Lab Design Guide

For Artificial Intelligence (AI), Internet of Things (IoT), Autonomous Vehicles, AR/VR, Blockchain and Industry 4.0 Labs

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Artificial Intelligence (AI)

Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. Particular application of AI include expert systems, speech recognition and machine vision.

AI can be categorized as either weak or strong. Weak AI, also known as narrow AI, is an AI system that is designed and trained for a particular task. Virtual personal assistants, such as Apple's Siri, are a form of weak AI. Strong AI, also known as artificial general intelligence, is an AI system with generalized human cognitive abilities. When presented with an unfamiliar task, a strong AI system is able to find a solution without human intervention.

Because hardware, software and staffing costs for AI can be expensive, many vendors are including AI components in their standard offerings, as well as access to Artificial Intelligence as a Service (AIaaS) platforms. AI as a Service allows individuals and companies to experiment with AI for various business purposes and sample multiple platforms before making a commitment. Popular AI cloud offerings include Amazon AI services, IBM Watson Assistant, Microsoft Cognitive Services and Google AI services.

While AI tools present a range of new functionality for businesses, the use of artificial intelligence raises ethical questions. This is because deep learning algorithms, which underpin many of the most advanced AI tools, are only as smart as the data they are given in training. Because a human select what data should be used for training an AI program, the potential for human bias is inherent and must be monitored closely.

Some industry experts believe that the term artificial intelligence is too closely linked to popular culture, causing the general public to have unrealistic fears about artificial intelligence and improbable expectations about how it will change the workplace and life in general. Researchers and marketers

hope the label augmented intelligence, which has a more neutral connotation, will help people understand that AI will simply improve products and services, not replace the humans that use them.

Types of artificial intelligence

Arend Hintze, an assistant professor of integrative biology and computer science and engineering at Michigan State University, categorizes AI into four types, from the kind of AI systems that exist today to sentient systems, which do not yet exist. His categories are as follows:

- **Type 1: Reactive machines.** An example is Deep Blue, the IBM chess program that beat Garry Kasparov in the 1990s. Deep Blue can identify pieces on the chess board and make predictions, but it has no memory and cannot use past experiences to inform future ones. It analyzes possible moves -- its own and its opponent -- and chooses the most strategic move. Deep Blue and Google's AlphaGO were designed for narrow purposes and cannot easily be applied to another situation.
- **Type 2: Limited memory.** These AI systems can use past experiences to inform future decisions. Some of the decision-making functions in self-driving cars are designed this way. Observations inform actions happening in the not-so-distant future, such as a car changing lanes. These observations are not stored permanently.
- **Type 3: Theory of mind.** This psychology term refers to the understanding that others have their own beliefs, desires and intentions that impact the decisions they make. This kind of AI does not yet exist.
- **Type 4: Self-awareness.** In this category, AI systems have a sense of self, have consciousness. Machines with self-awareness understand their current state and can use the information to infer what others are feeling. This type of AI does not yet exist.

Examples of AI technology

AI is incorporated into a variety of different types of technology. Here are seven examples.

- **Automation**: What makes a system or process function automatically. For example, robotic process automation (RPA) can be programmed to perform high-volume, repeatable tasks that humans normally performed. RPA is different from IT automation in that it can adapt to changing circumstances.
- **Machine learning:** The science of getting a computer to act without programming. Deep learning is a subset of machine learning that, in very simple terms, can be thought of as the automation of predictive analytics. There are three types of machine learning algorithms:
    - Supervised learning: Data sets are labeled so that patterns can be detected and used to label new data sets
    - Unsupervised learning: Data sets aren't labeled and are sorted according to similarities or differences
    - Reinforcement learning: Data sets aren't labeled but, after performing an action or several actions, the AI system is given feedback
- **Machine vision:** The science of allowing computers to see. This technology captures and analyzes visual information using a camera, analog-to-digital conversion and digital signal processing. It is often compared to human eyesight, but machine vision isn't bound by biology and can be programmed to see through walls, for example. It is used in a range of applications from signature identification to medical image analysis. Computer vision, which is focused on machine-based image processing, is often conflated with machine vision.

- **Natural language processing (NLP):** The processing of human -- and not computer -- language by a computer program. One of the older and best-known examples of NLP is spam detection, which looks at the subject line and the text of an email and decides if it's junk. Current approaches to NLP are based on machine learning. NLP tasks include text translation, sentiment analysis and speech recognition.
- **Robotics:** A field of engineering focused on the design and manufacturing of robots. Robots are often used to perform tasks that are difficult for humans to perform or perform consistently. They are used in assembly lines for car production or by NASA to move large objects in space. Researchers are also using machine learning to build robots that can interact in social settings.
- **Self-driving cars:** These use a combination of computer vision, image recognition and deep learning to build automated skill at piloting a vehicle while staying in a given lane and avoiding unexpected obstructions, such as pedestrians.

AI applications

Artificial intelligence has made its way into a number of areas. Here are six examples.

- **AI in healthcare**. The biggest bets are on improving patient outcomes and reducing costs. Companies are applying machine learning to make better and faster diagnoses than humans. One of the best-known healthcare technologies is IBM Watson. It understands natural language and is capable of responding to questions asked of it. The system mines patient data and other available data sources to form a hypothesis, which it then presents with a confidence scoring schema. Other AI applications include chatbots, a computer program used online to answer questions and assist customers, to help schedule follow-up appointments or aid patients through the billing process, and virtual health assistants that provide basic medical feedback.
- **AI in business**. Robotic process automation is being applied to highly repetitive tasks normally performed by humans. Machine learning algorithms are being integrated into analytics and CRM platforms to uncover information on how to better serve customers. Chatbots have been incorporated into websites to provide immediate service to customers. Automation of job positions has also become a talking point among academics and IT analysts.
- **AI in education**. AI can automate grading, giving educators more time. AI can assess students and adapt to their needs, helping them work at their own pace. AI tutors can provide additional support to students, ensuring they stay on track. AI could change where and how students learn, perhaps even replacing some teachers.
- **AI in finance**. AI in personal finance applications, such as Mint or Turbo Tax, is disrupting financial institutions. Applications such as these collect personal data and provide financial advice. Other programs, such as IBM Watson, have been applied to the process of buying a home. Today, software performs much of the trading on Wall Street.
- **AI in law**. The discovery process, sifting through of documents, in law is often overwhelming for humans. Automating this process is a more efficient use of time. Startups are also building question-and-answer computer assistants that can sift programmed-to-answer questions by examining the taxonomy and ontology associated with a database.
- **AI in manufacturing**. This is an area that has been at the forefront of incorporating robots into the workflow. Industrial robots used to perform single tasks and were separated from human workers, but as the technology advanced that changed.

AI Nvidia RoboEX

TensorFlow-based AI Education Platform with Object & Letter Recognition Function

You can learn from the basic theory of AI (Artificial Intelligence) to algorithms using TensorFlow for machine learning and deep learning. And with Nvidia's high performance GPUs, you can experience high levels of image processing and machine learning.

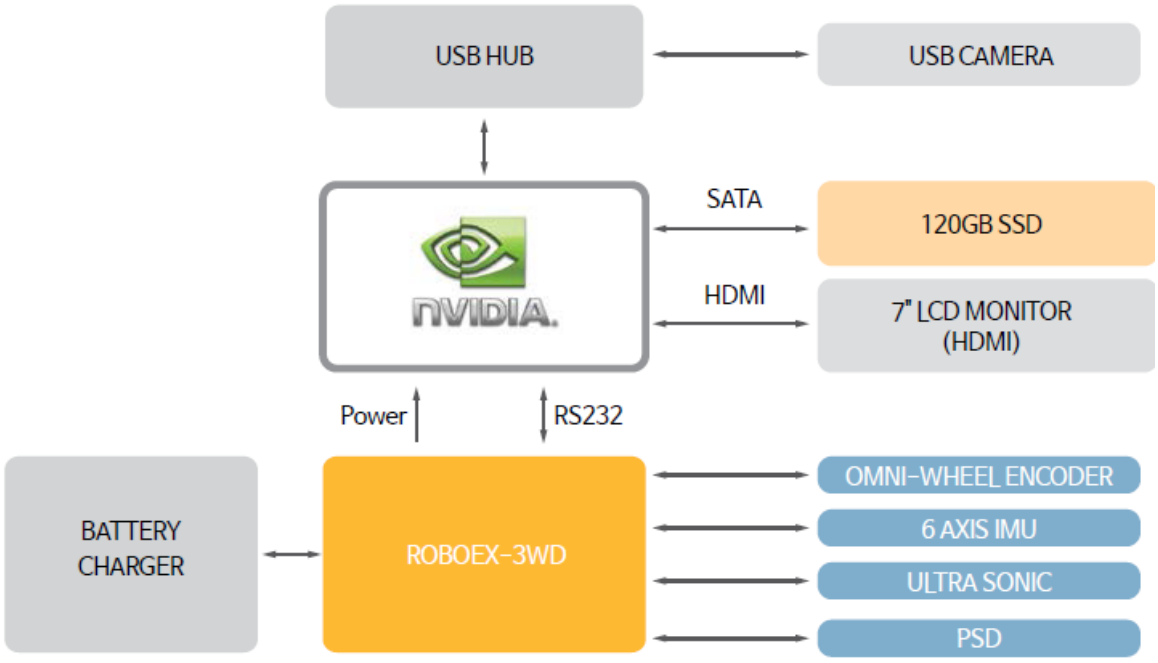
Introduction

It is a product that can learn from basic theory of artificial intelligence to algorithms using Tensor Flow which is used for machine learning in various fields. In addition, you can experience high-performance services such as object and character recognition through learning, face recognition and edge detection through image processing.

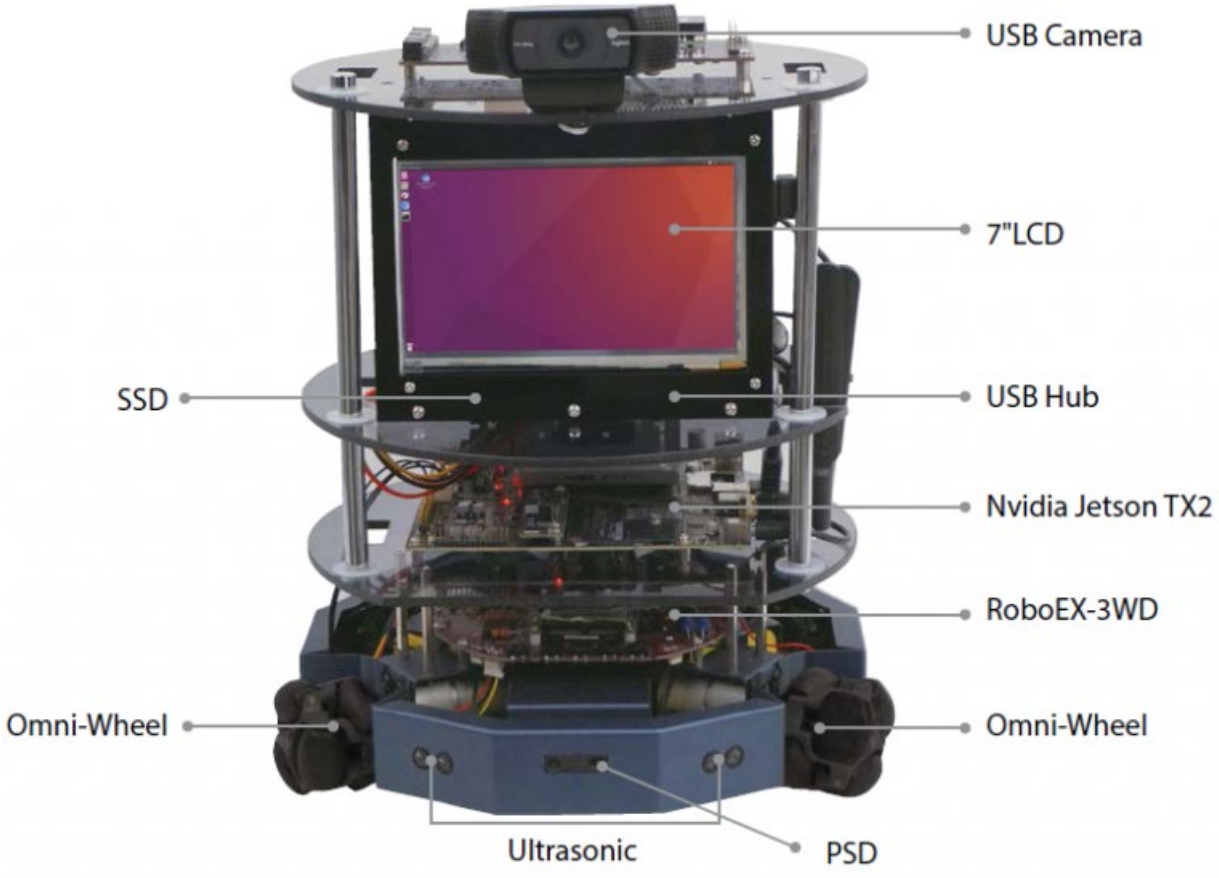
Features

- With this product, you can experience the basic theory for machine learning to the algorithm for implementation.
- You can learn about deep learning which is the basis of machine learning.
- Provides services for machine learning and deep learning using TensorFlow for high performance numerical computation.
- It is able to experience high levels of computation speed with high-performance GPU.
- Provides real-time image processing service using the attached camera.
- The robot driver module enables the DC motor required for robot design and omni-wheel control technology to be moved in all directions.
- It is possible to acquire the technology using the ultrasonic sensor and the infrared distance sensor (PSD), and it is able to learn various things such as object detection and obstacle recognition by intelligent robot application.
- By adopting Arduino, an open electronic control platform, the robot driver module minimizes the specificity required for hardware control, and can generalize the method of acquiring status information from the motor control and sensors required for operation definition.

