18TH MALAYSIA FIRA ROBOWORLD CUP 2025

RoboSot Challenge

Rules and Regulation for 2025

POLITEKNIK MALAYSIA ROBOT SPORT TEAM

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RoboSot Goals

Research on mobile autonomous robot platforms is receiving an increasing share of attention, especially in the area of household domestic appliances. The problems and challenges faced during the development of these robots are many and varies thus often significantly different from the problems faced in both the large sized robot and humanoid forms. Compared to the legged robots, as these robots are fully autonomous, they 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 challenge will be a dynamic challenge that continually shifts its goal 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.

1. Challenge Structure

The RoboSot Challenge this year consist of 3 major challenges namely the **Avoidance Challenge**, **RoboSot Race Challenge** and **RoboSot Soccer Challenge**.

2. The Referee and Assistant Referee

2.1 The Authority of the Referee

Referee and Assistant Referee are appointed among the technical committee. They has full authority to enforce the Laws of the Game along the gameplay.

2.2 Powers and Duties of the Referee

- Enforces the Laws of the Game.
- Controls the commencement of the match.
- Stops, suspends or terminates the match, at his discretion, for any infringements of the rules.
- 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 it is removed from the field.
- Allows gameplay to continue if the robot is, in his opinion, only slightly injured.
- Ensures that no unauthorized personnels enter the field during gameplay.
- 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 human players, and/or team officials and any other incidents which occurred before, during or after the match.

2.3 Before the Gameplay and during the Gameplay

- Before the event date, every participating team must attend the pre-challenge briefing conducted by the referee either thru an online platform or physical meet-up whichever is appropriate to inform the rules and changes if any to the team for preparation and development purposes.
- All participants must attend the briefing during the event to discuss and rectify any misconception of the challenge, and to solve the disputes on the rules.
- Only visual proof will be considered if any participant intends to appeal the decision made by the referee. The appeal must be made before the next trial/match is preformed.
- Interval time between trial/round depends on the referee’s decision as it depends on the number of participating teams for each challenge. During intervals between trials/rounds, human play may make any modification on the robot and are allowed to test the field

along with the challenges' tools but at a considerate manner among participating teams.

2.4 General Rules that apply to all RoboSot Challenge

- Any rules that state "Crossing the boundary/line" implies that the referred item (robot or ball) must cross at least 50% of its body from the center of the line.
- There are 2 types of ball used for the RoboSot challenges. The ball used in all RoboSot Race challenges and Avoidance challenge are plastic balls for children's ball pool with a diameter size of 68-70mm, as shown in Figure 5. The ball used for RoboSot Soccer Challenge is an orange Stress Therapy Foam Ball Red with a standard diameter of 6.6 cm, as shown in Figure 7.
- All 3 challenges allow the robot to maneuver across the boundary lines and return to the game field.
- All 3 challenges allow the use of either self-developed robots or any suitable robots available in the market such as TurtleBot 3 Burger manufactured by ROBOTIS company and Bveeta Mini manufactured by Bizbot Technology, as long as it complies to the specification of the different challenges size setting.
- All robots for every challenge must pass the verification process conducted by the referees. Any robot that fails the verification process are given 24 hours to correct or modify the robot and reverify before the challenges begin. Robots that pass the verification will be tagged and allowed to participate in the respective challenges. Robots that fail the verification process but still do not meet the requirements during the re-verification process are given another 15 minutes to make any other adjustments. Failure to correct the robot after 15 minutes will be disqualified for that challenge.
- Teams participating in any challenges must arrive 1 hour before the challenge for specifications inspection of the robot by the referee. The robot that does not meet the requirements must complete the modification 15 minutes before the challenge starts. If they cannot complete the modification, marks will be deducted.
- The RoboSot Master Award is given to the team with the highest total score from all RoboSot challenges. Points are awarded based on medal rankings: 3 points for a Gold medal, 2 points for a Silver medal, and 1 point for a Bronze medal. If two or more teams have the same total score, the tie is broken by the team with the higher achievement in the Soccer Challenge. If the tied teams did not participate in the Soccer Challenge, the tie is broken based on the highest achievement in the Race Challenge.

3. RoboSot Avoidance Challenges

The avoidance challenge requires the RoboSot platform to develop and exhibit capabilities in the area of obstacles avoidance with vision and sonar application.

Challenge Format:

The challenge is conducted in a one-by-one trial format. In each trial, every team must locate and deliver a blue-colored ball to the goal area marked by a blue goalpost in the shortest time possible to score points. The robot must avoid touching any obstacles or crossing the boundary line with the ball. All participating teams will compete in three trials, and the winner is determined based on the total score from all trials.

