WPI

RoboCrisis

@WPI

(actual event name subject to change)

Updated: 12/28/2017

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1 Introduction

1.1 About Worcester Polytechnic Institute

Worcester Polytechnic Institute, founded in 1865, was established for the sole reason of providing the masses with an exceptional science education. It was not until the late 1960's that WPI adapted its signature "Plan". The WPI Plan combines the theoretical based learning process of lecture and lab and combines this with practical, hands-on, projects to be completed by undergraduates within their years here.

1.2 About RoboCrisis (Actual Name TBD)

RoboCrisis is a multi-day robotics festival hosted by WPI! At RoboCrisis, teams of college students will have the opportunity to use robots they built to complete real world challenges and tasks. These challenges include autonomous navigation, item sorting, and terrain traversal.

1.3 About This Document

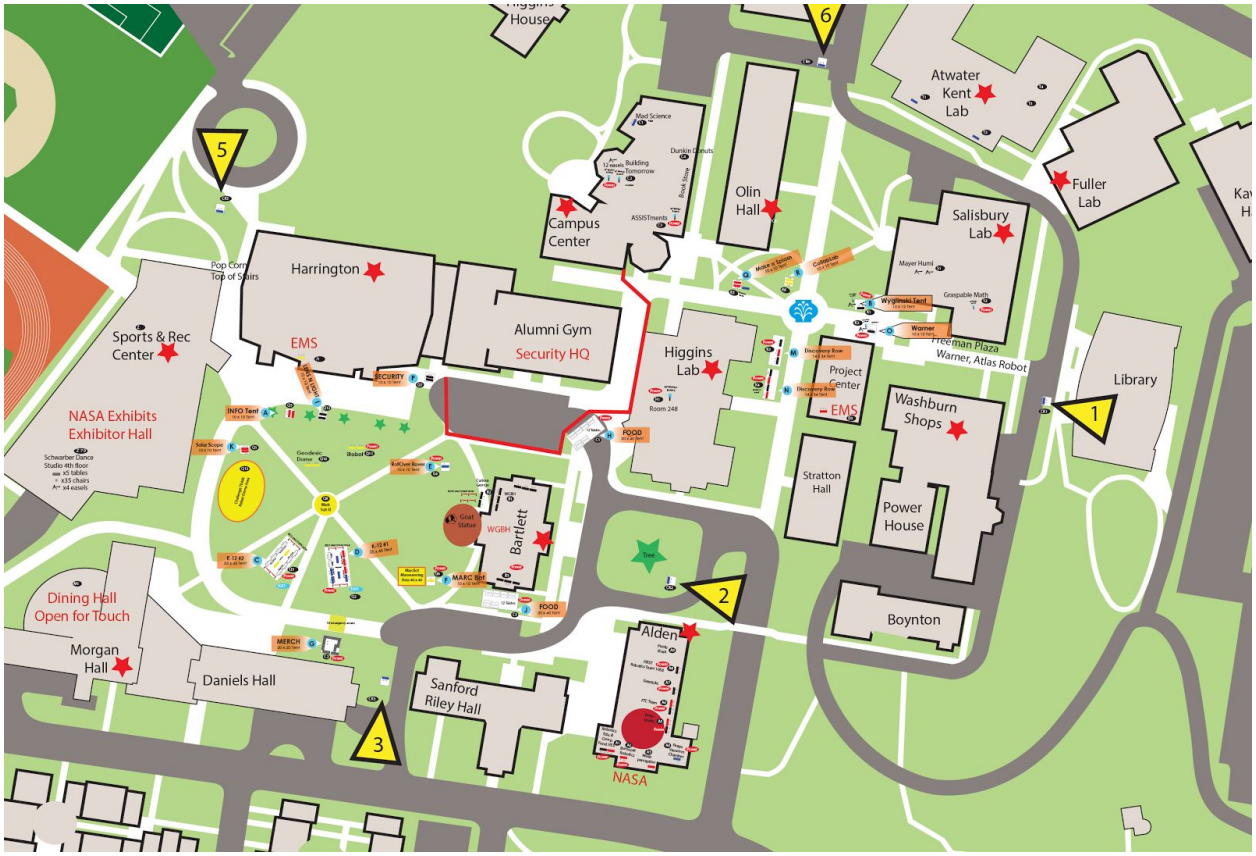
This document describes the rules and logistics for RoboCrisis 2019 and is intended to be a resource for all of the event's participants. The document should cover the following in detail:

- A general overview of RoboCrisis and its challenges
- Specific details about each challenge and the playing field for each challenge
- How to compete in each challenge
- Specific rules on each challenge

1.4 Competition Updates

For any updates on RoboCrisis and its rules please check https://wpi.edu/+robocrisis. There will be an update once a month that may contain rule clarifications or changes.

2 Competition Logistics



The following locations will be used for RoboCrisis:

- Institute Park
    - All-Terrain Challenge (Outdoors)
- Harrington Auditorium
    - All-Terrain Challenge (Indoors)
- Recreation Center Robot Pits
    - Competition Pit Area
- Recreation Center Swimming Pool
    - Underwater Aquaculture Challenge
- Riley Commons
    - Item Sorting Challenge
    - Firefighting Challenge

2.1 Event Parking

Specific information regarding parking will be disclosed as the event draws near.

2.2 Competition Participants

All participants of RoboCrisis must be enrolled in a four-year institute or univeristy as a student. There are NO exceptions. If you are attending RoboCrisis you must make an account, join a team, and fill out the required forms at robocrisis.org.

2.3 Team Registration

Each team must be registered by the deadline if they intend to compete in any of the RoboCrisis challenges. All members of a team do not have to come from the same university, but they must meet the participant guidelines described in section 2.2.

