UBIQUITOUS COMPUTING LAB

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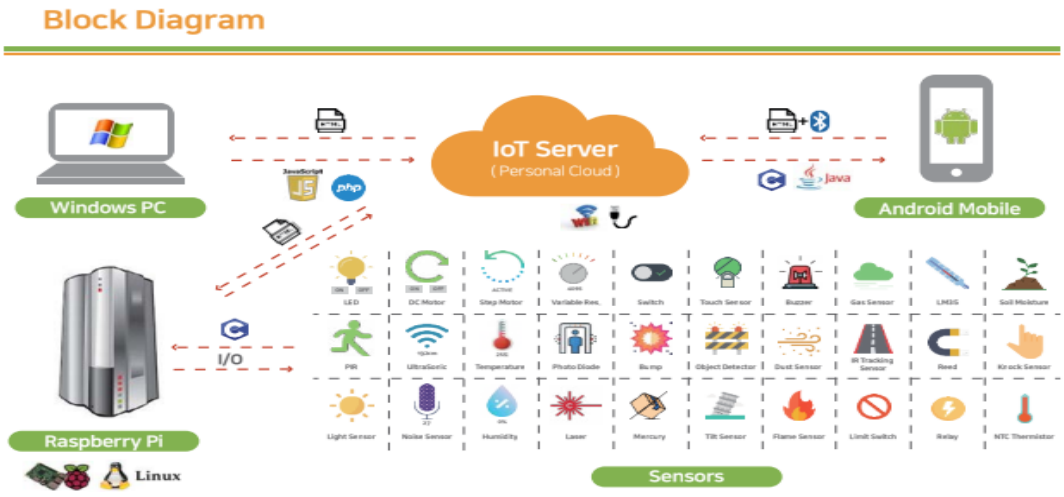
HBE-IoT Smart Server HBE-IoT Smart Server

Components and Concepts of Sensor Network, Sensor Network Platform, Sensor Network Protocol, Sensor Network, Development Environment, Basic Sensor Control, Extension Module Control 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

Product 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



Software Specification

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

Layout

HBE-IoT Xnode Home with Edge Server

Raspberry Pi 3B, RSP Shield, Sensor Modules, Actuator Modules

Features

- IoT connectivity application training equipment based on wireless personal network (WPAN)
- By using the mesh network method, it can be used in large quantities in a wide range of areas such as wireless
- control and monitoring, and a wide range of communication is possible
- Provides an environment for building a smart home with devices used in real home appliances such as door
- locks, gas circuit breakers, gas detectors, fans, and LED lights
- DC power is supplied and measured by the XNode Power board, and the measured usage can be monitored
- remotely
- Provides sensors such as GPS, IrThermo, IMU, and PIR in addition to the Basic Module
- The sensor node provides a 2100mA battery so that it can be operated independently, and also provides an LED
- for an indicator, and a light sensor and temperature/humidity sensor based on lux units
- Provided sensor node supports interpreter-style Python 3 to write control programs easily and concisely
- Visual Studio Code-based integrated development environment for professional application development
- Provides training contents for Python-based sensor nodes

Software specification

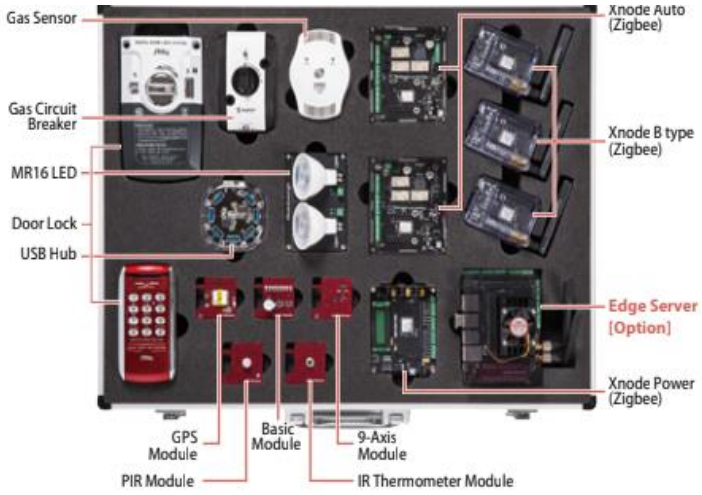
List	Specifications
Node B	MicroPython 3 (built in node)
	VSCode4Soda
	Configuration Software (compatible with Linux, OS X and Windows)
	Remote Terminal & Remote Desktop support
	Pop Library Output Object: LED, Buzzer Input Object: Switch, PIR, Thermopile, 9Axis IMU, GPS

Edge Server

Edge server supports sensor node control and artificial intelligence convergence programming in a web browser environment through Soda OS, an AIoT-only operating system, and Pop Library Edge server supports mDNS/DNS-SD, SSH, SFTP, SMB/CIFS, MQTT, NXX Window protocol Soda OS and Pop Library, an AIoT-only operating system are provided

