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

1. Background

As automation technology moves towards systematic integration, the Industry 4.0 wave has transformed unmanned vehicles (AGVs/AMRs) from simple path-following devices into intelligent terminals with complex control logic and logistics planning capabilities. These vehicles not only stably perform material handling tasks but also symbolize the digital transformation of production sites and service spaces.

The application of robotics technology is extending from industrial production to daily services, multiplying the potential for innovative applications. Therefore, seamlessly integrating robot hardware with cross-disciplinary creative thinking and systematically incorporating it into the education system has become a core key to enhancing the quality of future technology talent. Through the i-Service Smart Service Competition – Delivery Robot Project, this competition aims to deepen students' scientific literacy and practical skills, thereby strengthening the core competitiveness of Taiwanese youth in the international market and smart industries.

2. OVERVIEW

With breakthroughs in artificial intelligence and sensing technologies, service robots have officially transcended industrial boundaries and become an important part of modern smart living. Especially in dining spaces, robot food delivery services not only effectively optimize human resource allocation but also provide stable and high-quality contactless service, reducing hygiene risks in the environment and becoming a key indicator of smart restaurant transformation.

The core task of this competition is to create an AGV/AMR autonomous mobile robot with high environmental adaptability. In a simulated real-world scenario with five tables, participants will perform the following tasks:

1. The first task is to guide customers from the restaurant entrance to their designated seats and complete the ordering process.
2. The second task is to accurately deliver meals and beverages from the preparation area (back kitchen) at the back of the restaurant to designated table numbers and accept additional orders from customers.

3. The third task is to deliver the additional orders to customers and then return to the restaurant entrance to await the next group of customers.

To simulate the complex dynamics of a real restaurant, the difficulty has been increased this year, with two randomly moving obstacle robots appearing along the delivery path. The participating robots must avoid collisions in real time in a dynamic environment to ensure absolute safety protection for personnel and objects throughout the entire task.

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 five 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.

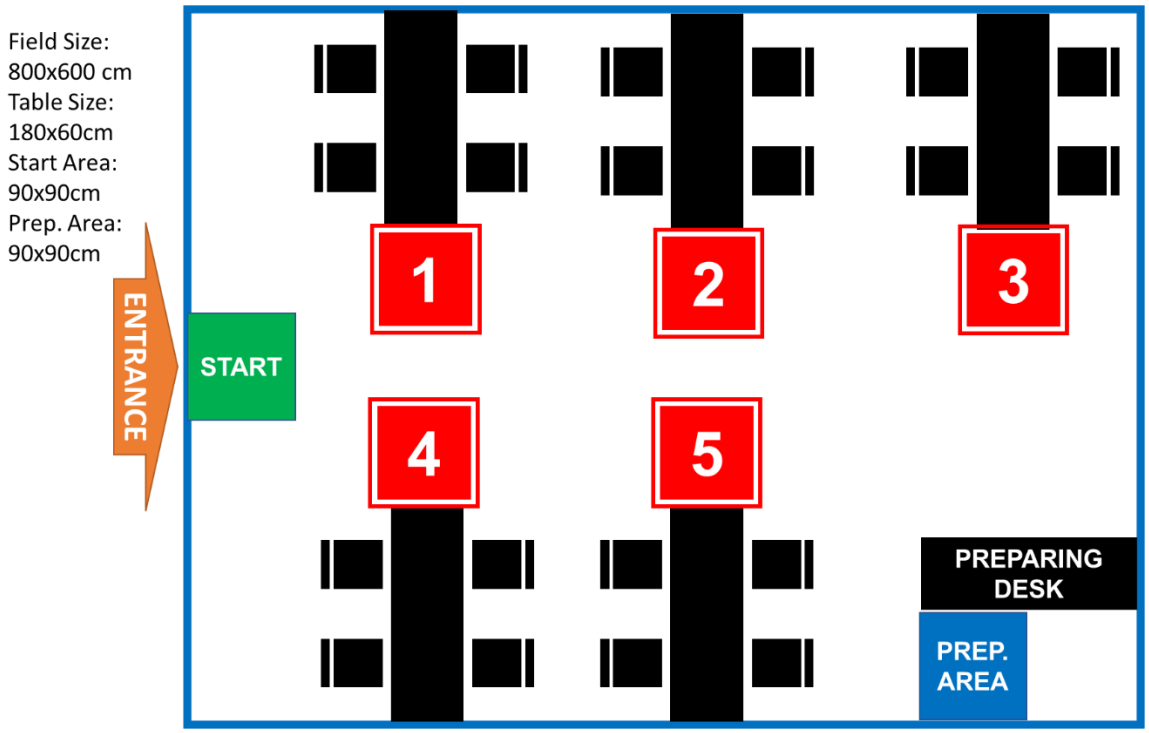

Figure 1: A layout of the simulated restaurant environment (cm)

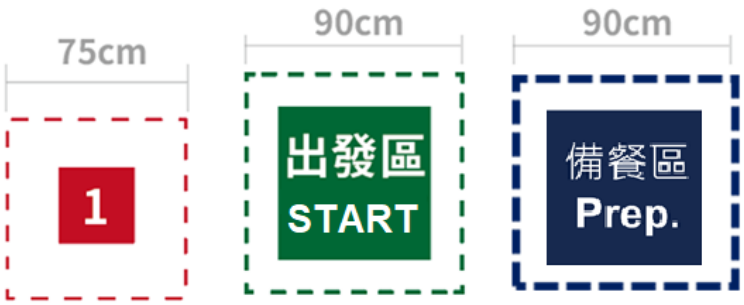

Figure 2: Reference Dimensions for the Waiting Area (Red Box), Starting Area (Green Box), and Meal Preparation Area. (Blue Box)

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

(2) Delivery Items

a. The transported items are a circular tray with a maximum diameter of 33cm. Depending on the order, the tray may contain a 0.5-liter PET bottled beverage, a cup (8/10 full), a fruit platter, and a bowl of noodles with sauce. As shown in Fig. 3.

b. The weight is less than 5kg.

Figure 3: Tray and contents.

(3) Add-on Card

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

Figure 4: depiction of Add-on cards. The actual content will be based on the announcement made on the day of the competition.

(4) Dynamic Obstacles

In every round, at most two dynamic obstacles 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) Five table-number cards will be drawn. If the team draws a card for the back area (tables 2, 3 and 5) in the first round, they can only draw one for the front area (tables 1 and 4) in the second round, and vice versa.

(2) After leading the judge to their assigned table and taking their order, the robot should proceed to the blue Preparation Area where the team can place the food tray onto the robot. The robot should then deliver the food to the judge.

(3) Then, the judge will select an "Add-on Card" for the robot to recognize. The robot must return to the blue Preparation 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.)

(4) After delivering the additional food, the robot should return to the green Starting Area.

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 front area (tables 1 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 move to the Preparation Area (The orthographic projection must be completely within the box) 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 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 (completely in the border area) to complete this round.

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

(11) In the absence of obstacles, the maximum time limit for each single trip for the robot is 1 minute and 30 seconds (90 seconds) from the starting area to the assigned table, from the assigned table to/from the preparation area, and from the assigned table back to the starting area. In the presence of obstacles, the allowance for each single trip is increased to 2 minutes (120 seconds). If the time limit is exceeded, the competition ends, and points are awarded based on the completed tasks.

8. Scoring

(1) Scores for Each Round

Leading to the Table				**Note**
Correct table and still in the box for 3 seconds	Still, for 3 seconds	Still less than 3 second	Wrong table	
	5 points	0 point	0 point	

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**
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	80 points

(2) The competition consists of 2 rounds; each round is worth a total of 80 points.