2.4 RoboCrisis Schedule

The final schedule for RoboCrisis will be released two months before the competition start date. RoboCrisis is expected to take place over a two-day period. In order to have a basic idea of the event here is the tentative schedule:

Thursday
Specific events schedules may change on a case by case basis. Please check with an information desk if you have questions

Time	**Activity**	**Location**
5:00 PM	Early Team Check-In & Equipment Drop-Off *Note: Practice Fields will be open until venues close	Harrington Auditorium
7:00 PM	Team and Volunteer Networking Dinner	The Odeum
8:30 PM	Venues Close *Note: that you will not be able to have access to the event venue overnight so please do not leave anything you might need when the venue closes*	

Friday

Time	Activity	Location
8:00 AM	Opening Ceremonies	Harrington Auditorium or WPI Football Field *Rain Location is Harrington Auditorium*
9:00 AM	Practice Fields Open and Open Q&A with Judges	See Competition Logistics section for field locations
10:00 AM	Challenge Events Begin	See Competition Logistics section for field locations
12:00 PM	Lunch Break *Events will be closed from 12:00PM-1:00PM. Teams will have an opportunity to practice. * There will be a keynote speaker for lunch in the Odeum.	Odeum
1:00 PM	Challenge Events Resume	See Competition Logistics section for field locations
2:00 PM	Project Poster Judging Begins	Robot Pits in Sports and Recreation Center
6:00 PM	Challenge Events Suspended *Note: Challenge Fields will be open for practice until closing. This is with the exception of Institute Park.	See Competition Logistics section for field locations
8:30 PM	Venues Close *Note: that you will not be able to have access to the event venue overnight so please do not leave anything you might need when the venue closes*	

Saturday
On this day TouchTomorrow is also occurring. If you are interested in any of the TouchTomorrow activities please see http://wp.wpi.edu/touchtomorrow/.

Time	Activity	Location
8:00 AM	Opening Ceremonies	Harrington Auditorium or WPI Football Field *Rain Location is Harrington Auditorium*
9:00 AM	Practice Fields Open and Open Q&A with Judges	See Competition Logistics section for field locations
10:00 AM	Challenge Events Resume	See Competition Logistics section for field locations
12:00 PM	Lunch Break *Events will be closed from 12:00PM-1:00PM. Teams will have an opportunity to practice. * There will be a keynote speaker for lunch in the Odeum.	Higgins House
1:00 PM	Challenge Events Finals	See Competition Logistics section for field locations
2:00 PM	Project Poster Judging Closes *Note: Any remaining poster judging will be carried starting at 10:00AM	Robot Pits in Sports and Recreation Center
5:00 PM	Challenge Event Finals End *Note: Challenge Fields will be open for practice until closing. This is with the exception of Institute Park.	See Competition Logistics section for field locations
6:00 PM	Closing Ceremonies Begin	Harrington Auditorium or WPI Football Field *Rain Location is Harrington Auditorium*

2.5 Accommodations and Travel Stipends

For a list of hotels near WPI campus please go to our website: robocrisis.org/accomadations. Registration will not cover any travel or accommodation costs for the event, but teams may apply for the following:

- Travel Stipends
    - If a team is not from the New England Area, they are eligible to apply for a travel stipend. Each Travel stipend will be a maximum of $TBD.
- On-Campus Housing
    - During the event, WPI can also provide housing accommodations to team's that may need it. Space is limited and accommodations will be assigned based on applications.

For more information please go to our website.

2.6 General Regulations

Any event official may inspect your robot at any time or request for your robot to be powered off for the safety of the event's attendees.

3 Event Rules

The following section will describe specific rules for each event at RoboCrisis. The rankings for each event will be described in the rules section of the event. In addition to the rankings of each event there will be judging on the engineering design of your robot. If you would like to be judged simply notify pit admin the day of the event.

All-Terrain Challenge

For this challenge, teams must build robots that are capable of traversing a variety of terrain. This is meant to simulate real life exploration and navigation problems. Points will be rewarded based on how far each robot travels. Robots will not be required to complete each terrain track, but an additional bonus will be awarded. There will also be an additional assessment task conducted by each robot.

1 All-Terrain Challenge Gameplay Rules

1.1 There will be four different types of terrain for this challenge. The terrain is specified in section 2.3.

1.2 The robot may only be supported through ground contact and at least one part of the robot must be in contact with the ground at all times.

1.3 Each robot drive team will consist of three members of each team. There can be up to two drivers per team and one coach.

1.4 When a team's robot is attempting to traverse terrain, their drive team may not have direct line of sight of their robots or the terrain.

1.5 The point breakdown will be as follows:

- Each Terrain Traversed: 10 Points
    - Defined as crossing a finish line
- Each Terrain Traversed Autonomously: 5 Points
- Fastest Time to Complete Track: 3 Points
- Each Target Identified: 2 Points
    - In order to simulate real-world simulations, there will be several targets on the field. The nature of these targets is TBD, but for each target identified there will be a point bonus. Example Target: Cone or Image of person.
- Correct Number of Targets Identified: 4 Points
- Translational Movement Bonus: 3 Points
    - There will be a bonus awarded for each terrain traversed in the following manner: Mechanisms that were in contact with the ground and provided translational movement did not rotate more than 360 degrees. Examples: legged robots.

2 All-Terrain Challenge Robot Rules

2.1 The total weight of any robot on the field may not exceed 150 lbs.

2.2 The total volume of the robot must not exceed L30in x W36in x H52in.

2.3 Your robot must have a working kill switch, to be demonstrated at check-in.

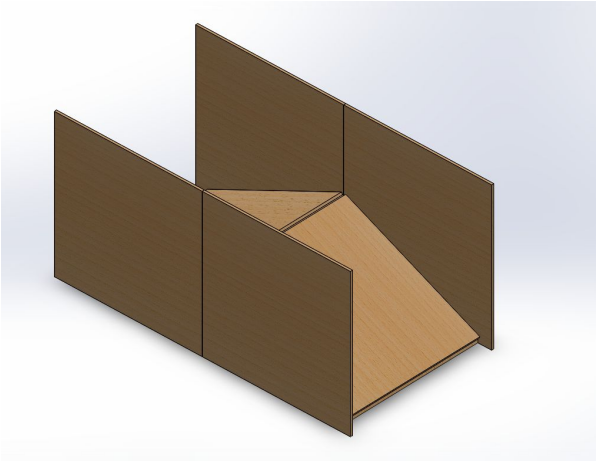
2.4 You may not do any runs without being approved through inspection.

