SEVENTH ANNUAL

ROBOTIC COMPETITION

UNIVERSITY COMPETITION

TECHNICAL SPECIFICATIONS

ORGANIZED BY

FACULTY OF ENGINEERING

SRI LANKA INSTITUTE OF INFORMATION TECHNOLOGY

1. Introduction

SLIIT ROBOFEST, as the premier robotic competition in Sri Lanka, is dedicated to make the annual competition more innovative, exciting, and competitive each year. Thus, this year's competition has been designed to challenge the competitors in terms of technical aptitude, innovation, and imagination, which with no doubt, will make way for an interesting and tightly contended competition.

To compete, each team must design and build a fully autonomous robot with technical specifications outlined in this document. Key features of the terrain and the tasks to be performed are also delineated herewith. Based on the design and performance of the robots, an impartial panel of judges will adjudicate the competition. The decision of these judges will be the final decision.

Also, please note that any amendments to the rules will be updated on the website, www.robofest.lk. If you have any questions or clarifications you may contact the ROBOFEST organizers through email robofest@sliit.lk or phone 0768526900.

2. General Rules

1. The competition is open to students of any university or any tertiary level educational institute.
2. A team may consist of up to a maximum of five members, all from the same institution.
3. The score for each robot will be judged based on the accuracy and timing in performing the given tasks.
4. Each team will be given 20 minutes to perform the task. Within this time, a team may attempt up to three runs, and the best score out of three attempts will be considered as the final score.
5. There will be a preliminary competition (round 1), in which ten finalists will be selected. Those finalists will compete in a final round for Gold, Silver, and Bronze medal awards.
6. Any amendments to the rules will be announced by the organizing committee and it will be updated on the website.
7. Judges of the competition are given full authority to interpret the rules and make any subsequent decisions about matters that may arise in the competition. The decisions made by the judges will be the final decision.

3. Playing Field

The playing field will be divided into two areas (see Figure 1). Area A – Maze Solving & Object loading and Area B – Arrow following and Object Unloading. The terrain and the key features of each area are described below.

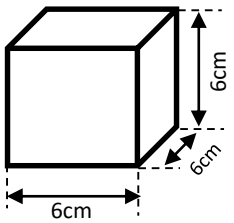
The robot should solve the maze and load the object (initially selected by the team leader) at the end of the maze to complete the tasks for Area A. The robot is said to be in Area B once the robot with the loaded object (payload) exits the maze and enters the area with coloured arrows. In Area B the robot is expected to follow arrows (**robot should navigate in the direction pointed by the arrow head**) that are of the same colour as the object.

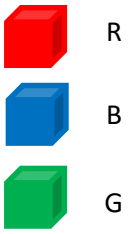
The robot is said to have completed the overall task successfully once it unloads the loaded object (payload) on top of the unloading destination which too will depend on the colour of the object.

A. PRELIMINARIES

1. Before each round the team leader of each team should randomly pick <u>one</u> object (payload) from an opaque sack which would contain a red, blue and a green box (payload).

   <u>Payload Information</u>
   - Dimensions: 6 cm × 6 cm × 6 cm.
   - Weight: Less than or equal to 100 grams.
   - Colour: Red (R), Green (G) or Blue (B).
   - Material: Matt (Sticker)





   The path for arrow following and location for object unloading will depend on the colour of the randomly picked object.

2. Samples of stickers of black, white, red, blue and green will be provided outside the arena for calibration purposes.

B. THE MAZE (Area A)

1. The robot is expected to find its way to an object placed at the end of area A, through a network of paths designed as a puzzle. The walls of the maze are 5 cm high and 1.2 cm thick (Tolerance may be up to 10% for maze dimensions).

2. The gap between two parallel walls and any opening in the navigable paths within the maze will be 30cm (1 Foot). The entire maze area will be 6 Feet ×6 Feet (36 Ft^2). Also, note that the gaps and openings within the maze may have a tolerance up to 5% (Figure 2).

