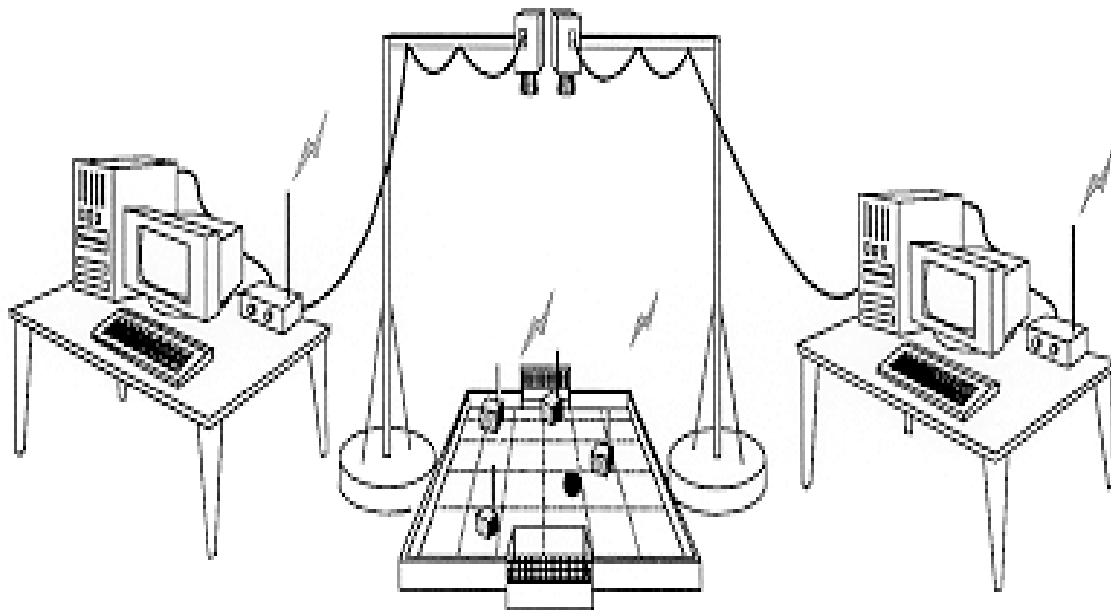


ROBOT SOCCER COMPETITION

INTRODUCTION

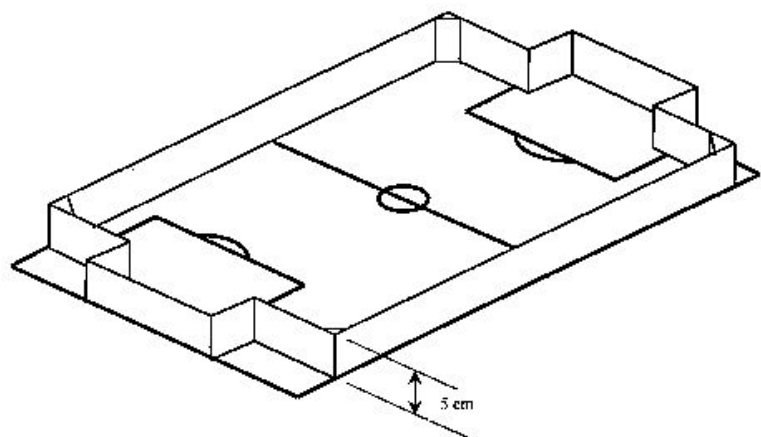
The objective of the robot soccer is to build a team of robots to play 3-a-side football against an opponent robot team. Each robot soccer team shall setup a global vision system, which is above the football field, to keep track of their robots and ball positions. A host computer may process the vision information and send the motion commands to soccer robots through radio frequency communication.



The robot soccer designers have to take up the challenges such as to identify their own robots, the ball, and the opponent robots through the vision information, and to establish a reliable protocol for the radio frequency communication. They need also to implement various strategies among the team robots for attacking and defending, and to manage the fouls that comprise of free ball, penalty kick, goal kick, and free kick.

1. THE FOOTBALL FIELD SPECIFICATIONS

- 1.1 The dimensions of the football field is 150cm (length) x 130cm (width) x 5cm (height). The whole field shall be made of wood and the surface texture shall be similar to the table-tennis table. The floor of the field is painted matted black and the walls that constitute the height are in white.



