

version 2.0



RUTHUNA ROBOTIC CHALLENGE

UNDERGRADUATE CATEGORY





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1. Platform Specifications

1.1 The Arena

The tolerances for lines, walls, line gaps can be varying ± 0.2 cm, ± 1 cm and ± 1 cm respectively.

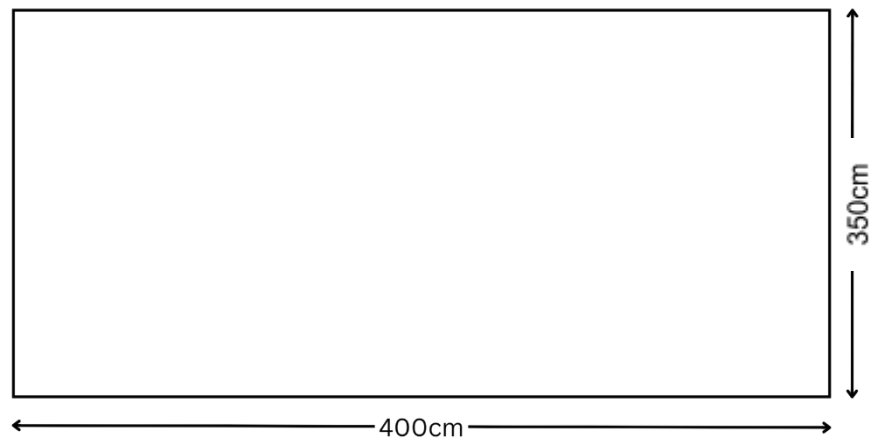


Figure 1: Arena dimension

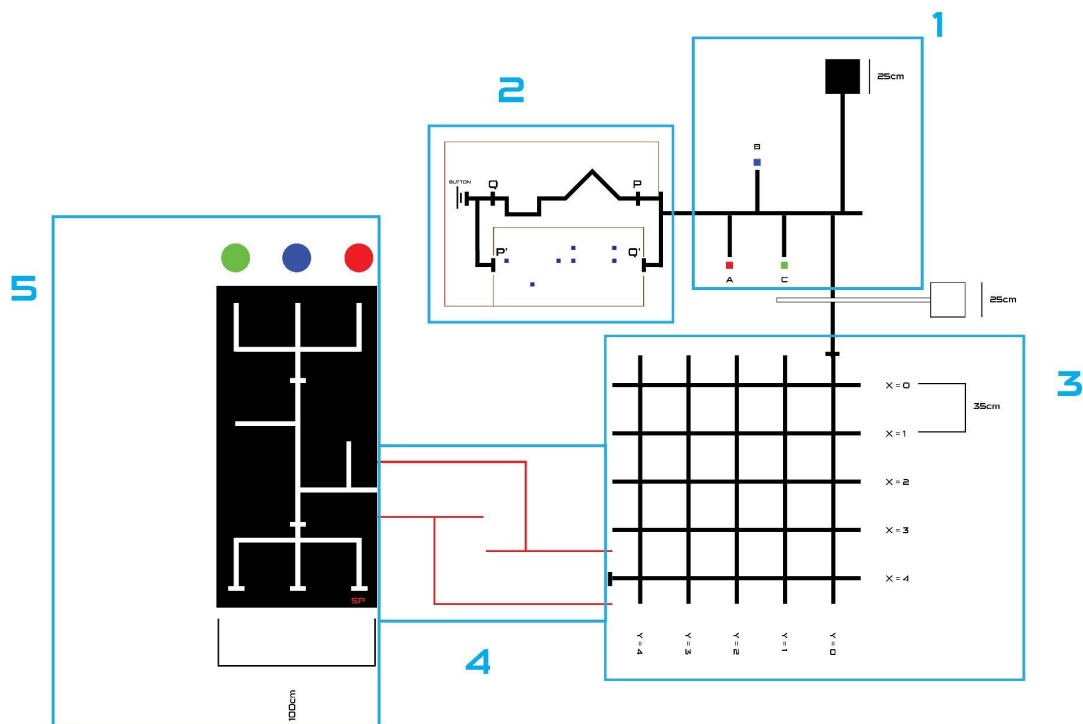


Figure 2: Overview of the arena

Basically stage 1, 2, 3, and 5 are line following tasks, stage 4 is a wall follow. Stage 1 and 3 are as same as illustrated in Figure 2. Stage 2, 4 and 5 follows will be revealed at the competition.

