2022 BRICS Skills Competition

(BRICS Future Skills Challenge)

TECHNICAL DESCRIPTION

Collaborative robotics technology and applications

(offline)

catalogue

目录

1 Introduction

1.1 Name and description of the skill competition

1.1.1 Name of the skill competition

Collaborative robot

1.1.2 Description of the skill competition

The brics national vocational skills competition collaborative robot offline competition organization based on collaborative robot technology and application comprehensive training platform competition platform, by digital twin module, trajectory drawing module, assembly motor module, collaborative robot tetris module, players need through P LC, H MI, collaborative robot, visual detection unit, artificial intelligence algorithm unit complete offline assessment, collaborative robot offline competition is a team skills competition, each team has two players.

Collaborative robot technology application skills include several aspects: robotics technology, mechatronics technology, electrical automation technology, mechanical manufacturing technology, computer foundation, robot vision technology, digital twin technology, etc.

Collaborative robotics application professionals will need to have the following job skills:

(1) Robotics technology

The safe operation specification of cooperative robot, the structure of cooperative robot, the kinematics and dynamics of cooperative robot and the AC servo motor drive, the control of cooperative robot, the structure and control of mobile transportation system, the approach and force perception sensor of cooperative robot.

(2) Mechatronics

Mechatronics development situation, selection and application of mechanical components, execution parts, control system, common sensor control principle and application, common electrical control principle and application, information technology, microelectronics technology application, signal transformation technology application, and limit and coordination, belt drive and chain drive, gradual opening gear transmission, fixed shaft wheel system, common mechanism, bearing, connection, hydraulic and pneumatic foundation, etc.

(3) Electrical automation

Basic electrical knowledge and basic skills, electrical design related safety standards and

specifications, the basic theory of electrical engineering. Including electrical foundation and electrical measurement two parts, the key for electrical foundation part, including dc circuit, electromagnetism, ac circuit, nonsinusoidal circuit and transition process basic concept, the basic principle of the structure and use of common electrical instruments, sensor and detection technology application, automatic control principle and application, power electronic technology, electric drag technology application and digital circuit and analog circuit theory basic content.

(4) Mechanical manufacturing

Standard specifications of mechanical design, basic theory of projection geometry and basic knowledge of drawing, drawing method of machining parts drawing and assembly drawing, national standard of engineering drawing, dimension tolerance, and labeling of surface roughness.Material properties, test methods and their selection. Heat treatment methods and their selection of commonly used metal materials. Basic knowledge and skills of mechanical product design of spare parts design, mechanical manufacturing process specification design, commonly used parts mechanical processing methods, equipment and advanced manufacturing technology. Formulate the basic knowledge and skills of the process process, and formulate the processing process of typical parts.

(5) Computer foundation, machine vision

Basic knowledge of computer language, visual system calibration, tuning parameters, point cloud processing, etc

(6) Digital twinning

Production process planning, production layout, production process simulation, virtual and real combination, production efficiency and output optimization, process monitoring, diagnosis and maintenance, digital twin and industrial Internet and manufacturing big data and other related content.

1.2 Relevance and importance of this document

This document contains information on the standards required for this skills competition, as well as the evaluation principles, methods, and procedures for managing the competition.

Each expert and contestant must understand and understand this technical description.

If there is any conflict between the technical instructions in the different languages, the English version shall prevail.

2 Skills standard

2.1 General description of the skill standards

Skills standards define knowledge, understanding, and specific skills that are international best practice in technical and professional performance. It will reflect a global global consensus on what the relevant job roles or professions are represented in industry and business.

The skill competition is designed to reflect the international best practices described by the skill standard and the extent to which it can reach. Therefore, the standard is a guide for the training and preparation required for skills competitions.

The standard is divided into different sections with titles and reference numbers.

Each fraction was assigned a percentage of the total score to indicate its relative importance in the criteria. This is often referred to as "weights". The sum score for all percentages was 100. The weights determine the allocation of the scores in the scoring criteria.

