

RMI
ROBOTICS AND MACHINE INTELLIGENCE

FOLLOWING '19

Greetings from RMI!

We are back with our yearly flagship event, Following! For aspiring roboticists, Following '19 serves as a platform for you to learn new skills, design your own robot and showcase your newfound talents to the world. So gear up, charge your batteries, and prepare to let your robots battle it out for glory!

1. PROBLEM STATEMENT:

After searching far and wide, Indiana Jones has finally found the map to the holy grail. The map leads him on a globetrotting adventure, with each location containing a pictographic clue to the next. Unable to decode some of the clues, Indiana turns to his good friend, the genius inventor, Dr. Deefeck to help him. Imagining yourself as Dr. Deefeck, design a robot that will follow the trail and help Indiana Jones recover the holy grail.

1.1 ARENA DESCRIPTION AND LAYOUT:

The arena consists of black lines arranged in a grid. A sample track is shown below, but the final track may have lines that are not parallel to each other. The points of intersection are known as nodes. All the nodes will have distinct 2D cartesian coordinates in the grid. Additionally, there will be a start node as shown in the sample arena. The arena consists of **25** nodes and a start node at (2, -1). The box at the start node will be of dimensions **5cm x 5cm**. Each node has a specific coordinate, denoted by X and Y axes. The numbering of the X and Y axes are shown in the figure. The thickness of all the lines is **3 cm**. The distance between the nodes will be at least **30 cm**.

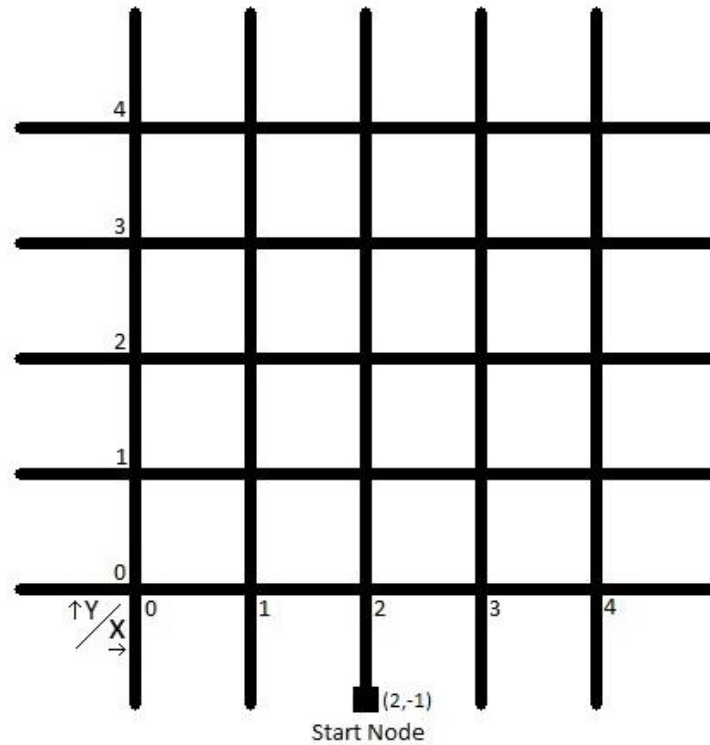


Fig. 1: A sample grid

NOTE:

The actual arena will be a warped version of the sample arena shown above (curved lines may be present). The lines need not be parallel to each other. The integrity of the grid will remain the same, i.e. the intersections will still be at right angles. The path between 2 nodes will have a maximum turning angle of 30 degrees. A sample section of how a warped 2 x 2 grid would look like is shown below (in Fig 2).

