



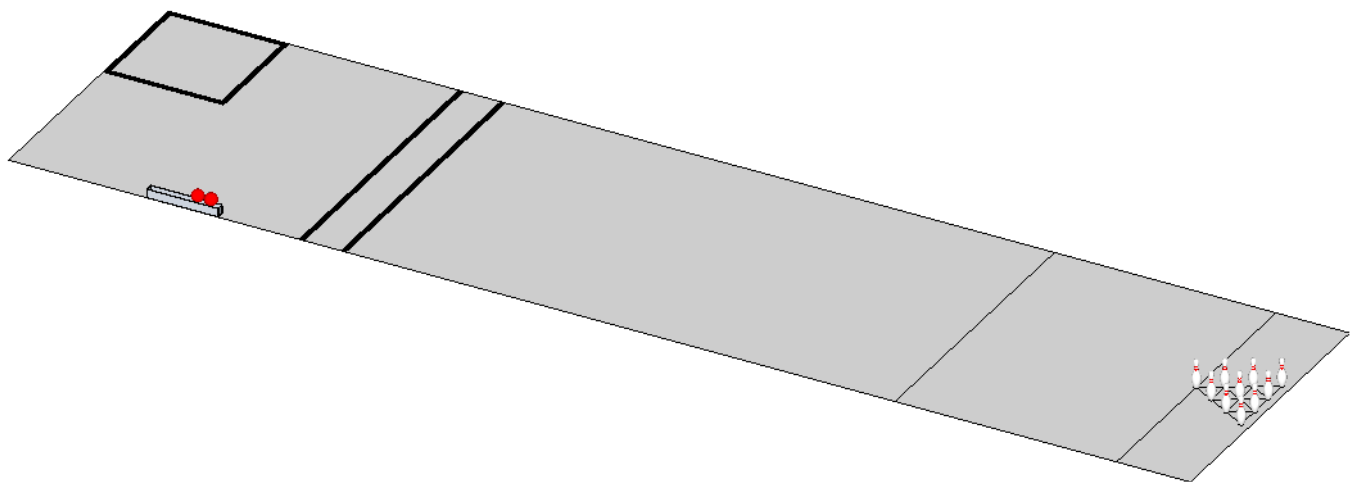
WRO University Regular Category
“WRO Bowling”
Game rules

1. Game Description

The name of this year's university regular category is "WRO Bowling".

This year's theme encourages students to build robots that can really "see" where the target is and precisely aim to the target.

The WRO University Regular category challenges you to build a robot that is tasked with picking 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.



2. Rules & Regulations

2.1. Preliminary round 1: The first preliminary round has three games and just as in ordinary bowling, bowling pins are placed as illustrated in figure 1.

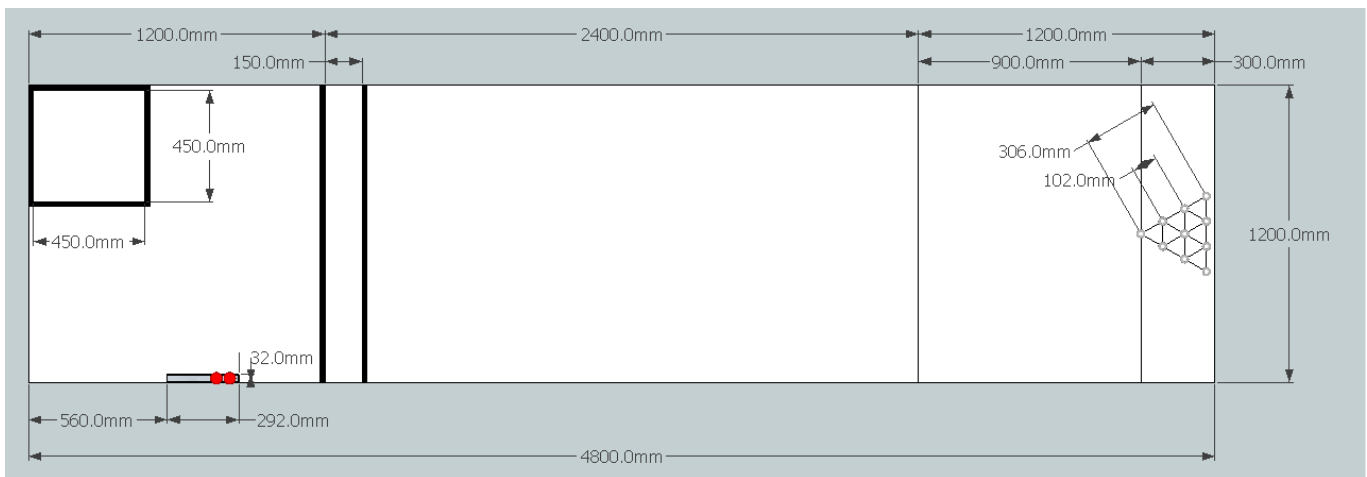
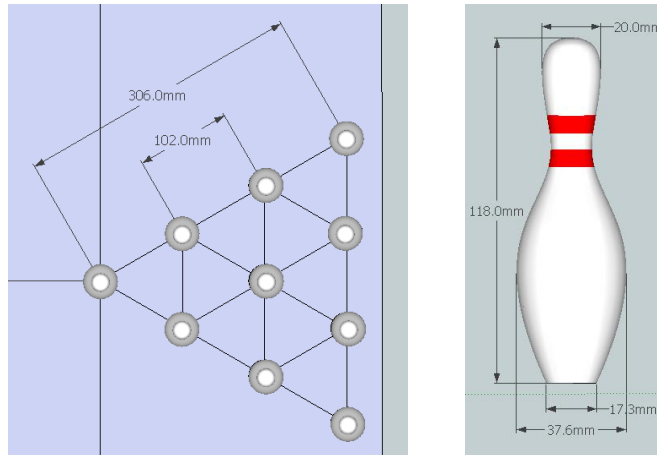


