TRON 1

User Manual

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Overview of the Robot

Brief Introduction

Product Name: LIMX TRON

Model:TRON1-EDU-WF, TRON1-EDU-PF, TRON1-EDU-SF

Feature:TRON 1 is a versatile biped robot designed for researchers. It features a novel configuration, ease of use, stability, durability, and strong extensibility, meeting the demands and needs of:

- Researchers engaged in motion control algorithm research for biped robots.
- Researchers utilizing model-based and reinforcement learning methods for robotic studies.
- Using biped robot as Autonomous Mobile Robot.
- Technology innovation exhibition.

Body Components and Interfaces

Front and Back Diagram
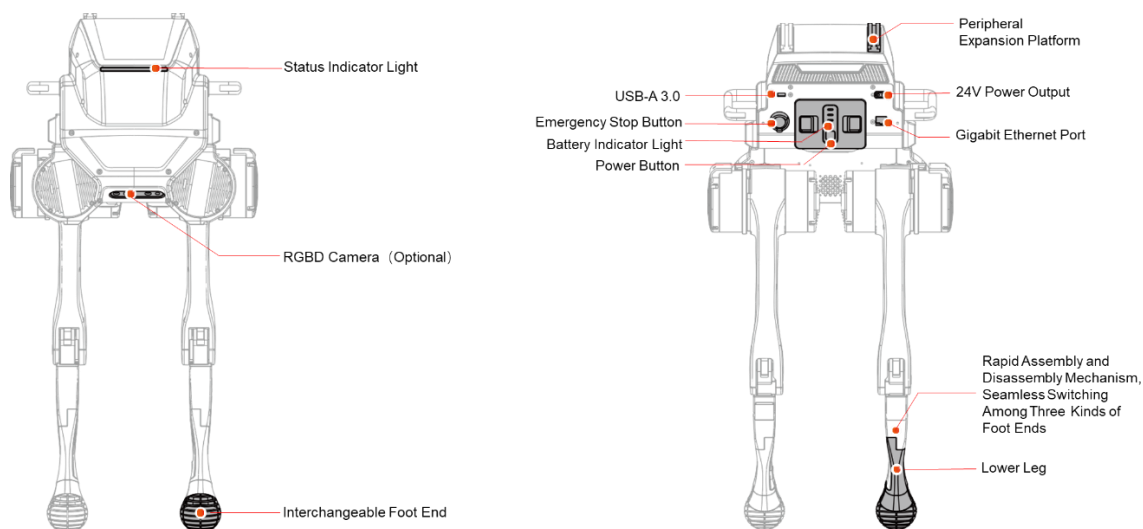
#	Item	Function Description
1	Status Indicator Light	Displays the robot's status (control status, abnormal status, low battery, etc.).
2	RGBD Camera (optional)	Binocular perception sensor
3	Interchangeable Foot End	Allows users to exchange rubber foot ends.
4	USB-A 3.0	Can be used for detecting and connecting perception peripherals, such as an additional

|		RGBD camera.
5	Emergency Stop Button	In an emergency, press this button to enter torque-free mode.
6	Battery Indicator Light	Displays the current battery level of the device.
7	Power Button	Power on/ Power off Button
8	Peripheral Expansion Platform	Allows users to attach and fix external devices.
9	24V Voltage Output Port	Capable of providing a stable direct current (DC) voltage of 24 volts, with a peak power rating of 100 W.
10	Gigabit Ethernet Port	Can be used to connect external computers, routers, or other communication modules, etc.
11	Lower Leg	Rapid assembly and disassembly mechanism, Seamless switching among three kinds of foot ends.

List of Items
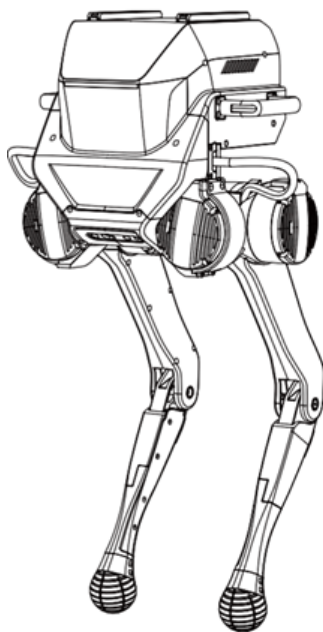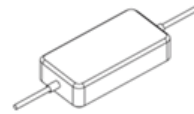
Remote Controller × 1
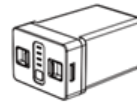
Battery × 1