Obstacles pattern will be changed on every trial. However, the ball will always be placed at the center of the game field during every game start or restart.

Testing Time:

Before the game begins, each team will have a separate 5-minute testing period. After all teams have completed their individual tests, there will be a common 5-minute testing session for all teams.

Note:

During the match, there will be no testing time allocated, and measuring the distance between the obstacles physically by human players is not allowed. All the locations of obstacles and goalpost will remain the same for every trial.

Robot:

The size of each robot is limited to a maximum of (W) 22cm × (L) 22cm x (H) 24cm in resting stage. All accessories such as the gripper and kicker must be fully attached during the robot verification process.

Challenge Setup:

- During the challenge, challenging team cannot place any markers in the field and are not given any testing time after placing robot at the start point (not allowed to move the robot).
- Every team must participate in 3 trials. The team may withdraw from any trial if unable to perform the challenge, either before or during the trial. Withdrawal from any trial will be give a “0” score for that particular trial.
- During the gameplay, human players are only allowed to press the start button on the robot or remotely. Any usage of computer or remote control system to move the robot is

prohibited and will be disqualified from that game.

- Referee will place 8 obstacles on the game field. A blue coloured ball will be placed at the center of the field.
- The robot placed on the start marker may face any direction at the start point.
- The referee will blow the whistle to start and end the trial.
- All participating teams will perform the challenge with the same obstacle placement pattern for each trial.
- The obstacle placing patterns will be changed every trial. Refer to **Obstacles and Placement Rules** for details.

Gameplay:

- During the gameplay, the participating team will compete by maneuvering their robot forwards to locate the blue coloured ball placed at the middle of the field, then bring the ball (either by dribbling or gripping the ball) to the goal area indicated by a blue goalpost, avoiding all obstacles along the way. The ball must cross the goal line (the line in front of the goalpost) to claim completion of the task.
- Shooting the ball from a distance to the goal area is allowed.
- The aim of the challenge is to move the ball across the goal line within the game time, therefore, the competing robot need not cross the goal line to complete the task.
- Any part of the robot that touches any part of any obstacles is considered a foul and the trial will be ended.
- Note that it is also a foul if the ball touches the obstacle when the ball is in possession of the robot either by dribbling or gripping method (the robot is touching the ball). However, it is not a foul if the ball rolled off and touched the obstacle if it is not attached to the robot.
- If an obstacle is touched / moved by the self-rolling ball (not attached to the robot), the obstacle(s) will not be returned to the original location/position until a foul is made or the task is successfully completed.
- The ball is **not allowed** to cross the boundary line of the game field no matter if the ball is in the robot's possession or not (roll across the boundary line by itself), as it is considered out-of-bound and a foul. However, the robot is allowed to cross any boundary lines.
- The ball must cross the goal line in the respective goalpost to be considered completion of the task.
- Time will be taken by the referee if the robot completes the task or a foul is called, indicating the end of the trial.
- If the robot fails to bring the ball to cross the goal line within 2 minutes, the current

distance traveled when the stop whistle is blown will be measured perpendicularly to the start line despite the furthest distance traveled during that trial. Travel distance is the farthest point of the robot touching the ground to the start point. However, different score calculation applies for either ball in possession or not during this condition. Measurement approach is the same if the robot happens to be out of boundary area.

- If a robot fails to move at the beginning of the challenge, human play must inform the referee to withdraw from the match and 0 mark will be recorded for that match.
- The ball must cross the goal line to complete the task. If the robot fails to pass the ball across the goal line but passed thru the end boundary beyond the goalpost (the white line) instead, then it is considered out-of-bound and the trial ended.
- It is considered out-of-bound if the ball was kicked over the crossbar of the goalpost.
- Human player may request to end their respective trial before 2 minutes game time ended upon consideration that their robot may not be able to complete the task. However, the trial for that team may only be stopped after the referee blows the whistle. Measurement of traveled distance will be taken at the point of whistle. Traveled distance is measurement from the farthest point of the robot's body touching the ground to the starting line despite the facing direction the robot.
- Winner of the challenge is decided based on the highest total score from the challenge.

