# World Youth Artificial Intelligence X Robotic Car Competition

#### 1) Background

- The story: An alien has its colon packed with unhealthy food. This condition puts it at risk of developing colorectal cancer. Talented young people like you are trying to save the alien by removing the red meat, fat, processed food, and those that are high in sodium and sugar from its colon.
- The mission: Each group should have no more than 12 participants. They will be sub-divided into the Robotic team and the Artificial Intelligence (A.I.) team to finish different inter-related challenges in the competition.

The Robotic team will build a robotic car using the materials provided by the Organiser. They will then use the car to push the unhealthy food out of the alien's colon. Next, they will have to deliver the food one by one with the car into the a box built by the A.I. team for object recognition.

The A.I. team will develop a program with *Scratch* and *Teachable Machine* that is able to perform object recognition for the unhealthy food "delivered" by the Robotic team AND calculate the risk for the alien to develop colorectal cancer according to the instructions.

#### 2) Competition schedule

School	Date of competition
C.C.C. Heep Woh Primary School	November 21, 2021
PLK Chong Kee Ting Primary School	November 27, 2021
TWGHs Wong See Sum Primary School	November 27, 2021
St. Peter Catholic Primary School	December 18, 2021
Tak Sun School	December 18, 2021
PLK Fung Ching Memorial Primary School	December 20, 2021
Tuen Mun Government Primary School	January 4, 2022
T.W.G.Hs Tang Shiu Kin Primary School	January 8, 2022
Children from South Africa's Township	January 9, 2022
Shatin Tsung Tsin School	January 29, 2022

Items	Date
Leaderboard for	To be updated on PolyU website (will be ready in November 2021) every two
Inter-school	weeks from November 2021 to January 2022
Competition	
Competition for	Intra-school competition: to be carried out on the competition day
Design Awards	Inter-school competition: February 2022
Announcement of	Intra-school competition: to be announced on the competition day
Competition Results	Inter-school competition: to be announced on PolyU's website in late February
	2022. Winning schools will be notified by phone or email in March 2022
Award Ceremony	Intra-school competition: to be conducted at the school on the competition day
	Inter-school competition: Winning schools are expected to receive the
	certificate by post in March 2022

## 3) Awards

Three competitions will be awarded in this project:

Competition	Intra-school Awards	Inter-school Awards *	
Events			
The	Champion (1 group) - STEM	Top 10 schools on the Leaderboard	
Challenge	learning kits and certificates	Overall Champion (1 group)- Trophy and Certificates	
Cup 1 <sup>st</sup> Runner-up (1 group) - Certificates 2 <sup>ndt</sup> Runner-up (1 Group) - Certificates	Overall 1 <sup>st</sup> Runner-up (1 group) - Trophy and Certificates		
	Overall 2 <sup>nd</sup> Runner-up (1 group) - Trophy and Certificates		
	Merit (7 groups) - Certificates		
Design	The Best Robotic Car Design (1	Top 5 schools on the Leaderboard	
Award	group) - Certificates	Overall Champion (1 group)- Trophy and Certificates	
(Robotic Car)	(Robotic Car)	Overall 1 <sup>st</sup> Runner-up (1 group) - Trophy and Certificates	
		Overall 2 <sup>nd</sup> Runner-up (1 group) - Trophy and Certificates	
	Merit (2 groups) - Certificates		
Design Award	The Best Code for A.I. Program (1 group)-Certificates	<i>Top 5 schools on the Leaderboard</i> Overall Champion (1 group)- Trophy and Certificates	
(Coding for A.I. Program)		Overall 1 <sup>st</sup> Runner-up (1 group) - Certificates	
		Overall 2 <sup>nd</sup> Runner-up (1 group) - Certificates	
		Merit (2 groups) - Certificates	

\* All winning teams in the intra-school competition will automatically join the inter-school competition with their competition results.