Power Adapter × 1

Accessories: Point-Foot x 2

Accessories: Sole × 2
(Optional)

Accessory: Wheeled × 2
(Optional)

Robot Body × 1
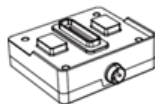
Battery Charging Dock

User Guide

Certificate of Conformity

Product Specifications

Category	Details	STD Ed.	EDU Ed.
Mechanical Parameters	Dimensions	≤392mm x 420mm x 845mm	≤392mm x 420mm x 845mm
	Material	Aluminum Alloy + Industrial Plastic	Aluminum Alloy + Industrial Plastic
	Net Weight	≤20kg	≤20kg
Battery Parameters	Battery Supply Voltage	48V	48V
	Maximum Battery Power	1000W	1000W
	Battery Swapping	✔	✔
	Battery Type	Ternary Lithium	Ternary Lithium
	Battery Capacity	240Wh（48v/5Ah)	240Wh（48v/5Ah)
	Battery Range	≥2h (At Rated Operational Conditions)	≥2h (At Rated Operational Conditions)
	Charging Methods	Battery Charging Quick Battery Swap	Battery Charging Quick Battery Swap
	Charger	Battery Charging Dock	Battery Charging Dock
	Charging Time	<1h（20%-80%）1.5h (100%)	<1h（20%-80%）1.5h (100%)

Performance Parameters	Load Capacity	10kg (Maximum 15kg)	10kg (Maximum 15kg)
	Movement Speed	• Point-Foot: ＜1m/s • Sole：＜1m/s • Wheeled ≥5m/s	• Point-Foot: ＜1m/s • Sole：＜1m/s • Wheeled ≥5m/s
	Maximum Climbing Angle	≥15°	≥15°
	Maximum Obstacle Height Limitation	15cm	15cm
	Computer Specification	12th Gen i3 / 16GB RAM /512GB (CPU/Memory/Storage)	12th Gen i3 / 16GB RAM /512GB (CPU/Memory/Storage)
	Operating Environment	-5℃ to 40℃ Operates in favorable weather conditions	-5℃ to 40℃ Operates in favorable weather conditions
Actuator Parameters	Rated Voltage (V)	48V	48V
	Rated Torque （Nm）	30Nm	30Nm
	Peak Torque (Nm)	80Nm	80Nm
	Peak Motor Speed (rad/s)	15rad/s	15rad/s
Foot End Extension	Point-Foot	Four-directional Movement, Turning, In-place Stepping, Squatting Up and Down In-place	Four-directional Movement, Turning, In-place Stepping, Squatting Up and Down In-place
	Sole	Four-directional Movement, Turning, In-place Stepping, Static Standing, Squatting Up and Down In-place	Four-directional Movement, Turning, In-place Stepping, Static Standing, Squatting Up and Down In-place
	Wheeled	Four-directional Movement, Movement, Differential Steering, Turning, In-place Stepping, Static Standing, Squatting Up and Down In-place	Four-directional Movement, Differential Steering, Turning, In-place Stepping, Static Standing, Squatting Up and Down In-place
Others	Spare Battery	1 (Optional)	1（Optional）
	RGBD Camera	/	1 (Optional)
	Roll Cage	1 (Optional)	1 (Optional)
	Accessories: Point-Foot	1 Pair (Optional)	1 Pair (Optional)
	Accessories: Wheeled	1 Pair (Optional)	1 Pair (Optional)
	Accessories: Sole	1 Pair (Optional)	1 Pair (Optional)
Wireless	**LORA**		

| info	**Remote Control** ● Frequency Range:410-525 MHz ● Module Model:Ra-02 ● Power Supply:2.5-3.7V，Typical 3.3V ● Operating Temp.: -30℃-85℃ ● Antenna:FPC Antenna (Gain: 1.69dBi) **Robot** **Wi-Fi** ● Module Name:BL-M7621AX7 ● Module Type: 802.11a/b/g/n/ac/ax 1800Mbps WLAN AP Module ● Frequency Range:2.4~2.4835GHz ● Tx power:18 dBm ● Power Supply:DC 12V±0.5V(power range 5~14V) @ 1500 mA (Peak for 12V) ● Operation Temperature:-10℃ to +50℃ ● Antenna: Monopole Antenna (Gain: 2.51dBi)

