

Resources:

1. *Motors:* You have a 6x \$15 motor credit for DC motors & multiple ratio gearboxes and RC servo motors. You may spend your \$50 budget or \$20 out-of-pocket money on other motors (or actuators), provided those motors could be procured by other students. If in doubt, ask the Mechatronics Supreme Court (see below). Donated materials must be included in your financial summary, and count towards the \$20 out-of-pocket limit.
2. *Mechatronics Lab:* wiring, electrical components, some fasteners, tools.
3. *Student Machine Shop:* materials, tools, machinery.
4. *Physics Storeroom:* electronics, metals, plastics, fasteners.
5. *Local stores:* Home Depot, Lowes, Hobbytown (5578 South Redwood Rd), etc.
6. *Internet supply stores:* for gears, pulleys, timing belts, bearings, see Berg (www.wmberg.com), Small Parts (www.smallparts.com), Stock-Drive Products (www.sdp-si.com), McMaster-Carr (www.mcmaster.com); for electronic components, see Digikey (www.digikey.com).

Competition rules:

1. *Contest table:* Each labyrinth is 2.3 m square with wall heights of 18.4 cm, as shown in Figure 2. The two labyrinths share a common edge and the walls are mirror-images. At the start of each competition, you must place your robot within the marked starting square on the designated side.
2. *Objective:* Your robot must find its way through the maze, using sensors to follow the walls and find your quaffle (ball), the secret code, the locked door, and the goblet. Your team wins immediately if your robot is the first to unlock the door using the secret code and put your quaffle in the goblet.

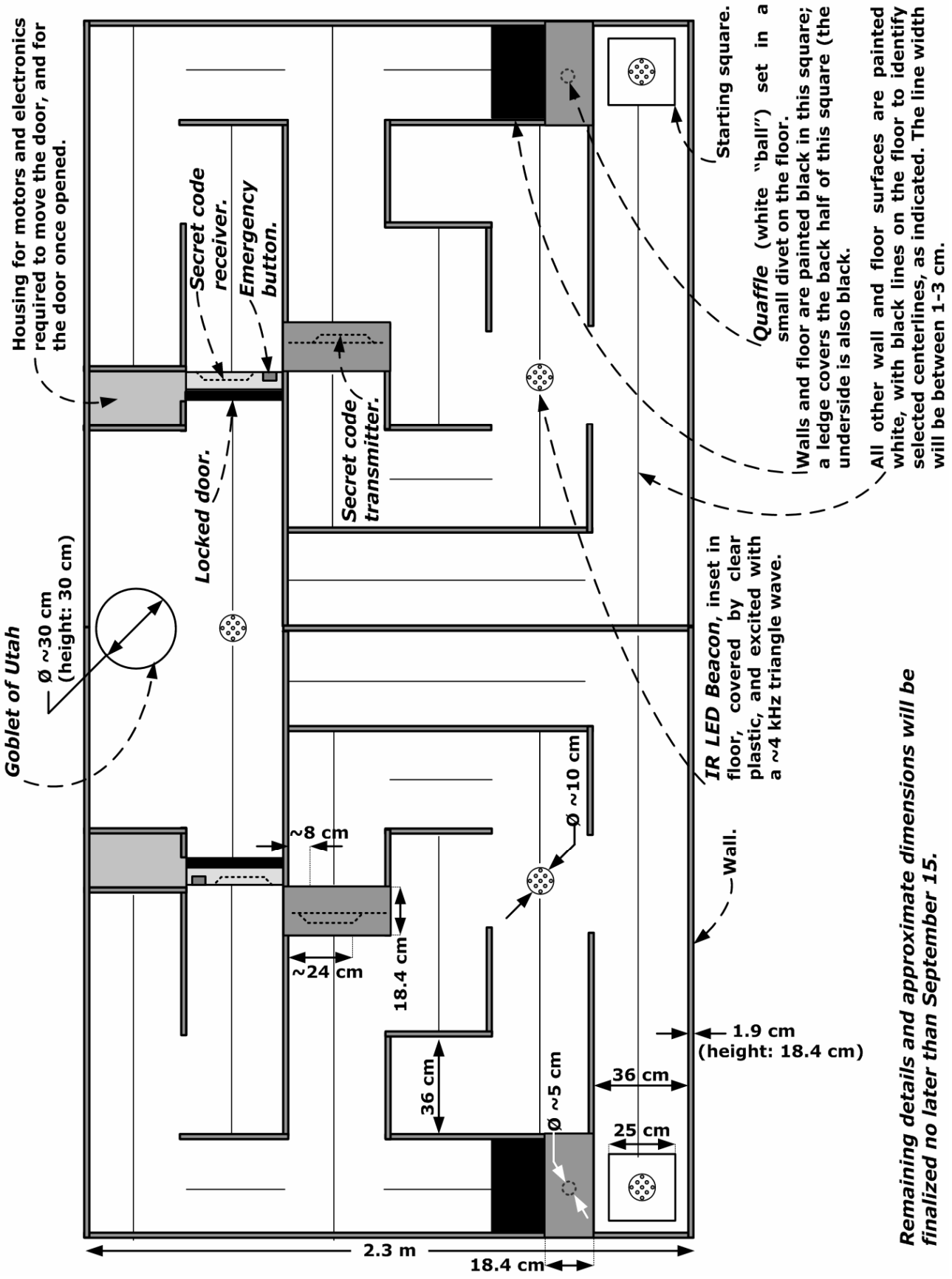
The locked door will have an emergency button your robot can activate to open the locked door if you are not able to retrieve and use the secret code (if you enter the wrong code three times, the door will open as if unlocked with the emergency button). If the door is opened with the emergency button, even if your robot puts your quaffle in the goblet first, the opposing team can win if they are able to unlock their door using the secret code before the ninety seconds are over.