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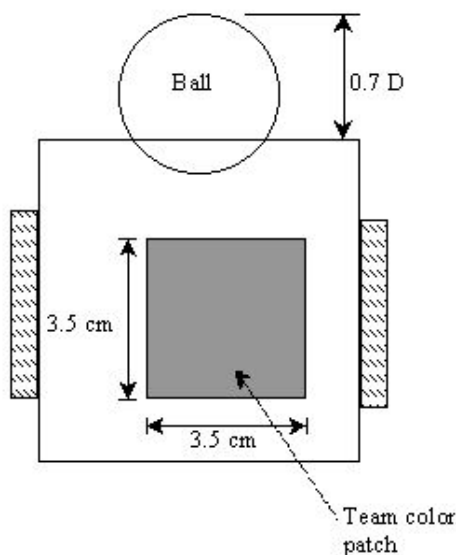
- 1.3 The goal shall be 40cm wide. No posts and net shall be used to avoid obstruction to the global vision system
- 1.4 The football field shall be located indoor and the luminous level shall be about 700 lux.

An orange golf ball shall be used as the football. Its diameter is 42.7mm and the weight is 46g.

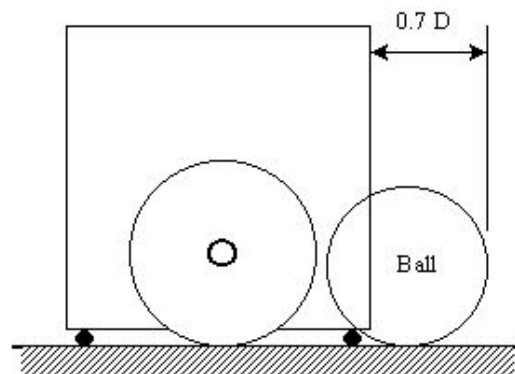
3. Robot Specifications

- 3.1 The dimension of each soccer robot shall be 7.5cm (width) x 7.5cm (length) x 7.5cm (height). The robot height shall not include the antenna.
- 3.2 Each robot shall put on a costume and the dimension shall not exceed 8cm (width) x 8cm (length) x 8cm (height). The costume shall not cover the antenna.
- 3.3 A color pad shall be printed or stuck on the top of the costume for team identification. Yellow and blue shall be used for team colors. The officials shall leave the two competing teams to decide which color to represent their robots. Otherwise the selection of team color shall be done by the toss of coin.
- 3.4 The dimension of color pad shall be not less than 12.25cm^2 or 3.5cm (length) x 3.5cm (width). The color pad shall not exceed the top area of the costume. A team may use more than one color for the robot identification provided the other color shall not be the same color as the ball (orange) or the opponent team color (yellow or blue).
- 3.5 All robots shall be fully autonomous (no external power source and manual control). The communication among the team robots and the host computer shall be through the radio frequency (rf). Each robot team shall accommodate two frequency channels so that no team shall share the same frequency channel with the opponent team.
- 3.6 Any robot may install a shooter or catcher but the overall robot size shall not exceed its allowable dimension (7.5cm (length) x 7.5cm (width) x 7.5cm (height)) when the shooter or catcher is activated. No team robot (except goalkeeper) shall be allowed to cover the ball more than 30% (neither from the side or top) when it occupies the ball. The goalkeeper robot shall hold and cover the ball completely only within the specified goal area.

The diameter of the ball $D = 42.7 \text{ mm}$



Top View of the Robot



Side View of the Robot

- 3.7 Whenever the referee whistles, all robots shall stop either by themselves or through the commands sent by the host computer.

4. Global Vision System Specifications

- 4.1 Each team shall be allowed to use their own vision system and camera for their robots. They may use their own camera stand provided the height of the camera is 2 meters or

above with respect to the floor level of the venue. The official camera stand shall be moved away if both teams provided their own stands. If both teams are not able to settle on their stand placements, the official stand shall be used.

- 4.2 The height of the official camera stand is 2 meters above the floor level of the venue. There shall be only **One** beam across the center of the football field supported by the camera stand. Either team may mount their camera on the left or the right side of the beam. The organizer shall leave the two competing teams to settle the camera positions. Shall there be any disagreement, the organizer shall decide the camera positions for both teams by the toss of coin.

