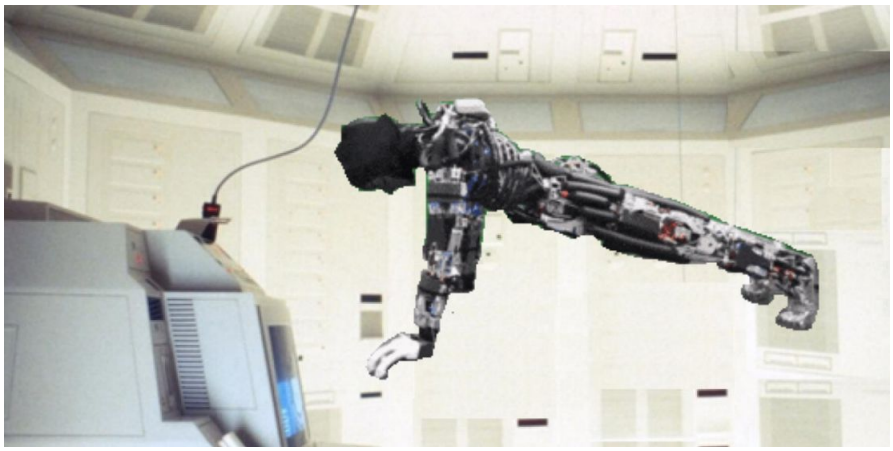
ENPH 253 – Introduction to Instrument Design - Summer 2017

DRAFT Competition Rules - June 13, 2017

Mission Impossible 8: Rogue Squishies

(Click here for “agent scream” sound effect) (here for 30 sec of M.I. theme)(or, full length)



Your mission, should you choose to accept it, is to rescue six of the IMF’s cutest, squishiest agents. Disguised as squishy toys, they are currently held captive in an enemy stronghold with exceptional security measures. To rescue the agents, you will have to pass through alarmed doors, timing your passage with the brief shutdown in the alarm system that will be arranged by your crew. You’ll then have to ascend a ramp running dangerously close to a wall at first, and then equally close to several drop-offs after that with all your equipment. One false step here and you and your gear will fall to the alarmed floor below, ruining your mission. Finally, you must reach into the holding tank where the agents are being held and rescue them.

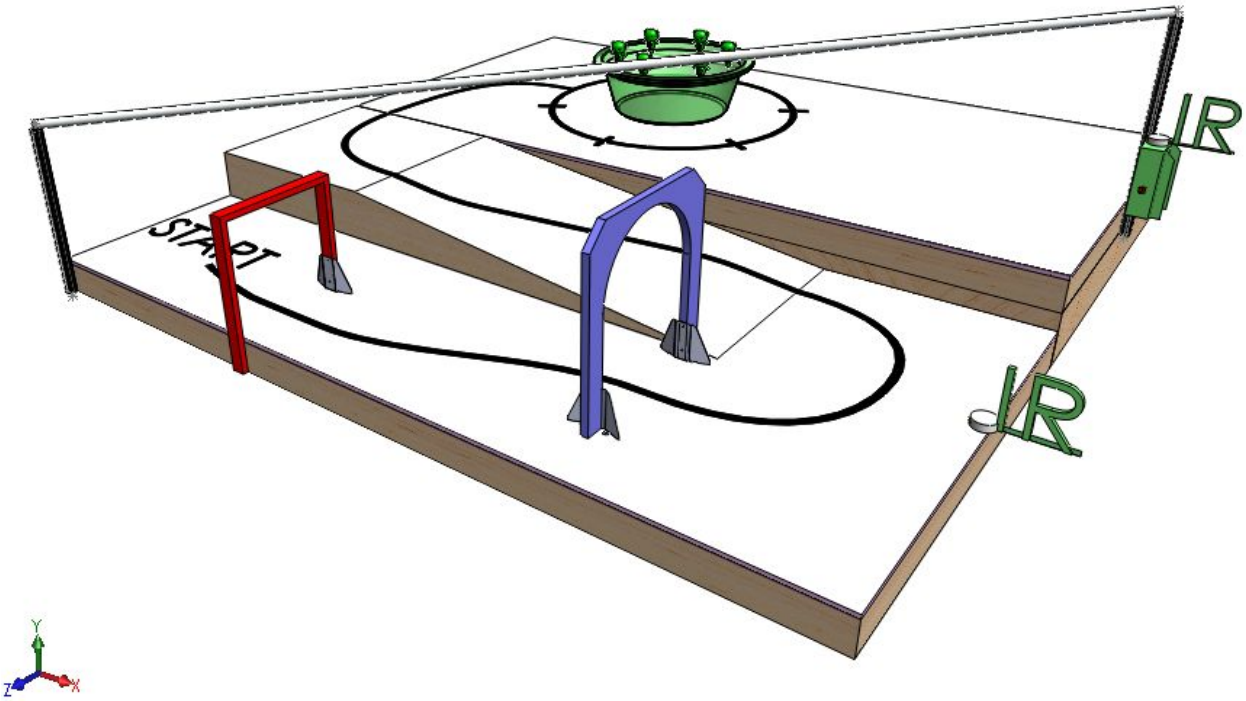
Note that as soon as you attempt your rescue run, the inevitable detection of an intrusion will start the clock ticking in an evil attempt to drown the agents. While our agents can swim for a brief period, their location will become increasingly hard to pinpoint as they float in the tank. Once you’ve rescued one or more of the agents, your only way to get them out of the stronghold is to send them to safety on a zipline going out of the stronghold, since you are now barricaded in. You will be rescued later by helicopter and do not need to leave the stronghold on the zipline unless you choose to do so in order to bring the agents to safety.