3. An outside wall encloses the entire maze (as well as the playing field).

4. The maze walls are black and the floor of the maze is white. Do not assume the walls within the maze will be consistently black. Though all walls are identical, the intensities may vary depending on lighting conditions.
   Do not assume that the platform provides a given amount of friction. The floor/surface will be a white matt surface.

5. The opening entrance to the maze will be constantly located (figure 01). The entrance point is bounded on two sides by walls and a start square (1 Foot ×1 Foot) will be given in black at that entrance point to denote the beginning of the maze.
   One of the judges will announce when to start the robot. Once the team member activates the robot, the adjudicator will start the timer.

6. Some paths in the maze may lead to dead ends.

7. At the end of Area A there will be the object, which was initially selected by the team leader (Refer Section A. Preliminaries). The robot should pick this object (payload) after successfully solving the maze.

8. The robot who solves the maze and successfully loads the object at the exit point of the maze is said to have completed tasks in Area A.
   However, there may be penalties based on the level of performance of the robot within the maze and during the loading process (Refer Section 6. Penalty Criteria.)

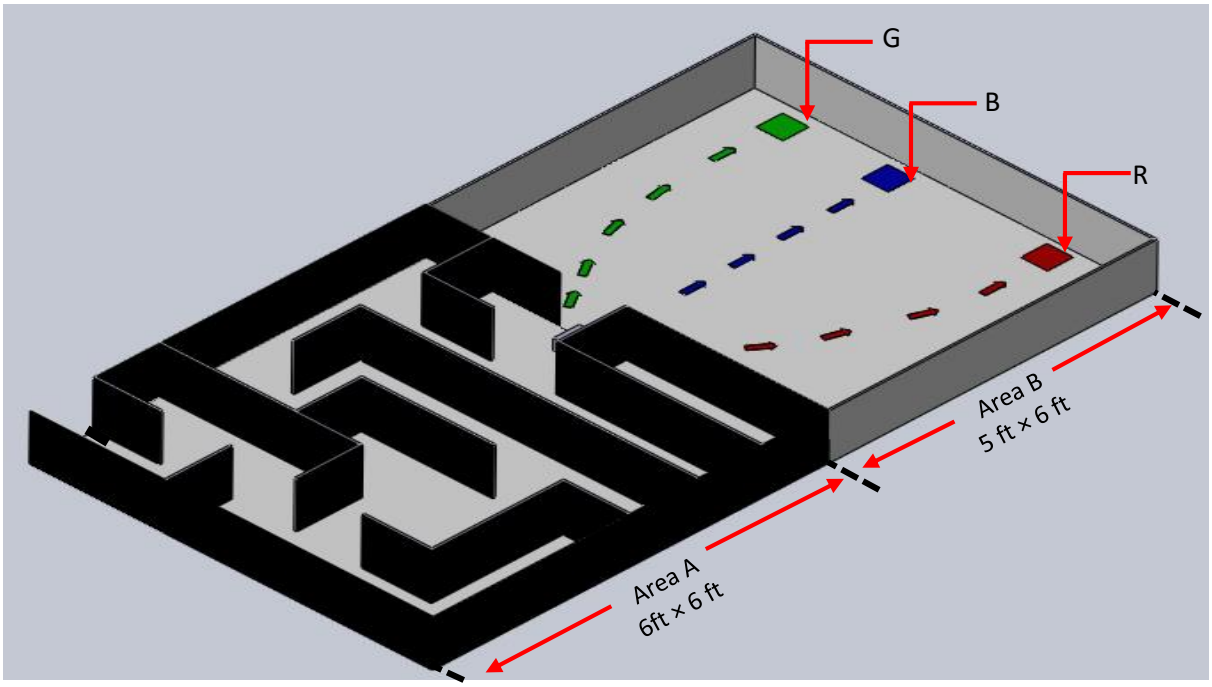


Figure 1- Example Model of the Play Ground (Left View)

Note: The destination squares will be at the end of the platform, but their order may differ from those shown in the figures.

