Raspberry Pi Introduction

Hankuk University of Foreign Studies
Dept. Information and Communications Engineering
Multimedia Communications Lab.
By. Wangsoo Kim

Index

- Introduction
- Settings
- Programming Example
- Assignment

Introduction

What is the Raspberry Pi?

- The Raspberry Pi is a small, barebones computer developed by The Raspberry Pi Foundation, a UK charity, with the intention of providing low-cost computers and free software to students.

- The main operating system for the Raspberry Pi is Rasbian and is based of Debian. It is a distribution of Linux so you will probably find it a little different if you're use to a Windows computer.

Specifications

- SoC: New BCM2837 chip
- CPU: Quad-core 64-bit ARM cortex A53 CPU
  - Clocked at 1.2GHz
- GPU: Broadcom VideoCore IV
- RAM: 1GB LPDDR2(900MHz)
- Networking: 10/100 Ethernet, 2.4GHz 802.11n wireless
- Bluetooth: Bluetooth 4.1 Classic, BLE
- Storage: microSD
- GPIO: 40-pin header, populated
- Ports: HDMI, 3.5mm analogue audio-video jack, 4xUSB 2.0, Ethernet, Camera Serial Interface(CSI), Display Serial Interface(DSI)

Reference

- https://www.raspberrypi.org/magpi/raspberry-pi-3-specs-benchmarks/

Arduino vs Raspberry Pi

	Arduino Uno	Raspberry Pi 3
Price	$30	$35
Size	7.6 x 6.4x 1.9 cm	8.5 x 5.4 x 1.7 cm
Memory	0.002MB	1GB
On Board Network	None	Ethernet, 802.11n, Bluetooth 4.1, BLE
Multitasking	No	Yes
Input voltage	7 to 12V	5V
Flash	32KB	SD Card
USB	One, input only	Four USB Port
Operating System	None	Linux distributions

What is the difference between the two?

- An Arduino is a microcontroller motherboard. A microcontroller is a simple computer that can run one program at a time, over and over again. It is very easy to use.

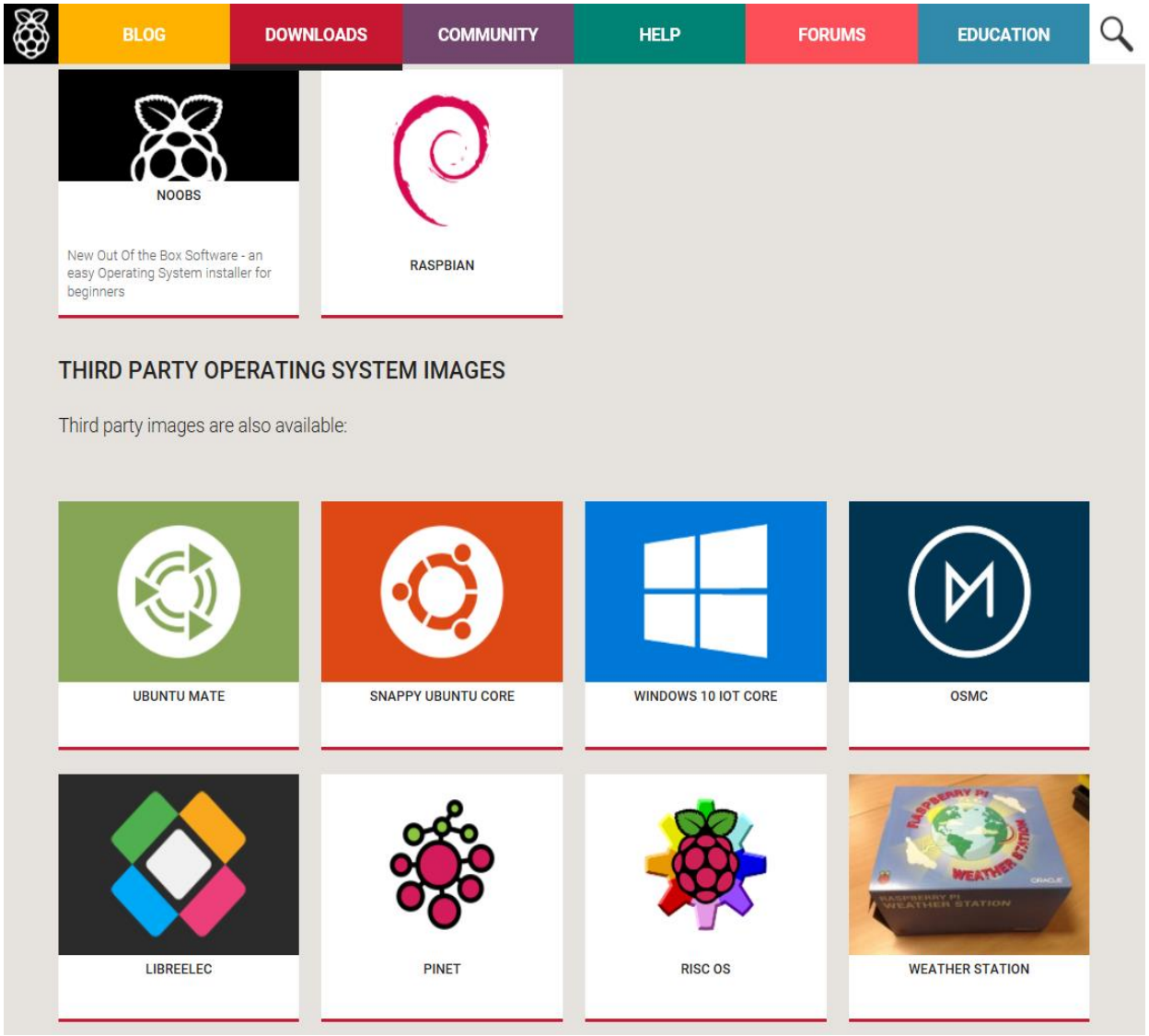
- A Raspberry Pi is a general-purpose computer, usually with a Linux operating system, and the ability to run multiple programs. It is more complicated to use the an Arduino.

Reference

- http://www.makeuseof.com/tag/arduino-vs-raspberry-pi-which-is-the-mini-computer-for-you/
- http://www.digitaltrends.com/computing/arduino-vs-raspberry-pi/

