SoutheastCon 2011 Student Hardware Competition Rules - Revision 1.1

Please send questions and comments concerning the Hardware Competition to ieeesb@tntech.edu. Questions and Answers will be posted on the web site at http://orgs.tntech.edu/ieee.

Changes from Revision 1.0

Section	Description of change
III.A	Corrected overall course dimensions
III.D	Added a marking for the starting location
III.F	Clarified locations of mounting holes
V.B	Removed incorrect Lowe's part number
V.D	Changed victim current from 1 mA to 10 mA
App.	Updated all course diagrams

I. Introduction

Natural disasters such as the 2004 and 2009 tsunamis as well as the most recent earthquakes on the island of Haiti and in Chile motivate engineers to use modern technology to help save lives. The survival of human victims is strongly related to the amount of time required to respond to the victims; therefore, emergency responders need accurate, timely information about the scene. The theme of the SoutheastCon 2011 hardware competition is how autonomous robots can assist with the response to natural disasters. Autonomous emergency response robots can safely evaluate the situation and relay vital information to emergency response teams.

II. Objective

The objective of this competition is to locate the victims trapped in a building, determine their status, sense hazards, and report this information to the emergency responders. The following information is known:

- Floor plan
- Types of obstacles which may be encountered
- Methods to locate victims and determine their health status
- Methods to sense hazards

III. Course Layout

A. The course is a 2.44 m x 2.44 m square containing rooms and hallways. Refer to the appendix for a diagram.

B. There are four rooms, one in each corner of the course. Each room is 1 m x 1 m square.

C. Each room has a unique number, where room number one starts is in the southwest corner of the course and increments by one in a clockwise direction, ending with room number four in the southeast corner of the course. Note that the terms North, South, East, and West are used only for convenience of presentation and are not oriented with respect to true or magnetic North.

D. There is a starting area located in the southern hallway that extends 25 cm from the wall. The starting area is painted yellow.

E. Each room has a grid where the southwest corner of that room is (0, 0) and the northeast corner is (10, 10).

F. There is a grid of mounting holes in each room; the holes are located at integer valued grid coordinates as defined in section III.E (also see diagram). There are also mounting holes at various locations in the hallways. The holes are no larger than 0.5 cm and will be used to place victims and obstacles.

G. Hallways are 40 cm wide.

H. Interior walls are 2 cm thick.

I. All walls are at least 23.5 cm high. Robots must not try to climb on or look over the walls

J. There is a virtual ceiling at height 25 cm. Even though the ceiling does not physically exist, the robot cannot at any time protrude into the virtual ceiling.

K. The floor and the walls are purple. The paint brand and shade of purple is unspecified.

L. As an aid to navigation there are lines on the course. The lines are yellow, 2 cm wide, centered in the hallways; lines continue into each room through the center of the doorway and form a square in each room with the perimeter 20 cm from the wall. The paint brand and shade of yellow is unspecified.

M. Obstacles may exist in the hallways or rooms.
N. Obstacles are either 2 cm wide x 2 cm high or 4 cm wide x 9 cm high, have an unspecified length, and are white. The paint brand and shade of white is unspecified.
O. Obstacles may be placed at any angle on the course.
P. Obstacles will never completely block access to rooms, hallways, or victims; however, the robot may need to navigate over or around obstacles in order to achieve an objective. When going over an obstacle, the robot must not "contact" the virtual ceiling (i.e. the top of the robot must not be over 25 cm above the floor).
Q. Obstacles and victims will be placed on the course using the mounting holes in the floor of the course. Victims and/or obstacles will never be stacked on top of each other.
R. One of the four rooms will contain a hazard which will be represented by an electromagnetic field. This will be generated by a coil with a current in which the product of the number of turns and the current through each turn is 1 mA RMS at a frequency of 44 kHz with an approximately sinusoidal waveform. The plane of the coil will be parallel to the floor of the room and no more than 5 cm below it. The shape is a square, 40 cm wide x 40 cm long, centered in the room and the square is oriented such that the sides of the coil will be parallel to the sides of the course.

IV. Robot

A. The robot, including all components, must not exceed a size of 20 cm x 20 cm x 20 cm at any time during the competition.
B. The robot must have a start button which will activate the robot at the beginning of a round.
C. The robot must be completely autonomous once the round begins.
D. Substances which may pose a hazard to persons or property are prohibited.
E. There are no weight restrictions.