#### 3.1) The Challenge Cup

- The competition has two parts. Part I is about "Cleaning up unhealthy food" and Part II is about "Recognising food".
- Part I "Cleaning up unhealthy food":
  - Participants must use a robotic car to push the unhealthy food out of the track that looks like the alien's colon across the finish line within the time limit. There are three rounds. The maximum time for each will be 3 minutes.
  - □ In each round, the car can only enter and exit the track once. The round will end immediately if both wheels of the robotic car touch the finish line.
  - There will be no penalty if the robotic car cannot arrive at the finish line within the time limit (3 minutes). The robotic car should be relocated to the start point of the track to kick start the succeeding round.
  - □ The robotic car can push as many food as possible out of the track at the same time in each round.
  - Upon completing each round, the team will have a maximum of 5 minutes to rest or make changes to their robotic car. The position of the food items in the track will remain as they are.
  - The judges should count only those food items that are being pushed out from the track across the finish line. (i.e. If any food items were pushed out through other means, such as over the fence, its score will not be counted and the food item will be returned to its original position for the next round.
  - Participants are not allowed to adjust the car manually, or step into the track under any circumstances when the competition is in progress. Teams that violate the rules will be suspended for one round or may be disqualified.
  - Within the 3 rounds, each team will have 2 chances to "Ask for Help" when their car were stuck on the track. Upon using the chance, the staff will help adjust the position of the car on the track as appropriate to continue the competition.

- Part II- "Recognising food":
  - Part II of the challenge will start after the Robotic team of a group has completed all the three rounds in Part I.
  - The A.I. team of the group will use their program coded with *Scratch* and *Teachable Machine* to perform object recognition for the food items that were being "delivered" in Part I. The program should be able to calculate the risk indexes for the alien according to the food items it recognises. (For the calculation method, please refer to section (6) Specifications of Artificial Intelligence System)
  - □ This part of the challenge will be divided into multiple rounds. The staff will place <u>one</u> food at the starting point for each round. A team member will have 10 seconds to use the robotic car to send the food item into the designated area of a box specially designed by the A.I. team for object recognition.
  - Only one food can be sent for object recognition in each round. The team member shall repeat the above steps until all the food delivered in Part I were sent for object recognition.
- During the process, participants cannot make any physical contact with the food, robotic car, or the box. The food will be taken away by the staff after each round of recognition.
- Combining Part I & Part II of the competition, the group with the lowest risk index will win. In the event of a tie, the team that completed Part I with the shortest time will be the winner.

#### 3.2) Design Award (Robotic Car)

- Participants are required to build their robotic cars according to section (5)
  Specifications of the Robotic Car. Accessories can be added for decoration purposes.
- PolyU students will help participants to take 5 photos of their robotic car during the first hour on the competition day and upload to the designated website (will be ready in November 2021).
- The Judging Panel will select the best car according to creativity, aesthetics, and usability.

### 3.3) Design Award (Coding for A.I. Program)

- Participants should create the A.I. program according to **section (6) Specifications of the A.I. Program**. They can add any sprites, backdrops, or background story to furnish their program but the background story cannot exceed 3 minutes.
- PolyU students will help participants shoot a video of no more than 3 minutes to introduce the program during the first hour on the competition day and upload it to the designated website (will be ready in November 2021). If the video exceeds 3 minutes, the content after the time limit will not be considered.
- The Judging Panel will select the best program based on creativity, aesthetics, and usability.

### 4) Introduction of The Challenge Cup competition mat

<image><image>

4.1) "The Colon" for Part I, "Cleaning up unhealthy food"

- The pink area of the colon is the race track. The robotic car must navigate within the track during the competition.
- Only one robotic car can navigate on each racing track in each round.
- Participants must stay within the Racers Area (yellow part) outside the track. The robotic car must be operated by a hand remote that governs its Left-and-Right direction. They must also use their DIY foot pedals to move their robotic car forward and backward.
- The entrance and the exit of the track are the same (at the checkered area).



Pushing the food out of the colon (finishing line)	Description
	A food item can only be passed on to Part II for object recognition when it has been completely pushed across the inner margin of the black and white grid.
	A food item that has not been completely pushed acrossed the inner margin of the black and white grid shall not be passed on to Part II for object recognition.
	It is not necessary for the food to stay in the black and white grid. The food item will be counted once it has been pushed across the inner margin of the black and white grid.
	The robotic car can push more than one food item out of the track at a time.



4.2) Part II, "Recognising food":

- Participants must stay within the Racers Area (yellow part) to navigate the robotic car for sending the food items into the box designed by the A.I. team to perform object recognition.
- Participants will need to push the food items collected in Part I (healthy and unhealthy foods) with the robotic car into the box one at a time, with a time limit of 10 seconds.
- If participants fail to push the food into the box for object recognition within 10 seconds, the food item will NOT be used in reducing the sugar, salt and fat levels, but participants are required to press button to run the scratch program for calculating the penalty.
- The front-edge of the two wheels must align with the start line. The edge of the box must be 50cm away from the start line.



