RoboBowl – Robofest 2015 Game

1-15-2015 Official verison V1.0 (minor changes after 1-15-2015 in red on page 6)

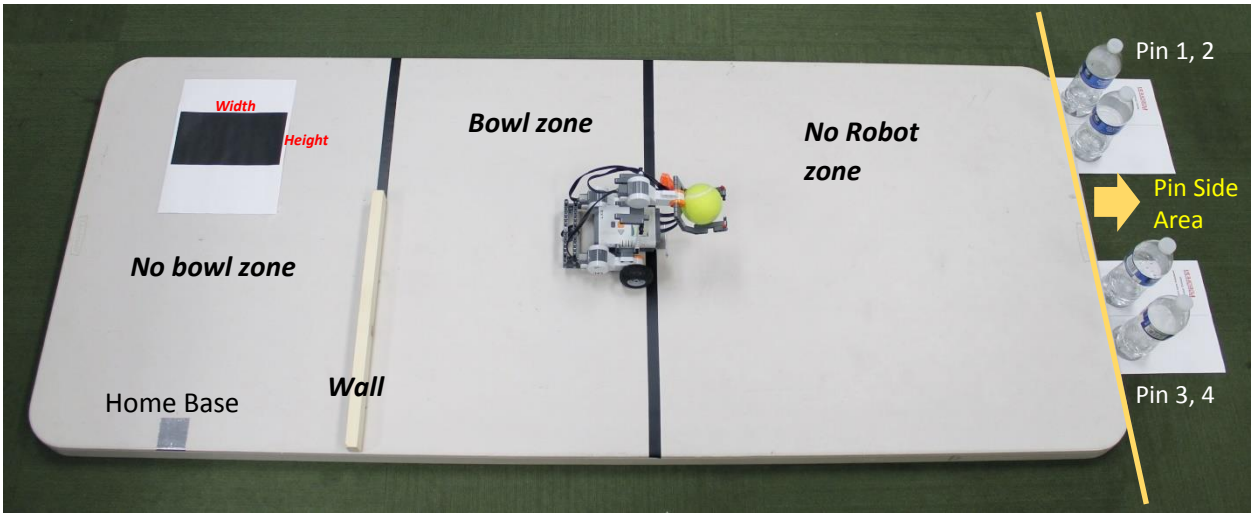

Figure 1 – RoboBowl Playing Field (Sr. Division pins)

Game Synopsis

The robot is to bowl, throw, shoot, or kick a tennis ball to knock down four pins (500 ml water bottles). If pins are knocked down, the highest point value will be awarded. If the ball just moves pins (not knocked down) partial points will be awarded. If the ball ends up in the Pin Side Area, some points are also given. In addition, the robot is required to report the height of the black rectangle shape on a letter size paper in millimeters. The location of Pins 1 and 2 will be unveiled. The location of Pins 3 and 4 is based on the rectangle height measurement.

Rules

1. 7 standard tennis balls (modification not allowed) & 2 minutes are given per game round
2. The robot can carry (play) only one ball at a time.
3. Once the ball is released from the robot, it cannot be (re-)moved by anyone.
4. The ball is manually loaded by a human player only when the robot is at Home Base.
5. Players may touch / modify the robot when it is on or over the Home Base
6. The robot cannot *physically touch* the “No Robot” zone, table surface to the right of the center black line as shown in Figure 1. Part of the robot may hover above the “No Robot” zone, as long as it does not touch the table surface.
7. Robot can bowl the ball as long as rule number 5 above is not violated. If the ball is released when any part of the robot touches the “No Robot” zone, it is a violation. See Violations section below.
8. For each violation, a ball is removed (dead). See *Violations section* below.
9. Robot must return to Home Base after each bowl, to get the next ball.
10. The robot is required to display the height x of the black rectangle printed on the letter size paper in millimeters on LCD panel ***after*** the game is over. See Figures 2 and 6.

Violations

If any of the following violation occurs, one ball is removed & marked as dead. Judge will order to grab the robot immediately to restart at the Home Base. The clock does NOT stop.