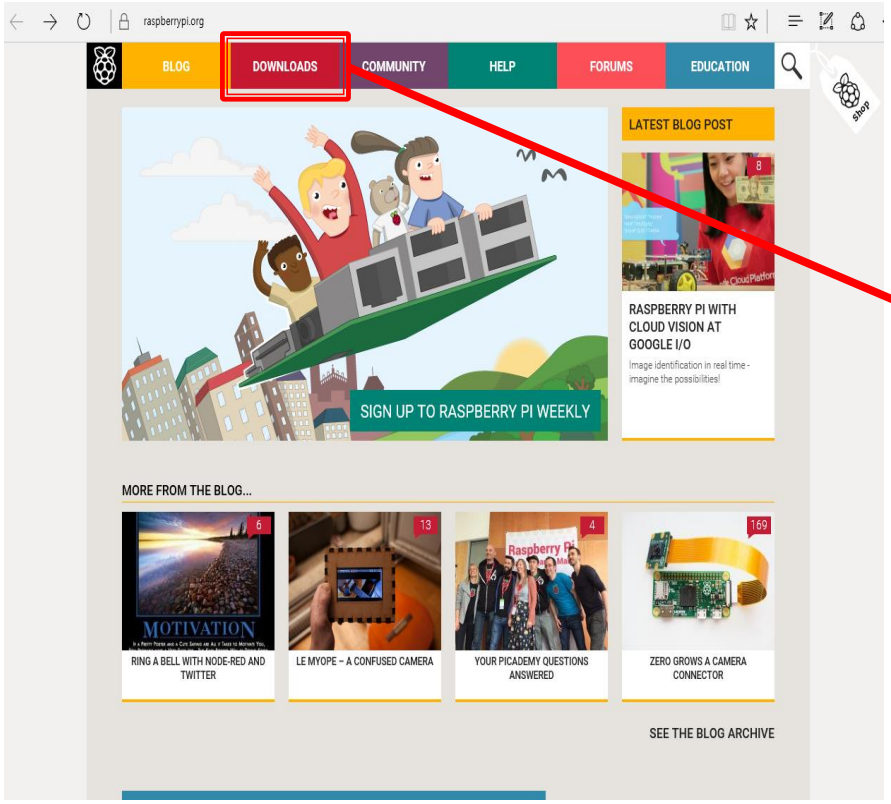
Settings

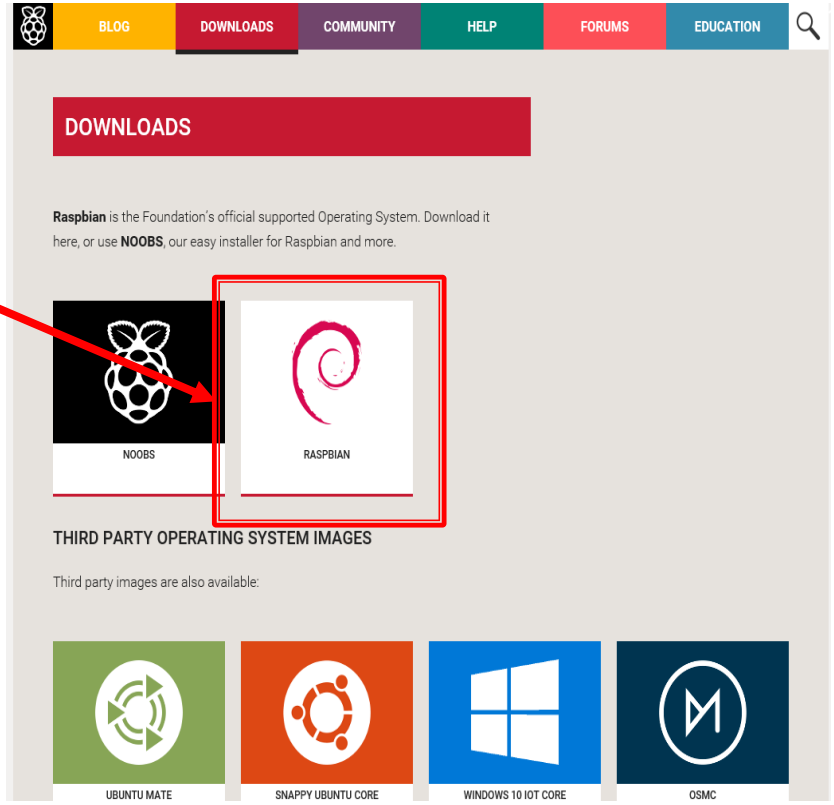
Raspberry Pi OS



Install OS

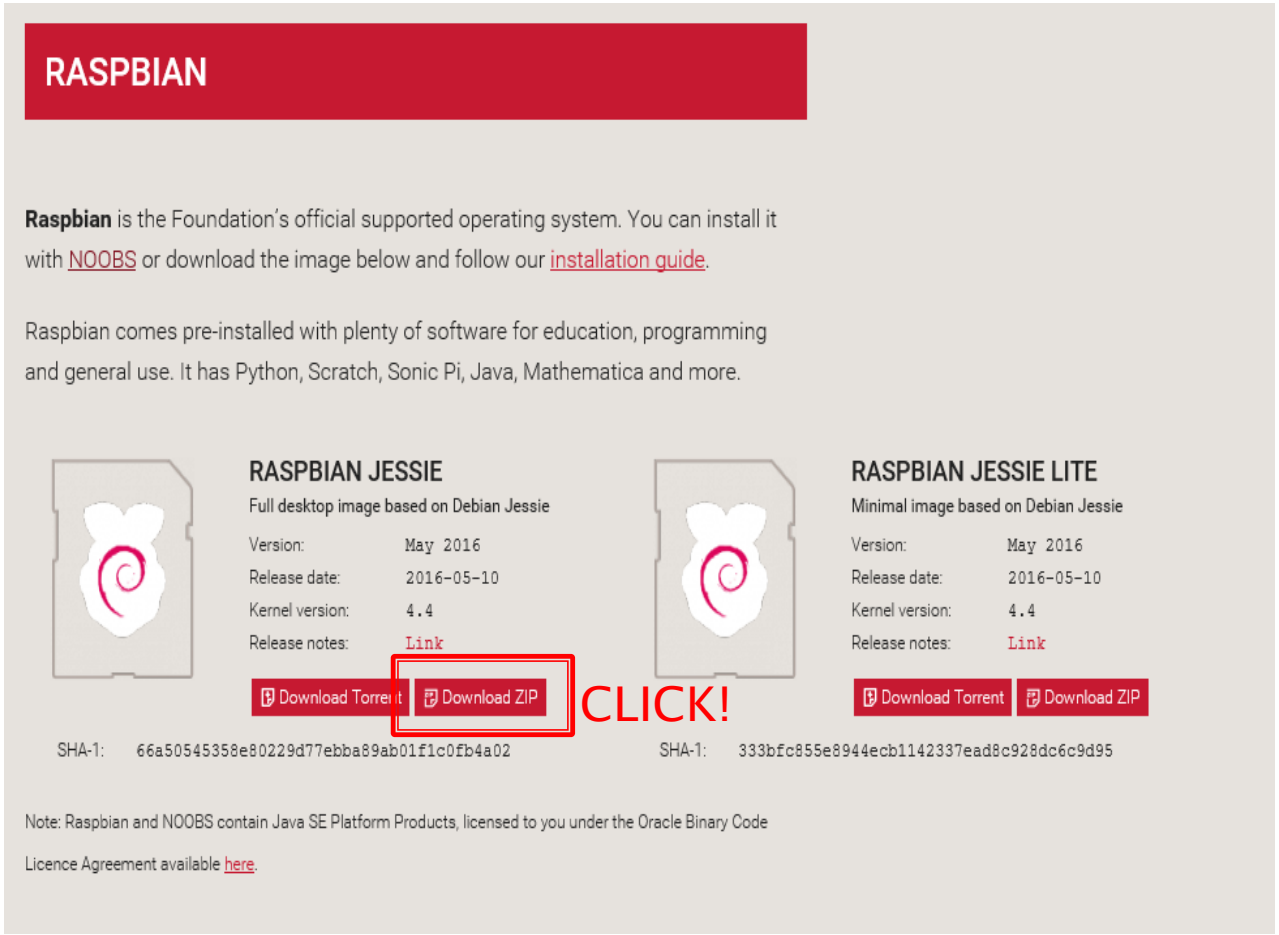
- Rasbian image Download
  - https://www.raspberrypi.org/