Moreover, the Arrow paths may not be direct as shown (Refer Section 3 – C Arrow Following and Object Unloading, (5) for more details). A coloured copy of this document is available on our website: www.robofest.lk.

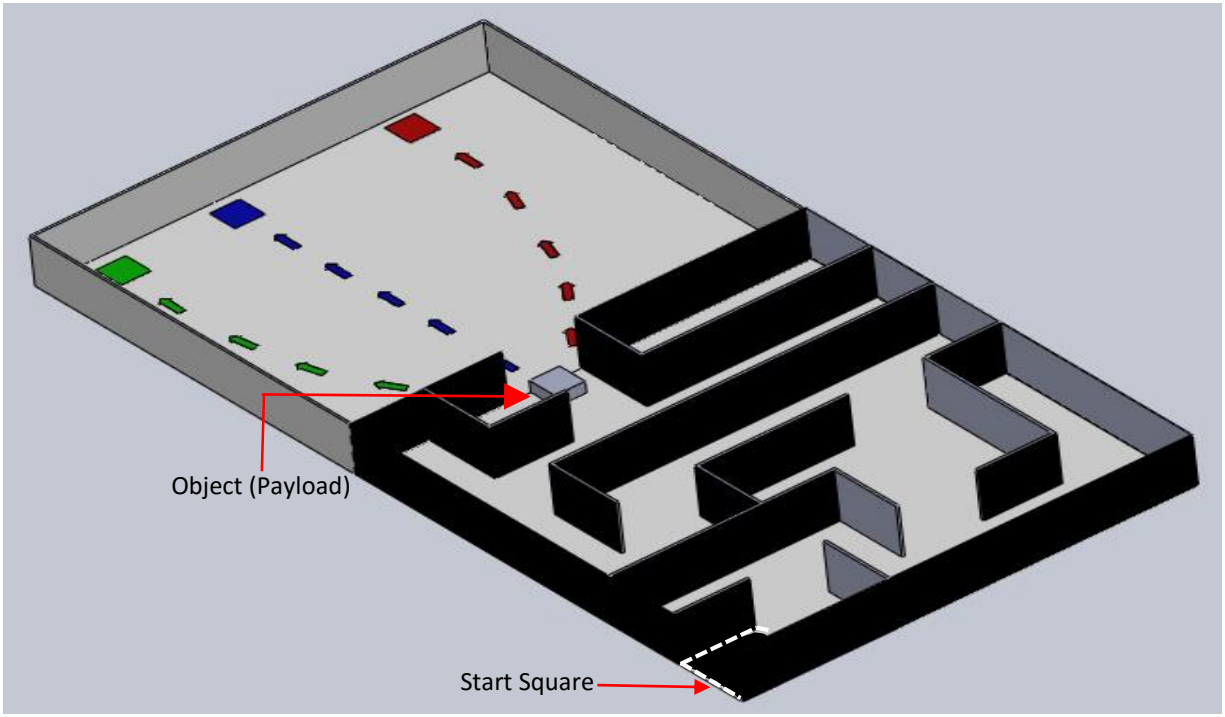


Figure 2-Model of the Play Ground (Right View)

Note: All dotted lines are for diagram explanation purposes only. No dotted lines will be present in the actual playing field.