1. Human contact with the official playing field materials, other than balls at Home Base
2. Human contact with the robot at any point on table other than Home Base
3. Robot falls off the table (Any part of the robot is touching the floor)
4. If any part of the robot touches the "No Robot" zone. The black tape itself is not regarded as No robot Zone.
5. The ball was released when any part of the robot was touching the "No Bowl Zone", near Home Base. The black tape itself is not regarded as No Bowl Zone.
6. Any attempt to knock down pins other than bowling the tennis ball. For example, air.

Playing Field Setup

The playing field is a 30"x72" (actual size is 75.6 x 182.3cm) plastic folding table that can be purchased at discount stores like Lowes, Kmart, or Sam's Club. Recommended brand is "LifeTime". The surface is light in color such as almond; however, the exact color, brightness, and edge shape are unknown until the competition day. The four corners of the table are rounded. The thickness of the table is about 4.5cm. The table is placed on a dark colored floor. Figure 2 is a drawing of the playing field features with dimensions shown in table 1. The 2" tall wall is made of a 1"x2" (1.9 cm x 3.7cm) pine wood bar attached to the table with VELCRO® or Dual Lock. The size of aluminum foil tape for the Home Base is approximately 5cmx5cm. Standard electrical tape (1.9cm wide) is used for the black lines. Four corners of the letter size paper will be scotch-taped.

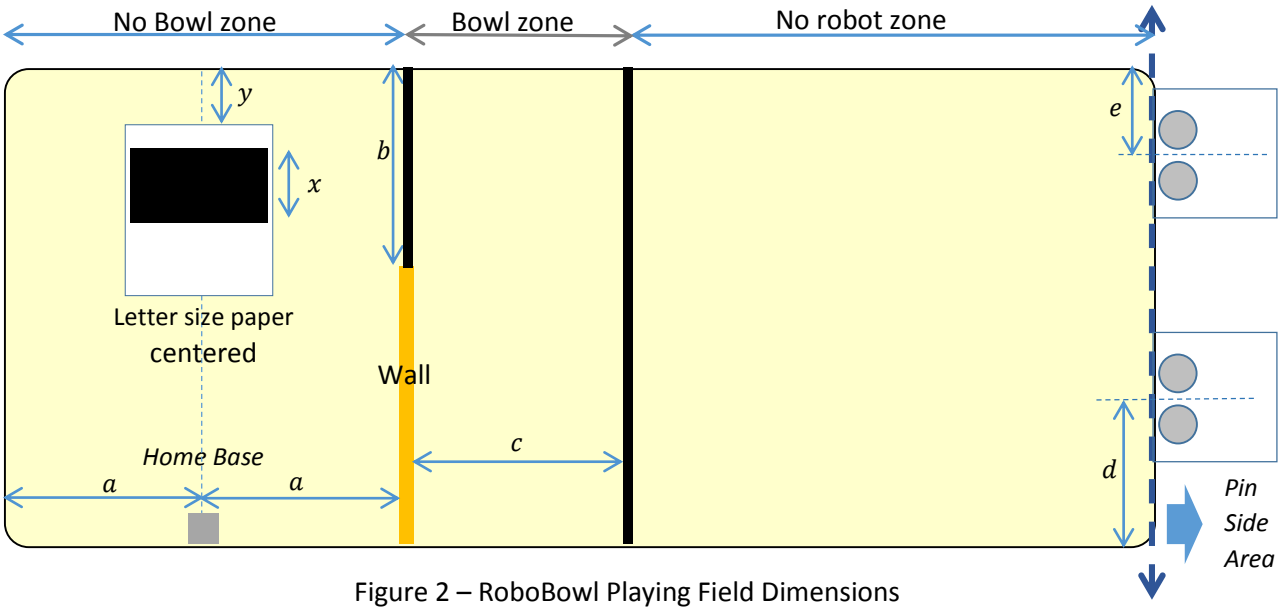

Figure 2 – RoboBowl Playing Field Dimensions

	Min	Max	Unveiled?
a, b	25cm	30cm	The tables will be set up at the competition and remain in that configuration during the entire event
c	35cm	50cm	
Weight of the bottles	See table 2 below		The bottles with Jr. or Sr. label will be set up at the venue and remain in that weight during the entire event
d	See table 2 below		A formula to calculate *d* will be unveiled. For example: $d = x/2$
e	12cm	18cm	Unveiled
x	90mm	235mm	The robot must measure this value
y	5cm	10cm	Changing for each round

