

SLR(2024



SRI LANKAN ROBOTICS CHALLENGE 2024

TECHNICAL SPECIFICATIONS

UNIVERSITY CATEGORY

UNIVERSITY CATEGORY

Robotics is an ever-evolving field in electronics. With new opportunities emerging in both local and international scales, it is of utmost importance to train and nourish the young minds of Sri Lanka in the field of robotics. The Electronic Club of the University of Moratuwa, alongside the Department of Electronic and Telecommunication Engineering, has launched the Sri Lankan Robotics Challenge (SLRC) for ten consecutive times as the longest and pioneering robotics competition in Sri Lanka. As the 11th iteration of SLRC draws near, anticipate an exciting and fierce battle between robots to seek the winner.

The University Category Competition, exclusively designed for undergraduates, aims to serve as a catalyst for learning, interaction, and the expression of profound passion for robotics. In addition to the excitement of the competition, winners will have the opportunity to receive amazing cash prizes and certificates.

In this forthcoming challenge, participants are challenged to engineer robots capable of overcoming a series of intricate obstacles. This competition not only scrutinizes technical expertise but also provides a dynamic arena for innovation, embodying the ever-evolving landscape of robotics in Sri Lanka. As the SLRC 2024 approaches, we extend an open invitation to all enthusiasts to partake in this technological spectacle—a convergence of ideas and a celebration of innovation.

"In the dance of destiny, every move counts. One wrong step, and the universe crumbles."

In the aftermath of a colossal battle, the Black Order's numbers loomed large, but the valiant heroes managed to secure five elusive Infinity Stones. The key to halting Thanos's rampage lay in the fabled power of the Infinity Gauntlet.

Yet, the Mad Titan himself possessed the final stone, safeguarded within the impenetrable confines of Titan. Two unbreakable doors, each with a key located on different planets, protected this cosmic treasure. Tony Stark (Iron Man), Earth's brilliant mind, sought a way to retrieve the stone from Thanos and crafted an autonomous robot for the perilous task.

Wounded in the Titan battle, Iron Man entrusted Hulk, Dr. Bruce Banner, with activating the robot to claim the last stone. So the Hulk went to the Stark Industries lab to find the robot but the enemies were already there and the robot was already destroyed. However, He discovered lab documents outlining the robot's construction. Lacking expertise in robotics, he reached out to Earth's foremost minds for assistance. Now, the fate of the entire universe hung in the balance as these geniuses endeavored to reconstruct the crucial robot.

The mission ahead was clear but treacherous. The robot needed to navigate the treacherous land and correctly place the stone into the Infinity Gauntlet. A single misstep could trigger a catastrophic collision of stones, unleashing a black hole that spelled doom for the heroes.

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01 Task Description

Sri Lankan Robotics Challenge 2024 consists of 3 main planets as shown in Figure 1.1.

1. **Planet A** – Mountains in Vormir
2. **Planet B** – Ruins in Sakaar
3. **Planet C** – Thanos's home

The robot is only allowed to start at the starting position, labeled as position 1 in Figure 1.2.

- **Size of the start square : 25 cm * 25 cm**

First, the robot should move straight and detect the color on the wall of the **stone holder** (Figure 1.2 – position 2). There can be only two possible colors, **Green** or **Blue**. Then, it should move to Planet A.

