Yahboom DOFBOT PRO

Yahboom DOFBOT PRO 3D Adaptive Robotic Arm Kit User Manual

Model: Ultimate-Orin Nano (4GB)

1. Introduction

The Yahboom DOFBOT PRO is an advanced 3D adaptive robotic arm kit designed for mechanical engineers and developers. This kit integrates powerful ROS master controllers, a 3D depth camera, and supports large AI models for enhanced performance in mechanical control, AI vision, and 3D depth applications. It offers capabilities such as object recognition, tracking, grasping, and sorting in three-dimensional space, along with various control methods and extensive course resources.

2. Safety Information

- Always operate the robotic arm on a stable, flat surface to prevent tipping.
- Keep hands and loose clothing clear of moving parts during operation to avoid injury.
- Ensure all power connections are secure and correctly polarized before powering on the device.
- Do not expose the device to water or excessive moisture.
- Use only the provided power adapter.
- This product is recommended for users aged 20 years and up due to its complexity.

3. Package Contents

The DOFBOT PRO kit includes the following components. Please verify all items upon unboxing.

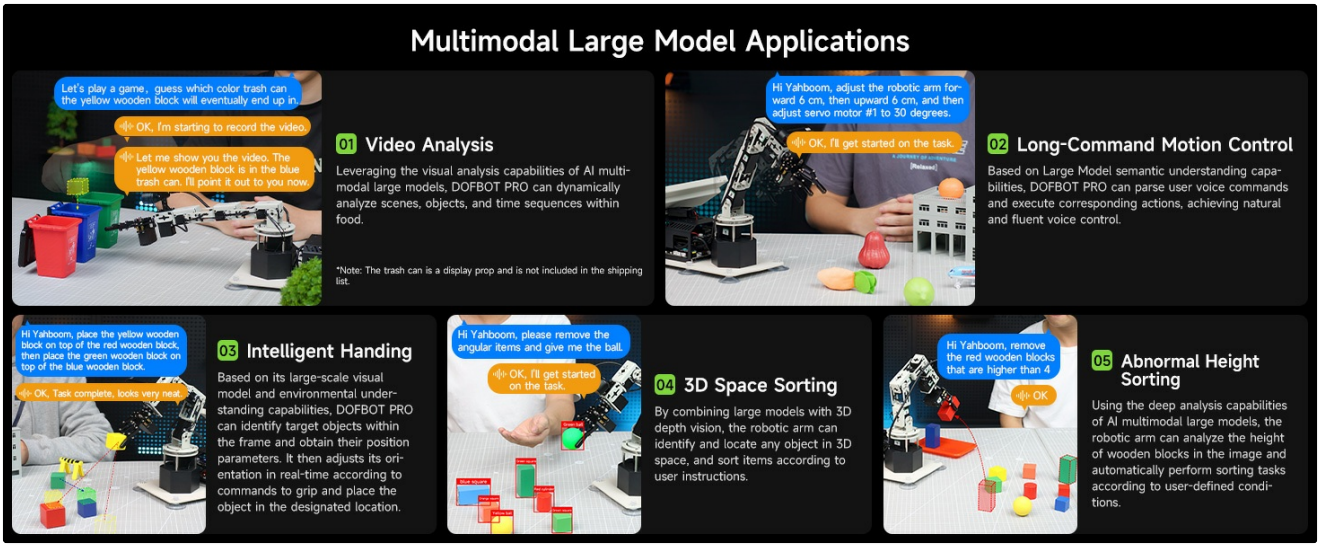

Image: Detailed view of the Yahboom DOFBOT PRO kit components, including the robotic arm, depth camera, control boards, accessories, and various blocks for testing.

DOFBOT-PRO Standard Version Accessories:

- DOFBOT PRO body + chassis
- DABAI DCW2 depth camera
- Robotic arm expansion board
- Wireless handle + AAA battery
- Depth camera bracket
- OLED screen
- Patch antenna *2
- PCB patch acrylic board
- 50*50*50 blocks *4 (red/green/blue/yellow)
- 30*30*60 blocks *4 (red/green/blue/yellow)
- 40*40*40 block *1
- DOFBOT PRO map
- 3D calibration & checkerboard card
- Suction cup
- Upper elbow Type-C data cable
- Power adapter + cable
- Nylon cable ties *6
- Micro USB data cable
- Screwdriver pillarwire
- AI Large Model Voice Module
- Speaker

DOFBOT-PRO Ultimate Version Accessories:

- 10.1 inch touch display screen
- DP to HDMI adapter cable
- M2*16mm round head screw

ROS Main Control Board (optional):

- Jetson Nano 4GB version accessories: Jetson Nano 4GB SUB board, 4009 cooling fan, U disk (system file), Network card, HDMI cable, Flex cable, M2*14mm screws

- Jetson Orin NANO SUPER 4GB/8GB version accessories: Jetson Orin NANO SUPER 4GB/8GB, DP to HDMI adapter cable (1.5m), SSD (system file), Power cord *2
- Jetson Orin NX SUPER 8GB/16GB version accessories: Jetson Orin NX SUPER 8GB/16GB, DP to HDMI adapter cable (1.5m), SSD (system file), Power cord *2

4. Setup and Assembly

Detailed assembly instructions are provided through the online course catalog. Please refer to the 'Assembly course' for step-by-step guidance. Ensure all components are securely fastened before proceeding to power on the device.

Image: An overview of the Yahboom DOFBOT PRO robotic arm kit, showcasing the main robotic arm assembly, depth camera, control board, and various accessories.

5. Hardware Overview

The DOFBOT PRO is built with high-performance hardware components to support its advanced functionalities.

Image: A detailed diagram illustrating the high-performance hardware components of the DOFBOT PRO, including the robotic arm, depth camera, OLED screen, ROS master control, and suction cups.

5.1. ROS Master Control

The DOFBOT PRO offers flexibility with three ROS master controller options: Jetson Nano 4GB, Orin Nano Super, and Orin NX Super development boards. These boards provide robust performance for mechanical control, AI vision, and 3D depth applications.

