotations**
    a. **Team members must not have the same role between the first two rounds, and each team member must assume a role in at least one round.**
    b. The crane operator(s) shall operate the crane from the side of the table opposite to the retrieval zone, and shall not have any visual access to the claw or objects on the ground.
    c. The other team member(s) will assume roles of setters and spotters, and may position themselves anywhere around the table. They shall only use verbal commands and hand gestures to communicate with the operators. The claw will have to be reset if any team member crosses the competition zone boundary (see *Object Placement* and *Resetting Objects*). The most successful teams are often teams with efficient competition strategies. Do not underestimate this!
3. **Multiple Claws**   Teams using multiple claws are permitted to swap claws at any time during any of the completion rounds, however the clock will continue to run; thus the "penalty" for swapping claws is the amount of time it takes to swap. Teams wishing to use multiple claws during competition should become proficient at swapping claws on and off of the crane.
4. **Retrieval Zone**   The Retrieval Zone is a rectangular container (approx. 40 cm long x 30 cm wide x 15 cm tall). The Retrieval Zone will be placed at a designated location on the ground by the team members to act as the Retrieval Zone.   The Retrieval Zone may not be moved once timing begins.
5. **Practice and Setup Time**   Prior to the start of the competition, teams will have up to 4 minutes to connect their claw systems to the crane and practice with their Claw Retrieval Systems. If all teams competing in the round are ready, the round may proceed. One object may be placed before timing begins for the Variety competition.

6. **Object Placement**   Objects shall be placed by the team members directly on the ground in the position and orientation they would like to be retrieved from (unless the orientation is specified in this document for that object). The Claw shall be at least 50 cm above the surface during or after the time a team member last contacts the object to be picked up. The 50 cm height boundary will be marked by tape. **Only one object may be placed and attempted at a time** during the Variety Round.   The object may be placed arbitrarily close to (but not inside!) the Retrieval Zone.

7. **Resetting Objects**   Objects may be reset and repositioned by the team members at any point for any reason (stuck on claw, shifting around on the surface), but shall be placed on the ground. Once the object is repositioned the claw shall again start at least 50 cm above the ground.

8. **End of timing and scoring**   If time expires when a claw is directly above the retrieval zone, waiting to release the object, the object will count. The discretion of the competition officials will be used to judge objects above the walls of the retrieval zone when time expires. Objects will count as being in the Retrieval Zone if the object is lifted permanently off of the ground when the Retrieval Zone container is lifted straight up from the ground (i.e. an object hanging over the side of the Retrieval Zone that does not fall off when the Retrieval Zone is lifted shall count towards scoring).

9. **Variety Competition**   Teams may attempt the objects in any order.   All objects are worth the same number of points. If a team is not successful with an object, they may retry it or skip that object to attempt other objects, then retry the object before time runs out.

10. **Bulk Competition**   A cylindrical container (26 cm diameter), filled with wooden beads to an initial depth of at least 5 cm will be placed in the competition zone. The beads appear as Item #9 in the list of items above. Teams will have 2 minutes to collect beads using their claws and transfer to the retrieval zone. After the allotted time, the retrieved load will be weighed.

11. **Cooperative Round**   After all teams from the studio section have competed in the individual round, they will have 12 minutes to cooperate together to pick up a series of large items.
    a. **Lift the Object** - Each item will need to be **completely** lifted over a 30 cm threshold (there is no retrieval zone in this round).
    b. **Up to 3 teams per Attempt** - Up to three teams can participate in lifting each item; however, each claw does not have to contribute equally. Once a team has participated in a successful retrieval, it advances to the "successful zone" until all other teams have made a successful attempt. A claw that has not advanced to the successful zone may be used again.
    c. **Advance up to 3 Claws to "Successful Zone"** - If less than three claws can successfully retrieve an item, other claws may occupy the empty slots (for a total of three claws per attempt) in order to advance to the successful zone.
    d. **One or Two Claws Per Team** - Teams with multiple claws are only required to participate in the cooperation round with one claw, but may participate with both. If a team has no functioning claw by the start of the cooperative round, the studio section may forfeit 1 point (retrieved items are worth 2 points) to advance that claw to the successful zone, thereby removing the requirement that it participate in the successful lifting of an object.
    e. **More Attempts After Everyone Successful** - After all teams have at least one claw in the successful zone, those claws may be reused to retrieve additional objects, provided no claw is used in back-to-back attempts.

f. **Cooperative Round Scoring** - The cooperative round will be timed, and whichever studio section collects the most cooperative items, in the shortest time will be awarded an extra bonus point.

Rule Clarifications

1. **Can you make any Software changes or updates during the competition, with no other physical changes?** YES, since this doesn't change the physical parameters of the claw, just the way it interacts with its existing hardware components. This includes the ability to connect to your laptop, upload new code, and remove your laptop, or to do something like use the joystick to cause the Arduino to change to another part of the code. (added Jan 20)

2. **Can you make any Physical changes at all to the claw during the competition?** NO, as this effectively means that you're creating a "new" claw out of your existing claw. Some examples of things which are NOT allowed:

    - adding or removing rubber bands from the claw to customize it for specific items.
    - bending a claw to change the way it grabs different items (except if it's an emergency fix, should be obvious to the observer)
    - swapping in or out a physical part of the claw.

    The instructors watching the competition will be watching to ensure that claws are not modified at any point during the 12min competition, even between the 3 different rounds of the competition. Rounds 1 and 2 may be easy to monitor, Round 3 will rely on the honour system. (added Jan 20)

3. **During the Bulk Round, can your claw mechanism lift up the bin holding all of the beads?** No, the claw may not pick up the bin. (added Jan 20)

4. **Can you use the joystick or sonar to remotely control the claw mechanism?** No, team members are not allowed to interact with the claw mechanism at all except through the string/pulley system. Sensors are only allowed to interact with the ground, string, or objects to be picked up. (added Jan 20)

Timing

During the competition, teams shall have up to 12 minutes in total at competition station, and will compete in parallel with up to two other teams (i.e. two or three teams compete at a time). The timing breakdown is as follows:

- 4 minutes to mount Claw to the crane and practice (round starts early if all teams are ready)
- 4 minutes for the Variety competition
- 2 minutes for the Bulk competition
- 2 minutes to disconnect claw and leave the competition area

Following the completion of the individual rounds and poster session evaluations happening in parallel, the Cooperation round will last 12 minutes at the end of the studio. Studio sections should plan a strategy in advance (order of items attempted, claw combinations, etc.) to maximize success.

Scoring

- Variety Round raw score =   1 point for each successful retrieval (maximum 15 points)
- Bulk Round raw score =   Total weight retrieved in grams
- Cooperation bonus points =   2 points for each item retrieved (maximum 12 points)

Final Score = (Variety raw score / Max Variety raw score of all teams in the class) * 50

   + (Bulk raw score / Max Bulk raw score of all teams in the class) * 50

   + (Cooperation bonus points)