EIE3105 / EIE3106
Integrated Project
Demonstration Guideline

Dr. Lawrence Cheung

Semester 2, 2024/25

Demonstrations

- Demonstration 1: Robot Car and Remote Control (Hardware and Software Development)
- Demonstration 2: Line Tracking
- Demonstration 3: Car Parking
- Demonstration 4: Relay Race (Group)

Demonstration 1

- Objective 1: Assemble a robot car and a remote control.
- Objective 2: Control the robot car through the remote control.
  - Make a demonstration video to show that you can use your remote control to move your robot car to do the following actions: move forward, move backward, move forward and turn left, and move forward and turn right.

Demonstration 1

- Hardware development
  - Assemble your robot car with PCB soldering.
  - Follow the guidelines “EIE3105 and EIE3106 Robot Car and Remote Control Assembly Guideline”.
  - Show the checkpoints one by one to our student helpers.
  - If you have any problems, please ask our technical officers for help.

Demonstration 1

- Software development
  - We give program codes for you to change the PWM of the motors and get the counter values from the motors.
  - We give program codes to show how to display a message on the OLED display.
  - We also give you a hex file to test the hardware part of your robot car.

Demonstration 1

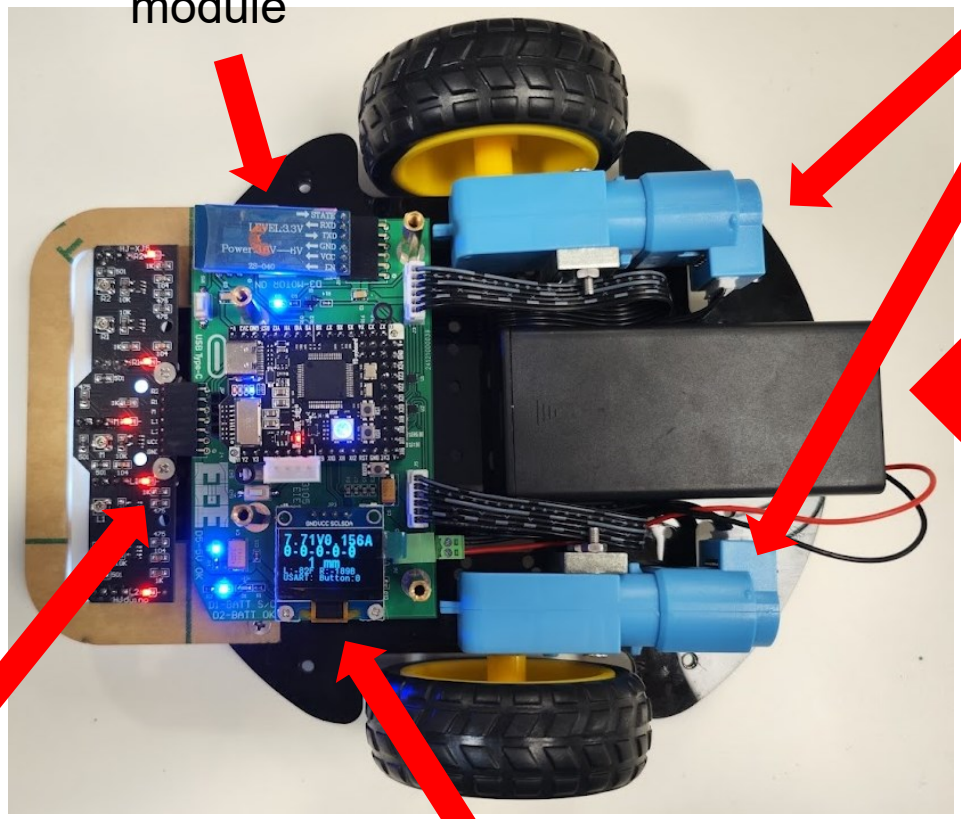
- You have four tasks to achieve:
  - Task 1: In the remote control, write a program to send an ASCII character to the robot car through serial port communication.
  - Task 2: In the robot car, change the PWMs of two motors according to the ASCII character sent by the remote control so that the car can move forward, move backward, move forward and turn left, and move forward and turn right.

