2025

BRICS SKILLS COMPETITION

(BRICS+ FUTURE SKILLS & TECH CHALLENGE)

Artificial Intelligence Computer Vision Application

BRICS-FS-26

Test Project

(International Final_Online)

August, 2025

I. Competition Time

Duration: 3 hours

II. Competition Tasks

The competition consists of four modules with 8 tasks in total. The point distribution and duration are as follows:

Competition Module	Task Content	Points	Duration
Comprehensive Application in Industrial AI Scenarios	Task 1: Industrial Scenario Analysis and Solution Design	15	1 hours
AI Machine Vision Dataset Creation	Task 2: Data Collection and Processing	35	2 hours
	Task 3: Data Annotation		
AI Machine Vision Model Training	Task 4: Model Construction and Training	40	2 hour
	Task 5: Performance Evaluation and Tuning		

Safety Awareness and Professionalism		10	Throughout

Contents

Notice to Competitors:

1. The task book consists of 7 pages. If there are missing pages or unclear text, please request a replacement from the judges immediately.
2. Competitors must comply with relevant regulations and safety rules during the competition. Any violation will result in a corresponding deduction from the total score according to the regulations.
3. The competition duration is a continuous 3 hours (including time for meals, etc.). All competitors must stop all operations when the time is up.
4. Please pay attention to saving files such as datasets and exported SDKs during the competition. Competitors are responsible for any issues such as computer or robot dog "freezes," "restarts," "shutdowns," or "damage" caused by improper operation.
5. Any malicious damage to competition equipment or interference with other competitors will result in disqualification.
6. Please read the competition content and requirements carefully. If you have any objections during the process, you may report them to the on-site staff. Do not disrupt the order of the examination room.
7. Abide by competition discipline, respect the judges, and follow arrangements.
8. All electronic files should be saved in one folder named "Workstation_Number". This folder should be copied to the USB drive provided by the competition venue and placed in an envelope along with any printed materials. The envelope must be sealed and signed by both the competitor and the judge.

Competition Task Background:

Task Name: Intelligent Quality Inspection of Capsule Appearance on a Pharmaceutical Production Line

Task Background Description:

In modern pharmaceutical production, ensuring drug quality is of paramount importance, directly related to public health and safety. As a common drug dosage form, the appearance quality of capsules is a key indicator of their qualification. Traditional manual visual inspection methods are not only labor-intensive and inefficient but are also prone to missed and incorrect inspections due to factors like eye fatigue and subjective judgment differences, making it difficult to meet the quality control requirements of large-scale, high-standard drug production.

With the rapid development of artificial intelligence and computer vision technology, using AI for industrial quality inspection has become an important means to improve production efficiency and quality assurance capabilities. This competition simulates the use of computer vision technology for real-time, automated appearance defect detection of capsules on a high-speed production line in a pharmaceutical company. By deploying high-definition industrial cameras to capture capsule images and combining them with deep learning algorithms, it is possible to accurately identify and classify various defects such as damage, dents, discoloration, and printing errors, thereby automatically rejecting non-conforming products.

The implementation of this task aims to test the competitors' comprehensive ability to apply cutting-edge AI technology to precision industrial quality inspection scenarios. It not only greatly improves the automation level and quality inspection accuracy of drug production but is also a key technical practice for ensuring drug safety and promoting the intelligent upgrading of the pharmaceutical industry.

Competition Task Objectives:

- **Comprehensive Application in Industrial AI Scenarios:** Ability to analyze the needs of pharmaceutical quality inspection scenarios and design a reasonable and feasible AI solution.

- **AI Application Dataset Creation:** Ability to clean, process, and perform high-quality annotation on capsule image data to build a dataset that meets model training requirements.
- **AI Application Model Training:** Ability to select, build, and train a high-performance defect detection model, and to evaluate and optimize the model.

Module A: Comprehensive Application in Industrial AI Scenarios (15 Points) (Time:

1 hours)

Task 1: Industrial Scenario Analysis and Solution Design

Description: Competitors need to study the simulated scenario of capsule quality inspection on a pharmaceutical production line, identify various possible defect types such as damage, dents, discoloration, printing errors, etc., and understand the speed and accuracy requirements of the quality inspection process. Based on this analysis, write a brief requirements analysis report, clarifying the application goals of AI in this scenario.

Deliverables: Submit a requirements analysis report and an AI solution design document. The solution should include technology selection (e.g., model, framework), data processing flow, model deployment method, etc., and clearly define the specific application logic of the AI system in the quality inspection process.

Module B: AI Machine Vision Dataset Creation (35 Points) (Time: 2 hours)

Task 2: Data Collection and Processing

Description: Competitors need to use data processing tools or write scripts to clean the given raw capsule image data (capsule_dataset.zip), including removing low-quality images (e.g., blurry, overexposed), unifying image sizes, and performing data augmentation to ensure data quality and diversity.

Deliverables: Submit the cleaned and processed dataset (named cleaned_dataset-workstation_number-name.zip) as well as the complete data processing script and a description document.

Task 3: Data Annotation

Description: Competitors need to use professional annotation tools to accurately annotate the cleaned capsule dataset. The specific location and category of each defect must be annotated.

Deliverables: Submit a clear annotation specification document. The annotation results must ensure high accuracy (bounding boxes tightly fit the defect areas, and classes are correct). Finally, export all annotated data in a standard dataset format (e.g., COCO), compress it (named annotated_dataset-workstation_number-name.zip), and submit it.

Defect Examples:

- **Normal Capsule:** Smooth surface, uniform color, clear printing, no damage.
- **Damaged:** Obvious cracks, chips, or holes in the capsule shell.
- **Dented:** Unintended pits or deformations on the capsule surface.
- **Discolored:** Uneven color, spots, or abnormal colors on the capsule surface.
- **Printing Error:** Blurred, missing, or misplaced printed text or patterns on the capsule.

Module C: AI Machine Vision Model Training (40 Points) (Time: 2 hours)

Task 4: Model Construction and Training

Description: Competitors need to select and build a suitable deep learning model (e.g., YOLO series, Faster R-CNN) based on the characteristics of the capsule defect detection task (e.g., small targets, multiple classes) and use the annotated dataset for model training.

Task 5: Performance Evaluation and Tuning

Description: Competitors need to use appropriate metrics (e.g., mAP,

Precision, Recall) to comprehensively evaluate the model's performance. Based on the evaluation results, adjust model parameters or structure for optimization to achieve the best detection effect.

Deliverables: Submit the final trained model weight file, complete training and inference code, and a model evaluation report containing performance analysis and the tuning process.

Module D: Safety Awareness and Professionalism (10 Points)

Assessment Points:

- **Safety Standards:** Strictly adhere to relevant professional ethics and safety regulations, compete in a civilized manner, and maintain safety awareness.
- **Equipment Check:** Carefully check whether all equipment is in normal condition before starting operations.
- **Data Archiving:** Archive all digital materials according to professional standards and requirements.
- **Equipment Operation:** Use and operate equipment according to standards. No equipment should be damaged during the competition. After the competition, return all equipment, tools, and instruments to their original positions.

If there is a clear violation of professional ethics, competition discipline, or safety operating procedures, or behavior that damages equipment, tools, or measuring instruments, and the consequences are serious, the score for the professionalism module will be zero. The decision will be proposed by the on-site judge and reviewed and approved by the Chief Judge.