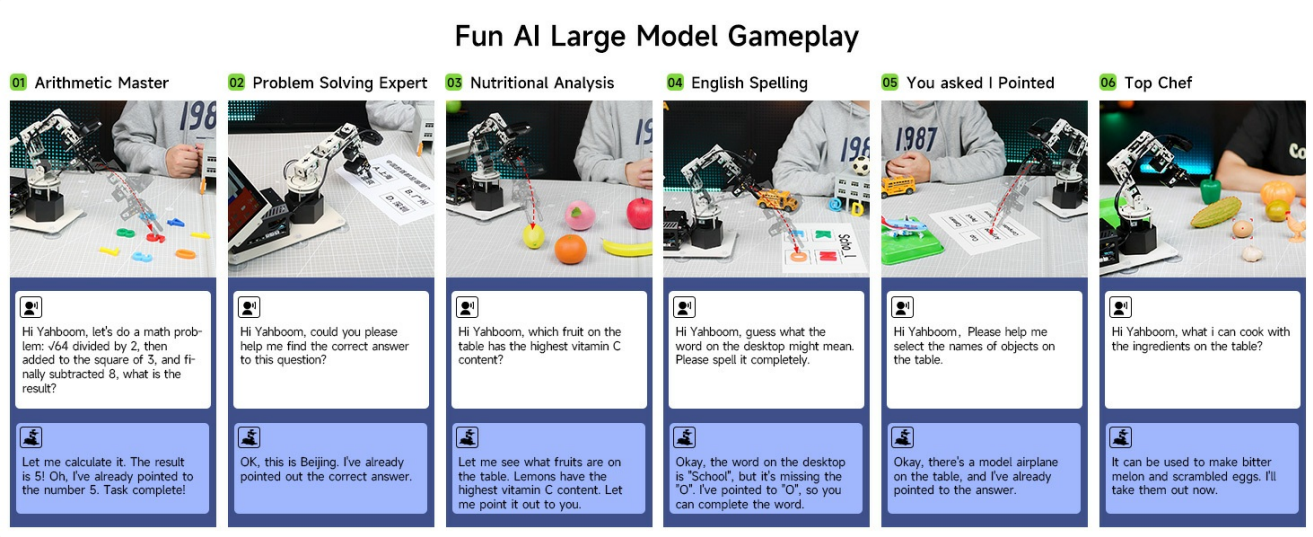

Image: A comparison table detailing the specifications and performance of different Jetson series main control boards (Jetson Nano B01 4GB, Jetson Orin Nano Super 4GB/8GB, Jetson Orin NX Super 8GB/16GB) for ROS master control.

5.2. 6DOF Robotic Arm

The DOFBOT PRO features a 6-Degrees-of-Freedom (6DOF) robotic arm, allowing for precise and complex movements. It is designed for user-defined programming and integrates with the 3D vision system for accurate object identification and localization.

Image: A diagram illustrating the 6-Degrees-of-Freedom (6DOF) robotic arm, highlighting its joints (J1-J6) and its integration with the 3D vision system.

5.3. DABAI DCW2 Depth Camera

The robotic arm is equipped with a DABAI DCW2 depth camera, enabling 3D vision capabilities such as depth distance measurement, object recognition, and height measurement. This binocular structured light depth camera has a measurement range of up to 5 meters.

5.4. AI Large Model Voice Module

The kit includes an AI large model voice module, facilitating embodied intelligence and multimodal applications through voice interaction.

5.5. 10.1-inch IPS Display (Ultimate Version)

The Ultimate version features a 10.1-inch IPS display (1920*1080p) for enhanced user interaction and visual feedback.

5.6. Control Board Interfaces

Image: A detailed diagram of the control board, labeling various interfaces such as T-type power supply, 12V output, power switch, PS2 Handle receiver base, RESET button, K1/K2 buttons, 5V output, IIC, micro USB, ultrasonic, PWM servo, bus servo, RGB light, MCU serial port function selection, buzzer, and status indicator.

6. Operating Instructions

6.1. 3D Vision Capabilities

The integration of the 3D depth camera transforms the robotic arm into a powerful tool for perceiving and interacting with its environment in three dimensions.

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Video: This video demonstrates the DOFBOT PRO's 3D tracking capabilities, showcasing how the robotic arm uses its depth camera to perceive, measure, and interact with objects in a three-dimensional space.

Image: A visual comparison highlighting the differences between 2D and 3D vision for robotic arms, emphasizing the advantages of 3D vision in depth measurement, object recognition, and spatial sorting.

Image: An illustration of the robotic arm's depth vision capabilities, showing 3D point cloud recognition, distance measurement, target object height measurement, and regional target volume measurement.

Image: A detailed explanation of the depth vision arm-camera integration, describing how the high-performance binocular structured light depth camera calculates distance, shape, height, volume, and position of objects in 3D space.

6.2. Sorting and Gripping in 3D Space

The robotic arm can perform advanced sorting and gripping tasks in 3D space, adapting to various scenarios.

