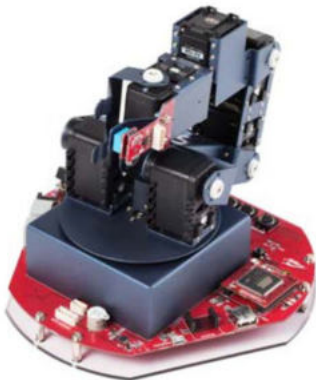# Intelligent Robot
>>HBE-RoboEX Series

HBE-RoboEX-Main : Main Controller Module

- Support of Integrity Serial Bus System, CAN to Build Intelligent Device Network
- Use of Open Hardware Platform, Arduino, to control Robot sub-Systems of motor-sensor
- Bluetooth Communication Test
- Use and Test Graphic LCD & Menu Configuration for RoboEX Series
- AndroX Studio Integrated development environment provided for Robot host System service development

HBE-RoboEX-Motor : Intelligent Robot Motor Study Module

- Support of Integrity Serial Bus System, CAN to Build Intelligent Device Network
- Use of Open Hardware Platform, Arduino, to control Robot sub-Systems of motor-sensor
- DC-Motor control and operation by Infrared sensor
- Actuator operation control by DC Encoder Motor
- Servo Motor control and operation by Accelerometer
- Step motor control and operation by PWM
- AndroX Studio™ Integrated development environment provided for Robot host System service development

HBE-RoboEX-ARM : Intelligent Robot ARM Module

- Support of Integrity Serial Bus System, CAN to Build Intelligent Device Network
- Use of Open Hardware Platform, Arduino, to control Robot sub-Systems of motor-sensor
- Dynamic Cell Servo Motor Control
- Daisy Chain Motor connect and Own ID Packet communication control
- Study of Haptics by Pressure sensor
- Servo Motor control and operation by Accelerometer and Gyro sensor
- Inter-connected with RoboEX-3WD, Application of Intelligent Robot
- AndroX Studio™ Integrated development environment provided for Robot host System service development

HBE-RoboEX-Brain : Intelligent Robot Intelligence Module

- Support of Integrity Serial Bus System, CAN to Build Intelligent Device Network
- Use of Open Hardware Platform, Arduino, to control Robot sub-Systems of motor-sensor
- Dynamic Cell Servo Motor Control
- Daisy Chain Motor connect and Own ID Packet communication control
- Multi-media application and Robot control
- OpenCV based Image Processing application
- Inter-connected with RoboEX-3WD, Application of Intelligent Robot
- AndroX Studio™ Integrated development environment provided for Robot host System service development

HBE-RoboEX-3WD : Intelligent Robot Actuator Module

- Support of Integrity Serial Bus System, CAN to Build Intelligent Device Network
- Use of Open Hardware Platform, Arduino, to control Robot sub-Systems of motor-sensor
- Use of movable Omni Wheel of Omni-Directional
- Actuator operation control by DC Encoder Motor
- DC-Motor control and operation by Accelerometer , Gyro, Ultrasonic and PSD sensor
- AndroX Studio™ Integrated development environment provided for Robot host System service development

HBE-RoboEX-Pendulum : Intelligent Robot Pendulum Control Module

- Support of Integrity Serial Bus System, CAN to Build Intelligent Device Network
- Use of Open Hardware Platform, Arduino, to control Robot sub-Systems of motor-sensor
- Inverted Pendulum Control by PID control
- PWM Duty operation and Motor control by Encoder counter
- Inverted Status Monitoring by Emulation
- AndroX Studio Integrated development environment provided for Robot host System service development

Introduction

HBE-RoboEX-Series are Intelligent Robot Study Modules which can design Prototypes. The series provides Arduino programming environment and Open Electronic Device Control Platform.

Features

2-1. Common Features

- This uses Modular design for Technology and Science, and this is available for individual study and cooperative study.
- HBE-RoboEX Series uses Cortex-M3 based 32bit late Microprocessor, which can be operated independently.
- This uses CAN communication used to build Intelligent Device Network which needs Integrity in order to inter-connect necessary modules to operate it as cooperative model.
- This includes CAN communication and Powers in one cable so it is possible to build effective Network when operating it as inter-connected cooperative model.
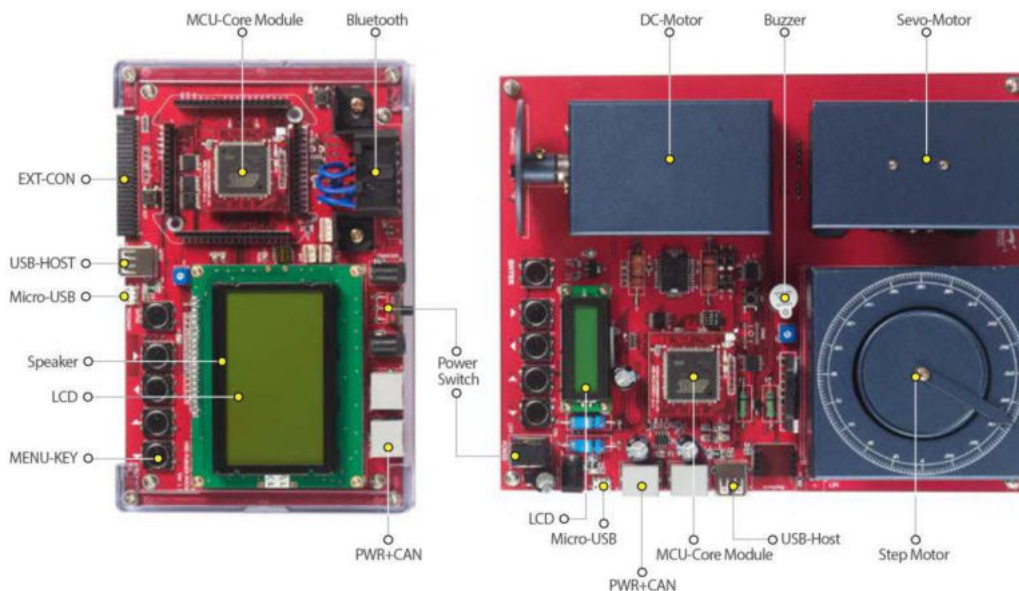
Intelligent Robot
>>HBE-RoboEX Series

- This uses Arduino, Open Electronic Device Control Platform, as Programming Environment, so this can minimize Specialty for Hardware control. Therefore, this can normalize how to get Status information from sensor and control Motor for operation definition.
- This supports Google ADK(Accessory Development Kit) in order to control the operation of Motor Study Module and monitor Sensor value from Smart phone or Tablet.
- This supports Bluetooth in order to control the operation of HBE-RoboEX Series and monitor Sensor value from Smart phone or Tablet.

