RST-Robot Challenge：Basketball Robot

Ver. 20120618

I. Purpose

To encourage experience exchange and technology development, activate creativities of teachers and students, cultivate talents of robotics. Taiwan Society of Robotics held the “RST-Robot Challenge：Basketball Robot”, and in hope of becoming the largest and most professional robot competition. All college students are welcomed to team up and attend the game!

II. General Rules

RST-Robot Challenge follows the rules which is made by 2012 Robot Hands On Competition Committee, and apply to this year’s competition only.

1. Qualification: Students with university certification of enrollment.
2. Team Composition: A team can have 2~6 members, and allowed to have 1 coach. Coaches can lead multiple teams, but students can join 1 team only. Team members can come from different schools and departments.
3. Software of Robot: NI LabVIEW is recommended by the committee, but other programming languages are also allowed to use.
4. Hardware of Robot:
   A. Robot should have electricity and ability of automatic control.
   B. K Kingdom KNR controller is recommended by the committee as the main
   C. The robot must be satisfying the following size constraints at the start of every round: Within 90cm in height, 65cm in length, and 65cm in width.
   D. To complete the tasks, robots can have appendages which can extend and retrieve automatically. Robots may extend up to 120cm in height, 100cm in length, and 100cm in width.
   E. The robot weight may not exceed 40 kg.
   F. Teams have to install an emergency button on the robot, which can stop the robot immediately. This button should approach easily. Judges have the right to stop the robot when it commit rules violation or interfere other robots’ movement.
5. Clothing Limit of the Shooter: Colors similar as the markers are not allowed, white is recommended.
6. Fouls
   A. Robots may not damage the court, any relevant equipment, or attack other teams’ members and robots.
   B. Robots may not use dangerous objects, or conduct any action that will endanger people and robots.
   C. Team members may not behave inappropriately to other team members, audiences, judges, and staffs.
   D. Any situation that may harm the spirit of the competition.

   Teams

7. During the competition, decision of the judges shall be final. Reexamination of any recording materials will not affect judges' final decision.
8. Judge assistants will calculate the score right after the game is over and ask the teams to check their score. After team members check and sign on the score sheet, they may not make the request of recalculating the score.
9. Teams which are announced disqualification by judges should leave the court immediately, and no score calculated.
10. When teams violate the rules, the committee has the right to revoke the qualification of teams.
11. When games cannot proceed or scores cannot be calculated because of courts or equipments, games should start over. If participants thought that the courts or relevant equipments affect their scores, they should bring up their opinion or request of restarting the game on the spot, and the judges will decide to restart the game or not. Whether the robots complete the game, the score of the replayed game will be final.
12. Teams should raise the objection on the spot, and leave it to the judges to decide. After the score sheets are signed, judges will not accept any objection. When there is any misunderstanding or opinion difference on the game rules, judges' decision should be the only basis.
13. If there is any situation not provided in the game rules, judges' decision will be the main basis. Judges have the right of final explanation and opinion about the rules.
14. Authorization: the committee has the right to photograph, video-record, reproduce, alter participants' works, and use it at every kind of media. Participants shall not dissent.

III. Game Rules

Summary: When the game starts, basketballs will be placed at the center circle. In the first 5 rounds, the robots should carry or pass the basketball to the shooter who waits in the shooting zones. The first, second and the third round have only two balls on the center circle. The fourth and the fifth round have three balls. In the 6^{th} round, which is a bonus round, the robot should be able to take and shoot the balls automatically. In the 7^{th} round, which is also a bonus round, the robot should still be able to automatically take and shoot the balls, but in this round the balls are shared with the others, the robot have to be quick.