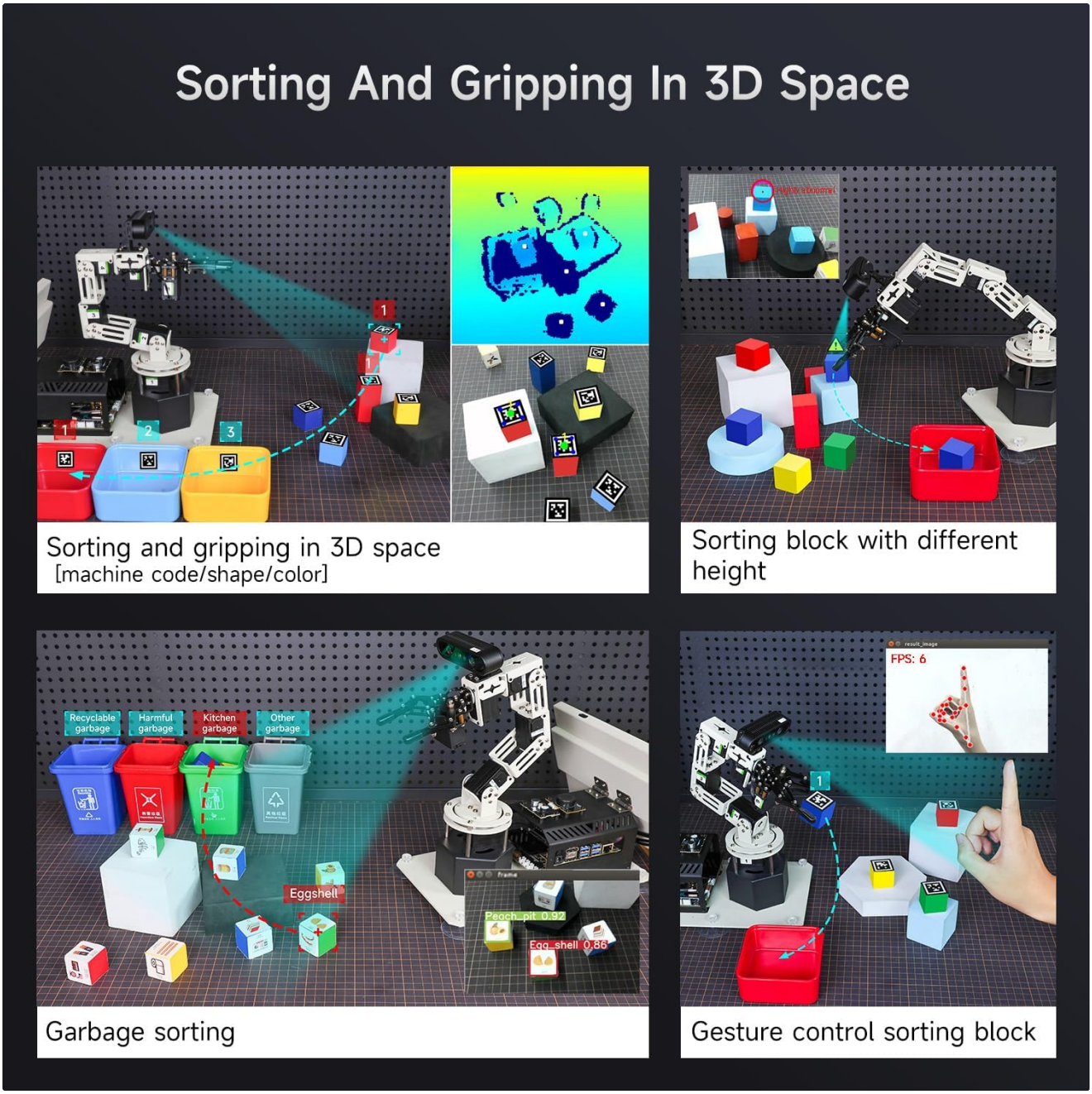

Image: Demonstrations of the robotic arm sorting and gripping objects in 3D space, including sorting by machine code/shape/color, sorting blocks with different heights, garbage sorting, and gesture-controlled sorting.

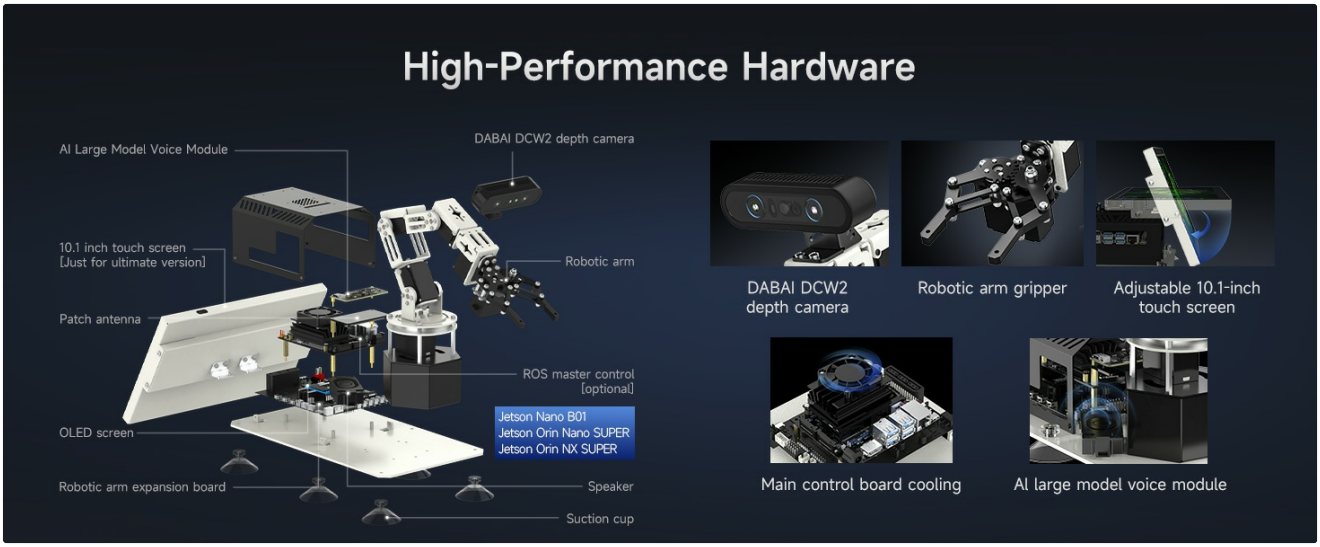

Image: Examples of AI vision recognition and target tracking, including color recognition and tracking, color block sorting, catch game, color interaction, face recognition and tracking, and label recognition and stacking.

6.3. AI Interaction and MediaPipe Development

The DOFBOT PRO supports MediaPipe development for AI interaction, allowing for gesture control and other advanced applications.

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Video: This video illustrates the DOFBOT PRO's AI large model capabilities, demonstrating how it processes complex commands and interacts with its environment using multimodal AI.

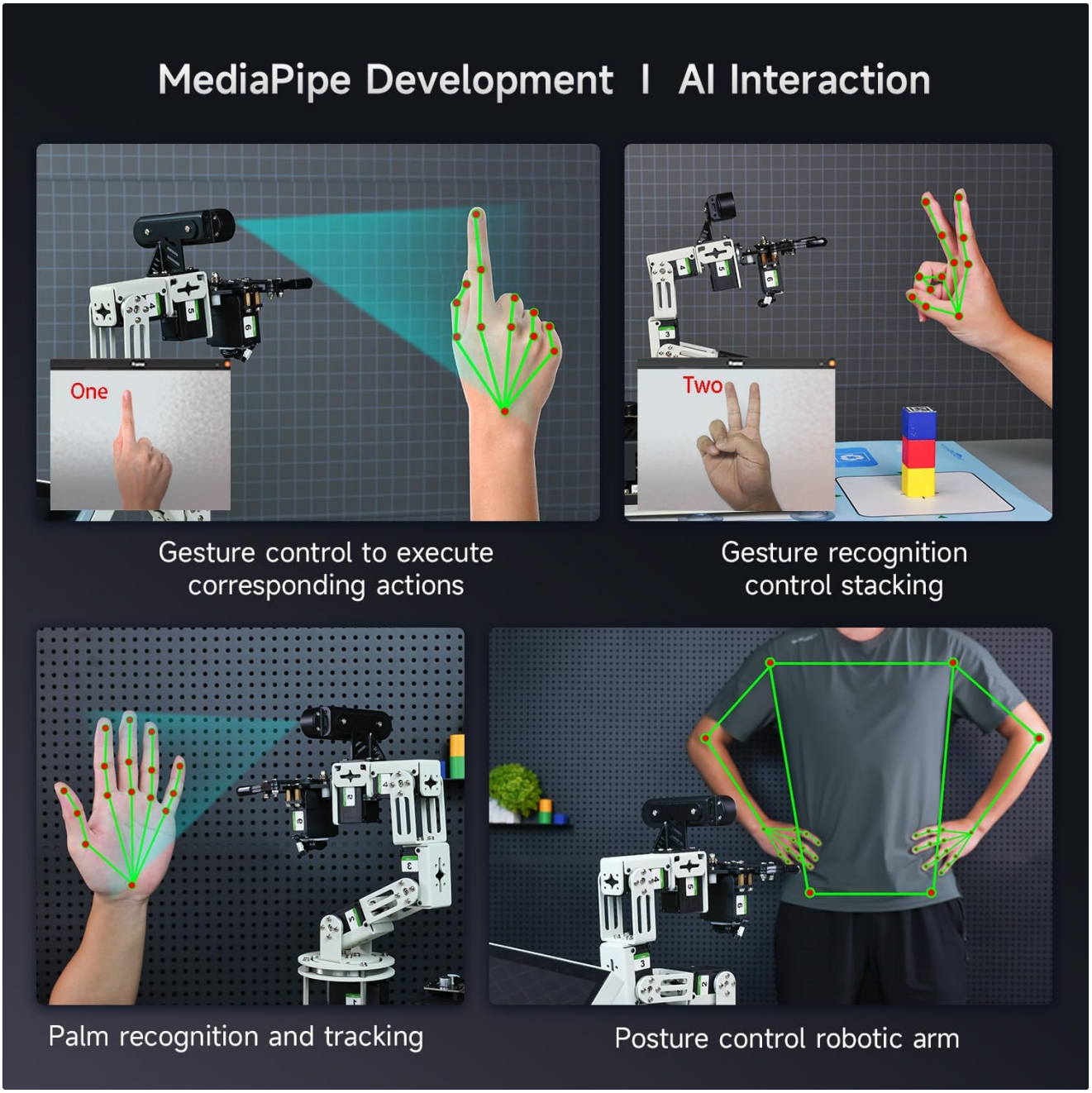


Image: Examples of MediaPipe development for AI interaction, showing gesture control to execute actions, gesture recognition for stacking, palm recognition and tracking, and posture control of the robotic arm.

Image: A detailed view of MediaPipe development and AI interaction, showcasing palm recognition and tracking, gesture control for sorting blocks, and gesture recognition for stacking.

6.4. Robotic Arm MoveIt Kinematics

The DOFBOT PRO supports MoveIt simulation for advanced kinematics and trajectory planning.