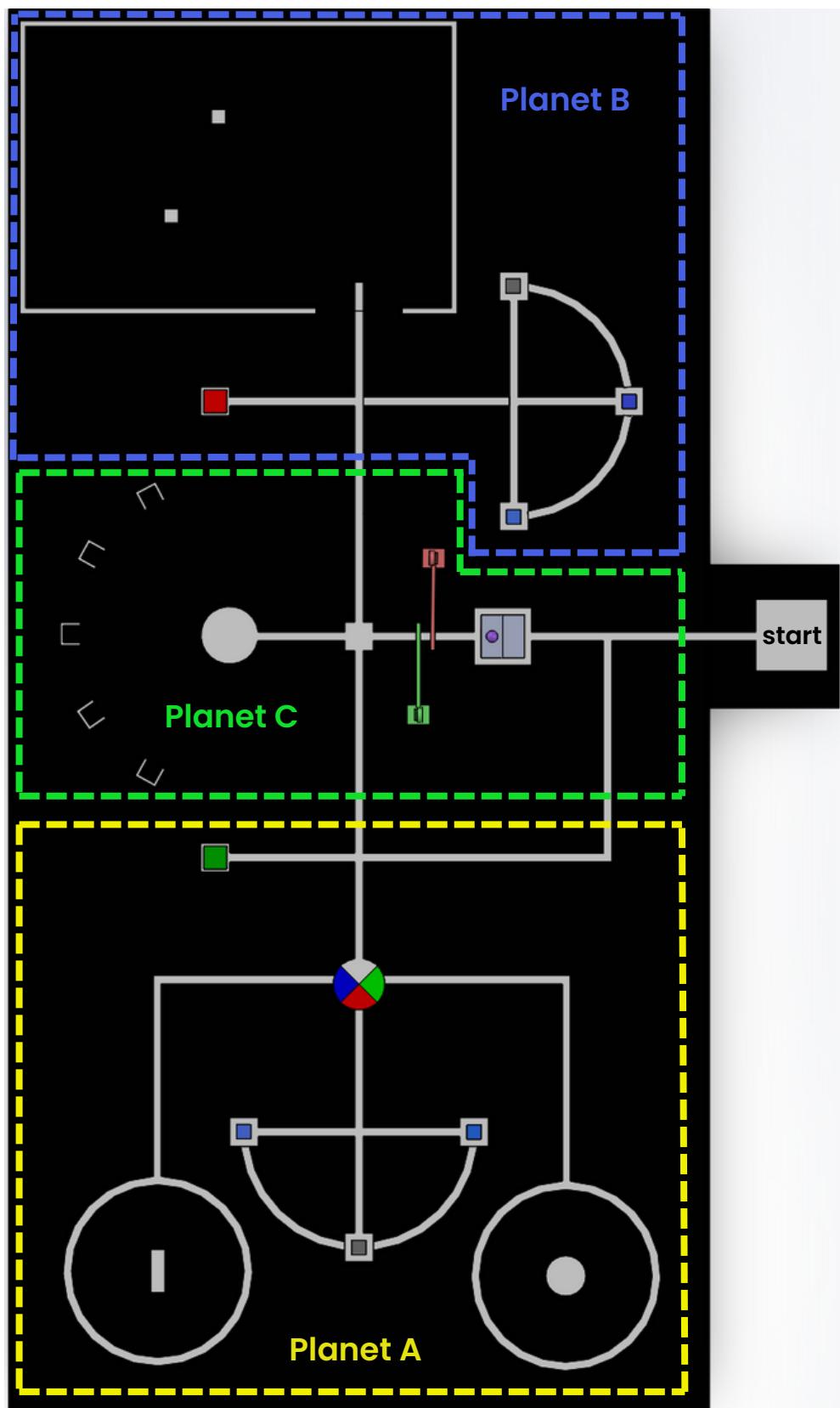


Figure 1.1 – Regions of the arena

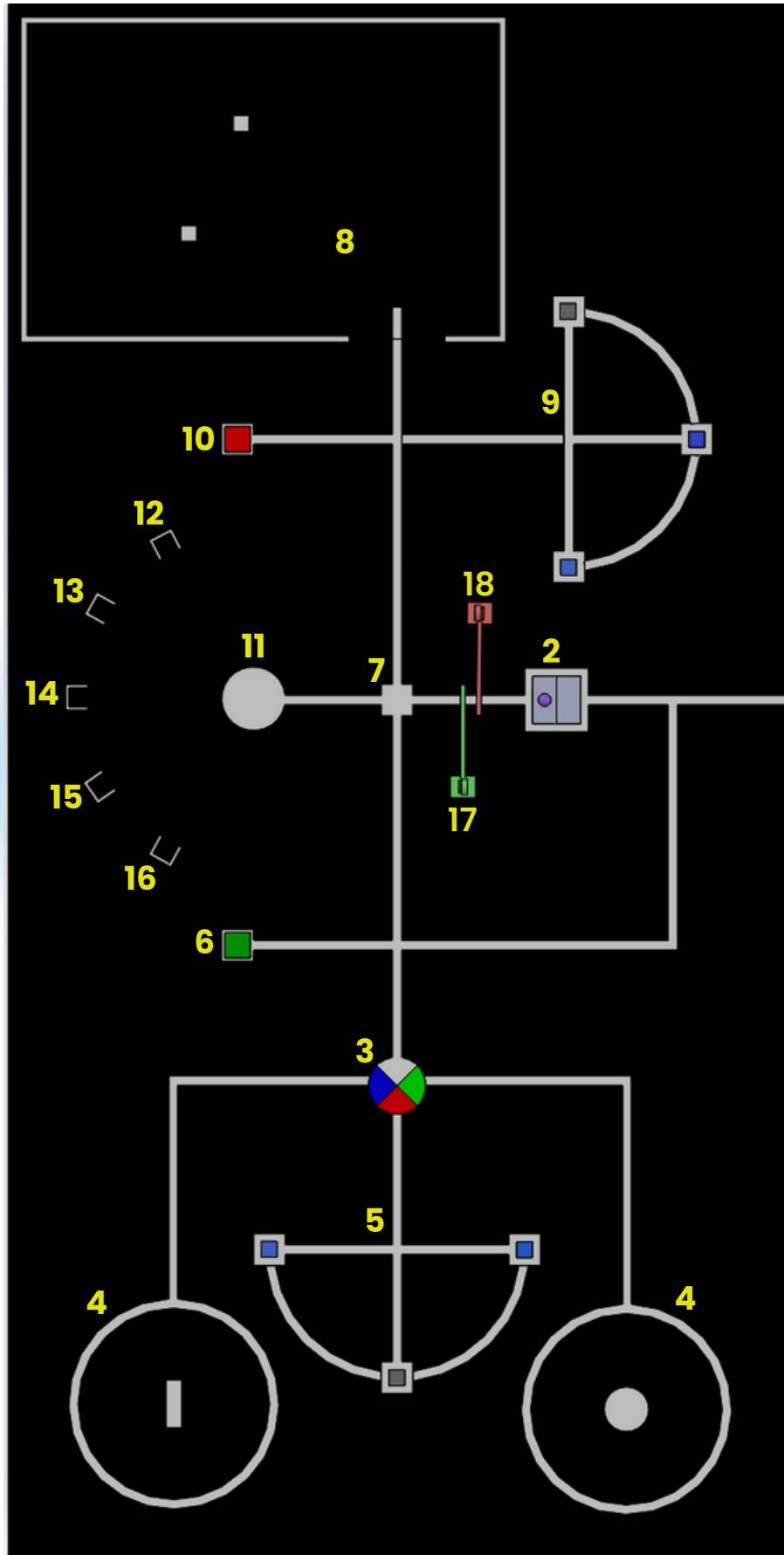
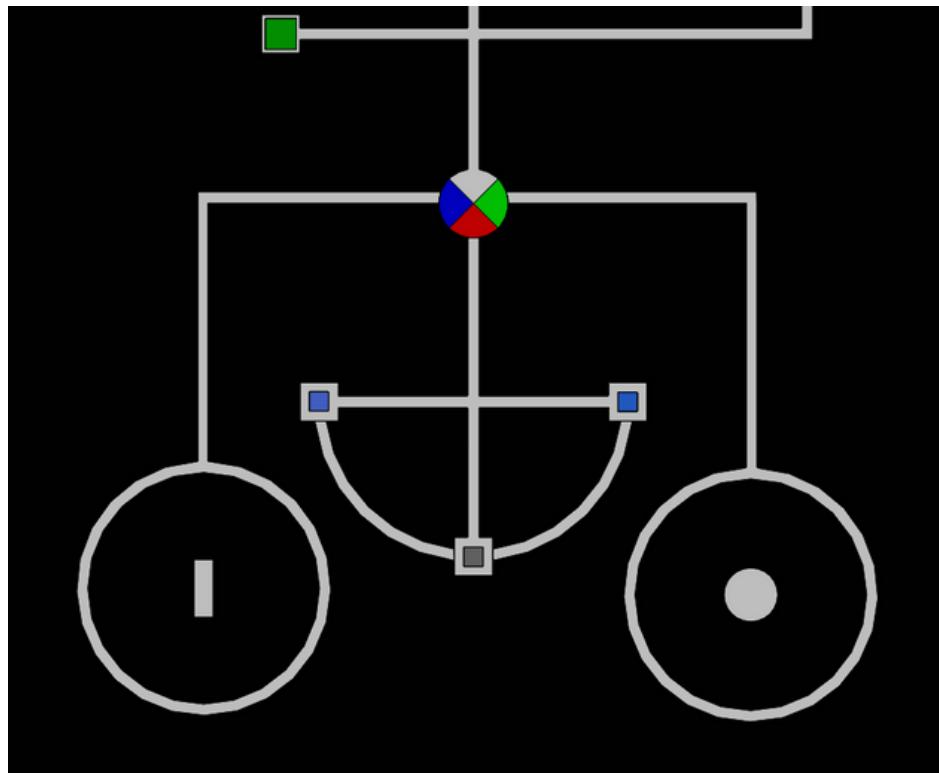