V. Victims

A. Each room contains up to 3 victims.

B. Physical characteristics: 8.9 cm diameter cylinder, 4.1 cm height, and white. (3'' PVC drain cap. Manufacturer: NDS, www.ndspro.com, Sewer and Drain>>Solvent Weld Fittings>>part #: 3P06.)

C. The victims are in one of three states: Conscious, Unconscious, or Dead.

D. All victims emit a low frequency electromagnetic field. This will be generated by a coil with a current in which the product of the number of turns and the current through each turn is 10 mA RMS at a frequency of 33 kHz with an approximately sinusoidal waveform. The coil will be horizontal, between 2 cm and 3 cm above the surface of the course, and have an 8 cm diameter.

E. Victims have a green LED with a relatively wide viewing angle. The LED is pointed upwards, centered in the victim, with the top of the LED even with the top of the victim, and with no objects blocking the view of the LED.
    i. Conscious victims have a LED that is blinking at a rate of 2 Hz with a 50% duty cycle.
    ii. Unconscious victims have a LED that is always on.
    iii. Dead victims have a LED that is always off.

VI. Rules of Play

A. Wireless communication with the robot is prohibited during a round.
B. Damage to the track or movement of obstacles or victims will disqualify the robot from the current round.
C. The robot must not jump or fly at any time during the competition.
D. At the beginning of a round the robot is placed in the starting area. The team must then finish initializing the robot and completely disconnect all communications such that the only remaining task to activate the robot is pressing the start button. At this time obstacles and victims may be placed or moved by the referees. The time keeper will then signal for the team to press the start button, activating the robot.

VII. Mission and Scoring

A. Upon locating a victim, the robot should output, in spoken form, the room, position, and state of the victim. This must be loud and clear enough to be easily heard and understood. A once per round award of 150 points will be given for clear, intelligible audio. Note: A PA system will be used to convey the audio signal to the judges and audience.

B. A display on top of robot should display the room, position, and state of the victim. The display height should be at least 2.5 cm and the format should be decimal digits. A once per round award of 50 points will be given for a working display. For victim state display 0=dead, 1=unconscious, and 2=conscious. Note: either the audio or

display information must be received by the judges during the round in order to receive location and status points; no points will be awarded for conflicting information.

C. Distance is measured in grid square. The distance measure used for scoring is Manhattan Distance:

Manhattan Distance = $|X_2-X_1| + |Y_2-Y_1|$.

D. Each correct position report of a victim will result in a score of 60 points. Points will be deducted for incorrect position based on the amount of distance error. 15 points will be deducted per grid square away from the correct position, with a minimum position score of 0.

E. In situations where multiple incorrect positions are reported, each report will be used such that the fewest number of points will be deducted.

F. A penalty of 30 points will be assessed for each nonexistent victim reported. This can result in a negative score.

G. Reporting the correct status of a victim is worth 40 points. Position error must be less than or equal to three grid squares to earn points for reporting the status of a victim.

H. Teams will be awarded 200 points for announcing the correct location of the hazard. If a robot announces an incorrect hazard location, even if the correct location is also announced, no hazard points will be awarded.

I. In the case of two teams with identical point scores, time is used as the tie breaker.

J. Disputes will be arbitrated by judges. Judges' ruling is final in all matters.

VIII. Competition Format

A. There will be both an open and an undergraduate competition.

B. The open competition is available to any school, organization, or group. There are no restrictions on individuals in this category.

C. The undergraduate competition will consist of only undergraduates from Region 3 IEEE sponsored schools with only one team/robot entry per school.

D. Robots entered in the open competition may not be entered in the undergraduate competition and vice versa.

E. The competition consists of multiple rounds.

F. All teams have a randomized position for each preliminary round.

G. Teams must be present and have their robot ready to compete when called or they forfeit their run for the current round.

H. The maximum duration of each run is 4 minutes. The run will be terminated if the robot does not leave the starting area within 30 seconds.

I. Preliminary Rounds: One run per team is given for each of the two preliminary rounds. Location of the obstacles and victims will be randomized for each run.

