Intelligent Service Competition (i-Service)
– Delivery Robot Group

1. Background

In recent years, automation equipment has gradually been integrated into production line systems, involving plenty of concepts of Industry 4.0. The unmanned transport vehicle, which can move along a predetermined path or programmed routes, is used for logistics planning, production experience, control logic, and mass production implementation and can stably perform various types of logistics and transportation work.

The application of robots continues to expand, increasing the possibilities for innovation and creative applications. Therefore, how integrating robot-building technology and creative thinking ability into the education system and systematically promoting interdisciplinary robot technology learning and education has become an important issue. Through the i-Service Smart Service Competition - Delivery Robot Project, we aim to enhance the foundation of science and technology education and strengthen the future competitiveness of Taiwanese students.

2. OVERVIEW

The rapid development of artificial intelligence technology has allowed robot applications to enter various aspects of life. For example, robots can be used in restaurants to deliver food to customers. This year, "Contactless Delivery Service" is emphasized in response to the pandemic prevention, which aims to reduce the chances of contact between people and avoid the risk of virus transmission.

As the possibility of robot application in daily life increases, using automatic guided vehicles (AGVs) in delivery services is worth exploring and implementing. Our goal for this year is to construct an AGV mobile robot, which we plan to deploy in a simulated field containing four tables. The robot's first task is to guide the judge to their seat and take their order. After that, it should deliver the food and drinks to the designated table. Lastly, the robot will use visual recognition to help the judge order more food. In addition, there will be a dynamic obstacle during the delivery process, and no threats to human or object safety are allowed.

3. Rules

(1) This is a multi-age competition; with 2 to 4 team members.

(2) The competition is open to vocational school students.

(3) On the day of the competition, competitors must check in and go through inspections according to the schedule announced by the organizer.

(4) On the day of the competition, after all teams have arrived, the order of their performance will be randomly selected by drawing.

(5) After the draw, teams must have their robots checked and then practice on the competition field. Before the start of the official competition, the vehicles must be placed in the designated area for inspection, and no further adjustments to the software or hardware (including batteries) are allowed.

4. Field Map and Description

(1) The field is a simulated restaurant environment of 600 × 800 cm.

(2) Blue lines represent the walls, with a maximum height of 75cm ± 5cm, depending on the competition field.

(3) The simulated space contains four tables, each with four chairs and a counter for meal preparation. The backs of the chairs will be at least 50cm apart from each other.

(4) Each table is covered with a tablecloth, no more than 10cm from the ground, depending on the competition field.

(5) The Starting Area is a green square that is 90cm x 90cm, and the robots must stop in a red square measuring 75 cm × 75 cm at the correctly numbered table.

5. Robot and Delivery Items
(1) Robot Specifications

   a. Hardware Size: Length and width not exceeding (L) 33cm x (W) 33cm. The LiDAR must be installed 18cm-30cm above the ground, while the visual module can be installed anywhere.

   b. The placement of the tray must be at a height of 65cm ± 5cm above the ground.

   c. Program Control Software: ROS BASE.

   d. Navigation: LiDAR must be used for navigation.

   e. Visual recognition: No restrictions.

