2022 BRICS Skills Competition

(BRICS Future Skills Challenge)

TECHNICAL DESCRIPTION

Intelligent Service Robotics (Offline)

Catalogue

1．Introduction

1.1 Name and Description of the Skill Competition

1.1.1 Name of the Skill Competition

Service Robot – Application of Epidemic Prevention

1.1.2 Description of the Skill Competition

The organization of the 2022 BRICs Skills Competition Service Robot–Application of Epidemic Prevention event online competition is based on intelligent detection and sensor technology, intelligent control technology, human-computer interaction technology, autonomous navigation technology, autonomous path planning and other technologies, and takes the service machine as the carrier to examine the contestants' application of the service robot hardware platform and software system. The offline competition of this event is a single player competition.

Service robot related professionals need to have the following working skills:

(1) Operation foundation of service robot, including installation and debugging specifications of service robot, basic knowledge of sensor technology, use specifications of tools, integration foundation of service scenario Application module, foundation of ROS robot operating system, foundation of Linux and other working skills.

(2) Human computer interaction technology, including basic knowledge of speech wake-up, basic knowledge of speech recognition, basic knowledge of speech synthesis, basic knowledge of semantic understanding, application theory of speech interaction, human-computer interaction theory and other knowledge and work skills.

(3) Map construction and autonomous navigation technology, including laser radar principle, camera ranging principle, basic knowledge of task planning, environmental map creation and self positioning, path planning, real-time autonomous navigation and other knowledge and work skills.

(4) Mobile mechanism control technology, including knowledge and working skills such as wheel chassis control, motor movement, Fundamentals of electrical and electronic technology, analog electronic technology, digital logic circuit, automatic control principle and single chip microcomputer principle and application.

(5) Intelligent perception technology, including machine vision, posture recognition, collision detection, fall detection, authentication technology and other knowledge and work skills.

(6) Working skills of service robot scene application, including basic knowledge of public service application of service robot (including special robot), basic knowledge of intelligent distribution application, basic knowledge of intelligent inspection application, basic technology of Internet of things, maintenance and management of service scene, etc.

(7) The basic working skills of artificial intelligence include the basic concepts and structures of artificial

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intelligence, the mainstream framework of artificial intelligence, the development history of artificial intelligence, the basic concepts of Intelligent Computing and its application, the basic knowledge of artificial neural network and its application, the basic knowledge of expert system and machine learning, the basic concepts of natural language processing and its application, etc.

(8) Data processing technology: including basic knowledge of data acquisition principles, data acquisition safety regulations, data acquisition tools and equipment; Data annotation engineering foundation, namely data cleaning and data annotation; Data preprocessing, sample evaluation, algorithm parameter optimization, algorithm model training, algorithm model verification and evaluation.

(9) Application basis of model deployment: including basic theories and methods of AI product interaction process design, basic theories and methods of AI product application solution design, basic theories of AI product application data monitoring and analysis, basic theories of AI product application data management, and other basic knowledge.

(10) Basic working skills of robot programming, including the application of data visualization programming technology such as c++ or python.

(11) Knowledge of safe and civilized production and environmental protection, basic knowledge of professional ethics, especially knowledge of safety norms in the application environment of service robots.

1.2 Relevance and significance of this document

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

Every expert and contestant must understand and understand this technical description. In case of any conflict between the technical descriptions in different languages, the English version shall prevail.

2. Skill standards

2.1 General description of skill standards

Skill standards define knowledge, understanding and specific skills, which are international best practices in technical and professional performance. It will reflect the global consensus on what relevant job roles or occupations represent in industry and enterprises.

The skill competition aims to reflect the international best practices described in the skill standard and the extent to which it can achieve. Therefore, this standard is a guide for the training and preparation required for skill competitions.

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

Each part is assigned a percentage of the total score to indicate its relative importance in the standard. This is often referred to as "weight". The total score of all percentages is 100. The weight determines the distribution of scores in the scoring standard.

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Through the test items, the scoring scheme only evaluates the skills listed in the standard. They will reflect the standards as comprehensively as possible under the constraints of skill competition.

The scoring scheme will be carried out according to the score assigned in the standard within the actual range. A 5% change is allowed, but the weight assigned by the standard specification shall not be changed.