Figure 1 Layout of lane and pins in preliminary round 1

2.2. Preliminary round 2: The second preliminary round has three games and the bowling pins are placed as illustrated in figure 2. A green bowling pin will be placed randomly in the front row. The position of the green bowling pin will be determined after “Practice Time of the second preliminary round”. By knocking down the green pin, extra points will be added.

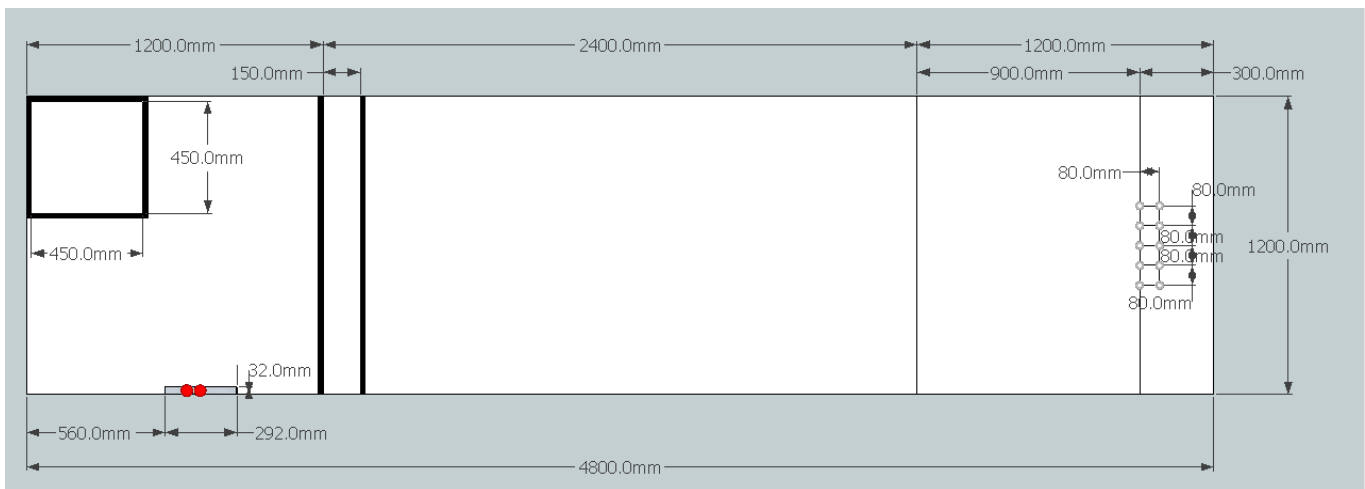
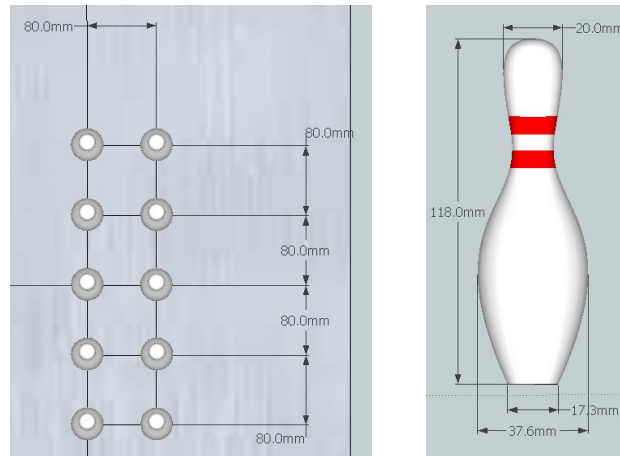