2-2. Features of each Modules

Item	Specifications
HBE-RoboEX-Motor	• Study how to control DC-motor, Servo motor and Step motor for Robot design.
HBE-RoboEX-ARM	• Get Dynamic Cell Servo-motor control technology to design Robot System. • Dynamic Cells of Dynamic Cell Servo Motor have their own ID, operated by Network, which are controlled by Packet communication on a Bus. • Dynamic Cell ervo Motor is connected by Daisy Chain, which has simple wiring and easy expandability.
HBE-RoboEX-Brain	• Get Dynamic Cell Servo-motor control technology to design Robot System and to use OpenCV based Image Processing technology. • Samsung Exynos 5 high-advance Application Process based and Cortex-M3 32bit based late Microprocessor, which can be operated independently.
HBE-RoboEX-3WD	• Control Omni Wheel of omni-directional mobility and DC-motor for Robot design. • Learn various application such as obstacle detection and object recognition with Ultrasonic and PSD sensor for intelligent robot.
HBE-RoboEX-Pendulum	• Study how to control DC-motor, Encoder counter and PID for ter and PID for Inverted Pendulum system design.

Configuration and Names

• HBE-RoboEX-Motor

• HBE-RoboEX-ARM

• HBE-RoboEX-Brain

Intelligent Robot
>>HBE-RoboEX Series

· HBE-RoboEX-3WD

· HBE-RoboEX-Pendulum
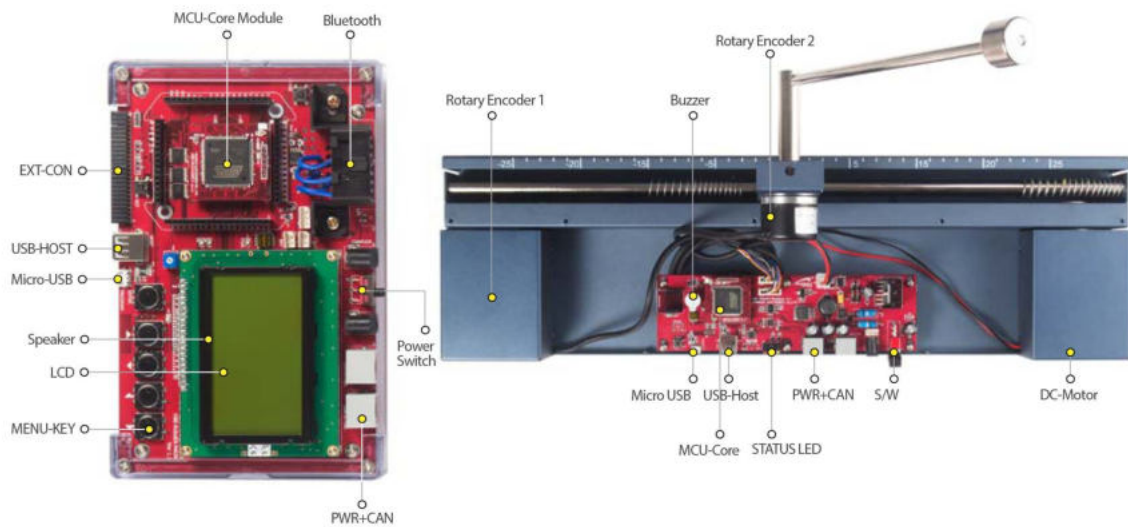
Block Diagram
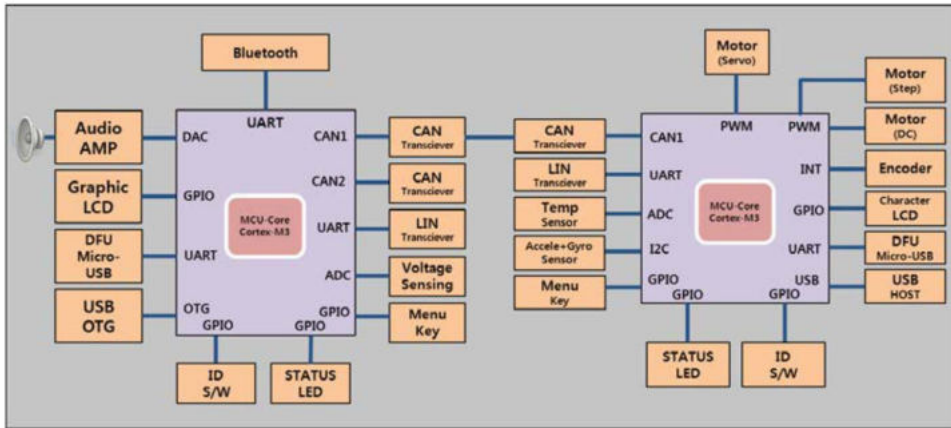
<Control System Module>   <Motor Study Module>