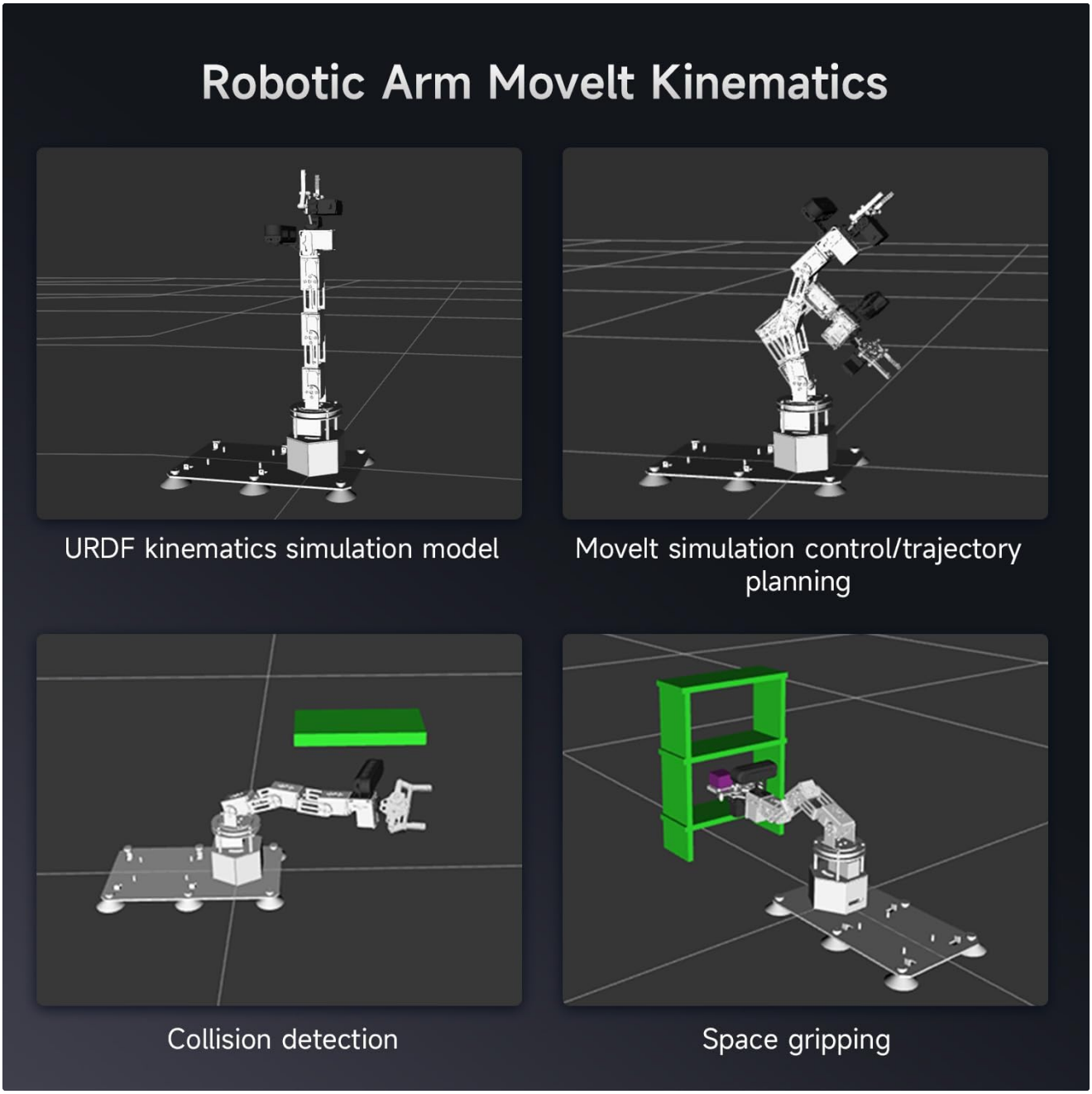


Image: Demonstrations of Robotic Arm MoveIt Kinematics, including URDF kinematics simulation model, MoveIt simulation control/trajectory planning, collision detection, and space gripping.

Image: A detailed explanation of MoveIt simulation control, showing how it reduces experimental environment requirements and improves experimental efficiency through URDF kinematics, simulation control, collision detection, and space gripping.

6.5. Cross-platform Interconnected Remote Control

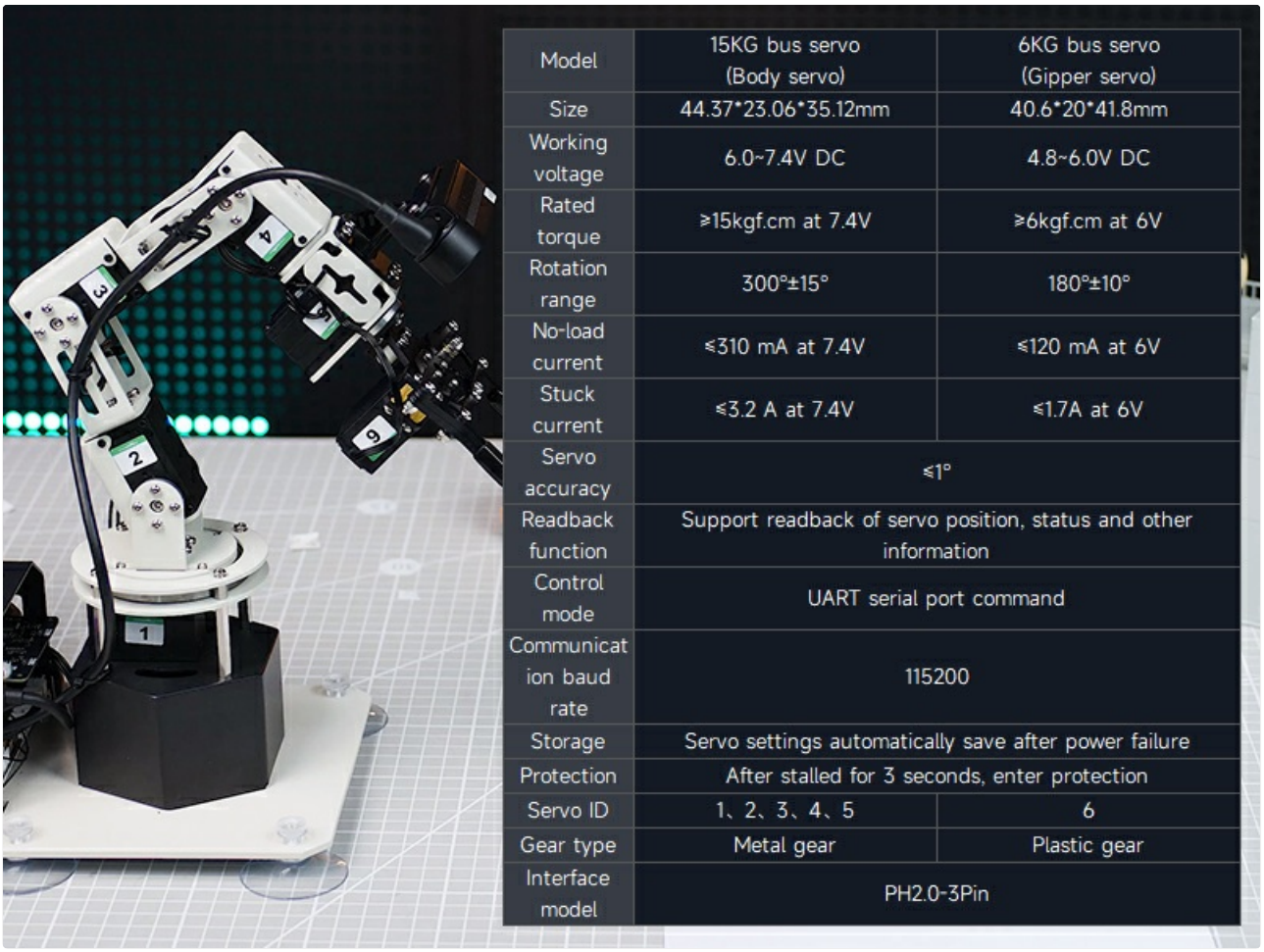
The DOFBOT PRO can be controlled via multiple platforms, including mobile apps (Android only), USB wireless handles, and PC web control.

