VERSION 1

SRI LANKAN ROBOTICS CHALLENGE 2022

SCHOOL CATEGORY

TECHNICAL SPECIFICATIONS

SCHOOL CATEGORY

Robotics has grabbed the critical interest of the local and international community for the past two decades with its innovative concepts. The Electronic club of University of Moratuwa, alongside the Department of Electronic and Telecommunication Engineering, has launched the Sri Lankan Robotics Challenge (SLRC) for nine consecutive times as the longest and pioneering robotics festival in Sri Lanka.

To celebrate its glorious tenth anniversary, the Sri Lankan Robotics Challenge 2022 will bring together robotics enthusiasts from all across the country to one location.

The School Category Competition aims to provide school children a platform to learn, engage, and show their passion for robotics. All the winners will be entitled to valuable cash prizes and certificates from University of Moratuwa.

Your task is to build a robot that can successfully conquer the given challenge with the knowledge you have gained through SLRC workshops and self-learning. The challenge mainly consists of line following, wall following, object detection, and color detection subtasks.

Once upon a time...

It was a soggy Monday when Sherlock and Watson were in their street reading the newspaper. Suddenly, Mrs. Hudson and an older woman arrived. Sherlock observed that the woman was having a problem, and before he could even ask what it was, the older woman began to cry and explain her situation. Mr. Smith Wilson was the inspector in charge of the rural London Waterloo East Railway Station on Sandell Street. When Mrs. Wilson arrived at the station on Monday morning of last week to deliver her husband his breakfast, he wasn't on duty. There was no message at all. She waited for her husband for a week, but he had yet to arrive. She then made her way to see Sherlock Holmes. Sherlock Holmes accepted the older woman's request and began looking for information to complete the mission. Mrs. Wilson claims that Mr. Wilson had worked at the station on Sunday night.

To gather information for his investigation, Sherlock and Watson took the same train that arrived at the London Waterloo East railway station last Sunday night. As usual, the train made a midnight stop at London Waterloo East Railway Station to pick up overnight mail. Every passenger was sound sleeping. Sherlock and Watson got off the train and were waiting for a cart to take them to Mr. Wilson's house when Sherlock noticed a horse cart driving unusually quickly towards the railway station.

Sherlock started to stop the cart by waving his hand, but despite his efforts, it moved forward. Sherlock noticed that the driver was also dressed in his customary high-end attire. After a few minutes, the same cart passed them and moved towards the village, but it appeared heavier.

Watson and Sherlock decided to follow that cart due to curiosity. They arrived at an ancient farm after following the horse's tracks along the muddy road. The cart approached haystacks that were used as a wall. Because there was hay everywhere and no sign of the cart, Sherlock decided to walk between the haystacks. The driver had leaped from the wagon, leaving behind his tracks that went into a corridor inside the barn but not along the corridor. As they moved carefully along the corridor, Sherlock and Watson discovered that the footprints had reappeared in a spacious hall.

When they followed, there were two tables on the right and left with different light bulbs on top of each table. White and black boxes were there as Sherlock and Watson moved closer. Sherlock glanced into a box right away. Woooh. They were stocked with weaponry. "Farmers don't need these weapons; this should be an act of a criminal group" Sherlock thought. Sherlock had some guesses, but who was in control needed to be clear.