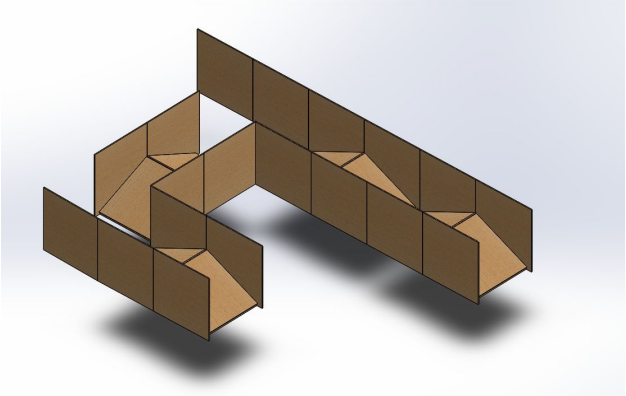
2.5 All Batteries must be sealed, immobilized-electrolyte types (such as gel cells, lithium, NiCads, NiMH, or dry cells.

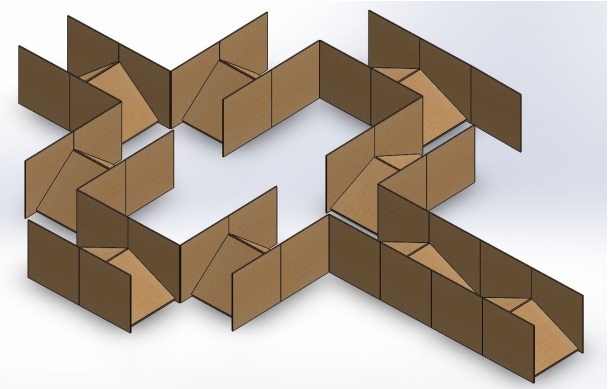
2.3 Terrain Descriptions

2.3.1 Stairs

2.3.2 Slanted Terrain

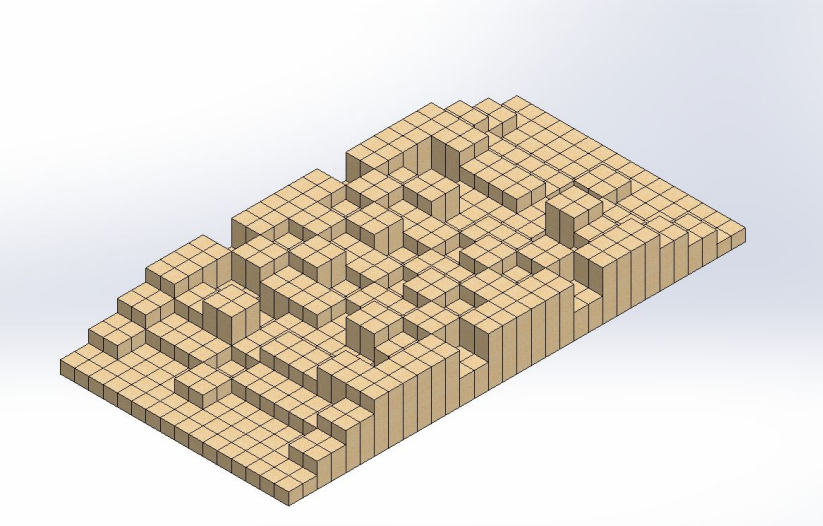






The field will be constructed out of plywood terrain blocks that can be rearranged to change the course between runs. The blocks will each have a gradient of either 15° or 25°.

2.3.3 Step Terrain



.2.3.4 Outdoor Terrain

The outdoor terrain field will be in Institute Park located next to WPI Campus. Teams will simply be required to traverse a grassy/dirt track. No potholes or object should exceed 5 inches in height or depth.

Institute Park

Autonomous Vehicle Challenge

Due to recent advancements, the autonomous vehicle industry is currently experiencing rapid growth and as such the demand for engineers in this field is growing. For this challenge, teams will build vehicles that will autonomously complete a small track and avoid obstacles.

1 Autonomous Vehicle Challenge Gameplay Rules

1.1 Two laps, best score of two runs counts.
1.2 Automated start and stop is required. Stop in a predetermined boxed area just past the finish line after two laps.
1.3 Each vehicle must be operated autonomously. If there is any human intervention, the score for that run will not be counted.
Stopping in the box gets you 25 points added to your score.
1.4 Each team will have five minutes per run to get as far as possible.
1.5 The point breakdown for this challenge is as follows:

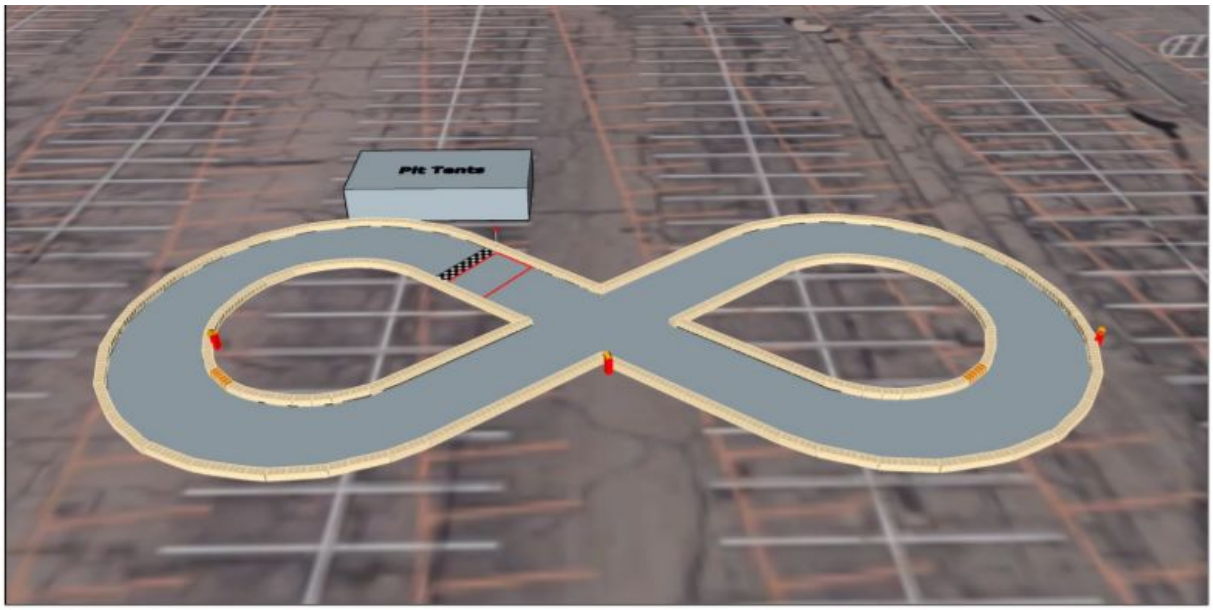
- Each time will get one point for each second remaining out of the maximum 5 minute time period (300 seconds)
- Stopping in the boxed area, past the finish line: 25 Points
- Each obstacle hit: -5 Points
    - Every time a vehicle contacts a cone obstacle there will be a penalty.
- Barrier Hit: -5 Points
    - Every time a vehicle contacts the barrier there will be a penalty.