1. 4 teams enter the court at the same time. There are 5 regular rounds and 2 bonus rounds.
2. Regular round: There should be one shooter and one robot on the court. Bonus round: There should be only one robot on the court, and the rest of the participants should be at the team area.
3. After the robot leave the base, participants' hands should not touch the laptop anymore to make sure the robot is moving automatically.
4. Except for judges' direction, there will be no time-out during the game. The shooter and the robot cannot exchange in the middle of the game.
5. Before the game starts, teams have 2.5 minutes to enter the court and prepare. Every round has 2.5 minutes, an interval of 1.5 minutes between every round. 1 minute to exit after the

game. The whole schedule is about 30 minutes (non-stop) .

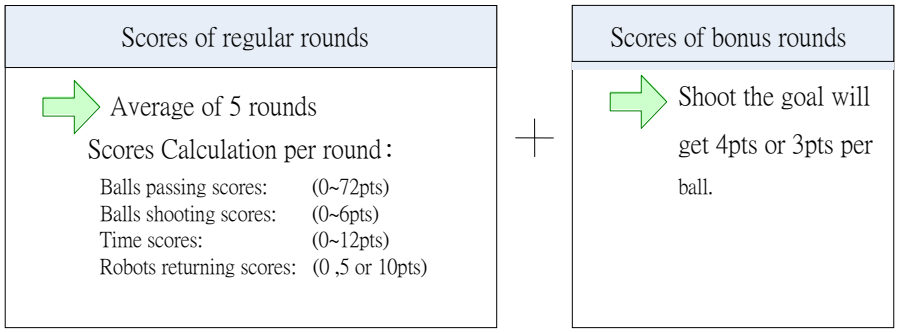
6. Teams should draw at the registration to determine the A, B, C, D area.
7. Beginning of the round:
    A. 8 or 12 balls will be placed at the center circle. Every quarter of the center circle should have 2 or 3 balls.
    B. Teams' designated ball are on the teams' quarter of center circle.
    C. At 5 regular rounds, the order to pass the balls is designated by color, and the order is: Red, Red→Blue, Blue→Red, Blue→Red, Blue, Blue→Blue, Red, Red. The standard of the ball refers to diagram 2. In the bonus rounds, the robot takes a white volleyball, a red or a blue basketball and shoot, the standard of the balls refers to diagram 3.
    D. At the beginning of the regular rounds, the robot should wait in the starting zone, and the shooter should stand in the shooting zone, as the diagram 1.1 shows. At the beginning of the bonus rounds, the robot should wait in the starting zone, as the diagram 1.2 shows (no shooter in the bonus rounds) .
8. The robot should move automatically in all rounds.
9. When the game starts, whether it's a regular or a bonus round, the robot should heads to the center circle and pick up the balls which are placed on the teams' quarter of the center circle.
10. In regular rounds, full marks of "Passing the Balls" are 72 points:
    A. A robot took all the balls with the designated color order and passed them to the shooter in "Valid Way" can get 72 points. If there were 2 or 3 balls to pass in a round, then the scores of each passed ball would be 36pts or 24pts.
    B. A robot passed the balls with incorrect color order would be regarded as passing balls to the shooter in "Other Way", which can get 36 points at most. If there were 2 or 3 balls to pass in a round, the scores of each passed ball would be 18pts or 12pts.
    C. Rounds have multiple balls should calculate the scores separately. For example, the designated color order is Red, Blue and Red, but the robot passed the balls in Red, Red and Blue order, the score would be 24pts, 12pts and 12pts, in total 48pts.
    D. Balls rolled out of the court can get no point.
11. In regular rounds, "Valid Way" to carry or pass balls have to satisfy the conditions below:
    A. Except for the process of taking the ball, ball holders should not be moved and should remain its initial position.
    B. Robot can move to utmost 0.75m from the center circle before throwing the ball. The ball can bounce no more than once before the shooter get the ball.
    C. Robot's movements should be always in the team's quarter of the court (within the sideline).
    D. The shooter should stand in the shooting zone and wait for the balls passed by the robot. When the shooter catch the ball or after jumping and catching the ball, their body parts on the ground should be complete in the shooting zone(within the lines), otherwise the pass/carry is void.
12. In regular rounds, "Other Way" to carry or pass balls have to satisfy the conditions below:
    A. The ball and the robot should be in the sideline while carrying or passing the ball.
    B. The shooter should stand in the shooting zone and wait for the ball passed by the robot.