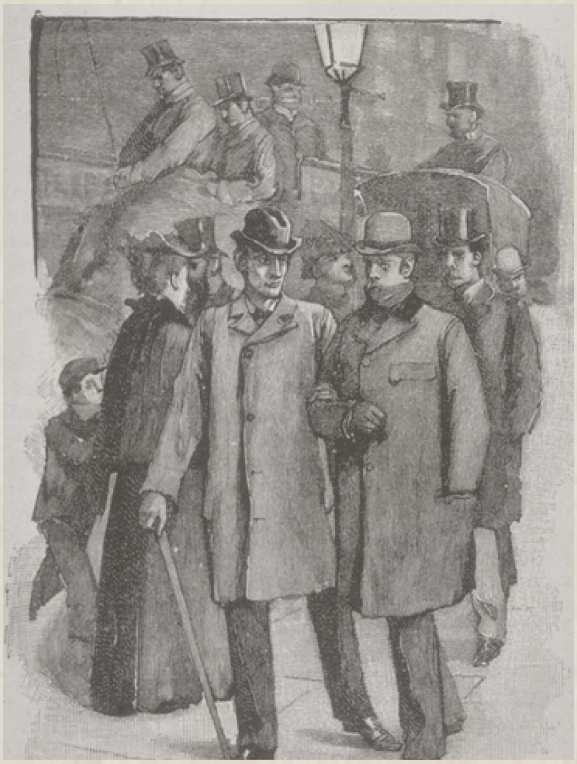
Despite Sherlock first believing it to be Professor Moriarty, he still needed to locate a clue. Sherlock kept looking at the box. Wait, there were letters in the white box on the right table, which Sherlock opened to read, but when he took it, the writings vanished. It was a light-sensitive ink that could only be seen in special lighting situations.

Perhaps there could be letters within other white boxes as well. There were letters in all white boxes on the right table, but there were no letters in any black boxes on the right table. Another different light bulb was present on the left table. "There can be letters in black boxes also; maybe they will appear if I move them to the left table," Sherlock assumed. Sherlock moved the black box to the left table and examined that to ensure his assumption. There were letters in it too, but none of them were meaningful. To find a clue, Sherlock must move all the white boxes to the right table and all the black boxes to the left.

To solve this job, you must act like Sherlock from the moment he steps off the train at London Waterloo East railway station, follow the driver's path and divide the weapon boxes into two tables.

SLR 2022

CONTENT



1. TASK

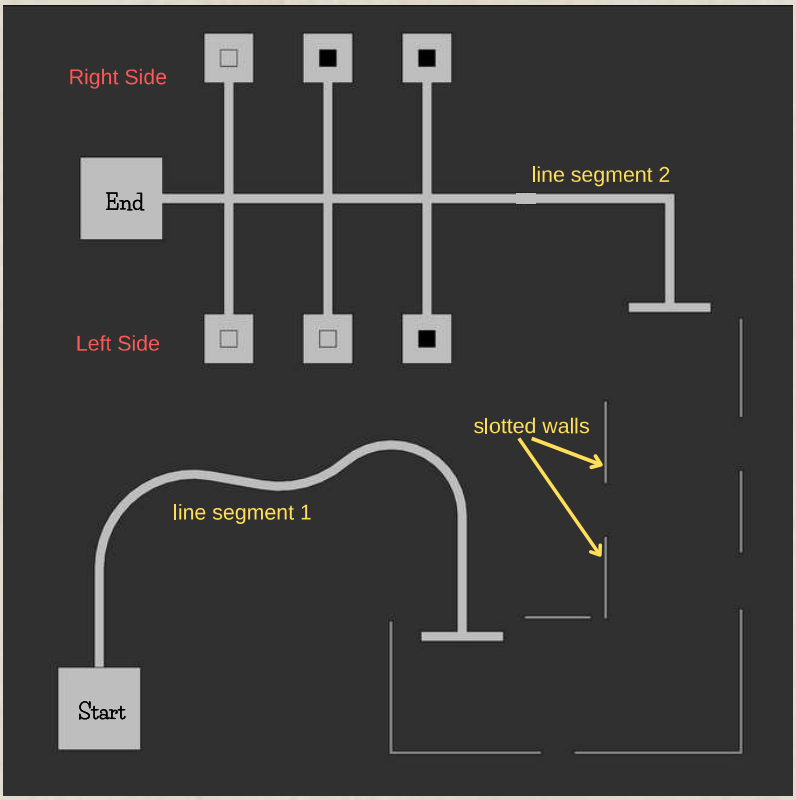


Figure 1.1 - Sample arena

Begin your mission by positioning the robot in the Start square, as shown in figure 1.1. Then, follow line segment 1 and go through the area with segmented walls without touching those walls. When you are following line segment 2, you must continue along that path until you reach a Tree Structure. First, identify the locations of the black and white boxes there, and then arrange all the white boxes on the right-hand side and all the black boxes on the left-hand side.
The task consists of several subtasks.