5. Host Computer Specification

Each team shall be allowed to use more than one computer (any computer) as the host computer. The host computer may send any information to the soccer robots through the rf communication while the match is in progress. But the host shall not control the motion of robots directly through the host keyboard or joystick. However the soccer strategies can be modified through the host computer while the match is paused.

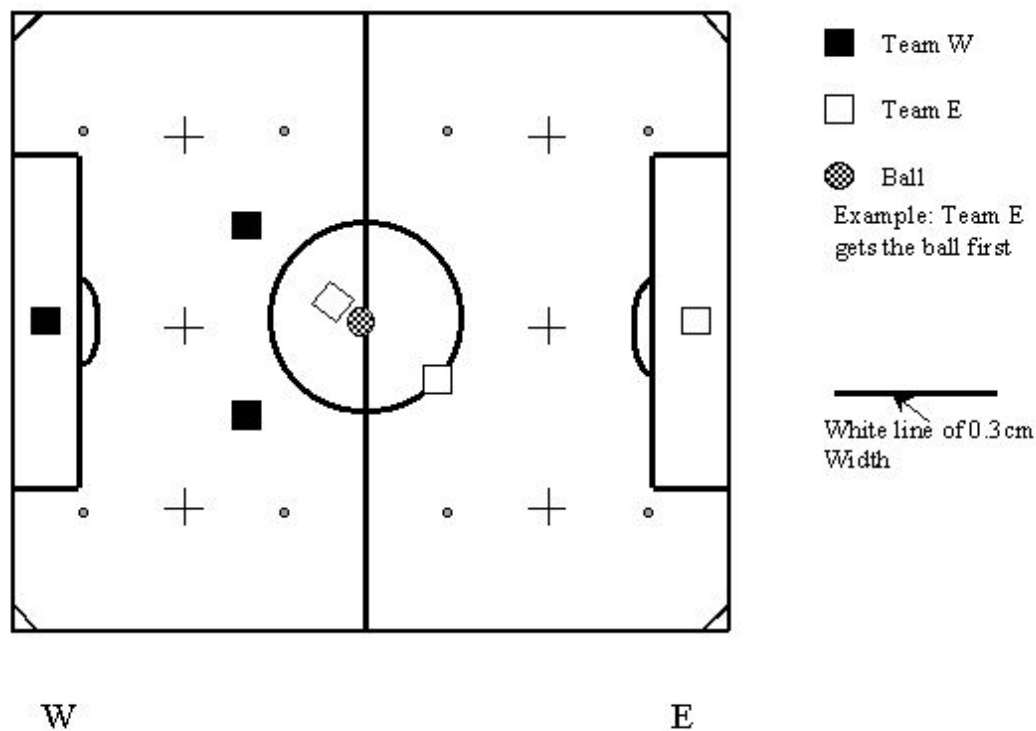
6. Rules for the Competition

- 6.1 All participating teams shall compete among each other through a mixture of the league and knock out systems. The final decision for the competition shall be announced upon the closure of the registration.
- 6.2 The duration of a match for two competing teams shall be divided into two periods. Each period shall last for 5 minutes, excluding the time for robot substitution, timeout, and any fouls encountered. A timekeeper shall be appointed to stop the official clock when all these happened. There is a **half time** break of 10 minutes between the two periods.
- 6.3 Any team shall be given an additional 5 minutes if they are not able to start the match or resume the match upon the expiry of the half time break. The team shall be considered to have lost the match if they are still unable to play after the additional 5 minutes is over.
- 6.4 Any team shall be given 3 chances to substitute faulty robots throughout the match. These chances shall be used either in the first period or the second period or both but the total substitutions shall not exceed 3 times. However, there will be no limits to the number of substitutions during the half time break. When a team requires a substitution, the handler shall notify the referee by calling '**substitution**' and the referee shall stop the match only when a foul or free ball situation is encountered.
- 6.5 Any team shall be given 2 time-outs throughout the match that includes the first period and the second period. When a team requires a time-out, the handler shall notify the referee by calling '**time-out**' and referee shall stop the match only when a foul or free ball situation is encountered.
- 6.6 Each team shall be allowed **two** members to handle the match. One of the members is to operate the host computer. Another is to place the robots in the football field during the start of the match period, the substitution, the time-out, and when any foul is encountered. The rest of members shall keep away from the football field area. A referee shall be appointed by the official to blow the match. He/she shall be a neutral person and is not a member of the competing teams.
- 6.7 When a match is about to start, the referee shall decide which home field for the two competing teams and which team to kick off first by the toss of coin. Both teams shall

settle the team color (yellow/blue) and the rf channel by themselves before seeking the referee's decision. The kick-off team shall place their robots in their own field first, followed by the opponent team. A kick-off robot shall be placed in the opponent field (within the center circle) for the kick off.

