POLY MAZE

Competition Specifications

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04

Summary

Chapter I
Introduction

POLYMAZE is a competition where robots compete to solve a labyrinth. This kind of competition is very popular all around the world, including in the United Kingdom, the United States, Japan, Singapore, India, South Korea, and elsewhere. This year, the VIC club is organizing the fourth edition of the first maze-solving competition in Algeria.

1.1 Competition Concept

The robot is designed to navigate the maze without any external assistance. As an autonomous entity, it must independently discover the path to solve the maze. Initially, the robot explores the maze to determine the optimal (fastest) route. Once identified, the robot proceeds to navigate this path as swiftly as possible.

To enhance the enjoyment and challenge, we've added several minigames that the robot must complete along the way.

1.2 Theme presentation

The theme for Polymaze 2024 is inspired by the popular series "Prison Break." Our robotic competition's main goal is to navigate and find the best path out of a maze, just like the characters in the series.

The story involves an older brother wrongfully imprisoned and awaiting execution. His brilliant sibling, Scofield, gets himself jailed to break his brother out using a special escape robot.

In our competition, the maze simulates a prison. Participants will build and program robots to navigate and escape efficiently. Teams must find the quickest route out while avoiding obstacles. Bonus points can be earned through mini-games. The participant with the best escape, following all guidelines, will be crowned the Scofield of Polymaze 2024.

1.3 Main Objective
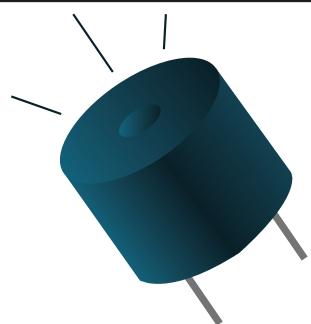
In this edition of Polymaze, your mission is to break out of a prison. You'll make a robot navigating the maze-like prison corridors to find the hidden escape path. The goal for your robot is to reach the exit **as quickly as possible**.

1.3 Minigames

Detection and LCD Display

When the robot reaches the **exit point** of the maze, it must identify this location and display a message on the LCD screen "**Prison Break**".
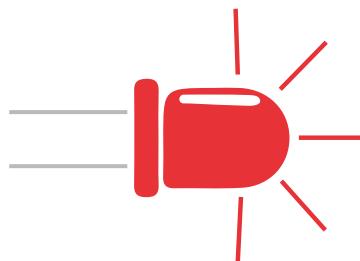
Blue Band Detection

If the robot detects a **blue band** on its path, it must emit a **distinctive beep** using the buzzer to signal this discovery. This blue band can symbolize a secure area by the prisoners.

Red Band Detection

When the robot identifies a guard post represented by the red color, it must activate an LED to signal its presence.

(*) Band Specifications could be found on the Maze Specifications part

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Chapter II
Rules &
Regulations

2.1 Robot Specifications and Rules

2.1.1 Self-Built Robots
- Only robots designed and **built by the team** are allowed. Maze Solvers (such as Pololu), which are sold ready-made, are forbidden.

2.1.2 Self-Contained and Safe
- Robots must be self-contained and operate **without remote controls**.
- They **cannot** use **combustion engines** as a power source.

2.1.3 No Dislodging Parts
- The robot **cannot lose any parts** while navigating the maze.
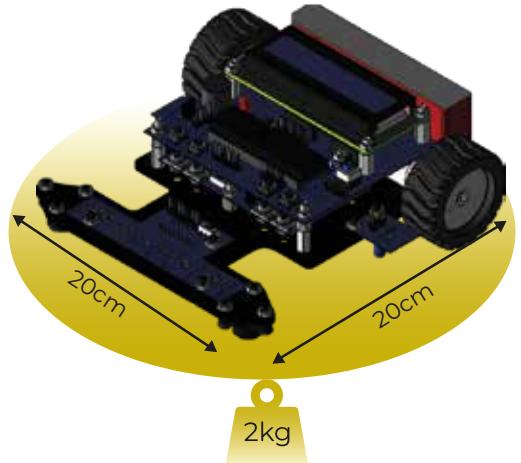
2.1.4 Respectful Movement
- The robot cannot **jump**, **fly**, **climb**, **scratch**, **cut**, **burn**, mark, or **damage** the maze walls.

2.1.5 Size Restrictions
- The robot's maximum length and width must not exceed **20 centimeters**.
- For robots that change shape, the maximum dimensions while navigating are **20cm x 20cm** (length and width).
- There is no height restriction.

2.1.6 Weight Restrictions
- The weight of the robot must not exceed **2kg**.

2.1.7 Pre-Competition Inspection
- All robots **will be inspected** before competing to ensure they meet these specifications and pose no safety risks.

