ROBOT SOCCER COMPETITION

1. THE FIELD AND BALL

1.1 Dimensions

A wooden rectangular playground (150cm x 130cm) painting in matted black, which is enclosed by 5cm high white walls, will be used. The surface texture of the wooden playground will be that of the table tennis table.

1.2 Markings on the playground

The field should be marked as shown in Appendix 1. Lines of 3mm thickness will mark the half-line and goal lines. The centre circle will have a diameter of 40cm. An arc (20cm along the goal line and 5cm in perpendicular to goal area) shall be used for the goal kick. The major lines/arcs (centre line, goal area borderlines, centre circle, arc just beyond the goal area) will be marked with 3mm white lines. The four-corners of the playground will be fended off (by 7cm), to avoid the ball to be stuck at the corner (See Appendix 1 and 2). The cross markings for penalty kick, free kick, and free ball shall be in 1mm thickness and the length of the lines is 5mm. The color of the marking is white. The solid circle markings for free ball positions are in white with 2mm diameter.

1.3 The Goals

The goal shall be 40cm wide. Posts or nets shall not be used at the goal for the vision system.

1.4 The Goal Area

The goal area shall be 70cm x 15cm in front of the goal.

1.5 The Ball

An orange golf ball shall be used as the ball (Diameter 42.7mm, weight 46g).

1.6 The Field Location

The field shall be in-door.

1.7 The Lighting Condition

The lighting condition in the competition site shall be fixed around 700 Lux.

2. PLAYERS

2.1 Overall System

Two teams shall play a match; each team consists of three robots, one of which can be a goalkeeper (See 2.2.2). One host computer per team, its functions mainly dedicated to vision processing, identify robot positions, and send start/stop commands to robots, can be used (See Appendix 3). Only two of the human team members, either the “manager”, the “coach”, or the “trainer” shall be allowed at the stage. One of these two members handles the robots. Another operates the host computer.

2.2 Robots

2.2.1 The size of each robot shall be limited to 7.5 cm x 7.5 cm x 7.5 cm. The height of the antenna will not be considered in deciding a robot’s size.

2.2.1.1 The tops of robots must not be colored in orange or white. Each team will be assigned with a team colors (either blue or yellow) so that the own robots and the
opponent robots can be distinguished. All robots must have a minimum 3.5cm x
3.5cm solid square region or a minimum 4.0cm diameter solid circle region or a
minimum 1.5cm x 9.0cm solid rectangle region for their team color patch (exactly as
provided by the organizers), which are visible on their tops. The minimum area for the
color patch is 12.25cm$^2$ and the maximum area for the color patch is 56.25cm$^2$ (the
dimensions of the color patch shall not exceed the robot size limit). Please note a team
color might need to change from game to game so the color patch on each robot
should be removable (See Appendix 4). When assigned with one of the 2 team colors,
the robots must not have any visible color patches of that of the opponent team.

2.2.1.2 Each robot team should have their uniforms and its size is limited to 8cm x
8cm x 8cm (excluding the height of antenna). The four sides of any robot uniform
should be colored in light colors, except at those sides necessarily used for its robot
functionality (such as sensors, wheels, and ball catching mechanism). The side is
intended to enable infrared sensing.

2.2.2 The robot inside its own goal area shall be considered as the "goalkeeper." The
goalkeeper robot shall be allowed to catch or hold the ball only within its own goal area.

2.2.3 Each robot must be fully autonomous, with self-contained power and actuators. The
transmission of commands between the robot and the host computer shall be only
allowed through wireless communication. All robots must be able to accommodate two
frequency channels so that no robot will share the same frequency channel with its
opponent robots.

2.2.4 The robots shall allow being equipped with limps but they must meet the size
restrictions even when the appendages are fully expanded. None of the robots, except the
“goalkeeper” robot shall be allowed to catch or hold the ball such that not more than
30% of its diameter shall be enclosed by the robot either from the top or the sides. The
ball should never be lifted up from the playground at any time (See Appendix 4).

2.2.5 Whenever the referee whistles, all robots shall be stopped by the host commands
transmitted through the wireless communication.

2.3 Substitutions

Three substitutes shall be permitted during the game in progress (including the first-half
match and second-half match). At half time, unlimited substitutions can be made. When
a substitution is desired while the game is in progress, the concerned team member who
handles the robots at the stage should call ‘substitution’ to notify the referee, who will
stop the game in cases of fouls, free balls, etc.