Training Content

- Components and Concepts
- of Sensor Network
- Sensor Network Platform
- Sensor Network Protocol
- Sensor Network
- Development Environment
- Basic Sensor Control
- Extension Module Control
- Zigbee Basic
- Communication
- Zigbee Communication
- Extension
- Zigbee and BLE
- Sensor Network
- Application Project



Appendix

- Visual Studio Code Add-on
- Edge Server Initialization

Composition

QUBE-SERVO-2-USB Workstation

Hardware integration, Step response modeling, Noise measurement and filtering, electromechanical modeling, Second-order systems, PD control, Stability analysis

The Quanser QUBETM-Servo 2 is a fully integrated lab experiment, designed for teaching mechatronics and control concepts at the undergraduate level. Integrating Quanser-developed QFLEX 2 computing interface technology, QUBE-Servo 2 offers educators more flexibility in lab configurations, using a PC, or microcontrollers, such as NI myRIO, Arduino and Raspberry Pi1. With the comprehensive course materials included, you can build a state-of-the-art undergraduate teaching lab for your mechatronics or control courses, and engage students in various design and capstone projects.

Features

- Compact and integrated rotary servo system
- Tool-less quick connect module interface
- Direct-drive brushed DC motor
- High resolution optical encoder
- Built-in voltage amplifier with integrated current and
- tachometer sensors
- Integrated data acquisition(DAQ) device
- User-controllable tri-color LED
- Flexible QFLEX 2 computing interface for USB and SPI connections
- Easy-connect cables and connectors
- Open architecture design, allowing users to design their own controller
- Fully compatible with MATLAB®/Simulink® and LabVIEWTM
- Fully documented system models and parameters provided
- for MATLAB®/Simulink®, LabVIEWTM
- Microcontroller examples and interfacing datasheet provided for the QUBE-Servo Embedded
- Additional community-created resources available on www.QuanserShare.com

Device specification

Dimensions (W x H x D)	102 mm x 102 mm x 117 mm
Weight	1.2 kg
Weight	9.5 cm
Servomotor encoder resolution	512 counts/revolution*
Inverted pendulum encoder resolution	512 counts/revolution*
DC motor nominal voltage	18 V
DC motor nominal current	0.54 A
DC motor nominal speed (no load)	4050 RPM
Interfaces available: QFLEX 2 USB	USB 2.0
QFLEX 2 Embedded	SPI

OMNI Bundle

Six degree-of-freedom positional sensing, Portable design and compact footprint for workplace flexibility, Removable stylus for end-user customization, two integrated momentary switches on the stylus for ease-of-use, and end-user customization
The Omni Bundle is a cost-effective and safe way to introduce intermediate and advanced control concepts and theories related to robotics and

Haptics. Combining Geomagic TouchTM (formerly SensAble Phantom Omni) haptic device with QUARC® control software and comprehensive Quanser-developed curriculum allows students to easily translate course theory into hands-on experience.

Features

- CE certified Geomagic Touch (formerly SenAble Phantom Omni) haptic device
- Six degree-of-freedom positional sensing
- Portable design and compact footprint for workplace flexibility
- Removable stylus for end-user customization
- Two integrated momentary switches on the stylus for
- ease-of-use, and end-user customization
- Wrist rest to maximize user comfort
- Constructed of metal components and injection-molded Plastics
- Stylus-docking inkwell for automatic workspace calibration
- Fully compatible with MATLAB®/Simulink®

- Fully documented system models and parameters provided
- for MATLAB®, Simulink®
- Open architecture design, allowing users to design their own controller

