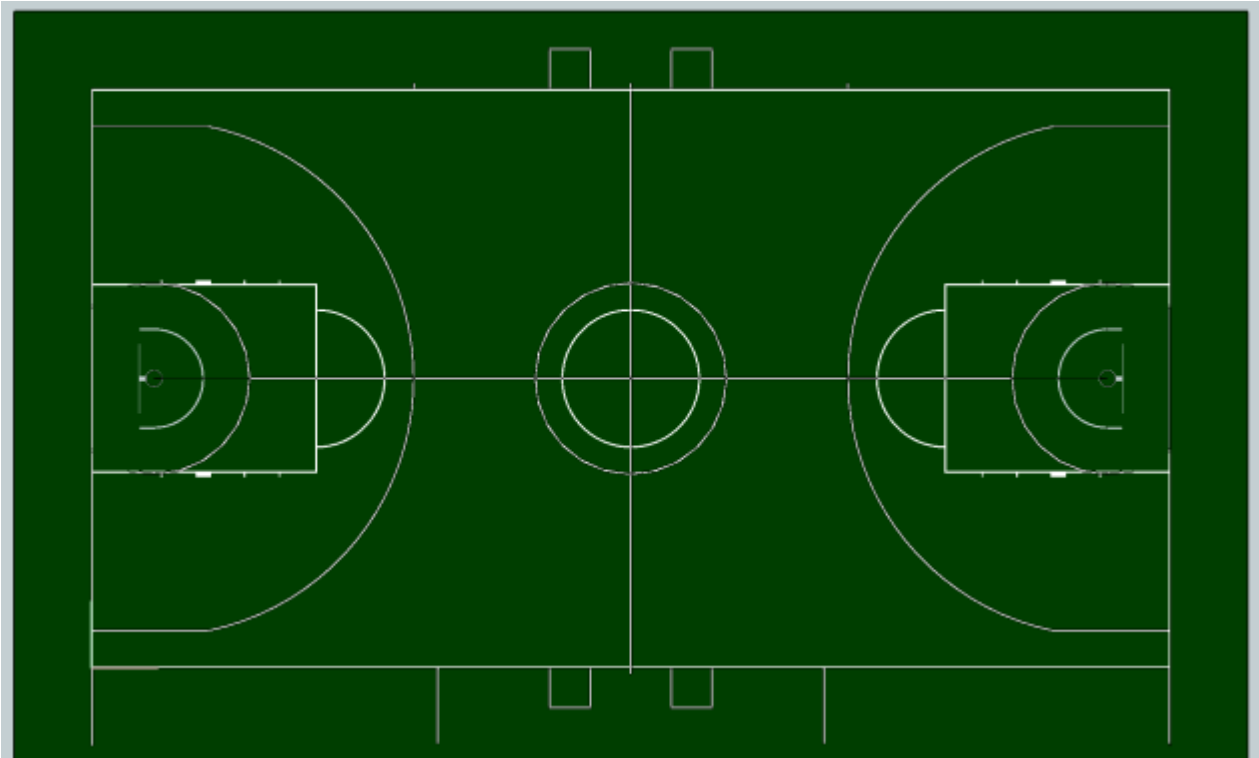




# IRHOCS 2015 Robot Challenge: Robot Basketball

Updated: 2015/06/10

The basketball competition will be divided into three main areas: moving, passing and shooting. We'll guide the competitors in stages through the competition rules, ensuring careful planning and a precise design. We hope to realize an all-robot basketball competition within a few years.



Court layout (white lines on a dark green background)

Major changes in the IRHOCS2015 robot basketball competition

- ✧ Elimination the first, third and fifth round, so the total rounds of the competition change from 6 to 3.