Image: A visual representation of the cross-platform interconnected remote control options, including APP Control (Android), USB Wireless Handle Control, and PC Web Control.

Image: A detailed view of the cross-platform interconnected control options, showing the user interface for APP control (Android), a USB wireless handle, and a PC web control interface.

7. Specifications

Detailed technical specifications for the DOFBOT PRO.



Model	15KG bus servo (Body servo)	6KG bus servo (Gipper servo)
Size	44.37*23.06*35.12mm	40.6*20*41.8mm
Working voltage	6.0~7.4V DC	4.8~6.0V DC
Rated torque	≥15kgf.cm at 7.4V	≥6kgf.cm at 6V
Rotation range	300°±15°	180°±10°
No-load current	≤310 mA at 7.4V	≤120 mA at 6V
Stuck current	≤3.2 A at 7.4V	≤1.7A at 6V
Servo accuracy	≤1°	
Readback function	Support readback of servo position, status and other information	
Control mode	UART serial port command	
Communication baud rate	115200	
Storage	Servo settings automatically save after power failure	
Protection	After stalled for 3 seconds, enter protection	
Servo ID	1、2、3、4、5	6
Gear type	Metal gear	Plastic gear
Interface model	PH2.0-3Pin	

Image: A table outlining the dimensions and key specifications of the DOFBOT PRO AI Large Model 3D Vision Robotic Arm, including programming language, ROS master control, input/output, robotic arm degrees of freedom, payload, gripper maximum opening distance, communication method, and weight.

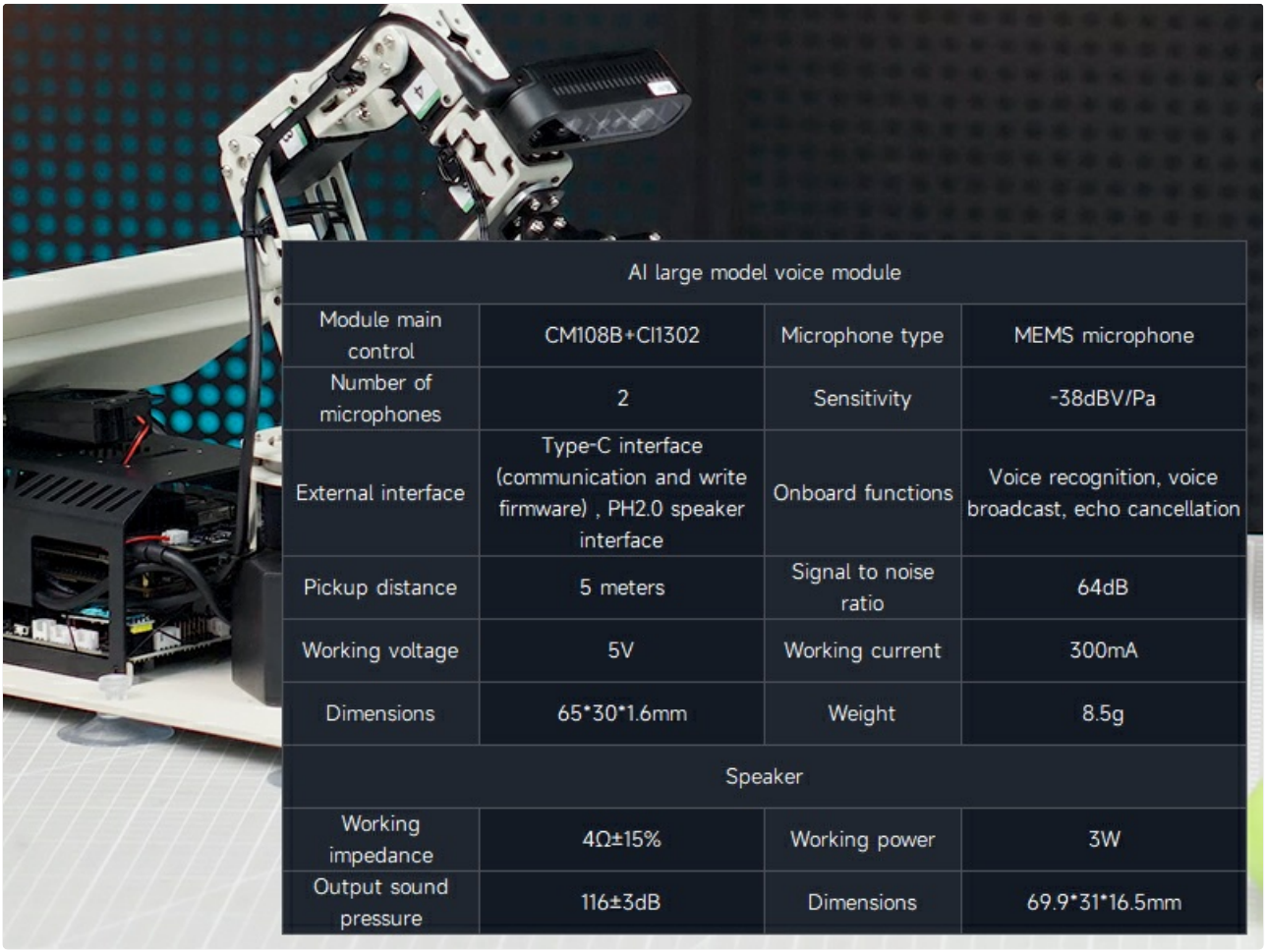
7.1. General Dimensions

- Product Dimensions: 9.4 x 7 x 5.5 inches
- Overall Dimensions: 348.6 * 242.4 * 491.1mm
- Weight: 3780g
- Arm Span: 350mm (Maximum effective arm span)
- Effective Gripping Range: 300mm
- Repeatability Accuracy: ±0.5mm

