# >>Intelligent Robot

## Intelligent Mobile Robot Platform for ICT Convergence Service

### HBE-SmartCAR

- Advanced Concept Robot Solution using Smart Phone and Tablet as Robot Brain
- Java based OpenCV solution provided to use Android to Vision Robot Study
- Use of Open Hardware Platform, Arduino, to control Robot sub-System of motor and sensor
- Obstacle detection and Autonomous control using multiple Ultrasonic sensor
- Line Tracer operation using Infrared sensor
- Actuator operation control using DC Encoder Motor
- Intelligent control using Eco sensor
- Intelligent control using Accelerometer, Gyroscope, Magnetic sensor
- Available of usual Smart Phone and Tablet holding in addition to own HBE-SM7-S4412
- AndroX Studio™ Software Integrated development environment provided for Robot host System service development

## Introduction

This is developed to support the study of ICT convergence service using Intelligent Mobile Robot and high-value added manpower cultivation, which supports Smart Device based Vision processing. So this provides the best Intelligent Mobile Robot Study environment.

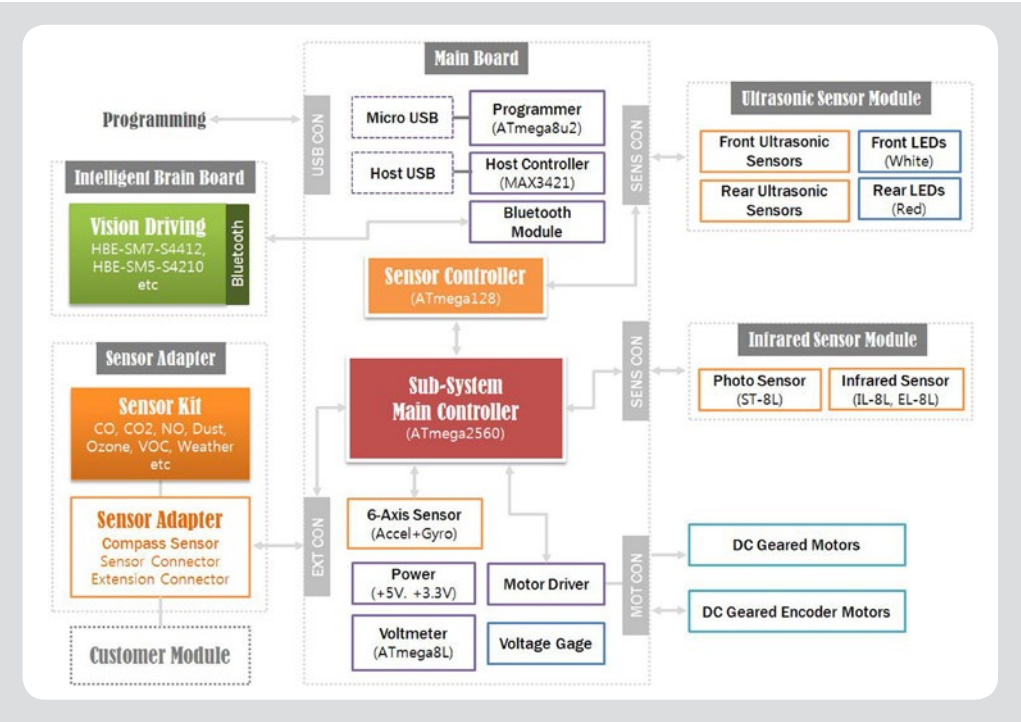
This is designed to use Smart Phone or Smart Pad as Robot Brain for high-performance vision processing, and this combines data collected from Acceleration, Magnetic and Gyroscope sensor in addition to 12 Ultrasonic sensors and 8 Infrared sensors with vision to develop innovative Autonomous algorithm and application service for Intelligent Mobile Robot.