Device specification

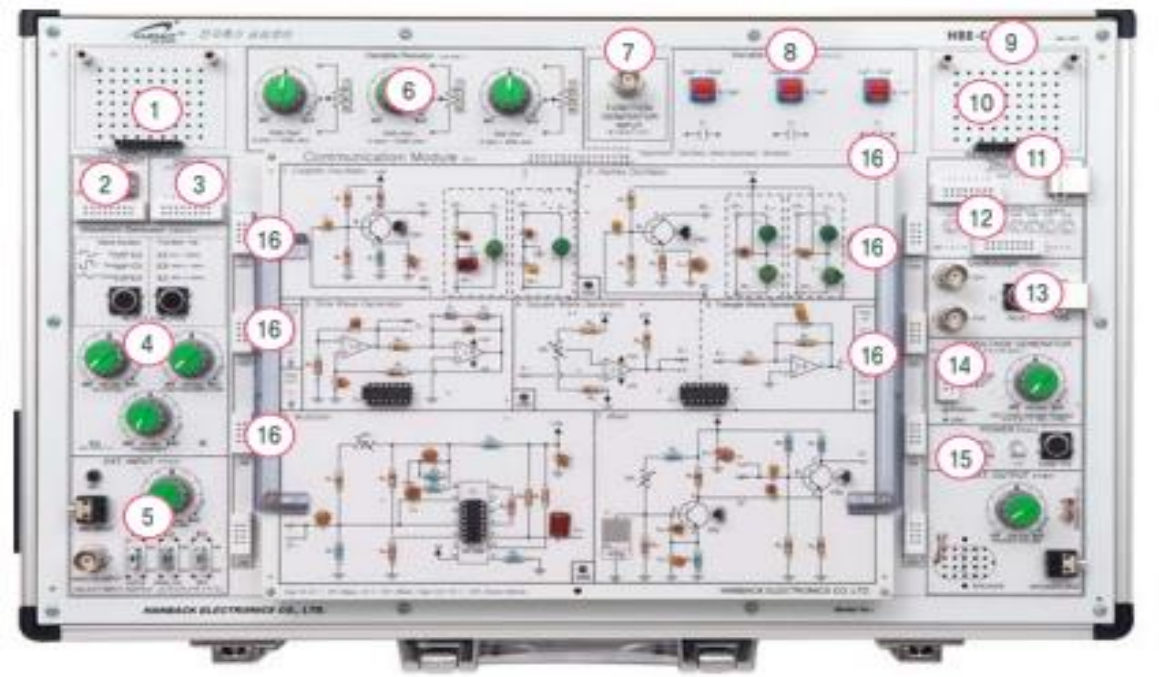
Force feedback workspace (W x H x D)	160 mm x 120 mm x 70 mm
Footprint (physical area device occupies on desk)	168 mm x 203 mm
Device mass	1.8 kg
Range of motion	hand movement pivoting at wrist
Nominal position resolution	> 450 dpi / 0.055 mm
Maximum exertable force at nominal position	3.3 N
Continuous exertable force (24 hrs.)	0.88 N
Stiffness	1.26 N/mm (X axis) / 2.31 N/mm (Y axis) / 1.02 N/mm (Z axis)
Inertia (apparent mass at tip)	45 g
Force feedback	x, y, z
Interface	Ethernet port

Complete workstation components

Plant	Geomagic TouchTM (formerly SensAble Phantom Omni) haptic device
Control design environment	Quanser QUARC® add-on for MATLAB®/Simulink®
Documentation	Quick Start Guide, Instructor and Student Workbooks
Real-time targets Sample controller(s) are supplied	Microsoft Windows®

Communication System

Testing For easy understanding of Basic Communication Engineering



Observation of Communication Waveform using Oscilloscope and Waveform Generator Modularization by Communication Themes 2 channel Digital Oscilloscope 8 channel DAQ Basic Circuit of Analog Communication and Digital Communication Test using Bread Board For basic communication, we can understand Signal Generator, Frequency Multiplier, and Filter and then we can know the basic circuit of Analog Communication and Digital Communication. This is the basic Education Theme of Communication Engineering used in Educational Field for a long time. HBE-Comm arranges the basic circuit as drawn on Circuit Diagram to understand it easily, and this uses generates Carrier Signal with Waveform Generator and inputs it to the circuit and also uses Oscilloscope to see the waveform of main parts. Then, we can know how to use Waveform Generator and Oscilloscope. For Education Course, basic communication equipment includes Basic Circuit, Analog Communication, Digital Communication and Application Communication and each communication has own Module. So we can start Test immediately after mounting Module to the equipment. Application Circuits of AM receiver and FM receiver are added in order to understand how the public airwaves is received. This provides Bread Board and Ext.Power so we can make other communication circuit with it.

Features

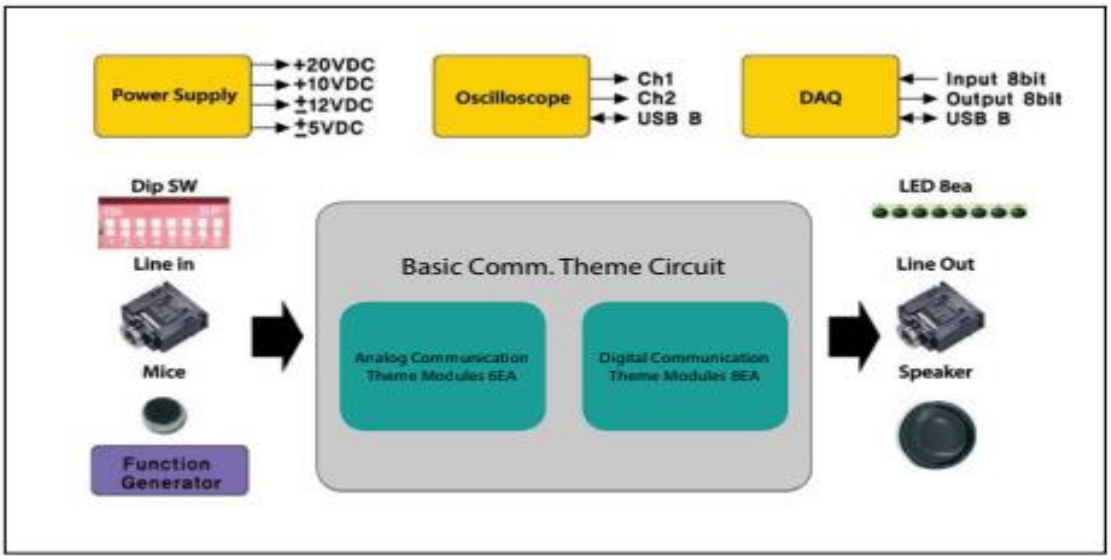
- Test uses Measuring Equipment so it is possible to understand how to use Measuring Equipment.
- Module by Themes are provided from Basic Circuit to Application Circuit for communication.
- Channel Digital Oscilloscope and PC programs are provided basically.

