2024

BRICS SKILLS COMPETITION

(BRICS FUTURE SKILLS & TECHNOLOGY CHALLENGE)

COLLABORATIVE ROBOT

BRICS-FS-30

Test Project

(International Final)

July, 2024

BRICS Skills Competition (BRICS Future Skills Challenge)

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1. Form of participation

Team entry (2 people).

2. Content of the competition

The competition consists of three modules, completed in order. Provide participants with task description, circuit diagram, equipment layout, equipment operation description, as well as data sources or other technical foundations required to ensure the independence and fairness of each task module. The competition includes the following task modules developed based on the application of the collaborative robot training platform:

1) Mechanical installation and cooperative robot pattern drawing

2) The cooperative robot assembly motor before handling and palletizing

3) Cooperative robot with visual Tetris

The competition assignment and scoring criteria can only be changed if the competition site is not completed and approved by the chief expert.

Competitors may be disqualified if they do not comply with occupational health and safety environment requirements, or put themselves and other players at risk.

Participants will score the results after completing the module

3. Project module and time requirements

3.1 Project modules and time requirements

The cooperative robot competition has three modules in the event, which contestants are required to complete within 12 hours. See Table 1 for the specific project module name and time requirements.

Table 1 List of item modules and time requirements

order number	Module name	Completion time of the competition content
1	Module A: Installation and debugging of the assembly and positioning platform, and cooperative robot pattern drawing	240 min
2	Module B: The cooperative robot assembles small motors before handling and palletizing	240 min
3	Module C: Cooperative robot with visual Tetris	240min

Competition Schedule

(The specific time is subject to the time announced by the organizing committee.)

Date	time	Content description
Day 1	8:00-9:00	Welcome ceremony for the contestants. Introduce the competition rules, players are familiar with the competition items, competition environment acceptance.
	9:00-9:30	Contestants collection
	9:30-10:00	The contestant accepts the competition test questions, and the chief expert introduces the competition content
	10:00-12:00	Perform "Module A: Mechanical assembly and cooperative robot trajectory coating"
	12:00-13:00	lunch
	13:00-15:00	Execution: "Module B: cooperative robot assembling small motor after handling and palletizing"
	15:00-17:00	The referee score
Day 2	9:00-9:30	Contestants collection
	9:30-10:00	The contestant accepts the competition test questions, and the chief expert introduces the competition content
	10:00-12:00	Execute "Module C: Cooperative robot with Visual Down Tetris"
	12:00-13:00	lunch
	13:00-15:00	Execution: "Module C: Cooperative robot with visual Tetris"
	15:00-17:00	The referee score
Day 3	9:00-10:00	closing ceremony

3.2 Introduction of task scenarios

Scenario 1: The company has introduced a new set of equipment, requiring technicians to assemble and color-classify the small motors. While completing the assembly and sorting of the motors, we need to learn the track exercises of collaborative robots.

Scene 2: in recent years with the development of the robot, between collaborative robot man-machine collaboration function makes collaborative robot in the service and application more widely, such as: coffee flower robot, tea robot, milk tea making robot, etc., on the basis of the game industry new development collaboration robot Russian scene, need company technical personnel to cooperate robot with visual detection debugging to complete the artificial intelligence robot under the Russian game.

3.3 Introduction of the comprehensive training platform for cooperative Robot technology and application

1. Composition

Collaborative robot, component shelf, sorting conveyor belt, assembly positioning platform, finished material plate, disordered component material plate, excessive material plate, cooperative robot tool platform, 3D vision, 2D vision, upper computer system, programmable controller system, artificial intelligence algorithm platform, digital twin platform, etc.

3.4 Task content

Module A mechanical assembly and cooperative robot pattern drawing

The contestants shall complete the installation and debugging of the assembly and positioning platform of the collaborative robot training platform according to the task requirements. The tasks include the following contents:

1) Assembly of mechanical parts

2) Trpipe connection

3) Installation of the magnetic switch

4) Mechanical debugging

5) Pneumatic commissioning

6) Electrical debugging

Task description: This module is verified by the organizing committee for practical operation view on the collaborative robot training platform.

Task A1: Assembly and positioning platform assembly and debugging

Please assemble according to the mechanical assembly drawing, and install according to the installation location map. Please ensure that screws are fastened reliably, gas tube is inserted correctly and electrical components are installed correctly.

1. Task requirements

1) Assembly is performed according to the assembly diagram

2) Install in the correct position of the platform according to the assembly position required drawings (± 3mm)

3) Conduct the pipe and debug according to the gas diagram

4) Install and debug the position of electrical components according to the schematic diagram