Block Diagram



Layout



Hardware Specifications

Module	Category	Specifications
Nvidia Jetson TX2	CPU	HMP Dual Denver 2/2 MB L2 + Quad ARM A57/2 MB L2
	GPU	NVIDIA Pascal, 256 CUDA cores
	Video	4K x 2K 60Hz Encode (HEVC) 4K x 2K 60Hz Decode (12-bit Support)
	Memory	8GB 128bit LPDDR4 59.7GB/s
	Display	2x DSI, 2x DP 1.2 / HDMI 1.0 / eDP 1.4
	CSI	Up to 6 Cmeras (2 Lane) CSI2 D-PHY 1.2 (2.5 Gbps/Lane)
	PCIE	Gen 2 | 1x4 + 1x1 OR 2x1 + 1x2
	Data Storage	32GB eMMC, SDIO, SATA
	Other	CAN, UART, SPI, I²C , I²S, GPIOs
	USB	USB 3.0 + USB 2.0
	Connectivity	1 Gigabit Ethernet, 802.11ac WLAN, Bluetooth
RoboEX 3WD	Controller	32bit ARM Cortex-M3 ATSAM3X8EA-AU MCU up to 84MHz
	Flash Memory	512KB
	SRAM	64 + 32KB
	DFU Controller	Low Power AVR 8bit Microcontroller ATmega16U2-AU(DFU)
	EXT-Interface	0.8MM 2Raw 40Pin Connecter 2EA
	Program Interface	Micro-USB Type (DFU)
	User Interface	Character LCD(16x2), Buzzer 1EA, Function Button 5EA, Status LED 2EA, Power LED 1EA
	Communication	- 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
	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	310mm x 310mm x 390mm	

Software Specifications

Module	Category	Specifications
AI	TensorFlow	TensorFlow 1.7.0
	keras	Keras 1.2.2
Nvidia Jetson TX2	OS	Ubuntu 16.04
	CUDA	CUDA 9.0
	cudnn	cudnn 7.0.5
	Multimedia	OpenCV 3.4.0
	Others	- Python 3.5 - ROS kinetic
RoboEX 3WD	AndroXStudio	Launcher : 2.0
		ARM Cross Toolchain : GCC 4.6.3 for Windows (Newly build the source code)

		Host Toolchain : GCC 4.5.3 (Built-in cygwin)
		Cygwin : 1.7.17
		Make : GNU Make 3.82.90
		Eclipse Platform : Kepler (4.3)
RoboEX 3WD	AndroXStudio	Arduino Platform : 1.0.5
		Java SDK : Java SE Runtime Environment (build 1.6.0_26-b03)
		Android NDK : Release R8E
		Android SDK : Android 4.2 (API 17)
		ADT : 22.0.1
		Android SDK Tools : 22.0.1
		Remote Explorer : 5.1.1
		Remote Shell : 0.62
		Remote Viewer : 2.7.1
		Serial Packet Monitor : 1.2
		Application Package : 1.2
		Installer : 1.4

Training Contents

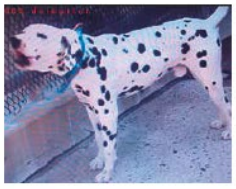
Book1: Deep Learning with AI Nvidia RoboEX

- AI / Machine Learning / Deep Learning
- Introduction of Equipment
- Deep Learning using TensorFlow
- Image Processing

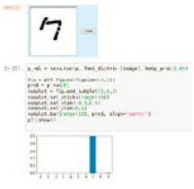
Book2: Robot Control with AI Nvidia RoboEX

- RoboEX 3WD
- Robot OS
- Connecting RoboEX 3WD to Jetson board
- Moving & Tracking

APPS



Puppy Recognition



Handwriting Recognition

Face Recognition

Lane Recognition

Object Recognition

AI IoT Smart Light

TensorFlow-based AI Education Platform with Voice Recognition Function

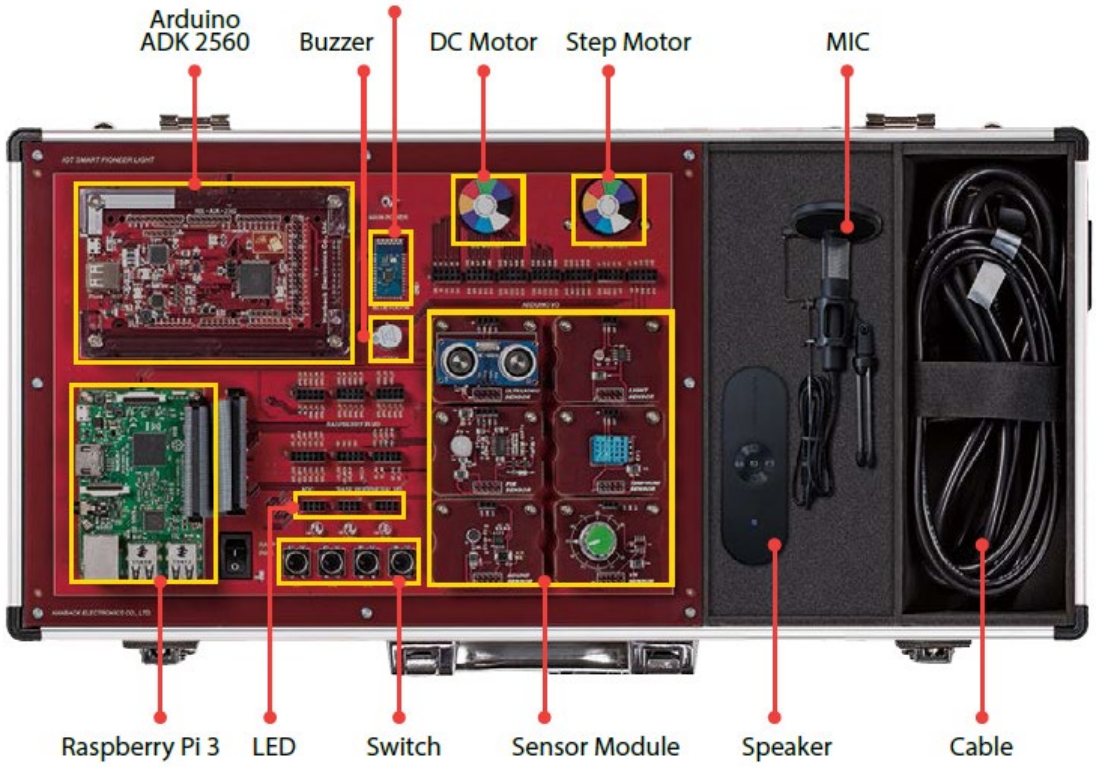
Introduction

From the basic theory of AI, you can learn algorithms using TensorFlow that are used for machine learning and deep learning. And it provides the service to control the actuator and the response to information request based on speech recognition using API provided by Google.

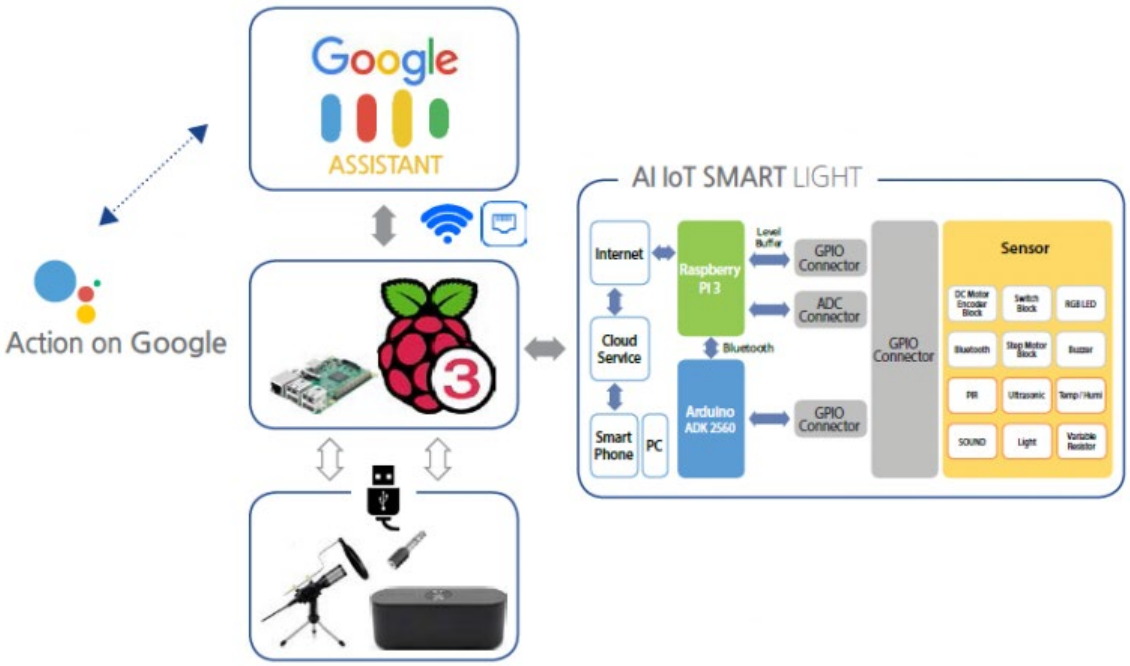
Features

- Sensor data collection through Open Hardware Platform.
- Machine Learning & Deep Learning using TensorFlow.
- Voice recognition using Google's API.
- Provides 10 basic sensor data bases and application examples.
- Provides unit module practice function using firmware to learn sensor information and actuator control exercises for acquiring.
- IoT basic skills for each module.
- By building a gateway, it is possible to carry out various projects through sensor information monitoring and remote access control function.
- Provide AWS-based cloud services.
- Android-based cloud interworking app is provided.