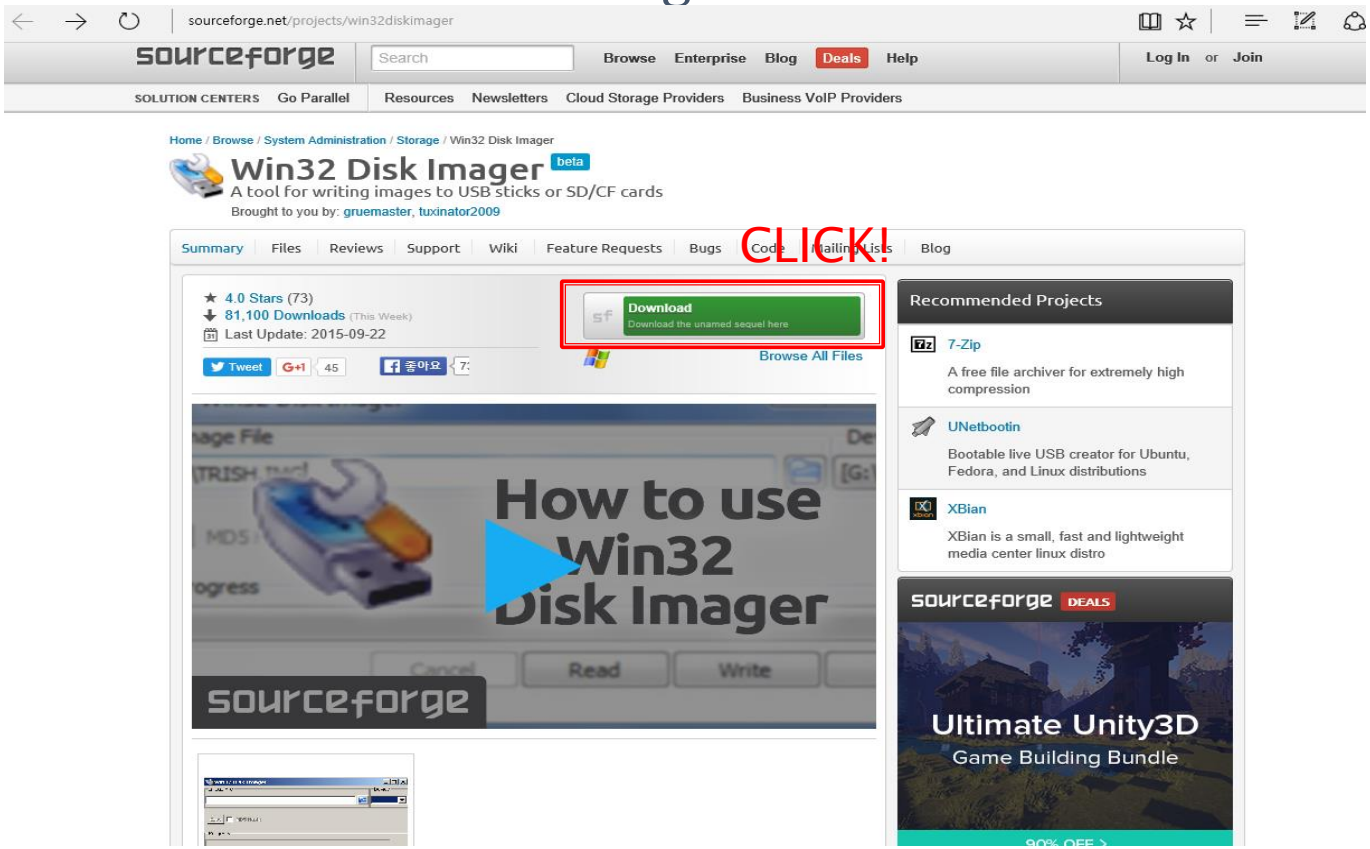
Install OS

- Rasbian image Download
  - https://www.raspberrypi.org/



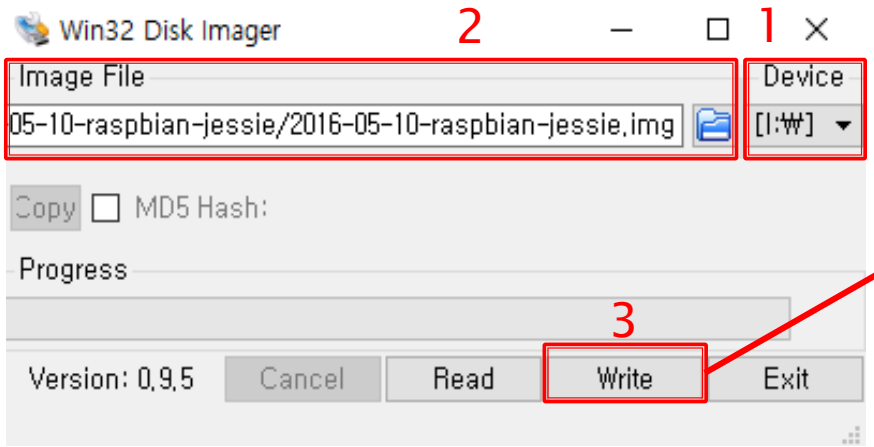
Install OS

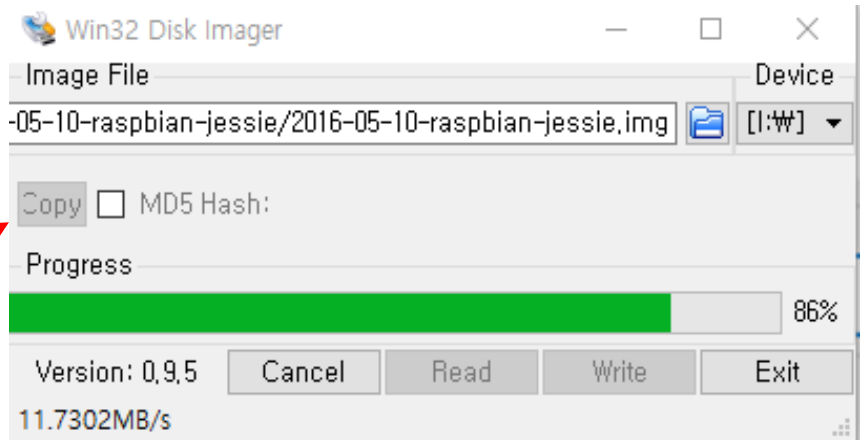
- Win 32 Disk Imager Download
  - https://sourceforge.net/projects/win32diskimager/
  - SD Card에 Rasbian OS Image를 쓰기 위함.



Install OS

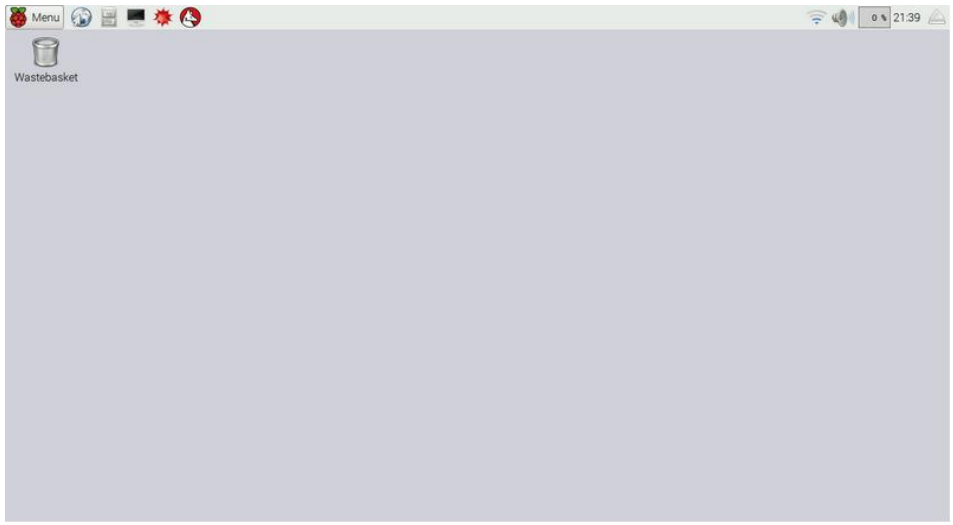
- 1. Win32 Disk Imager를 실행 시킨 후 Device에서 SD Card의 위치 선택.
- 2. Image File에 다운받은 Rasbian OS의 Image File Path 설정
- 3. Write 버튼 누른 후 대기.