By testing the items, the scoring scheme only evaluates the skills listed in the standard. They will reflect the criteria as fully as possible under the constraints of skills competitions.

The scoring scheme will be performed within the assigned score assigned in the criteria. A 5% change is allowed, but the weight assigned by the standard specification shall not be changed.

2.2 Skill Standards

part		Relative importance of the (%)
1	**Work organization and management**	5
	Players need to understand and understand: – Principles and methods of safety work implementation; – The use, use, maintenance and maintenance of all equipment and materials and their impact on safety; – Environmental and safety principles and their application in good housekeeping; – Principles and methods of work organization, control, and management;	

	– Principles of communication and cooperation; – Scope and limitations of the roles, responsibilities and obligations of players and others, individually and collectively; – Parameters to be followed when planning activities; – Principles and techniques of time management.	
	Players should be able to: – Prepare and maintain a safe, tidy, and efficient working area; – Prepare for the task at hand, including full consideration of the OHS; – Arrange work to maximize efficiency and reduce schedule disruption; – Apply (or exceed) OSH standards related to the environment, equipment and materials; – Restore the work area to the appropriate state; – Contribute to teamwork and organizational performance in both the overall and specific aspects; – Provide and receive feedback and support.	
2	**communication skill**	**5**
	Players need to understand and understand: – Organizational culture and industry practices within the enterprise and the industry; – The purpose and scope of the required documents submitted in paper and electronic form; – Technical terms related to occupation and departments; – Standards required for routine and special reports in oral, written and electronic form;	
	Players should be able to: – Interact with various businesses and behaviors to learn professional norms at any time; – Communicate orally, written, and electronically to ensure clarity, effectiveness and efficiency; – Use of standard communication skills; – Read, understand, and extract technical data and instructions from any available document;	
3	**Layout and design**	**10**
	Players need to understand and understand: – Principles and related applications of computers and electronics;	

	– Related practical application of engineering science and technology; – Related practical application of part drawing and assembly drawing; – Principles and related applications of electrical engineering and pneumatic engineering; – Design, use, repair and maintenance of related machinery and tools; – The principle and application of robots, robot tools and equipment installed on robots and robot units;	
	Players should be able to: – Obtain and check instructions and instructions for assigned tasks; – Identify and resolve the uncertainty regions in the profile parameters; – Preliminary system design for a given industrial application; – Check the installation locations or use other methods to test the suitability of the initial system design; – Measurement and modeling of mechanical parts and engineering drawing generation; – Determines the application of pneumatic elements in the selection and connection of control and drive devices; – System analysis of the risk assessment, detailing the requirements and implications of the associated installation and integration; – Robots, assistive devices, and tools – Estimate the impact on production during installation;	
4	**Installation and connection of the comprehensive practical training platform of cooperative robot technology and application**	**20**
	Players need to understand and understand: – Receiving the norms and culture of industrial sites; – Principles and methods for safe receiving and continuous management of equipment, tools and materials; – Basic principles of the physical installation of robots in production systems; – The principle and method of assembling and using the preprocessed robot at its position; – The principle and method of installing the conveying system in its position; – The basic principles of the positioning, connection and use of the pneumatic device; – Basic ale of foundation and fixed methods for installation of	

		collaborative robots and peripherals;	

		Players should be able to:
		
		   – Check whether all products are delivered properly, and follow up as required;
		   – Organize the safe storage of all the articles, and arrange the entry and exit of the articles;
		   – Check the documentation connected to the collaborative robot system components;
		   – Test during installation to ensure functional functionality;	

5	Automatic debugging and programming of cooperative robot technology and application		40

		Players need to understand and understand:
		
		   – Computer capabilities and symbolic logic;
		   – Manage the purpose and functions of computer hardware and software;
		   – Manipulate the cooperative robot coordinate system, and calibrate it with the cooperative robot, components and tools;
		   – Control the movement of the cooperative robot;
		   – Realize the reprogramming and adjustment;
		   – Provides principles, reasons, and methods for breaking down information or data;
		   – How to use various software tools to develop and improve models;
		   – How to use visual software to obtain image data;	