2.1.8 Disqualification for Rule Violations
- Any violation of these rules will result in **immediate disqualification** and ineligibility for prizes.

2.1.9 Homologation
- Extra points will be given for competitors with a good aesthetics of the Robot, the given points are detailed in the **ranking system**.

2.2 Maze Specifications

There are different labyrinths for each round in the race, available in **3 different sizes**:
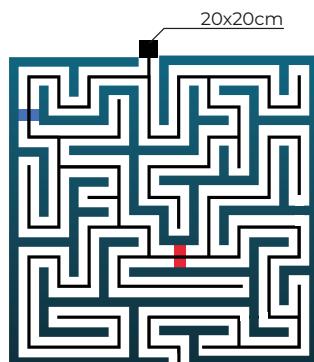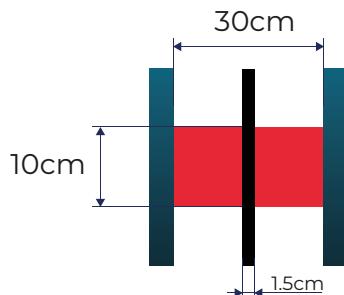
First Day - Qualification:
- First-Phase: **5x5 Labyrinths**.
- Second Phase: **6x6 Labyrinths**.

Second Day - Knockout Stage:
- Semi-finals: **7x7 Labyrinths**.
- Final: Four identical **7x7 labyrinths** will be assembled, each with the same exit in the center.

Notes:
- Each block is 30 cm x 30 cm.
- The labyrinths are made of white forex.
- The walls are 20cm high.
- Two walls facing each other are 30 cm apart.
- A black line 1.5 cm thick is drawn along the paths of the labyrinth, in the middle of each of the two opposite walls.
- The final point of the labyrinth (the exit) is marked by a black square of 20 cm x 20 cm

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Chapter III

Conduct of
Competition

3.1 Competition Rules

3.1.1 Time
- Each team receives the same **number of minutes** for maze access, starting from the moment of beginning. However, the number of minutes allocated differs in each phase.
- This time **includes adjustments** between runs.
- Each successful run's time is **recorded**.
- The team's **best run** is their official time.
- In case a team fails to complete the race within the time limit, the evaluation system will take into account the **distance covered**.

3.1.2 Stopping/Removing the Robot
- Multiple runs **are allowed** within the given time limit.
- Teams can **abort runs and return the robot** to the starting square.
- Once the first run starts, other participants will not be **allowed to physically touch** or interact with their robots while any of the other teams competing in the same maze are also racing.
- After that, the teams who finished racing can touch their robot before their second run.

3.1.3 Room Conditions
- The room will have an ambient environment (0-100% humidity, non-condensing).
- **Don't assume specific lighting conditions** at the competition site: Participants must work on calibrating functions that make the robot adapt to its environment, the lighting conditions between the test and the actual race may be different.

3.1.4 Run Time
- The race timer starts as soon as the **front edge** of the robot crosses the starting line and stops when the **front edge** of the robot reaches the finish square.

3.1.5 Starting a Run
- Each exit from the **starting square** begins a new run.
- **No time is recorded** if the destination square isn't reached.
- Re-entering the starting square before reaching the destination **aborts the run**.

3.1.6 Continued Navigation
- Time spent navigating **after reaching the destination** doesn't count towards a run.
- The robot can **explore freely** without operator intervention.

3.1.7 Modifying/Reprogramming the Robot
- Participants are **allowed to reprogram their robots during the races**, but the **time spent reprogramming is included** in the overall race time (this doesn't apply for the finals which is detailed in chapter 4)
- Feeding information about the maze to the robot is **prohibited**. The robot must navigate the maze **independently** and **automatically** choose the most suitable path.
    - Allowed modifications include:
        - Changing switch settings (e.g., selecting algorithms)
        - Replacing batteries
        - Adjusting sensors
        - Changing speed settings
        - Making repairs

3.1.8 Changing the Robot's Weight
- **Altering the robot's weight** after the time begins is not allowed (e.g., removing sensors or switching batteries for speed).
- **Judges will arbitrate all interactions with the robot.**

3.2 First Day: Qualifications

3.2.1 Verification and Check-up:
- The organizing team will **check the conditions** of the application of each team. If one or more conditions (on the participants or their robot) are not fulfilled, the team in question will be **disqualified**.
- During this Verification and Check-up, **bonus points** will be given to each robot if some requirements have been met, these details are explained in the ranking system.

3.2.2 Warmup and Tests:
- Each team is allowed to explore the test mazes, which lasts for **one hour at the beginning of the event**. Every team will have access to them to experiment. During this phase, teams can freely set up, maintain, or move their robots within their assigned maze.
- **No score will be given for the warm-up phase**, which will not count towards the final competition score. The purpose of the warm-up phase is to **allow teams to familiarize** with the competion environment and fine-tune their robot's performance.

