

# HOMECOMING

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## 1. Introduction

The Indian sub-continent is home to an amazing variety of wildlife that resides in the diverse terrain of the country. From Bengal and Indochinese tigers to various species of Deer, including Chital, Hangul, Barasingha, India preserves this huge variety of animals in its 120 national parks, 18 Bio-reserves and more than 500 wildlife sanctuaries. Moreover, India has some of the most biodiverse regions of the world.

Motivated by this, in this edition of e-Yantra Robotics Competition (eYRC-2018) we present the theme Homecoming.

After visiting a plethora of fauna in our Jungle Safari let's check our general knowledge about different types of animals and their natural habitats. We see some of the largest habitats which include Oceans, Wetlands, Forest, Grasslands, Deserts, Mountains etc. and the animals that reside there.

The arena for the theme is an abstraction of an ecosystem in a grid-form. The goal is to devise an autonomous robot to negotiate a path on the arena to visit the Animals and Habitats and to identify them using Machine Learning algorithms. It then picks up the identified Animals and places them in their respective Habitat on the arena.

The challenges and learnings in this theme include Machine Learning for identification (of Animals and Habitats), sensor interfacing, path planning, and designing of a mechanism for picking and placing the Animals.

The team that finishes the given task in the least amount of time whilst incurring the least penalties will be declared the winner.

All the best!!!

## 2. Theme Description:

a). An ecosystem of animals is abstracted as an arena for this theme. Arena with Start Node, Cell Numbers and Animal Locations is shown in Figure 1.

- Thermocol blocks are present around the outermost periphery of the arena to represent **Animals**.

Each Animal is placed in designated locations as shown in examples in Figure 1.