f. The robot can be connected to an external keyboard, a mouse and a speaker, and a display (must be fixed on the robot)
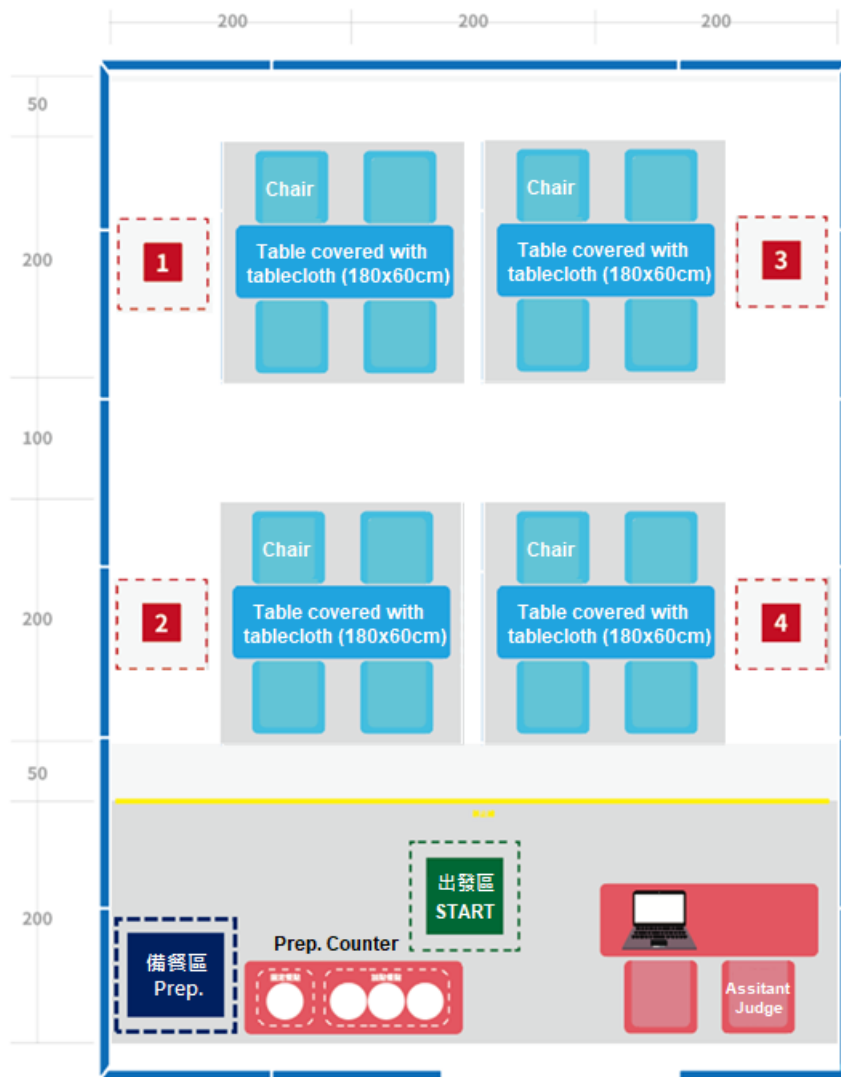

Figure 1: A layout of the simulated restaurant environment (cm)

Figure 2: Reference Dimensions for the Waiting Area (Red Box), Starting Area (Green Box), and Meal Preparation Area. (Blue Box)

(2) Delivery Items

a. The transported items are a circular tray with a maximum diameter of 33cm containing a 0.6-liter drink bottle, cup (8/10 full), fruit platter, and a bowl of noodles with sauce.

b. The weight is less than 5kg.
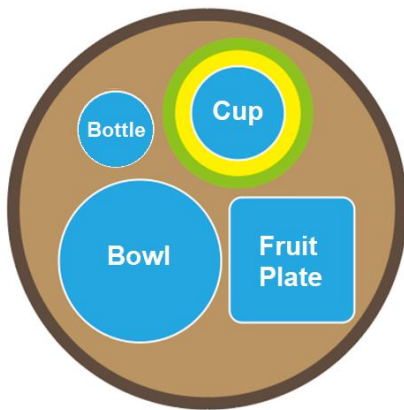
(3) Add-on Card

The judge can order more meals by using an add-on card.

Figure 3: depiction of Add-on cards. The actual content will be based on the announcement made on the day of the competition.

(4) A Dynamic Obstacle

In every round, a dynamic obstacle will be added to the Field during the meal deliveries, and they will move freely. The size of the obstacle will be within 33cm x 33cm x 60cm.

6. Robot Tasks and Rules:

There are two rounds in the competition. At the beginning of the competition, the robot stops at the green Starting Area.

Round 1: Customer seating, table delivery, an additional order

Round 2: Customer seating, table delivery, an additional order

The total score is calculated by adding up the scores of both rounds.

(1) Four table number cards will be drawn. If the team draws a card for the back area (tables 3 and 4) in the first round, they can only draw one for the front area (tables 1 and 2) in the second round, and vice versa.

(2) The team is responsible for placing the delivery food weighing less than 5 kg to the drawn table.

