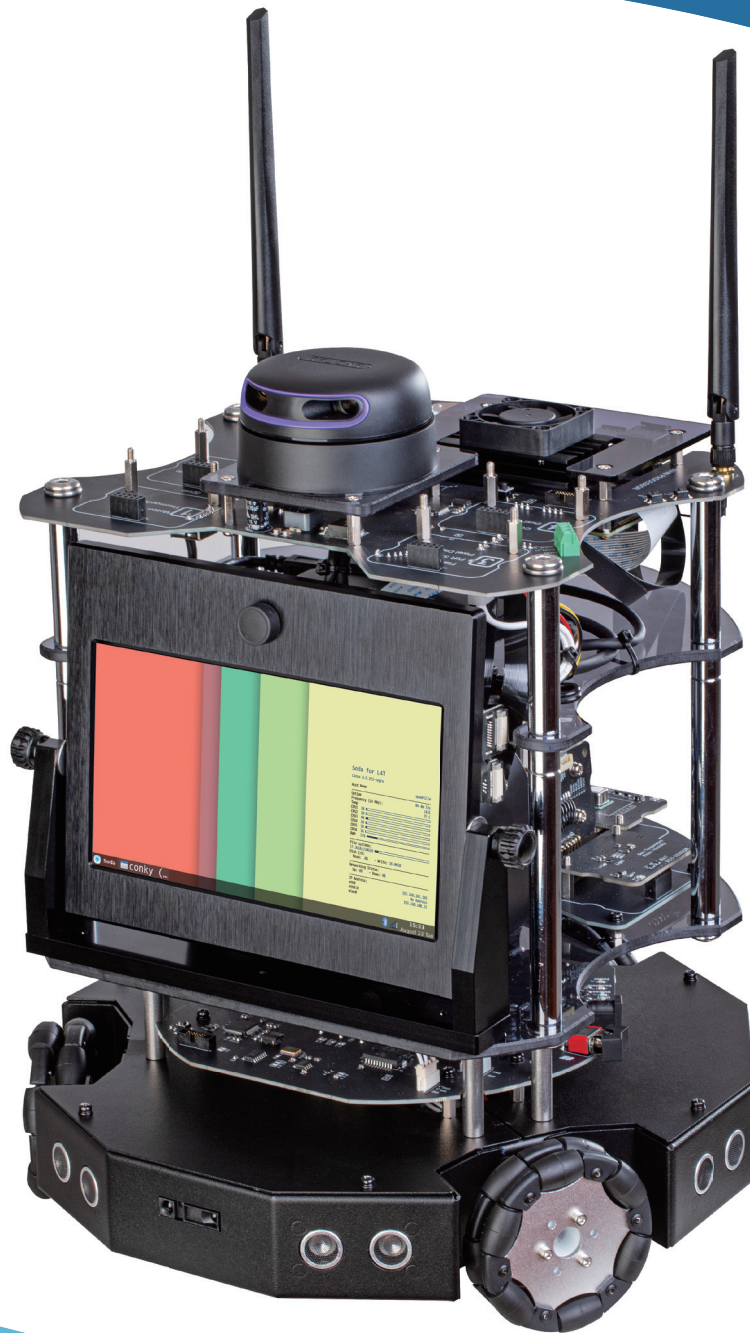


Autonomous Driving Service Robot Training Equipment Based on Artificial Intelligence



SerBot G

- AI application practice equipment based on indoor service robot platform
- Main processor is GPU supercomputer platform for edge device
- 7-inch touch display with 1024x600 resolution and 8M pixel 160° wide-angle camera
- Gigabit Ethernet, dual-band Wi-Fi (2.4GHz, 5GHz), and Bluetooth 4.2
- Voice recognition and audio play through digital microphone and speaker
- Supports various IoT sensor modules through four exclusive expansion interfaces
- 3-axis omni wheel to maximize the movement efficiency and minimize the turning radius
- Multiple PowerPath blocks allowing to practice even while the battery is charging
- Robot standard middleware ROS2 and Pop library are provided
- Supports CUDA-based PyTorch and Tensorflow artificial intelligence framework
- Supports web browser-based Google block coding platform (Blockly)
- Supports a public integrated development environment based on Visual Studio Code for professional application development
- Service robot learning content based on artificial intelligence and deep learning is provided