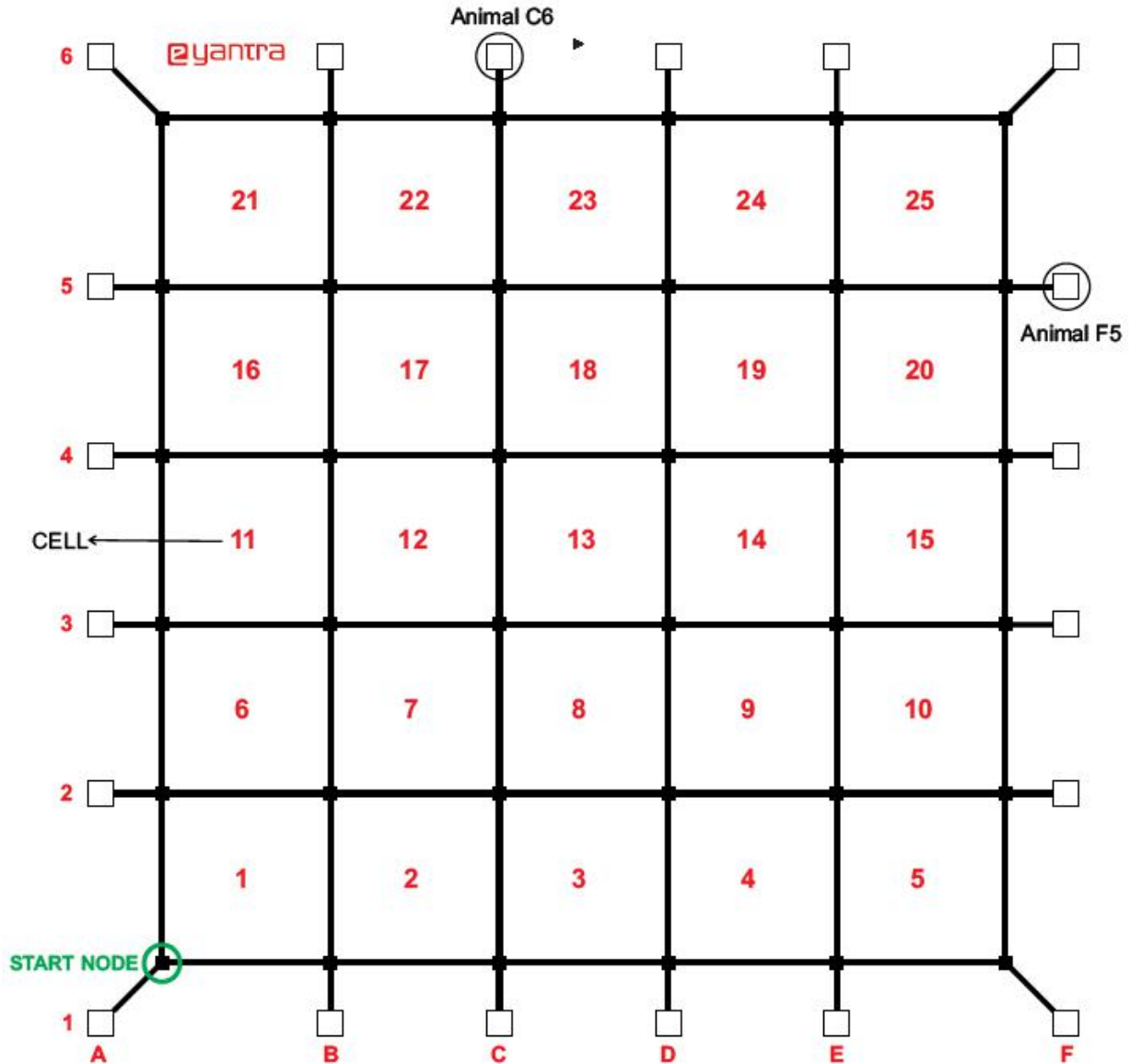
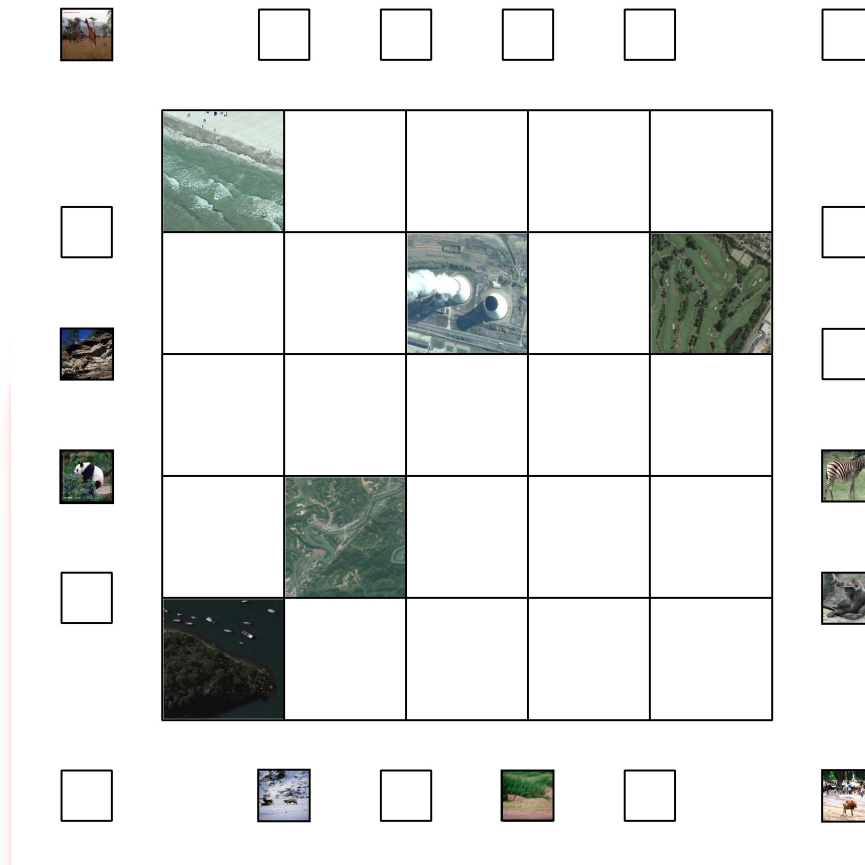


Figure 1: Arena

- A **Habitat** for Animals can be designated using any cell in the arena. Each Habitat can be of two types:
  - Valid Habitat: refers to a Habitat to which one or more Animals in the dataset are associated with
  - Invalid Habitat: refers to a Habitat to which none of the Animals in the dataset are associated with

b). The robot is kept on the START NODE facing the e-Yantra logo.