3. *End of Match and Winning:* The competition ends immediately once either of the following conditions occur, with the winners determined as described:
 - a) Robot enters the secret code and puts its quaffle in the goblet: automatic win.
 - b) Ninety seconds pass. Winner is determined by the following equation:
$$\begin{aligned} \text{Points} = & 100 * (\text{door opened with secret code}) + 50 * (\text{quaffle in goblet}) \\ & + 25 * (\text{first quaffle in goblet}) + 10 * (\text{quaffle possession}) \\ & + 5 * (\text{first robot to goblet}) - 200 (\text{not})(\text{auto-off at 90 seconds}) \end{aligned}$$

In the case of a tie, the robot closest (along the direct path) wins.

To win, your robot may not violate any of the competition or robot rules.

4. *Interference:* Team members may not interfere with the contest table or robots.
5. *Time Limit:* Each match is ninety seconds, after which the robots must stop automatically (see Robot Rule #8 and scoring in Competition Rule #3).
6. *Competition structure:* Your robot will compete at least twice and no more than ten times on competition day. Winners from the first round will move directly into a “Sweet Sixteen” bracket; the remaining spots will be filled through elimination rounds of the teams with losses in the first round. The teams in the “Sweet Sixteen” bracket will compete in single-elimination to determine the winner.
7. *Grand Prize:* Students on the team that wins the competition will have the option to skip the final exam if they have better than average scores on the exams and homework assignments.



Remaining details and approximate dimensions will be finalized no later than September 15.

Figure 2. Spring Competition Course

Robot rules:

1. *Locomotion:* Any method of moving your robot is allowed; spiked wheels (or other surfaces damaging to the course) are expressly forbidden (see Rule 13).
2. *Size:* The robot must fit within a 25 cm x 25 cm x 25 cm cube (sizing boxes are provided in lab); it will be sized the day of the contest. The robot may not expand beyond this size until the starting beacon indicates that the contest round has begun (e.g. any graspers or end-effectors must be retracted).
3. *Weight:* The robot may not exceed 3kg; it will be weighed the day of the contest.
4. *Power source:* All robots must use the provided (single) rechargeable battery pack and Handyboard battery only. No other energy sources are permitted.
5. *Motors:* See notes on motors above, under Resources.
6. *Exterior Skin:* A protective outer skin is required for the competition in the spring. It must protect all interior components as well as convey the theme of the robot. It must be removable and well secured. Holes in the skin are permissible for sensors, grasping devices, access to the controller, etc., and may provide structural support for the robot.
7. *Appearance:* High quality craftsmanship and finishing is expected. Wires must be neatly harnessed, circuits well organized, and the exterior skin visually appealing. A skin that conveys the robot theme as well as showing some interior features is encouraged. The appearance will be a factor in both fall and spring robot grades.
8. *Autonomy:* The robots will initially be placed on one of the two starting squares. Each team will power on their robot, and the match will be *started* when the beacons at the centers of the starting squares are simultaneously turned on. This will signal the start of the match, and the robots must compete without user intervention. The robots must stop automatically after 90 seconds have elapsed.
9. *Manufacturing:* Each group must design and build all functional components of their robot. This includes and is not limited to the mechanisms, support frame, etc.
10. *Allowed Purchased Components:* Fasteners, bushings, bearings, raw material (bar stock, threaded rods, straight rods), motors/actuators (as detailed above, under Resources), gears, pulleys, springs, cables, belts, chains, wheels, or tracks are acceptable. If in doubt, ask the Mechatronics Supreme Court (see below).
11. *Budget:* Net expenditures must not exceed \$70 (not including motor credit), and must be proven via a cost analysis included in the presentation.
12. *Allowed robot-to-robot conduct:* Grabbing (via a grasper or end-effector), pushing (via body contact or after a grasper has secured a grip), and lifting/flipping (via a grasper, end-effector, or body contact).
13. *Un-allowed conduct:* Hitting, kicking, striking, burning, melting (heat or chemicals), sensory interference (distracting light sources, light shields), and the use of projectiles are not allowed. Discarding (which includes dropping, launching, ejecting, or losing) any pieces, parts, components, liquids, gasses, or solid matter is also forbidden. Bottom line: you should compete with your opponent, but you should not attempt to disable or destroy them. In addition, damaging or anchoring to the contest table (e.g. no spikes, cleats, suction cups, or anchors) is prohibited.

Rule clarification and amendment:

These rules may be modified for clarity or to preserve the "spirit" of the contest. If you have questions, e-mail Dr. Bamberg at sbamberg@eng.utah.edu with "Mechatronics Supreme Court" in the subject line. Any clarifications or changes will be discussed and decided upon on Monday mornings by the Mechatronics Supreme Court (Dr. Bamberg and the lab TAs), described in class, and detailed on web-ct/Project.