2.4 Time-Out

Only the concerned team member who handles the robots at the stage can call for ‘time-
out’ to notify the referee. The referee should have to approve these requests in cases of
fouls, free balls, etc. Each team will be entitled to requesting for time-out, twice in a
game (including the first-half match and second-half match) and the duration of each
time-out is 2 minutes.
3. TRANSMISSIBLE INFORMATION

Only those two team members, who are at the stage, may transmit certain commands directly from the host computer to their robots. Commands, such as, reset signals to stop all robots or the restart signals can be transmitted during the game is in progress. Other information, such as soccer strategies, can be communicated only when the game is not in progress. The manager, the coach or the trainer under no circumstances, directly controls the motion of their robots either with a joystick or by keyboard commands. The host computer can send any information during a game autonomously.

4. VISION SYSTEM

Global vision system can be used. The location of camera or any other sensor systems should be restricted to the top of the area above their own half of the playground including the centre line (so that the camera need not be moved at halftime). Should both teams want to put their cameras over the centre circle, they will be placed side by side at equal distance from the center and as close as possible. The height of the camera or the sensor system should be higher than or equal to 2 meter, above the playground (See Appendix 3).

5. DURATION OF THE GAME

5.1 The duration of the game shall be two equal periods of 5 minutes each with a half time interval of 10 minutes. An official timekeeper will stop the clock, during the substitutions, during the time-out, and any fouls encountered. The timekeeper will resume the clock when the referee whistles the game to re-start. The referee should allow the free kick and penalty kick to be finished even though the game period is over when the clock resumes.

5.2 If a team is not ready to resume the game after the half time, additional 5 minutes shall be allowed. The team will be disqualified from the game if the team is still not ready to continue after the additional half time given.

6. THE START OF PLAY

6.1 Before the beginning of a game, two competing teams will decide the team color (blue/yellow) and the ball by a toss of a coin. The team getting the toss shall be allowed to choose either the team color or the ball. The team getting the ball shall be allowed to opt for the frequency channel for the wireless communication. The team selecting the team color shall be allowed to choose which side of the field for their robots playing first. The referee should allow the two competing teams to settle the team color and the frequency channel for the wireless communication on their own efforts. If so, the toss of a coin shall determine the ball and the side of the field playing between the competing teams.

6.2 The attacking team will position their robots freely within their own area. Then the defending team can place their robots freely within their own area except in the centre circle (See Appendix 5). A robot of the attacking team can be placed in the opponent side within the centre circle.

At the beginning of the game, in the first and second half, the ball should be kept at the centre of the centre circle and the ball should be kicked or passed back towards the attacking team area. Failing to do so which the game will be stopped and a second chance will be given. Failing to do so in the second time, a goal kick will be given to the opponent team. Once the referee whistles the game to play, all robots may move freely.
6.3 At the beginning of the game or after a goal has been scored, the game shall be commenced/continued, with the positions of the robots as described in 6.2.

6.4 After the half time, the teams shall have to change their sides.

7. **Method of Scoring**

7.1 **The Winner**

A goal shall be scored when the whole of the ball passes over the goal line. The winner of a game shall be decided on the number of goal scored.

7.2 **The Tiebreaker**

In the event of a tie after the second half, the winner will be decided by sudden death. The game will be continued with the robot positions, as were, at the end of the second half time, for a maximum period of three minutes. The team managing to get the first goal will be declared as the winner. If the tie persists even after the extra 3 minutes of play, the winner shall be decided by penalty-kicks (three chances for each team), which differs from Law 11, as only a kicker and a goalkeeper shall be allowed on the playground. The goalkeeper should be in its own goal area and positions of the kicker and of the ball shall be the same as in Law 11. After the referee’s whistle, the goalkeeper may come out of the goal area. In the case of a tie even after the three-time penalty-kicks, additional penalty-kicks shall be allowed one-by-one, until the winner can be decided. All penalty-kicks may be taken by one robot and shall commence with the referee’s whistle. The robot shall be only allowed to kick once. A penalty-kick will be assumed to be completed, when any one of the following happens:

1. When the goalkeeper catches the ball in the goal area.
2. When the ball comes out of the goal area.
3. Since 30 seconds pass after the referee's whistle.

8. **Fouls**

8.1 Colliding with an opponent robot, either intentionally or otherwise; the referee will call such fouls, that directly affect the play of the game or that appear to have potential to harm the opponent robot. It is permitted to push the ball and an opponent player backwards provided the pushing player is always in contact with the ball. It is not permitted to push the opponent goalkeeper under any circumstances within the opponent goal area (even if the ball is between the pushing robot and the goalkeeper). If this happens, the referee shall call the “goal kick” as “goalkeeper charging”.

