

FIRA RoboSot Competition

Rules and Regulations for 2016

Version - 2.4.2

Prof. Jong-Hwan Kim
Prof. Shih-An Li
Dr. Hung-Chih Teng
Sunglok Choi
Cheng-Yao Ho
Kung-Han Chen
Sheng-Po Huang

Prof. Ching-Chang Wong
Dr. Daniel J. Stonier
Dr. Chih-Cheng Liu
Naveen S. Kuppuswamy
Chia-Jun Yu
Li-Hsiang Chou

Aug 2, 2016

RoboSot Goals

Research on mobile robot platforms is receiving an increasing share of attention, especially in the area of household domestic appliances. The problems and challenges facing the development of these platforms are many, varied and often significantly different from the problems faced in both the smaller sized and humanoid leagues.

Compared to the smaller sized leagues, these robots are fully autonomous and this brings many challenges in the areas of hardware design, communication, co-operation, intelligence and sensing. While in comparison to the humanoid leagues, they have the flexibility to employ non-human like sensing and motion systems. This creates a much faster platform and this alone brings challenges in sensing, locating, and planning to the fore.

It is our goal that the RoboSot competition will be a dynamic competition that continually shifts its goalposts from year to year to meet the problems and challenges that arise in this field. We also hope that competing teams will also find the challenges along this path both interesting and rewarding.

Recent Changes

This is a list of the recent changes made to this document.

Competition Structure - We add descriptions of **Captains' Meeting** and **Referees' Meeting**, please read thoroughly. [*Addition - 05/20/2016 - v.2.4.0*]

Decision of the Referee and Assistant Referee - Before the match, every referee must attend the referee meeting. Each team can assign more than one referee (assigning two referees is suggested). The main purpose for the meeting is to ask if they are willing to be a referee and to solve the disputes on the rules. [*Addition - 03/04/2016 - v.2.3.0*]

RoboSot Challenges - The Open Challenge has been removed. On the other side, we add new challenge, Passing Challenge. In addition, the other two challenges' rules and new challenge's rules have been announced, please read thoroughly. [*Addition - 03/04/2016 - v.2.3.0*]

The rule of time recorded, score information, and obstacles placing rules in Avoidance Challenge has been amended. In Passing Challenge, the mainly rules (orange cone has been modified to red one) and score information has been amended, please read thoroughly. [*Amendment - 07/20/2016 - v.2.4.1*]

The field in Localization Challenge has been amended. Add a ball-placed point at the center of the field, please read thoroughly. [*Amendment - 08/02/2016 - v.2.4.2*]

The Field of Play - The statement about "Free Ball Points", "Corner Points", and "The Goal" has been amended. [*Amendment - 05/20/2016 - v.2.4.0*]

The Appearance of Robot - The title of this chapter has been changed from "Robot Color" to "The Appearance of Robot." New rules about "Each robot must be marked with number" has been updated, for more details, see section 4.4.2. [*Addition - 05/20/2016 - v.2.4.0*]

Game Setup - The statement about "Coin Toss" is amended. [*Amendment - 05/20/2016 - v.2.4.0*]

Interruption - If a team wants to change robot, the team leader must call "Substitution" instead of "Time out" now. The statement about "A Goal is Scored" has been amended. [*Amendment - 05/20/2016 - v.2.4.0*]

Fouls - The statement about "Handling" has been amended. New penalties for "Kicking" has been updated, for more details, see section 4.8.3. [*Amendment - 05/20/2016 - v.2.4.0*]

Action - Notice that when the actions occur out of the penalty area, the robots that are not holding the ball must stay at least 1 meter away from the ball. The description of the subtitle of this rule is amended too. The statement about "Free Kick" and "Goal Kick" has been amended. [*Amendment - 03/04/2016 - v.2.3.0*]

Contents

1. Competition Structure	1
1.1 Captains' Meeting	1
1.2 Referees' Meeting	1
2. The Referee and Assistant Referee	2
2.1 The Authority of the Referee	2
2.2 Powers and Duties of the Referee	2
2.3 Duties of the Assistant Referee	2
2.4 Decision of the Referee and Assistant Referee	3
3. RoboSot Challenges	4
3.1 Localization Challenge	4
3.2 Avoidance Challenge	7
3.3 Passing Challenge	9
4. RoboSot Soccer Competition	14
4.1 The Field of Play	14
4.1.1 Markings on the Playground	14
4.1.2 Playground Dimensions	15
4.1.3 The Goal	15
4.1.4 Field Location and Lighting	16
4.2 The Ball	16
4.3 The Team	17
4.3.1 Human Personnel	17
4.3.2 Team Size	17
4.3.3 Goalkeeper	17
4.3.4 Remote Computer	17
4.4 The Robots	17
4.4.1 Robot Size	17
4.4.2 The Appearance of Robot	17
4.4.3 Autonomous System	18
4.4.4 Robot Behavior	18
4.5 Communication	19
4.5.1 Remote Computer Control	19
4.5.2 Inter-Robot Communication	19
4.6 The Game	19
4.6.1 Game Setup	19
4.6.2 Game Duration	20
4.6.3 Kick-Offs	20

4.6.4	Winning the Game	20
4.7	Interruptions	21
4.7.1	Substitutions.....	21
4.7.2	Repair and Stop.....	21
4.7.3	Fallen Robot.....	22
4.7.4	A Goal is Scored	22
4.7.5	Ball Outside	22
4.7.6	Stalemate.....	22
4.8	Fouls.....	22
4.8.1	Handling.....	22
4.8.2	Collision.....	23
4.8.3	Kicking.....	23
4.8.4	Goalkeeper Push	23
4.8.5	Obstruction.....	24
4.8.6	Offside.....	24
4.8.7	Touch	24
4.9	Actions	24
4.9.1	Free Kick.....	24
4.9.2	Penalty Kick.....	24
4.9.3	Free Ball.....	25
4.9.4	Throw-In	25
4.9.5	Corner Kick.....	25
4.9.6	Goal Kick.....	25

1. Competition Structure

The RoboSot Competition will consist of a series of challenges as well as the traditional soccer competition. All teams are expected to participate in the challenge competition. Teams not participating in the tournament are welcome to participate in the challenge competition. The winner of the challenge competition will be awarded a prize for technical achievements. For each category, an award will be presented to the winning team.

- RoboSot Soccer Competition
- Localization Challenge
- Avoidance Challenge
- Passing Challenge

In Addition, all participating teams must attend the following two meetings, in order to avoid the loss of rights.

- Captains' Meeting
- Referees' Meeting

1.1 Captains' Meeting

Before the match, each captain must attend the captains' meeting. Each team must assign one or two representatives to attend the meeting. The main purpose for the meeting is to solve the disputes on the rules and check the size and appearance of the robots (details shown in section 4.4.1 and 4.4.2). If a robot does not follow the rules, it will not be permit to join the competition.

1.2 Referees' Meeting

Before the match, every referee must attend the referees' meeting. Each team can assign more than one referee (assigning two referees is suggested). The main purpose for the meeting is to ask if they are willing to be a referee and to solve the dispute on the rules.

2. The Referee and Assistant Referee

2.1 The Authority of the Referee

A referee who has full authority to enforce the Laws of the Game in connection controls each match.

2.2 Powers and Duties of the Referee

- Enforces the Laws of the Game.
- Controls the match in co-operation with the assistant referees.
- Stops, suspends or terminates the match, at his discretion, for any infringements of the Laws.
- Stops, suspends or terminates the match because of outside interference of any kind.
- Stops the match if in his opinion, a robot seriously injured and ensures that he is removed from.
- Allows play to continue until the ball is out of play if a robot is, in his opinion, only slightly injured.
- Punishes the more serious offence when a player commits more than one offence at the same time.
- Acts on the advice of assistant referees regarding incidents, which the referee has not seen.
- Ensures that no unauthorized persons enter the field of play.
- Restarts the match after it has been stopped.
- Provides the appropriate authorities with a match report, which includes information on any disciplinary action taken against players, and/or team officials and any other incidents which occurred before, during or after the match.

Note: The rules are accomplished by referencing the FIFA Rule.

2.3 Duties of the Assistant Referee

- Acts as timekeeper and keeps a record of the match.
- When misconduct or any other incident has occurred out of the view of the referee.
- Assist the referee to control the match in accordance with the Laws of the Game.

Note: The rules are accomplished by referencing the FIFA Rule.

2.4 Decision of the Referee and Assistant Referee

Each participating team must train the referees and assistant referees before the game. Third party team acts the referees and assistant referees of each game.

The referees and assistant referees' schedule of each game will announce on the FIRA competition day.

***Note:** The rules are accomplished by referencing the FIFA Rule.*

3. RoboSot Challenges

The RoboSot challenges will change from year to year to reflect different research goals on a mobile robot platform.

3.1 Localization Challenge

The localization challenge requires the robots to develop and exhibit capabilities in one of the areas related to motion control, localization or path planning. This may often involve the interaction with other systems on the robot, but the goal is primarily to produce an efficient and effective localization system that enhances the robot's capabilities.

Note: The ball-placed point will not be draw.