3.2.3 Maze Solving

First Phase

- The labyrinths will be assigned to the teams **randomly**, all labyrinths are identical
- They will have two rounds, each round lasting **5 minutes**. The teams can make multiple attempts during each 5-minute round, and their **best attempt** will be considered in their final score
- Teams will be ranked, regardless of the group/labyrinth they were in, as follows:
  - Teams that have solved the labyrinth have priority and are ranked among themselves. Teams that have not solved the labyrinth will be ranked according to the number of points obtained.
  - The ranking system is divided into two categories: one for those who completed the labyrinth and one for those who did not complete it in less than 5 minutes.
  - Competitors have the right to touch their robot three times during the race with a penalty. After the third touch, the robot will be returned to the starting point.
- The ranking will be shown on the scoreboard after this phase and will be shared with the participants, the top 16 teams will advance to the next phase.

First Phase Standings

Finished the race   Didn't finish the race
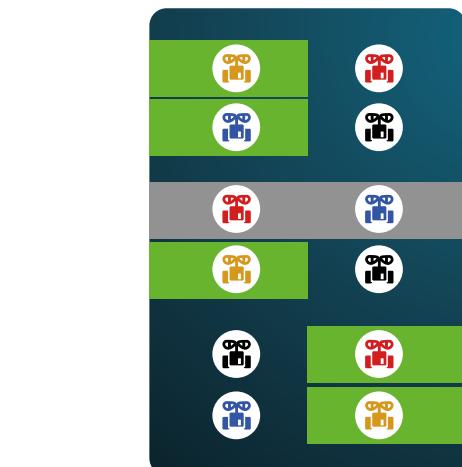
Second Phase

- In this phase, participants who have advanced from the initial round are divided into four pots according to their ranking in the previous round made into four groups. Within each group, teams engage in a round-robin format, where every team competes against each other once.

- Each team will play an equal number of matches across various mazes. Every match takes place in a different labyrinth.
- Teams will only have one round of 5 minutes. The teams can make multiple attempts during each 5-minute round, and their best attempt will be considered in their final score.
- Points are awarded based on match outcomes:
  - Three points for a win.
  - One point for a draw (when both teams have finished / not finished the maze with the same number of points).
  - Zero points for a loss.
- At the conclusion of the group stage, teams are ranked within their respective groups based on their accumulated points. In the event of tied point totals, a series of tiebreakers are employed, considering the following criteria:
  - Number of completed mazes
  - Points for completing the maze
  - Points for not completing the maze
- Advancement to the next stage is reserved for the top two teams from each group

	PTS	CMP	SUCC	UNSUCC
	9	3	1200	0
	4	2	680	120
	4	2	645	145
	0	1	120	750
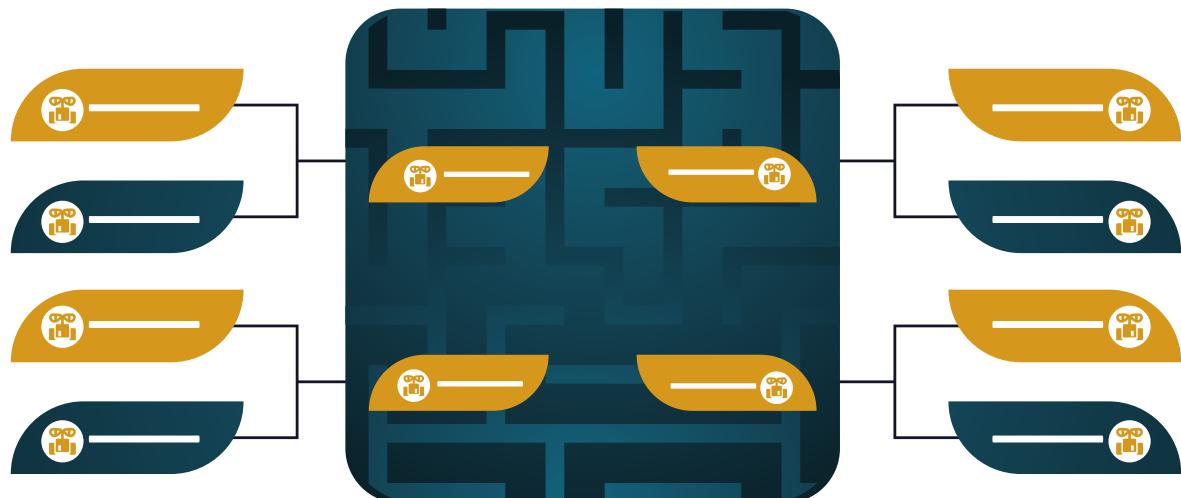
3.3 Second Day: Knockouts

