2009 IEEE Region 5 Conference Robotics Competition

Official Rules

I. CONTEST VENUE

The IEEE 2009 Region 5 Robotics Competition will be held in the Exhibit Hall inside the Lubbock Memorial Civic Center at 1501 Mac Davis Lane in Lubbock, TX 79401. Tables and extension cords will be set up for teams to work on their robots. The competition space will be open to contestants and spectators throughout the event. A picture of the exhibit hall can be seen at http://lmcc.ci.lubbock.tx.us/images/exhall.jpg, although the seating arrangement will not be as shown in the picture. In order to minimize ambient lighting, flash photographs will not be permitted during the competition runs.

II. ELIGIBILITY & TEAMS

The 2009 IEEE Region 5 Conference Robotics Competition has been designed for **undergraduate students only**. Teams must not contain any non-undergraduate students, and all team members must be properly registered for the regional conference. Each university is allowed to register 2 teams to participate in the robotics competition, with a maximum of 4 members per team.

III. THEME OF THIS CONTEST

In concert with this year's Region 5 Green Technology Technical Conference, the task this year is to construct a land-based robot which can autonomously transport toxic containers from multiple locations to a remote processing area. Due to the high risk of human infection, it is desirable to transport waste from multiple city sites to a remote processing facility using autonomous unmanned transport.

IV. CONTEST GOAL

Each team must design and build one autonomous robot that can detect and transport a container from each of the 4 corners of the course to the assigned square area in the center of the course. The robot must visit all 4 corners, pick up the 4 cargo containers and transport them to their correct positions, but the desired order of pickup will be decided on the day of the competition and will vary from round to round.

V. ROBOT CONSTRUCTION

The only limitations to the construction of the robot are that it must be **autonomous**, meet the **size and weight** requirements, contain a **"kill" switch**, and be **safe**.

Each team can enter only 1 autonomous robot into the competition. No human interaction with the robot is allowed once the robot starts running after pre-programming. The use of

external computers or remote processing is also not allowed (for example, no wireless communication with an outside laptop). The mobile robot must be completely independent of any other external component during the run.

The robot cannot exceed 50 pounds in weight. The maximum starting size of the autonomous robot must not be greater than 1 foot in length, 1 foot in width and 2 feet in height. To be within the size limitations, the robot must fit in the 1' x 1' x 2' box that will be provided. When inside the measuring box, the robot cannot be tilted but must be upright and in the same position that it would be at the start of its run. After the end of a round, the robot must still meet the size and weight requirements.

The single robot may expand or split up into multiple robots to accomplish the goal. In this case, reconnection of the split robots is required at some point prior to measuring the robot after the completion of the run. This reconnection can either be done automatically during the run, or manually (reattaching the pieces together by hand) after the robot completes the run and is taken off the field.

Each robot must have a visible and easily accessible "kill" switch or emergency stop button to turn off all power to the robot in case of malfunction or improper activity.