<Control System Module>   <Robot ARM Module>
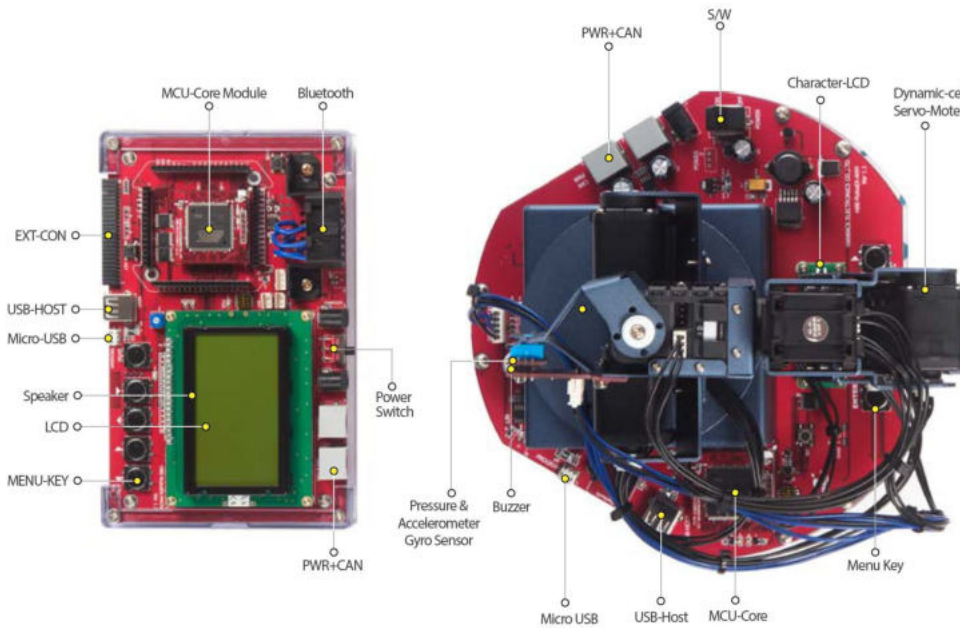

<Control System Module>   <Robot Intelligence Module>
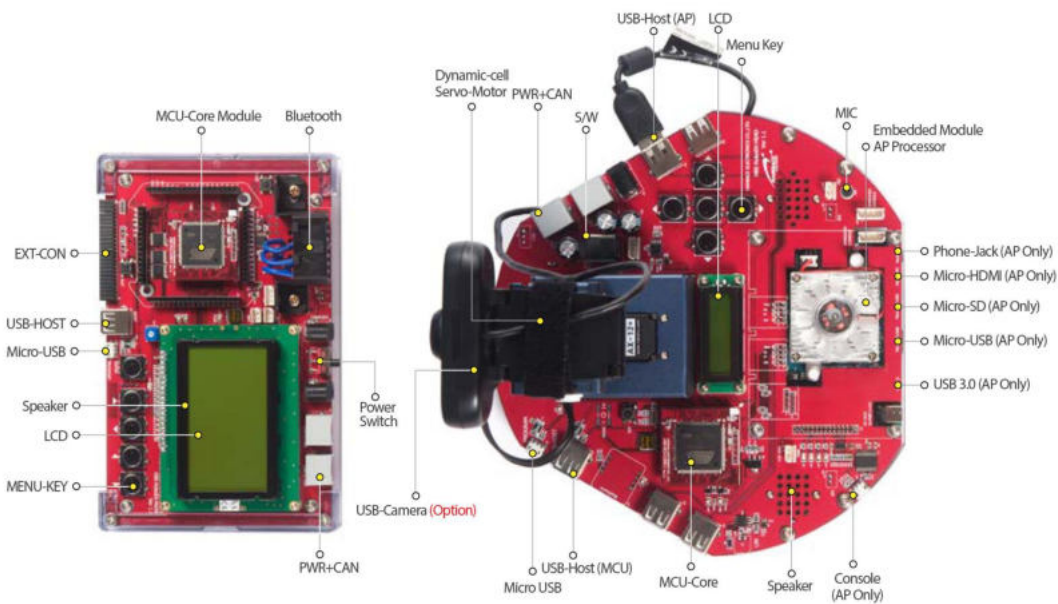
Intelligent Robot

Autofly_Spring

HBE-RoboEX Series

HBE-SmartCAR

HBE-RoboCAR-Embedded II

HBE-ROBONOVA-AI II

HBE-RoboCAR

HBE-MCU-Robot

HBE-RoboBuilder-MSRDS

![Scientech logo]