Install OS

- Rasbian OS Image File을 SD Card에 쓰는데 성공했다면, SD Card를 Raspberry Pi에 장착 후 전원 공급.
  - Basic-Kit의 HDMI Cable을 이용하여 모니터와 연결, Adapter를 이용하여 전원 공급.(Appendix 참조)



Basic command

- $ sudo apt-get update
  - 프로그램 패키지 목록 업데이트
- $ sudo apt-get upgrade
  - 설치된 프로그램 중 버전 업 된 프로그램 업데이트
- $ cat /proc/version
  - OS version 확인
- $ vcgencmd version
  - 펌웨어 확인
- $ sudo rpi-update
  - 펌웨어 업데이트
- $ sudo reboot
  - 재부팅
- $ sudo shutdown –h now
  - 종료
- $ ifconfig
  - 유/무선 네트워크 확인

Wi-Fi Setting

- Raspberry Pi 3는 Wi-Fi 모듈이 내장되어 있으므로 동글 없이 Wi-Fi 연결이 가능합니다.
- $ sudo iwlist wlan0 scan
  - 현재 신호가 잡히는 AP를 스캔하여 연결한 AP의 eesid와 password 확인
- $ sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
  - ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev 설정

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1

network={
        ssid="공유기 ESSID"
        psk="패스워드"
}
```

  - Ctrl + x 누른 후 y를 누르면 저장 됩니다.
- 무선랜 모듈을 껏다가 켜주면 공유기와 접속
- $ sudo ifdown wlan0
  - 모듈 off
- $ sudo ifup wlan0
  - 모듈 on
- $ ifconfig
  - 아이피를 확인하여 정상적인 접속이 되는지 확인.

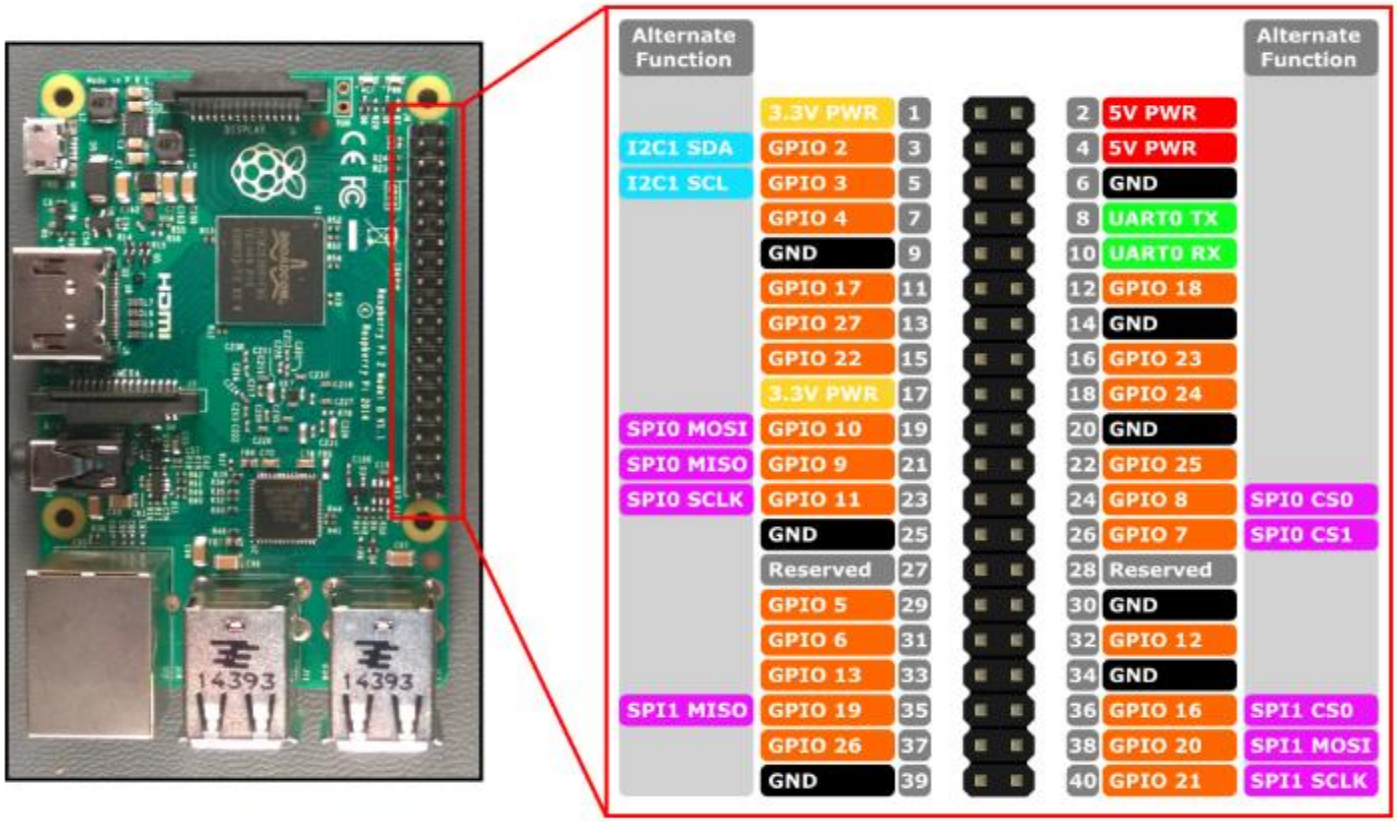