Testing Time

Before the game starts, each team will have an independent 10-minutes testing time by turns, after that, there will be a 5-minutes common testing time.

Rules of the draw

The field will be divided into five regions: four points located on the four corners, and one point located on cross-shaped at the midfield. For the first to the fourth points, the field will be divided into four equal parts, and each part will have an independent draw. The fifth point will have a draw among the cross-shaped points.

Mainly

- Each team has 3 trials to complete this challenge. A robot plays this challenge in the play field without putting any objects or marks.
- There are 22 points on the field, divided into five regions. The five drawn-out points are the set points that all teams will challenge.

Note: The point at the center of the field is where the ball will be set before the challenge beginning.

- Before the game starting, the soccer ball will be placed at the center of the field, which call ball-placed point. The ball used in the challenges is same as the ball used in the soccer game. (Completely information in section 4.2)
- Before the challenge beginning, there are 3 minutes for each team to import these points information. When time is up, the game starts. The complete time will be recorded immediately while ten points are touched. If the robot does not complete the challenge, the number of

localization points will be the final scores. The best grade of three trials will be ranked according to the complete time, which is shortest.

- There are 3 minutes for each round. When time is up, the game stops.
- The robot should take the ball to the first point, and take it back to the circle at the midfield after reaching the point. The rest points should be done in the same mode. During the challenge, as long as the ball touches the localization points and the circumference of the midfield circle, it is regarded as a success, and the rule of holding ball is the same as the Soccer Competition.

Out-of-bounds

If the ball hits any object, which is not in the field, it will be regarded as out-of-bounds.

Score

- One point get ten scores, plus the time you have left (*minute*) multiplied by 10 divided by 180, At least one point is touched.

Localization points:

Hollow rectangular with inner length 30cm and outer length is 40cm, like following figure 1. In figure 2, the ball-placed point is at the center of the field, and other 22 points are localization point.

