

# Intelligent Service Competition

## Test Project : Automatic Warehouse Robots

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# 1. Competition Rules

## (1) Goal

With the development of technology and automation, the concept of unmanned warehouses has become quite popular in recent years. This competition aims to inspire student creativity and deepen their understanding of autonomous warehouse robots.

Competitors will design a mobile robot capable of recognizing information in QR codes, picking up specified objects, and stacking them in **Object Placement Zone**. The robot must also interact with humans by receiving packages and transporting them to designated areas, then finally returning to the **Starting Zone** to complete the task.

## (2) Rules

- a. Eligibility: Students in high school or above.
- b. Registration: Register online with no fee required.
- c. Team Composition: Each team must consist of 2 to 3 members and 1 advisor. Once registered, team members cannot be changed or duplicated in other teams.
- d. Robot Autonomy: Robots must operate **autonomously** throughout the competition.
- e. Controller: Each robot is **limited to one controller** (any brand).
- f. The size of the robot body (length, width, height) is limited to 60 cm or less, and the weight is limited to 30 kg or less.
- g. Parts and Assembly: The robot must be built with building blocks or homemade parts. Commercially available finished products are not allowed.
- h. Consistency: The same robot must be used for the entire competition; substitution with another robot is not permitted.

## (3) Indicator Lights and the Emergency Switch

The emergency switch and indicator lights must be installed **at the highest position** of the robot. The specifications of the robot indicator lights are as below:

Green	Power on
Yellow	Robot in Motion
Red	Emergency Switch Pressed

#### **(4) Match Period**

Each match period is 4 minutes. 1 minute for preparation and 3 minutes for a robot to operate. The competition order is based on the workstation number.

#### **(5) Start and End of the match**

- a. During the competition, competitors are not allowed to enter the competition field or touch the robot, except when placing packages. If a competitor violates this rule, the match will end immediately, and the score will be based on the situation at that time. Competitors may only enter the competition area after the match is over.
- b. Judges will score the robot for each match. Competitors must confirm their scores before leaving. No objection to the results will be raised after leaving the field.
- c. Matches start and end based on the timer's or judge's signal or whistle.
- d. Before each match, the robot and equipment must be inspected. Teams that do not pass inspection will be disqualified and receive a score of zero for that match.
- e. If the robot becomes uncontrollable, a judge or robot operator can enter the field and press the emergency switch to stop it. The match will end, and the score will be based on the situation at that time.

## 2. Competition Field and the Task

### (1) Field

The playing field will be a 240cm×240cm square area surrounded by Cagebot pieces, as shown in Figure 1. The walls and partitions between each zone will be built using 7-cm-height / 1-cm-width Cagebot pieces. No tape will be applied to the walls. The bottom of the field is covered with a layer of a 5-mm-thick PP (polypropylene) plastic board. The **Starting Zone** and **Pickup Zone** will be marked with electrical tape. The 3D diagram of the field is shown in Figure 2. (The dimensions in Figure 1 are for reference only, and the actual ones will be based on the playing field, with a 3 cm tolerance for each measurement.)



Figure1: Field Layout (mm)

