Unitree

G1 , G1- EDU

Overview & Key Facts

Introduction

What is Unitree G1

- **Unitree G1 is a full-size humanoid robot designed for research, education, and development.It is widely used in labs and universities for robotics, AI, motion/control experiments, human-robot interaction, perception, locomotion, and manipulation tasks.**

Physical Dimensions & Body

The Unitree G1 consists of an upper and lower body with multiple DOFs: each arm has 5 DOFs (shoulder, upper arm, elbow), and each leg has 6 DOFs (hip, leg, knee, ankle).The waist adds 1 DOF through the lumbar joint.Depending on the version, the G1 comes as a 23-DOF basic model or a 23–43-DOF EDU model.These joints enable precise whole-body motion and posture control.

| type	G1
Total Degrees of Freedom (Joint Freedom）	23
Single Leg Degrees of Freedom	6
Waist Degrees of Freedom	1
Single Arm Degrees of Freedom	5
Single Hand Degrees of Freedom	/
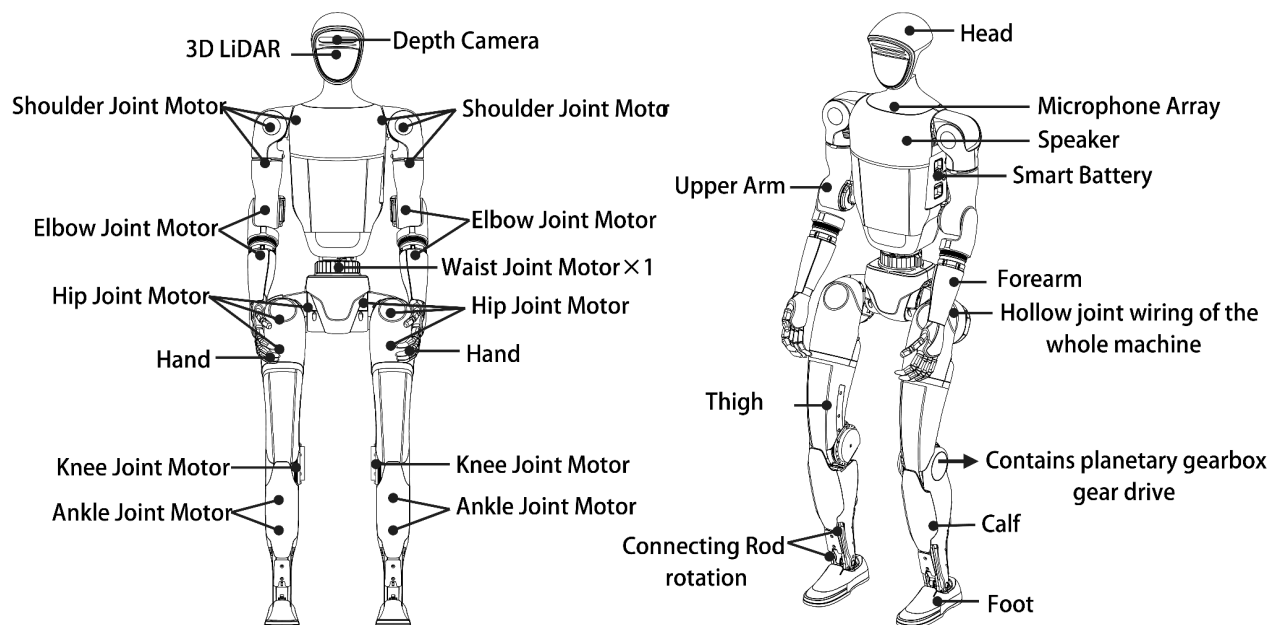
| type	G1-EDU
Total Degrees of Freedom (Joint Freedom）	23
Single Leg Degrees of Freedom	6
Waist Degrees of Freedom	1
Single Arm Degrees of Freedom	5
Single Hand Degrees of Freedom	**7**(Optional Force outrolled three-fingered dexterous hand Dex3-1) **+2**(Optional 2 additional wrist degrees of freedom)
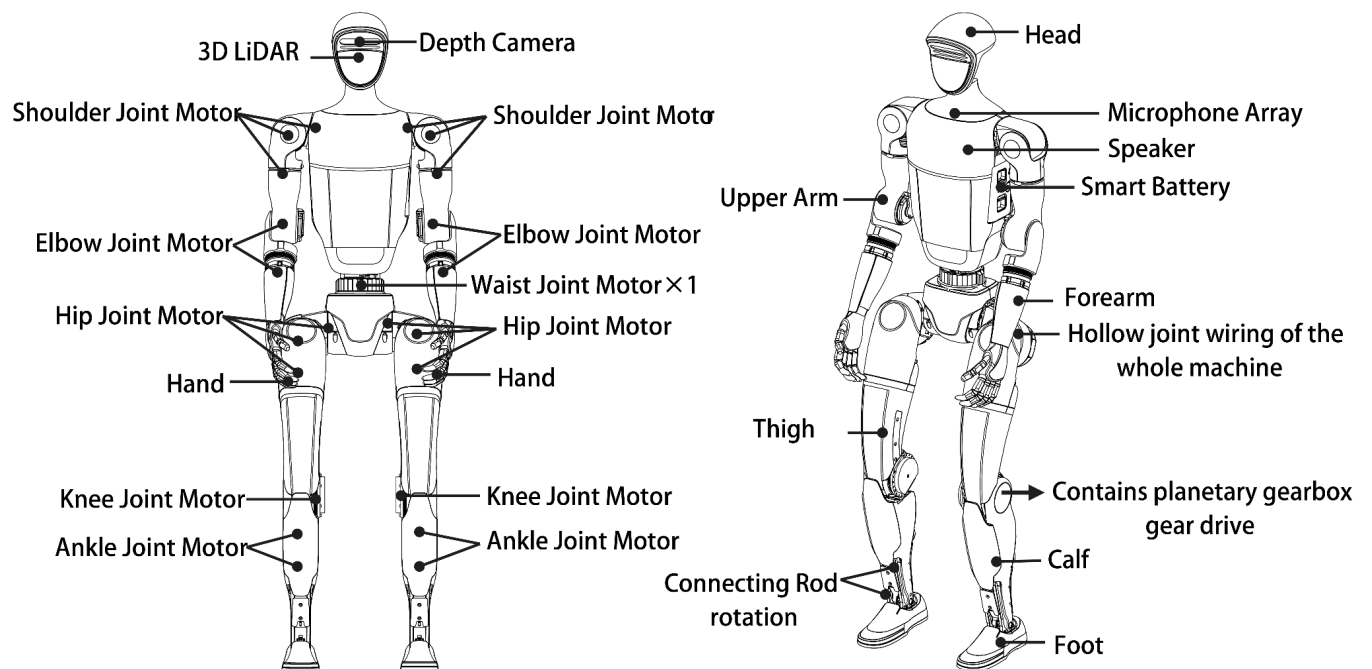
Electrical Interface:

The right side of the G1 is equipped with electrical interfaces, which are used to connect the various body joint motors, sensor peripherals, network ports, etc. This design makes it easy to debug, troubleshoot problems, and do secondary development.

Top view of equipment
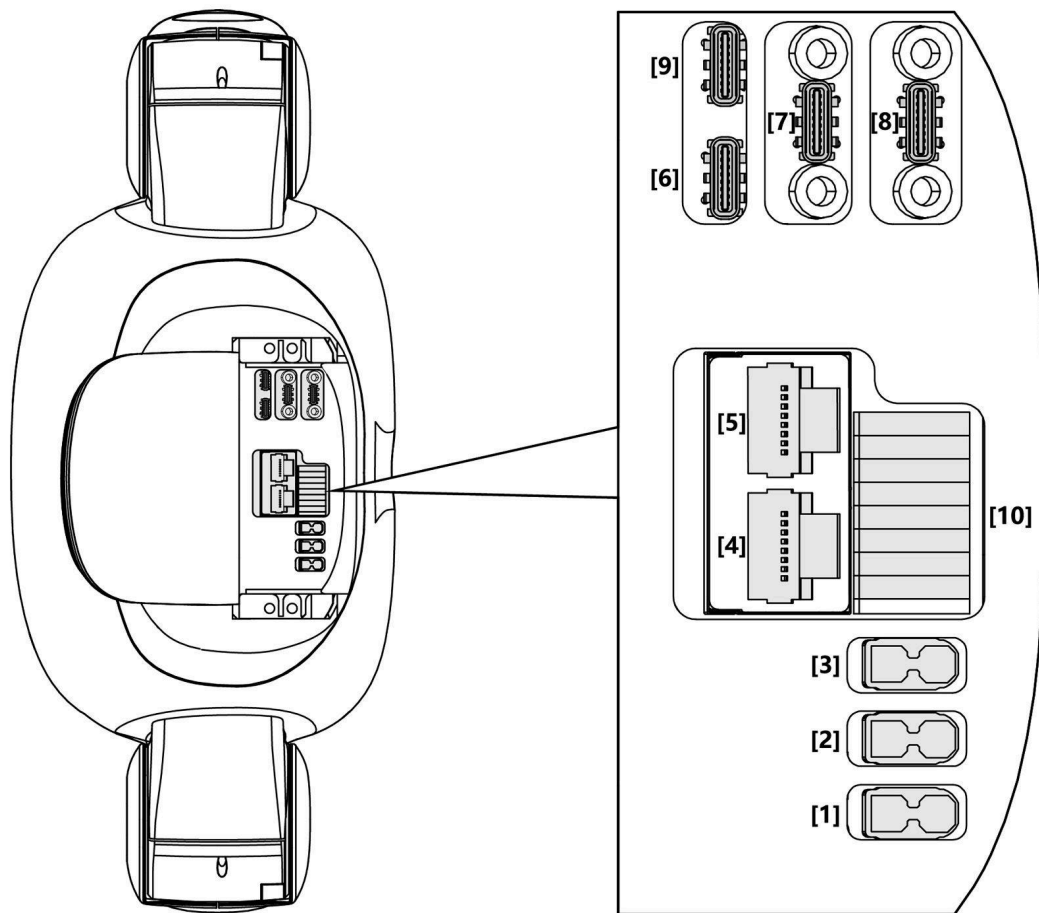
RJ45 and the IO list interface:
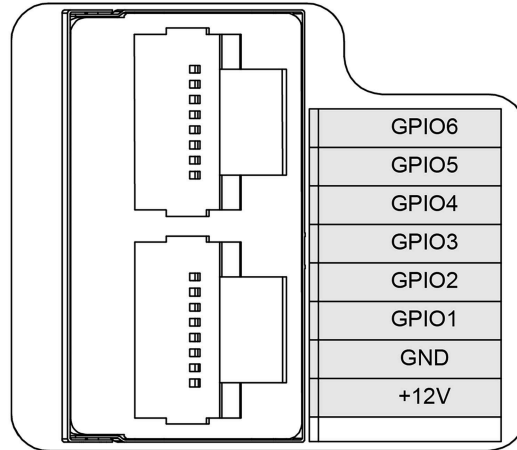
GPIO Number	NX Pin Number	Multiplexing Relationship	Pin name of the debugfs file system
GPIO1	203	UART1_TXD	GPIO3_PR.02
GPIO2	205	UART1_RXD	GPIO3_PR.03
GPIO3	232	I2C2_SCL	GPIO3_PI.03
GPIO4	234	I2C2_SDA	GPIO3_PI.04
GPIO5	128	GPIO	GPIO3_PCC.02
GPIO6	130	GPIO	GPIO3_PCC.03

The most convenient way to join this subnetwork is directly plug your device into it.It's clear that you need to connect to the robot via the LAN interface, signed as "Switch" on the robot.

On-board computer

parameter	development computing unit (PC 2)
Model	Jetson Orin NX
CPU	Arm® Cortex®-A78AE
Number of cores	8
Number of threads	8
Max largest rate	2 GHz
graphic memory Memory	16G
Memory	16G
Cache	2MB L2 + 4MB L3
Storage	2T
Intel ® Image Processing Unit	No
GPU	1024 NVIDIA Ampere architecture Gpus with 32 Tensor cores
Maximum dynamic frequency of graphics card	918MHz

|	
Gaussian and Neuro Accelerator	3.0
Intel ® deep learning promotion	Yes
Intel ®Adaptix™ Technology	Yes
Intel ® hyperthreading technology	Yes
Instructions set	64bit
OpenGL	4.6
OpenCL	3.0
DirectX	12.1
IP address	192.168.123.164