2.2 Skill description

RELATED REQUIREMENTS	Weight proportion (%)
Organisational skills, management and communication	**5**
The individual needs to understand and master: − Principles and methods of safety work implementation; − The purpose, use, maintenance and maintenance of all equipment and materials and their impact on safety; − Environment and safety principles and their application in good housekeeping in the workplace; − Principles and methods of work organization, control and management; − Principles of communication and cooperation; − The scope and limitations of the roles, responsibilities and obligations of individuals and others individually or collectively; − Parameters to be followed when planning activities; − Principles and techniques of time management;	
The individual shall be able to: − Prepare and maintain a safe, tidy and efficient work area; − Prepare for the task at hand, including giving full consideration to OHS; − Arrange work to maximize efficiency and reduce schedule disruption; − Apply (or exceed) OHS standards related to environment, equipment and materials; − Restore the working area to an appropriate state; − Contribute to teamwork and organizational performance in both overall and specific aspects; − Provide and receive feedback and support;	

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− Obey the rules of the game.	
Foundations of service robot	**15**
The individual needs to understand and master: − Composition of service robot, working principle of service robot and basic knowledge of service robot installation and debugging specifications. − Relevant tool usage specifications, basic knowledge of scenario service Application module integration. − Knowledge of safe and civilized production and environmental protection, basic knowledge of professional ethics, especially the safety in the application environment of service robots.	
The individual shall be able to: − Flexibly use the knowledge of service robot installation specification, process flow and control flow − Equipment and application service robot related test tools and instrumentation capabilities. − Read the part drawings and assembly drawings of simple mechanical parts. Have the ability to process non-standard parts and complete assembly.	
Human-computer interaction technology	**20**
The individual needs to understand and master: − Basic knowledge of ROS robot operating system and Linux. − Basic knowledge of speech wake-up technology, speech recognition technology, speech synthesis technology and semantic understanding technology. − Theoretical basis of voice interactive application and application technology based on different scenarios.	
The individual shall be able to: − Proficient in operating service robot system and Linux system. − Understand and flexibly use human-computer interaction technology of service robot to solve relevant problems.	
Mapping and Navigation Technology	**20**

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The individual needs to understand and master: – Lidar principle, camera ranging principle. – Basic knowledge of task planning and mobile mechanism control. – Environmental map creation and self positioning, basic theory of path planning, real-time navigation technology and other basic knowledge.	
The individual shall be able to: – Complete the navigation path planning of different tasks based on map construction and autonomous navigation technology. – Complete the wheel chassis control, and be able to complete the motion control of relevant institutions of the service robot based on the knowledge of motor motion basis, electrical and electronic technology basis, analog electronic technology, digital logic circuit, automatic control principle, single chip microcomputer principle and application.	
Intelligent perception technology	**20**
The individual needs to understand and master: – Machine vision technology, posture recognition technology, authentication technology. – Detection and sensing technology, communication technology, self diagnosis technology and other key technologies of service robot.	
The individual shall be able to: – Understand and flexibly use the principle, performance and main parameters of the main sensors of the service robot to solve problems. – The fusion robot uses machine vision technology, attitude recognition technology and authentication technology.	
Scene application technology of service robot	**20**
The individual needs to understand and master: – Basic theoretical knowledge of safety and epidemic prevention scenario application technology. – Basic theoretical knowledge of human-computer interaction scene application technology. – Basic theoretical knowledge of intelligent distribution scenario application technology. – Basic theoretical knowledge of Internet of things scenario application	

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technology. − Basic theoretical knowledge of artificial intelligence, data processing technology, model deployment and application.	
The individual shall be able to: − Consult and integrate relevant technical data of service robot scene application. − Explain customer needs and actively manage customer expectations based on service robot scenario application and related technologies. − Provide advice and guidance on products / solutions (such as technological progress), and skillfully master the scene application of service robot.	

3．Evaluation method

3.1 Evaluation method

The scoring of this competition is completed offline by the referee team. If there are cheating or other violations during the competition, the referee will deal with them according to the violations of the players, and the results will be cancelled if the circumstances are serious.

(1) Each station is ruled by a referee team composed of two or more referees. The principle of avoidance is adopted. When the referee on duty is in charge of his team, he will actively avoid it, and the substitute referee will join in to replace his ruling.