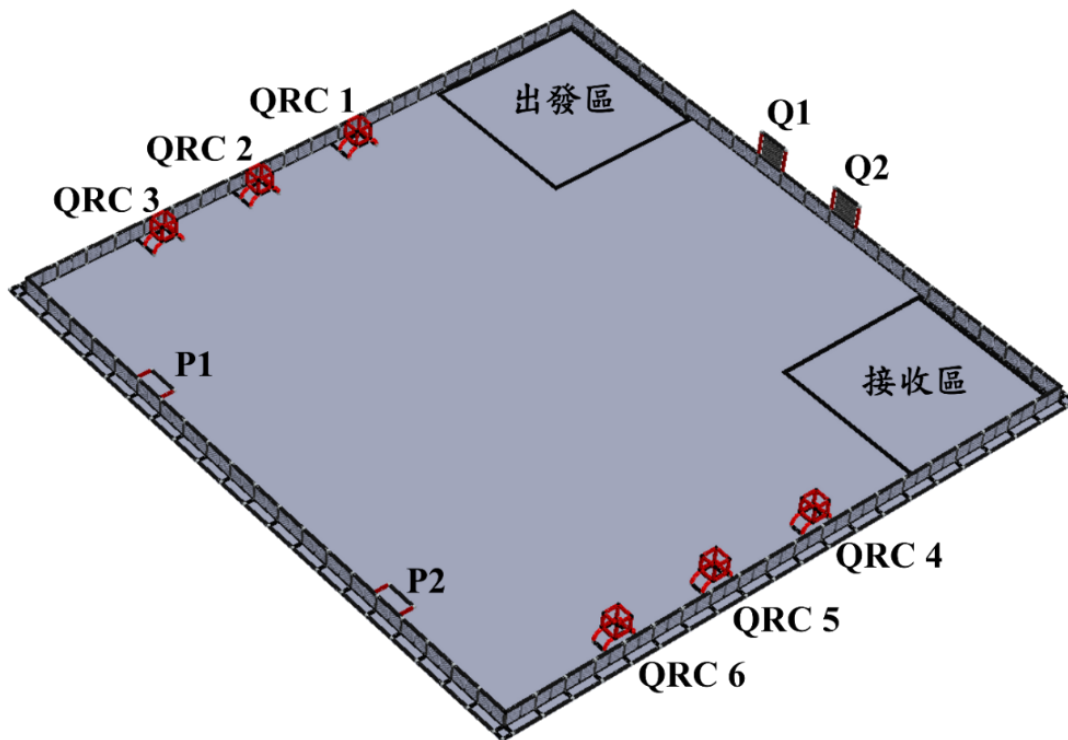


Figure 2 Three-dimensional Field Layout

## (2) Task

During preparation, the competitor inputs the location of the **Object Placement Zone** (P1 or P2) into the robot. After the round starts, the robot starts from the **Starting Zone**, moves to the **Task Boards** (Q1 and Q2, as shown in Figure 3), and scans the QR code on each board (Figure 4). According to the task order (Q1 first, then Q2), it stacks and places the designated objects (the Q2 **Object** must be fully supported by the Q1 **Object**) in the **Object Placement Zone** (P1 or P2). Then, the robot moves to the **Pickup Zone** to collect a package (**Object**, as shown in Figure 6) from the competitor and places it in the **Drop-off Zone**. (P1 or P2. For example, if the **Object Placement Zone** is P1, then the package should be placed in P2.) After completion, return to **Starting Zone** to end the task.

- a. After inspection, the **Objects** (Q1 and Q2) and the **Object Placement Zone** are randomly selected from QR codes numbered 1 to 6. The order of the drawn QR codes decides which **Objects** are Q1 and Q2, and the location of the **Object Placement Zone**.
- b. The **Object Placement Zone** (either P1 or P2) is decided based on the drawn QR code number: if the QR code is 1, 2, or 3, the **Object Placement Zone** will be P1; if the QR code is 4, 5, or 6, the **Object Placement Zone** will be P2.
- c. The competitors can touch and operate the robot only when placing the package to continue the task.

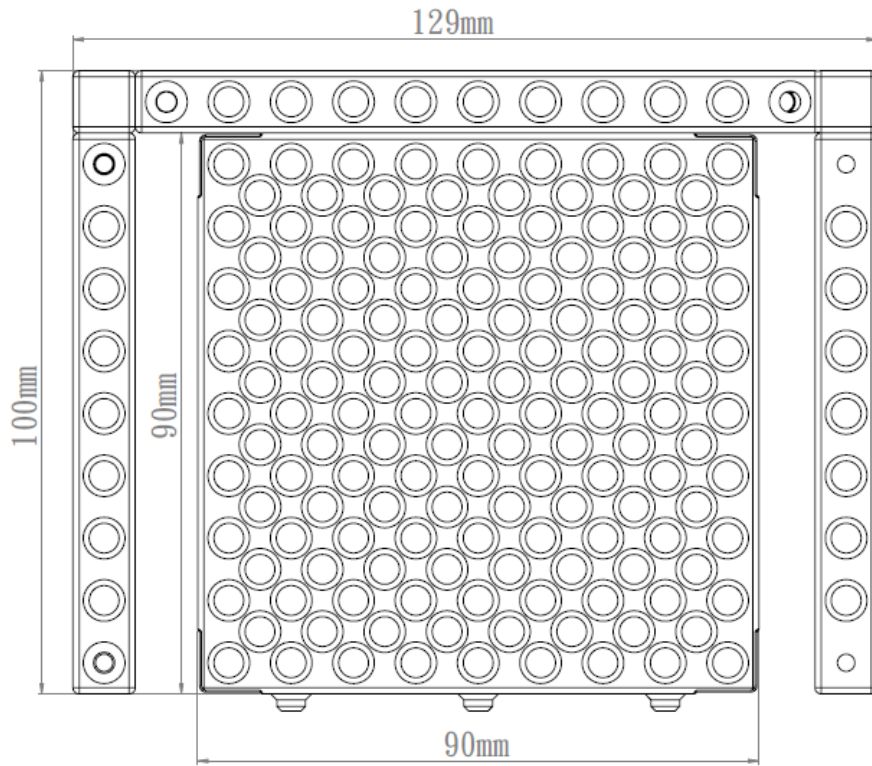


Figure 3 Task Board(mm)

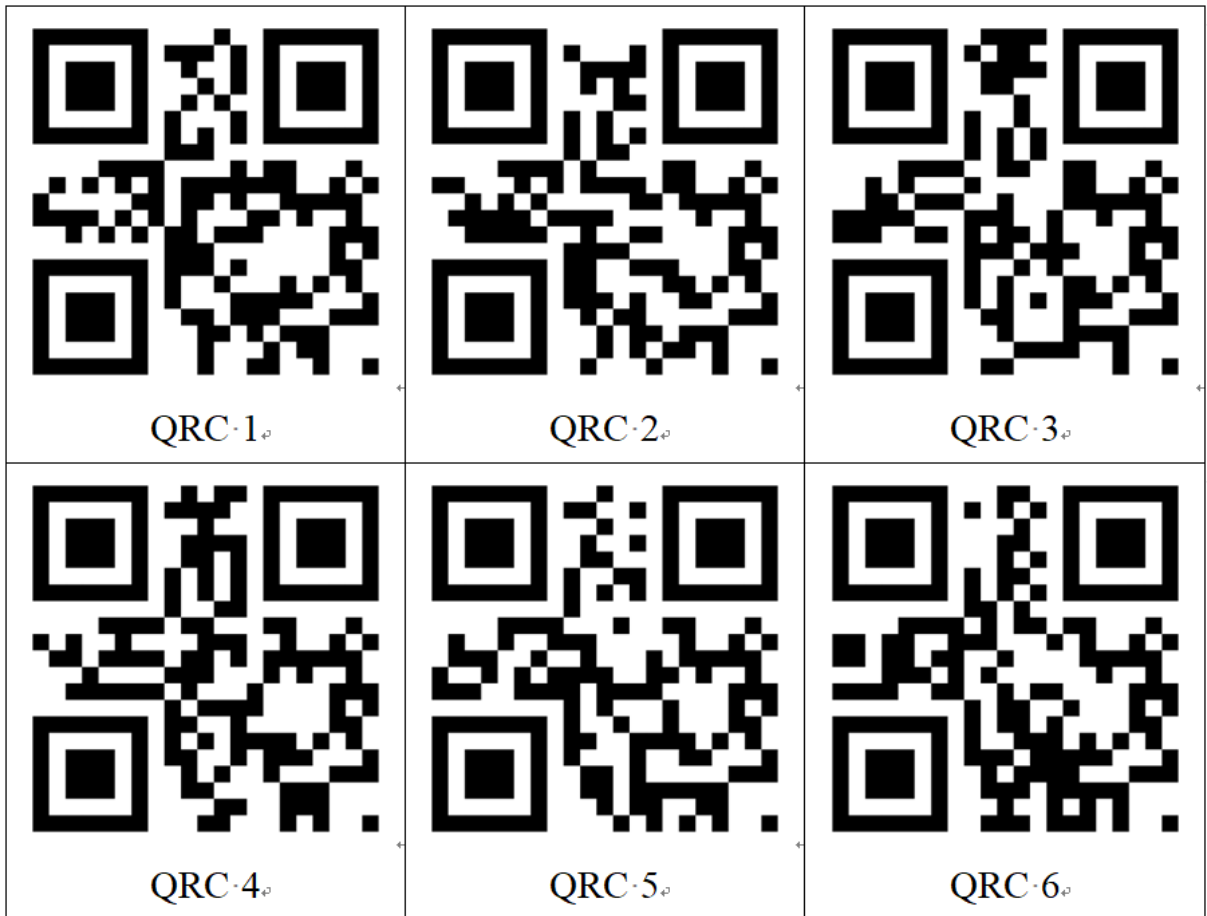


Figure 4 QR Code(9x9cm)