Figure 1.2 – Sample Layout of the arena

Planet A – Mountains in Vormir



The task in Planet A consists of the following sub tasks.

Hidden Gems in the Mountain

- First, the robot should reach the junction consisting of 4 color sections (Figure 1.2 – position 3) shown in Figure 1.3, by following the white lines.
 - **Radius of the circle in color junction: 6 cm**

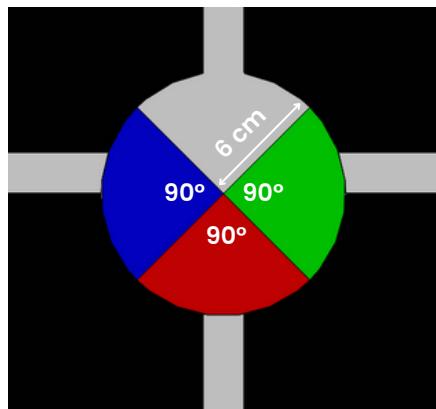


Figure 1.3 – Color junction

- Then the robot should turn in the correct direction corresponding to the wall color of the stone holder. (**blue or green**) (Figure 1.11).
- After that, the robot should follow the line to reach a circle (Figure 1.2 - position 4) with an object positioned in the center as in Figure 1.4.
 - **Radius of a circle: 30 cm**
- Next, the robot should follow the circle and identify the object positioned in the center of the circle.
- A **cuboid** or a **cylinder** with a **height of 15 cm (± 2 cm)** will be positioned at the **center** of the circle. (Figure 1.5)
- Dimensions of the cuboid and cylinder can be **different** except the height.
- The diameter of cylinder or maximum length of one side of cuboid will **not exceed 7cm**.
- Color of the objects will be **white**.

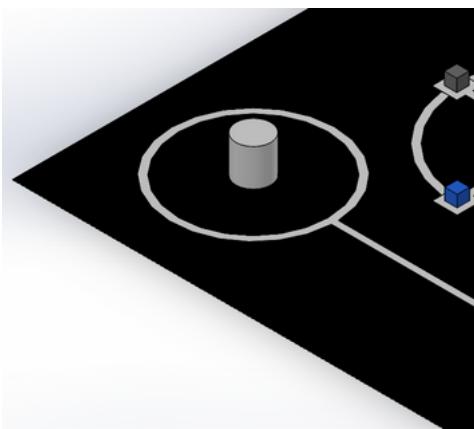
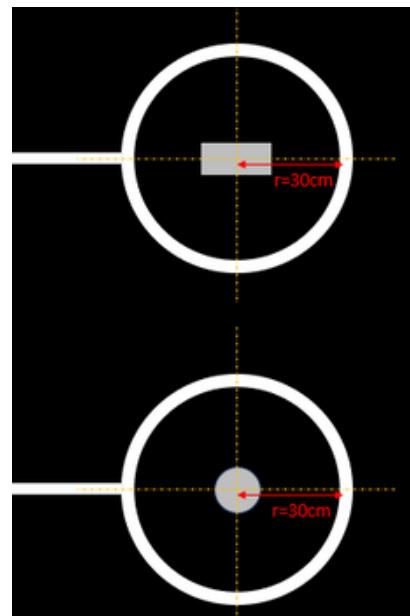


Figure 1.4 – Two circles with objects placed in the middle



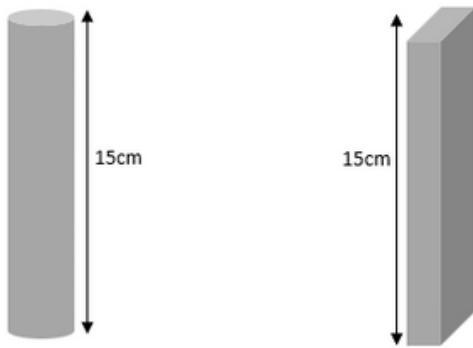


Figure 1.5 - Objects and their respective heights

Calculation:

- If the object is a **cylinder**, the robot will earn **10 gems** and if the object is a **cuboid**, the robot will earn **20 gems**.
- According to this, the robot should calculate total gems earned in Planet A.