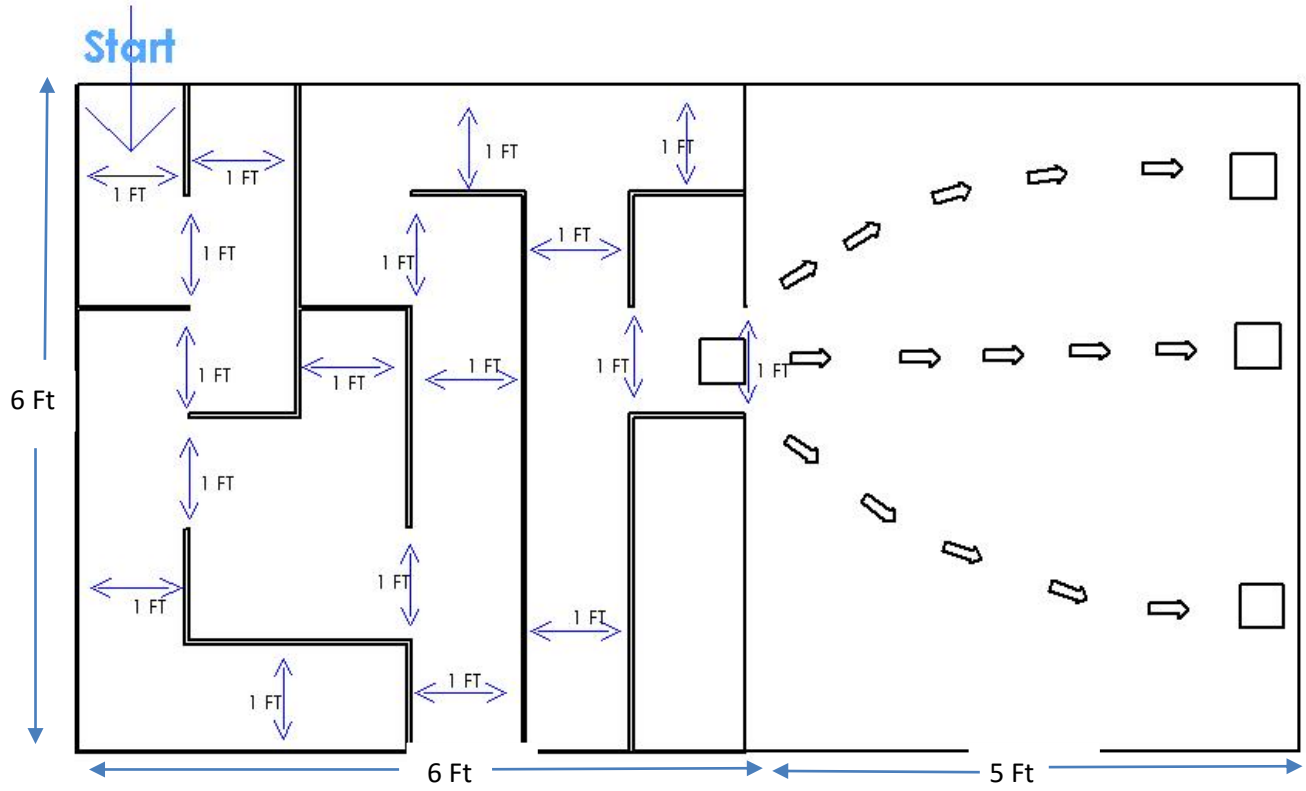


Figure 3- 2D View with dimensions of a sample path

C. ARROW FOLLOWING AND OBJECT UNLOADING (Area B)

1. Area B will consist of a series of arrows for the robot to follow where arrows of the same colour will lead to a goal. The playfield surface will be a white matt surface.

2. A set of arrows will be in **Red,** another set will be in **Green** and the remaining arrows will be in **Blue**. The material of the arrows will have a matt finish (Matt Sticker).

3. Each arrow will be 10.5cm long, 3cm wide at the base, and 5cm wide at the head (figure 4).

4. An arrow will always point towards the base of another arrow of the **same colour**. The robot should follow the arrows that would be of the same colour as the object (payload) that was at the end of task A.

5. The arrows will not always directly guide the robot to the respective unloading square. For example:

   - There may be curved paths
   - Arrows of a different colour (Red, Green or Blue) placed in-between two arrows of the same colour etc (i.e. there may be a red arrow in between two greed arrows, a blue arrow between to red arrows etc).