Table 1: Important values for the playing field

To Set Up the Bowl Pins

Four 500 ml water bottles are used for the pins. Height of the bottle is approximately 21cm. Diameter of the bottom portion is around 6.5cm. Exact shape of bottle is unknown. Bottles will be partially filled with water. Two bottles will be placed on each letter size sheets of paper (21.6cm X 27.9cm) as shown in Figure 3 & 4.

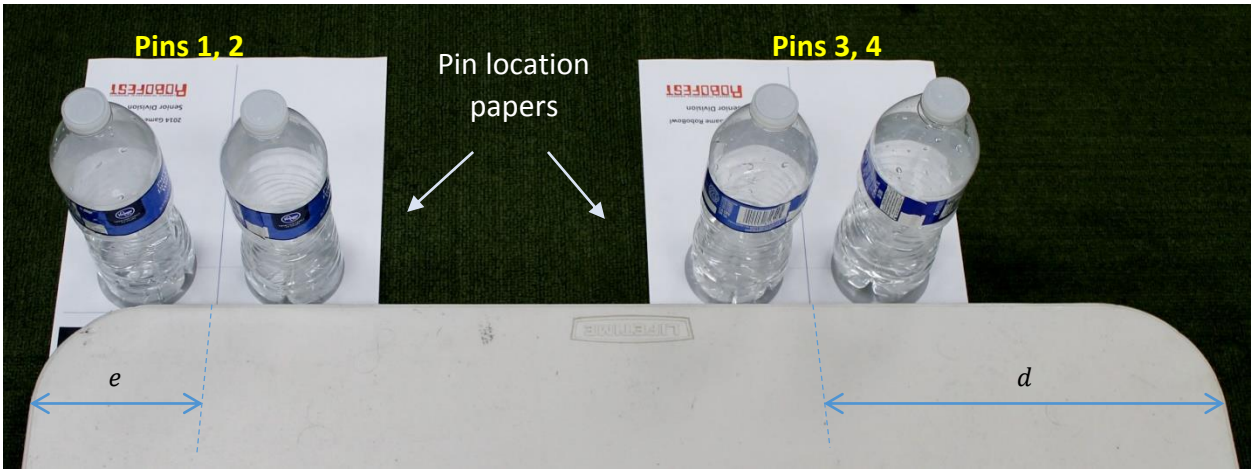

Figure 3 – RoboBowl Pin Setup (Sr. Division)

The letter size paper has two circles for the bottles and a center line to locate each paper relative to the edge of the table (See Figure 5). The papers may be taped down on the floor. PDF files for the papers may be downloaded:

- Jr. Division: http://www.robofest.net/2015/pinlocatorJr.pdf
- Sr. Division: http://www.robofest.net/2015/pinlocatorSr.pdf

Please note the only difference between the Jr. and Sr. Division is the spacing between the pins.

