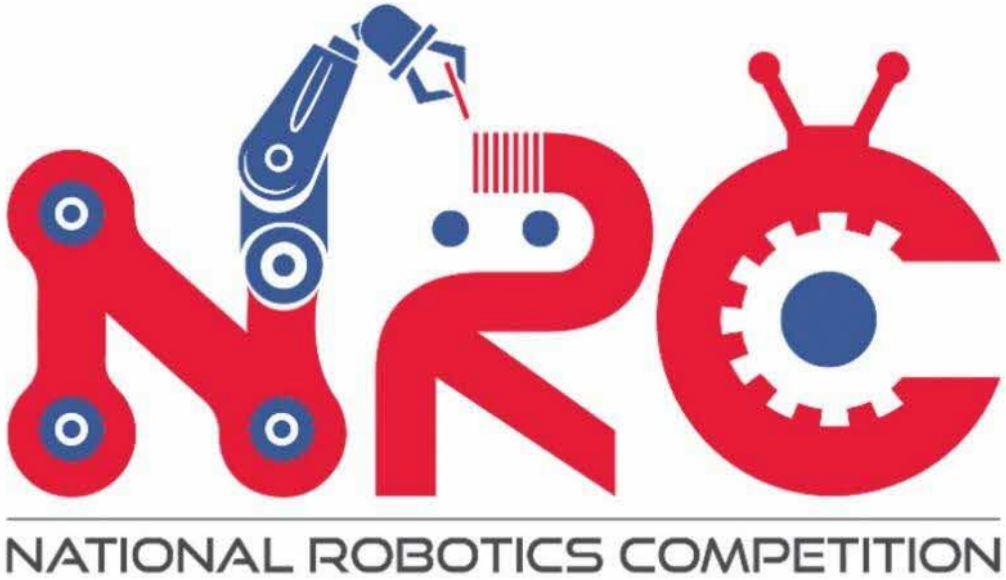


Welcome to National Robotics Competition 2023

Organiser:

Sponsored by:

Supported by:

NATIONAL ROBOTICS COMPETITION

NRC Regular Category

Lower Primary: 7-9 years old | Upper Primary: 10-12 years old
Secondary: 13-16 years old | Tertiary: 16-19 years old

NRC Open Category

Primary: 8-12 years old | Secondary: 13-16 years old | Tertiary: 16-19 years old

NRC AI Maker Series

Primary: 8-12 years old | Secondary: 13-16 years old

NRC Pre-School (Kubo and ARTec Challenge)

5-6 years old

NRC CoderZ Coding Challenge (Online)

Primary: 8-12 years old | Secondary: 13-16 years old

NRC RoboCup Singapore CoSpace Coding Challenge *NEW*

Primary: 8-12 years old | Secondary: 13-16 years old | Tertiary: 16-19 years old

Organiser:

Science Centre Singapore

DUCK LEARNING opportunities in education

Sponsored by:

Ministry of Education SINGAPORE

Supported by:

GLOBAL ROBOTICS GAMES

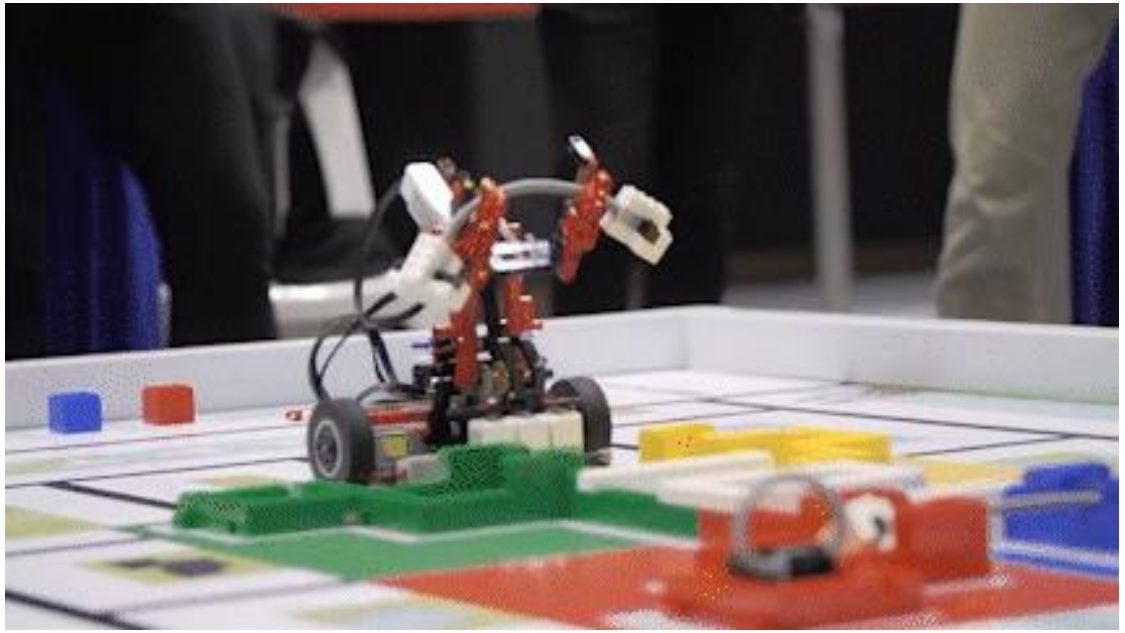
SP Singapore Polytechnic

RoboCup SINGAPORE

WOW Learning

NATIONAL ROBOTICS COMPETITION

Held live on-site at Science Centre Singapore from 21 August to 9 September 2023



Organiser:

Science Centre Singapore

DUCK LEARNING opportunities in education

Sponsored by:

Ministry of Education SINGAPORE

Supported by:

GLOBAL ROBOTICS GAMES

SP Singapore Polytechnic

RoboCup SINGAPORE

WOW Learning

RoboCup Singapore
CoSpace Coding Challenge 2023
(Autonomous Driving Category)

Primary | Secondary

Theme: Smart Transportation

Organiser:

Sponsored by:

Supported by:

Agenda for the Webinar

- Introduction to the RoboCup SG CoSpace Coding Challenge (Autonomous Driving Category)
- Introduction to Gameplay
- Scoring
- Qualifiers and Finals
- Important Dates

Organiser:

Sponsored by:

Supported by:

Introduction

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- Teams are required to solve 5 individual tasks commonly used in smart transportation for the coding challenge, such as
    - Navigation challenge
    - Smart sensing challenge
    - Path planning challenge
- The challenge missions are designed to increase in difficulties and complexities as students progress from the Primary to the Secondary category. This increasing complexities is reflected in various aspects of the challenge tasks.

Organiser:

Sponsored by:

Supported by:

Introduction

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Teams**
  - Primary Category:
    - 8 – 12 years old (in season 2023: born years: 20011 – 2015)
  - Secondary Category
    - 13 – 16 years old (in season 2023: born years: 2007 – 2010)
  - Each participant can only register for one CoSpace coding challenge team.
  - Each team must have a team leader.
    - Be responsible for communication with officials during the game.

NATIONAL ROBOTICS COMPETITION

RoboCup CoSpace Autonomous Driving Challenge

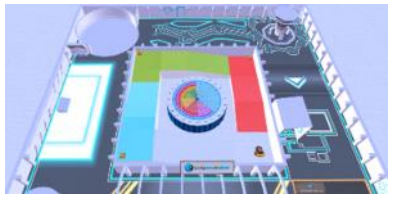
Decomposition

Navigation

- Line tracking using IR sensors
- Obstacle avoidance using ultrasonic sensor

Smart Sensing

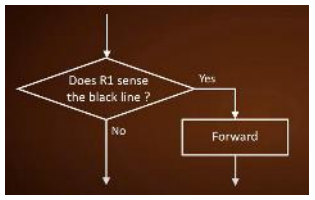
- Colour detection using RGB colour sensor