Configuration and Name



Block Diagram



Hardware Specifications

Module	Category	Specifications
AI	TensorFlow	TensorFlow 1.0.1
Module	Google Assistant	Google Assistant 0.1.1
Gateway	Item	Specification
	OS	Raspbian Linux 3.xx
	Camera Program	Pi Camera Driver, Camera Streaming Server
	Audio	Alsa Driver
	Server Program	Sensor Control S/W
ADK-2560	F/W IDE	Arduino 1.6.x
	Communication	Bluetooth Communication S/W
	Function	Sensor Control S/W
Cloud	Thing +	• Powered by Amazon Web Service(AWS) Cloud infrastructure • Flexible cloud Architecture scalable to the number of IoT Devices and users • Provides virtual sensors /actuators from a variety of external data sources • Web user interface : Provides easy administrator screen through web interface • Device management : Gateway registration, software distribution management • Sensor management : Provides the ability to manage(register/modify/delete) and test the sensor • Rule settings and timelines(trigger/condition/actions based rule engine provided)
IDE	AndroX Studio	• Launcher : 2.0 • ARM Cross Toolchain : GCC 4.6.3 for Windows (Newly build the source code) • Host Toolchain : GCC 4.5.3 (Built-in cygwin) • Cygwin : 1.7.17 • Make : GNU Make 3.82.90 • Eclipse Platform : Kepler(4.3) • Arduino Platform : 1.0.5 • Java SDK : Java SE Runtime Environment (build 1.6.0_26-b03) • Android NDK : Release R8E • Android SDK : Android 4.2(API 17) • ADT : 22.0.1 • Android SDK Tools : 22.0.1 • Remote Explorer : 5.1.1 • Remote Shell : 0.62 • Remote Viewer : 2.7.1 • Serial Packet Monitor : 1.2 • Application Package : 1.2 • Installer : 1.4

IoT (Internet of Things)

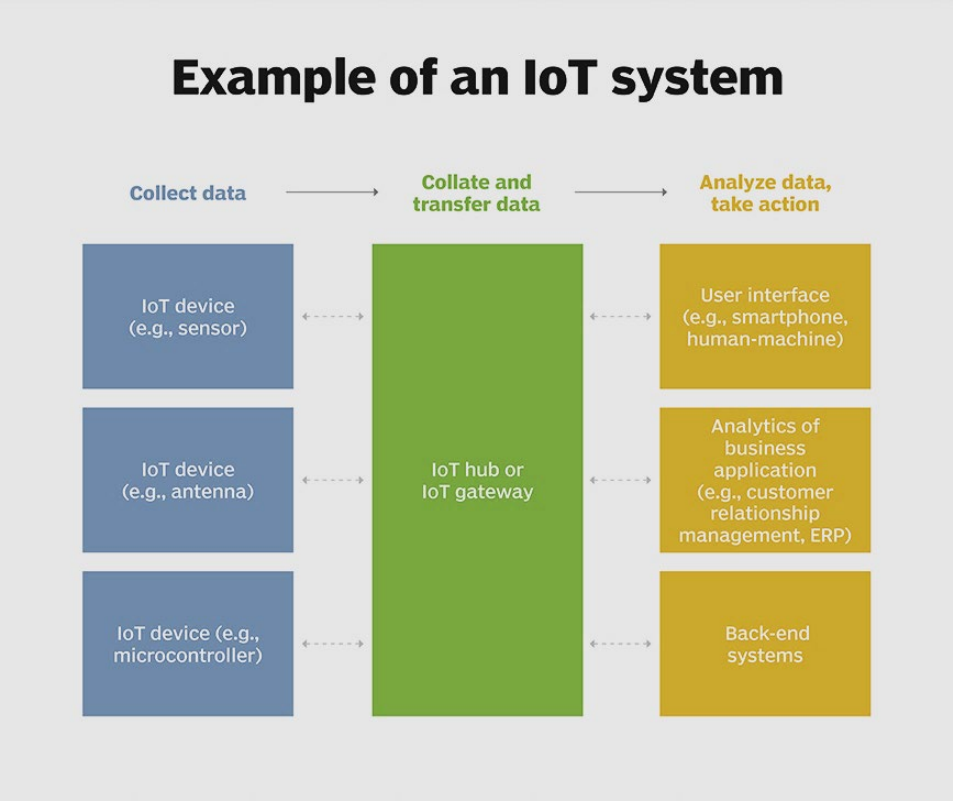
What is IoT?

The internet of things or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

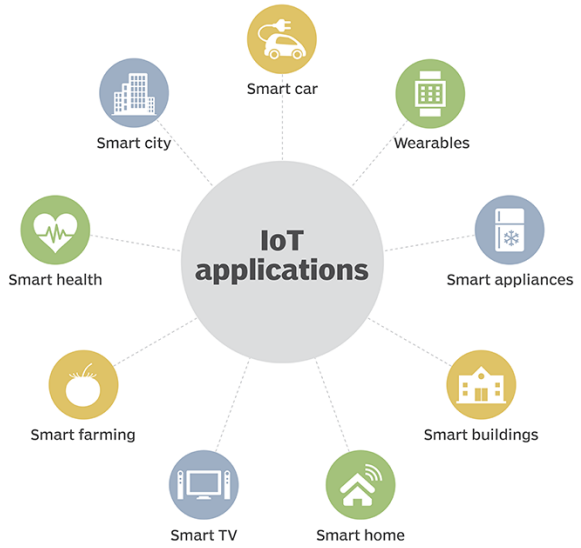
How IoT works

An IoT ecosystem consists of web-enabled smart devices that use embedded processors, sensors and communication hardware to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analysed or analysed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

The connectivity, networking and communication protocols used with these web-enabled devices largely depend on the specific IoT applications deployed.



IoT Applications

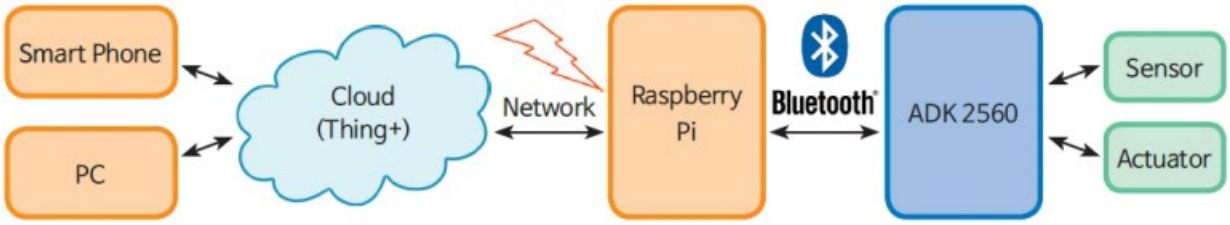


IoT Smart Pioneer Light

IoT Integrated Platform

It is possible to acquire sensor information for IoT basic technology and practice various motor and actuator control exercises, and it is possible to experience IoT service easily by using Android based cloud Interworking app.

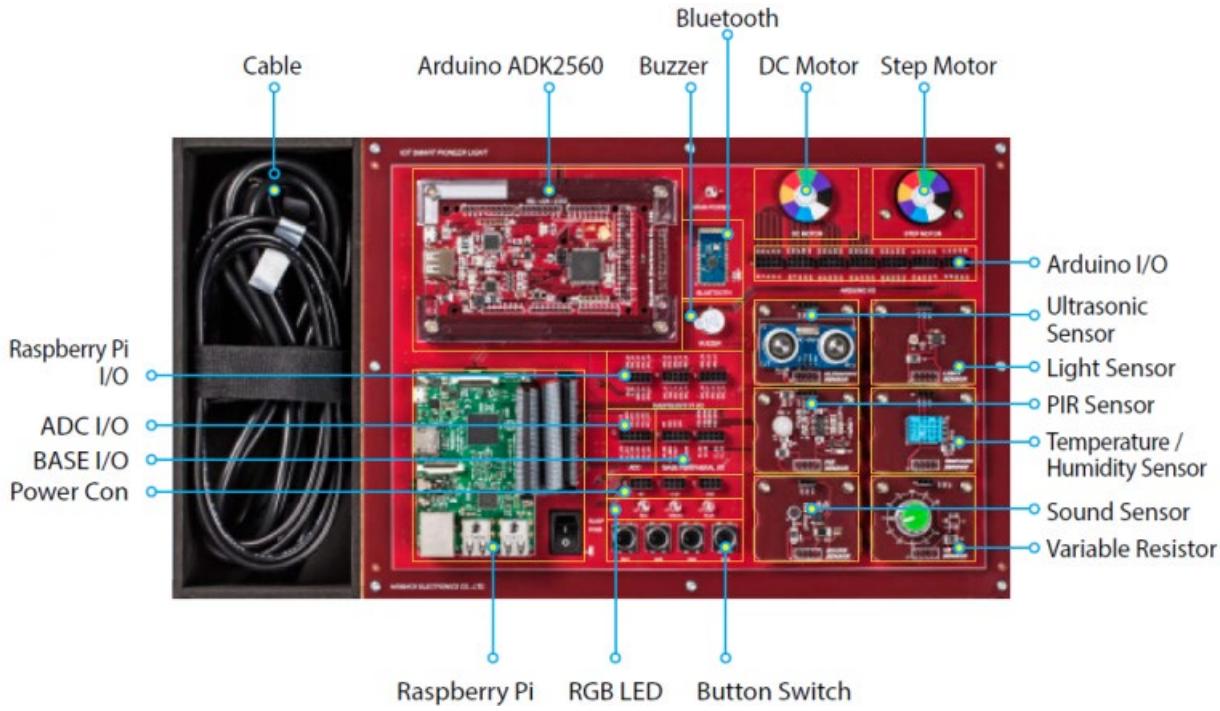
Introduction



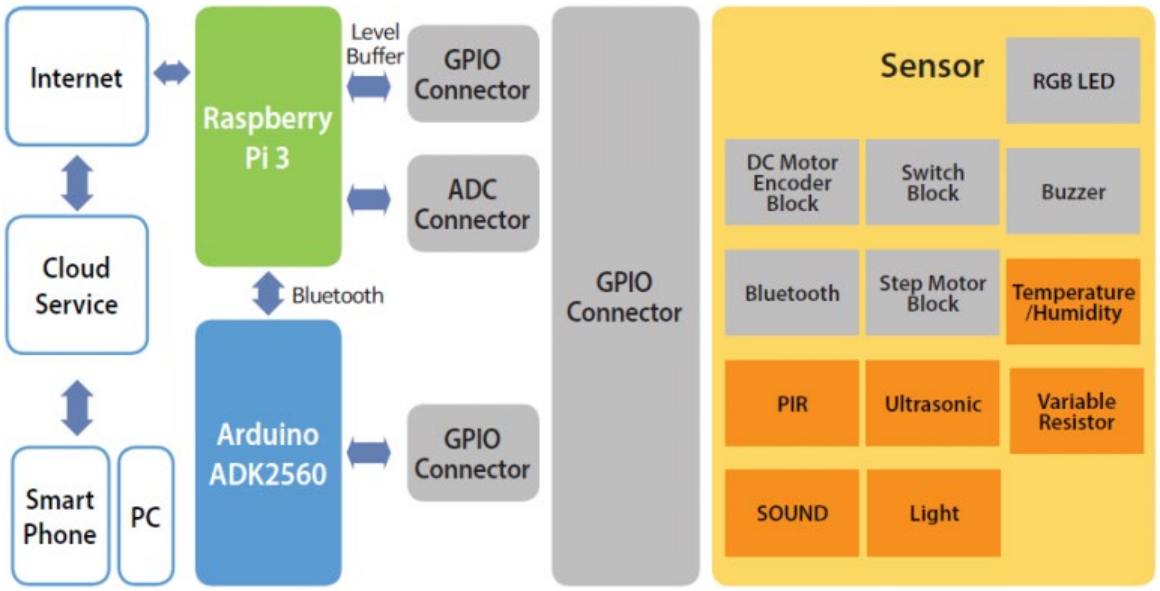
Features

- Sensor data collection is implemented around Open Hardware Platform, so anyone can easily experience IoT service.
- Provides 6 basic sensor data bases and application examples.
- Provides module practice function using firmware and it is possible to acquire sensor information and practice actuator control to acquire IoT basic technology for each module.
- By building a gateway, it is possible to process various projects through sensor information monitoring and remote access control function.
- Provides AWS-based cloud services.
- Android-based cloud Interworking apps.

Configuration and Names



Block Diagram



Hardware Specifications

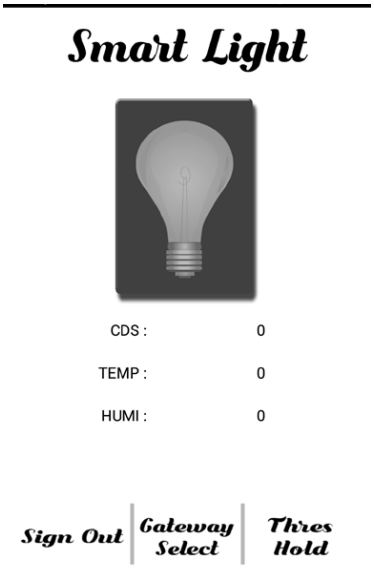
Module	Item	Specifications
Gateway(Raspberry Pi 3)	Processor	Broadcom BCM2837 1.2GHz Cortex-A53 quad-core
	RAM	1GB LPDDR2 SDRAM(900MHz)
	Storage	MicroSD 8GB
	USB 2.0	USB A Type x 4 Ports
	Power	600mA up to 1.8A @ 5V
	Audio	3.5mm A/V JACK
	Digital Video	HDMI 1.4 Video Output
	Networking	10/100 Ethernet, 2GHz 802.11n wireless
	Bluetooth	Bluetooth 4.1 Classic, Bluetooth Low Energy
	Expansion I/O	40EA GPIO (2x20 2.54mm pitch Header)
	Size	87 x 58mm
	Micro Controller	ATmega2560 16MHz
HBE-ADK-2560	Flash Memory	256kByte(8KB USED BY BOOTLOADER)
	Clock Speed	16MHz
	USB Controller	ATmega8U2 16MHz
	USB Host Controller	MAX3421E USB 2.0
	GPIO Socket	2x18 Socket(1EA), 1x10 Socket(1EA), 1x8 Socket(5EA)
	Operating Voltage	7~12V
	Dimension	122 x 76(mm)
Sensor Module	PIR	Sensor: RE200B
		Sensing Range: 110 degree
		Operating Voltage: 3.3V
		I/O Interface: 1pin Digital Output
	Sound Sensor	Sensor : Microphone
		Feature : ambient sound detection, sound level detection
		Operatiing Voltage : 5V
		I/O Interface : 1pin Analog Output

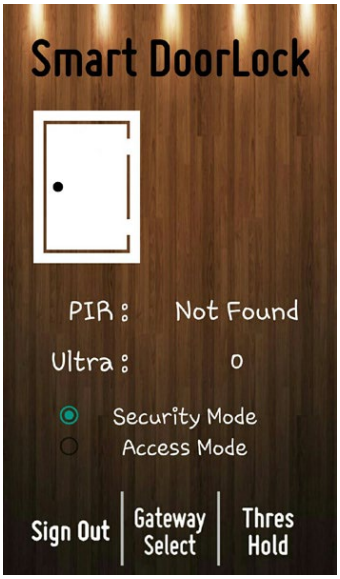
	Humidity / Temperature Sensor	Sensor : DHT11
		Feature : temperature and humidity sensor, ambient temperature and humidity detection
		Operation Voltage : 5V
		I/O Interface : 1pin Digital Output
	Ultrasonic Sensor	Sensor : HC-SR04
		Feature : 2~500cm distance measuring range, 40kHz Frequency
		Operating Voltage : 5V
		I/O Interface : 1pin Digital Input, 1pin Digital Output
	Light Sensor	Sensor : CdS
		Operation Voltage : 5V
		I/O Interface : 1pin Analog Output
	Variable Resistor Module	Sensor : 1kΩ Variable Resistor
		Feature : 0 ~ 5V DC Variable Voltage out
		I/O Interface : 1pin Analog Output
BASE	Raspberry Pi 3 block	Raspberry Pi 3 Connector, Power Switch, I/O Port
	ADK2560 Block	ADK2560 Connector, I/O Port
	Sensor Module Block	Sensor Module 6 Connectors, I/O Port
		Feature : Step Motor, 32 Step, 1/16 Gear Motor
	Step Motor Block	Motor Driver : ULN2003
		Operation Voltage : 5V
		I/O Interface : 4pin Digital Input
	LED Block	Feature : RED, GREEN, BLUE COLOR LED
		Current Consumption : 20mA
		Lumminous Intensity : 6000~7000mcd at 20mA
		Viewing Angle : 30 degree
		I/O Interface : 3pin Digital Input
	Switch Block	Feature : Button 4EA
		I/O Interface : 4pin Digital Output
Jumper Cable	-	-

Software

Module	Item	Specification
Gateway	OS	Raspbian Linux 3.xx
	Camera Program	Pi Camera Driver, Camera Streaming Server
	Server Program	Sensor Control S/W
BLE Module	F/W IDE	Arduino 1.6.x
	Communication	Bluetooth Communication S/W
	Function	Sensor Control S/W
ADK-2560 Module	F/W IDE	Arduino 1.6.x
	Communication	Bluetooth Communication S/W
	Function	Sensor Control S/W
Cloud	Thing +	Powered by Amazon Web Service (AWS) cloud infrastructure
		Flexible cloud architecture scalable to the number of IoT devices and users
		Provides virtual sensors / actuators from a variety of external data sources
		Web user interface: Provides easy administrator screen through web interface
		Device management: gateway registration, software distribution management
		Sensor management: Provides the ability to manage (register / modify / delete) and test the sensor
		Rule settings and timelines (trigger / condition / action-based rule engine provided)

APPS





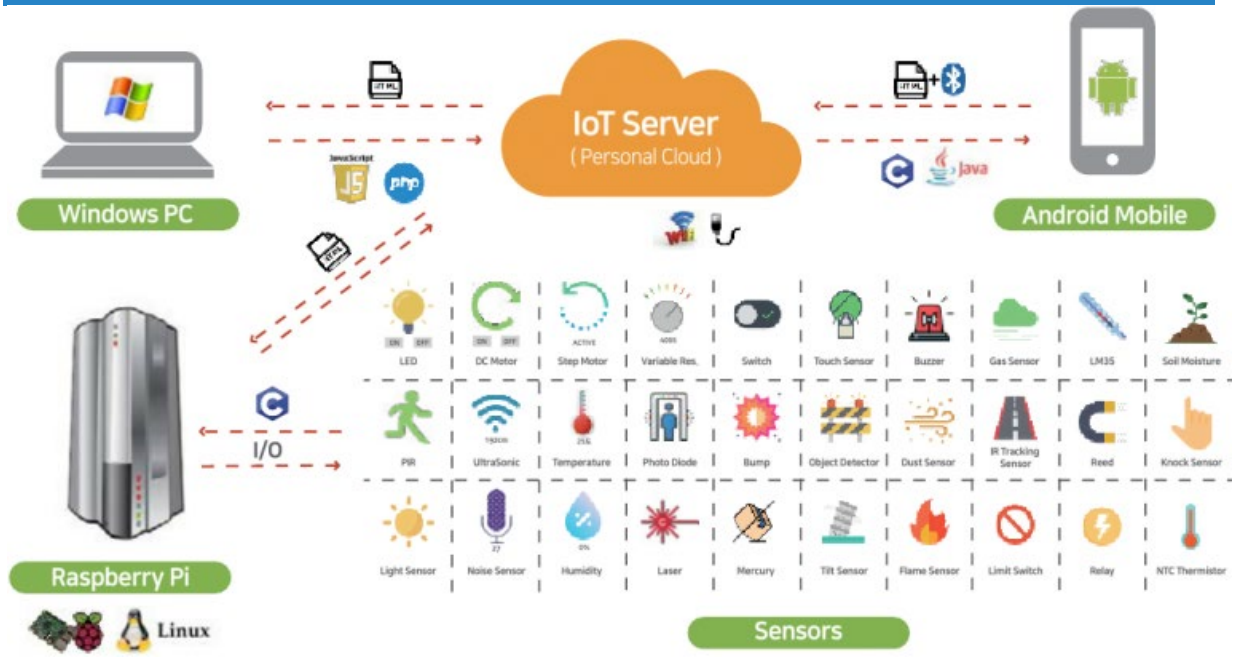
IoT SMART Server

In addition to the basic concept of IoT, it is also possible to learn to implement IoT remote control system in various ways. This product was developed to provide the broad knowledge and experience from the beginning to the completion of IoT field leading the future science and technology.

Features

- Learn different ways to control sensor including basic control, remote control via wireless communication
- Provides about 120 examples and programs
- Control and experience about 30 kinds of sensors used in real life
- Experience server building required in IoT
- Experience Raspberry Pi and Linux
- Learn about Bluetooth communication
- Experience HTTP protocol and server/client communication
- Learn the interface between programs through CGI
- Experience a wide range of programming language such as C, HTML, PHP, and JavaScript, etc.
- Provides training on web page composition via JavaScript
- Provides Android-based HTTP interlocking application
- Provides Android-based Bluetooth interlocking application

Block Diagram



Hardware Specification

Module	Category	Specification	Module	Category	Specification
	Processor	Broadcom BCM2837 1.2GHz Cortex-A53 Quad-core		Touch Sensor	Sensor : TTP223 Operating Voltage : 3.3V~5V Dimension : 15x11(mm) I/O Interface : 1pin Digital Output
	Memory	1GB LPDDR2 SDRAM			
	Storage	MicroSD 8GB			

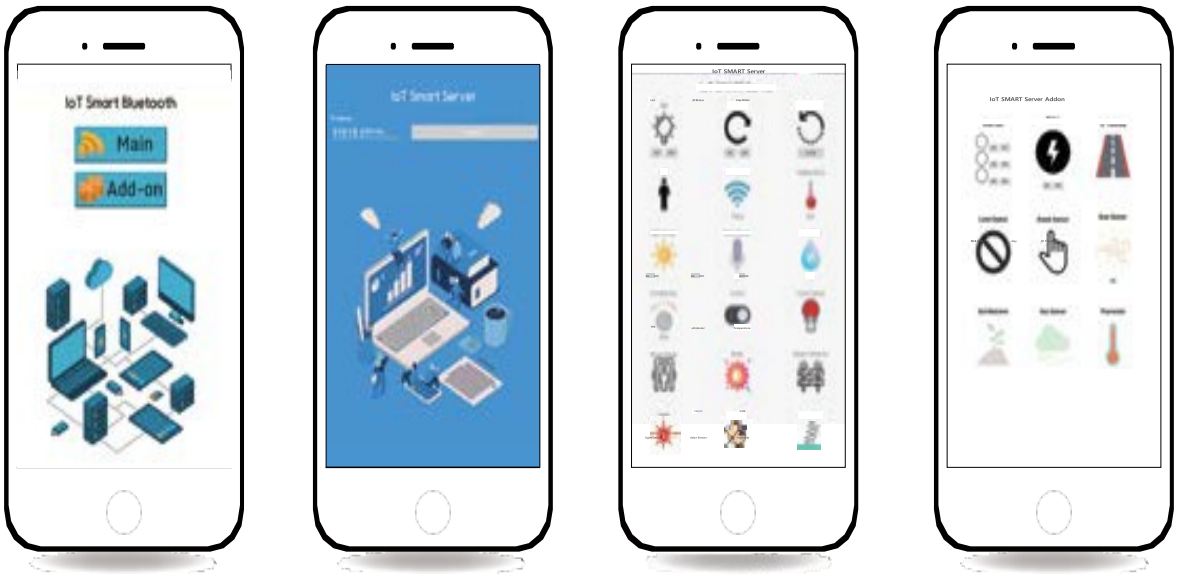
Raspberry Pi 3B			Sensor Modules	Photo Diode	Sensor : FC33 Operating Voltage : 3.3~5V I/O Interface : 1pin Digital Output
	USB 2.0	USB A Type 4 ports		Hit Sensor	Sensor : SW-420 Operating Voltage : 5V I/O Interface : 1pin Digital Output
	Power	Micro USB socket 5V, 2A		Dust Sensor	Sensor : GP2Y1014AU0F Operating Voltage : 5V I/O Interface : 1pin Digital Input, 1pin Analog Output
	Audio	3.5mm A/V Jack		Gas Sensor	Sensor : MQ-2 Operating Voltage : 3.3V~5V I/O Interface : 1pin Analog Output
	Video	HDMI 1.4 Video		Soil Moisture	Operating Voltage : 3.3V~5V I/O Interface : 1pin Analog Output
	Ethernet	10/100 Base T		IR Tracking	Operating Voltage : 3.3V~5V I/O Interface : 1pin Digital Output
	Wireless	802.11n, Bluetooth 4.0		Thermistor Temperature	Operating Voltage : 3.3V~5V I/O Interface : 1pin Analog Output
	Expension I/O	40EA GPIO (2x20 2.54mm Pitch Header)		Temperature	Sensor : LM35 Operating Voltage : 3.3V~5V I/O Interface : 1pin Analog Output
	Size	116x56mm		Limit Switch	Operating Voltage : 3.3V~5V I/O Interface : 1pin Digital Ouput
RSP Shield	Expension I/O	40EA GPIO (2x20 2.54mm Pitch Header)		Knock Sensor	Operating Voltage : 3.3V~5V I/O Interface : 1pin Digital Output
	ADC	8ch 12bit Analog to Digital Converter		Relay	Feature : NC/NO Relay, 250VAC 10A / 30VDC 10A Operating Voltage : 3.3V~5V I/O Interface : 1pin Digital Input
Sensor Modules	PIR	Sensor : RE200B Sensing Range : 110 Degree Operating Voltage : 3.3V I/O Interface : 1pin Digital Out	Actuator Modules	LED Module	Feature : RED Operating Voltage : 3.3V~5V Current : 20mA Lumminous Intensity : 6000~7000mcd at 20mA View Angle : 30 Degree I/O Interface : 1pin Digital Input
	Sound Sensor	Sensor : Microphone Feature : ambient sound detection, sound level detection Operating Voltage : 5V I/O Interface : 1pin Analog Output		DC Motor	Motor : Micro Type DC Motor Motor Driver : TB6552 Operating Voltage : 5V I/O Interface : 2pin Digital Input
	Humidity Temperature Sensor	Sensor : DHT11 Feature : temperature and humidity sensor, ambient temperature and humidity detection Operating Voltage : 5V I/O Interface : 1pin Digital Output		Step Motor	Feature : 32 Step, 1/16 Gear Motor Motor Driver : ULN2003 Operating Voltage : 5V I/O Interface : 4pin DigitalInput
	UltraSonic	Sensor : HC-SR04 Feature : 2~500cm distance measuring range, 40kHz Frequency Operating Voltage : 5V I/O Interface : 2pin Digital Output		Switch Module	Feature : Tact Button I/O Interface : 1pin Digital Input
	Light Sensor	Sensor : CdS Operating Voltage : 5V I/O Interface : 1pin Analog Output		Buzzer Module	Sound Output at 10cm : 60dB(Min) Operating Voltage : 3.3V~5V Current Consumption : 2mA Dimension : 15x19(mm) I/O Interface : 1pin Digital Input
	Variable Resistor	Sensor : 1kΩ Variable Resistor Feature : 0~5V DCVariable Voltage out I/O Interface : 1pin Analog Output			
	Tilt Sensor	Contact Resistance : 50mΩ max Operating Voltage : 3.3V~5V I/O Interface : 1pin Digital Output Dimension : 15x19(mm)			
	Mercury Sensor	Operating Voltage : 3.3V~5V I/O Interface : 1pin Digital Output Dimension : 15x19(mm)			
	Reed Sensor	Operating Voltage : 3.3V~5V Switching Current : 0.5A Contact Rating : 10W/VA Dimension : 21x36(mm) I/O Interface : 1pin Digital Output			