© Operating Program Specification

List	Specifications	
OS	Desktop	X-Server, Openbox, LightDM, Tint2, blueman, network-manager, conky
	CLI	Zsh, Tmux, Peco, powerlevel9k thema, Powerline fonts, Powerline fonts
	Tool Chain	GCC 9, JDK, Node JS, Python3, Clang
	IDE	Visual Studio Code, NeoVim
	Connectivity	Mosquitto(MQTT), Bluez, mtr, nmap, iptraf, Samba, Blynk Server, Remote Desktop Server
	Multimedia	portaudio, sox, OpenCV 4, Google Assistant
	Data Science & AI	Python3, Numpy, Matplotlib, sympy, Pandas, Seaborn, Scipy, Gym Scikit-learn, Tensorflow, Keras
Middleware	ROS2 Foxy	Rviz2, RQt, ament, RTPS, Fast DDS, TF2
	Output Object	Led, Laser, Buzzer, Relay, RGBLed, DCMotor, StepMotor, OLed PiezoBuzzer, PixelDisplay, TextLCD, FND, Led Bar
Pop Library	Input Object	Switch, Touch, Reed, LimitSwitch, Mercury, Knock, Tilt, Opto, Pir, Flame LineTrace, TempHumi, UltraSonic, Shock, Sound, Potentiometer, Cds SoilMoisture, Thermistor, Temperature, Gas, Dust, Psd, Gesture
	Multimedia	AudioPlay, AudioPlayList, AudioRecord, Tone, SoundMeter
	Voice Assistant	GAssistant, create_conversation_stream
	AI	Linear Regression, Logistic Regression, Perceptron, ANN, DNN, CNN, DQN

© Hardware Specification

List	Specifications
Body	Size : 290 x 290 x 310 mm Weight : 6.8Kg
	LCD : 7inch TFT LCD Resolution 1024 x 600 Interface HDMI Touch Screen
	CAMERA : Image Sensor: Sony IMX219 Resolution: 8M pixel native resolution sensor (3280 x 2464 pixel static images) Video: 1080p30, 720p60 and 640x480p90 Linux intergration: V4L2 driver available Focal length: 3.04 mm Angle of view: 160 degrees Focal ratio (F-Stop): 2.35