1.2 Component Specifications.

The following images show the details of the various compartments in the arena.

1.2.1 Navigation Lines

All black and white navigation lines have line width of 3



Figure 3: Dimension of Navigation Lines

1.2.2 Switch Lines

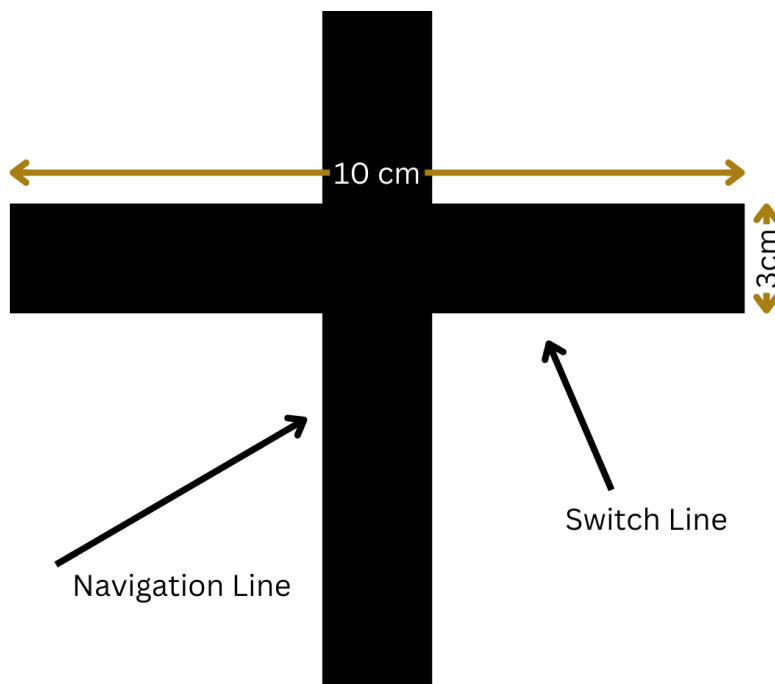


Figure 4: Dimension of Switch Lines

1.2.3 Starting Square

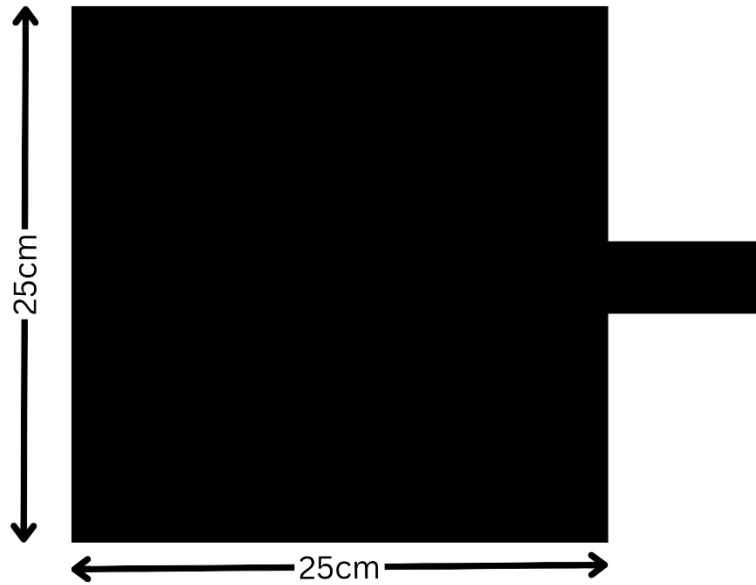


Figure 5: Dimension of Starting Square

1.2.4 Shooting Position

This is the place where the robot should stop to shoot the ball as described in task procedure.