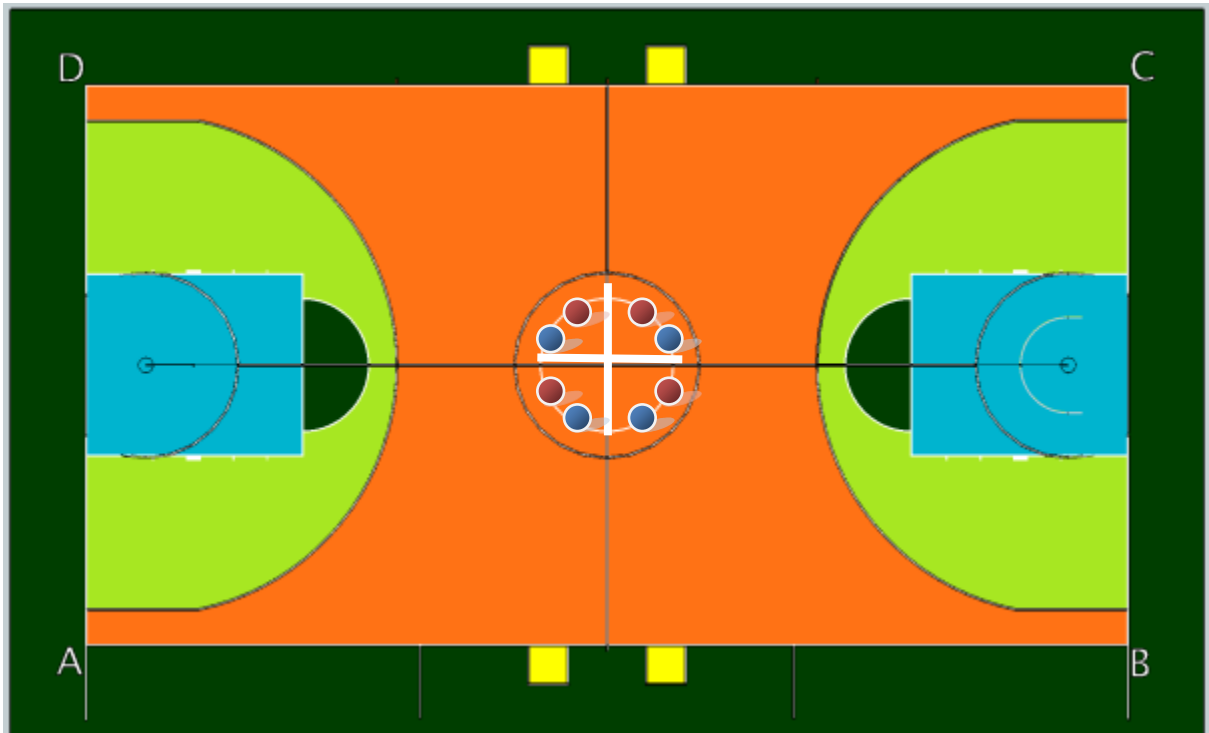
## General Rules

The rules of the IRHOCS Robot Basketball Competition ("this competition") are drafted by the IRHOCS 2015 International Robot Hands-on Competition - Competition Committee ("the organizer"), and are applicable solely to this competition.

1. Eligibility: All tertiary college students worldwide with proof of enrollment. Limited to current tertiary college students, not including class participants already in employment.
2. Team composition: Two to six contestants, one coach. Each contestant can only join one team. The contestants on each team do not need to be from the same academic department.
3. Robot software: The organizer suggests NI LabVIEW, but other programming languages may also be used.
4. Robot hardware:
  - A. Participating robots must possess autonomous power and control abilities. Each team may have only one robot.
  - B. The organizer suggests a KNR series controller as the main control unit.
  - C. Size of robot: The contact area between the robots and the floor must be within the length and width limits of 65 cms or less. The robots may have additional automatic extend and retract mechanisms to meet the needs of competition; these mechanisms have the following maximum permissible dimensions: height 120 cms, length 100 cms, and width, 100 cms.
  - D. Total weight of robot: 50 kgs
  - E. An emergency stop button must be installed on the body of the robot where it can be easily seen. Where there is any violation or behavior that might disturb other teams during the competition, the referee reserves the right to stop a robot on an emergency basis at any time.
5. Since practice time will be limited on the day of competition, the organizer will open the site for practice a day prior to the competition day.
6. On the day of the competition, each team will only have 10 to 15 minutes of exclusive use of the court for practice and preparation prior to each round of the competition.
7. Shooter outfit: The color of the outfit can't be identical or similar to that of the markers or basketball.
8. Violations
  - A. Destruction of the competition site or relevant equipment; actively attacking the other team's members or robot.
  - B. Use of dangerous objects or actions that endangers others or another robot.
  - C. Use of inappropriate language or behavior toward other teams, audience members, referees, or workers.
  - D. Any situation that the referee deems to be in violation of the spirit of the competition. When a violation occurs, the team responsible will receive zero points for that round.
9. During competition, the referee has the final say, and decisions will not be changed once made. Even if the competition's video recording is re-examined, an existing decision will not be affected.
10. The assistant referee will add up the points after each competition is completed, and scores will be handed over to each participating team for confirmation. After the participating teams sign the tally sheet, they cannot ask the organizer for a recount.
11. A disqualified team must leave the competition site immediately after a disqualification announcement is made by the referee.
12. When any participating team violates the rules, the committee has the right to terminate that team's participation in the competition.
13. When the competition cannot be held due to issues with the site or equipment, or calculation of scores cannot be performed, the referee may restart the competition. If the participating teams believe that their score is affected by the competition site or relevant equipment, they must state their views or request to restart the competition on the spot. The referee will decide whether a restart is necessary. When a competition is restarted, the score from the restarted competition will be counted as the result of the competition, regardless of whether a robot has finished the competition or not.
14. The participating teams must state any objections or issues regarding the competition on the spot, and these will be handed over to the referee for decision. The referee will not accept any objection after the tally sheet has been signed. Any misunderstanding or disagreement regarding the competition rules will be resolved in accordance with the referee's decision.
15. When a situation is not specified in the competition rules, it will be determined in accordance with the referee's decision during the competition. The referee shall have the right to interpret and enforce the rules.