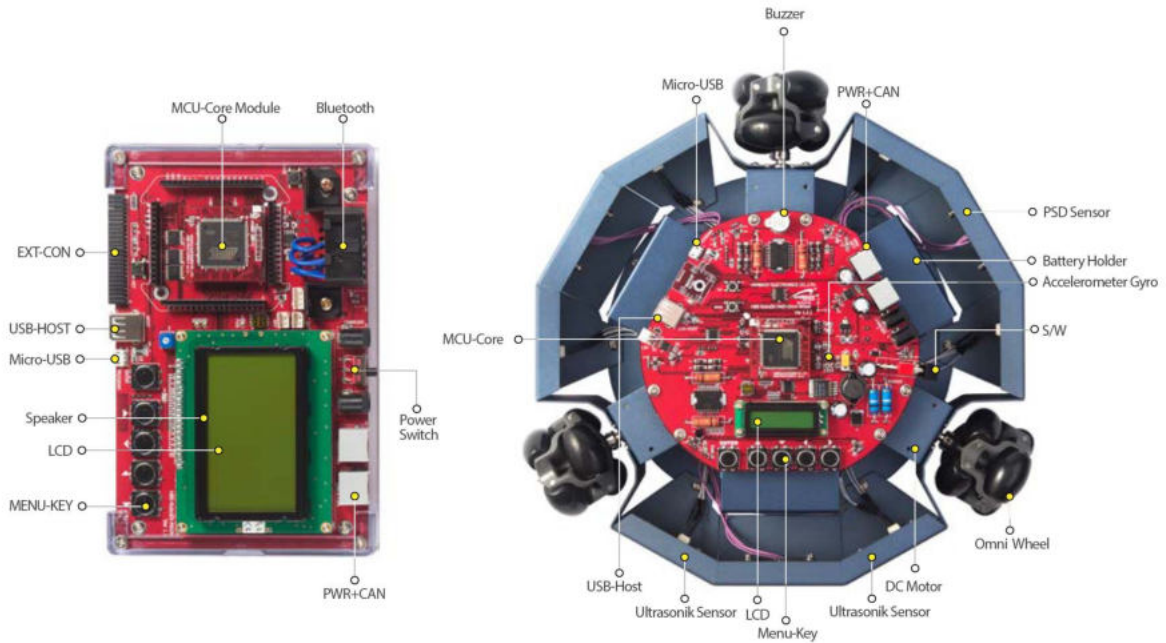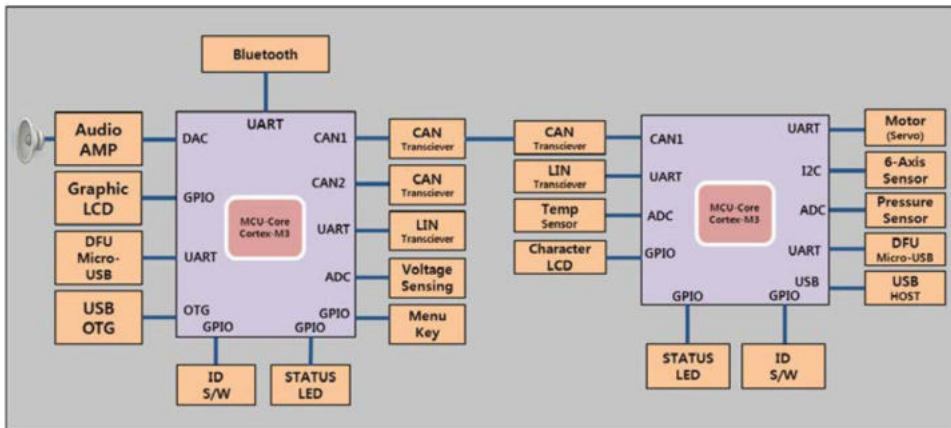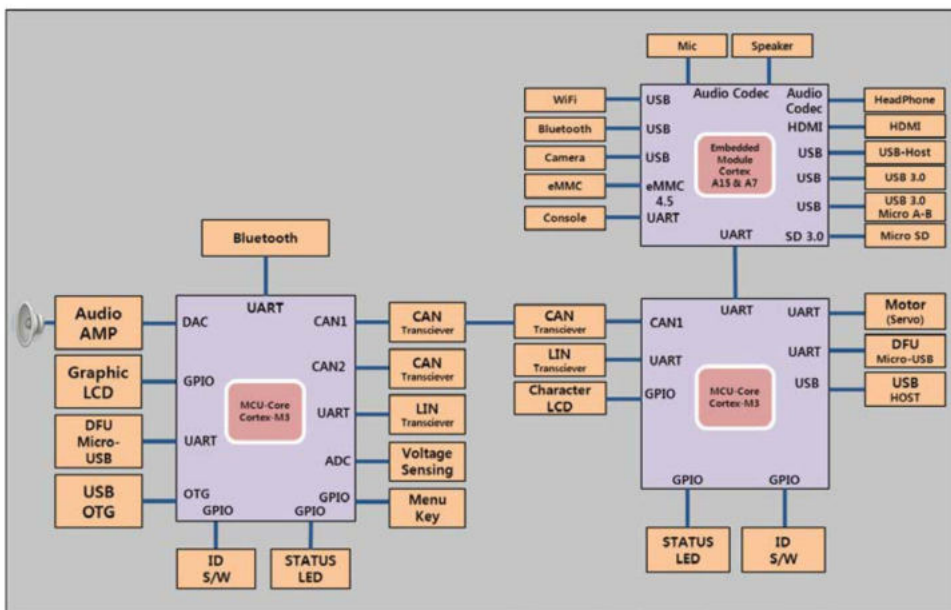# Intelligent Robot
>>HBE-RoboEX Series

<Control System Module> <Robot Actuator Module>

<Control System Module> <Pendulum Control Module>
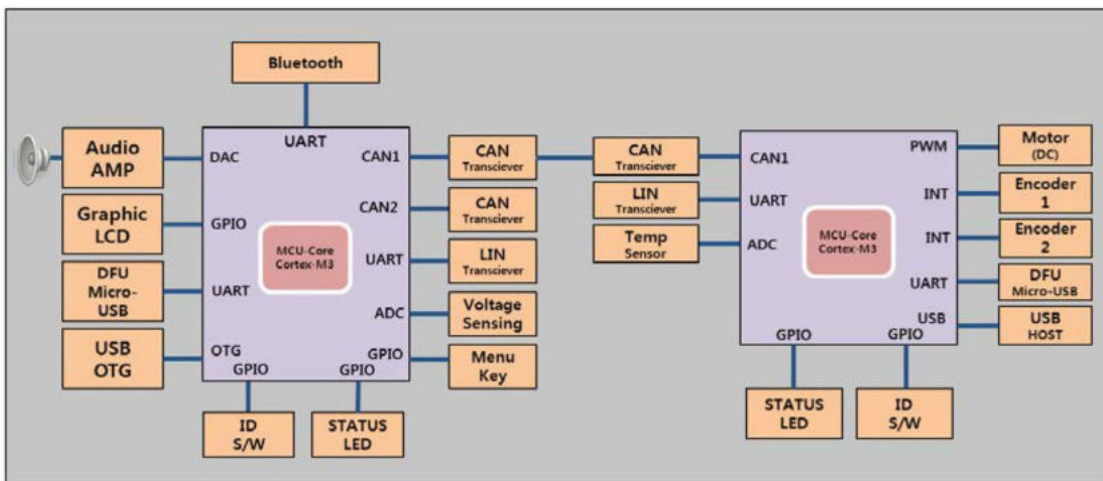
Hardware Specifications

RoboEX-Main (Control System Module)