(2) In case of any dispute, the leader of the referee team shall reorganize the decision. If the dispute cannot be resolved, the presiding judge shall preside over the decision.

(3) Contestants can request scoring at any time during the task time, and each task scoring request has and only has one chance. After requesting a score for a task, the task item for which the score is requested cannot be changed.

(4) After the end of the task time, you must signal to the referee and stop working, waiting for the referee to score. You cannot enter the station without the permission of the referee.

3.2 Evaluation rules

1. The person with high total score ranks first;

2. Those with the same total score will be ranked first in the order of module C, module B, module a and module D. see Section 4.2 for details of each module.

When the order cannot be arranged according to the above two rules, the player with a short

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accumulated competition time will rank first.

3.3 Evaluation basis

In the process of competition design, the selection of standards and evaluation methods will be determined by scoring schemes and test items. The practical assessment score is composed of result score and illegal deduction. Each team will compete in a centralized way, and use the competition platform provided by the venue to complete the tasks specified in the assignment within the specified time.

(1) Result score

The scoring referee will give an objective score according to the quality of the results of the contestants' completion of the competition questions, and combine it with the score of the competition platform software to give a comprehensive score.

(2) Illegal deduction of points

Points will be deducted if a contestant has the following circumstances in the competition:

1) In the process of completing the work task, if the accident is caused by improper operation, the total score will be deducted by 10 ~ 15%. If the situation is serious, the competition qualification will be cancelled.

2) If the equipment provided by the stadium is damaged due to illegal operations, and the environment of the stadium is polluted, and other behaviors that seriously do not conform to professional norms, the total score will be deducted by 5 ~ 10% depending on the circumstances, and those in serious cases will be disqualified from the competition.

3) Disturb the order of the competition field and interfere with the work of the referee, and the total score will be deducted by 5 ~ 10% depending on the circumstances. Those in serious cases will be disqualified from the competition.

4) If the competition is not carried out in accordance with the competition rules and assignment, the tools on the competition site are not placed neatly, the operation process is chaotic, the clothes are not standardized, and the data archiving is incomplete, the total score will be deducted by 5 ~ 10% depending on the circumstances.

5) If the behavior affects the normal competition of other contestants, the total score will be deducted by 5 ~ 10% depending on the circumstances.

6) There is no upper limit for the above violations until they are deducted.

4．Test items

4.1 Common precautions

Whether it is a single module or a series of independent or associated modules, the test project can evaluate the application of knowledge, skills and behaviors defined in the skill specification.

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

The test items do not include aspects outside the standard, nor does it affect the balance of scores within the standard.

The evaluation of knowledge and understanding of the test project is only carried out through its application in actual work.

4.2 Test item format / framework

The test project is composed of four relatively independent and related modules:

Module A: Key module debug of service robot

Module B: Epidemic prevention of service robot

Module C: Human computer interaction of service robot

Module D: Safety awareness and professional quality

4.3 Time allocation and score weight of test items

Module	Time（min）	Weight proportion（%）
Module A: Key module debug of service robot	120	30
Module B: Epidemic prevention of service robot	120	35
Module C: Human computer interaction of service robot	120	30
Module D: Safety awareness and professional quality	/	5
Total	360	100

4.4 Operation contents and requirements of each module

Service Robot–Application of Epidemic Prevention application competition is composed of four modules, including: service robot module integration and installation, service robot safety and epidemic prevention application, service robot human-computer interaction comprehensive application and safety production and professional norms, and comprehensively examine the service robot technical ability of the contestants.

Module A Key module debug of service robot: Based on the service robot platform provided by the competition organizing committee, the assessment focuses on the integration and assembly of mechanical, electrical and electronic, software systems, intelligent detection and network modules, as well as the

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model training, model deployment, map construction, autonomous obstacle avoidance and path planning of the service robot;

Module B Epidemic prevention of service robot: the assessment focuses on the service robot voice interaction, Internet of things module, simulation debugging, 3D scene construction, safety and epidemic prevention application and programming debugging;

Module C Human computer interaction of service robot: it focuses on the performance of service robots in human-computer interaction scenarios, including self explanation scenario application, visual recognition, material distribution, distribution scenario application, programming and debugging, etc;

Module D Safety awareness and professional quality: the assessment focuses on strictly following the relevant professional quality requirements and safety norms, civilized competition, safety awareness, professional norms, complete archived materials, and preventing personal injury caused by machinery and equipment during the competition.