16. The organizer shall have the right to photograph, film, reproduce, modify, and use in various media any works participating in this competition, and the teams may not object.

### Competition rules



Court layout for the first round (colors are schematic)

Thick white lines: Central crossing partitions

Yellow area: Starting areas for robots in all rounds (base)

Orange area: Range of movement of robots during the first round

Green area: Range of movement of shooters during the first round

Blue area: Restricted area

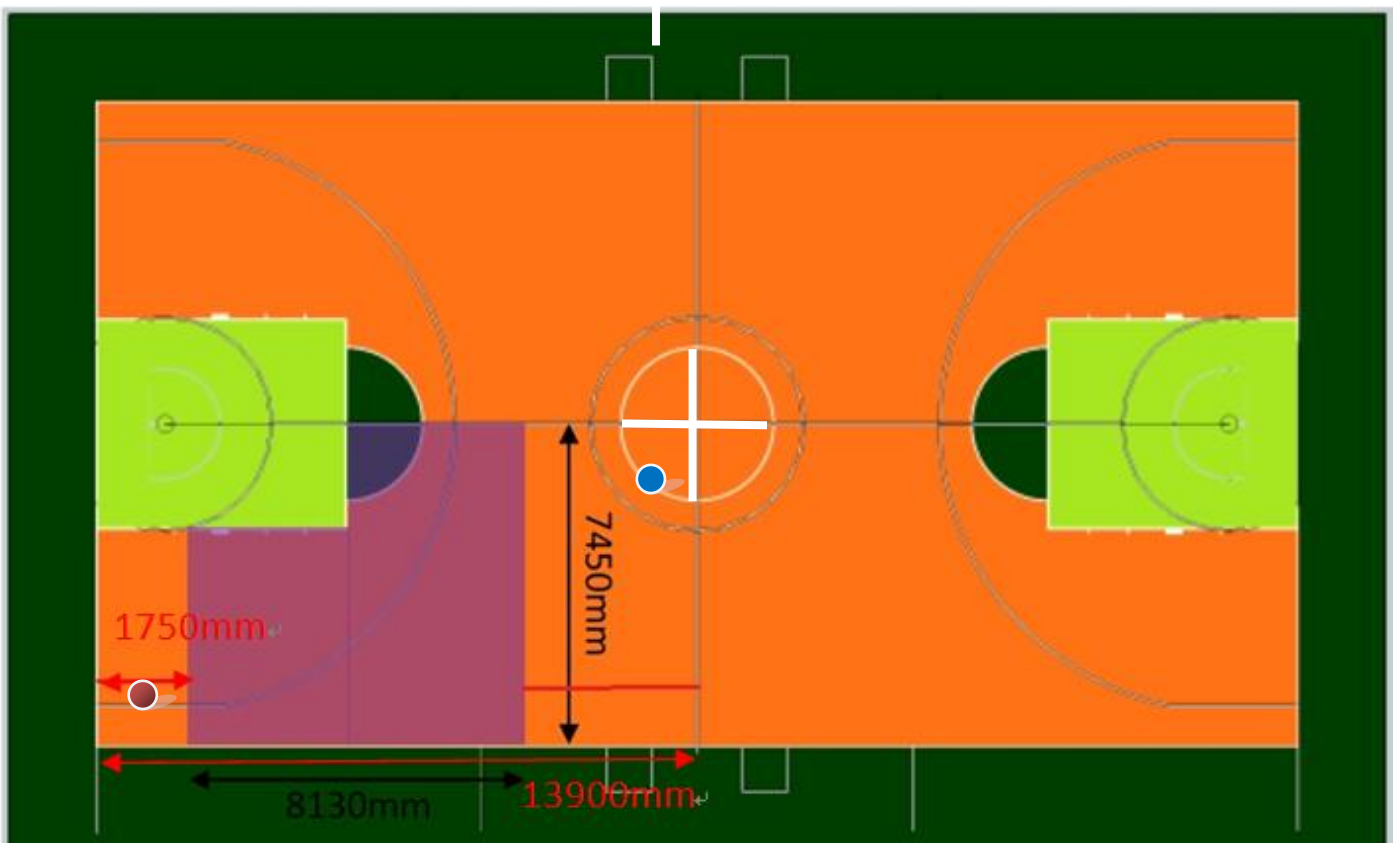
(The robots and shooters can only play in the designated 1/4 of the court during the first two rounds.)