Item		Specifications
Core Module	Controller	32bit ARM Cortex-M3 ATSAM3X8EA-AU MCU up to 84MHz
	Flash Memory	512KB
	SRAM	64 + 32 KB
	DFU Controller	Low Power AVR 8bit Microcontroller ATmega16U2-AU
	EXT-Interface	0.8MM 2Raw 40Pin Connector 2EA (Plug)
	Size	35MM x 35MM
Core-Module Interface		0.8MM 2Raw 40Pin Connector 2EA (Receptacle)
Program-Interface		Micro-USB Type (DFU)
User-Interface		Graphic LCD 128 X 64 STN / Yellow/Green Backlight
		Speaker 1EA
		Function Button 5EA
		Status LED 2EA, Power LED 1EA
Communication		Bluetooth 2.0+EDR (FB155BC)
		CAN 2.0 Part A & CAN 2.0 Part B
		LIN 1.3 & 2.0
EXT-Interface		USB-Host
		2x25Pin Connector 1EA
		1x15Pin Socket 2EA, 1x18Pin Socket 2EA
Size		185MM X 115MM

RoboEX-Motor (Motor Study Module)

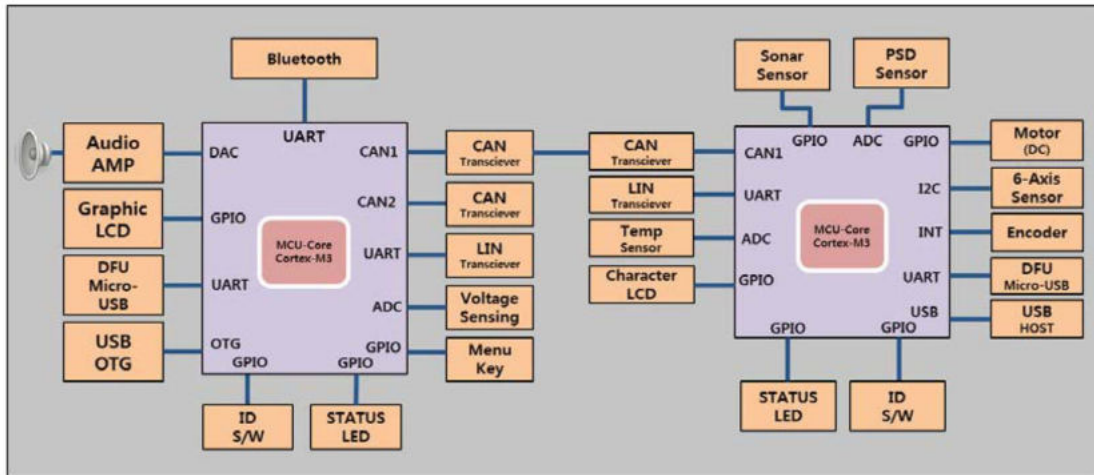| Item		Specifications
Core Module	Controller	32bit ARM Cortex-M3 ATSAM3X8EA-AU MCU up to 84MHz
	Flash Memory	512KB
	SRAM	64 + 32 KB
	DFU Controller	Low Power AVR 8bit Microcontroller ATmega16U2-AU (DFU)
	EXT-Interface	0.8MM 2Raw 40Pin Connector 2EA (Plug)
	Size	35MM x 35MM
Core-Module Interface		0.8MM 2Raw 40Pin Connector 2EA (Receptacle)
EXT-Interface		USB-HOST
Program-Interface		Micro-USB Type (DFU)
User-Interface		Character LCD 16x2
		Buzzer 1EA
		Function Button 5EA
		Status LED 2EA, Power LED 1EA
Communication		Bluetooth 2.0+EDR (FB155BC) (*Factory Option)
		CAN 2.0 Part A & CAN 2.0 Part B
		LIN 1.3 & 2.0
Motor		RG35GM 11Type DC12V 1/50 with Encoder DC-Motor
		MRS-D2009 Servo Motor
		SST42D1100 Step-Motor
Motor Driver		L298P Dual Full-Bridge Driver
		SLA7024M High-Current PWM, Unipolar Stepper Motor Driver
Sensor		MPU-6050 3Axis Accelerometer
		TMP36GT9 Low Voltage Temperature Sensor
		Encoder With DC-Motor
		MI-23HT Photo Interrupter
Size		215MM X 175MM X 90MM

Intelligent Robot

Autofly_Spring

HBE-RoboEX Series

HBE-SmartCAR

HBE-RoboCAR-Embedded II

HBE-ROBONOVA-AI II

HBE-RoboCAR

HBE-MCU-Robot

HBE-RoboBuilder-MSRDS

Intelligent Robot
>>HBE-RoboEX Series

RoboEX-ARM (Robot ARM Module)

Item		Specifications
Core Module	Controller	32bit ARM Cortex-M3 ATSAM3X8EA-AU MCU up to 84MHz
	Flash Memory	512KB
	SRAM	64 + 32 KB
	DFU Controller	Low Power AVR 8bit Microcontroller ATmega16U2-AU (DFU)
	EXT-Interface	0.8MM 2Raw 40Pin Connector 2EA (Plug)
	Size	35MM x 35MM
Core-Module Interface		0.8MM 2Raw 40Pin Connector 2EA (Receptacle)
Program-Interface		Micro-USB Type (DFU)
EXT-Interface		USB-HOST
User-Interface		Character LCD 16x2
		Buzzer 1EA
		Function Button 5EA
		Status LED 2EA, Power LED 1EA
Communication		Bluetooth 2.0+EDR (FB155BC) (*Factory option)
		CAN 2.0 Part A & CAN 2.0 Part B
		LIN 1.3 & 2.0
Motor		AX-12A Dynamic-cell Servo-Motor 7EA
Sensor		MPU-6050 3Axis Accelerometer + 3Axis Gyro
		IESP-12 Pressure Sensor
		TMP36GT9 Low Voltage Temperature Sensor
Size		275MM X 275MM X 460MM