- 6.8 The ball shall be placed by the referee at the center of the center circle for the kick off. The kick-off team shall pass or kick the ball back to its own field area first. If a kick-off team fails to complete this task for twice, a goal kick shall be awarded to the opponent team. The defending team has to wait for the kick-off team to touch the ball before their robots start to move.

- 6.9 A sample for the robot kick-off positions is given below



- 6.10 The robot kick-off positions shall be applied after a goal is scored by a competing team. The loser shall be the kick-off team.
- 6.11 After the half time break, both competing teams shall exchange their home field before the kick-off.
- 6.12 A team shall be considered to have scored a goal if its robot passes/kicks the ball across the goal line. The number of goals scored shall determine the match winner. If there is a draw after the second period, the match shall continue for an additional 3 minutes under the '**sudden death**' rule that is the match winner is determined by the team which scores the goal first within the additional 3 minutes. During the additional 3 minutes match, there shall be no changing of field between the two teams.
- 6.13 If a draw still persists after the additional 3 minutes has expired, the match winner shall be determined by penalty kicks. Each team shall be given 3 chances. Any team robot shall be the penalty kicker. The referee shall place the ball at the penalty kick marking. The kicker shall place the robot behind the ball first and the opponent goalkeeper robot shall be placed along the goal line later. After the referee's whistle, the goalkeeper may move freely within the goal area box and the kicker shall kick the ball. A penalty kick shall be completed, if:

1. the ball crosses the goal line,
2. the goalkeeper catches the ball in the goal area box,
3. the ball comes out from the goal area,
4. 30 seconds have passed after the referee's whistle.

If the score is still a draw after the 3 penalty kicks from each team, the penalty kick shall proceed on a one-to-one basis until a match-winner is decided. A goal scored shall be disqualified if the kicker pushes the goalkeeper and the ball across the goal line.

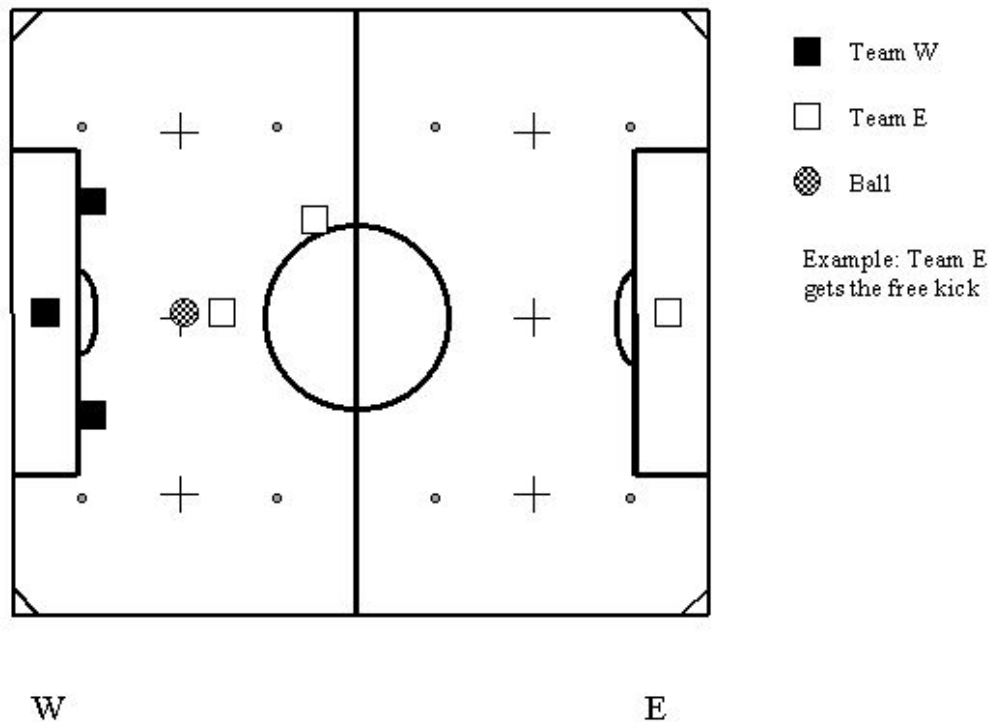
6.14 There shall be 8 fouls situations, they are

- 6.14.1 Any robot shall not adopt pushing away the opponent robots (except the opponent goalkeeper) as the match strategy. The referee shall award a free kick to the opponent team whenever this happens. However the referee shall allow both competing robots to push each other indirectly through the ball or if the push (directly or indirectly) does not affect the play of the match.
- 6.14.2 Any attacking robot shall not be allowed to push the defending goalkeeper robot and the ball to score a goal. Any goal scored under this circumstance shall be disqualified. The referee shall award a goal kick to the goalkeeper.
- 6.14.3 The attacking team shall not send any robot to block the defending goalkeeper robot from attending the ball as the match strategy. If this happens, the referee shall award a goal kick to the goalkeeper.
- 6.14.4 An attacking robot shall not stay within the opponent's goal area box for more than 10 seconds. The robot has to retrieve from the goal area within 10 seconds and then re-strike again if necessary. The referee shall award a goal kick to the goalkeeper if the attacking robot stayed longer than 10 seconds. Under no circumstances shall two attacking robots be allowed to stay in the opponent's goal area. Whenever this happens, the referee shall award a goal kick to the goalkeeper immediately. An attacking robot shall be considered to be within the opponent's goal area if more than 50% of its body is inside the goal area.
- 6.14.5 Only the goalkeeper shall be allowed to stay within its own goal area box. Any additional team robots, besides the goalkeeper; shall not stay in the goal area for more than 10 seconds otherwise the referee shall award a penalty kick to the attacking team. However, the additional team robot (other than the goalkeeper) may be allowed within the goal area provided the robot does not perform the defense or affect the play of the match. The referee shall be the judge of the situation.
- 6.14.6 A goalkeeper shall not hold/cover the ball for longer than 10 seconds in the goal area (2 chances) otherwise the referee shall award a free kick to the opponent team.
- 6.14.7 A goalkeeper shall not hold/cover the ball outside the goal area otherwise the referee shall award a free kick to the opponent team.
- 6.14.8 If a ball does not move for more than 10 seconds, the referee shall award a free ball to both teams.

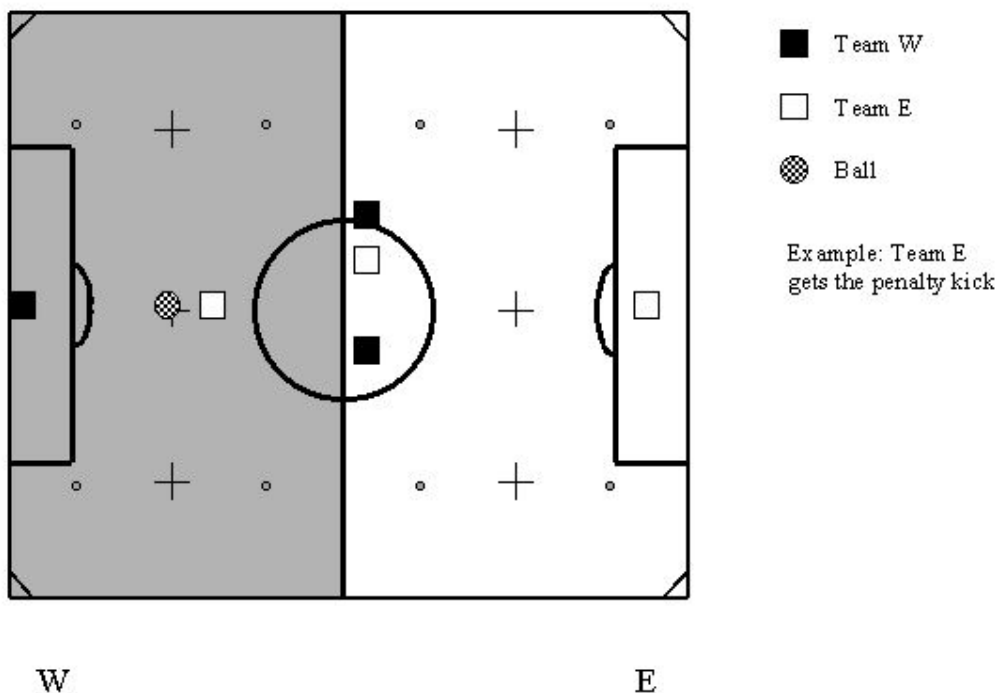
6.15 Samples of the robot placements for various kicks are given below,