Status Indicator Light

Event/Status	Light Color	Light Indication of the Robot's Conditions	Frequency (Seconds/Time)	Notes
Booting	Slow Flashing White	During booting process	1	In the Booting-up and Self-check Process
Abnormality Warning	StaticRed	An abnormality has occurred with the robot	/	Maintenance Required
Low Battery Warning	Flashing Red	Battery is low (below 20%)	2	Battery Swap ASAP
Extremely Low Battery Warning	Quick Flashing Red	Battery is extremely low (below 5%)	0.5	Robot will squatautomatically
Emergency Stop	Flashing Yellow	The Emergency Stop button has been pressed	2	You cannot manipulate the robot under this state
Developer Mode	Static Green	System determines color based on mode setting	/	Once powered on, the robot's system decides the color according to your setting
Remote Control Mode	Static Blue	System determines color based on mode setting	/	Once powered on, the robot's system decides the color according to your setting
Idle Status	Static (Green/Blue)	Robot is in the torque-freemode.	/	It shows static green if the robot is in Developer Mode, static blue if in Remote Control Mode
Standing Status	Static (Green/Blue)	Robot is in the stance mode.	/	It shows staticgreen if the robot is in Developer Mode, static blue if in Remote Control Mode
Walking Status	Dynamic (Green/Blue)	Robot is in the steppingmode.	2	It shows dynamic green if the robot is in Developer Mode, dynamic blue if in Remote Control Mode

How to Charge the Battery

1. Connect the "Battery Charging Dock" to the "Power Adapter". After aligning the aviation plug with the limit stop, insert it fully and tighten the nut clockwise.
2. Plug the Power Adapter into the electrical outlet.

3. Insert the battery into the dock in the direction indicated by the limit stop, and press down firmly to ensure it is securely inserted.

4. When the battery indicator light is flashing and the red light on the power adapter remains constantly lit, it indicates that the battery is successfully charging. When the battery indicator light remains constantly lit and the green light on the adapter is constantly on, it indicates that the battery is fully charged.

5. It takes approximately one hour to charge the battery from 20% to 80%.
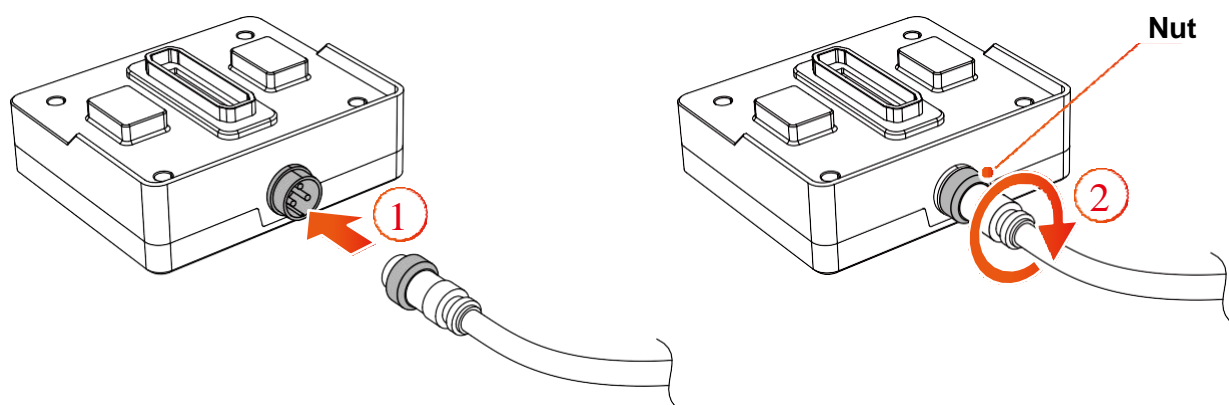
Charging-related Light Signals

	Not charged	**Charging in progress**	**Charging complete**
Battery Indicator Light	No light is on	Green light is flashing	Green light is always on
Power Adapter Light	Green light is always on	Red light is always on	Green light is always on

⚠ • When the device is not used for a long time, it is recommended to charge the battery every three months to avoid battery damage

• Overnight charging is not recommended.

Startup and Shutdown Process

Startup Process

a. Insert the battery into the battery compartment and press firmly until the latch clicks into place.

b. Ensure that the emergency stop button is released.

c. Press and hold the power button for 3 seconds, then release. The battery indicator light and the robot's status light will illuminate.

d. Wait for approximately 20 seconds as the entire robot's system automatically completes the startup program.

e. Upon successful startup, the status indicator light on the robot's body will change from white to a Static Blue or green.