Indication Method:

- For marking purposes, there **must be** an indication method for the detected object in the Planet A. (use LEDs only)
- Use following color LEDs,
 - If the detected object is a **cuboid**, a **blue** LED should light up.
 - If the detected object is a **cylinder**, a **green** LED should light up.
- The LED should remain lit until all the tasks are completed.

Vormirian Sentinel Key

- Then the robot should return back to the color junction and move in the direction of the red colored quarter of the circle. (Figure 1.3)
- According to Figure 1.2, the movement should be directed towards position 5 where there will be a box or boxes placed on the semi-circle.
- There are only three positions for box placement on the semicircle as shown in Figure 1.6.
- The size of white square will be 10 cm x 10 cm x 10 cm
- There will be 1, 2 or 3 boxes, but only one metal box.**
 - Size of all boxes: 5 cm x 5 cm x 5 cm
- The robot has to detect and grab the metal box.
- All the boxes are white in color including the metal box. (The metal box may have a different white color from non-metal boxes)

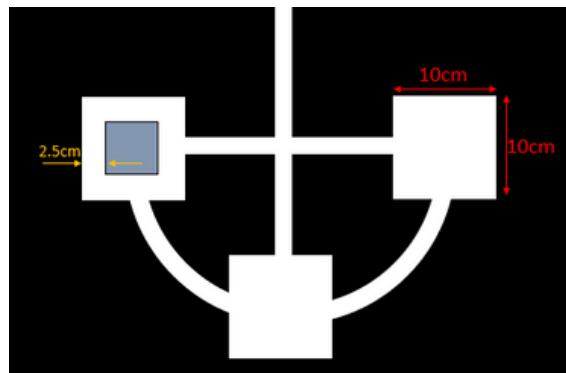
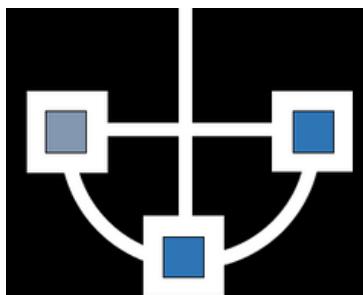
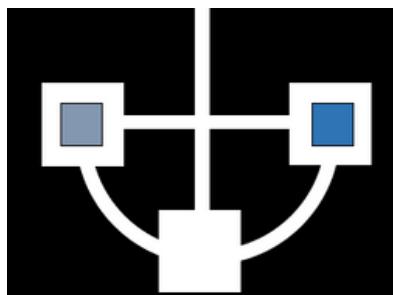


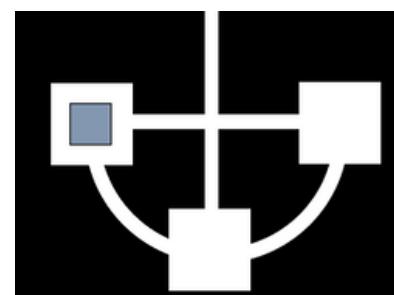
Figure 1.6 – Semicircle and three positions where the boxes will be located



one metal box and two non-metal boxes



one metal box and one non-metal boxes



only the metal box

- After that, the robot should go to the position named as Vormirian Sentinel Chamber. (Figure 1.2 – position 6)
- There will be a box with a hole as depicted in Figure 1.8, on the Vormirian Sentinel Chamber position. The box color on the Vormirian Sentinel Chamber position is **green**.
- The robot needs to insert the **metal box** into the hole of the box.
 - **Size of the box:** 8 cm x 8 cm x 8 cm
 - **Size of the hole:** 6 cm x 6 cm x 6 cm
- After inserting the metal box, Vormirian Sentinel Portal (Figure 1.2 – position 17), will open. (As per Figure 1.2, two portals will be located between positions numbered as 2 and 7.)