		Players should be able to:
		
		   – Negotiate with customers and other personnel to clarify the project intention;
		   – Write, analyze, analyze events, and optimize procedures using flow charts and icons;
		   – Create application software programs that are easy to record, understand, and maintain;
		   – Write changes to and maintain computer programs or software packages to handle specific work;
		   – According to the provided model, build the competition platform 3-dimensional simulation animation;
		   – Communication with collaborative robots through P LC;
		   – Communicate with collaborative robots through visual software;	

6	Equipment maintenance and fault inspection and troubleshooting		15

		Players need to understand and understand:	
		– Formal requirements for successful site acceptance tests; – Scope and limitation of technical methods and operating environment; – Standard methods for testing the equipment and systems; – Discover faults, solve problems, and optimize strategies; – Principles and techniques for producing creative and innovative solutions; – Resume and the principles of maintaining the production system;	
		Players should be able to: – Check whether the cooperative robot and the peripheral equipment are operating normally according to the procedures; – Modify, optimize, or extend existing programs to improve operational efficiency or use new requirements; – Develop human-machine interface (H MI) applications for collaborative robot platforms using W INCC or other W EB technologies;	
7	Documents and reports		**5**
		Players need to understand and understand: – Content composition of the user document; – The format specification of the user documents; – The operation method of using the office software; – Keep the role and importance of records at each stage of the activity, the necessary media and format for records and reporting, and ensure that contracts, regulations and laws are compliant for verification and auditing. Information, guidance, and instructions required by users and experts (in the appropriate form of media, content, language, format, and presentation). Customer specific information needs, introduction and basic principles and techniques for non-professional end users.	
		Players should be able to: – Communicate with customers to understand, and clarify their needs; – Analyze the usage scenarios and permission scope of different user roles; – Combing through the operation process of different roles of users; – To what the technical document needs to be presented and organize the technical language to make the technical document clear and easy to use. – Contact other personnel or departments for project integration. Development documents were designed as needed, writing programs and	

| | | subsequent revisions inserted in the coding instructions so that others can understand the computer program. Provide the test results during the commissioning process. Help and guide end users to make the technical documentation clear and easy to use. | |

3. Scoring scheme

3.1 Scoring method

The scoring of this competition will be completed by the referee group offline. If the player cheats or commits other violations during the competition, the referee will deal with them according to the players' violations, and the results will be cancelled.

3.2 Scoring rules

1. The person with the high overall score ranks first;

2. For those with the same total score, according to the order of module B, module C and module A, and the highest module score will rank first.

According to the above two rules can not discharge the order, the cumulative competition time is short ranking in the top.

3.3 Evaluation basis

During the event design process, the choice of criteria and evaluation methods will be determined through the scoring scheme and test items.

Evaluation basis, including, but not limited to:

● Integrity and specification of the work process

● Integrity and specification of the work record card filling in

● Process correctness of index calculation, the correctness and standardization of code

● Normative nature of electrical installation and commissioning

● Application proficiency of cooperative robot technology and application of comprehensive practical training platform

● Process, integrity, and correctness of the component assembly

● Results of the troubleshooting

● Personal protection

4 Test project

4.1 Common precautions

Whether it is a single module or a series of separate or associated modules, a test item can evaluate the application of knowledge, skills, and behavior as defined in the Standard (Skill Specification).

Combined with the scoring scheme, the purpose of the test project is to provide comprehensive, balanced and real opportunities for standard evaluation and scoring. The relationship between test items and scoring schemes and standards will be a key indicator of quality, as is the relationship between standards and actual work performance.

Test items did not include aspects other than the criteria and did not affect the balance of scores within the criteria.

The evaluation of the knowledge and understanding of the test items is carried out only through their practical application.