Score:

- Fail to reach the goal line within 2 minutes with no ball in possession. Maximum travel distance of 400cm only:
  - Score = distance traveled (cm) * 0.2
    - Up to 80 points.
- Fail to reach the goal line within 2 minutes with ball in possession, with maximum travel distance of 400cm only:
  - Score = distance traveled (cm) * 0.2 + 20 (ball bonus)
    - Up to 100 points.
- Successfully completed the task as judged by the referee within 2 minutes:
  - Score = 106 (completion score) + [Remain time (sec) * 0.2] +20 (ball bonus)
    - Up to 150 points.
- The winner of the challenge is based on the total score of all trials. If two or more teams have the same score, the tiebreaker will be based on the shortest time to complete the challenge in any of the trials. In case of no team successfully completes the challenge in any trial, the tiebreaker for teams with the same scores is based on the total traveled distance in all 3 trials.

Obstacles and Placement Rules:

- The white line is the boundaries of avoidance challenge, with the size of 400cm x 300cm.
- The size of black coloured matte surface cone obstacles has a based and height size of 13.5cm (W) x 13.5cm (L) x 23cm (H) (Refer Figure 2.).
- The obstacles will be placed between the goal areas and the starting line.
- The ball will be placed at the center of the game field.
- Before the game starts, there will be 5-minute common testing time with only 3 obstacles for calibration purposes. When the common testing time is up, the referee will place randomly 8 obstacles within the play area by himself/herself or may appoint any participant or audience to help placing the obstacles.
- The referee will ensure the distance between every two obstacles is at least 45 cm apart measured on the base of the obstacles. Referee will mark the obstacles' location to ensure patterns for all matches of each trial are identical.
- However, note that there is no minimum distance between the ball to any obstacles, as long as it is reachable by the robot as judged by the referee without causing a foul.
- Obstacles placement pattern will change for every trials.

Field and Accessories Specification:

Total Field size:	5m x 6m
Game field:	3m x 4m (Excluding Line Thickness, effective size is measured between center of the boundary line)
Material:	100% fiber synthetic needle punch carpet
Colour:	Light green

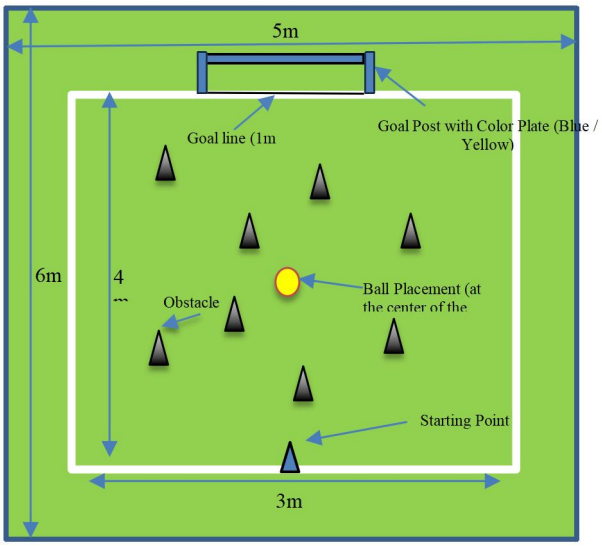

Figure 1: Avoidance Challenge robot game field and robot's starting point.

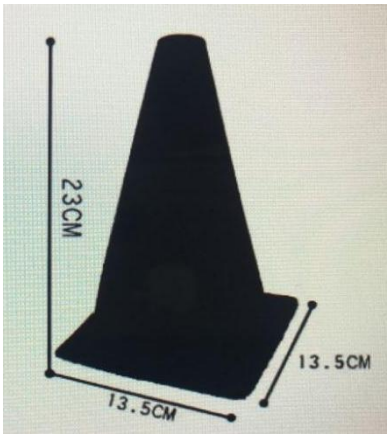

Figure 2: Avoidance Challenge Obstacle size: black matte cone

Goalpost Specification

- 1.0m x 0.3m x 0.5m (Width, depth, height)
- Frame material: Wooden (white colour)
- 3cm x 3cm crossbar at the top of the goal box (white)
- Goal internal colour: Navy blue

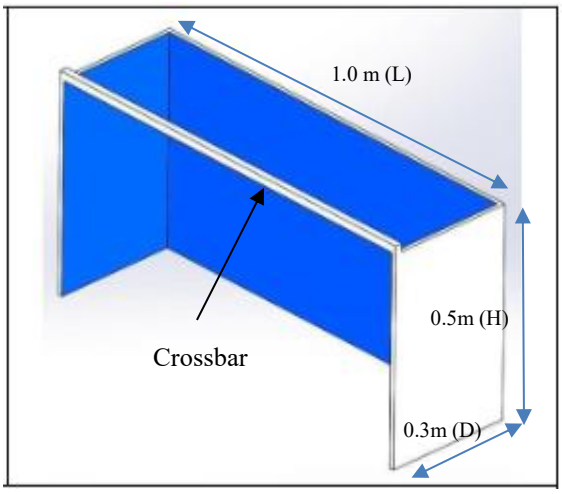

Figure 3: Avoidance and Soccer Challenge goalpost size

4. RoboSot Race Challenges

This is a small-sized wheeled robot challenge. The Race Challenge requires the development of robots to exhibit capabilities in the area of vision identification and path planning.