1. Line Following
2. Wall Following
3. Sorting the boxes in the Tree Structure

1.1 Line Following

At the beginning of the task, the robot will be placed on the starting white square. First, the robot has to follow a white line on a black surface. These paths may contain straight lines, curved lines, and 90-degree corners. All the line segments you encounter throughout the task will be of similar specifications as described later.

1.2 Wall Following

The robot has to go through an area by following segmented walls. Wall segments are placed such that some length at the end of a wall segment on one side will slightly overlap with some length at the start of a wall segment on the other side. All the wall segments will be black (used a different color in figure 1.1 for the clear visualization). These walls may contain 90-degree corners.

1.3 Sorting the Boxes in the Tree Structure

The robot has to follow line segment 2 and enter the Tree Structure with seven white squares. The Tree Structure will be the same as shown in figure 1.1, with three squares on the left-hand side, three squares on the right-hand side, and a single square at the end. Initially, three black boxes and three white boxes will be placed randomly on these six side squares. Note that the placement of the boxes on squares will be random and will not be the same as what is shown in figure 1.1.

The task is to keep the three white boxes on the three squares on the right side and the three black boxes on the three squares on the left side. The End square can temporarily hold the boxes while exchanging the boxes' positions. You can carry multiple boxes at a time and drag boxes along the path, but only one box can be placed inside a white square simultaneously (empty squares are also acceptable). When there is no contact between the box and the robot, the box should be placed inside a white square. (Note: Some boxes are already kept in the correct position, and there is no need to change their position).

After placing all the boxes correctly at the center of the white squares, the robot should proceed to the End square and stop to complete the task.

2. Arena Specifications

2.1 Full View

The full view of the sample arena with all the subtasks is as in figure 2.1. The layout of the final competition arena may differ from this sample arena.