When catching the balls or after jumping and catching the ball, shooters' body parts on the ground should be complete in the shooting zone(within the lines), otherwise the pass/carry is void.

C. If the ball rolled on the ground during the carrying/passing process, it's void.

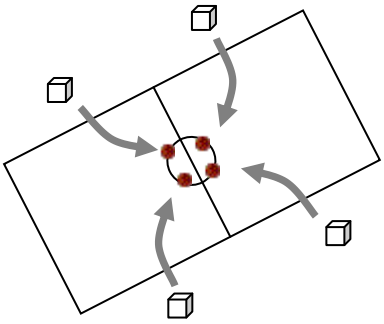
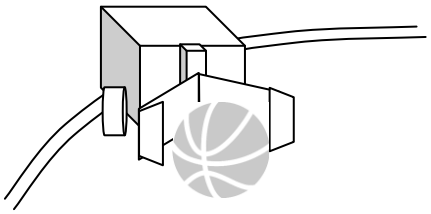
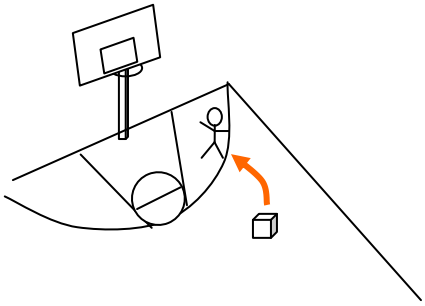
13. In regular rounds, the full marks of the shooter's shooting is 6pts. After catching the ball from the robot carrying/passing by "Valid Way" or "Other Way", the shooter can shoot the ball in the shooting zone, and each shot is worth 3pts (1^{st}, 2^{nd} and 3^{rd} round), or 2pts (4^{th} and 5^{th} round). Between the shooter catch and throw the ball, he/she has to follow every rules in the IBF Official Basketball Rule.
14. If the robot failed to pass the ball to the shooter, the robot can try to take the ball again. However the whole process should follow the "Other Way" condition to get the carrying/ passing ball scores.
15. In regular rounds, the full marks of "In Time" bonus are 12pts. "In Time" would start counting from the beginning of every round and end in the last balls hit the backboard, net, or hoop. Teams can get time scores if the robots passed all the balls to the shooter in "Valid Way" and spend less than 150secs. Calculating formula: min{12, (150- used time)/4}. For example, finish a round within 102secs can get 12pts. Finish a round between 102secs and 150secs, the more time the team use, the less scores teams can get.
16. In regular rounds, the full marks of the robot "Return to Base" are 10pts. A robot able to return to the base after passing/carrying all balls to the shooter can get 5 or 10pts. Teams are not allowed to use any equipment to help the robot returning. After the robot return to the base and stop, if the robot is complete in the base without crossing the boundary line worth 10pts, crossing on the line worth 5pts.
17. Total scores in regular rounds: Ball Passing Scores (0, 12, 18, 24, 36, 48, 54, or 60pts) + Ball Shooting Scores(0, 2, 3, 4, or 6pts) + In Time Scores (0 ~ 12pts) + Robot Return to Base Scores (0, 5 or 10pts).
18. Other rules about the shooter:
    A. During the games, using body language or sound to communicate with your robots is acceptable, but using any form of machinery or electronic communication devices would be regarded as a violation of the rules.
    B. Shooters should not interfere or sabotage other robots' movements.
    C. During the games, shooters should not leave the shooting zone except for the judges' directions. If shooters stepped out of the shooting zone, the round would be terminated.
19. Robots interfering in other teams' movements might cause 50pts deduction per time, and judges have the right to disqualify the team.
20. Rounds will be terminated when there are no basketball on the court (ball has been threw by shooters or rolled out of the court) or robots were emergency stopped.
21. Not until the preparation time in between the rounds starts, team members may not enter the court and take robots back to the base.
22. During the rounds, judge assistants can stop the robots with team members' permission due to some situations. Team members can't enter the court until the rounds are over. Teams get 0pts in these rounds.