Module	Module Name	Content
A	Key module debug of service robot	According to the service robot platform provided by the competition organizing committee, on the basis of fully understanding the mechanical module, electronic and electrical module, software system module and network module, the contestants will complete the following work within the specified time: 1. According to the task requirements, use the data set production software to complete the data collection, cleaning and labeling of the detection unit, make the data set, optimize the parameters of the operation model, and complete the model verification and model training; 2. Complete the installation and commissioning of mechanical module, electronic and electrical module, software system module, network module and identity recognition module according to the task requirements; And use the service robot application development and testing tools to test each module; 3. According to the task requirements, compile and debug the service robot program, intelligently empower the service robot, and complete the application of map construction, autonomous obstacle avoidance, and path planning functions of the service robot; 4. According to the task requirements, combined with the training model, voice interaction, autonomous navigation, intelligent detection and other functions deployed on the service robot, realize the scene application of epidemic prevention detection of the service robot.

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B	Epidemic prevention of service robot	According to the service robot platform provided by the competition organizing committee, on the basis of fully understanding the application task of safety and epidemic prevention, the contestants will complete the following work within the specified time: 1. According to the task requirements, start the simulation environment. In the built simulation environment, call the corresponding module programs and analog sensors, and fuse the sensor data to complete the corresponding scene map construction. Based on the constructed scene, set the corresponding navigation points and enable the robot to complete the corresponding tasks. 2. According to the task requirements, complete the programming and debugging of the intelligent non-contact epidemic prevention and disinfection module, and realize the control of the intelligent non-contact epidemic prevention and disinfection module through the service robot. 3. According to the task requirements, complete the programming and debugging of the IOT module, configure the network of each IOT module, realize the normal communication between modules, and control each IOT module through the service robot. 4. According to the task requirements, compile and debug the service robot program, combined with the Internet of things module and voice interaction system, to realize the scene application of autonomous disinfection of robots through intelligent voice control.
C	Human computer interaction of service robot	According to the service robot platform provided by the competition organizing committee, on the basis of fully understanding the human-computer interaction tasks, the contestants will complete the following work within the specified time: 1. According to the task requirements, compile and debug the service robot program, combine the scene and service robot map construction, autonomous obstacle avoidance, path planning and voice interaction system, set different explanation contents, and complete the scene autonomous explanation task. 2. According to the task requirements, complete the programming and debugging of the manipulator and visual recognition module, and realize the control of the manipulator and visual recognition module; 3. According to the task requirements, intelligently empower the service robot, compile and debug the service robot program in combination with the scene and service robot map construction,

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		autonomous obstacle avoidance, path planning, Internet of things module, visual recognition module, etc., and complete the scene application of service robot material distribution and distribution.
D	Safety awareness and professional quality	1. Strictly follow relevant professional quality requirements and Safety specifications. 2. Participate in civilized competition and maintain safety awareness. 3. Professional specifications and complete archived data to prevent personal injury caused by machinery and equipment.

4.5 Announcement of test items

The test items will be announced through the official website of the competition or other ways approved by the Organizing Committee:

1. The project discloses facilities, equipment and sample competition questions;

2. The test items and scoring standards of the competition shall be announced by the referee on the day of the competition.

4.6 Test item changes

Before the official competition, the test items will be changed by 30%.

5. Competition equipment

The model of the competition device is HG CASTLEX-BRICS. The main technical parameters of the competition robot are as follows:

1. Universal service robot ontology controller

Using the Ubuntu+ robot meta-operating system architecture, it provides robot hardware abstraction, low-level device control, implementation of common functions, inter-process messaging, package management and other services, as well as tools and library functions needed to run code across computers.

2. Hardware functions of general service robot ontology

(1) Three-wheel omnidirectional chassis, sports chassis mechanical structure is stable and durable.

(2) With laser radar, ultrasonic sensor, gyroscope sensor, safety touch sensor, emergency stop button, electrical signal to acoustic signal transducer, anti-drop sensor and other sensors

3. General service robot ontology software functions

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(1) Integrated multi-sensor fusion SLAM solution, including lidar, camera, ultrasonic, odometer.