This is to assess whether the robot has the ability to accurately distinguish between the three colours and to clarify that the robot detects and navigates in the direction pointed by the **arrow head** of the coloured arrow path that it follows.

However, the arrows of the same colour will always lead the robot to the respective unloading square which will also be of the same colour, regardless of how indirect or curved the path is.

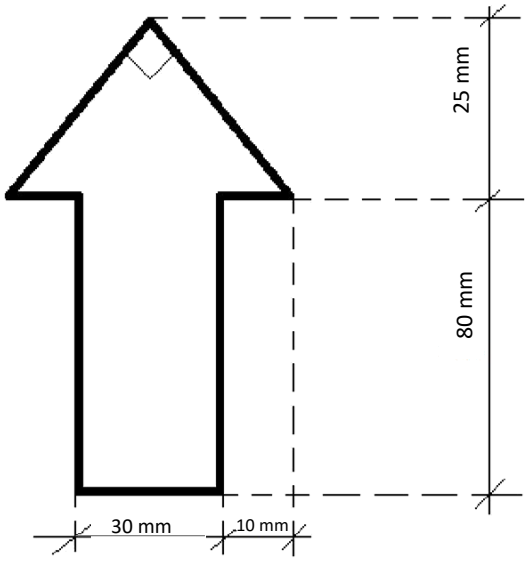


Figure 4- Arrow Dimensions

D. Rules for Object loading and Unloading

1. Payload dimensions are given under section **A - Preliminaries**.

2. There will be a significant difference between the three colours of the given boxes and the exact intensities will not be specified.

3. If the robot drops the payload while carrying it and continues to navigate without picking it up, the robot can complete the task but marks for carrying the payload will be deducted. However, if the robot picks up the payload again, marks for carrying will be awarded but a penalty will be given.

4. There will be three separate destination squares (Blue, Green and Red), each with an area 8cm × 8cm, to unload the object. The robot should unload the object on one of the three destination squares – on the square which is of the same colour as the object that it carried and the arrows that it followed.

   For an example if the team leader initially picked the green box, the robot should unload the box (payload) on the green square (By then the robot would have reached the green square IF it successfully followed the path directed by the green arrows).

5. The robot can adjust the position of the box after unloading. The object (payload) should perfectly be within the destination square after unloading, in order to gain the full amount of marks allocated for unloading.
   The adjudicators will decide whether the box is placed correctly or not. A penalty will be given if the box is placed partially inside the unloading square.

6. All tasks of Area B are considered to be successfully completed by the robot if the robot navigates in the path directed by the arrows which are of the same colour of the object (payload) and if the robot securely carries the object until it is unloaded in the correct destination square.
   If the tasks are partially completed, marks will be awarded based on the performance of the robot in the field.

7. The adjudicators will announce the attempt completion and stop the timer when the robot is no longer in contact with object after the robot unloads the object (payload) successfully.

4. Rules for the Robot

1. The Robot must be self-contained (autonomous, no remote controls) and should not use any energy source employing a combustion process.

2. A Robot must not leave any part of its body behind while negotiating the maze.

3. Robot may not jump over, fly over, climb, scratch, cut, burn, mark, damage, or destroy the walls of the maze.

4. Dimensions of the robot are not defined in this document. The competitor can decide the dimensions depending on the requirements of the task.

5. The robot must be designed and built by the competitors themselves. No off-the-shelf robot kits are allowed **except** the following.
   - Processing Development Boards.
   - Drive gears (wheels, gear box, motor)
   - Sensor modules (IR, Sonar, color etc.)

6. The robot must comprise of a start switch that will activate the robot at the start of the contest. Once switch is turned on, no human interaction with the robot will be allowed until the end of the round.

7. The robots may be decorated according to the team's preference, without violating the rules of the competition.
   Any violation of these rules will constitute immediate disqualification from the contest and may cause the team to be ineligible for any prizes awarded.