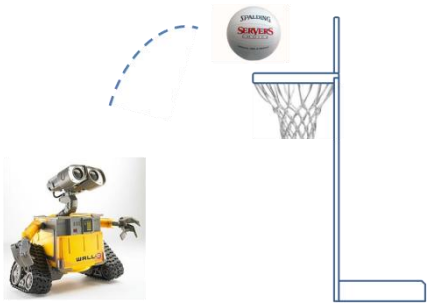
23. If there were violations or any situation which might affect the games, judges or judge assistants can stop the robots, and judges will decide the game continue, cease, or cancel the round.
24. When 5 regular rounds are over, scores will be calculated. Final scores will be the average of 5 regular rounds.
25. Followed by 5 regular rounds are bonus rounds. In the 6t^{h} (bonus) round, there are one volleyball, one red and one blue basketball on each quarter of the center circle. The ways of the robot taking the ball are the same as regular rounds, but after taking the ball, the robot have to throw the ball beyond 2.5m from the hoop by itself. The hoop for bonus rounds would be a smaller basketball stand set up under the regular basketball hoop, details of place and size refer to diagram 6. 2 teams will share a basketball stand in bonus rounds, please pay attention to the collision which might accidently happen.
26. In the bonus rounds, robots which shoot the goal will get another up to 10pts (volleyball worth 4pts, basketball worth 3pts) .
27. In the 7th (bonus) round, the cross divider on the center circle will be removed. The robots are allowed to move to whole center circle and get other teams' balls (in total four volleyballs and eight basketballs) to shoot the goal (volleyball still worth 4pts, and basketball still worth 3pts) to win up to 40pts bonus.



28. Games might include preliminaries and final. Top 4 scoring teams in preliminaries will make it to final.
29. Only the score in the final will determine the rank of the competition. When there are teams have the same score, robots with the lighter weight will win.

IV. Flowchart of the Game

Flowchart	Description
	Four teams enter the court simultaneously. 8 or 12 balls should be placed on the center circle. Every quarter of the center circle should have 2 or 3 balls. In regular rounds, every team would have one shooter and one robot on the court, rest of the members are not allowed to enter the court. When the game starts, robots have to move toward the center circle, and take the teams' balls.
	Robots use "Valid Way" (In a word, balls can bounce once or less) or "Other Way" to pass the balls. Details refer to Ⅲ - 9~11. The movements of the robot and the balls should be within the sidelines, or the carry/pass is void.
	Robots take the ball with the right color order and pass it to the shooters in "Valid Way" can get at most 72 points. Pass the ball in "Other Way" can get at most 36pts. If there were more than one ball in a round, robots can keep passing the balls to the shooters. Shooters should stand at the shooting zone and wait for balls passed by robots. When shooters catch the balls, their body parts on the ground should be complete in the shooting zone. If they were not in the shooting zone, then the pass/carry is void.
	Shooters throw all the balls in a round can get 6pts, details refer to Ⅲ-12. If robots passed all the balls in "Valid Way" within 150 seconds, teams can get In Time points, details refer to Ⅲ-13. Robots which are able to return to the base after robots passing/carrying the balls to shooters can get 5 or 10pts.

	In bonus rounds, robots shoot the goal will get another 3 or 4pts. There will be 2 bonus rounds, each can win up to 10 and 40 bonus point.