This rescue involving a large water tank and the potential for your high tech gear to get disabled or destroyed by water, everything has to be designed with ruggedness in mind. Due to the scale and complexity of the challenge, you will have to develop efficient strategies and highly capable equipment to overcome all challenges and timing issues in the most efficient manner. Good luck!!

Revision History:

1.0 AM initial draft
2.0 2.0 JN edit
3.0 AM edit - for release on first day of classes May 16
4.0 BZ edit (June 13)

Figure 1 – Competition Surface
(see more detailed info here)



COMPETITION RULES

1) **Enemy fortress competition surface** - The competition surface is approximately 8 feet x 8 feet, split over two levels (one is 6” higher than the other) which are joined by a ramp that is 24” wide and 47” long. The surface is made of wood and will have some warp and slight bumps at the joints. Robots must be designed to accommodate for imperfections and irregularities in the surface. The diagram above shows the most likely configuration of the surface (The final surface may not be exactly identical to the diagram as shown). There will be one surface for each of the two competing robots – they will be mirror-images of each other, and similar but not necessarily 100% identical.

2) **Path** - The Path through the fortress is marked in black electrical tape approximately as marked in the diagram. At several locations the path leads within six inches of either the edge of the surface or a wall. Precise tape following will greatly enhance the robot’s chance to get up to the tank without falling off the surface or colliding with obstacles.

3) **Start Aera** - The robots will start with the back of the robot lined up with the back of the playing surface, behind the entry arch.

4) **Entry Doorway** - The robots must first pass through a 12” by 12” entry doorway. If the robot gets stuck, the team is allowed to start over but the run timer will keep running.

5) **Alarmed Door** - The path secondly goes through an Alarmed Door that has an opening measuring 14” wide by 18” high. Aligned with the door is an infrared signal pulsing at 10 kHz to indicate the alarm is ARMED, or 1 kHz to indicate the alarm is DISABLED. A visible light will also be used to indicate to the audience when the alarm is ARMED or DISABLED. The Alarmed Door will be ARMED for a random time ranging from 0 to 5 seconds, followed by being DISABLED for 5 seconds. These times will cycle indefinitely until the round is over, and will not be reinitialized at a restart. The robot must pass through this door while the alarm is DISABLED. If the robot passes through the door when it is ARMED, the robot will have to be returned to the start area for a re-start.

6) **Ramp** – The Ramp is 24” wide and 47” long with an incline of about 7 degrees. The Path will travel up the ramp being at some point very close to a wall, and then the edge. The distance can get as close as (but never less than) 6” to either, also this applies to the rest of the competition surface and the layout of the path in general.

7) **Holding Tank** – The Holding Tank will be placed on the top surface, and will measure ~ 22” diameter and ~7” tall. I holds 20 to 22 liters of water and will be filled to somewhere from 30 to 50mm below the top edge. It will be filled with water both for practice runs in the weeks leading to, and during the actual competition.

8) **Circle Path near Holding Tank** – The path will make a circle around the holding tank about 6” away from top edge of the tank. Agent positions (when not floating) will be marked with 4” wide tape marks centered on the path.

9) **Agents** - Agents will be small rubber bath toys. They will not be modified with magnets or any other means to ease collection. Six Agents will be positioned on 6 platforms at the following heights below the top edge of the tank: -10mm, -30mm and -50mm. The platforms can be individually controlled and tilted to throw agents into the water.

10) **Timing** - All agents will be thrown into the water automatically, according to the following sequence: 60 seconds after the start of each run, the agent in position #1 will be thrown in, followed by agent positions 2 to 6 every five seconds after that. Due to the mirror-image nature of both competition surfaces, this will result in a clockwise release on one surface while going counter-clockwise on the other. The last agent will be in the water exactly 85 seconds into the run.

11) **Zipline and Rescue Marker** - A steel tube “Zipline” will be mounted from the top surface to the start area. The Zipline is made of a 29.5mm diameter steel tube elevated to a height of 20” above the surface at its beginning, and 16” at its lowest point. The Zipline will be marked with the Rescue Marker, an IR beacon pulsing at 10kHz. The Rescue Marker is mounted so that the emitters are 8” above the surface, and 8” beyond the edge of the surface to avoid mechanical interference with approaching robots.

