IRHOCS 2015 Robot Challenge: Robot Bowling

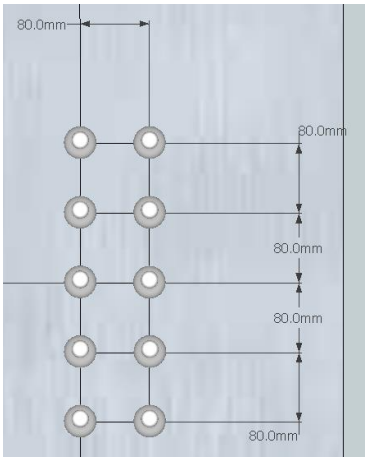
Updated: 2015/6/10

The robot must start in the base, pick up a bowling ball (red snooker ball) from the ball rack, and roll the ball down the lane with the objective of scoring points by knocking down as many pins as possible.

Major changes in the IRHOC S2015 robot bowling challenge

- The numbers of games and rounds of preliminary change to 2 rounds, 2 games each, final change to 1 round 3 games.

  The setup of bowling pins will be change as shown in the Figure below which during the second round of preliminary round and the second game of final round. There will be one green bonus pin in the five bowling pins near the start area which give extra bonus points after knock down, the setup position of green pin of each game will be decide after the preparation time.



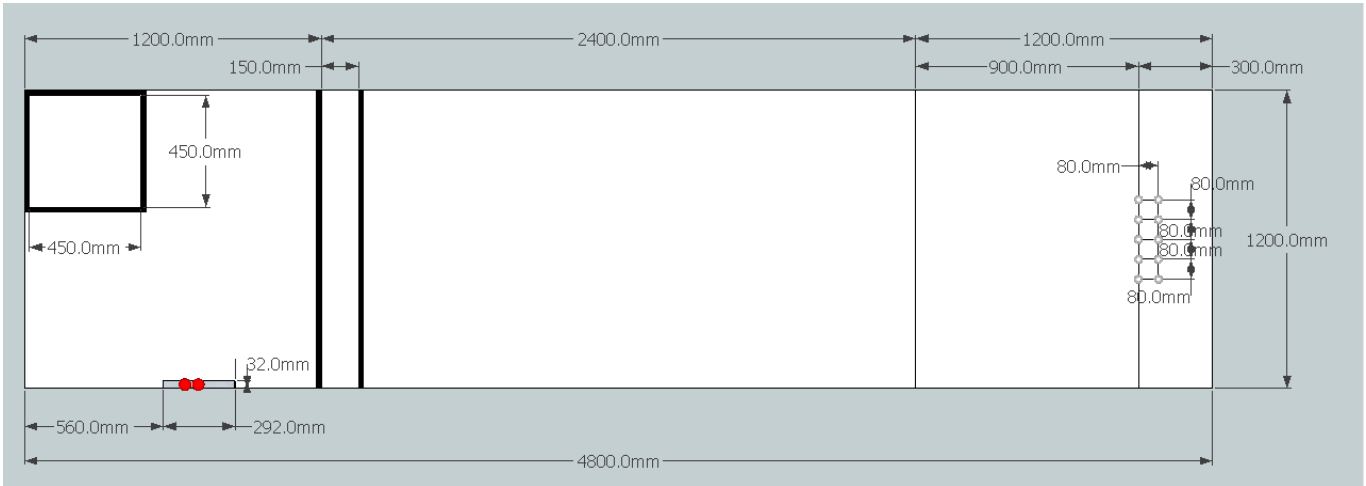


Figure 1 Competition area setting for second game of preliminary and final round（±5 mm）

Explanation of bowling competition area:

1. The lanes will have dimensions of 4800 mm × 1200 mm (see Fig. 1). The lane surface will have a natural wood finish, and black electrical tape will be used to mark lines (lines will be approximately 20 mm in width; dimensions below are the same). The lanes may consist of several boards fitted together, without any side walls. The contestants must overcome the effect of any possible irregularities, and ensure that their robots do not fall over on the lanes during the competition.

