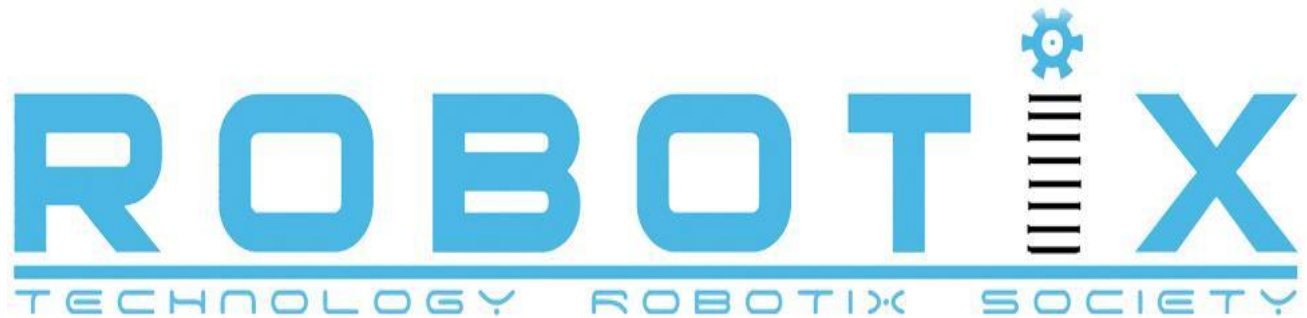# INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

KSHITIJ 2013

A.C.R.O.S.S.

INTRODUCTION

A.C.R.O.S.S. (Automated Constructions Robot Operations Systems)

If indeed the world does face a calamity at the end of 2012, we will need to start re-building in 2013. And bridges are what we will need greatly; to connect people, to cross gaps, and to break down barriers and restrictions. Chances are we will need the help of our robots for that very purpose should such a day ever come!
In the aptly named event A.C.R.O.S.S (Automated Constructions Robot Operations Systems), teams will have to design a pair of autonomous robots which can collaborate with each other. With one robot above and the other below, a series of chasms in between raised buildings will have to be crossed so as to reach the other end. No mountain too high; no valley too low for these robots!

PROBLEM STATEMENT

Build two autonomous robots that communicate and collaborate with each other to cross a series of chasms (Gaps that the robot will encounter in its path).

TASK

Make two autonomous robots, the first robot capable of traversing through the arena by following a line and the second robot capable of traversing a grid. The first robot is constrained to move over the top of blocks (viz. buildings) of varying length, but constant height and width, with gaps in between (refer the Arena). The buildings are present over alternate rows of the grid surface. The second grid following robot on the lower surface must communicate and assist the first in crossing over the gaps.

The event would be conducted at two levels:

Round One

1 There will be a single run of total run time 10 minutes.
2 The maximum number of gaps will be four.

Round Two

1 There will be a single run of total run time 12 minutes.
2 The maximum number of gaps will be eight.
3 Some of the nodes in the arena would not accessible due to path blockers placed on a few nodes.

ARENA

1. The arena will consist of parallel blocks (viz. buildings) with a navigable top based on alternate rows of a **8 x 8** grid placed on the floor. The buildings are highlighted by red boundaries in the picture below.
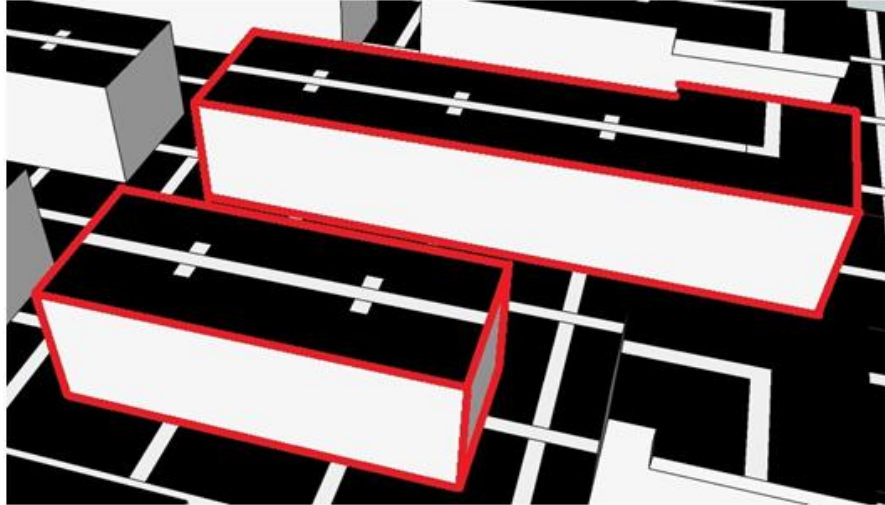
Fig: Buildings are highlighted in red.