Path Planning

- Accurate turning using gyro sensor

- Decision making



Build up foundation and confidence

CoSpace Coding Challenge (Auto-driving category) @NRC

NATIONAL ROBOTICS COMPETITION

Virtual Robot & Field

Organiser:

Sponsored by:

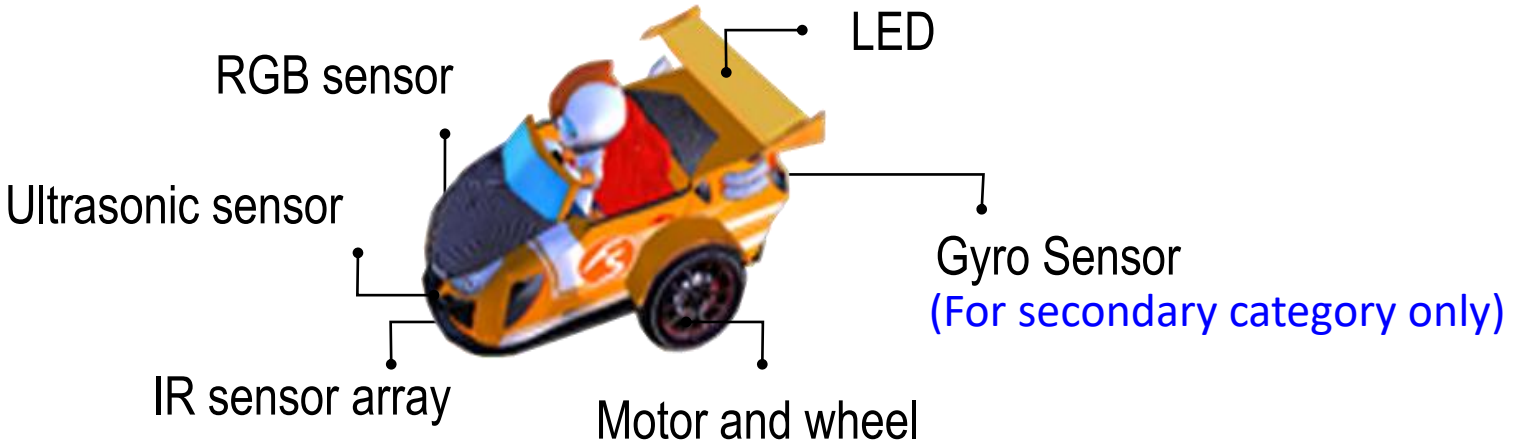
Supported by:

Virtual Robot & Field

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Virtual Robot**



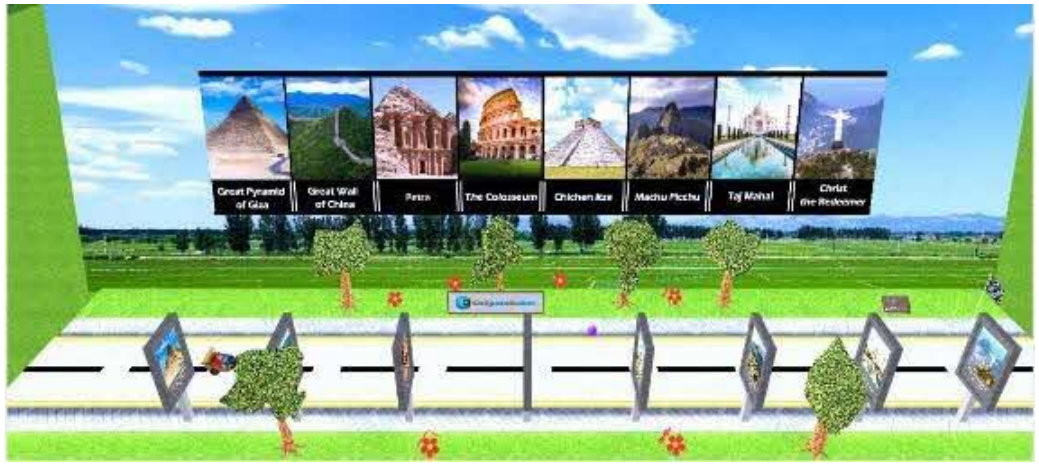
Organiser:
Sponsored by:
Supported by:

Virtual Robot & Field

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Field**
  - Road colour: White or Black
  - Elements in field
    - Lines
    - Buildings, fence, walls, etc which block the robot's movement
    - Colour markers on floor



Organiser:

Sponsored by:

Supported by:

NATIONAL ROBOTICS COMPETITION

Gameplay

Organiser:

Sponsored by:

Supported by:

Gameplay

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Challenge Tasks (Primary)**

  - for students with little experience with robotics and coding, including novice teams.

Navigation Challenge I	Navigation Challenge II	Smart Sensing Challenge	Open Challenge I	Open Challenge II
Focus: Using Infrared (IR) sensors for line tracking.	**Focus:** Using ultrasonic sensor and IR sensors for obstacle avoidance.	**Focus:** Using RGB colour sensor, IR sensors for road marker detection and line tracking.	**Focus:** To complete the auto-driving challenge mission I using IR and ultrasonic sensors.	**Focus:** To complete the auto-driving challenge mission II using IR, ultrasonic and RGB sensors.

Organiser:

Sponsored by:

Supported by:

Gameplay

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Challenge Tasks (Primary)**

  - for students with little experience with robotics and coding, including novice teams.

Task	Navigation Challenge I	Navigation Challenge II	Smart Sensing Challenge
Sensors used	IR sensors	IR & ultrasonic sensors	RGB sensors
Environment (Example)			
Open Challenges I & II: use IR, ultrasonic, and RGB sensors to solve open challenges			

Gameplay

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Challenge Tasks (Secondary)**

  - for students with foundation of robotics and coding, such as application using different sensors.

Navigation Challenge I	Navigation Challenge II	Smart Sensing Challenge	Open Challenge I	Open Challenge II
Focus: Using Infrared (IR) sensors for line tracking.	**Focus:** Using ultrasonic sensor and IR sensors for obstacle avoidance.	**Focus:** Using RGB colour sensor, IR sensors for road marker detection and line tracking.	**Focus:** To complete the auto-driving challenge mission I using IR and ultrasonic sensors.	**Focus:** To complete the auto-driving challenge mission II using IR, ultrasonic and RGB sensors.

Organiser:

Sponsored by:

Supported by:

Gameplay

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Challenge Tasks (Secondary)**

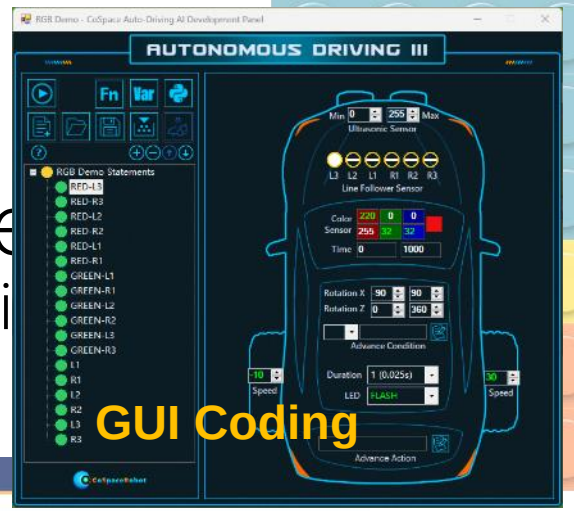
  - for students with foundation of robotics and coding, such as application using different sensors.

Task	Navigation Challenge	Smart Sensing Challenge	Path Planning Challenge
Sensors used	IR & ultrasonic sensors	RGB sensor	Compass sensor
Environment (Example)			
Open Challenges I & II: use all sensors mounted on robot to solve open challenges			

Gameplay

RoboCupSG CoSpace Coding Challenge

(Autonomous Driving Category – Smart Transportati



Open Challenge Example

The smart car changes its speed autonomously based on the colour maker on road.