Install Python

- Raspberry Pi에서 Python을 이용하려면 Python Package를 설치해야 한다.
- $ dpkg –l | grep python
  - Python 설치 확인
- $ sudo apt-get install python-dev
  - 설치되어있지 않다면 위의 command로 설치
  - 설치 후 'python' 또는 'python3' command를 입력하여 제대로 설치가 완료되었는지 확인하자.

Programming Example

GPIO

- Raspberry Pi의 Pin은 다음과 같이 Mapping되어있으며, 2와 3버전 모두 동일한 구조를 가진다.

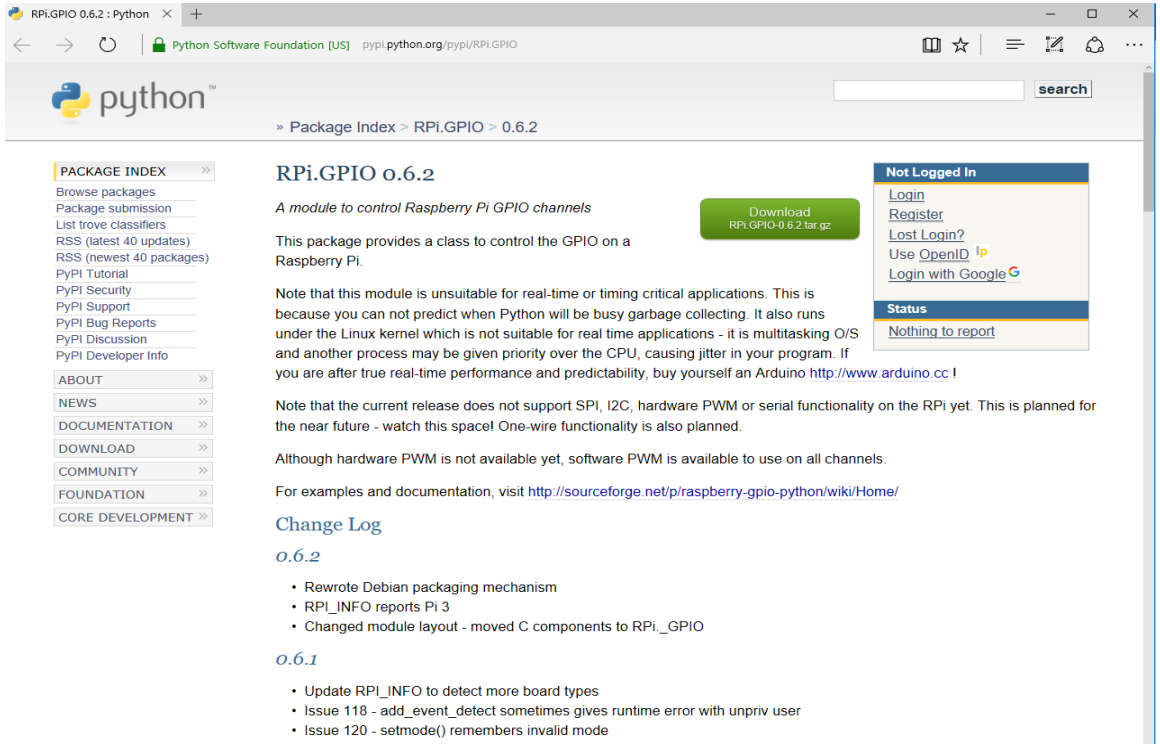


Image

- https://developer.microsoft.com/en-us/windows/iot/docs/pinmappingsrpi

GPIO

- Raspberry Pi의 GPIO를 제어하기 위한 Python 라이브러리
  - http://pypi.python.org/pypi/RPi.GPIO/
  - $ wget \ https://pypi.python.org/packages/source/R/RPi.GPIO-0.5.9.tar.gz

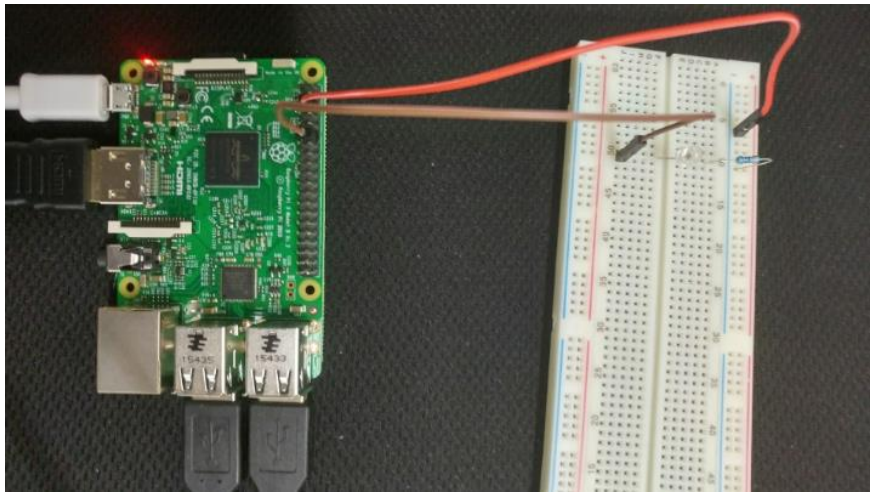


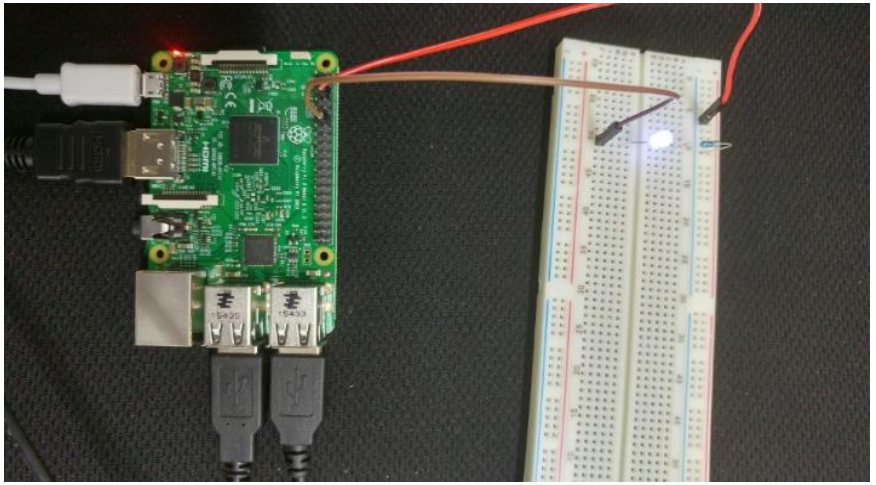
- $ tar xfz Rpi.GPIO-0.5.9.tar.gz
- $ cd Rpi.GPIO-0.5.9
- $ sudo python setup.py install

GPIO

- LED Control

```
import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BCM)

LED = 18

GPIO.setup(LED, GPIO.OUT)

try:
    while(True):
        GPIO.output(LED, GPIO.HIGH)
        time.sleep(1)
        GPIO.output(LED, GPIO.LOW)
        time.sleep(1)