- 8 channel DAQ is provided as Hardware and PC software is provided in order to design digital data for
- Circuit and check data from circuit.
- Test Point is provided for easy contact of Probe to a part for measurement.
- It is possible to provide Standard Waveform, Microphone and Line-in selectively to communication circuit.
- We can listen to received signal with one of Head Phone and embedded speaker.

Configuration and Names

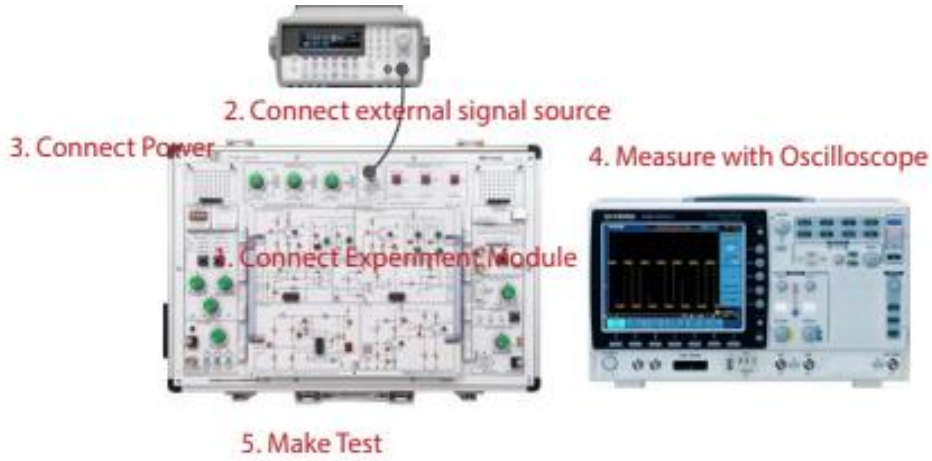
- Additional Option Connector
- Digital Input Switch
- DAQ program Digital Input
- Standard Signal Generator
- Signal Select Switch for Modulation
- Variable Resistor
- Signal Generator Connector for Carrier Wave
- Variable Capacitor
- Additional Option Connector
- DAQ program Digital Output
- Digital Signal Check LED
- 2 channel Oscilloscope(PC required)
- Variable Voltage Generator
- Power(Overcurrent Protection Circuit incl.)
- Signal Output
- Fixed Voltage(+20VDC, +10VDC, ±12VDC, ±5VDC) Connector
- Breadboard

Block Diagram

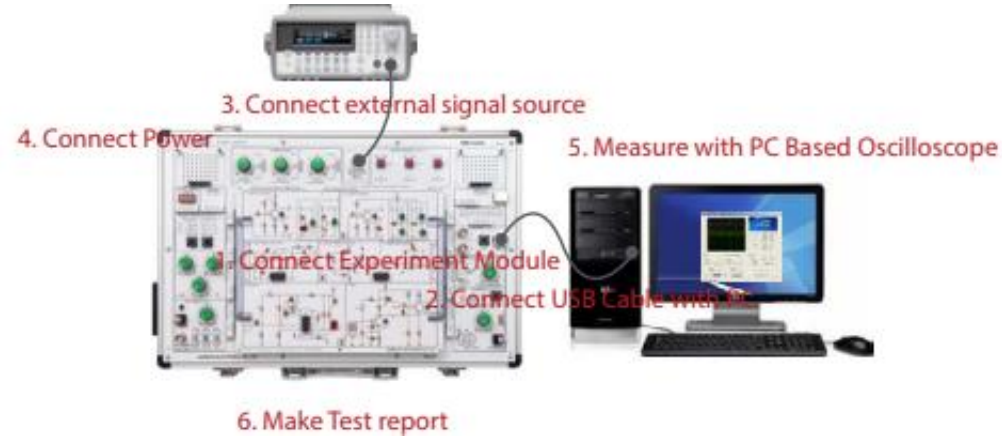


Experiment Example

❖ The experiments illustrate the oscilloscope and waveform generator



❖ Experiments with PC oscilloscope and waveform generator example



Specification

Name	Characteristics	Description
Variable Voltage Generator	Voltage	+10V ~ -10V
	Current	< 750mA
Variable Resistance	50KOhm	1EA
	100KOhm	2EA
Variable Capacitor	10pF ~ 150pF	1EA
	10nF ~ 150nF	1EA
	1uF ~ 15uF	1EA
Analog Input	MIC	1EA
	Audio Jack	1EA
	BNC	1EA
Analog Output	Speaker	1W 8Ω1EA
	Audio Jack	1EA
Digital Input	dip SW	8EA
Digital Output	LED	8EA
	Signal Type	Triangular Wave, Square Wave
	Signal Size	-5V ~ +5V

