University of Central Florida

IEEE Region 3 and Orlando Section

ROBOTICS CLUB at UCF

IEEE SoutheastCon 2012 Hardware Competition
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I. Introduction
An exciting avenue for robotics is their potential for exploring, taking measurements, and interpreting information. Autonomous information-gathering robots are needed for a far-reaching number of tasks ranging from the inspection of a ship's hull; to exploring the far reaches of space; to just seeing what's around the corner.

II. Objective
Robots will be tasked with traversing a maze-like course, analyzing electrical signals and other information along the way to point it in the right direction. Points will be assessed for correctly reading and interpreting this information consistently as it circulates the track. Winners will be determined by the robot who has achieved the most points, where a high ratio of correct choices vs. total tasks completed determines a tie break.

III.Playing Field
The course is set up as a set of connected boxes. Against a wall in each major box is a task. There are four tasks in all, of varying difficulty. The following is a list of the tasks, in order of appearance when traversing the course clockwise from the starting line.

1. Measure voltage across two plates; if the magnitude of the voltage is greater than 11V, go right, if less than 9V, go left.
    a. Maximum current that can be sourced is 10mA
    b. Maximum voltage is 15V
    c. Minimum voltage is 5V
    d. Plate polarity will not be defined
2. Measure the temperature of a plate; if it is 10°F greater than room temperature, go right, if it is 10°F less than room temperature, go left.
    a. Room temperature will be established as the ambient air temperature of the room that the competition is present in.
3. Measure the capacitance between two plates; if the capacitance is greater than 550 nF, then go right, if it is less than 450 nF, go left.
    a. Capacitors will be bidirectional
    b. Maximum capacitance is 10µF
    c. Minimum capacitance is 10nF
    d. Maximum voltage tolerance is 12V
4. Interpret signal waveform; if it is a square wave, go right, if it is a saw-tooth wave, go left.

a. For this task, the left plate will be the signal source, and the right plate will be ground
b. Wave frequency will be on the order of 100 kHz
c. Maximum current that can be sourced is 10mA
d. The RMS voltage for both signals will be 5V

The course's physical dimensions are laid out in *Figure 1*. All dimensions have a tolerance of +/- 1", with the exception of the size, separation, and height of the plates for measuring which will have significantly tighter tolerances. The plates in tasks 1, 3, and 4 will be 2" wide x 3" tall. They will be 1" off the ground and have 1" of separation in between them. The plate for task 2 will be 1.5" x 1.5", and the base will sit 2" from the ground. See *Figure 2* for mounting visualization. The course will be physically bound by 1" PVC pipe, and the surface on the ground will be Astroturf.

To assist your robot in knowing where it is and how to move around, there will be a yellow line on the ground indicating all possible paths for the robot. Additionally, hash marks at the entrance to every room will be present on either side of the yellow line to indicate the current task. The first task will have 1 hash mark, second will have 2, etc. See *Figure 2* for a more detailed view.

When a vehicle leaves a given room, it will pass one of two "virtual checkpoints". Upon crossing said checkpoint, the robot's points will be assessed based on whether it took the correct path. For audience appeal, a buzzer or satisfying ring will play from an incorrect or correct path taken, respectively. An extra virtual checkpoint is in place by the starting line, which will trigger automatic randomization of the course parameters. This randomization will be controlled by an automated system, and therefore no human will have a hand in determining the parameters for a given lap. Correct paths will be indicated to the audience in a manner which is not visible to the robot for reference.