2. A 450 mm × 450 mm (solid interior) square area in the upper left marked out using black electrical tape will serve as a base for the robots.
3. During the entire competition, the robots must not leave the 450 mm × 450 mm × 450 mm area. If the robot cannot be placed in the wooden boxes prepared by the organizer, it will not be possible for the robot to take part in the competition nor will it be possible to calculate the robot's score.
4. A ball release area 150 mm in width will be located in the center of the lane. The right and left sides of this area will be marked using black electrical tape, and the foul line will be on the right.
5. The balls will be placed on a ball rack with a length of 292 mm, width of 32 mm, and height of 32 mm The ball rack will be assembled from Matrix parts. (See Figures 2), and will be attached to the floor using foam tape with a thickness of 1 mm.
6. The bowling balls will consist of standard red snooker balls, and will have a diameter of approximately 57 mm (see Fig. 3).
7. During the first game of preliminary rounds and final round, the pin area will hold 10 white wooden bowling pins with two red stripes (see Fig. 4); During the second game of preliminary rounds and final round, the pin area will hold 9 green wooden bowling pins with two red stripes and change the setting (see Fig 1); The third game of final round is creative challenge games, an extra three identical bowling pins will be placed at the marked obstacle pin locations 900 mm in front of the ball rack, while employing the same pins and spacing. The remainder of the setup will be entirely the same as in first game of preliminary rounds (see Fig 5).