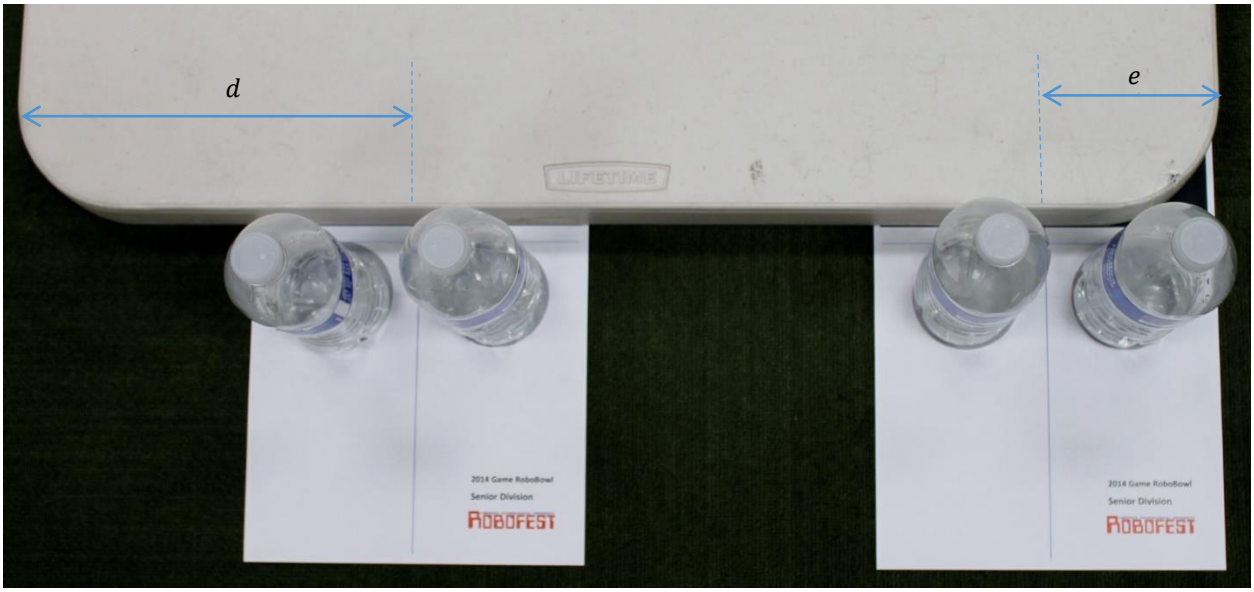

Figure 4 – RoboBowl Pin Setup from behind (Sr. Division)

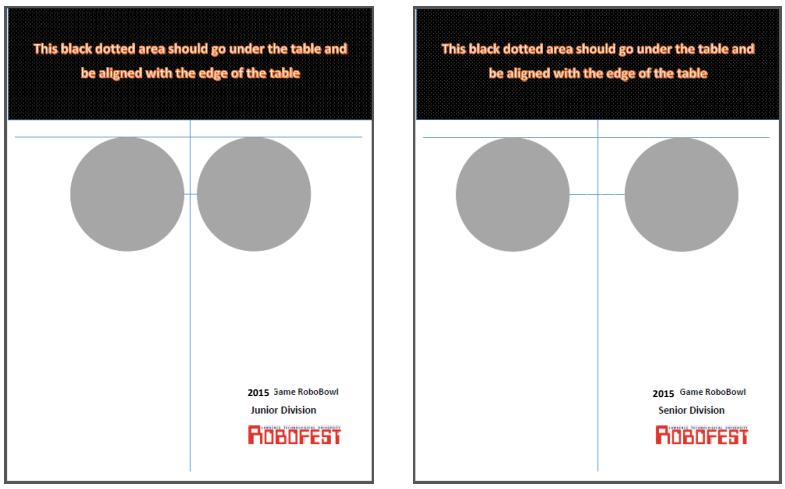

Figure 5 – RoboBowl Pin locator letter size papers (left: Jr. Division, right: Sr. Division)

The location, e, for pin locator page of pins 1 and 2 will be unveiled at the beginning of the 30 minute period. However, the location of the pin locator page for pins 3 and 4 will be unknown and placed after the robots are impounded. The unknown distance, d, must be calculated from the measurement, x, and an unveiled formula for d which is based on x.

For example, the unveiled formula could be $d = x/2 + 200$. In this case, the location of the pin locator center line from the edge of the table, d, will be determined by dividing the robot measured distance, x, by 2 and adding 200mm. If the measured distance, x, is 100mm, then d = 100 / 2 + 200 which is 250mm.