Figure 2 Layout of lane and pins in preliminary round 2

Preliminaries Rounds			
	First game	Second game	Third game
First Round	Figure 1	Figure 1	Figure 1
Second Round	Figure 2	Figure 2	Figure 2

Overview of positioning of pins for the two preliminary rounds

2.3. Final round: There are five games in the final round. In the first and second games, bowling pins placed as illustrated in figure 1. In the third and fourth games, bowling pins are placed as illustrated in figure 2. In the fifth game, **an extra three identical bowling pins will be placed at the marked obstacle pin locations 900 mm in front of the 10 pins**, 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.(figure 3)

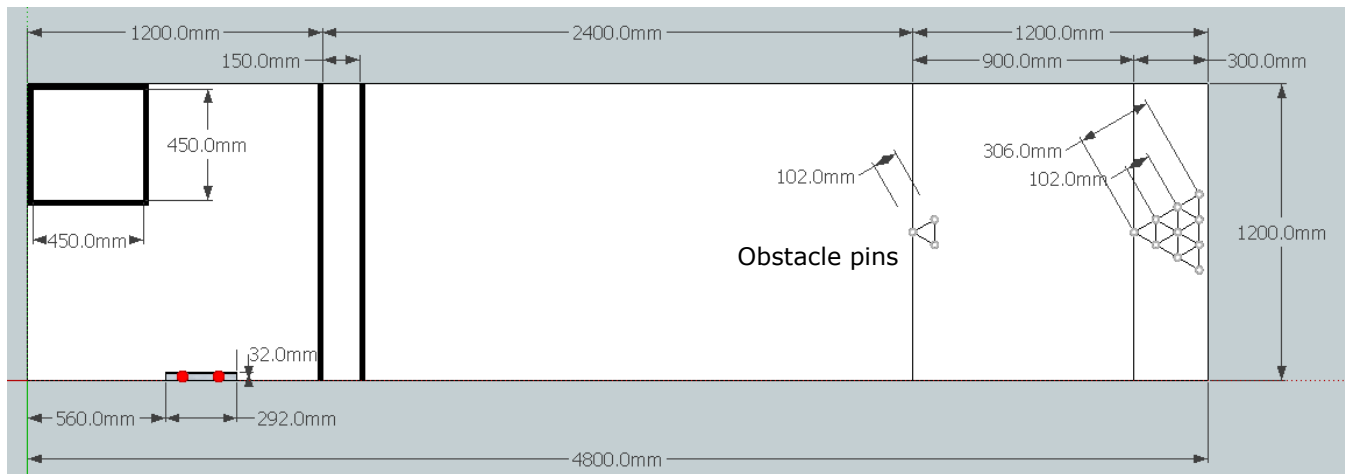


Figure 3 Layout of lane and pins in final game 5 (± 5 mm)

Final Round					
	First game	Second game	Third game	Fourth game	Fifth game
Round	Figure 1	Figure 1	Figure 2	Figure 2	Figure 3

Overview of positioning of pins for the final round

- 2.4. The organizer will perform uniform timing throughout the competition, which will consist of two preliminary rounds (each round will consist of three games), and one final round (consisting of five games).
- 2.5. **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 game.**
- 2.6. 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 (i.e., Does not include back to base and take the ball scores).
- 2.7. 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 bowling pins or clear away the fallen bowling pins. If a robot begins sighting or rolling the ball too early, the contestants must take the risk that the bowling pins will not have been fully prepared.
- 2.8. **The assistant judge will rearrange the bowling pins if the robot knocks a strike or spare in the last game.**
- 2.9. 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.
- 2.10. **Black lines are also considered part of the base.**
- 2.11. **The bowling pins will be scored which has been knocked down, if robot rolls ball before the time for each game is up.**
- 2.12. **The ball must roll forward at a speed of 2m/s or less**
- 2.13. **The bowling pins will be scored which has been knocked down, but the robot must use the standard red snooker ball by the organizer.**
- 2.14. **Robot will not score for knocking down pins if robot carries over one ball at any time. .**
- 2.15. **During each game, the robot must perform tasks autonomously.**