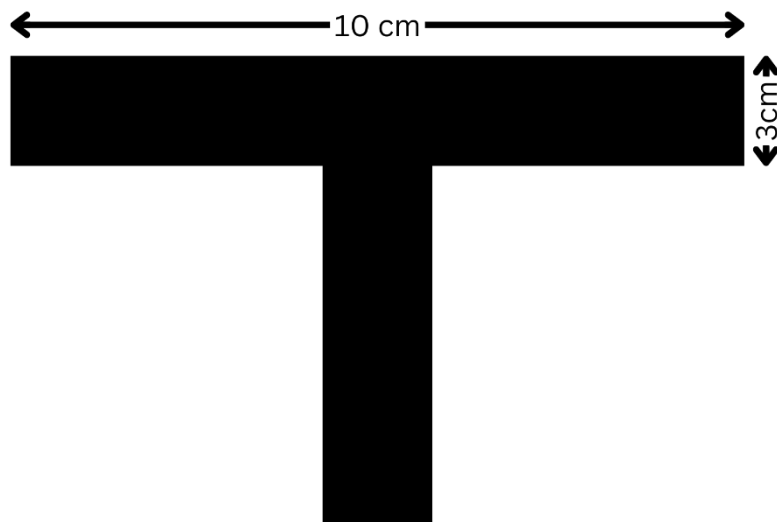


Figure 6: Dimension of Shooting Position

1.2.5 Cube

These are the cubes which are placed at the junctions of the grid as described in task procedure.

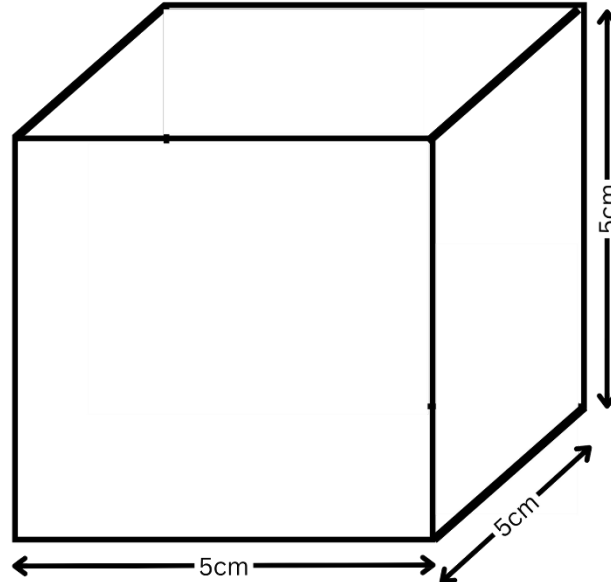


Figure 7: Dimension of a Cube

1.2.6 Switch

This is the push button which robot should push to open the gate to enter the stage 3. The push button in the switch is indicated by the circle which is 5.0 cm above the platform's surface. Push button is extruded from support surface and support surface is vertical orientation. The touching area of the push button would be 1 cm radius circle.

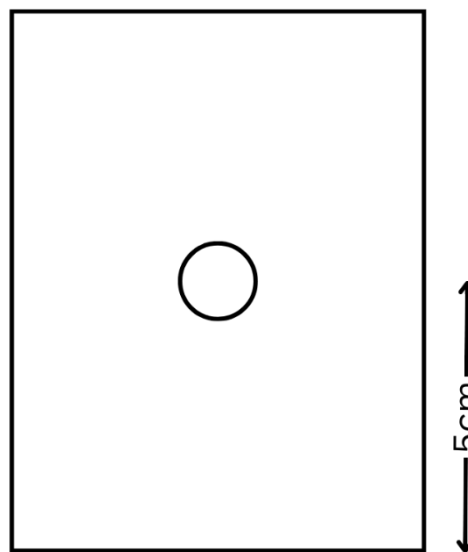


Figure 8: Dimension of the Switch

1.2.7 Color Plate

This is the holders which used to hold the colors in stage 1 and stage 3.