Shutdown Process

a. After the robot has completed its tasks, initiate a squatting motion to ensure a smooth landing.

b. Once the robot has stopped moving, press and hold the power button for 3 seconds, then release.

c. The robot's system will automatically proceed through the power-down sequence, turning off the battery indicator light and the status light.

d. Shutdown is now complete.

⚠️ • If you have pressed the power button but are unable to control the robot or access the system normally, please check the battery level first before attempting to restart it.

• If the robot, upon power-up, fails to remote control commands, please verify if the emergency stop button has been pressed.

Remote Controller Buttons Instruction

A	Directional buttons, for correcting the robot's positional offset
B	Share Button
C	Screen
D	Speaker Hole
E	Options Button
F	△ Button, ○ Button, X Button, □ Button
G	Right Joystick, for controlling the robot's rotation direction
H	Power Button, for turning the remote controller on/off
K	Left Joystick, for controlling the robot's movement in all directions (forward, backward, left, right)
L	R1 Button
M	R2 Button
N	Light Bar
O	L1 Button
P	L2 Button
Q	Micro-USB port: Charging Port

Turning the Remote Controller On/Off

● **To turn on the remote controller:**Press and hold the power button for at least 3 seconds. Upon hearing a single "beep," this signifies that the remote controller has been successfully powered on and has entered its default interface.

● **To turn off the remote controller:**Press and hold the power button for at least 2 seconds. When you hear three consecutive beeps ("beep, beep, beep"), this indicates that the remote controller has been powered off and the screen display has been turned off.

Remote Controller Screen Information Description
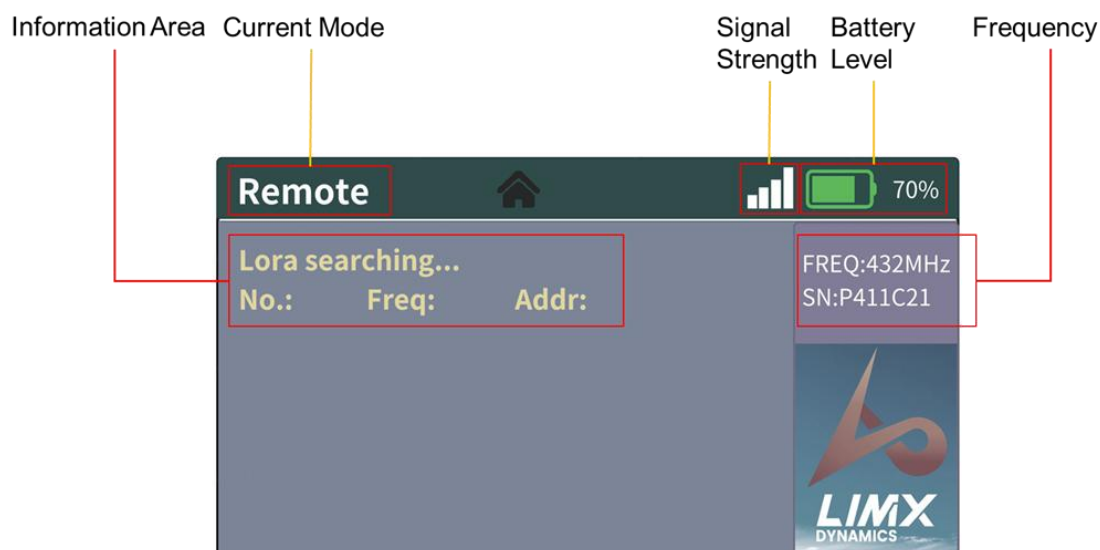
Information Area: Displays key information, machine error messages, and other pertinent data.

Current Mode: Developer Mode / Remote Control Mode

Signal Strength: When disconnected from the robot, the remote controller does not display a signal icon.

Upon connection, a white signal bar appears, and a greater number of lit bars signifies a stronger signal.

Battery Level: Indicatesthe battery level of the remote controller.

Frequency: Displays the ongoing communication frequency between the remote controller and the robot.

Robot Configuration : Indicates the current robot configuration, including Point-Foot, Wheel-Foot and Sole-Foot.