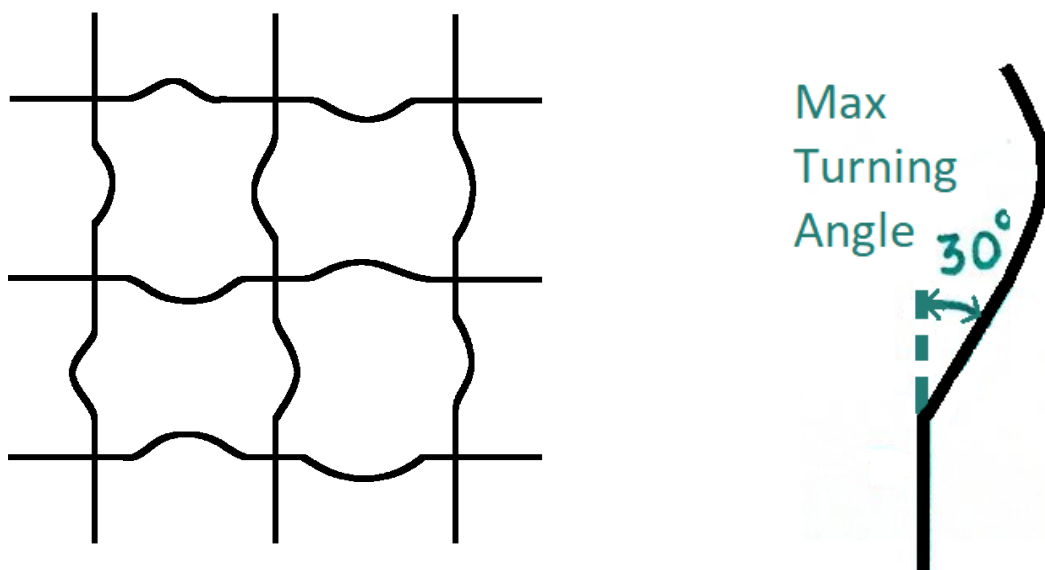


Fig. 2: Warped 2x2 grid

1.2 PHASES OF THE PROBLEM STATEMENT

The Task is divided into 2 segments, Phase 1 and Phase 2:

Phase 1:

At the beginning of the task, the bot will be placed at the start node. The goal of Phase 1 is to make the bot move to any given node, with coordinates (X, Y). The coordinates of the target node can be sent to the bot via any wireless means. The bot has to travel to the target node, light a green LED for 1 second, come back to the starting point, and make a U-turn such that the bot faces the grid, as at the beginning of Phase 1. If the bot does not make a U-turn and face the grid at the end, there are negative points as mentioned in the points distribution.

Phase 2:

The bot will start from the start node. Two shapes printed side by side on an A4 sheet will be shown to the laptop camera. Your task is to read and decode the X and Y coordinates of the target node from the shapes (For more details, refer *Image Processing Guidelines* section). The bot then has to move to the decoded target node, light the green LED and wait there until another set of shapes is shown. This will specify the next target node.

This process will be repeated 3 more times with different shapes. Each time it reaches a destination node the green LED should light up for 1 second. Shapes corresponding to the Start Node will be shown at the end, which implies that the bot has to return to the starting node.

NOTE (Only for phase 2):

In case the bot moves to a point which does not match the image processing result, the bot will be reset to the correct node by the organiser in the orientation desired by the participant, before the next set of shapes is shown to the laptop. (eg: If the IP detects (2,3) and the bot moves to any other point, then the organiser will reset the bot to (2,3))

2. IMAGE PROCESSING (IP) GUIDELINES:

The shapes for determining the coordinates will be printed on an A4 sheet in solid black. The sheet will then be shown to the laptop's camera. There will be two shapes on the sheet. The X-coordinate will be determined by the number of sides of the solid black polygon. The Y-coordinate will be determined by the number of radial lines (spokes) in the other shape we give you.

For example, the shape with 3 sides will represent an X coordinate 0 and the shape with 3 radial lines will represent a Y coordinate of 0.

The following table represents the relation between the various shapes and coordinates.


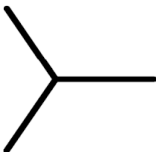
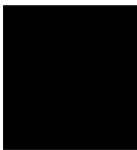
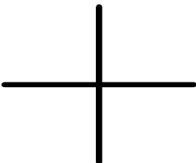
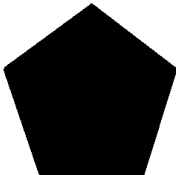
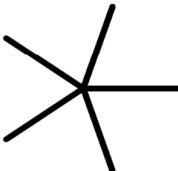
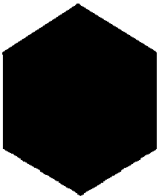
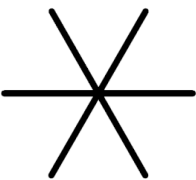
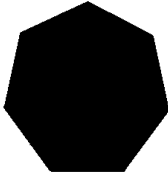
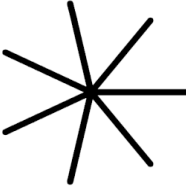
Shape for X	Coordinate	Shape for Y
	0	
	1	
	2	
	3	
	4	

Fig. 3: The two shapes will be placed side by side on the same sheet and will be shown together. The participant's code must differentiate between the two shapes and figure out the coordinate. The solid polygon placed on the left will determine the X coordinate and the radial lines placed to the right of the polygon will determine the Y coordinate.