## Features

- This is Mobile Robot Platform including ADK based Electronic Device development environment, and Google Smart Device peripheral device design platform, and this provides the knowledge and experience necessary to develop Smart Convergence Service and test the operation control of mobile robot.
- Arduino integrated development environment makes anyone implement Firmware for electronic device control easily and rapidly. Arduino integrated development environment is based on development environment using Processing/Wiring language so this is effective to develop Interactive Object and operates Microcontroller easily and also this can make programming easily with USB.
- This supports ADK based electronic device development environment, Google Smart Device peripheral device design platform, so we can develop an application program connected with Smart Device on which Google Android platform is mounted.

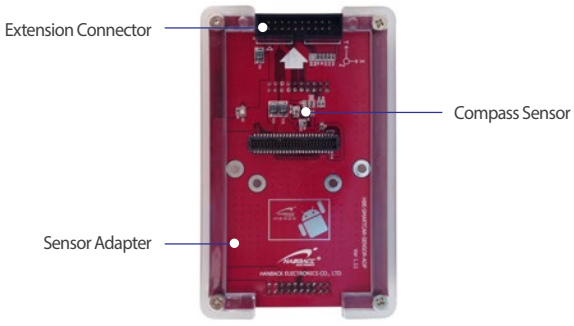
- This supports International Standard Real Time OS, OSEK/VDX, to develop Electronic Device Firmware of Reliability and Stability of automobile level. OSEK/VDX is the best level Real Time OS to control Electronic Device for automobile and Robot, which is small and fast. And this can reduce the time and effort for implementation with standardized development environment.
- This uses 12 Ultrasonic sensors and 8 Infrared sensors to execute Mission moves to the path and avoid an obstacle.
- This includes Magnetic, Acceleration and Gyroscope sensor to detect and device the information of Robot acceleration, vibration, shock and motion by itself so it is possible to develop autonomous Intelligent Robot.
- 2 of 4 DC Geared motors operated independently include Encoder to detect the operation status of motor and calculate the rotating direction and speed of it.
- This includes Bluetooth communication module so this is available of SPP profile based remote control by PC, Notebook, Smart Phone and Tablet supporting Bluetooth communication.
- This provides Holding in order to use Smart Phone or Tablet as Mobile Robot Brain so it is possible to implement Mobile Robot based ICT Convergence Service with communication environment of Wi-Fi and high-performance processor provided by Smart Phone or Tablet.
- For Android based Smart Phone or Tablet, this provides Java based "OpenCV for Android" in order to develop Image Processing based Intelligent Robot application service.
- It is available of function expansion by Extension port. And this can combine various Eco sensors of CO, CO2, N, Ozone and Weather to implement Mobile Robot based environment detection service as an option.
- To develop Android based Robot Image Processing and Host Service, this provides Integrated Development Environment, AndroX Studio™.