- Initially a team is given a **.jpg image** (example in Figure 2) comprising of Animals and Habitats in the arena which the team has to feed into their Machine Learning code/model



**Figure 2: Sample .jpg Image**

- The model then recognises the Animals and Habitats and print them on the terminal of the PC/System in the following format:
  - For Animals  
**Animal(Location)** (for example: *Lion(B6), Giraffe(D1)*)
  - For Habitats  
**Habitat(Cell Number)** (for example: *Grasslands(7), Desert(11)*)  
**NOTE:** If the Habitat is an Invalid Habitat it should be printed in the following format:  
**Habitat(Cell Number) - Invalid** (for example: *Kitchen(23) - Invalid*)
- Team then prints the *Animal and Habitat association* in the form of two Python Lists namely, **Animals** and **Habitats**  
The value in the indices of the Animals list should correspond to the value in the indices of the Habitat list to which that Animal is associated to.

For example, if there are 6 animals and 5 Habitats in the arena, then the two lists may resemble the following:

*Animals* = [A2, B6, C1, C6, E6, F3]

*Habitats* = [11, 6, 25, 2, 25, 14]

The above example indicates that Animal at A2 location is associated with the Habitat at cell number 11, Animal at B6 location is associated with the Habitat at cell number 6 and so on.

- The Animal and Habitat association described above i.e. Animals and habitats list is the only information that should be transferred to the Fire Bird V.
- The robot is then switched ON and has to do the following:
  - i. Traverse the arena to pick the Animals
  - ii. Place the Animals in their corresponding Habitat
- **FINISH** line/node is **NOT** marked on the arena; the robot stops when all the Animals are placed in their respective Habitats and sounds a continuous buzzer as an indication to show that the task is finished.

## 3. Arena

The arena for this theme is an abstraction of an animal ecosystem.

### Preparing the arena:

The team has to prepare the arena which consists of the following steps:

1. Printing the arena on Flex Sheet
2. Preparing the Animals
3. Arena Image Configuration

### 3.1 Printing the arena design:

1. PDF file containing the arena design is given to the teams in Task 2 folder. Each team prints the arena design on flex sheet according to the instructions given in *Read Me.pdf* along with the file.
2. Teams are not authorized to make any changes in the arena design. Any team making unauthorized modifications will be disqualified from the competition.

### Details of Arena design (Refer to Figure 3):

- Dimension of working arena is 243 cms x 243 cms.
- The arena consists of black lines of thickness 1.2 cms. Square nodes of dimension 3cms x 3cms are provided at the intersection of two or more black lines.
- The dimension of each cell is 40cms x 40cms.