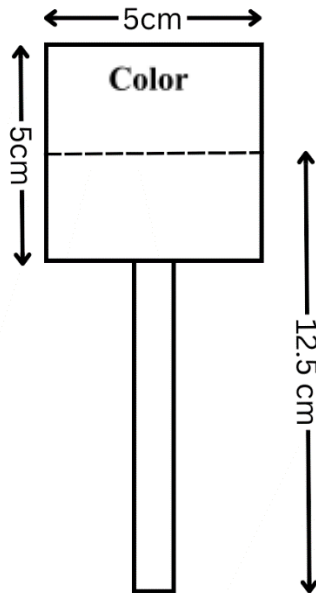


Figure 9: Front view of the Color Holder

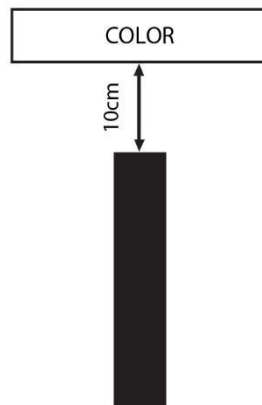


Figure 10: Top View of the Color Holder

1.2.8 Bucket for shooting the ball.

This is the bucket which robot should shoot the ball

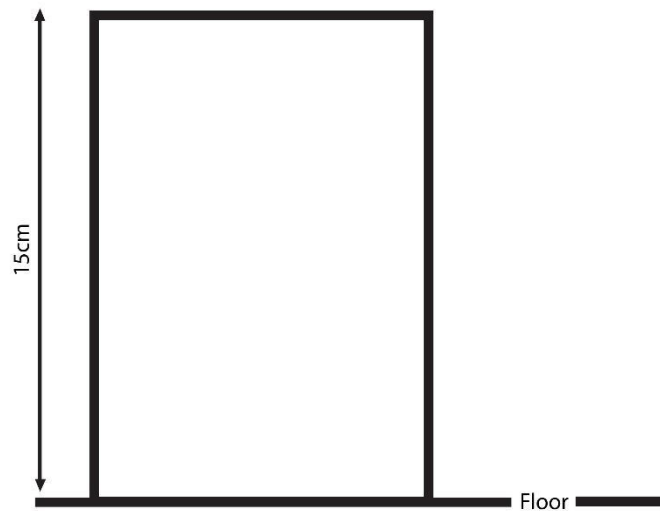


Figure 11: Front view of the Bucket

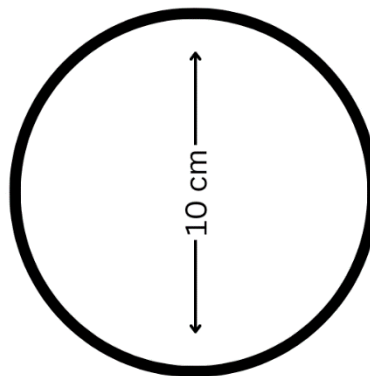


Figure 12: Top view of the Bucket

1.2.9 Side view of the wall



Figure 13 : Side view of the wall

1.2.10 Top view of the wall

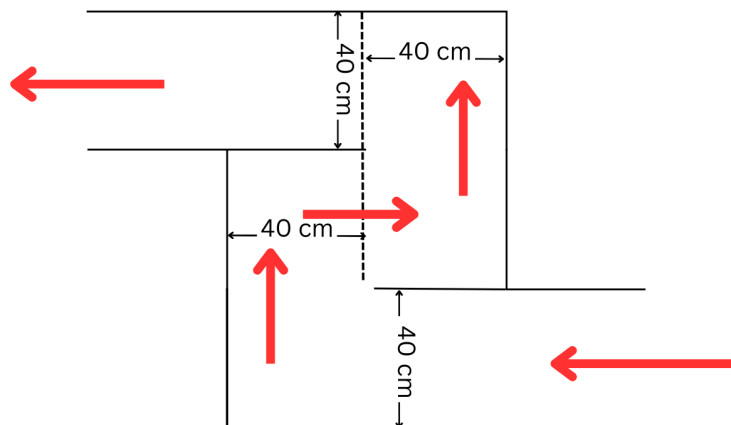


Figure 14 : Top view of the wall

2. Task Procedure

- The contest consists of two rounds and five stages in the arena.
- Throughout both rounds, the robots will compete on the same platform with slight modifications made to the platform in the second round.
- The top 10 teams of the first round will be qualified for the second round, and the ultimate competition winner will be determined based on performance in the second round.