V. Game court and equipments

1. Standard basketball court, 28 meters long and 15 meters wide (diagram 1).
2. Use standard basketballs in regular rounds, circumference of the balls can't be smaller than 75mm or larger than 78mm. SPALDING NBA Varsity basketball and SPALDING NBA Highlight Black/Blue basketball are adopted (diagram 2).
3. Use SPALDING Servers Choices Volleyball for bonus rounds (diagram 3).
4. Balls will be placed on the holders (diagram 4). Center circle will be divided into 4 zones by a cross divider which is 45cm high and 2m wide.
5. Different colors represent different teams' game areas and bases (not the color of the court floor).
6. Base: A 100cm X 100cm square. In regular rounds, robots have to return to the square base.
7. Positioning marks for robots:
   A. At the center of center circle and the top of the three-point line will be positioning marks for robots to position, locations of the marks refer to diagram 1.
   B. Colors of the center circle mark are green/yellow (green top, yellow bottom). IKEA floor lamp is adopted (SKIMRA lampshade, GRUNDTON floor lamp base), details please refer to diagram 5.
   C. In regular rounds, positioning marks will be set on the cross point of center circle and the top of three-point line for robots to pass the balls to shooters. Colors of positioning mark are red/blue (zone A/D: red top, blue bottom; zone B/C: blue top, red bottom), details please refer to diagram 5.
   D. In bonus rounds, positioning marks in C will be moved underneath the smaller basketball stand to assist in positioning. Official basketball hoops, smaller basketball stand hoops and positioning marks will be concentric.
8. Details of basketball stands for bonus rounds refer to diagram 6.