- 6.15.1 Free Kick – The ball shall be placed at the free kick marking by the referee. Both defending robots shall be placed along the front line of the goal area box. One of the attacking robot shall be placed behind the ball and the other shall be placed

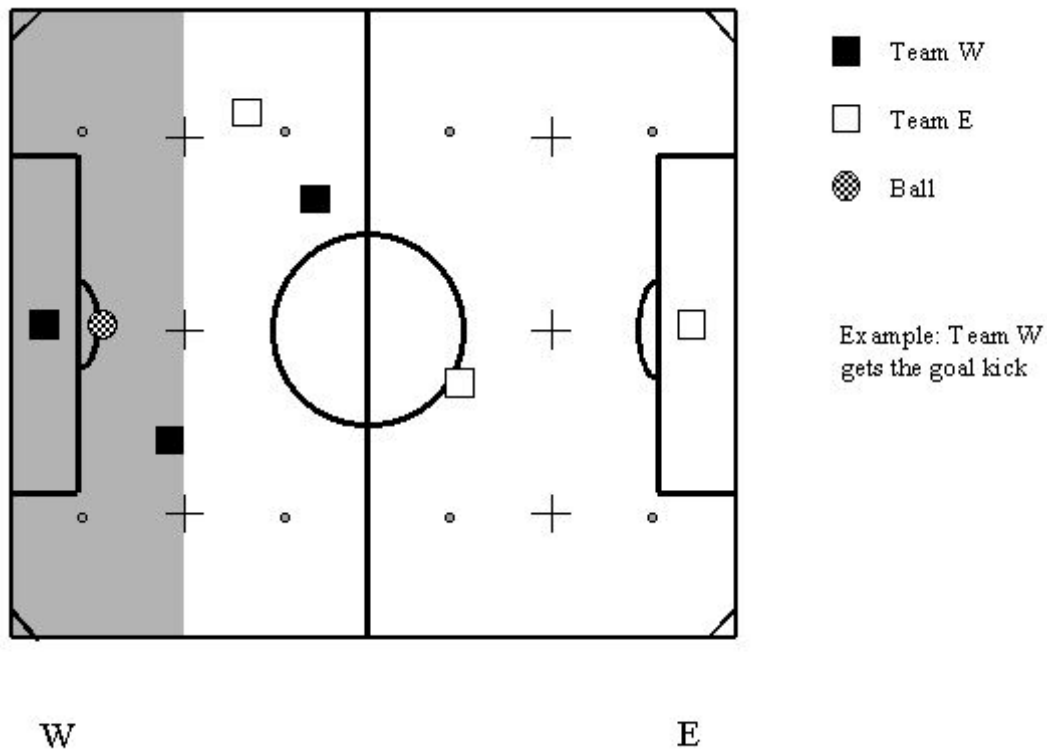
behind the robot taking the free kick. The opponent team shall place their robots first.



6.15.2 Penalty Kick – The ball shall be placed by the referee at the penalty kick marking. The defending goalkeeper robot shall be placed along the goal line. An opponent robot taking the kick shall be placed behind the ball. All other robots shall be placed in the opponent field behind the centerline. The defending team shall place their robot first. After the referee's whistle, all robots shall wait for the penalty kicker to touch the ball before they are allowed to move freely.



- 6.15.3 Goal Kick – The goal kicker team can place the ball at any position within the goal area box or along the goal area box lines. The goal kicker team shall place the robot freely in the field first. The opponent team shall not place their robots beyond the free ball markings on the goal kicker's home field.



- 6.15.6 Free Ball – There are 4 free ball placement markings provided in each quarter of the football field for which to place the ball for free ball situations, depending on which quarter the ball is in when the whistle is blown. The referee shall place the ball at the quarter's free ball markings. The defending team shall place their robots first. Both other team robots shall be placed outside the quarter that the free ball is to be kicked.