Challenge Format:

The challenge is performed in one-by-one trial setting, as in every trial, every team must find and bring the coloured balls to the goal area (marked by red, blue and yellow patches) in the shortest time to score points on each trial, without touching any obstacles by the robot along the way or the ball to the wrong colour patched. After the game starts, the robot must search for the colour ball in the field and push the ball into the corresponding colour area to gain scores. The winner of the challenge is the team with the highest total score.

All participating team will compete in all 3 trials as winner of the challenge is based on the total scores from all trials. Ball and obstacles pattern will be changed on every trial.

Testing Time:

Before the game begins, each team will have a separate 5-minute testing period. After all teams have completed their individual tests, there will be a common 5-minute testing session for all teams.

Robot:

- The size of each robot is limited to a maximum of (W) 22cm × (L) 22cm x (H) 24cm in resting stage, without extending any of the parts to the maximum size.
- All accessories such as gripper and kicker must be fully attached during the robot verification and measuring process.
- Additional accessories may not be added-on during the gameplay as all accessories must be attached during size verification process.

Challenge Setup:

- Team that participates in this challenge may used robot that is self-developed or purchased, such as TurtleBot 3 Burger and Bveeta Mini, as long as it meets the robot specifications.
- Teams can use any software to integrate with robot system.
- During the robot verification process, the competing robots are measured in the resting state, without extending any of the parts to the maximum size. However, additional accessories may not be added-on during the gameplay as all accessories must be attached during size verification process. During the gameplay, the robot is allowed to expend bigger than the maximum size.

Gameplay:

- Every team must participate the challenge in 3 rounds, and with 3 minutes per round.
- Robot must start from the start point. The start point is mark with X (Refer Figure 4).
- Before starting each round, referee will place twelve (12) balls consist of three colours (red, yellow and blue) with four (4) ball each colours as shown in the Figure 5 and 3 obstacles randomly on the field, as shown in the Figure 4.
- The size of obstacles as shown in the Figure 2.
- The ball and obstacles' placement pattern will be made as similar as possible by the referee for every round.
- Before the challenge start of each round, the referee will draw out the specified colours as the bonus ball. The specified colour of each team in the round will be the same and will not be redrawn until the next round.
- Participants will be awarded double score when their robot pushes the specified colour ball into the corresponding area. For example, pushing the specified yellow ball into the yellow area.
- During the gameplay, the robot has to search for the ball autonomously and push the ball into specified area automatically.
- Upon a successful score during the game play (once a ball entered and touched the respective colour box successfully), the ball will be removed from the game field by the referees to avoid that ball from being pushed unintentionally by other balls or robot into other colour box.
- The playing robot is allowed to maneuver autonomously outside the game field to grab any balls that was either intentionally or unintentionally pushes/kicked out of the game field, then maneuver back to the game field within the game time. Human player and referee are not allowed to relocate the balls that was pushed/kicked out from the game field. However, if the robot fails to return to the game field autonomously, human play may call for a fail attempt to the referee before pushing the stop button. Reminder that human player is not allowed to touch the robot during the game play.
- Interval time between trial/round depends on the referee's decision as it depends on the number of participating team for each challenge. During interval between trials/rounds, human play may make any modification on the robot and are allowed to test the field along with the challenges' tools but at a considerate manner among participating teams
- Each robot must move autonomously throughout the game. During the gameplay, human player manipulation or interruption is not allowed, and team who violated this rule would be warned or marks will be deducted (if violation has been repeated after a warning has been given along the challenge). the violation continues after the points deduction, the team will be disqualified