2. Pneumatic schematic diagram

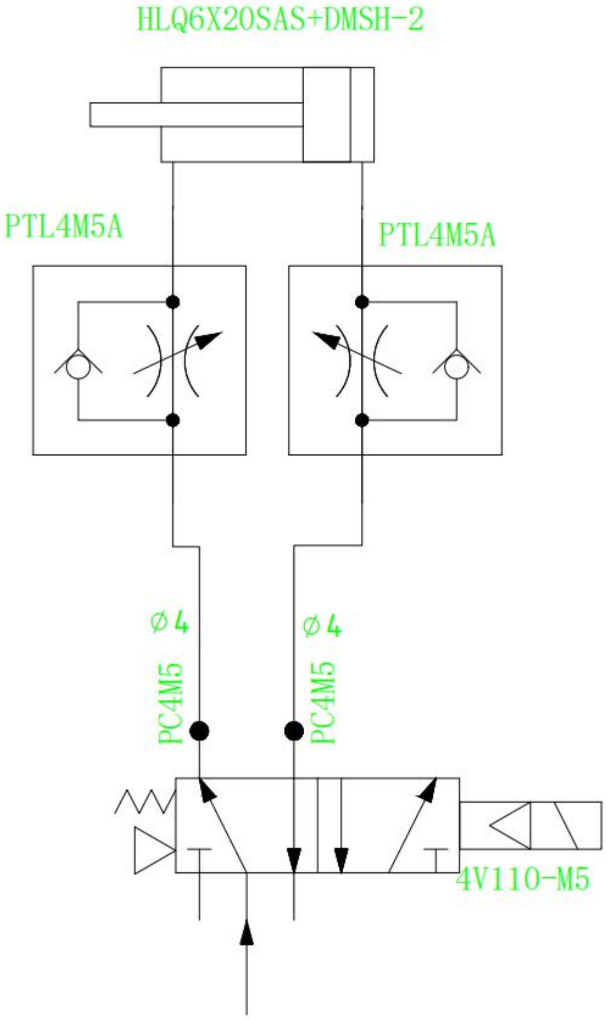


Figure 3 Schematic diagram of assembly and positioning cylinder

3. Electrical schematic diagram (in part)

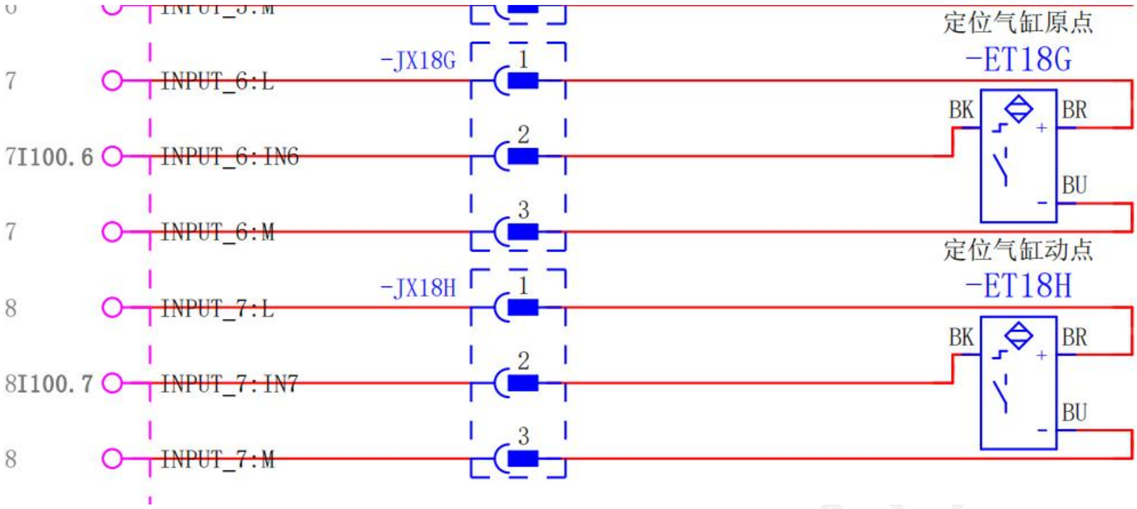
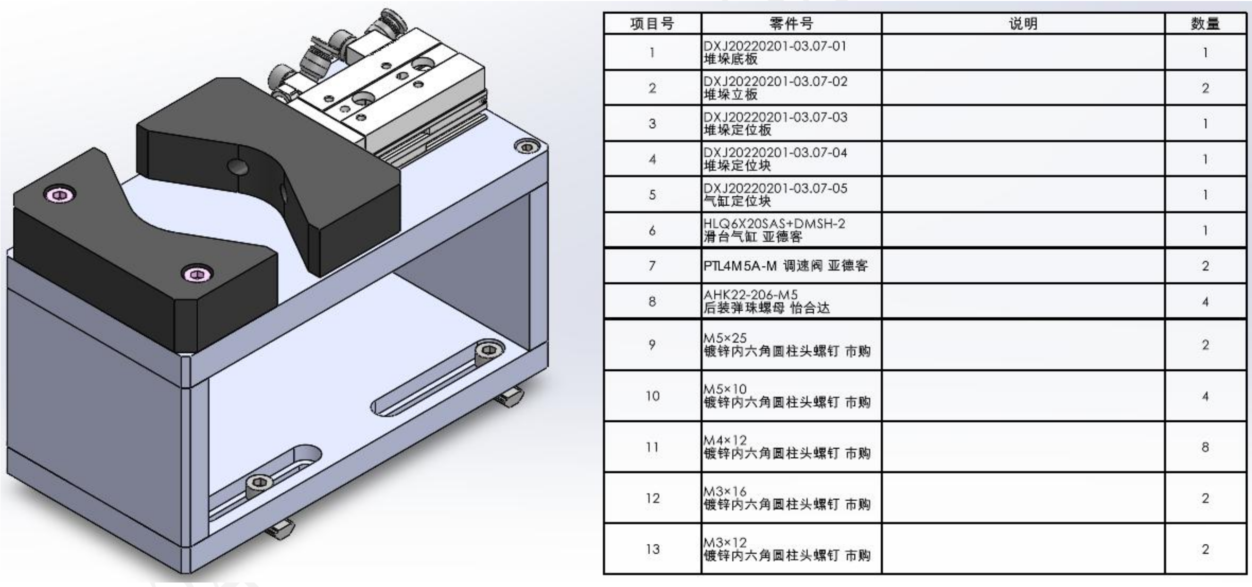

定位气缸原点
-ET18G
7
INPUT_6:L
-JX18G
1
BK
BR
7I100.6
INPUT_6:IN6
2
7
INPUT_6:M
3
BU
定位气缸动点
-ET18H
8
INPUT_7:L
-JX18H
1
BK
BR
8I100.7
INPUT_7:IN7
2
8
INPUT_7:M
3
BU

Figure 4 Schematic of magnetic switching

4. Parts list



项目号	零件号	说明	数量
1	DXJ20220201-03.07-01 堆垛底板		1
2	DXJ20220201-03.07-02 堆垛立板		2
3	DXJ20220201-03.07-03 堆垛定位板		1
4	DXJ20220201-03.07-04 堆垛定位块		1
5	DXJ20220201-03.07-05 气缸定位块		1
6	HLQ6X20SAS+DMSH-2 滑台气缸 亚德客		1
7	PTL4M5A-M 调速阀 亚德客		2
8	AHK22-206-M5 后装弹珠螺母 怡合达		4
9	M5×25 镀锌内六角圆柱头螺钉 市购		2
10	M5×10 镀锌内六角圆柱头螺钉 市购		4
11	M4×12 镀锌内六角圆柱头螺钉 市购		8
12	M3×16 镀锌内六角圆柱头螺钉 市购		2
13	M3×12 镀锌内六角圆柱头螺钉 市购		2

Figure 5. Parts Table

5. Assembly Drawing

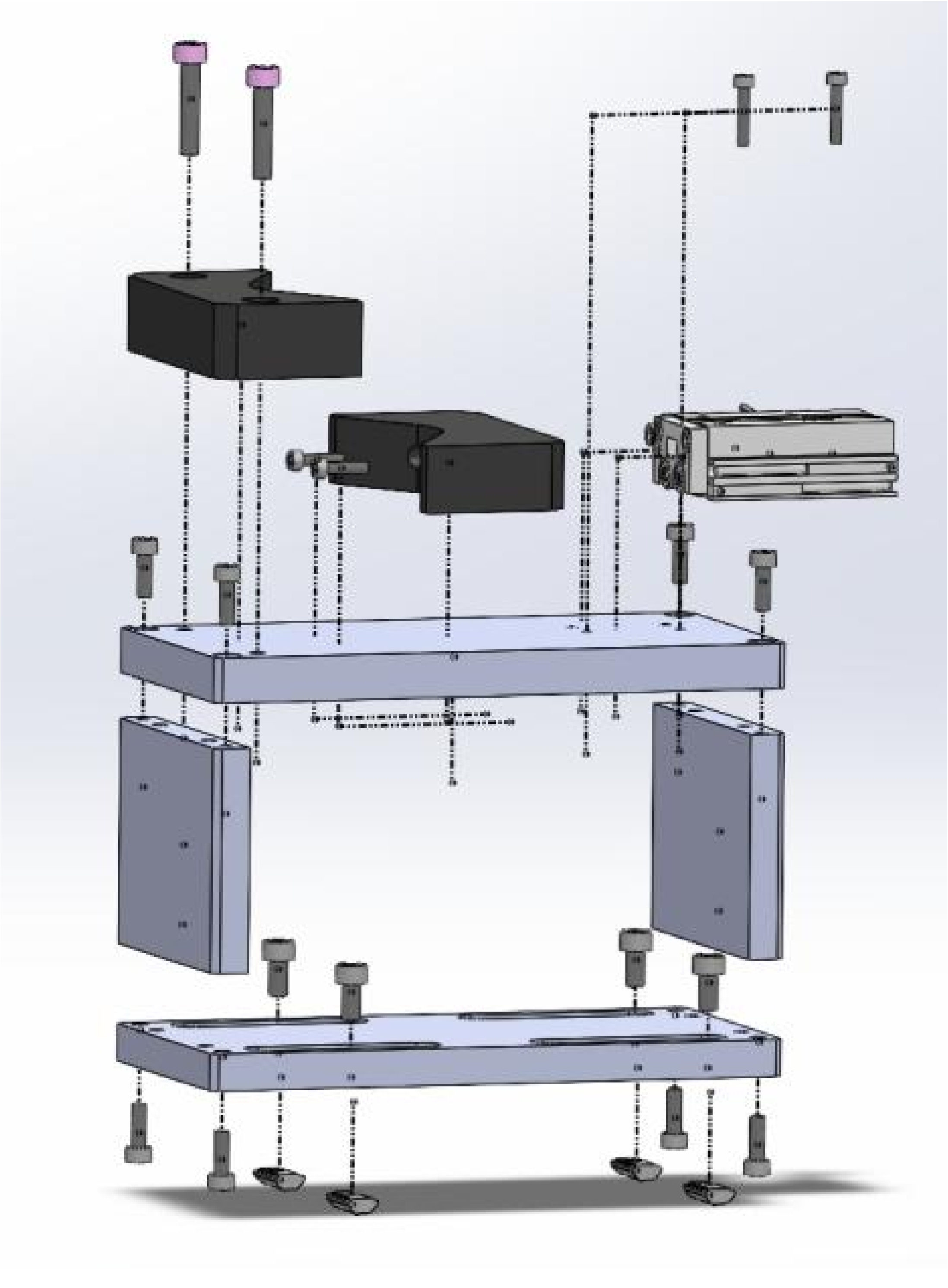


Figure 6 Assembly Fig

6. Installation location requirements

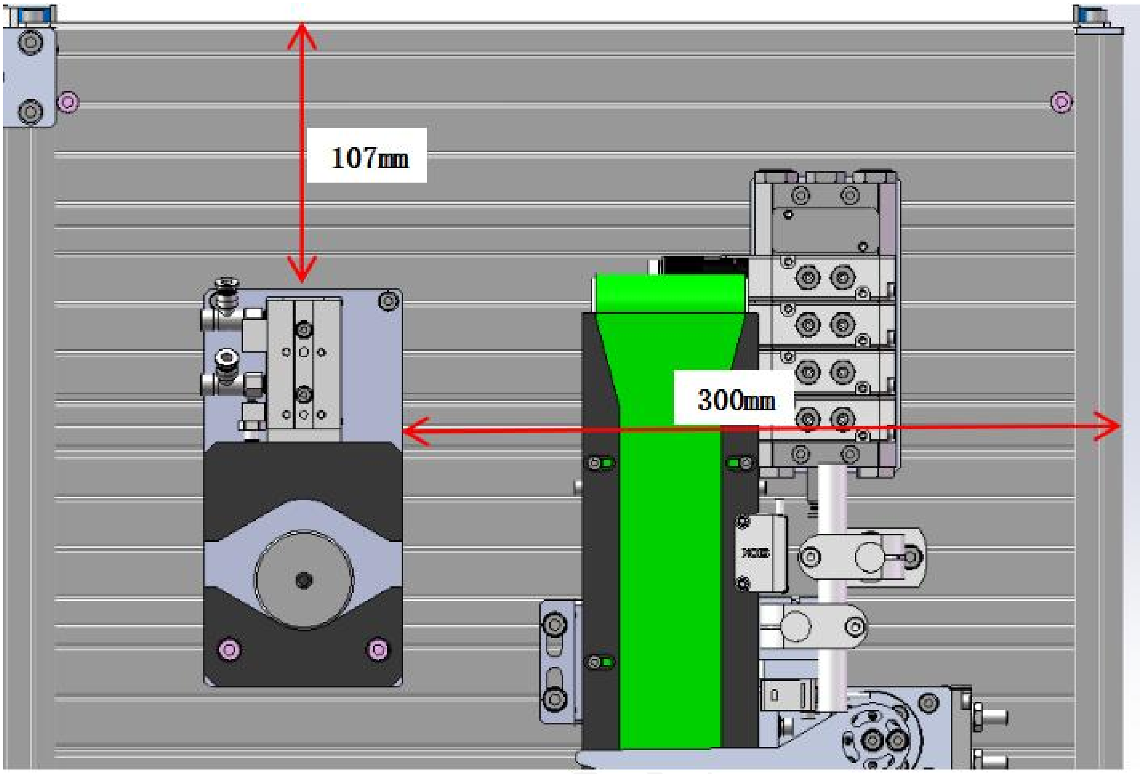


Figure 7. Installation position diagram

A2 Draw the pattern and text according to the pattern of the track table, and take and put the brush tool

The contestants shall complete the robot debugging and teaching according to the task requirements, including the following contents:

1) Edit the automatic program to install the brushes;

2) The editing automatic program draws the corresponding pattern on the track table;

3) Edit the automatic program to uninstall the brushes;

Task description: This module is verified by the organizing committee for practical operation view on the collaborative robot training platform.

Task A2: automatically install the brush, draw the track pattern as shown in Figure 8, and automatically uninstall the brush

1. Automatic program flow of collaborative robot

Please use the teaching ator to program

Specific requirements:

1) The cooperative robot is started and operated at a reasonable initial position;

2) Automatically install the brush, draw the track pattern as shown in Figure 8 (purple), automatically unload the brush, there can be appropriate delay in the middle, and the whole process needs to be completed continuously in one program;

3) No mechanical collision is allowed in the middle;

2. Track pattern

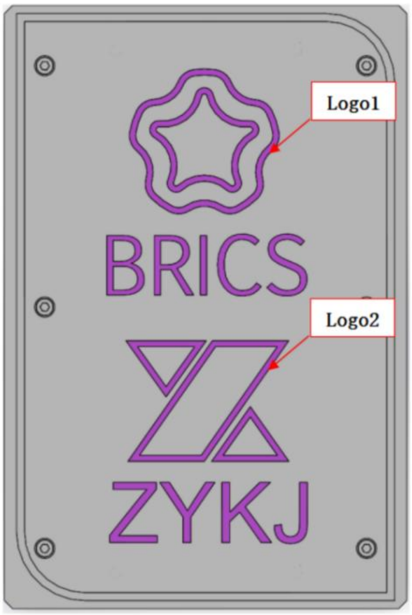


Figure 8. Track pattern

3. tool table

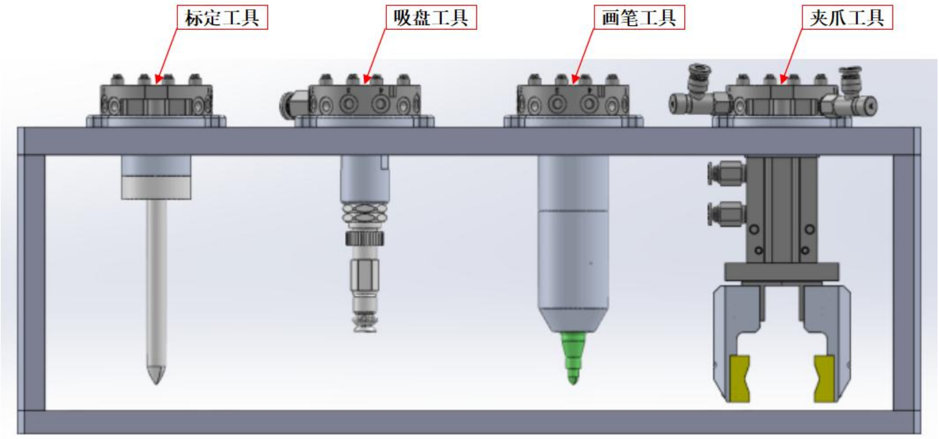


Figure 9. Toolbox table

4. Collaborative robot I / O definition

Table 1 Cooperative robot I / O definition

stitch	The PLCI / O description	Remote I / O description	Robot I / O instructions
SI00			Robot emergency stop circuit 1
SI10			Robot emergency stop circuit 2
DI00			vacuum
DO00			vacuum chuck
DO01			Claw cylinder
DO02			quick-change connector

Module B cooperative robot assembly of small motor after handling and palletizing

The contestants shall complete the robot debugging and teaching according to the task requirements, including the following contents:

1) Automatic installation and unloading of the claw tool;

2) PLC programming;

3) Touch-screen configuration;

4) Motor bottom shell is sorted according to the color;

5) Motor assembly;

6) Finished product motor stacking;

Task description: This module is verified by the organizing committee for practical operation view on the collaborative robot training platform.

Task B 1: Motor base case according to color sorting, motor assembly, pick and release clamp tool

1. Automatic program flow of collaborative robot

Please use the teaching ator to program

Specific requirements:

1）The cooperative robot is started and operated from a reasonable initial position;

2）Automatic installation of claw tool, motor bottom shell according to the color sorting, rotor assembly, motor cover assembly, finished product stacking, there can be appropriate delay in the middle, the whole process needs to be continuously executed in a program (a total of 6 motors);

3）Design according to the touch screen design requirements;

4）No mechanical collision is allowed in the middle;

2. Touch-screen design requirements

Table 2 Design requirements for touch screen

region 1	region 2	region 3	region 4
region 5	region 6	region 7	region 8
region 9	region 10	region 11	region 12
region 13	region 14	region 15	region 16

1616 cases, cases respectively representing 16 different regions, each area requirements are as follows:

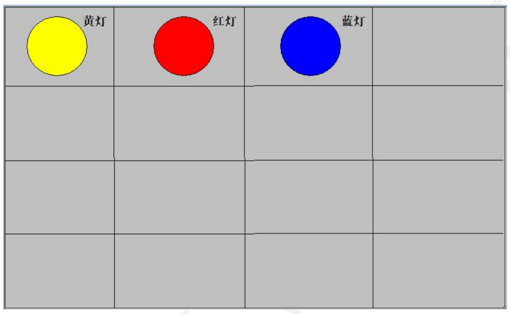


Figure 9. Touch-screen design

The indicator light is gray or white when it is not lit;

When the yellow indicator is detected yellow and the other indicator remains the initial status The yellow indicator light is turned off after the fixed slide;

Similar with yellow when detected as red or blue.

3.I / O definition

Table 3 Cooperative robot I / O definition

stitch	The PLCI / O description	Remote I / O description	Robot I / O instructions
I0.0	firing		
I0.1	reset		
I0.2	suspend		
I0.3	initialise		
I0.4	hand movement		

I0.5	voluntarily		
I0.6	jerk		
I100.0		Front block to the cylinder origin	
I100.1		Front block the cylinder moving point	
I100.2		Channel 1 blocks the cylinder origin	
I100.3		Channel 1 blocks the cylinder moving point	
I100.4		Channel 2 blocks the cylinder origin	
I100.5		Channel 2 blocks the cylinder moving point	
I100.6		Position the cylinder cylinder origin	
I100.7		Position the cylinder-cylinder moving point	
I101.0		Color detection 1	
I101.1		Color detection 2	
I101.2		Color detection 3	
I101.3		Channel product detection # 1	
I101.4		Channel product detection 2	
I101.5		Channel product detection # 3	
I101.6		Inspection of the delivery line products	
Q0.0	Start the indicator light		
Q0.1	Reset the indicator light		
Q0.2	Stop the indicator light		
Q0.3	Initialize the indicator light		
Q0.4	Delivery line motor starts		
Q100.0		Front block to the cylinder action	
Q100.1		Channel 1 blocks the cylinder action	
Q100.2		Channel 2 blocks the cylinder action	
Q100.3		Positioning cylinder action	
Q100.4		Three color light red	
Q100.5		Three color light yellow	
Q100.6		Three-color light green	

4. Local profile

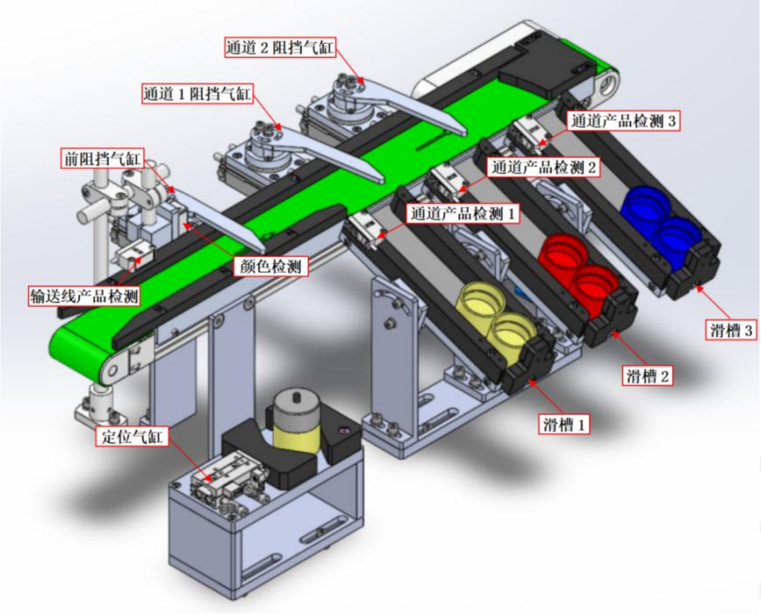

通道 2 阻挡气缸
通道 1 阻挡气缸
前阻挡气缸
通道产品检测 3
通道产品检测 2
通道产品检测 1
颜色检测
输送线产品检测
滑槽 3
滑槽 2
滑槽 1
定位气缸

Figure 10 The sorting and delivery line and the assembly and positioning platform

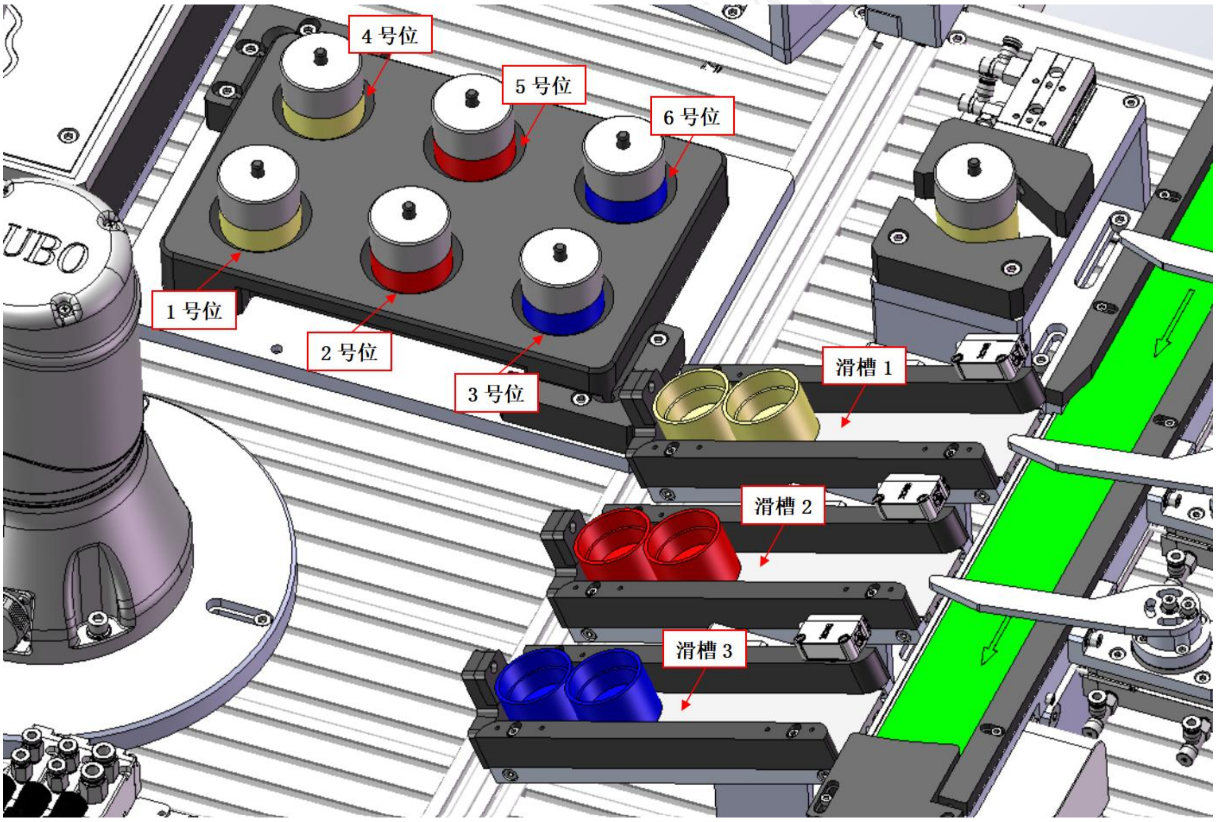

4 号位
5 号位
6 号位
1 号位
2 号位
3 号位
UBO
滑槽 1
滑槽 2
滑槽 3

Figure 11 Finished product material plate

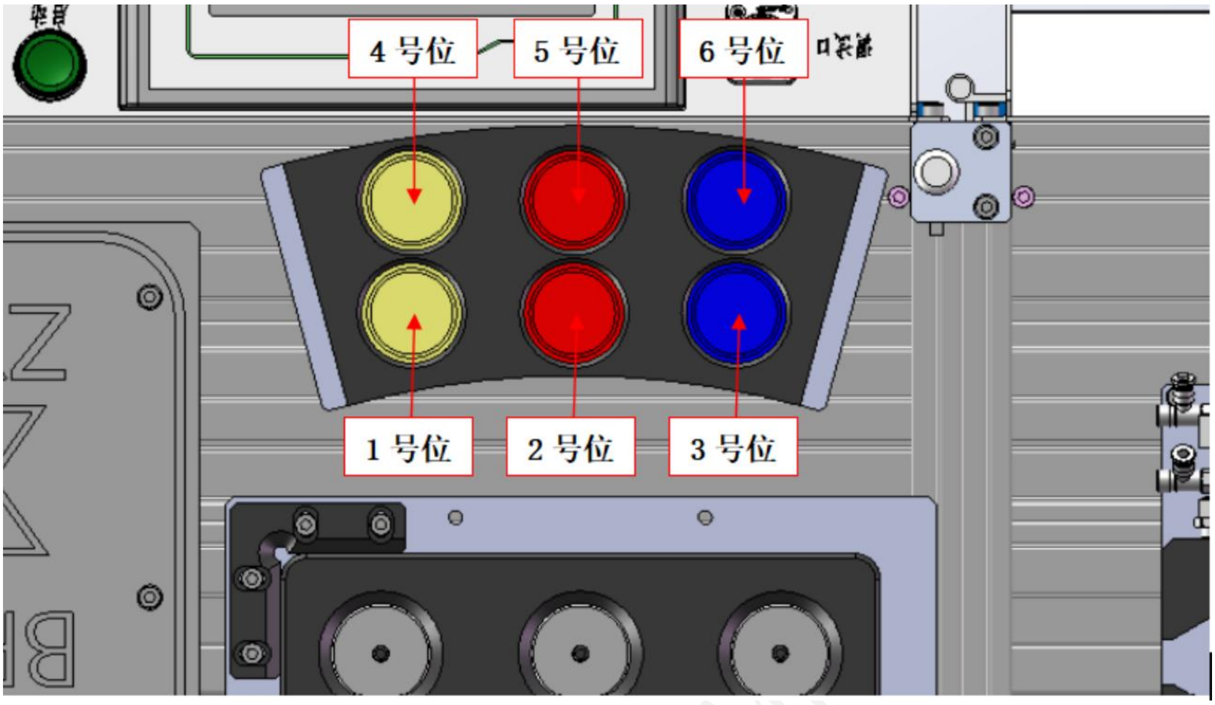

4 号位
5 号位
6 号位
1 号位
2 号位
3 号位

Figure 12 Bottom layer of the element shelf

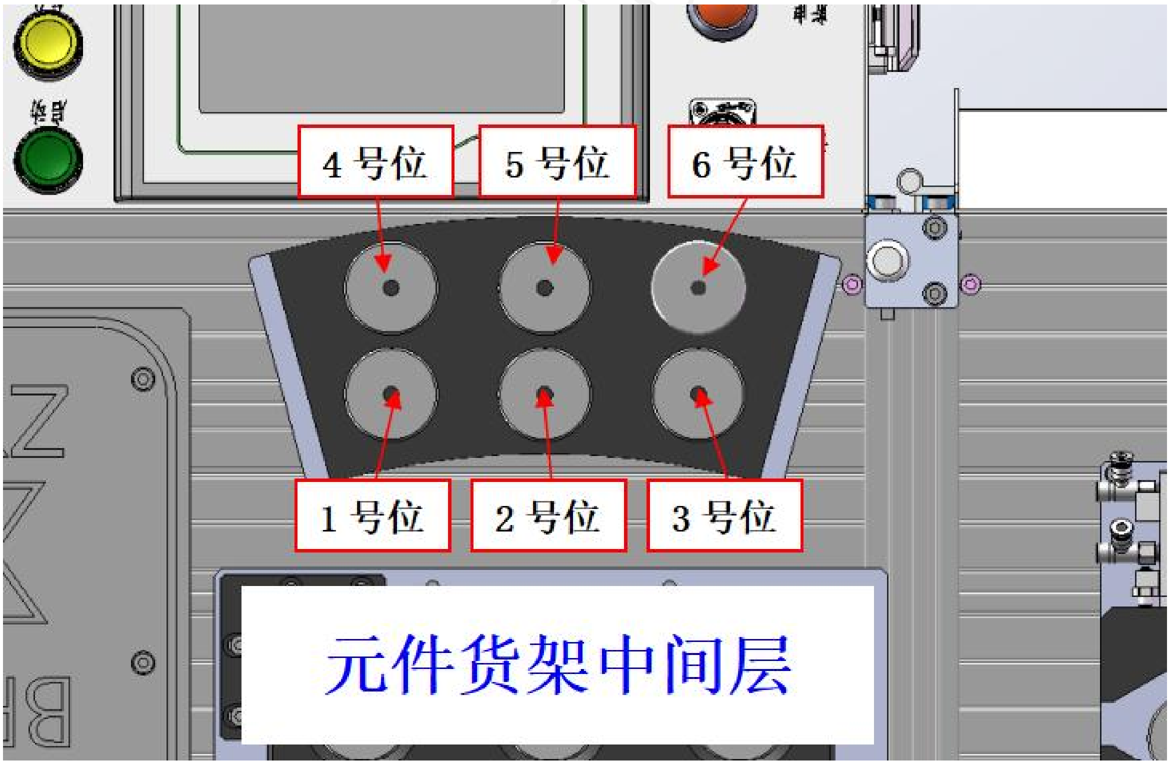

4 号位
5 号位
6 号位
1 号位
2 号位
3 号位
元件货架中间层

Figure 13 Middle layer of the element shelf

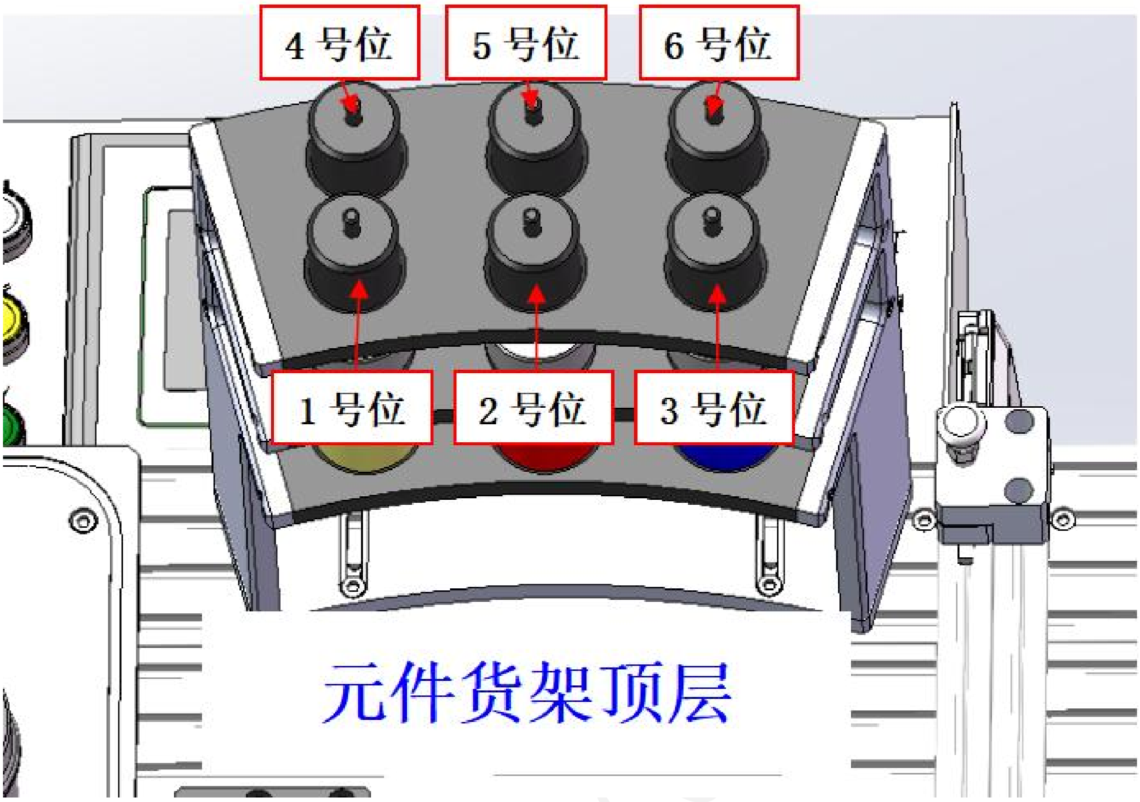


Figure 14. Top floor of the component shelf

Module C cooperative robot with visual under Tetris

The contestants shall complete the robot debugging, instruction and visual calibration according to the task requirements, including the following contents:

1) 3D camera hand-eye calibration;

2) Hand-eye calibration of 22D cameras;

3) 2D camera (bottom) production template position input;

4) 2D camera (above) production template position input;

5) Automatic extraction and release of the suction cup tool;

Task description: This module is verified by the organizing committee for practical operation view on the collaborative robot training platform.