J. Each team's top score from the preliminary rounds will be used for determining placement in the final rounds.

K. Final Rounds: The top eight teams from the preliminary rounds compete in the final rounds. A single elimination tournament format is used for the final rounds. Obstacles are identical for both tracks.

L. There will be a quarantine on robots in effect for each of the final rounds. The quarantine starts at the beginning of a final round and ends when the round is completed. During the quarantine teams may not alter or interact with their robot in any way. Teams will be given at least 5 minutes between each of the three final rounds to work with their robots.

IX. Tolerances and Notes

A. $\pm$ 10 % tolerance for voltages and currents.

B. $\pm$ 2 % tolerance for frequencies.

C. $\pm$ 2 cm for course and victim dimensions greater or equal to 1 m.

D. $\pm$ 1 cm for course and victim dimensions greater or equal to 10 cm and less than 1 m.

E. $\pm$ 0.5 cm for course and victim dimensions less than 10 cm.

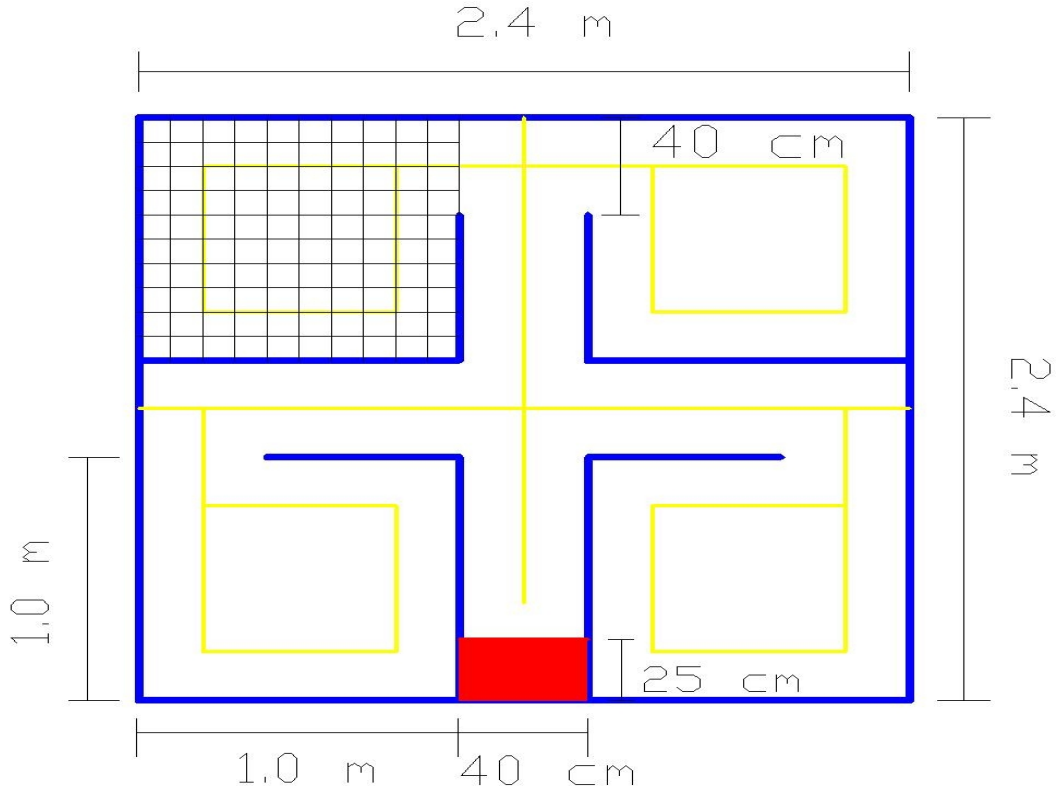
F. Note that the most of the dimensions chosen are consistent with standard lumber sizes available in the U.S. with minimal amount of cutting.