Hardware Specification

List		Specifications
Body	LiDAR	Distance Range : White object: 12 meters Black object: 10 meters Minimum Operating ranging : 0.2m Angular Range : 0 ~ 360degree Sample Rate : 16KHz Scan Rate: 10Hz Angular Resolution : 0.225° Scan Field Flatness : ±1.5 Communication Speed : 256000 bps
	CPU	Quad-core ARM Cortex-A57 MPCore processor
Main Module	GPU	NVIDIA Maxwell architecture with 128 NVIDIA CUDA® cores
	Memory	4 GB 64-bit LPDDR4, 1600MHz 25.6 GB/s
	Storage	MicroSD 64GB
	Video Encoder	4Kp30 4x 1080p30 9x 720p30 (H.264/H.265)
	Video Decoder	4Kp60 2x 4Kp30 8x 1080p30 18x 720p30 (H.264/H.265)
	Camera	MIPI CSI-2 lanes
	Connectivity	Dual Band Wireless WiFi 2GHz/5GHz Band, 867Mbps, 802.11ac Bluetooth 4.2 1x Gigabit Ethernet
	Display	1x HDMI 4x USB 3.0 Type-A, 1x Micro-USB (device mode)
	Power Block	Battery Charger Controller Block INFET Low Loss Ideal Diode PowerPath Control Indicator State : DC Adapter, Charging, Complete, Current Limiting +5V, +12V Switching Power Block +3.3V Power Block Power Voltage Display(3 Digit FND) LED : Low Battery, Normal Battery Piezo : Alarm Low Battery or Booting
	Battery	14.8V / 14000mA
Wheels	3 Omni-Wheels	
Motor with Encoder	DC 12V Motor 3ea Encoder 26P/R Gear Rate 1:50 Speed 6000RPM	
Motor Controller	Arm® 32-bit Cortex®-M4 CPU with FPU 210 DMIPS/1.25 DMIPS/MHz (Dhrystone 2.1), and DSP instructions CAN Communication Motor Driving Control UltraSonic / PSD Sensor Control	
Motor Driver 3ea	Double H bridge drive Drive current 2A(MAX single bridge) Direction, PWM Control	
UltraSonic Sensor 6ea	Effectual Angle < 15° Ranging Distance : 2cm ~ 400cm Resolution : 0.3cm Measuring Angle : 30 degree Trigger Input Pulse width : 10us	
Base Board	PSD Sensor 3ea	Distance measuring range: 10 cm to 80 cm (4" to 32") Output type: analog voltage Update period : 38 ± 10 ms
	Microphone	High performance Digital Microphone x 4ea Sensitivity : -26 dBFS(Omnidirectional) Acoustic Overload Point : 120dBSPL SNR : 63dB
	Speaker	Output : 3W x 2ea 3.5mm Audio Jack Frequency Response : 30Hz ~ 20KH
	Sensor Controller	Arm® 32-bit Cortex®-M4 CPU with FPU 210 DMIPS/1.25 DMIPS/MHz (Dhrystone 2.1), and DSP instructions CAN Communication App. Sensor Control 9-AXIS Sensor Control
	9-AXIS Sensor	an advaced triaxial 16bit gyroscope, a versatile, leading edge triaxial 14bit accelerometer and a full performance geomagnetic sensor Gyroscope Range switchable ±125°/S to ±2000°/S Low-Pass filter bandwidth 523Hz - 12Hz Accelerometer Range: ±2, ±4, ±8, ±18g Low-Pass filter bandwidth 1kHz -< 8Hz Magnetic field rage typical ±1300uT(x-,y-axis), ±2500uT(z-axis) Magenetic field resolution of ~0.3uT Interface: I2C
	App. Sensor Module Block 4ea	Sensor Block: +5V, +3.3V, GND, I2C, ADC, GPIO, SPI
	Basic Module	Input Device : Tact Switch x 2ea(GPIO) output device : LED 8ea(I2C) Actuator : Passive Buzzer(GPIO)
	Flame Module	Sensing Range : 60 Degree I/O Interface : 2 pin Digital Output
	ECO Sensor Module	Light Sensor Illuminance to digital converter Wide range : 1 ~ 65535(lx) Temperature Measure : -40 ~ 85°C Humidity Measure : 0 ~ 100%r.H. Pressure range : 300 ~ 1100hPa VOC Measure : Ethane, Ethanol, Acetone, Carbon Monoxide, Butadiene, methyl I/O Interface : I2C
	Carbon Dioxide(CO2) Gas Sensor Module	Measuring Range : 0 ~ 10000 ppm Accuracy : ±7% ±50ppm Response time : 18 ~ 30 sec I/O Interface : I2C
App. Sensor Module	Pixel display Module	Color : pixel RGB Pixel : 8x8 I/O Interface : GPIO(Serial protocol)
	Dust Sensor Module	Measurement range PM1.0 : 0 ~ 10000ug/m3 PM2.5 : 0 ~ 10000ug/m3 PM10 : 0 ~ 10000ug/m3 I/Resolution : 1ug/m3 Respond time : 1sec Time to first reading : ≤8seconds I/O Interface : I2C
	Digital Thermopile Module Laser(DTPML)	IR refresh rate : 50Hz Digital resolution : 0.1°C Standard start-UP Time : 3 sec Accuracy : ±2% Stabilization Time : 1 min I/O Interface : SPI
	Microwave Motion Sensor Module	Frequency Setting : 10.525 GHz(Typ) Spurious Dmission : -7.3 dBm Pulse Repetition Frequency : 2KHz Setting Time : 3 uSec I/O Interface : Pulse Operation
	PIR Senor Module	Sensing Range : 110° Spectral Response : 5 ~ 14 um I/O Interface : Digital Out

Training Contents

1. Artificial Intelligence and Autonomous Driving

- 1.1. Components of Autonomous Driving
- 1.2. Autonomous Driving Overview

2. Environment for Experiment

- 2.1. AIoT SerBot-G
- 2.2. Communication between PC and AIoT SerBot-G
- 2.3. Development Environment