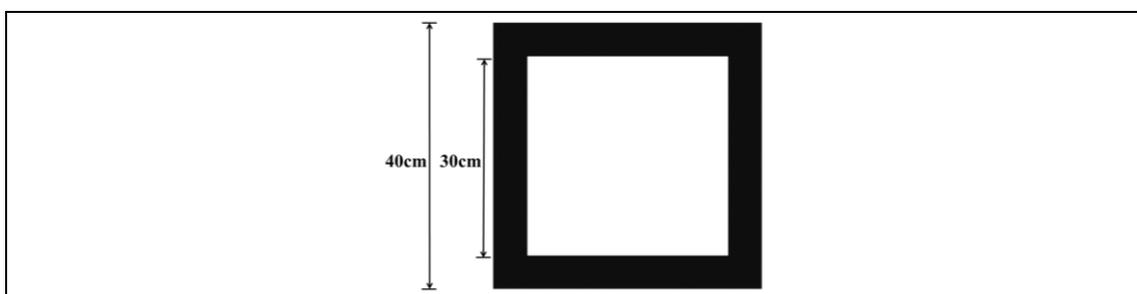


Fig.1. The Hollow Rectangular

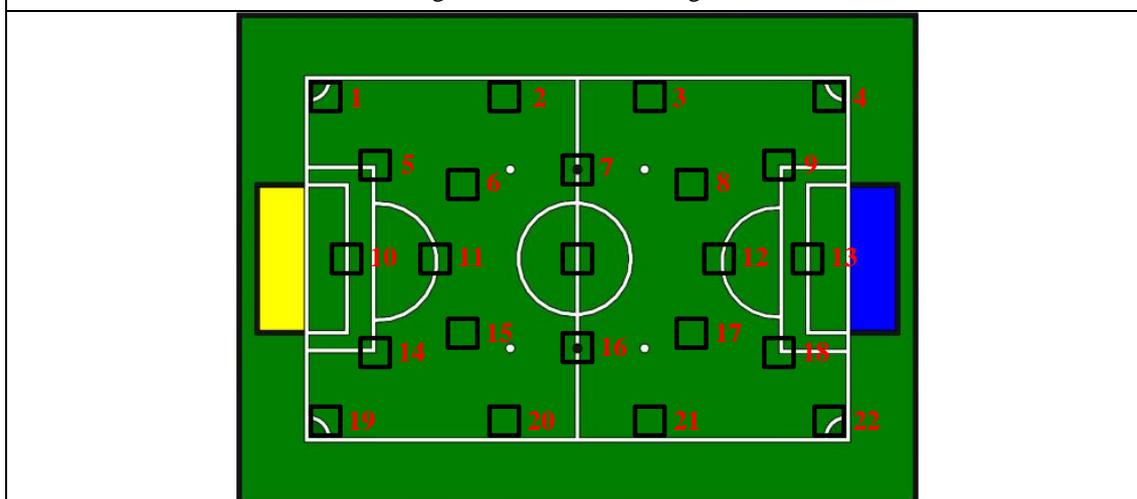


Fig.2. The Localization Challenge Field

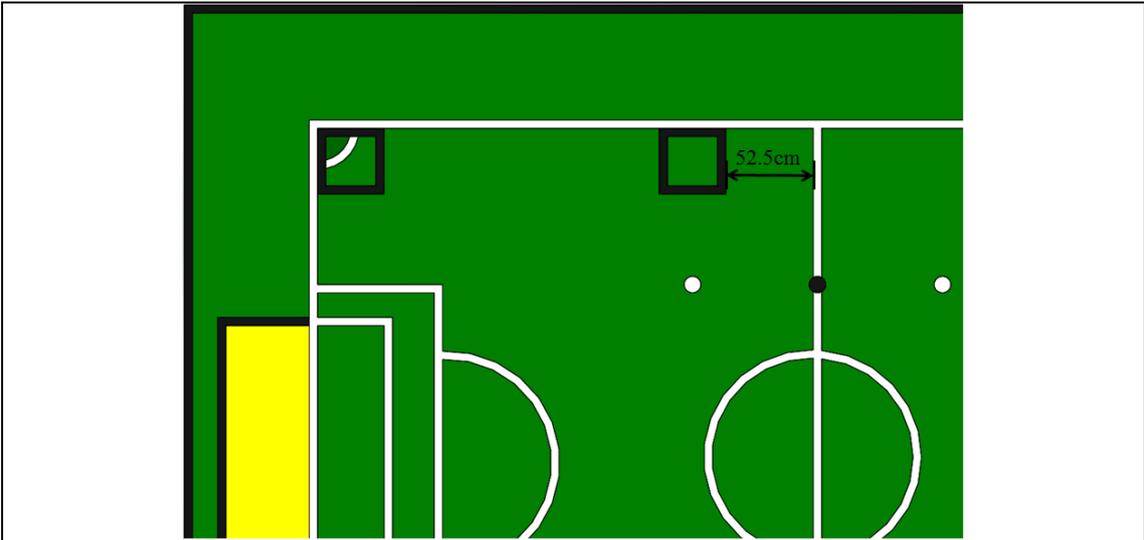


Fig.3. The Localization Points: Part I

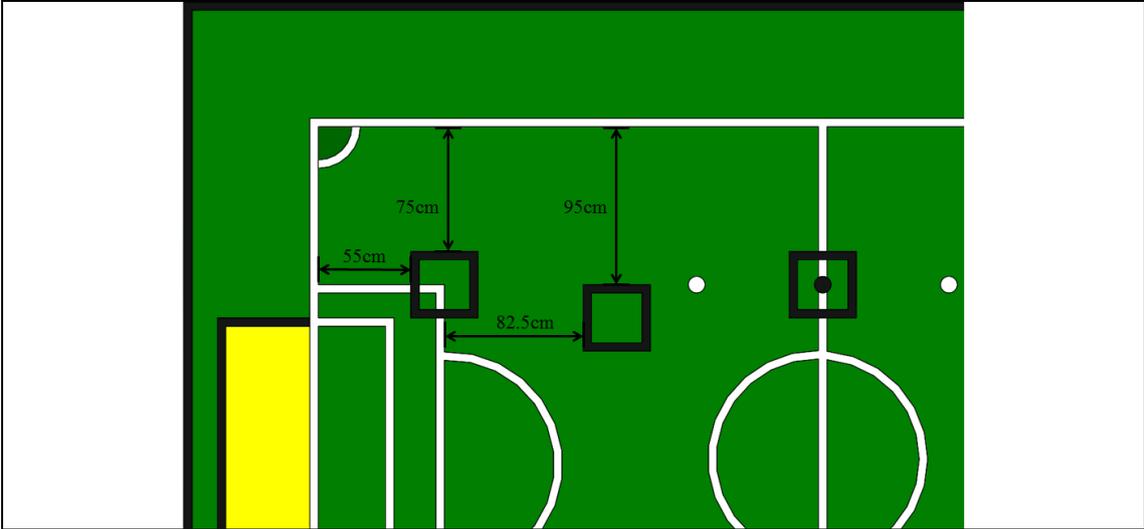


Fig.4. The Localization Points: Part II

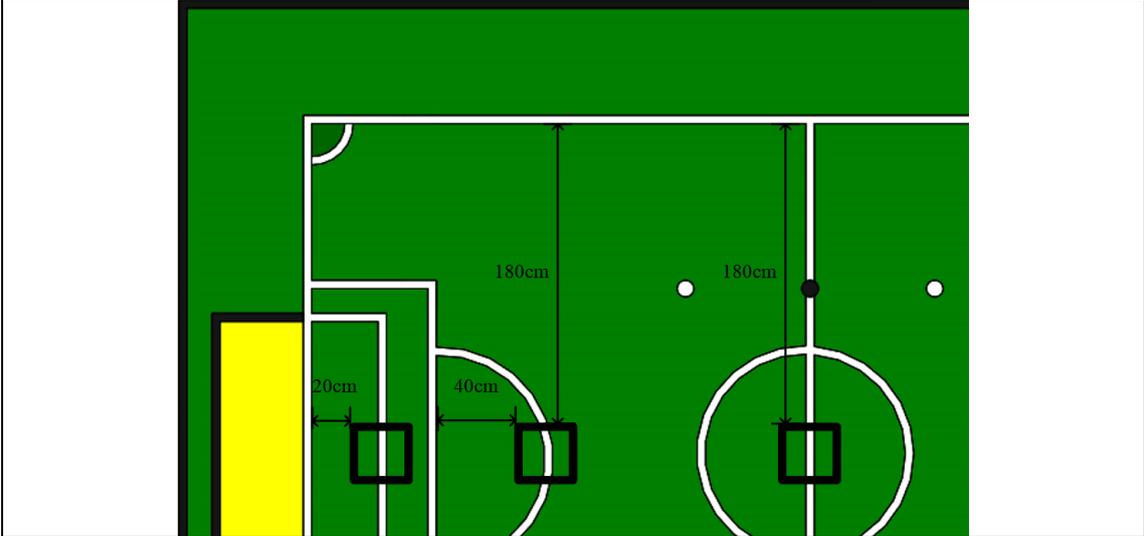


Fig.5. The Localization Points: Part III

3.2 Avoidance Challenge

The avoidance challenge requires the RoboSot platform to develop and exhibit capabilities in the area of identification and path planning.

Testing Time

Before the game starts, each team will have an independent 10-minutes testing time by turns, after that, there will be a 5-minutes common testing time.

Rules of the draw

When the common testing time is up, the referee will draw out the number of obstacles in each area, the number will be one or two, and there will be eight obstacles in total. After placing the obstacles, the game will start immediately.

Note: There will be no testing time, and measuring the distance between the obstacles is not allowed during the game.

Mainly

- Each team needs to complete this challenge three times.
- At this challenge, anyone can not place any markers in the field, and do not have any test time.
- Before each round, need place the robot in the waiting area, and do not touch the robot.
- The game is progressing, except press the start button, using computer or remote control the robot is illegal.
- The middle of the blue goal line is the starting point.
- The robot should reach the opposite goal area within 3 minutes, while avoiding all obstacles. If the robot touches the obstacles, this round will be regarded as failure and the score will be recorded based on the distance the robot has passed through. Score information is shown as the following.
- It will be consider to success and time will be recorded when the robot touched opposite goal area. Score information is shown as the following.

Note: Here add a new rule in the last line.

Out-of-bounds

If cross red line more than half robot, it will be regarded as out-of-bounds.

Score

- Touches the obstacle (Fail): Score = $1\text{cm} * 0.2$ (Up to 104 points.)
- Reach the opposite goal area (Success): Score = $150 + \text{Remain Seconds} * 0.1$ (Up to 168 points.)
- Every team will have 3 rounds, and using the average score. If more than two teams have the same score, there will be an extra round.

*Note: Here amend the score formula from $100 + \text{Remain Seconds} * 0.1$ to $150 + \text{Remain Seconds} * 0.1$.*

Obstacles placing rules:

- The red rectangle is the competition field of avoidance challenge, which is sized $300\text{cm} * 600\text{cm}$, shown as Fig. 6.