Waveform Generator	Bias	-5V ~ +5V
	Frequency	0~200Hz,100Hz~2khz,1k~20khz
Carrier Input Terminal	BNC	1EA

Oscilloscope, DAQ, Power Supply

Name	Characteristics	Description
Oscilloscope	Channel	2EA
	Input Voltage	-16 ~ +16VDC
	Sampling	500KHz
	Connection	USB
DAQ	Input Channel	8EA
	Output Channel	8EA
	Response Speed	Min. 1m Sec
	Connection	USB
Power Supply	Voltage	+20VDC, +10VDC, ±12VDC, ±5VDC
	Current	< 1.1A
	Protection Circuit	Current Sensitive type using Processor
	Ripple	< 20mV

IoT Smart Health LAB

Medical Care, Health Care and IoT

This is a healthcare practice equipment with IoT technology. It is capable of analyzing up to 13 types (11 basic types) of biomedical signals and transmitting or receiving the data through Wi-Fi or Bluetooth. It also can be remotely monitored from PC and Smart Phone through Hybrid Web.

- Application of Raspberry Pi based IoT Gateway
- Arduino-based sensor transmission and reception
- Up to 13 bio signal measurements
- Acquiring bio signal knowledge
- 10.1 inch touch monitor application
- Monitoring measured values on GUI (Graphical User Interface) via App and Web
- Setting specific sensor value and sending the data through SMS and E-Mail

Features

- It is possible to learn about implementation and analysis of measurement algorithm based on principle of bio-signal.
- Measurement of up to 13 sensors is available including 2 options of GSR and DUST in addition to
- The basic 11 sensors such as ECG, EEG, EMG+HHI, EOG, PCG, Respiration, NIBP, BT, SpO2, HR and Bio-impedance.
- It is convenient to monitor measurement data using 10.1 inch electrostatic touch LCD.
- Each sensor module has a rechargeable battery and can be linked with Wi-Fi and Bluetooth.
- AVR MCU with Arduino is applied to the sensor module and the receiving module for more various exercises.
- In addition to the basic 11 sensor modules, you can select and use additional modules depending on the learning purpose.
- Measured sensor values can be monitored on PC and Smart Phone through Hybrid Web.
- Provides SMS and e-mail service for specific sensor values by using alarm process and IFTTT.
- Supports interface linked with Android and Arduino for comprehensive application practice.
- Supports both on-board type and module type at the same time.

Hardware & Software Specifications

Module	Category	Specifications
10.1inch Touch LCD	DISPLAY	HDMI 1280x800 IPS Touchscreen
Raspberry Pi 4	CPU	Broadcom BCM2711 1.5Ghz Cortex-A72 quad-core
	Bluetooth	Ver 5.0
	Ethernet	10/100 BaseT
	Wi-Fi	802.11n
	Storage	Micro-SD
	USB	USB 2.0 2ports, USB 3.0 2ports
	HDMI	HDMI 2 * micro HDMI

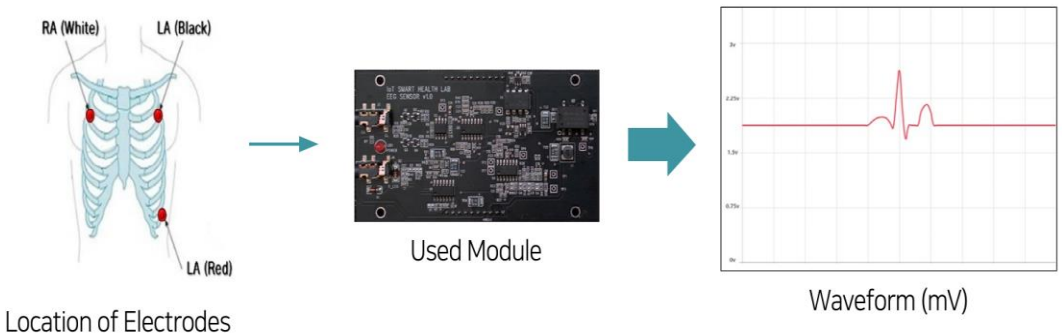
Software	Raspberry pi	- Raspbian : Nov 2018 - Kernal : 4.14.98-v7+ - GCC : 6.3.0
	Server	- Lighttpd : 1.4.45 - PHP : 7.0.33-0+deb9u3