	IR obstacle Sensor	Operating Voltage : 3.3V~5V Sensing Range : 2~40cm Dimension : 16x41(mm) I/O Interface : 1pin Digital Output, 1pin Analog Output		Laser Module	Wavelength : 650nm Operating Voltage : 5V Dimension : 15x19(mm) I/O Interface : 1pin Digital Input
	Flame Sensor	Operating Voltage : 3.3V~5V Sensing Range : 60 Degree Adjustable Sensitivity : Variable Resistor Dimension : 15x41(mm) I/O Interface : 1pin Digital Output, 1pin Analog Output		RGB LED	Operating Voltage : 3.3V~5V I/O Interface : 3pin Digital Input

Software Specification

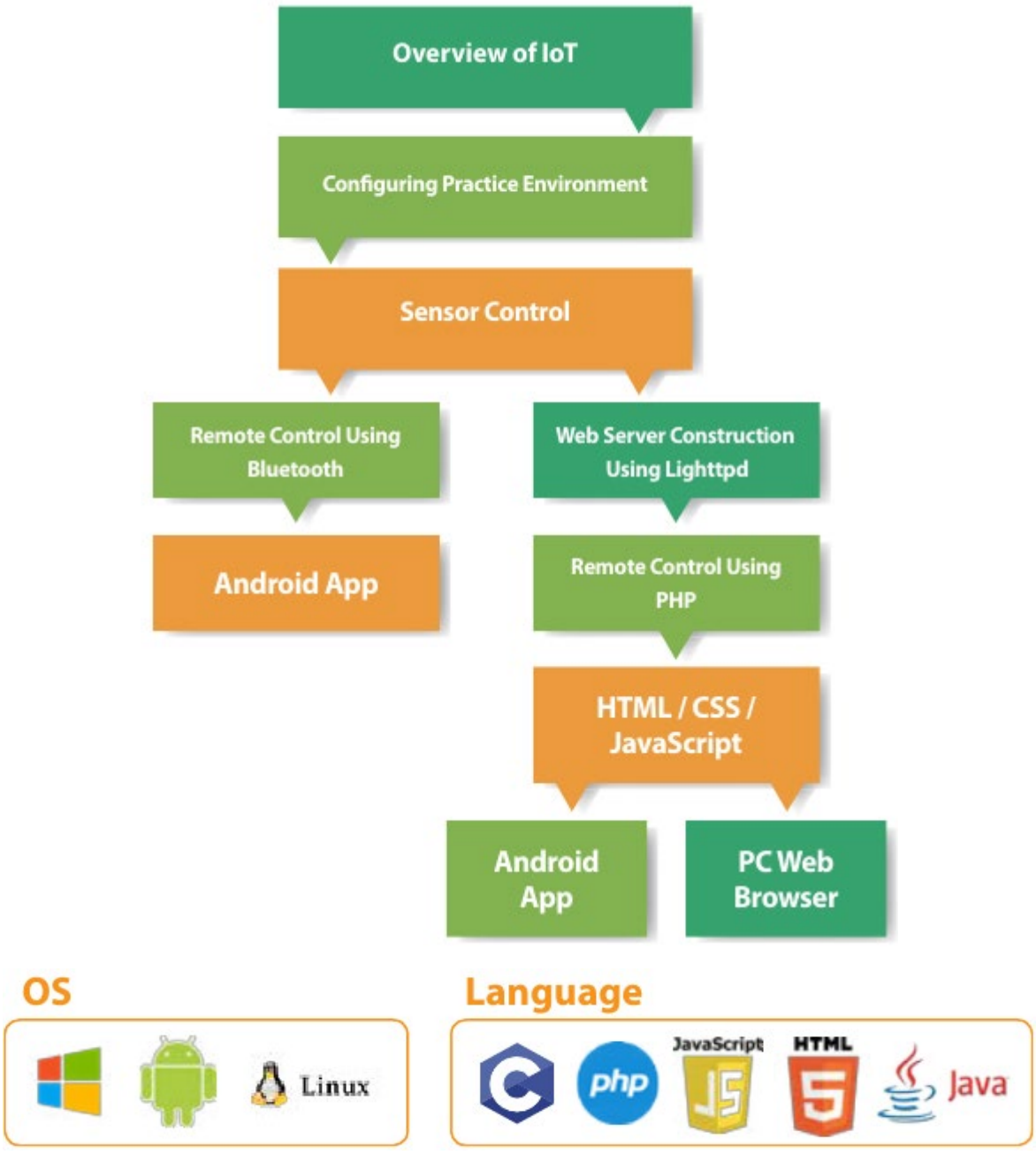
Module	Category	Specification	Module	Category	Specification
RaspberryPi 3B	Raspbian	4.9.2-10	Android Application	SDK	API 18 (4.3 Jellybean) to API 28 (9.0 Pie)
	Kernel	4.4.11-v7+		JRE	1.8.0_152
	GCC	4.9.2			
Server Software	lighttpd	1.4.35			
	PHP	5.6.36-0+deb8u1			
	Bluetoothctl	5.23			

APPS



Training Contents

- Chapter1. Overview of IoT
- Chapter2. Configuring IoT Smart Server and Practice Environment
- Chapter3. Practice for Smart Sensor Control Using Raspberry Pi
- Chapter4. Remote Control Using Bluetooth
- Chapter5. Web Server Construction Using Lighttpd
- Chapter6. Remote Control Using PHP
- Chapter7. Configuring Interface Using JavaScript



Layout


SOUND
PHOTO DIODE
REED
SHOCK
LED
TEMPERATURE
LIGHT
GAS
MERCURY
LASER
PIR
LIMIT SWITCH
ULTRA SONIC
RGB LED
TILT
VARIABLE RESISTANCE
SOIL MOISTURE
KNOCK
IR OBSTACLE
TOUCH
RELAY
DUST
IR TRACKING
SWITCH
BUZZER
STEP MOTOR
TEMPERATURE-HUMIDITY
FLAME
THERMISTOR
IOT SMART SERVER SHIELD
RASPBERRYPI 3B
DC MOTOR

Autonomous Vehicle

What is Autonomous Vehicle?

An autonomous vehicle can guide itself without human conduction. This kind of vehicle has become a concrete reality and may pave the way for future systems where computers take over the art of driving.

An autonomous vehicle is also known as a driverless vehicle, robot vehicle, self-driving vehicle or autonomous vehicle.

Driverless cars, including Google's autonomous car design, have logged thousands of hours on American roads, but they are not yet commercially available on a large scale.

Autonomous cars use various kinds of technologies. They can be built with GPS sensing knowledge to help with navigation. They may use sensors and other equipment to avoid collisions. They also have the ability to use a range of technology known as augmented reality, where a vehicle displays information to drivers in new and innovative ways.

Some suggest that significant autonomous car production could cause problems with existing traffic controls used for human-controlled cars. Significant research on autonomous vehicles is underway, not only in the U.S., but also in Europe and other parts of the world. According to some in the industry, it is only a matter of time before these kinds of advances allow us to outsource our daily commute to a computer.

At the same time, mass transit theories like Elon Musk's "hyperloop" design contemplate a future world where more guided transport takes place in public transit systems, rather than with individual car-like vehicles.

LiDAR Steering SmartCAR

Automotive Robot with Lidar sensor, Radar sensor and Steering System

- Adopts Arduino, an open hardware platform for controlling robot subsystems such as motors and sensors.
- LiDAR sensor configuration for autonomous driving.
- Robot Operating System (ROS) training, a robot middleware.
- Simultaneous localization and mapping (SLAM) training.
- Obstacle detection using multi-ultrasonic sensor.
- Speed measurement with LiDAR.
- Line tracer drive using infrared sensor.
- Control of driving part operation using DC Encoder Motor.
- Providing Java-based OpenCV solution to utilize Android for vision robot research.
- Intelligent control using Accelerometer, Gyroscope sensor.
- Using smartphones and tablets as robots' brains.
- Provides AndroX StudioTM integrated development environment for robotic system service development.

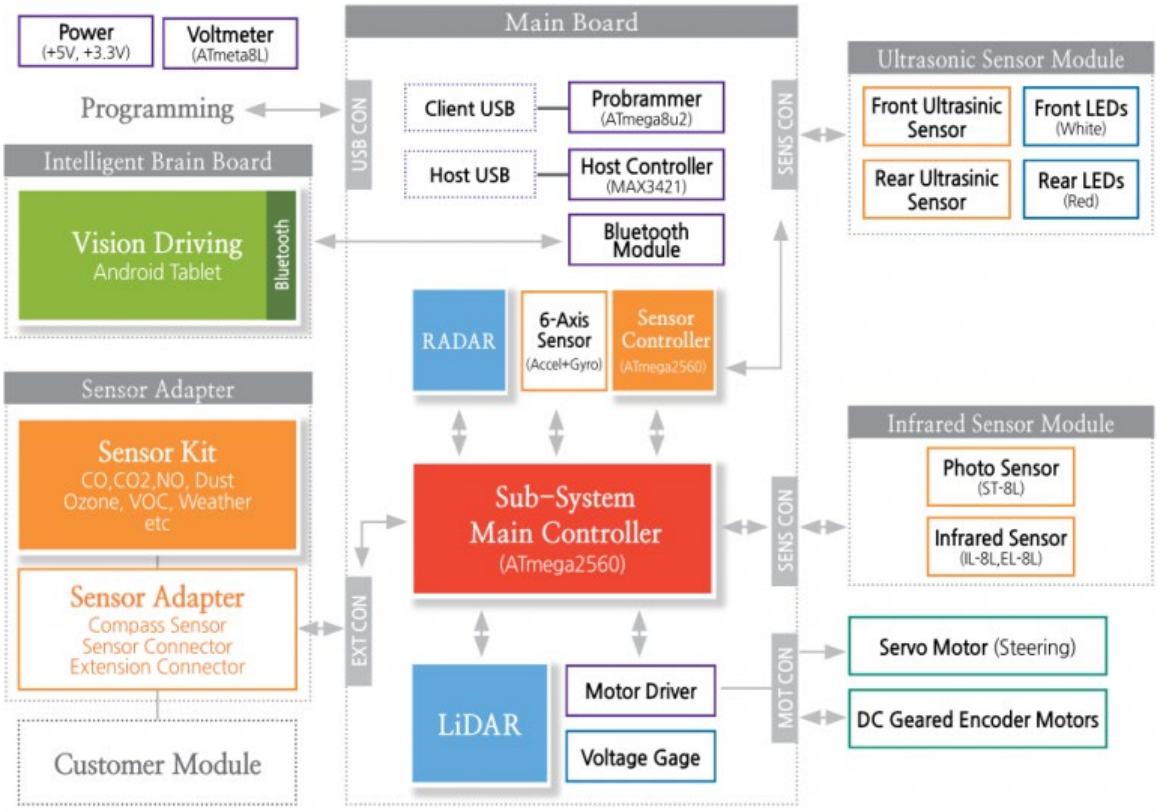
Introduction

LiDAR STEERING SmartCAR is developed to support the research of ICT convergence service using intelligent mobile robot and the training of high value human resources. With LiDAR Sensor and Steering System, it is educational device to learn about LiDAR, various sensor, autonomous driving, ROS (robot operating system) and SLAM (Simultaneous localization and mapping). Designed to enable smart phone and PC to be used as robots' brains for high-performance vision processing, it combines data from acceleration, magnetic, and gyroscope sensors with vision, including 12 ultrasonic sensors and 8 infrared sensors, It can be used to develop innovative autonomous navigation algorithms and application services for mobile robots.