except KeyboardInterrupt:
    GPIO.output(LED, GPIO.LOW)
    GPIO.cleanup()
```





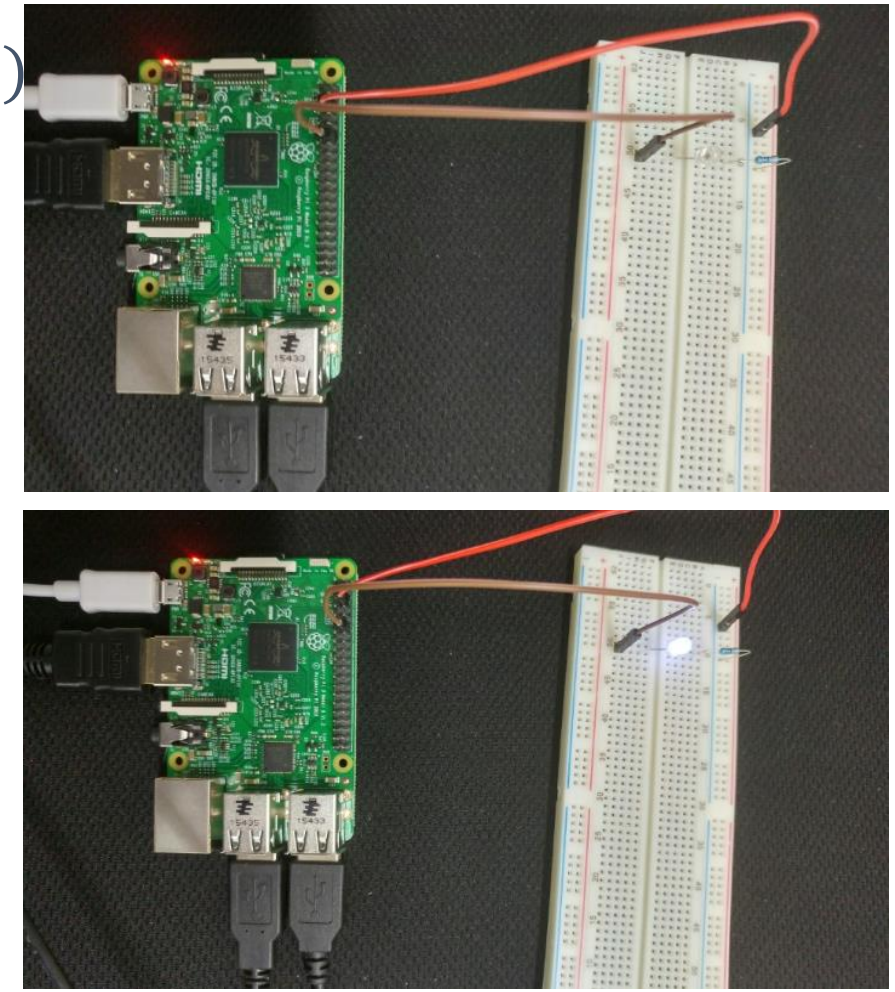
Run

- $ sudo python filename.py

GPIO

- LED 밝기 조절(using PWM)

```
import RPi.GPIO as GPIO
import time

LED = 18
GPIO.setmode(GPIO.BCM)

GPIO.setup(LED, GPIO.OUT)

LED.start(0)

delay = 0.1


try:
    for i in range(0, 101):
        LED.ChangeDutyCycle(i)
        time.sleep(delay)

    for i in range(100, -1, -1):
        LED.ChangeDutyCycle(i)
        time.sleep(delay)

except KeyboardInterrupt:
    LED.stop()
    GPIO.cleanup()
```



Run

- $ sudo python filename.py

Arduino & Pi

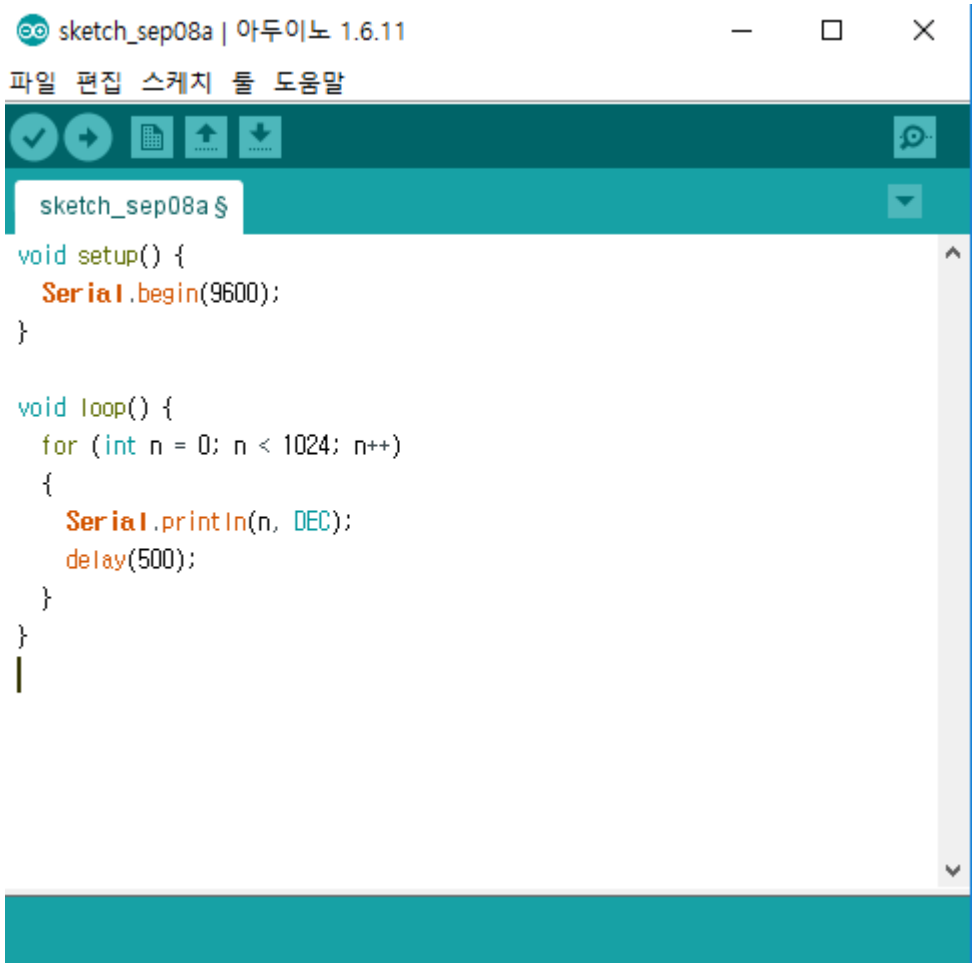
- Arduino와 Raspberry Pi 시리얼 통신하기

- $ sudo apt-get install Arduino
  - Arduino IDE 설치

- 시리얼 통신으로 0~100까지 출력

Arduino & Pi

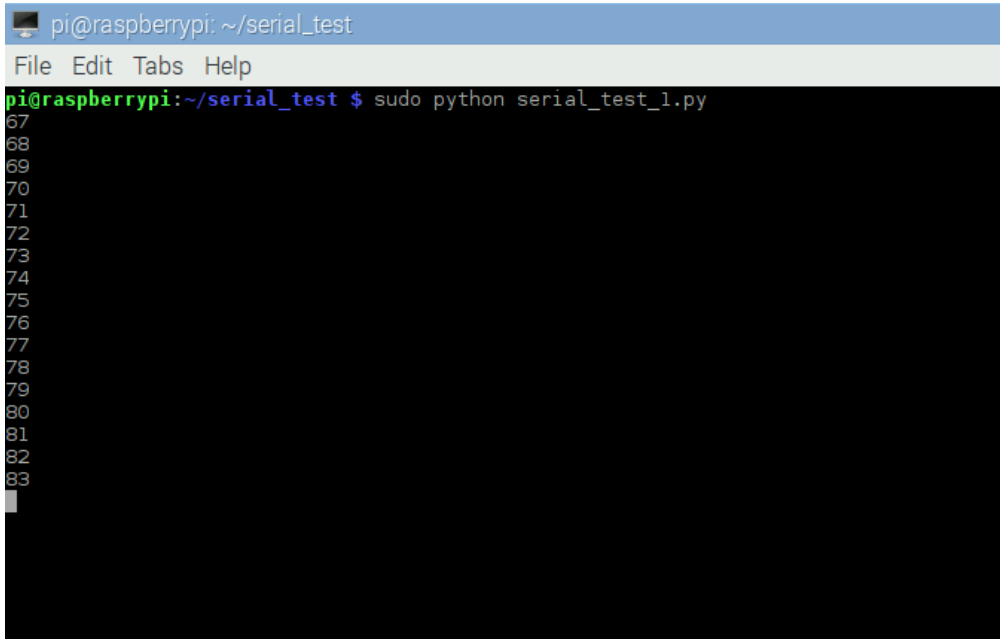
- Arduino



Arduino & Pi

- Raspberry Pi

