IEEE Region 5 Conference

Student Competitions

Robotics Competition

2018 Competition Description and Rules

Change Log

Date	Comment
7/13/2017	Rev 1.0 Draft WS
8/3/2017	Rev 1.1 Draft LL
8/22/2017	Initial Release

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Venue

The 2018 Region 5 Robotics Competition will be held in the ballroom at the AT&T Center at 1900 University Avenue, Austin, TX 78705 on Saturday April 7th, 2018. For detailed information regarding practice boards, practice times, and competition times, refer to the Robotics Competition page on the Region 5 website. Wireless communications with the robot is prohibited within the competition ballroom during the competition.

Team Composition

This document contains the rules of the 2018 IEEE Region 5 Student Robotics Competition. The competition is open to teams of no more than 5 undergraduate students who are enrolled in a College or University within the IEEE Region 5 boundaries. The competition encourages a multidisciplinary approach to robot development and recognizes the participation of students who may already be members of other profession organizations (ACM, SAE, ASME, EEGS, etc.) Therefore, only one team member will be required to be a current IEEE Student Member.

Events and Prizes

There are several events and meals scheduled starting Friday night. Registration is required for area entry and badges must be obtained at registration. The competition will conclude on Saturday evening during the awards banquet. Cash prizes and certificates will be awarded at the awards banquet to the top three teams. Specific details of award values will be provided on the Region 5 website.

Videotaping

Videotaping and photography will be allowed at the competition. Flash photography and the use of any light sources external to the robot will be prohibited during the competition.

Competition Description

The 2018 Competition will be a challenge to the strategist to build and program your autonomous robot to most efficiently complete a “simple” set of pick & place task

Overall Objective

The objective of the competition is for teams to demonstrate the use of an autonomous robot on a playing field with various set tasks to complete. The goal of the design of the competition is to provide a challenge which combines readily understood tasks which begin in early rounds with relatively simple requirements for completion while providing a pathway to increasing complexity in later rounds. The intended aim of this competition design is to allow great flexibility in the way solutions are crafted so that teams with access to varying amounts of skill and resources can, with clever applications of strategy, be fully competitive.

The Playing Field

Specifications for the materials used in the construction of the competition fields will be included in an appendix once a list is complete. The playing field, when assembled, will measure 8’x8’. The field will be made from two 4’x8’ sheets of plywood. The playing surface will be painted as shown in Figure 1.

In Figure 1:

- The brown dashed line is intended to illustrate where the two 4’x8’ sheets of plywood meet and will not appear painted on the finished playing field.
- All black lines are 0.5” wide.
- The colored squares along the perimeter, the white squares in the centers of two faces, and the center gray square are all 1’x1’ at the outer edges of the black lines delimiting the squares.
- The squares along the perimeter are either located exactly at the corners or are oriented with their center lines at the center of the side. The center of the gray square is at the center of the board.
- The line boxes surrounding the center square are all squares centered on the center of the playing field, and are respectively 2’x2’, 3’x3’, 4’x4’, and 5’x5’ measured at the outer edge of the black lines. There is a black line perimeter at the edge of the playing field.
- A black line will be drawn connecting the each corner of the center gray box to the corner of the corresponding colored box in that corner of the field. This will also connect the corners of each of the line boxes. Similarly, for the two colored boxes at the center of a playing field edge, there will be a black line connecting the center of that side of the gray box to the center of the side of the colored box. This will intersect the center points of the line boxes.

- At each of the 24 points where the black lines cross the line boxes, shallow depressions will be cut into the playing surface to accommodate a set of tokens with which the robots will need to interact. These positions are marked as gray circles. Each depression should be centered at the center point of where the lines cross. Each depression should be 1” in diameter and 1/16” in depth. The inner surface of the depression should be painted the same black as the lines.
- The background color for the board should be a pure white. The lines should be a pure black. The center square should be as close as possible to a 50% neutral gray. The edge squares should be as close as possible to pure red, green, blue, cyan, magenta, and yellow. Exact shades are to be considered less critical that finding shades which are readily distinguishable from one another by electronic means. These same colors should be used for the tokens.