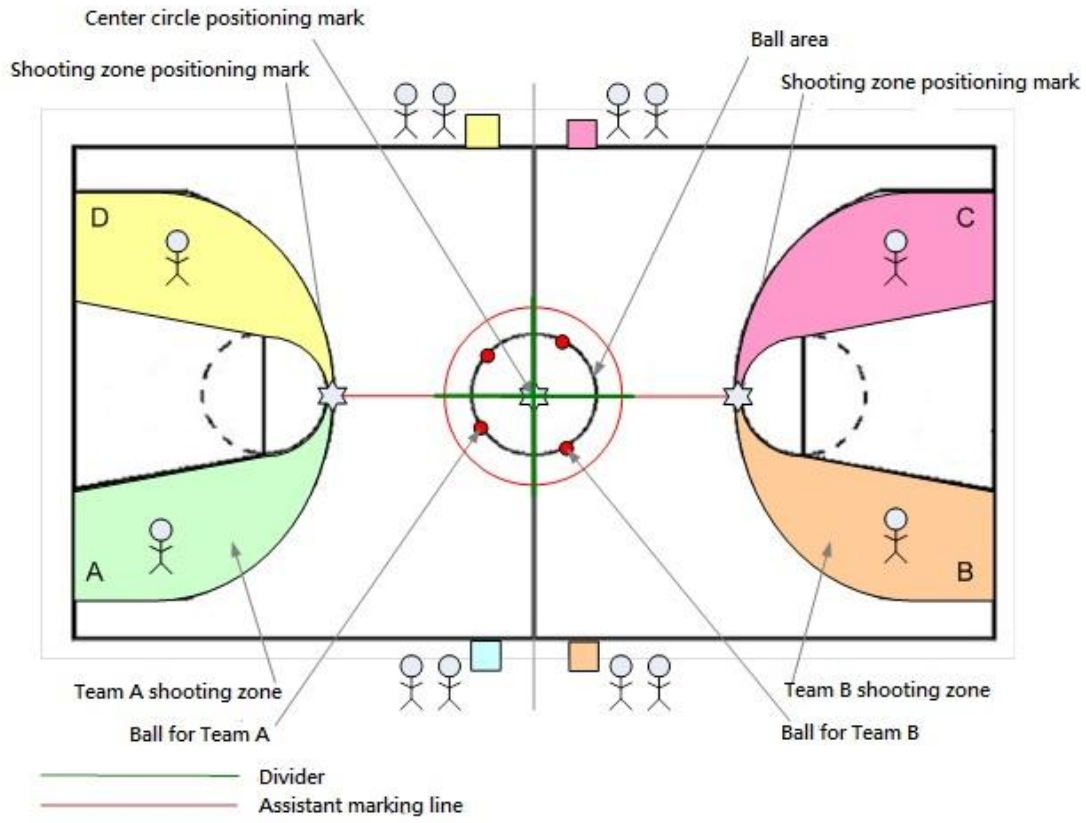


Diagram 1-1: Regular Round

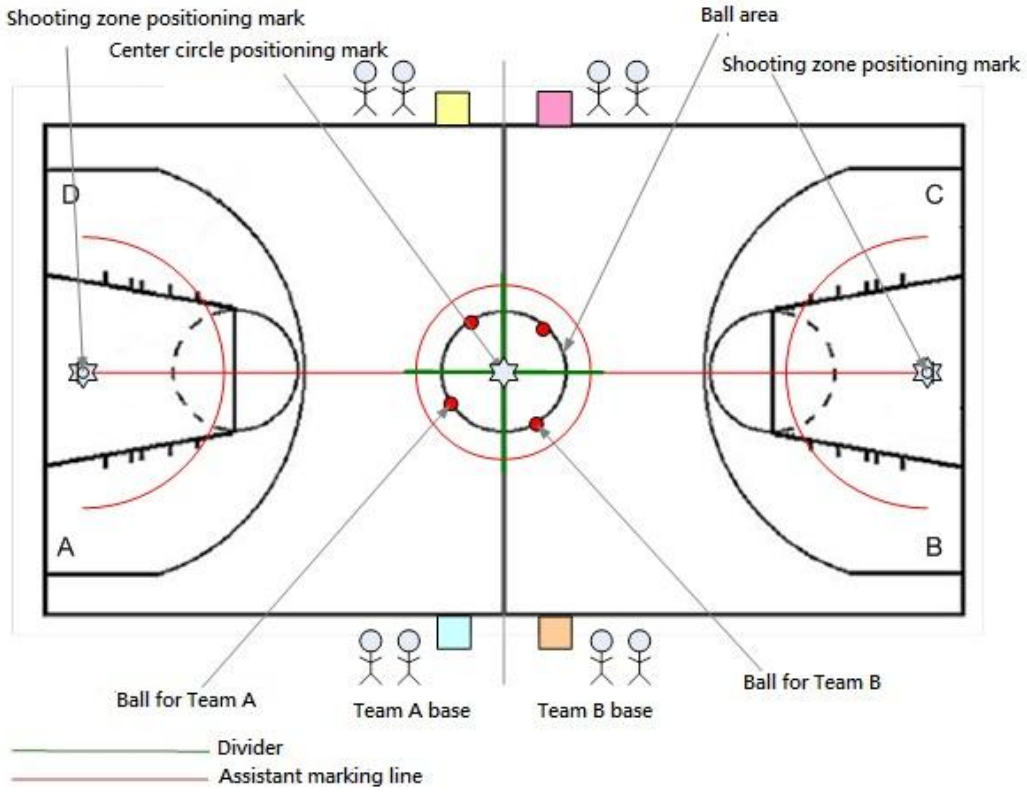


Diagram 1-2: Bonus Round

Diagram 2: Basketball in regular and bonus rounds. (Left) SPALDING NBA Highlight Black/Blue basketball; (Right) SPALDING NBA Varsity basketball.

Diagram 3: Volleyball in bonus rounds. SPALDING Severs Choice.

