

## **Warehouse Firefighting Robot**

*Version 2*

### **Objective**

The goal of this competition is to advance the capabilities of robotic firefighting robots in particular, the application of firefighting robots to the suppression of warehouse fires. Sprinkler systems are effective but extremely costly water damage can result once they are triggered. Specifically the challenge is for an autonomous robot to navigate a model floor plan of a warehouse with several rooms and hallways. The robot must find a candle and extinguish it in the shortest time possible.

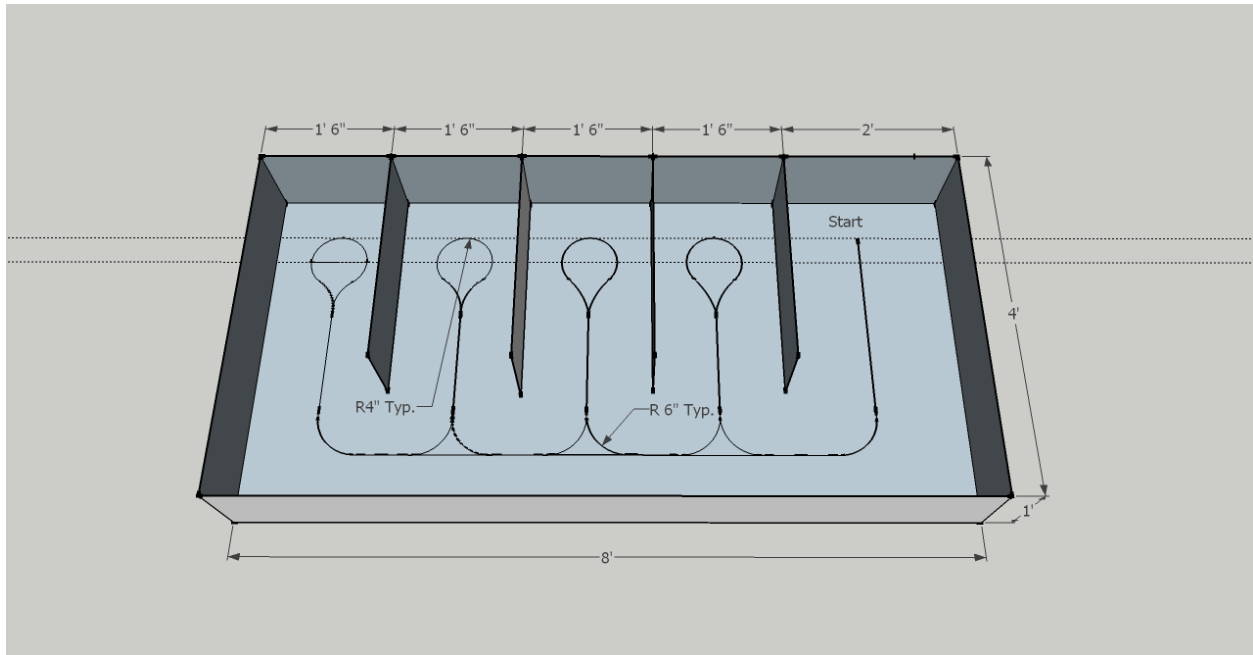
### **Dimensions and Specifications**

This is a contest that simulates real world activities and capabilities. As such, there are many areas of uncertainty that a Robot must be able to handle in order to succeed. The goal of the contest is spur the development of Robots that can perform in the real world with all the variations and problems that exist there. Therefore, all the dimensions and specifications listed in these rules are given as a general aid to the participants. None of them are meant to be exact and they will vary somewhat at the actual contest. Any Robot that is meant to function in the real world needs to be able to handle these uncertainties. This contest, like the real world, is imprecise and your Robot needs to be able to handle that.

### **Platform**

The official floor plan of the contest arena for the Flutterbot Fire Fighting contest hosted at Lawrence Technical University is shown below. The walls of the structure will be made of wood and will be 12 inches high. The walls will white. The floor of the arena will be a smooth white surface. The seams in the floor section may not be perfectly flat however. Make sure that your Robot can handle a discontinuity of up to 1/8 inch.

All hallways and will be 12 to 18 inches wide. There will no doors.



### Judge's Decisions

The judge's decisions will be the final word in all conflicts arising from interpretation of rules, running of robots and methods of scoring. We are making every attempt to provide rules that are clear and easy to follow.

### Ambient Lighting

Contestants will be given time on the contest days to take ambient light level readings to calibrate their Robot. Once set, the lighting in the contest area will not be changed to suit individual competitors. Part of the challenge of the contest is to make a Robot that can operate in real world situations and that includes inconsistent lighting, shadows, glare, etc.

### Robot Operation

Once turned on, the Robot must be fully autonomous, self-controlled and without any human intervention. That is, they are to be computer controlled and not manually controlled devices. Robot can bump into or touch the walls of the arena as it travels, but it should not mark or damage the walls in doing so. There will be no penalty for touching a wall other than the time lost in doing so. The Robot cannot make any marks on the floor or walls of the arena that aid in navigation as it travels. Any Robot that in the judges' opinion, deliberately damages the contest arena (including the walls) will be disqualified for that trial. This does not include any accidental marks or scratches made in moving around.