3. Control AIoT SerBot-G

- 3.1. 3WD Omni Wheel Moving Device
- 3.2. 9DOF IMU Sensor
- 3.3. Ultrasonic Sensor
- 3.4. Psd Sensor

4. CAN Protocol

- 4.1. CAN Network
- 4.2. CAN Communication
- 4.3. CAN Communication in Linux
- 4.4. Example of CAN Protocol Application

5. Moving Device Library based on CAN Communication

- 5.1. Start Library
- 5.2. Moving Device Control Library based on CAN communication
- 5.3. Implement Sensor Action and Broadcast Reception

6. MQTT

- 6.1. MQTT Standard
- 6.2. MQTT Broker and Client
- 6.3. Topic
- 6.4. Session
- 6.5. MQTT Development Environment
- 6.6. Remote Control of MQTT Moving Device

7. LiDAR

- 7.1. LiDAR Sensor
- 7.2. LiDAR Control
- 7.3. Avoidance Driving using LiDAR

8. Artificial Intelligence

- 8.1. Machine Learning and Perceptron
- 8.2. Neural Network and Learning
- 8.3. Machine Learning Framework

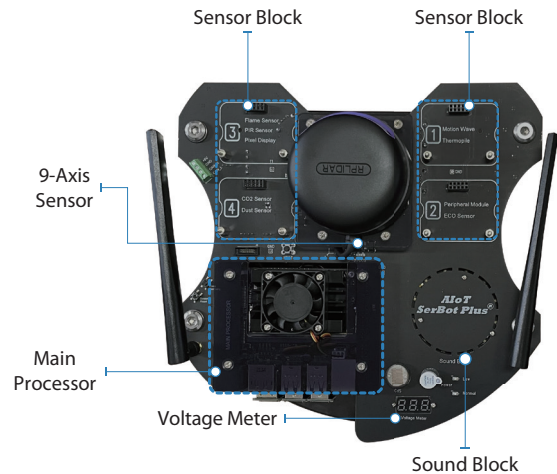
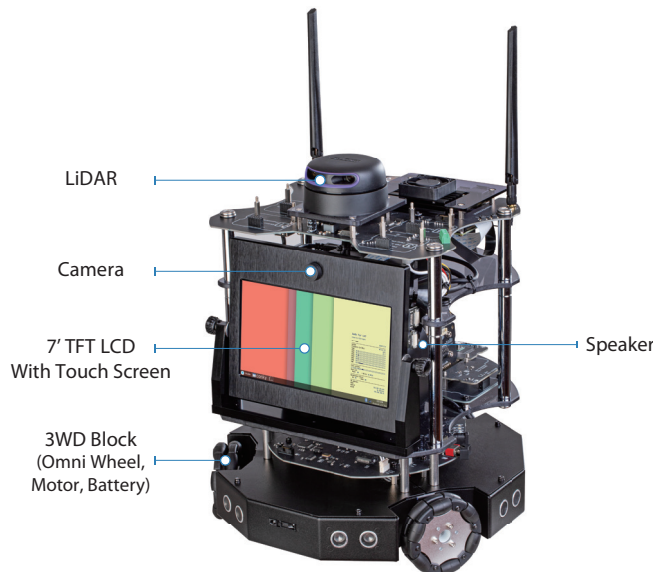
9. Autonomous Driving

- 8.1. Vision Processing
- 8.2. Deep Learning and Convolutional Neural Network
- 8.3. Lane Recognition based on Deep Learning
- 8.4. Object Detection and Moving Object Control

Appendix

- A. Flame Sensor
- B. PIR Sensor
- C. ECO Sensor
- D. CO2
- E. Dust Sensor
- F. Thermopile Sensor
- G. Micro Wave Sensor
- H. Peripheral
- I. Pixel Display

Layout



Accessories Provided



SerBot G



Platform USB
(include OS image and Tools)
1EA



19V 4.6A DC Adapter
1EA



USB to Ethernet
Adapter
1EA



Ethernet Cable
1EA



Learning Textbook
1EA