



ELECTRICAL TEAM TRAINING

TASK 3

Preface



Batman has discovered that the Joker has planted mines across Gotham City. These mines emit light, and Batman has designed a minesweeper bot mini-tank to detect and neutralize these bombs. Your mission is to build and program this bot to help Batman save the city. Follow these steps to ensure the safety of Gotham:

1. **Detecting Mines:** Equip the mini-tank with a photoresistor to detect the light emitted by the mines. When light is detected, the bot will activate a buzzer to signal the presence of a mine.
2. **Defusing Mines:** Implement a mechanism to defuse the bomb using a servo motor.
3. **Navigating the City:** Program the tank to yaw right, yaw left, move forward, and move backward.
4. **Avoiding Obstacles:** Equip the mini-tank with ultrasonic sensors to detect and avoid obstacles such as walls and debris.

5. **Localization:** After each movement, the tank should track its location within the city.



Problem 1: Detecting Mines

Description

The streets of Gotham are dark, and the Joker's mines emit just enough light to be detectable but not immediately noticeable to the naked eye. Your bot will serve as Batman's eyes, patrolling the city to find these hidden dangers.

Connect a Photoresistor: The photoresistor will be the bot's primary sensor, detecting light from the mines. It must be connected to the Arduino Uno via a breadboard and resistors to accurately read light levels.



Activate the Buzzer: Once a mine is detected, the bot needs to signal using a buzzer. When the photoresistor detects light above a certain threshold (assume 500), the buzzer will sound, alerting the presence of a mine.



Components

- Arduino Uno
- Breadboard
- Photoresistor
- Buzzer
- Resistors



Appendix

- **How Photoresistors Work:** <https://eepower.com/resistor-guide/resistor-types/photo-resistor/#>
- **How Buzzers Work:** <https://www.elprocus.com/buzzer-working-applications/>
- Buzzers arduino library: <https://www.arduino.cc/reference/en/language/functions/advanced-io/tone/>

Problem 2: Defusing Mines

Description

To neutralize the mines, your bot needs to perform a specific action. The bot will use a servo motor to create this mechanism, moving in a precise pattern to defuse the mine.

Using a servo motor, you will move the mechanism from 0 to 60 degrees, defuse the bomb in 2 seconds and then will rotate back to 0 degrees.

Components

- Servo motor(micro servo in Tinkercad)
- Arduino Uno
- Breadboard

Problem 3: Movement

Description

To effectively patrol the perilous streets of Gotham and locate the Joker's hidden mines, Batman's mini-tank must navigate in specific patterns using 2 wheels. This involves precise movements in yaw directions, forward, and backward. Your task is to program the tank to execute these movements using an L298N motor driver and two DC motors. The ability to yaw right and left allows the tank to scan its surroundings comprehensively, while forward and backward movements ensure it can systematically cover the ground.

The mini-tank should perform the following sequence:

1. **Yaw Right:** Rotate 90 degrees to the right by activating the left motor forward and the right motor backward for 1 second.

2. **Yaw Left:** Rotate 90 degrees to the left by activating the right motor forward and the left motor backward for 1 second.
3. **Move Forward:** Advance 1 meter by activating both motors forward for 1 second.
4. **Move Backward:** Reverse 1 meter by activating both motors backward for 1 second.

Your task is to move the robot in every direction of the above and print in the serial monitor where the robot is moving.

Components

- Arduino Uno
- L298N Motor Driver
- 2 DC Motors
- Breadboard
- Battery 9v

Appendix

- How Motor Drivers Work:
<https://howtomechatronics.com/tutorials/arduino/arduino-dc-motor-control-tutorial-l298n-pwm-h-bridge/>

Problem 4: Obstacle Detection

Description

Gotham's streets are fraught with obstacles like walls, debris, and other hazards that could hinder Batman's mini-tank. To ensure safe and efficient navigation while searching for mines, the mini-tank needs the capability to detect obstacles in its path. Your task is to equip the tank with ultrasonic sensors to detect obstacles by measuring the distance to them and print a message to the serial monitor when an object is detected within a specific range.

Your task is to print that an object detected whenever the ultrasonic detects anything in its range.

Components

- Arduino Uno
- Ultrasonic Sensor
- Breadboard

Appendix

- How Ultrasonic sensors work:
<https://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/>

Bonus Problem: Integrate and Localise

Description

In this final challenge, you will integrate all the components into a fully operational minesweeper tank designed to navigate Gotham's streets, detect obstacles, locate mines, and defuse them. The tank must also be capable of localizing its position within the city's grid to ensure thorough coverage.

Your tasks include:

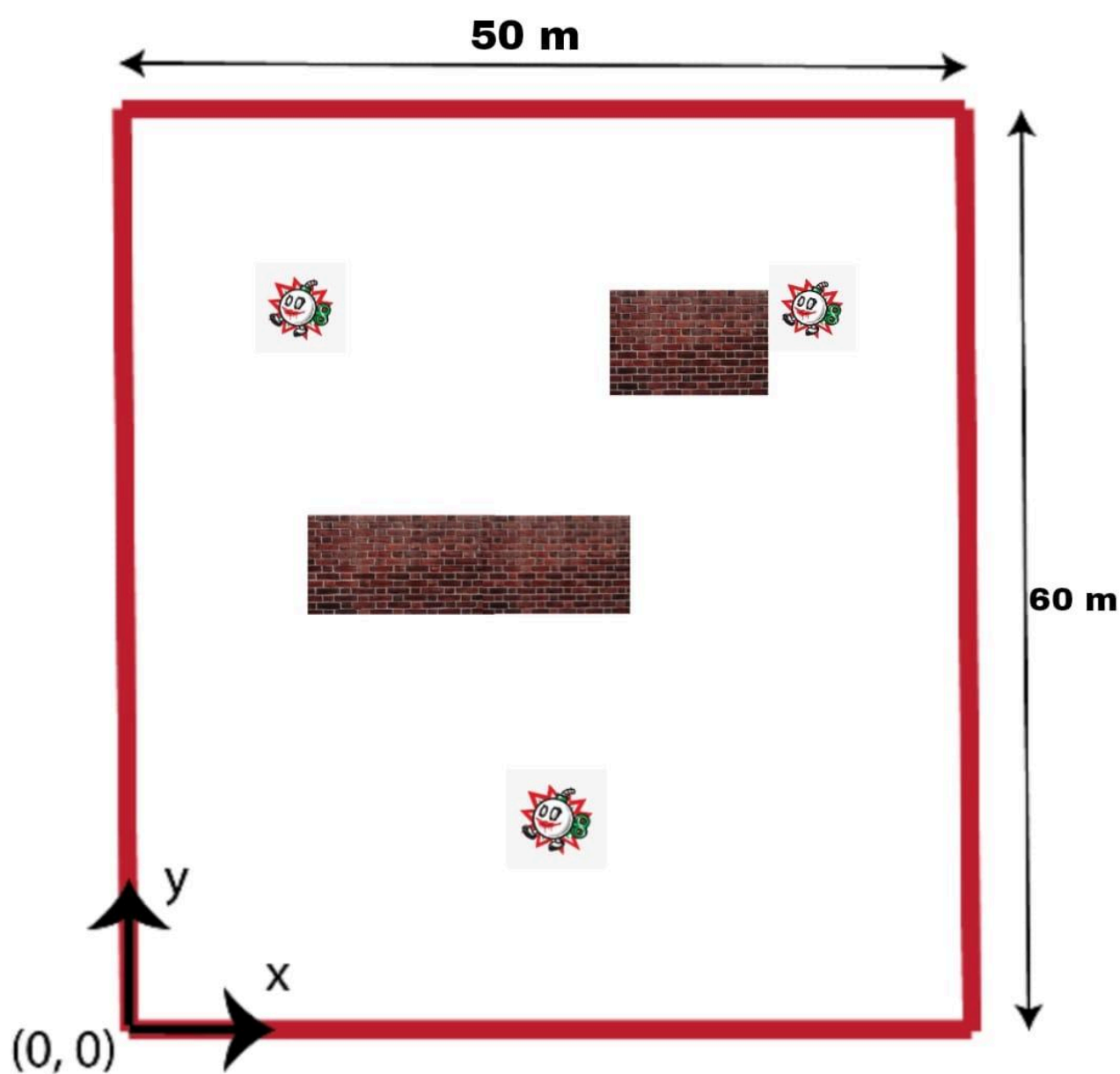
1. **Integration of Components:** Combine the ultrasonic sensors, photoresistor, buzzer, servo motor, and motor driver into a cohesive system.
2. **Movement and Navigation:** Program the tank to move in various directions, including yawing, moving forward, and backward as mentioned in problem 3.
3. **Obstacle Detection:** Utilize four or less ultrasonic sensors positioned at specific angles to detect obstacles and adjust the tank's path accordingly as in problem 4.
4. **Mine Detection and Defusing:** Implement systems to detect mines using the photoresistor and defuse them using the mechanism controlled by the servo motor as in problems 1 and 2.
5. **Localization:** Incorporate a system to localize the tank's position within the 50m x 60m city grid. After each movement, the tank should **print** its current position to provide real-time localization data.

- You will move through the city printing your current location, defuse bombs if detected, print when the bomb is detected and when defused and avoid moving through the obstacles.
- Assume that the obstacles will never make you move backward (all your movements will be rotation and forward)
- Assume the origin of the city on the left-down corner
- Take into consideration the new axis of the bot and the arrangement of the ultrasonic sensors after each rotation.
- Remember you can move in these ways:
 - **Yaw Right:** Rotate 90 degrees to the right by activating the left motor forward and the right motor backward for 1 second.
 - **Yaw Left:** Rotate 90 degrees to the left by activating the right motor forward and the left motor backward for 1 second.
 - **Move Forward:** Advance 1 meter by activating both motors forward for 1 second.