(2) Provide the chassis kinematics model control debugging interface, including the distance from the wheel to the center of the chassis in the kinematics control model and the included Angle of the wheel.

(3) It has visual interactive software, which can complete drawing, navigation, voice wake up, offline command word recognition and voice interaction.

(4) Provide control interface to achieve modular installation.

4. Uv prevention and elimination module:

Supports voice prompts such as start, finish, and security. Speech processing technologies such as speech synthesis, speech wake up and speech recognition are used to realize speech interaction and control functions. SLAM navigation data interactive interface. It has disassembly control interface to realize modular installation.

5. Health security check module:

It has a pattern recognition camera and temperature measurement module, and provides a digital IO or robot operating system control interface through which the device status can be obtained.

6. Intelligent Iot module:

Including intelligent lighting system, intelligent doorbell system, intelligent curtain system, etc.

7. Desktop intelligent operation arm:

(1) Graphical programming software and interactive control GUI software can be used.

(2) Open communication protocol and function library.

(3) With voice interactive control interface and voice capture function, it can realize 2D intelligent visual capture system of variable height.

(4) Visual intelligent recognition and grasping.

(5) SLAM navigation data interactive interface.

6. Skill management and communication

6.1 Expert group

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

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6.2 Discuss

Skill description before the competition, if you have any questions about the preparation of software and hardware, the deployment of the examination environment and so on, you can enter the forum of the competition official website and other platforms, technical training competition platforms for feedback. The training exchange of this competition, the exchange before, during and after the competition will also be carried out through the forum.

The online communication will be carried out using the instant messaging tool wechat (alternative: wechat enterprise version), and the time of the offline discussion forum will be uniformly announced by the organizing committee.

7. Safety requirements

7.1 Requirements for safety protection measures of athletes

The requirements of safety protection measures for athletes are shown in Table below.

Table Safety protective equipment for players (selected as required)

Items	Illustration	Description
Eye protection		1. Splash proof. 2. Myopia glasses must also be worn.
Hand protection		Stab proof and insulation.
Insulating gloves		Made of natural rubber, withstand voltage grade 1000V.
Safety hat		1. Shallow dome hat made of steel or similar materials used to protect the head to prevent the head from being injured by impact objects. 2. Players must wear safety helmets throughout the competition.

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Coverall		1. Must be trousers. 2. Protective clothing must be tight and not loose, and meet the requirements of three tightness. 3. Do not wear gloves when operating the machine tool.

During the competition, the expert will warn and correct the competitors and phenomena who violate the safety and health regulations and operating procedures. Contestants who do not listen to the warning and do not make corrections will be punished in varying degrees, such as not being allowed to enter the competition site, penalty of safety points, suspension of processing, disqualification of competition and so on.

7.2 Management and restriction of toxic and harmful substances

Contestants are forbidden to carry inflammables and explosives, as shown in Table below.

Table Items prohibited

Items	Illustration	Description
Antirust cleaning agent		No carrying ⊘
Alcohol, gasoline		No carrying ⊘
Toxic and harmful substances		No carrying ⊘

7.3 Medical equipment and measures

The site must be equipped with medical personnel and necessary drugs.

7.4 Environmental protection

1. Environmental protection
The national competition should pay attention to environmental protection and never allow damage to the environment.
2. Recycling
The waste generated during the national competition must be collected and recycled by category.

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8 Materials and equipment

8.1 Infrastructure list

The infrastructure list lists in detail all the equipment and facilities that participants need to prepare. See "2022 BRICs skills competition offline competition Service Robot–Application of Epidemic Prevention offline infrastructure list ".

8.2 Materials, equipment and tools brought by competitors

Tools and materials that do not need to be brought by contestants and are not allowed to be brought out of the competition. Others will be provided by the competition organizer. Contestants are forbidden to carry USB flash drives and any form of communication equipment.

8.3 Materials and equipment prohibited in the skill area

Any materials and equipment carried by contestants should be declared (shown) to experts. Experts may prohibit the use of any item that has nothing to do with the performance of the task or may give an unfair advantage to competitors.

8.4 Proposed competition area and final layout

See "2022 BRICs skills competition offline competition Service Robot–Application of Epidemic Prevention offline Final layout ".

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