5. Competition Rules

1. The initial run shall be made from the starting square (refer to the figures).

2. The team may abort a run at any time. However, if the competitor touches the Robot during a run (attempt), it is deemed aborted, and the robot must be removed from the maze.
   If a robot has already finished the given task, it may be removed from the platform. In that case, the runtime of that attempt will not be affected. (Conditions for full task completion is specified in Section 3-D. Rules for Object Loading and Unloading, (7)).

3. During the time allocated for one team (20 minutes), the team may program the robot between each attempt. Attempting to program the robot during a run (attempt), once the robot has been activated will be a factor for disqualification.
   Hardcoding will be a reason for penalization & in doubt that the team has hardcoded, the adjudicators may question the team or test the robot (within or outside the platform/playing field) to clarify this aspect.

4. The lighting conditions in the arena may not be the same conditions that the team experienced during the testing of their robot. The platform is placed on a stage, where "stage-lights" will be focused on the playfield on the day of the competition.
   Therefore, an area will be allocated for calibration, near the platform playfield, where similar material samples will be provided for the team to calibrate their robot before the team's first attempt, under supervision of the adjudicators.

5. The timer will start when the robot is activated on the command of the judges. The adjudicators will announce the attempt completion and stop the timer when the robot is no longer in contact with object after the robot unloads the object (payload) successfully on the unloading (destination) square.

   NOTE: Time is NOT the only factor that determines the winner. Marks awarding criteria will be also based on time, accuracy and the robots ability to follow the arrows, accurately detecting the arrow head.

6. The judges reserve the right to ask the operator for an explanation of the Robot. The judges also reserve the right to stop a run, declare disqualification, or give instructions as appropriate (E.g., if the structure of the maze is damaged by continuing operation of the robot).

7. During the 20 minutes allocated for the team the, contestants are allowed to do the following between two attempts (Keep in mind, once the robot is activated, no human interaction is allowed and if touched, the attempt is said to be aborted):

   - Replace batteries
   - Adjust sensors
   - Change speed settings
   - Make repairs
   - Reprogram the chip

8. At the beginning of the competition, scoring for each robot begins at zero '0' and marks will be added according to the marks awarding criteria. However, a robot may attain a negative score for an attempt as a result of losing marks due to penalties.

9. All robots, whether or not they have competed in previous contests, compete on an equal basis. All robots must be presented to the judges by the original design team.

6. Penalty Criteria

1. Robot should navigate through the maze without hitting its walls. In the case of failing to do so, marks will be reduced for each wall hit. If the adjudicators decide that the robots actions could potentially damage or deform the maze, they reserve the right to terminate the attempt.

2. Marks will be separately awarded for (a) box loading and (b) carrying the box throughout the task. The robot may attempt more than once to load the box within the region. However, a penalty will be given for each extra attempt.

3. If the robot drops the payload (object/box) while carrying it, the robot can complete the task but marks for carrying the load will be deducted. However, if the robot picks up the payload again, marks for carrying will be awarded but with a penalty.

4. Marks allocated for unloading the payload will not be awarded in the following cases:
   - No payload to be unloaded.
   - Unloading the payload at an incorrect location (outside the correct unloading square).
   - Robot has the payload but doesn't unload it in the arena.

   Full marks will not be allocated but a partial mark will be awarded if the box is partially unloaded within the destination square.

5. There will be a penalty if the robot is incapable of detecting the arrow heads of the arrows of the colour that it is supposed to follow i.e. the colour of the object.

6. The maximum time a robot can compete in the playing area is 20 minutes. (A team may decide to begin a new attempt within this time and the team may take up to a maximum three attempts).
   The performance of the robot after the 20 minutes allocated for the team will not be considered regardless of the accuracy of the robot. Marks will be awarded up to the point the robot has completed the tasks in the playing field on the completion of the 20 minutes and the team must remove the robot from the playfield afterwards.