### General instructions:

During the first round, the robots must try to get the ball in the central jump circle. The robots must not leave the central circle (the circle that is slightly bigger than the jump circle), and must pass the ball to the players. The basketball may bounce no more than once, and the ball must be shot through the hoop by a shooter. An obstacle simulating a defending player will be adopted in the second round. It is hoped that the robot could overcome the defense, obtain the basketballs placed in the four corners of the site, and pass them to the players in the restricted area for shooting. In the third round, the robot must get the basketball by itself when it can use a standard basketball shared with the other team to perform autonomous shooting with no distance restriction.

1. Four teams will enter the court for the competition at the same time. The competition consists of three rounds.
2. Number of players on each team that may enter the court in each round: Only one shooter and one robot on each team during the first two rounds. Only the robots can enter the court in the third round, and other players must stay next to the starting area outside the court.
3. After the robots have entered the court (left their bases), the players must stay away from the remote control notebooks to ensure that the robots move autonomously.
4. A robot's location on the court shall be determined by its area of contact with the ground, even if it appears to touch the line or go out of bounds. A robot's orthographic projection may be used as an auxiliary means of location-finding, but only when the contact area is difficult to determine.
5. Except when ordered by the referee, a competition cannot be suspended when it is in progress; and the shooters cannot be switched during the preparation for the next round.
6. Prior to the preparation time during the first round, after the organizer tells the participating teams to enter the court, the teams will have approximately 2 minutes to enter. The preparation time prior to each round shall last 100 seconds, and the duration of competition shall be 150 seconds. The total time for all three rounds will be approximately 15 minutes.
7. Initial state at beginning of round: The jump circle is divided into four sections by white wooden crossing partitions that are 200 cm in radius and 45 cm in height. Eight balls are placed along the jump circle. Two balls are placed randomly at every 1/4 circle, and one is a standard orange basketball ("standard ball") and the other is a colored basketball ("colored ball"); these are the designated areas and designated balls for each team's robot.
8. During the preparation period for each round, the robots should remain on standby in the designated starting areas (bases) outside the court. The shooters should stay in the green designated areas during each round, as shown in the layout map for each round.
9. The robots must move and operate autonomously in all rounds, and the robots are only allowed to control or carry one ball at any time.
10. The teams are allowed to communicate with their own robot via body language or voice during the competition. However, any type of mechanical or electronic communication device is prohibited, and the use of such devices shall be regarded as a violation.
11. It is prohibited to disrupt or sabotage other team's robots handling of the ball during the competition.
12. Except under the referee's instruction, the shooter must not leave the designated shooting area during the competition. If a player's foot steps outside the shooting area (or steps on the line) before the ball leaves the player's hands, the round will be over.
13. After the competition starts, during the first round, the robot should go to the central circle to get the standard ball and the colored ball in sequence from the jump circle, and then pass them to the shooter.
14. The robot will receive 20 points for each ball that is successfully passed to the hands of the shooter via a "valid method" in the first round; 10 points will be granted for successfully passing each ball via an "other method." "Valid shooting" (basketball rules are not violated and the ball is not out of bounds) by a shooter will receive 10 points for each ball that is thrown through the hoop.
15. A "valid method" of moving and passing in the first round must meet the following conditions:
  - A. Except during the process of getting the ball, the ball and the ball-holder should not be visibly moved, and should remain in the initial location.
  - B. A robot is not allowed to leave the central circle (radius 250 cm) after it gets hold of the ball in the jump circle in the first and second rounds.
  - C. The ball may only bounce on the floor once during the passing process and before a shooter catches the ball.
  - D. The movement of the robot before the ball is passed must be within the boundary line of the designated 1/4 of the court.
  - E. The shooter must stand within the designated area (green area) to wait for the ball to be dribbled or passed by the robot. The shooter can jump up to catch the ball, but the contact area when the player lands must be in the same area (stepping on the line or going out of bounds is prohibited).