Demonstration 1

- Task 3: In the robot car, get the reading from the photoresistors for line tracking and show it on the OLED display.
- Task 4: In the robot car, get the reading from the ultrasonic transducer to measure the distance between the car and an object in front. The distance should be shown on the OLED display.
- Score full marks if you complete the above four tasks.

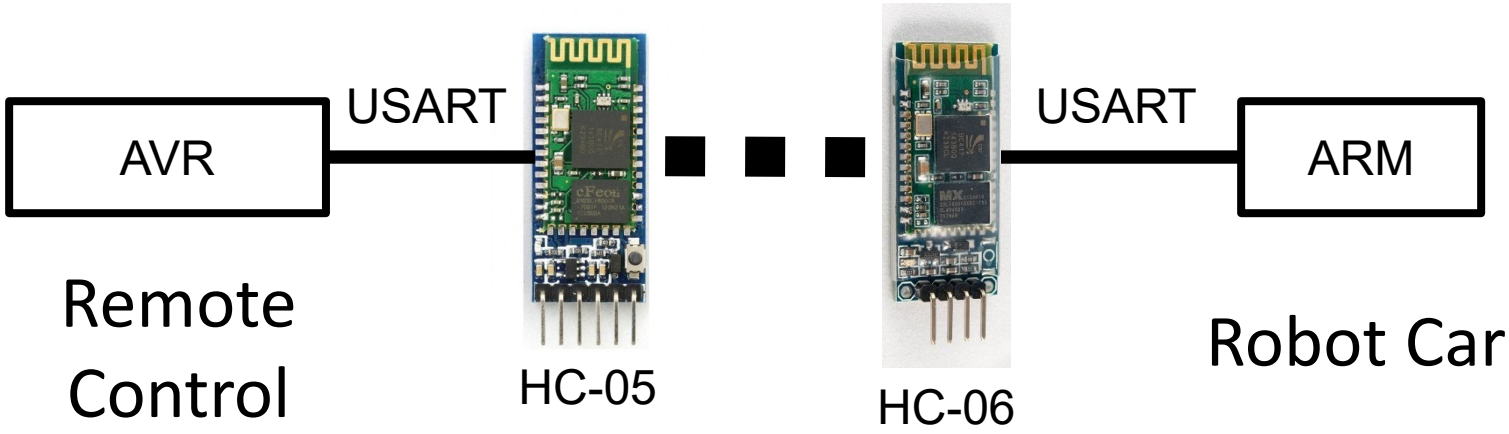
Demonstration 1

- Robot Car



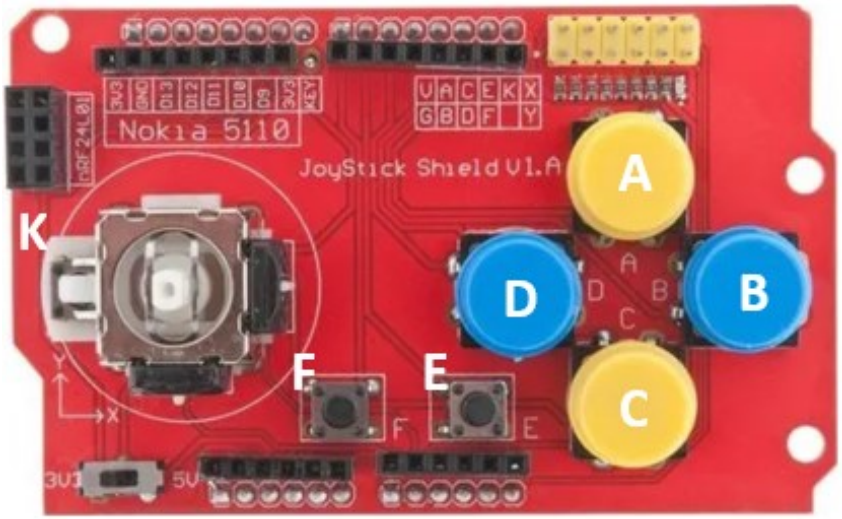
Demonstration 1

- Block diagram (Communication)
  - Baud rate: 115200

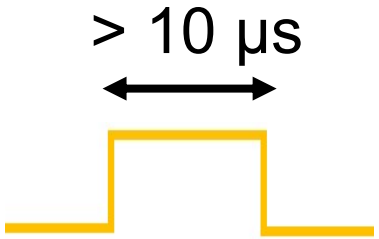


Demonstration 1

- Remote Control
  - Button A: PD2, button B: PD3, button C: PD4, button D: PD5
  - Use the buttons to control your car.