4.2 Test the project format / framework

The test item is composed of four relatively independent and connected modules:

Module A: Mechanical assembly and cooperative robot pattern drawing

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

Module C: Collaborative robot with visual Lower Tetris

4.3 Time allocation and score weight of test items

module	duration (min)	Scoading weight (%)
Module A: Mechanical assembly and cooperative robot pattern drawing	120	20
Module B: cooperative robot assembly of small motor after handling and palletizing	240	45
Module C: Collaborative robot with visual Lower Tetris	360	30

module	duration (min)	Scoading weight (%)
Module D: Professional quality		5
amount to	720	100

4.4 Operation content and requirements of each module

The competition covers mechanical installation and adjustment, cooperative robot pattern drawing, small motor handling, assembly, palletizing, 2D visual system, 3D vision and other contents, and comprehensively examines the application and engineering implementation ability of the comprehensive training platform of cooperative robot technology and application.

Module A mechanical installation and cooperative robot pattern drawing: it is the mechanical and electrical installation of the positioning assembly mechanism, sensor detection and debugging, and the cooperative robot basic trajectory teaching as the assessment focus;

Module B cooperative robot assembly of small motor after handling, palletizing: it is based on color sensor, pneumatic unit sorting, P LC programming, H MI writing, cooperative robot point teaching, grasping, handling, assembly, palletizing as the assessment focus;

Module C cooperative robot with visual Lower Tetris: it is the collaborative robot program writing, visual and cooperative robot communication Settings, visual image point picking, visual master program writing, artificial intelligence algorithm as the assessment focus;

Module D professional quality: it is the focus of the operation norms, professional ethics and team cooperation for electrical engineers and robot system integration engineers.

Module number	Module name	Scope of operation
A	Mechanical assembly and cooperative robot pattern drawing	1 Install the positioning and assembly module 2 Draw the specified logo pattern
B	The cooperative robot assemthe small	1 Color sorting of small motor components using a collaborative robot

	motor and carries the palletizing	2 The sorted motor components were assembled using a cooperative robot 3. Use a cooperative robot to carry and palletizing the finished motor
C	Collaborative robot with visual Tetris	1. Use a cooperative robot combined with 3D vision and 2D vision for one point point vision, and disorderly disassemble the Russian cubes 2. Use collaborative robot and 2D vision to teach two points together with artificial intelligence algorithm under tetris.

4.5 Announcement of test items

The test items will be published via the website.

4.6 Changes of test items

Before the official competition, the test items is changed 30%.

5. Skill management and communication

5.1, The Expert Group

The skill expert group is composed of the chief expert, the deputy chief expert and the expert members, who are responsible for jointly further revising the technical documents of the remote final and the daily skill management.

5.2 Discussion group

Before the competition, with questions related to the software and hardware preparation and test environment deployment, the participants can enter the 2022 BRICS Skills Competition Collaborative Robot Competition group for feedback. The training and exchange of this competition, before, during and after the competition, will also be carried out through the group.

Online communication will be held using instant communication tool Tencent conference, and the offline discussion forum will be held by the organizing committee.

6 Safety requirements

6.1 Event safety management

6.1.1. Competition equipment and facilities shall be installed in strict accordance with the safety construction standards, and power wiring and electrical appliances installation shall be constructed according to the specifications.

6.1.2. Arrange fire extinguishers according to fire safety requirements, and designate the responsible person to use them in emergency.

6.1.3. The norms, regulations and qualification certificate requirements of the national (or industry) related vocational job safety shall be specified in the competition procedures.

6.1.4. The Executive Committee shall conduct safety training to all the referees and staff before the competition. In accordance with the Labor Law of the People's Republic of China and other laws and regulations, a sound safety and accident prevention system shall be established, and the players shall be trained before the competition to avoid personal injury accidents.

6.1.5. The Executive Committee will establish a special plan to ensure the safety of the competition proposition, storage, distribution, recycling and evaluation process.

6.2 Competition environment safety management

6.2.1. The competition executive committee shall organize special personnel to inspect the competition site, accommodation place and transportation guarantee before the competition, and put forward clear requirements for the safety work. The layout of the stadium, the equipment and equipment in the stadium shall meet the relevant national safety regulations. The competition field simulation test is also carried out to find out the possible problems.