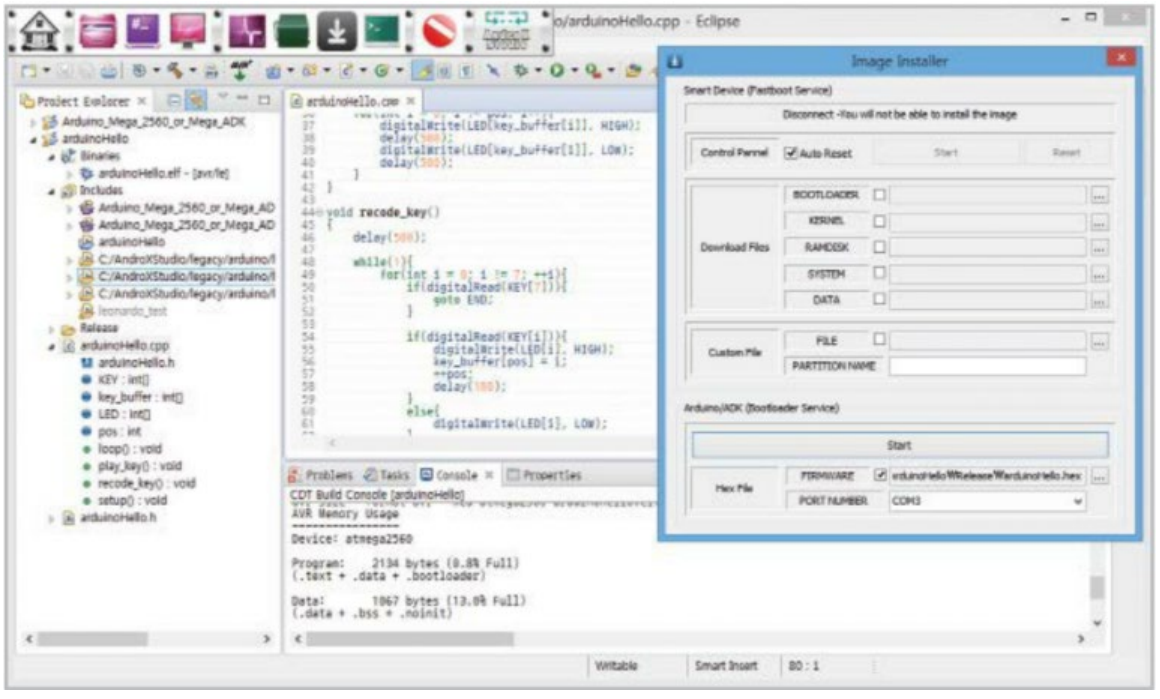
Features

- This is a moving robot with an autonomous LiDAR sensor. It contains examples of collision avoidance and examples of position tracking, so you can learn about ROS and SLAM.
- With the integrated development environment, anyone can easily and quickly implement firmware for electronic device control. The Arduino integrated development environment is based on the environment using processing / wiring language which is effective for developing interactive objects, easy operation of microcontroller, and easy programming via USB.
- By supporting the ADK-based electronic device development environment, the Google Smart Device Peripheral Design Platform, you can quickly and easily develop applications that work with Smart Devices with the Google Android platform.
- With 12 ultrasonic sensors and 8 infrared sensors, obstacles can be avoided and missions can be performed on a given route.
- By incorporating acceleration and gyroscope sensors, it is possible to develop intelligent robots that autonomously travel by detecting and judging the acceleration, vibration, shock and motion information of the robot by itself.
- DC geared motor has built-in encoder, so it can detect the operation status of motor and can calculate rotation direction and speed.
- Accurate steering control using servo motor is possible and it is able to change the rotation axis of front wheel for forward direction.
- Built-in Bluetooth communication module enables remote control based on SPP profile through PC, notebook, smartphone, tablet etc. that support Bluetooth communication
- Smart phones and tablets can be used as the brain of mobile robots, enabling the implementation of mobile robot-based ICT convergence services using high-performance processors and Wi-Fi communication environments provided by smartphones and tablets.
- We provide AndroX StudioTM, an integrated development environment for Android-based robot image processing and high-end service development.

Block Diagram



Integrated Development Environment AndroX Studio



Configuration and Name

Hardware Specifications

Category	Specification
Main Body	
Size	340mm x 600mm x 220mm
Weight	6Kg
Sub-System Main Controller	
Controller	ATmega2560 (Google ADK Platform with Arduino Mega2560)
Driving Clock	16MHz
Flash Memory	256 KB
EFPROM 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	On-Board Bluetooth (FB155BC)
	v2.0+EDR
	SPP, A2DP, HSP
Sensor Controller	
Controller	ATmega128
Driving Clock	7.3278MHz
Flash Memory	128 KB
EFPROM 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
Infrared Sensors	
Light Emitter	3mm, 940nm Infrared Emitter Diode 8EA
Receiver	3mm, Photo Transistor 8EA
6-Axis Physical Sensors	
Acceleration, Gyroscope Sensor	MPU-6050
	3-Axis MEMS Gyroscope
	3-Axis MEMS Accelerometer
Motor	
DC Motor	12V DC Geared Encoder
Servo Motor	5kg/cm at 6V, 0.14 sec/0.12sec 4.8V/6V
Motor Driver	L298P
Digital Voltmeter	
Controller	ATmega8
Display	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 B type Port	B Type USB 1Port
Expansion Port	2x10 Header 2EA (Power, I2C, UART 2Port, GPIO)
Sensor Adaptor	
3-Axis Compass Sensor	AK8975C
	3-Axis Electronic Compass
Sensor Connector	2x25 1.27mm Pitch Header
Expansion Connector	UART 1Port, GPIO 5EA, Power(3.3v, 5v, 12v)
Power	

Battery	NionH Battery 2400mA 8.4 Volts

RADAR Specification

Parameter	Notes	Min	Typical	Max	Units
Frequency Setting	1	10.520	10.525	10.530	GHz
Radiated Power (EIRP)	1	12	15	20	dBM
Spurious Emission	1			-7.3	dBM
Settling time			3	6	µSec
Received Signal Strength	2		200		µVp-p
Noise	3			5	µVrms
Antenna Beam-width (3 db) - Azimuth			80		°
Antenna Beam-width (3 db) - Elevation			40		°
Supply Voltage		4.75	5.00	5.25	VDC
Current Consumption			30	40	mA
Pulse Repetition Frequency	4		2		KHz
Pulse Width	4	10			µSec
Operating Temperature		-15		55	°C
Weight			8		gm

LiDAR Specification

Item	Unit	Min	Typical	Max	Comments
Distance Range	Meter(m)	TBD	0.15 - 6	TBD	White objects
Angular Range	Degree	n/a	0-360	n/a	
Distance Resolution	mm	n/a	<0.5 <1% of the distance	n/a	<1.5 meters All distance range*
Angular Resolution	Degree	n/a	≤1	n/a	5.5Hz scan rate
Sample Duration	Millisecond(ms)	n/a	0.5	n/a	
Sample Frequency	Hz	n/a	≥2000	2010	
Scan Rate	Hz	1	5.5	10	Typical value is measured when ples per sca

Software Specifications

Category	Specification
Robot Subsystem Arduino Firmware	
Arduino Integrated Development Environment	AndroX StudioTM, Arduino IDE, ArduBlock
User Library	Arduino Private Library by Hanback Electronics
Functional Test Firmware	Motor / Encoder, Ultrasonic Sensor, Infrared Sensor, LED, Compass Sensor, Gyro Sensor, Accelerometer, Buzzer, UART / Bluetooth
Intelligent Robot Test Firmware	Remote Control between Smart Device and HBE-SmartCAR based on Bluetooth Automatic Obstacle Avoidance using Ultrasonic Sensor Autonomous Driving that Recognizes Objects using Vision Specified Route Driving using Infrared Sensor Specified Route Driving using Encoder, Acceleration, Gyro Sensor
Robot System Vision / Service Program	
Smart Device Integrated Development Environment	AndroX StudioTM
Vision Library	OpenCV for Android

Vision Application	YUV to RGB Conversion, Pixel based Image Processing, Mask based Image Processing, Color Recognition, Feature Recognition, Face Recognition, Motion Recognition
Smart Device Applications	HBE-SmartCAR Sensor Value Reception and Direction Remote Control Obstacle Avoidance Autonomous Driving Remote Monitor using Ultrasonic Sensor Object Recognition Autonomous Driving Monitor using Vision Specified Route Driving Monitor with Infrared Sensor Specified Route Driving Monitor with Encoder, Acceleration, Gyro Sensor

ROS

Robot Operating System (ROS) is robotics middleware (i.e. collection of software frameworks for robot software development). Although ROS is not an operating system, it provides services designed for heterogeneous computer cluster such as hardware abstraction, low-level device control, implementation of commonly used functionality, message-passing between processes, and package management.

SLAM

Simultaneous Localization and Mapping (SLAM) is a concept used in robotics and so on. It is a technology that the mobile robot moves around in arbitrary space, searches for the surrounding area, and maps the space and estimates the current position.

Autonomous Drone

High-performance drone for indoor labs

The Quanser QDrone autonomous air vehicle is a midsize quadrotor equipped with a powerful onboard Intel® Aero Compute Board, multiple high-resolution cameras, and built-in Wi-Fi. As part of the Autonomous Vehicles Research Studio, this direct-access research-grade drone is tuned to accelerate your research and is ideal for innovative research in multi-agent, swarm, and vision-based applications.

Intel® Inside

Intel® Aero Compute Board

Durable

Light-weight carbon-fibre frame suitable for advanced applications

Open Software Architecture

Design, deploy, and tune your algorithms through QUARC® for Simulink®

Extensive and Expandable

Multiple on-board cameras, additional digital and analog I/O channels their own advanced robotics applications.

Product Details

Dimensios	40 x 40 x 15 cm
Weight (with batteries)	~1000 g
Max Payload	~300 g
Power	3S 11.1V LiPo (3300mAh) with XT60 connector
Flight time	~11 minutes for hover per battery charge
Onboard Computer	Intel Aero Compute Board – Intel Atom x7-Z8750
	Quad-core 64-bit 2.56 GH z processor
	4 GB LPDDR3-1600 RAM
Expandable I/O	PWM (8x)
	UART (2x)
	SPI (3x SS pins)
	I²C
	ADC (4x)
	Encoder input (3x)
	CPU GPIO (5x)
Cameras	
Intel RealSense (R200)	Depth sensing: 3-4 m
	Vision: 640×480 @ 60 FPS or 1080p @ 30FPS
Omnivision OV7251	VGA
	640×480 @ 120 FPS

Drone with Lidar Sensor That You Can Control with GCS & GPS

- Drone Manufacturing and Control Using Open Platform
- Mission Flight Autofly Using GPS and GCS
- GPS(Global Positioning System) / GCS(Ground Control System)

Features

• Drone flight and control (driver source code and flight mode source code provided)
• 4-propeller Quad Copter
• Learn how to assemble hardware and fly with open source
• Hovering function using LiDAR
• Drone flight using controller
• Support Ground Control System capable of drone control on Windows or Android OS
• Support auto-flight using GPS and Ground

Control System configured in drone
• Mission planning function : Waypoint routing, event execution
(Go to designated place and carry out mission (photographing, collecting geographic information, etc.))