1.3 First Round

- Platform specifications provide detailed information about the platform and its components.
- Refer to Figure 2 for an overview of the arena.
- In the first round, competitors must successfully complete stages 1, 2, and 3.
- The robot must initiate the task from the designated starting square.
- Three random colors from the five following colors will be placed in positions A, B, and C. Each color has a corresponding value.

Table 1: Colors and their respective values

Color	Value
White	1
Red	2
Green	3
Blue	4
Black	5

- Robot should clearly identify the given value of the color. The indication method should be described to the judge panel before starting the game.
- The assigned values for each image at positions A, B, and C are as follows:

Table 2: Positions and their respective values

Position	Value
A	a_1
B	a_2
C	a_3

- As the robot traverses the arena, it should accurately identify the colors of the individuals at positions A, B, and C. Once the identification is made, the robot must calculate the corresponding x and y values based on the provided logic.

$$x = (a_1 + a_2 + a_3) \% 6$$

$$\text{If } (a_1 + a_3) > 6,$$

$$y = (a_1 + a_3) - 6$$

$$\text{If } (a_1 + a_3) \leq 6,$$

$$y = (a_1 + a_3)$$

- Once the identification and calculation of x and y values are completed, the robot should proceed to stage 2.
- In stage 2, the robot is required to follow a designated line(PQ) and push the button. When returning, the robot should imitate the line(P'Q') followed to reach the button in the white area. In the white area, there are no lines to follow. Several points are given according to the designated line are established on white area. Robot should go over them to get marks. (The robot can just go through the white area without imitating the followed line but marks will be reduced.)



- Pressing the button will open the gate, allowing the robot to enter stage 3.
- If somehow the robot cannot press the button, the gate will automatically open when the robot is near to the gate. However, marks for opening the gate will be lost for the particular attempt.
- In stage 3, the robot must navigate to the x and y coordinates determined in the stage 1 on the grid, utilizing a preferred indication method such as an LED or buzzer, to indicate its successful arrival at the designated coordinate

1.4 Second Round

The second round is similar to the first round, with some modifications. At the beginning of the second round, a table tennis ball (a ball having a mass of 2.7 ± 0.3 grams and a diameter of 40 ± 2 millimetres.) is given to the robot. The robot should be able to hold this ball and shoot the ball to a bucket at the end of the round.

- Until the robot enters stage three, all steps remain the same as the first round.
- In stage one, the robot is required to identify each color at positions A, B, and C, and subsequently count the color plates associated with each color.
- Stage 2 task is the same as the round one.
- At stage three, random color plates from the above five colors will be placed randomly at the end of grid lines (not all the edges will have a color plate). The robot should identify each color, calculate the number of color plates from each color, including color plates placed at stage 1, and show which color plate has shown for maximum times. (Consider this maximum number as **m**)
- Robot should clearly indicate the detected color's value. The indication method should be described to the judge panel before the start of the game.
- In addition, some junctions of the grid will be blocked using 5x5x5cm cubes, and the robot should also count the number of cubes. These cubes are colored in purple (no need to consider the color of these cubes to determine **m** value and take the number of cubes as **n**)
- When a robot identifies a cube, robot should indicate that it has identified a cube, and also when leaving the grid robot should indicate the total number of cubes.

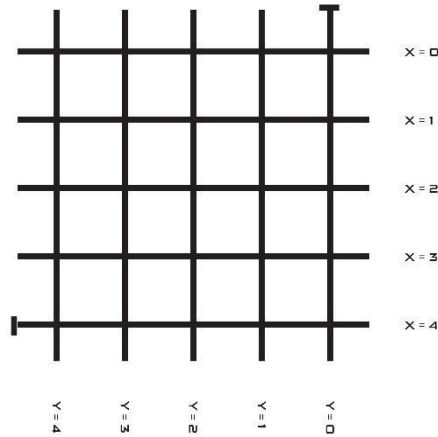


Figure 15: The Grid

$$p = m + n$$

- Depending on the value of p robot should choose a color, according to following logic
 - If, $0 \leq p < 5$, color is Red.
 - If, $5 \leq p < 10$, color is Green.
 - If, $p \geq 10$, color is Blue.
- Following stage 3, the robot should proceed to stage 4, which involves navigating through a wall follow.
- Shape of the walls in stage 4 is the same as the given figure 2. The dimensions that are not provided in figure 14 can be varied.
- At stage five, the robot should choose the relevant bucket based on the above-selected color and shoot the ball into that bucket from relevant SP-# where # can be R, G or B. For example, if the robot chooses the red color, the ball should be shot into the red color bucket from SP-R (Shooting point for red).