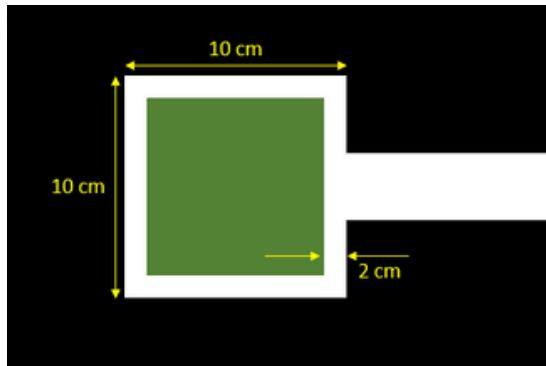


Figure 1.7 - Vormirian Sentinel position

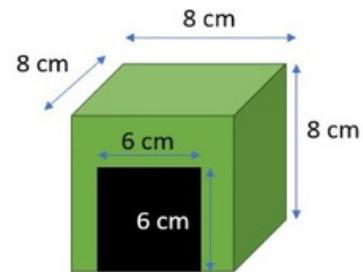
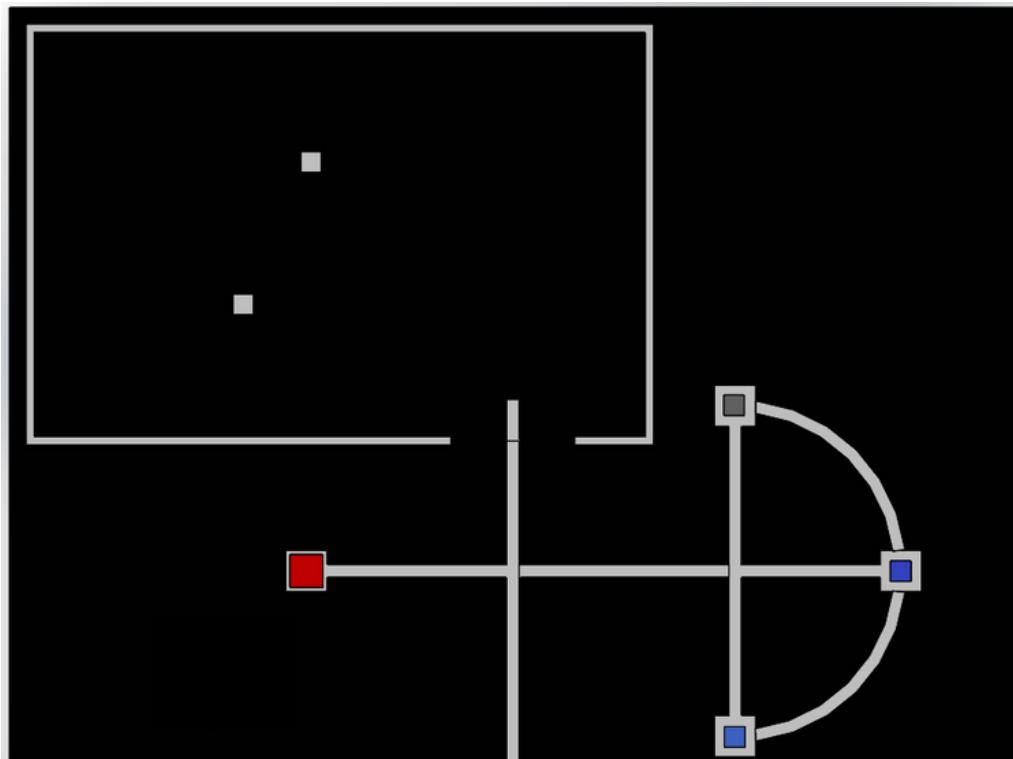


Figure 1.8 - Box on the Vormirian Sentinel position

- The metal box should go **at least 3cm** inside the hole in order to open the portal.

Planet B – Ruins in Sakaar



After completing the sub tasks in Planet A, the robot should go to the junction in Planet B by passing through the white square in the middle of the Planet C (Figure 1.2 - position 7).

The task in Planet B consists of the following sub tasks.

Ruins with Gems

- Next, the robot should enter to the Trash yard which is surrounded by walls (Figure 1.2 – position 8) as shown in Figure 1.9. The robot is allowed to move inside the Trash yard.
 - **Height of the walls: 20 cm**
 - **Color of inner side of the walls: White**

- There will be only one opening to enter and exit from the Trash yard, but the position of that opening may not be same as in the figure below. It may vary.

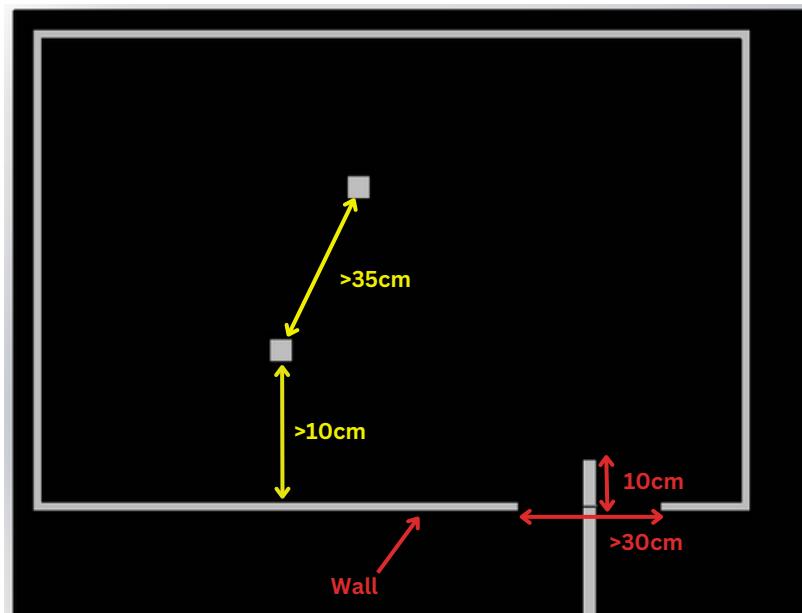


Figure 1.9 - Trash Yard

- There will be 1 or 2 cuboids (maximum 2) of the same or different heights which are fixed on the floor in random positions inside the Trash yard.
- Minimum distance between the wall and a cuboid will be 10 cm.
- All the cuboids are **white** in color.