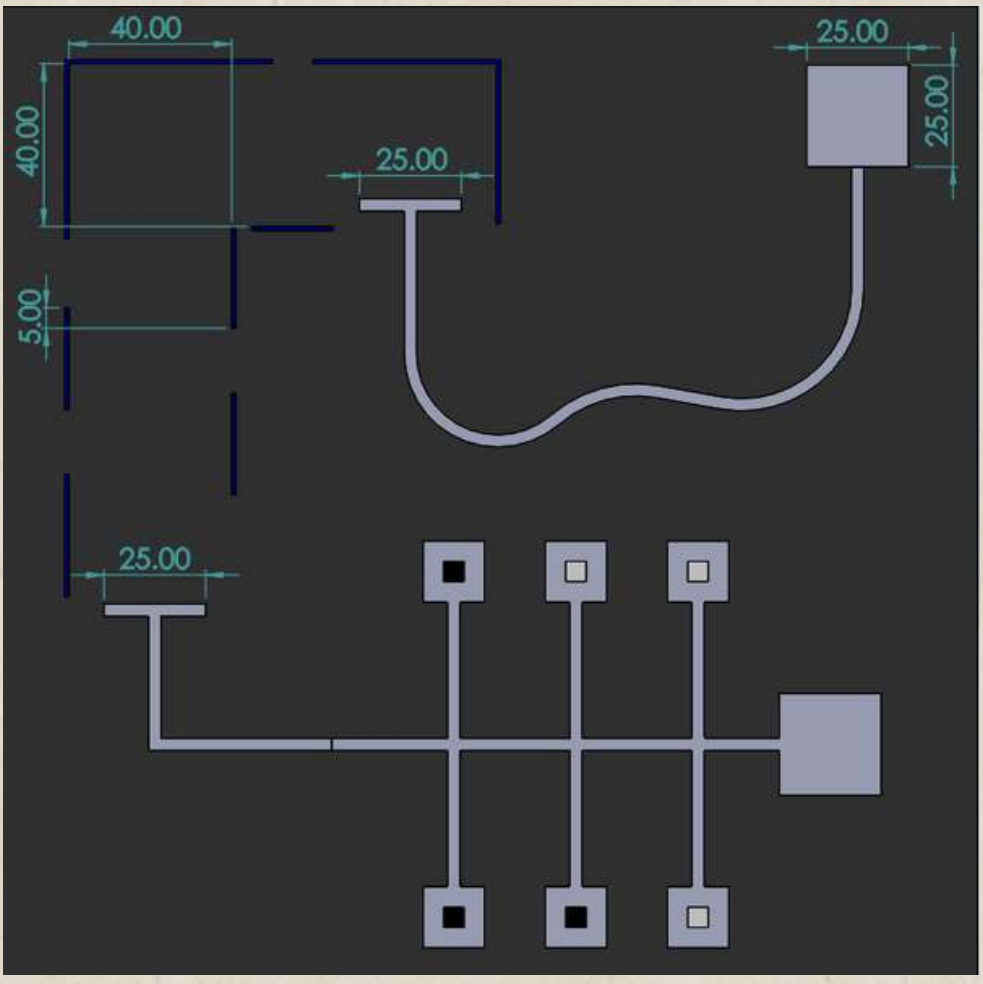


Figure 2.1 - Sample arena (dimensions are in cm)

2.2 Key Arena Specifications

1. Start and End squares are white squares of 25 cm x 25 cm.
2. Line segments are white lines with a width of 3 cm on a black background.
3. The height of every wall will be 15 cm, and its color will be black.
4. Since the whole arena can't be constructed on a single board, there can be slight differences in height at the boundaries of the 8 ft x 4 ft (240 cm x 120 cm) boards.
5. The minimum distance between the middle of the lines and the edges of the arena will be 20 cm.
6. The surfaces of the lines and the walls will be matte-finished. The type of the sticker used will be "buffel" stickers.
7. All the dimensions may be subject to a maximum error margin of ± 1 cm.

2.3 Line Segments

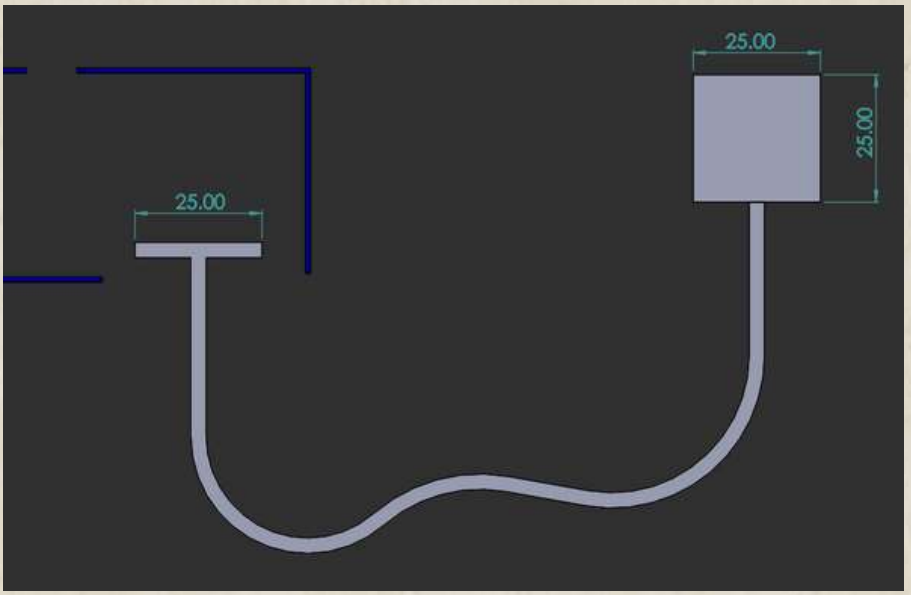


Figure 2.2 - Sample line segment 1 (dimensions are in cm)