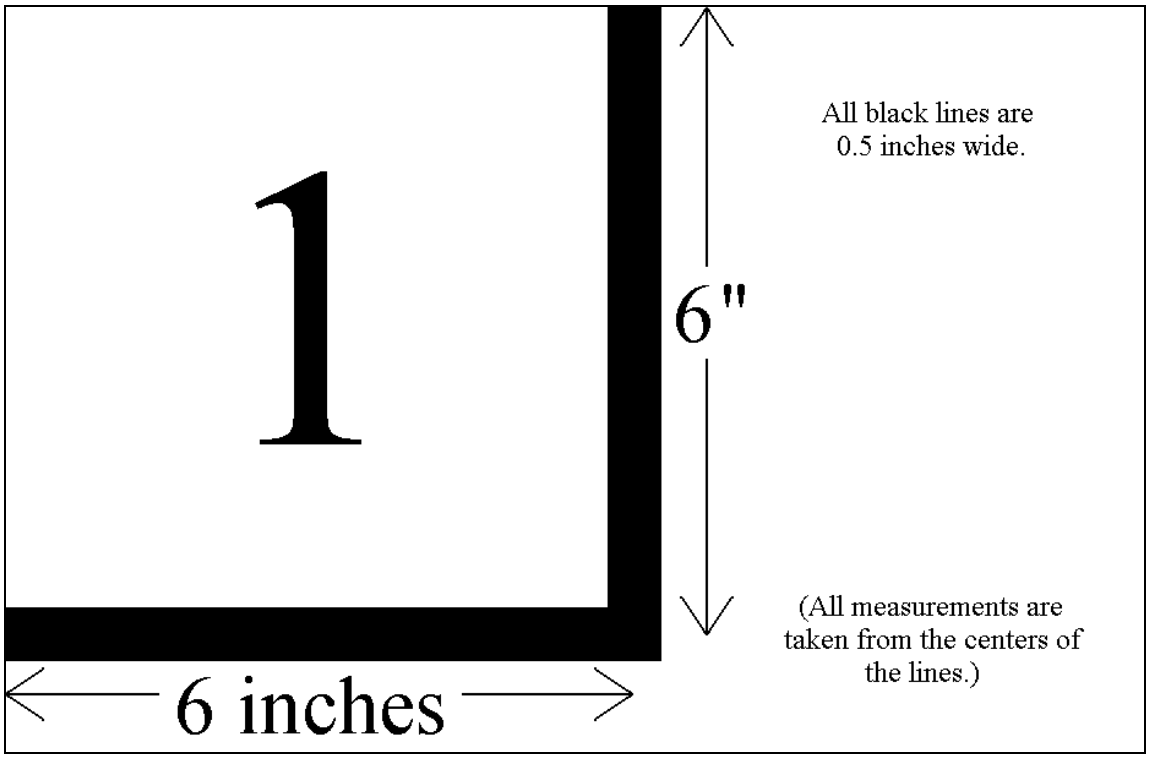
A 'safe' robot is one that has a low potential to catch on fire, destroy/damage the field, or injure humans. For this reason, no robot may use a combustion engine power system. Care must also be taken to ensure that batteries are enclosed in a manner that will prevent any danger to the course or the facility.