Note: You can do as much as you can in this problem, even if you didn't do all the requirements.

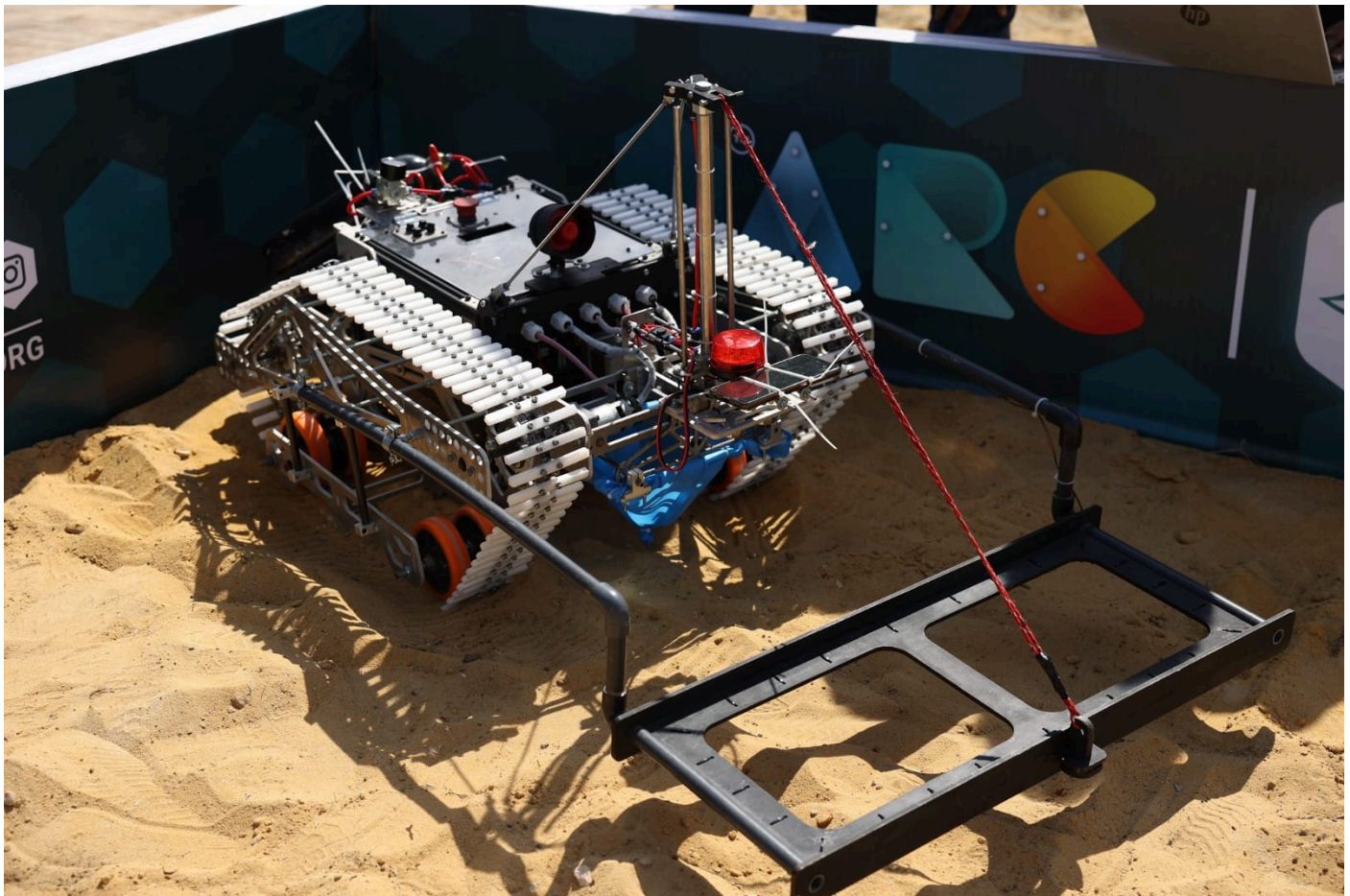
Components

- Arduino Uno
- 4 Ultrasonic Sensors
- Photoresistor
- Buzzer
- Servo Motor
- L298N Motor Driver
- 2 DC Motors
- Breadboard
- Battery 9V



Optimo

This problem is inspired from the minesweepers competition that M.I.A. team has joined before and this is their latest robot Optimo which competed in Minesweepers 2023 competition and got the best mechanical design award



Submission

- All the tasks can be done in tinkercad
- Submission Link
<https://forms.gle/n8Jbwyo7PCEfnEX26>
- The Task's deadline is 26/7 11:59 PM.
- Q&A Sheet (if you have any question regarding the sessions or the task) :
https://docs.google.com/spreadsheets/d/1Y0rni3-tSgYQ7Ox-1R9Lp5foVDbNku0jZ_8p-5yNPw4/edit?gid=1521150305#gid=1521150305
- Cheating is severely penalized