



ROBOTICS DESIGN CHALLENGE

Colorado TSA State Conference 2017-2018 (with special thanks to Pennsylvania TSA)

Building Collapse

A building has partially collapsed due to recent earthquake. Search and rescue operations are ongoing, but have been suspended because a gas leak deep inside the building has been discovered. The mission of the team is to navigate through the rubble to the source of the leak and turn off the gas as soon as possible so search and rescue operations may resume.

The rescue crews have identified an entry point (Zone 1) in the structure for the robot. It is through this entry point that the robot must enter and exit the structure. Once the gas leak has been located and turned off, the robot must return to the entry point for egress. All robots must start and finish within the 12" x 12" x 12" entry/egress

The robot will need to navigate through the structure without disturbing any vertical support beams (vertical [upright] structures that the robot encounters cannot be disturbed, since they may be supporting the structure above). There are eight (8) vertical support columns in the structure that are represented by 12" x 1" diameter PVC pipe, standing on end. These vertical supports are randomly placed throughout the course. Penalty points will be assessed for each support structure that is knocked over.

As the search and rescue crews exit the structure, the robot will need to move out of the way to allow them to pass (Zone 2). Each team must park their robot in the designated area in Zone 2. The entire robot must be inside of the parking area (25" long and 16" wide). The wheel(s) or tracks closest to the PVC pipe must be between the designated. Parallel parking is defined as having the side of the robot parallel to the pipe which represents the back wall of the parking area (see illustration below).

The rescue teams have identified packed rubble the robots must traverse in order to get through the structure (Zone 3). The team must navigate the robot over packed rubble which is represented by four (4) bags (each containing 80-100 standard sized marbles) arranged in a staggered pattern.

The robot will encounter several horizontal members that have fallen in the path of the robot that will need to be "flipped" out of the way to allow the robot to pass. The robot may not traverse over or around the horizontal members (they need to be moved out of the way) (Zone 4). The horizontal "beams" are represented by pieces of 1" diameter PVC pipe, each anchored on a pivot at one end.

The search and rescue teams have also identified several loose obstacles the robot will need to move to an area they have designated as a "safe" zone before the gas can be shut off (Zone 5). The rubble in Zone 5 that needs to be moved to a designated safe area is comprised of:

- Three (3) - 1" x 1" x 2" wooden cubes
- Three (3) baseball-sized Wiffle balls
- Three (3) golf balls

The designated safe area is 14" long and 6" wide and parallel to the wall in front of Zone 5.

In Zone 6, the robot must turn off the "gas leak." The gas shut off valve is represented by a light bulb, controlled by a push button switch. The robot must turn the light off to represent turning off the gas leak.

After the robot "stops the gas leak" it must return to the entry point (Zone 1) for egress. The time stops when the robot has returned and parked in the staging area. The robot may not navigate over any of the PVC pipe defining the course.

Time is of the essence; each team has 3 minutes to prep their robot (not practice or modify the robot), and three (3) minutes to enter the structure, navigate the obstacles, shut off the gas leak and return to the entry point for egress.

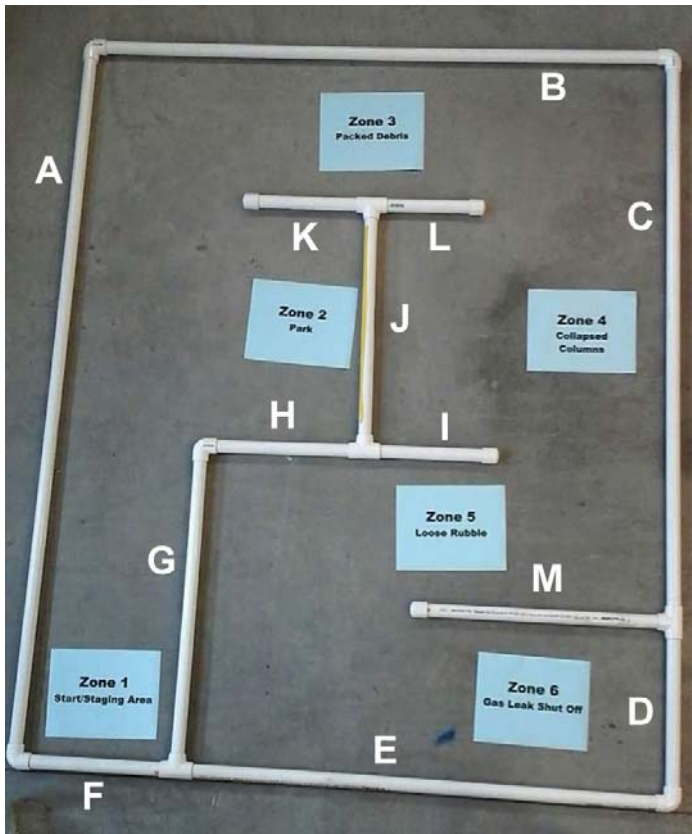


ROBOTICS DESIGN CHALLENGE COURSE MATERIALS AND SET UP

Materials – The Field:

The field boundaries, vertical and horizontal columns are as specified below.

- 5 pieces: Schedule 40 1" x 10' PVC Pipe
- 4 each: Schedule 40 1" x 1" x 1" Tee
- 5 each: Schedule 40 1" x 1" 90° Elbow
- 4 each: Schedule 40 1" Cap
- OPTIONAL: Schedule 40 1" x 1" Couplers may be used to connect longer pieces for ease in transporting and storing the field. There is approximately 14" clearance between "walls" of the demonstration field.



PART #	LENGTH
A	72"
B	60"
C	57"
D	14"
E	45"
F	15"
G	29-1/2"
H	15"
I	12"
J	24"
K	12"
L	11"
M	24"

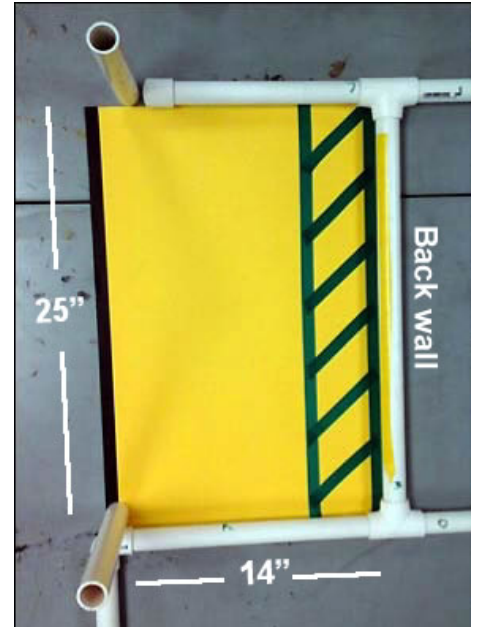
The Field Zones:

The Zone 1 – Entry/Egress Point:

The entry/egress point is a 12" x 12" x 12" area from which the robot must start and return. The robot may expand as necessary once the time starts, but must start and stop within this 12" x 12" x 12" cube. No parts of the robot may extend past this cube until the time starts.

Zone 2 - Parking Area:

The Zone 2 Parking Area measures 25" L and 16" wide. The entire robot must be clear of the entrance "hallway". The robot may parallel, head-on, or back-in park in the Parking Area (see rubric for points for each type of parking). The wheel(s) or track(s) closest to the "back wall" of the parking area must be in the striped area (as shown in the illustration at the right).



Zone 3 - Packed Rubble:

The "packed rubble" is represented by four (4) "bags" containing 80-100 standard sized marbles. Each bag is made from a lint snare (Ace Hardware #40960) and sealed with a zip tie. The snare filled with marbles is then placed inside a nylon stocking. Final approximate size is 7" L x 1-3/4" H (shown in the illustration at the right).



Zone 4 - Collapsed Beams:

The “collapsed beams are made from the following materials:

- 3 pieces - 1" diameter x 12" PVC Pipe
- 6 pieces - 3/4" T x 2" W x 4" H beam supports
- 3 pieces - 1/4" Diameter x 4" round stock
- 1 piece - 1/4" x 20" x 17" plywood for base

Each beam fulcrum is 3" from above the base of the obstacle.

Double beams are placed 10-1/2" O.C.

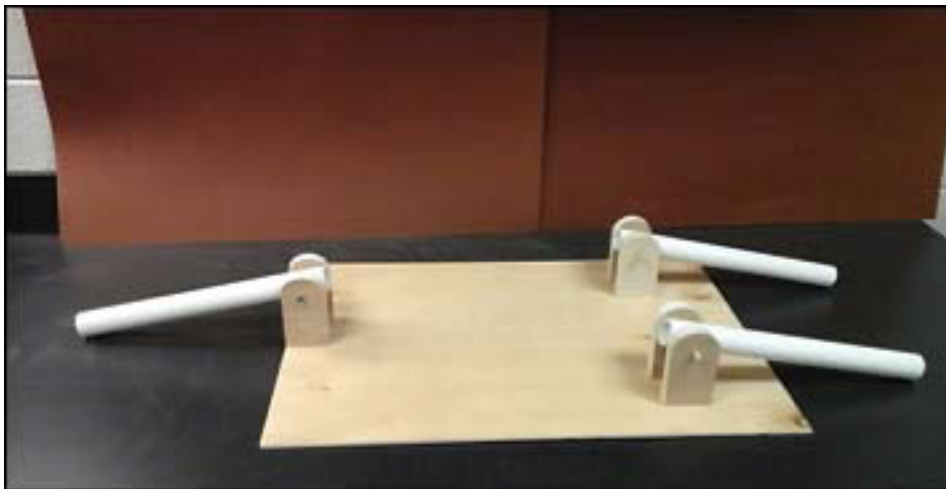
Single beam centered between double beams.

Minimum of 14" clearance between beam supports.

Starting Position for the beams:



“Flipped” position for the collapsed beams:

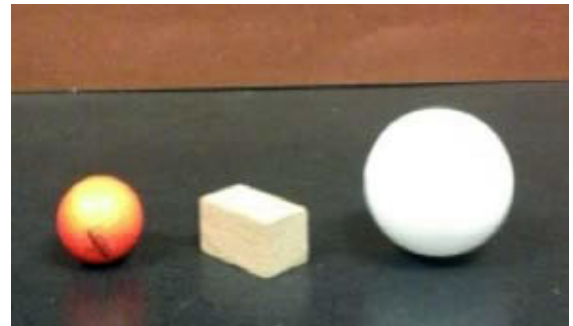


Zone 5 – Loose Rubble:

The “loose rubble” the robot must move is made from the following materials:

- 3 - standard golf balls
- 3 - 1" x 1" x 2" wooden blocks
- 3 - baseball-size Wiffle balls

The “loose rubble” (shown in illustration at the right) is randomly placed in Zone 5.



Zone 6 – Gas Shut Off Simulator

The Gas Shut Off Simulator is made from the following materials or their equivalent:

- 1 - Push Dimmer (ACE Hardware # 3217205)
- 1 - Toggle Cover (ACE Hardware # 30299)
- 1 - Handy Box (ACE Hardware # 30337)
- 1 - Keyless Plastic Lamp Holder (ACE Hardware #3217171)
- 1 - 7-1/2 watt incandescent bulb (ACE Hardware #3179082)
- 1 - Octagon Box ACE Hardware #30327)
- 3 - 3/8" NM Connector
- 1 – Standard plug and wiring for wall outlet power supply

Inside dimensions of box are: 6-1/4" W x 8" H x 5-3/4" D. The handy box containing the switch is surface mounted on the inside back wall of the box. The box is mounted on a 1/4" piece of plywood 14" W x 14" L. The simulator is shown in the illustration at the right.



Field Set Up:

