INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR
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ROBOTIX

TECHNOLOGY ROBOTIX SOCIETY

Warehouse

Semi-autonomous robotics

USP: RFID detection and gesture control

Introduction

Time is money, efficiency defines our lives, yet menial work is a necessary evil. What if all menial work could be completed by a literal flick of your wrist or snap of your fingers?

Problem statement

Build a gesture controlled semi-autonomous robot that is capable of sorting blocks on multi-layered platforms according to their RFID tags.

USP:

- **RFID Tag Detection.**
- **Picking mechanism.**
- **Gesture Controlled Traversal.**

General Arena Description & Event Setup:

1. The semi-autonomous robot movement and traversal has to be a **gesture controlled** (with no buttons or any keyboard), preferably using a Touchpad.
2. There will be multiple **5 cm blocks**, each with a particular **RFID tag**
3. The "centre platform" consists of three parts. There are two lower platforms which are **1 cm** above ground level due to platform thickness, each and **50 cm X 10 cm** in dimension each. Between the two lower platforms is a raised platform at a height of **10**

cm above ground level including the platform thickness, and **50 cm X 30 cm** in dimension.

4. The "shelves" are on the four corners of the arena. They are **two-tiered**. The four lower shelves are called **'1A, 2A, 3A, 4A'** each of which corresponds to a particular corner and it is **1 cm** above ground level due to the platform thickness. The upper shelves are called **'1B, 2B, 3B, 4B'** corresponding to the lower shelf and it is **12 cm** above ground level including the platform thickness. Each shelf (lower and upper) is **20 cm X 20 cm**.

5. The bot must have a gripping mechanism which is capable of accessing blocks placed on both the levels. It must be able to pick and drop blocks on any of the eight shelves. (Preferably a forklift or a gripper along with rack and pinion mechanism).

6. Each block will have two strips beneath it (Like a railway track) which will be **0.5 cm wide and 1 cm high** in cross-section and the same length as the block **(5 cm)**. This will create a vacant space of **4 cm X 1 cm X 5 cm** beneath the block. This has been done to allow bots using forklift mechanism to be able to pick the blocks from beneath. If you implement a forklift then it's forks can enter this gap and pick the block. You can also use a mechanism to grip from beneath.

7. The RFID tag on each block will be placed on the top. Each RFID tag gives a **unique alpha-numeric number** when you read it. This contain information as to which shelf the block belongs to among 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B. **You will be provided with the unique RFID number for each shelf at the time of the event and you can feed it into your robot.**

8. On the corner edge of every shelf there will be a **15 cm X 15 cm** square safe zone as shown in the diagrams. While placing the block on any shelf the bot must ensure that the block is kept within the safe zone itself.

9. Some blocks will have RFID tags that don't correspond to any of the eight shelves and these blocks are to be placed anywhere on the center platform. If they are already on the center platform they are to be ignored.

10. **Two** of the four corners will have **shelves with gates.**

11. The gates open when their corresponding **Infra-Red button** is activated. The button is located on the ground, **10 cm inward** from the arena border and **midway** between two adjacent shelves as shown.

12. The button consists of a Infra Red proximity based sensor. It is activated when the bot stops over it for **3 seconds.** Once activated, the corresponding gates of the both shelves of the corresponding corner are opened for a total of **30 seconds** each. The bot must pick/drop the block in that duration and should not touch the gates at any time.

13. The gates can be closed immediately before the 30 second are over if the bot goes and stops over the button for another **2 seconds** within that 30 second countdown.

14. The gates can then be reopened after it has been closed by activating the button again.

15. The event ends when the user has placed **all the blocks correctly** on their corresponding shelves and leaving those blocks which do not correspond to any shelf on the central platform. **All the gates must also be closed.**

Round 1:

Task:

1. The Bot will start from the Start zone which will be a **30cmx30cm** square on any side of the square Arena.
2. The bot then has to pick and place all the **6** given blocks from their initial position to whatever shelf it belongs to.
3. The blocks in round 1 will belong to shelves **'1A, 2A, 3A, 4A'** only. No block will belong to Zone B.
4. There will be **two** dummy blocks which won't be transmitting any shelf id and hence must be placed on the center platform, if those blocks are on the shelf they must be placed on the center platform.
5. The bot has to traverse the arena and reach the blocks by Gesture control.
6. Upon reaching the block the bot must pick it up using a gesture controlled gripper or forklift mechanism.
7. Then the bot has to read the information received from the RFID and **display** it through a device, and then proceed towards depositing the block to it's corresponding shelf.
8. A maximum of **2** timeouts and **2** restarts can be taken in this round. However a restart will be granted in the event of a technical failure and will be based on Team ROBOTIX discretion.
9. A maximum of **4** minutes will be given to complete this round. The restart will only be given before **3:00** into the round.
10. The round ends when the bot **returns** to the start zone after completing the task.

Round 2:

Task:

1. The Bot will start from the Start zone which will be a **30cmx30cm** square on any side of the square Arena.
2. The bot then has to pick and place all the **9** given blocks from their initial position to whatever shelf it belongs to.
3. The Blocks may belong to **any** of the Shelves, in **any** of the zones.
4. There will be **three** dummy blocks which won't be transmitting any shelf id and hence must be placed on the center platform, if those blocks are on the shelf they must be placed on the center platform.
5. The bot has to traverse the arena and reach the blocks by Gesture control.
6. Upon reaching the block the bot must pick it up using a gesture controlled gripper or forklift mechanism.
7. Then the bot has to read the information received from the RFID and display it through

a device, and then proceed towards depositing the block to its corresponding shelf.

8. A maximum of **2** timeouts and **2** restarts can be taken in this round. However a restart will be granted in the event of a technical failure and will be based on Team ROBOTIX discretion.

9. A maximum of **6** minutes will be given to complete this round. The restart will only be given before **4:30** into the round.

10. The round ends when the bot **returns** to the start zone after completing the task.
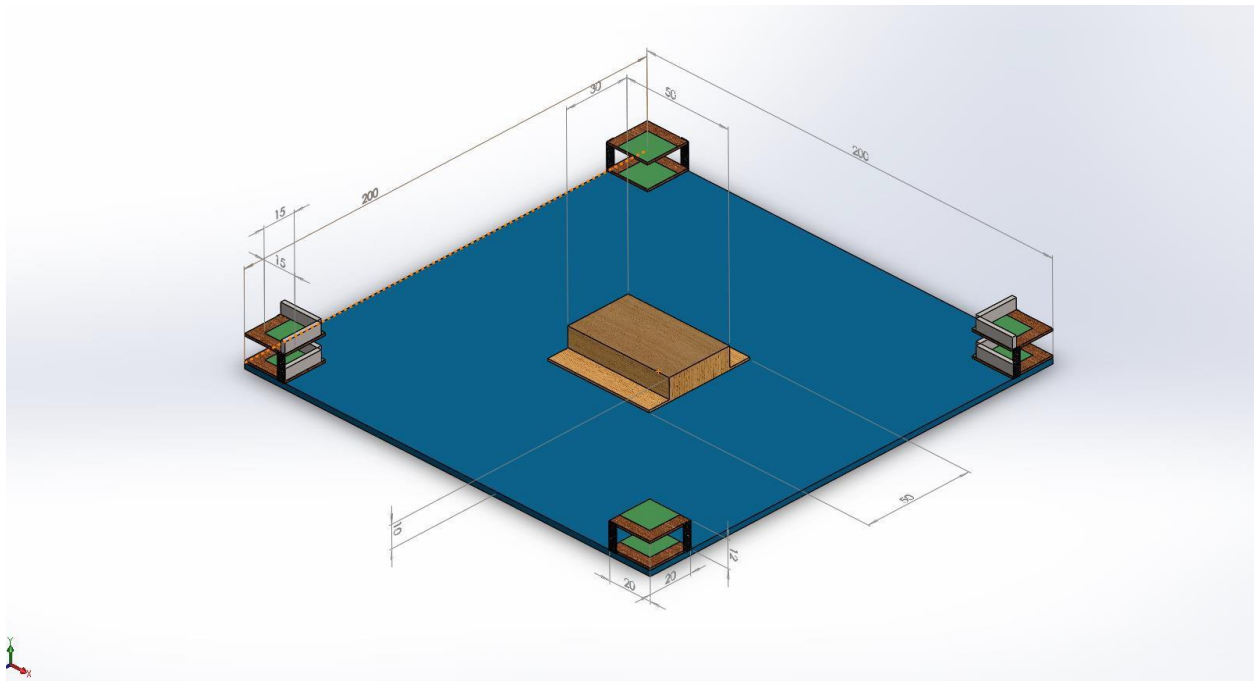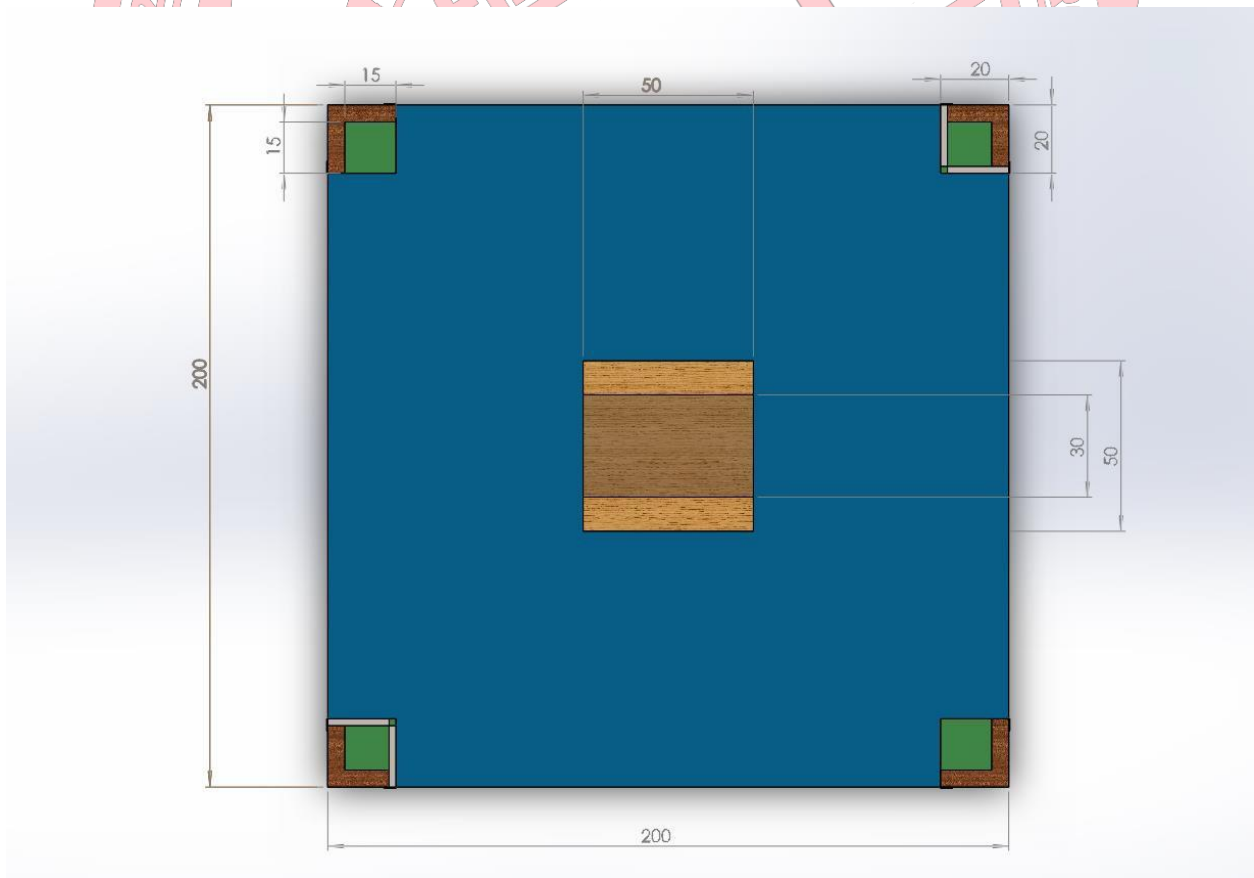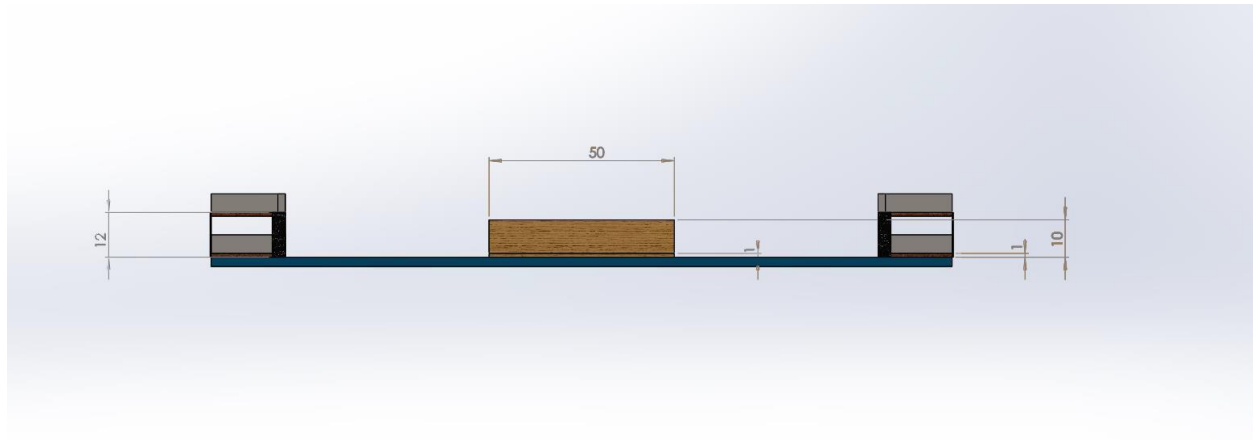
Arena:
For Both Rounds:

Descriptive View.
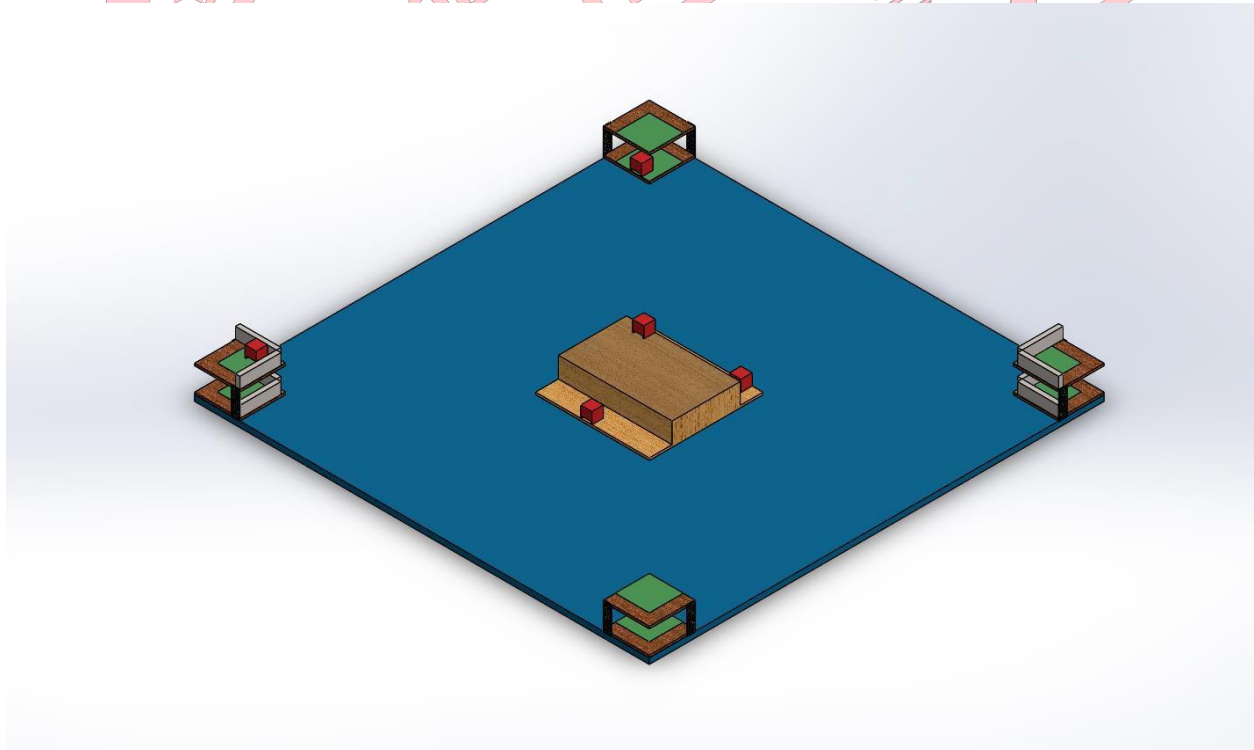
Isometric View
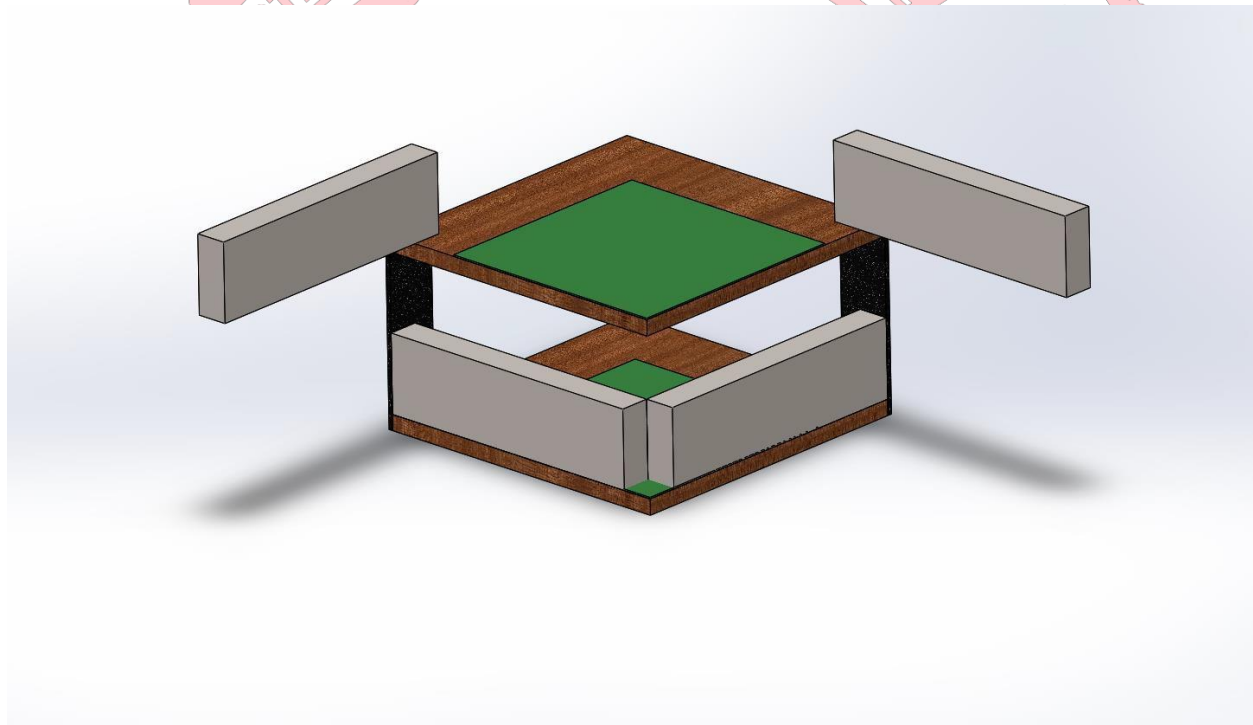
Top View

Side View

Gate (Open and Closed Profiles)


Rules And Specifications:

General Rules:

1. All arena dimensions may have a tolerance (error) of up to 10%.
2. Each team can consist of a maximum of 4 members.

3. Only **2** members per team will be allowed to control the robot.
4. The participants will be provided with 220 volts, 50 Hz standard AC supply.
5. Each team should have unique participants i.e. no two teams can have even a single participant common.
6. The team members can be from different institutes or colleges.
7. Teams qualifying the first round will go into the second round and and those qualifying the second round will participate in the third round.
8. The teams cannot touch their bots during the course of the run, unless timeout is taken.
9. The right spirit of participation is expected from the participants.
10. **The decision of Team ROBOTIX will be final and binding.**

Event Rules:
Block:
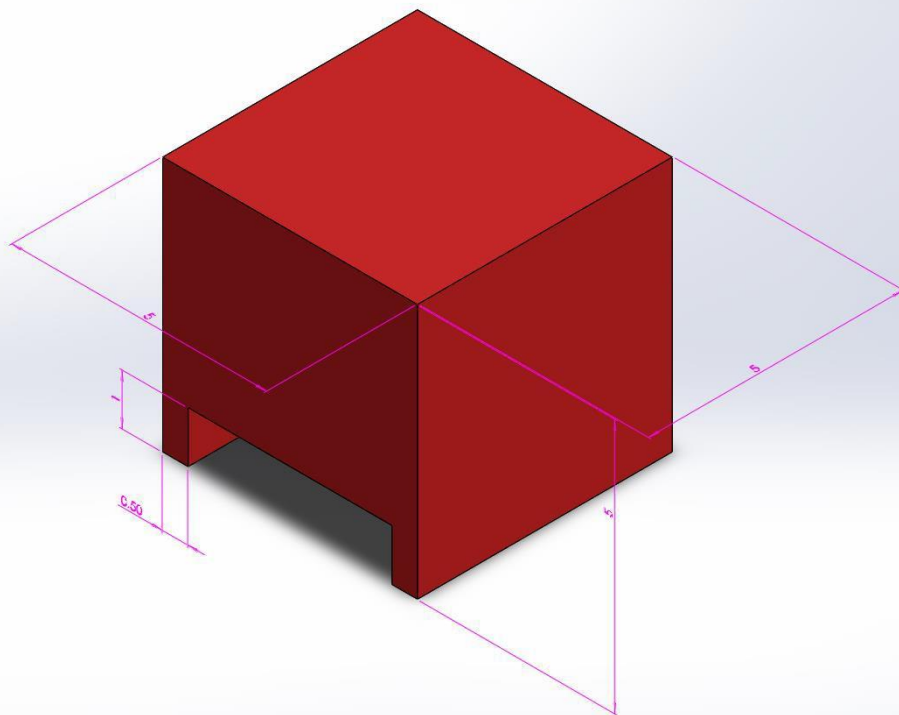
Isometric View
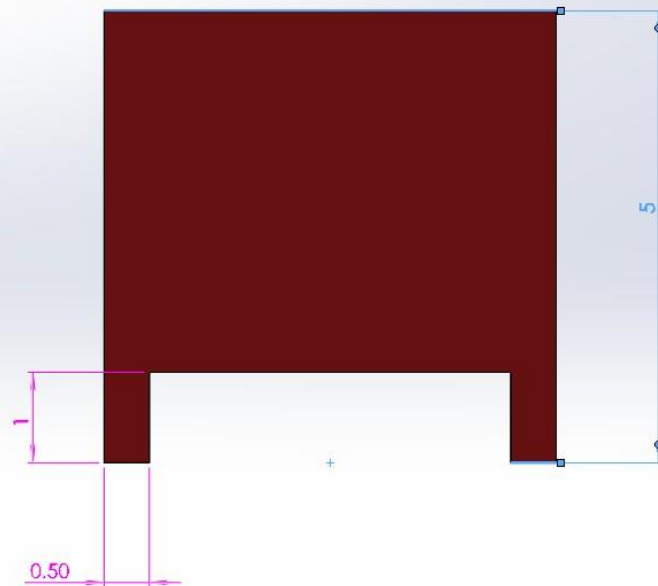
Front View

1. The Blocks will be made of Hollow wood.
2. The tolerances allowed in the dimensions of the block are **10%**.
3. The weight of the block will not exceed **50** grams.
4. The position of the blocks will be decided by Team Robotix and will be random.

Arena And Locomotion

1. The robot has to start from the **Start Zone** that will be a **30 x 30 cm** square zone adjacent to the center of one of the edges at ground level.
2. The bot has to go to complete the tasks as specified above. Any discrepancies will be handled by Team ROBOTIX and their decision will be final and binding.
3. The gesture control mechanism **shouldn't use any physical buttons**. The general methods of gesture control are Accelerometer, IMU, touch phone, Touch Screen Sensor, Flex Sensors. The types of sensors that must not be used include IR LED photodiode pairs, Proximity Sensors, and **buttons**. Permission for using any method for Gesture control other than the above mentioned ones must be taken from Team ROBOTIX beforehand. Laptops can only be used if IP is being used for gesture control, no processing on laptops is allowed.

4. The Block must be placed on the platform safezone. Sliding the block on the platform is allowed but if the block falls from the platform while picking or placing, it will incur negative points.
5. Time will be kept by Team ROBOTIX and will their decision will be final and binding.
6. Gesture Control is to be used for **locomotion** as well as **block controlling**.

Picking up the Block
1. The picking mechanism must be **gesture** controlled.
2. The Blocks have to be picked up from the shelves as neatly as possible. Dragging it a little is allowed.
3. The block falling down, when picking up may lead to penalties.

Placing the Block
1. The picking mechanism must be **gesture** controlled.
2. The Block must be placed at the shelf where it actually belongs. Failure to do so will result in **penalties**.
3. The block **mustn't fall** down on the way to the destination.

Initial Orientation of Robot:
1. The participant is **allowed** to decide the initial orientation of his robot on the start zone.
2. Team ROBOTIX reserves the right to disallow any initial orientation of the robot inside the starting zone if it gives the participant an undue advantage, solely based on the judge's discretion.

Restarts and Timeouts:
1. A maximum of **2** Timeouts of **1** minutes each may be taken. Penalty will be awarded for each timeout and robot will start from its last position on the arena.
2. The participant's robots can have a maximum of **2** restarts. A penalty will be imposed on the team for every restart that they take.
3. After the restart, the participant's robot will be set to its initial position. Timer will be set to **zero** and the run will start afresh with the addition of the penalty for restart.
4. A timeout can be taken anytime at the user's discretion.
5. Restart can be taken only if there is a genuine technical fault in the bot, Team ROBOTIX may refuse restart if the reason is not genuine.

