

# AI Autonomous Driving Vehicle Training Equipment

AutoCar III G



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- On-Device AI Autonomous Driving Vehicle Training Equipment
- High-performance on-device AI platform of NVIDIA is adopted for the Brain Board
- Built-in high-resolution wide-angle camera for deep learning-based autonomous driving practice
- Built-in 9-axis high-precision IMU sensor for path tracking and vehicle posture control
- Built-in high-precision serial servomotor for more accurate steering control
- Built-in DC motor with encoder and high-efficiency dual motor driver to increase driving accuracy
- Motor, encoder, and sensor control with a controller equipped with a high-performance MCU for precise control of the driving unit
- Connect brain board and controller with highly reliable CAN FD communication
- Built-in Gigabit Ethernet, dual-band Wi-fi, and Bluetooth for IoT connectivity applications
- Built-in digital microphone and speaker for voice recognition and audio playback
- Built-in power path management circuit enabling practice even while the battery is charging
- Indoor or indoor/outdoor DToF lidar for SLAM and path planning applications
- Selectable sensor pack with built-in breadboard to use various IoT sensor modules
- Selectable touch display to implement GUI-based user interface
- Provides high-level Pop Library to help focus on implementing autonomous driving
- Supports autonomous vehicle applications based on robot standard middleware ROS2 and Pop Library
- Supports CUDA-based PyTorch and Tensorflow artificial intelligence framework
- Supports web browser-based Google block coding platform (Blockly)
- Supports pre-set integrated development environment based on Visual Studio Code for professional application development
- Provides learning contents for self-driving cars based on deep learning



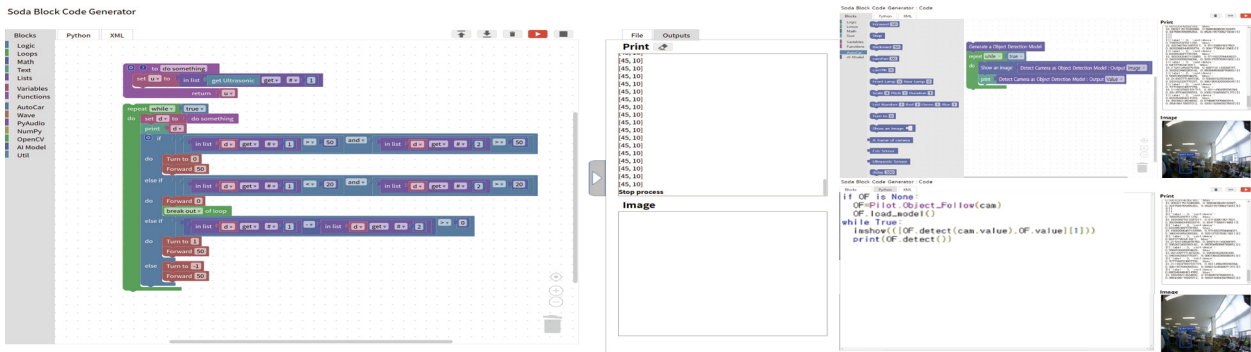
## © Operation Program

	List	Specifications
Linux OS	Desktop	X-Server, Openbox, LightDM, Tint2, blueman, network-manager, conky
	CLI	Zsh, Tmux, Peco, powerlevel9k thema, Powerline fonts, Powerline fonts
	Tool Chain	GCC, JDK, Node JS, Python3, Clang
	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 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 Object Follow, Track Driving, YOLO
PC linkage development environment	Jupyter Lab	Python3 and Cling support IPython Widgets Terminal support Pop Library support
	Visual Studio Code	Remote SSH Python3 and Debugging support
	Insiders	Terminal support Pop Library support

# Hardware Specification

	List	Specifications
<b>Body</b>	Size: 200 x 320 x 148mm   Weight: 3Kg(About)   Battery: 14.8V/7000mA   Wheels: 4 Wheels	
	Motor: Rear Wheel Motor 2ea : RPM 500, Encoder   Gear Rate 1:30   Max Speed 1.5m/s	
	Steering : Serial Bus Servo Motor , High-precision potentiometer for more stable operation, 35kg.cm Torque, Servo accuracy 0.2°, Metal Gear, avoid stalling and overheat protect	
	UltraSonic Sensor 2ea : Effectual Angle < 15°   Ranging Distance : 2cm ~ 400cm   Resolution : 0.3cm (Front 1ea, Rear 1ea)   Measuring Angle : 30 degree   Trigger Input Pulse width : 10us	
	LED: Front 2ea, Rear 2ea	
<b>Brain Parts</b>	Barin Module : 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) Connectivity : Dual Band Wireless WiFi 2GHz/5GHz Band, 867Mbps, 802.11ac Bluetooth 4.2   1x Gigabit Ethernet	
	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° ~ 120° Tilt	
	Microphone : High performance Digital Microphone x 4ea   Sensitivity : -26 dBFS(Omnidirectional) Acoustic Overload Point : 120dB SPL   SNR : 63dB	
	Speaker : Output : 3W x 2ea   3.5mm Audio Jack   Frequency Response : 30Hz ~ 20KH	
	Touch Display(option) : 5inch Capacitive Touch AMOLED Display, 960x544, HDMI, Optical Bonding Toughened Glass Cover	
	LIDAR(Option) : 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	
	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	
	Main 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, Steering Control   UltraSonic Sensor Control   9-AXIS Sensor Control   Power Check	
	Motor Driver 2ea : Double H bridge drive   Drive current 3.4A(MAX single bridge)   Direction, PWM Control	
	9-AXIS Sensor : AHRS IMU sensor. With its in-built posture solver and the dynamic Kalman filter algorithm, the sensor can accurately output the current posture of the product in a dynamic environment. The measurement accuracy of the X and Y axis can reach 0.05°, and the stability is extremely high. Data output frequency : 0.2~200Hz   Baud Rate: 4800~961200 (adjustable) Output Content: 3-axis Acceleration+Angle+Angular Velocity+Magnetic Field+Quaternion Range: Acceleration (±6g), Gyroscope (±2000°/s), Magnet Field (±4900µT), Angle (X, Z-axis: ±180°, Y ±90°) Resolution: Acceleration (0.005g), Gyroscope (0.61°/s), Magnet Field (16 bits) Angle Accuracy(after calibrated): X, Y-axis: 0.05° (Static) , X, Y-axis: 0.1° (Dynamic)	
<b>Sensor Pack (option)</b>	Tiny Bread-F405 Module : Bread Board: 470 Tie-point (Terminal Strip, Distribution Strips)   +5V, +3.3V, GND, I/O Connector ARM®32-bit Cortex®-M4 CPU   CAN, ADC, I2C, SPI, GPIO etc   USB OTG Port 1ea SPI CAN FD Controller and Transmitter   Mixed CAN 2.0B and CAN FD   Conforms to ISO 11898-1:2015	
	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: 4~8in (10~20cm) White BackLight LED 4ea(GPIO Control)	

# [ Supports Google Block-Based Programming ]



## Training Contents

### DDS/RTOS Network-Based Autonomous Driving Vehicle Control in ROS2 Environment

- WSL2-Based Linux Development Environment
- Understanding Python Syntax for ROS2
- Understanding Network Programming for ROS2
- ROS2 Installation and Environment Configuration
- Understanding Node, Topic, Service, and Parameter Action
- ROS2 Build Environment
- Publisher and Subscriber Nodes
- Services and Customized Interface
- Actions 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
- High Speed Multidimensional Matrix Library
- Time Series, Table Data Analysis Library
- Data Visualization Library
- Overview of Autonomous Driving Technology
- Basic Driving and Remote Control
- Collision Prevention and Follow Object
- Transfer Learning
- Advanced Autonomous Driving

## Layout



## Components



AutoCar III G



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Subject to Change