Power-On Zero Calibration

1. Upon powering on the robot, you will notice the status indicator light change from white to blue or green.

2. Ensure the robot is hoisted or lifted, maintaining a height of at least 30 centimeters above the ground, as illustrated in the flowing image.
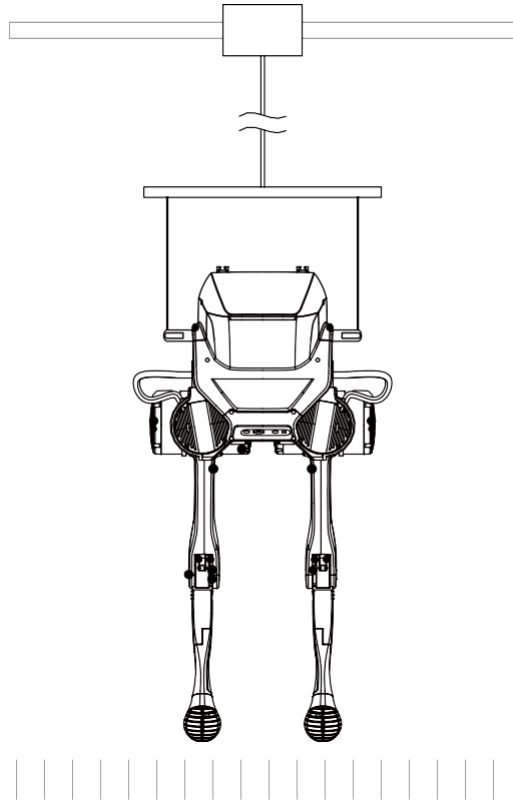
3. To initiate the automatic zero calibration process, press the L1 and R1 buttons simultaneously on the remote controller. It is crucial to ensure that the robot's joints remain unobstructed during this calibration.

4. Once the zero calibration is successfully completed, gently descend the robot's lower legs to the ground in preparation for a smooth stand-up, as depicted in the provided image.

Usage Process

Power-on

Automatic Judgment

Developer Mode
No Preset Control Algorithm

Remote Control Mode
Run Preset Control Algorithm

Press R1+Left Buttons to Set Developer Mode

Automatic

Automatic

Press R1+Right Buttons to Set Non-Developer Mode

Idle Status

Press L1+R1 Buttons

Automatic Reset

Press L1+O Buttons

Squatting Status

Preparing Status

Press L1+△ Buttons

Press L1+X Buttons

walking status

Lateral Movement

Forward and Backward Movement

In-place Rotation

Offset Correction

End

Global

Press L1+□ Buttons → Idle Status

Press Left Joystick & Right Joystick → Emergency Stop

Press Right Joystick → Emergency Stop Release

Remote Controller Buttons Instructions

| Concept	Status Description	Precondition	Buttons	Notes
Automatic Reset	All joints initialization	Idle Status	L1+R1	
Idle Status	All joint motors are in damping mode, causing them to slowly descend. The robot will enter this mode upon startup.	Global (excluding emergency stop status)	L1+ □	
Preparing Status	Legs will be automatically powered on and execute movements of touching the ground and lifting the upper body.	Idle Status	L1+ ○	Requires external assistance, with lower legs extended and both feet touching the ground.
Walking Status	Robot stands automatically to enter stepping status. Can be remotely controlled.	Standing Status	L1+ △	
Four-directional Movement	Robot follows remote commands, moves forward, backward, left and right.	Walking Status	Left Joystick	
Rotation in Place	The robot rotates clockwise and counterclockwise according to remote commands.	Walking Status	Right Joystick	Invalid when pushed forward or backward.
Forward Tilt Correction	Real-time correction of the robot's tendency to move forward during in-place marching	In-Place Stepping Status	Down Button	

Backward Tilt Correction	Real-time correction of the robot's tendency to move backward during in-place stepping	In-Place Stepping Status	Up Button	
Left Tilt Correction	Real-time correction of the robot's tendency to move forward-left during in-place stepping	In-Place Stepping Status	Right Button	
Right Tilt Correction	Real-time correction of the robot's tendency to move forward-right during in-place stepping	In-Place Stepping Status	Left Button	
Squatting Status	The robot squats autonomously.	Walking Status	L1+ X L1+ X	Hand support is needed, otherwise the robot is prone to falling down.
Developer Mode	Users can perform secondary development, deploy programs, and exercise control.	Idle Status	R1+Left R1+Left	
Remote Control Mode	Used for remotely controlling robot movement in the context of an RL (Reinforcement Learning) model.	Idle Status	R1+Right R1+Right	Remains valid until manually switched to another mode (the developer mode).
Emergency Stop Button	All motor drivers power off immediately, but battery power supply and light signals remain on, and the whole machine will drop.	Global Position	Left joystick + Right joystick	Press both buttons simultaneously to trigger an emergency stop, which will immediately cut off power supply to all motors

|				
				regardless of the current mode or state.
Emergency Stop Release	Motor Power on	Emergency Stop Status	Right joystick	Single-click the right joystick to release the emergency stop. Clicking in other modes has no effect. After releasing the emergency stop, the robot will enter damping mode.
Switching Mode	Under Wheel-Foot configuration, switching between Ground mode / Stair mode	Wheel-Foot configuration	Share Button	Long press for 2s