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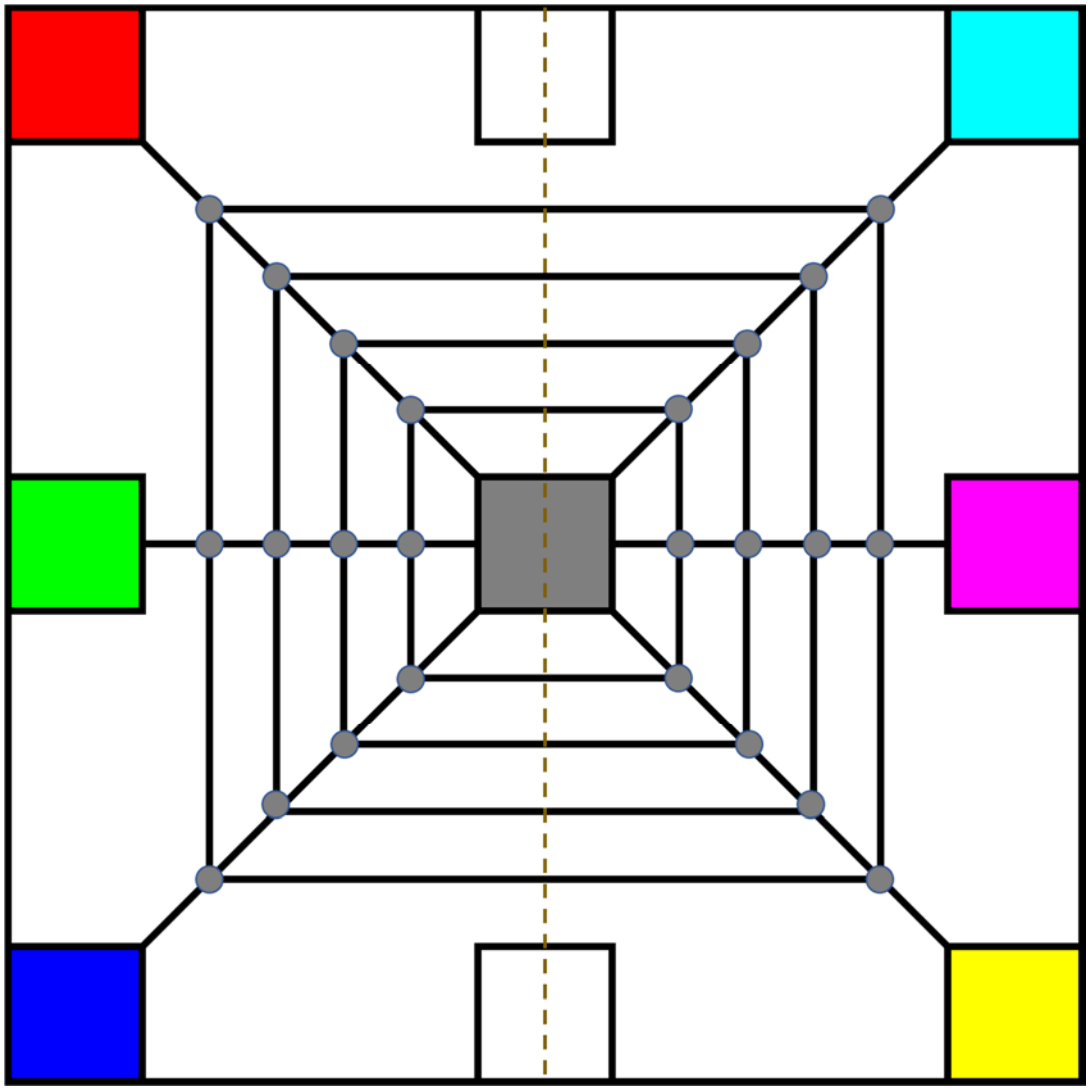

Figure 1: Playing Field Layout

Tokens

Tokens are to be 1.0” diameter and 1/16” thick and make of any mild, magnetic steel so that they may be lifted using a mild electromagnet. One face of each token, referred to as the back, and the edge of the token will be painted the same gray as the center square. The opposite face of the token will be called the front. A total of 24 tokens will be needed. For 6 tokens, the front will be painted the same gray as the back. For 3 tokens each, the fronts will be painted red, green, blue, cyan, magenta, and yellow, respectively. Each should match the same paint color as the respective square on the field

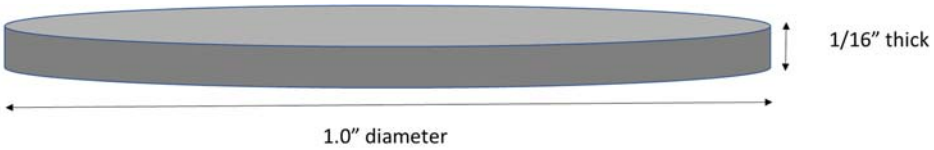

Figure 2: Token

General Gameplay

There will be three rounds of competition. Each team will get one opportunity per round. Scores will be cumulative over the three rounds. The basic gameplay consists of the robot being placed into one of the two white squares at the center edge of the field. When prompted by the judge, the [player will press the start button on the robot and the robot will proceed to find the tokens on the field, identify which color is on the front of the token, and deposit the token in the appropriately colored square. The number of available tokens and scoring changes on a per round basis. Once the task is completed, the robot should return to either of the white squares and stop.