```
import serial

port="₩dev₩ttyACM0"

serialFromArduino = serial.Serial(port, 9600)

serialFromArduino.flushInput()

while True:
    input_s = serialFromArduino.readline()
    input = int(input_s)
    print(input*10)
```



Run

- $ sudo python filename.py

Assignment

Assignment

- 1. Example Program을 수행 후 보고서 작성

- 2.
  - 2개의 Arduino와 하나의 Raspberry Pi를 연결
  - 1번 Arduino에는 온도센서, 2번 Arduino에는 Servo motor, Raspberry Pi에는 LED 회로 구성.
  - 온도센서의 온도가 특정온도이상 올라갈 경우 Raspberry Pi의 LED가 켜지면서 2번 Arduino의 Servo motor가 움직이도록 하세요.
  - 온도센서의 Threshold는 임의로 정한 후 보고서에 명시하세요.

- 제출형식
  - <과제명>_<학번1, 학번2>.pdf
  - 보고서에는 과제 수행 내용, 코드, 사진 및 동영상의 URL이 들어가야 합니다.

Appendix

Raspberry Pi 3 Basic-kit & Premium-kit

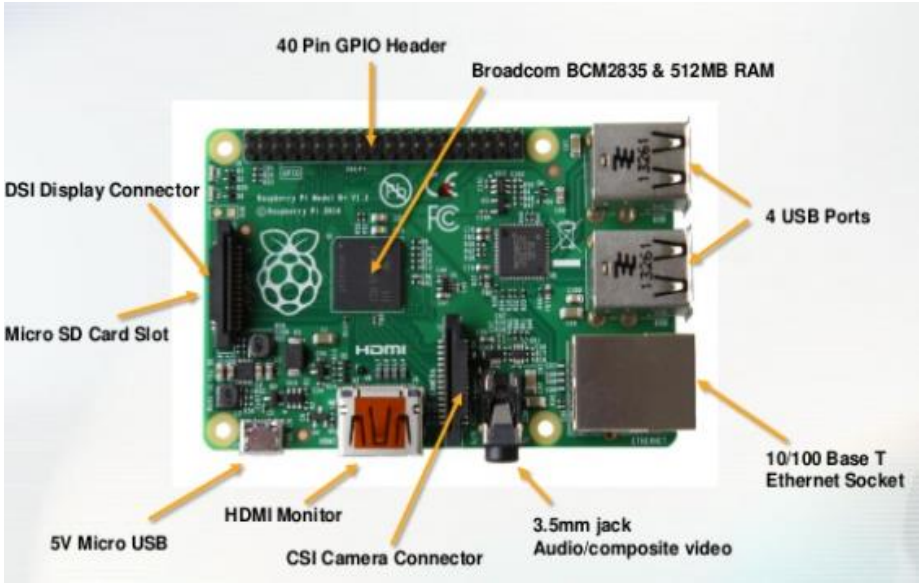
Basic-kit

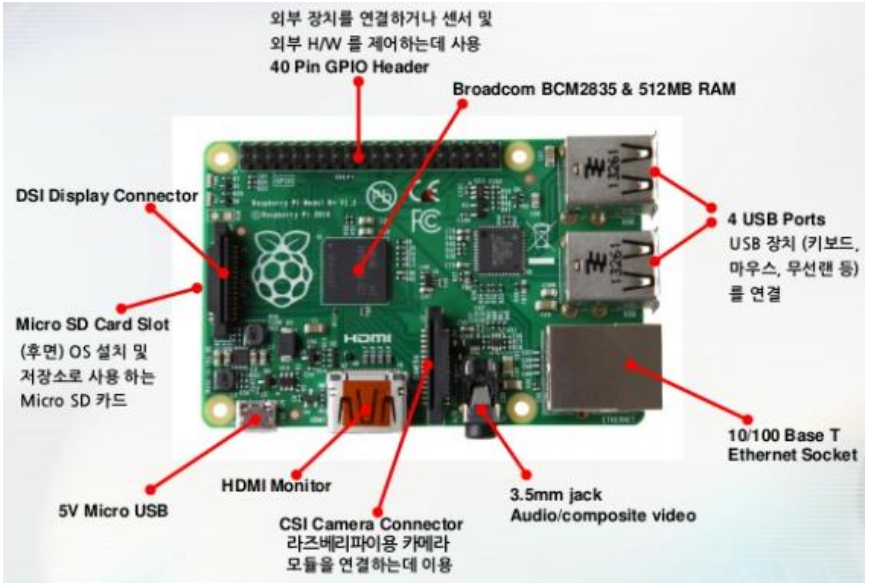
Basic-kit

- Raspberry Pi 3
- LAN cable
- SD card(16 GB)
- HDMI cable
- 2500mA 가정용 직류 전원 어댑터
- Micro SD(USB 2.0)
- Raspberry Pi 3 휴대용 케이스
- Heat sink(알루미늄 쿨러)
- 설명서
- Kit 케이스

SD Card는 Raspberry Pi 또는 Micro SD USB 2.0에 꽂아 사용할 수 있습니다.

Basic-kit


40 Pin GPIO Header
Broadcom BCM2835 & 512MB RAM
DSI Display Connector
4 USB Ports
Micro SD Card Slot
10/100 Base T
Ethernet Socket
HDMI Monitor
5V Micro USB
3.5mm jack
Audio/composite video
CSI Camera Connector


외부 장치를 연결하거나 센서 및
외부 H/W 를 제어하는데 사용
40 Pin GPIO Header
Broadcom BCM2835 & 512MB RAM
DSI Display Connector
4 USB Ports
USB 장치 (키보드,
마우스, 무선랜 등)
를 연결
Micro SD Card Slot
(후면) OS 설치 및
저장소로 사용 하는
Micro SD 카드
10/100 Base T
Ethernet Socket
HDMI Monitor
5V Micro USB
3.5mm jack
Audio/composite video
CSI Camera Connector
라즈베리파이용 카메라
모듈을 연결하는데 이용

Premium-kit

번호	품목	개수
1	1k 저항	5
2	10k 저항	5
3	220R 저항	10
4	LED 빨강	5
5	LED 노랑	5
6	LED 파랑	5
7	LM35 센서	1
8	불꽃센서	1
9	조도센서	2
10	IR 센서 수광부	1
11	부저	2
12	RFID 키 체인	1
13	NFC 카드 리더 모듈	1
14	16버튼 터치 스위치 모듈	1
15	SR04 초음파센서 모듈	1
16	라즈베리 파이 LED 매트릭스 모듈	1
17	라즈베리 파이 GPIO 확장 보드 (V3)	1
18	가변저항 50K	1
19	dhseh alc 습도 DHT11 모듈	1
20	ADCL345 센서모듈	1
21	10mm RGB LED 모듈	1
22	0.96인치 OLED LCD 모듈	1
23	점퍼와이어(30 in 1)	1
24	GPIO 40P 무지개 케이블	1
25	테스트점퍼소켓 케이블 M/F(20 in 1)	1
26	브레드보드	1
27	노랑 버튼 택트스위치	4
28	ULN2003 스테퍼 보터 드라이버 모듈	1
29	5V 릴레이 모듈	1
30	수위 센서 모듈	1
31	9g 서보	1
32	PCF8591 모듈	1
33	7 세그먼트	1
34	7 세그먼트 (4단)	1
35	74HC595 IC	1
36	로터리 엔코더	1
37	DS3231 RTC 모듈	1
38	5V 스테핑모터	1
39	PS2 조이스틱 모듈	1
40	MQ-5 가스 센서 모듈	1
41	KEYES-345	1
42	HC-05	1
43	Fan Motor	1
44	YL-40	1

Premium-kit


MQ-5 가스 센서 모듈


5V소형 DC모터


5V 스테핑모터


PS2 조이스틱 모듈


Fan Motor


1, 10K x 5 / 220R 저항 x8


LED 빨강, 파랑, 노랑 x5


NFC 카드 리더 모듈


SR04 초음파센서 모듈


0.96인치 OLED LCD모듈


점퍼와이어 (30in1)

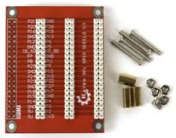

5V 릴레이 모듈


수위 센서 모듈


LM35 센서


불꽃센서


16버튼 터치 스위치 모듈


라즈베리 파이 GPIO 확장 보드 (V3)


GPIO 40P 무지개 케이블

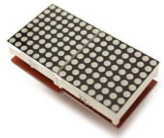