Establishing a Connection to the Robot

Communication Structure Diagram
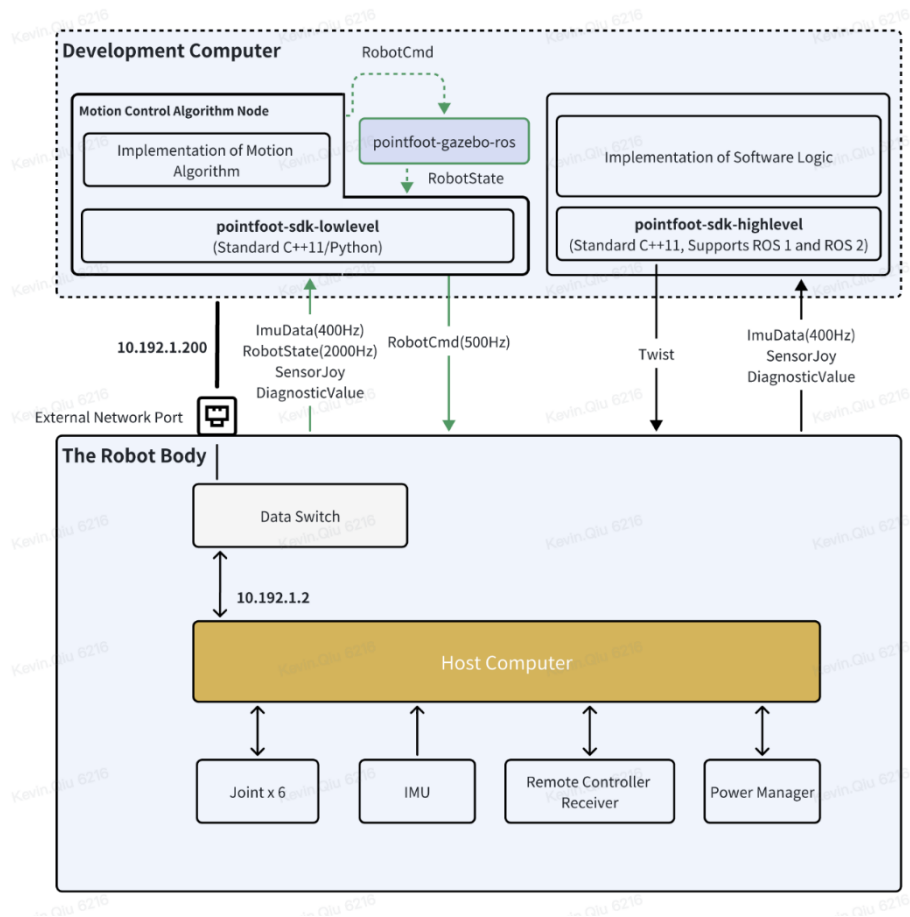
Wired Connection