- The size of black obstacle, length and width from 40 to 45 cm, height from 40 to 75 cm. (The accurate size of the obstacle will be decided by the organizer.)
- The obstacles will be placed between the goal areas of two goals.
- The obstacles will be placed in five $300\text{cm} * 50\text{cm}$ areas, and there will be a 60cm gap between each area. The distance between each obstacle should be more than 60 cm.

Note: Here add a new condition about the distance between each obstacle in the last line.



Fig.6. The Avoidance Challenge Field

3.3 Passing Challenge

The passing challenge requires the robots to possess the following items: stable and accurate positioning system, and powerful shooting mechanism.

Testing Time

Before the game starts, each team will have an independent 10-minutes testing time by turns, after that, there will be a 5-minutes common testing time.

Mainly

- In this challenge, several upside-down training cones will be placed on the field. The robot should touch the colored training cones by passing the corresponding-numbered balls on the field. The ball used in the challenge is the same as the ball used in the soccer game. (For detailed information, see section 4.2.) Each team has two chances to challenge four levels. As shown in figure 9 - 12, the position of training cones is different in every level. All cones must be touched in order to pass to the next level. Detailed rules are shown as the following:
- The starting point for the robot can be placed anywhere on the field.
- Robot shall not cross the yellow line, shown as Fig. 9.
- If the robot kicks the ball in front of the yellow line, and the ball touches any training cones after touching the corresponding one, these training cones can be put back to their original position; otherwise, the touched training cones will be removed.
- The time for each level is 3 minutes. (The timer will be stopped if all the training cones are touched correctly or the team abstains the game.)
- The colors of the training cones and the corresponding numbers on the balls: red cone corresponds to ball no.1, white cone to ball no.2, blue cone to ball no.3, and yellow cone to ball no.4.

Note: Here amend the cone color from orange to red in last line.

Out-of-bounds

If cross side line more than half robot, it will be regarded as out-of-bounds.

Score

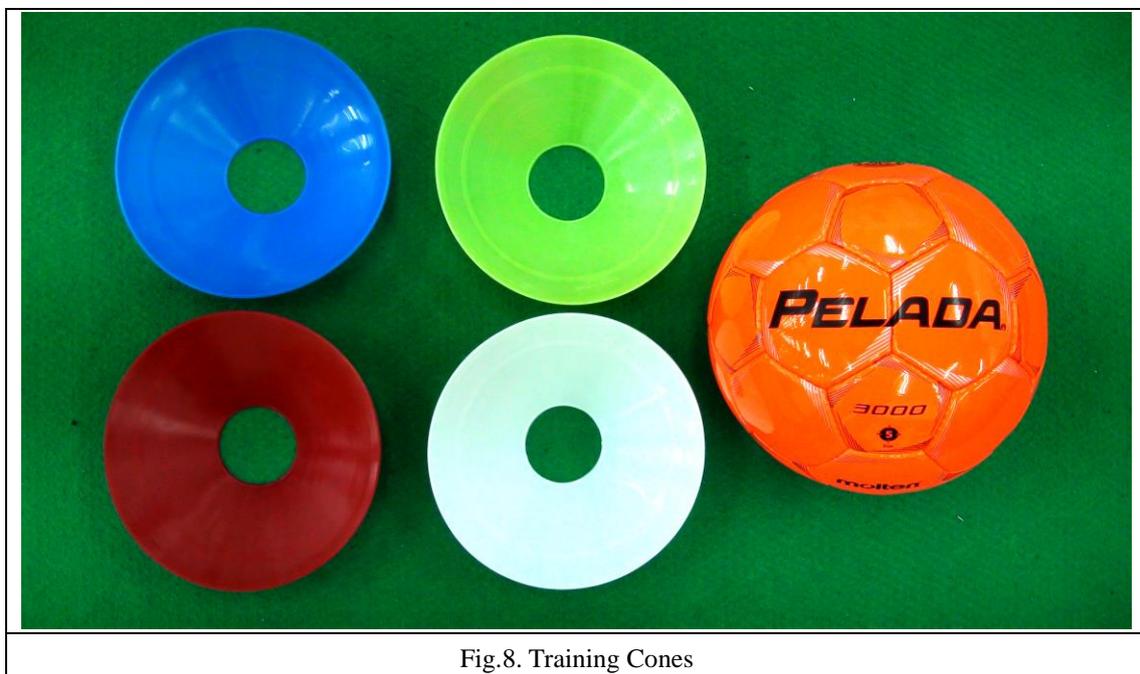
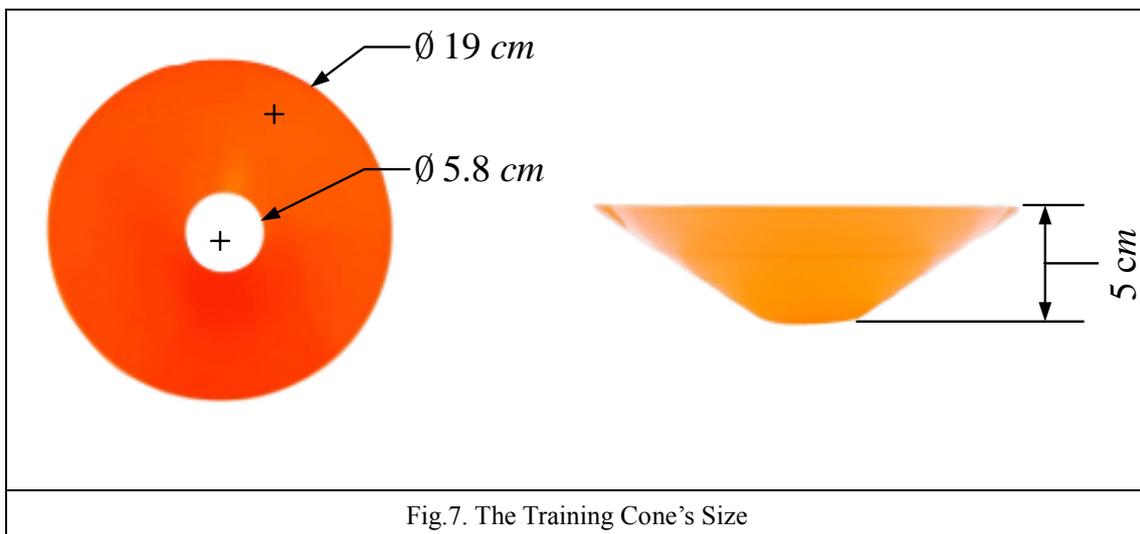
- One point for each touched training cone. If the robot crosses the yellow line, the score will not be counted.
- The team which touches all training cones within the shortest time (which means the time of each