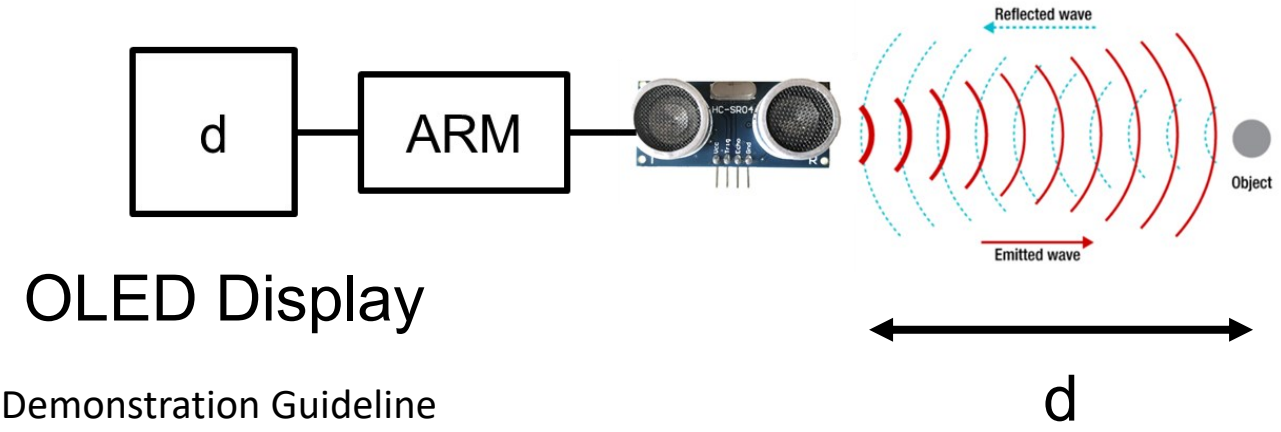


Demonstration 1



– Ultrasonic Transducer mechanism

- Step 1: Send a pulse from the MCU to the ultrasonic transducer through PC7 high to activate the ultrasonic sensor. The pulse width is not less than 10 µs.
- Step 2: Read a pulse (low-high-low) from PC6. It is sent by the ultrasonic transducer. The pulse width is the traveling time of the ultrasonic sound wave.

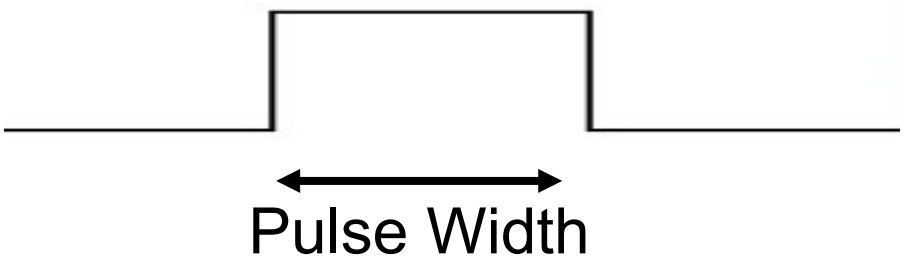


Demonstration 1

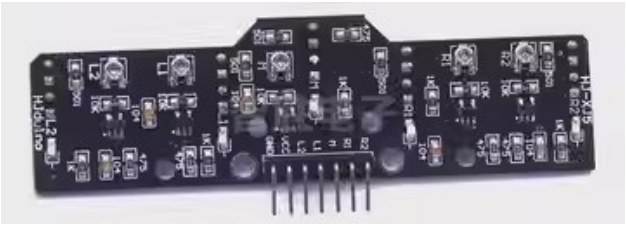
- Use the pulse width to find the distance d and show it on the OLED display.