16. Moving and passing via an "other method" in the first round must meet the following conditions:
  - A. During the passing process, the ball and robot must stay within the boundary line of the court at all times, and the ball cannot roll on the floor.
  - B. The shooter must stand within the designated area (green area) to wait for the ball to be dribbled or passed by the robot. The shooter can jump up to catch the ball, but the contact area when the player lands must be in the same area (stepping on the line or going out of bounds is prohibited).
17. The robot can try again to get and dribble the ball if the ball is not successfully passed to the shooter's area during the passing process. Points will only be granted when the entire process complies with the requirements for moving and passing the ball via an "other method."
18. The robot should again start out from its base in the second round. Its range of movement is expanded to the designated 1/4 of the court. In the beginning there will be a colored ball placed in the jump circle, robot must follow the rule of the first round, pass the ball to the shooter in the restricted area for shooting, and then pass through the defenses of the five obstacles to gain the basketball on the three-point line, the shooter cannot dribble the ball after catching it; however, moves that do not violate the rules of basketball, such as cutting, can be used before shooting. A basket scored via a "valid method" will be awarded 10 points.
19. In the second round, the moving and passing of the basketball via the "valid method" must comply with points A, C, D, and E of Rule 17. The full score for a successful pass from the robot to the shooter is 20 points; 10 points will be granted when an "other method" is used and complies with Rule 18.



Site layout map for the second round (colors are schematic)

Thick white lines: Central crossing partitions

Orange area: Range of movement of robots in the second rounds

Green area: Restricted area - Range of movement of the shooters before they catch the ball in the second rounds.

