Vision Centric Challenge 2018

FiCO: Find & Count Objects

A Robofest® (www.robofest.net) Challenge for Pre-college and College Students
Lawrence Technological University, Southfield, Michigan

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Computer vision gives robots the ability to see. In order to learn and promote research & development of computer vision and autonomous mobile robotics, we challenge college and talented high school students with the following vision-based robot competitions during the Robofest® 2018 season.

1. Team Age Divisions

- Senior (Advanced High School): maximum **3** members per team
- College: maximum **2** members per team

2. Challenge Synopsis

A maze is constructed by using an unknown number of dark color floor mats. An unknown number of objects are placed outside maze as shown in Figures 1~3. The robot is shown a target object by a human player at the beginning of a run. There is an unique ending object unveiled 30 minutes before the official runs. The robot is supposed to visit all the objects, stop (on the mat) in front of the ending object and display the number of target objects after spinning around 360 degrees. If there is no target object, -1 should be displayed.

As an example using Figure 1, if the ending object is a pink color paper and the target object is a letter size yellow paper, the robot must display 2 at the pink paper, since there are two yellow letter size papers around the mats.

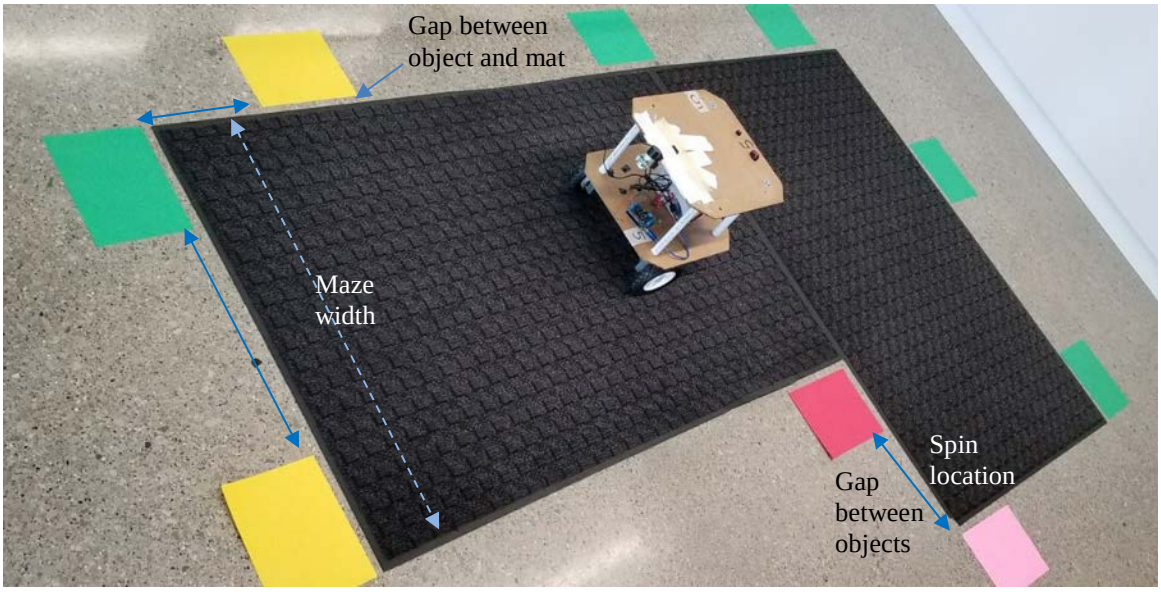

Figure 1. Letter size color papers as objects (for High School Sr. teams)

3. More Examples

As an example using shapes in Figure 2, if the ending object is a white circle shape and the target object is a white square (not rectangles), the robot must display 2 at the circle, since there are two identical square shapes. Each shape is cut from a letter size unknown color paper. The size (area) of the shape will be at least 30% of the letter size paper.

Figure 2. Different shapes (circle, triangle, square, and rectangle) as objects

As another example, using real-word objects in Figure 3, if the ending object is a hammer and the target object is a blue plastic cup, the robot must display 1 at the hammer, since there is a blue cup.