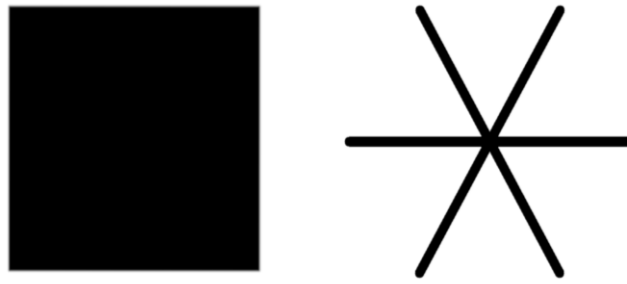


Fig. 4: A sample image representing the coordinate (1, 3)

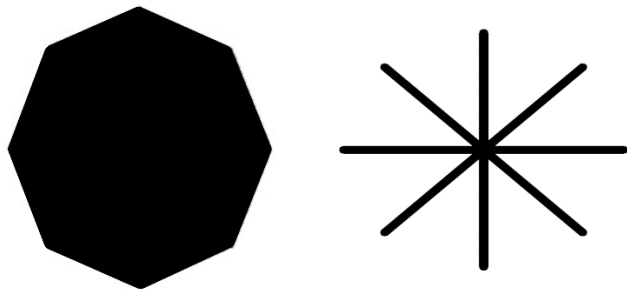


Fig. 5: The starting node representation

NOTE:

We recommend adding a simple GUI to change any required Image Processing thresholds at the venue since lighting conditions may vary with location and time.

3. RULES:

- A team can have a maximum of three members.
- Maximum robot size is 30cm x 30cm x 30cm.
- Extra points will be awarded for self-fabrication of any sensors.
- Each team can have one trial run to test both phases (not considered for evaluation) and a maximum of two final runs for each phase (best of two).
- The code can be changed between 2 phases. Any changes in the code made after a run in a phase will deem the previous run invalid and extra runs will not be given.
- No two points on the bot can have a potential difference greater than 13V.
- The bot must be powered only by onboard batteries.
- Choice of the microcontroller is left to the participant.

- Maximum time for completing a phase is 10 minutes, beyond which the current trial ends.
- The starting procedure of the bot should be simple and should not involve giving the bot manual force or impulse in any direction.
- Participants are allowed to adjust sensors (Gain, Position etc.), change speed settings and make repairs, without changing the code between runs.
- Participants **are not allowed** to touch the robot during a run, or damage the arena in any way. Failure to comply will result in disqualification.
- The decisions of the organisers are final.
- **Readymade Robotic kits are not allowed.**

4. POINTS DISTRIBUTION:

Key:

X_{start} - Starting x coordinate = 2.

Y_{start} - Starting y coordinate = -1

X_{target} - Target x coordinate.

Y_{target} - Target y coordinate.

$X_{detected}$ - x coordinate detected by Image Processing Code.

$Y_{detected}$ - y coordinate detected by Image Processing Code.

$X_{reached}$ - Last reached x coordinate of the robot before stopping.

$Y_{reached}$ - Last reached y coordinate of the robot before stopping.

PHASE-1:

- +25 Points for traversing the grid and going to a specified node from the starting node. If not " $25 - 5*(|X_{target} - X_{reached}| + |Y_{target} - Y_{reached}|)$ " points will be awarded.
- +25 Points for coming back to the start node from the specified node. If not " $25 - 5*(|X_{start} - X_{reached}| + |Y_{start} - Y_{reached}|)$ " points will be awarded.
- If the bot reaches the start node, but doesn't make a U-turn and face the grid, a "*penalty of 5 points*" will be given.

PHASE-2:

- +25 Points for recognizing the polygon and determining the X and Y-coordinate of the target node.

- +25 Points for the bot to move to the target node, if not “ $25 - 5 * (|X_{detected} - X_{reached}| + |Y_{detected} - Y_{reached}|)$ ” points will be awarded. As mentioned earlier, the bot will be reset to the correct node and desired orientation.
- In case the bot has reached the target node, but the orientation is desired to be changed to ensure that it can continue to the next target, then the participant can request for this with a “*penalty of 5 points*”.
- In case of tie, the time for completion of this phase may be used as a judging criteria.

BONUS:

- Top 2 fastest teams in TASK 1 will gain +20 points.
- Top 2 teams with compact/best design will get +20 points.
- Usage of self-fabricated boards/sensors (should be working) will add 30 points to your score. Partial points also will be awarded based on the complexity of the board being designed. The magnitude of the points will be decided by the organizers after scrutiny.

CONTACT:

Harshith	9445576198
Aquif	9500708264
Akshaya	9487763540

STAY HUNGRY, STAY FOOLISH