URC
ULTIMATE ROBOTICS CHAMPIONSHIP

PCCOER'S URC 2024 RULE BOOK

Copyright Information

- **Note** : For any clarification on rules/articles mentioned in this draft rulebook, please wait till the release of Final Rulebook on “PCCOER URC 2024” forum

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PARTICIPATION REQUIREMENTS :

- **Eligibility:** Any undergrad pursuing students

- **Team Composition:** Each team participating in the **Ultimate Robotics Championship** competition must consist of 2 to 6 members, including an assigned team leader. Each team must have a designated team leader who will be the primary point of contact.

- **Robot Specifications:** Robots must adhere to size and weight constraints specified in the competition rules.All robots must be self-constructed or significantly modified by the participants.Off-the-shelf robots are not permitted unless they are heavily customised.

- **Autonomous and Manual Control:** Teams must ensure their robots can switch between autonomous and manual modes.

- **Safety Compliance:** Try to wear safety gear, such as safety glasses, shoes and gloves, at all times in the designated areas. No running or horseplay is allowed in the event area. Robots must have an accessible and clearly marked emergency stop button. Only approved power sources and batteries are allowed.Batteries must be securely mounted and properly insulated to prevent short circuits.

- **Pre-Competition Inspection:** Verify that the robot adheres to the specified size and weight limits.Ensure batteries and power sources are securely installed and insulated.Ensure the robot complies with all event-specific rules and regulations.Confirm that any modifications are within allowed limits.

COMPETITION OVERVIEW:

PROBLEM STATEMENT:

Design and develop a multi-functional robot capable of autonomously navigating through a series of challenges which will be followed by an manually controlled pick and place challenge. The competition will test the robot's precision, problem-solving skills, adaptability, and manual control.

Challenge Overview:

Round 1: Line Follower (Autonomous Task).
The robot must autonomously follow a predefined line path on the ground from start to finish.
Goal: Successfully navigate the entire course without deviating from the line.

Round 2: Maze Solver (Autonomous Task).
The robot must autonomously navigate through a maze with a clear start and end point.
Goal: Identify and execute the optimal path to solve the maze in the shortest time possible.

Round 3: Color code navigator (Autonomous Task)
The robot must autonomously follow a colored stripes on the ground, where each strip directing a change in direction or action.
Goal: Accurately follow the colored line to navigate to reach the end point.

Round 4: Pick and Place (Manual Task).
The robot must manually pick up and arrange blocks to form a specific pattern displayed at the start.
Goal: Accurately complete the pattern with precise block placement.

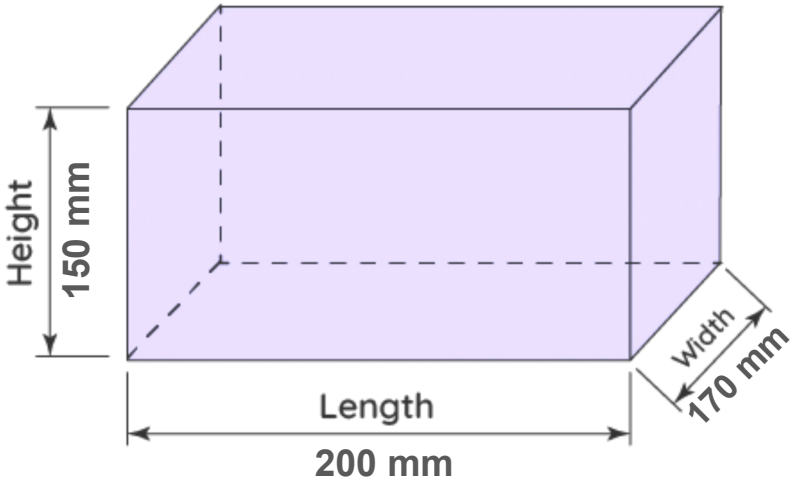
Round 5: Control Pathway(Autonomous Task).
The robot must be autonomously navigate through an obstacle course featuring various physical barriers and challenges.
Goal: Successfully overcome all obstacles and reach the end point in the shortest time possible by following a fixed trace on ground.

NOTE: A strict mode of operation is defined for each task, and participants are required to follow these guidelines precisely.

30 Seconds of Preparation and Checkup time will be provided after each round.

Model Specification And Requirement:

1. **Dimension** (Including Robotic manipulator) : The maximum dimension allowed for the robot are 200 mm x 170 mm x 150 mm (L x W x H).



*The robot's minimum allowable footprint is 150 mm x 120 mm (L x W), ensuring that the base dimensions remain within these limits for eligibility in the competition.

After adding robotic manipulator the maximum allowed height with tolerance will be 150 + 50 mm.

2. **Weight** : Up to 2500 gm

3. **Autonomous Navigation System:**

The following approaches are highly recommended:

- **Navigation Algorithms**
  - Participants are encouraged to implement advanced navigation algorithms to enhance the robot's autonomous operation capabilities.
- **Line Following:**
  - Utilise proportional-integral-derivative (PID) control to ensure smooth and accurate line tracking.
  - Can implement computer vision techniques to recognize and follow the line using cameras and image processing algorithms.
- **Maze Solving:**
  - Apply graph-based algorithms such as Depth-First Search (DFS), Breadth-First Search (BFS), or A* for efficient maze navigation.
  - Wall-following strategies combined with decision-making algorithms to handle dynamic environments.
- **Color Code Following:**
  - Employ color detection algorithms using RGB or HSV color space to identify and react to different colored strips.
  - Integrate finite state machines (FSM) to manage the sequence of actions based on detected colors.

4. Manual Robotic Manipulator:

- The manipulator must be controllable by a remote control or interface provided by the team.
- It must have a smooth and controlled motion to avoid sudden movements.
- All joints and moving parts must be shielded to prevent injury.

- **Maximum payload requirement : 150gm**
- **Control:**
  - Robot must be integrated with accurate and precise manual control for completion of course.
  - The manipulator must have an emergency stop mechanism.

5. Power System And Battery:

- Robot Should be Battery Powered
- Max Operating voltage should not exceed 16.8V DC(4S)
- Batteries must be securely mounted to prevent movement during operation.
- All wiring should be insulated and properly secured.
- Each robot must have an accessible and clearly marked power switch.
- Teams are allowed to bring spare batteries
- **All systems will be inspected before the competition.**
- **Non-compliance with rules will result in disqualification.**

6. Safety :

- No open flames or flammable materials are allowed in the competition area..
- Robots must be operated in a controlled manner, avoiding sudden or unpredictable movements.
- Stop the robot immediately if it poses any danger or if instructed by an official.

7. Maintenance:

- Address any identified issues promptly to maintain robot safety and Functionality

FIELD AND TRACK DETAILS

Track 1: Line Follower

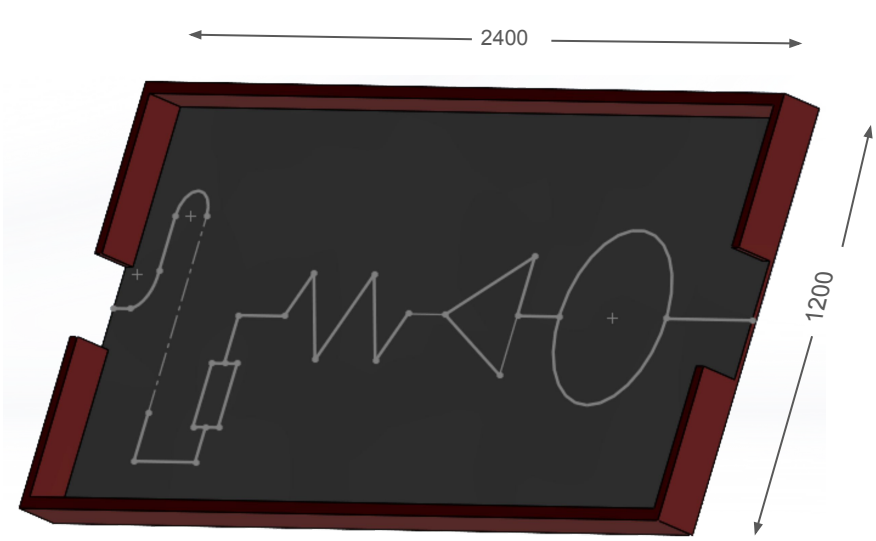
Objective:
To assess the robot's ability to autonomously follow a black line (#000000) on a surface, demonstrating precise navigation and control.

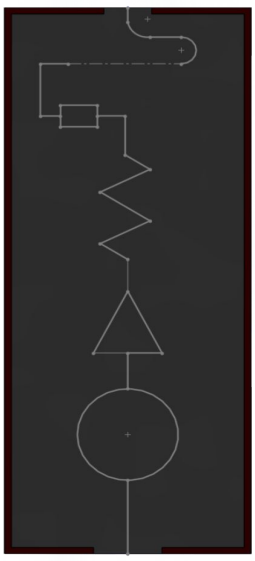
Setup:

- **Course Design:** The track has a clearly defined black line of width 20 mm on a surface. The track includes both straight sections and curves, and can have sections with varying widths and sharp turns.
- **Track Features:** There are intersections along the track to increase difficulty. The track challenges the robot's line-following capability without causing damage.
- **Sensor Requirements:** Equip the robot with line-following sensor.

Procedure:

1. **Autonomous Line Following**:
   - The robot must start from a designated starting point and autonomously follow the black line to the finish line.
   - The robot should navigate through curves and handle sudden changes in direction while staying on the black line.
2. **Obstacle Navigation:**
   - The track will include intersections where the robot must continue following the black line without deviating.
3. **Time and Accuracy:**
   - The robot must complete the course within least time possible
   - Accuracy will be assessed based on how well the robot stays on the black line and handles the course's challenges.





Track 2: Maze Solver

Objective:
To evaluate the robot's ability to autonomously navigate a maze or grid-like environment

Setup:

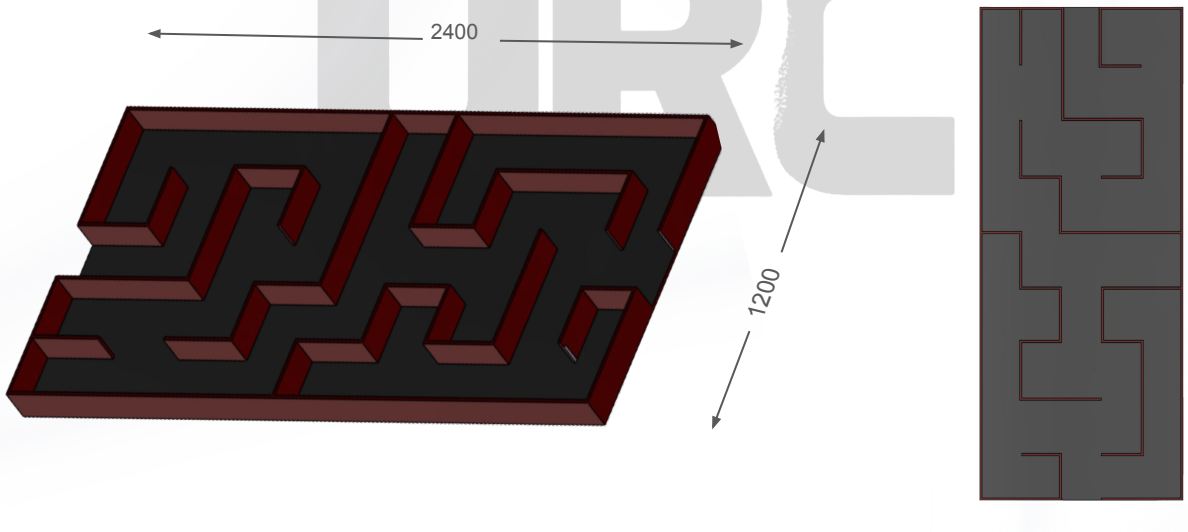
- Course Design: Track consists of a grid or mesh pattern on the surface.The grid is made with physical barriers on the surface. Include various types of elements within the grid that the robot needs to interact with such as joint,dead Ends and loops. The height of walls will be 150 mm , wall width will be 8 mm and the minimum distance between two parallel walls will be 295 mm.

- Sensor Requirements: Equip the robot with sensors capable of detecting the grid walls within the grid, such as cameras, proximity sensors to solve the mesh.

Procedure:

1. Autonomous Navigation:
   - The robot must autonomously navigate the grid, following the grid walls or navigating through the maze without human intervention.
   - The robot should demonstrate effective pathfinding and grid navigation skills.

2. Time and Accuracy:
   - Accuracy will be assessed based on how well the robot performs the required tasks and navigates the grid.



Track 3: Color Code Navigator

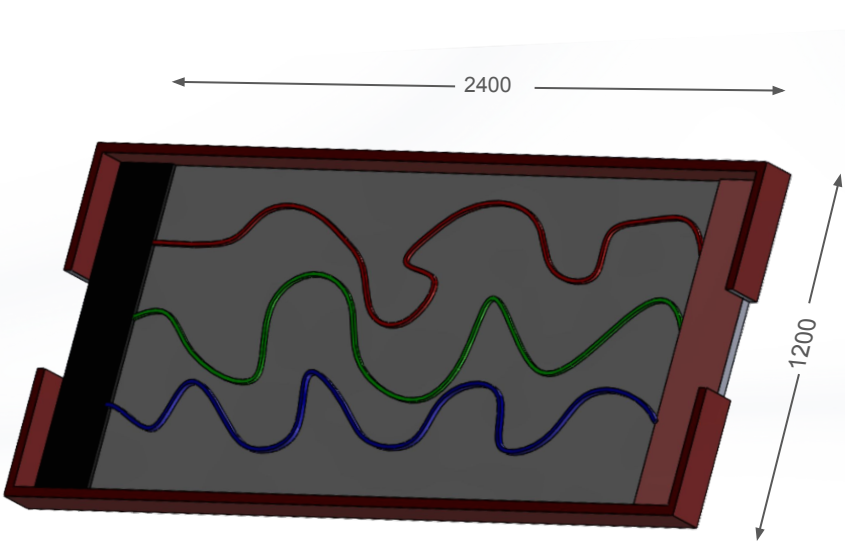
Objective:
To assess the robot's ability to autonomously follow a path based on color codes (red #FF0000, green #00FF00, and blue #0000FF), demonstrating color recognition and navigation skills.

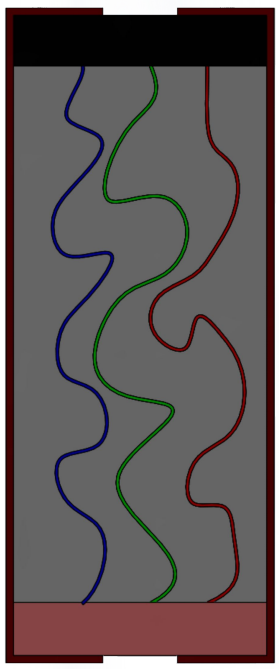
Setup:

- Course Design: Robot must follow a track with sections marked in red, green, and blue. The track include various color-coded segments that the robot needs to follow. The color will be chosen randomly at the start of the round
- Color Code Features: The robot must follow the path according to the color code assigned to the team. Each colored path will have width of 20 mm.
- Sensor Requirements: Equip the robot with color sensors or cameras capable of detecting and differentiating between red, green, and blue colors and follow the designated color till the end of task.

Procedure:

1. **color Specification:**
   - Before the task begins,a random color will be assigned to the team which the robot must follow.
   - The robot must be prepared to follow the specified color throughout the Course.
2. **Autonomous Color Code Following:**
   - The robot must autonomously navigate the track by following the color specified.
   - The robot should accurately detect and stay on the color-coded path,adapting to transitions between colors.





Track 4: Pick And Place

Objective:

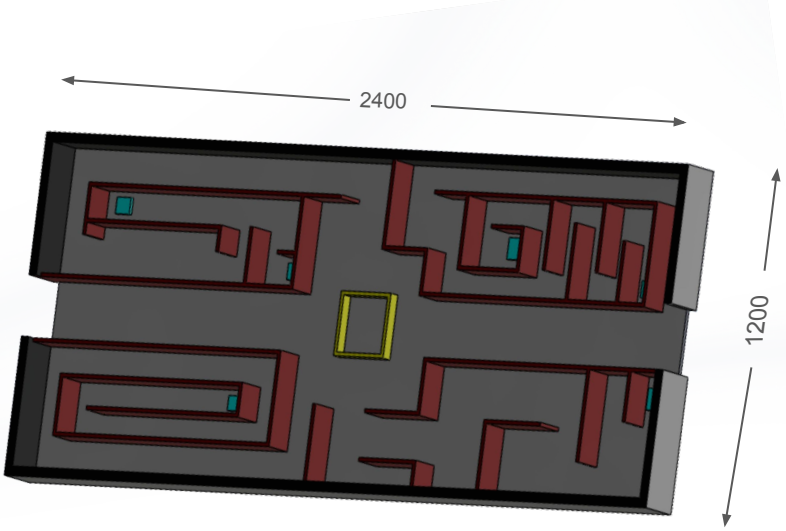
Robots must pick up and arrange blocks to form a specific pattern provided at the start of the round. This round tests the robot's precision, dexterity, and ability to follow instructions accurately

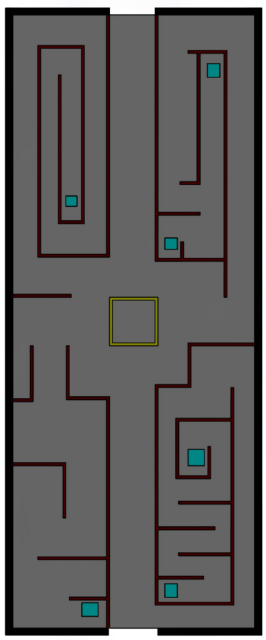
Setup:

- **Arena:** A square arena with a designated start area for the robots and a target area where the blocks need to be arranged.
- **Blocks:** A set of 6 uniform blocks of 50mmx50mmx50mm are placed randomly within the arena.
- **Mesh:** The track consists of a grid or mesh pattern on the surface, created with physical barriers. The cubes are located at the end of multiple mazes.
- **Pattern:** The unique pattern and arrangement of the blocks will be assigned to each team at the start of the task.

Rules:

- **Pattern Display:** The pattern will be revealed at the start of the round.
- **Starting Position:** Robots must start from the designated start area.
- **Block Handling:** Robots must pick up and place the blocks one at a time.
- **Pattern Accuracy:** The blocks must be arranged exactly as shown in the pattern.
- **Penalty:** A penalty of -2 points will be added for each block that is misplaced or not aligned correctly.
- **Assistance:** No manual corrections are allowed once the round starts.





Track 5:Control Pathway :

Objective :
To evaluate the robot's performance in a autonomous obstacle course, testing its ability to navigate through physical obstacles without human intervention.

Setup:

Course Design: The Control Pathway features a variety of physical barriers to challenge the robot's autonomous navigation capabilities:

- **Slalom Posts**: Markers placed to test the robot's ability to autonomously navigate around them without collisions, requiring precise control and movement adjustments.
- **Passageways**: Narrow corridors or openings that the robot must autonomously navigate through, assessing its ability to accurately follow a confined path.
- **Crossing Gates**: Barriers that the robot must autonomously pass through, evaluating its capability to handle different widths and heights.
- **Bridges**: Elevated platforms that the robot must autonomously traverse, testing its stability and ability to manage varying heights and surfaces.

These obstacles are designed to rigorously test the robot's autonomous maneuverability and control, ensuring that' robots can handle complex challenges independently.

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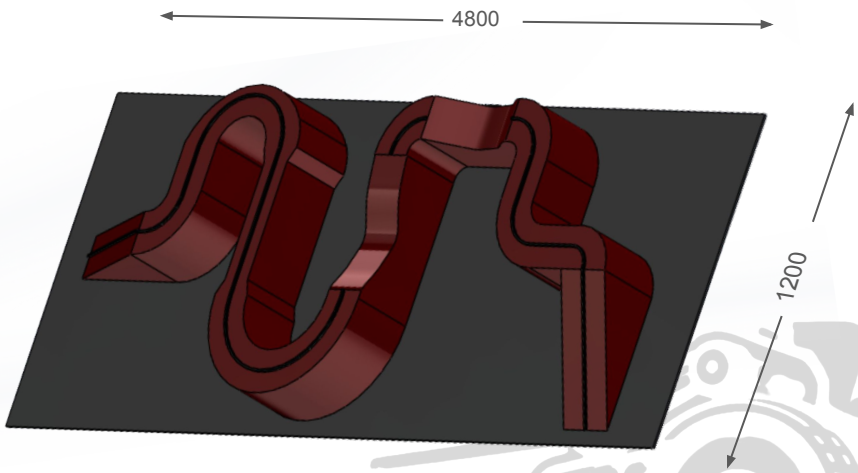
- **Obstacle Features:** Include a range of obstacles that require precise navigation and handling, such as tight turns, elevation changes, and barriers that must be carefully manoeuvred around.
- **Control Requirements:** The robot must be autonomously controlled and follow a black line (#000000) to navigate through the obstacle course