round, not whole challenge time.) wins if two or more teams have the same score.

Note: Here add a more detail description about the time in the last line.

Training cones

The training cone with inner length 5.8 cm, outer length is 19 cm and height is 5 cm, like following figure 7 - 8.



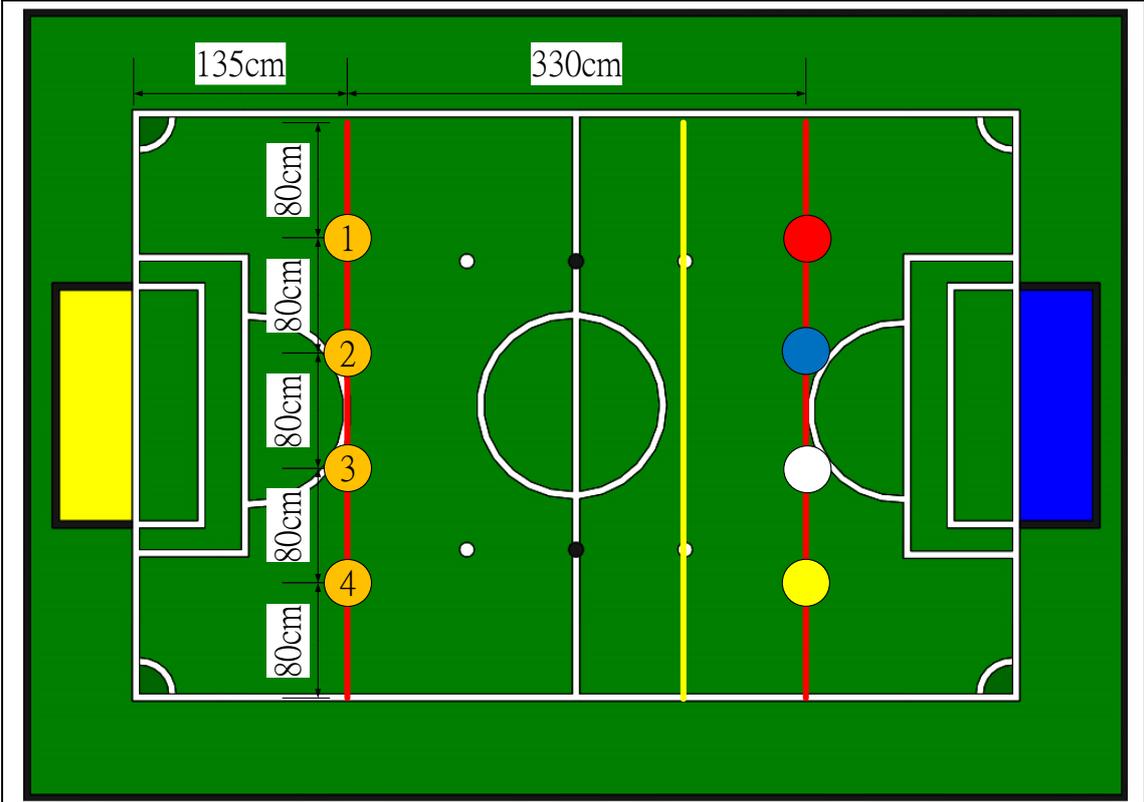
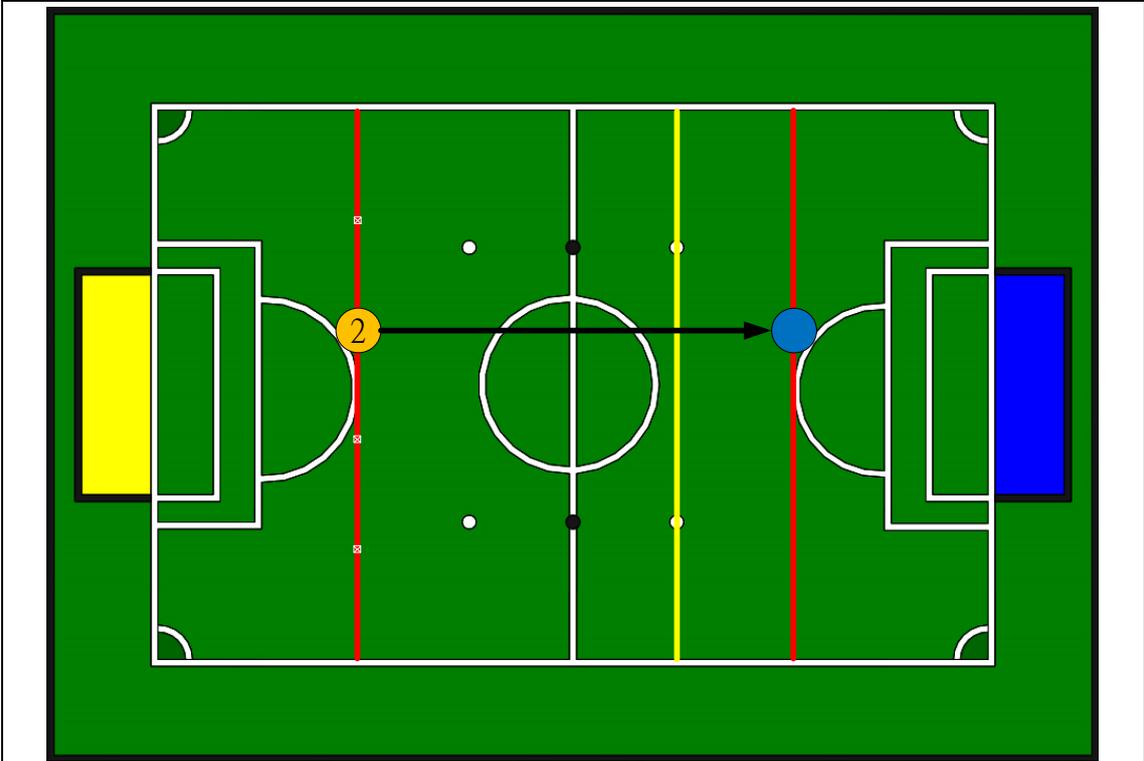
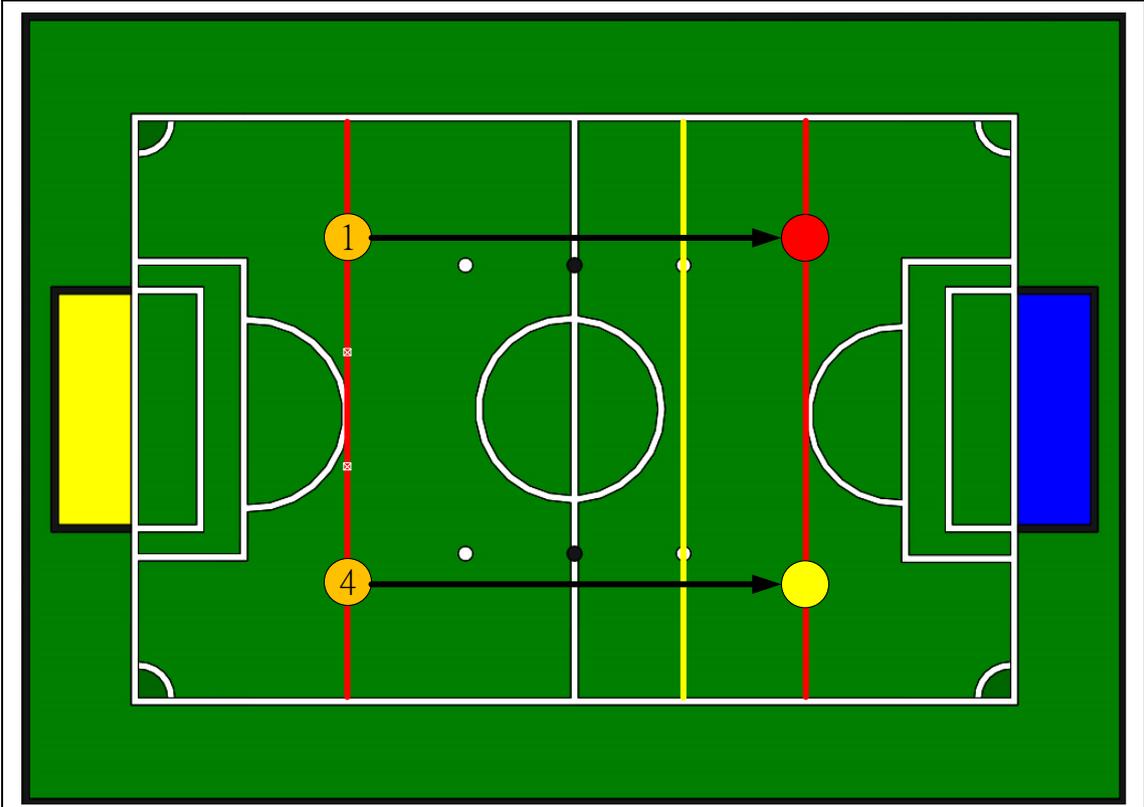