12) **Return via Zipline** – Agents are considered Returned once they arrive in the quadrant that is the robot starting area. The team may carry and use a max of one team-created Zipline Agent Carrier to attach to the zipline. The Zipline Agent Carrier is the only item which is allowed to physically separate from the Robot (see General Rules, B)

13) **Scoring** - Scoring is as follows: + 1 point for every agent rescued from the holding tank + 2 points for every agent returned to the start area. Each Agent may count for up to 3 points, for a maximum of 6*3 = 18 points overall.

14) **Multiple Runs During One Heat, and Restarting Robots** - A Robot which successfully completes a Run for a score can be restarted to attempt a higher score. Scoring is not cumulative during the Heat, only the single-highest scoring Run during the Heat will count. Robots may also be rescued by the team and restarted as many times as desired during the heat, for any reason.
This includes but is not limited to:
    1. Falling off the Playing Surface.
    2. Getting lost or stuck on the Playing Surface.
    3. Falling off the ramp, getting stuck.

    Time during the Heat does not stop for a restart. Any Agents moved outside of the Holding Tank will be placed back into the tank, either onto their little platforms or into the water, depending whether or not agent platforms have been triggered (tilted down) or not.

15) **Time Limit** – Heats are a maximum of 2 minutes. Additional time may be allowed in the finals to resolve heats that are tied at the end of two minutes. Judges may choose to end a heat early if there is a clear winner during the heat.

General Rules

A) **Autonomy:** Robots must be completely autonomous – no form of remote control is allowed.

B) **Size:** At the start of the run, the Robot be small enough to pass through the entry arch. The robot may not grow in size beyond a 24” cube. The Robot may not intentionally leave any part of itself on the surface or break into multiple robots, with the exception of a Zipline Agent Carrier. If the robot cannot meet these size restrictions, the Judges may choose to allow the Robot to run individual rounds but not to compete in the overall competition.

C) **Power:** Robots may only be powered by one large battery pack (nominally 14.8V) provided, plus two low-voltage (nominally 7.4V) batteries intended for use for sensor circuits. The large battery pack is the only electrical power which may be used to drive any motors (DC or servo) on the Robot (cannot use the low-voltage packs in series).

D) **Components:** All components outside of those provided by the course instructors or listed at the end of this document must be approved by course instructors. Teams that choose to purchase their own items will not be reimbursed, and are limited to a maximum of $50 per team.

E) **Damage to the Surface:** Robots may not permanently modify or damage to the competition surface or any individual competition piece. No glues, nails, screws or similar “rough measures” are allowed to pick up the agents.

F) **Start Mechanism:** Robots will initiate motion only when the START button on their controller is pressed by a team member at the start of the run (signalled by a Judge).

G) **Competition Surface Variations:** The surface is made of wood and will have some warp and slight bumps all over. Robots must be designed to accommodate for imperfections and irregularities, as well as variation between practice and final surfaces. The surface will be painted at the beginning of the course but will not be repainted before competition day to avoid sudden changes in reflectivity. If during training it is necessary to step on the surface, do your best to avoid damaging it. Take off your shoes, don’t use tools or work on your robot while on the surface. Design your robot in such a way that it won’t damage any parts of the surface while navigating it.

H) **Wall Climbing:** Robots are not allowed to climb walls in order to avoid passing through the gates.

I) **Rules Finalization:** Rules and dimensions will change slightly between now and the competition. Finalized rules will be issued after completion of the competition surface construction in Hebb 42. Qualifying heats (“Time Trials”, with no opponent) will take place 2 weeks prior to the competition in Hebb 42.

J) **Sportsmanship Rules:** Other strategies or designs that obviate the design elements of the course or that do not follow the intent of the competition will be disallowed whether or not they explicitly break these rules. All strategies which have been designed specifically to come as “close to” violating any of the posted rules as possible must be presented to the course instructors during the design stage of robot building. All decisions are at the discretion of the course instructors.

ALLOWED AND RESTRICTED MATERIALS

Approved

1. Solenoids (when used with mechanical constraints).
2. Elastic bands.
3. Wheels and hubs from existing RC or other small vehicles.

Must be Reviewed By Course Instructors

1. Springs are generally allowed, but must be reviewed individually for safety.
2. Compressed air may be allowed, but all valves and fittings must be reviewed for safety and a maximum pressure limit will be imposed.

Banned:

1. Any RC servo motors not supplied or approved by the course instructors.
2. Discrete H-bridge driver chips.
3. Any components other than wheels and hubs from existing RC or other small vehicle chassis, including (but not limited to) suspensions, differentials, steering mechanisms.
4. Alternate battery power sources.