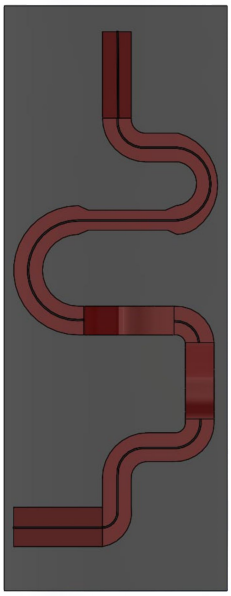
Procedure:

1. **Autonomous Operation:**
   - The robot must be autonomously controlled by following a marked trace and make its way through the obstacle course.
2. **Obstacle Navigation:**
   - The robot must successfully pass through all designated obstacles, including tight turns, ramps, and other physical challenges.
   - The operator should ensure the robot does not collide with or knock over any obstacles.

3.Time and Accuracy:

- The robot must complete the obstacle course within the shortest time.
- Accuracy will be assessed based on how well the robot navigates the course, avoids collisions, and handles the obstacles.





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Note: All images are used for illustrative purpose only, actual track will vary from the images. All dimensions are in mm.

Scoring:

Points Will Be Awarded For:

- **Successful Completion:** Each successfully completed task will award 5 points.
- **Checkpoints:** There are 5 checkpoints in each task. Crossing each checkpoint earns +1 point.
- **Time Efficiency:** Each task has a relative marking system based on the time required for completion.

Penalties Will Be Applied For:

- **Technical Issues:** If the robot is stuck in one place or in a loop for more than 30 seconds due to a technical issue, manual course correction is allowed. Each manual correction will incur a penalty of -3 points.
- **Manual Course Correction:** The decision to use manual course correction is up to the team.
- **Referee's Discretion:** Not all situations will permit manual course correction; it is at the referee's discretion to allow or deny such corrections.

OBJECTIVE	POINT
Completion	+5
Clear Checkpoint	+1
Time Taken	0-10
Manual Course Correction	-3

Points Table:

ROUNDS	POINT Upto
Line follower	20
Maze Solver	20
Color Code Navigator	20
Pick and Place	20
Control Pathway	20