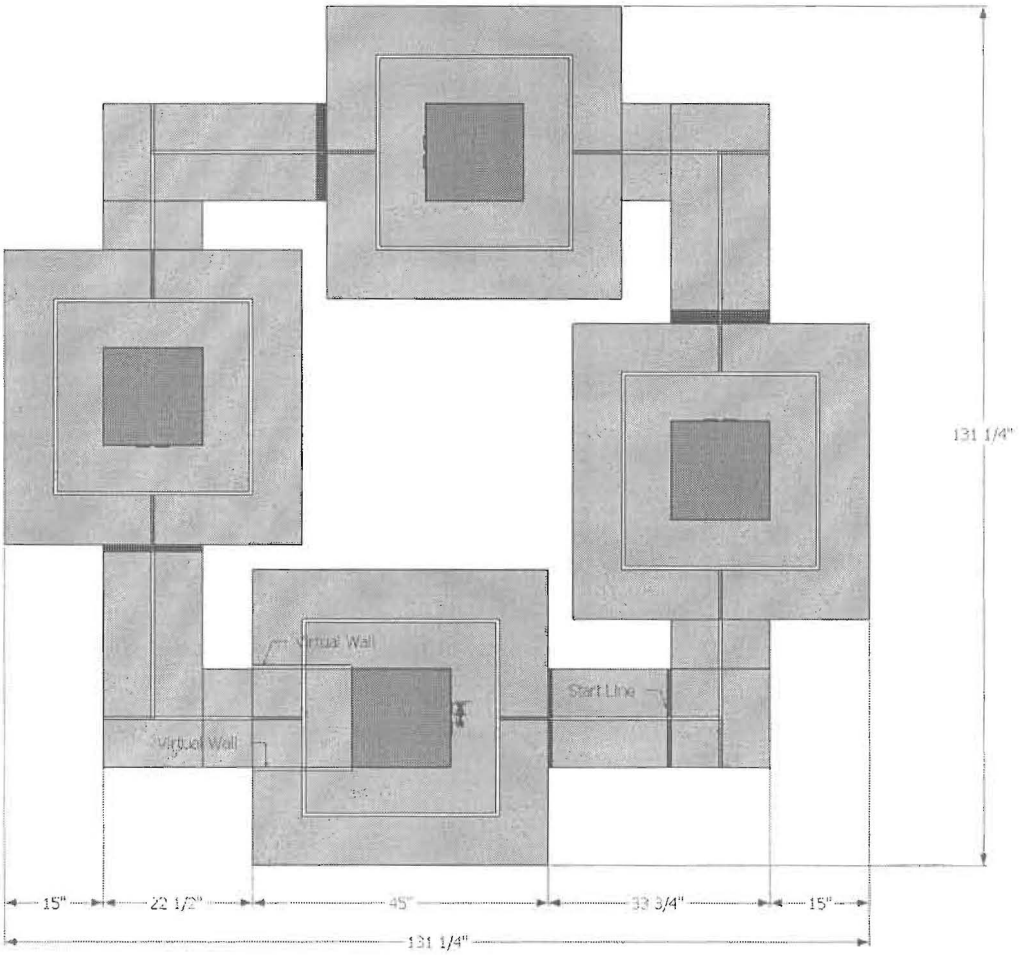

Figure 1: Top view of course layout

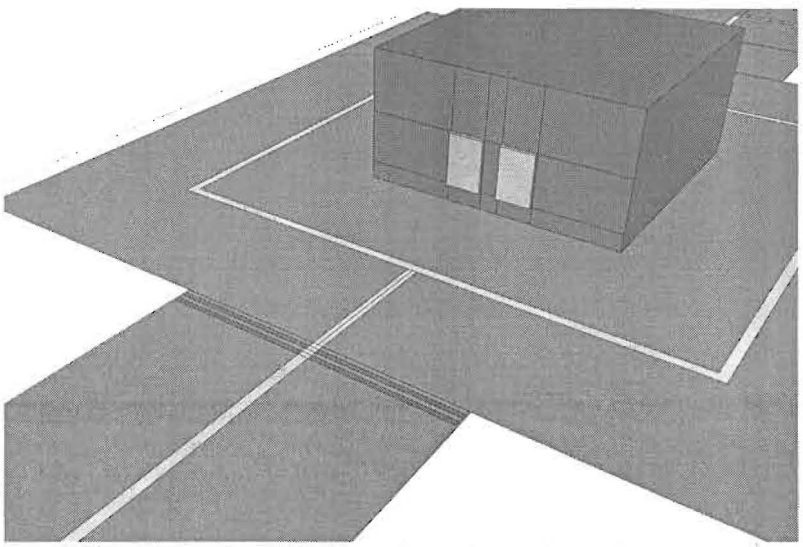

Figure 2: Hash marks indicate the task

IV. Vehicle

We are placing no limitations on the vehicle itself, except that it must only operate within the bounds of the playing field. Robots should not extend themselves over the course boundaries. A clearly indicated start button or switch must be present on the robot.

V. Rules of Play

1. A single team member may place the robot behind the starting line. No portion of the robot may extend past this line before the challenge has started.
2. When indicated by the judges, one individual from the team will activate the robot with its starting button or switch. After the switch is toggled and the challenge has started, there can be no interaction between the robot and any human or machine external to the robot until the challenge has terminated.
3. Each challenge run will last for 4 minutes.
4. The complete robot must do laps around the course, interpreting measured data, using it to determine the correct path around the course.
5. The robot is not required to finish in any particular location; points will be assessed based on the tasks completed when time ends or a team member calls time.
6. If a team member at any point calls time, their run is terminated and no additional points will be granted, at which point they may remove their robot from the course. No retrials are permitted.
7. During a robot's run, it may make as many or as few laps as is possible in the given amount of time.
8. Values at each task location will be randomized automatically every lap for every team. There is no guarantee that any two robots will experience the same circumstances on a given lap. There are no "default" values, nor is there any pattern other than what a pseudo-random number generator would produce.

VI. Competition Format

Qualifying Round

A team must be able to demonstrate that, after pushing the start button, the robot is able to move at least 1 foot forward.

Preliminary Rounds

The teams which qualified will compete in 3 preliminary rounds, where the average of the three calculated scores will determine the teams that advance to the final rounds. The top **4?** teams overall will advance to the final rounds. These teams will have the 4 highest scores, where a higher ratio of correctly completed tasks vs. total completed tasks determines a tie break.

Final Rounds

A **single?** final round will be held, the team with the highest score will be the winner. Tie breaks will be determined based on a ratio of correctly completed tasks vs. total completed tasks.

VII. Scoring

- 5 points will be awarded for crossing the starting line.

- 10 points * X will be awarded for each correctly completed task, where X is a multiplier equal to the number of tasks consecutively completed correctly + 1.
    - For example, if no tasks were previously consecutively completed correctly, X=1.
        - If the previous 2 tasks were completed correctly, then X=3.
        - Regardless of the value of X, if a given task is performed incorrectly, the multiplier for the next task is equal to 1, X=1.
    - Competition participants and audience members will be able to clearly hear a buzzer when a task is completed incorrectly, and a satisfying ring when one is completed correctly. This indication is for audience members and competition judges, and is not necessary to be identified by competition participants.

VIII. Afterward

The objective of this competition is to promote good engineering practices and robust systems. A robot should be able to adapt to its environment, and understand the context of a given task at hand. Additionally, a vehicle should be robust enough to compensate for dynamic or non-ideal settings. These themes were the motivation for the competition. For this reason, it is, although not against the rules, strongly discouraged for teams to use dead reckoning as a means of getting around the course. In addition, teams should be able to tolerate and compensate for minor discrepancies in the layout or setting of the course, e.g. a small bump in the competition surface, or a minor difference in the width of a given hallway.