RoboEX-Brain (Robot Intelligence Module) Embedded Part

Item	Specifications
Processor	Samsung Exynos5 Octa 1.8GHz(Cortex-A15 Quad + Cortex-A7 Quad)
Memory	2Gbyte LPDDR3 RAM PoP (800MHz, 1600Mbps, 2x32bit Bus)
GPU	PowerVR SGX544MP3 GPU (OpenGL ES2.0, OpenGL ES1.1 and OpenCL 1.1EP)
Storage	eMMC 16GByte(eMMC 4.5 Support), *Option 8/16/32GByte MicroSD Card
Network	802.11b/g/n Wireless LAN
Bluetooth	4.0+EDR, 1.1/1.2/2.0/2.1+EDR compatible (*Max data speed 3Mbps)
PMIC	1EA Power Management IC
Digital Video	HDMI 1.4 Video Out (1080p)
Audio	Audio Codec, Build-In Speaker, Headphone-Jack (Mic + Speaker)
USB	USB 3.0 Host (Super Speed Standard A Type Connector x 1 Port)
	USB 3.0 OTG (Super Speed USB Micro A-B Type Connector x 1 Port)
	USB 2.0 Host (High Speed Standard A Type Connector x 2 Port)
UART	1 Port Serial to USB (Micro Type, Default : Debugging UART)
Camera	USB Camera [UVC Support] (*Option)

RoboEX-Brain (Robot Intelligence Module) Sub-system Part

Item		Specifications
Core Module	Controller	32bit ARM Cortex-M3 ATSAM3X8EA-AU MCU up to 84MHz
	Flash Memory	512KB
	SRAM	64 + 32 KB
	DFU Controller	Low Power AVR 8bit Microcontroller ATmega16U2-AU (DFU)
	EXT-Interface	0.8MM 2Raw 40Pin Connector 2EA (Plug)
	Size	35MM x 35MM
Core-Module Interface		0.8MM 2Raw 40Pin Connector 2EA (Receptacle)
Program-Interface		Micro-USB Type (DFU)
EXT-Interface		USB-HOST
User-Interface		Character LCD 16x2
		Speaker 2EA
		Function Button 5EA
		Status LED 2EA, Power LED 1EA

	Specifications
Communication	CAN 2.0 Part A & CAN 2.0 Part B
	LIN 1.3 & 2.0
Motor	AX-12A Dynamic-cell Servo-Motor 7EA
Size	275MM X 275MM

RoboEX-3WD (Robot Actuator Module)

Item		Specifications
Core Module	Controller	32bit ARM Cortex-M3 ATSAM3X8EA-AU MCU up to 84MHz
	Flash Memory	512KB
	SRAM	64 + 32 KB
	DFU Controller	Low Power AVR 8bit Microcontroller ATmega16U2-AU (DFU)
	EXT-Interface	0.8MM 2Raw 40Pin Connector 2EA (Plug)
	Size	35MM x 35MM
Core-Module Interface		0.8MM 2Raw 40Pin Connector 2EA (Receptacle)
Program-Interface		Micro-USB Type (DFU)
EXT-Interface		USB-HOST
User-Interface		Character LCD 16x2
		Buzzer 1EA
		Function Button 5EA
		Status LED 2EA, Power LED 1EA
Communication		Bluetooth 2.0+EDR (FB155BC)
		CAN 2.0 Part A & CAN 2.0 Part B
		LIN 1.3 & 2.0
Motor		RG35GM 13Type DC12V 1/30 with Encoder DC-Motor
Motor Driver		L298P Dual Full-Bridge Driver
Sensor		MPU-6050 3Axis Accelerometer
		TMP36GT9 Low Voltage Temperature Sensor
		Encoder With DC-Motor
		MA40S4R / MA40S4S Ultrasonic Sensor
		GP2Y0A21YK Distance Measuring Sensor
Wheel		Omni Wheel 60MM Active Type / 6MM Motor Shaft Hole
Battery		11.1V @ 5200mA 3EA
Size		205MM X 192MM X 190MM

RoboEX-Pendulum (Pendulum Control Module)

| Item		Specifications
Core Module	Controller	32bit ARM Cortex-M3 ATSAM3X8EA-AU MCU up to 84MHz
	Flash Memory	512KB
	SRAM	64 + 32 KB
	DFU Controller	Low Power AVR 8bit Microcontroller ATmega16U2-AU (DFU)
	EXT-Interface	0.8MM 2Raw 40Pin Connector 2EA (Plug)
	Size	35MM x 35MM
Core-Module Interface		0.8MM 2Raw 40Pin Connector 2EA (Receptacle)
Program-Interface		Micro-USB Type (DFU)
EXT-Interface		USB-HOST
User-Interface		Buzzer 1EA
		Status LED 2EA, Power LED 1EA
Communication		Bluetooth 2.0+EDR (FB155BC)
		CAN 2.0 Part A & CAN 2.0 Part B
		LIN 1.3 & 2.0
Motor		RA35GM 07Type DC12V 1/6
Motor Driver		LMD18200T H-Bridge DC and Stepper Motor Driver
Encoder		E40S6-1024 1024 Pulse Rotary Encoder 2EA
Sensor		TMP36GT9 Low Voltage Temperature Sensor
Size		516MM X 157MM X 340MM

Intelligent Robot
>>HBE-RoboEX Series

Software Specifications

Item	Specifications
Arduino Integrated Development Environment	AndroX Studio™
HBE-RoboEx-Main Firmware (Common)	Bluetooth based Remote control between Smart Device and Motor Study Module CAN communication based Remote control of Motor Study Module Control System Integrated Firmware, Remote Control Program for Smart Phone
HBE-RoboEx Series Module Firmware(Common)	DC-Motor operation control by Infrared sensor DC-motor operation control by Encoder Servo Motor Control by Accelerometer Step Motor control Input Voltage and Temperature measurement Buzzer Control Motor Study Integrated Firmware Digital I/O control (LED, CLCD, PUSH & DIP SWITCH) Data Transmit/Receiving with Main Control Module using CAN Remote Control Program for SmartPhone
HBE-RoboEx-ARM Firmware	Dynamic Cell Servo Motor Control Servo Motor Control by Pressure sensor Servo Motor Control by Accelerometer and Gyro sensor Buzzer Control Input Voltage and Temperature measurement
HBE-RoboEx-Brain Firmware & Application	Dynamic Cell Servo Motor Control Data transformation with Embedded System by UART communication Intelligent Application Program based image processing(OpenCV)

