

## EN2532 - Robotics Module Task

### STORY OF THE TASK

Renowned as **Batman's** greatest enemy, the **Joker** has placed several deadly obstacles on the road for the batman to avoid him from saving his fiancé **Selina Kyle**, better known as **Catwoman**. Your task here is to design an attractive **batmobile** which can save him from these deadly obstacles and lead him to his fiancé. First batman must start his ride from the **Wayne Manor**, better known as **Batcave**. Then he needs to navigate to **The East End** which is a well-protected area by his fiancé Catwoman. In this underdeveloped part of **Gotham** laden with poverty, crime, prostitution, and the circulation of illegal drugs, batmobile needs to follow a haunted road which only has alternative walls to follow. Next, the batmobile enters the spooky circle which is operated by the Joker's fiancé **Harley Quinn**. As Harley is interested in each man in Gotham and co-worked with Catwoman, she sets up an interesting mysterious box in order to make it easier for Batman to find the way back to Catwoman. Joker has made the finding more difficult by making the **Grand Avenue** road to a dashed one. Hence, in some parts batmobile needs to traverse blindly without being attacked by the batman's foes. At **the hill**, Batman needs to make a decision according to Harley's mysterious box. Meanwhile, Harley has revealed the entire mysterious puzzle to her personal interest, **Poison Ivy** and she secretly kept big pillars on the ally of the hill to indicate the correct answer of the box, in case batman misses the correct decision. After taking the decision batmobile enters the **Ace Chemical Processing Inc.** where Joker hides the Catwoman. To rescue the Catwoman, the batmobile needs to go through a deadly crushing machine. This synchronized crushing machine will rip apart your batmobile with its deadly blades if your batmobile gets stuck. Your lover is waiting handcuffed into a rigid chair. **Go and get her.**



## **TASK**

Task consists of several stages as mentioned below.

1. Line Following section - First, the robot must follow a white line on a black surface. This line contains a straight line path and a curved line path with 90 degree turns to left or right.
2. Alternate Wall Following - After the robot follows the line, the robot will have to perform wall following action. This wall following section contains two curved walls which will be alternated (when one wall ends the other will start)
3. Circular Maze Area - Robot should enter the circular maze area after the wall following section. In this section a box will be placed inside the circle in the middle of a radius section.
4. Color Detection - The robot should identify colours of two sides of the box (bottom and front sides).
5. Ramp area - After exiting the circular maze the robot should move up a ramp and choose the correct direction at the junction on the top of the ramp using the calculation done based on the colors of the box faces detected. Then the robot can move in the selected direction to exit the ramp area.
6. Pillar Counting - In case if the robot chooses the incorrect path, it can identify whether its moving in the correct path or not by counting the number of pillars on its way. Therefore, a robot is able to identify its decision and go back if it has taken the wrong direction.
7. Synchronized gates - Before the robot enters into the ending square, the robot should go through synchronous gates which opens and closes at given time intervals.

## **TASK PROCEDURE**

- Robot should start the task from the starting square and should follow the white line till the wall following the area.
- Then the robot should follow the Alternative walls to move to the next line-following section.
- Then it should enter the circular line maze area.
- The circle consists of four quadrants divided by the cross inside. The robot enters from quadrant No. 1. The quadrants are numbered in the clockwise direction. The robot should indicate the quadrant number which it currently is.
- A multi-colored box lies on one side of the cross in the middle of a radius line section.
- The side of the box that faces the center of the circle is called the front face of the box. The difference of the bottom and the front face color values (as indicated in the below table) should be calculated. This difference is taken into account in the future.

colour	value
red	1
green	2
blue	3

- Then the robot should exit the quadrant area and move forward along the path.
- The path then will lead to a dashed line as shown in the arena. Here, the robot should travel along this dashed line and then enter the ramp.
- On the top of the ramp the robot will have to choose the path it should follow according to the difference it calculated earlier.
  - Odd difference- Right
  - Even difference-Left

*Ex: bottom face color- red , front face color- blue ----- difference=  $|3-2| = 1$  (odd) - take the right path*

- The robot is then expected to follow the path accordingly. In case if the robot was unable to identify the correct path it can rectify the mistake by counting the pillars in the pillar arrangement along the path. The pillars will be placed away from the line towards the inside of the arena.
- If the number of pillars is even the robot has taken the correct path. If the number of pillars is odd the robot has taken the wrong path and then the robot can rectify its mistake and take the correct path.
- Then the robot will come to the area of the synchronised gates. The two gates are synchronised so that both of them will be open for 7 seconds and each gate stays open for 10 seconds and . The synchronisation is as follows.

Time	Gate 1	Gate 2
0s	open	closed
3s	open	open
10s	closed	open
13s	closed	closed
20s	open	closed
23s	open	open

- Then the robot should arrive and stop on the exit square.

## ARENA

### Overview

- The starting square, the destination square of first round and the destination square of second round are white squares of dimensions 25cm x 25cm. Final arena may be different to the arena illustrated below.
- The size of the arena is 8ft x 16ft. The dimensions of the arena will be accurate within 5% or 20mm, whichever is less.
- Paths are white lines with a width of 3cm on a black background.
- Minimum length of a continuous line is 25cm.

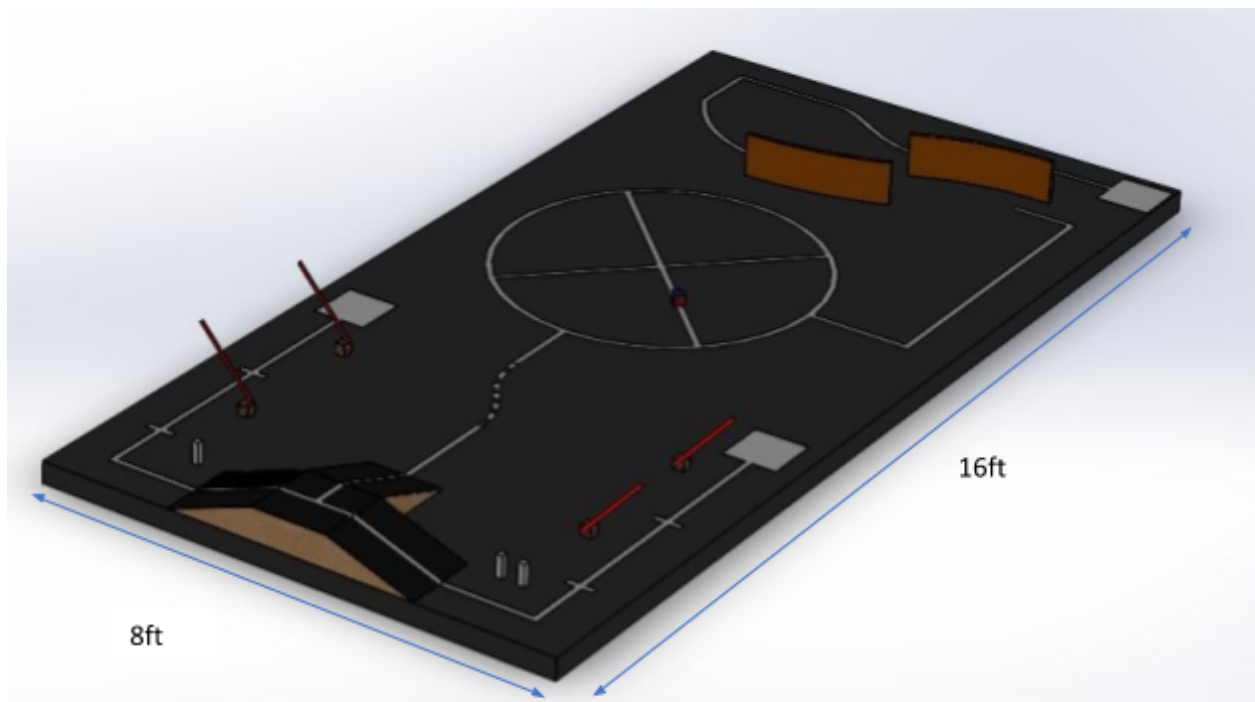


Figure 1 - Overview of the Arena

### Wall Design

- Walls have a height of 10cm and are placed 15cm away from line.
- Wall-follow side changing region is larger than 5cm.
- Length of wall following segment is greater than 25cm.

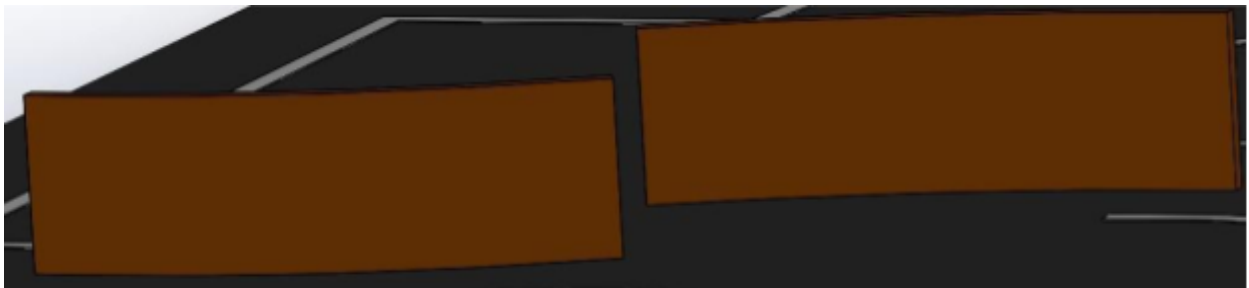


Figure 2 - Wall follow area

### Circle Line Area

- Radius of the circle is 75cm as indicated in the illustration.
- Entrance to the circle is at the left side and the exit from the circle is at the top side in the illustration.
- Color box is placed in the middle of a line segment which is a radius of the circle.
- Color box is a 5cmx5cmx5cm cube which has 6 sides colored with either red, green or blue.
- All surfaces of the box have matte finish stickers.
- Face of the box is considered to be the surface which faces towards the center of the circle.

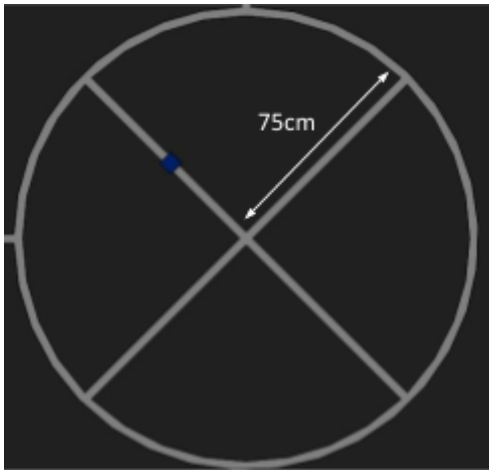


Figure 3 - Circle line area

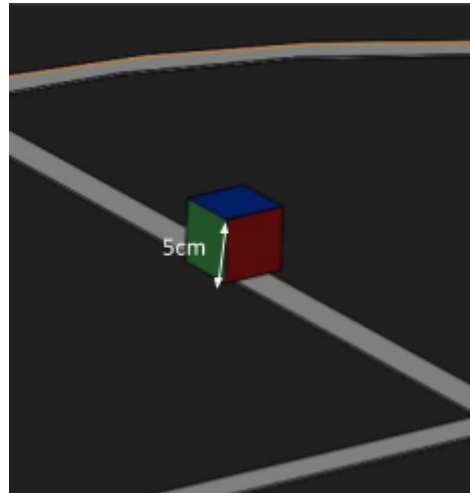


Figure 4 - Color Box

### Dash-Line Follow Area

- Length of a dotted line segment can be in the range of 5cm-25cm and maximum distance between two dotted line segments is 3-5cm.

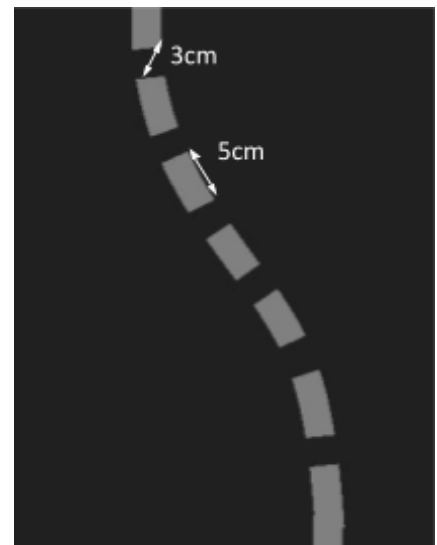


Figure 5 - Dash line following

### Ramp Area

- Ramp inclination is 20° and consists of 3 angles segments and a top area segment.

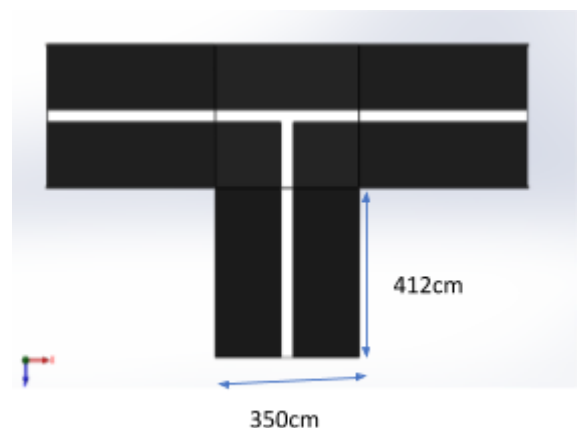


Figure 6 - Ramp top view

- Each angle segment is 350cm wide and 412cm long as shown in Figure 6.

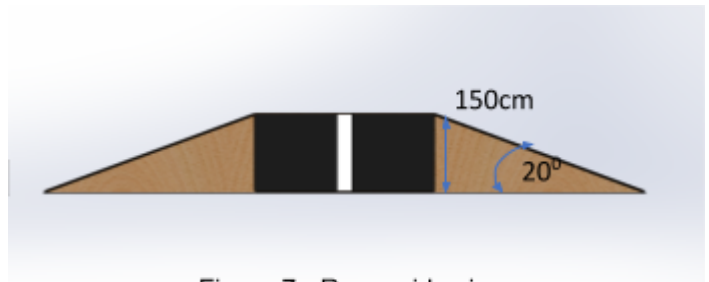


Figure 7 - Ramp side view

### Pole Design

- Poles are 15cm away from the white line.
- Poles are square shaped in base which is 3cmx3cm and has height of 10cm.

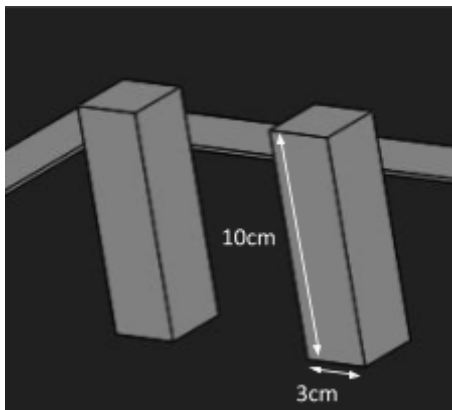


Figure 9 - Pole Design

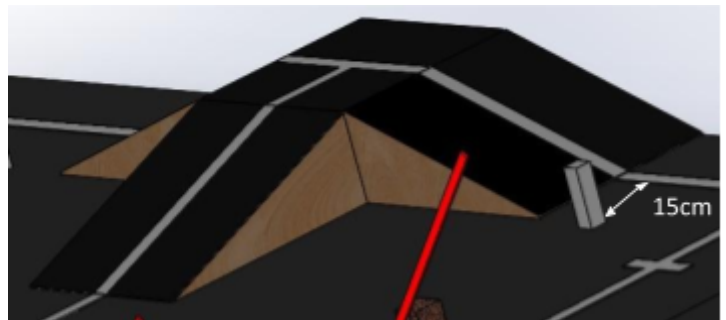


Figure 8 - Ramp and pole 3D view

### Gate Area Design

- Gate area consists of 2 gates which synchronously close and open to a defined time intervals.
- 2 intersection line segments are situated 60cm between a gate. Each line intersection line segment is 10cm.
- Destination square is situated after the second gate.
- A gate consists of a base which is a cube of 5cmx5cmx5cm. Width of the gate is 40cm as illustrated in Figure 11.
- Moving part of the gate is mounted to the base at 3cm height in a side face of the cube.

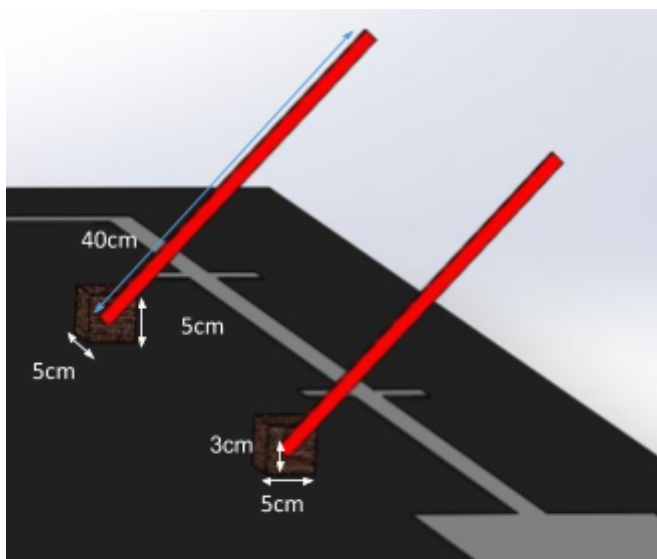


Figure 11 - Gate design

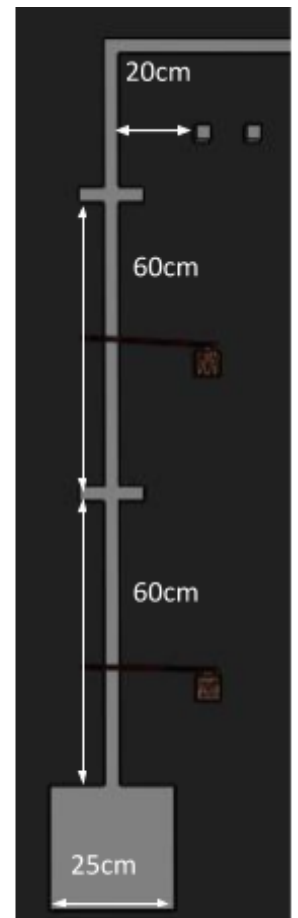


Figure 10 - Gate area design

## **ROBOT SPECIFICATION**

- Dimensions of the robot should not exceed 25 cm x 25 cm (width x length).
- The robot should be completely autonomous. Any sort of remote controlling would lead to disqualification of robots.
- The robot should be supplied with an internal power supply with a supply voltage not exceeding 24V and the final unit including the power source should be within dimensions specified above.
- The robot must be completely built by the team members. No off-the-shelf kits are allowed except the processing boards, sensor modules and drive gears.
- The robot should not cause any damage to the platform (arena). Any kind of damage to the platform leads to disqualification.
- The robot should be activated using a single start switch which is placed on the robot itself.
- The robot should be able to operate under provided lighting conditions.

## **GAME RULES**

- All the teams must submit their robots to the organizers 15 minutes before the start of the competition.
- Each team member will be questioned about the functionality of the robot prior to the start of the contest in order to prove their own design. A team may be disqualified depending on the answers given.
- At the start of their run, a team should place the robot inside the starting area with the line that leaves the starting area centered on the robot. When the judges give the signal, they can switch on the robot. From then on, the robot should navigate autonomously.
- Programme modifications of the robot is not allowed. A maximum of 3 attempts is given in a single round and the fastest run will be counted. Maximum time of 15 minutes is allocated per team. All the attempts and modifications are reserved for this time period only. If the robot exceeds the time limit of 15 minutes, your robot will be removed from the arena.
- If the robot drifts out of the line to the extent that no part of it is on top of the line (except while wall following), the judges will consider it as a jumping out of line. However, if the robot manages to find its way back on to the line automatically, it can be allowed to continue provided that the distance skipped by the robot along the line is less than 30cm. The judges may deduct points in this case.
- No timing bonus will be given unless the robot completes the task.
- Task is considered complete when the robot arrives inside the destination square. The clock will be stopped when the robot reaches the relevant end point.

## **CONTACT**