2013 IEEE Region 5

Annual Meeting and Student Competitions

April 6 – 7

Denver, Colorado

Student Robotics Competition
Problem Statement and Competition Rules

Venue

The IEEE 2013 Region 5 Robotics Competition will be held Saturday, April 6, 2013 in the Grand Ballroom at the Hyatt Regency Denver Tech Center in Denver, CO. The competition will be open to contestants, spectators, and visitors throughout the event. Student teams will be provided with tables, outlets, and practice space the evening before and day of the competition. Students must arrive to the competition prior to the 0800 start time on April 6 and enter their robots; however, participation in the competition will require pre-registration before the deadline. More details on this will be provided on the web site.

1 Revisions

As in the past, rules are subject to change based upon input received from teams. Changes will be notated here. There will also be a question and answer website that will be updated as questions are received.

- August 18, 2013 – Preliminary release of document to public. At this time, the details for the question and answer website are still not finalized. As soon as we have a working site, this will be published. Furthermore, the details of the file contents with locations of the samples has not been determined. This will also be published as soon as it is finalized.
- September 2, 2013 Entry requirements section edited to reflect quarantine requirements.

2 Contestant Eligibility

The competition is open to all undergraduate students attending IEEE Region 5 educational institutions. Teams may not include any non-undergraduate students. Contestants are required to register appropriately for the regional conference and student activities. In order for your team to participate in the ongoing internet based Question and Answers, your team must be pre-registered.

3 Contest Description

This year's contest will preserve the tradition of compact mobile and autonomous robots operating on a predefined playing field. The challenge will be to collect simulated 'soil' samples placed on the field, the competition will be won by the robot that collects the most samples in the allotted timeframe.
The competition will begin at promptly 0800.

4 Entry Requirements

The robots will be screened by a judge before each round of competition. Entries not meeting the requirements will be disqualified for the round. At the beginning of each round of competition, all qualified robots will be placed in a 'quarantine' area and will remain there until the robot is scheduled to compete. Prior to the scheduled time (during the round of the previously scheduled teams), a team member will come to the quarantine area to collect their robot. The team member will not be allowed to leave the competition area with the robot until after the robot has competed in the round. Any violation of these rules will result in disqualification.

1. Entries must be fully autonomous and self-contained. Human or remote computer intervention is prohibited during play.
2. The robot must be able to read soil sample locations from a usb flash memory drive at the start of the round.
3. The maximum dimensions of the robot are 1'x1'x1' high. The robot in its entirety should fit within this bounding box at the start, during, and at the end of the competition.
4. Entries must be generally safe in the opinion of the judges. The possibility of the robot causing harm to persons or property will be the deciding factor. This precludes the storage of flammable gases or liquids. Batteries should be enclosed in a way that will not present any danger to the operator or playing field.
5. Robots may not exceed a generous weight limit of 50 pounds.
6. An easily accessible "start/stop" button must be provided for the judges to initiate competition. This button must be distinct and separate from any other buttons.

5 Objective

One of the biggest problems with revegetation after forest fires is the determination of the level of human intervention required. After some fires, it is possible to let nature take its course to restore

the forest to optimal health. Other fires can be so devastating to the forest ecosystem that intensive human intervention is necessary to assist nature. One of the best ways of making the determination is through soil samples. This year's objective is to build a robot capable of entering the playing surface and collecting 'soil samples' at points specified prior to the start of the round. The locations will be provided to the robot in a file contained on a USB flash drive. The flash drive will be provided upon entry into the robot 'quarantine' area.The robot must be able to read the file and subsequently act on the information. XXX The file specifics will be provided prior to the release of the competition rules to the public. XXX

The file will provide the locations of 6 the desired samples; the sample locations will list the number of each sector containing a sample. The locations will remain constant throughout the round; each team will receive identical sample locations. The locations will change for the second round and the final round. The sample will be located in the middle of the sector specified. The successful robot will move to each location and collect a sample returning to sector 1 upon completion. There will be no specified order for sample collection. Due to the inherent problem of bringing a large quantity of soil into the Grand Ballroom of the Hyatt Regency, the soil samples will be simulated. Each 'sample' will consist of a disc, constructed of Delrin®, located on the floor in the specific location provided. The disc will be secured to the floor, in the center of the designated sector, using one square of Saunders UHU TAC ® Adhesive Putty (OfficeMax Item # 20109188). The adhesive square will be replaced after each round for all collected or moved samples. Each sample disc will be 3" in diameter and 0.5" in height. In keeping with the nature of the challenge, the robot will be required to collect the sample using a probe which moves vertically down from the robot. There is no specified location for this probe; it can be located on the front, back, or sides of the robot. The robot can use whatever method deemed appropriate to pick up the discs. The robot may either store the discs on the robot, or the robot may deliver each disk to sector 1 and then return to the field to collect the remainder. The playing field, with obstacles from a top-down viewpoint, can be seen in figure 1 below.