VI. THE COURSE

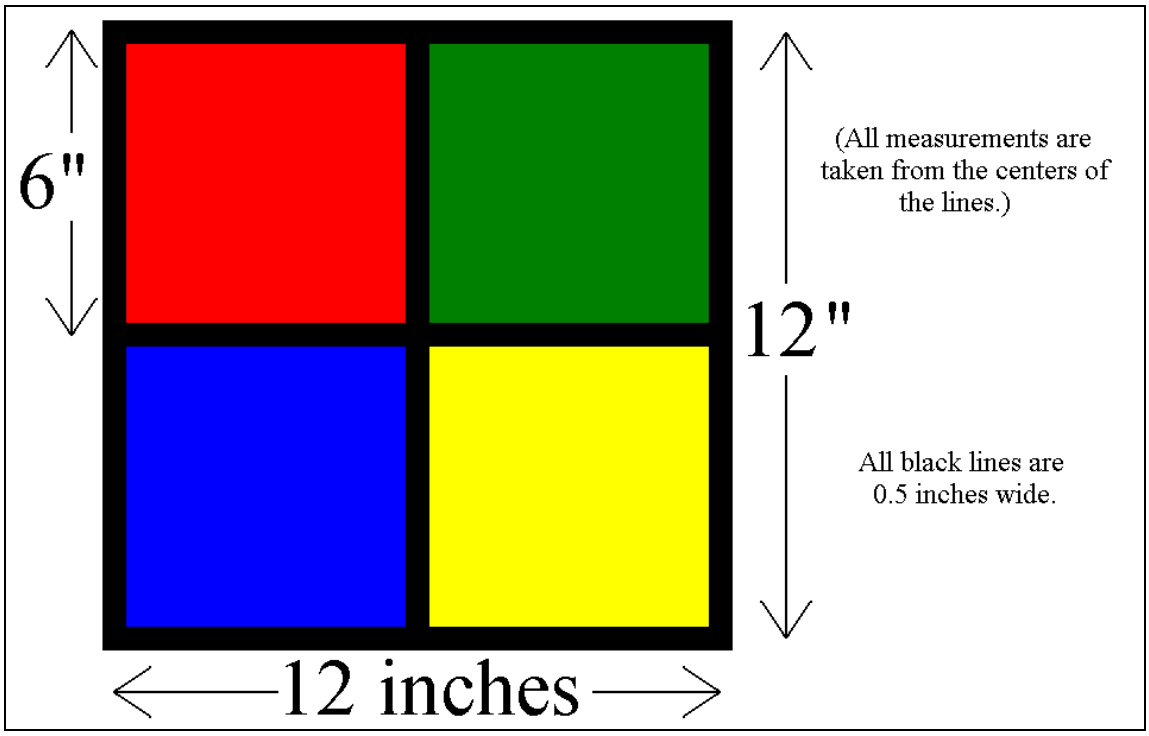
A. Field

The field is called "floor underlayment" or "particleboard underlayment" with dimensions of ¾" x 4' x 8'. Two pieces of particleboard will be put together to form the entire field. The top surface of the field will be painted with four coats of white paint. The white paint used will be Kilz 2 latex interior/exterior water base white primer. All black lines anywhere on the field will be 0.5 inches wide. The black paint used will be American Accents latex flat black smooth flat finish (224171 - Flat Black).

Each corner of the field will have a white square with a painted black border. The black painted border will only mark the inner 2 sides of the corner square, leaving the edge of the field to act as the other 2 sides. Each square will measure 0.5 feet (6 inches) in length. All measurements on the field involving lines will be made from the **center of the line**. An example figure of the top-left corner square is shown below in Figure 1. In the figure, the field extends to the bottom and to the right. There will be a number on each one of these corner squares, ranging from 1 to 4, also painted with black paint.



There will also be a square in the center of the field measuring 1’ by 1’ (measurements are made from the **center of the line**). This square will be divided into 4 equal quadrants with black lines. Each one of the quadrants will be painted a different color - red, blue, green or yellow. A figure of the center square is shown below in Figure 2.



The paint used for any part of the course will be as follows:

Red:	Sunrise Red	Rust-Oleum™	7762
Blue:	Sail Blue	Rust-Oleum™	7724
Green:	Hunter Green	Rust-Oleum™	7738
Yellow:	Sunburst Yellow	Rust-Oleum™	7747

An online color reference can be found at:
http://rustoleum.com/CBGProduct.asp?pid=24

See Figure 1 below for an aerial-view plan of the field. The dots in the 4 corners of the field are explained further under the section '**B. Lights**' below.