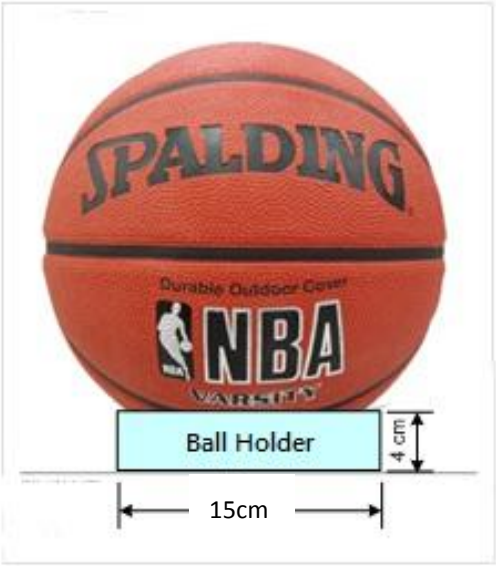


Diagram 4: Basketball and volleyball use the same ball holder.

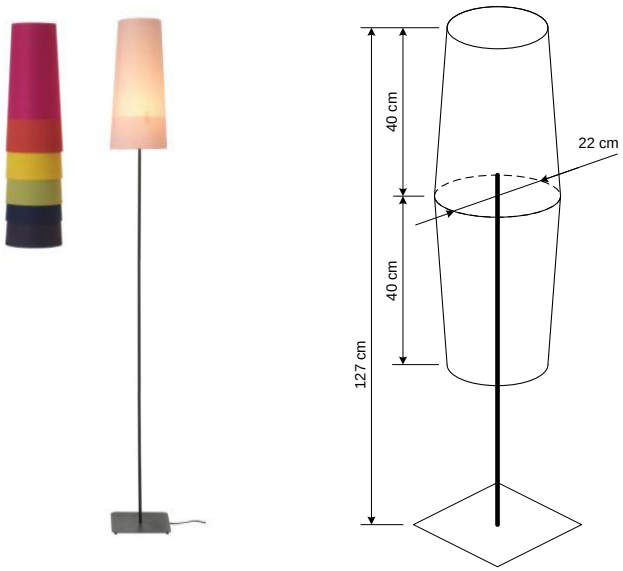


Diagram 5: (Left) IKEA floor lamp. (Right) Positioning mark for the game.

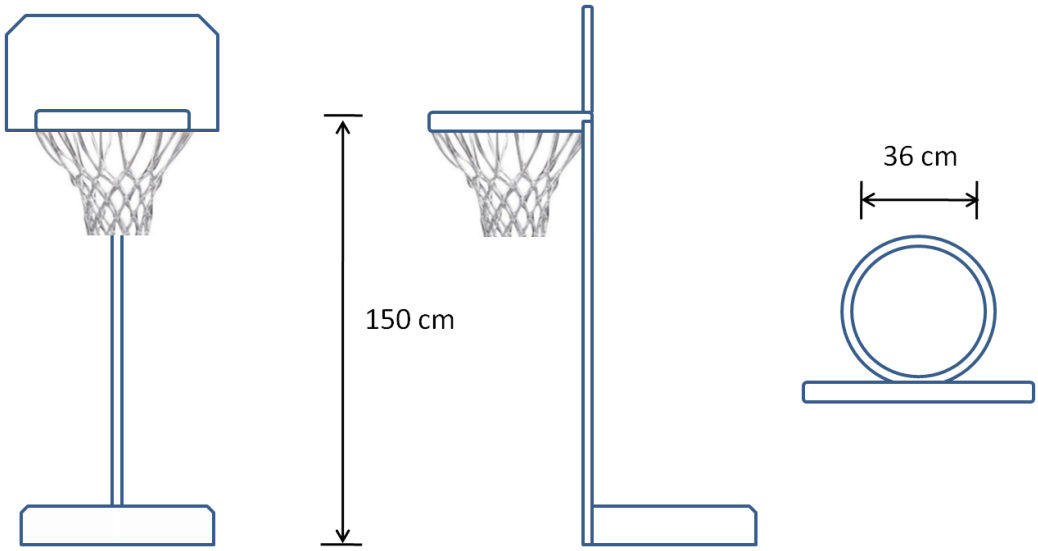


Diagram 6: Standard of basketball stand in bonus rounds.