ISO 9001
www.hanback.com

AI Autonomous Driving Vehicle Training Equipment

AIoT AutoCar 3

HANBACK ELECTRONICS
Since 1984

HANBACK ELECTRONICS CO.,LTD.
518 Yuseong-daero, Yuseong-Gu, Daejeon 34202, South Korea
TEL. +82-42-610-1111, 1164 (Dir.)
FAX. 042. 610. 1199
E mail. support@hanback.co.kr

Homepage

AIoT AutoCar 3

- AI & IoT Convergence Training Equipment based on autonomous driving platform
- Artificial intelligence development platform composed of brain module and operating module
- Makes easy programming through block coding possible and provides function of automatic conversion into Python codes
- Fulfills software packages and desired service types through ROS2-based development environment
- Supports real-car-like mechanism and deep-learning-based autonomous driving technology by adopting the steering system
- Its main module is Edge Super Computer which supports all popular AI frameworks
- Provides the module of 8M-pixel, 180° wide-angle camera that can be freely movable
- Provides Gigabit Ethernet, dual-band Wi-Fi and Bluetooth
- Supports commands of speech-to-text & text-to-speech and voice by digital microphone and speaker
- Supports various IoT sensor modules through dedicated extension interface
- High-capacity battery is adopted and continuous training is possible even while battery is being charged
- Supports Soda OS and Pop Library which are AIoT dedicated operating system
- Supports development environment for Python 3 and interpreter-based C/C++ that is optimal for introductory programming
- Supports web-browser based learning environment in which one can learn Python 3 and C/C++ simultaneously in PC or Tablet
- Supports the dispersion name identification based on mDNS/DNS-SD and the network service posting & detection
- Supports open integrated development environment based on Visual Studio Code for professional applied development
- Provides the learning contents of artificial intelligence and the learning models of autonomous driving based on deep learning

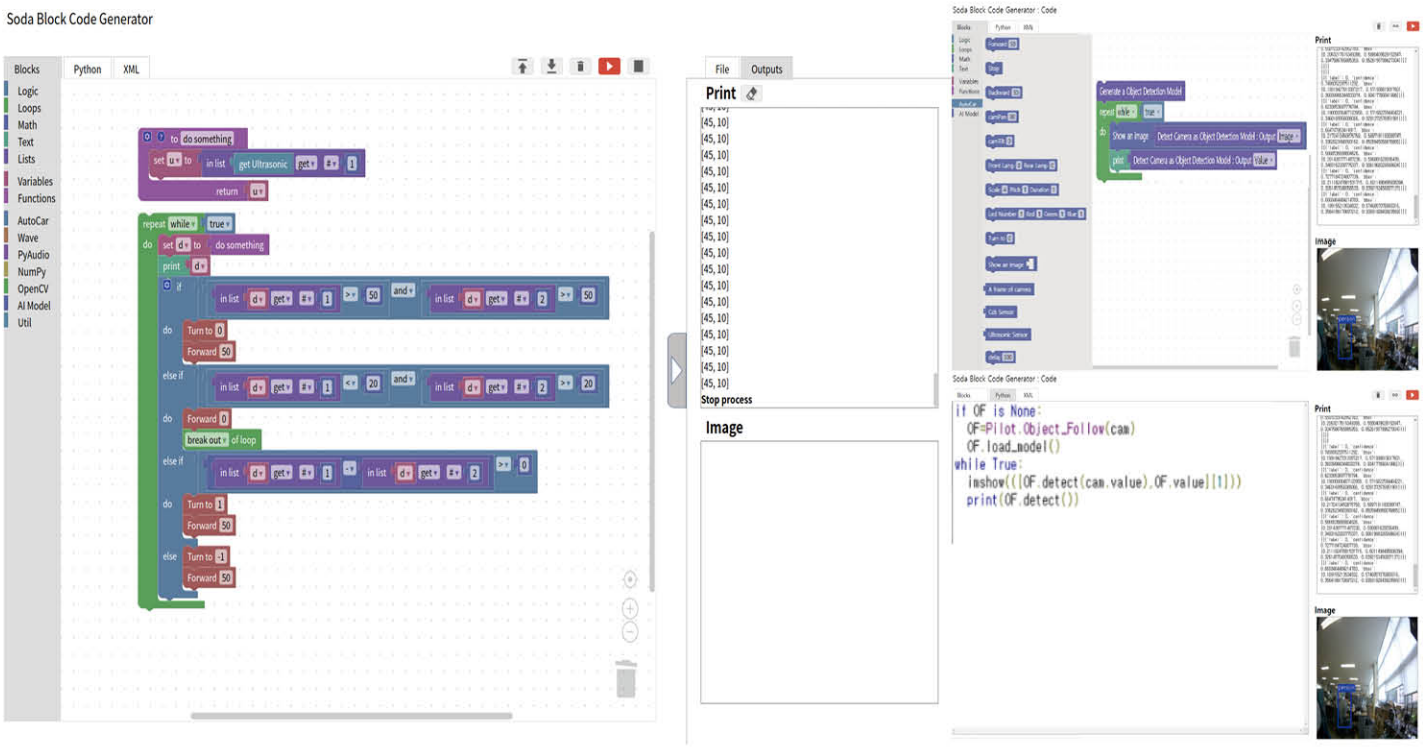
Operating Program

List		Specifications
Soda OS	Linux Kernel	aarch64 4.x
	Lightweight Desktop	X-Server, Openbox, lxdm, Tint2, blueman, network-manager, conky pcmanfm, lxterminal
	CLI	Zsh with Oh-My-Zsh, Tmux, Peco, powerlevel9k thema, Powerline fonts
	Tool Chain	GCC (c, c++), JDK, Node JS, Python3, Cling, Clang
	IDE	Visual Studio Code, NeoVim, Geany
	Connectivity	SSH Server, Samba Server, Remove Desktop Server, mDNS(avahi) Bluez, MQTT Server(Mosquitto), Blynk Server
	Multimedia	PulseAudio, sox (lame, oggenc), snowboy, Google Assistant OpenGL ES, CUDA, OpenCV 4
	Data Science & AI	Numpy, Matplotlib, Pandas, Scipy, Seaborn Scikit-learn, TensorFlow, Keras, PyTorch, TorchVision, OpenAI Gym
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 Co2, Thermopile, Microwave, Lidar
	Multimedia Object	AudioPlay, AudioPlayList, AudioRecord, Tone, SoundMeter
	Voice Assistant Object	GAssistant, create_conversation_stream
	AI Object	Linear Regression, Logistic Regression, Perceptron, ANN, DNN, CNN, DQN Pilot with AutoCar & SerBot
PC Linkage Development Environment	Jupyter Lab	Python3 and Cling support IPython Widgets Terminal support Pop Library support
	Visual Studio Code Insiders	Remote SSH Python3 and Debugging support Terminal support Pop Library support

Hardware Specifications

	List	Specifications
Body	Size : 200 x 320 x 148mm | Weight : 3Kg(About) | Battery : 14.8V/7000mA / Temperature Monitoring	
	Wheels : 4 Wheels | Motor (Rear WheelMotor) 2ea : RPM 500, Gear Rate 1:30, Max Speed 1.5m/s	
	Steering (Servo Motor) : Stall torque: 9.4 kgf·cm (4.8 V), 11 kgf·cm (6 V), Operating speed: 0.17 s/60º (4.8 V), 0.14 s/60º (6 V)	
	Ultrasonic sensor : Front 1ea, Rear 1ea | LED : Front 2ea, Rear 2ea	
Main Module	CPU : Quad-core ARM A57 @ 1.43 GHz | GPU : Maxwell Core 128ea	
	Memory : 4GB 64-bit LPDDR4 25.6 GB/s | Storage : microSD (64GB)	
	Video Encoder : 4K@30 | 4x 1080p@30 | 9x 720p@30 (H.264/H.265)	
	Camera : MIPI CSI-2 DPHY lanes | Display : HDMI and DisplayPort | USB : 4x USB 3.0, USB 2.0 Micro-B	
	Connectivity : Dual Band Wireless WiFi 2GHz/5GHz Band, 867Mbps, 802.11ac, Bluetooth 4.2, Gigabit Ethernet	
Base Board	Driver and Measure Part : 32bit Cortex-M4 Processor, Motor Driver 2ea, Ultrasonic Tx/Rx 2 pair, CAN Communication	
	Voltage Meter : DC 2.4~28V measurement, Accuracy : 3% Measurement rate ≥ 200ms / times	
	Sensor Module Interface : Sensor Block: +5V, +3.3V, GND, I2C, ADC, GPIO, SPI	
	IMU Sensor : Gyroscope Range: ±125°/s to ±2000° Accelerometer Range: ±2g/±4g/±8g/±16g Magnetic field range: ±1300uT(x-, y-axis), ±2500uT(Z-axis) Interface: I2C, Supply Voltage: 3.3V	
	Camera : Image Sensor: Sony IMX219 Resolution: 8M pixel native resolution sensor (3280 x 2464 pixel static images) Video: 1080p30, 720p60 and 640x480p90 Linux integration: V4L2 driver available Focal length: 3.04 mm Angle of view: 160 degrees Focal ratio (F-Stop): 2.35	
	Sound : 1ch Microphone, Omni-directional, Sensitivity: -42dBV, Stereo Speaker 2W | LED : Front/Rear LED 4ea	
	Illuminance Sensor : Sensor : CdS, Operating Voltage : 3.3V, Interface : Analog Output	

[Supporting Google Block-based Programming]



List		Specifications
Option	LCD Touch Screen	Size: 5 inch, Resolution: 960x544, Touch: 5-Points, Capacitive, Interface: HDMI
	Track	Track Layout Size : 3660*4800 mm Wall height : 233mm Traffic light : 2ea Outbreak : 2ea Traffic Signs : 5ea Tablet PC : 1ea
	Base	Bread Board: 470 Tie-point (Terminal Strip, Distribution Strips) +5V, +3.3V, GND, I/O Connector
	Tiny MCU Module : ARM®32-bit Cortex®-M4 CPU, CAN, ADC, I2C, SPI, GPIO etc, USB OTG Port 1ea	
	CAN FD Module : Mixed CAN 2.0B and CAN FD, Conforms to ISO 11898-1:2015	
	LiDAR : Distance Range : 12m, Angular Range : 0 ~ 360degree, Distance Resolution : <0.5(0.15 ~ 1.5meters) Angular Resolution : 0.9degree, Sample Duration : 0.25 millisecond, Sample Frequency : 4KHz, Scan Rate : 10Hz	

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 AutoCar III
2.2.Communication between PC and AutoCar III
2.3.Development Environment

3.AutoCar Control
3.1.Vehicle Control
3.2.Ultrasonic Sensor
3.3.Battery
3.4.Buzzer

4.CAN Protocol
4.1.CAN Network
4.2.CAN Communication
4.3.CAN Communication in Linux

5.Vehicle Location and Surrounding Environment Positioning Method
5.1.9-Axis Sensor
5.2.9-Axis Sensor and Position Coordinate

6.Driving by Calculation Algorithm
6.1.Number 8-Shaped Driving
6.2.Wheel Alignment Adjustment
6.3.Vehicle Posture Control
6.4.Parallel Parking

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

8.Image Processing
8.1.Color Space
8.2.Image Processing using OpenCV
8.3.Detect Movement
8.4.Lane Detection

9.Understanding Machine Learning for Autonomous Driving
9.1.Machine Learning
9.2.Deep Learning
9.3.Deep Learning Framework

10.Convolutional Neural Network and Resnet Structure
10.1.Structure of Convolutional Neural Network
10.2.Color Image and Convolutional Neural Network
10.3.ResNet

11.Object Detection and Moving Object Control using YOLO
11.1.Object Detection
11.2.YOLO

12.Sensor Fusion
12.1.Strategy for Sensor Fusion
12.2.Measure Object Size using Camera and Ultrasound
12.3.Distance Measurement and Avoidance Driving using LiDAR and Ultrasonic Sensor

ROS2
1. ROS (Robot Operating System)
2. ROS2 Development Environment Configuration
3. ROS2 Basics
4. Subscriprion and Publishing
5. Services Application
6. Action Interface
7. Parameter Application
8. Multi Launching
9. Advanced ROS2 Programming

Appendix
A. rclpy API
B. pop_ros and pop_interfaces
C. Rviz2
D. LiDAR Visualization

Layout

Components

AutoCar 3

Platform USB
(include OS image and Tools)
1EA

19V 4.74A Adapter
1EA

Micro SD Adapter
1EA

USB to Ethernet
Adapter
1EA

Ethernet Cable
1EA

User Guide book
1EA