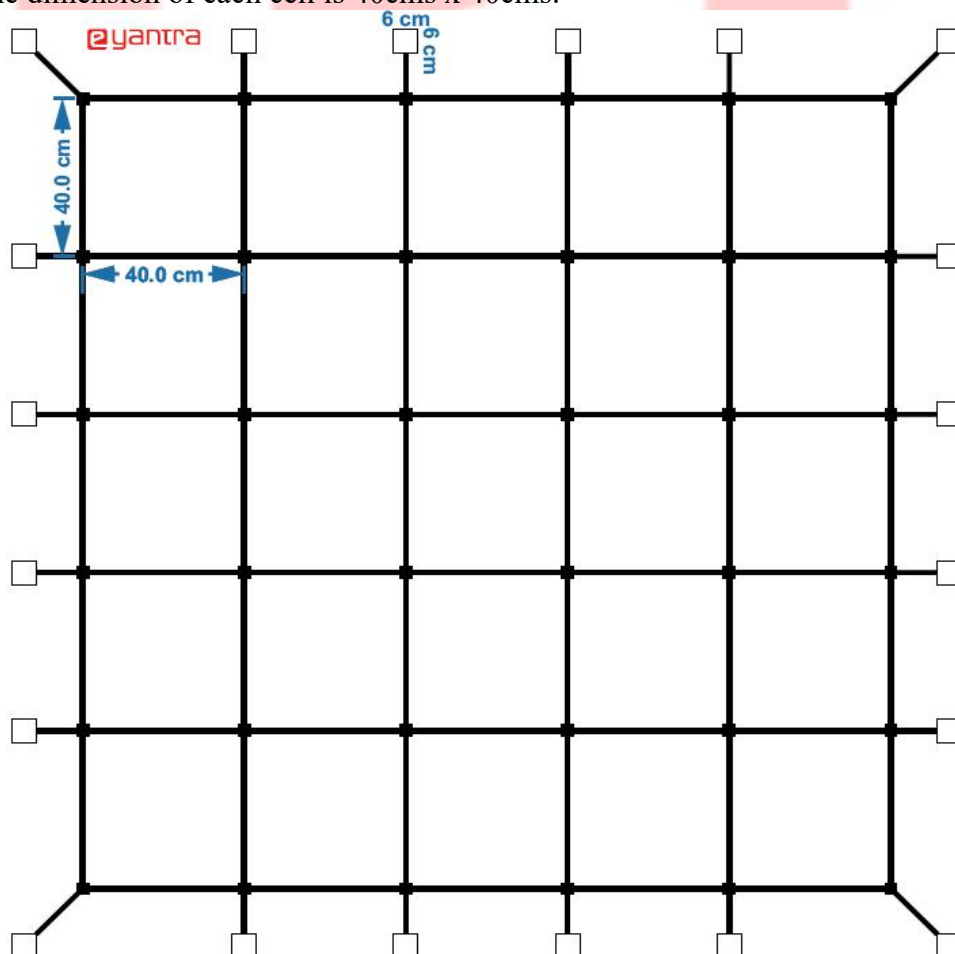
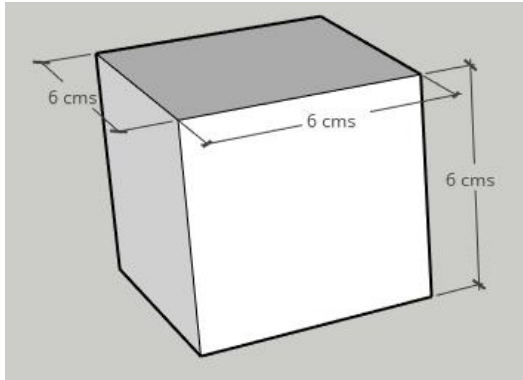


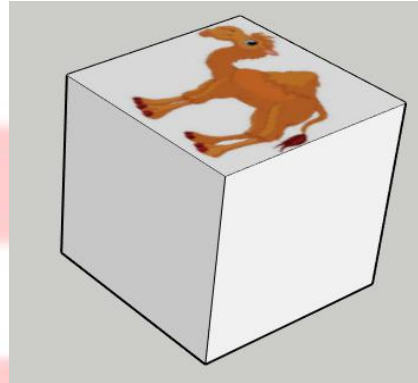
Figure 3: Arena with Dimensions

### 3.2 Preparing the Animals:

- Team prepares 30 Thermocol blocks.
- Dimension of each block is 6cm x 6cm x 6cm as shown in Figure 4A (if the Thermocol sheets of required dimensions are not available then the teams may cut or join the available sheets on their own to build the blocks of the mentioned proportions).
- Team then has to paste the printed copies of Animals on any one side of the block (Refer to Figure 4B).