Competition flow	Description
	Participants will push the food items collected in Part I with the robotic car into the box one at a time for object recognition. Participants will repeat the above action according to the staff's instruction until all food items collected in Part I have got a chance to be "sent" for object recognition.
	The entire food has to be placed inside the box.
	The robotic car must move away from the box when the "delivery" is done. The whole process (each round) is limited to 10 seconds.

## 5) Specifications of the Robotic Car

• A robotic car must be built according to the list of materials below:

Material	Compulsory (the exact amount	Optional	Optional in terms of the amount to
Microphits provided in the	should be used)		
official competition pack (x2)	✓		
Wukong expansion board			
provided in the official	✓		
competition pack (x1)			
DC motors provided in the	1		
official competition pack (x2)	•		
Plastic wheels provided in			
the official competition pack	✓		
(x2)			
Ball caster wheel provided			
in the official competition		✓	
pack (x1)			
DIY model-building strips			
provided in the official			
competition pack (multiple			
pieces)			

- Participants will be regarded as committing a foul if they were found to have replaced the materials provided in the official competition pack with other materials to boost the car's performance. The Judging Panel reserves the right to ban the car from the competition until it has been revised appropriately.
- The length and width of the robotic car cannot exceed a piece of A4 paper (210 x 297 mm). There is no restriction on the car's height and weight.



- Participants can decorate their car with any accessories.
- The robotic car must be operated by a hand remote that governs its Left-and-Right direction; and a DIY pedal(s) that make(s) the car go Forward and Backward.
- Each robotic car will be assigned a unique radio channel to ensure that the performance of an individual car would not be affected by other cars.
- To ensure a fair competition, the Judging Panel will check each car to ensure that they were built up to standard.

### 6) Specifications of the Artificial Intelligence System

- The A.I. system must be coded with *Scratch*, and connected to *Teachable Machine* for object recognition.
- Participants should design their program in such a way that when a certain key is pressed, the program will perform object recognition and calculation of the risk index.
- The program should set the sugar, salt and fat levels to 100 as defaults respectively. When a food item is being "scanned" for object recognition, it may lead to a corresponding increase or decrease in the risk index. For details, please refer to scoring chart on Page 13.

		Sugar	Salt	Fat	Risk index (300)
		(100)	(100)	(100)	– Sugar + Sait + Fat
Bread		-5	-5	-5	-15
Pizza		0	-15	-15	-30
Cake		Will	lannounce	e on the d	ay of the competition
lce-cream		-15	0	-5	-20
Hamburger	8	-5	-15	-10	-30
Egg tart		-10	-5	-10	-25
French fries		Will announce on the day of the competition			
Fried chicken		-0	-10	-15	-25
Coke		-10	0	-10	-20
Popcorn	Reconv.	-10	0	-5	-15
Healthy Food (Penalty)*		-	-	-	+15

\* When a healthy food is being pushed out of the track or the A.I. program fails to recognise a food item, the team will have a 15-point increase for the risk index.

• The calculation of the **risk index = sugar level + salt level + fat level + penalty**. The smaller the risk index, the better the health condition.

Risk Index	Health Condition
>220	Unhealthy
151 - 220	Average
<151	Very healthy

- The program needs to clearly display the changes in levels of sugar, salt, fat, penalty, and the overall risk index.
- Participants can design the sprites, backdrops, and background story of the program as long as the background story is under 3 minutes. For details, please refer to the information in section (3.3) Design Award (Coding for A.I. Program).
- If participants fail to use their program to calculate the risk index accurately or fail to display any one of the risk-index components (i.e. sugar level, salt level, fat level, penalty), 50 points will be added on top of the final risk index worked out manually by the Judging Panel as a penalty.

# 7) Specifications of The Box for Part II

- Participants will design a box for food recognition in Part II of The Challenge Cup.
- The length and width of the box cannot exceed A3 size (297 x 420 mm), and the height cannot exceed 300mm. There is no restriction on the materials used for making the box as long as it can perform object recognition for the food items.
- The box should be equipped with a USB webcam connected to the A.I. program to perform object recognition.

## 8) Rules and Points to note

- Any objections to the decisions made by the Judging Panel during the competition should be made immediately at the end of each round. The Judging Panel reserves the right to decline objections that were "voiced too late" in order to keep the competition going.
- Competition results rest on the final decision of the Judging Panel and Organiser. Participants must not display any insulting or offensive behavior towards other participants, judges, or staff.
- Participants must not present any insulting or sensitive text or pictures on any of products being used in the competition (i.e. A.I. program, robotic car, box for object recognition).
- The Organiser reserves the right to to modify the Competition rules. Violation of the above rules could result in disqualification without no rooms for objection.