7.2. DABAI DCW2 Depth Camera Specifications

Image: A table detailing the specifications of the DABAI DCW2 depth camera, including working distance, device size, communication/power supply method, relative accuracy, depth resolution, depth FOV, color image resolution, color FOV, image format, applicable scenarios, safety, camera principle, weight, and certification.

7.3. Robotic Arm Servo Specifications



AI large model voice module			
Module main control	CM108B+CI1302	Microphone type	MEMS microphone
Number of microphones	2	Sensitivity	-38dBV/Pa
External interface	Type-C interface (communication and write firmware) , PH2.0 speaker interface	Onboard functions	Voice recognition, voice broadcast, echo cancellation
Pickup distance	5 meters	Signal to noise ratio	64dB
Working voltage	5V	Working current	300mA
Dimensions	65*30*1.6mm	Weight	8.5g
Speaker			
Working impedance	4Ω±15%	Working power	3W
Output sound pressure	116±3dB	Dimensions	69.9*31*16.5mm

Image: A table detailing the specifications of the 15KG bus servo (body servo) and 6KG bus servo (gripper servo), including size, working voltage, rated torque, rotation range, no-load current, stuck current, servo accuracy, readback function, control mode, communication baud rate, storage, protection, servo ID, gear type, and interface model.

7.4. 10.1-inch Touch Screen Specifications (Ultimate Version)

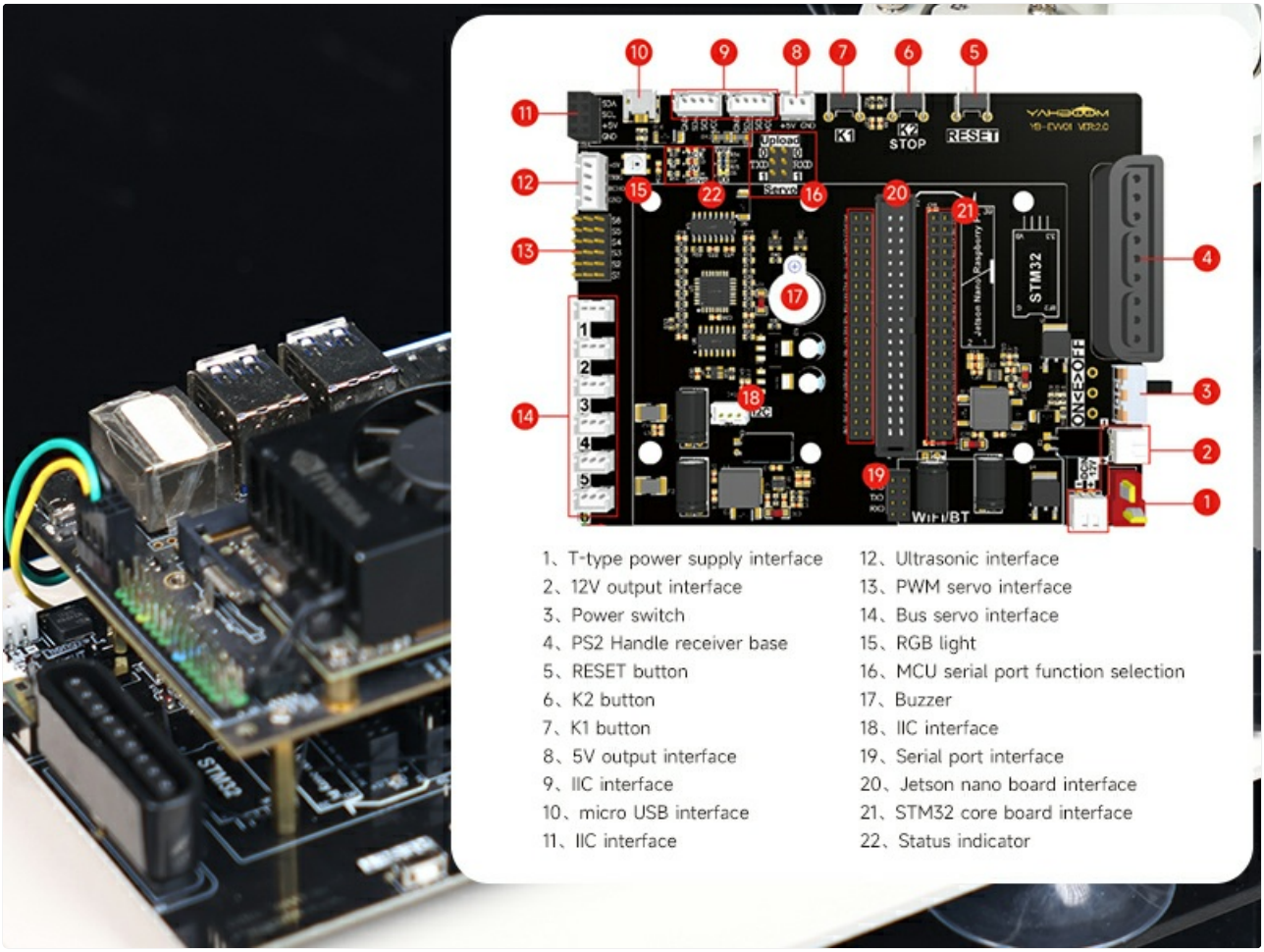


Image: A table detailing the specifications of the 10.1-inch touch screen, including material, process, design, wire interface, screen size, screen type, backlight adjustment, screen resolution, touch screen type, power supply, total power, video input interface, and overall weight.