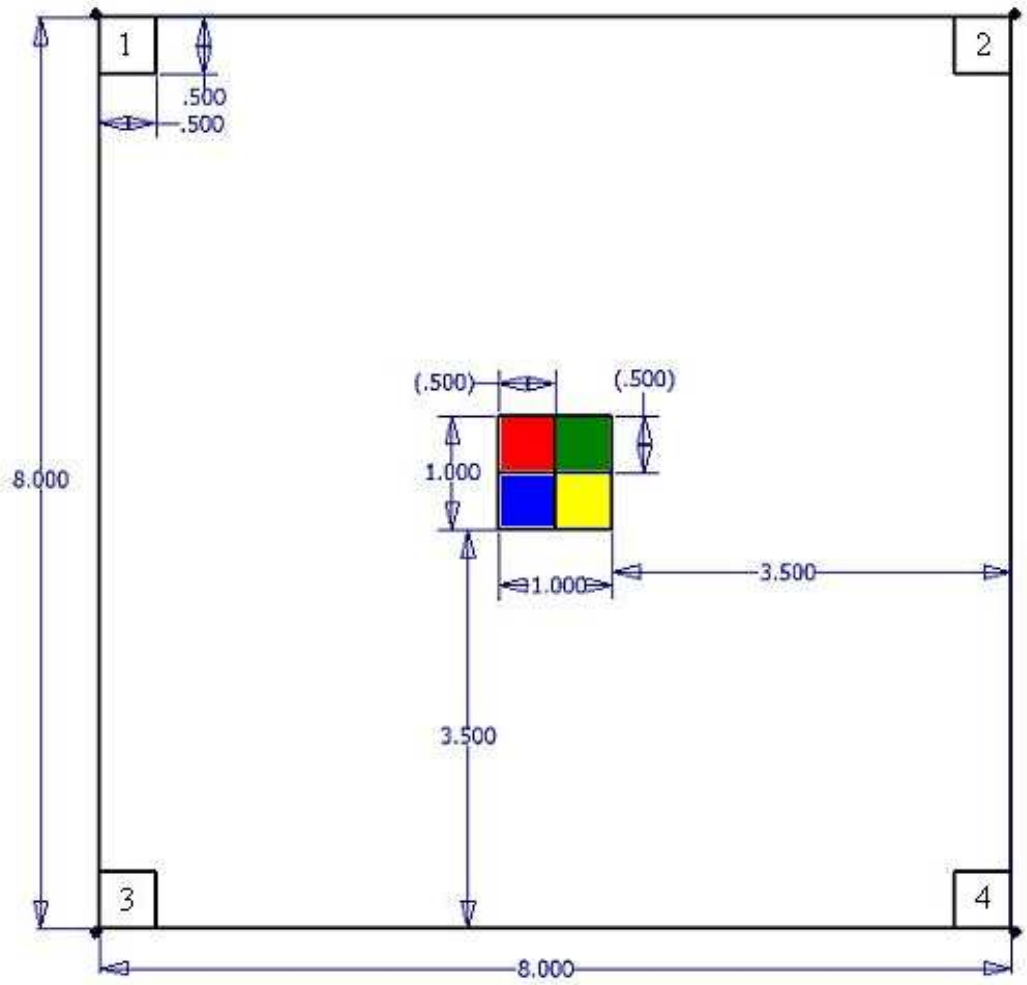


Figure 1: Aerial-View plan of Field [Measurements are in feet]

B. Lights

On every corner of the field, there will also be a side-emitting white light (Luxeon LXHL-FW3C) flashing at a frequency specified below. Each corner light will be positioned atop a white segment of PVC piping at a height of 8 inches from the surface of the field and will have a light frequency different from that of the other 3 corners. The PVC piping itself will be outside the field, so running into the pipe should not be an issue. The frequencies are as follows:
Corner 1 - **10 kHz ± 2 kHz**
Corner 2 - **80 kHz ± 2 kHz**
Corner 3 - **60 kHz ± 2 kHz**
Corner 4 - **20 kHz ± 2 kHz**

At the very center of the field (in the center of all 4 quadrants) there will be another side-emitting white light (Luxeon LXHL-FW3C) suspended in the air 8 inches above the surface of the field with some sort of twine or wire. A support structure will be built over the field to suspend the center LED but it will not interfere with the competition field. The light at the center of the field will flash at a constant frequency of **40 kHz ± 2 kHz**.

Since the LED will be suspended, any contact the robot makes with the LED may cause it to move, swing, or even malfunction. Any problems that arise from a robot making contact with the suspended LED will be the responsibility of the team whose robot is participating at the time.

The LEDs will be flashing at a duty cycle of approximately 50%.

C. Cargo Container

At the start of the competition, each of the 4 corners of the field will contain 1 cargo container. The cargo containers will be equidistant from (and parallel with) all the sides of the corner squares. Each cargo container will be a hollow cardboard cube with a side length of 3 inches. Each of the 4 cargo containers will be painted a different color - red, blue, green or yellow. The cargo containers will be weighted at a total of around 150 grams. There will be an object or multiple objects in the box that weigh it down. Therefore, tilting the box on its side might cause the inner items to roll or move causing a slight imbalance of weight, similar to that of a real toxic cargo container.

Any method may be used to transport the cargo containers to its final destination. Lifting, pushing, dragging, and rolling are all acceptable methods of movement, as long as the cargo container is not damaged or completely destroyed.