$$\text{Time} = \text{Pulse Width} / \text{Clock Frequency}$$

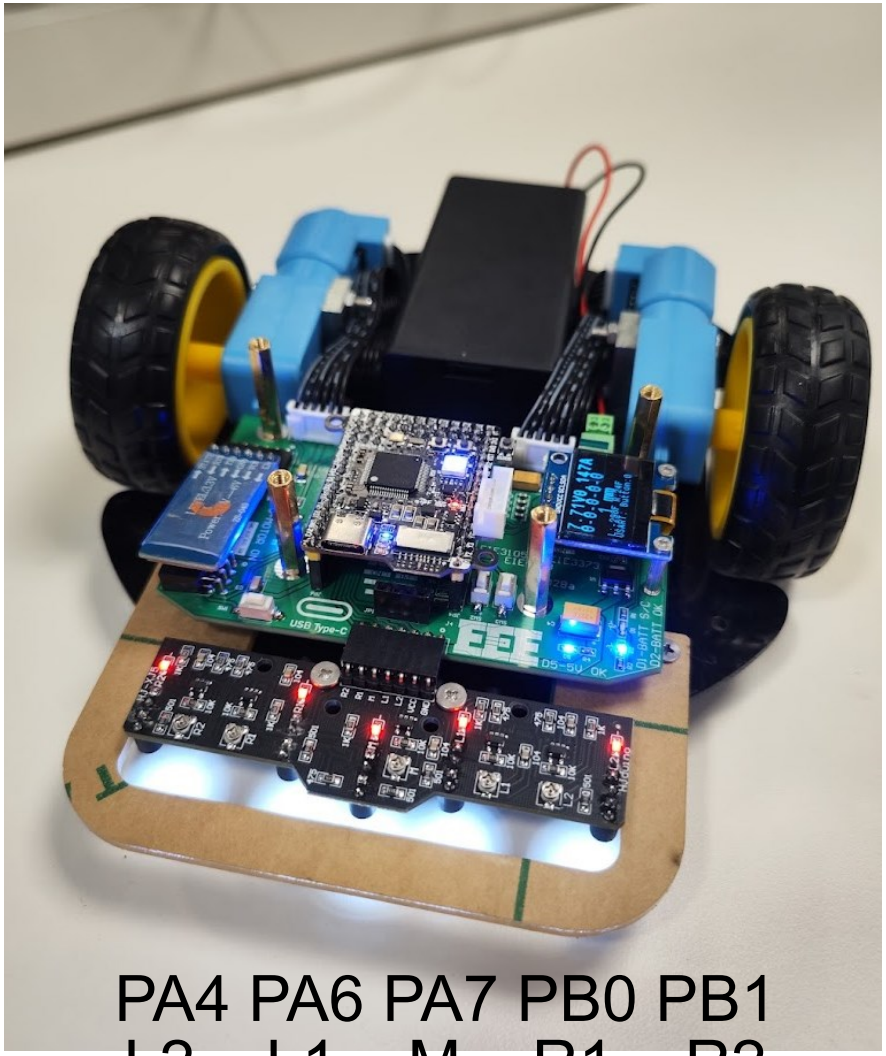
$$\text{Distance d} = \text{Time} / 2 \times \text{Speed (330 m/s)}$$



Demonstration 1



- Photoresistors
  - They are connected to GPIOs.

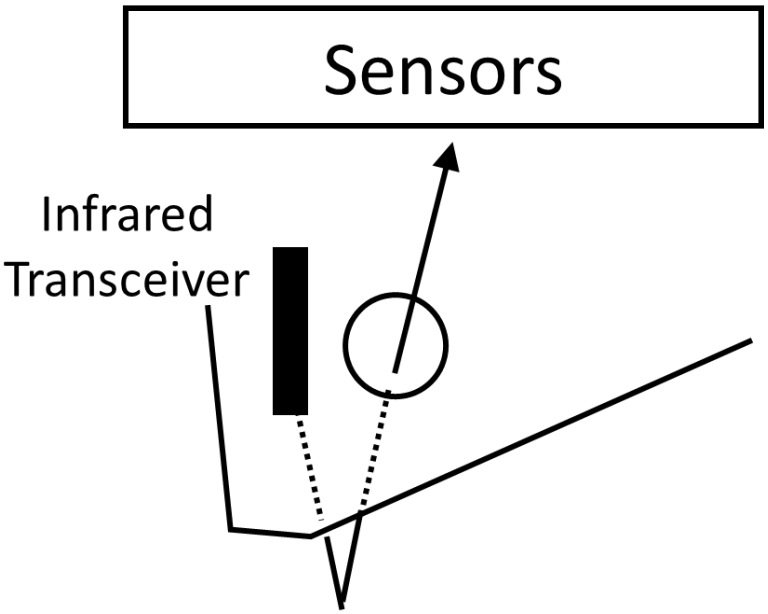


PA4 PA6 PA7 PB0 PB1
L2 L1 M R1 R2

Demonstration 1

Demonstration 1

- How to track a line?
  - White ground ⇒ Strong reflection ⇒ Reading = 1
  - Black ground ⇒ Weak reflection ⇒ Reading = 0