3. Scoring

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

- 3.1. Ball pick-up score for 3 games (max 18 points) + total bowling pins knocked over (max 90 points) + return points for 3 games (max 15 points) + green bowling pins for 3 games(max 15 points) = 138 points.
- 3.2. The robot who has the highest score in the total score will be the winner. If two or more robots have the same score, the highest score of bowling pins knocked will be the winner. And if two or more robots are still tied, the robot with the highest score of strike will be the winner. **And if two or more robots are still tied, the robot with the shortest time will be the winner.**

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

- 3.3. Ball pick-up score for 5 games (max 30 points) + total bowling pins knocked over (max 150 points) + return points for 5 games (max 25 points) + green bowling pins for 3 games(max 15 points)+ number of obstacle bowling pins not knocked over in the fifth games (0 points subtracted for each) = 220 points. The robot who has the highest score in the total score will be the winner. If two or more robots have the same score, the highest score of bowling pins knocked will be the winner. And if two or more robots are still tied, the robot with the highest score of strike will be the winner. **And if two or more robots are still tied, the robot with the shortest time will be the winner.**

Appendix:

- 3.4. In normal bowling, each bowler will have a maximum of two opportunities to roll a ball in each frame.
- 3.5. If a bowler knocks over all the bowling 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 bowling pins with the first ball, that bowler may roll a second ball.
- 3.6. If the bowler's second ball knocks over all the remaining bowling pins, a spare (/) is marked in that frame.
- 3.7. If a bowler gets a strike, then the score in that frame will be 10 points for the 10 bowling pins knocked over plus the number of bowling pins knocked over the next two times that bowler rolls the ball.
- 3.8. If a bowler gets a spare, then the score in that frame will be 10 points for the 10 bowling pins knocked over plus the number of bowling pins knocked down the next time the bowler rolls the ball.
- 3.9. 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.

	7	/		4	2	X		☑
14			20					

	7	/		4	2		/	☑
14			20					

4. Lane Specification

- 4.1. The dimension of lane is 4800 mm × 1200 mm , equivalent to 6 WRO tables with official WRO dimensions (figure 1). Black electrical tape will be used to mark lines (lines will be approximately 20 mm in width; dimensions below are the same).
- 4.2. 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.
- 4.3. The maximum dimension of the robot before it starts must not be more than 450 mm × 450 mm × 450 mm . 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.
- 4.4. 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.
- 4.5. The balls will be placed randomly 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 or Tetrax parts (figure 4).
- 4.6. The bowling balls will consist of standard red snooker balls, and will have a diameter of approximately 57 mm (figure 5).
- 4.7. During standard rounds, the pin area will hold 10 white wooden bowling pins with two red stripes (figure 6); in the fifth game of the final round, an extra three identical bowling pins will be placed at the marked obstacle pin locations 909 mm in front of the ball rack, while employing the same bowling pins and spacing. The remainder of the setup will be entirely the same as in standard rounds.