2. The buildings will not be continuous throughout the arena, i.e. there will be gaps between the buildings. A gap will always correspond to a node of the grid.

3. The upper navigable surface of the buildings will have a white line centrally aligned on a black surface.

4. There will be node indicators on the top surface to mark a corresponding grid junction on the lower surface. The node indicator has been highlighted with red outline in the picture below.
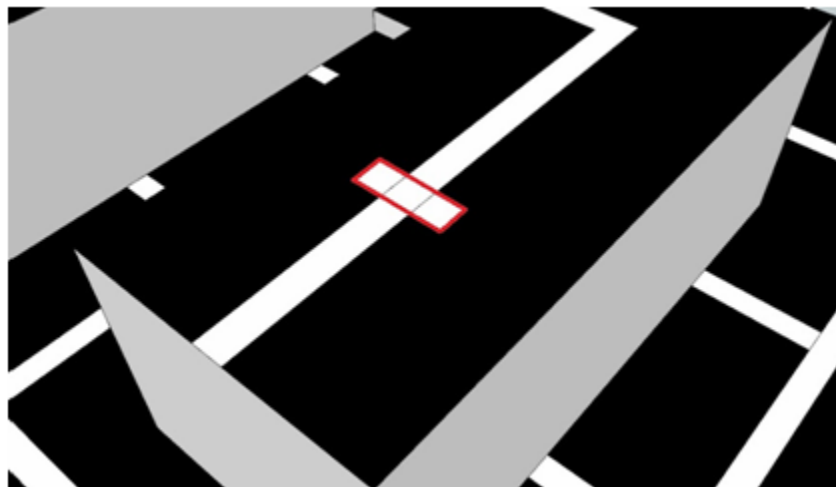

Fig: Node indicator highlighted in red.

5. The exact positions of gaps and path blockers are not fixed at any stage of the event. The number of gaps will remain the same, though.

6. In the second round of the event, there will be certain nodes that are inaccessible due to the presence of path blockers.