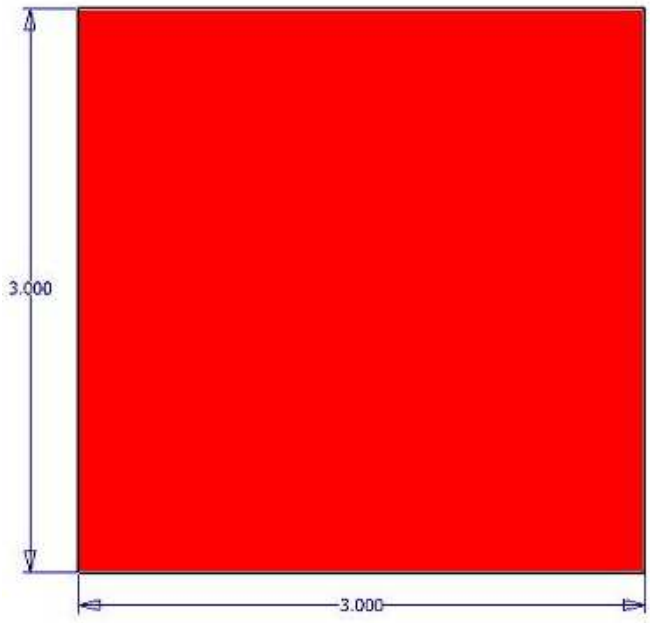


Figure 2: Plan of Sample Cargo Container [Measurements are in inches]

VII. RUNS

Each team will be allowed 1 minute to place their robot on the course and prepare their robot for the run. Since lighting may play a factor in color and frequency determination, teams are welcome to calibrate to the conditions of the course during the preparation time (1 minute). The team will be then given the sequence of the containers that have to be picked. The sequence will resemble the form 2-4-1-3 (for example), meaning that the robot needs to pick up the container at corner 2, followed by the one at corner 4, corner 1 and finally the container at corner 3. The team will then be allowed 1 minute to pre-program their robot to set the order in which to visit the 4 corners. Once pre-programming or 1 minute (depending on which finishes first) is complete, the colored boxes will be placed randomly on the four corners.

The starting placement and orientation of the robot is up to the discretion of the competing team as long as no part of the robot touches the center square or any of the corner squares. Touching any part of any line of any square will count as being inside the square and is not allowed during initial positioning.

Once a robot places a cargo container in its destination area in the center of the field, it will be considered to be in the correct area only if the container is in its respective color-coded area and it is not in contact with any quadrant of a different color (touching the black line of the correct quadrant is permissible).

No part of the robot is allowed to be outside the 8’ x 8’ boundary of the field for more than 5 seconds at a stretch. This allows teams a little leeway in case a robot veers off to a side but corrects itself quickly. However, the robot will be immediately disqualified if any part of it touches the ground (the surface on which the field is placed).

There will be 2 rounds of competition. All teams must compete in any 1 or both of the first 2 rounds. Teams have the option to sit out either of the first 2 rounds if they choose to do so. The desired order of cargo transportation will be changed after every round. The feasibility of a third and final round is being discussed and will be announced as soon as possible.

Each run will be limited to 3 minutes of run time, beginning when the robot starts. Run-time will end when the fourth and final cargo container is placed in the center of the field. The position of the robot after the final container is placed is irrelevant and will not affect score. Any team whose robot takes longer than 3 minutes to complete the course will be penalized in score.

VIII. SCORING

Scores will be assigned based primarily on the completion of detection and transportation of cargo containers. The speed at which the robot accomplishes the assigned tasks is of secondary importance. More details of scoring will be determined and announced at a later date.

The following scenarios will result in immediate disqualification:

- Robot does not meet the size or weight requirements at the start or end of the run.
- Robot does not have an emergency stop button ("kill" switch).
- Robot damages or destroys the field or a cargo container.
- Robot is not safe (based on the decision of the judges).
- Robot goes touches the ground (the surface on which the field is placed).

IX. JUDGING

All decisions made by the judges during the course of the competition are final.

X. QUESTIONS & COMMENTS

A webpage has been set-up for frequently-asked questions. Please refer to this page for potential clarifications of the rules:

http://www.r5conferences.org/StudentCompetition/Robotics/Robotics.htm

In addition, please feel free to direct your questions/comments to any of the following students:

Davis Chanjaplammootil: davis.chanjaplammootil@ttu.edu
Will Gray: christopher.gray@ttu.edu
Jared Gurley: jared.gurley@ttu.edu