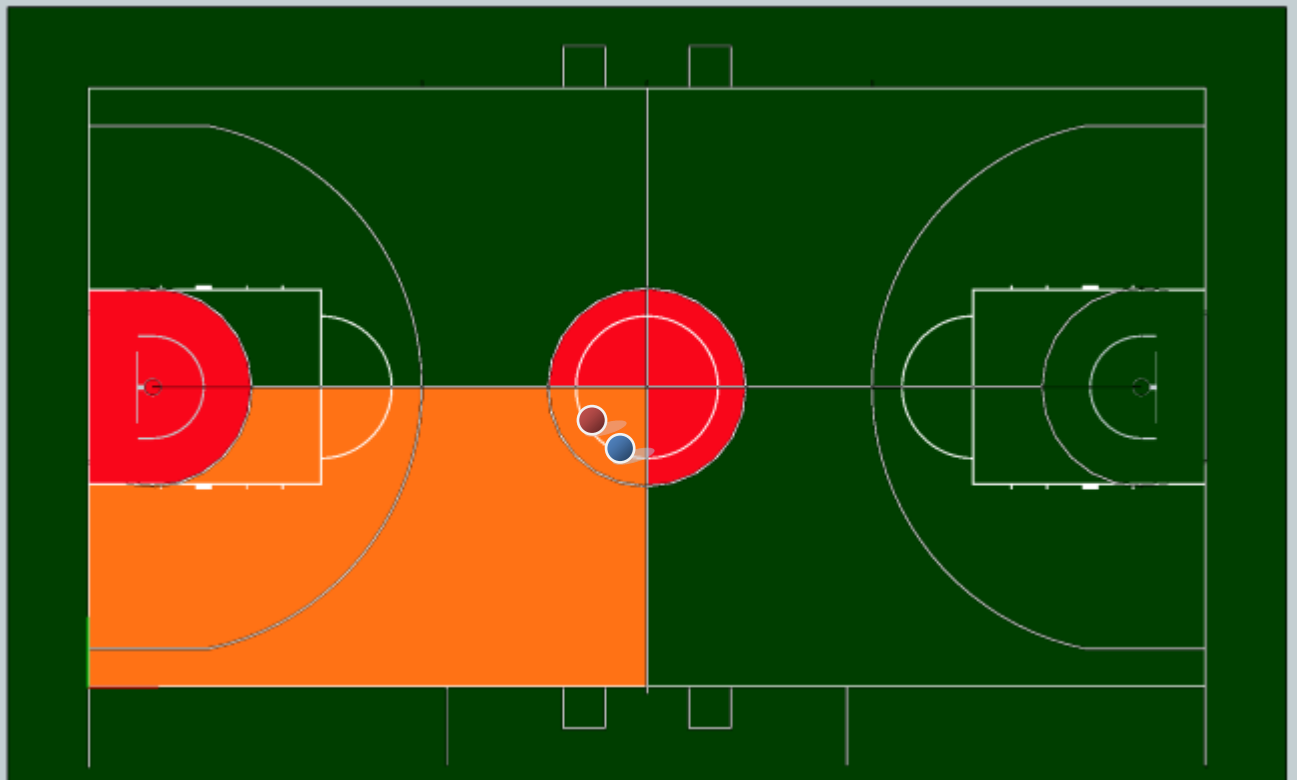
Purple double arrow: Possible location of the basketball on the three-point line

Purple area: Possible locations where stationary defensive obstacles might appear. They should be placed randomly by the assistant referee during preparations for the second round.

There are two sizes of the obstacles : Length 45 cm, width 45 cm and height 130 cm or length 47 cm, width 37 cm and height 51 cm

(The robots and shooters may only play in the designated 1/4 of the court.)

20. In the sixth round, the crossing partitions in the center of the court will be removed. The movement range of the robots near the central circle will be enlarged to include the entire passing area (within a radius of 2.5 m from the center of the court), and the area under the center of the basketball hoop will be expanded to within a radius of 2.5 m. A robot can take all eight basketballs on the court (four standard balls and four colored balls), but must first throw all basketballs in its designated area. In this round, 50 points, there is no restriction on the distance a robot throws a ball in this round, but robots are prohibited from colliding with another team's robot or stealing a ball controlled by another team's robot in this round.



Site layout map for the sixth round (colors are schematic)

Orange area: Range of movement of robots in the third round  
 Red area: Conditional range of movement of robots

21. Additional points will be granted for tasks that are completed early in the first two rounds; a full score is 10 points. The referee will start the timer when each round is started, and will stop the timer after the shooter (or robot) throws the last ball and the ball which touches the backboard or goes through the net or the hoop. A robot will receive time points if it passes the ball to the shooter via a "valid method" in a round and the time used is less than 150 seconds. Calculation method:  $\text{Time points} = \min\{10, (150 - \text{number of seconds used}) / 4\}$ , which means that 10 points will be granted when it is completed within 110 seconds. When a pass is completed between 110 seconds and 150 seconds, the team will receive reduced time points due to its increased time usage.
22. A robot's full return score is 10 points in the first two rounds. The robot will receive a return score of 5 or 10 points when it can return to the designated starting area (base) autonomously before a round is over and after it passes or carries the last ball to the shooter. 10 points will be granted when a robot's entire contact area is within the base frame line after stopping in the base; five points will be granted if the robot steps over the line. No instrument can be used to help a robot return.
23. 50 points will be deducted for each instance of a robot's autonomous interruption of other team's picking up, passing, or shooting of a ball, and the referee shall have the right to cancel a team's competition eligibility should such an interruption occur.

