

FRUIT PLUCKING ROBOT

1. Introduction

To feed its increasing population, already at 1.2B people, India has to increase its agricultural productivity, profitability, and sustainability. e-Yantra Robotics Competition 2013 aims to bring awareness to problems in Agriculture by assigning themes from this vital domain.

Greenhouses have been used to grow plants in controlled environments within a covered space. Greenhouses are recent additions to the Indian landscape, giving Indian farmers opportunities to grow exotic flowers and vegetables all round the year.

As the population densities of cities increase, the phenomenon of “Urban Agriculture” -- where even rooftops of buildings may be used for growing plants-- is becoming increasingly attractive.

Thus, as both (i) a productivity boosting technology for traditional farmers and (ii) a revolutionary technology for growing vegetables and fruits in the cities such that the costs of production and distribution are reduced, greenhouse technology holds great promise.

Today most greenhouse automation solutions available in India are typically imported from other countries. e-Yantra believes that talented engineering college students are capable of developing indigenous automation solutions using Embedded systems and Robotics concepts. e-Yantra Robotics Competition 2013 challenges student teams from across the country to solve technical problems in this domain.

In this theme the basic task of fruit plucking is proposed. The robot has to pluck ripe fruits from the tree without damaging unripe fruits. The arena for this theme consists of two parts:

1. Black lines on white background for the robot to navigate in the arena.
2. A thermocol block in the center of the arena that represents a tree. On this tree two types of fruits are attached -- ripe and unripe.

The robot has to detect the ripe fruits and pluck them. Robot has to drop the plucked fruits in the deposition zones marked in the arena.

You are free to design the mechanism for detecting the position of ripe fruits and plucking them. The challenge is to complete this task in the fastest manner. The robot that performs the task best as per the set rules is the WINNER.

2. Problem Statement

Make an autonomous robot that detects ripe fruits and plucks them. Robot has to deposit these fruits in the deposition zones and at the same time it should not disturb the unripe fruits.

3. Arena

The arena for this theme consists of a cubical box that represents a tree and black lines on white surface for navigation. START point is marked on the arena by a small black line and deposition zones are marked by red lines on either side of the START point. We present the finished arena used for this theme in Figure 1.

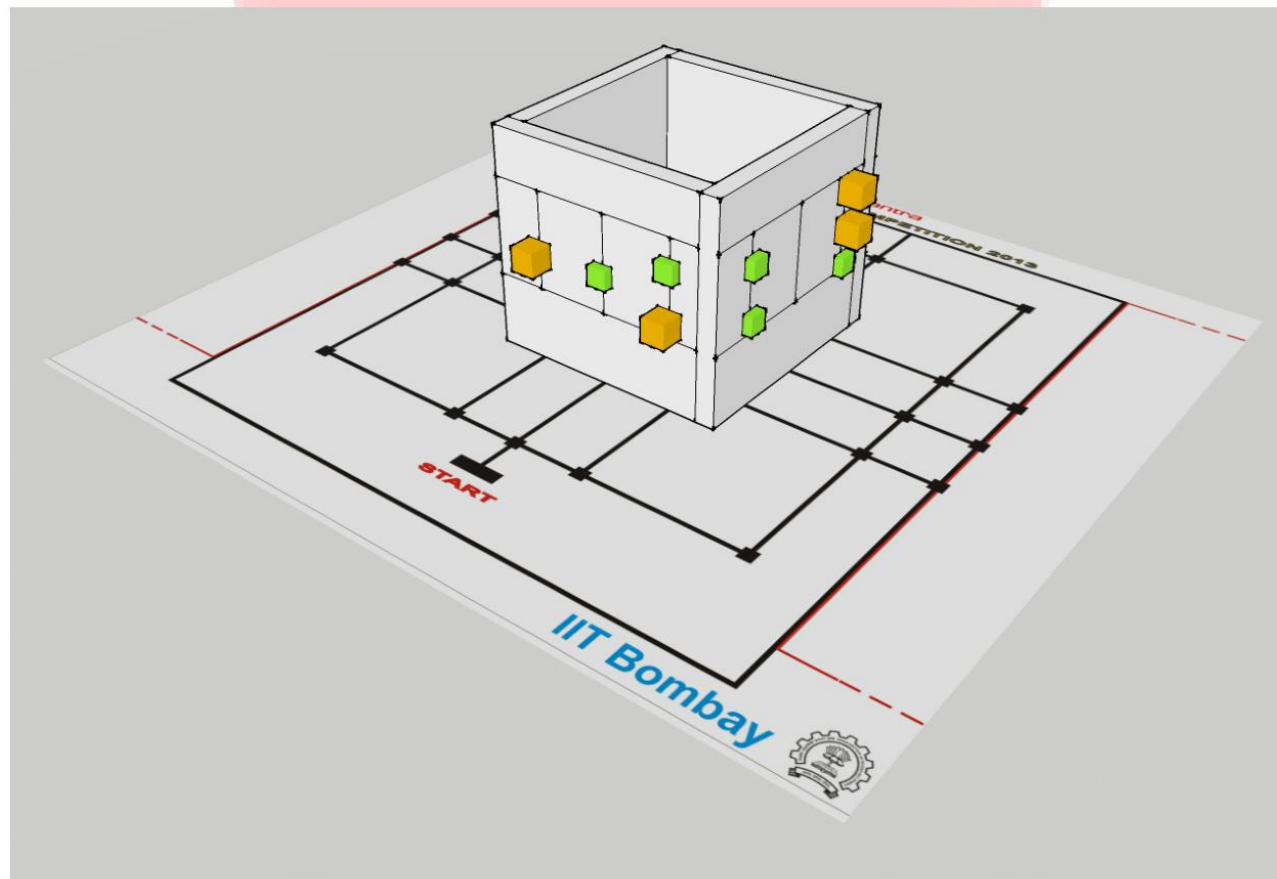


Figure 1: Finished arena

4. Hardware Specifications

Machine:

1. Only one robot is allowed per team.
2. All participating teams must use **only** the Firebird-V robot sent to them in the kit.
3. No other microcontroller-based board can be attached to the Firebird-V robot.
4. Team cannot dismantle the robot. However a team is allowed to attach any **self-designed** mechanical assembly and external motors needed for the work. **The design of this mechanical assembly/structure should be documented in the report along with its cost. A manual on how the mechanical assembly was constructed along with precise drawings and measurements should be provided.**

5. The participating team is not permitted to use any readymade mechanism such as Lego kits or other off-the-shelf readymade components to design the structure on the robot.
6. The robot should be **completely autonomous**. The team is not allowed to use any wireless remote or any other communication protocol or devices such as a camera while the robot is performing the task. The team is also not allowed to use any other sensors apart from those provided in the kit.
7. During the run, the robot can expand itself provided it does not damage the arena in any manner. However, it is not allowed to make any marks while traversing the arena. All robots found damaging the arena will be immediately disqualified. **The final decision is at the discretion of the e-Yantra team.**

Power Supply:

1. The robot may be charged through battery or auxiliary power supply. These are shipped with the robot.
2. The team cannot use any other source for powering the robot.
3. The team can use auxiliary power during practice but final demo should only be made using the battery-powered robot.

Controls

1. The robot must be completely autonomous.
2. It should not receive any extraneous input.

5. Software Specifications

1. e-Yantra has provided all teams with ATMEGA 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.
2. As per e-Yantra policy, all your code and documents is open-source and maybe published on the e-Yantra website.

6. Theme Rules

1. The robot must be self contained, and not externally operated by wire or by remote radio control during the competition.
2. Teams are not allowed to make any changes in the dimensions of the arena and dimensions of fruits.
3. There will be a random arrangement of ripe and unripe fruits on each line(L1, L2, L3) during the actual competition.
4. On each line 0-3 fruits can be arranged.
5. The robot must be started by only one switch. The starting procedure of the robot should be simple and should not involve giving robot any manual force or impulse in any direction.

6. Robot should be kept at the **START** line with the castor wheel of the robot positioned on the line.
7. The team should **Switch ON** the robot when asked by reviewer. This is the start of a RUN. The timer will start at the same time.
8. Once the robot is switched on, human intervention is NOT allowed.
9. Maximum time given for completing the task is **10 minutes**. A maximum of **two** runs will be given to a team. A maximum of two **repositioning**(explained below)will be allowed in each run.
10. A run ends and the timer is stopped when
 - ✓ The robot stops and sounds the continuous buzzer or
 - ✓ If the maximum time limit for completing the task is reached or
 - ✓ If the team needs repositioning but has used both repositioning options of that run.
11. Buzzer sound for more than **5 seconds** will be considered as continuous buzzer.
12. 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.
13. The arena provided will be same for all the teams.
14. **Repositioning**: During a RUN, a participant may request for the robot to be placed in the START position. This is referred to as "**repositioning**"; each team is allowed a maximum of two repositioning during a RUN.
If robot is found to displace the tree or damage the arena, then the robot is placed in the START position; this is counted as a "**repositioning**".
15. **In case of any disputes/ discrepancies, e-Yantra's decision is final and binding.**
16. **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 total score is calculated by the following formula:

$$\text{Total Score} = (600 - T) + (40 \times C1) + (10 \times C2) - (20 \times I) + B - P$$

- 1) **T** is the total time taken by the robot to complete the task in seconds.
- 2) **C1** is the total number of ripe fruits deposited in the deposition zones at the end of the run.
- 3) **C2** is the total number of ripe fruits that robot is able to uproot but is not able to deposit into deposition zone
- 4) **I** is the total number of ripe fruit that robot is unable to uproot.
- 5) **Bonus Points (B)**: Sixty (60) bonus points will be awarded, if the robot
 - a) Uproots and deposits all the ripe fruits in deposition zones and
 - b) Completes its task in less than 10 minutes and
 - c) Does not displace or damage any unripe fruit or tree.
- 6) **Penalty (P)**: If robot damages or displaces any unripe fruit then 15 points are deducted for each such fruit.

ALL THE BEST....!!!