7.5. AI Large Model Voice Module Specifications

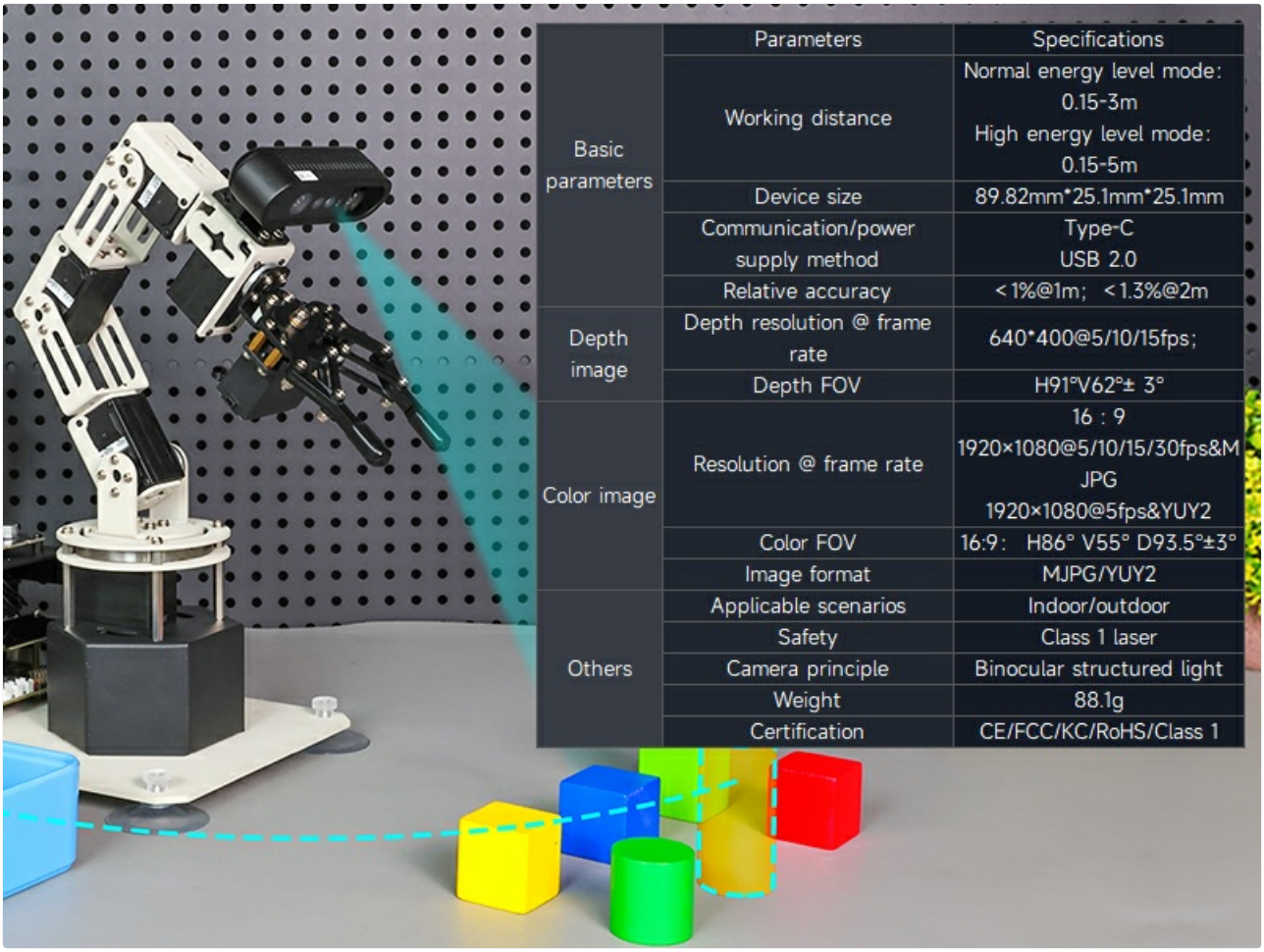


Image: A table detailing the specifications of the AI large model voice module, including main control, microphone type, number of microphones, sensitivity, external interface, onboard functions, pickup distance, signal to noise ratio, working voltage, working current, dimensions, weight, working impedance, output sound pressure, and speaker dimensions.

8. Maintenance

- Regularly inspect all mechanical joints and fasteners for tightness. Tighten any loose screws to ensure stable operation.
- Keep the robotic arm and its components clean and free from dust and debris. Use a soft, dry cloth for cleaning.
- Avoid applying excessive force to the robotic arm joints or gripper, as this may cause damage to the servos.
- Store the robotic arm in a dry, cool environment when not in use.
- Periodically check for software updates and firmware upgrades to ensure optimal performance and access to new features.

9. Troubleshooting

- **Robotic Arm Not Responding:** Check all power connections and ensure the main control board is powered on. Verify that the control software is running correctly and that communication between the control board and the robotic arm is established.
- **Inaccurate Object Recognition:** Ensure the depth camera lens is clean and unobstructed. Calibrate the camera if necessary, following the instructions in the online course catalog. Ensure proper lighting conditions.
- **Unstable Gripping:** Check the gripper mechanism for any obstructions or damage. Ensure the object being gripped is within the gripper's maximum opening distance and weight capacity.
- **Software Errors:** Refer to the online documentation and community forums for specific error codes. Ensure all necessary libraries and dependencies are installed and up-to-date.

- **Overheating:** Ensure the main control board cooling fan is operating correctly and that there is adequate ventilation around the device.

10. Warranty and Support

Specific warranty and support information was not provided in the product data. Please refer to the manufacturer's official website or contact their customer service for detailed warranty terms, technical support, and service options.