1.6 Participants must have enough batteries to make consecutive runs. Charging batteries between heats will cause the event to run too long.
1.7 Deviating from the course (unless vehicle can self-correct) results in disqualification.
1.8 Only one vehicle may race at a time.

2 Autonomous Vehicle Challenge Robot Rules

2.1 Vehicles must be less than or equal to 36" wide and 62" long, but can be any configuration (three wheels, four wheels, etc.). There is no weight restriction.
2.2 Your vehicle must have a working kill switch, to be demonstrated at check-in.
2.3 You may not do any runs without being approved through inspection.
2.4 Fixed beacons can not be placed on the track to aid in navigation.
2.5 All Batteries must be sealed, immobilized-electrolyte types (such as gel cells, lithium, NiCads, NiMH, or dry cells)

3 Track Information



3.1 The track is a figure-eight layout with a major axis length of approximately 178 feet and a minor axis of approximately 78 feet.
3.2 Track width is 16 feet.
3.3 Track extents are defined by barriers or tape.
3.4 The finish line is a box outlined in red tape that spans the width of the track and extends beyond the starting line by 10 feet.

Drone Challenge

***Challenge Inspiration:** http://www.aerialroboticscompetition.org/

Unmanned Aerial Vehicles have been a growing topic within the technology industry over the past couple years. These vehicles allow for individuals to complete tasks in areas that are typically difficult to reach. This competition gives college students the opportunity to create fully autonomous flying robots that demonstrate behaviors never before demonstrated while completing missions with real world applications.

For this challenge, teams will deploy autonomous drones into a challenge area as described in Section 3 and must

1 Drone Challenge Gameplay Rules

1.1 The main objective is to score as many points as possible for each mission. There will be 2 missions and teams will have the opportunity to do each mission 3 times. Only the best score from each mission will be considered.
1.2 There will be prizes for the best average performance for each mission as well as an overall winner for this challenge.
1.3 Both missions will be in the same challenge area.
1.4 Mission One- For this mission teams will be deploying their aerial robotic vehicles into the challenge area and can score points for the following:

- Package retrieved from home (5 Points)
- Each Package delivered to drop zone (10 points)
- Drone returns to home (10 points)

There will also be obstacles to avoid in the form of "skyscrapers" (see section 3)/
1.5 Teams will have a total of 5 minutes to complete Mission One
1.6 For mission one points will be deducted for the following:

- Aerial vehicle hits a skyscraper (deduct 5 points)
- Package dropped (deduct 5 points)

1.7 Packages will weigh 1kg and will be NxNxN volume. They will have a metal plate glued on top so they can be retrieved by magnet. There will be 10 packages in total.

1.8 Mission Two- For this mission teams will be sharing the challenge area with one other competing team. Concerns by teams that their aerial robotic vehicle investment may be jeopardized by collisions of vehicles should drive their designers toward more robust designs. The IARC scoring formulas will also reward robust “crash-proof” air vehicle designs. Points can be scored for the following:

- Package retrieved from home (5 Points)
- Each Package delivered to drop zone (10 points)
- Drone returns to home (10 points)

There will also be obstacles to avoid in the form of “skyscrapers” (see section 3)/
1.9 Teams will have a total of 10 minutes to complete Mission Two
1.6 For mission one points will be deducted for the following:

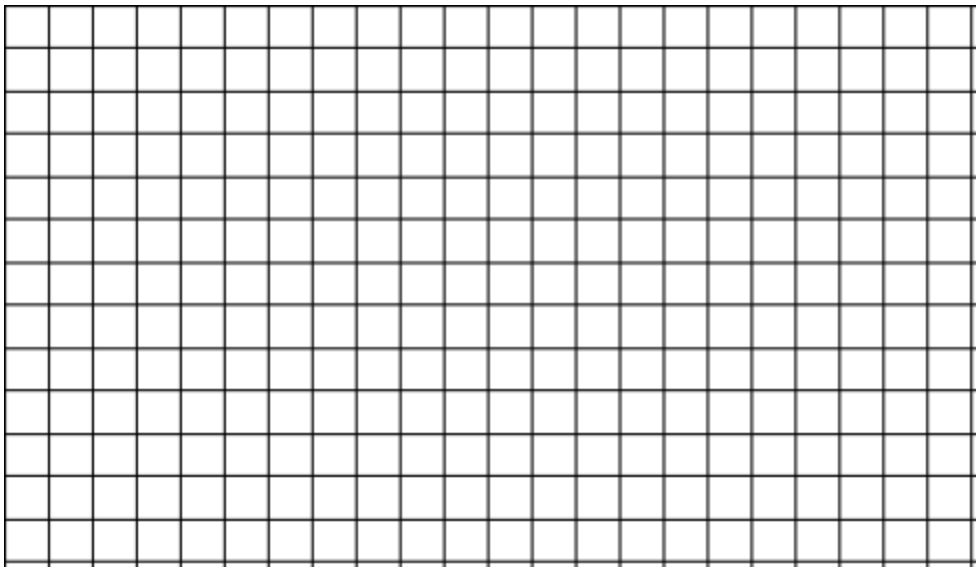
- Aerial vehicle hits a skyscraper (deduct 5 points)
- Package dropped (deduct 5 points)
- If the team’s aerial vehicle crashes into another competitor's vehicle (deduct 15 points)
- For every 5 seconds aerial vehicle touches ground (deduct 5 points)