Demonstration 1

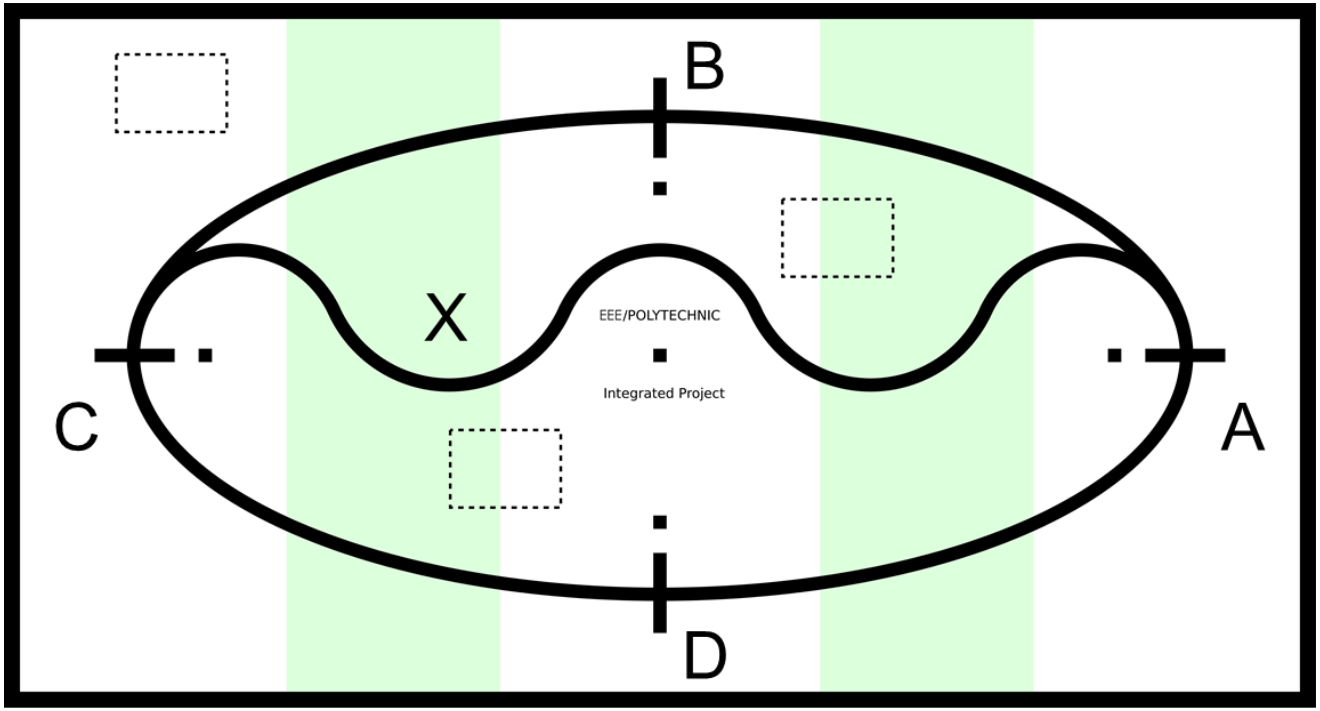
- Advice
  - Do not do the checking or get the reading too frequently. It is good enough to process it every 100ms.
  - Remember to keep the source files (save them in a folder as a backup).
  - Keep using the OLED display to check.