Fig.9. The Passing Challenge Field

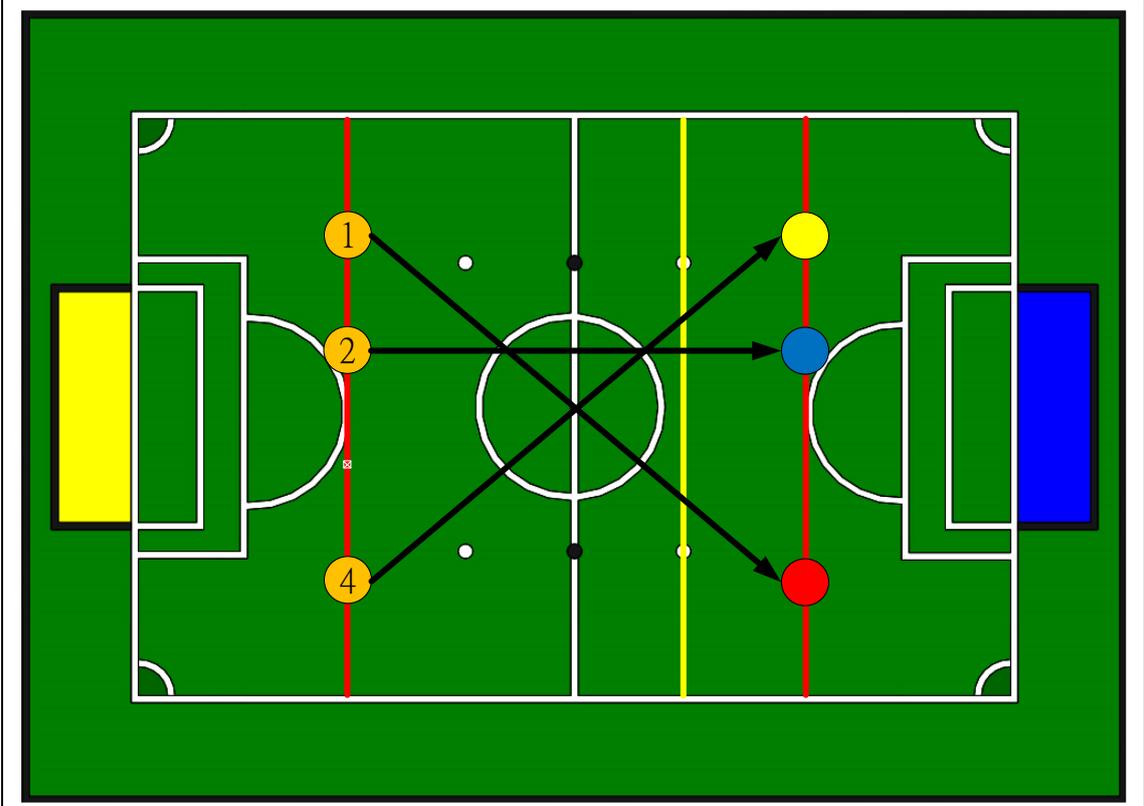
The level map



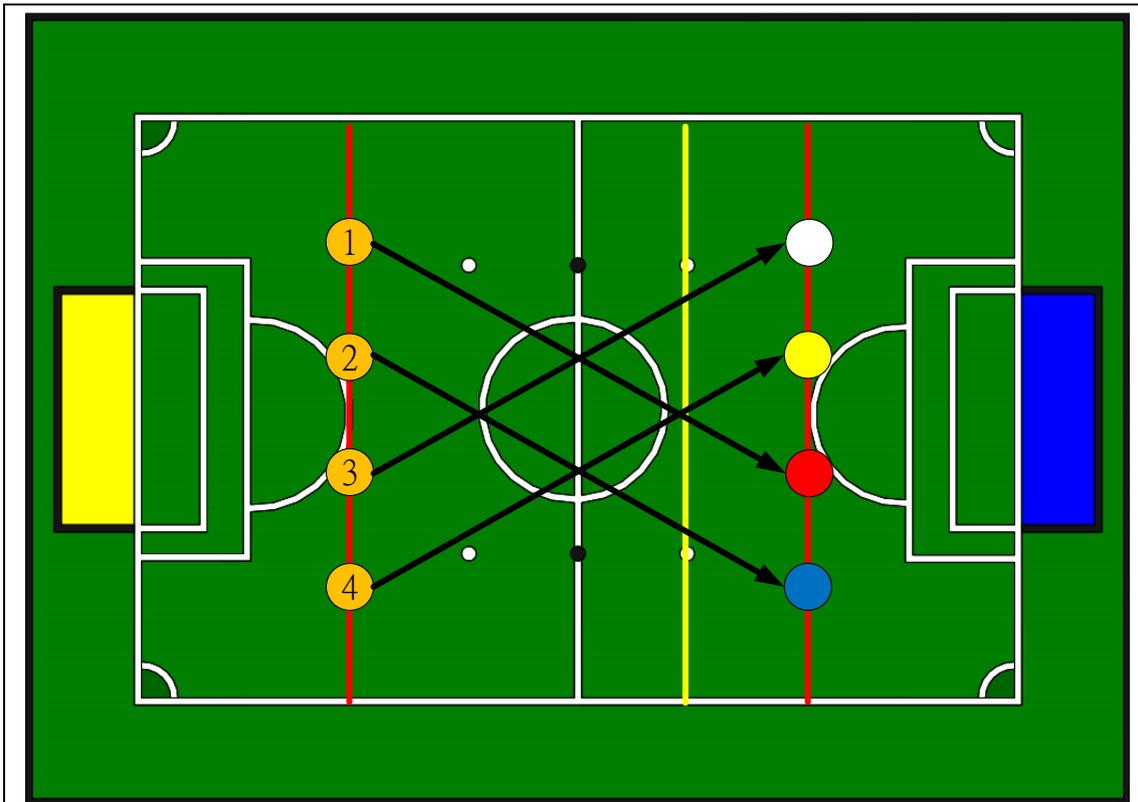
(a) The Field in Level 1



(b) The Field in Level 2



(c) The Field in Level 3



(d) The Field in Level 4

Fig. 10. The Level Map of Passing Challenge

4. RoboSot Soccer Competition

4.1 The Field of Play

4.1.1 Markings on the Playground

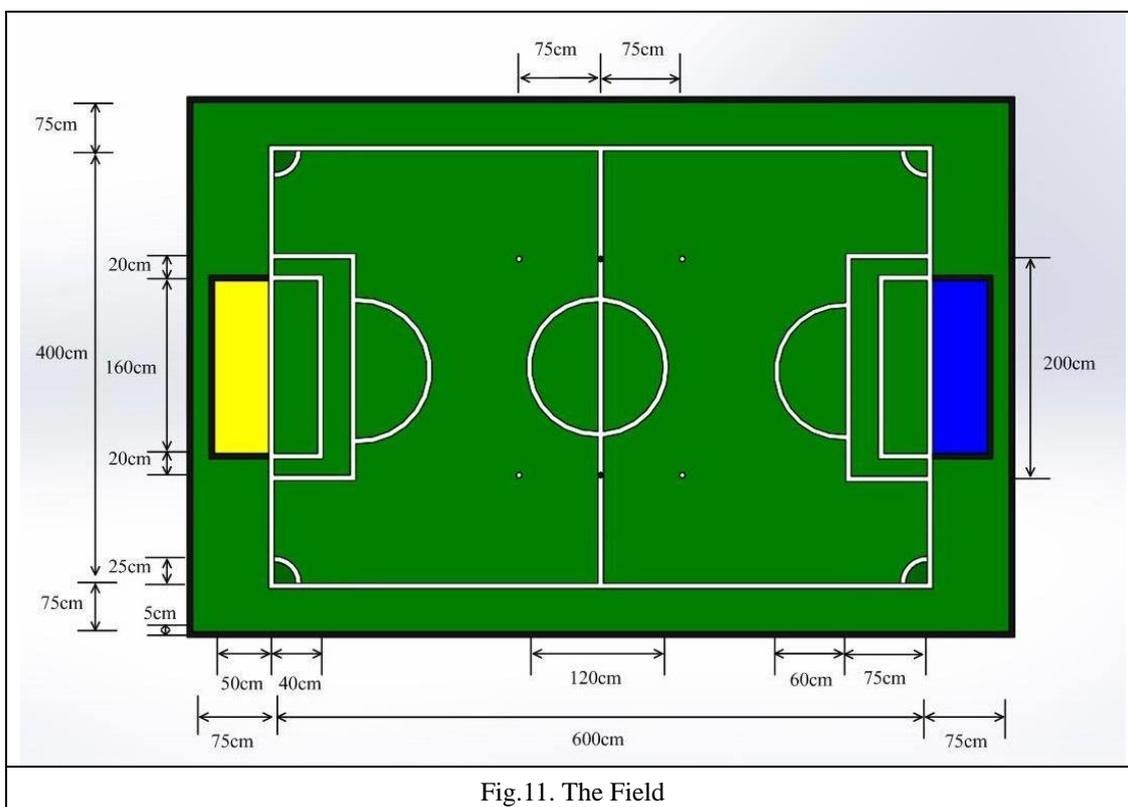


Fig.11. The Field

The field of play shall be marked as shown on the diagram in figure 11.

- All line markings will be painted with a 5cm thickness and must be white in color.
- The center circle will have a radius of 60cm.
- The goal area will be 160cm wide, 40cm deep and positioned directly in front of each goal.
- The penalty area will be 200cm wide, 75cm deep and positioned centrally in front of each goal.
- The goal kick semi-circles will have a radius of 60cm and marking on the center of each penalty area line.
- Six free ball points must be placed on the field shown as Fig.11. Two are placed on the middle line and spaced 1 meter inside either touch line. These are marked as small circles (approximately 5-10cm in diameter) and painted grey in color.
- The field is surrounded by a black safety boundary, the height of which is 10cm. It is placed 75cm

outside of each field border. The only purpose for this boundary is to prevent robots from running into the audience.

- Quarter-circular is placed on the four corner of the play field, and every circular is 25cm in radius.

4.1.2 Playground Dimensions

The playground must contain both a rectangular playing field $600\text{cm} \times 400\text{cm}$ in size surrounded by a bordering region of minimum width 75cm . The playground and bordering region should be green in color.

Note: Out the bordering region, the safety boundary is set. The height of safety boundary is 10cm , and the thick is approximately $5\text{-}8\text{cm}$.

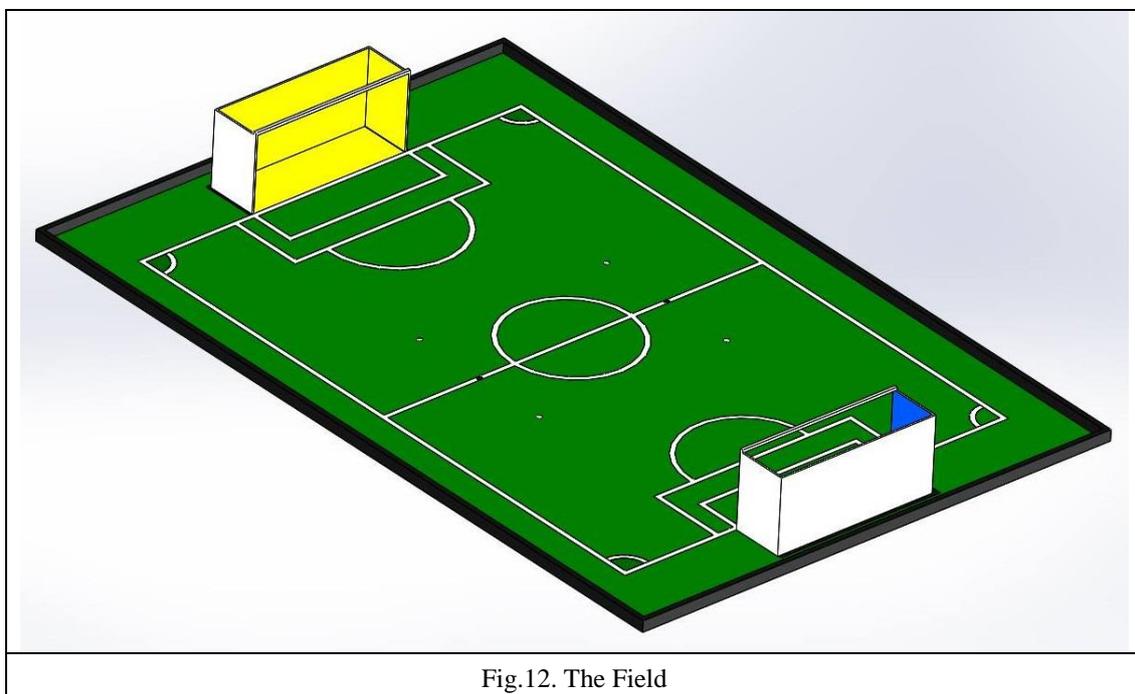
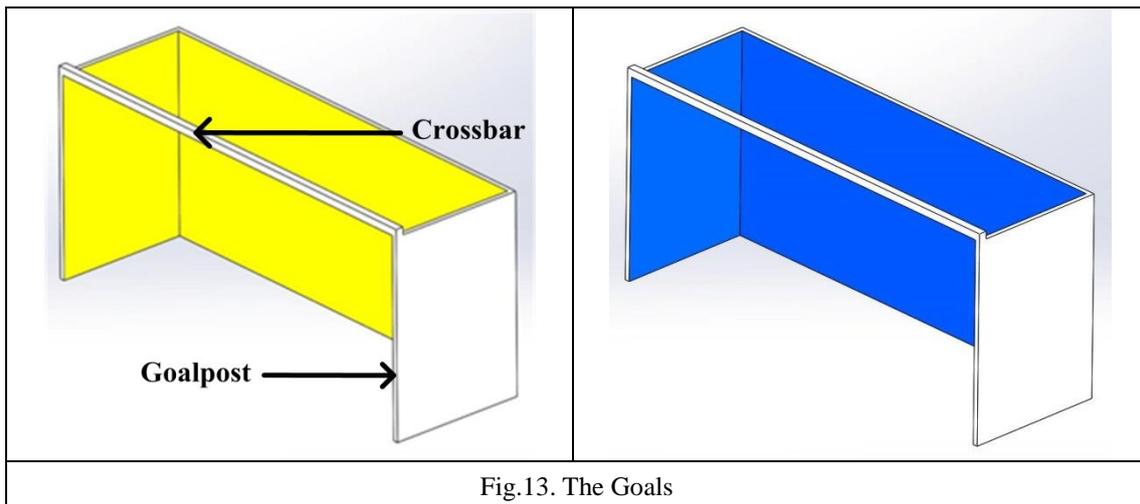


Fig.12. The Field

4.1.3 The Goal

The goals must be in the form of a wooden box with open front and top. The dimensions of the goal should be $160\text{cm} \times 50\text{cm} \times 75\text{cm}$ (width, depth, height). A $3\text{cm} \times 3\text{cm}$ crossbar is placed across the front top of the box representing the upper bar of a soccer goal. To distinguish and identify them, the goals shall be painted in blue (navy blue) and yellow colors. The goalposts and crossbars must be white, like figure 13 show.

Note: The goal colors will probably be removed in 2017.

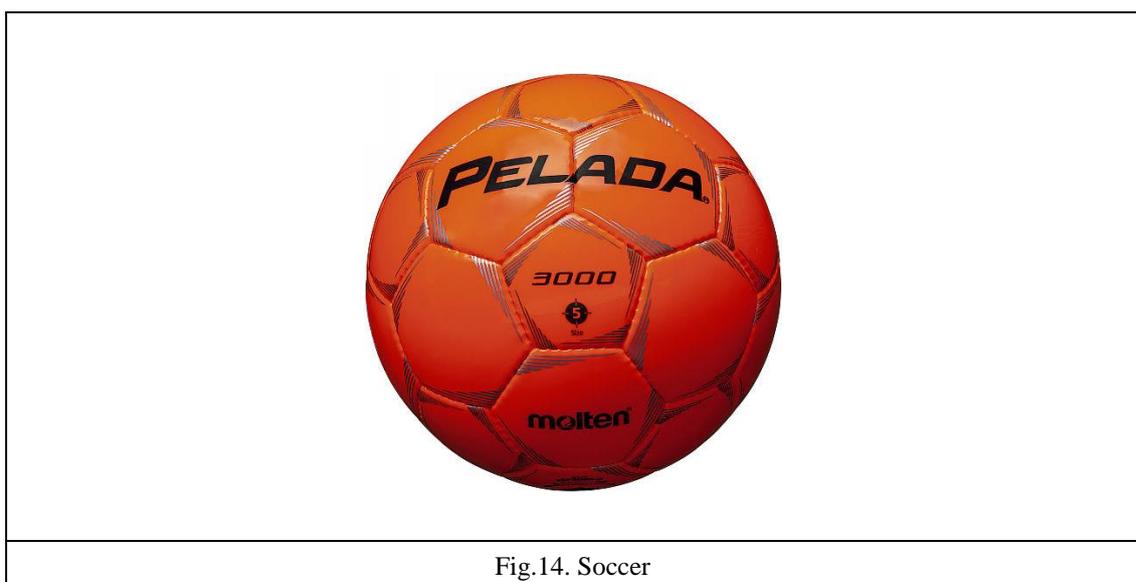


4.1.4 Field Location and Lighting

The field should be located indoors. Lighting for the competition should be fixed at around approximately 400-1000Lux.