Arena Dimensions

1. The arena is a black plywood surface with dimensions "**3m x 3m**" divided into a 10X10 grid as shown in the figure.

2. The height of each building is **20 cm** and its top would have a width of **30 cm**. The width of the gap between two buildings is **20 cm**.
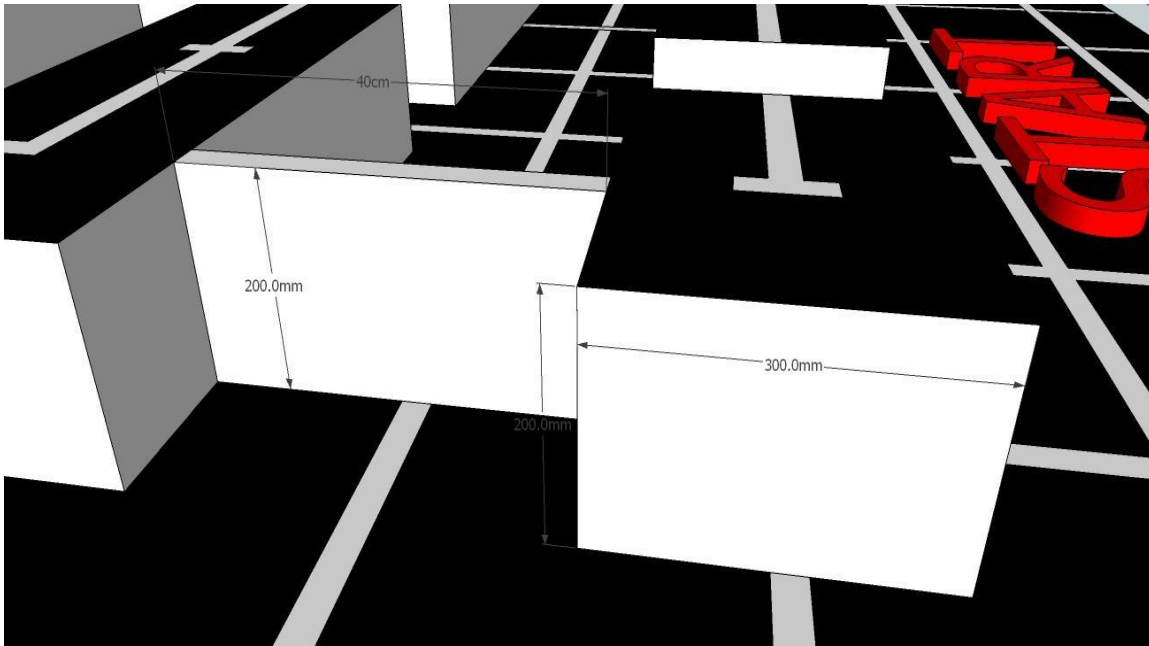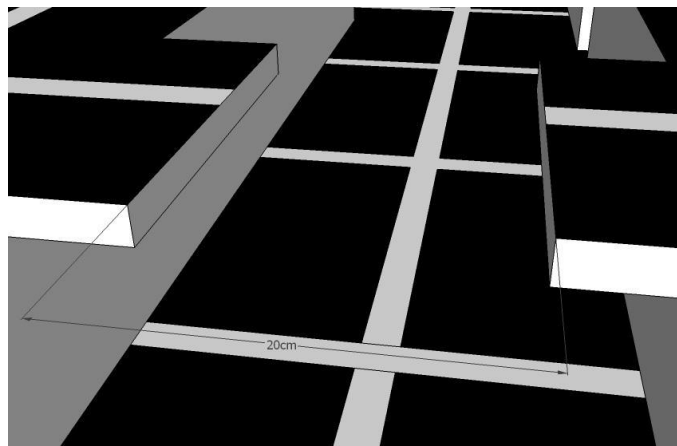

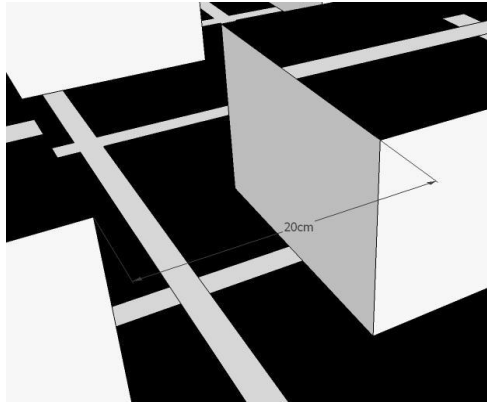Fig: Dimension of building and path blocker

