

# Artificial Intelligence-Based Autonomous Driving

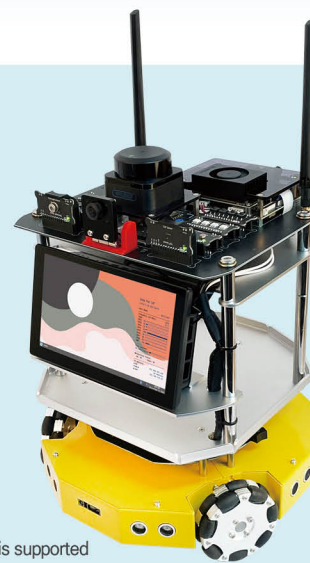
# Service Robot Training Equipment

AIoT SerBot II



# SerBot II

- AI application practice equipment based on indoor service robot platform
- NVIDIA high-performance on-device AI platform is adopted for Brain board
- Touch display and high-resolution wide-angle camera for GUI-based user interface and deep learning are provided
- Gigabit Ethernet, dual-band Wi-Fi, and Bluetooth are provided
- Voice recognition and audio playback through digital microphone and speaker are possible
- Various IoT sensor modules through 4 dedicated expansion interfaces are supported
- The driving part adopts a 3-axis omni wheel to maximize the robot's movement efficiency and minimize the turning radius
- For precise control of the driving part, controller equipped with a high-performance MCU controls omni wheel motor, encoder and sensor
- Connected via highly reliable CAN FD communication for collaboration between brain board and controller
- Built-in power path management circuit to make it possible to continue practicing even while the battery is charging
- Service robot development is supported through ROS2, robot standard middleware
- High-level Pop libraries enabling to focus on application implementation is provided
- CUDA-based PyTorch and Tensorflow artificial intelligence framework are supported
- Web browser-based Google block coding platform (Blockly) is supported
- Pre-set integrated development environment based on Visual Studio Code for professional application development is supported
- Provides deep learning-based service robot learning content
- On-device AI autonomous driving training equipment



## Operating Program

List	Specifications	
Linux OS	Desktop	X-Server, Openbox, LightDM, Tint2, blueman, network-manager, conky
	CLI	Zsh, Oh-My-Zsh with powerlevel9k thema and nerd fonts, Tmux, fzf, bat, lsd
	Tool Chain	Python3, NodeJS, Java, Clang, GCC, LLVM
	IDE	Visual Studio Code, Jupyter Lab, NeoVim
	Connectivity	Remote Desktop Server with NoMachine, MQTT Broker with mosquitto, Jupyter Lab Server Bluez, paho-mqtt
	Multimedia	portaudio, sox, OpenCV, Google Assistant
	Data Science & AI	Python3, Numpy, Matplotlib, sympy, Pandas, Seaborn, Scipy, Gym Scikit-learn, Tensorflow, Keras
Middleware	ROS2	Rviz2, RQt, ament, RTPS, Fast DDS, TF2
Pop Library	Output Object	Led, Laser, Buzzer, Relay, RGBLed, DCMotor, StepMotor, Oled PiezoBuzzer, PixelDisplay, TextLCD, FND, Led Bar
	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 310mm	Weight	5.2Kg(About)	Battery	14.8V/7000mA 2ea	Wheels	3 Wheels	
	Motor: 3ea	RPM 500, Encoder	Gear Rate	1:30	Max Speed	1.5m/s			
	UltraSonic Sensor 6ea	Effectual Angle < 15°	Ranging Distance	2cm ~ 400cm	Resolution	0.3cm			
		Measuring Angle : 30°	Trigger Input Pulse width	10us					
	PSD 3ea	Effectual Angle < 15°	Ranging Distance	2cm ~ 400cm	Resolution	0.3cm			
	Measuring Angle : 30°	Trigger Input Pulse width	10us						
Brain Module (Default)	CPU	Quad-core ARM Cortex-A57 MPCore processor							
	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							
Connector	1x HDMI   4x USB 3.0 Type-A, 1x Micro-USB (device mode)								