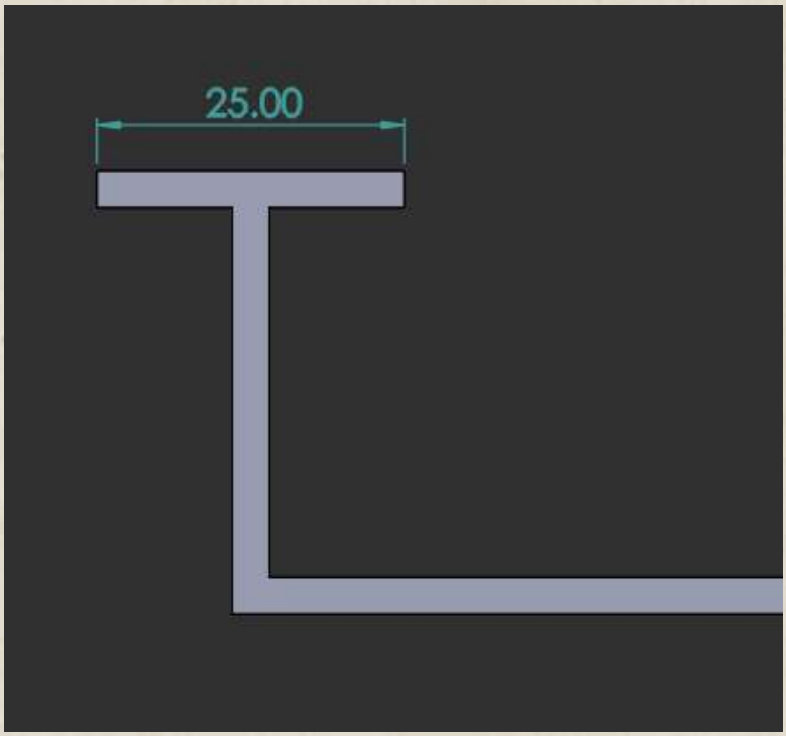


Figure 2.3 - Sample line segment 2 (dimensions are in cm)

1. Paths are white lines with a width of 3 cm on a black background.
2. As shown in figure 2.2 and figure 2.3, any of the line segment paths may contain straight lines or curved lines. In addition, there can be 90-degree corners along the path.
3. The minimum radius of curvature of a curved line is 10 cm.
4. The minimum length of a straight-line segment is 30 cm.
5. At the beginning and end of the line following part, there is a T- shaped line (as shown in figures 2.2 and 2.3) to indicate the start and the end of the line. (end of the line segment 1, beginning of the line segment 2)
6. The layout of the lines for the final competition may differ from the sample arena in the diagram.