	Embedded Module	Bootloader	U-boot 1.3.4
		OS	Linux Kernel 3.4.5
		Platform	Android Jelly Bean 4.2.2
		Audio	Audio driver, ALSA
		USB	USB gadget driver

Item	Specifications
HBE-RoboEx-3WD Firmware	DC-Motor operation control DC-Motor operation control by Encoder DC Motor Control by Accelerometer and Gyro sensor Distance Measurement Using Ultrasonic Sensors Distance Measurement Using PSD Sensor Buzzer control Input Voltage and Temperature measurement Robot Actuator Integrated Firmware
HBE-RoboEx-Pendulum Firmware	PID DC-motor control DC-motor operation control by Encoder Inverted Pendulum module angle measurement by Encoder Buzzer Control Input Voltage and Temperature measurement
Smart Device Application Program	Sensor value Receive and Romote control of RoboEX OpenCV Image Processing (HBE-RoboEx-Brain) Voice Recognition Processing (HBE-RoboEx-Brain) Pendulum monitoring Emulation program (HBE-RoboEx-Pendulum)

Expandability

Inter-connectable with HBE-SM7-S4412 and SmartPhone
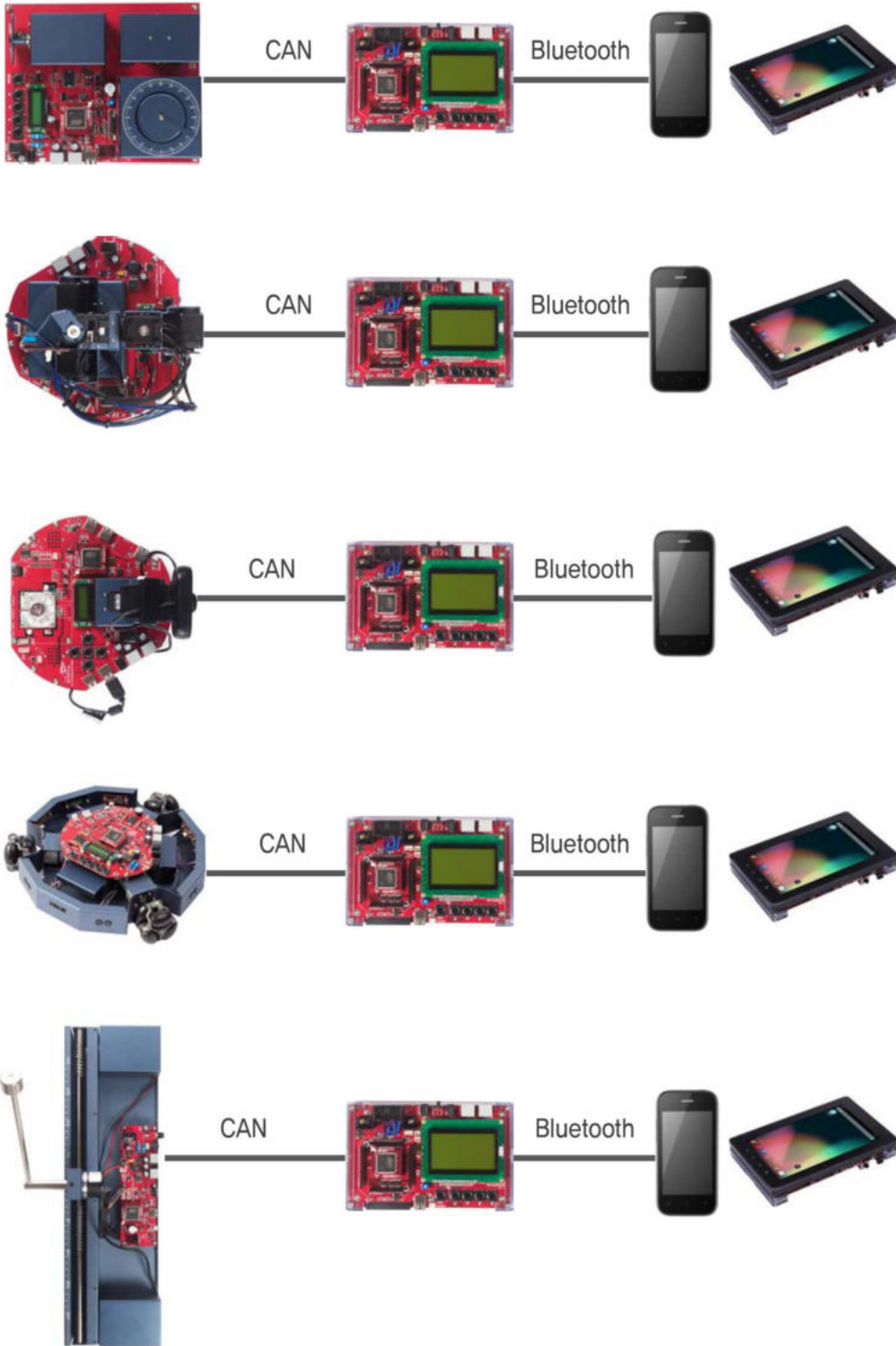
CAN — Bluetooth