# Hardware Specification

List		Specifications
Brain Module (Option 1)	CPU	6-core ARM v8.2 64-bit 6MB L2 + 4MB L3 Max Freq: 6-core@1900MHz
	GPU	384-core NVIDIA Volta™ GPU with 48 Tensor Cores Max Freq: 1100MHz
	Memory	8 GB 128-bit LPDDR4x 59.7GB/s
	Storage	16GB eMMC 5.1, NVMe 256GB SSD 1ea(M.2)
	Video Encoder	2x 4K60   4x 4K30   10x 1080p60   22x 1080p30   H.265
	Video Decoder	2x 8K30   6x 4K60   12x 4K30   22x 1080p60   H.265
	Connector	1x HDMI
Brain Module (Option 2)	USB	4x USB 3.0 Type-A, 1x Micro-USB (device mode)
	CPU	8-core ARM® Cortex®-A78AE v8.2 64-bit CPU 2MB L2 + 4MB L3
	GPU	NVIDIA Ampere architecture with 1024 NVIDIA® CUDA® cores and 32 tensor cores
	Memory	16GB 128-bit LPDDR5 102.4 GB/s
	Storage	NVMe SSD 256GB
	Video Encoder	1x 4K60   3x 4K60   6x 1080p60   12x 1080p30 (H.265)   H.264, AV1
	Video Decoder	1x 8K30   2x 4K60   4x 4K30   9x 1080p60   18x 1080p30 (H.265)   H.264, VP9, AV1
Connector	1x HDMI 2.1	
Top Board	USB	4x USB 3.2 Type-A (10Gbps), 1x USB2.0 Type-C (Device Mode)
	Information	Power Voltage Display (3 Digit FND)   LED : Low Battery, Normal Battery Piezo : Alarm Low Battery or Booting
	Application Controller	ARM® 32-bit Cortex®-M4 CPU with FPU 210 DMIPS   1.25 DMIPS   MHz (Dhrystone 2.1), and DSP instructions CAN FD Communication   App. Sensor Control   IMU Sensor Control   Power Check
	CAN FD	CAN FD Controller   CAN FD Transmitter x 2ea
	IMU Sensor	Pitch Roll Yaw (X Y Z axis) Accelerometer + Angular Velocity + Angle +Magnet Field I²C Interface
	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   Tilt : 0° ~ 100° Tilt
	Microphone	High performance Digital Microphone x 4ea   Sensitivity : -26 dBFS(Omnidirectional) Acoustic Overload Point : 120dB SPL   SNR : 63dB
	Light Sensor	Illuminance to digital converter   Wide range : 1 ~ 65535(lx)   Interface: I²C
	App. Sensor Module Block x 7ea	Power: +5V, +3.3V, GND   Interface: I²C, ADC, GPIO, SPI
	Motor Board	Power Block
Motor Controller		ARM® 32-bit Cortex®-M4 CPU with FPU 210 DMIPS   1.25 DMIPS   MHz (Dhrystone 2.1), and DSP instructions   CAN FD Communication Motor Driving Control   UltraSonic Sensor Control   PSD Sensor Control   Battery Temperature
Motor Driver 3ea		Double H bridge drive   Drive current 3.4A(MAX single bridge)   Direction, PWM Control
TFT LCD		7inch 1024 x 600   Interface HDMI   Touch Screen   Speaker 2ea
Base Components	LiDAR(option1)	Distance Range : White object: 12 meters   Black object: 10 meters Minimum Operating ranging : 0.2m   Angular Range : 0 ~ 360degree Sample Frequency : 16KHz   Scan Frequency: 10Hz   Angular Resolution : 0.225°
	LiDAR(option2)	Both outdoor and indoor environments with reliable resistance to daylight (≥80klux) Distance Range : White object: 0.05-40 meters (under 70% reflection) Angular Range : 0 ~ 360degree   Sample Frequency : 32KHz Scan Frequency: Typ. 10Hz, 10~20Hz Angular Resolution : Typ. 0.1125°, 0.1125°~0.225°   Resolution : 10mm
Expansion Module(Option)	Switch Module	Power : +3.3V, GND   Input Device : Tact Switch x 4ea(GPIO 4)
	RGB LED Module	Power : +3.3V, GND   output device : RGB LED 4ea(GPIO 12)
	Analog Module	Power : +3.3V, GND   output device : CdS, NTC, VR(Analog 3)
	TPHG Sensor Module	Power : +3.3V, GND   I/O Interface : I²C   Temperature Measure : -40 ~ 85°C Pressure range : 300 ~ 1100hPa   Humidity Measure : 0 ~ 100%r.H. VOC Measure : Ethane, Ethanol, Acetone, Carbon Monoxide, Butadiene, methyl
	Thermopile Sensor Module	Power : +3.3V, GND   I/O Interface : I²C Factory calibrated in wide temperature range : -40 ~ +125°C for sensor temperature and -70 ~ +380°C for object temperature High accuracy of 0.5°C over wide temperature range (0 ~ +50°C for both Ta and To) High (medical) accuracy calibration   Measurement resolution of 0.02°C
	TOF Sensor Module	Power : +3.3V, GND   I/O Interface : I²C   940 nm laser VCSEL   Measures absolute range up to 2 m Eye Safe : Class 1 laser device compliant with latest standard IEC 60825-1 : 2014 - 3rd edition
	PGCA Sensor Module	Power : +3.3V, GND   I/O Interface : I²C, GPIO   Proximity Sensing   Gesture Detection RGB Color Sensing & Ambient Light   Operating Range: 10-20cm White BackLight LED 4ea(GPIO Control)