RGB Demo D.py

```
144  def Game0():
145      global Duration, CurAction, CurGame
146      global WheelLeft, WheelRight, LED_1
147      global MyState_1, US_Front, IR_L3, IR_L2, IR_L1, IR_R1, IR_R2, IR_R3,
148      bOnRed = CS_R>=220 and CS_G<=32 and CS_B<=32
149      bOnGreen = CS_R>=220 and CS_G<=32 and CS_B<=32
150
151      if Duration>0:...
153      elif IR_L3>=1 and bOnRed:   #RED-L3...
156      elif IR_R3>=1 and bOnRed:   #RED-R3...
```

Code in Python

RGB Demo D.c

Miscellaneous Files (Global Scope)

```
175  }
176  void Game0()
177  {
178      bool bOnRed = CS_R >= 220 && CS_G <= 32 && CS_B <= 32;
179      bool bOnGreen = CS_R <= 32 && CS_G >= 220 && CS_B <= 32;
180
181      if(Duration>0){ ... }
185      else if(IR_L3>=1 && bOnRed){ ... }
190      else if(IR_R3>=1 && bOnRed){ ... }
195      else if(IR_L2>=1 && bOnRed){ ... }
200      else if(IR_R2>=1 && bOnRed){ ... }
```

Code in C

Sponsored by:

Ministry of Education SINGAPORE

Supported by:

GLOBAL ROBOTICS GAMES

Singapore Polytechnic

RoboCup SINGAPORE

WOW Learning

Gameplay

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Challenge Task (SuperTeam)**
  - SuperTeam is the combination of 2 – 3 teams from different schools.
  - SuperTeam participants will have opportunity to use both virtual and real robots (CoSpace) for Smart Transportation challenge.
  - Real robots will be provided by the organiser.

Judging & Scoring

Organiser:

Sponsored by:

Supported by:

Judging & Scoring

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Scoring**

Primary Category

Task 1: Navigation challenge I – 10%
Task 2: Navigation challenge II – 15%
Task 3: Smart sensing challenge – 15%
Task 4: Open challenge I – 30%
Task 5: Open challenge II – 30%

Secondary Category

Task 1: Navigation challenge – 10%
Task 2: Smart sensing challenge – 15%
Task 3: Path planning challenge – 15%
Task 4: Open challenge I – 30%
Task 5: Open challenge II – 30%

Organiser:
Sponsored by:
Supported by:

Judging & Scoring

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Team Sharing and Presentation Video**
  - Teams are encouraged to submit a team sharing and presentation video (Template will be given)
  - Selected videos will be featured on the RCAP Academy Official YouTube Channel (www.youtube.com/RCAPacademy) and be eligible for the RoboCup Singapore Influencer Awards.
    - People's Choice Award
    - Most Popular Video Award
    - Educational Value Award
    - Community Awareness Award
    - Community Building Award

Organiser:

Sponsored by:

Supported by:

Qualifiers and Finals

Organiser:

Sponsored by:

Supported by:

Qualifiers and Finals

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

- **Qualifying Process**

Organiser:

Sponsored by:

Supported by:

Important Dates

	Dates	Time	Remarks
Introductory Workshop on NRC Robocup SG Coding Challenge @SCS	15th & 16th April	8am – 5pm	Look out for EDM
Training Workshops (Online)	July - August		
Video Submission	25th August 2023		Subjected to changes
Preliminary + Interview @ SCS	2th September 2023	8am – 5pm	
Finals @ SCS	4th September 2023	8am – 5pm	
Award Ceremony	9th September 2023	8am – 5pm	

Organiser:

Sponsored by:

Supported by:

RoboCup Singapore
CoSpace Coding Challenge 2023
(Autonomous Driving Category)
Tertiary

Theme: Autonomous Delivery

Organiser:

Sponsored by:

Supported by:

Introduction

RoboCup SG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Delivery)

- In RoboCup SG CoSpace coding challenge auto-driving category tertiary group, teams need to develop and program a virtual robot car based on the Intelligent Transportation System (ITS) to solve the last mile delivery challenge.