Measure Black Rectangle Shape on a Paper

The robot is to measure the height, x, of a black rectangle in millimeters. The black rectangle will be printed on a letter size page with the dimensions shown in figure 6. A PDF sample page can be downloaded from: http://www.robofest.net/2015/bbpaper.pdf

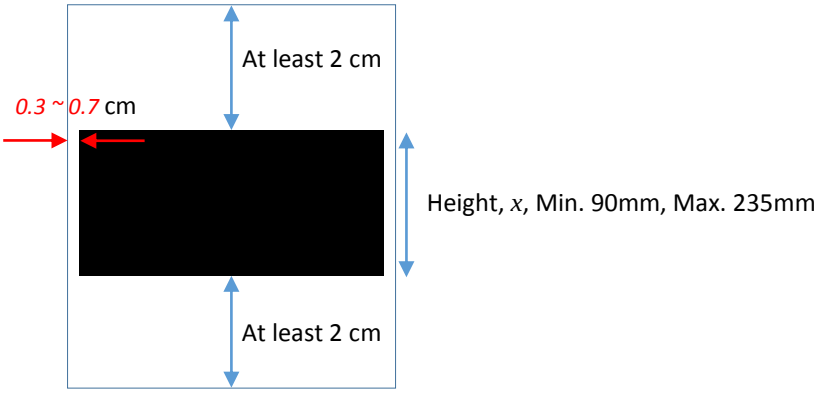

Figure 6 – A black rectangle shape on a letter size paper

Robot Specifications (For both Junior and Senior Division)

1. Your robot may expand to bowl the ball. However, it still must fit in within a box with 35cm x 35 cm base (height of the measuring box is unlimited) when fully expanded.
2. Height and weight limitation: none
3. Any number of sensors/sensor types (unless it is harmful to humans)

4. Any number/type of motors/servo motors (multiplexor is OK to use)
5. Any material/robot kit may be used to construct your robot including tape, glue, bolts and nuts, rubber bands, etc.
6. Team ID tag on top of the robot is required.

Differences between Junior and Senior age divisions

	Junior (5 ~ 8th grades)	**Senior (9 ~ 12th grades)**
Weight of the bottle with water	between 120g and 170g	Between 150g and 250g
The formula to calculate *d*	Simple $20cm \leq d \leq 40$cm	Complex $15cm \leq d \leq 50cm$
Distance between two bottles	~ 7mm	~ 34mm
Number of controllers	One	Not limited

Table 2: Differences between Jr. and Sr. age divisions

Rules to Play Two Rounds and Determine Winners

1. Playing field configuration including box size may be different for each round.
2. Teams will be given 30 minutes after unknown factors are unveiled.
3. All teams must submit their robot to the impound area when 30 minutes has expired.
4. After impounding, the judges will re-setup tables.
5. The Emcee shall announce the following before each round: *No adult is allowed in the pit area from now through the end of the round. None can come in and out during the 30 min. The use of any communications devices to remotely control robots or communicate with players is prohibited in this competition arena. If anyone sees any suspicious activities, please notify the nearest volunteer immediately. Only two team members can stay in the competition area.*
6. Teams will compete in a pre-determined order decided by the site host.
7. Winners in each age division will be decided by the average Final Score of the 2 rounds. Tie breakers will be: (1) best Final Score of two rounds, (2) rerun, if needed.

Special Notes

1. Though every effort is made to be consistent and precise, in all of the dimensions of the playing field and parts, Robofest assumes some error of up to ±0.2cm or ±0.2grams.
2. If there are multiple playing fields at the competition sites, the Chief Game Judge will check consistency between the playing fields.
3. When the robot is searching for the pins using distance sensor(s), Judges should maintain at least 4 feet distance from the table.
4. Final decisions are at the discretion of the Chief Game Judge.

FAQs

Q1. A bottle was knocked down or moved because it was hit by anther bottle. Is that counted as “knocked down” or “moved”? Yes

Q2. A ball was dropped in the No Bowl Zone. What should Judge do? It is a violation! Judge will announce the ball as dead, remove the ball, and ask the team to restart with a new ball.

Q3. A ball was released when the robot was touching the No Robot Zone and a bottle was knocked down. What should Judge do? It is a violation! Judge will announce the ball as dead, remove the ball, reset the bottle, and ask the team to restart with a new ball.

Q4. The robot fell off the table while holding a ball. What should Judge do? Violation! Judge will take ~~the~~ **a** ball and announce the ball as dead, and ask the team to restart ~~with a new ball~~.