(3) Then, the judge will select an "Add-on Card" for the robot to recognize. The robot must return to the green Starting Area, where the team will place the additional food item(s) designated by the judge onto the robot. The robot will then deliver the item to the judge and stop at the corresponding red Waiting Area.   (Note: The add-on card will not be provided to the team.)

7. Rules

(1) Before the competition, a drawing will be held to determine the table numbers for the two rounds of the competition.

(2) The robot will autonomously move to the designated destination after the team operator sets the seating destination.

(3) There are two rounds in the competition.

Round 1: Customer seating, table delivery, an additional order

Round 2: Customer seating, table delivery, an additional order

The total score is calculated by adding up the scores of both rounds and will determine the ranking order. In case of a tie, the whole time spent on completing the tasks in both

rounds will be compared, and the team with a shorter time will rank higher. If the scores and the whole time spent on the tasks are still tied, the results of the tables in the back area (tables 3 and 4) will be compared to determine the final ranking.

(4) Each team has 4 minutes for tuning before the competition. Before the start of the competition, the competitor must place the robot in the green Starting Area. After the whistle blows to start the game, only one operator can stay inside the field, and the remaining team members must stand outside the gray wall.

(5) Once the whistle blows to begin the round if the robot does not move or respond for 2 minutes at any point during the round, the task will be considered incomplete, and the score for that round will be 0 points.

(6) At least one judge should sit at the designated table according to the table number drawn by the player.

(7) Once the competition starts, the robot must guide the judge to the drawn table and stop at the relative Waiting Area. If the robot leads to the wrong table, that round of the competition will end with no points. The robot must remain still for 3 seconds after leading the judge to the correct table (timing is paused during this period, and no movement is allowed). Only after receiving the order from the judge can the robot leave (continue timing). To order food, the judge will give the robot a QR code card to scan. After receiving the order, the robot must return to the Meal Preparation Area to prepare for the first meal delivery.

(8) For the first meal delivery, the competitor must put the correct meal on the robot. The robot should immediately deliver the meal to the judge. After providing the meal to the designated table, the robot must stay still for 3 seconds in the waiting area (timer paused) before the judge takes the meal. The judge will then provide an Add-on Card for the robot to scan. The robot must return to the Meal Preparation Area for the second meal.

(9) After the competitor puts the correct second meal on the robot, the robot should immediately deliver it to the judge. After arriving at the designated table, the robot must stay still for 3 seconds in the Waiting Area (timer paused) before the judge takes the meal. The judge will then provide a card for no more orders. The robot must then return to the Starting Area to complete this round.

(10) A dynamic obstacle will move freely in the Field during the meal deliveries. The obstacle will not exceed the size of 33cm × 33cm × 60cm.

8. Scoring

(1) Scores for Each Round

The First Meal					Note
Water Cup	No liquid spilled	Liquid spilled within the yellow area	Liquid spilled within the green area	The cup dropped out of the tray	
	10 points	5 points	1 point	0 point	
Bottle	Intact and upright in the tray	Tilted but still in the tray	The bottle dropped out of the tray.		
	10 points	5 points	0 point		
Fruits	Intact and placed on the fruit plate	Rolled out of the plate but still in the tray	Rolled out of the tray		
	10 points	5 points	0 point		
Rice/ Noodles	Intact and upright in the tray	Tilted but still in the tray	Rice/noodles dropped out of the tray.		
	10 points	5 points	0 point		
Still in the box for 3 seconds	Still, for 3 seconds		Still less than 3 second		
	5 points		0 point		
The Add-on Meal					**Note**
The Correctness of the Meal	Correct Meal		Wrong Meal		
	5 points		0 point		
Location Accuracy	Correctly delivered to the designated table.		Delivered to the wrong location		Points are not counted if the meal is incorrect (0 point)
	5 points		0 point		
Contents	No liquid spilled	Liquid spilled within the green area	Liquid spilled within the brown area or spilled outside the tray		
	10 points	5 points	1 point		
Still in the box for 3 seconds	Still, for 3 seconds		Not still for at least 3 second		
	5 points		0 point		
				Total	70 points

(2) The competition consists of 2 rounds; each round is worth a total of 70 points.