G. These rules are subject to change if necessary for the good of the competition.

Appendix

Course Layout:

Legend:
Walls:
Painted Lines:
Start:
Grid (Not on course):



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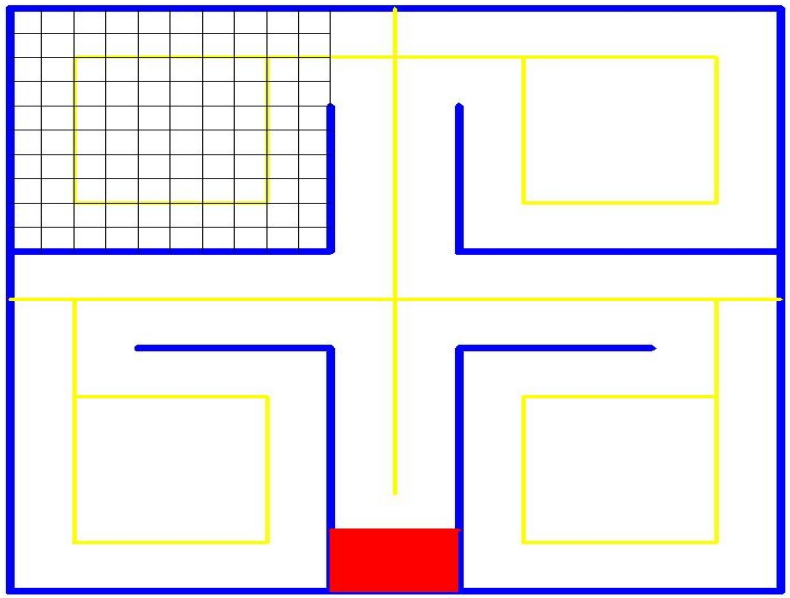
Grid (Not on course):



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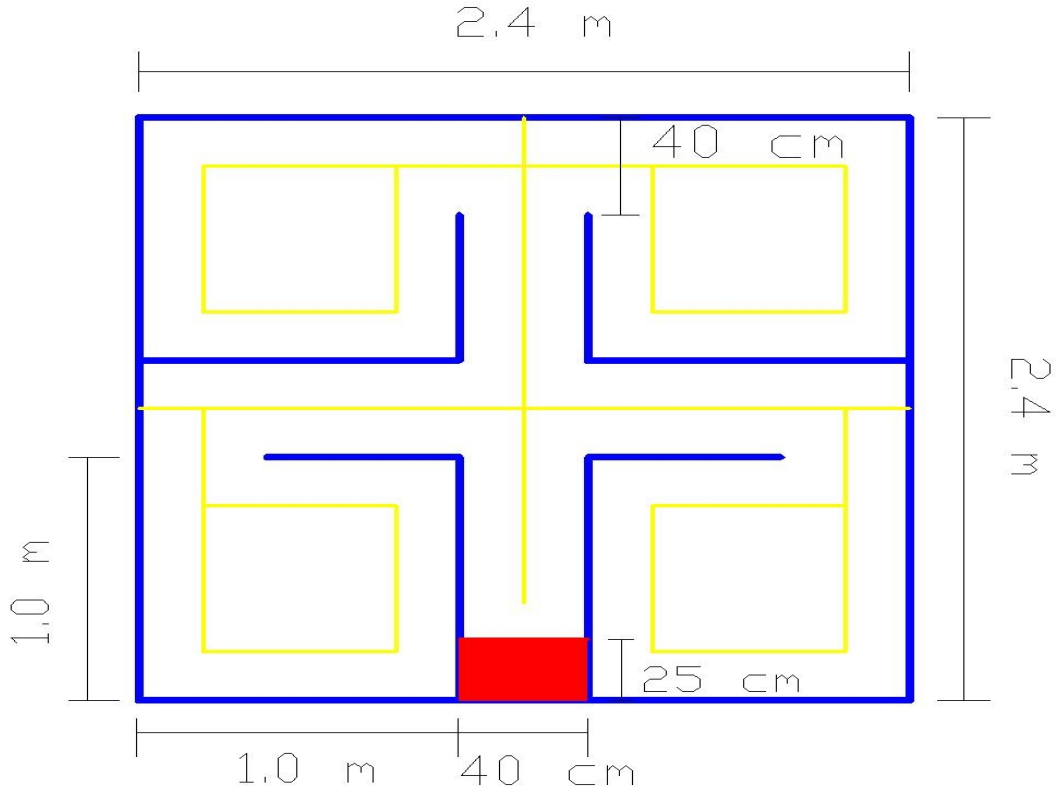

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