Field of view of G1 radar and camera

\The G1 head is equipped with LIVOX-MID360 laser radar, which provides excellent environmental perception capabilities for robots.Lidar adopts omnidirectional and full-angle scanning technology, with a FOV level of up to 360° and a maximum vertical angle of 59°, enabling real-time acquisition of accurate environmental data.It can quickly identify and measure surrounding objects, providing high-resolution point cloud.
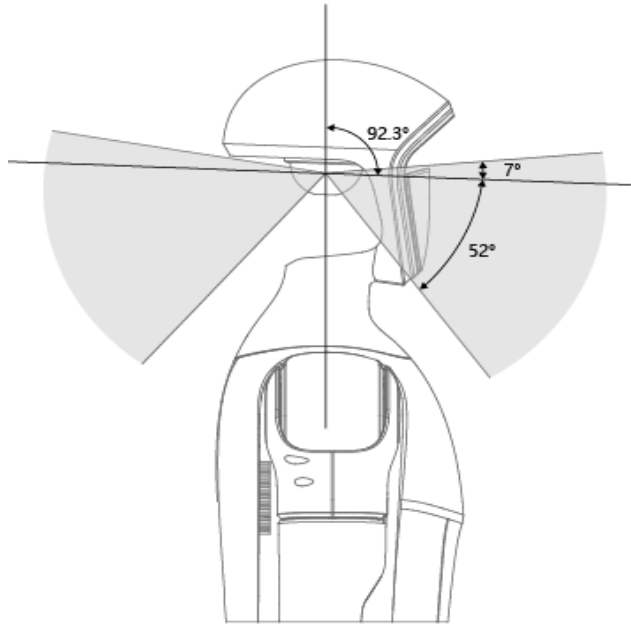
MID360 laser radar FOV
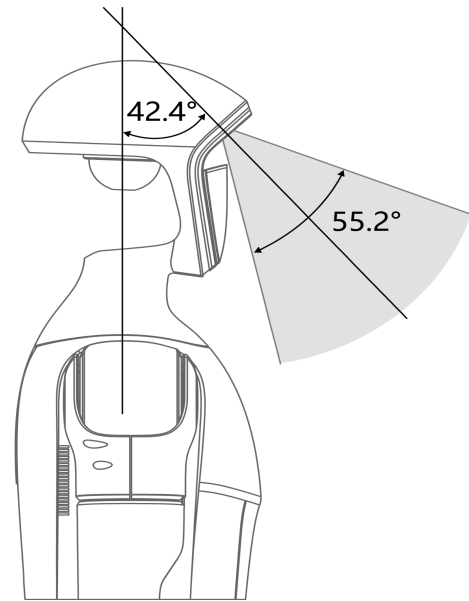
D435i Depth Camera FOV

The G1 head is equipped with a D435i depth camera, which provides the robot with excellent visual perception capabilities, enabling it to more accurately perceive and understand its surroundings, achieve precise spatial perception and obstacle detection, and enable the robot to interact with the environment and respond to various scenarios more intelligently and flexibly
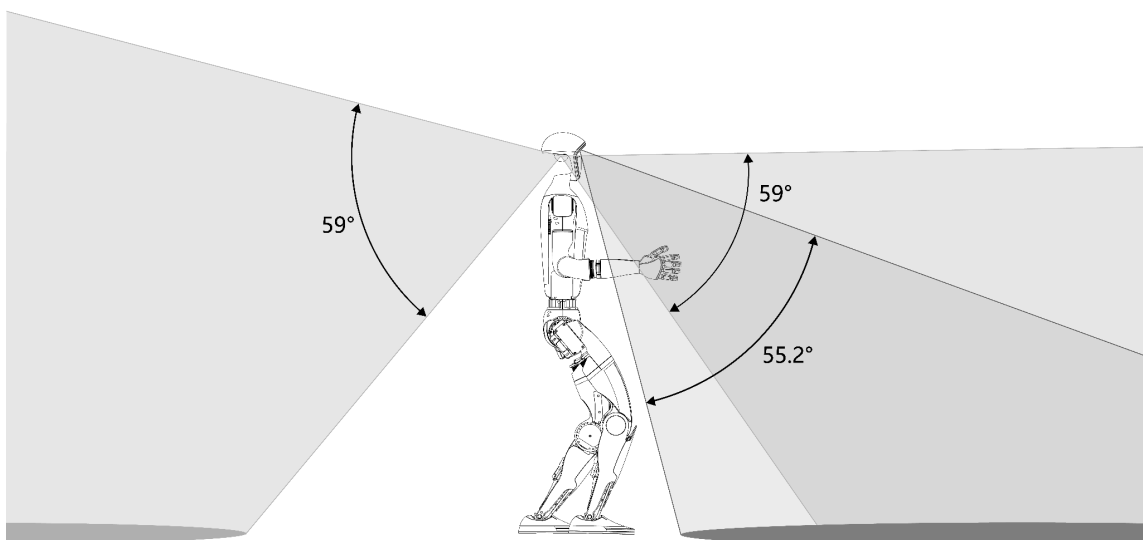
Coordinate system, joint rotation axis and joint zero point