- Attach an Ethernet cable to the robot's rear Gigabit Ethernet port for connectivity.
- Modify the IP address of your personal computer to ensure it is within the same subnet as the robot to establish a connection with the robot.
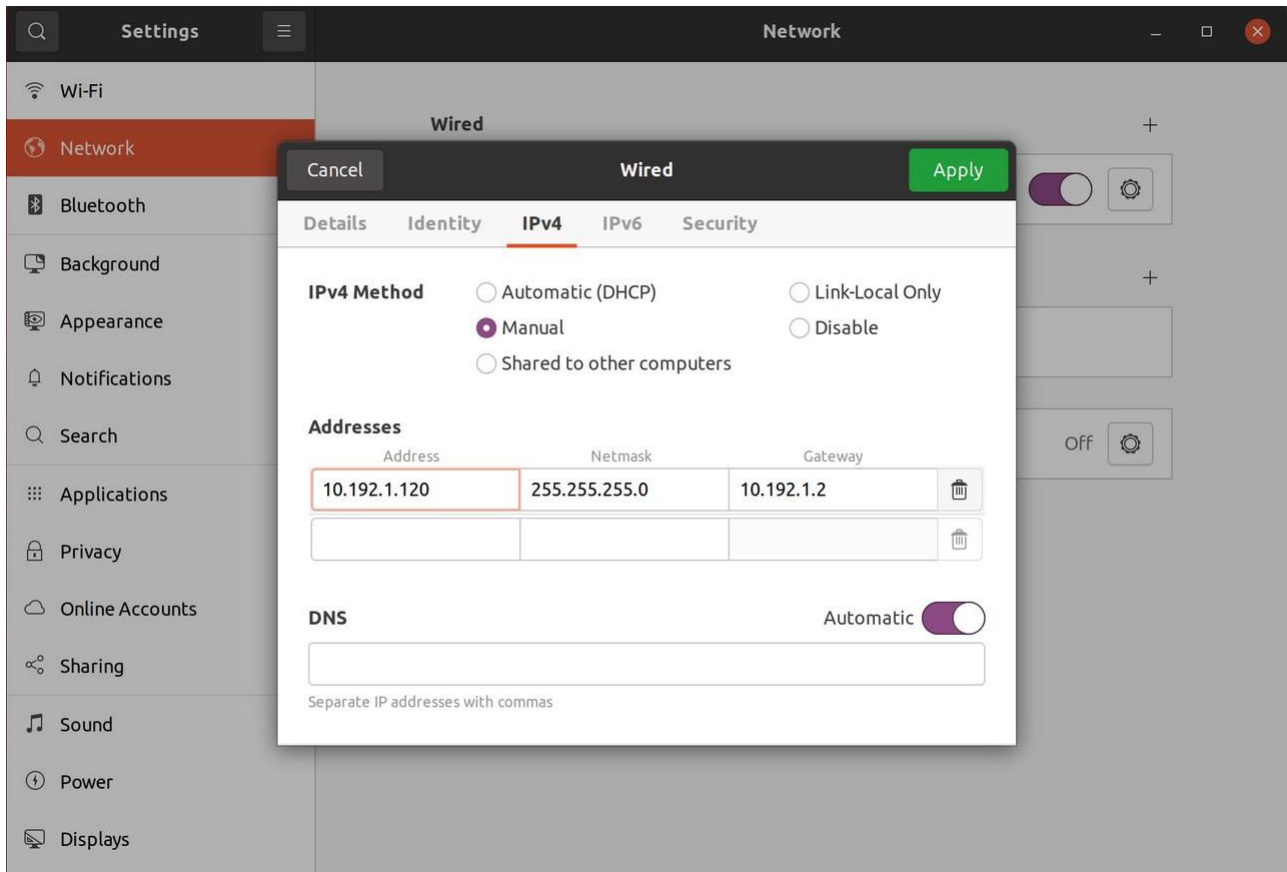
For example, to ensure compatibility with the robot's network, set the IP address of your personal computer to 10.192.1.120.

Wireless Connection

- Once the robot has completed its boot-up process, connect your personal computer to the robot's Wi-Fi network, which generally follows the naming convention of "P441C_01" or "PF_P441C_01".
- Enter the Wi-Fi password "12345678".

Robot Software Upgrade

Please go to the LimX Robot Manager page through the browser and select the version of the robot software that you have downloaded in advance for the upgrade. The steps are as follows:

Connection and IP settings:

- Connect your personal computer to the robot by following the instructions in the "Establishing a Connection to the Robot" section.

- Verify that the robot can successfully respond to the Shell command "ping 10.192.1.2" to ensure network communication with your computer.

Visit the LimX Robot Manager page:

- Enter the following address in your browser's address bar: http://10.192.1.2:8080 to access the LimX Robot Manager page.

LimX Robot Manager

Chinese(中文)

| **Version Management** | EC-Master Config | Robot Info |

Version Info

Software Version : 1.0.0

Power board Version : 3.1.0

EC-Master Version : 1.0.9

Motor Version :
Left ABAD:1.0.1; Left HIP:1.0.1; Left KNEE:1.0.1; Right ABAD:1.0.1; Right HIP:1.0.1; Right KNEE:1.0.1;

Upgrade Software

Browse [   ] Upgrade Rollback
Status

Select and upgrade the software:

Select the file you have downloaded for the upgrade and proceed with the upgrade process.

Once the upgrade is complete, the robot's host computer will automatically restart.

Manufacturer information

Manufacturer: Limx Dynamics Technology Co.,Ltd.