2.4 Wall Segments

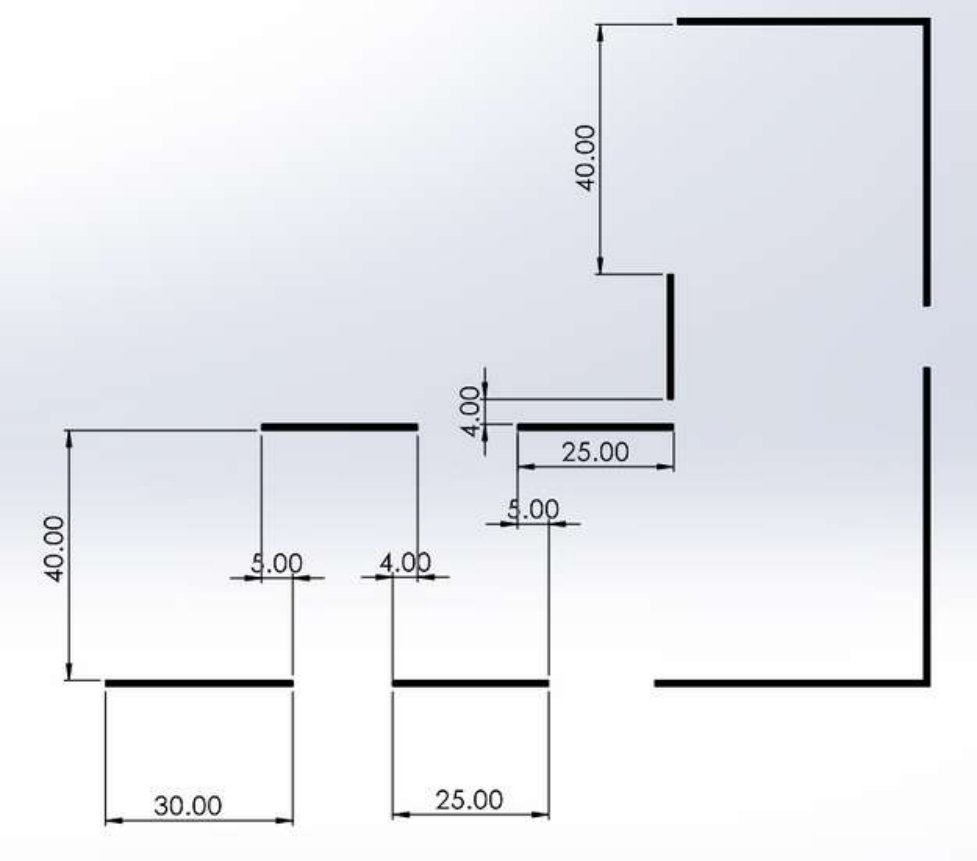


Figure 2.4 - Sample wall following area (dimensions are in cm)

1. Figure 2.4 shows that segmented walls may contain straight parts and 90-degree turns.
2. The inner wall distance is in the range of 40 cm ± 1 cm.
3. There is a 3 cm-5 cm overlapping between the wall segments at the start and end of walls on opposite sides.
4. The walls are of the color black.
5. The wall segment height is 15 cm.
6. There may be more than one 90-degree corner.

Special Note - The dimensions, except those constrained according to the above 6 points, may differ from the sample arena in figure 2.4.