24. A round will end early when no basketball is left on the court (all balls have been shot by the shooter or have rolled off the court) or the robot has been stopped on an emergency basis before the time is up for this round. However, the teams must wait until the preparation for the next round has started before bringing their robots back to their bases.
25. When a situation occurs in the middle of a round, and when the players request it, the assistant referee can stop a robot on an emergency basis. The team in question can retain the score the robot received prior to the emergency stop.
26. The referee or assistant referee can stop a robot on an emergency basis when any violation has occurred in the middle of the competition or if any situation that the referee deems might affect the competition and/or safety has occurred. Depending on the circumstances, the referee may indicate whether to retain or cancel the score received during this round.
27. Total score for each round:

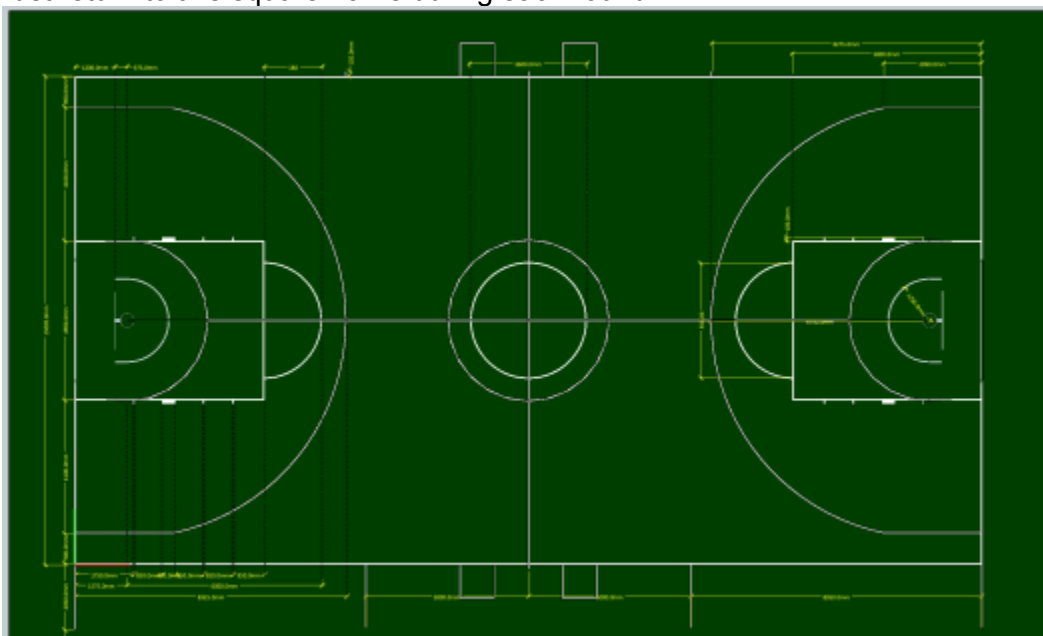
First round (two passes: 40 points + two shots: 20 points + round time: 10 points + effective return: 10 points)	80
Second round (obstacle avoidance: 50 points + two passes: 40 points + two shots: 20 points + round time: 10 points + effective return: 10 points)	130
Third round (each basketball shooting: 50, two balls each 1/4 round, eight balls total)	100 (maximum score: 400 points)
Total score	310(~610)

28. Depending on the number of teams, the competition may be divided into a preliminary competition, semifinals, and final. The top four teams from the semifinals will enter the final. One team from each country can enter the semifinals regardless of its preliminary score.
29. In the final, the total score of the round will determine the ranking in the competition. The team with the lighter robot will be the winner when more than one team share the same score.

## Explanation of competition site and relevant equipment

1. The competition site consists of a standard basketball court (28 m x 15 m), and is pieced together from 21 dark green thin floor mats. The lines are laid out with paint or white packing tape with a width of 5 cm, as shown in the Figure below. The unevenness caused by the joints in the floor mats must be taken into the consideration when designing robots.

The robots' starting location is inside the lines of the 100 cm square frame. The front edge of the frame lines are even with the boundary lines, and the sides of the frame lines are 100 cm from the centerline. The robot must return to this square frame during each round.



2. Standard No. 7 basketballs are used, and the balls' circumference will not be smaller than 75 mm or larger than 78 mm. The organizers will use Spalding NBA Varsity basic orange basketballs and Spalding colored basketballs.



(photo from the PChome shopping network)

3. Central crossing partitions: The balls are placed on the ball-holders located along the circumference of the central circle (3.6 m diameter). White crossing partitions, 45 cm in height and 200 cm in radius, are installed in the center, and divide the central circle into four sections.