테스트점퍼소켓 케이블
M/F (20in1)


9g 서보


7세그먼트


조도센서 x3


IR센서 수광부


라즈베리 파이 LED 매트릭스 모듈


온도 및 습도 DHT11 모듈


브레드보드


리모컨


PCF8591 모듈


74HC595 IC


부저 x2


RFID 키 체인


가변저항 50K


10mm RGB LED 모듈


노랑 버튼 택트스위치 x4

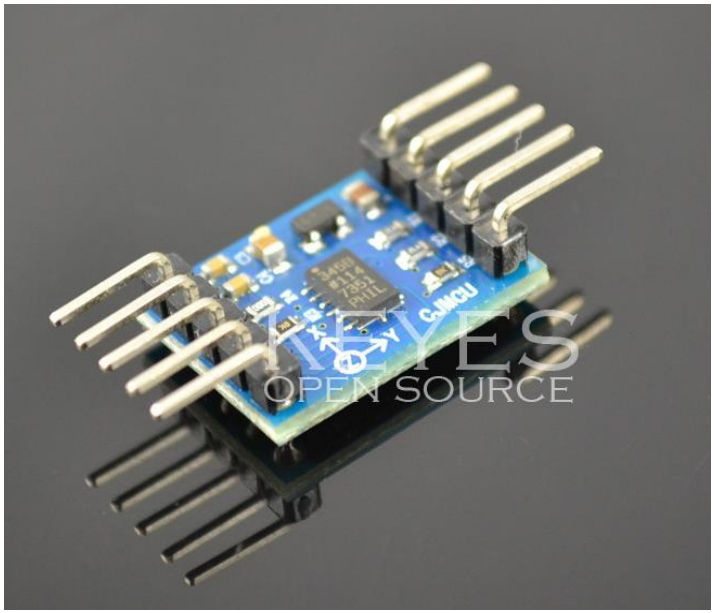

ULN2003 스테퍼 모터
드라이버 모듈


7세그먼트 (4단)


DS3231 RTC 모듈

Premium-kit

- KEYES-345: Digital 3-Axis Gravity Acceleration Sensor Module



Specifications

ADXL345 Digital 3-Axis Gravity Acceleration Sensor Module

- Material: Circuit board
- Power supply: 3~5V
- Resolution: 13bit, 4 mg / LSB
- Measurement range: +/- 16g
- Communication type: SPI / IIC
- The digital output data is 16-bit two's complement format
- ADXL345 is low power consumption and a 3-axis accelerometer
- Suitable for portable device application.
- Great for microcontroller's experiment
- Capable of measuring less than 1 degree inclination angle change
- With freefall detection function
- Activity and non-activity detection function, and detects if arbitrary axis acceleration exceeds a user-set limits
- Packing list:
- 1 x Sensor module

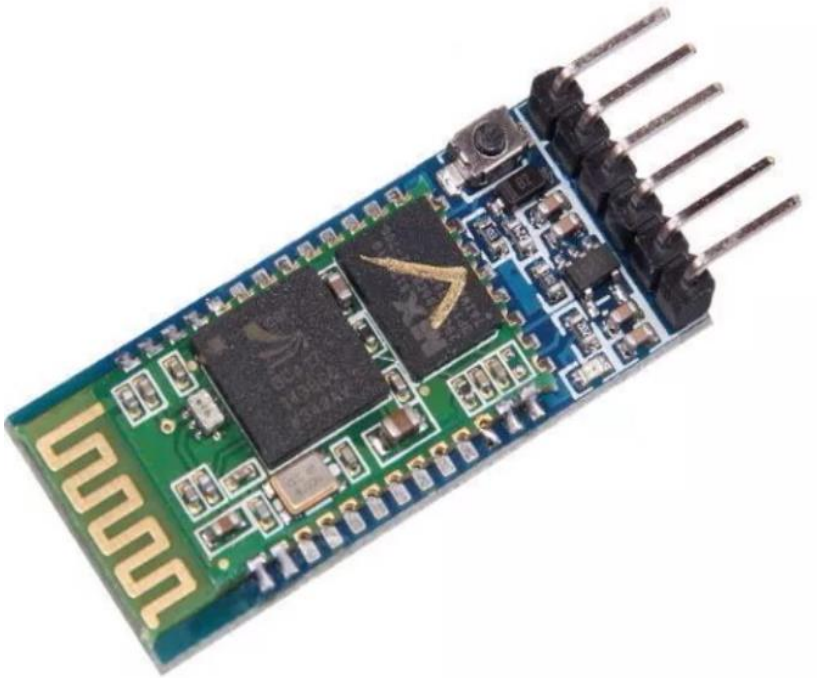
Premium-kit

- YL-40: 8-bit A/D D/A Converter Module

- Model: PCF8591
- Color: Blue + black
- Material: PCB + metal
- The PCF8591 is a single-chip, single-supply low power 8-bit CMOS data acquisition device with four analog inputs, one analog output and a serial I2C-bus interface
- Three address pins A0, A1 and A2 are used for programming the hardware address, allowing the use of up to eight devices connected to the I2C-bus without additional hardware
- Address, control and data to and from the device are transferred serially via the two-line bidirectional I2C-bus
- Single power supply
- Operating supply voltage 2.5 V to 6 V
- Low standby current
- Serial input/output via I2C-bus
- Address by 3 hardware address pins
- Sampling rate given by I2C-bus speed
- 4 analog inputs programmable as single-ended or differential inputs
- Auto-incremented channel selection
- Analog voltage range from VSS to VDD
- On-chip track and hold circuit
- 8-bit successive approximation A/D conversion
- Multiplying DAC with one analog output
- Applications:
- Closed loop control systems
- Low power converter for remote data acquisition
- Battery operated equipment
- Acquisition of analog values in automotive, audio and TV applications
- Packing list:
- 1 x A/D D/A converter module
- 4 x Dupont cables (21cm)

Premium-kit

- HC-05: Bluetooth 2.0/2.1 Module



HC-05 Specifications

- 2.45Ghz **Frequency**
- Asynchronous **Speed** 2.1Mbps (max) .160Kbps
- **Security:** Authentication
- **Profile:** Bluetooth Serial Port
- **Power Supply:** +3.3 VDc
- **Working Temperature:** >20C
- **Cost :** Around INR 300