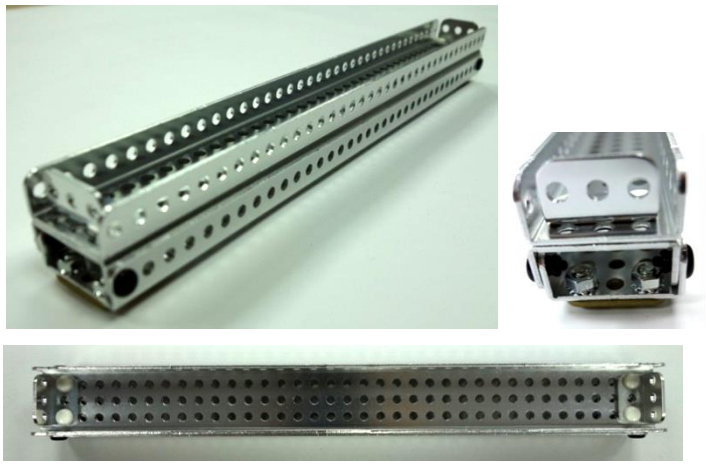


Figure 2 Ball rack

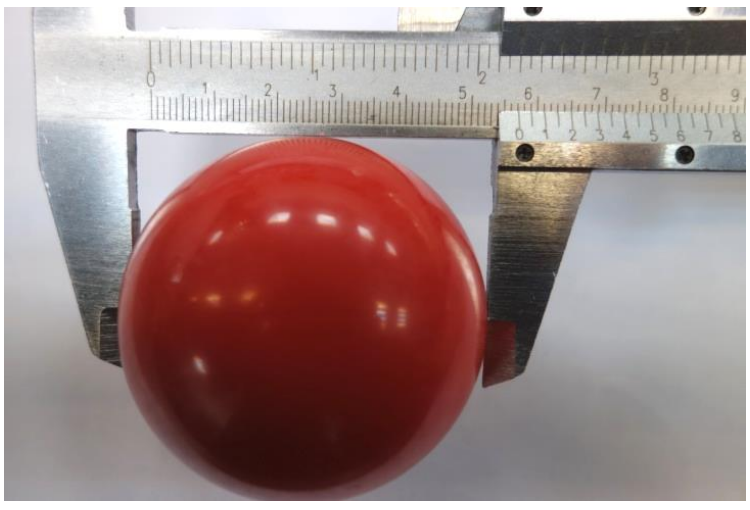
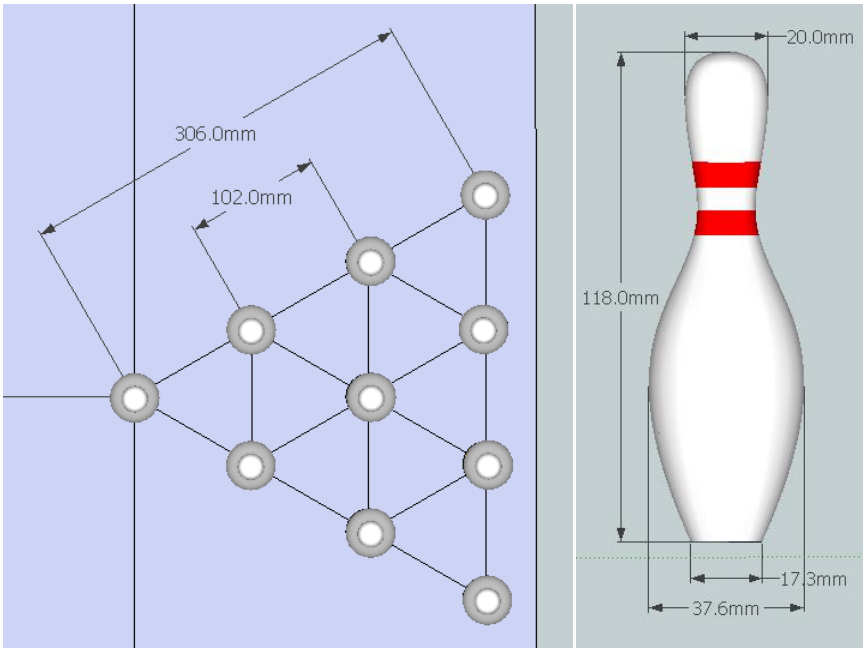


Figure 3 Bowling ball – standard red snooker ball



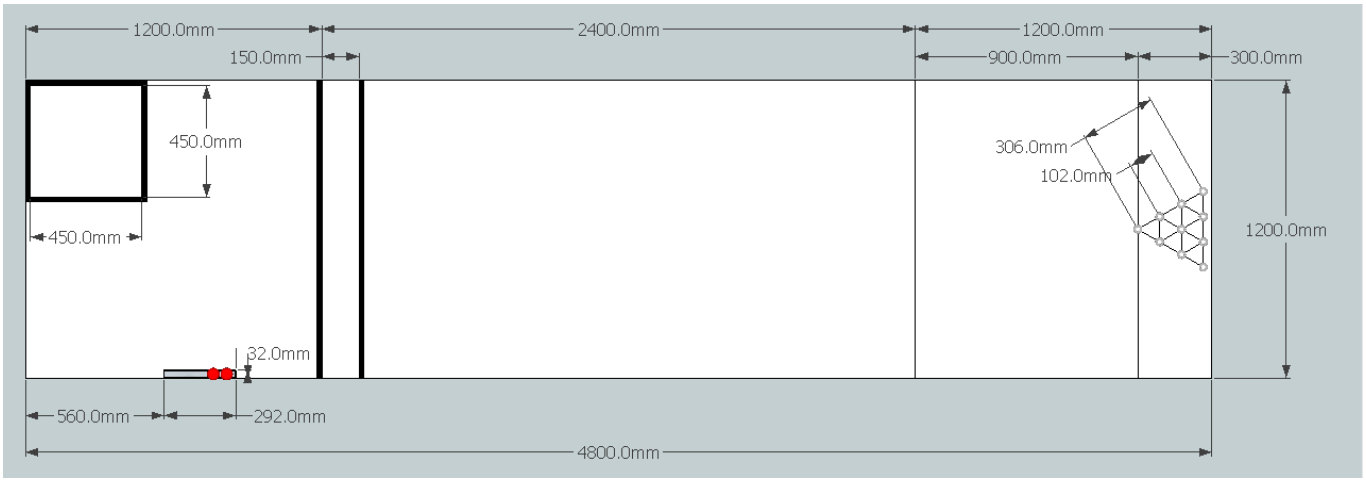


Figure 4 Competition area setting for first game of preliminary and final round （±3 mm）