## Block Diagram



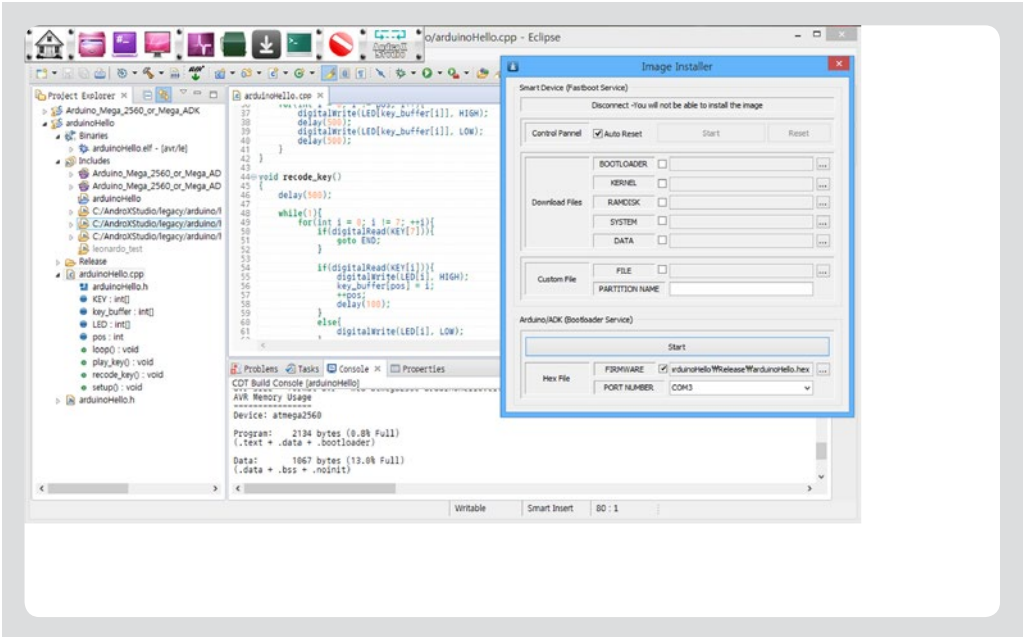
## Configuration & Name

HBE-SmartCAR




Sensor Adapter

### Integrated Development Environment




## H/W Specification

| Item | Specification |
|---|---|
| **Main Unit Body** | |
| Size | 245mm x 380mm x 70mm |
| Weight | 5Kg |
| Material | Steal(Iron) + Aluminum, Powder Coating |
| **Sub-System Main Controller** | |
| Controller | ATmega2560 (Google ADK Platform with Arduino Mega2560) |
| Drive Clock | 16MHz |
| Flash Memory | 256 KB |
| EEPROM Memory | 4 KB |
| SRAM Memory | 8 KB |
| ADC | 10bit 16Channel |
| USB Host Controller | MAX3421E USB 2.0 With SPI Bus |
| Buzzer | 5V Sound Pressure Level: 88 dB |
| **Connectivity** | |
| Bluetooth<br>(Wireless Communication) | On-Board Bluetooth ( FB155BC)<br>v2.0+EDR<br>SPP, A2DP, HSP |
| **Ultrasonic Sensor Controller** | |
| Controller | ATmega128 |
| Drive Clock | 7.3278MHz |
| Flash Memory | 128 KB |
| EEPROM Memory | 4 KB |
| SRAM Memory | 4 KB |
| Ultrasonic Tx Sensor | MA40S4S ( 40KHz / 20 Vp-p ) 12EA |
| Ultrasonic Rx Sensor | MA40S4R ( 40KHz / 20 Vp-p ) 12EA |

# Intelligent Robot
## >>HBE-SmartCAR

| Item | Specification |
|---|---|
| **Infrared Sensors** | |
| Luminous part | 3mm, 940nm Infrared Emitter Diode 8EA |
| receiving part | 3mm, Photo Transistor 8EA |
| **6-Axis Physical Sensors** | |
| Acceleration, Gyroscope Sensor | MPU-6050<br>3-Axis MEMS Gyroscope<br>3-Axis MEMS Accelerometer |
| **Motor** | |
| DC Motor | 1RB35GM 13Type 1/30 DC12V 2EA<br>RB35GM 13Type 1/30 DC12V with Encoder 2EA |
| Motor Driver | L298P |
| **Digital Voltmeter** | |
| Controller | ATmega8 |
| Display part | 3Digit 7-segment |
| **Programmer** | |
| USB Controller | ATmega8U2 16MHz (include bootloader) |
| Interface | Programed as USB-to-Serial converter with DFU mode |
| **External Interface** | |
| USB Host | USB 2.0 1Port |
| USB Device | Micro USB 1Port |
| Expansion port | 2x10 Header 2EA (Power, $I^2C$, UART 2Port, GPIO) |
| **Sensor Adaptor** | |
| 3 Axis Compass Sensor | AK8975C<br>3-Axis Electronic Compass |
| Sensor connector | 2x25 1.27mm Pitch Header |
| Expansion connector | UART 1Port, GPIO 5EA, Power(3.3V, 5V, 12V) |
| **Power** | |
| Battery | Lithium-ion Battery 5200mA ( ~12.6V) |
| Charger | DC 12.6V 1.2A Battery Charger |