Data Collecting Part

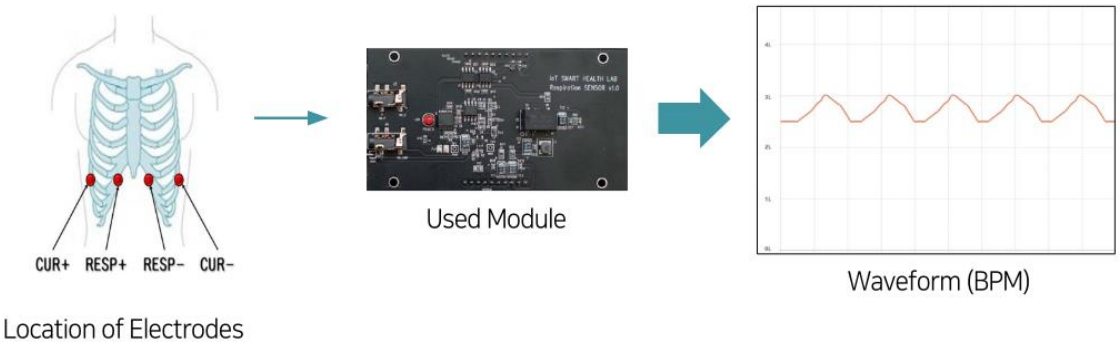
Module	Category	Specifications
DAQ 	MCU	ATMEGA2560
	Memory	256KB Flash
	Bootloader	Arduino
	Clock Speed	Up to 16MHz
	Debug	SWD & USB
	External ADC	4ch
BLUETOOTH 	MCU	ATMEGA2560
	Memory	256KB Flash
	Bootloader	Arduino
	Clock Speed	Up to 16MHz
	Debug	SWD & USB
	Bloutooth	V2.0 UART 9600bps

How to Measure & Interlock

1. **ECG (Electro CardioGram)**
   When the heart is beating, the minute action potential difference in the myocardium is measured by the electrode attached to the body surface, and the change curve over time is expressed in mV.

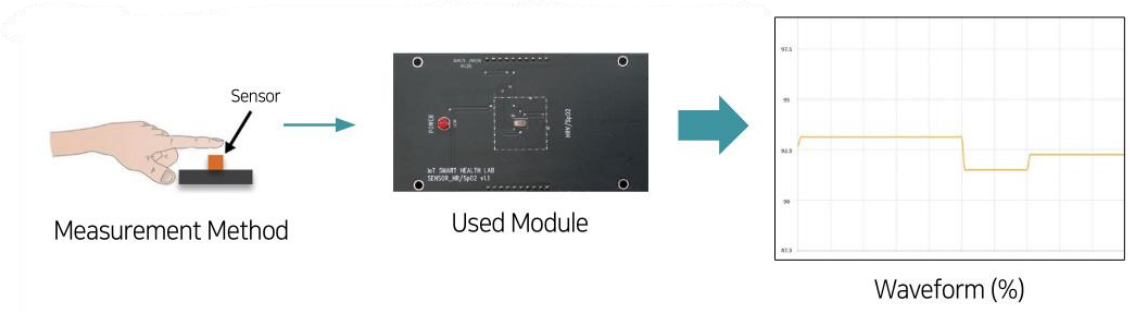


2. **Respiration**
   The change in impedance due to changes in volume inside the chest is measured.