Figure 3. Real-world objects

As another example using Figure 3, if the ending object is a hammer and the target object is a soccer ball, the robot must display -1 at the hammer location, since there is no soccer ball. The minimum length of a real-world object is 8 cm.

4. Difference between Age Divisions

- Senior (Advanced High School): Only letter size color papers will be used.
- College: any objects such as “letter size color papers as in Figure 1”, “paper shapes as in Figure 2”, and/or “real-world objects as in Figure 3” can be used. Note that “same object” means same size and color. For example, blue cup and red cups are different objects even if the sizes are the same. Some shapes may be changing. For example, the angles of two scissors will be different, but they are considered to be the same object.

5. Unveiling Items and Procedures

- After check-in and before starting a round: the floor, floor color, mat, mat size, mat color, *some* sample objects used, and lighting condition are unveiled.
- There will be 3 rounds. Before starting each round, there will be 30 min work-time. The Judge will unveil the following items for each age division just before the work-time:
  - all the objects used
  - an ending object
  - a target object (target object cannot be the ending object)
  - starting location and orientation
- After impounding all the robots, the maze will be setup. Exact location & orientation of each object will be unveiled.

6. Course Setup Instruction

- Maze width: at least 4ft. (see Figure 1)
- Color of the floor mat is dark. Website links of sample mats will be posted later on this document.
- Letter size color papers used **as samples**: www.officedepot.com/a/products/170719/Neenah-Astrobrights-Bright-Color-Paper-8
- Location & orientation of objects: unveiled after impounding
- The gap between an object and mat is between 1 and 3 inches. (see Figure 1)
- The gap between edges of two neighboring objects is at least a foot. (see Figure 1)
- The maximum size of the object is 11 x 11 x 11 inches. (See Figure 3)
- Will paper objects be taped on the floor? Possibly, but it does not matter since robots are not supposed to touch objects.
- ~~Start the robot at the root node with any orientation the team wants~~ (removed on April 3)
- Lighting conditions on the course are unknown and possibly dynamic.

