

2016 IEEE R5 Conference Student Robotics Competition Rules

Change Log

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Logistics

This document contains the rules for the 2016 robotics competition. The competition is open to teams of no more than 5 undergraduate students who reside within the IEEE Region 5 boundaries.

Venue

The 2016 Region 5 Robotics Competition will be held in the ballroom at the Intercontinental hotel at 401 Ward Parkway, Kansas City, MO 64112 on Saturday April 9th, 2016. For detailed information regarding practice boards, practice times, and competition times, refer to the Robotics Competition page on the Region 5 website. Wireless communications with the robot is prohibited within the competition ballroom during the competition.

Events and Prizes

There are several events and meals scheduled starting Friday night. Registration is required for area entry and badges must be obtained at registration. The competition will conclude on Saturday evening during the awards banquet. Cash prizes and certificates will be awarded at the awards banquet to the top three teams. Specific details of award values will be provided on the Region 5 website.

Videotaping

Videotaping and photography will be allowed at the competition. Flash photography and the use of any light sources external to the robot will be prohibited during the competition.

Competition Description

Robotics can play an important role in search and rescue applications; robots are able to navigate and travel through hazardous conditions and terrain in order to reach victims that a human rescuer might have trouble reaching.

Goal/ Summary

The objective of this year's competition is to autonomously locate and transport several disaster victims to the appropriate care facility depending on the severity of their condition as quickly as possible. There will be four **victims** on the playing field, two in the city section and two in the off-road section. The victims are represented by wooden cylinders with the severity of each victim's injuries being indicated by their color, where red is severe and yellow is less severe. Victims must be transported to one of the two drop-off zones (red and yellow) based on their injury severity. Victims do not need to be placed in their corresponding drop-off zone for points, matching victims with their appropriately colored drop-off zone will count for bonus points (for more detail read the scoring section). At the end of the round, each team will be scored based on the number of victims recovered and how much time was spent rescuing all victims on the field.

Competition Board¹

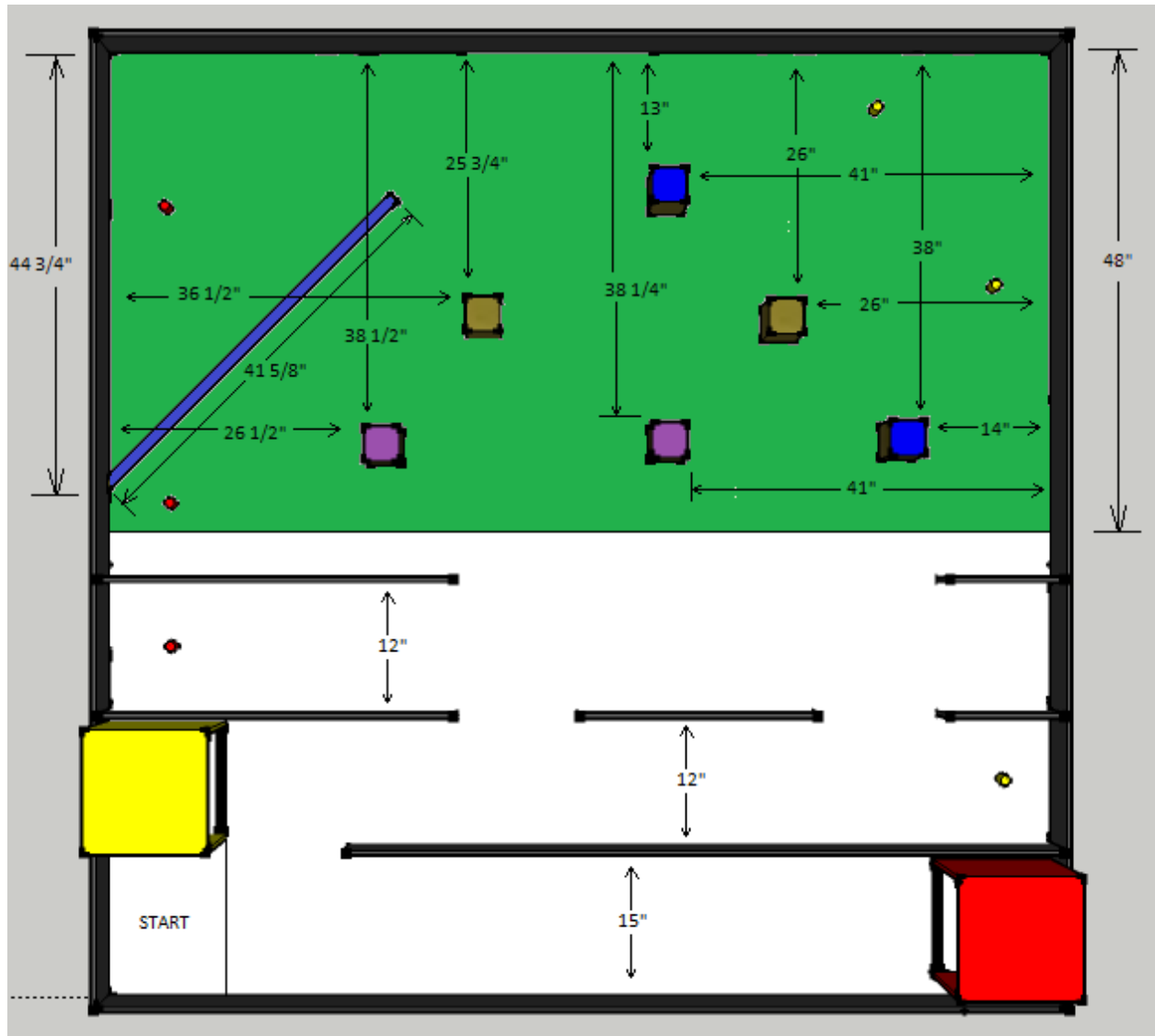


Figure 1

The playing field will be an 8x8 foot area divided into two main sections - half of the board will represent a city setting with easier to navigate paved road, while the other half of the board will represent an off road setting with more difficult terrain and obstacles.

¹ Details will be included in the Appendix including materials and dimensions. All dimensions have a ± 0.5 " tolerance.

City Section

The **city section** of the board will have walled off lanes and openings, representing paved roads. The robot will begin the round in the starting area located in the bottom left corner of the field in the first lane. Two **drop off zones** are located in this section, colored red and yellow, representing the care facilities. The first lane will be 15" wide, the 2nd and 3rd lane will be 12" wide. Each opening in between the walls will be 12". Each wall will be 0.5" wide and 6" tall. The starting area will be as wide as the lane and will extend 12 inches from the left wall. The robot will be considered as being within the starting area as long as the majority of the robot's mass is within the area and the robot is touching the left wall.

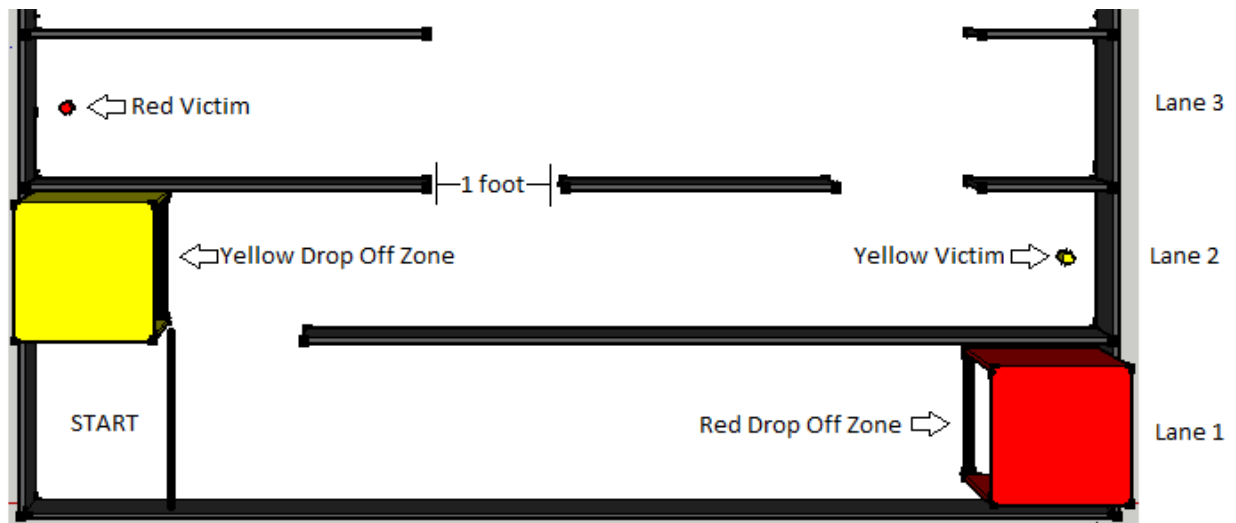


Figure 2

Off-road Section

The **off-road section** of the board will not have any walls and will also be covered with artificial grass² in order to simulate rough terrain.

There will be a total of 4 obstacles made of wood painted blue measuring 4" by 4" with a height of 6" that will be velcroed to the playing field located in the off-road section. The obstacles will have a total of 6 possible locations and will be placed according to the following rules:

1. All obstacles will be located in the off-road section.
2. Two of the obstacles will have a stationary position on the field during all stages of the competition, in the picture below they are represented as the green squares.
3. The remaining two obstacles will have their position randomly decided between each stage of the competition,³ these locations are represented by the purple and blue squares.
4. One obstacle will be in one of the positions of the purple squares, and the last obstacle will be in one of the blue square positions.

In addition, there will be a square wooden rod (1"x1") laid flat in the top left quarter of the field at a 45° angle from the wall that will represent a river that should not be crossed; it will be painted blue.

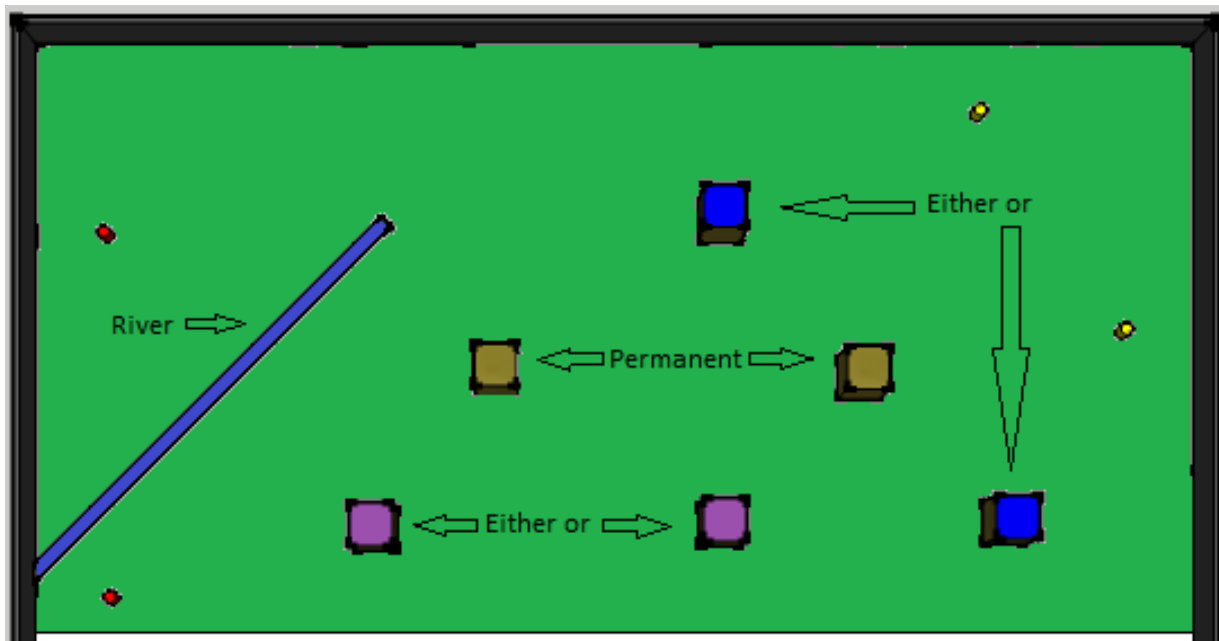


Figure 3

² Check Field Section in Appendix for more information about field specifications and materials

³ Refer to the Gameplay section of the rules regarding details of the structure of the competition.

Location of Disaster Victims

There will be a total of four victims on the board. The victims' locations will be randomized between the six potential locations for each stage of the competition according to the following placement rules:

1. There will be six fixed possible locations where victims can be found on the board total - two locations in the city section, and four in the outdoor section.⁴
2. Two victims will be located in the city section, and two in the off-road section.
3. Of the two victims in the city section, one will be colored yellow and the other red.
4. Of the two victims in the off-road section, one will be colored yellow and the other red.
5. Of the two victims in the off-road section, one will be located on the left side of the field, and the other will be located on the right side of the field.
6. The color of the victims will be randomized within each section.⁵

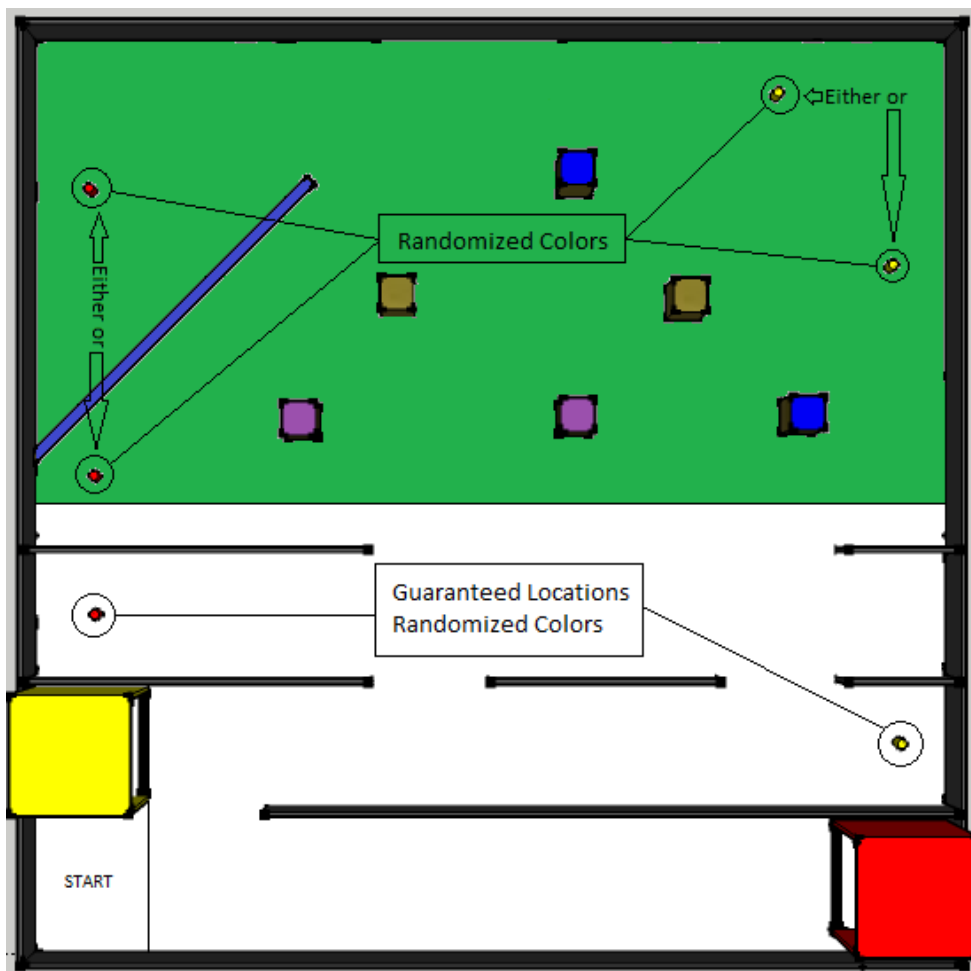


Figure 4

⁴ Victims will be a minimum of 6" away from any wall

⁵ In the city section, the red victim can be on either the left or right side of the field. The same applies to the off-road section.

Gameplay

The competition will be set in three **stages**. Each stage will provide each team a single chance to complete the task providing a total of three chances throughout the competition to get the best possible score they can. Each stage will have the victims and non stationary obstacles randomly positioned in the playing field according to the placement rules previously described. The position of these victims will remain consistent for all rounds within each individual stage allowing all teams a chance with the field configuration. The winners will be decided based off of the best score.

Each stage will begin with all qualifying robots set into a quarantine area located next to the competition fields. After the robots have been placed into the quarantine area, they can not be modified by the teams. If they are modified during a stage and before they have completed their run for that stage then they will receive zero points for that stage of the tournament. After the robots have been quarantined the victim and obstacle placements will be randomly determined according to the placement rules and will remain consistent throughout each round of that stage.

When it is time for a team to compete, they will have a previously appointed representative place the robot into the starting position. The robot will have 60 seconds to begin moving after being placed. After the robot has been placed, the round timer will begin as soon as the robot begins moving. If it does not move within the first 60 seconds of being placed, the timer will begin. The robot has 6 minutes to complete the round. The round will end when the robot has completed all the tasks and has positioned itself within the starting area of the playing field at which point the total elapsed time from round start to finish will be recorded. The robot will be considered at the starting position when the majority of the robot's mass is within the starting area. After the round has finished, the robot will be scored based on each of the completed tasks and the round's elapsed time as described in the Scoring Section.

The team's representative also has the choice to prematurely end the round by notifying the judge that they wish to end the round. The judge will then proceed to press the emergency stop button on the robot. Prematurely ending the round will cause the team to receive zero points for that stage of the competition.

Gameplay restrictions

- The robot may only retrieve one victim from the field at a time. If the robot is in possession of a victim then any points that they would have gained from another victim (i.e. navigating to a victim while already in possession of a victim) will not be earned.
- In order for the victims to be considered within the drop off zone, the majority of the victim must be within the footprint of the drop off zone and must remain within the drop off zone until the end of the round.
- The robot may interact with the parts of the field (i.e. walls, obstacles) but should not move or damage the obstacles. The field will be considered damaged when there is a noticeable change (i.e. scratch, dent, or displacement of obstacle) in the the field.
- The robot must remain completely within the field’s boundaries during gameplay.
- The judge will reserve the right to disqualify a robot if he determines it is running with reckless abandon (i.e. malfunctioning, purposely damaging the field).

Scoring⁶

Score will be calculated by adding up points for each task completed below. Points will stack for each victim retrieved - a team that completes all tasks will pick up 4 victims and drop off 4 victims at the correct drop zone earning 108 points; 8 points for navigating to the victims, 20 points for picking up the victims, 40 points for dropping off the victims, and 40 bonus points for dropping off the victims at the correct locations. Time will be used to break ties.

Task	Points
Navigating to a victim location. (physically touching the victim is required)	2 point each
Picking up a victim.	5 point each
Dropping off a victim at either drop zone.	10 points each
Bonus for placement in correct drop off zone	10 points each
Point deduction for field manipulation or damaging board	-35 points per offense
Point deduction for completely crossing the “river”	-20 points
Return to home spot	determines start and stop time for round (not for points)

⁶ Further Scoring examples provided in Appendix.

Robot Requirements

All robots must be operated autonomously.

If your team decides to attempt to build a non-land based robot (i.e. a drone) you are required to inform the IEEE Robotics Committee by November 30, 2015 so that we may ensure that all proper safety precautions can be met. It will be up to the team deciding to build a drone to come up with a solution to maintain the safety of the other attendees. If the IEEE Robotics committee or the IEEE Regional committee decides that it would be too dangerous or that there is not an adequate amount of safety precautions in place, we reserve the right to deny that aerial robot's entry into the competition. Should the team decide to change to a land based robot or submit a new safety precaution prior to November 30 and it is considered to provide proper safety, the robot may compete in the competition.

Explosives and volatile liquids will not be permitted in the competition, i.e. gasoline. Chemical batteries will be allowed but only if used correctly and with the appropriate safety and handling. A link is provided in the appendix as a guide on safe battery handling.

The robot must fit into a box with a maximum volume of 1 cubic foot. It is required by the individual teams to provide proof that their robot meets the size limitation by constructing a single rectangular box whose volume is 1 cubic foot. The robot must be capable of fitting inside of the box with no parts hanging out and the box must be a cuboid. The robot must remain within this size limitation at the beginning of the round. After the round has begun the robot may exceed the volume limitation and is not required to meet the size limitation at the end of the round. It is still required to have the majority of its mass within the starting area to count as the end of the round unless the team decides to manually end the round.

In this competition there will not be a limitation on weight as long as it is reasonable and does not cause damage to the playing field.

A bill of materials (BOM) will need to be included with the robot along with documentation on the robot in regards to the purpose of each sub-system, why each major component was selected (ie type of processor, size of battery, etc), a copy of the code, and a section that address safety issues and concerns that were encountered during the build process. Each team must send their documentation in by March 31, 2015. The paper will not count for points, but teams failing to provide documentation will be disqualified. The paper must be typed, handwritten submissions will not be allowed.

The robot must have an easily accessible emergency shut off switch as well as a "Go" button to signal the robot to start.

The robot may not have any wireless communications. No devices that can be used for wireless communications can be used, ie smartphones. The robot can not have communications with any source outside of the playing field.

Appendix

Playing Field Materials

- The board will be constructed out of 2 particle boards of 4x8 foot dimensions placed next to each other to form an 8x8 foot square.
 - city section will be painted white with black walls
 - black walls will also surround the playing field to act as the boundary of the playing field
- The artificial grass will be Ivy Topsail carpet and will be held in place using Loctite spray adhesive or staples.
- The walls will be constructed out of Plywood and will be 0.5 inches thick and 6 inches high.
- The drop zones will consist of a cardboard box 12" x 12" x 12" painted according to their location. The entrance (side facing towards center of field) and the bottom of the box will be removed. Since the red drop off zone is smaller than the width of the first lane, it will be placed in the top rightmost corner of the first lane.
- The river will be a 1 inch by 1 inch rod painted blue. It will be placed in the top left corner of the board at a 45 degree angle as represented in Figure 1. The river will be 41.625" long and will make contact with the left wall 44.75" down from the top left corner.

Item	Lowes Part Number
Turf	Coronet Stock Carpet 234774
Turf Adhesive ⁷	Loctite Spray Adhesive 275900
Walls	0.5" 4'x8' Plywood sheating 12242
Floor	0.75" 4'x8' Particle Board 180471
Victim	1.5" diameter Round Poplar Dowel 43821
River	1" x 1" wooden rods
Paint Base	Valspar HydroChroma Interior Matte Base C 49494
Blue Mix	Skydive Blue CI252
Red Mix	Pantone Universe Poppy Red 17-1664

⁷ Staples may also be used but some form of adhesive is suggested along the edges to prevent them from being pulled up

Yellow Mix	Light Rail ar1805
Black Mix	Tuxedo Tie ar2104

Victim Materials

The victims will be made using 1.5" diameter Poplar dowel rods cut to be 2" long painted yellow and red using Valspar Interior Flat Latex based paint and primer in one.

Obstacle Materials

4"x4"x6" Plywood blocks painted blue.

Safety Information

Battery Handling

<http://www.icharger.co.nz/articles/ArticleId/3/Lipo-Lithium-Battery-Safety-Guide.aspx>

Examples of Scoring

Successfully navigating to, picking up, and dropping off at the correct location for one victim.

Received Points: $(2 + 5 + 10 + 10) = 27$

Successfully navigation to, picking up, and dropping off at the incorrect location for one victim.

Received Points: $(2 + 5 + 10) = 17$

Successfully navigating to the first victim, failing to pick up the victim, and continuing to the next victim and successfully picking up victim 2 and dropping off victim 2 at the correct location.

Received Points: $(2 + 2 + 5 + 10 + 10) = 2(\text{for victim 1}) + 27(\text{for victime 2}) = 29$

Successfully navigating to, picking up, and dropping off at the correct location for three victims.

Received Points: $(2 + 5 + 10 + 10)*3 = 27*3 = 81$