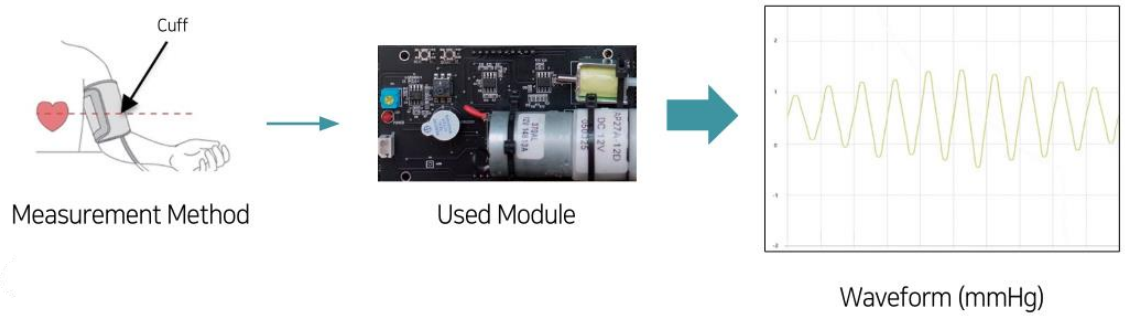


Location of Electrodes

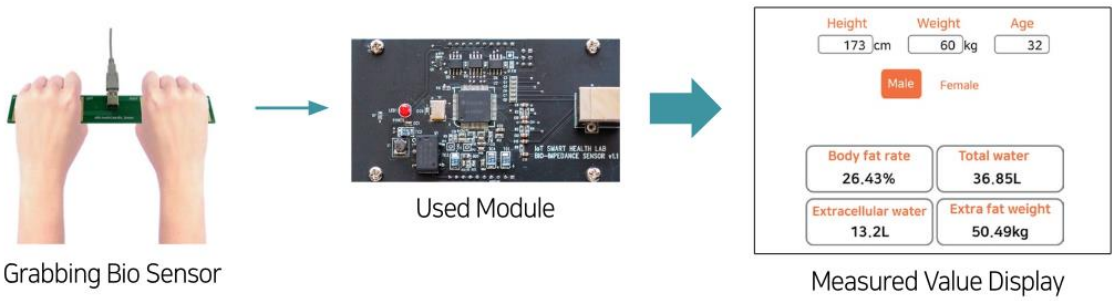
3. **SpO2 (Pulse Oximeter)**
   The percentage of hemoglobin concentration that contains oxygen to the concentration of total hemoglobin in the blood stream is measured by optical method.



4. **NIBP (Non-Invasive Blood Pressure)**
   NIBP is the way to measure blood pressure that we see easily around ourselves. If you put a cuff on your forearm and use an air pump to put air into the cuff, the cuff swells and blocks the artery. Systolic blood pressure and diastolic blood pressure are determined while listening to the vortex sounds that occur when the blood flows as the cuff is decompressed step by step.



5. **Bio Impedance**
   Of the constituents of the human body, the substances measurable by impedance are water and fat. Body fat and body water content are measured by bio-impedance

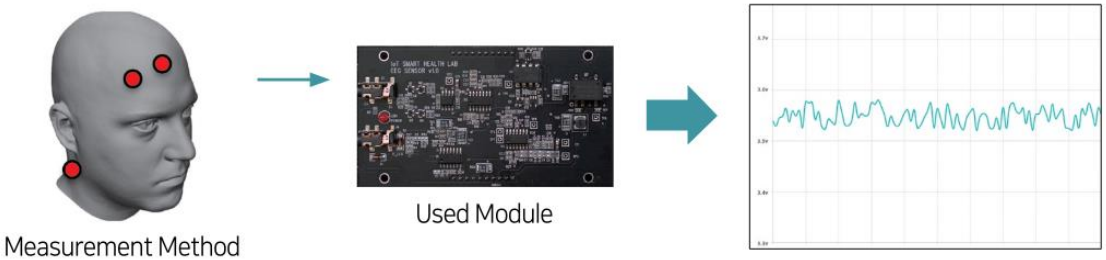


Grabbing Bio Sensor

Used Module

Measured Value Display

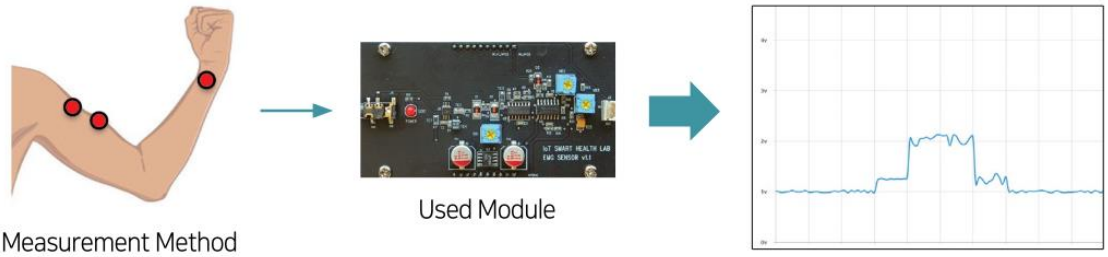
6. **EEG (Electro EncephaloGram)**
   Using an electrode attached to the surface of the head, electrical signals from the brain's electrical activity are measured non-invasively


Measurement Method

Used Module

Waveform (Hz)

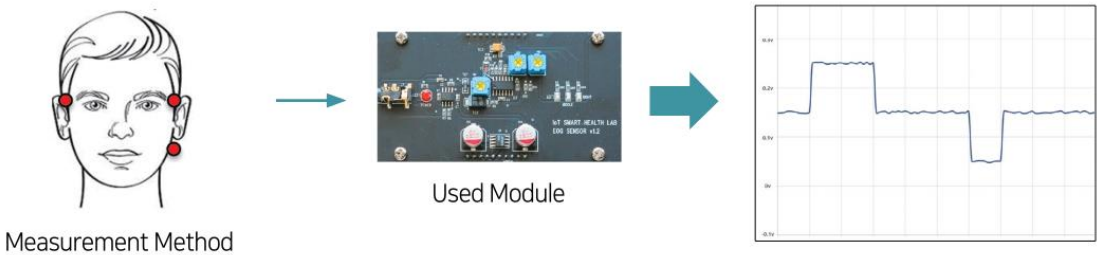
7. **EMG (Electro MyoGraphy**
   Attaches an electrode to the surface of the skin and measures the electrical signal generated when the muscle cells are activated electrically and neurologically