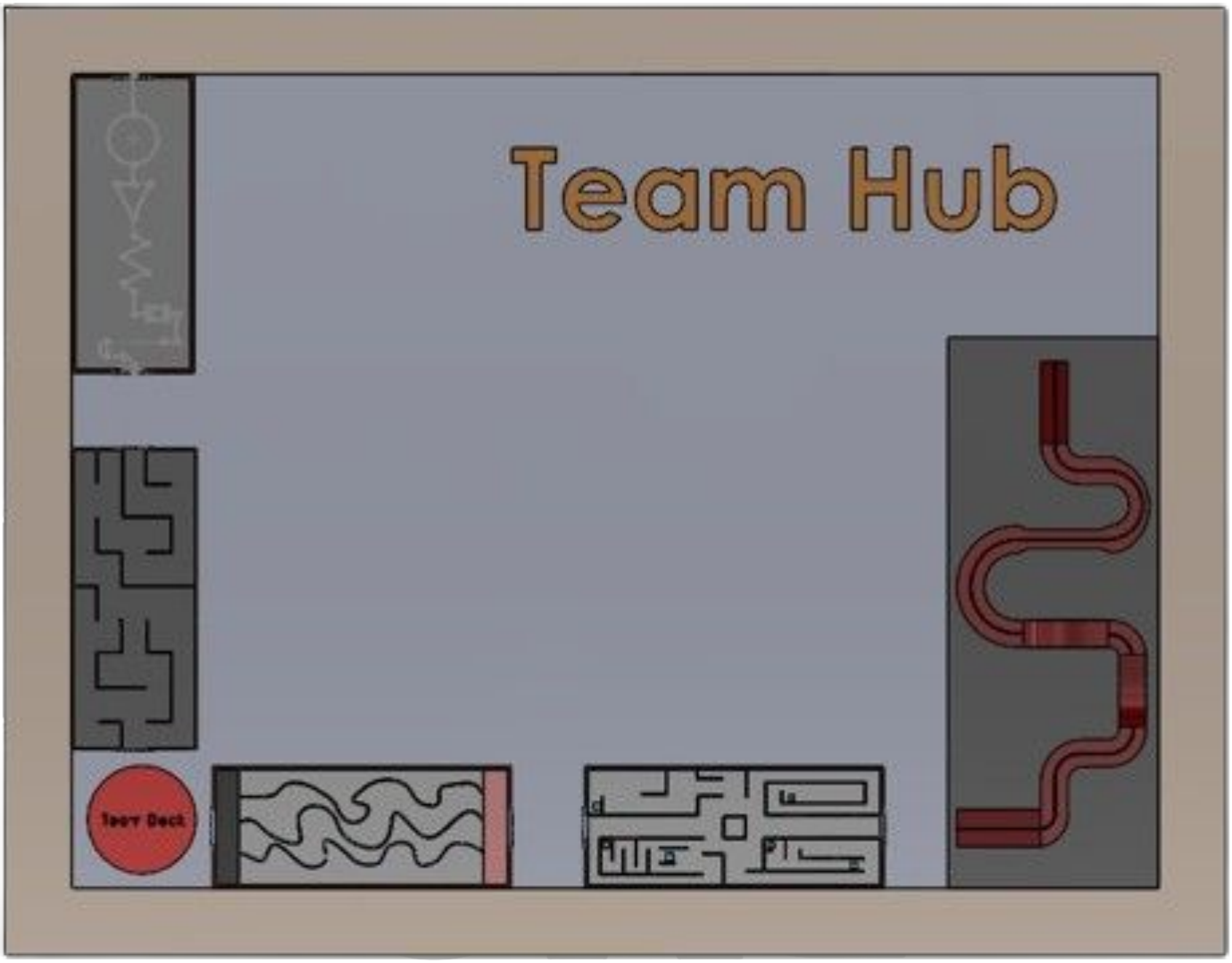
Note :
- Anything that interrupts the Path of the Robot is mentioned as Obstacle in the rulebook !!! It does not mean Actual Obstacle or Physical Hindrance !!!
- Whether to allow manual course correction is the call of head referee present at the event arena
- Points assigned to time required for the task are given via relative marking system

TECHNICAL INSPECTION RULES

● **Post-Round Inspection:** After each round of the competition, a technical inspector will conduct a safety check on the robot.
● **Safety Assessment:** The inspector will evaluate whether the robot meets all safety standards and technical requirements. This includes verifying that the robot is functioning properly and that it adheres to all competition rules.
● **Continuation of Competition:** If the robot passes the safety assessment, it will be permitted to continue in the competition. If any issues are identified, the team will be required to address them before proceeding to the next round.
● **Inspection Timing:** Technical inspections will take place immediately following each round. Teams should be prepared for prompt inspections and may need to make adjustments to their robots as directed by the inspector.
● **Compliance**: It is the team's responsibility to ensure that their robot is in compliance with all safety and technical guidelines throughout the competition. Failure to pass the inspection may result in disqualification from the current or subsequent rounds.

PARTICIPANT RULES

● **Prototype Presentation:** Participants must present a fully functional prototype on the day of the event. No additional machinery or technical equipment will be provided at the venue.
● **Rule Updates:** Rules may be updated or changed without prior notice. Participants are responsible for checking the official competition website regularly for the latest updates.
● **Event Directives:** During the event, participants must adhere to all directives given by the event head and competition organizers.
● **Required Documents:** Participants must bring their registration receipts, valid ID (e.g., college ID), and any other items as specified in the pre-event instructions. A detailed list of required items will be provided closer to the event date
● **Dispute Resolution:** Winners will be selected at the sole discretion of the judges. In case of any disputes, the decision of the organizers and judges will be final and binding.
● **Official Communication:** All official communication will be conducted via the competition email address. Participants should regularly check all folders in their email accounts to ensure they receive important updates.
● **Withdrawal Policy:** Teams that need to withdraw from the competition must do so officially by emailing [email1] with a copy to [email2] no later than 15 days before the event. Registration fees are non-refundable and non-transferable



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