Gameplay and Scoring – Round 1

- In Round 1, a total of 12 tokens; 2 each of red, green, blue, cyan, magenta, and yellow; will be placed on the field in the depressions with the colored face (front) down so that the color of the token cannot be seen without lifting the token. The 12 tokens will be distributed in random order along the 2' line square and 4' line square, except that no token will be placed along the line from the center to its respective color square.
- The robot must begin and should end in one of the 1'x1' white squares on the edge of the playing field.
- Once the player presses the button to start the robot, any further interaction with the robot stops the round.
- The robot should locate each of the tokens, identify their color, and deposit the each token in the corresponding colored square, i.e. red token in red square, etc.
- The round will proceed for a maximum of 5 minutes. The round will end early if the robot is touched or a team member tells the judge that they are finished. The round will also end if all tokens have been placed and the robot stops in one of the two white squares. If any token or the robot touches the floor outside of the board, the round ends immediately.
- At the end of the round, every token correctly placed in its corresponding color square will score +3 points each.
- Tokens placed in the wrong colored square, e.g. a yellow marker in the blue square, or in the center gray square will score +1 point each
- Tokens still in their depressions at the end of the round will score 0 points each
- Tokens at any other location on the board will score 0 points each
- If any token or the robot touches the floor outside of the board, the round ends immediately and the total round score is 0.
- If all 12 tokens are correctly placed in their corresponding color square, a bonus of +10 points will be awarded.
- If the robot finishes its round by returning to one of the two white squares and stopping of its own accord, a bonus of +10 points will be awarded.

Gameplay and Scoring – Round 2

- In Round 2, a total of 18 tokens; 3 each of red, green, blue, cyan, magenta, and yellow; will be placed on the field in the depressions with the colored face (front) down so that the color of the token cannot be seen without lifting the token. The 18 tokens will be distributed in random order along the 2' line square, 3' line square, and 4' line square, except that no token will be placed along the line from the center to its respective color square.
- The robot must begin and should end in one of the 1'x1' white squares on the edge of the playing field.
- Once the player presses the button to start the robot, any further interaction with the robot stops the round.
- The robot should locate each of the tokens, identify their color, and deposit the each token in the corresponding colored square, i.e. red token in red square, etc.
- The round will proceed for a maximum of 6 minutes. The round will end early if the robot is touched or a team member tells the judge that they are finished. The round will also end if all tokens have been placed and the robot stops in one of the two white squares. If any token or the robot touches the floor outside of the board, the round ends immediately.
- At the end of the round, every token correctly placed in its corresponding color square will score +3 points each.
- Tokens placed in the wrong colored square, e.g. a yellow marker in the blue square, or in the center gray square will score +1 point each
- Tokens still in their depressions at the end of the round will score 0 points each
- Tokens at any other location on the board will score a penalty of -1 points each
- If any token or the robot touches the floor outside of the board, the round ends immediately and the total round score is 0.
- If all 18 tokens are correctly placed in their corresponding color square, a bonus of +20 points will be awarded.
- If the robot finishes its round by returning to one of the two white squares and stopping of its own accord, a bonus of +5 points will be awarded.
- If the score after penalties would be negative, a score of 0 is assigned for the round.

Gameplay and Scoring – Round 3

- In Round 3, a total of 24 tokens; 3 each of red, green, blue, cyan, magenta, and yellow plus 6 all gray tokens; will be placed on the field in the depressions with the colored face (front) down so that the color of the token cannot be seen without lifting the token. The 24 tokens will be distributed in random order in the 24 depressions, except that no token will be placed along the line from the center to its respective color square.
- The robot must begin and should end in one of the 1'x1' white squares on the edge of the playing field.
- Once the player presses the button to start the robot, any further interaction with the robot stops the round.
- The robot should locate each of the tokens, identify their color, and deposit the each token in the corresponding colored square, i.e. red token in red square, etc. The gray tokens should be placed in the center gray square.
- The round will proceed for a maximum of 8 minutes. The round will end early if the robot is touched or a team member tells the judge that they are finished. The round will also end if all tokens have been placed and the robot stops in one of the two white squares. If any token or the robot touches the floor outside of the board, the round ends immediately.
- In Round 3, at least one marker of each color, including gray, must be placed correctly in order to score a non-zero round.
- At the end of the round, every token correctly placed in its corresponding color square will score +3 points each.
- Tokens placed in the wrong colored square, e.g. a yellow marker in the blue square, will score 0 points each
- Tokens still in their depressions at the end of the round will score 0 points each
- Tokens at any other location on the board will score a penalty of -1 points each
- If any token or the robot touches the floor outside of the board, the round ends immediately and the total round score is 0.
- If all 24 tokens are correctly placed in their corresponding color square, a bonus of +30 points will be awarded.
- If the robot finishes its round by returning to one of the two white squares and stopping of its own accord, a bonus of +5 points will be awarded. If the robot fails to finish in one of the two white squares, a penalty of -3 points will apply.
- If the score after penalties would be negative, a score of 0 is assigned for the round.