Fig: Dimension Of Gap

3. The white line on the building top will be **3 cm** wide.

4. The white line on the grid will be **3 cm** wide.

5. The node indicator will be a white strip of dimension **3 cm x 9 cm**.

6. The path blocker will be plank of dimension **40 x 20 cm (b*l)** and of thickness **1cm.**
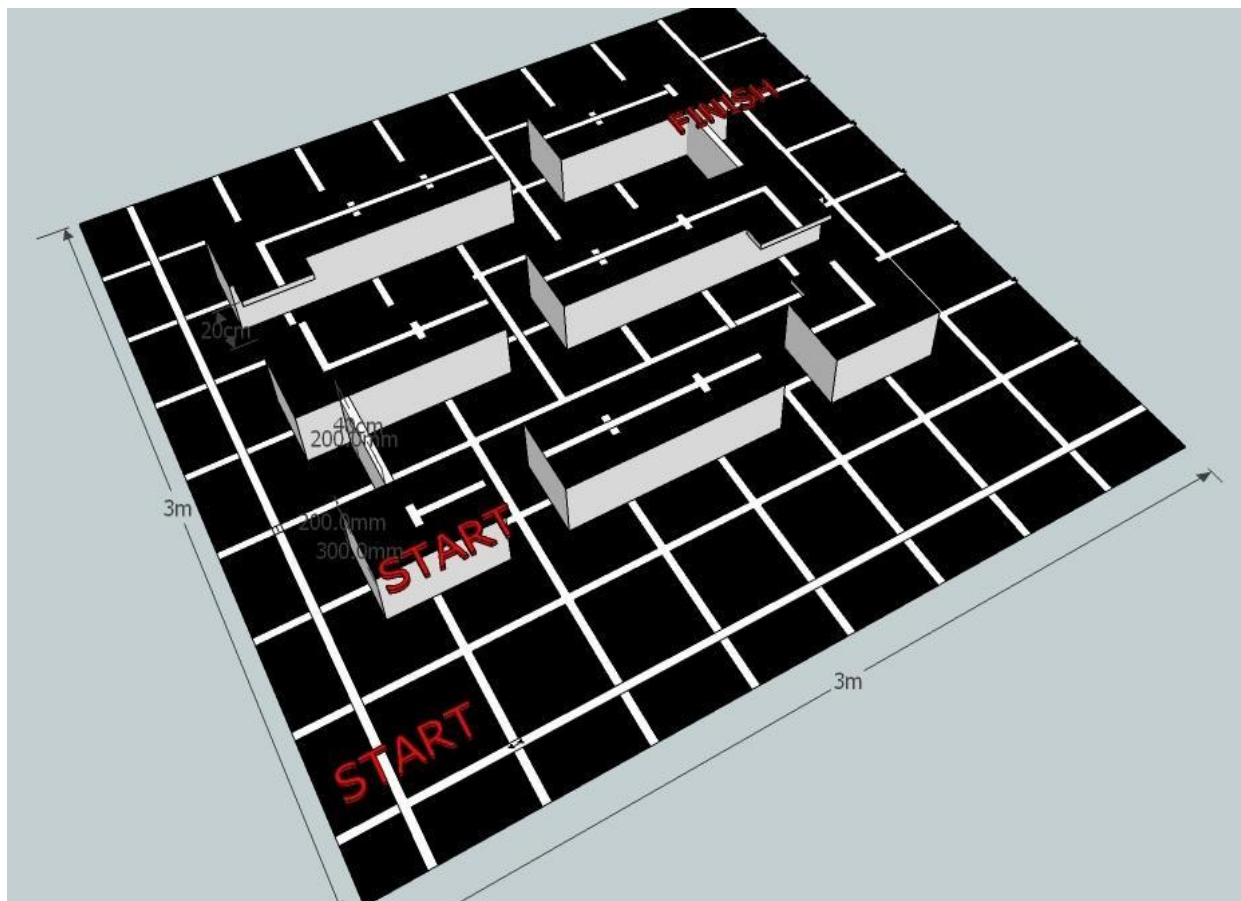

Fig: Arena Picture.

RULES AND SPECIFICATIONS

General Rules

1. All arena dimensions have a tolerance of 10%.
2. Each team can consist of a maximum of 4 members.
3. Each team should have unique participants i.e. no two teams can have even a single participant common.
4. The team members can be from different institutes or colleges.
5. The right spirit of participation is expected from the participants.
6. The decision of the **ROBOTIX Team** will be final and binding.

Event Rules

Robot

1. Both the robots should be completely autonomous.
2. The upper robot needs to follow a preset white line against a black background on the upper surface.
3. The lower robot needs to traverse a 10x10 grid made of white strips on a black background on the lower surface.
4. Both wired and wireless communication may be used for communication between the robots.