2 DroneChallenge Robot Rules

2.1 Each must robot must fit in a 70x710x70cm box.
2.2 Each robot must not exceed 10lb.
2.3 All Batteries must be sealed, immobilized-electrolyte types (such as gel cells, lithium, NiCads, NiMH, or dry cells)
2.4 Robots must be completely autonomous and teleoperated control in any form by a human is prohibited.
2.5 Each team may field up to 5 robots
2.6 Teams may only use the following methods for communication:

- Wi-Fi
    - *Details to be determined for actual event*
- Bluetooth
    - *Details to be determined for actual event*

3 Drone Challenge Arena



THIS IS AN EXAMPLE PICTURE. ACTUAL FIELD MAY VARY CONSIDERABLY

3.1 The Challenge Arena is NxN inches *Details to be determined for actual event*

3.2 Skyscrapers, drop zones, and home areas will be randomly moved before each round.

3.3 Skyscraper dimensions:*Details to be determined for actual event*

3.4 Drop zone area: *Details to be determined for actual event*

3.5 Home area size:*Details to be determined for actual event*

Fire Fighting Challenge

Firefighting is one one of the most dangerous professions today. In order to foster the development of technology that can complete fire-fighting tasks without a human individual, this challenge was created. For this challenge teams must construct robots that autonomously navigate an “indoor maze” and extinguish a candle that is somewhere in the arena.

1 Fire Fighting Challenge Gameplay Rules

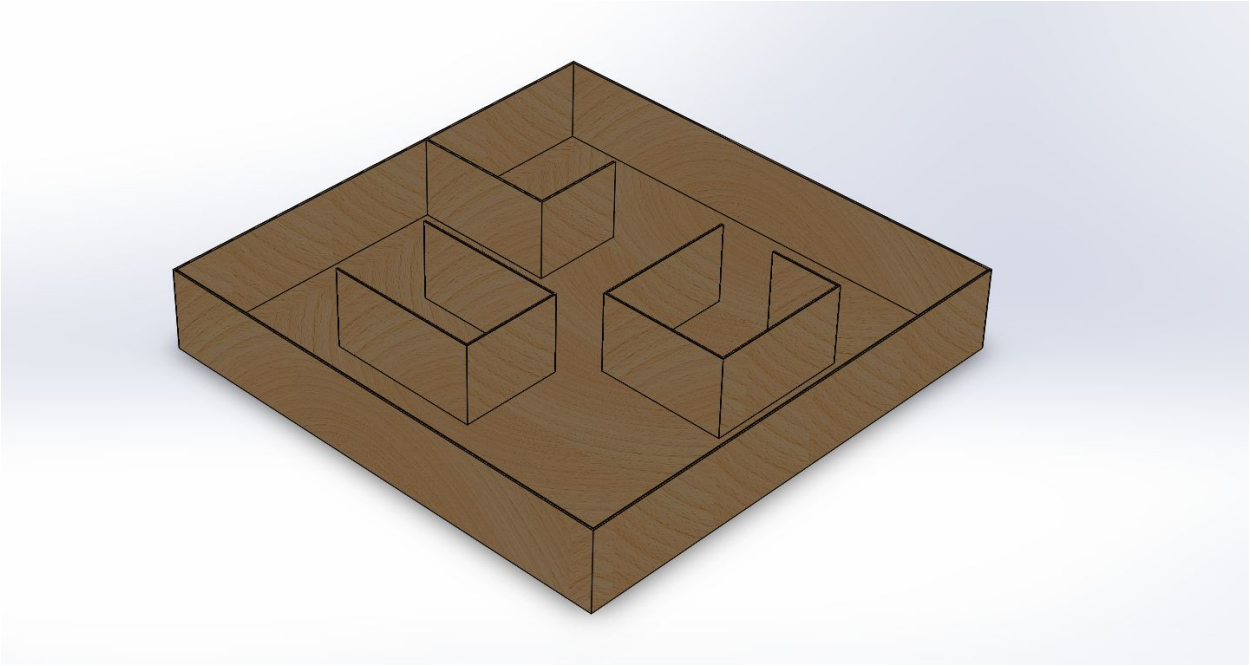
1.1 The candle flame will be from 15cm to 20cm above the nominal floor level. The candle thickness normally will be between 2-3cm. The exact height and size of the candle will change throughout the contest depending upon the condition of the candle and its surroundings. Robots will be required to locate the candle no matter what size the flame is at that particular moment.
1.2 The candle will be placed in a random room of the arena.
1.3 The judges will choose to place your robot in a random room of the arena.
1.4 Robots must autonomously navigate the arena to locate and extinguish the candle. The point breakdown will be as follows:

- Candle is located: 5 Points
- Candle is extinguished: 10 Points
- Robot Returns to Random Starting Position: 15 Points
- Fastest Time to Extinguish Candle: 5 Points
- Fastest Time to Return to Start: 5 Points
- Location of Candle Determined: 5 Points
    - If the location of the candle was determined the robot must display the location of the candle on a display mounted on the robot
    - That location must be accurate to +/- 3cm in the X and Y axis

2 Fire Fighting Challenge Robot Rules

2.1 Each must robot must fit in a 31x31x27cm box.
2.2 Each robot must not exceed 10lb.
2.3 All Batteries must be sealed, immobilized-electrolyte types (such as gel cells, lithium, NiCads, NiMH, or dry cells)
2.4 Robots must be completely autonomous and control in any form by a human is prohibited.

3 Fire Fighting Challenge Arena



The rendering depicted is not accurate to the actual field

3.1 The field for the Fire Fighting Challenge will be 12’x12’

3.2 The field will be constructed out of plywood.

3.3 There will be several obstacles throughout the field such as stairs.

3.4 For complete specifications on the field please visit our website.

Item Sorting Challenge

Warehouse automation is already a large industry and is growing quickly every year. For this challenge teams must build and design robots that will be able to pick and sort different objects.