6.2.2. A police cordon shall be set up around the stadium, and security personnel shall not lend their certificates to others to prevent irrelevant personnel from entering. Provide the necessary labor protection for the players in the competition site according to the requirements of the relevant professional positions. In the dangerous operation link, the referee should check and confirm that the equipment is normal before the game, and strictly prevent the players from making the wrong operation during the game.

6.3 Notes noted for epidemic prevention

6.3.1. Students and teachers who take public transportation should wear masks, take good personal protection, and keep good ride records.

6.3.2. According to the relevant regulations on regular COVID-19 epidemic prevention and control, those who enter the match point should voluntarily show their electronic health code (green code) and voluntarily take their temperature measurement as required. Candidates

with non-green codes are not allowed to compete.

6.3.3. Those who cannot provide the health certificate, and who have suspicious symptoms (temperature above 37.3°C) confirmed by the field health and epidemic prevention professionals, with persistent dry cough, fatigue, dyspnea and other symptoms), are not allowed to enter the match point;

6.3.4. People entering the match point should pay attention to personal protection, bring yourself disposable medical masks or medical surgical masks, and wear masks as required.

6.3.5. Those who have a history of living in medium-or high-risk areas or countries (borders) within 14 days before the competition shall report to relevant local authorities and consciously accept quarantine observation, health management and nucleic acid testing in accordance with relevant regulations on epidemic prevention and control.

6.3.6. Stadium layout and public space shall be formulated in accordance with the epidemic prevention requirements.

7. Materials and Equipment

7.1 Infrastructure list

The list of infrastructure details all the equipment and facilities to be prepared by the participants, and see the "List of Infrastructure Items for the Offline Competition Collaborative Robot Competition of the BRICS Skills Competition 2022".

7.2 contestant's kit

Participants can use their own tools. They need to be approved by technical experts for safety reasons. Tool and tools with open blades shall not be used to avoid damage (except for pneumatic hose cutters with a maximum clamp opening of 8 mm).

Recommended tools for performing tasks:

- Screwdriver (one word, cross)
- connection cover cutting pliers
- Electrical inspection pen
- multimeter
- inner hexagon spanner
- band tape

When other special tools are needed, the chief expert of the competition will announce them.

7.3 Materials, equipment and tools brought by the competitors

The toolbox used by the competitors to complete the competition is brought by the competitors, and others are provided by the competition organizer.

7.4 Materials and equipment prohibited in the skill area

Any materials and equipment carried by the participant shall be declared (presented) to the expert. Experts may prohibit the use of any items unrelated to the performance of the mission or that may confer an unfair advantage on a competitor.