CAN — Bluetooth

CAN — Bluetooth

CAN — Bluetooth

CAN — Bluetooth

Intelligent Robot

Autofly_Spring

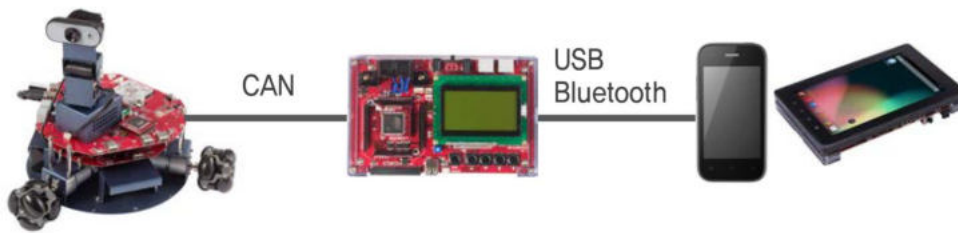**HBE-RoboEX Series**

HBE-SmartCAR

HBE-RoboCAR-Embedded II

HBE-ROBONOVA-AI II

HBE-RoboCAR

HBE-MCU-Robot

HBE-RoboBuilder-MSRDS

Intelligent Robot
>>HBE-RoboEX Series

### Inter-connectable with other products of HBE-RoboEX series

- Expendable to Image Processing Robot Solution executing project by inter-connection with HBE-RoboEX 3WD

CAN   USB Bluetooth

- Expendable to Manipulator Robot Solution executing project by inter-connection with HBE-RoboEX 3WD

CAN   USB Bluetooth
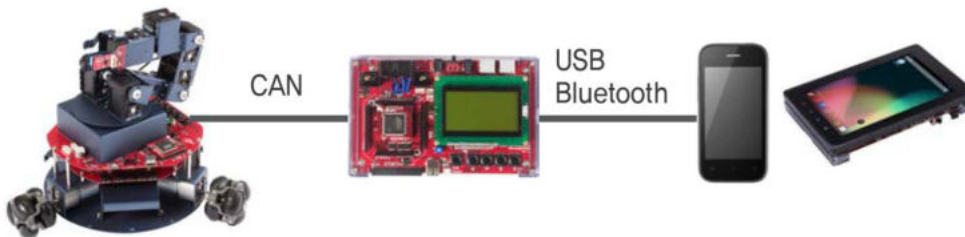
- Inter-connectable with other products of HBE-RoboEX series and controlled by Smart phone

Brain   3WD   ARM

CAN   USB Bluetooth
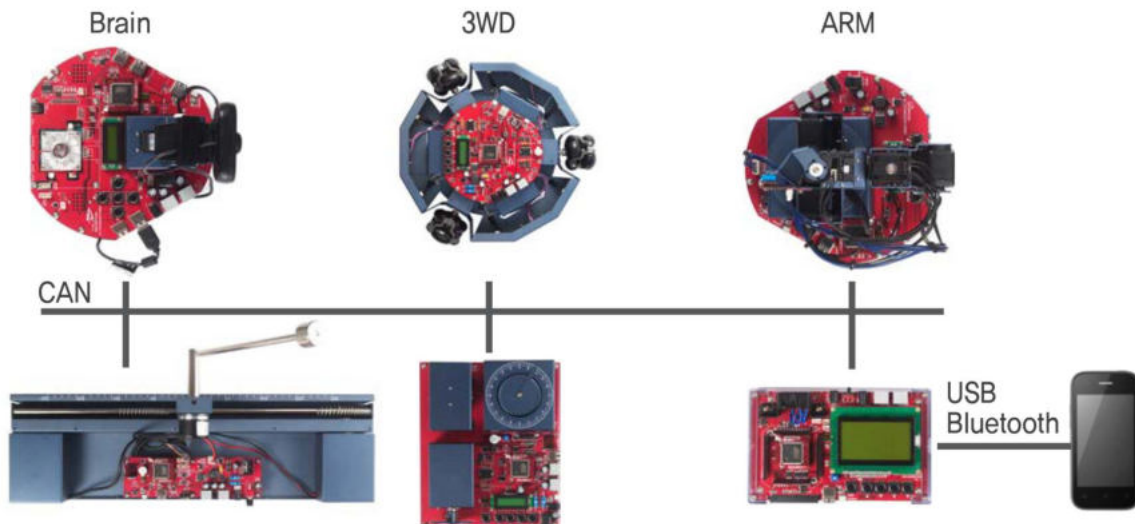
Components

Common package	Control System Module 1EA, UTP cable 1EA, Power Adapter 1EA, Platform CD 1EA, AndroX Studio DVD 1EA, User Manual 1EA, Micro USB cable 1EA
HBE-RoboEX-Motor	Motor Study Module 1EA, Experiment Manual 1EA
HBE-RoboEX-ARM	Robot ARM Module 1EA, Experiment Manual 1EA
HBE-RoboEX-Brain	Robot Intelligence Module 1EA, Experiment Manual 1EA
HBE-RoboEX-Pendulum	Pendulum Module 1EA, Experiment Manual 1EA

Intelligent Robot

Autofly_Spring

HBE-RoboEX Series

HBE-SmartCAR

HBE-RoboCAR-Embedded II

HBE-ROBONOVA-AI II

HBE-RoboCAR

HBE-MCU-Robot

HBE-RoboBuilder-MSRDS

Education Content

HBE-RoboEX-Brain	Chapter 1 HBE-RoboEX-Brain Chapter 2 Configuration of Development Environment Chapter 3 AndroX Studio Chapter 4 Embedded System Chapter 5 Device Control Chapter 6 Controlling Motor for Image Tracking Chapter 7 Voice Processing and Recognition Chapter 8 Android Image Processing Chapter 9 Ubuntu Chapter 10 Appendix
HBE-RoboEX-Theory	Chapter 1 Microcontroller Chapter 2 Arduino Chapter 3 Digital I/O Chapter 4 Interrupt Chapter 5 Motor Chapter 6 A/D Converter Chapter 7 Communication Chapter 8 Sensor Chapter 9 PID Chapter 10 Inverse Pendulum System
HBE-RoboEX-Experiment	Chapter 1 Development environment setting of RoboEX Chapter 2 Digital Input/output Chapter 3 Interrupt Chapter 4 DC Motor Chapter 5 STEP Motor Chapter 6 SERVO Motor Chapter 7 Communication Chapter 8 A/D Converter Chapter 9 Movement Direction Control of Omniwheel Module Chapter 10 PID Control Method Chapter 11 Ultrasonic Sensor Chapter 12 Application

Subject to Change