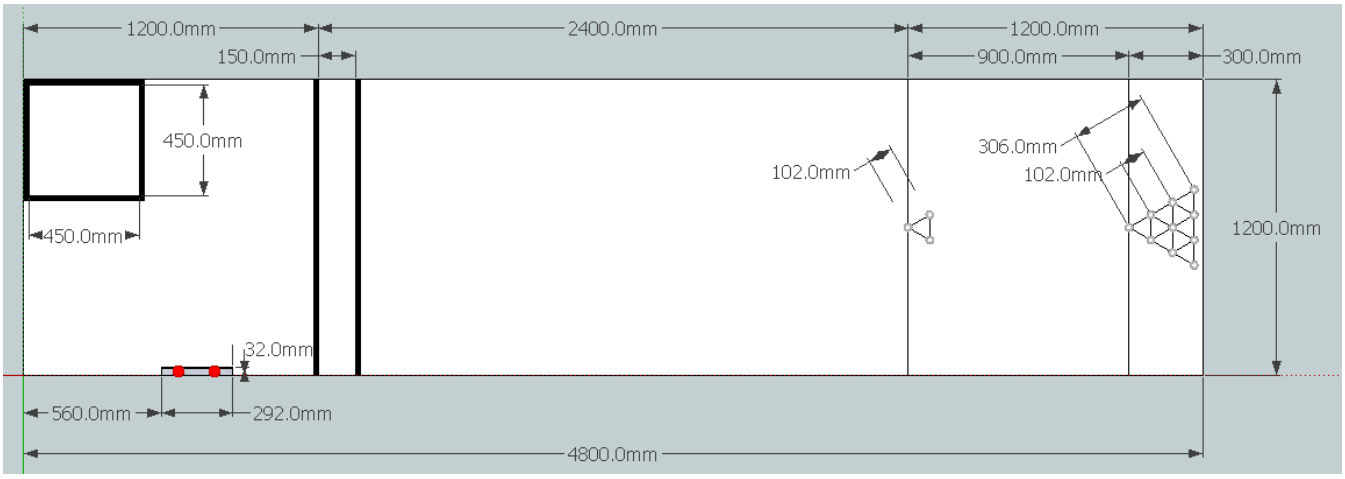


Figure 5 Competition area setting for third game of final round （±3 mm）

Explanation of bowling competition procedures and rules:

1. The organizer will perform uniform timing throughout the competition, which will consist of two preliminary rounds (each round will consist of two games), and one final round (consisting of three games).
2. On the day of the competition, there will have a practice time before the start of the first round. The contestants may use this time to perform practice in their places, or may queue with their robots to have one practice game, or may take measurements in the competition site in so far as this does not interfere with other teams' practice.
3. All robots must be placed on the reviewing table for preparatory review after the end of the preparation period. No mechanisms or programs may be modified after this time.
4. Robots may take part in the competition only after they have passed review by the judges.
5. Preparation time before the first game may not exceed 60 seconds, and, once started, individual games may not exceed 180 seconds. After all robots have completed the first round, the robots will be taken back to the reviewing table, and the next team will compete. After all teams have completed the first round, there will be 20 minutes of preparation time, the robots will be reviewed again, and the second round will then begin.
6. The time limit of final game of each round is 240 seconds.
7. The organizer will uniformly signal the start of competition as follows: "Three, two, one, begin," after which bowling may start. The contestants may not touch their computers or the robots after the robots have started moving, and doing so will cause the game to be stopped.
8. After the competition begins, the robots must autonomously leave their base, move to the ball rack, and pick up a ball. Robots will receive 6 points if they successfully pick up a ball each time
9. A ball release area with a width of 15 cm is located at the center of each lane. The ball must be released before the foul line on the right, and the projection of any part on a robot may not touch the foul line, otherwise the robot will receive zero points for that game.
10. The number of points given for knocking over pins shall be calculated according to the ordinary rules of bowling. Each lane will have marks for the central locations of the bowling pins (the mark will consist of a decal approximately 10 mm in diameter). A pin that has been moved sufficiently to completely expose its central location will be considered fallen; pins that have not fallen and scoring pins will be left for the next roll of the ball.
11. After a robot rolls a ball, there will be a pause of at least 10 sec. before the next roll to allow the assistant judge to reposition the pins or clear away the fallen pins. If a robot begins sighting or rolling the ball too early, the contestants must take the risk that the pins will not have been fully prepared.
12. Unless the first ball gets a strike, in the first game of the preliminary rounds (first two games of the final round), the robot will have two more chances to roll the ball. Even when there are two balls in the rack, the robot can only take one ball at a time. If the robot scores a strike or a spare during the final game of either the preliminary or final round, it will be able to roll a third ball. In this case, the ball used by the robot as its third ball will be placed randomly on the ball rack.
13. If the robot rolls all its balls and returns to its base (its orthographic projection has reached the base) before the time for each game is up, it will receive 3 points each time, and it will receive an additional 2 points if its orthographic projection is completely within the base.
14. During each game, the robot must autonomously complete the actions of picking up a ball, rolling the ball, picking up another ball, and again rolling the ball. The contestants may however adjust the robots' programs or mechanisms during the preparation time between games.
15. The contestants may not use any props to help the robots to recognize the red balls or white pins with two red stripes, and may not wear red or white clothing in an effort to influence the competition.