Demonstration 1

- In your demonstration video, you need to show your student ID card and the ID of the car before showing the demonstration.
- Zip your projects, progress report, and demonstration video into a single file and submit it to Blackboard.
- Deadlines: **11:59 p.m., 14 Feb 2025 (Friday, Week 4)**

Demonstration 2

- Line Tracking: A ➔ B ➔ C ➔ D ➔ A ➔ X ➔ C ➔ D ➔ A ➔ B ➔ C ➔ X ➔ A



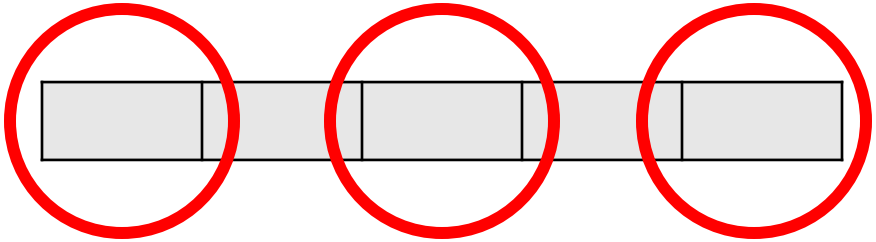
Demonstration 2

- Methodology: Event lookup table

Previous States (Readings)	Current State (Reading)	Actions to be taken (Change PWM duty cycles)

Demonstration 2

- It may be too many states (32) if you consider all five phototransistors.
- You may consider three phototransistors only (8 states only!).



Demonstration 2

- Remarks
  - It is acceptable if your car sometimes does not follow the track, but the duration must be short (not longer than **ONE** second).
  - But … how to get back to track the line when the line is out of the line tracker?
  - How can the counters be used to find out the location of the robot car in the arena?

Demonstration 2

- Divide the demonstration into four sub-tasks.

Week	Sub-task	Deadline
5	Demonstration 2A: Follow the outer loop and inner line	11:59 p.m., 21 Feb 25 (Friday, Week 5)
6	Demonstration 2B: Go from the outer loop to the inner line	11:59 p.m., 28 Feb 25 (Friday, Week 6)
7	Demonstration 2C: Go from the inner line to the outer loop	11:59 p.m., 7 Mar 25 (Friday, Week 7)
8	Demonstration 2D: Integration	11:59 p.m., 14 Mar 25 (Friday, Week 8)

Demonstration 2

- Marking criteria
  - Demonstration 2A: 20%
  - Demonstration 2B: 10%
  - Demonstration 2C: 10%
  - Demonstration 2D: 60%
    - Top 30% or ($t \leq 40s$): 60% (full marks)
    - Top 31% to 50% or ($40s < t \leq 50s$): 45%
    - Top 51% to 75% or ($50s < t \leq 60s$): 30%
    - Last 25% or ($t > 60s$): 15%

Demonstration 2

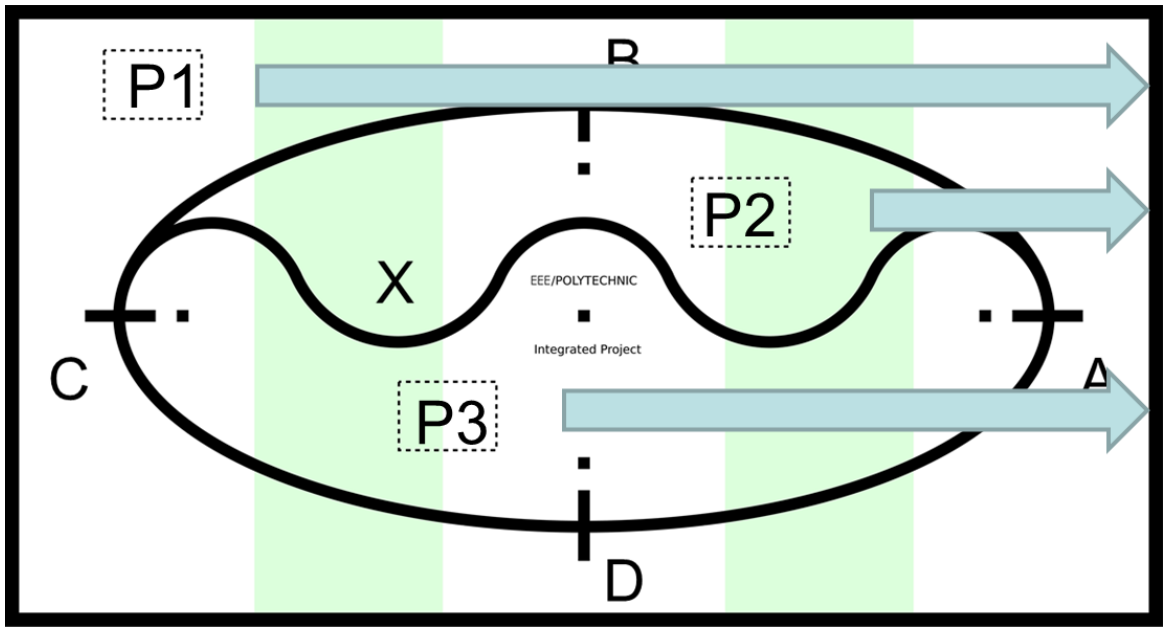
- Advice
  - If your car is too fast, it cannot detect the line properly, and thus, it cannot follow the track.
  - If your car is too slow, you cannot score high marks.
  - Your car should be sometimes fast (e.g., when your car is not turning) and sometimes slow (e.g., when it switches from one line to another line).