When all joints are zero, each coordinate system is as follows. Red is the X-axis, green is the Y-axis, and blue is the z-axis.
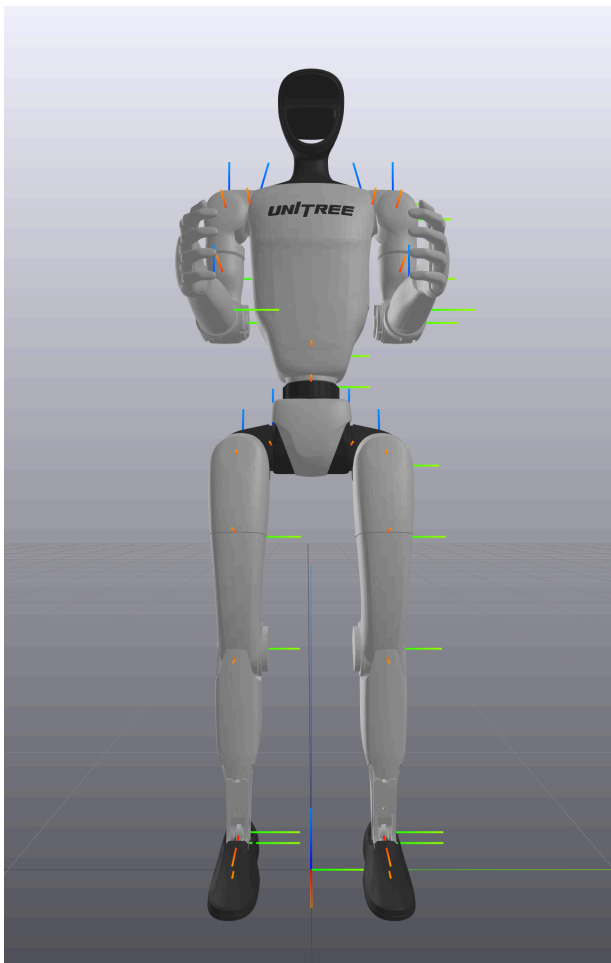
23 dof	29dof

Robot specifications

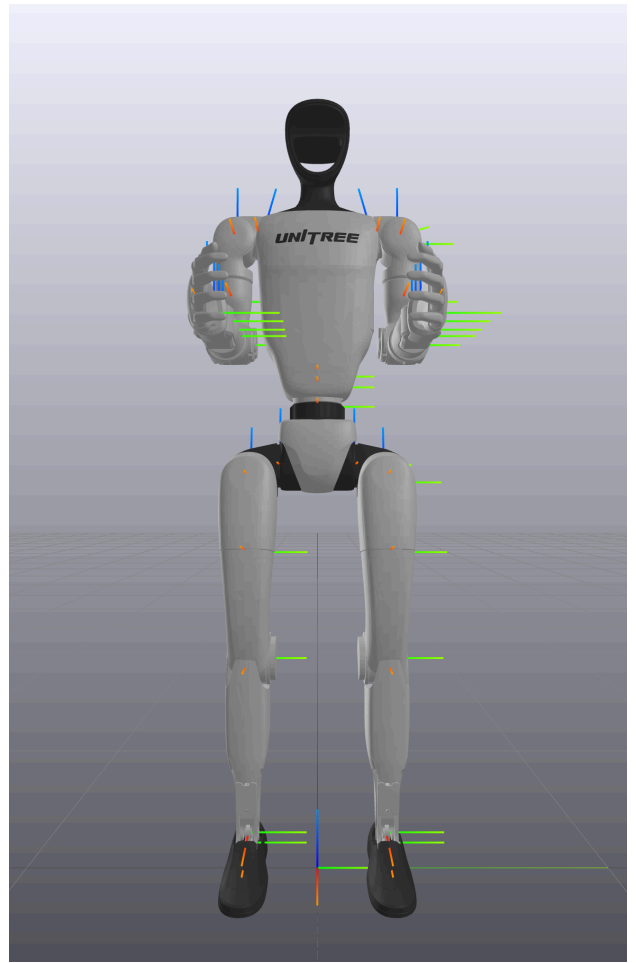| model	G1	G1-EDU
Height, Width and Thickness (Stand)	1320x450x200mm	1320x450x200mm
Height, Width and Thickness (Fold)	690x450x300mm	690x450x300mm
Weight (With Battery)	About 35kg	About 35kg
Total Degrees of Freedom (Joint Freedom）	23	23~43
Single Leg Degrees of Freedom	6	6
Waist Degrees of Freedom	1	1+ (Optional 2 additional waist degrees of freedom)
Single Arm Degrees of Freedom	5	5
Single Hand Degrees of Freedom	/	**7**（Optional Force control of three-fingered hand）**+2**(Optional 2 additional wrist degrees of freedom)
Joint output bearing	Industrial grade crossed roller bearings (high precision, high load capacity)	Industrial grade crossed roller bearings (high precision, high load capacity)
Maximum Torque of Knee Joint[1]	90N.m	120N.m