Explanation of bowling competition scoring and determination of rank:

1. Preliminary rounds: Just as in ordinary bowling, scores will be calculated on the basis of number of pins knocked down in all two games (see appendix for details).
2. Final round: Just as in ordinary bowling, scores will be calculated on the basis of number of pins knocked down in the first two games in this round (see appendix for details). In the third games, while the number of points will be calculated according to the ordinary rules of bowling, after the conclusion of each game, 5 points will be subtracted for each obstacle pin knocked down, to a minimum of 0 points for that game.

Total score for preliminary rounds (two rounds, with two games in each round)

1. Ball pick-up score for 2 games (max 12 points) + total pins knocked over (max 60 points) + return points for 2 games (max 10 points) = 82 points.
2. After the end of competition, the robot whose best score from either of the two rounds is the highest will be the winner. If two or more robots have the same score, then the robot with the best score in its second-best round will be the winner. If two or more robots have the same scores in their second-best rounds, then the robot with the best total score from pins knocked over will be the winner. If two or more robots are still tied, then the robot with the largest number of spares in the first three games will be the winner. And if two or more robots are still tied, then the robot with the greatest number of pins knocked over and number of spares in its second-best round will be the winner.

Total score for final round (one round with three games)

1. Ball pick-up score for 3 games (max 18 points) + total pins knocked over (max 90 points) + return points for 3 games (max 15 points) + number of obstacle pins not knocked over in the 3rd games (0 points subtracted for each) = 123 points.
2. After the end of competition, the robot whose score is highest will be the winner. If two or more robots have the same score, then the robot with the best score from knocking over pins will be the winner. Any remaining ties will be decided by the number of spares in the first three games, and finally by the number of pins knocked over and number of spares.

Appendix:

In normal bowling, each bowler will have a maximum of two opportunities to roll a ball in each frame. If a bowler knocks over all the pins with the first ball, a strike (X) is marked in that frame, concluding the frame; If a bowler does not knock over all the pins with the first ball, that bowler may roll a second ball. If the bowler's second ball knocks over all the remaining pins, a spare (/) is marked in that frame. If a bowler gets a strike, then the score in that frame will be 10 points for the 10 pins knocked over plus the number of pins knocked over the next two times that bowler rolls the ball. If a bowler gets a spare, then the score in that frame will be 10 points for the 10 pins knocked over plus the number of pins knocked down the next time the bowler rolls the ball. As a result, if a bowler gets a strike or spare in the final frame of a game, that bowler will be able to roll a ball again in order to determine the score in that final frame. In other words, bowlers may roll the ball up to three times in the final frame.