8.2 Attacking with more than one robot in the opponent goal area, (a robot is considered to be in the goal area if it is more than 50% inside, as judged by the referee), shall be penalized by a goal kick to be taken by the defending team.

8.3 Defending with more than one robot, (including the goalkeeper robot), in its goal area, (a robot is considered to be in the goal area if it is more than 50% inside, as judged by the referee), shall be penalized by a penalty kick to be taken by the attacking team.

An exception to this is the situation, when the additional robot in the goal area is not there for defense or if it does not directly affect the play of the game. The penalty kick should not be awarded. The referee shall judge the situation.
8.4 Being called “Handling” by the referee; when a robot that is not a goalkeeper catches the ball or a goalkeeper catches the ball out of its own goal area. It is also considered “Handling” if a robot firmly attaches itself to the ball so that no other robot can take the ball. A penalty kick will be called against the team committing the “Handling”.

8.5 The goalkeeper robot should kick out the ball in the goal area within 10 seconds of its holding. The failure to do so will be penalized by a penalty kick to the opponent team.

8.6 Intentional blocking of a goalie within its goal area will be penalized by a goal kick given to the defending team.

9. **INTERUPTION OF PLAY**

The play shall be interrupted and the team member who is at the stage to handle the robots, shall do the relocation of robots only when:

9.1 A robot has to be changed.
9.2 A robot has fallen in such a way as to block the goal.
9.3 A goal is scored or a foul occurs.
9.4 Referee calls "goal-kick" (See Law 12) or "free-ball" (See Law 13).

Only the referee and the team member who is at the stage to handle the robots shall be allowed to touch the robots. Touching the robots without the referee’s permission shall be penalized by a penalty kick awarded to the opponent team.

10. **FREE-KICK**

The team that fouled places robots at positions in touch with the goal area on either side of the arc, which is just outside the goal area. The ball shall be positioned at the free kick marking, which is same as the penalty kick marking. The attacking robot which is taking the ball, should be behind the ball. Another attacking robot shall be in any position but it has to be behind the robot which is taking the ball (See Appendix 6). When the whistle blows, all robots can start moving freely.

11. **PENALTY-KICK**

When the referee calls a penalty kick, the ball shall be positioned at penalty kick marking, which is same as the free kick marking. The goalkeeper is placed along the goal line. The robot taking the kick shall be behind the ball. All other robots (including other defending robots) are placed in the opponent half field (See Appendix 7). The defending team shall position the robots first. All robots (including goalkeeper) must wait for the penalty taker to touch the ball before they start to move when the whistle blows.

12. **GOAL-KICK**

A goal kick will be called by referee whenever the goalkeeper catches the ball in its own goal area or when an attacking robot pushes the goalkeeper in its goal area or when a stalemate continues for 10 seconds in the goal area.

At the beginning of the game, in the first and second half, the ball should be kept within the centre circle and the ball should be kicked or passed towards one’s own area. Failing which the game will be stopped and a second chance will be given. Failing to do so in the second time, a goal kick will be given to the opponent team.
During goal kick only the goalie will be allowed within the goal area and the ball shall be placed along the arc in front of the goal area. Other robots of the team shall be placed outside the goal area and the arc during goal kick. The attacking team will get preference in positioning their robots anywhere in the playground then the defending team. The defending team can not place the robots beyond the free ball markings on the opponent field. But it also must be as per 8.3. The game shall be restarted by the referee’s whistle (See Appendix 8).

13. **Free-Ball**

The referee will call a free ball when a stalemate continues for 10 seconds outside the goal area. The field shall be divided into 4 equal areas. Each quarter has a free ball marker, which positions at 25cm apart from the nearest side of the field and 37.5cm apart from the nearest goal line. When a free ball is called within a quarter, one robot per team will be placed at locations 20cm apart from the ball position in parallel. The defending team can place the goalie robot within the goal area. Other robots (of both teams) can be placed freely outside the quarter where the free ball is being called (but the defending team gets their preference for positioning their robots (See Appendix 9).

**Appendix 1 : The Playground - its dimensions and markings**
Appendix 2 : Side view of the playground

Appendix 3 : Overall System

Appendix 4 : The contact between the robot and the ball must satisfy the 70% rule
Appendix 7

Example: Team E gets the penalty kick

Appendix 8

Example: Team W gets the goal kick
Example: The free ball called in Area P.