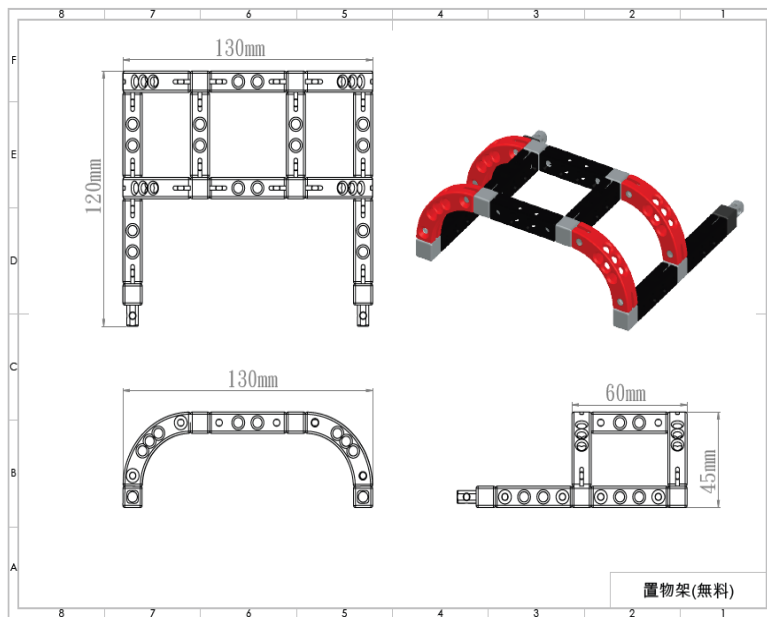


Figure 5 Storage Shelf where the robot takes objects from (mm)

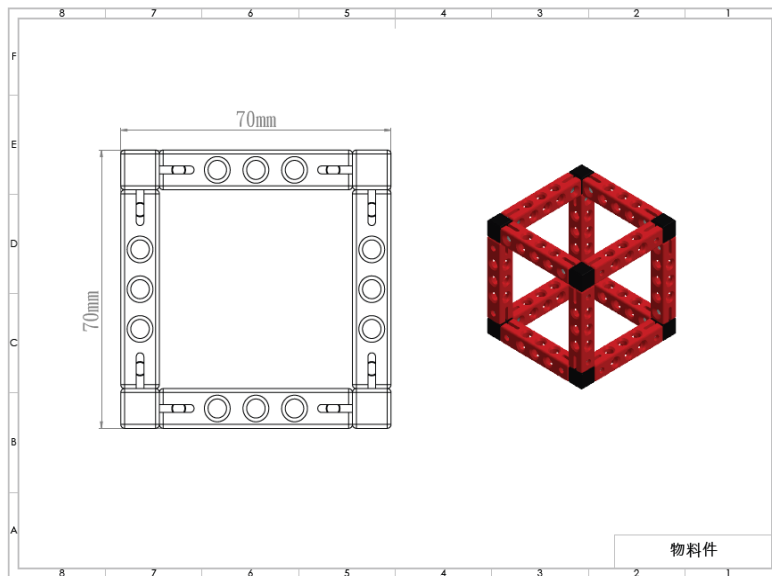


Figure 6 Object (mm)

