
DOBOT

Intelligent Manufacturing Challenge

(University Level)

CONTEST

RULES

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1.About the contest

By simulating the intelligent sorting process, participants can get more knowledge of robotics, and master the programming skills and cultivate programming thinking.

(1) Students' hands-on and innovative abilities can be truly assessed because of on-site collaboration and programming.

(2) It's helpful to promote the application of high-tech products in education and explore the new education mode.

As an advanced robotic arm, Dobot Magician has been applied in many universities and institutions. The smart factory is built in combination with industry 4.0, which is an upgrade practice and a new teaching exploration on the basis of the current practical application.

Advantages:

Lightweight machine: It's a desktop machine which is very easy to carry and assemble.

Standardized end-tool: The ends can be replaced, so that participants can achieve different functions.



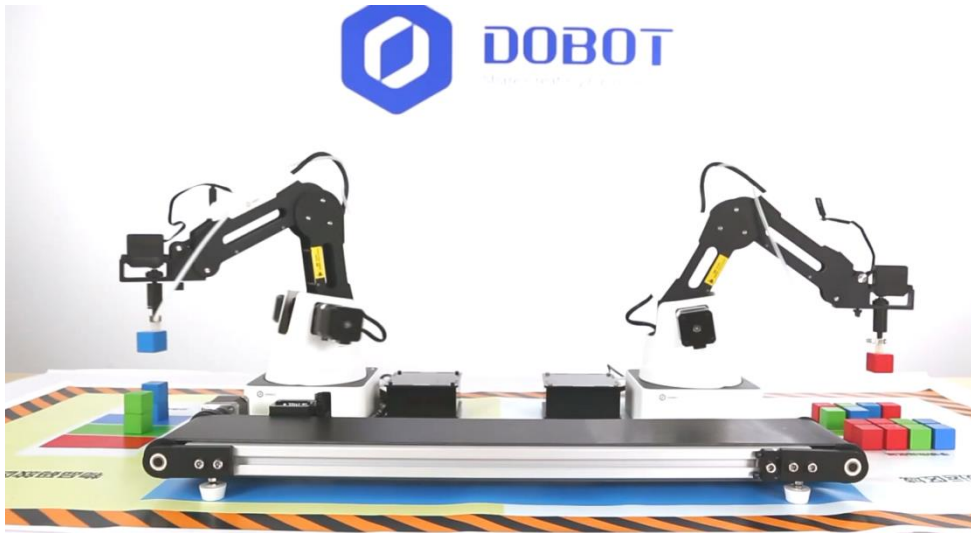


Figure1.Contest Process

2.Equipment and Tasks

2.1 Task overview

Intelligent Manufacturing Challenge aims to simulate the production scene of intelligent manufacturing, the teams control two robotic arms and a mini conveyor belt to complete the picking and sorting tasks through robotic arms and visual system controlled by program.

Tasks as bellow:

- (1) Picking: Pick materials (wood blocks) from raw material area by robotic arms and convey them by conveyor belt.
- (2) Sorting: Inspect the materials and put the detective ones into temporary storage area.
- (3) Stacking: Stack the qualified materials into stacking area based on color.

2.2 Equipment specification

The total length and width of the drawing is 600mm x 1400mm.

The robot placement area is 158x158mm.The stacking area is 60mm × 120mm, which is divided into three parts: red, green and blue. The conveyor belt placement area is 700mm × 140mm. And the temporary storage area is used for storing detective materials.

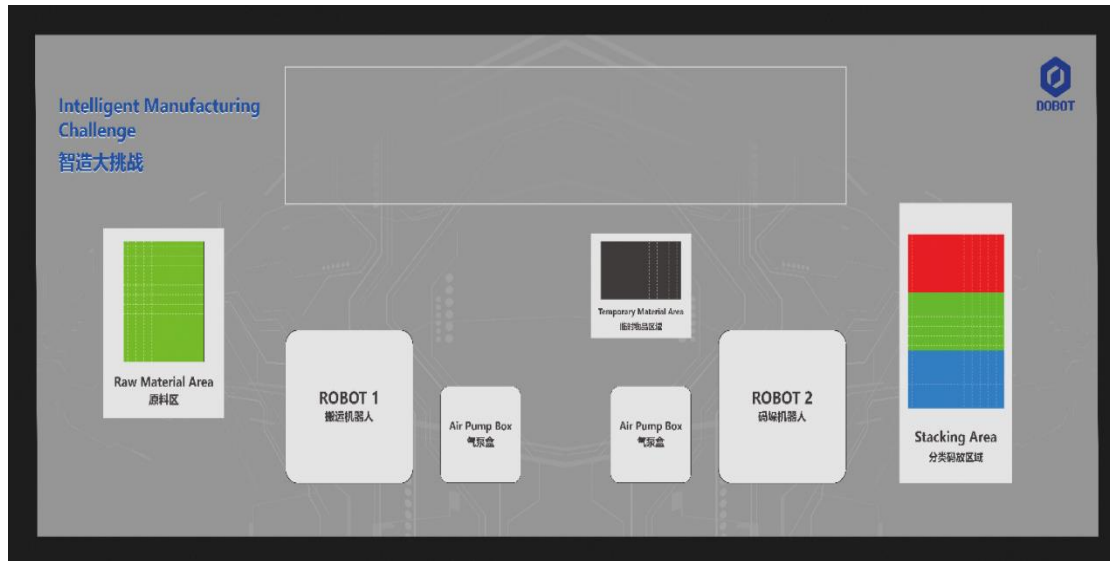


Figure2. Contest Map

1. The size of raw material (wood block) is 25x25x25mm, three colors including red, green and blue.

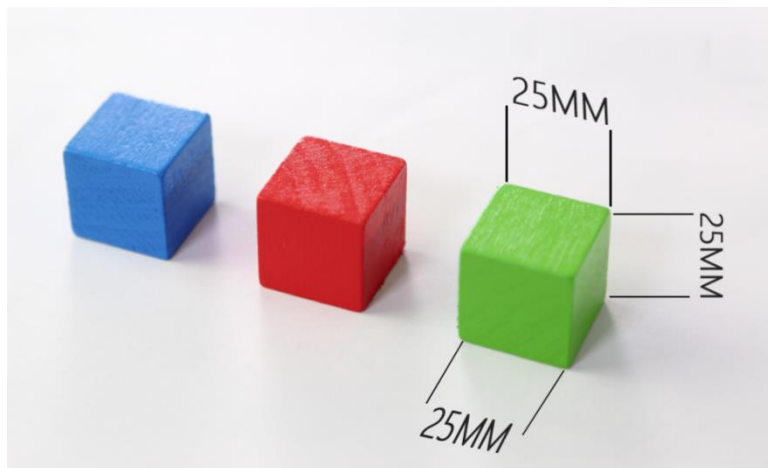


Figure3 Blocks

2. There are some [defective materials] in the raw material area. The defective materials can be any color other than red, green and blue, while yellow is the default. (In the contest, it could be replaced by other colors according to the specific situation. Its size would be the same as the basic one).



Detective Material-Yellow , 25×25mm

2.3 Rules and Scoring

2.3.1 Preparation

40 blocks are needed in the contest, including 12 red blocks, 12 yellow blocks, 12 green blocks and 4 defective blocks (yellow is the default but could be replaced by other colors in the contest).

Teams should stack the blocks as $5 \times 4 \times 2$ in the raw material area randomly by hand, obvious regularity is not allowed. Blocks rearrangement would be required if the judges are not satisfied.

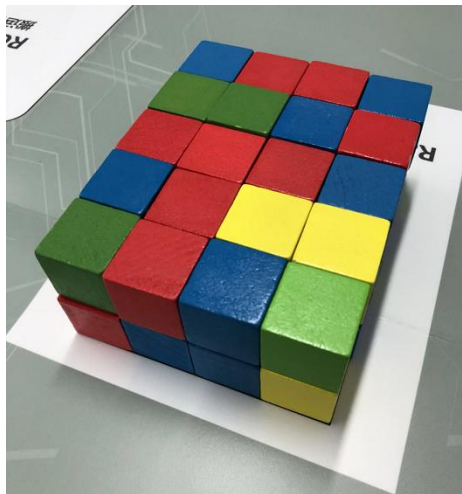


Figure4 Raw Materials Area

TIPS:

- (1) The accuracy and stability of block placement will affect the accuracy of the picking process, please practice more to improve the success rate.
- (2) Blocks would stick together sometimes, please cover the contact surfaces of blocks with transparent tape or put a piece of paper between two layers if necessary. (Take away the paper during the contest).

2.3.2 Contest process

1. Pick the blocks from raw material area by robotic arm and place them on the conveyor belt.
2. After conveying, picking up blocks with robotic arm and identifying the color by camera at the same time.
3. Stack the blocks in the stacking area based on color and place the defective blocks in the temporary storage area.

TIPS:

1. The color recognition would be disturbed by light, please test the camera with upper computer software before the contest. If the color couldn't be recognized because of strong light, please adjust the exposure parameters of camera or

block the strong light with props to reach better performance.