The highest cumulative score after three rounds wins. In the case of a tie score, a tiebreaker round will be run.

Gameplay and Scoring – Tiebreaker

- In the case of a tiebreaker round, a total of 14 tokens; 2 each of red, green, blue, cyan, magenta, yellow and gray tokens; will be placed on the field in the depressions with the colored face (front) down so that the color of the token cannot be seen without lifting the token. The 14 tokens will be distributed in random order in 14 of the 24 depressions.
- The robot must begin and should end in one of the 1'x1' white squares on the edge of the playing field.
- Once the player presses the button to start the robot, any further interaction with the robot stops the round.
- The robot should locate each of the tokens, identify their color, and deposit the each token in the corresponding colored square, i.e. red token in red square, etc. The gray tokens should be placed in the center gray square.
- The round will proceed for a maximum of 4 minutes. The round will end early if the robot is touched or a team member tells the judge that they are finished. The round will also end if all tokens have been placed and the robot stops in one of the two white squares. If any token or the robot touches the floor outside of the board, the round ends immediately.
- At the end of the round, every token correctly placed in its corresponding color square will score +1 points each.
- Tokens placed in the wrong colored square, e.g. a yellow marker in the blue square, will score 0 points each
- Tokens still in their depressions at the end of the round will score 0 points each
- Tokens at any other location on the board will score 0 points each
- If any token or the robot touches the floor outside of the board, the round ends immediately and the total round score is 0.
- If the robot finishes its round by returning to one of the two white squares and stopping of its own accord, a bonus of +1 points will be awarded.
- If, at the end of the tiebreaker, the score is still tied, the robot which completed the tiebreaker round in the shortest time will be declared the winner.

Robot Specifications and Rules

- The robots built for this competition are intended to be fully autonomous during gameplay. No communications to/from the robots are allowed during gameplay except for the start and stop buttons.
- The robot must be no larger than 11” wide x 11” long x 11” tall at any time on the playing field. This means that the robot should fit within the white start/stop square without overlapping the black lines. Robots must remain in one contiguous piece and may not split into multiple, smaller units. Judgement on whether or not a robot qualifies for size is at the sole discretion of the head judge.
- The robot may weigh no more than 40 pounds. Judgement on whether or not a robot qualifies for weight is at the sole discretion of the head judge.
- Chemicals or explosives – Explosives and volatile liquids are not permitted. Thus, gasoline engines are not permitted. Chemical batteries are allowed but only if used correctly and with appropriate safety and handling. Any robot deemed hazardous by the head judge may be disqualified.
- For this competition, robots are to move along the surface of the playing field. Wheeled, tracked, or legged robots are all valid. Flying robots, e.g. drones, are not allowed.
- The robot must have a Red “STOP” button and Green “GO” button easily accessible on the uppermost horizontal surface of the robot. Each button will be labeled STOP or GO using Arial Font, Regular Style, Size 20 or larger.
- At the beginning of the round, the robot should not move until the “GO” button is pressed. After the “GO” button is pressed, the robot should be completely autonomous.
- At any time that the “STOP” button is pressed, the robot should cease all movement immediately. Failure to stop when the “STOP” button is pressed is considered a safety hazard and may result in disqualification of the robot.
- A bill of materials (BOM) will need to be included with the robot along with documentation on the robot in regards to the purpose of each sub-system, why each major component was selected (ie type of processor, size of battery, etc), a copy of the code, and a section that address safety issues and concerns that were encountered during the build process. Each team must send their documentation in by March 31, 2018. The paper will not count for points, but teams failing to provide documentation will be disqualified. The paper must be typed, handwritten submissions will not be allowed.

Appendix – Materials List

4’ x 8’ x ½” plywood – 2 sheets

1” diameter by 1/16” thickness “tokens” – steel – magnetic – total of 24

White paint

Black paint

Gray paint

Red paint

Green paint

Blue paint

Cyan paint

Magenta paint

Yellow paint