- The round will begin only when the referee blows the whistle. Robots must remain stationary until the whistle is sounded. Any team that violates this rule will receive a warning and must restart the challenge. If the violation is repeated, the team will be disqualified from that round.
- Participants are not allowed to hinder or postpone the challenge and will be disqualified from the trial.
- The game field are designed durable to the gameplay. Therefore, the weight and the size of the robots will not affect or damage the game field. If there are any possible disruption, it will be rectified after verification.
- Factors that caused disruption or difficulty of gameplay due to the venue's condition must be resolved by the competing team themselves as it may not be affecting other teams. However, the participating team may discuss with the organizing committee on the matter for possible solutions if judged as appropriate.
- The organizer reserves the right to interpret the challenge's rule.
- All teams are free to design the ball pushing/dribbling mechanism as long as the robot did not exceed the size limits.
- Point to note by all participant during gameplay, the ball **must touch** the correct area to gain points. However, if the ball rolled over the wrong colour area, 5 points will be deducted from the total score. This rule does not apply if the ball did not touch the ground.
- If the robot touches any obstacles on the field, marks will be deducted for every foul, but the obstacles will not be returned to their original position. (Refer to scoring rules).

Game Field Specification:

- The game field size is 400 (L) x 300 (W) (cm). The goal is divided into 3 areas as shown in Figure 4. The size of each goal is 50 (L) x 50 (W) (cm).
- The ball used in the challenge is a plastic ball for children's ball pool. The diameter ofthe ball is about 68-70mm, as shown in Figure 5.

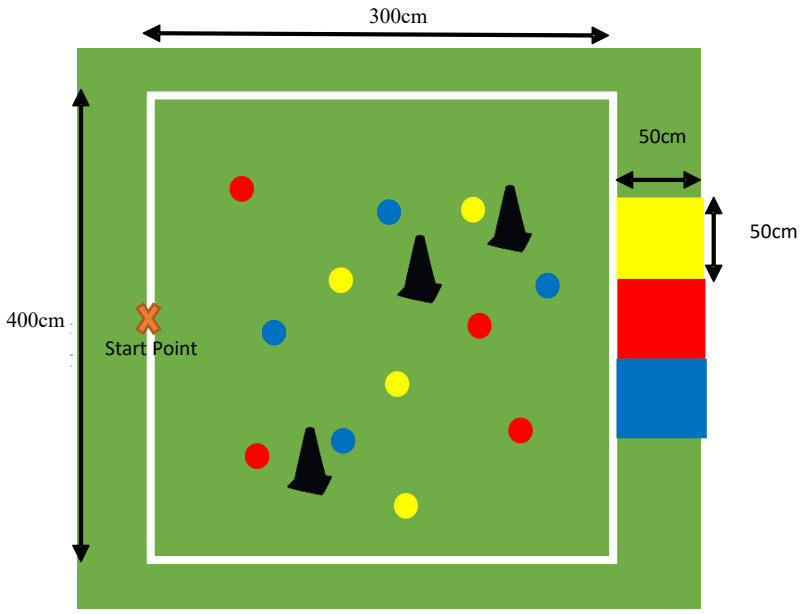

Figure 4: Game Field size and setup

Figure 5: Plastic ball for Race Challenge

Score:

- When successfully push or kick the ball into the respective colour area, the Golden Ball (specific coloured ball drawn by the referee) will be awarded 20 points, other coloured ball gain 10 points.
- Pushing the ball (the ball much touch the ground) into the wrong colour area will deduct 5 points.
- The ball must touch the correct colour patch to gain points. If the ball rolled over the wrong colour area first, 5 points will be deducted from the total score. This rule does not applies if the ball did not touch the ground.
- The robot will deduct 3 points every time it touches any obstacles on the field.
- Human players interruption during the game without referee's approval will deduct 5 points.
- Failure to complete the modification within 15 minutes before the game start due to inappropriate specification will deduct 5 points.
- The above conditions are judged by the referee.
- The score for each round will be calculated by the referee. The team which gets the

highest total scores is the winner.

- During an event where two teams obtained the same score, tie breaker would be the team that spends less time in three rounds wins.
- The score of the winner must not be less than 0 points. In the case where the challenge is unable to identify 3 top qualified scorer from the first three rounds, two more rounds will be played on next days.

5. RoboSot Soccer Challenge

The Soccer Challenge requires the RoboSot platform to develop and exhibit capabilities in the area of dynamic obstacles avoidance with passing capability.

Challenge Format:

The challenge is performed in league format, as every team's robot must perform penalty task in a soccer game, with both team only allows to place 2 robots on the game field. A minimum of 4 teams is need to perform this challenge.

Testing Time:

Before the game starts, each team will have 5 minutes setup time.

Team:

- Human Personne: Only one human team members are permitted to participate actively in a match.
- Team Size: A match shall be played by two teams, each consisting of 1 to 3 robots. Additional robots may be used as substitutes.
- 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.
- Remote Computer: Each team is also permitted a remote computer/control to transmit procedural information upon stoppages in play.

Robot:

- Each robot must not exceed the maximum dimensions of 22cm (W) × 22cm (L) × 24cm (H) when fully extended. Unlike the previous two challenges, this limitation is implemented to prevent teams from completely blocking the goalpost, ensuring that the ball can still enter successfully.
- All accessories such as gripper and kicker must be fully attached during the robot verification and measuring process.

- Additional accessories may not be added-on during the gameplay as all accessories must be attached during size verification process.
- A color patch, either magenta or cyan is allowed to easy identification of robot.
- Each team may choose to play each game with either one or two robots.

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.

Robot Behavior

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

Communication

- 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, and penalty 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. Repositioning may alternatively be done by a human handler. These will make the game more autonomous (reduced robot handing) and improve the event visually RoboSot Soccer Competition 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 remote electronic referee.

Inter-Robot Communication

- Robots may freely transmit information between one another.

Challenge Setup:

- Referee will develop the game match table before the challenge.
- 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 - Each team may attach color patches to their robot if needed. However, in the event of a conflict between teams in a match, the decision will be determined by a coin toss conducted by the referee.
- Coin Toss - A coin toss will be made by the referee immediately prior to the commencement of the game. The winner of the toss shall choose who will attack in the first half of the match.
- Game Duration: The duration of a game shall be two equal periods of 5 minutes each, with a half time interval for 5 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 asper 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.

Gameplay:

- Before any placing of robots, the referee will quickly draw the ball position, either Left, Center, or Right (refer Figure 6 for ball position). Once drawn, the referee will place the ball on the white marker.
- The team with the kick-off (attacking team) will be allowed to position their robots on the field. The defending team can then place their only once the attacking team has remove their hand from their robots. Robots can be positioned either with the designated human handler or via instruction from the remote computer.
- Once all placing is completed, referee will whistle to start the game and time starts.
- Referee will whistle during the game play if a goal is scored, or a foul is done. Time stops after the whistle.
- During the start game, defending robot may not move until the attacking team starts moving. A foul is called if the defending team move before the attacker. The first offence in this situation is a warning. The continuous offence will cause a deduction of 1 score on each offence. The ball could be kicked or passed towards any direction by the attacker. Thereafter the robots may move freely.
- The ball must be kicked in 5 seconds, otherwise, a foul is called to the attacking team. The

first offence in this situation is a warning. The continuous offence will cause a deduction of 1 score on each offence.

- Placing of robots during the initial game start is based on the kick-off position detailed in the "Actions" section below.
- The attacking team may choose to dribble the ball towards the goal to score or pass the ball to the teammate.
- After every score or foul, referee must draw a ball position again, meaning the ball position may be different for every kick-off.
- Once the first half is completed (5 minutes), both teams will be given 5 minutes for recalibrations or substitutions if necessary. The second half will require both teams to switch positions and roles. The game continuous for 5 minutes with the same game mode.
- Interruptions
    - The game time would not be interrupted when any events happened except the concerned team manager calls 'time-out'.
- Substitutions
    - There are 3 substitutes which are permitted while a game is in progress for each team, but can only be performed when game time is stopped. At half time, unlimited substitutions can be made. During game play, substitution can only be called by the interruptions or fouls happen. During an interruptions or fouls, the concerned team manager should call 'time-out' to notify the referee. And the team can substitute the robot at the next time of interruptions or fouls. 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. Substitution must be performed immediately. Any substitution that took time will be called repair and stop, as mentioned below.
- 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. And 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.
- 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 when play was halted. Upon signal from the referee, game restarts and the robots may move freely.

- A Goal is Scored
    - When the ball passes the goal line as judged by the referee, a goal is awarded to the attacking team despite which team causes the goal.
    - Game time is halted and robots are set up for the next kick-off.

Fouls:

- Ball Outside (Out of boundary)
    - If the ball passes over any boundary line despite which team that causes the foul, a kick-off is called.
- Stalemate
    - A referee will call a stalemate whenever the ball remains stationary for more than 5 seconds.
    - Stalemate may occur under this 5 condition:
        - Stalemate in goal box:
            - If the ball is not kick out by the goalie after 5 second, a penalty kick is awarded to the attacking team.
        - Stalemate outside goal box
            - If it occurs anywhere outside the goal box, a kick-off is awarded with ball placed at the kick-off point nearest to the stalemate location as judged by the referee.
        - Stalemate during kick-off
            - If the attacking team fails to kick-off within 5 seconds for the second time (first offence is a warning), a goal kick is awarded to the defending team.
        - Stalemate during penalty kick
            - If the attacking team fails to kick the ball within 5 seconds, a goal kick is awarded to the defending team.
        - Stalemate during goal kick
            - If the defending team fails to kick the ball within 5 seconds, a kick-off is awarded to the attacking team with.
- Attacking foul
    - Attacking with 2 robots in the goal box is a foul.

    - Goal kick is awarded to the defending team.
- Defending foul
    - Defending with 2 robots in the goal box is a foul.
    - Penalty kick is awarded to the attacking team.
- Collision
    - 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 calls the "collision", a penalty kick (defender foul) or goal kick (attacker foul) will be awarded to the team whose robot has been charged/pushed.
    - 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.
- Touch by human player
    - If any human from either team should touch the robots against the referee's permission, a penalty kick / goal kick will be awarded to the opposing team (depending on the foul caused by which team). Note that only one person from each team may touch the robots when given permission by the referee.
- Goalkeeper (Goalie) pushed
    - It is only permitted to push the goalkeeper robot in the goal box 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. When an opponent robot pushes the front of the goalkeeper robot, it should move away from the goalkeeper robot right away. Subsequently, if the goalkeeper is pushed directly, or if the goalkeeper is pushed along with the ball into the goalpost as described, then the referee shall call a foul and award a goal kick to the defending team.

Actions:

- Kick-off
    - Ball is placed on the position drawn by the referee.
    - Attacking team:
        - Attacking team will perform the robot placement first. Once the human player hands off their robot or announces completion of placement (the robot performs placement autonomously), the attacking robot may no longer be touched or moved.
        - A robot may be placed near or touching the ball facing towards any direction. Holding the ball at this stage is allowed.

        - If the attacking team has a second attacking robot, the second attacker may be placed at any position on the game field but must be 1 m away from the ball and the goal box.
    - Defending team:
        - The defending team may only make placement once the attacking team completes their robot placement.
        - A goalkeeper must be placed on the game field with any part of the robot touching the goal line.
        - If the defending team has a second defending robot, the second defender must be placed 1 m apart from the goalkeeper, the ball, and all other attacking robots.

- Penalty Kick
    - Penalty kick is awarded to the attacking team, as foul is caused by the defender.
    - Ball is place at penalty point as shown in Figure 6.
    - Attacking team:
        - Attacking team will perform the robot placement first. Once the human player hands off their robot or announces completion of placement (the robot performs placement autonomously), the attacking robot may no longer be touched or moved.
        - A robot may be placed near or touching the ball facing towards any direction. Holding the ball at this stage is allowed.
        - If the attacking team has a second attacking robot, the second attacker may be placed at any position on the game field but must be 1 m away from the ball and the goal box.
    - Defending team:
        - The defending team may only make placement once the attacking team completes their robot placement.
        - A goalkeeper must be placed on the game field with any part of the robot touching the goal line.
        - If the defending team has a second defending robot, the second defender must be placed 1 m apart from the goalkeeper, the ball, and other attacking robots.
    - Once whistled, attacking team must kick the ball first before the defending team can move.
    - Failure to kick the ball by the attacker team will cause a stalemate foul.

- Goal Kick
    - Goal kick is awarded to the defending team, as foul is caused by the attacker.
    - Ball is place at penalty point as shown in Figure 6.
    - Defending team:
        - The defending team will perform the robot placement first. Once the human player hands off their robot or announces completion of placement (the robot performs placement autonomously), the defending robot may no longer be touched or moved.
        - A goalkeeper must be placed on the game field with any part of the robot touching the goal box (goal box includes the goal line).
        - If the defending team has a second defending robot, the second defender must be placed 1 m apart from the goalkeeper, the ball, and all other attacking robots.
    - Attacking team:
        - The attacking team may only make placement once the defending team completes their robot placement.
        - All attacking robots must be placed 1 m apart from the goalkeeper, the ball, and all other defending robots.
    - Once whistled, defending team must kick the ball first before the defending team can move.
    - Failure to kick the ball by the defending team will cause a stalemate foul.