1 Item Sorting Challenge Gameplay Rules

1.1 There will be 15 Items to sort. Full information on 10 of those items will be given before hand. Teams will learn of the other 5 items the day of the event.
1.2 Each robot drive team will consist of three members of each team. There can be up to two drivers per team and one coach.
1.3 Each Item will follow the following rules:

- The item can fit in a 42 x 27 x 14 cm or smaller volume.
- The item will have a total length + width + height of 61 cm or smaller.
- The item will weigh 2 kg or less.

1.4 The point breakdown will be as follows:

- Each item picked up autonomously: 5 Points
- Each item picked up through a teleoperated method: 1 Point
- Each item autonomously sorted into a storage container: 5 Points
- Each item teleoperated sorted into a storage container: 1 Point

1.5 Teams may provide their own storage containers. If they do not the event will provide the following containers:
https://www.amazon.com/Rubbermaid-Commercial-Storage-14-Gallon-FG9S3000GRAY/dp/B016UT9VRC/ref=sr_1_7?ie=UTF8&qid=1506098172&sr=8-7&keywords=storage+tote

1.6 If teams provide their own storage containers they must follow these guidelines:

- It must occupy an area of no more than 5,000 square centimeters, and its length, width, or height must be no longer than 125 centimeters. It may be placed on top of a table or other supporting structure.
- It must be static and contain no motors or actuators. It may contain parts such as drawers that are moved by the robot, provided that these parts start and end the task inside the bounding box of the Storage System.

1.7 For this event 15 items must be sorted into four different storage containers. Teams will be notified about how to sort these items at the event.
1.8 The retrieval and storage of each item should take no longer than 10 minutes.
1.9 Judges will place each item in each team's designated retrieval zone. Robots may only retrieve items when they are in this zone.

2 Item Sorting Challenge Robot Rules

2.1 All Robots must include an emergency stop function to halt movement of the Robot.
2.2 No Robots may include teleoperation or semi-autonomous user input features.
2.3 Robots that are designed to intentionally damage items or their packaging (such as piercing or crushing) will be disqualified from the Challenge.
2.4 Robots may include vacuum systems or other noise generating components but the noise levels must allow others to work effectively nearby.
2.5 Excessive high-pitched noises are not allowed.
2.6 Questionable designs should be cleared with the event committee prior to the Challenge.

Swarm Challenge

***Challenge Inspiration:** https://www.youtube.com/watch?v=Ar88kAW5oGk

Swarm intelligence and hive minds are heavily prevalent in nature. Swarms in nature make use of many redundant separate entities to accomplish tasks that would have been difficult to complete alone. These characteristics are highly desirable for completing many real-world tasks, causing the field of swarm robotics to emerge.

This challenge will give college students the opportunity to develop multi-robot systems on a hardware and software level as well as specific software skills such as computer vision and environment navigation and is highly inspired by the hive mindset seen in nature in which groups of creatures work in an organized manner to accomplish tasks. Swarm has been a major topic within the technology industry in the past few years since multi-robot systems have the potential to accomplish tasks greater than any individual robot could alone.

In order to build real-world experience, teams will deploy a swarm of up to 5 robots in a warehouse setting described in section three.

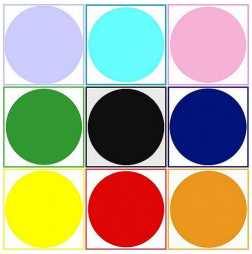
1 Swarm Challenge Gameplay Rules

1.1 The main objective is to score as many points as possible within the 10 minute runtime.
1.2 Points are earned when a task is completed. All tasks are associated with the sorting, moving, and placing different cases.
1.3 Case Specifications are as follows:

- Dimensions for Case Type 1:
  - Length: *To be determined*
  - Width: *To be determined*
  - Height: *To be determined*
- Weight of Case Type 1 (Approximate):*To be determined*
- Dimensions for Case Type 2:
  - Length:*To be determined*
  - Width:*To be determined*
  - Height:*To be determined*
- Weight of Case Type 2 (Approximate):*To be determined*
- Each case will be constructed by *To be determined*

1.4 Teams will have three different options for case identifiers. There will be a point bonus awarded based on identifier used in that run.:

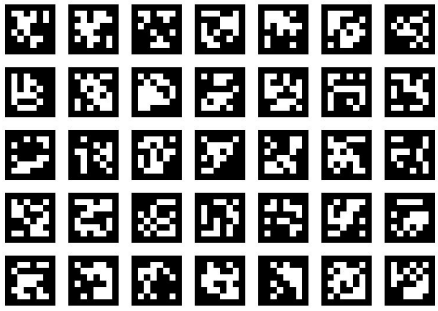
- Shapes + Colors (5 Points)



- Different colored circles will be used as case identifiers
- Each circle will be *inches in diameter
- The specific color hues are as follows:
  - Black:*To be determined*
  - White:*To be determined*
  - Red:*To be determined*
  - Blue:*To be determined*
  - Yellow:*To be determined*
  - Green:*To be determined*
  - Orange:*To be determined*
  - Pink:*To be determined*

- Barcodes (5 Points)

  - The following barcodes will be used:
    - 1*To be determined*
    - 2*To be determined*
    - 3*To be determined*
  - Each barcode will be approximately NxN inches.
- April Tags (5 Points)



  - See Above Picture

- Square Barcodes (10 Points)
- Images (15 Points)

    - Different Images will be used in order to simulate item sorting as well
        - Each image will be NxN images
        - Images that will be used:
            - Teddy Bear
            - Bowls
            - Etc.