Hardware Specifications

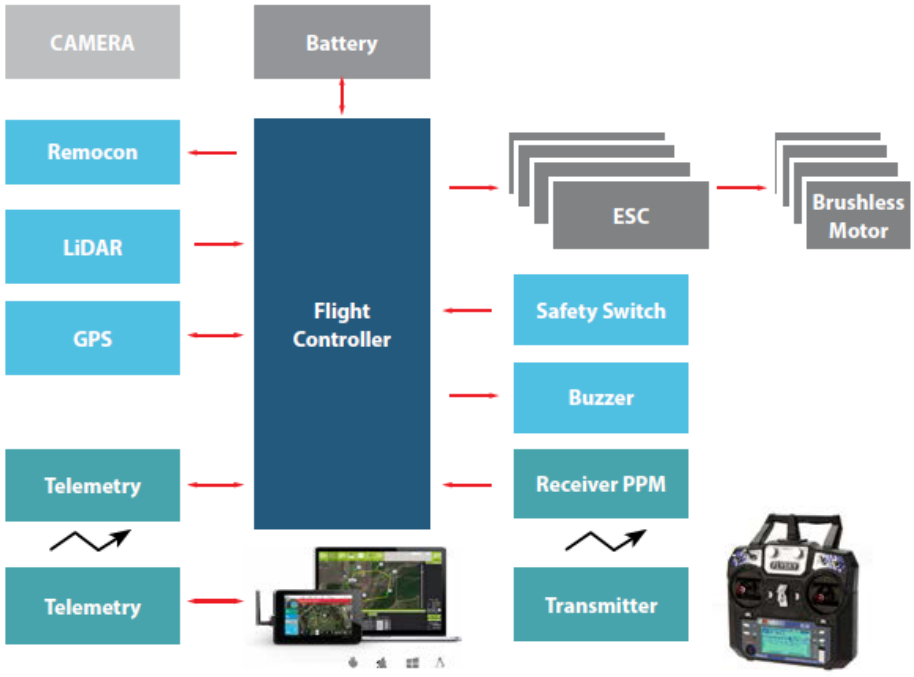
Item	Spec
Flight Controller	Processor : Cortex-M4F 168MHz / 252MIPS
	14 PWM / Servo outputs (8 with failsafe and manual override, 6 auxiliary, high-power compatible)
	Abundant connectivity options for additional peripherals (UART, I²C, CAN)
	Backup system integrates mixing, providing consistent autopilot and manual override mixing modes (fixed wing use)
	Redundant power supply inputs and automatic failover
	External safety switch
	Multicolor LED main visual indicator
	High-power, multi-tone piezo audio indicator
	microSD card for high-rate logging over extended periods of time
	16GB TF Card
Frame	Wheel-base 450mm 4EA, Landing Support 4EA, BASE PCB(For Fixing Frames)
Motor	Brushless, 22x12mm, 920RPM/V, 4EA
ESC	5.6V ~ 16.8V(2~3 Cell LiPo, 5~12 Cell NiHm Battery Support), Constant Current 30A(less than 40A 10 secd), BEC 2A 4ea
Propeller	For Prevention of Loosening(CW / CCW) 2 sets ea, 9x4.5 inch
Guard	For Prevention of Contact between surrounding obstacles and propellers, 13 inch
GPS	168dBm navigation Sensitivity, Navigation update rate up to 10Hz, include Digital Compass Sensor
LiDAR	- Operating Range : 0.3m ~ 12m
	- Applicable voltage range : 4.5V ~ 6V (Serial TTL Level is 3.3V)
	- Acceptance angle : 2.3º
	- Frequency : 100Hz
	- Accuracy : 1%(~6m), 2%(6m~12m)
	- Laser Wavelength : 850nm
	- Light Sensitivity : 70,000lux
	- Communication Interface : UART

Item	Spec
Battery	11.1V, 3S1P, 45C+ 2800mAh Li-Polymer Battery
Charger	Charging Power 20W, Charge Current 1.6A, Balance Charging Current : 16mmA
Telemetry	Radio Telemetry Air/Ground Module with OTG Cable
	Support MWC / APM / PIXHAWK / PX4 open source Flight Controller, etc
	Receivers sensitivity : -118dBm
	MAVLink framework agreement
	FHSS
	2way full-duplex communication adaptive TDM
Camera	CMOS Sensor : SONY 179 8M
	Viewing Angle : 170º
	Focus 12cm ~ Unlimited
	LCD 2.0" LTPS LCD
	Storage : Micro SD 16GB
	Video Output : 4K (3264 * 1836) 30FPS, MP4
	Effective Pixels : 16M /12M / 8M / 5M / 2M, JPEG
	RF Remocon : Single Shot, Recording Movie
Controller/ Receiver	Controller 10channel, Receiver: 14channels
	RF Range 2.40 ~ 2.48GHz
	Band width : 500kHz
	Band : 142
	RF Power : Less than 20dBm
	2.4GHz System : AFHDS 2A and AFHDS
	Code Type : GFSK
	Sensitivity : 1024
	DSP Port : PS2, Output : PPM
	KC Certification
Dimension	Size : 520 x 520 x 230 (Except Propeller Guard)
	Weight: 2.3kg

Software Spec

Item	Spec
Firmware	[ArduPilot Platform Support and Source Description] - Support Copter, Plane, Rover, Antenna Tracker - Package for Integrated Controlling of Peripheral Sensor Controller and Output Device - Support Code or Function executed on Controller
GCS	[Mission Planner (Windows Environment)] - Open Source (GPLv3) - Specify (with a Mouse Click) Halfway Point Using Google Map, etc - Select 'Mission' from Dropdown Menu - Download and Analyze Mission Record File
	[QGround Control (Android Environment)] - Open Source (GPLv3) - Platform : Windows , Linux, Android, iOS - Mission Planning for autonomons fright - Marking the Location, Flight Trajectory, and Waypoint of Body on Flight Map

Block Diagram



Port Driver

Port Name	Related File
SPKT/DSM	AP_RCProtocol_DSM.cpp
TELEM 2	AP_Radio.cpp
	AP_Radio_backend.cpp
TELEM 1	GCS_MAVLink.cpp
USB	USBDriver.cpp
SPI	SPIDevice.cpp
POWER	
SWITCH	AP_Arming.cpp
BUZZER	Buzzer.cpp
SERIAL 4/	AP_RangeFinder_Light-WareSerial.cpp

Port Name	Related File
GPS	AP_GPS_NMEA.cpp
CAN	CAN.cpp
I2C	I2CDevice.cpp
ADC 6.6V	Analogin.cpp
ADC 3.3V	
LED	AP_BoardLED.cpp
SD	DataFlash.cpp
RCIN	RCInput.cpp
AUX OUT	SRV_Channel_aux.cpp
	AP_Relay.cpp
MAIN OUT	SRV_Channel_aux.cpp

Flight Software

Function	Related File
Auto-flight mode	mode_auto.cpp
Loiter mode	mode_loiter.cpp
Land mode	mode_land.cpp
Altitude hold mode	mode_althold.cpp
Circular flight mode	mode_circle.cpp
Return to home mode	mode_rtl.cpp
Sports mode	mode_sport.cpp
Throw mode	mode_throw.cpp
Data communication	GCS_mavlink.cpp
Total file size	860KB

Contents

Augmented reality / Virtual reality (AR/VR)

What is AR?

Augmented reality (**AR**) is an interactive experience of a real-world environment where the objects that reside in the real-world are "augmented" by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory. The overlaid sensory information can be constructive (i.e. additive to the natural environment) or destructive (i.e. masking of the natural environment) and is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment.[3] In this way, augmented reality alters one's ongoing perception of a real-world environment, whereas virtual reality completely replaces the user's real-world environment with a simulated one. Augmented reality is related to two largely synonymous terms: mixed reality and computer-mediated reality.

The primary value of augmented reality is that it brings components of the digital world into a person's perception of the real world and does so not as a simple display of data, but through the integration of immersive sensations that are perceived as natural parts of an environment. The first functional AR systems that provided immersive mixed reality experiences for users were invented in the early 1990s, starting with the Virtual Fixtures system developed at the U.S. Air Force's Armstrong Laboratory in 1992. The first commercial augmented reality experiences were used largely in the entertainment and gaming businesses, but now other industries are also getting interested about AR's possibilities for example in knowledge sharing, educating, managing the information flood and organizing distant meetings. Augmented reality is also transforming the world of education, where content may be accessed by scanning or viewing an image with a mobile device or by bringing immersive, markerless AR experiences to the classroom. Another example is an AR helmet for construction workers which display information about the construction sites.

Augmented reality is used to enhance natural environments or situations and offer perceptually enriched experiences. With the help of advanced AR technologies (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable. Information about the environment and its objects is overlaid on the real world. This information can be virtual or real, e.g. seeing other real sensed or measured information such as electromagnetic radio waves overlaid in exact alignment with where they actually are in space. Augmented reality also has a lot of potential in the gathering and sharing of tacit knowledge. Augmentation techniques are typically performed in real time and in semantic context with environmental elements. Immersive perceptual information is sometimes combined with supplemental information like scores over a live video feed of a sporting event. This combines the benefits of both augmented reality technology and heads up display technology (HUD).

What is VR?

Virtual reality (**VR**) is an interactive computer-generated experience taking place within a simulated environment. It incorporates mainly auditory and visual feedback, but may also allow other types of sensory feedback. This immersive environment can be similar to the real world or it can be fantastical.

Current VR technology most commonly uses virtual reality headsets or multi-projected environments, sometimes in combination with physical environments or props, to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment. A person using virtual reality equipment is able to "look around" the artificial world, move around in it, and interact with virtual features or items. The effect is commonly created by VR headsets consisting of a head-mounted display with a small

screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. Other forms of VR include augmented reality and mixed reality systems.

VR systems that include transmission of vibrations and other sensations to the user through a controller or other devices are known as haptic systems. This tactile information is generally known as force feedback in medical, video gaming, and military training applications.

Dream ARVR

AR VR Education Platform Using Unity, POLY, Vuforia and Audio Spatializer

This product is an educational equipment that helps to realize VR(Virtual Reality) and AR(Augmented Reality) through VR HMD, AR HMD, and 360 degree camera. You will learn how to use the Unity engine, Vuforia, POLY library, the Audio Spatializer, and 360-degreee camera as well as basic techniques for game development, C#, Java, etc.

- Oculus Go (VR HMD) & Aryzon (AR HMD)
- Poly library, Vuforia, Audio Spatializer, Unity Engine
- VR game development, Marker-based AR, Markerless AR

VR HMD (Oculus Go)

Introduction

Oculus Go is a HMD (Head Mounted Display) that allows to experience VR (Virtual Reality). VR has wide range of applications such as image contents, game industry, healthcare, telesurgery, and interior design. You will learn how to use the Unity engine, the POLY library, the Audio Spatializer, and 360-degreee camera as well as basic techniques for game development, C#, Java, etc. in this tutorial.

Features

Oculus Go

Learn how to create VR games and applications through Oculus Go, the world's 1st VR headset

Unity Engine

Learn how to use Unity engine and how to set up development environment

Audio Spatializer

Learn about theory and implementation of Audio Spatializer

High-Definition

High-definition guaranteed by 2580 * 1440 WQHD

POLY Library

Learn about POLY library and how to use it

Configuration and Names

Hardware Specifications

Category	Specification
PLATFORM	Android OS
DISPLAY	Fast-Switch WQHD LCD
RESOLUTION	2560 X 1440
REFRESH RATE	60-72Hz
CPU	Qualcomm Snapdragon 821
FIELD OF VIEW	100 degree
IPD	64mm
CONTROLLER	Dimensions : 111mm X 37mm X 57mm Weight : 65g(including 25g AA battery)
SENSORS	Orientational Tracking
TRACKING AREA	Yes
CONNECTIONS	3.5mm Audio Jack, USB Micro-B USB2.0
LED STATES	White (static) : Screen on Blue (blink) : Connected to the companion app Red (static) : Low battery indicator Orange (static) : Charging, but not full Green (static) : Charged with full battery
BUILT IN AUDIO	Yes
BATTERY	Built-in Lithium Ion Battery 1.5-2 hours of gaming
CHARGE TIME	~ 3 hours with 10W AC adapter
WEIGHT	468g
DIMENSION	190mm X 105mm X 115mm
MATERIAL	Fabric, Plastic

Software Specification

Category	Specification
Unity Engine	Unity Download Assistant- 2018.2.0f 2.exe
Oculus Go ADB driver	Oculus-go-adb-driver-2.0

POLY toolkit	Poly-toolkit v1.0.3. Unitypackage
Audio Spatializer SDK	Unity-Technologies nativeaudioplugins-2018.2

Contents of Provided Examples

Example	No. of Files & Application size
Sound of Forest	23 files / 61.7KB
World Tour Sightseeing	2 files / 124.7KB
Town Navigation	1 file / 38KB
Shooting Game	61 files / 71.8KB
Show Room	13 files / 49.3KB

AR HMD (Aryzon)

Introduction

Aryzon is an HMD (Head Mounted Display) which allows you to experience AR (Augmented Reality). It is expected to be applied in more and more diverse applications as well as broadcasting, games, education, medical, manufacturing, shopping, exhibition, and marketing, etc. In this tutorial, you will learn how to use Vuforia, 360-degree camera, C#, Java which is necessary for AR development. Besides, you will also learn the basic principles of AR such as motion tracking, environment understanding, light estimation, etc. in addition to the implementation process through practical exercises.