2.5 Tree Structure

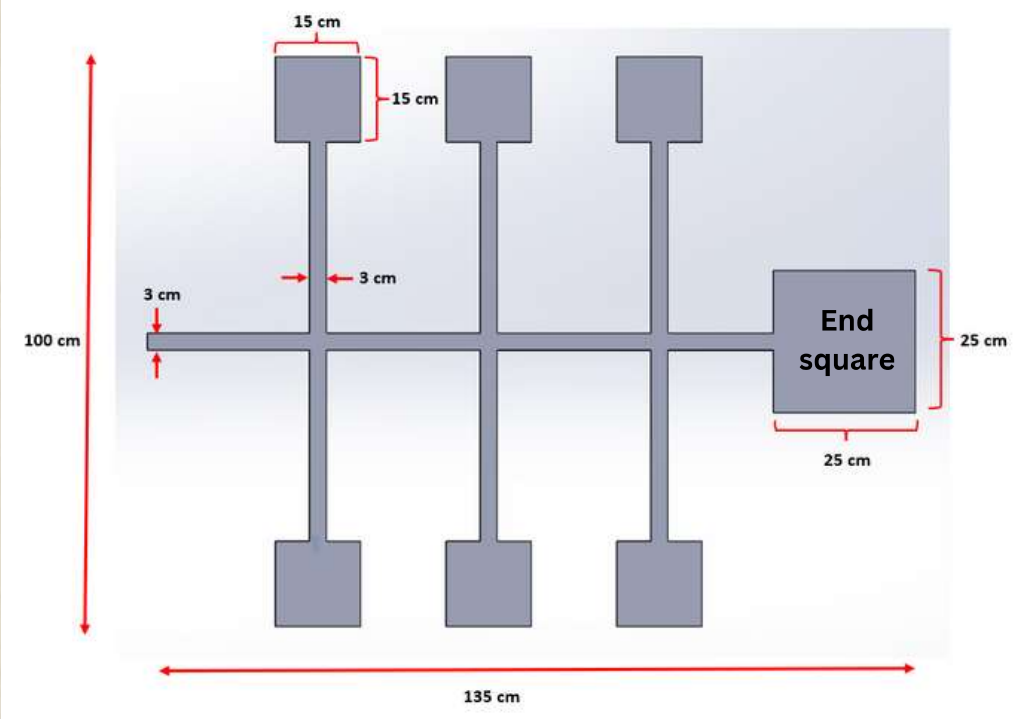


Figure 2.5 - Tree Structure

1. The layout of the Tree Structure will be the same as in figure 2.5, but the arrangement of boxes in the squares and the arena dimensions will differ.
2. Paths are white lines with a width of 3 cm on a black background.
3. Six squares in the Tree Structure are white squares of 15 cm x 15 cm and the End square is a white square of 25 cm x 25 cm.
4. The boxes (either black or white) kept on the Tree Structure area are of dimensions 5cm x 5cm x 5cm.
5. Boxes should be placed at the center of each white square (except on the End square) with a tolerance of 3 cm between the box's center and the square's center.
6. There is no box in the End square initially. However, you can use the End square to place boxes when arranging the boxes as an exchange point. If you place boxes in the End square, they need not be positioned at the center but should be fully inside the square.
7. Minimum length of a line segment in the Tree Structure is 30 cm.

Special Note - The dimensions, except those constrained according to the above 7 points, may differ from the the sample arena in figure 2.5.

3. Robot Specifications

1. Dimensions of the robot should not exceed 25 cm x 25 cm (width x length). It will be tested before the start of the first round by placing the robot inside a 25 cm x 25 cm box.
2. The robot should be completely autonomous. Any remote control would lead to the disqualification of the robot.
3. The robot should be powered with an internal power supply with a supply voltage not exceeding 24V. The final unit, including the power source, should be within the dimensions specified above.
4. The robot must be built entirely by the team members. Therefore, no off-the-shelf Lego kits or assemblies are allowed except for the ready-made processing boards, sensor modules, drive gears, and other electronic modules.
5. The robot should not cause any damage to the platform (arena). Any damage to the arena leads to disqualification. If the judges feel that a robot has a high risk of damaging the arena, they can deny the attempt.
6. A team can use any preferred method for wall sensing; however, the robot must not exert a force on a wall, likely to cause damage. For example, the robot must not jump over, climb, scratch, damage or destroy the walls in the arena.
7. The robot should be activated using a single start switch placed on the robot itself. Therefore, the robot should have a simple starting procedure.
8. The starting procedure of the robot should not involve giving the robot any manual force or impulse in any direction.
9. The robot should be able to operate under provided lighting conditions.
10. The robot cannot transform into two robots during gameplay.
11. There should be a way to indicate that the robot has completed its task. This will be considered to measure the time. (eg. turn ON a LED bulb)
12. The minimum distance between the middle of the lines and the edges of the arena will be 20 cm. The robot should be designed such that it won't fall out of the arena.
13. The robot should not leave any of its components behind in the rest of the arena.

4. Team Composition & Eligibility

1. A team can have a maximum of 5 members and a minimum of 1 member. Students from different schools can form a team, but the team should register under one school name.
2. Each team member should be 20 years or below to be eligible to compete, and a student can only represent one team.
3. All members of the team should be attending school or after A/Ls but should not be selected to attend nor registered at a university at the time of their participation in the competition.
4. All the team members should have a valid document to prove their eligibility to participate in the competition.
5. Multiple teams could compete, representing the same school, but one team can only submit one robot.
6. Violation of the above conditions would lead to disqualification.