Address: 1511-009A, Xiangjiang Financial Building, No. 3046 Xinghai Avenue, Nanshan District, Shenzhen, China

Safety Warnings

⚠	■ General Safety Warning: This product must be operated in accordance with the instructions in the user manual. Incorrect usage may result in injury, damage, or malfunction. Always ensure that the robot operates in a safe environment.
⚠	■ Battery Safety Warning: This robot is powered by a rechargeable battery. Use only the recommended battery type and follow the correct installation procedures. Improper handling or installation of the battery may result in fire, explosion, or leakage. Dispose of used batteries according to local regulations.
⚠	■ Environmental Conditions Warning: Avoid exposing the robot to excessive moisture, extreme temperatures, or hazardous environments. Operating in wet or freezing conditions can damage internal components and compromise safety.
⚠	■ High-Impact and Collision Risk: This robot may perform high-impact movements, particularly in dynamic environments. Ensure that people and animals are kept at a safe distance to avoid injury from collisions or sudden movements.
⚠	■ Adaptation to Different Environments: This robot is designed to operate in various environments. Ensure the terrain is stable and clear of obstacles before use. Use on uneven surfaces, inclines, or rough terrain may affect stability and performance, potentially causing tipping or loss of balance.
⚠	■ Maintenance Warning: Always turn off and disconnect the power supply before performing any maintenance or repairs. Regular inspection and maintenance are required to ensure safe operation and to prevent malfunctions.
⚠	■ Hand or Body Part Entrapment Risk: Keep hands, feet, and other body parts clear of moving parts during operation to prevent injury or entrapment. This robot contains actuators that may cause injury if body parts come into contact with them while moving.

DECLARATION OF CONFORMITY

I hereby declare that the product
    Product Name: LIMX TRON
    Brand Name: Limx dynamics
    Model: TRON1-EDU-WF, TRON1-EDU-SF, TRON1-EDU-PF
    (Name of product, type or model, batch or serial number)
    System components:

    433 Antenna: FPC Antenna (Gain: 1.69dBi)
    WIFI2.4G Antenna: Monopole Antenna (Gain: 3dBi)

    Battery: Rechargeable Li-ion Battery
    Model: C1589A1
    Specification: Whole machine: DC 46.8V, 4.5Ah, 210.6Wh
                Remote control: DC 3.7V,1000mAh,3.7Wh
    Manufacture: Guangdong Pow-Tech New Power Co.,Ltd.

    Adapter: Model: XSG5463000
    Input: 100-240V ~ 50/60Hz 3A Max 660W
    Output: DC 54.6V 3A Max 163.8W

    Hardware Version: Remote control hardware version: RCTGen2A4AIM
    Firmware version: Remote controller firmware version: V3.0.6
    Software Version: Control software version: V2.0.12

Satisfies all the technical regulations applicable to the product within the scope of Council
Directives 2014/53/EU, 2014/35/EU and 2014/30/EU:and declare that the same application has not
been lodged with any other notified body.

Health & Safety (Art. 3(1)(a)):	EN IEC 62311:2020 ; EN 62479:2010
	EN IEC 62368-1:2020+A11:2020
EMC (Art. 3(1)(b)):	ETSI EN 301 489-1 V2.2.3 (2019-11)
	ETSI EN 301 489-3 V2.3.2 (2023-01)
	ETSI EN 301 489-17 V3.2.4 (2020-09)
	EN 55032:2015+A1:2020;
	EN 55035:2017+A11:2020
	EN IEC 61000-3-2:2019+A1:2021;
	EN 61000-3-3:2013+A2:2021
Radio Spectrum (Article 3.2)	ETSI EN 300 220-1 V3.1.1 (2017-02)
	ETSI EN 300 220-2 V3.2.1 (2018-06)
	ETSI EN 300 328 V2.2.2 (2019-07)
	(Title(s) of regulations, standards, etc.)

All essential radio test suites have been carried out.

NOTIFIED BODY: Timco Engineering, Inc.
– **Address**:

    849 NW State Road 45 Newberry FL 32669
    America
    Notified Body number 1177

MANUFACTURER or **AUTHORISED REPRESENTATIVE**:
– **Address**:

    Limx Dynamics Technology Co.,Ltd.

    1511-009A, Xiangjiang Financial Building, No. 3046 Xinghai Avenue, Nanshan District,
    Shenzhen, China

This declaration is issued under the sole responsibility of the manufacturer and, if applicable, his
authorised representative.

Robot

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception,
which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.
-- Connect the equipment into an outlet on a circuit different
from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.
To maintain compliance with FCC's RF Exposure guidelines,

This equipment should be installed and operated with minimum distance between 20cm the radiator your body: Use only the supplied antenna.

Remote Control

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
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-- Connect the equipment into an outlet on a circuit different
from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.