Features

AR Experience

Experience Augmented Reality that shows virtual objects superimposed on the real world

Vuforia Engine

Learn how to use Vuforia engine to build Augmented Reality and how to set up the development environment

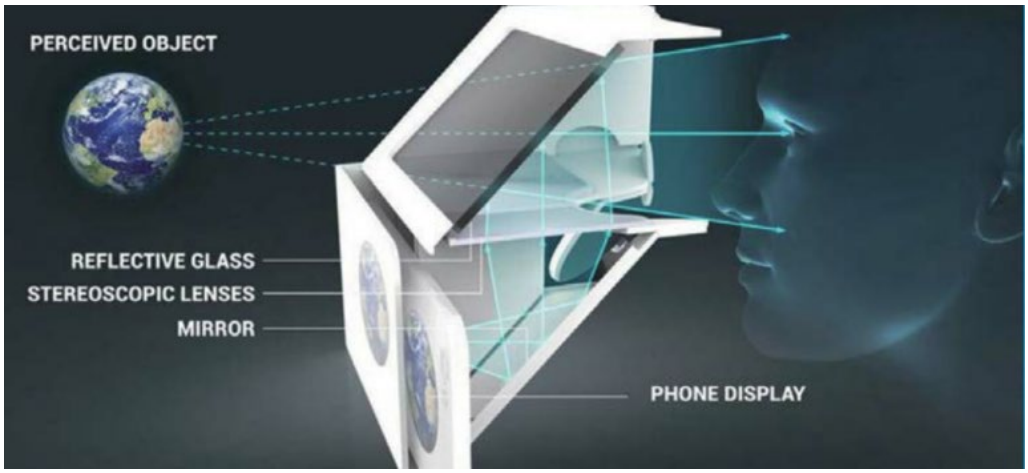
Basic Understanding

Learn basic concepts of Augmented Reality such as motion tracking, environment understanding, and light estimation through basic examples

Marker-based & Markerless

Learn about Marker-based AR, Markerless AR through AR examples

Configuration and Names



Hardware Specifications

Category	Specification
Field of View	35 X 20 (degree)
Headstrap	Yes
Foam cushion	Yes
Operated on	All kinds of Smart phones which it & AR Core

Software Specification

Category	Category
Aryzon SDK	Completely Free and Open-Source
Features of Aryzon Application	Designed for out-of-the-box use of the Google Poly library
Aryzon 3D AR Tool	Easy 3D Modeling with Aryzon 3D Model Importer

Contents of Provided Examples

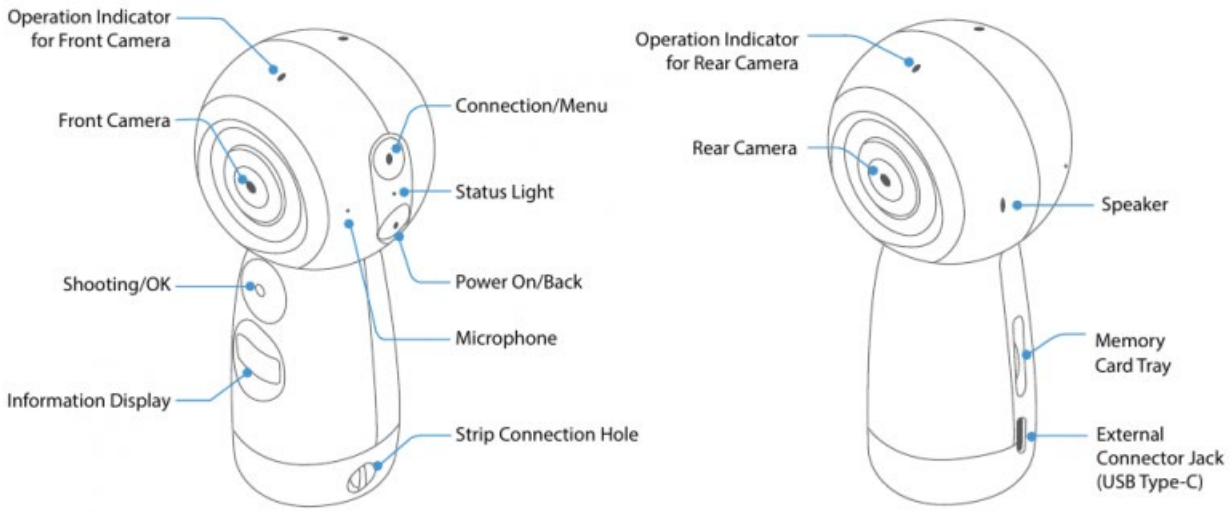
Example	No. of Files / Application size
Marker-based 3D Character	1 file / 16.8MB
Marker-based 3D Animation	3 files / 18.6KB
Markerless Interior Design	1 file / 22.3KB

360° Camera (Gear 360)

Introduction

Gear 360 is a camera that can take 360-degree pictures. The demand is increasing due to the advantage that it enables users to create VR contents on their own. You can create needed contents with this device when creating Virtual Reality.

Configuration and Name



Hardware Specifications

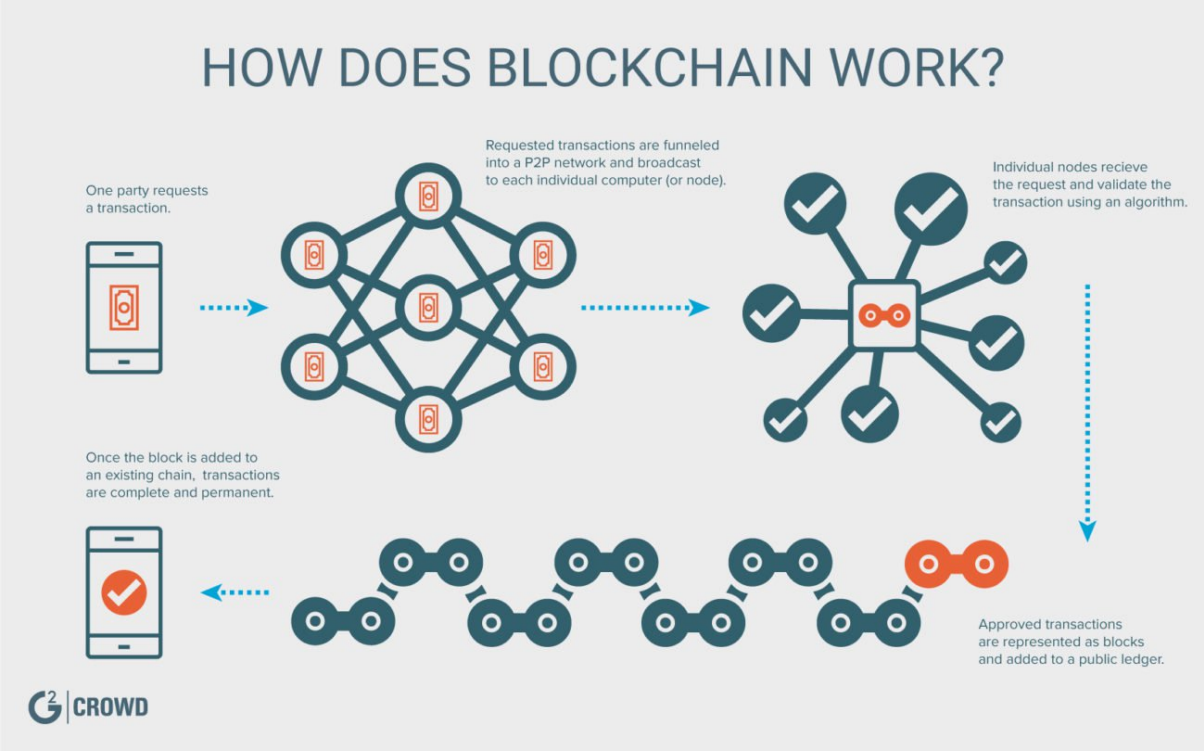
Category	Specification
Camera	15 million pixel F2.0 fisheye lens (Viewing angle 195 degrees) X 2
Video Resolution	Dual-Cam : 3840 X 1920 (30fps) / Single-Cam : 2560 X 1440 (30fps)
Photo Resolution	Dual-Cam : 7776 X 3888 (30M) / Single-Cam : 3072 X 1728 (5M)
Camera Mode	Photo, Video, Time-lapse Video, Loop video
Screen	0.5 inch PMOLED
Storage	Micro SD Slot (Max.128GB)
Network	Wi-Fi 802.11a / b / g / n / ac, Wi-Fi Direct, Bluetooth 4.1, NFC
Sensors	Gyro Sensor, Acceleration Sensor
Battery	Removable Type, 1350mAh
Codecs	Video: MP4 (H.265), Photo: JPEG
Size & Weight	6.7 X 56.2 X 60mm, 153g
Terminal Type	USB 2.0
Others	IP53 rated waterproof and dustproof

Blockchain

What is Blockchain?

A **blockchain**, originally **block chain**, is a growing list of records, called blocks, which are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data (generally represented as a merkle tree root hash).

By design, a blockchain is resistant to modification of the data. It is "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way". For use as a distributed ledger, a blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol for inter-node communication and validating new blocks. Once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks, which requires consensus of the network majority. Although blockchain records are not unalterable, blockchains may be considered secure by design and exemplify a distributed computing system with high Byzantine fault tolerance. Decentralized consensus has therefore been claimed with a blockchain.



Blockchain Training Platform Which Enables to Create Your Own Cryptocurrency

It provides a wide range of experience from basic concept of blockchain to P2P network system, network security, block data analysis, and cryptocurrency development using Java. It explains high-level technology in easy way. You can use Java to train on various operating systems.

Introduction

This product has been developed to provide wide and deep knowledge and experience from the basic theory of Blockchain to the development practice. Blockchain is the new technology that will change the root of existing database system as well as the future financial market. This product is based on Java to enable learning in various operating system environments. You can develop your own cryptocurrency through P2P network, network security, SHA-256 hash, RSA encryption algorithm, and block data analysis.

Features

- Learn basic concept and theory about blockchain
- Able to train on various OS such as Linux, Windows, and Mac, etc.
- Provides experiences of Socket programming and TCP/IP communication
- Provides training about SHA-256 hash, RSA cryptographic Algorithm, and other cryptographic
- Provides theory and practice about P2P Network System

- Provides theory and practice about network security
- Provides theory and practice about data analysis
- Provides development process of cryptocurrency using Blockchain
- Able to train about various networks and security theories.
- Able to train specific structures and theories of commercial cryptocurrency
- Five embedded systems are available for distributed processing

Hardware Specification

Module	Category	Specification
Main Node	CPU	1.2 GHz Quad-Core ARM Cortex A53 64-Bit Processor-A64
	GPU	Mali-400 MP2 500MHz
	Memory	2GB DDR3 SDRAM
	Storage	eMMC 8GB, MicroSD Slot (up to 64GB)
	Ethernet	10/100/1000Mbps Realek RTL8211E/D
	Wi-Fi	802.11 b/g/n AP6212
	Bluetooth	BT 4.0 AP6212
	Others	2.0 USB-A x2, USB OTG x1, HDMI x1, 3.5 Audio x1, 5V 2A DC Power Port x1
4 Sub Nodes	CPU	1.6GHz Quad-Core ARM Cortex-A7
	GPU	Mali-400 MP2 600MHz
	Memory	1GB DDR3
	Storage	eMMC 8GB, TF slot (up to 32GB)
	Ethernet	10/100Mbps RJ45
	Others	2.0 USB-A x3, USB OTG x1, HDMI x1, 3.5 Audio x1
Router	802.11 b/g/n	
LCD	13" Display	

Software Specifications

Module	Category	Specification
Main Node	**OS**	Ubuntu MATE 16.04
	Kernel	4.4
	Java	JDK 1.8.0_172 Java 10.0.1
Sub Node	OS	Debian 8
	Kernel	3.4.112
	Java	JDK 1.8.0_172 Java 10.0.1
Development Software	Java	JDK 1.8.0_172 Java 10.0.1
	IDE	Eclipse Photon 4.8.0
	Library	HBE-Crypto Chain 1.0.7 HBE-Base58lib 1.0.1 HBE-P2PNET 1.1.2 HBE-Protectors 1.0.2 HBE-Dataset 1.0.0 HBE-Miner 1.1.0

Training Contents

- Blockchain Overview
- P2P Network
- Secured Communication
- Block Data & Mining
- The Mechanism and Structure of Cryptocurrency
- Cryptocurrency Development

Layout