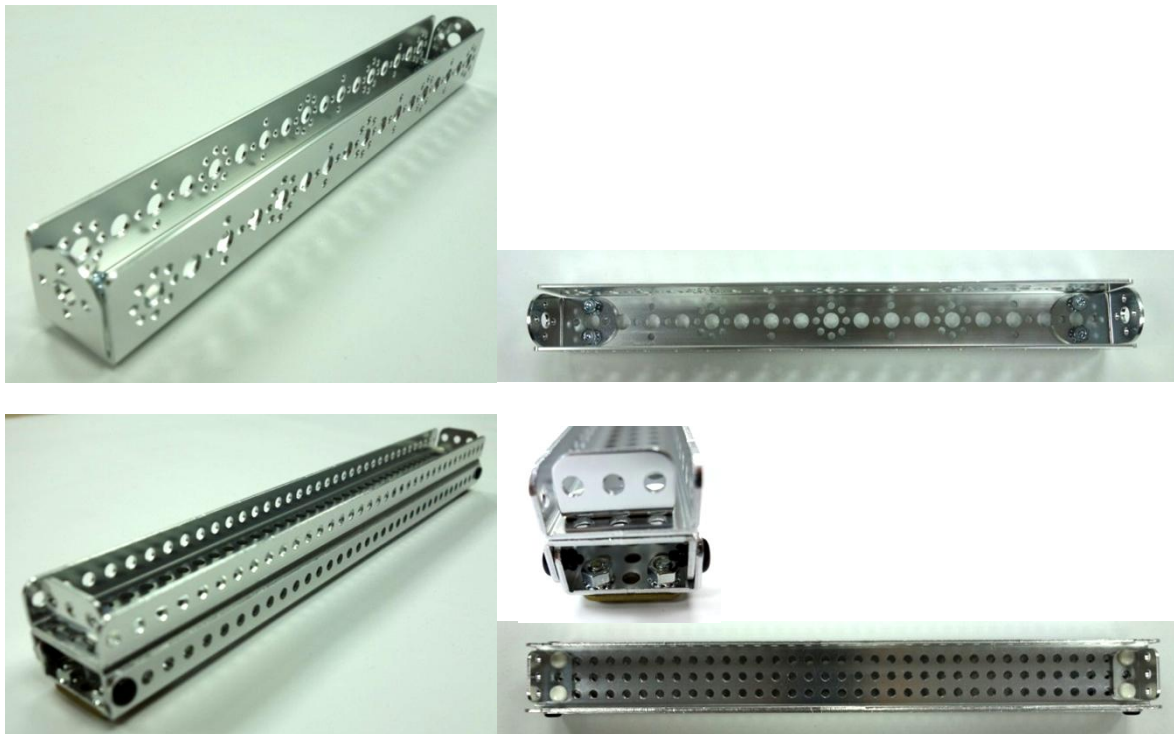


Figure 4 Ball rack using Tetrax or Matrix

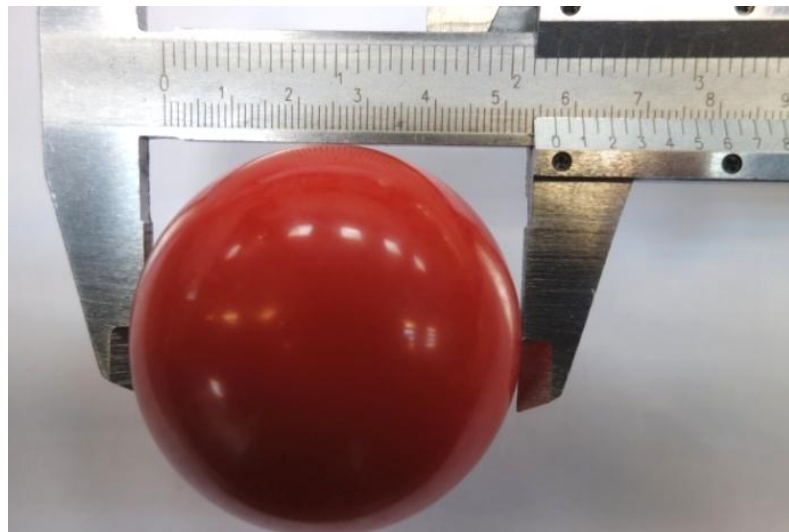


Figure 5 Bowling ball – standard red snooker ball

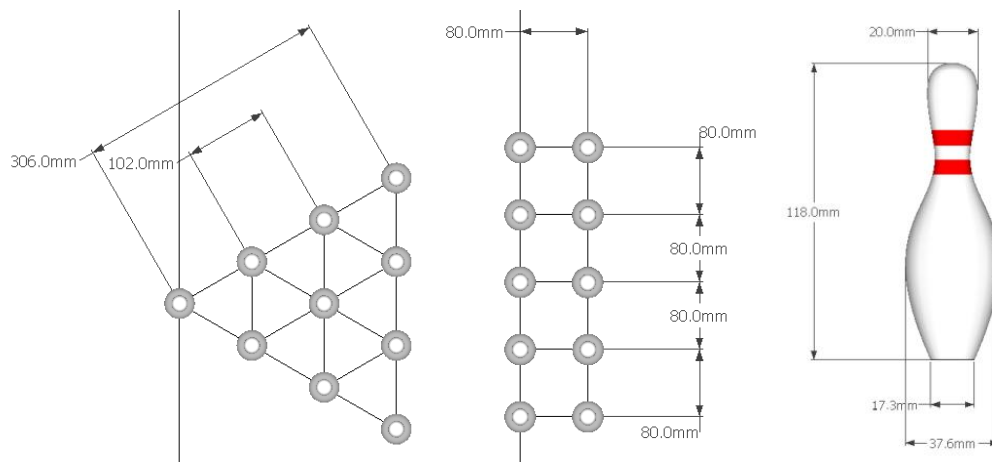


Figure 6 Specifications of wooden bowling pins (± 3 mm)