## S/W Specification

| Item | Specification |
|---|---|
| **Robot Sub-System Arduino Firmware** | |
| Arduino Integrated Development Environment | AndroX Studio™, Arduino IDE, ArduBlock |
| User Library | Arduino Private Library by Hanback Electronics |
| Function Test Firmware | Motor/Encoder, Ultrasonic, Infrared Sensor, LED, Compass Sensor, Gyro Sensor, Acceleration Sensor, Buzzer, UART/Bluetooth |
| Intelligent Robot Test Firmware | Bluetooth based Remote control between Smart Device and HBE-SmartCAR<br>Obstacle avoidance Autonomous using Ultrasonic sensor<br>Object recognition Autonomous using Vision<br>Specified Path driving by Infrared sensor<br>Specified Path driving by Encoder, Acceleration and Gyro sensor |
| **Robot Sub-System OSEK/VDX Firmware(optional)** | |
| OSEK/VDX Integrated Developing Environment | Cygwin, WinAVR |
| Function Test Firmware | Motor/Encoder, Ultrasonic, Infrared Sensor, LED, Compass Sensor, Gyro Sensor, Acceleration Sensor, Buzzer, UART/Bluetooth |
| Intelligent Robot Test Firmware | Bluetooth based Remote control between Smart Device and HBE-SmartCAR<br>Obstacle avoidance Autonomous using Ultrasonic sensor<br>Object recognition Autonomous using Vision<br>Specified Path driving by Infrared sensor<br>Specified Path driving by Encoder, Acceleration and Gyro sensor |

## S/W Specification

| Item | Specification |
|---|---|
| **Robot Host System Vision/Service Program** | |
| Smart Device Integrated Development Environment | AndroX Studio™ |
| Vision Application Program | YUV to RGB conversion, Pixel based Image processing, Mask based Image processing, Color recognition, Feature recognition, Face recognition, Motion recognition |
| Smart Device Application Program | HBE-SmartCAR sensor value received and direction remote control<br>Obstacle avoidance Autonomous remote monitor using Ultrasonic sensor<br>Object recognition Autonomous monitor using Vision<br>Specified Path driving monitor by Infrared sensor<br>Specified Path driving motor by Encoder, Acceleration and Gyro sensor<br>Wi-Fi based Smart Device image Real Time receive |

## Product Configuration

HBE-SmartCAR

Manual / CD

Charger
(12.6V/1.2A)

## Option Items

HBE-SM7-S4412
(Option)

HBE-Healthcare
/Eco Sensor Kit
(Option)

Optional Battery
(when order additional,
can provide with Parallel
Connected one)

## Educational content

### SmartCAR Basic Curriculum

HBE-SmartCAR control & Vision APP design
- HBE-SmartCAR Control
- Android Camera Control
- Camera Image Processing based OpenCV
- HBE-SmartCAR control using Camera Image Processing
- Camera Image Transfer based Wi-Fi

### SmartCAR Firmware Curriculum (Option)

HBE-SmartCAR Firmware Design
- Overview Mobile Robot
- Characteristic & Control of Motor
- HBE-SmartCAR's LED Control
- Remote Control using UART
- Mobile Robot's Wheel Control
- Mobile Robot's Moving Direction Control
- Mobile Robot's Moving Speed Control using PID
- Robot Position Control using 6-axis Sensor(MPU-6050)
- Implement Line Tracer using Infrared Sensor
- Auto-Driving using Ultrasonic Sensor
- Measuring Earth Magnetic field using Compass sensor
- Autonomous mobile location of HBE-SmartCAR