Ch7. Serial interface, IR

양 세훈

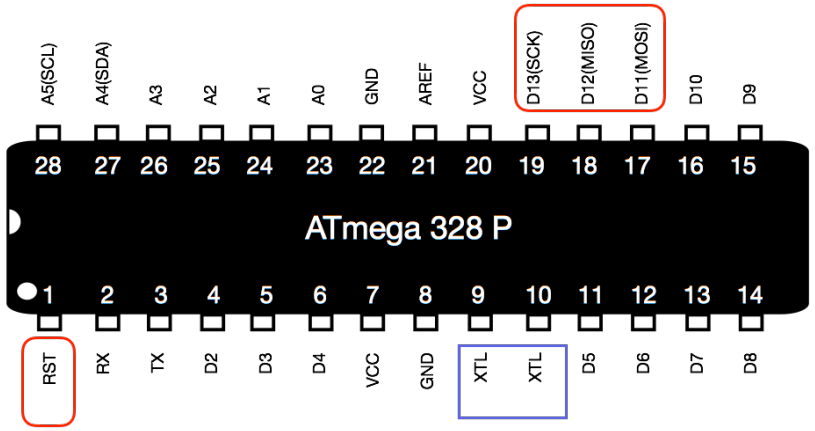
SEOUL NATIONAL UNIVERSITY

Ch7. Serial Interface

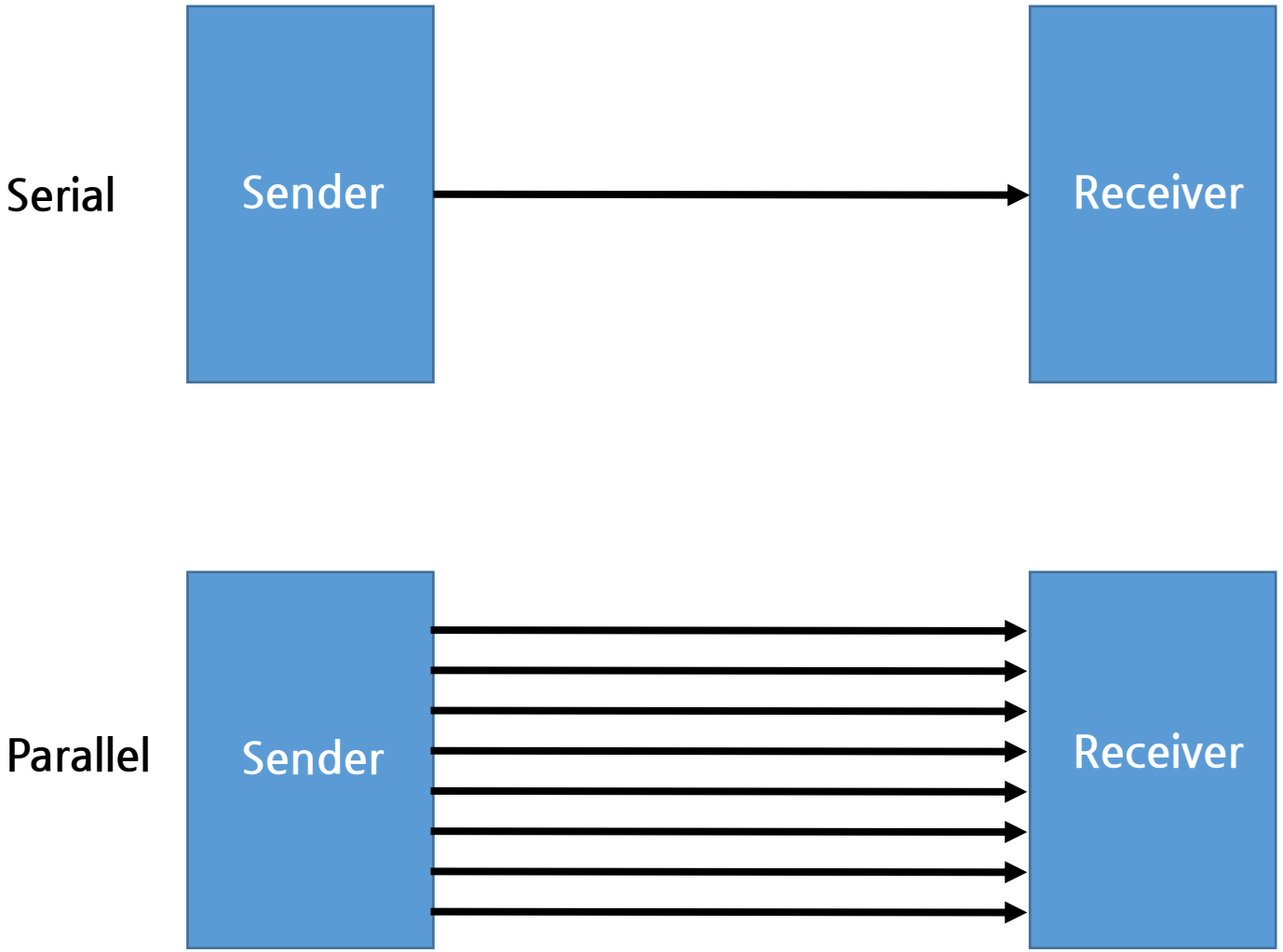
1) UART

2) I2C
2-1) I2C : Between Arduino
2-2) TC74XX I2CTemp sensor
2-3) I2C-LCD

3) SPI: Serial Peripheral Interface



Serial vs Parallel : 장단점



1) UART

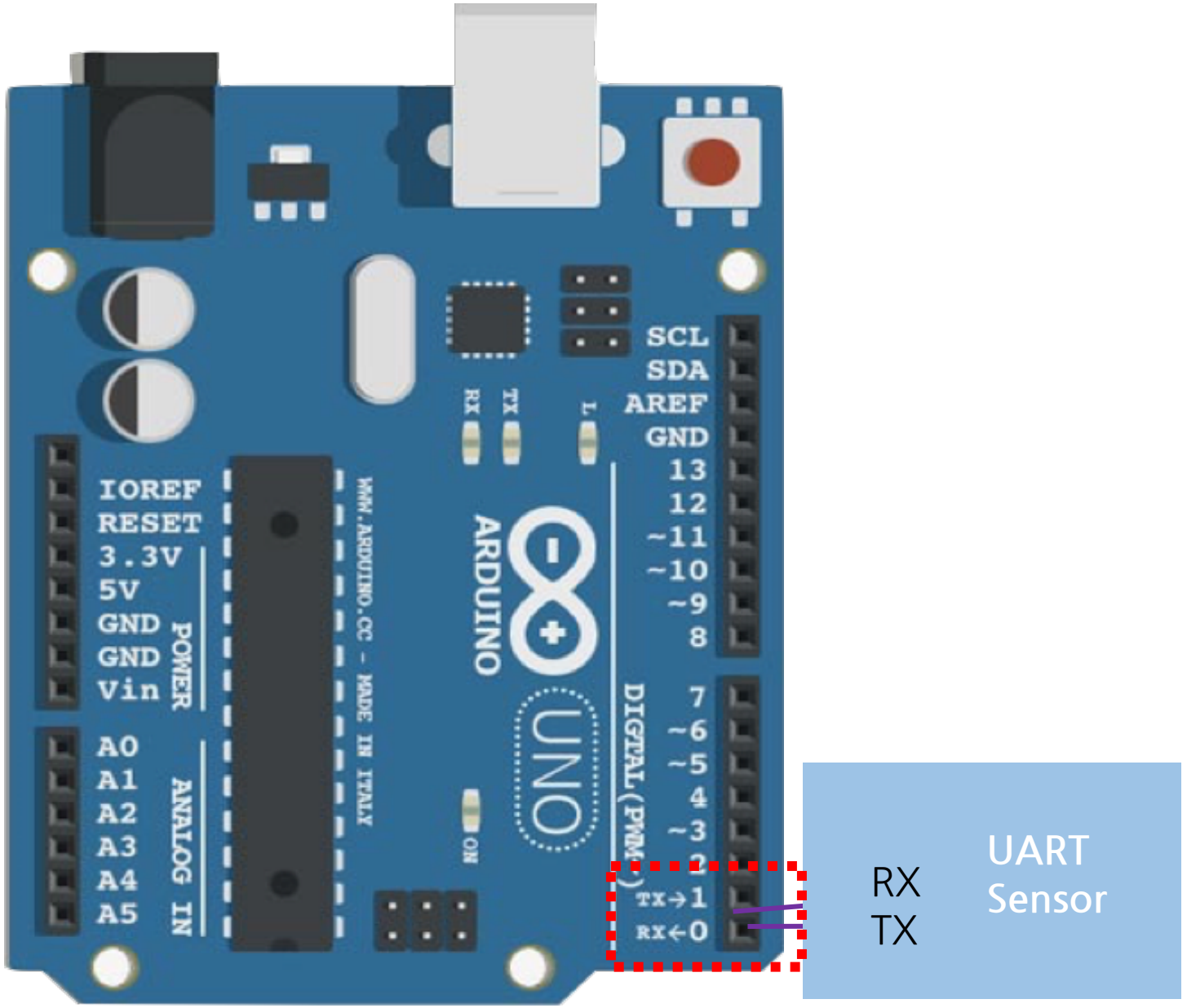
UART: 범용 비동기식 송수신

Universal Asynchronous

Receive/Transmit

대표적 통신 방법(1:1)

0 번 (RX) 핀으로 받고.
1 번 (TX) 로.



시작	0	1	2	3	4	5	6	7	정지

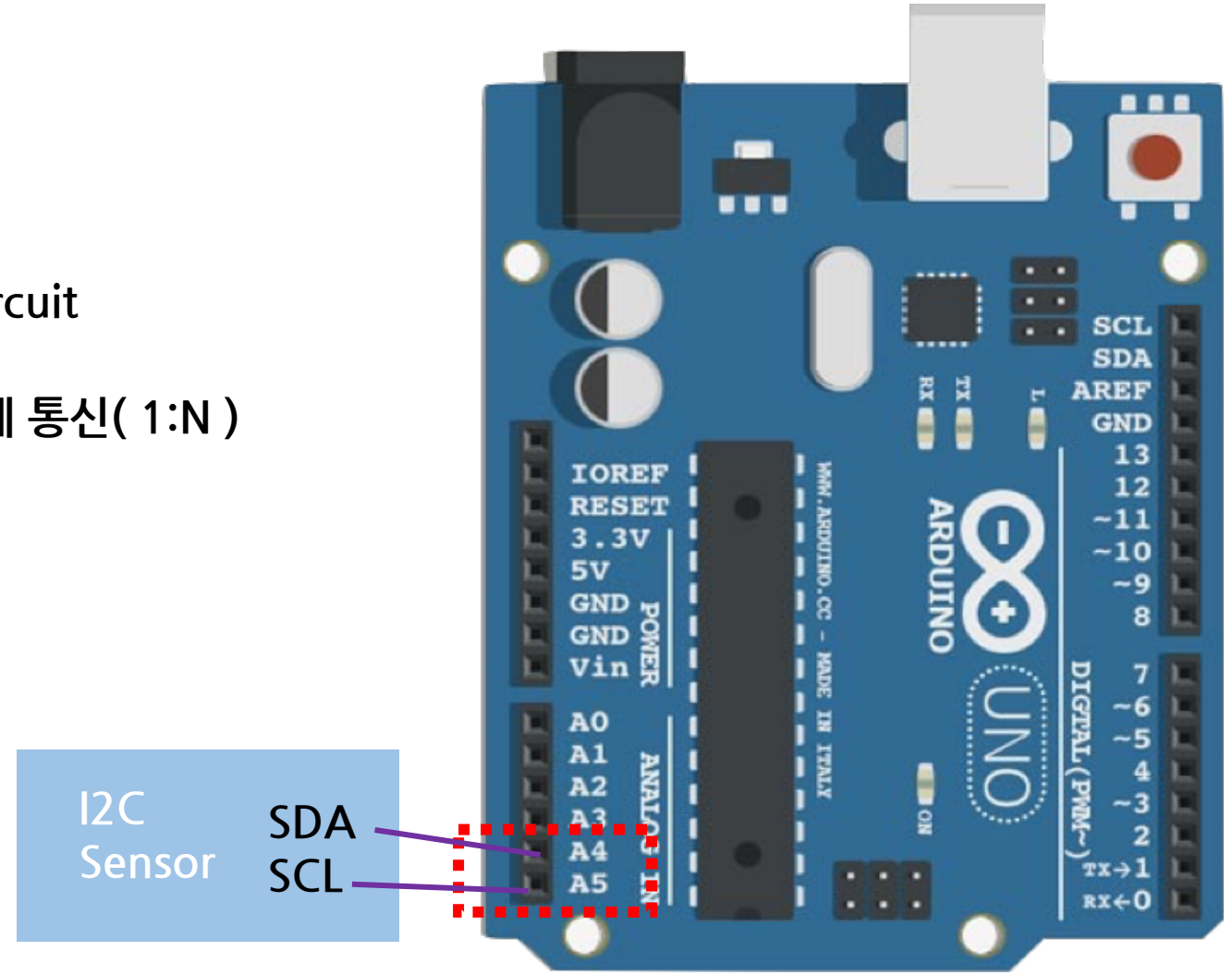
2) I2C

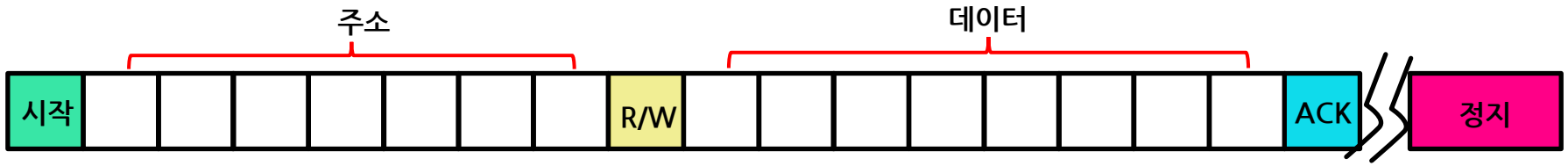
I2C: 일명 TWI

Inter Integrated Circuit

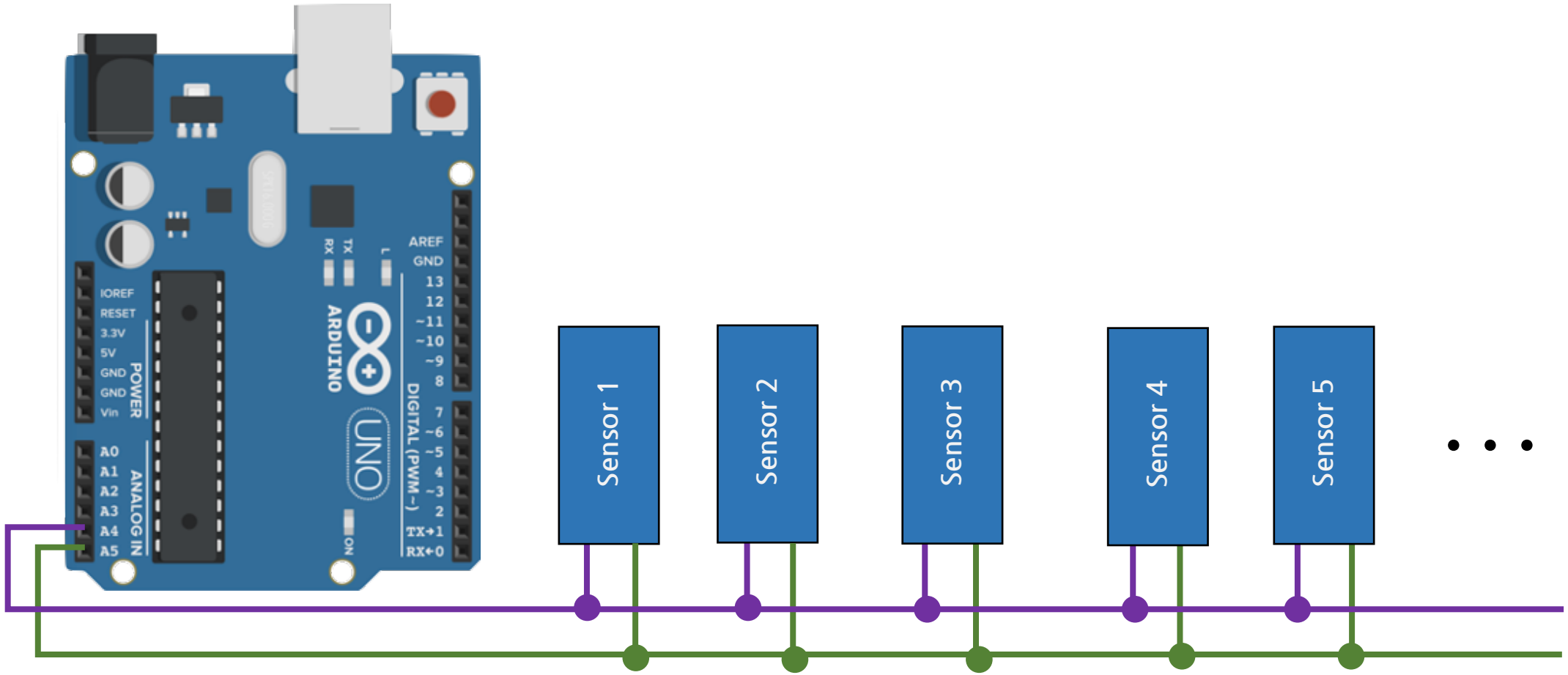
여러개 센서와 동시에 통신(1:N)

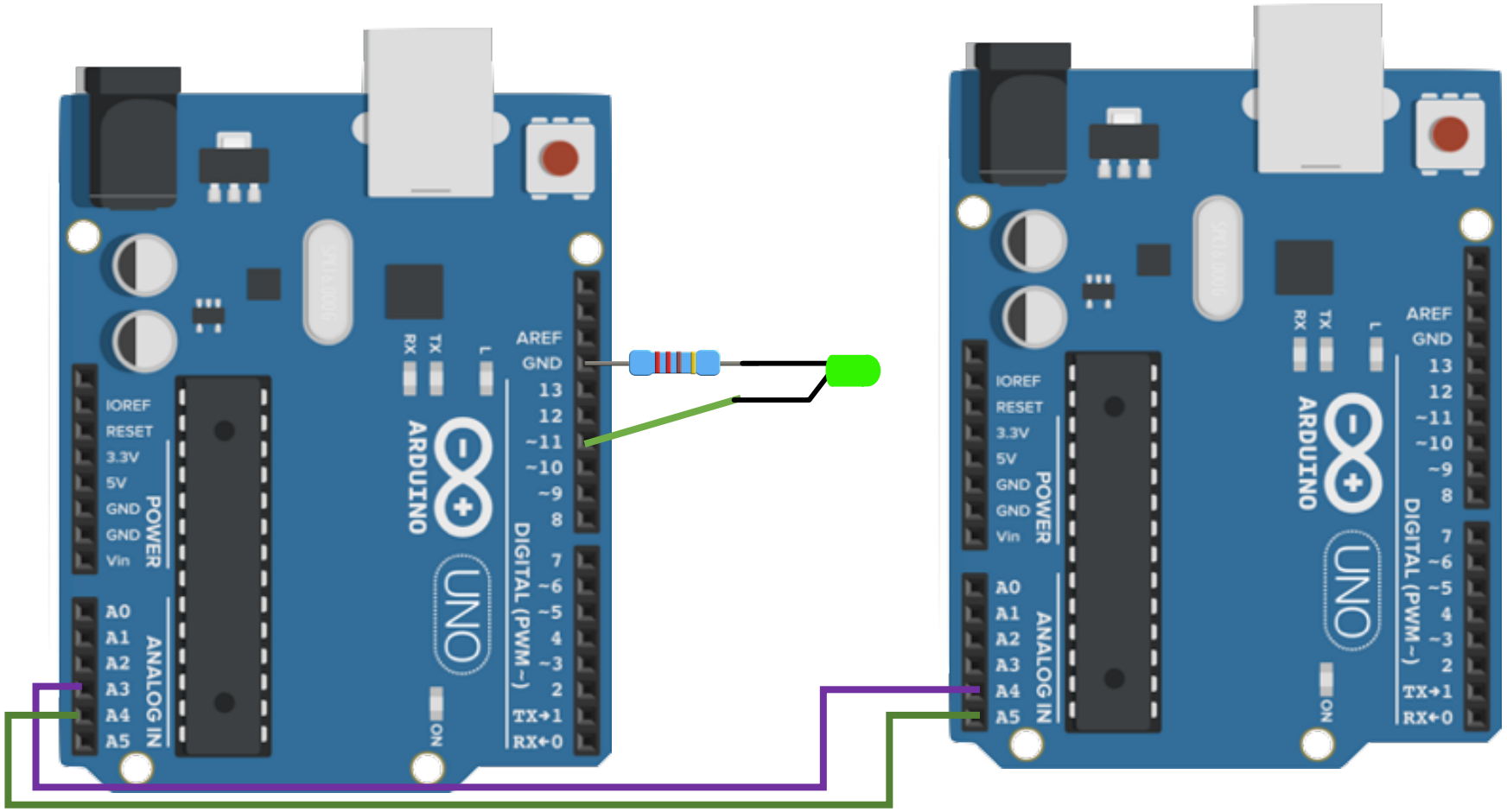
A4 핀 SDA
A5 핀 SCL

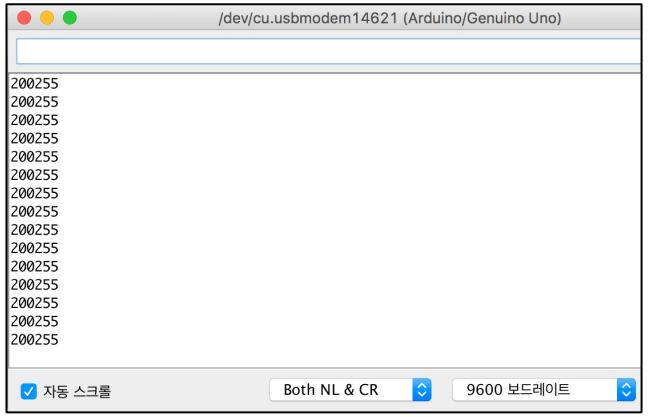




I2C Sensor making




IOREF
RESET
3.3V
5V
GND
GND
Vin
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ON
ARDUINO
UNO


/dev/cu.usbmodem14621 (Arduino/Genuino Uno)
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
200255
자동 스크롤
Both NL & CR
9600 보드레이트

2-1) I2C :

Between Arduino

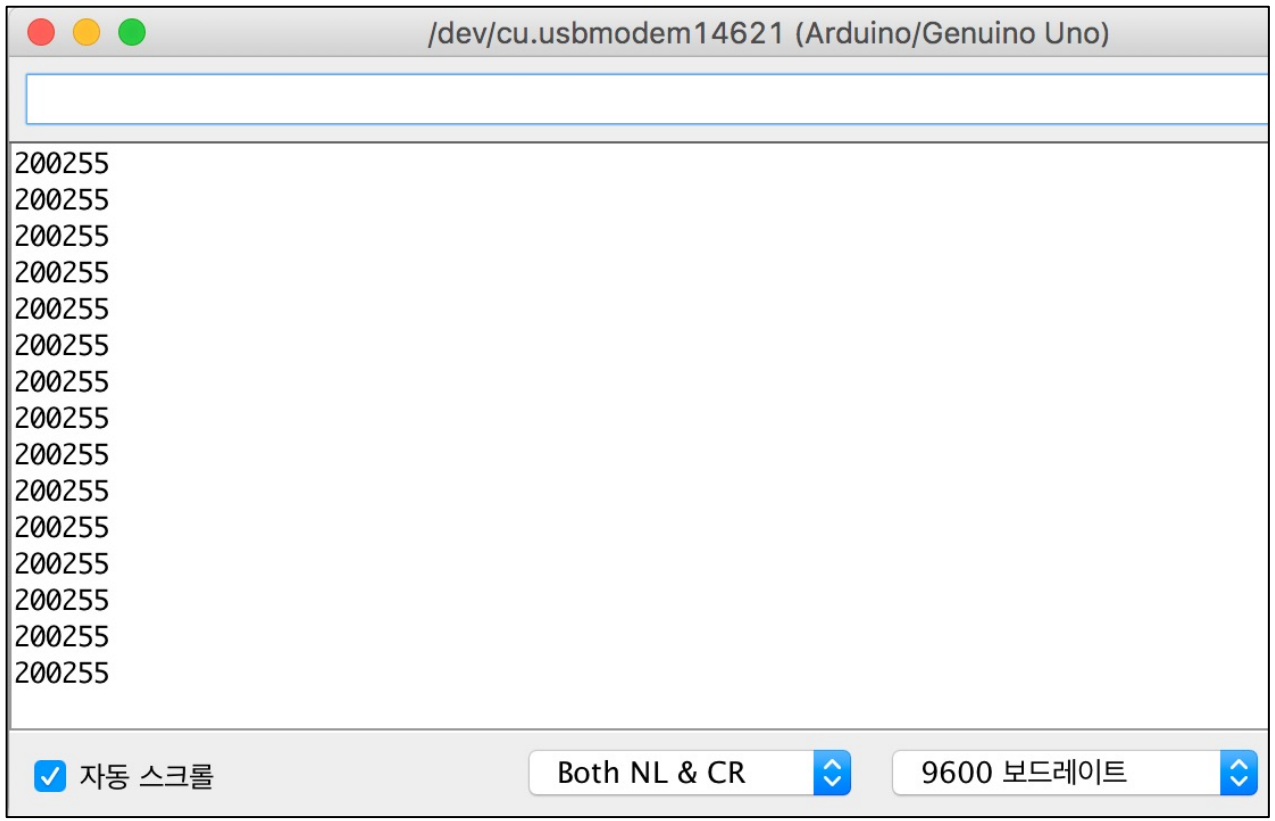
I2C_2_Way_Server

```
// I2C_2_Way_Server :
 // Send big number and Receive 'H' or 'L'

#include <Wire.h>

void setup() {
 Wire.begin(0);
 Serial.begin(9600) ;
 Wire.onReceive(Action);
 pinMode(11,OUTPUT);
}

void loop() {
 Wire.beginTransmission(1);
 Wire.write(200);

 Wire.write(255);
 Wire.endTransmission();
 delay(200);
}

void Action() {
 char letter;

 while(Wire.available() > 0) {
   letter = Wire.read();
   Serial.println(letter) ;
   if (letter == 'H')
   {
     digitalWrite(11, HIGH);
   }
   else if (letter == 'L')
   {
     digitalWrite(11, LOW);
   }
 }
}
```

I2C_2_way_Slave

```
// I2c_2_Way_Slave :
 // Send 'H' or 'L' and Receive Big number

#include <Wire.h>

void setup() {
 Wire.begin(1);
 Serial.begin(9600) ;
 Wire.onReceive(Action);

 pinMode(11,OUTPUT);
}

void loop() {
 Wire.beginTransmission(0);
 Wire.write('H');
 Wire.endTransmission();

 delay(200);

 Wire.beginTransmission(0);
 Wire.write('L');
 Wire.endTransmission();

 delay(200);
}

void Action() {
  int num1 ;
  int num2 ;

if(Wire.available() <= 2)  {
   num1 = Wire.read();
   num2 = Wire.read();
 }
   Serial.print(num1) ;
   Serial.println(num2) ;
}
```

2-1) I2C : Between Arduino



2-1) I2C :

Between Arduino

Using onRequest

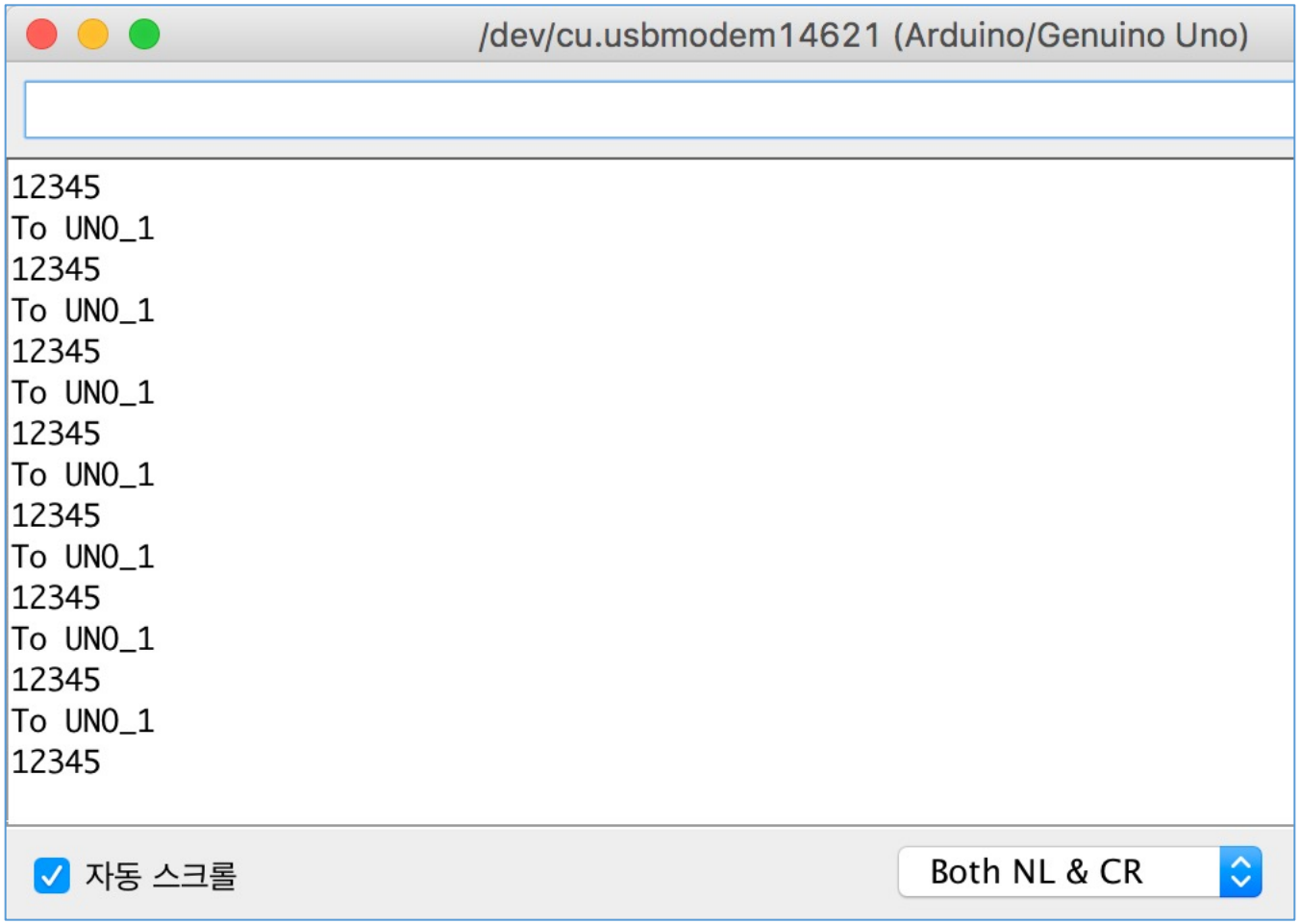
I2C_2_WAY_Server_m1

```
// UNO_1 : address=1
#include <Wire.h>

int LED=11 ;
char x = 0;

void setup() {
Wire.begin(1);
pinMode(LED,OUTPUT);
Serial.begin(9600) ;
Wire.onReceive(read_Character) ; // to receive from 5
Wire.onRequest(requestEvent_5) ;
delay(500) ;
}

//==========================
void read_Character() {
 x = Wire.read();    // read one character from the I2C
 Serial.println(x) ;
}

void loop() {
LED_Control() ; // Receive from 5 then control LED
delay(300) ;
}

//==========================
void  requestEvent_5() {
Wire.write("12345678") ;
 }

//======================
void LED_Control() {
 if (x == 'H') {
   digitalWrite(LED, HIGH);
 }

 else if (x == 'L') {
   digitalWrite(LED, LOW);
 }
}

```

I2C_2_Way_Slave_m1

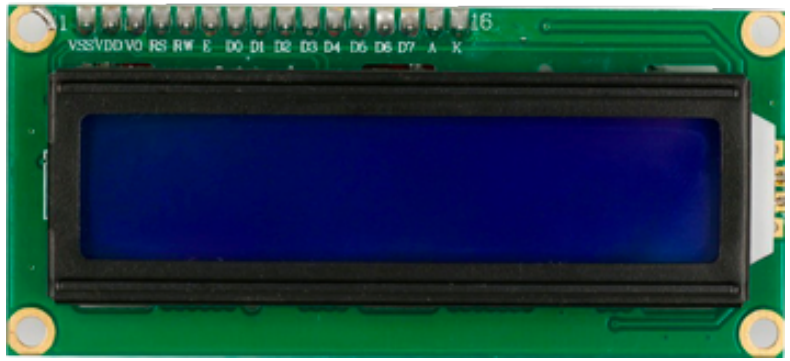
```
// Server address=5
#include <Wire.h>

void setup() {
 Wire.begin(5);
 Serial.begin(9600) ;
 }

void loop() {

request_1() ; // requst data from UNO_1

Send_to_1() ;   // send to UNO_1
}
//==========================
void request_1() {
Wire.requestFrom(1,5) ;

while(Wire.available()) {
   char c =Wire.read() ;
   Serial.print(c) ;
 }
 Serial.println("") ;
}

//==========================

void  Send_to_1() {
 Wire.beginTransmission(1);
 Wire.write('H');
 Wire.endTransmission();
  delay(500) ;
  Serial.println("To UNO_1 ");

 Wire.beginTransmission(1);
 Wire.write('L');
 Wire.endTransmission();
  delay(500) ;
 }

```

2-1) I2C : Between Arduino

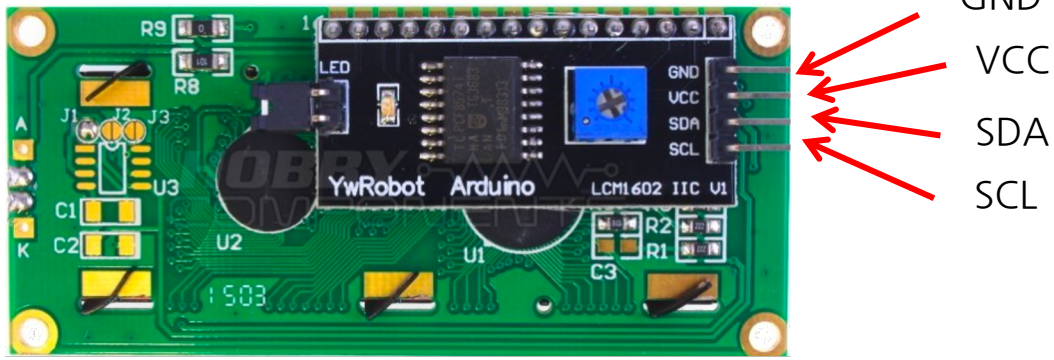


2-3) I2C LCD

I2C LCD :16X2



Front view



GND

VCC

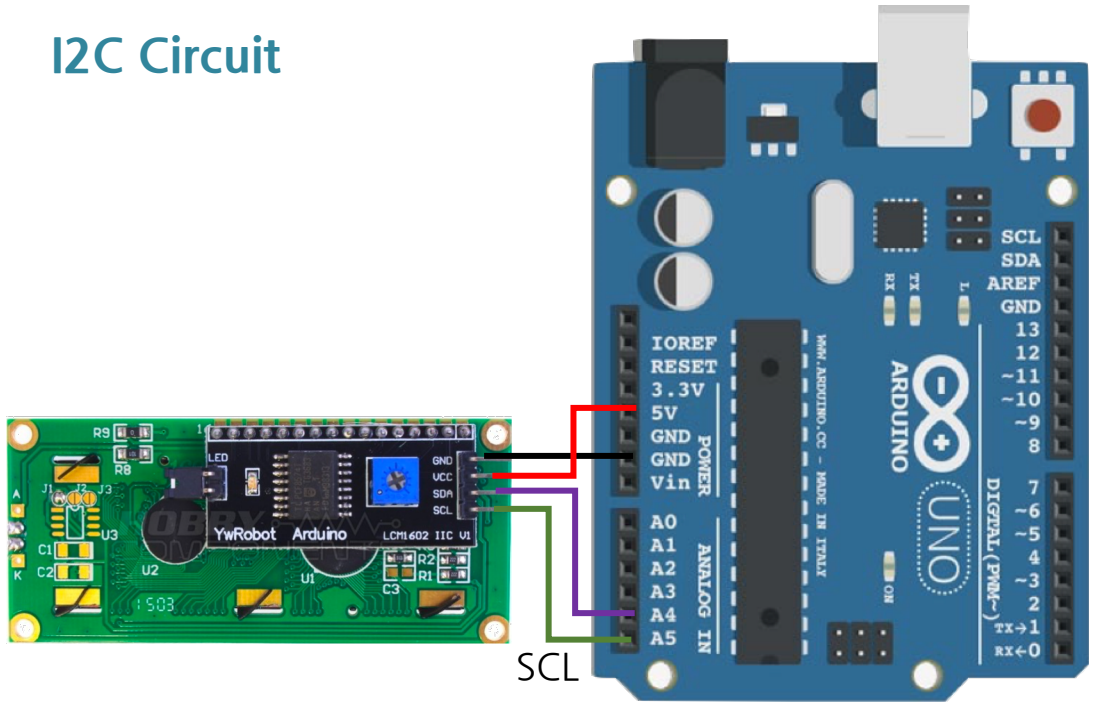
SDA

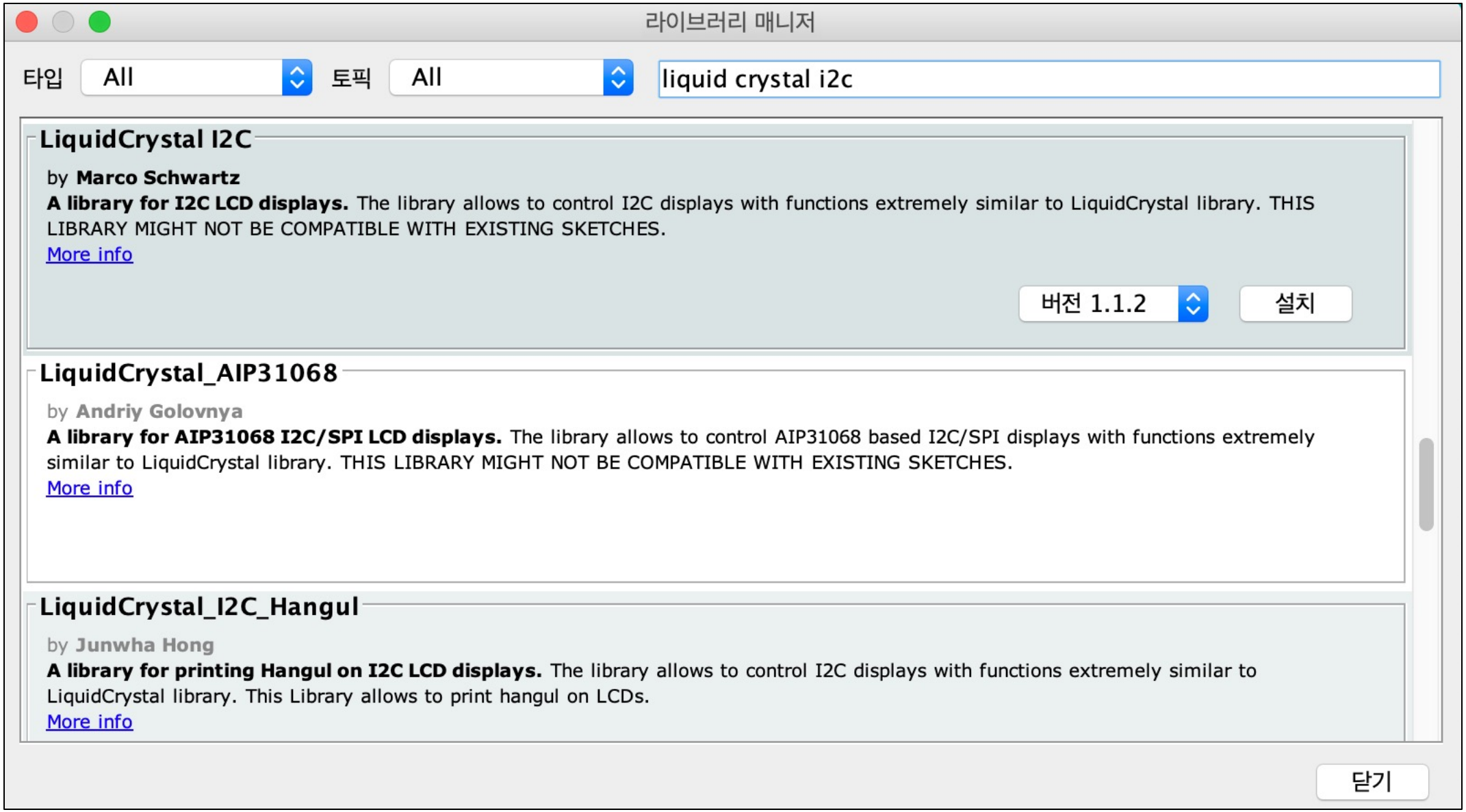
SCL

Rear view

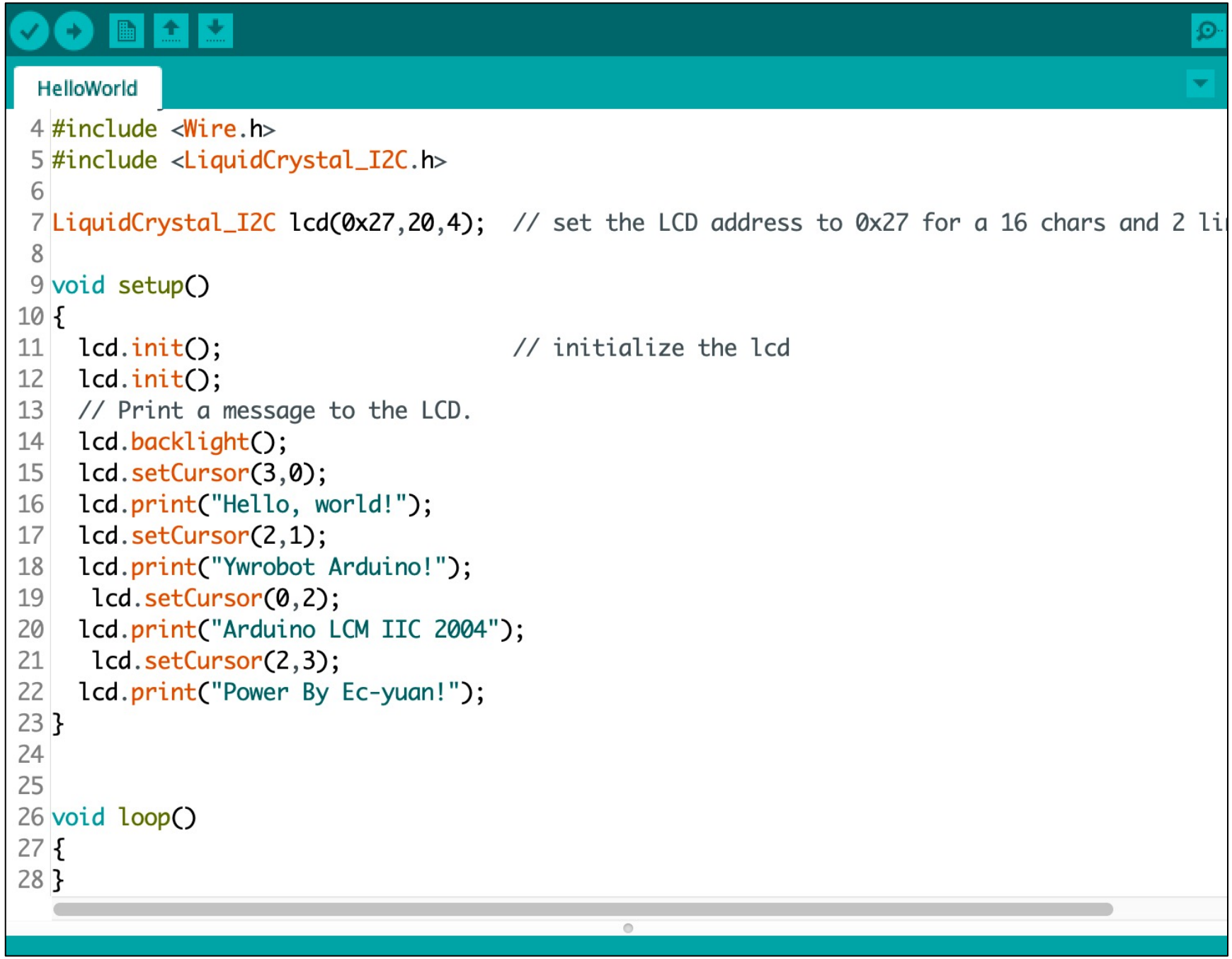
2-3) I2C LCD

I2C Circuit



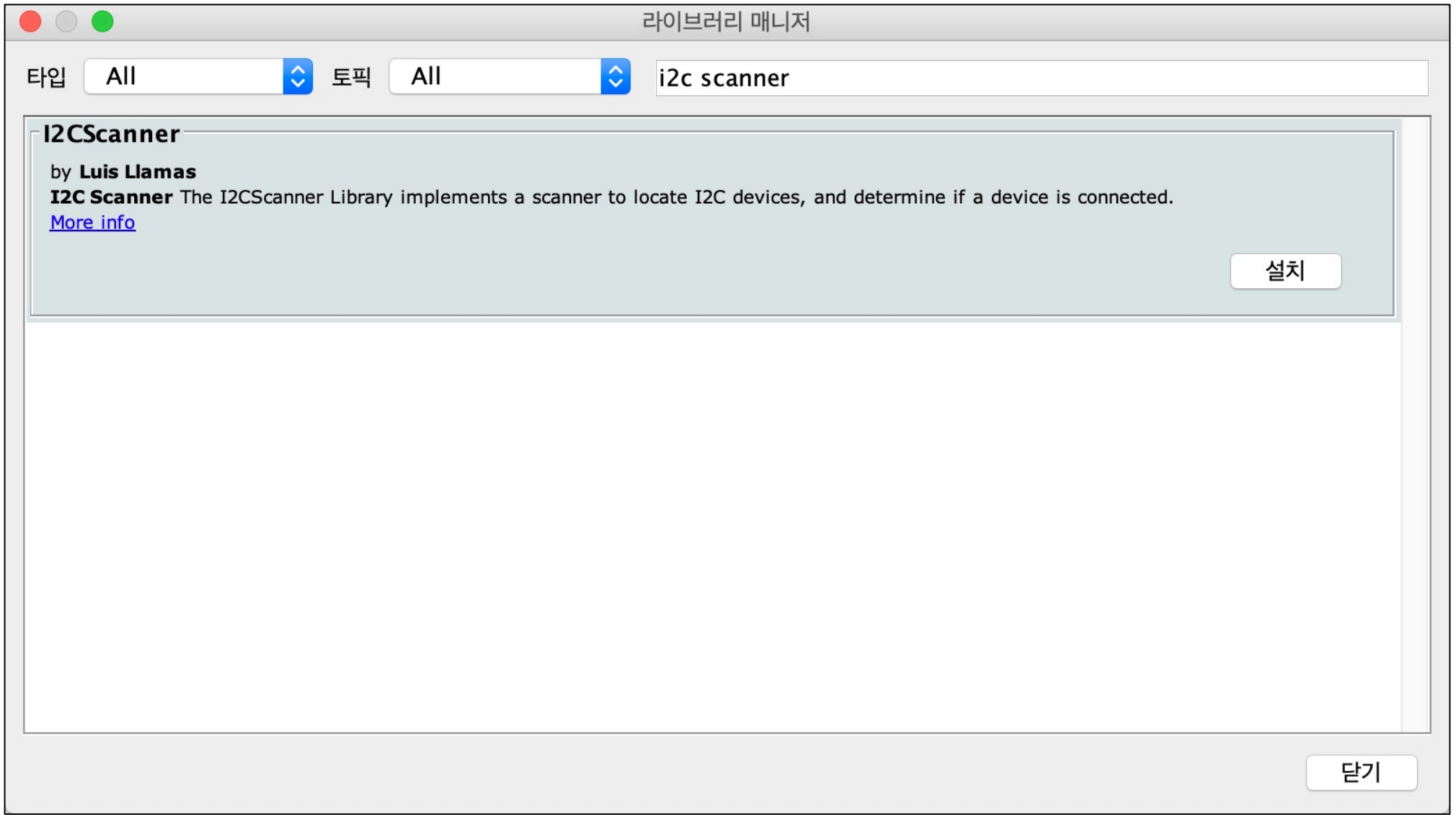

라이브러리 매니저
타입
All
토픽
All
liquid crystal i2c
LiquidCrystal I2C
by Marco Schwartz
A library for I2C LCD displays. The library allows to control I2C displays with functions extremely similar to LiquidCrystal library. THIS LIBRARY MIGHT NOT BE COMPATIBLE WITH EXISTING SKETCHES.
More info
버전 1.1.2
설치
LiquidCrystal_AIP31068
by Andriy Golovnya
A library for AIP31068 I2C/SPI LCD displays. The library allows to control AIP31068 based I2C/SPI displays with functions extremely similar to LiquidCrystal library. THIS LIBRARY MIGHT NOT BE COMPATIBLE WITH EXISTING SKETCHES.
More info
LiquidCrystal_I2C_Hangul
by Junwha Hong
A library for printing Hangul on I2C LCD displays. The library allows to control I2C displays with functions extremely similar to LiquidCrystal library. This Library allows to print hangul on LCDs.
More info
닫기

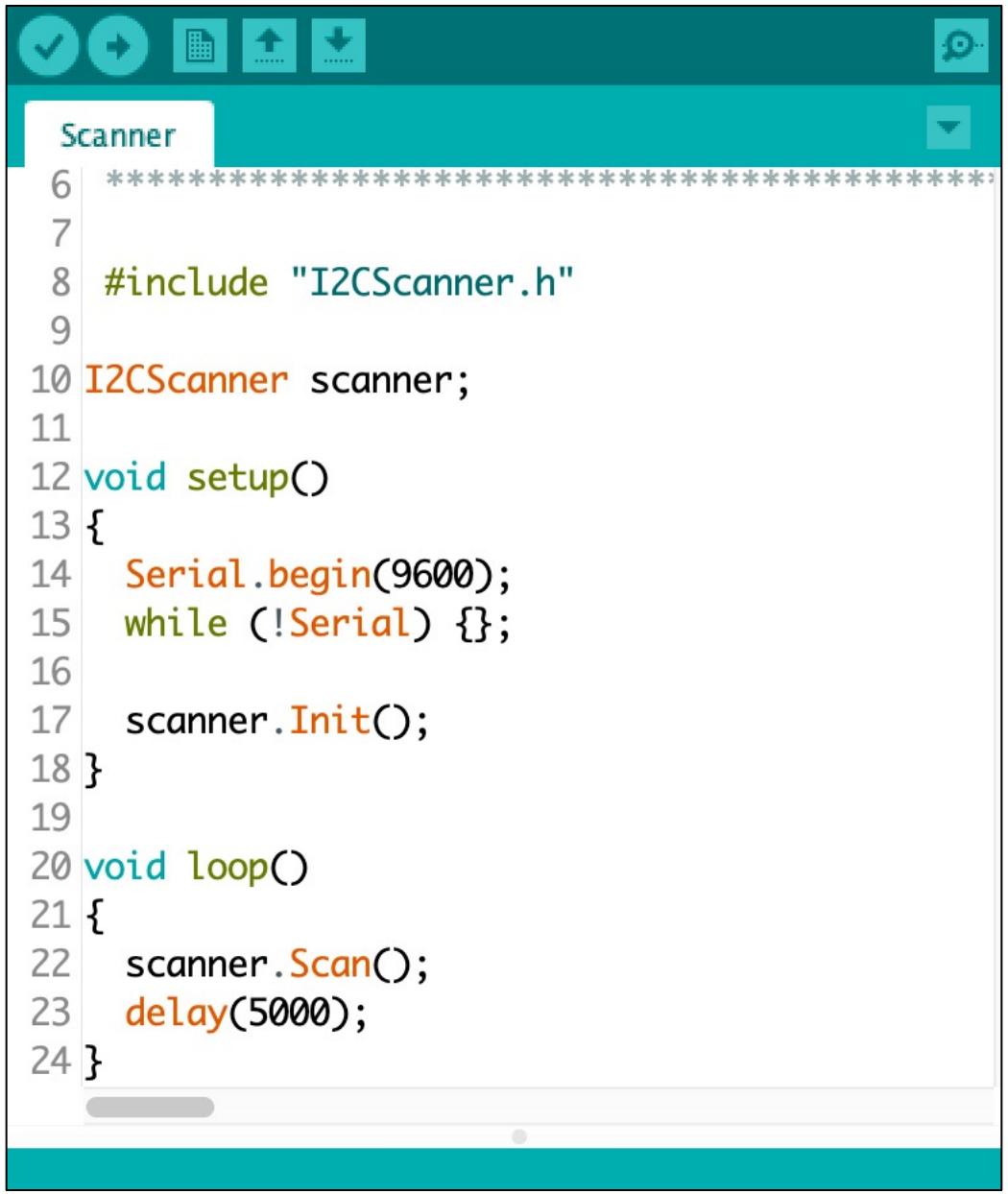

Arduino
파일
편집
스케치
툴
도움말
새 파일 ⌘N
열기... ⌘O
최근 파일 열기
스케치북
예제
닫기 ⌘W
저장 ⌘S
다른 이름으로 저장... ⇧⌘S
07.Display
08.Strings
09.USB
10.StarterKit_BasicKit
11.ArduinoISP
모든 보드의 예제
I2C
Lib3
LiquidCrystal I2C
Low-Power
MCP7940
CustomChars
HelloWorld
SerialDisplay

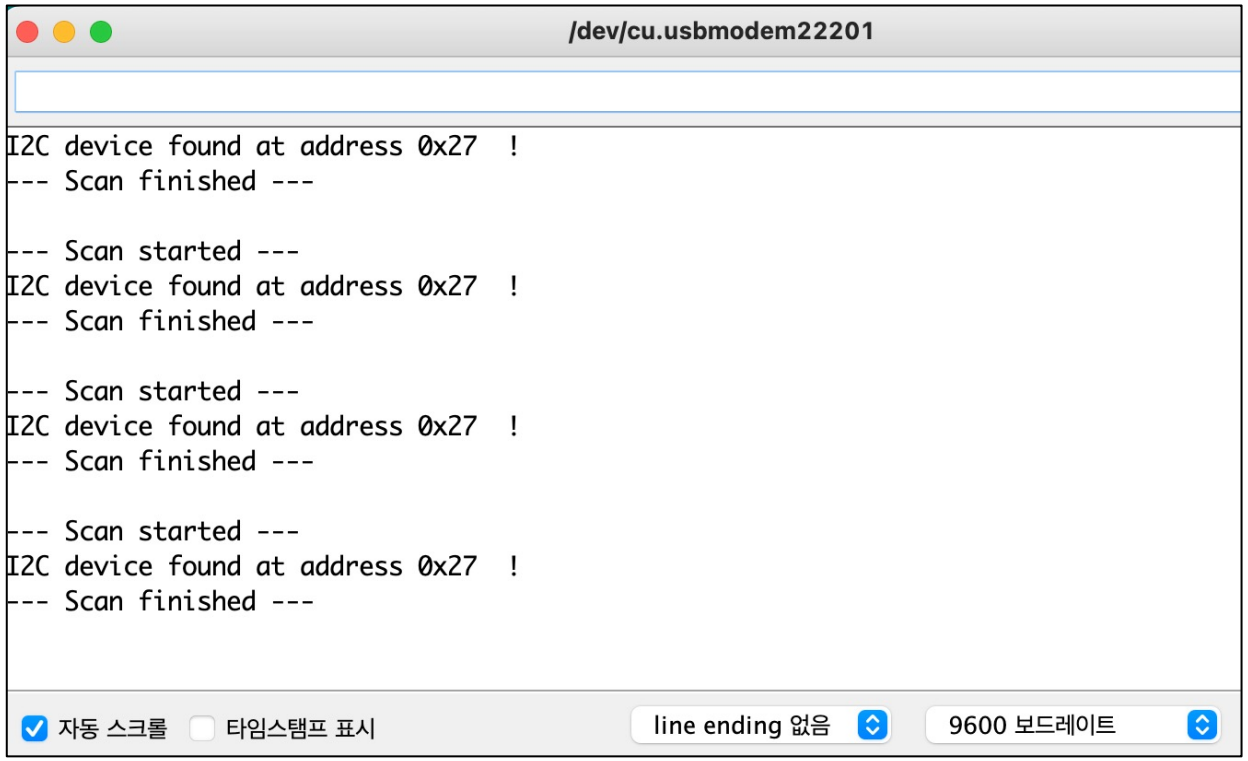

HelloWorld
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,20,4); // set the LCD address to 0x27 for a 16 chars and 2 li
void setup()
{
lcd.init();   // initialize the lcd
lcd.init();
// Print a message to the LCD.
lcd.backlight();
lcd.setCursor(3,0);
lcd.print("Hello, world!");
lcd.setCursor(2,1);
lcd.print("Ywrobot Arduino!");
lcd.setCursor(0,2);
lcd.print("Arduino LCM IIC 2004");
lcd.setCursor(2,3);
lcd.print("Power By Ec-yuan!");
}
void loop()
{
}

How to find 0x27

https://github.com/luisllamasbinaburo/Arduino-I2CScanner/tree/master/examples/Execute

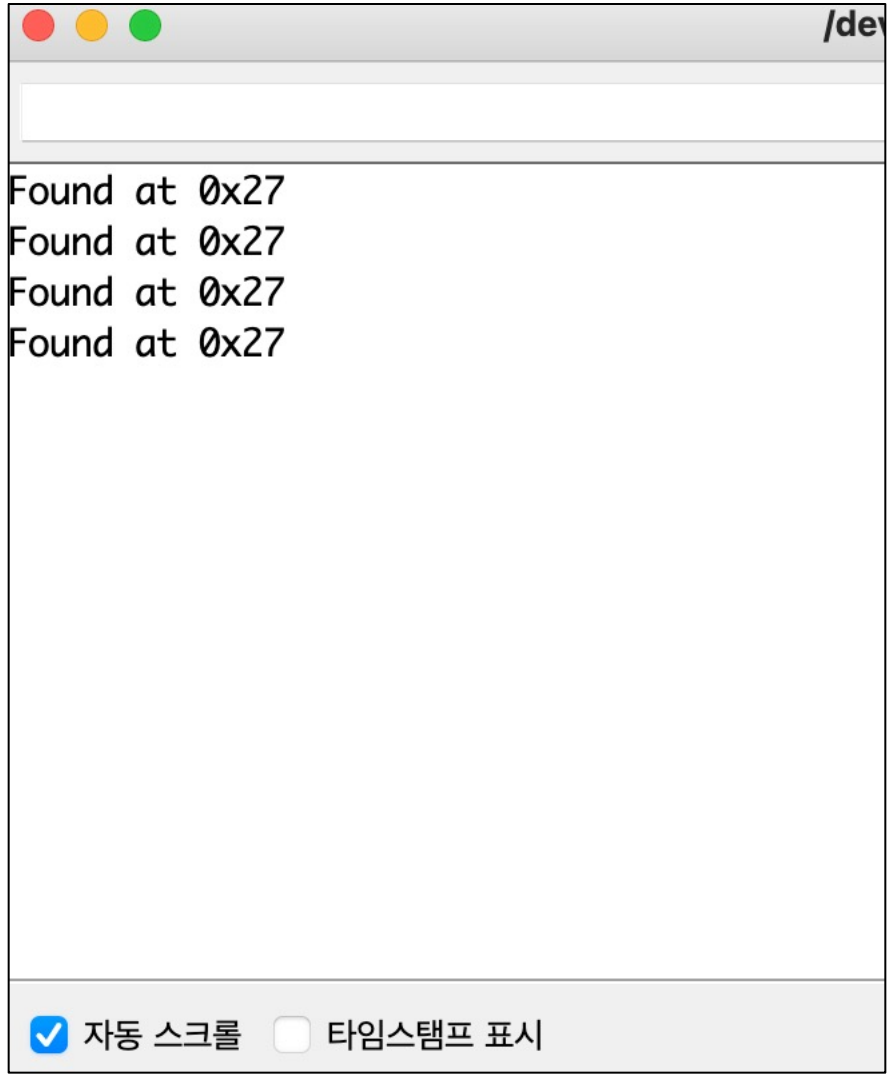



Scanner
6 **********
7
8 #include "I2CScanner.h"
9
10 I2CScanner scanner;
11
12 void setup()
13 {
14 Serial.begin(9600);
15 while (!Serial) {};
16
17 scanner.Init();
18 }
19
20 void loop()
21 {
22 scanner.Scan();
23 delay(5000);
24 }


/dev/cu.usbmodem22201
I2C device found at address 0x27 !
--- Scan finished ---
--- Scan started ---
I2C device found at address 0x27 !
--- Scan finished ---
--- Scan started ---
I2C device found at address 0x27 !
--- Scan finished ---
--- Scan started ---
I2C device found at address 0x27 !
--- Scan finished ---
자동 스크롤
타임스탬프 표시
line ending 없음
9600 보드레이트

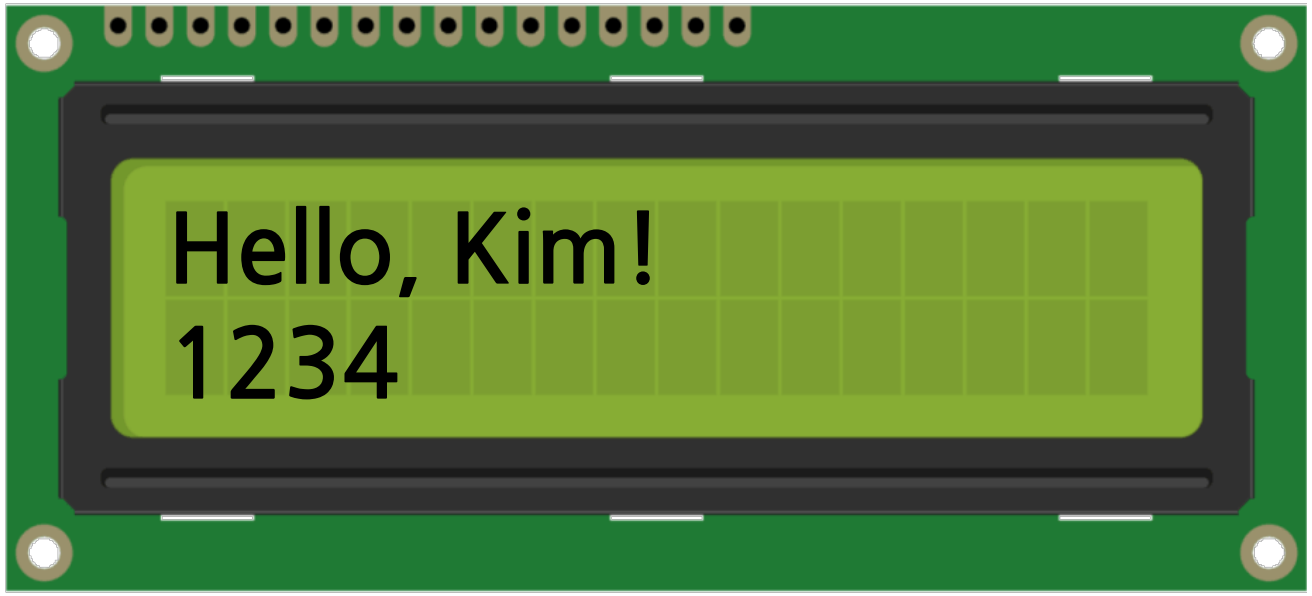
Execute

```
#include "I2CScanner.h"

I2CScanner scanner;

const byte address;

void debug(byte address)
{
  Serial.print("Found at 0x");
  Serial.println(address, HEX);
}

void setup()
{
  Serial.begin(9600);
  while (!Serial) {};

  scanner.Init();
}

void loop()
{
  scanner.Execute(debug);
  delay(5000);
}
```



Project：

Make first line your name and second line second counter



LiquidCrystal Library

This library allows an Arduino board to control LiquidCrystal displays (LCDs) based on the Hitachi HD44780 (or a compatible) chipset, which is found on most text-based LCDs. The library works with in either 4- or 8-bit mode (i.e. using 4 or 8 data lines in addition to the rs, enable, and, optionally, the rw control lines).

Examples

- Autoscroll: Shift text right and left.
- Blink: Control of the block-style cursor.
- Cursor: Control of the underscore-style cursor.
- Display: Quickly blank the display without losing what's on it.
- Hello World: Displays "hello world!" and the seconds since reset.
- Scroll: Scroll text left and right.
- Serial Display: Accepts serial input, displays it.

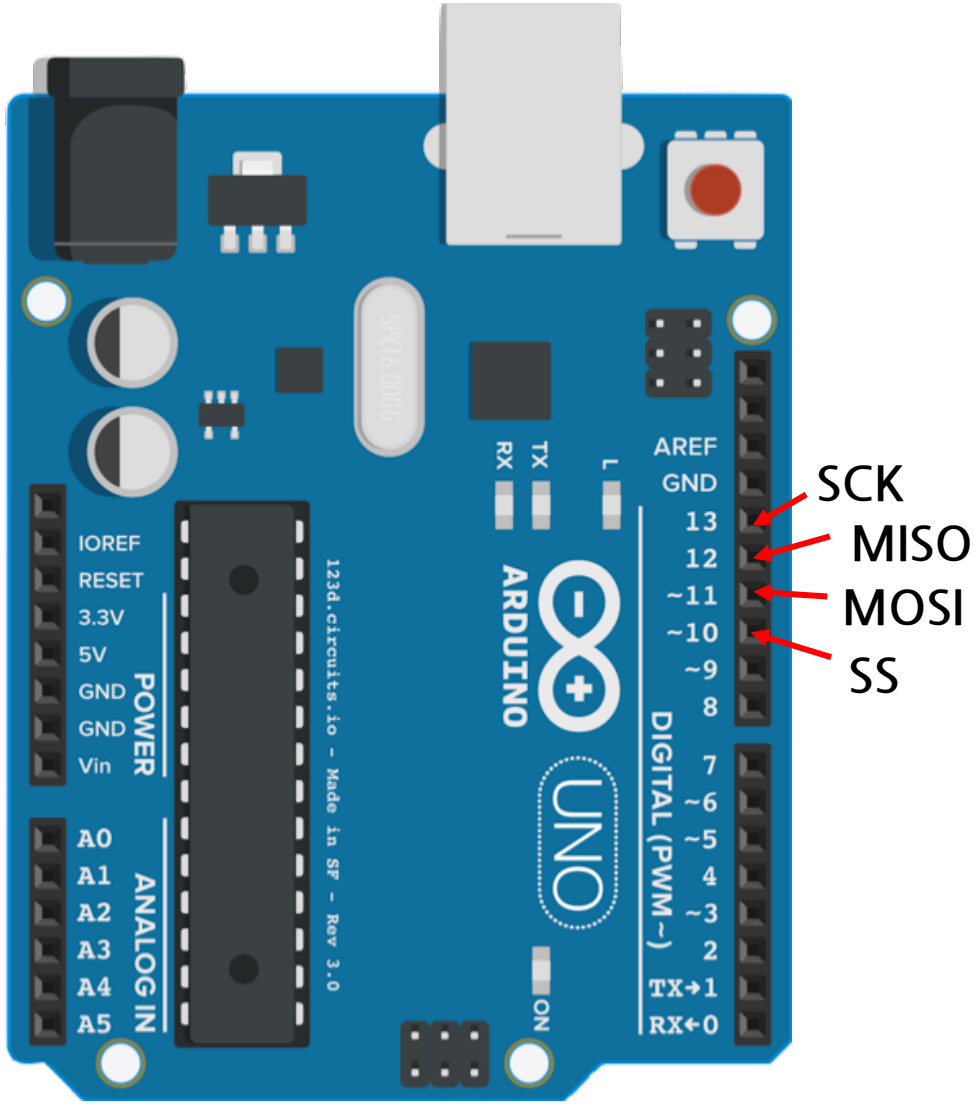
Function

- LiquidCrystal()
- begin()
- clear()
- home()
- setCursor()
- write()
- print()
- cursor()
- noCursor()
- blink()
- noBlink()
- display()

3) SPI

아두이노 와 여러개 센서 사이 고속 통신 방법(1:N)

SPI: Serial Peripheral Interface



SCK(System ClocK)

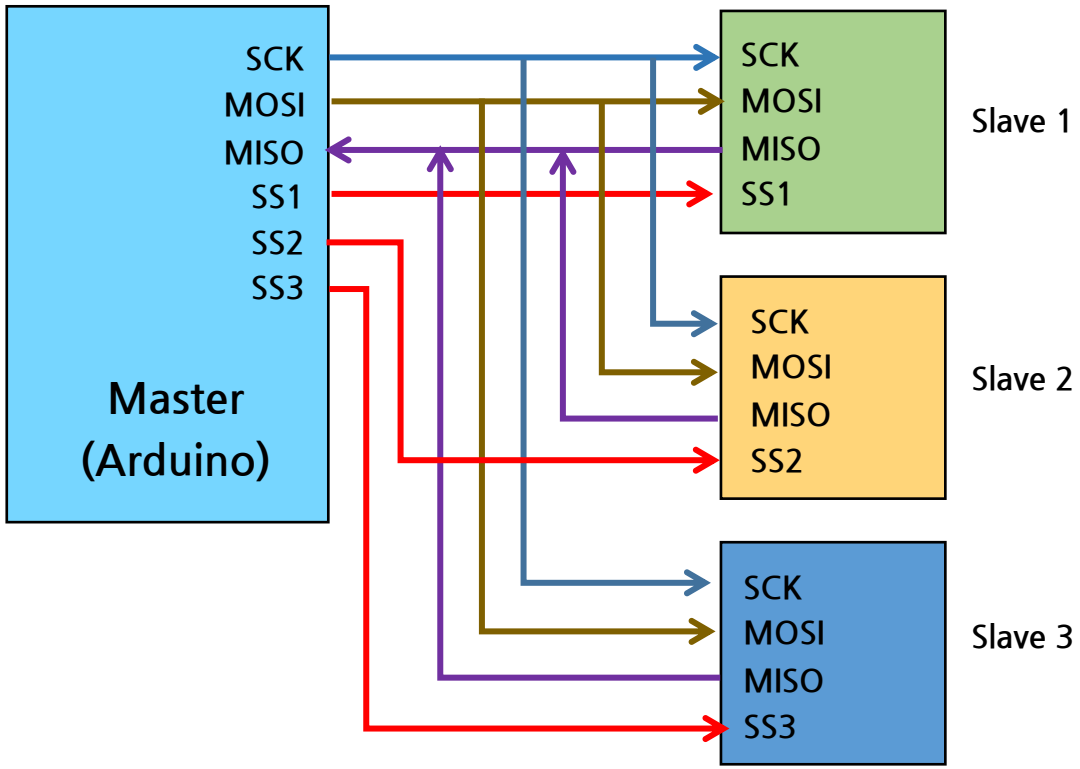
MISO(Master In Slave Out)

MOSI(Master Out Slave In)

SS(Slave Select)

3-1) SPI-circuit

Circuit



유선 통신 방법 비교표

통신방법	최대속도	사용거리	장점	단점
UART	115 Kbs	40m <	사용간편	연결 부품수
I^2C	400 Kbs	짧다	많은 부품 연결	속도
SPI	20 Mbs	매우 짧다	사용간편	연결 부품수

RFID Card and Reader

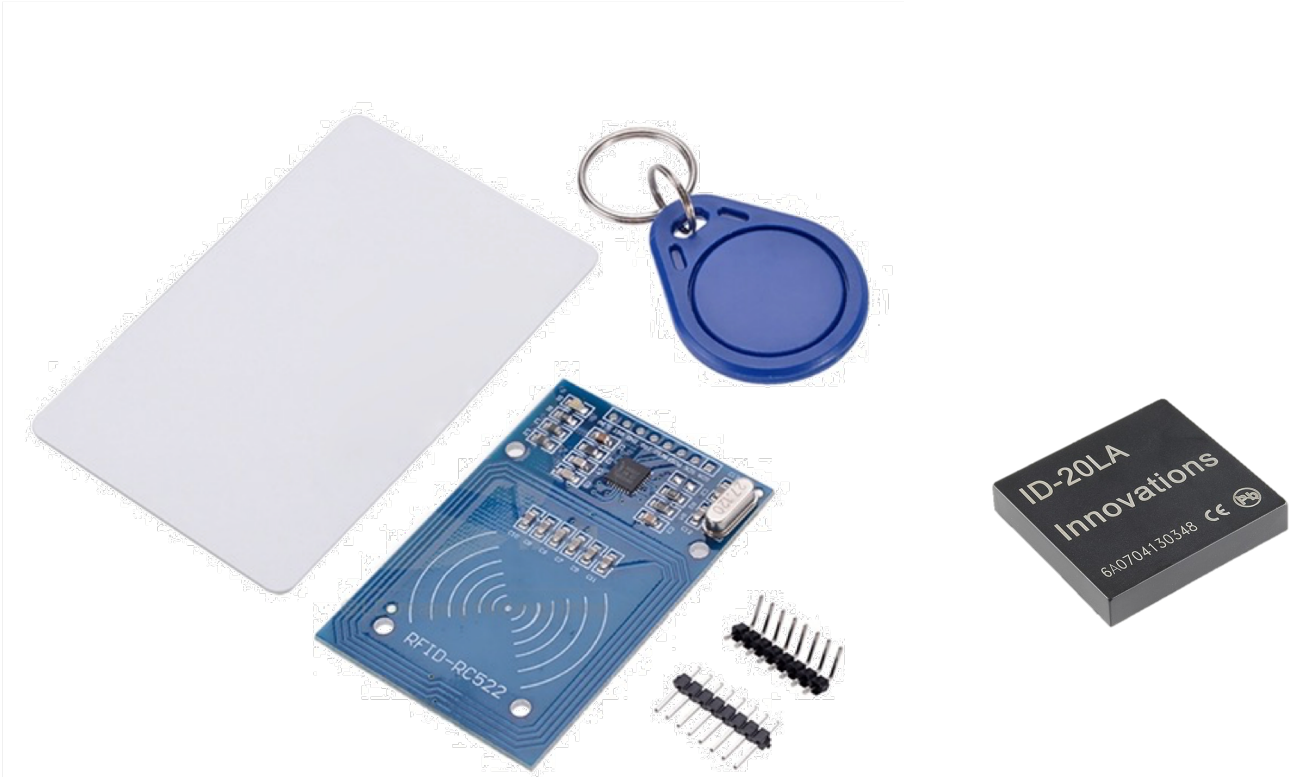
3-2) RFID Card and Reader

Active type and Passive type

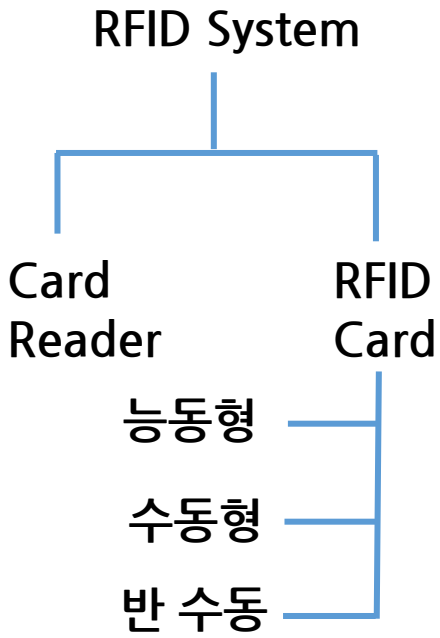
High-pass 는 Active type

Door 카드는 Passive type

RFID 카드 와 리더기



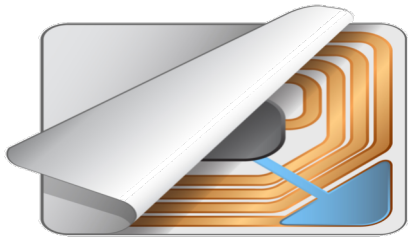
3-2) RFID Card and Reader



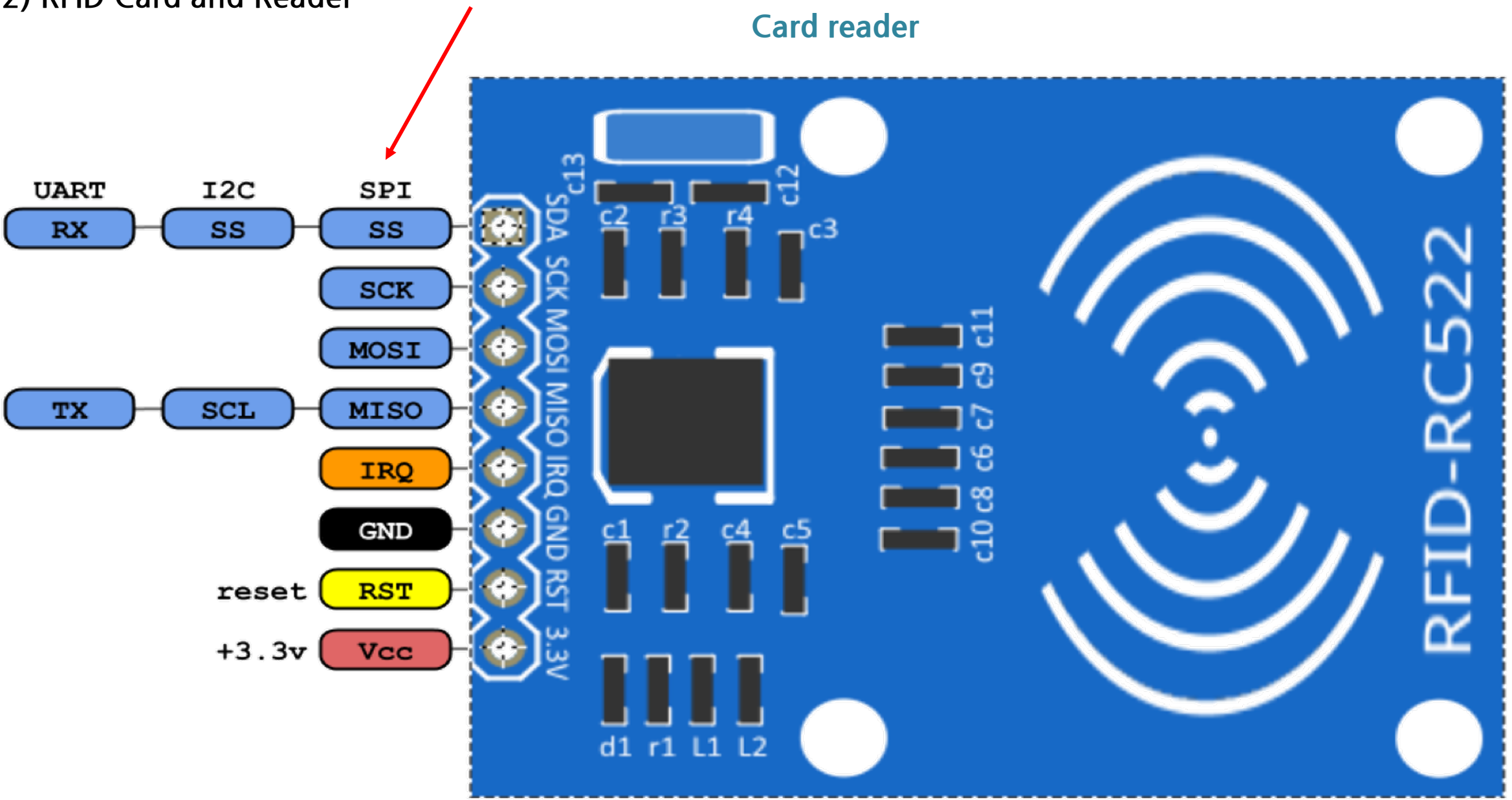
3-2) RFID Card and Reader

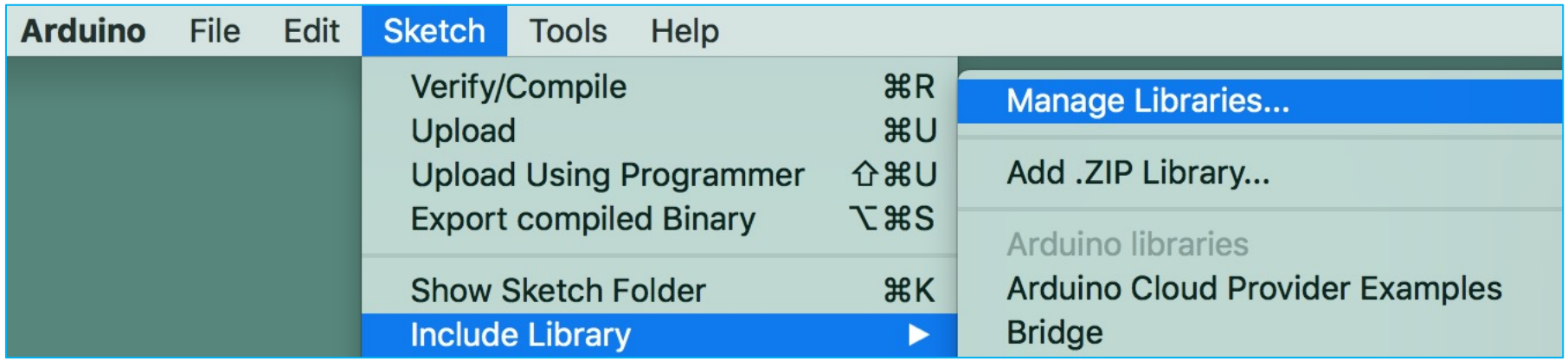
수동 타입 RFID 카드가 작동 방법:

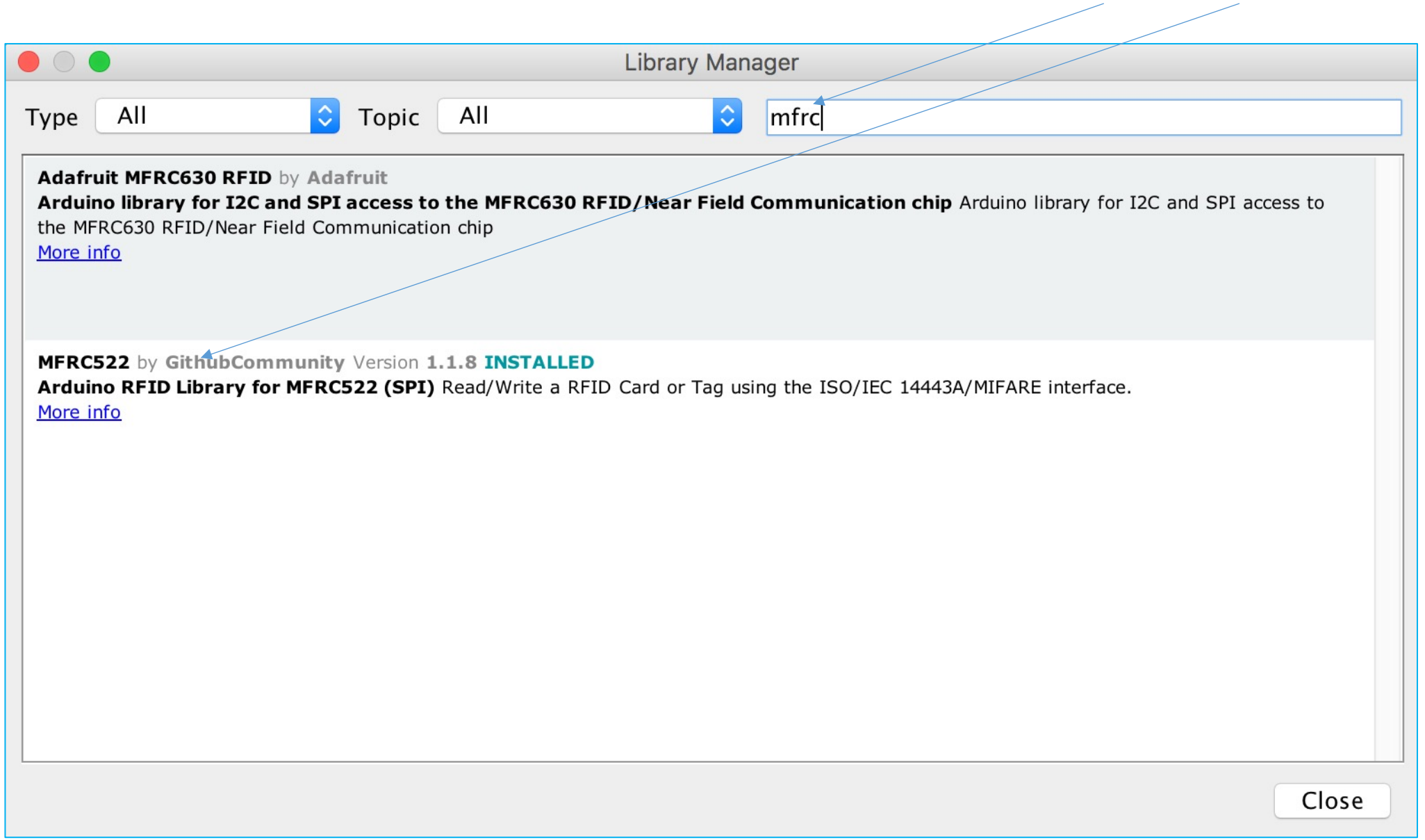
1. 리더기에서 전자기장 발생
2. 카드의 안테나 코일 이 전자기파를 받아 전기에너지로 전환
3. 전기에너지로 카드에 있는 정보를 리더기에 전송
4. 리더기는 수신받은 데이터를 읽어 카드의 ID 파악



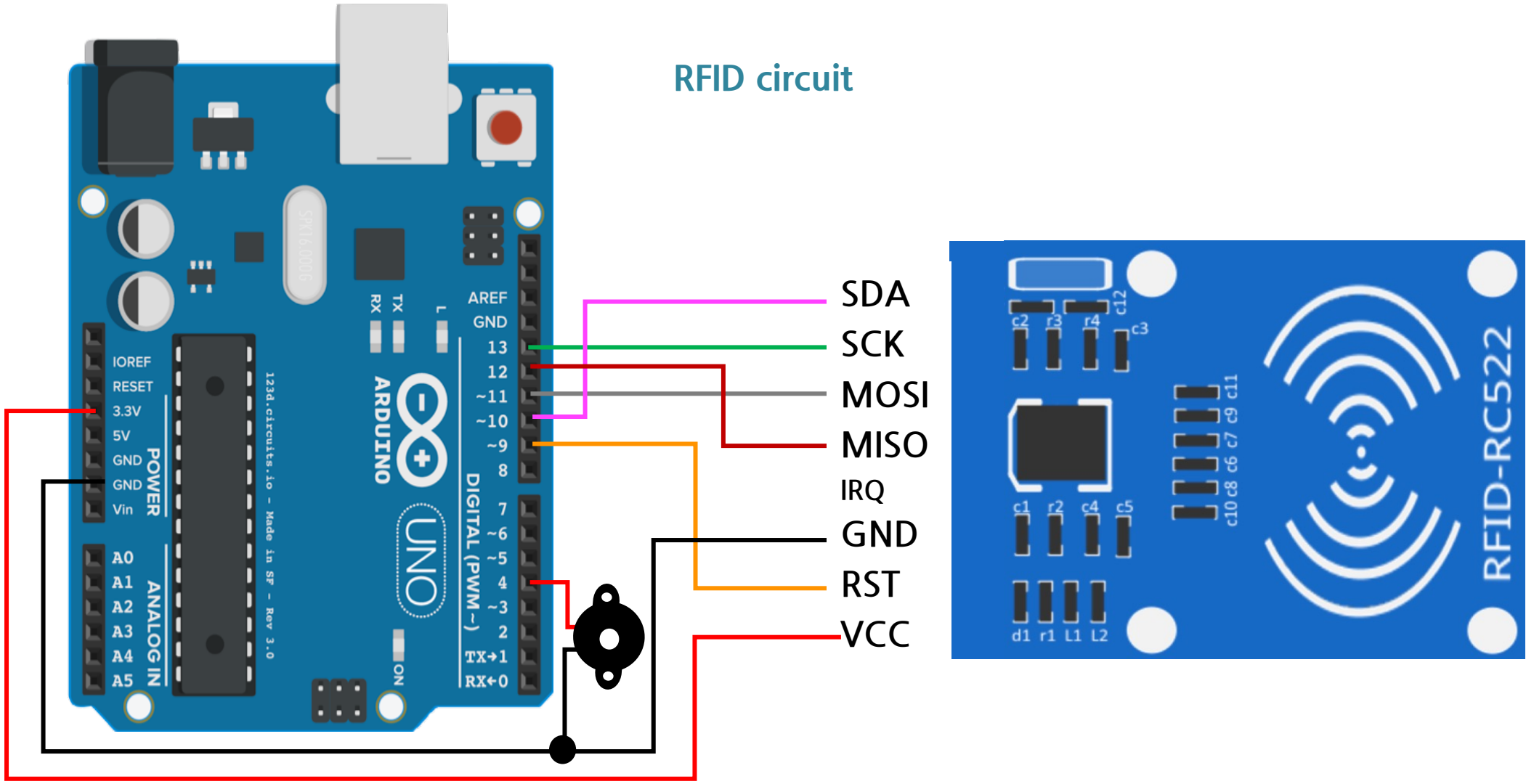
3-2) RFID Card and Reader



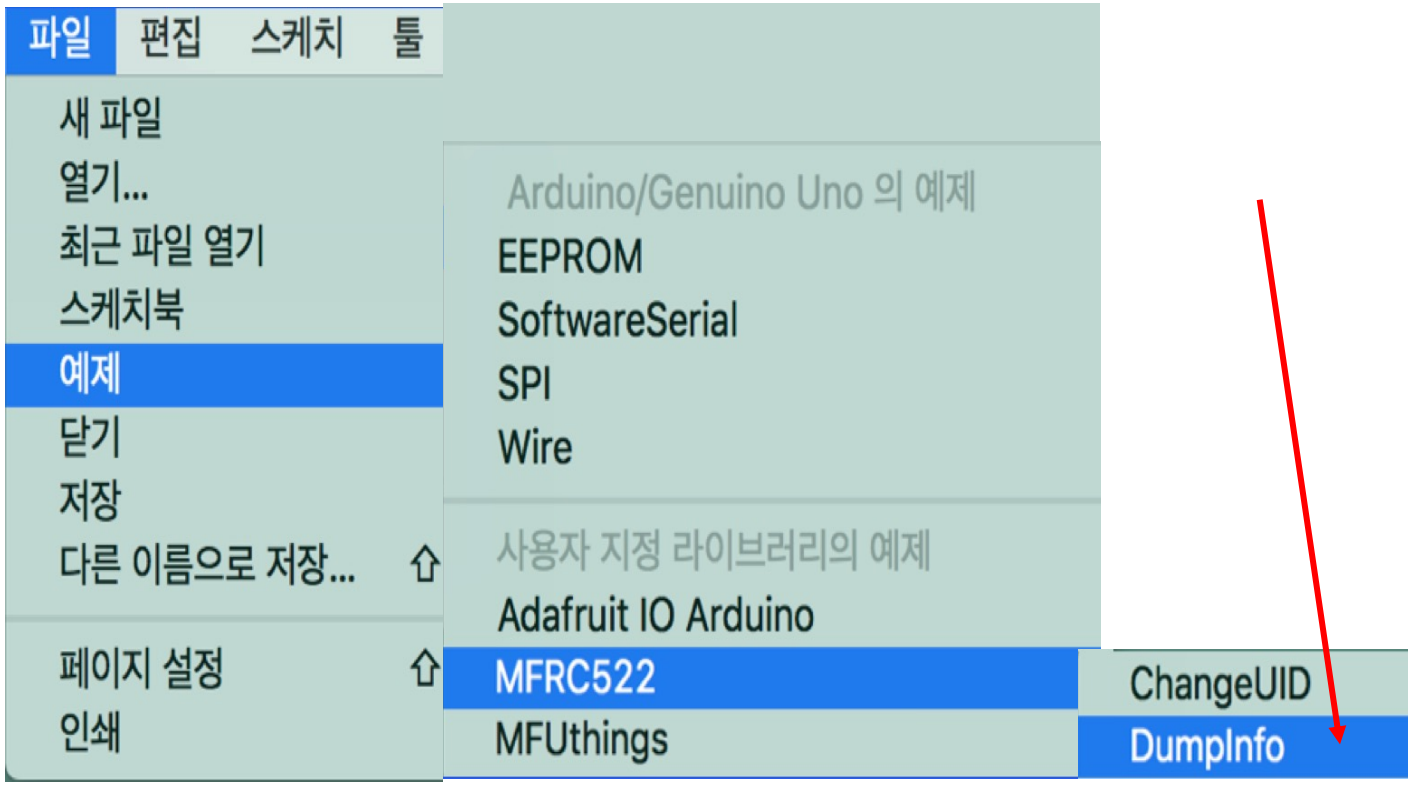

Arduino
File
Edit
Sketch
Tools
Help
Verify/Compile ⌘R
Upload ⌘U
Upload Using Programmer ⇧⌘U
Export compiled Binary ⌥⌘S
Show Sketch Folder ⌘K
Include Library ▶
Manage Libraries...
Add .ZIP Library...
Arduino libraries
Arduino Cloud Provider Examples
Bridge


Library Manager
Type
All
Topic
All
mfrc
Adafruit MFRC630 RFID by Adafruit
Arduino library for I2C and SPI access to the MFRC630 RFID/Near Field Communication chip Arduino library for I2C and SPI access to the MFRC630 RFID/Near Field Communication chip
More info
MFRC522 by GithubCommunity Version 1.1.8 INSTALLED
Arduino RFID Library for MFRC522 (SPI) Read/Write a RFID Card or Tag using the ISO/IEC 14443A/MIFARE interface.
More info
Close

3-2) RFID Card and Reader



3-2) RFID Card and Reader



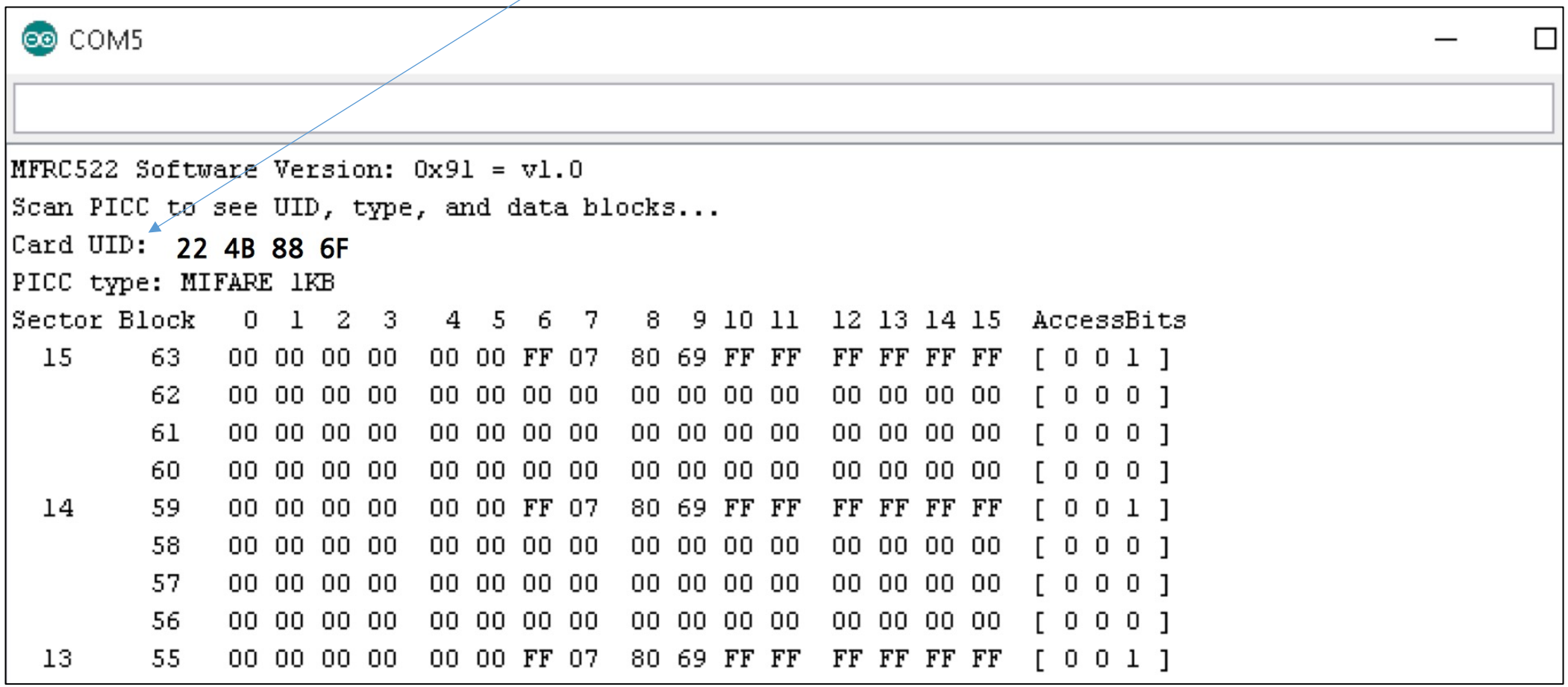
3-2) RFID Card and Reader

Dumpinfo Sketch

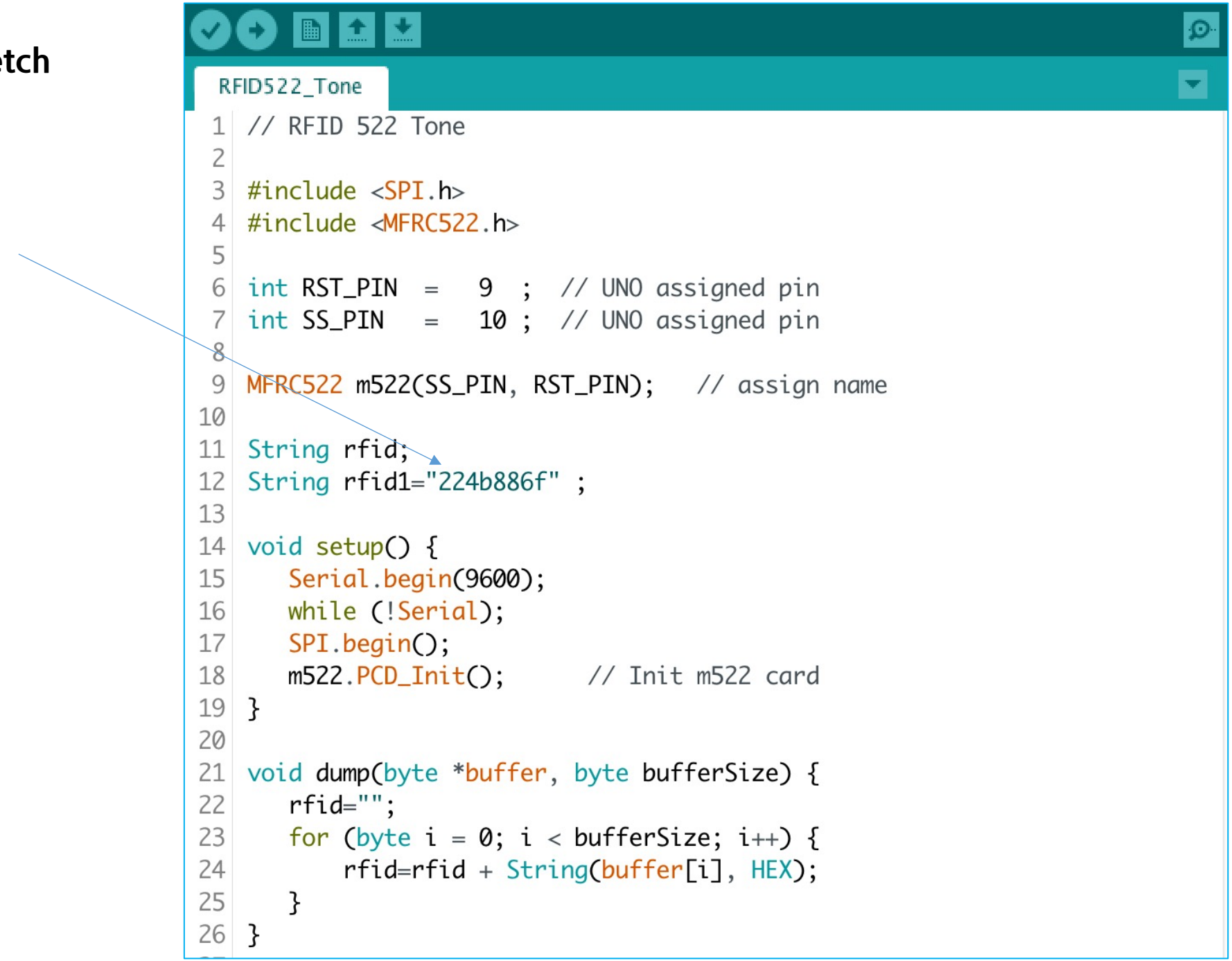
DumpInfo

```
35
36 #include <SPI.h>
37 #include <MFRC522.h>
38
39 #define RST_PIN         9          // Configurable, see typical pin
40 #define SS_PIN          10         // Configurable, see typical pin
41
42 MFRC522 mfrc522(SS_PIN, RST_PIN);  // Create MFRC522 instance
43
44 void setup() {
45   Serial.begin(9600);   // Initialize serial communications with the
46   while (!Serial);    // Do nothing if no serial port is opened (add
47   SPI.begin();      // Init SPI bus
48   mfrc522.PCD_Init();   // Init MFRC522
49   mfrc522.PCD_DumpVersionToSerial();  // Show details of PCD - MFRC5
50   Serial.println(F("Scan PICC to see UID, SAK, type, and data blocks
51 }
```

Dumpinfo result



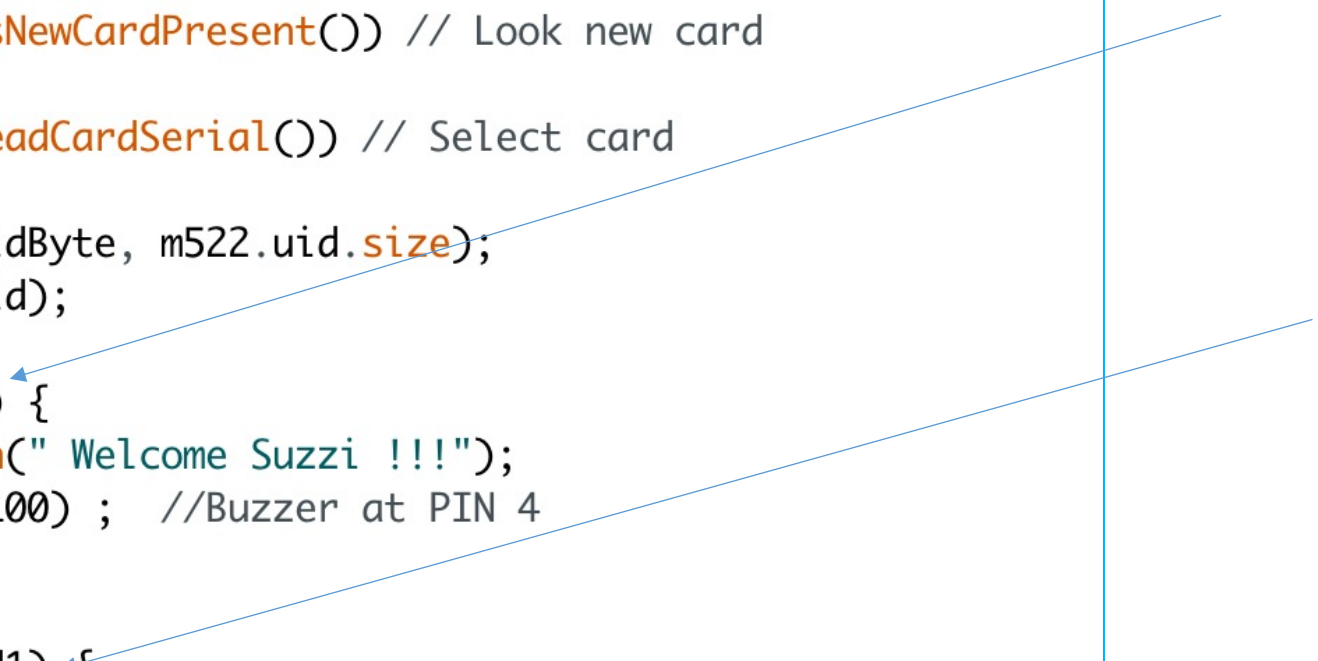
New Sketch



RFID522_Tone

```
// RFID 522 Tone

#include <SPI.h>
#include <MFRC522.h>

int RST_PIN  =   9  ;  // UNO assigned pin
int SS_PIN   =   10 ;  // UNO assigned pin

MFRC522 m522(SS_PIN, RST_PIN);   // assign name

String rfid;
String rfid1="224b886f" ;

void setup() {
   Serial.begin(9600);
   while (!Serial);
   SPI.begin();
   m522.PCD_Init();      // Init m522 card
}

void dump(byte *buffer, byte bufferSize) {
   rfid="";
   for (byte i = 0; i < bufferSize; i++) {
       rfid=rfid + String(buffer[i], HEX);
   }
}
```

```
27
28 void loop() {
29
30 if ( ! m522.PICC_IsNewCardPresent()) // Look new card
31         return;
32 if ( ! m522.PICC_ReadCardSerial()) // Select card
33         return;
34    dump(m522.uid.uidByte, m522.uid.size);
35    Serial.print(rfid);
36
37    if (rfid==rfid1) {
38      Serial.println(" Welcome Suzzi !!!");
39      tone(4, 300, 100) ;  //Buzzer at PIN 4
40      delay(500);
41    }
42    if (rfid != rfid1) {
43      Serial.println(" Alert ");
44      tone(4, 3000, 1500) ;
45      delay(500);
46    }
47 }
```



Ch10. IR Sensor

1) IR Distance sensor

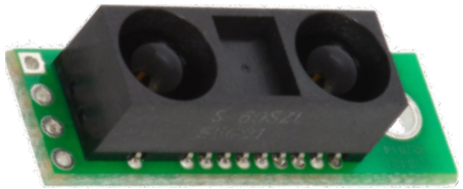
2) IR (TCRT5000)

IR Sensor

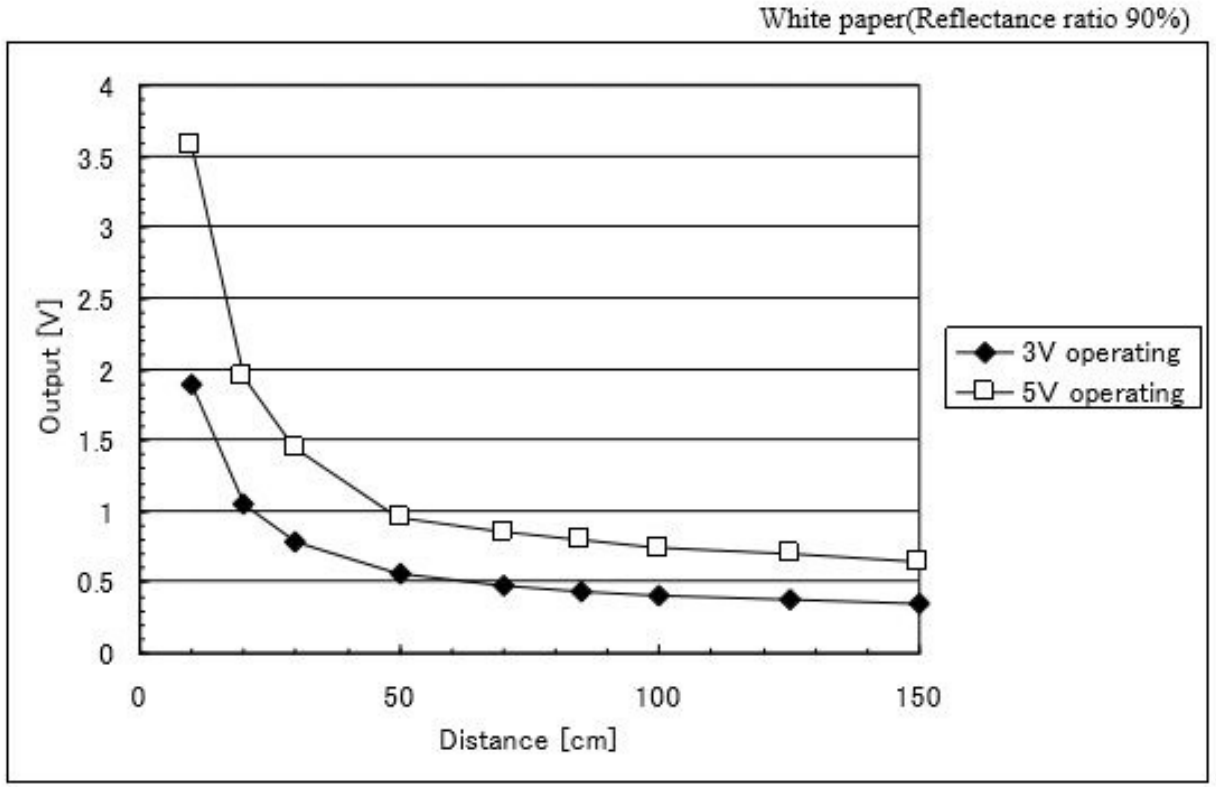
목적 : IR Distance sensor 이해 및 길이 측정 방법

준비물 :

- 아두이노 우노 1 개
- 브래드보드 1개
- GPY Sharp Distance sensor
- 점퍼케이블



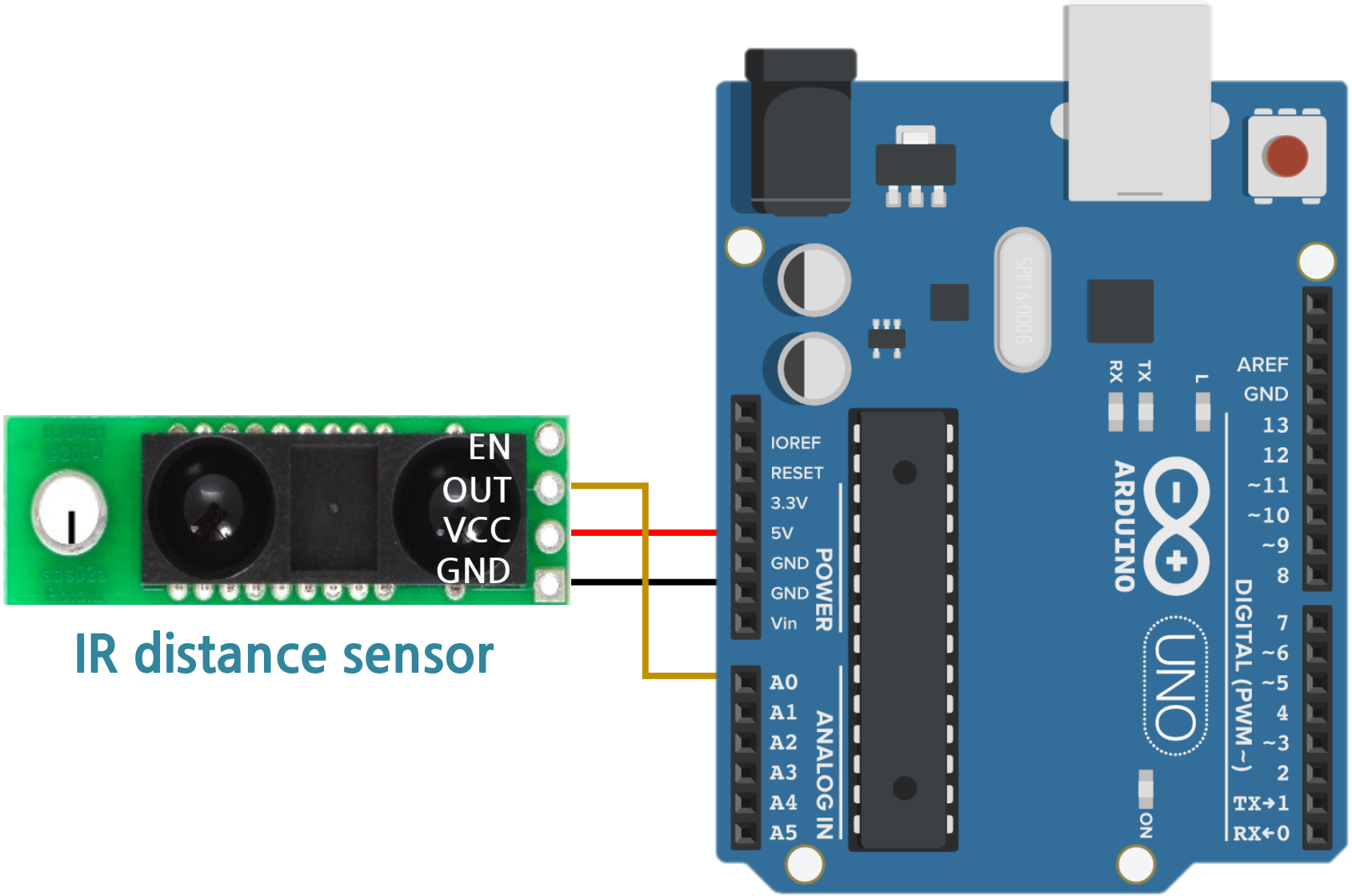
1) IR Distance sensor



IR distance sensor

http://www.instructables.com/id/How-to-setup-a-Pololu-Carrier-with-Sharp-GP2Y0A60S/

1) IR Distance sensor



IR distance sensor

1) IR Distance sensor

For calibration

IR_Distance_sensor

```
 calibrating the Infra-Red sensor mean of 500 values
*/
long sensorsum = 0;
int n = 1;
int mean = 0;
int lastmean = 0;

// The setup routine runs once when you press reset:
void setup() {
  // Sets pin 13 for output in order to blink the LED:
  pinMode(13, OUTPUT);
  // Initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
}

void loop() {

  int sensorValue = analogRead(A0);

  // Calculate mean to smooth the results for regression line
  sensorsum = (sensorsum + sensorValue);
  mean = (sensorsum / n);
  n = n + 1;

  if (n > 5) {  // 500
    delay(5);  //250
  //  Serial.println("-----RESET------------");
    n = 1;
    sensorsum = 0;
    lastmean = mean;
  }

  Serial.print(" Mean = ");
  Serial.print(mean);
  Serial.print(" Last Mean = ");

  Serial.print(lastmean);
   Serial.print(" Dist = ");
  float Dist = (1./lastmean)*10000 ;
  Serial.println(Dist) ;
  delay(25);
}
```

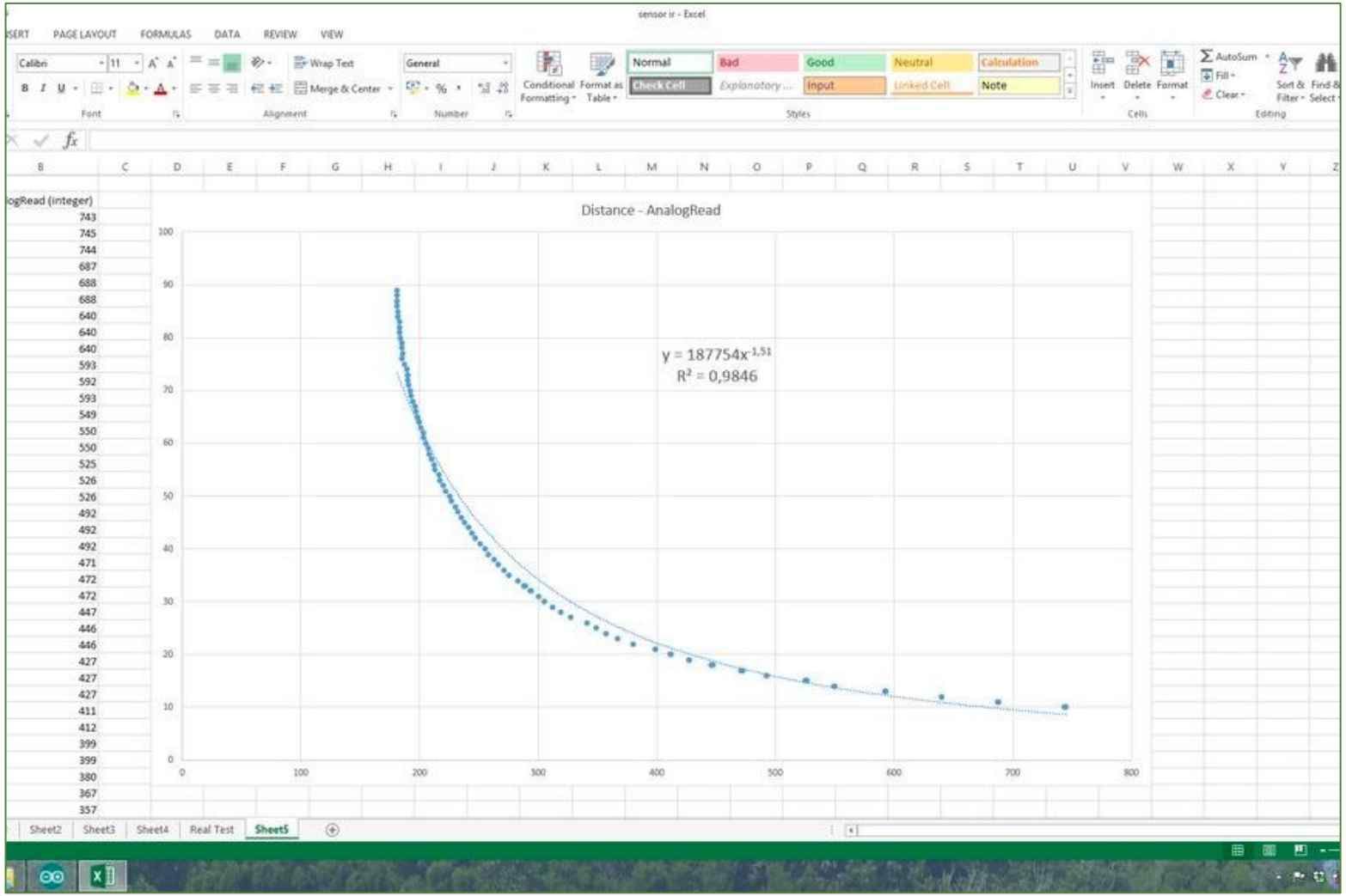
1) IR Distance sensor

IR_Distance_sensor_Calibed

```
1
2  // Sharp GP2Y0A60SZLF  10~150 cm, 5V, Analog Distance sensor
3  //  VCC - 5V, GND - GND, out - A0, EN  - not connect
4
5
6  float sensorValue = 0;
7  int Sum_Value ;
8
9
10 void setup() {
11   Serial.begin(9600);
12 }
13
14 void loop() {
15   sensorValue = analogRead(A0);
16
17   float Dist =pow(sensorValue, -1.51)*188854 ; // Regressioned
18
19   Serial.print(" Dist = ");
20   Serial.println(Dist,1) ;
21   delay(300);
22 }
```

1) IR Distance sensor

$Y=187754X^{-1.51}$



IR distance sensor