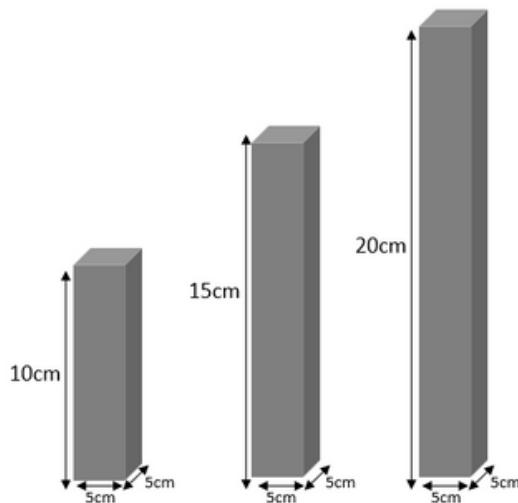


Figure 1.10 - Cuboids with different heights that can be found inside the Trash yard

- The robot should measure the heights of all cuboids. The cuboids should not be damaged when measuring the heights.
- The heights of the cuboids can take any value from the following set of 3 values: **10 cm, 15 cm, 20 cm** as depicted in Figure 1.10.
- After measuring the heights, the robot should record the maximum height among them.

Calculation:

- If the maximum height of the cuboids is,
 - **10 cm** - 10 gems
 - **15 cm** - 20 gems
 - **20 cm** - 30 gems
- According to the cuboid configuration of the Trash yard, the robot can calculate its total earned gems in Planet B.

Indication Method

- For marking purposes, there **must be** an indication method for detected maximum height in the Planet B. (use a separate LED for this task, **don't** use the same LED used in the task in Planet A)
- Use following colors for gems earned in Planet B,
 - 10 gems - **red**
 - 20 gems - **green**
 - 30 gems - **blue**
- The LED should remain lit until all the tasks are completed.

Sakaarian Nexus Key

- Next, the robot should exit the Trash yard and go to the junction in planet B and then, the robot should turn to the direction of the semicircle which is shown as position 9 in Figure 1.2.
- Following the approach from the task in Planet A, the robot should detect and grab the metal box.
- After that, the metal box should correctly be inserted into the box (similar in shape to Figure 1.8) on the Sakaarian Nexus Chamber (Figure 1.2 - position 10).
- The box color on the Sakaarian Nexus Chamber position is **red**. (Figure 1.2 - position 10)
- Then, the Sakaarian Nexus Portal (Figure 1.2 - position 18) will open.

Planet C - Thanos's home

After completing the task in Planet B, the robot should go to the white square in the middle. (Figure 1.2 - position 7).

The task in Planet C consists of the following sub tasks.

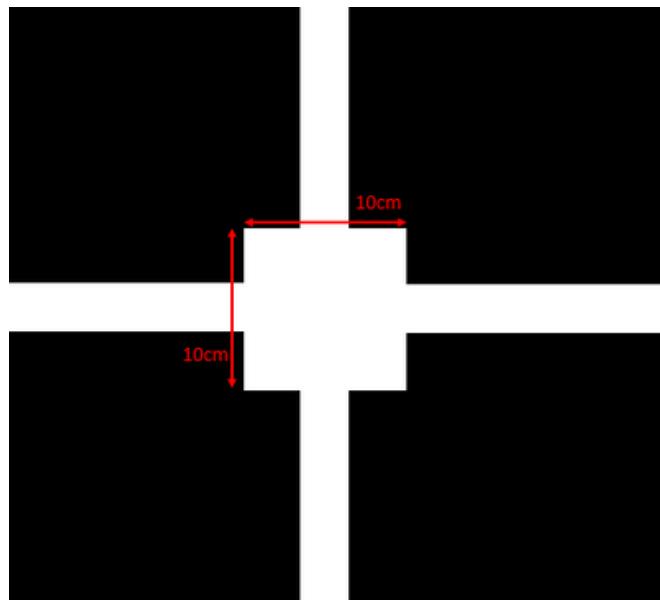


Figure - middle box

The Final Stone

- After coming to the middle box, the robot should turn to the direction of the stone holder.
- Since both portals are open now, the robot can move closer to the stone holder.
- A stone will be placed on the stone holder surface, as depicted in Figure 1.11 (cross-section of the stone holder).
- Next, the robot should grab the stone. The dimensions of the stone are mentioned below. (similar to a table tennis ball)
 - **Radius: $2\text{ cm} \pm 0.5\text{cm}$**
 - **Weight: $3\text{ g} \pm 1\text{g}$**
- The stone holder will be placed on a $20\text{ cm} \times 20\text{ cm}$ white square.
- After that the robot should return to the white square in the middle. (Figure 1.2 - position 7).