### Putting out the candle

The Robot must, in the opinion of the judges, have found the candle before it attempts to put it out. For example, the Robot cannot just flood the arena structure with CO2 thereby putting the candle out by accident. The Robot must not use any destructive or dangerous methods to put out the candle. It can use such items as water, air, CO2, etc., but any method or material that is dangerous or will damage the arena is prohibited. For example the robot cannot explode a firecracker putting out the candle by

concussion. The robot cannot knock over the candle to put it out. If a robot accidentally knocks over a candle after it has put it out it is acceptable, the run still counts.

### **Design parameters**

The robot must be based on the Flutterbot Robot kit. Design modifications, improvements and augmentations are allowed. The AVR Butterfly must be the main controller, additional microcontrollers and processors can be added. Additional sensors can be added. All source code must be open source and submitted electronically to the judges at the end of the competition.

### **Robot Size**

Robot must be able to fit in a box 4 inches long by 5 inches wide by 12 inches high. If the Robot has feelers to sense an object or wall, the feelers will be counted as part of the Robot's total dimensions. The Robot cannot separate into multiple parts and must never extend itself beyond the 12 inches allowed.

If contestants want to add a flag, hat or other purely decorative, non-functional items to the Robot that extends above the 12 inch height, they may do so as long as the item has absolutely no effect on the operation of the Robot.

### **Robot Weight**

There are no restrictions on the weight of the Robot.

### **Robot Construction Materials**

There are no restrictions on the types of materials used in the construction of the Robot.

### **The Competition Trials**

There will be three trials for each robot and the combined score will determine the winner.

### **The Gallery**

Prior to each trial all robots competing in that trial will be checked into the Robot Gallery where they will stay until the trial is over. Robots will be assigned an order of competition and called in that order.

### **The Candle**

The lit candle is supposed to represent a small fire that the Robot is attempting to find and put out. The candle flame will be between approximately 6 ½ to 8 ½ inches from the floor. The candle used will be a standard approximately 7/8 inch thick white candle. The exact height and size of the flame is unknown and variable and will be determined by the specific conditions of candle and its surroundings. The Robot is required to find the candle no matter what the size of the flame is at that particular moment.

For each trial the candle will be placed at random anywhere in the arena. The location of the candle will be changed for each trial. On successive trials the location in which the candle was previously placed will be removed from the list of random choice possibilities. Thus every Robot will have the candle in each of 3 locations during the 3 trials.

### **Sensors**

There are no restrictions on the type of sensors that can be used as long as they do not violate any of the other rules or regulations. Contestants are not allowed to place any markers, beacons or reflectors on the walls or floors to aid in the Robot's Navigation. Robot builders should be aware that many cameras transmit infrared light as part of their automatic focusing systems. All possible attempts will be made to prohibit the use of such cameras during Robot runs. No guarantee are made.

### **Start Button**

All robots will have an easily accessible start button to activate the robot.

### **The Order of Running**

The Robots will be assigned numbers to determine the order in which they will compete in the contest. Each Robot will make a trial run in the arena in the order in which it is assigned. The Robots will compete consecutively and when everyone is done with their first attempt the whole process will repeat for the second and third attempts. Once the Robot running before you has completed its trial, then you will have 2 minutes to get your Robot in the arena and ready to start its trial. Any Robot that is not ready to run after 2 minutes will forfeit its chance at that trial. It may still compete in any other trials. Once assigned, the order of running will not be changed. The time between turns is undetermined and is controlled by how long the other competitors take to complete their trials. Be ready to collect your Robot from the gallery and run it when it is your turn. Contestants will place their robot on the home circle and show a judge how to actuate the Robot. The judge will press whatever buttons necessary to start the Robot.

### **Time Limits**

Finding the fire within a reasonable period of time is very important. The maximum time limit for a Robot to find the candle will be 5 minutes. After 5 minutes the trial will be stopped. If in any trial, a Robot gets stuck in a loop and performs the same movement 5 times in a row, that trial will be stopped. Any time the Robot does not move at all for 30 seconds, the trial will be stopped. Stopping a trial run for any of the above reasons will have no impact on any of the other trial runs made by the Robot.

### **Scoring Method**

The Robot with the lowest Final Score (FS) is the winner. The Final Score is calculated from a number of different factors including time, if the candle is found and if the candle is put out.

If The Robot fails to find the candle in 5 minutes or is disqualified as described under "Time Limits" it will be given a score of 300 seconds for the trial.

If in the opinion of the judge The Robot finds the candle the Find Time (FT) will be recorded. If The Robot fails to put the candle out subsequent to finding it the Find Time (FT) will be the score for the run.

If The Robot puts out the candle both a Find Time and an Out Time (OT) will be recorded. The Out Time will be divided by 4. The smaller of the two times FT and OT/4 in will be the score for the trial.

The sum of all trials will be Final Score (FS).