Demonstration 2

- In your demonstration video, you need to show your student ID card and the ID of the car before showing the demonstration.
- Zip your projects, progress report, and demonstration video into a single file and submit it to Blackboard.
- Deadlines: **11:59 p.m., 14 Mar 2025 (Friday, Week 8)**

Demonstration 3

- Car Parking: Your car should get close to the wall but not hit the wall.



Wall

Demonstration 3

- The positions of the car (three positions) and the wall can be found in the arena.
- The car must start from the specified position **at rest**.
- You need to build the wall by yourself, e.g., a few boxes of lemon tea on the line.

Demonstration 3

- Marking criteria
  - Score 40% of the total if your car can get close to the wall from the three specified positions, and each time, the total distance between the car and the wall (say d) is less than 6cm and the total time taken to finish the parking (say t) is less than 10s.

Demonstration 3

- 60% of the total marks are related to t and d.
  - Top 30% or ($t \leq 4s$): 30% (full marks)
  - Top 31% to 50% or ($4s < t \leq 5s$): 20%
  - Top 51% to 75% or ($5s < t \leq 6s$): 10%
  - Last 25% or ($t > 6s$): 0%
  - Top 30% or ($d \leq 2cm$): 30% (full marks)
  - Top 31% to 50% or ($2cm < d \leq 3cm$): 20%
  - Top 51% to 75% or ($3cm < t \leq 4cm$): 10%
  - Last 25% or ($t > 4cm$): 0%

Demonstration 3

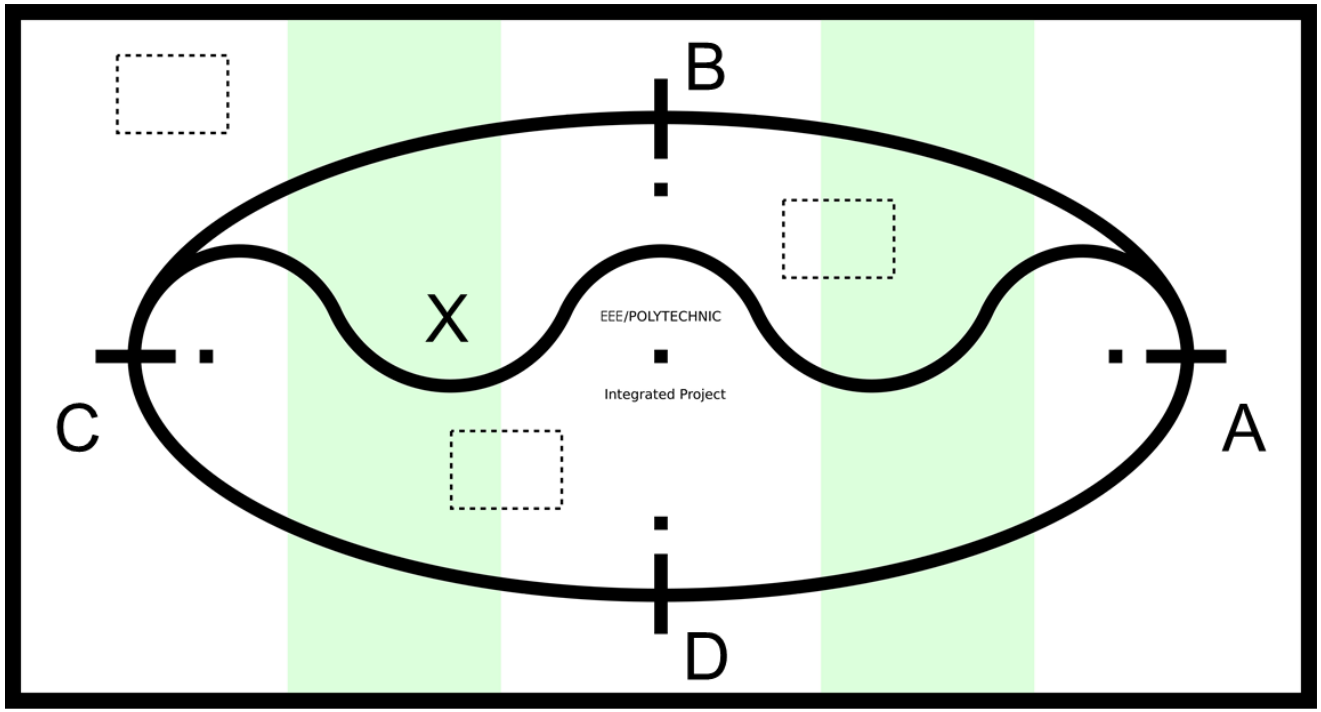
- Methodology: It is easy to just set up different if-then-else rules to change the PWMs of two wheels and the duration according to the reading from the ultrasonic transducer.