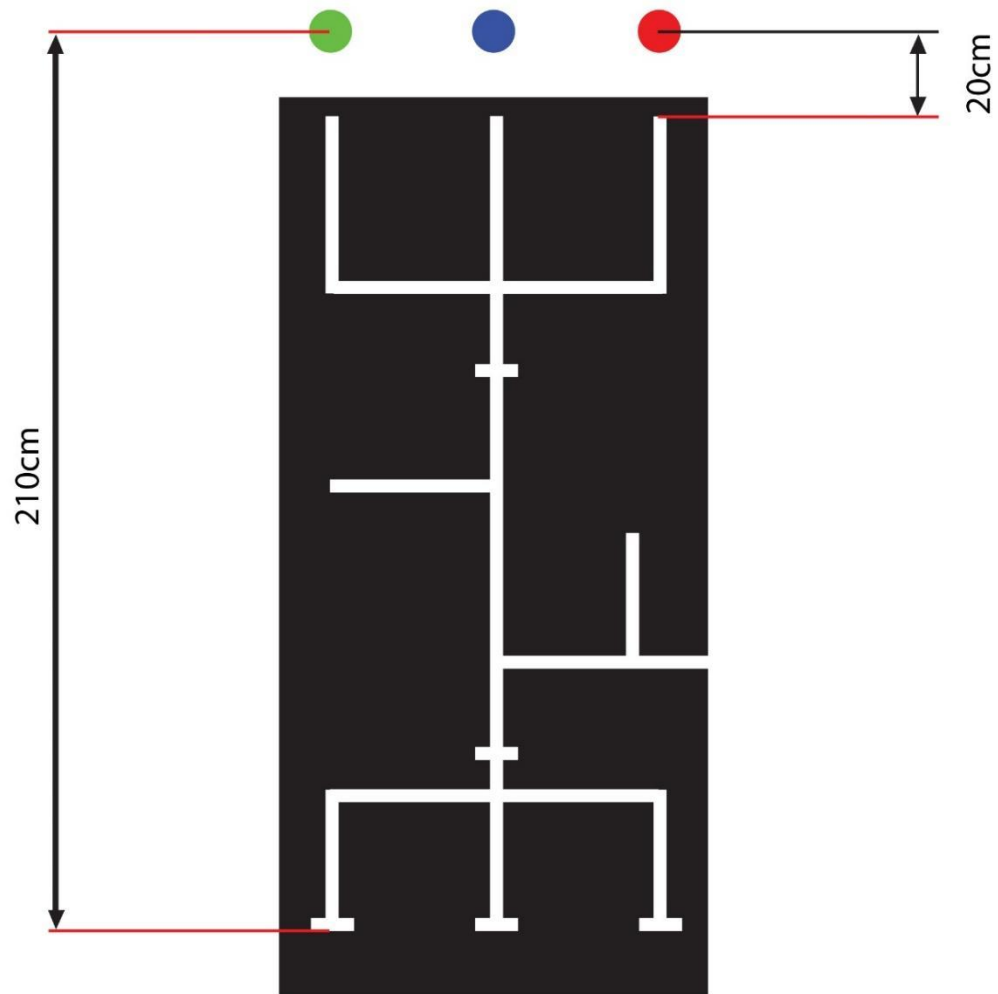


Figure 16: Stage 5 maze

- Maze between P1 and P2 will be changed.
- Buckets will be placed randomly, and robot can move on the maze lines to identify buckets.