Q5. The robot without a ball fell off the table when it comes back to Home. What should Judge do? Violation! Judge will take one ball, announce the ball as dead, and ask the team to restart with a new ball.

Q6. A human player touches the robot with a ball outside Home Base. What should Judge do? Violation! Judge will take ~~the~~ a ball and announce the ball as dead, and ask the team to restart ~~with a new ball~~.

Q7. A human player touches the robot without a ball outside Home Base. What should Judge do? Violation! Judge will take a ball and announce the ball as dead, and ask the team to restart with a new ball.

Q8. There was a violation, but there is no ball alive. What should Judge do? Judge will ask the team to restart. (The team may try the rectangle shape height reporting)

Q9. Can the height of the rectangle shape be measured more than once? Yes. But it should be reported only once at the end of the game.

Q10. A ball hits and moves a bottle but does not knock it down. Can the team request the reset of the bottle? No.

Q11. Is there any penalty if the robot hits the "wall"? No.

Q12. Will the Judge give a starting orientation for the robot? No. The bot can use any orientation.

Q13. A ball was dropped on Bowl Zone or No Robot Zone. Is the ball removed? No, Judge will not remove the ball, since it is not a violation.

Q14. What happens if your robot can't come back Home Base? A player can pick up the robot. But violation will be announced.

Q15. Can the robot just stop after the last bowl and display the value? Yes

Q16. Can multiple programs be used? Yes. But the program selection must be done only at Home.

Q17. Can the robot be repaired at Home Base? Yes

Q18. The measurement is shown to Judge. Can they continue to bowl? No. If you show the number, the game is over.

Bill of Materials to Construct a Playing Field

	Est. Unit Cost	Quantity	Cost
30" x 72" Folding Table; Suggested tables can be found at: www.buylifetime.com/Products/BLT/PID-22901.aspx; Almond color; Folding tables will be re-used in future Robofest games. Note that the thickness of the table is about 4.5cm.	$50 (at Lowe's)	1	$50
Tennis ball	$1	7	$7
White letter-size paper for the effective zone (Reuse scratch paper)			N/A
Aluminum foil tape at Home Depot or Lowes	$7	1	$7
1"x2" (1.9 cm x 3.7cm) pine wood bar top choice (6ft long) at Lowes	$2.50	1	$2.50
VELCRO® or Dual Lock	$5	1	$5
Total			$71.50

Robofest 2015 Game RoboBowl Scoring Sheet

Division: Junior / Senior Team Name: _____

Team School / Organization Name: _____ Team Number: _____

Round: *First* *Second* Track No.: _____

Judging Items	Count	Point Value (per count)	Score Earned / Lost
Number of pins knocked down	0 1 2 3 4	15	*Max. 60*
Number of pins moved that were not knocked down	0 1 2 3 4	10	*Max. 40*
Number of balls in "Pin Side Area"	0 ~ 7	2	*Max. 14*
Number of live (unused) balls ***after all four pins knocked down***	0 ~ 6	3	*Max. 18*
The robot reported the height, *x*: _____ (*) (Measured Value) in millimeters **at the end of the Game**.	0 (no) 1 (yes)	5	*Max. 5*
The robot remained intact throughout Game.	0 (no) 1 (yes)	5	*Max. 5*
Number of dead balls due to violations (just to count)	0 ~ 7	0	
(*) If Measured Value is "blank", Final Score is Total Score. If Measured Value is a number, calculate $e = \frac{\lvert CorrectValue - MeasuredValue \rvert}{CorrectValue}$ $\text{Final Score} = \begin{cases} Total\ Score & if\ e > 1.0 \\ Total\ Score + 11 * (1 - e) & otherwise \end{cases}$	**Total Score**		
	Final Score ** Calculated by Scorekeeper using Excel. Not to be rounded.		

Judge initials: _____ *Team player initials:* _____

If two balls are used to knock down all the pins and the measurement error e is zero, then the final score will be 100.
Though almost impossible, if one ball is used to knock down all the pins and the error e is zero, then the final score will be 101.