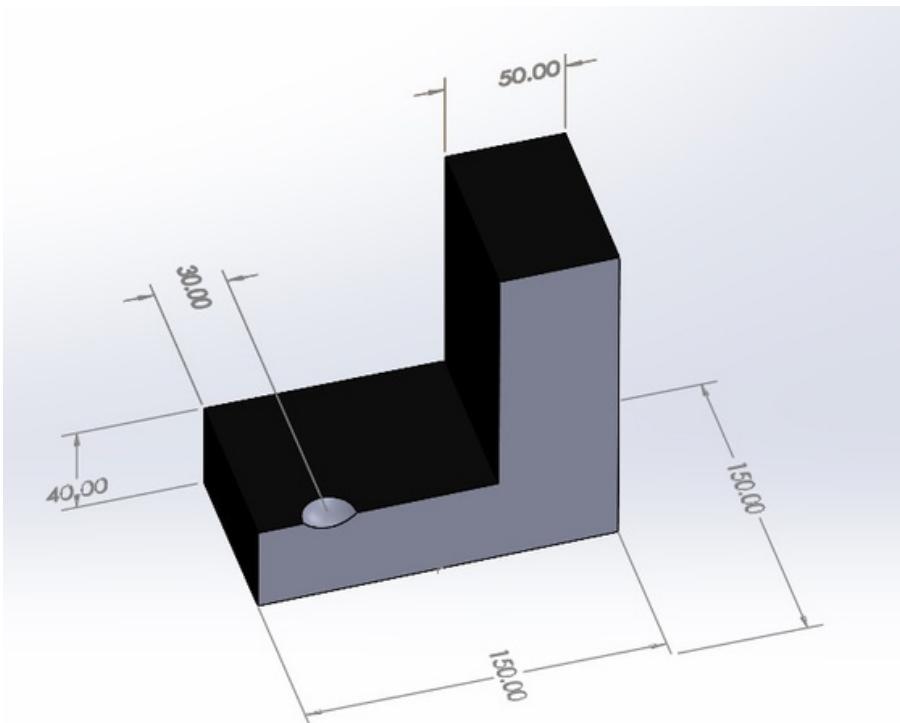


Figure 1.11 - **Cross section** of Stone holder

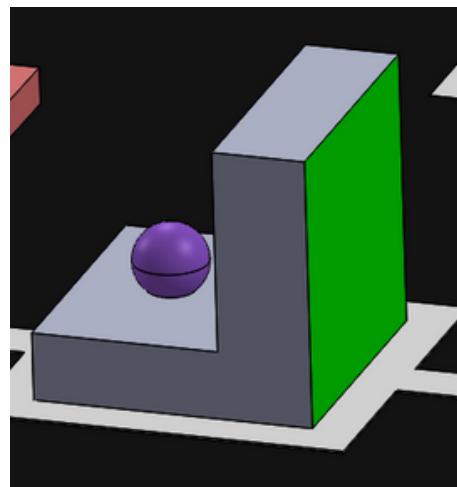
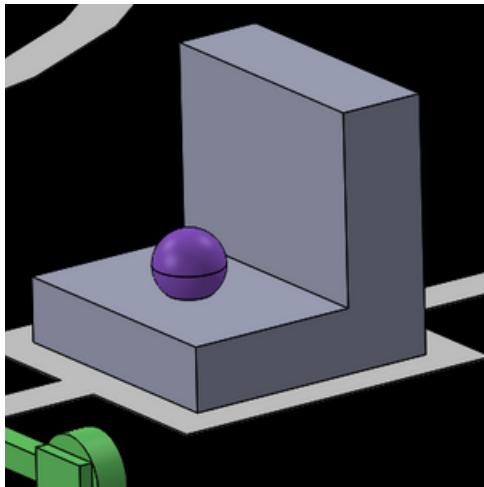
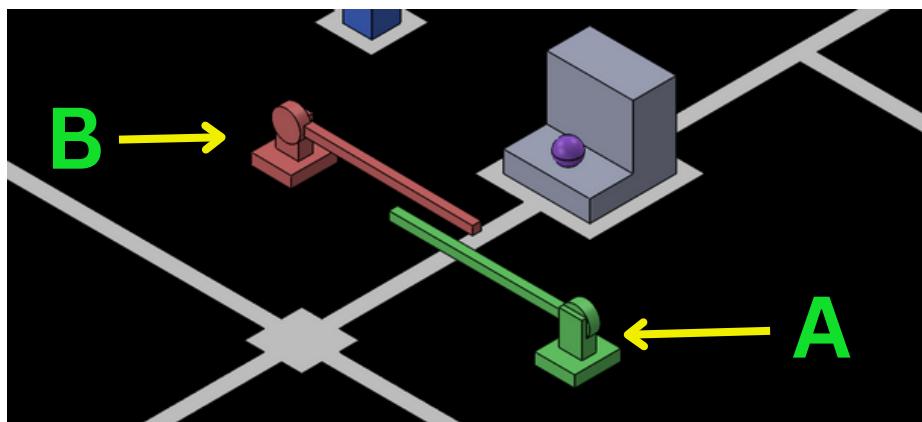


Figure - side view of stone holder

Two Portals



- The portals will be open after inserting the respective metal boxes.
- Two portals must be opened before going to the stone holder.
- The robot should not damage the portals.
- After inserting the metal box of Planet A, Vormirian Sentinel Portal (Figure 1.2 - position 17), will open. (**Gate numbered as A** in above figure)
- After inserting the metal box of Planet B , Vormirian Sentinel Portal (Figure 1.2 - position 18),will open. (**Gate numbered as B** in above figure)

The Infinity Gauntlet

- Next the robot should go to the shooting position. (Figure 1.2 - position 11)
- There will be five target positions numbered as **20, 30, NO value, 40, 50** (Figure 1.2 - positions 12, 13, 14, 15 and 16 respectively) in front of the shooting position. (Figure 1.12)
 - **Angle between two target positions: 30 degrees**
 - **Distance between one target position and the shooting position: 50cm ± 5cm**
 - **Radius of the shooting position: 10 cm**