<u>3.3.1 Semi-Finals:</u>
- The 8 teams that advanced from the first day will be facing each other in this stage.
- The phase will be a double elimination, it will be arranged in such a way that the best teams (those who ranked first in their groups) face the less good ones (those who ranked second in their groups)
- Each 2 teams will be assigned one labyrinth, in which they will compete against each other (1V1), one winner from each labyrinth will advance to the finals.
- If both teams finish the labyrinth or do not finish it, they will be judged according to the scoring system explained in the ranking system.
- The winner from each duel will advance to the finals.
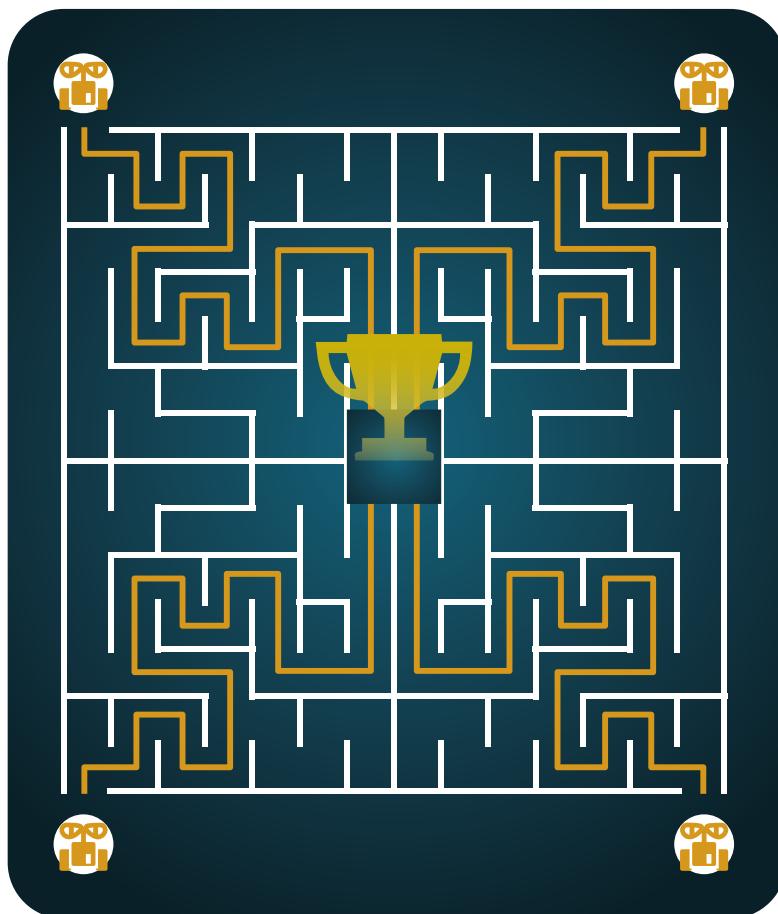
3.3.2 Finals:

- In this phase, the four teams will compete simultaneously. Identical 7x7 labyrinths, each leading to a common central exit, will be assembled for the challenge.
- Participants will have 7 minutes to explore the maze before the race officially commences.
- Once the exploration time elapses, the robots will simultaneously start the race. The objective is simple: the first robot to reach the center will be declared the winner. There are no points to calculate; the sole criterion for victory is reaching the center first.
- Participants are not allowed to touch or adjust the robot but they can reset the robot to the starting position any time in the race.

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Chapter IV

Ranking System

4.1 Bonus Points

4.1.1 Minigames
- Detection of mazes's end & LCD Display (6 points)
- Blue Band detection & Buzzer starting (5 points)
- Red Band detection & LED light up (4 points)

4.1.2 Homologation
- These points will be counted as bonus points for the first phase only.
  - Respecting the theme (Prison Break) in robot aesthetically (1 point)
  - Cable management / PCB (2 point)

4.2 Penalties

Penalties are substracted when the competitior:
- Touches the robot to help it when it is blocked (7 points for each adjustment ; **max of 3 touches** are allowed before restarting the whole maze on the first day , **no touch is allowed on the finals**).
- Every time the robot hits a wall, a 3 points penalty will be taken.

4.3 Points Calculation

If the robot finished the maze:

Total Points = (300 - Time Consumed) + **Bonus** - **Penalties**

- Each competitor has 300 seconds (420 for the final) to solve the maze. Once completed, the consumed time in seconds will be substracted from the total score.

If the robot has not completed the maze within 5 minutes :

Total Points = (distance covered) + **Bonus** - **Penalties**

- The distance covered will be calculated by the number of blocks covered on the shortest path.

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