LINE FOLLOWER

1. Introduction

The theme "line follower" uses an arena with a line as a path which is of contrasting color with respect to the background; for example, a white line which is drawn on a black background. The white line acts as a reflecting surface and the black background acts as an absorbing surface for incident light. Thus by detecting the light captured by the sensor, the robot is able to distinguish the line from the background to follow the line. This is an efficient way for guiding robots that have to follow a pre-defined path.

Such robots can be used to deliver mail within an office building or deliver medications in a hospital. Autonomous navigation technology has been suggested for running automated mass transit systems, and it is likely to be used in the near future to navigate autonomous vehicles on freeways.

The task here is to efficiently traverse a path to reach the destination even under some constraints. The challenge is that the robot has to adhere to the path and once placed at the starting point you are not allowed to touch the robot. Now let's race and may the *FASTEST BOT WIN*!!!!!!

2. Problem Statement

The objective of this theme is to traverse the specified arena of white/black lines in the shortest period of time. During the course of the competition, the robot which will be placed on **START** point has to navigate through a course of various turns and curves to reach the **END** point. The robot should accurately track the course of line from start point to end point.

3. Arena

1. Arena has two parts. The first part has white lines on a black surface and second part has black lines on a white surface as shown in Figure 1.
2. Dimension of arena is 220 cm x 220 cm.
3. The width of the line is 30mm.
4. The arena is a mixture of straight lines, curved lines, a maze and a loop.
5. The arena has **4 checkpoints** as indicated in **RED** in Figure 1. These points are used for repositioning and scoring as explained in **theme rules** below.

6. The grid is present between checkpoint 1 and checkpoint 2. It consists of 3 black junctions as seen in Figure 1.

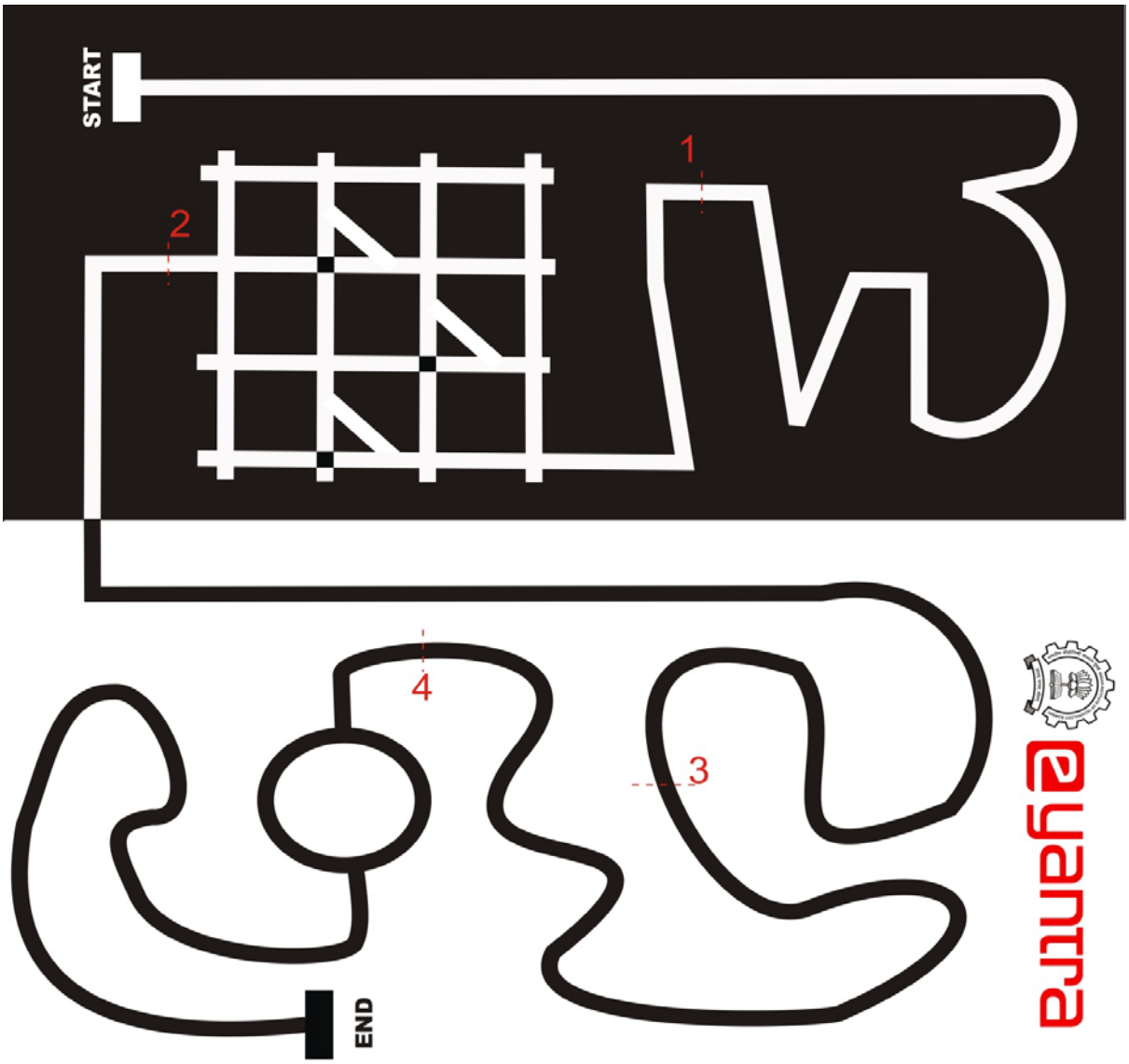

Figure 1: Arena Design

7. Teams are not authorized to make any changes in the arena design. Any team making such manipulations will be disqualified from the competition.