Demonstration 3

- In your demonstration video, you need to show your student ID card and the ID of the car before showing the demonstration.
- Zip your projects, progress report, and demonstration video into a single file and submit it to Blackboard.
- Deadlines
  - **11:59 p.m., 21 Mar 2025 (Fri, Week 9, EIE3105)**
  - **11:59 p.m., 28 Mar 2025 (Fri, Week 10, EIE3106)**

Demonstration 4

- Relay Race (Group)



Demonstration 4

- Requirement:
  - Car 1 (at A): A → D → C (activate Car 2)
  - Car 2 (at C): C → X → A → B → C (activate Car 1)
  - Car 1 (at C): C → D → A
  - Automation
  - Two cars are not allowed to be hit together.

Demonstration 4

- Car 2 uses its ultrasonic transducer to detect whether Car 1 is coming.
- Note that the ultrasonic transducer of Car 1 must be turned off; otherwise, it will disturb the operation of the ultrasonic transducer in Car 2.
- The ultrasonic transducer of Car 1 should be turned on when it is waiting for Car 2 to return.

Demonstration 4

- Make two demonstration videos for two cars (say Car X and Car Y). One video is for Car X as Car 1 and Car Y as Car 2. Another video is for Car X as Car 2 and Car Y as Car 1.

Demonstration 4

- Two main challenges
  - Challenge 1: You can use the ultrasonic transducer to detect that a car is coming. Timer counting is not allowed. You will score no marks if timer counting is used. To use the ultrasonic transducer properly, your car must head to the coming car.
  - Challenge 2: After detecting the coming car, your car can turn 180 degrees and then move.

Demonstration 4

- Marking criteria
  - The total time taken for two demonstrations = t
  - Top 30% or ($t \leq 60s$): 100% (full marks)
  - Top 31% to 50% or ($60s < t \leq 80s$): 80%
  - Top 51% to 75% or ($80s < t \leq 100s$): 60%
  - Last 25% or ($t > 100s$): 40%

Demonstration 4

- In your demonstration video, you need to show your student ID card and the ID of the car before showing the demonstration.
- Zip your projects, progress report, and demonstration video into a single file and submit it to Blackboard.
- Deadlines: **11:59 p.m., 18 Apr 2025 (Friday, Week 13)**

Progress Reports and Final Report

- Two parts:
  - Flowchart/Pseudo code/Algorithm
  - Difficulties you have and how to overcome them
- Requirements
  - Progress Report: not more than two pages
  - Final Report: not more than five pages
- English writing and organization
  - You can use some tools to enhance your writing.

Presentation

- Give a five-minute presentation video with edited demonstration video clips.
- Two parts:
  - Flowchart/Pseudo code/Algorithm
  - Difficulties you have and how to overcome them
- The content can be the same as your final report.
- Submission deadline for final report and presentation: **11:59 p.m., 18 April 2025 (Friday, Week 13)**

End