**Figure 4A: Animal (Plain)**



**Figure 4B: Animal (Sample)**

Each Animal to be printed and pasted on the blocks is simply a visual representation of one particular animal in the dataset. Animals to be printed are provided in the folder:

**Print\_Animals** given in Task 2 folder.

### 3.3 Arena Configuration:

When you are ready with all the above steps, you have to set up the Arena according to a given Configuration. Each Configuration involves an **Animal Location Table** as shown in Table 1 that describes the placements of the Animals in the arena.

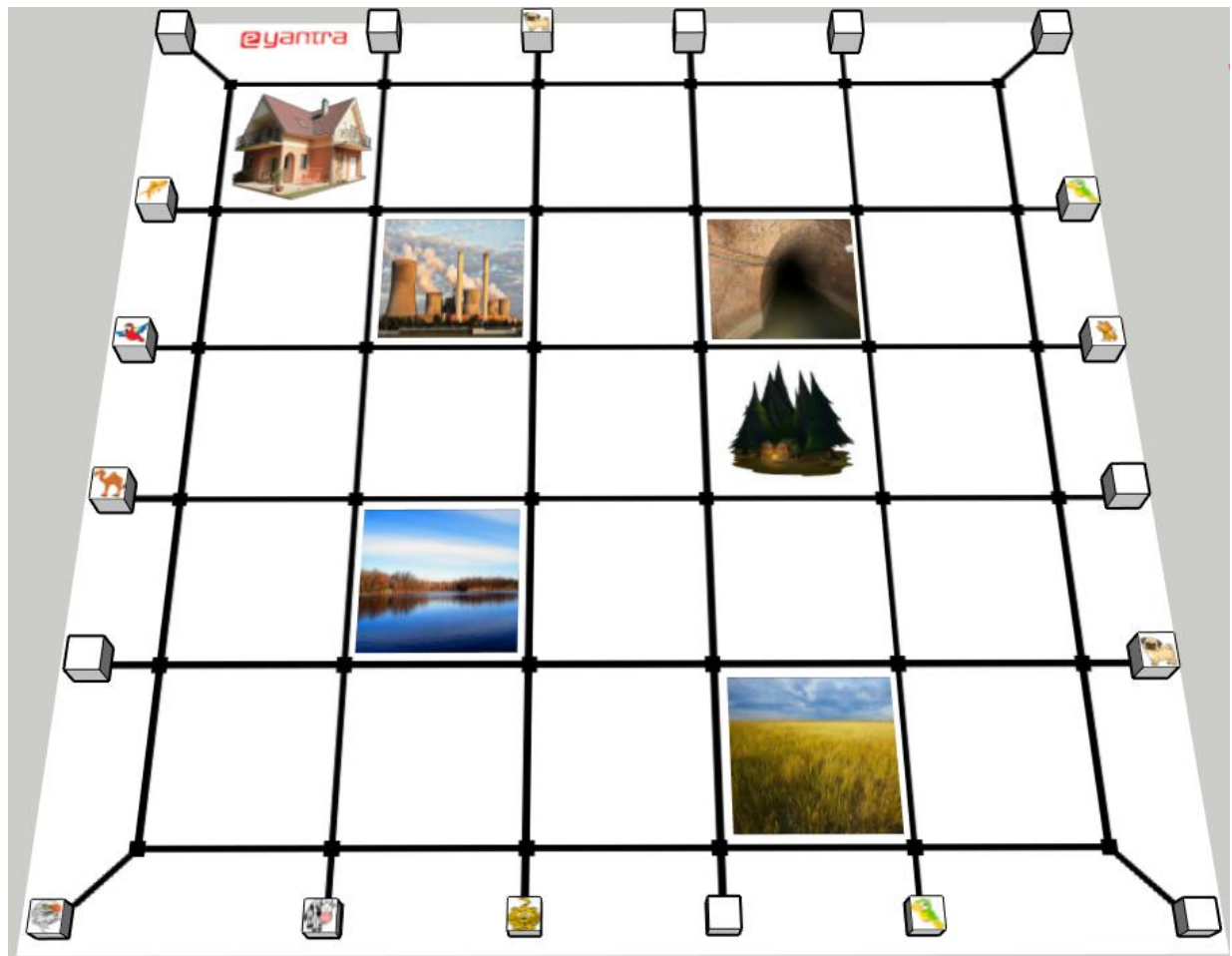
**Table 1: Animal Location Table**

Location	Animal
A1	Rat
A2	None
A3	Camel
A4	Parrot
A5	Fish
A6	None
B1	Cow
B6	None
C1	Lion
C6	Dog
D1	None
D6	None
E1	Parrot
E6	None
F1	None
F2	Dog
F3	None
F4	Cat
F5	Parrot
F6	None

The team simply needs to put the prepared Animals in their given locations. There is obviously no need to print/prepare Habitats as they are simply the placeholders wherein the corresponding Animals will be picked and placed.



After the team is done the arena would resemble the Figure 5



**Figure 5: Final Arena**

Now, we are ready with the arena. Please maintain the arena in good condition. If the arena is found damaged or in a condition not good enough to properly evaluate the team, e-Yantra has the right to disqualify the team. The final decision is at the discretion of the reviewer.

**Note:**

1. The arena shown in Figure 5 is simply an example so that the teams can understand the given configuration. During the final task: Video and Code Submission, the .jpg image as well as Animal Location Table will be different.
2. Habitats in the arena in Figure 5 are shown for representation purposes only. They will not be physically visible on the arena during the course of the run. Habitats will be given in the .jpg image.

**WARNING:** Please be careful while handling the flex sheet – avoid folding it like a bed-sheet since the resultant folds will cause problems while the robot moves. One way of “flattening” flex if it has been compromised is to hang it for a few hours in the sun – it tends to straighten out. Never attempt ironing it or applying heat of any kind – it may be a fire hazard. Best is to store the sheet rolled up.

## 4. Hardware Specifications:

### 4.1 Use of Firebird V:

- All participating teams must use **only** the Firebird V robot procured from the college. **Only one** robot is allowed per team.
- Team shall not dismantle the robot.
- The robot should be **completely autonomous**. The team is not allowed to use any wireless remote or any other communication protocol unless specifically allowed or devices such as a camera while the robot is performing the task.

### 4.2 Use of additional components NOT provided in the kit:

- No other microcontroller-based board shall be attached to the Firebird V robot.
- Teams may connect external actuators along with their driver circuits to the Firebird V robot only on the condition that the actuators must be controlled by the robot.
- The team is not allowed to use any other sensors apart from those provided in the kit.

### 4.3 Power Supply:

- The robot can be charged through battery or auxiliary power supply. These are available to you when you procure the robotic kit from your institute.
- The team **cannot** use any other power source for powering the robot.
- The team can use auxiliary power during practice but the final demonstration should only be made using the battery powered robot.

## 5. Software Specifications:

- e-Yantra has provided all teams with ATMEL STUDIO 6, a free software for programming AVR microcontroller. Participating teams are free to use any other open source Integrated Development Environment (IDE) for programming AVR microcontroller.
- Use of any non-open source libraries is not allowed and will result in disqualification.
- As per e-Yantra policy, all your code and documents are open-source and may be published on the e-Yantra website.

## 6. Theme Rules:

- The maximum time allotted to complete the task is 10 minutes. A maximum of two runs will be given to a team (the better score from the two runs will be considered as the team's score). A maximum of two repositions (explained below) will be allowed in each run.
- Animal Location Table and .jpg image will be given before start of a run. Only 5 minutes will be given to input this image in your program.
- The robot should be kept at Start Node position with the castor wheel positioned on the black line and robot facing towards the e-Yantra logo on the arena.
- The team should switch ON the robot when told to do so by reviewer. This is the start of a run. The timer will start at the same time.
- There can be any number of Habitats in the arena during a run, maximum being twenty-five (25).
- There can be a maximum of twenty (20) Animals in the arena during a run.
- A Habitat can accommodate maximum of two Animals in the arena.
- Once the robot is switched on, human intervention is NOT allowed.
- Buzzer sound for more than 5 seconds will be considered as continuous buzzer.
- A run ends and the timer is stopped when:
  - i. The robot stops and sounds the continuous buzzer or
  - ii. If the maximum time limit for completing the task is reached or
  - iii. If the team needs repositioning but has used both repositioning options of that run (repositioning is explained below).
- Second run will start once again whilst resetting the score, timer and arena. The score of both runs will be recorded and best of two runs will be considered as the team's score.
- Time will be considered maximum if team does NOT identify at least four correct Animals and two correct Habitats (by showing on the PC terminal), pick one correct Animal and drop one correct Animal in its respective Habitat.
- Teams are not allowed to keep anything inside the arena other than the robot. The time measured by the reviewer will be final and will be used for scoring the teams.
- Time measured by any team by any other means is not acceptable for scoring.
- Once the robot starts moving on the arena, teams are not allowed to touch the robot.
- The robot is not allowed to make any marks while traversing the arena. Any robot found damaging the arena will be immediately stopped; repositioning will be allowed as per the rules. The final decision is at the discretion of the e-Yantra team.
- Animal is considered deposited only if it is inside the periphery of the Habitat (i.e. Cell in the grid arena). Refer Figure 6.
- This rule must be kept in mind while designing the arm mechanism so that there is no hindrance in the path of the robot.

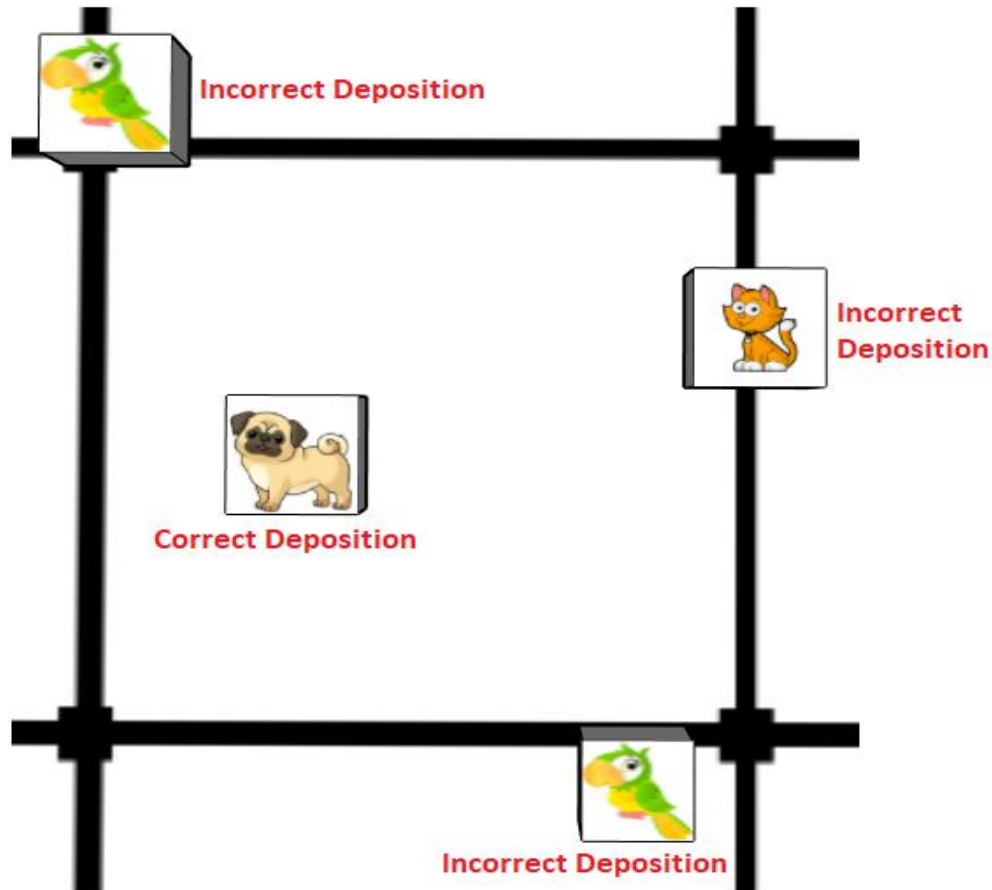


Figure 6: Deposition Rule

## Repositioning of robot:

Suppose while traversing the arena robot strays off the black line (Refer to Figure 7), a member of e-Yantra team monitoring the task will place that robot on the previous node (node already traversed by the robot) in such a way that both the wheels of robot are parallel to the node and castor wheel is on the black line (Refer to Figure 8). This is termed as a **Reposition**. Note that the timer used for measuring the task completion time in the competition will be continuously running during a Reposition and the robot will not be switched off. Robot is given **only two repositions** per run. If the robot has been repositioned twice and requires a third reposition, the run will be ended and the maximum time for the Task will be recorded for that run.

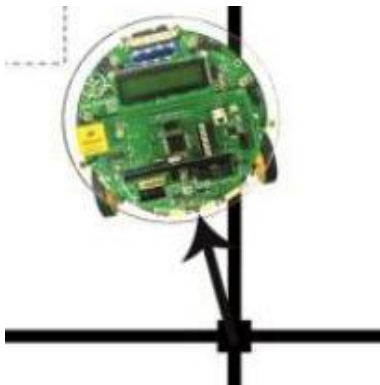


Figure 7: Robot strays off the line

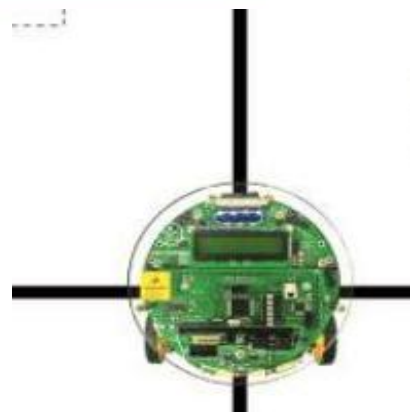


Figure 8: Robot after Reposition

## NOTE:

- You will be given .jpg image and Animal Location Table just before the submission of Task 4: Video Submission along with instructions to complete the task.
- After completion of all tasks, teams will be selected as finalists based on their cumulative scores across all the tasks. Complete rules and instructions for the finals at IIT Bombay will be sent to those teams that qualify for the finals.
- In case of any disputes/ discrepancies, e-Yantra's decision is final and binding. e-Yantra reserves the rights to change any or all of the above rules as we deem fit. Any change in rules will be highlighted on the website and notified to the participating teams.

## 7. Judging and Scoring System:

- The competition time for a team starts from the moment the robot is switched ON. The timer will stop as soon as the robot finishes the task.
- Better score of the two runs for a team will be considered as the final score of the team.
- The team's total score is calculated by the following formula:

$$\text{Total Score} = (600 - T) + (CIA \times 60) + (CIH \times 40) + (CP \times 25) + (CD \times 25) + B - P$$

- ❖ **T:** is the total time in seconds taken to complete the task.
- ❖ **CIA: Correct Identification of Animals** is the number of Animals that are correctly identified and shown on the PC/System terminal
- ❖ **CIH: Correct Identification of Habitats** is the number of Habitats that are correctly identified and shown on the PC/System terminal  
Note: CIH includes both valid and invalid Habitats
- ❖ **CP: Correct Pick** is the number of Animals that are correctly picked
- ❖ **CD: Correct Deposit** is the number of picked Animals that are correctly deposited in their respective Habitats. .
- ❖ **B: Bonus** are 100 points awarded, when:
  - the task is completed within 10 minutes,
  - no penalty is incurred
- ❖ **P: Penalty** is 30 (thirty) points deducted:
  - for each reposition
  - for each object in the arena that the robot dashes against or displaces during the run

ALL THE BEST....!!!