Node Indicators

1. Node indicators will be present on the upper surface to indicate the presence of a node or grid junction, i.e. an intersection of perpendicular lines, of the grid underneath.
2. A node indicator will be a white strip **3 cm** long and **9 cm** wide that will be attached perpendicular to the **3 cm** white line being followed by the upper robot.
3. The arena for the event with exact positions of the gaps would not be revealed before the commencement of the event.
4. The arena images showed here are just pictorial representations of what the arena might look like at the time of the event.

Path Blockers

1. In the second round there will be some nodes, which would not be accessible.
2. Path Blocker will be a plank which would exactly fit between two buildings thereby restricting the robot's freedom of movement in a given direction.
3. A robot cannot remove a Path Blocker from its path. It has to change its course to reach on the other side of the Path Blocker.
4. The arena for the event with exact positions of the Path Blockers would not be revealed before the commencement of the event.
5. The arena images showed here are just pictorial representations of what the arena might look like at the time of the event.

Traversal

1. The upper robot has to traverse the arena on the top of the buildings by following a preset line, moving from one building top to the other across the gaps with the assistance of the lower robot.
2. On sensing the gap the upper robot has to light a **visible LED** indicating that it has detected the gap and keep it lit until it crosses the gap.
3. No points would be awarded for crossing the gap unless the robot lights the **LED** for the entire process.
4. The lower robot should light a **visible LED** as soon as it reached the gap node and keep it lit for as long as it takes the upper robot to cross the gap.
5. Separate points will be awarded for lighting both the LEDs.
6. **Team ROBOTIX** must be informed of the position of the LEDs on the robots, which will give aforementioned indication, before the start of the run.

Restarts & Timeouts

1. A maximum of **2** Timeouts of **2** minutes each may be taken. A Penalty will be imposed for each timeout and robots will start from the last node crossed.
2. The participant can have a maximum of **3** restarts. Restarts, if any, will apply to both the robots. A penalty will be imposed on the team for every restart taken.
3. In case of a restart the participant's robots will be set to their initial positions. The timer would be set to zero and the run will start afresh with the addition of the penalty for restart.

Robot Specifications

1. Each robot can have maximum dimension of sides (**30*20*20**) cm, (**L*B*H**) respectively. 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.
2. The robots need to follow lines and traverse only along the grid.
3. The autonomous robots should be On board processing robots, i.e., the robots cannot be controlled by a remotely kept computer.
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 harm the A.C.R.O.S.S. 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**.

Technical Rules

1. **Team Robotix** would not be responsible for any difficulties a participant team faces in the working of it RF receivers due to the transmitters of any other team in the vicinity.
2. A standard 220 volt AC supply will be provided by Team Robotix in the arena.
3. All circuitry and sensory equipment should be placed on the robot adhering to the ROBOT SPECIFICATIONS.
4. Participants will have to bring their own programmers, cables and soft-wares. No programmers will be supplied.
5. Hard coding is NOT allowed. Hard coding is defined here.
6. The bot can be powered on-board as well as off-board.
7. No kind of external control will be allowed.

SCORING

Factors

1. Number of times the lower robot positions itself below the gap and thereby lights an LED = **L.**
2. Number of times upper robot senses a gap and lights an LED = **U**.
3. Time bonus (**TB)** = (Total allotted run time – Run time of robot in the event).
4. Extra time taken (apart from the allotted four minutes) by the robot for grid mapping = **EX**.
5. Number of times lower robot collides with the buildings or path blockers = **C**.
6. Number of grid lengths passed while grazing the wall = **K.**
7. Number of restarts = **R**.
8. Number of timeouts = **T**.

Where **TB** is the time rounded off to the nearest higher multiple of 4, and **EX** is rounded off to the next higher integral minute.

Total Score = (L*150) + (U*75) + (TB/4) - (EX*50) - (C*15) - (K*40) - (R*60) - (T*40).

FORUM

In case of doubts regarding this event feel free to post on our forum:
http://forum.robotix.in/

REGISTRATION

For registration, visit http://ktj.in/
For registration help, visit here

TUTORIAL

http://robotix.in/tutorials
http://robotix.in/events/tutorial/across

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