Organiser:

Sponsored by:

Supported by:

NATIONAL ROBOTICS COMPETITION

Virtual Robot & Field

Organiser:

Sponsored by:

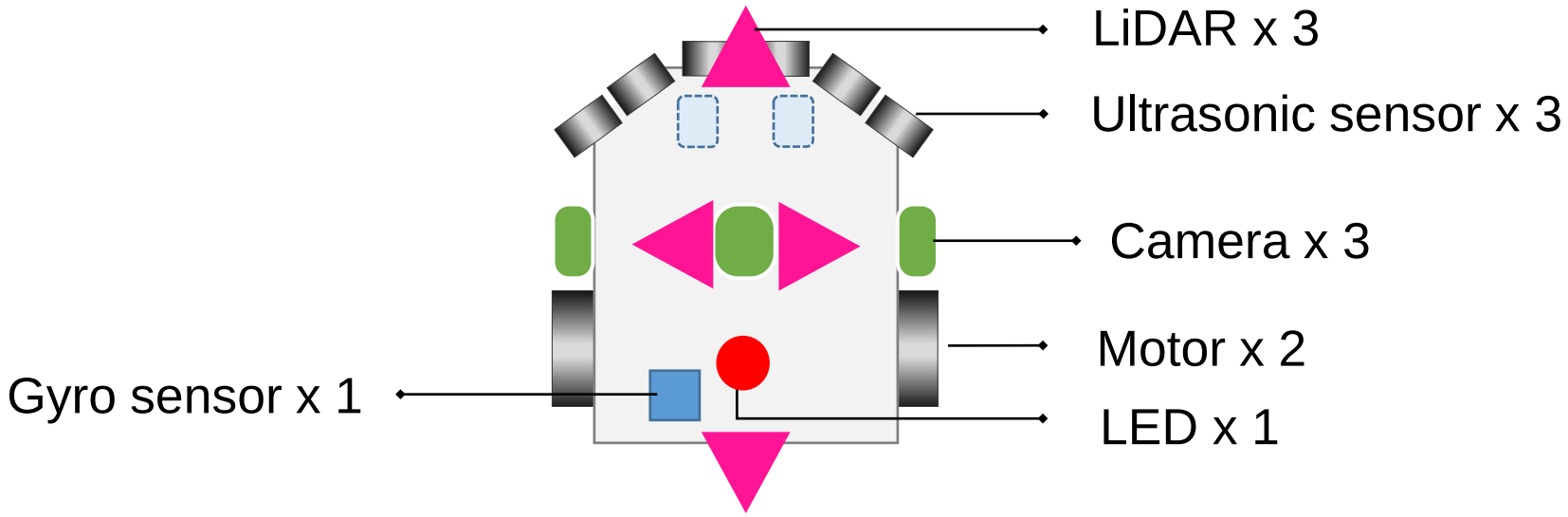
Supported by:

Virtual Robot & Field

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Delivery)

- **Virtual Robot**



Organiser:
Sponsored by:
Supported by:

Virtual Robot & Field

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Delivery)

- **Field**
  - Field size: 20m x 20m
  - Elements in field
    - Distribution Centre
    - Collection Station
    - Navigation Points
    - Obstacles,
    - Colour markers,
    - Lines
    - Buildings,
    - Walls, etc

Organiser:

Sponsored by:

Supported by:

Virtual Robot & Field

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Delivery)

- **Field**
  - Intelligent Transportation System (ITS)
    - Providing robot's position and orientation with respect to road's center line
    - Providing location of all distribution centres and collection stations
    - Providing information of the nearest navigation point to the delivery robot.