4.2 The Ball

Each team has to be able to play with any orange FIFA standard size 5 football ("[molten] F5P3000-O", shown as Fig. 14) at any time. There will be no specific official ball and the vision system of the robots has to be robust enough to handle any above mentioned ball without re-calibration. The ball should be not used up too much and both team leaders have to find an agreement before a match about which ball they want to use. Else, the referee decides about the ball.



4.3 The Team

4.3.1 Human Personnel

Only one human team members are permitted to participate actively in a match.

4.3.2 Team Size

A match shall be played by two teams, each consisting of 1 to 3 robots. Additional robots may be used as substitutes.

Note: If competing teams become firmly established and are looking for further challenges, we may consider expanding the competition to five robots per side at some point in the future. This will be reviewed on a year to year basis.

4.3.3 Goalkeeper

Only one of the robots can be designated as the goalkeeper. The goalkeeper may only catch or hold the ball when it is inside its own goal or the penalty area.

4.3.4 Remote Computer

Each team is also permitted a remote computer/control to transmit procedural information upon stoppages in play. This is covered in detail in Section 3.5.

4.4 The Robots

4.4.1 Robot Size

The size of each robot shall be limited to a maximum of $45\text{cm} \times 45\text{cm}$ (width \times length). The height shall be limited to a maximum of 70cm . The robot must be in a fully extended state when being measurement.

4.4.2 The Appearance of Robot

The base color of a robot's body must be somewhere between black and dark grey (50% grayscale). The paint or material used to achieve this must be matte to minimize reflectivity. Some areas of the robot cannot obviously comply with this rule (the camera lens) but in all cases, teams must minimize the use of shiny materials and/or materials similar in color to colors used in the game.

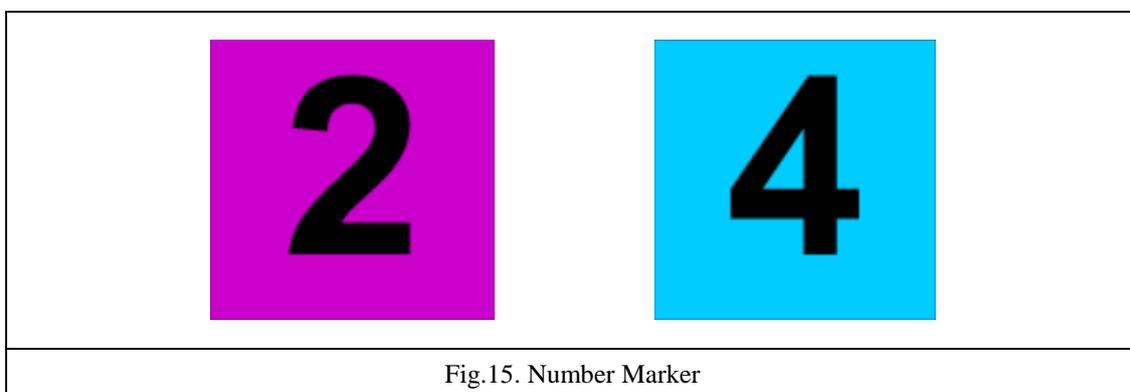
A robot must be marked for being recognized by other robots and being distinguished by the referee. Each robot must carry color marker and number marker.

-Color marker

Color marker can be any shape, but they must be present and visible from all sides. The height and width of color mark must be greater than or equal to 10 cm, and the marker color must be one of the two predetermined official colors, which refer to magenta (purple) and cyan (light blue). It is the responsibility of team leaders to obtain the samples of marker colors. Moreover, team leaders have to ensure that their own color is as close as possible to the official colors. Every team must provide the markers in each team color and attach one of them prior to each game.

-Number marker

There should be a number marker consisting of one digits at most on each robot, the number must come in black color with height taller than 8 cm. In addition, the number will be fixed on the color markers and must be easily visible from all four major sides (front, back, left, and right) of the robot. In addition, number 1 is reserved for goalkeeper.



4.4.3 Autonomous System

Each robot must be fully independent, with vision system, powering and motoring mechanisms self-contained. Image processing must be done on board the robot. No global vision system is allowed. Communications are described in Section 3.5.

4.4.4 Robot Behavior

Each robot must finish the following behaviors autonomously, navigating on the game field and following the ball. If anyone robot cannot finish, it would lose the qualification in RoboSot Soccer Competition.

4.5 Communication

4.5.1 Remote Computer Control

A remote computer or control may be used to transmit procedural information to and from the robots whenever there is a stoppage in play or upon explicit instruction from the referee. Permissible commands include:

- Start/Stop Commands.
- Formation/Setup Commands

Commands may not transmit any positional data. Positional data must only be stored on the robots themselves. These commands are executed via a button-press on a remote control, or a key-press/mouse click on a host computer. Examples of the use of such commands would be automating the positioning of robots for kick-offs, free kicks, penalty kicks, corner kicks, throw-in, and goal kicks.

Teams must be able to start and stop the robots from the remote computer/control. Formation and setup functionality is desirable but not essential. A human handler may alternatively do repositioning.

Note: These will make the game more autonomous (reduced robot handing) and improve the event visually for spectators. For now, this functionality is transition. Eventually it is hoped that these can also be automated by detecting pre-specified cues from either a human or a remote electronic referee.

4.5.2 Inter-Robot Communication

Robots may freely transmit information between one another.

4.6 The Game

4.6.1 Game Setup

Teams must meet at least 15 minutes prior to the game to resolve communication issues and color patch designations.

-Communications

Any communication conflicts must be resolved prior to the commencement of the coin toss to initiate the game. This is especially the case for teams using RF communication.

-Color Patches

Color patches will be randomly assigned to each team on the basis of a coin toss by the referee.

-Coin Toss

The referee will make a coin toss immediately prior to the commencement of the game. The winner of the toss can choose whether kick off in the first half or decide which goal they will attack in the first half. In the second half, the kick-off team and the target goal will be exchanged.

4.6.2 Game Duration

The duration of a game shall be two equal periods of 15 minutes each, with a half time interval for 10 minutes. An official timekeeper will pause the clock during substitutions, while transporting an injured robot from the field, during time-out and during such situations that deem to be right as per the discretion of the timekeeper.

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

4.6.3 Kick-Offs

The team with the kick-off will be allowed to position their robots freely within their own half or anywhere within the centre circle. The defending team can then place their robots anywhere in their own half except within the centre circle. Robots can be positioned either with the designated human handler or via instruction from the remote computer. The ball should be placed in the centre of the centre circle.

When given the signal from the referee, the game shall be started. The ball should be kicked or passed towards the team's own side. Thereafter the robots may move freely. The ball should be kicked in 5 seconds; otherwise, the ball will be opponent team.

4.6.4 Winning the Game

A goal shall be scored when the whole of the ball passes over the goal line either on the ground or in the air, and under the crossbar, which is show in figure 16. The winner of a game shall be decided on the basis of the number of goals scored. If one team win opponent team exceed 10 points, the team will be the winner directly.

In the event of scores being even after the second half, the game will proceed into extra time after a 5-minute break. Extra time will be 10 minutes.

If the tie persists after 10 minutes, the winner shall be decided through penalty shootout. Each team shall take 3 penalty kicks. These differ only from Section 3.9.2 in that only a kicker and a goalkeeper shall be allowed on the field. A penalty-kick will be completed, when any one of the following happens:

- The goalkeeper catches the ball with its appendages (if any) in the penalty area.
- The ball comes out of penalty area.
- Thirty seconds pass after the penalty kick has commenced.

In case of a tie even after three penalty-kicks, additional penalty kicks shall be allowed one by one, until the winner is decided.

4.7 Interruptions

The following list represents events that trigger certain actions in the course of play, also the game time would not be interrupted when these events happened except the concerned team manager calls 'time-out' (Section 3.7.1).

4.7.1 Substitutions

There are 3 substitutes which are permitted while a game is in progress for each team. At half time, unlimited substitutions can be made. When there is an interruption or foul occurs, substitution can be only called by the interruptions or fouls happen. When interruptions or fouls, the concerned team manager should call "substitution" to notify the referee. In addition, the team can substitute the robot at the next time of interruptions or fouls. The time will not be stop. After substituting robot, the game will restart, with all the robots and the ball placed at the same positions as they were occupying at the time of interrupting the game.