6 Playing Surface

The playing surface base is an 8'x 8' surface constructed out of MDF or equivalent (two 4'x8' sheets). The face of the surface will be painted with – White Rust-Oleum® 1990. The playing surface will contain a random placement of 'obstacles' such as might be found in a typical forest; these obstacles will be painted with – Black Rust-Oleum® 7776. The obstacles are:

1. **downed trees** - simulated by a simple wooden dowels of 2" in diameter placed as shown across the playing field. The dowels will be nailed to the floor. As you can see from figure 1, the starting location is the such that the robot cannot go around these obstacles. In short, the robot must be able to go over the downed trees.

2. **standing trees** - simulated by half gallon sized milk/juice cartons filled with sand for ballast and nailed to the playing floor. The robot must navigate around these obstacles. Point deductions will occur if these obstacles are in any way damaged by the robot. Damage will be determined by denting or significant scratching of the obstacles.

3. **rocks or boulders** - simulated by gallon sized paint cans nailed to the playing floor.

The field is broken up in to 16 2'x2' sectors as shown in Figure 1. The sectors will not be painted onto the surface; there will be a small, 1" in diameter, red dot to indicate the intersection points of the lines making up the sectors as shown in figure 1; the paint type is to be determined. The robot

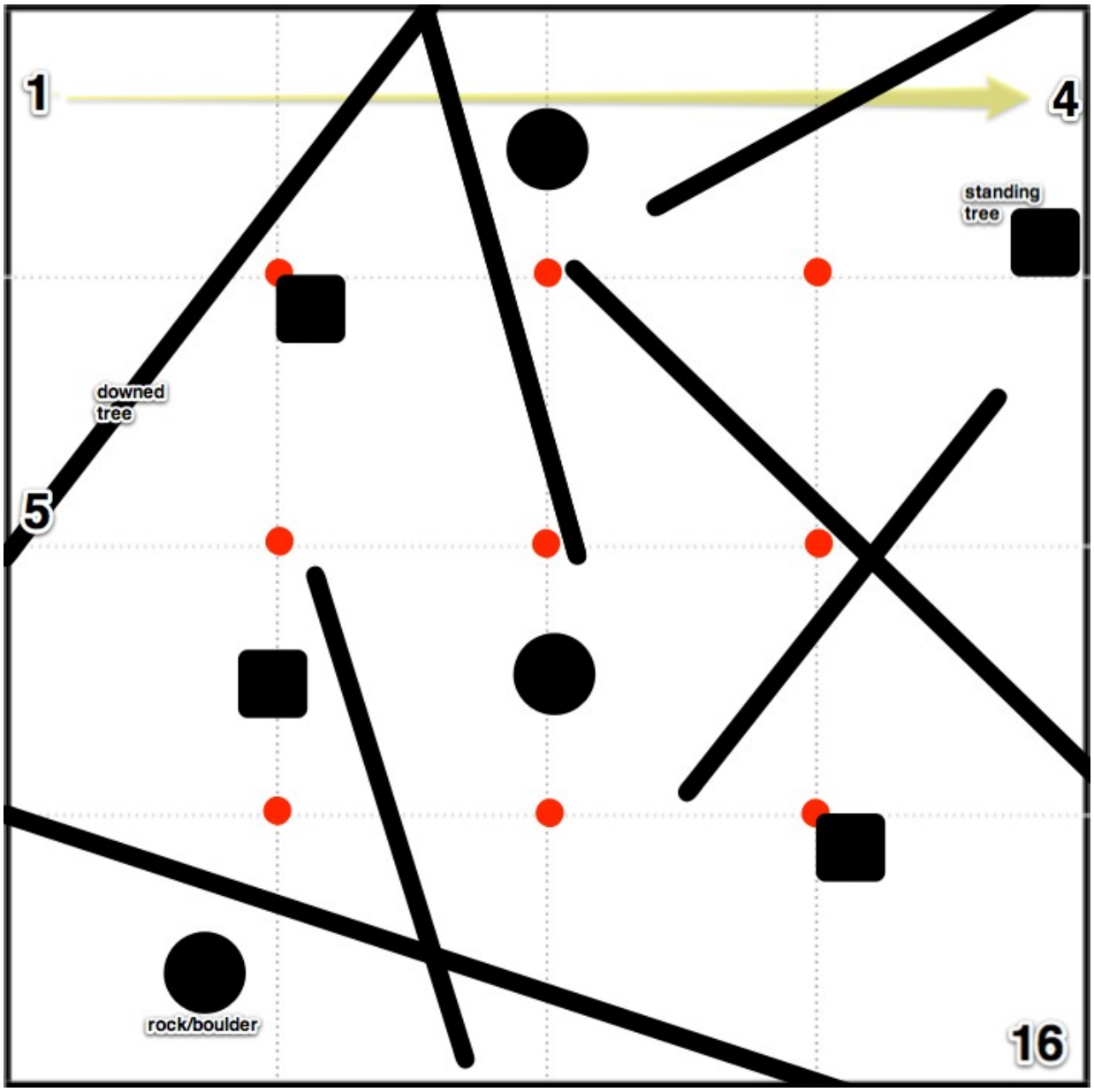

Figure 1: 2013 IEEE R5 Student Competition Playing Field Diagram - obstacles will be placed on the field in the positions shown

will enter the field in the upper left of sector 1 and proceed thenceforth to collect samples. At the completion of the collection sequence, the robot is to return to sector 1 with the 6 samples.

7 Scoring

Scoring will be based on both success of the mission and the time required to successfully complete the mission. Each sample successfully collected will score 100 points; the points will be scored with successful collection. If a robot does not successfully complete the entire mission, the score for each

collected sample will remain. If the robot is able to successfully collect all samples and return to sector 1 in less than 1 minute, the team will receive 480 bonus points. The 480 bonus points will be reduced by 20 for every additional 10 seconds required to complete the mission. Thus, if a robot collects all 6 samples and returns to sector 1 in 4 minutes, the score attained will be 720 with no further deductions. If a robot collects only 4 samples, the score will be 400. If the robot collects all 6 samples but fails to return to sector 1, the score is 600. If an obstacle on the board is moved or damaged by a robot, the point deduction will be 100 for every violation. If, at point during the round, any part of the robot leaves the 8' x 8' floor area, the round is complete and the score is zeroed. In order for the mission to be judged a success and receive time bonus points, the robot must end completely within sector 1.

8 Round Description

Each team will get 2 rounds of play. The scores from both rounds will be added together to make up the final score. The top three teams will play one final round to determine the 1st, 2nd, and 3rd place winners. The rounds will proceed as follows:

1. The judge requests the team from the "on deck" area.
2. Students have 1 minute to place their robot in the starting area and step back behind the predetermined team observation area. The robot must fit entirely in the starting point of the field.
3. The judge will press the "start" button and begin timekeeping.
4. The robot will have 5 minutes of play to collect as many samples as possible and return to the start.
5. After 5 minutes of play, the robot will be stopped or may stop on its own. The number of samples and points scored will be recorded by the judge.

If a robot leaves the playing field or for some reason no longer meets its size or safety requirement the round will be ended. The team captain may also give the judge a command to end the round for any reason at any time.

9 Prize

A cash prize will be given to the winning team. Amount to be announced at a later time.

10 Technical Award

A reward will be given to the team with the best technical report of their robot.The format must be IEEE standard conference format; a template is available at the following link: IEEE templates. Paper will be judged based upon the following criteria:

1. Quality of the writing (e.g., clarity, organization, figure size, style, etc.) (15%)
2. Innovation and originality in the solution methodology and approach to robot design (25%)

3. Sufficient depth and breadth of the research (15%)
4. Ability of a reader in the field to replicate the robot and understand its theory of operation (25%)
5. Validation of results reported in paper (20%)

The award amount to be announced at a later time.

11 Contact Info

For questions regarding the rules and all other matters related to the robotics competition, please contact the robotics chair, Megan Paciaroni, robotics AT r5conferences DOT org.