Organiser:

Sponsored by:

Supported by:

NATIONAL ROBOTICS COMPETITION

Gameplay

Organiser:

Sponsored by:

Supported by:

Gameplay

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Delivery)

- **Challenge Task (Tertiary)**
  - To plan the most efficient route, devise suitable tactics, and code the virtual delivery robot to navigate through a smart city. The autonomous robot must successfully transport all the pre-loaded tasks to each collection station by following the planned optimal path.
  - The game will end either by the successful delivery of all items or if the maximum allotted delivery time has been surpassed.
  - For details, refer to the official rules: https://robocupap.org/Rule_Book/RCAP_CoSpace_Auto_Delivery.pdf

Organiser:
Sponsored by:
Supported by:

Judging & Scoring

Organiser:

Sponsored by:

Supported by:

Judging & Scoring

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving – Delivery)

- **Scoring**
  - 20 points will be awarded for each successful delivery
  - Total points awarded to the team at the end of game determines the team rank.

Organiser:

Sponsored by:

Supported by:

Judging & Scoring

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving – Delivery)

- **Team Sharing and Presentation Video**
  - Teams are encouraged to submit a team sharing and presentation video (Template will be given)
  - Selected videos will be featured on the RCAP Academy Official YouTube Channel (www.youtube.com/RCAPacademy) and be eligible for the RoboCup Singapore Influencer Awards.
    - People's Choice Award
    - Most Popular Video Award
    - Educational Value Award
    - Community Awareness Award
    - Community Building Award

Organiser:

Sponsored by:

Supported by:

Qualifiers and Finals

Organiser:

Sponsored by:

Supported by:

Qualifiers and Finals

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Delivery)

- **Qualifying Process**

Organiser:

Sponsored by:

Supported by:

Important Dates

	Dates	Time	Remarks
Training Workshops (Online)	July - August	8am – 5pm	Look out for EDM
Video Submission	25th August 2023		Subjected to changes
Preliminary + Interview @ SCS	2th September 2023	8am – 5pm	
Finals @ SCS	4th September 2023	8am – 5pm	
Award Ceremony	9th September 2023	8am – 5pm	

Organiser:

Sponsored by:

Supported by:

Contact us/Updates/FAQ

Organiser:

Sponsored by:

Supported by:

FAQ

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

1. **What is the difference between RCAP CoSpace Autonomous Driving Challenge and CoSpace Coding Challenge (Auto-Driving category)**

NATIONAL ROBOTICS COMPETITION

RoboCup CoSpace Autonomous Driving Challenge

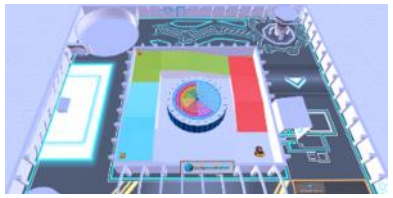
Decomposition

Navigation

- Line tracking using IR sensors
- Obstacle avoidance using ultrasonic sensor

Smart Sensing

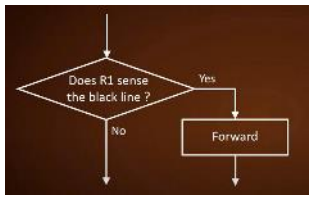
- Colour detection using RGB colour sensor



Path Planning

- Accurate turning using gyro sensor

- Decision making



Build up foundation and confidence

CoSpace Coding Challenge @NRC

FAQ

RoboCupSG CoSpace Coding Challenge 2023

(Autonomous Driving Category – Smart Transportation)

2. **What software used for RoboCup SG Coding Challenge (Auto-Driving category)**
   - CoSpace Autonomous Driving Simulator
   - It can be downloaded from 1 July 2023. Download link will be send to registered teams.
3. **Where there be any training workshop by organizer?**
   - Yes. The 2-hours training workshop will be conducted by CoSpace Committee in July. Details will be sent to registered teams
4. **Where can we buy the real robots?**
   - OC will provide the real robot
5. **What should be included in the Technical demonstration video?**
   - Video template will be provided

Organiser:
Sponsored by:
Supported by:

Contact us/ Updates/ FAQ

Website

Social Media

For any queries

Email

cospace@robocupap.org
NRC@science.edu.sg

Organiser:

Sponsored by:

Supported by: