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# AIoT SerBot AGV

Service Robot Training Equipment based on Artificial Intelligence and ROS2

Edge Super Cluster Computer

CPU Module (1~4ea)


HANBACK ELECTRONICS Since 1984

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Homepage

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| List | | | Specifications | | |
|---|---|---|---|---|---|
| Operating Program | Linux 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, powerlevel10k thema, Powerline fonts | | |
| | | Tool Chain | GCC (c, c++), JDK, Node JS, Python3, Cling, Clang | | |
| | | IDE | Visual Studio Code, NeoVim | | |
| | | Connectivity | SSH Server, Samba Server, Remove Desktop Server, mDNS(avahi), Bluez, MQTT Server(Mosquitto), Blynk Server | | |
| | | Multimedia | PulseAudio, sox (lame, oggenc), Google Assistant, OpenGL ES, CUDA, OpenCV 4, Qt5 | | |
| | | Data Science & AI | Numpy, Matplotlib, Pandas, Scipy, Seaborn, Scikit-learn, TensorFlow, TensorRT, Keras, PyTorch, TorchVision, OpenAI Gym, JAX Framework | | |
| | | Middleware | ROS2 Eloquent(or Higher), Rviz, DDS, Colcon Build System | | |
| | 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, Camera(Single& Stereo) | | |
| | | Voice Assistant Object | GAssistant, create_conversation_stream | | |
| | | AI Object | Linear Regression, Logistic Regression, Perceptron, ANN, DNN, CNN, DQN, Pilot with AutoCar & SerBot Series | | |
| | 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 | Body | Dimension | 330 x 450 x 680 (mm) | Motor | In Wheel Motor 2ea, 24VDC, 100W \| Payload < 60kg, Wheel Size 130mm, Rated RPM 400prm |
| | | Weight | 17kg (about) | Display | 11.6" TFT LCD(1920x1080) \| Resolution: 1920 x 1080 \| Interface: HDMI |
| | | Battery | 25.9V / 5200mA | Camera | Resolution: 1080p/30fps \| Focus: Auto \| Lens: Full HD glass \| Field of View: 78° \| Interface: USB |
| | | Wheels | 2Wheels, Auxiliary wheel 4ea | LiDAR | Distance Range : 12m \| Angular Range : 0 ~ 360degree<br>Distance Resolution : <0.5(0.15 ~ 1.5meters) \| Angular Resolution : 0.9degree<br>Sample Duration : 0.25 millisecond \| Sample Frequency : 4KHz \| Scan Rate : 10Hz |
| | | Microphone | High Performance Digital Microphone x 4ea \| Sensitivity : -26 dBFS(Omnidirectional) \| Acoustic Overload Point : 120dBSPL \| SNR : 63dB | | |
| | | Voltage/Current Meter | DC 4.5~30V measurement \| Current 0~10A measurement \| Tolerance +- 1% \| Operation temperature -10°C ~ 65°C | | |
| | Artificial Intelligence Unit (1~4 Cluster option) | Using Edge Super Cluster (1 - 4ea), Gigabit Ethernet Port 1ea | | | |
| | | Multi Gigabit Switching HUB : 2.5Gbps port, Cat6 | | | |
| | | 1 Cluster : CPU: 8-core Arm® Cortex®-A78AE v8.2 64-bit CPU 2MB L2 + 4MB L3<br>- GPU: NVIDIA Ampere architecture with 1024 NVIDIA® CUDA® cores and 32 tensor cores<br>- Memory: 16GB 128-bit LPDDR5 102.4 GB/s<br>- Storage: NVMe SSD 256GB<br>- Video Encoder: 1x 4K60 \| 3x 4K60 \| 6x 1080p60 \| 12x 1080p30 (H.265) \| H.264, AV1<br>- Video Decoder: 1x 8K30 \| 2x 4K60 \| 4x 4K30 \| 9x 1080p60 \| 18x 1080p30 (H.265) \| H.264, VP9, AV1<br>- Camera: MIPI CSI-2 lanes<br>- Connectivity : Dual Band Wireless WiFi 2GHz/5GHz Band, 867Mbps, 802.11ac, Bluetooth 4.2, 1x Gigabit Ethernet, 1x CAN<br>- Display: 1x HDMI 2.1<br>- 4x USB 3.2 Type-A (10Gbps), 1x USB2.0 Type-C (Device Mode) | | | |
| | | User can select the performance and quantity of the cluster | | | |
| | Operation Control Unit | Tiny MCU | Cortex™-M4 core (with floating point unit) running at 168 MHz \| 1x USB OTG (one with HS support) \| 1x SPI running at up to 42 Mbit/s<br>1x I²C \| 1x CAN \| 6x 12-bit ADCs reaching 2.4 MSPS or 7.2 MSPS in interleaved mode \| 12x GPIO \| 1x SWD | | |
| | | Motor Driver | DC 12V ~ 48V BLDC Motor Control, Encoder line Driver, 10A x 2ch, 200W, RWM Control | | |
| | | Ultrasonic Tx/Rx x 6 pair | Operation Voltage 5V \| Measurement Range 4cm – 400cm | | |
| | | PSD x 2ea | Operation Voltage 5V \| Detecting distance, 10cm – 80cm \| Distance Output type : Analog Voltage | | |
| | | CAN Transceiver | Fully ISO 11898-2, 11898-5 & SAE J2284 Compliant \| CAN FD Ready \| Communication Speed up to 5 Mbps | | |
| | Sensor Pack (Option) | 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 | 1x Power : +3.3V, GND \| I/O Interface : I²C \| Temperature Measure : -40 ~ 85°C \| Pressure range : 300 ~ 1100hPa \| Humidity Measure : 0 ~ 100%r.H.<br>VOC Measure : Ethane, Ethanol, Acetone, Carbon Monoxide, Butadiene, methyl | | |
| | | Thermopile Sensor Module | Power : +3.3V, GND \| I/O Interface : I²C<br>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<br>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<br>Operating Range: 4-8in (10-20cm) \| White BackLight LED 4ea(GPIO Control) | | |

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- Deep learning based indoor service robot developing platform composed of cluster computing-artificial intelligence unit (recognition/judgment) and MCU-operation control unit
- The artificial intelligence unit is composed of a computer cluster where 1-4 industrial-use high-performance NVIDIA edge super computing modules are tied with the Gigabit switch on-board enabling to develop and operate high-performance deep learning models in the robot operating system (ROS2) environment
- The artificial intelligence unit provides the interfaces of Gigabit Ethernet, 802.11ac Wi-Fi, Bluetooth, USB 3.0, USB OTG, CAN, I2C, SPI, GPIO so that operating control of unmanned vehicle can be possible
- The operating control unit connected to the artificial intelligence unit with CAN is composed of high-performance STM Cortex-M4 processor, motor driver, ultrasonic sensor, proximity sensor, Zigbee V3.0, and CAN transceiver to control the unmanned vehicle in real time
- Camera and high-performance 360-degree Lidar are provided to realize autonomous driving service that learns and operates the surrounding situation
- The 11.6-inch touch display with a resolution of 1080p is provided to realize the GUI-based intelligent service robot interface
- High-performance digital microphone and speaker are provided to control the robot and check service robot condition by voice
- Ultrasonic sensor and PSD sensor are provided to sense obstacles and autonomous driving of the service robot, and DC motor including an encoder is also provided to calculate the driving distance
- Wi-Fi and Bluetooth communication are provided to enable remote control of the service robot through PC, smartphone, and tablet, and ZigBee V3.0 is provided to enable the platoon driving and collaboration among service robots
- Enable continuous training with the large capacity battery and efficient charging system
- Minimize the time required to install and set the corresponding library and framework with controlling Soda OS where Ubuntu Linux is optimized for robot operating system (ROS2) and CUDA-based deep learning framework
- Supports Visual Studio Code based open integrated development environment for professional application development
- Learning models of deep learning based service robot and training contents are provided

# AIoT SerBot AGV

## Training Contents

| | |
|---|---|
| Introduction of SerBot AGV<br>Composition of SerBot AGV<br>Training Environment of SerBot AGV | Robot Operating System<br>Basic Concept of Robot Operating System<br>Autonomous Driving HW Abstraction Layer<br>Applications of Topic and Service<br>Applications of Action and Parameter |
| Technology based on Artificial Intelligence for Autonomous Driving<br>Pop.AI based Linear & Logistic Regression Theory and Training<br>Pop.AI based ANN, DNN, and CNN Theory and Training<br>Image Processing<br>Deep Learning and YOLO | Realization of Deep Learning Autonomous Driving<br>Overview of Deep Learning based Autonomous Driving Technology<br>Basic Driving Training<br>Remote Control Training<br>Collision Prevention Traning<br>Object-following Movement Training<br>Transfer Learning |

## Components

AIoT Serbot AGV

Platform USB (include OS image and Tools) 1EA

25V DC Adaptor 1EA

29.4V Charger 1EA

Ethernet Cable 1EA

Micro USB Cable 1EA

USB to Ethernet Adapter 1EA