Game Field Specification:

- Field size: 8m x 6m (Excluding Line Thickness)
- Material: 100% fiber synthetic needle punch carpet
- Colour: Light green

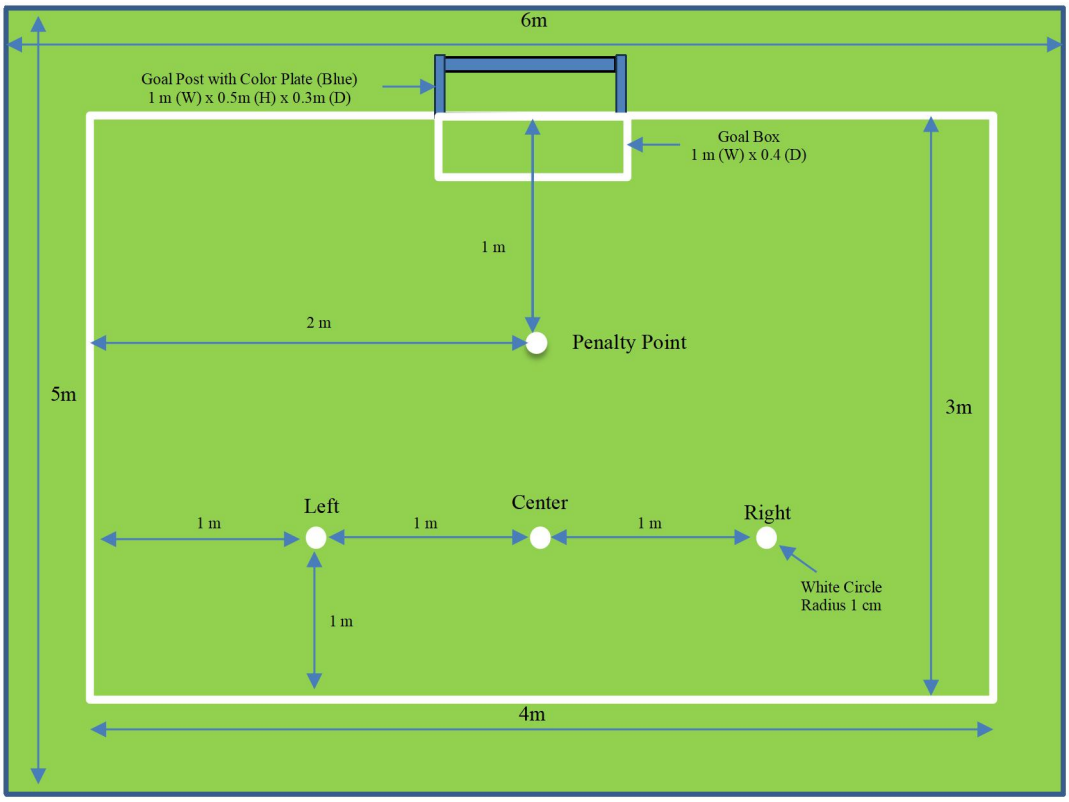

Figure 6: Soccer Game field and lines.

Ball Specification

- Type: Stress Therapy Foam Balls
- Material: Rubber
- Size: 6.5 mm – 6.6mm
- Colour: Orange

Figure 7: Stress therapy foam ball for Soccer Challenge

Goal Specification

- The goalpost used for Soccer Challenge is the as for Avoidance Challenge

Score:

- A goal is valid only if at least half of the ball passes the goal line as judge by the referee. 1 point is awarded for every valid goal.
- A goal is invalid if the ball is kick over the goal bar, as it is considered out of boundary.
- In case if a foul occurs simultaneously with a valid goal as judged by the referee, the goal will be counted then followed by the foul. However, if the valid goal happens after the foul, the goal is not counted.
- Any objection on the referee's decision must made before the game play continues during the match. Every objection must be supported with a clear video proof. Any objection that is brought forward after the game continues will not be entertained as referee's decision is final and valid.
- If one team win opponent team exceed 10 points, the team will be the winner directly
- Winner of the match is awarded 3 marks, draw awards both team 1 marks, and losing team of the match will now be awarded any marks.
- Team with the highest marks will be announced as the winner of the challenge.
- Tie breaker will be based on the most goal obtain during the challenge.
- In case of teams with same marks and same goals obtained in the challenge, tie breaker is based on the biggest score difference in any match played in the challenge.

6. Conclusion

RoboSot is one of the category in FIRA Malaysia Cup that challenged all competing team to develop a fully functioning wheeled robot if not by modifying an existing robot such as TurtleBot 3 Burger manufactured by ROBOTIS company or Bveeta Mini manufactured by Bizbot Technology to perform difficult task. The challenges introduced in RoboSot category slowly pathed the participating team towards building wheeled robots that could interact with the environment using various sensors and well-developed programming. The evolution of challenges would eventually require interact among robots to perform tasks that needs effective problem solving and decision making strategies autonomously.