Task C 1: Cooperative robot with visual Tetris

1. Automatic program flow of collaborative robot

Please use JSP, MVP, programming

Specific requirements:

1) Automatic installation of the suction cup tool;

2) With the cooperation of 3D camera, 2D camera (bottom) and cooperative robot, 14 (7 kinds of) disordered Tetris (Figure 19) are placed from 3D plate to 2D plate in the specified order (Figure 20);

3) With 2D camera (top) and cooperative robot, 14 (7 kinds) disordered (no superposition) are placed from the 2D material plate according to the specified order of the generator (FIG. 17);

4）Automatic unloading of the sucker tool;

5) No mechanical collision is allowed in the middle;

ETITION

2. Platform profile

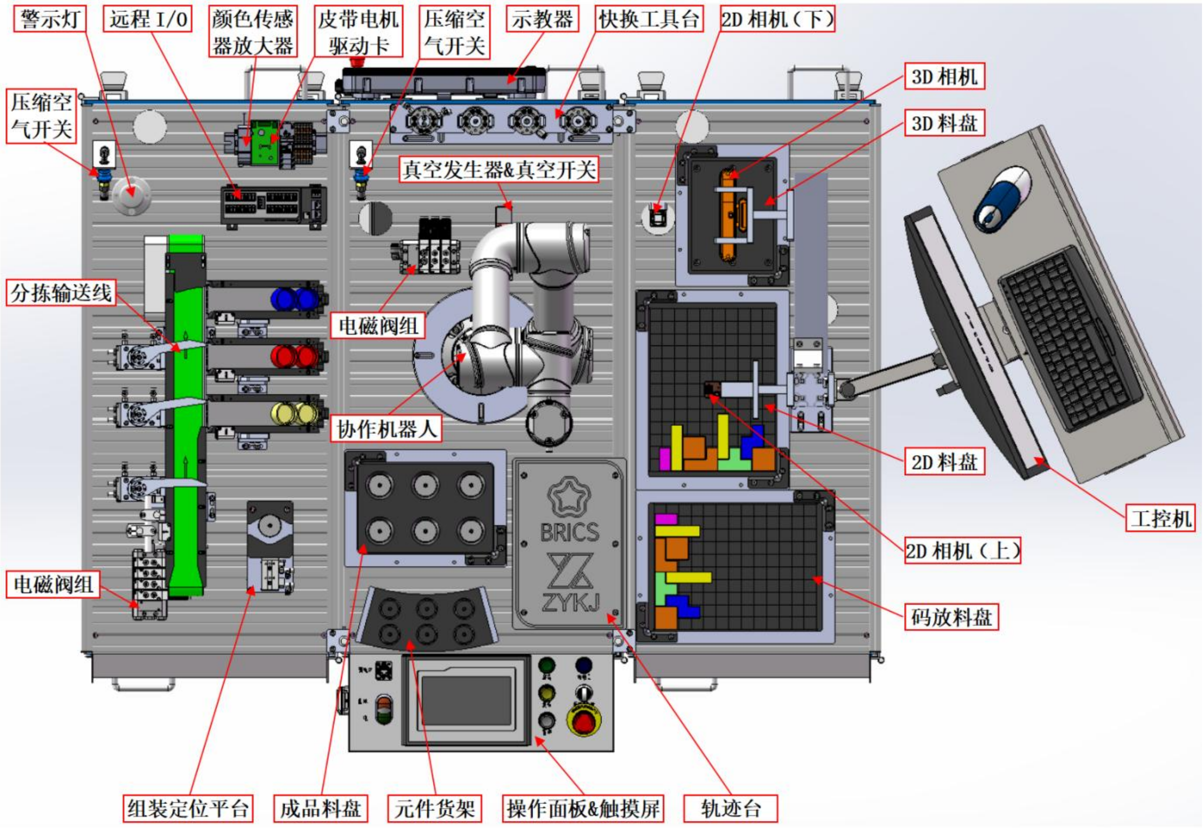

警示灯
远程 I/O
颜色传感器放大器
皮带电机驱动卡
压缩空气开关
示教器
快换工具台
2D 相机（下）
压缩空气开关
3D 相机
3D 料盘
真空发生器&真空开关
分拣输送线
电磁阀组
协作机器人
BRICS
ZYKJ
2D 料盘
工控机
2D 相机（上）
电磁阀组
码放料盘
组装定位平台
成品料盘
元件货架
操作面板&触摸屏
轨迹台

Figure 15 Introduction to the platform

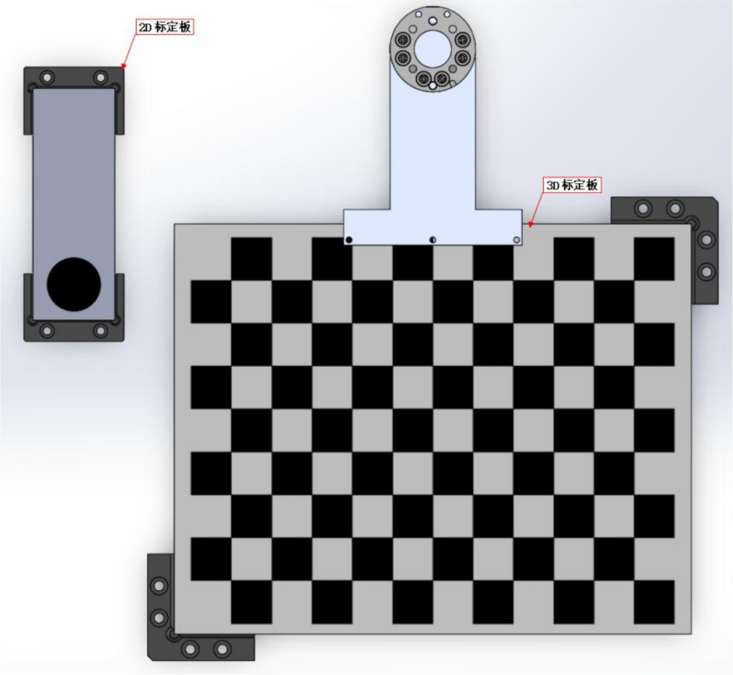
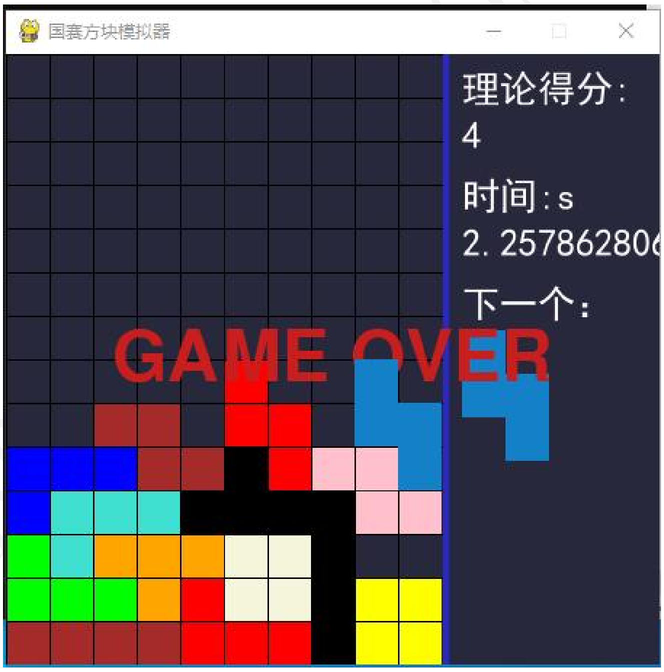