1.5 Teams can earn points for the following tasks:

- Case retrieved from Inbound Cell (2 Points)
- Case placed in proper shelf area (5 Points)
- Incorrectly placed case removed from shelf (3 Points)
- Incorrectly placed case deposited in proper shelf (7 Points)

1.6 Points will be deducted for the following:

- Case is dropped (Minus 3 Points)

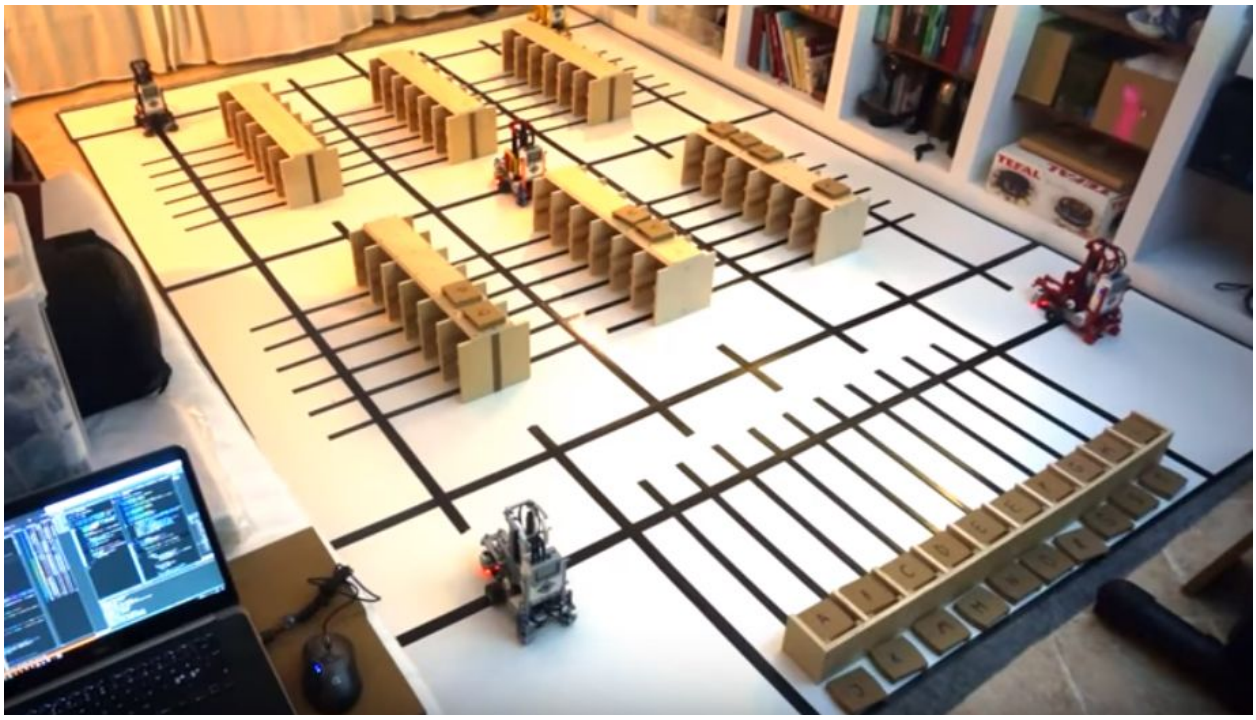
2 Swarm Challenge Robot Rules

2.1 Each must robot must fit in a 40x40x40cm box.
2.2 Each robot must not exceed 10lb.
2.3 All Batteries must be sealed, immobilized-electrolyte types (such as gel cells, lithium, NiCads, NiMH, or dry cells)
2.4 Robots must be completely autonomous and teleoperated control in any form by a human is prohibited.
2.5 Each team may field up to 5 robots
2.6 Teams may only use the following methods for communication:

- Wi-Fi
    - *Details to be added*
- Bluetooth
    - *Details to be added*

2.7 If teams are using a centralized computer, it is adv

3 Swarm Challenge Arena



THIS IS AN EXAMPLE PICTURE. ACTUAL FIELD MAY VARY CONSIDERABLY

3.1 The Challenge Arena is NxN inches *To be determined for actual event*

3.2 There will be N shelves for storing and retrieving cases

- Shelf Dimensions:
    - *To be determined for actual event*

3.3 There will be inbound area where judges/refs can place cases based on their discretion. They will only place cases in empty Inbound area cells. Robots will retrieve cases from this area.

- Inbound Area Dimensions:
    - *To be determined for actual event*

3.4 There will be an outbound area where robots simply place packages.

- Outbound Area Dimensions:
    - *To be determined for actual event*

Underwater Aquaculture Challenge

With the increasing demand for fish and the reduction of fish populations around the world, the aquaculture industry has grown to account for half of the world's seafood. Despite its large success, the aquaculture industry has many problems.

For coastal aquaculture farms, nets require constant inspection as they have a tendency to break, causing thousands of fish, often non-indigenous, to escape into local waters. This causes both substantial losses to the farm and untold ecological problems. Every aquaculture farm also faces the problem of diseased fish. Since there are no current systems to identify and separate diseased populations, farms have suffered heavy losses.

This challenge was created in order to foster the development of technologies that solve these problems.

1 Underwater Aquaculture Challenge Rules

1.1 Each robot may be teleoperated, but will receive bonuses for each task done autonomously.
1.2 Each robot drive team will consist of three members of each team. There can be up to two drivers per team and one coach.
1.3 Once a robot has unsubmerged then that robot may not attempt to score more points.
1.4 There will be a 30 Minute Time Limit to complete as many tasks as possible.
1.5 Points will be awarded as follows:

- Each target recognized: 5 Points
    - The nature of the targets is *To be determined for actual event*
- Accurate Target Count: 10 Points
- Waste Retrieved: 20 Points**
    - This bonus task will require a robot to retrieve a TBD object from the bottom of the pool.

- Challenge done fully autonomously: 10 Point Bonus

2 Underwater Aquaculture Challenge Robot Rules

2.1 Each robot may not exceed 40 lbs.
2.2 Each robot may not exceed a starting volume of 30in x 36in x 52in.
2.3 Your robot must have a working kill switch, to be demonstrated at check-in.
2.4 You may not do any runs without being approved through inspection.
2.5 All vehicles must be battery powered. All batteries must be sealed to reduce the hazard from acid or caustic electrolytes. Batteries must not be charged inside of sealed vessels at any time. The open circuit voltage of any battery (or battery system) in a vehicle may not exceed 60 VDC.

Engineering Design Award Judging Criteria

For each event there will also be a judging section. If a team would like to participate in this aspect of the competition they must register on the event website by the deadline and submit a report by the report deadline.

To be considered for the Engineering Design Award, a team must submit a report on their robot and their design process.
Example of what judges will be looking for in your design process:

- Understanding – Define the Problem
- Define – Determine Solution Specifications
- Ideas – Generate Concept Solutions
- Prototype – Learn How Your Concepts Work
- Choose – Determine a Final Concept
- Refine – Do Detailed Design
- Implement– Implement the Detailed Solution
- Test – Does the Solution Work?
- Iterate - Changes between iterations?

The report should be in IEEE format and should contain:

- Cover Page
    - Team Name, University Name, Team Member Names, and Advisor Names
- Abstract
- Introduction
    - Team Background Information
    - Team Website (If you have one)
    - Team Photo
    - Picture of Robot
- Design Strategy
    - Analysis of Problem
    - Approach to Problem
    - Solution Presented and Design/Prototyping Process
    - Use of Available Resources
    - In-Depth Overview of any major design elements used to successfully apply strategy
    - Final Robot Design
        - Hardware Architecture
        - Software Architecture
        - Mechanical Design
- Discussion & Conclusion
    - Share your team's learning experience
    - Highlight collaboration with other teams if any
- Acknowledgements

- References

For reference the judge's will use the following rubric when for each report:

Criteria	**Rating Option 1**	**Rating Option 2**	**Rating Option 3**	**Rating Option 4**	**Points Awarded**
Proper rules of composition (spelling, grammar, capitalization, punctuation, sentence structure, paragraph length and organization) observed. Report is cleanly IEEE formatted.	No composition Errors and report is in IEEE format. **15 Points**	A few composition errors or the report does not completely meet IEEE format standards. **10 Points**	Several composition errors, suggesting inadequate proofreading. **5 Points**	Many composition errors, suggesting the report was not proofread or revised before submission. **0 Points**	
Expected Sections Included in the Report.	All expected sections of the report are included with expected content. **15 Points**	Most of the expected sections of the report are included with expected content. **10 Points**	Few of the expected sections of the report are included with expected content. **5 Points**	None of the expected sections of the report are included with expected content. **0 Points**	
Design Approach	Problem was properly identified and analyzed. Solutions to the problem were identified based on research and solid reasoning. **15 Points**	Problem was adequately identified and analyzed. Solutions to the problem have some justification and reasoning. **10 Points**	Analysis of problem is unclear. Solutions to problem have no justification. **5 Points**	No analysis of problem and solution to problem has no justification. **0 Points**	

Design Process	Use of available resources demonstrated and design process clearly outlined. Examples would include the iteration and prototyping process. **10 Points**	Use of available resources somewhat demonstrated and design process is not clearly outlined. For example, final design is presented with no mention of prototypes. **5 Points**	No mention of design process. **0 Points**	N/A	
Robot Overview	Design of robot is clearly defined including the hardware architecture, software architecture, and specific details on mechanical design. **10 Points**	Design of robot is somewhat defined. Report may not include complete information on the hardware architecture, software architecture, and specific details on mechanical design. **5 Points**	No mention of the robot and its design. **0 Points**	N/A	

An award for best report will be presented at the award ceremony.

In addition to the report, teams competing for the Engineering Design Award will also have a poster displayed in their pit. This poster will go in-depth on a specific aspect of the robot. This can be anything from an innovative software solution to an interesting mechanical design.

The Poster should meet the following criteria:

- Poster size does not exceed 48”x60”
- Specific Aspect of Robot Presented in Detail

The judges will use the following rubric when judging your poster:

Criteria	**Rating Option 1**	**Rating Option 2**	**Rating Option 3**	**Rating Option 4**	**Points Awarded**
Proper rules of composition (spelling, grammar, capitalization, punctuation, sentence structure, paragraph length and organization) observed. Poster is cleanly IEEE formatted.	No composition Errors and poster is in IEEE format. **15 Points**	A few composition errors or the poster does not completely meet IEEE format standards. **10 Points**	Several composition errors, suggesting inadequate proofreading. **5 Points**	Many composition errors, suggesting the poster was not proofread or revised before submission. **0 Points**	
Quality of Poster	Poster is presented in a clear, professional, and uncluttered format. **10 Points**	Poster is somewhat professional, with some aspects of the poster unclear. **5 Points**	Poster is unprofessional or content is not presented in any clear manner. **0 Points**	N/A	
Presentation of Design	Specific aspect of robot is clearly presented. **10 Points**	Specific aspect of robot is adequately presented. **5 Points**	Specific aspect of robot is unclearly presented. **0 Points**		

Justification of Design	Problem was properly identified and analyzed. Solutions to the problem were identified based on research and solid reasoning. **15 Points**	Problem was adequately identified and analyzed. Solutions to the problem have some justification and reasoning. **10 Points**	Analysis of problem is unclear. Solutions to problem have no justification. **5 Points**	No analysis of problem and design solution to problem has no justification. **0 Points**	
Design Process	Use of available resources demonstrated and design process clearly outlined. Examples would include the iteration and prototyping process. **10 Points**	Use of available resources somewhat demonstrated and design process is not clearly outlined. For example, final design is presented with no mention of prototypes. **5 Points**	No mention of design process. **0 Points**	N/A	
In-Person Presentation	Professional presentation of poster that clearly met the expectations for content to be presented. **10 Points**	Somewhat professional presentation of poster that did not fully meet the expectations for content. **5 Points**	Unprofessional presentation that did not meet expectations. **0 Points**	N/A	
Q+A Period	All judge's questions were clearly and justly	Some of the judge's questions were clearly	No clear answers to judge's questions.	N/A	

	answered. **10 Points**	and justly answered. **5 Points**	**0 Points**		
Judge's Choice	The judge's have an option of awarding up to an additional 10 Points based on personal discretion.				

Teams will also have an opportunity to present their poster content to the judges in person over the course of the event. At the event the judge's will schedule a time to visit teams at their pit for this poster presentation (maximum of 5 minutes with 2 minutes for questions).

An engineering design award will be awarded within each challenge and a judge's award for most innovative design will also be awarded.

Both the report and poster rubrics will be used to determine the winners of each award.