Technical Rules:
1. All Circuitry and sensory equipment placed on the robot should be adhering to the ROBOT SPECIFICATIONS.
2. Participants will have to bring their own programmers, cables and software. No Programmers will be supplied.
3. Hard Coding (http://en.wikipedia.org/wiki/Hard_coding) is not allowed.
4. All the dimensions of the arena and the blocks are to be considered with a tolerance of 10%.

Robot Specifications:

1. Each robot can have maximum dimension of **30 x 30 x 30 cubic cm** (L x B x H) respectively.
2. No part/mechanism of/on the robot should exceed the given dimensions before the commencement of the event run. The robots can exceed their respective dimensions once the event commences.
3. There is no weight restriction on the robot.
4. LEGO kits or its spare parts or pre-made mechanical parts are not allowed.(http://en.wikipedia.org/wiki/Lego_Mindstorms)
5. Ready-made gearboxes, sensors, development boards can be used but no other part of the robot should contain any ready-made components. Simple car bases with no extra features may be used.
6. The bots should not damage the Warehouse event arena in any way. If it does so, a penalty will be imposed on the team. The magnitude of the penalty will be decided by Team ROBOTIX.
7. Processors of **less than 16-bits** are allowed. ARM processors are not allowed.
8. Ready-made gripper is also allowed but it should be controlled using gesture.

Scoring:

Round 1:
Positives

1. Base score: 1000
2. For each block picked/gripped (given only once for each block): 100 (**L**)
3. For successful RFID reading and correct indication of each block: 150 (**S**)
4. For placing the block on the correct platform: 150 (**P**)
5. Time bonus: time left in seconds (provided the task is complete) (**B**)

Negatives

1. For incorrect RFID reading and indication: -50 (**NS**)
2. For placing block on an incorrect platform: -50 (**NP**)
3. For dropping the block each time: -50 (**D**)
4. Collision with the walls each time: -50 (**W**)
5. Collision with the gates each time: -50 (**G**)
6. Negative marks for each timeout: -100 (**T**)
7. Negative marks for restart: -150 (**R**)

Scoring Formula:

1000 + 100 x L + 150 x (S + P) + B - 50 x (NS + NP + D + W + G) - 100 x T - 150 x R

Round 2:

Positives

1. Base score: 1000
2. For each block picked/gripped (given only once for each block): 100 (**L**)
3. For successful RFID reading and indication of each block: 150 (**S**)
4. For placing the block on the correct platform: 100 (**P**)
5. Time bonus: time left in seconds (**B**)

Negatives

1. For incorrect RFID reading and indication: -50 (**NS**)
2. For placing block on an incorrect platform: -50 (**NP**)
3. For dropping the block each time: -50 (**D**)
4. Collision with the walls each time: -50 (**W**)
5. Collision with the gates each time: -50 (**G**)
6. Negative marks for each timeout: -100 (**T**)
7. Negative marks for restart: -150 (**R**)

Scoring Formula:

1000 + 100 x L + 150 x (S + P) + B - 50 x (NS + NP + D + W + G) - 100 x T - 150 x R

Note

- You will be provided with the unique RFID number for each shelf before the start of the event and you can feed it into your robot.
- This is the RFID reader we have used for testing. Link
- This is the RFID tag we will be using during the event. Link
- It is suggested that the participant try to make a wireless robot, in which case the robot should be battery powered on board.

Tutorial & Resources

Visit www.robotix.in/event/warehouse to check out the latest Event Updates.
Read our Tutorial for Warehouse.
Get our DIY for Warehouse.
Watch the Demonstration Video for this event.
Join the Event Facebook Group for latest updates and doubt sessions.

Contact

For queries, contact our event heads:

Mratunjay Gupta   **Riya Bubna**
(91) 8609266778   (91) 9007388802
mratunjay@robotix.in   riya@robotix.in