3. Robot Specifications

- 3.1 The dimensions of the robot should not exceed 25 cm x 25 cm x 40 cm (width x length x height). Robots that fail to meet these requirements will be disqualified.
- 3.2 The robot should be **completely autonomous** without any sort of remote controlling.
- 3.3 The task should be completed by only one autonomous robot and **secondary robots are not allowed**.
- 3.4 The robot should be supplied with an internal power source. External power supplies are not allowed.
- 3.5 Voltage difference between any two points on the robot must not exceed 24 volts and the final unit including the power source should be within dimensions in specification 3.1 above.
- 3.6 The robot must be completely built by the team themselves. No off-the-shelf kits are allowed except the processing boards, sensor modules and drive gears.
- 3.7 The robot should not cause any damage to the gaming platform. Any kind of damage to the gaming platform would lead to **disqualification**.
- 3.8 A single start/stop switch should be available on the robot for activating the robot at the start and the robot should be stopped using the stop switch.
- 3.9 The starting procedure of the robot should be simple and should not involve giving the robot any manual force or impulse in any direction.
- 3.10 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'x4' boards.
- 3.11 Minimum distance between the middle of the lines and the edges of the arena will be 20 cm. The robot should be designed in a way that it won't fall out of the arena.
- 3.12 There should be an indication method to indicate detected colors or values. RGB LED indication, LCD display or any other clear indication method which can be observed by the judge panel are accepted. (Selected indication method should inform to judge panel prior to relevant stage)



4. Game Rules

- 4.1 The robot should satisfy the specifications under the **section 3**.
- 4.2 All the robots are collected 15 minutes before the competition.
- 4.3 When a team is called to compete for the task, they must report within five minutes.
- 4.4 Before start the first attempt 2 minutes is given for calibration of the robot.
- 4.5 Maximum time of 15 minutes is allocated for a team (for all three attempts except 2 minutes calibration time). Modification for the program or the hardware of the robot is **allowed only between interval of first round and second round**. Three maximum number of attempts are given for a team. The best attempt is considered for grading. All the attempts are reserved for this time period only. If the robot exceeds the time limit of 15 minutes, your robot will be removed from the arena.
- 4.6 If they fail to finish calibrating within this 2 minutes, the extra time taken will be deducted from the time allocated for the three attempts.
- 4.7 After commencement of an attempt, any interaction between the robot and the team members would be prohibited. Interaction with the robot is considered as the termination of the attempt.
- 4.8 Each new attempt should start from the starting square and the moving direction of the robot can be decided by the team.
- 4.9 During any parts of the task, if a robot deviates from a line and fails to return within 20 seconds, human intervention would be allowed, and the next trial has to be taken as a new attempt. You can also take a new attempt before the 20 seconds with the permission of the judges.
- 4.10 Time is measured from the starting referee signal to the point of stopping the attempt.
- 4.11 The team can decide to stop the robot anytime and be credited with the distance traveled along the line and the time consumed until the robot stops.
- 4.12 If there is a tie between the robots, a run-off will determine the winner.
- 4.13 There will be a technical inspection before every round.
- 4.14 A sample arena will be given for tuning purposes.
- 4.15 Participating teams are responsible for the safety of their robots.
- 4.16 The organization and the organizing team members are not held responsible or liable for any incidents and/or damages to the robots caused by the participating teams and/or testing and/or competing the task.



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- 4.17 The team leader may forward their objectives or doubts on the task and the game rules to the organizing committee. Then the organizing committee will attend to these objections and doubts with the help of the judge panel.
- 4.18 The decisions taken by the judges will be the final decision. No objections shall be declared against the judges' decisions.
- 4.19 Penalties are given for following robot behaviors in the steps described in section.
- Not including any indication method for the count and cube colors.
 - The gate is open manually by organizing team.
 - The robot fails to solve the optimum path of the maze.
 - Robot does not consistently move in the navigation paths.

5. Team Requirements

A team may consist of maximum 5 members from the **same** educational institute.

6. Eligibility

All students possessing a valid identity card, issued by the respective educational institute are eligible to participate in the event. All the members of the team should not exceed 28 years of age.

****Any changes will be informed to the team leaders via e-mail.**