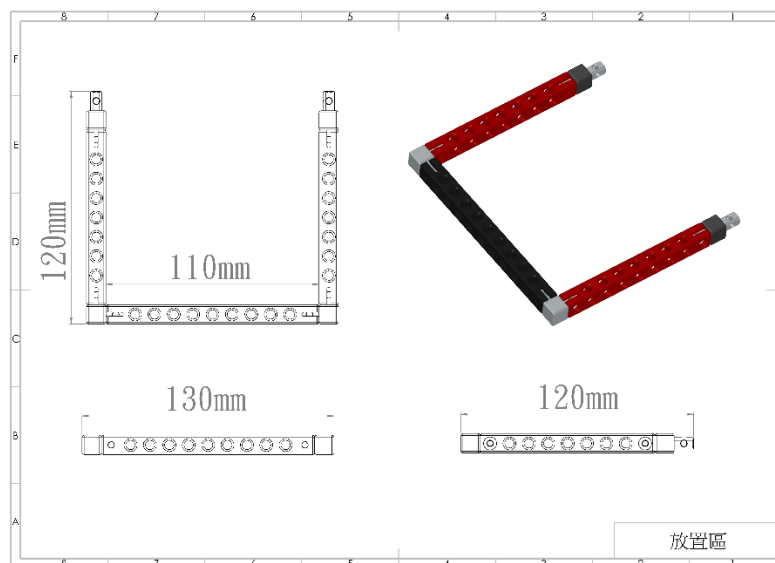


Figure 7 Deposit Shelf where the robot delivers objects to (mm)

### 3. Competition Guidelines

- (1) There are two rounds in the competition. The ranking criteria are as follows:
  - a. Higher score.
  - b. Shorter completion time of the higher score.
  - c. Lower score (if higher scores and completion times are equal).
  - d. Shorter completion time of the lower score (if lower scores are equal).
- (2) Competitors must wear neat clothing and closed-toe shoes.
- (3) **Objects** and placement zones are drawn after inspection.
- (4) The **Object Placement Zone** is determined by a draw. During preparation time, competitors must input this information into the robot using the QR code drawn.
- (5) The objects are placed by the competitors. Please ensure that one side of each piece is parallel and aligned with the outer edge of the storage shelf.
- (6) Programs must be loaded onto the robot before inspection. Once inspected, the robot must be turned off and cannot be modified.
- (7) After leaving the field, no form of evidence (including photos or videos) will be accepted to adjust scores.
- (8) If a robot completes a round with a zero score, the round time is counted as 3 minutes.
- (9) After the match, robots should be placed back in the inspection area and wait for all other robots to finish. Only retrieve your robot with the permission of the judge.
- (10) The practice will be based on the number of players' workstations. The practice time for each team is 8 minutes (tentative).
- (11) The field dimensions will be determined on the day of the competition. No tape will be applied to the walls.
- (12) Any unspecified matters will be decided by the judges based on the situation at the venue.



## 4. Competition Schedule

<b>Time</b>	<b>Events</b>
08:00-09:00	Check-in
09:00-12:00	First Practice Session
12:00-12:50	Lunch Break (Robot Adjustment and Maintenance)
12:50-13:00	Inspection
13:00-14:00	First Official Match
14:00-15:00	Second Practice Session (By Registration)
15:00-15:10	Robot Adjustment and Maintenance (No Practice )
15:10-15:20	Inspection
15:20-16:20	Second Official Match
16:20-16:50	Score Tallying
17:00-17:30	Award Ceremony

The schedule may change depending on the ongoing conditions on the competition day.

## 5. Marking Scheme

Task	Points	Score		
Indicator Lights and Emergency Switch	5	0	5	
Leave <b>Starting Zone</b>	5	0	5	
Q1 Object Removed from Rack	10	0	10	
Q1 Object Correctly Placed( in <b>Object Placement Zone</b> )	10	0	10	
Q2 Object Removed from Rack	10	0	10	
Q2 Object in <b>Object Placement Zone</b> /Correctly Stacked on Q1	5/20	0	5	20
Enter <b>Pickup Zone</b>	5	0	5	
Partially / Completely Collect Package in <b>Pickup Zone</b>	10/20	0	10	20
Package Correctly Placed	10	0	10	
Return to <b>Starting Zone</b>	5	0	5	
Non-designated <b>Object</b> Removed from Rack	-5	-		
Damage to Field (Penalty)	<10% deduction	-		
<b>Total</b>				
<b>Round Time / Total Score</b>	<b>(seconds)</b>		<b>(points)</b>	

Note:

1. If the judge confirms field damage by the robot, up to 10 points will be deducted for that round.