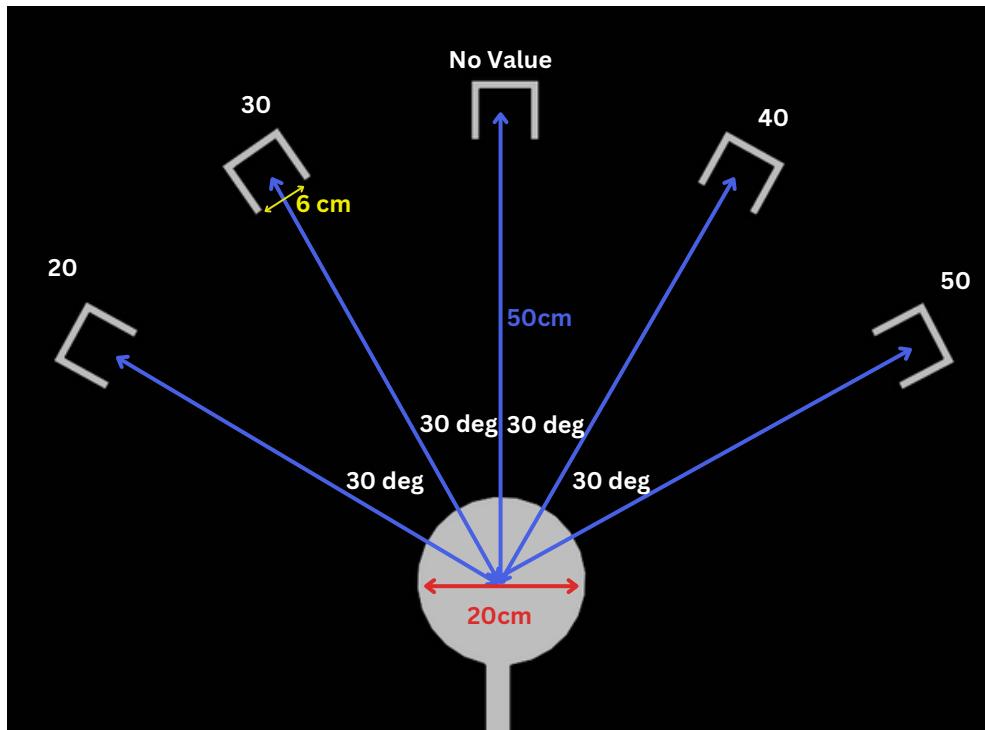


Figure 1.12 - Shooting pot and shooting positions

- The robot has to shoot the stone retrieved from the stone holder to one of the five target positions along the floor.
- The robot should **not leave** the shooting position before or while shooting the stone.
- There will be five boxes with a hole at these five designated target positions.
 - Size of hole: 6 cm**
 - depth and height: 8 cm**
- To determine the correct target position, the robot should use the previously obtained gems from the tasks in Planet A & B.

$$\text{Target Position Value} = \text{Total gems earned in Planet A} + \text{Total gems earned in Planet B}$$

- The sum of gems will correspond to the number assigned to the correct target position where the stone should be shot.

02 Arena Specifications

- The arena consists of four 8 ft x 4 ft (240 cm x 120 cm) boards such that the final arena size is 16 ft x 8 ft (480 cm x 240 cm).
- The surface can be slightly uneven at the places where two boards are connected.
- The arena will be black, and the lines will be white.
- The width of all the line following lines will be 3 cm.
- The minimum length of any straight-line segment will be 25 cm.
- The surfaces of the lines and the walls will be matte-finished. The type of sticker used will be "buffel" stickers.

03 Robot Specifications

- 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.
- The robot should be completely autonomous. Any remote control would lead to disqualification of the robot.
- 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.
- 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.
- 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.
- A team can use any preferred method for wall object detection; however, the robot must not exert a force on the object, likely to cause damage. For example, the robot must not scratch, damage or destroy the objects in the arena.

- The robot should be activated using a single start switch placed on the robot itself. Therefore, the robot should have a simple starting procedure.
- The starting procedure of the robot should not involve giving the robot any manual force or impulse in any direction.
- The robot should be able to operate under provided lighting conditions. The robot cannot transform into two robots during gameplay.
- There should be a way to indicate that the robot has completed its task. This will be considered to measure the time.
- The minimum distance between the middle of the lines and the edges of the arena will be 15 cm. The robot should be designed such that it won't fall out of the arena. The robot should not leave any components behind in the rest of the arena.

04 Team Composition and Eligibility

- A team can have a maximum of 5 members and a minimum of 1 member.
- Undergraduates from different state or private universities can form a team, but the team should register under one university name.
- Each team member should be under 28 years of age to be eligible to compete, and one undergraduate can only represent one team.
- All team members should be registered or selected to register as undergraduates of any state or private university in Sri Lanka at the time of their participation in the competition.
- All the team members should have a valid document to prove their eligibility to participate in the competition.
- Multiple teams could compete, representing the same university, but one team can only submit one robot.
- Violation of the above conditions would lead to disqualification.

05 Rules and Regulations

General

- There won't be any arena changes once the round has started. All teams will have the same arena.
- 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.
- The contestants must be prepared to start within 5 minutes after the call; if not, the attempt is lost.
- 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. In addition, the contestants should not communicate with or control the robot during an attempt.
- 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.
- 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.

- Program or hardware modifications of the robot are not allowed within this 15 minute.
- The time taken to travel from the start square to the shooting position and finish shooting the stone is called the total run time. The clock will start when the judges give the signal to start. Then, the clock will stop when the shooting stone has landed.
- The clock will not be paused during attempts.
- 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, that would be considered the end of that attempt, and you will be allowed to remove the robot from the arena.

Calibration

- Two additional minutes before the gameplay period of 15 minutes is given for the calibration of the robot.
- The robot can only use the arena from the starting square until the end of line segment 1 for calibration.
- Calibrations can only be done through external adjustments of the robot. Therefore, program changes nor hardware part replacements are not allowed.
- 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 three attempts).
- 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.

06 Judging

- 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.
- The robot's code will be checked for hard coding upon judges' request.
- No timing bonus will be given unless the robot completes the task.
- 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.
- The decision of the panel of judges will be the final decision.

07 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.