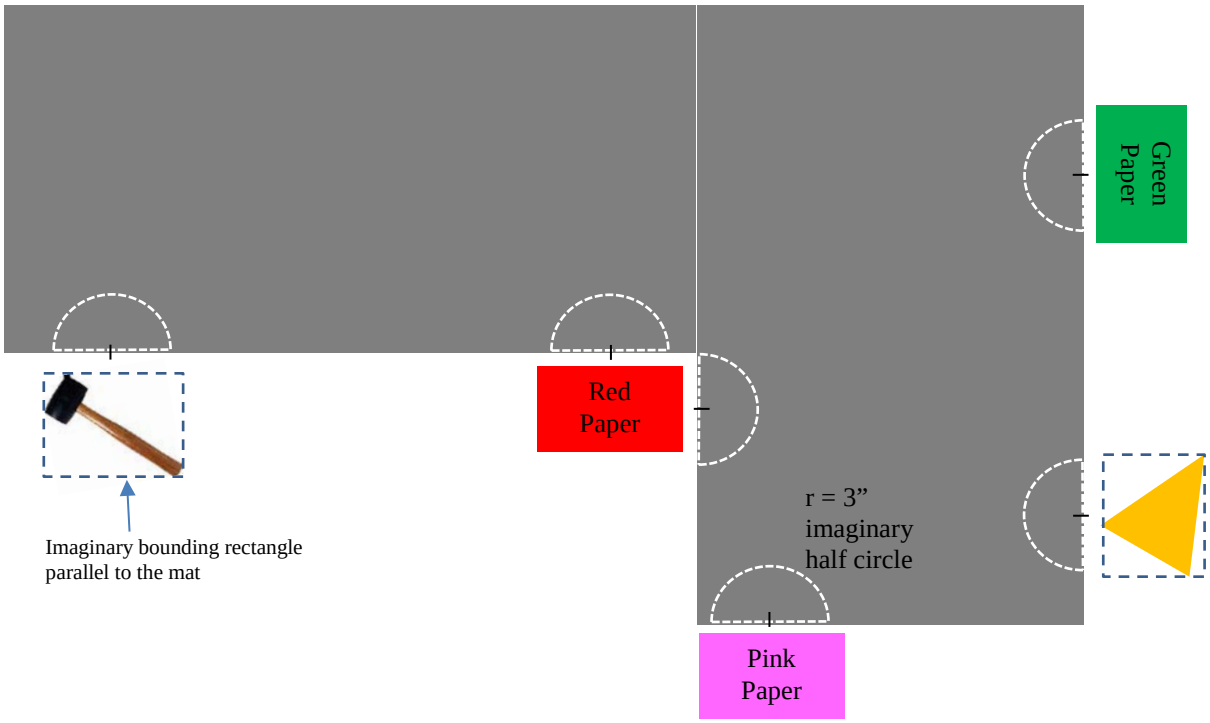

Figure 4. How to determine stop locations for various objects and locations

7. Competition Rules

- Each team will run 3 rounds.
- For each round there will be at least 30 min. allotted as work-time after unveiling the items described in Section 3.
- All robots will be impounded (quarantined) before starting each “round”.

- After all the robots are impounded, the real competition field (maze) will be setup: See section 3 above.
- For each round, each robot has a maximum of **2** minutes to complete the mission.
- The Judge will start the robot program at the starting location. Teams are NOT allowed to touch the robot after impounding. The team must provide verbal or written instruction to the Judge indicating how to start the robot. Note that Judges will not calibrate the vision system. Robots must be calibrated before impounding or have a means of dynamic calibration.
- *When the robot is completely ready to move when the target object is detected*, a team member is supposed to show the target object to the robot after the program is started by a Judge. The team member should ***not* touch the robot at all**.
- Violations that will terminate the run include:
    - Team players touch of the robot
    - Robot moves before seeing the target object
    - Robot is completely out of the maze
    - Robot touches the object outside the maze
    - Illegal signal to the robot
- To complete a successful round, the robot must spin about 360 degrees at the ending objecct and then display a correct number to the Judge. When the robot stops after spinning, any part of the robot must be on the radius ~~3"~~ **6"** half circle centered at the target object as shown in Figure 4.
- The winner will be decided by the number of successful rounds. The first tie breaker is the total number of objects visited for 3 rounds. A valid object visit is declared when any part of the robot **touches or passes over** the imaginary half circle. 2nd tie breaker is to rerun with more difficult objects until a winner is decided. New objects and/or new lighting condition can be introduced for the rerun and just 5 min preparation time will be given.

8. Robot Requirements

- Must be completely autonomous. (No remote control by human driver or remote computer is allowed). Main controller can be a laptop, notebook, tablet, Raspberry PI, or even a smart phone.
- Any robot platform with up to 2 cameras is allowed. No other external sensors are allowed. Internal encoders for motors are permitted.
- Any programming language may be used.
- Width must be less than 2ft.
- Length: less than 3ft
- Height (including camera): maximum 2ft
- Weight: no limit
- The robot may *not* automatically expand its dimension larger than the specified max values.
- Camera angle: no restriction. You may use motors to move the camera. Wide angle lens can be used.

9. Prize: Winners receive trophies. Each high school team member of the winning team may receive $2,000 LTU renewable scholarship. Monetary prizes for college students - 1st place: $200, 2nd place: $100, 3rd place: $50

10. Competition Dates

- World Championship at LTU in Michigan
    - Saturday, May 19, 2018, 8:00am ~ 4:30pm
    - Practice field will be setup on May 18, 2018, in the afternoon. Exact time: TBD
- Other locations/dates: To be announced at www.robofest.net

11. Miscellaneous Information

- Go to https://www.robofest.net/index.php/current-competitions/vision-centric-challenge for more info and possible rule updates
- Questions regarding rules, registration, or L2Bot lease: Contact Prof. Chung at cchung@LTU.edu
- The event is open to the public. Admission is free. Parking is free.