2. When the light condition changes or recognition is inaccurate, please reset and improve the recognition accuracy.

2.3.3 Scoring

Teams are required to control the robotic arms to pick and sort blocks by programming, please try to stack as many blocks as possible in stacking area of corresponding color in 6 minutes.

1. No strict limitation of stack form, but all the materials should be put in the assigned area. Please note that higher you stack, more scores you will get. (The way of stack in the demo video is just for reference).

2.The stack is successful only if the block is completely within right area of the corresponding color (Only for the first layer of the blocks, the higher layer of the blocks will be judged by the stability) , If any blocks are outside the specified area, no score is awarded.

The maximum height of stack is 6 layers, and the score table is as follows:

Layer	Score
1	1
2	2
3	3
4	4
5	5
6	6

3. If there are wrong color or defective materials stacked in the stacking area, the total layer will be subtracted based on the wrong number of blocks when scoring.

4.All the detective blocks should be stacked in the temporary storage area, no restrictions on the form of stack, but must be within the specified area, and each successful piece counts 2 points.

Additional Scores:

Technical innovation score

Technical innovation score: Extra points from 0 to 20 will be given to the unconventional and innovative teams based on your technical report and technical implementation status. Please submit your technical report to apply before the contest, otherwise you will be regarded as waiver.

- The technical innovation could be structure innovation, algorithm innovation and

comprehensive scheme innovation and so on.

- Technical report is limited to 2-4 pages and the key source code can be provided in the attachment.

The competition committee will give a comprehensive evaluation and score based on the technical report and competition performance.

Bonus score for fast assembly

Please refer to 3.2

3. Contest Rules and Process


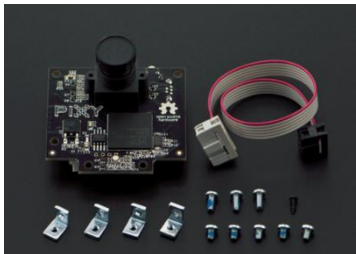
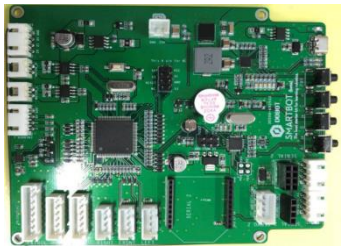
3.1 About the teams

Each participating team should have one instructor and two to four competitors (students). Please prepare the needed equipment and drawings for the competition by yourselves.

- Please use the specified hardware equipment: Dobot robotic arm, conveyor belt and the related designated visual suite.

- All the participating teams are required to use the Arduino IDE, various graphic programming software and Dobot Studio to complete the program development and robot control.

- The participating teams can carry out innovative design for suction cup, sensor and core controller, and add or replace suction cup or sensor to finish the task. But additional mechanical structure transformation to change the production process (adding slides and pallets, modifying conveyor belt etc.) are not allowed.

End-tools	Camera	ARDUINO Mega Compatible Controller
<p>You can design the end-tools of robotic arm as you need.</p> 	<p>Please use one of the two visual schemes (PIXY or OPENMV) to complete the contest. Up to two additional sensors (limit: ultrasonic, infrared, limit switch) are allowed, too.</p> 	<p>You are allowed to choose the appropriate controller as you want based on the requirement of contest committee.</p> 

3.2 About contest time



(1) Warm up

Please complete the task debugging offline before the contest

(2) Debugging

Please finish programming debugging according to the contest requirements in 60 minutes.

Teams that have completed the debugging ahead of time can apply for pre-judging.

Bonus score:

Teams who complete the preparation within 20 minutes will be awarded additional points, as shown below:

Finish Time	Additional Score
00'00" - 10'00"	15
10'01" - 15'00"	10
15'01" - 20'00"	5

If the preparation time exceeds 60 minutes, one point will be deducted for every extra minute. The maximum preparation time is 100 minutes.

(Note: Please indicate to the judge to record your debugging time when you finish the debugging preparation. Participants are not allowed to operate the equipment that will interfere with the result after the debugging time. Starting time shall be determined by the judge.)

(3) Contest and scoring

- You have 3 minutes to reset the materials and get ready to start.
- Competition time is 6 minutes.
- When the competition time is over, the judge will give a score according to the current status.

Others:

1.You have the only one chance to ask for a restart if an unexpected machine failure happened. And then you will have 10 minutes for debugging. If both attempts are unsuccessful, the contest score will be subject to the higher one.

2.Please save your programs in case of computer crush or restart.

3. Other undefined rules and details will be set by the judge with unified standard
4. All rights are reserved by the contest committee.