WARNING: Please be careful while handling the flex sheet – avoid folding it at any stage like a bed sheet since the resultant folds will cause you 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.

4. Hardware Specifications

Robot:

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 may be attached to the Firebird-V robot.
4. Team is also not allowed to use any other sensors apart from that provided in the kit.
5. Team cannot dismantle the robot.
6. Robot should be completely autonomous. Team is not allowed to use any wireless remote or any other communication device (e.g. camera) while robot is performing the task.
7. During the run, any robot found damaging the arena will be immediately disqualified. The final decision is at the discretion of e-Yantra.

Power Supply:

1. Robot can be charged through battery or auxiliary power supply. These are shipped with the robot.
2. Team cannot use any other source for powering the robot.
3. Team can use auxiliary power during practice but final demo should only be made using 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 ATMEL STUDIO 6, a free software for programming AVR microcontroller. Participating teams are free to use any other free/open source Integrated Development environment (IDE) for programming AVR microcontroller.
2. As per e-Yantra policy, all your code and documents will be open-source and may be published on the e-Yantra website.

6. Theme Rules

1. The Line Follower robot must be self contained, and not externally operated by wire or by remote radio control during the race.
2. 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.
3. Robot must be positioned at the **START** point in the arena; the reviewer will start measuring time as soon as the robot is switched on.
4. The robot has to follow the line at all times. If the robot deviates from the line (no part of the robot overlaps with the line), it needs to regain contact with the line at the same point where contact was lost.
5. Robot is considered to have drifted if all the seven line sensors come on the black surface (while following white line) or all the seven line sensors come on the white surface (while following black line) and is unable to regain contact with the line.
6. If the robot moves in reverse direction (moving towards the Start point), it will be repositioned at the last traversed checkpoint as explained below in the "Repositioning rules" section.
7. During repositioning, a participant **cannot** (i) feed information about the arena to the robot and (ii) modify the program.
8. However, the team can modify the program between two runs.
9. The robot should not cross the black junctions present in the grid. If the robot crosses any of these black junctions, penalty will be imposed.
10. The maximum time for completion of the task is 8 minutes.
11. The task will be considered complete only if the robot crosses the **END** point within the specified time.
12. The time measured by the reviewer is final and will be used for scoring the teams. The time measured by any participant by any other means is not acceptable for scoring.
13. **In case of any disputes / discrepancies, e-Yantra's decision is final and binding.**
14. **e-Yantra reserves the rights to change any or all of the above rules as they deem fit. Change in rules, if any will be highlighted on the website and notified to the registered teams.**

Number of runs:

1. A maximum of **two runs** will be given to a team.
2. Best score from two runs will be considered as the team's score.

Repositioning Rules:

1. There are four checkpoints in the arena excluding the START and END points as numbered in Figure 1.
2. If the robot drifts from the path or gets stuck anywhere, the team member near the arena can make a request to the reviewer for repositioning the robot.
3. If approved by the reviewer, the robot will be placed at the last traversed checkpoint and it will continue with the task.
4. The checkpoint crossed by the robot will be considered as the last traversed checkpoint only when **both** the wheels of the robot have crossed that checkpoint line marked in the arena.
5. The robot will be repositioned to the START point if the robot drifts or gets stuck even before reaching the first checkpoint.
6. During repositioning, the robot will be placed in such a way that the castor (front) wheel of the robot is behind the last traversed checkpoint.
7. While repositioning the robot, it may be either in Power on or Power off mode.
8. The **timer will not be paused** for any repositioning.
9. The robot can be repositioned for **a maximum of 5 times** during each run.

7. Judging and Scoring System

Competition Scoring System:

Scoring will be done based on how well the robot follows the given path using the following formula:

Total Score = (480- T) +100*checkpoints+ Bonus- Penalty
Where,
T: Total time for completing the task calculated in seconds.
Checkpoints: Number of checkpoints completed in one run. The robot will be considered to have completed the checkpoint if the rear wheels of the motor pass the RED line of the

checkpoint for the first time and not during the repositioning of the robot. Note that for a given run, maximum number of check points completed can be only 4.

Bonus Points:

Bonus point of **50** will be awarded if robot stops at end point and turns on the buzzer.

Penalty Points:

1. **20** points will be deducted each time the robot passes a black junction in the grid.
2. If the **repositioning** option is exercised, 20 points will be deducted for each repositioning.

ALL THE BEST….!!!