Measurement Method

Used Module

Waveform (v)

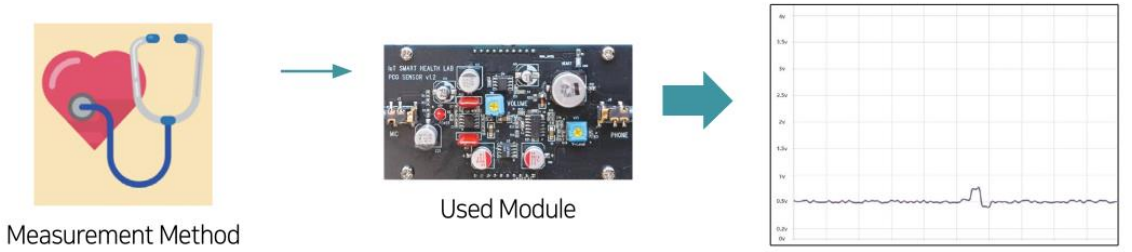
8. **EOG (Electro OculoGraphy**
   Measures minute voltage between retina and cornea caused by eye movement.


Measurement Method

Used Module

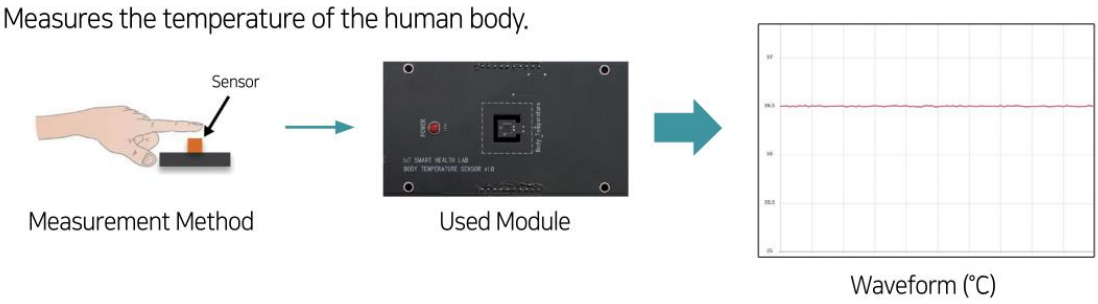
Waveform (V)

9. **PCG (Phono CardioGram)**
   The condenser microphone is used to amplify the heart sound and the value is measured with its waveform and sound.



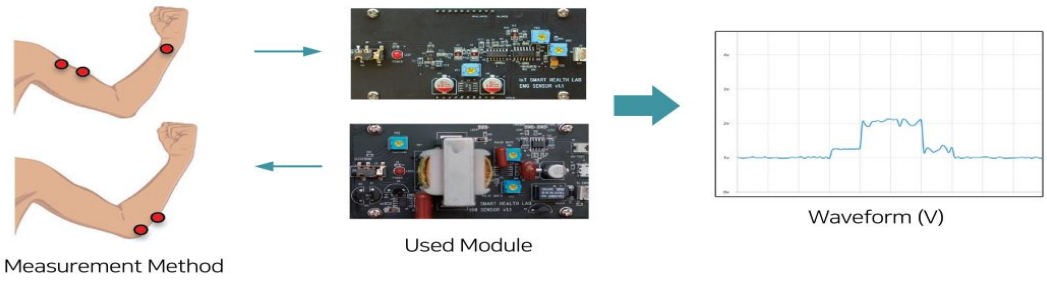
10. BT (Body Temperature)

Measures the temperature of the human body.



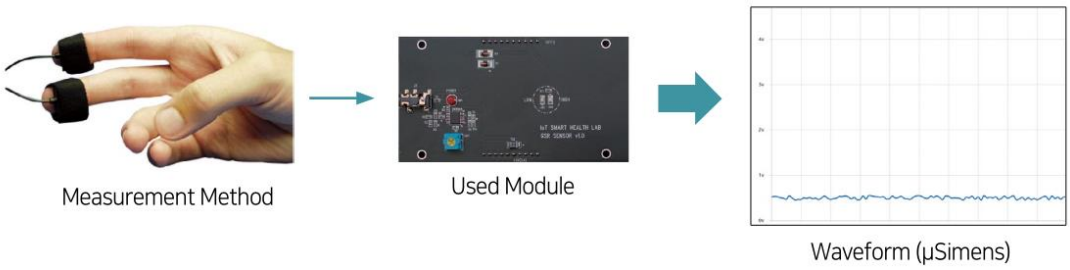
11. HHI (Human-Human Interface)

Experiment of interlocking between two persons. When an electrical signal is detected in the movement of one person's arm, an electrical signal is generated in the other person's arm.



12. GSR (Galvanic Skin Response)

When you have strong feelings, sweat is released from the sweat glands by the stimulated sympathetic nervous system. The conductivity of the skin at this time is measured with the electrodes attached to two fingers.



13. DUST

Measures fine dust in the air.