5. Rules and Regulations

5.1 General

1. There won't be any arena changes once the round has started. All teams will have the same arena.
2. All the teams must submit their robots to the organizers 15 minutes before the start of the first round. After that, the robot will be given to the relevant team only for its attempts at the round.
3. The contestants must be prepared to start within 5 minutes after the call; if not, the attempt is lost.
4. A team should place the robot entirely inside the starting square at the start of their run. When the judges give the signal, the robot can be switched on. From then on, the robot should navigate autonomously. The contestants should not manually alter the orientation of the robot during the gameplay. Additionally, the contestants should not communicate with or control the robot during an attempt.
5. A maximum of 3 attempts are given in a single round, and the overall time (the total time of all attempts taken) will be counted.
6. A maximum time of 15 minutes (period of gameplay) is allocated per team. Therefore, all the attempts are reserved for this period only. If the robot exceeds the time limit of 15 minutes, your robot will be removed from the arena.
7. Program or hardware modifications of the robot are not allowed within this 15 minutes.
8. The time taken to travel from the start square to the End square is called the total run time. The clock will start when the judges give the signal to start. The clock will stop when the robot reaches the End square, and a proper indication is issued by the robot that it has completed the task.
9. The clock will not be paused during an attempt.

10. If the robot drifts out of the line to the extent that no part is on top of the line in line following segments, the judges will consider it as jumping out of line. However, if the robot finds its way back to the line on itself, it can continue, provided that the distance skipped by the robot along the line is less than 30 cm. The judges may deduct points in this case. If the robot does not find its way back to the line within a skipped distance of 30 cm, which would be considered the end of that attempt, you will be allowed to remove the robot from the arena.
11. When arranging the boxes in the Tree Structure, the boxes should be placed inside the white squares at all times except while in contact with the robot. For example, placing a box on the path or on the black surface while not having any contact with the robot will result in a points deduction.
12. Only one box can be placed inside a square.
13. All boxes should be placed at the center of the white squares as specified earlier in the final placement to consider that attempt complete.

5.2 Calibration

1. Two additional minutes before the gameplay period of 15 minutes is given for the calibration of the robot.
2. The robot can only use the arena from the starting square until the end of line segment 1 for calibration.
3. Calibrations can only be done through external adjustments of the robot. Therefore, program changes nor hardware part replacements are not allowed.
4. The team can request the start of their first attempt before the calibration period ends. The gameplay period of 15 minutes will start at that moment. (The remaining calibration time will not be added to the 15 minutes given for the three attempts)
5. If a team fails to finish calibrating within these 2 minutes, the extra time taken will be deducted from the period of gameplay of 15 minutes.

6. Judging

1. Each team member may be questioned about their robot; every member should clearly understand and be able to explain the robot's working principles and mechanisms. There would be an immediate disqualification of defaulters of any kind.
2. The robot's code will be checked for hard coding upon judges' request.
3. No timing bonus will be given unless the robot completes the task.
4. Penalties will be mainly given to but not limited to;
    - Touching the walls of the arena
    - Deviation of less than 30 cm in length without covering any part of the line in line following segments
    - Placing boxes on the path or the black surface within the Tree Structure without any contact with the robot and the box
5. The final judging criteria will be given in a later version of this task document, which we will release before the competition.
6. If the robot is not performing well, the judges may ask to stop the current attempt. However, the team will still be given all three attempts. If this happens in all three attempts, the total run time of 15 minutes may not be allowed.
7. The decision of the panel of judges will be the final decision.

7. Contact Information

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Special Note

Please don't assume anything about the task or the arena if it is not specified in this document. Contact us if you need any clarification.

This is version 1 of the task document. Please be updated on the WhatsApp group and the SLRC website for further updates.

2022/01/14