Figure 16 The calibration plate



理论得分：
4
时间：s
2. 25786280
下一个：
GAME OVER

Figure 17 The generator specifies the placement position

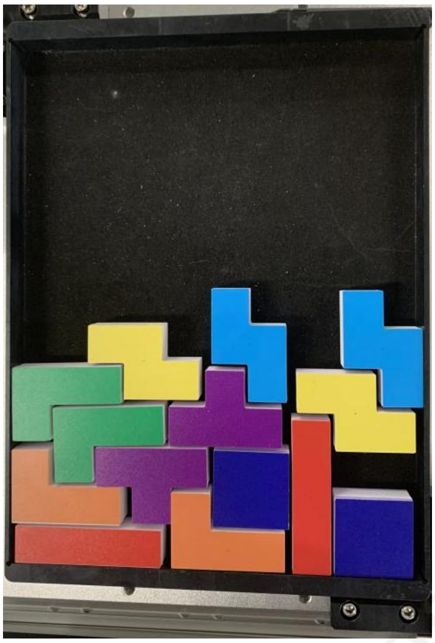


FIG. 18 plays to the plate state according to the position specified by the generator

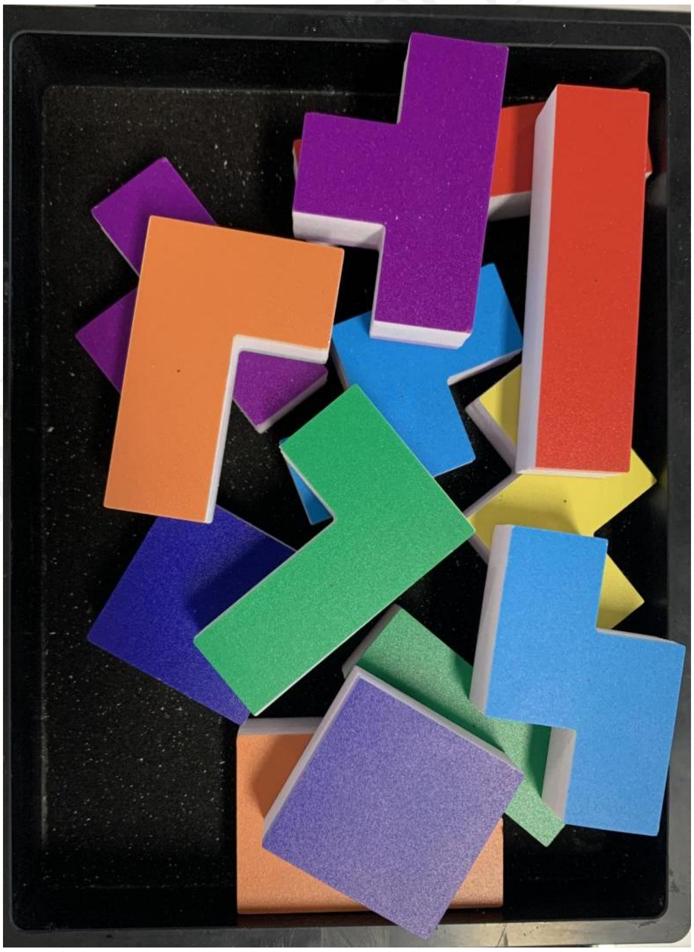


Figure 19 3D material plate

2024 BRICS COMPETITION

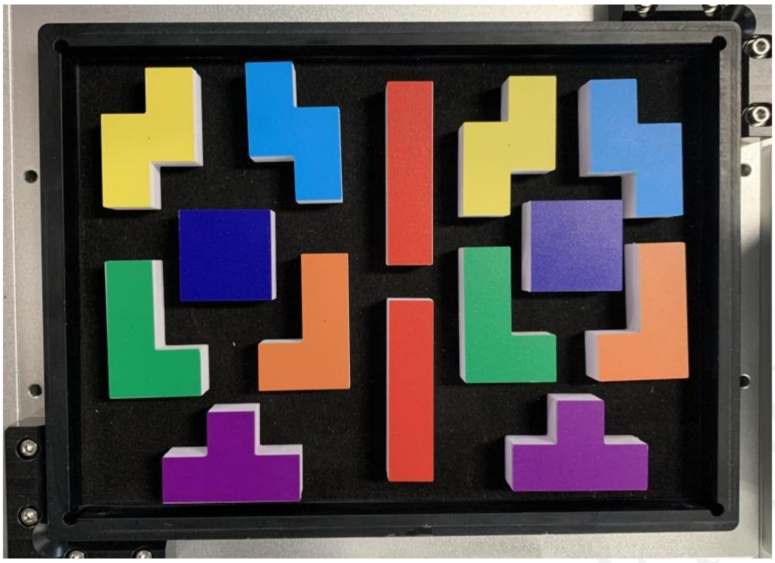


Figure 20 2D material plate

4. Scoring criteria

Table 10. Scoring criteria

module	detailed rules and regulations	value
A 1	1. The correct mechanism assembly meets the assembly specification (2 points); 2. The installation position of the mechanism is accurate within ± 3mm (2 points); 3. Correct tracheal insertion (2 points); 4. Correct installation position of the magnetic switch (I / O signal is correct) (2 points); 5. Cable and trachea binding positioning is beautiful and reasonable (2 points);	10
A 2	1. Automatic brush installation success (2 points); 2. Draw the trajectory respectively: {Logo 1, Logo 2, B, R, I, C, S, Z, Y, K, J} (1 + 0.5 * 10=6 points); 3. Successful automatic brush unloading (2 points); 4. The subsequent action of this module does not score after the mechanical collision in operation (refers to the impact protection of the robot);	10

B	1. Successful installation of automatic claw clip (1.5 points); 2. Successfully remove and release 6 motor bottom shells (0.5 * 12=6 points); 3. Successfully sorted 6 motor bottoms and slid into the corresponding chute (1 * 6=6 points); 4. In the process of sorting 6 motor bottoms, the touch screen lights up the corresponding color lights, and the warning lights light up the corresponding color lights (yellow bottom-yellow light, red bottom-red light, blue bottom-green light) (0.5 * 12=6 points); 5. Successfully removing and placing 6 motor bottom shells during the motor assembly process (0.5 * 12=6 points); 6. Successfully collect and assemble 6 motor rotors (0.5 * 12=6 points); 7. Successful motor assembly process, material extraction and assembly of 6 motor upper covers (0.5 * 12=6 points); 8. After the assembly, successfully put the 6 motors into the finished material plate (0.5 * 12=6 points); 9. Automatic unloading of claw clip successfully (1.5 points); 10. The subsequent action of this module does not score after the mechanical collision in operation (refers to the impact protection of the robot);	45
C	1. Automatic installation of suction cup tool (1 point); 2. Place 14 (7) disordered Tetris (Figure 19) from 3D to 2D (2 D in Figure 20) (0.5 * 28=14 points); 3. Place 14 (7 kinds) disordered (no superposition) Tetris from the 2D material plate to the feeding plate (Figure 18) according to the order specified by the generator (Figure 17) (0.5 * 28=14 points); 4. Automatic unloading of the suction cup tool (1 point);	30
D	professional quality	5
total points		100.00