## © Training Contents

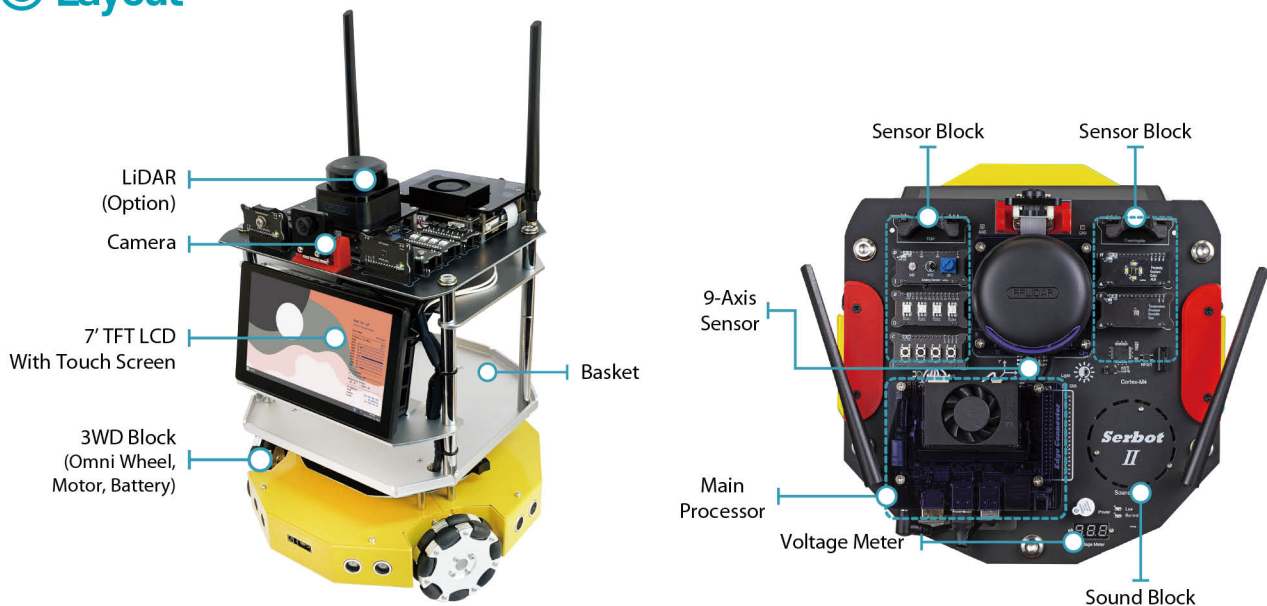
### DDS/RTPS network-based autonomous driving control in ROS2 environment

- WSL2-based Linux development environment
- Understanding Python core syntax for ROS2
- Understanding network programming for ROS2
- ROS2 installation and environment configuration
- Understanding node, topic, service, and parameter action
- ROS2 build environment
- Publisher node and subscriber node
- Services and user defined interface
- Action and multi-node
- Launch and multi-execution
- Advanced ROS2

### Deep learning-based autonomous driving technology

- WSL2-based Linux development environment
- Supervised learning and unsupervised learning
- Linear Regression and Logistic Regression
- ANN, DNN, CNN basics
- Understanding machine learning framework
- Fast multidimensional matrix library
- Time series, table data analysis library
- Data visualization library
- Overview of autonomous driving technology
- Basic driving and remote operation
- Avoid collision and move along object
- Transfer learning
- Advanced autonomous driving

## © Layout



## © Component



SerBot II



Platform USB  
(include OS image and Tools)  
1EA



Ethernet Cable  
1EA



19V 4.6A DC Adapter  
1EA



USB to Ethernet  
Adapter  
1EA



User Guide book  
1EA