4.7.2 Repair and Stop

Each team has 2 repair times for repairing robot. During game play, repair can be only called by the interruptions or fouls happen. When interruptions or fouls, the concerned team manager should call 'time-out' to notify the referee. In addition, the team can get repair time for up to 2 minutes at this time point, which meaning interruptions or fouls. The time will be stop for 2 minutes. After 2 minutes, the game will restart, with all the robots and the ball placed at the same positions as they were occupying at the time of interrupting the game.

4.7.3 Fallen Robot

When a robot that has fallen in such a way to block the goal or directly affect the course of the game, the referee will call a halt to play whilst the fallen robot is righted (restored to a standing position) or removed (if broken). All remaining robots must come to a halt when the call is made. The ball is also positioned in the exact position it was located in when play was halted. Upon signal from the referee, play restarts and the robots may move freely.

4.7.4 A Goal is Scored

No matter which team scored, all robots are set up for the next kick off (Section 3.6.3), and the timer will not be stopped.

4.7.5 Ball Outside

If the ball pass over the goal line by attacker, the defender will get goal kick, shown as Section 3.9.6. If the ball pass over the goal line by defender, the attacker will get corner kick, shown as Section 3.9.5. If the ball pass over the side line, the opponent team will get throw-in, shown as Section 3.9.4.

4.7.6 Stalemate

A referee will call a stalemate whenever the ball remains stationary for more than 6 seconds. If it occurs within the penalty area, a free kick is awarded to the defending team. If it occurs anywhere outside the penalty area, a free ball repositioning is made. See Section 3.8 for details on free balls.

4.8 Fouls

A foul will be called for the following cases. In each case, the subsequent action is indicated. Refer to Section 3.9.

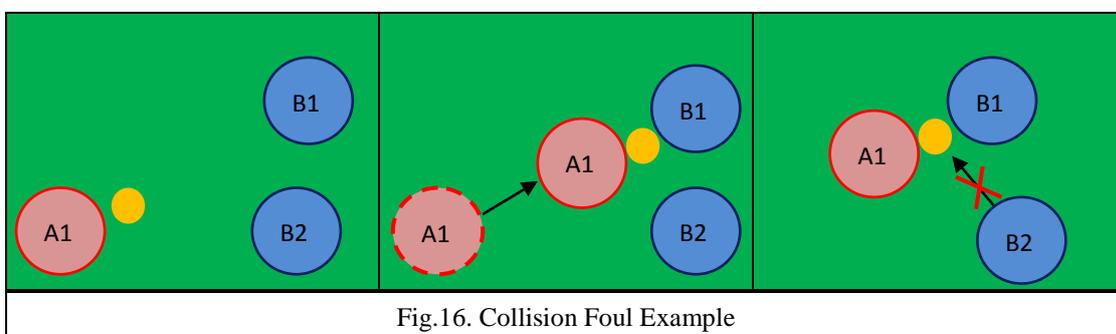
4.8.1 Handling

It refers to handling how the robots besides the goalkeeper catch the ball. During the game, the robot should not hold more than one third of the diameter of the ball when moving. (Up to one third of the diameter, from any point of view.) On the other hand, the robot should not hold more than half of the diameter of the ball when it is static. (Up to half of the diameter, from any point of view.) In addition, the ball should scroll naturally when held by a robot. If any robot violates the handling rule, (the goalkeeper can ignore this rule in the penalty area,) the referee will announce a handling foul, and the other team will get a free kick. If the handling foul is called inside of the penalty areas then a penalty kick is awarded.

4.8.2 Collision

While two robots from opponent teams are disputing the ball, that is, while two robots of opponent teams are simultaneously touching the ball, no other robot from either team can step forward to help with the two robots disputing the ball. If more than one robot is trying to intercept an opponent robot which is currently dribbling the ball, like figure 16 show, then the referee will call foul awarded to the offended team.

Colliding with a robot of the opposite team, either intentionally or otherwise. The referee will call such collisions that directly affect the game or that appear to have potential to harm a robot. If the referee outside the penalty areas calls the “collision”, a free kick will be awarded to the team whose robot has been charged/pushed. If the collision is called inside the penalty area, a penalty kick will be awarded. Note that it is permitted to push the ball and an opponent player backwards provided the pushing player is always in contact with the ball.



4.8.3 Kicking

All robots must be equipped to decide whether they can execute a kick without threatening or damaging other robots. Apart from the content above, robots must avoid kicking each other, if physical contact with other robots cannot be avoided, it must be soft. If, in the opinion of the referee, physical contact through a kicking device is not soft, then the referee shall call a foul and the robot will be expelled temporarily. The team should remove the irregular function from the robot within 10 minutes; otherwise the robot is not allowed to enter the field again.

Note: With small force, the stronger a kicking device is designed, the more fine-grained control of its activation is required.

4.8.4 Goalkeeper Push

It is only permitted to push the goalkeeper robot in the penalty area if the ball is between the pushing robot and the goalkeeper. However, pushing the goalkeeper into the goal along with the ball is not allowed. Subsequently, if the goalkeeper is pushed directly, or if the goalkeeper is pushed along with the ball into the penalty area as described, then the referee shall call a foul and award a free kick to the defending team.

4.8.5 Obstruction

The goalkeeper is the only defender allowed in the goal area at all times. If another defender is present within the goal area whilst the ball is in the defender's penalty area, an obstruction is called and a penalty kick is awarded to the attacking team.

4.8.6 Offside

Only one attacker is allowed into the opposition's goal area at any point in time. If two attackers are present in the goal area, the second attacking player is called offside and a free kick is awarded to the defending team.

4.8.7 Touch

If any human from either team should touch the robots against the referee's permission, a penalty kick will be awarded to the opposing team. Note that only one person from each team may touch the robots when given permission by the referee.

4.9 Actions

The following actions for the previously described interruptions are outlined in detail here. Where robots are required to be repositioned, the task may be done either by the designated human handler or autonomously via command from the remote computer as described in Section 3.5.1. Notice that when the actions occur out of the penalty area, the robots that are not holding the ball must stay at least 1 meter away from the ball. In all cases, the referee blowing a whistle signals resumption of play.

4.9.1 Free Kick

When a free kick is awarded, all robots must immediately halt. The referee then places the ball at the closest available free ball mark. The team which is awarded with a free kick may place a robot around the ball. The robots which are not holding the ball must stay at least 1 meter away from the ball. Upon signal from the referee, play restarts and the robots may move freely.

4.9.2 Penalty Kick

When a penalty kick is awarded, all robots must immediately halt. The referee places the ball in the centre of the semi-circle attached to the penalty area in which the penalty occurred. The attacking team is then allowed to move one robot (the kicker) behind the ball. All other attackers must move behind the free ball marks. The defending team may then move the goalkeeper into position anywhere in the penalty area so long as one part of the goalkeeper remains in touch with the goal line. All other defenders must move outside the penalty area. Upon signal from the referee, play restarts and the

robots may move freely. If a goal is scored, play resumes with a kick-off.

This rule ensures the attacking team obtains the penalty advantage whilst also simplifying and speeding up the penalty kick process.

4.9.3 Free Ball

When a free ball is called, the referee repositions the ball as swiftly as possible on the closest available free ball mark. Each robot must stay at least 1 meter away from the ball. See the diagram labeling field markings in the Appendix.

4.9.4 Throw-In

A throw-in is a method of restarting play. A goal cannot be scored directly from a throw-in. A throw-in is awarded when the whole of the ball passes over the touch line, either on the ground or in the air.

The following are some rules about throw-in. First, at the moment of throwing the ball, the thrower should face the soccer field and kick the ball. On the other hand, the other team's robots must stay at least 1 meter away from the ball. Second, the thrower may not touch the ball again until another player has touched the ball. Third, the ball is in play immediately after it enters the soccer field. Finally, the goal cannot be scored directly from a throw-in.

When a throw-in is called, the referee or assistant referee will collect the ball and return the ball to the field of play as quickly as possible. There will be no stoppage in play.

4.9.5 Corner Kick

The following are some rules about corner kick. First, the ball is placed inside of the corner arc at the nearest corner flag-post. Second, a player of the attacking team kicks the ball, and the robots of the defending team should stay at least 1 meter away from the ball. Third, the kicker does not kick the ball second time until the ball has been touched by another player. Fourth, the ball is in play when it is kicked and moves. Finally, a goal may be scored directly from a corner kick.

4.9.6 Goal Kick

A goal kick is a method of restarting play. A goal may be scored directly from a goal kick, but only against the opposing team. A goal kick is awarded when the whole of the ball, having last touched a player of the attacking team, passes over the goal line, either on the ground or in the air, and a goal is not scored in accordance.

A player of the defending team kicks the ball from any point within the penalty area. Opponents remain outside the penalty area until the ball is in play. The kicker does not play the ball a second time until it

has touched another player. The ball is in play when it is kicked directly beyond the penalty area.

When a goalkeeper kick is called, all robots must immediately halt. All robots from both teams except for the defending goalkeeper must move out of the goal area. The defending team may then position the ball and the goalkeeper anywhere inside the goal area. Upon signal from the referee, play restarts and the robots may move freely.

When proceeding a goal kick, the kick-off robot can kick the ball into the goal directly, but dribbling into the goal directly is not allowed.