7.5 Suggested competition area and workstation layout
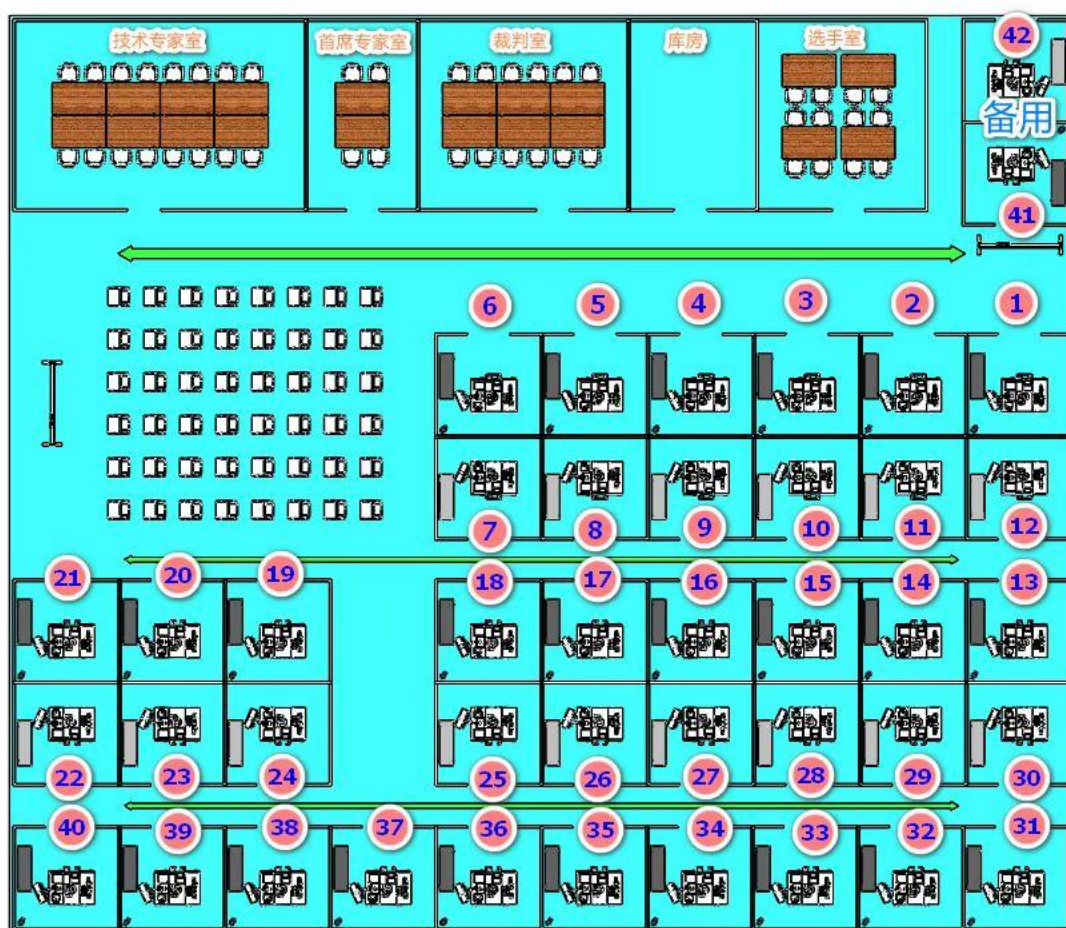
8 Skills-specific rules

Skills-specific rules cannot contradict or prioritize the rules of the game. They will provide specific details and clear illustrations of different aspects that vary by skill

competition. They include, but are not limited to, personal computing devices, data storage devices, Internet access, work procedures, and document management and distribution.

Themes / Tasks	Skills-specific rules
Use technology- -USB, memory stick	1) Participants can only use the memory stick provided by the race organizers. 2) Do not bring memory cards or any other portable storage devices out of the arena. 3) Memory cards or other portable storage devices must be at the end of each day 4) Submit it to the chief expert or the deputy chief expert for safe storage.
Technology used: personal laptops, tablets, and mobile phones	1) Experts and interpreters can use personal laptops, tablets, and mobile phones. 2) Participants are not allowed to bring their personal laptops, tablets or mobile phones into the arena.
Using Technology-Personal Camera	Participants, experts and interpreters can use the workshop with personal photo and video equipment only after the test program is completed or with the consent of the lead expert.
Evaluation of the test items	1) For each workstation (module), the lead expert assigns the supervisor with the highest level of expertise in the field. During the participant's completion of the test program, the expert controls OHS compliance, the completion or failure of the test program points, that can only be assessed during the participant's completion of the task. The designated expert is fully responsible for the fairness of the contestants' assessment. 2) If on the workstation, the participant and the expert are from the same organization, the expert can be replaced once during the duration of the module.
Make 30% of the changes in the test items	During the introduction of 30% changes (on Day C-2), the expert must perform the following: According to the equipment and software provided by the competition sponsor (all modules): -Update the installed assembly drawing (or photo); -Updated the electrical and pneumatic schematic diagram; -Update mission point instructions on device software and hardware features provided by competition sponsors.
Participants had technical	1）If a technical problem occurs during the implementation of the test

problems during the mission	program (not at the fault of the participant), the participant will receive additional time, equal to the time from the discovery of the defect, to the complete elimination. 2）If the technical problem is found to be caused by the fault of the contestant, the contestant will not receive additional time.
PPE (Personal Protection)	Personal protective equipment such as safety clothing, steel-headed shoes and gloves shall be provided by the participants.