Arm Maximum Load[2]	About 2Kg	About 3Kg
Calf + Thigh Length	0.6M	0.6M
Arm Span	About 0.45M	About.45M
Extra Large Joint Movement Space	Waist joint：Z±155° Knee joint：0~165° Hip joint：P±154°、R-30~+170°、Y±158°	Waist joint：Z±155°、X±45°、Y±30° Knee joint：0~165° Hip joint：P±154°、R-30~+170°、Y±158° Wrist joint：P±92.5°、Y±92.5°
Full Joint Hollow Electrical Routing	YES	YES
Joint Encode	Dual encoder	Dual encoder
Cooling System	Local air cooling	Local air cooling
Power Supply	13 string lithium battery	13 string lithium battery

Basic Computing Power	8-core high-performance CPU	8-core high-performance CPU
Sensing Sensor	Depth Camera+3D LiDAR	Depth Camera+3D LiDAR
4 Microphone Array	YES	YES

5W Speaker	YES	YES
WiFi 6 、Bluetooth 5.2	YES	YES
High Computing Power Module	/	NVIDIA Jetson Orin
Smart Battery (Quick Release)	9000mAh	9000mAh
Charger	54V 5A	54V 5A
Manual Controller	YES	YES
Battery Life	About 2h	About 2h
Upgraded Intelligent OTA	YES	YES
Secondary Development[3]	/	YES

System architecture

Cloud Service (Only connect after user authorization)

Unitree Robotics Management Platform

mgtt Server | turn/stun Service | HTTP Web API

Transfer/Connection

G1

Transfer/Connection

PC1

OTA Management Module | BLE Network Module | WebRTC Module

Direct Connection | Local WebRTC Signaling

DDS Data Middleware

Basic Services | LiDAR Point Cloud | Motion Control | Functional Modules | Multimedia Services

Executive Mechanism and Sensors

Switch

PC2

DDS SDK | ROS2 SDK | GST SDK

Unitree Explore App

USER

Remote WebPTC signaling

WebRTC Module

BLE Module

External Development Board/PC

DDS SDK

ROS2 SDK

GST SDK

Data Stream

→ DDS data
→ WebRTC Data Communication
⇢ Other Data Communication
→ MQTT Publishing Subscription
⇠ HTTP Data
→ Bluetooth BLE Data
▭—▭ Serial Communication

Note 1:
The functional modules include obstacle avoidancepath planning, speech recognition, etc.

Note 2:
DDS is compatible with ROS2 and can be directly accessed.

Note 3:
Users can deploy programs on G1 build-in PC or external development board /PC for secondary development.

The G1 robot has **two computers inside**, plus optional cloud and app connections.

1. PC1 (Main Robot Computer)

- Controls walking, balance, arms, sensors, LiDAR, and cameras
- Handles all robot functions
- Uses DDS (Data Distribution System) to send/receive data inside the robot

2. PC2 (Developer Computer)

- Used for ROS2, SLAM, AI, and custom programs
- Developers run their own code here
- Connects to PC1 through the internal network

3. Unitree App

- Connects using Bluetooth or WebRTC
- Allows the user to control the robot and view camera feed

4. Cloud (Optional)

- Only used for remote access, OTA updates, and account services

5. External PC (Your Laptop)

- You can connect via LAN
- Can run ROS2 or SDK to control the robot or read sensors

Super Simple Summary:

PC1 runs the robot

PC2 runs your programs

App controls the robot

Cloud is optional

Your laptop connects to develop