

온도(습도) 센서활용

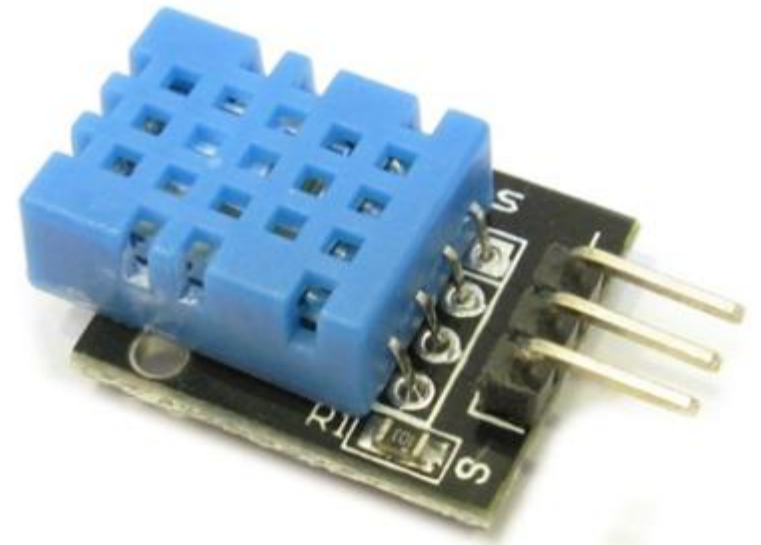
DHT11 vs TMP36

목표

- 라이브러리를 이용한 DHT11 센서 데이터 확인 및 활용
- TMP36 온도 센서의 데이터 확인 및 활용
- TMP36과 DHT11 센서 데이터 비교 실험
- 마이크센서 실험
- 3색LED 실험 → CCD센서(이미지)

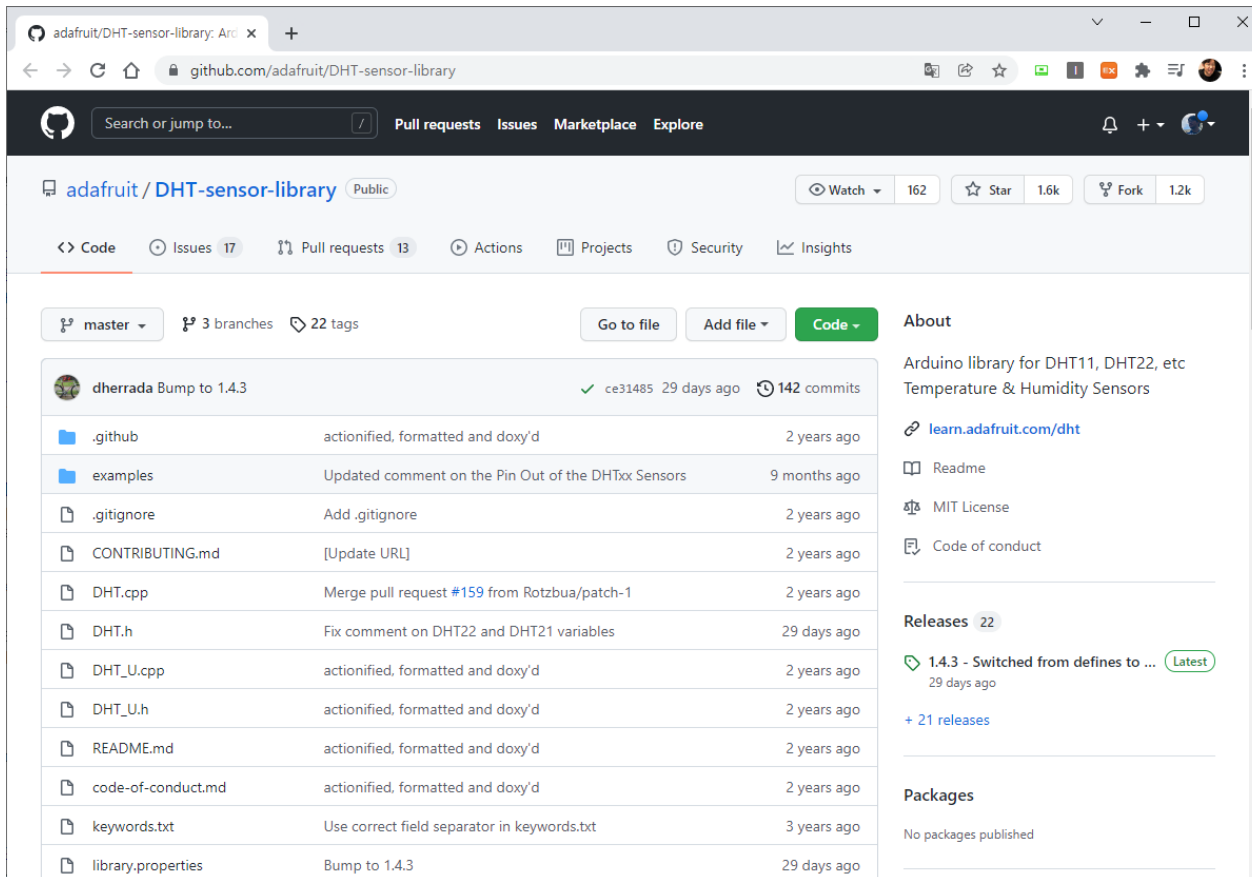
DHT11

- 동작 전압 (Power) 3~5 V
- 온도 측정 범위 (Temperature range) 0 ~ 50 °C (± 2 °C)
- 습도 측정 범위 (Humidity range) 20 ~ 80 % (± 5 %)
- 최대소비전력 (Max. current) 2.5 mA
- 데이터 주기 (sampling rate) 1 Hz



DHT11 라이브러리 사용

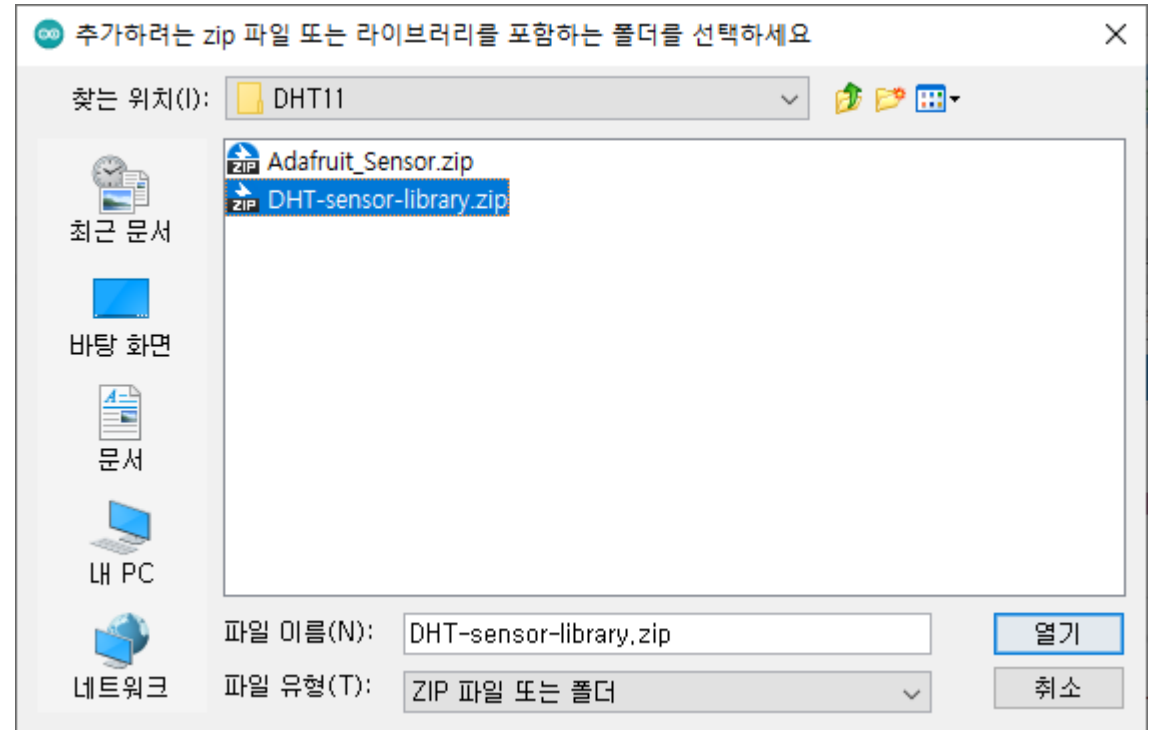
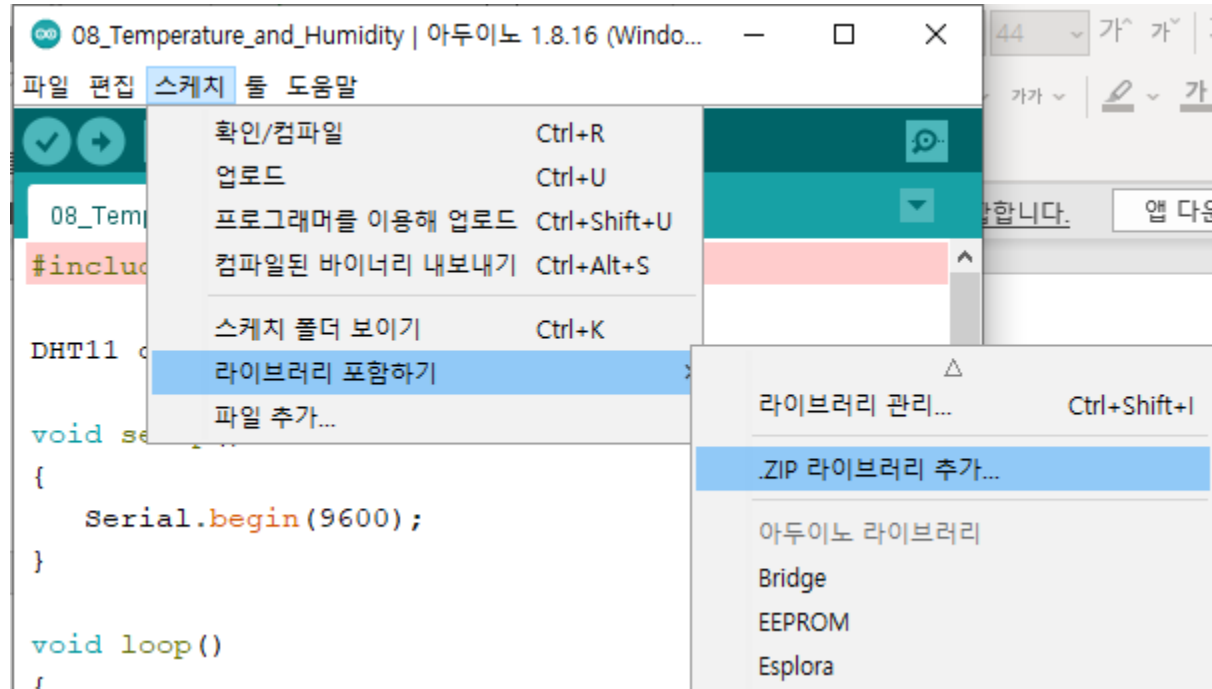
- <https://github.com/adafruit/DHT-sensor-library>



The screenshot shows the GitHub repository page for `adafruit/DHT-sensor-library`. The repository is public and has 162 watchers, 1.6k stars, and 1.2k forks. It contains 3 branches and 22 tags. The main branch is `master`. The repository description is "Arduino library for DHT11, DHT22, etc Temperature & Humidity Sensors". The repository includes a README, MIT License, and Code of conduct. The latest release is 1.4.3, which was switched from defines to ... 29 days ago. The repository also has 21 releases in total. The file list shows the following files and their commit history:

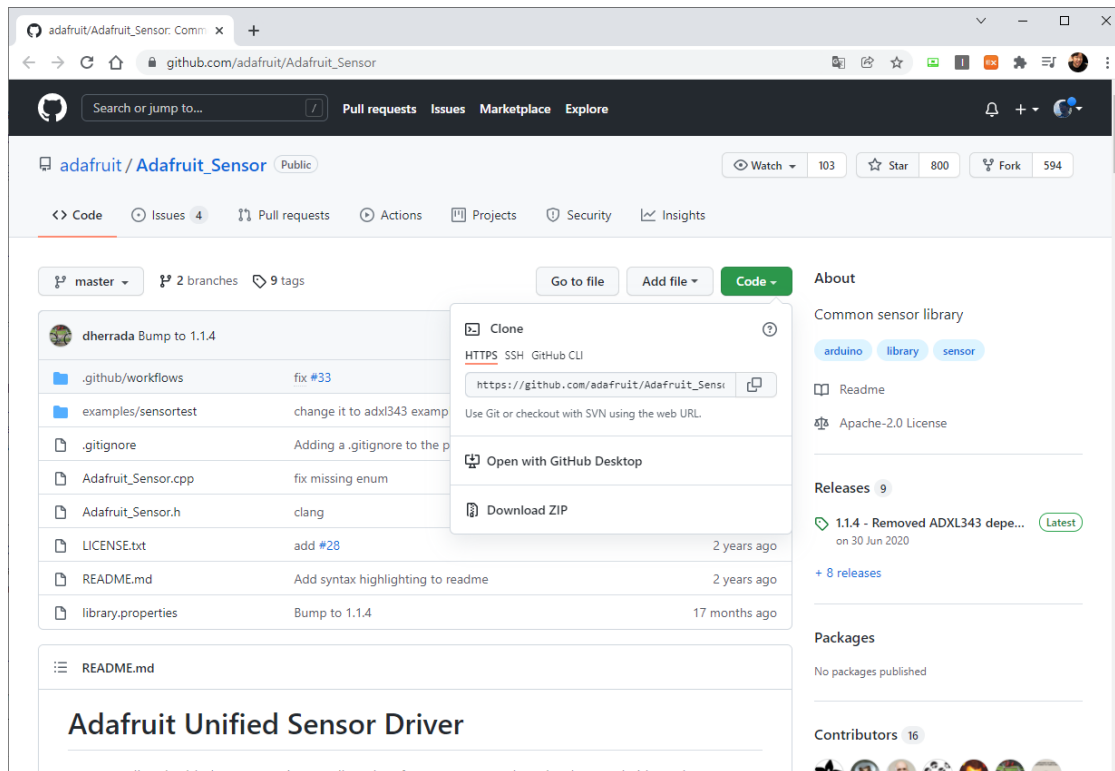
File	Commit Message	Commit Date
<code>.github</code>	actionified, formatted and doxy'd	2 years ago
<code>examples</code>	Updated comment on the Pin Out of the DHTxx Sensors	9 months ago
<code>.gitignore</code>	Add .gitignore	2 years ago
<code>CONTRIBUTING.md</code>	[Update URL]	2 years ago
<code>DHT.cpp</code>	Merge pull request #159 from Rotzbua/patch-1	2 years ago
<code>DHT.h</code>	Fix comment on DHT22 and DHT21 variables	29 days ago
<code>DHT_U.cpp</code>	actionified, formatted and doxy'd	2 years ago
<code>DHT_U.h</code>	actionified, formatted and doxy'd	2 years ago
<code>README.md</code>	actionified, formatted and doxy'd	2 years ago
<code>code-of-conduct.md</code>	actionified, formatted and doxy'd	2 years ago
<code>keywords.txt</code>	Use correct field separator in keywords.txt	3 years ago
<code>library.properties</code>	Bump to 1.4.3	29 days ago

DHT11 라이브러리 사용

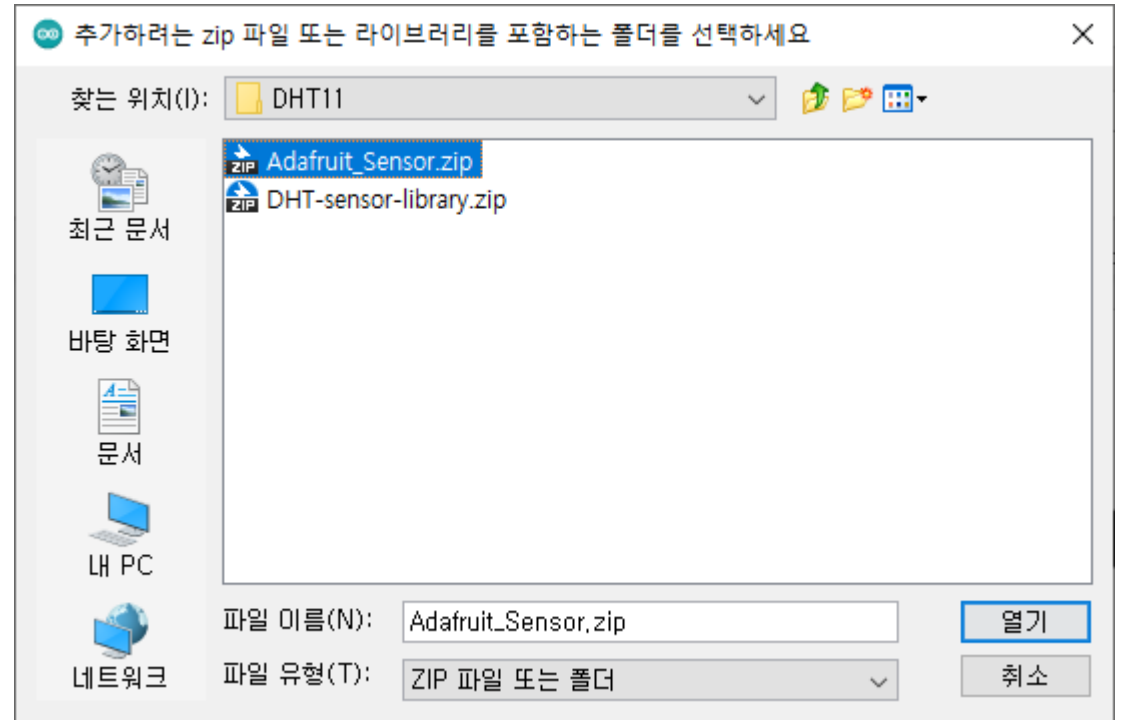
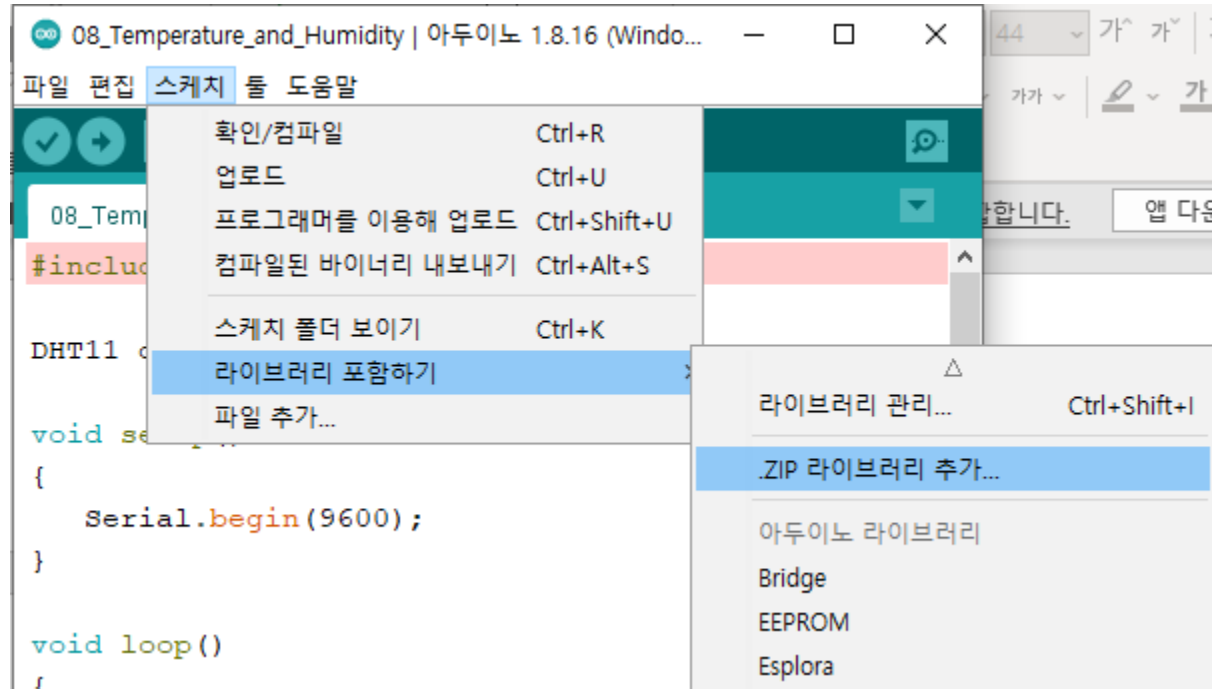


DHT11 라이브러리 사용

- adafruit_sensor.h no such file 에러 발생
- https://github.com/adafruit/Adafruit_Sensor 라이브러리 추가

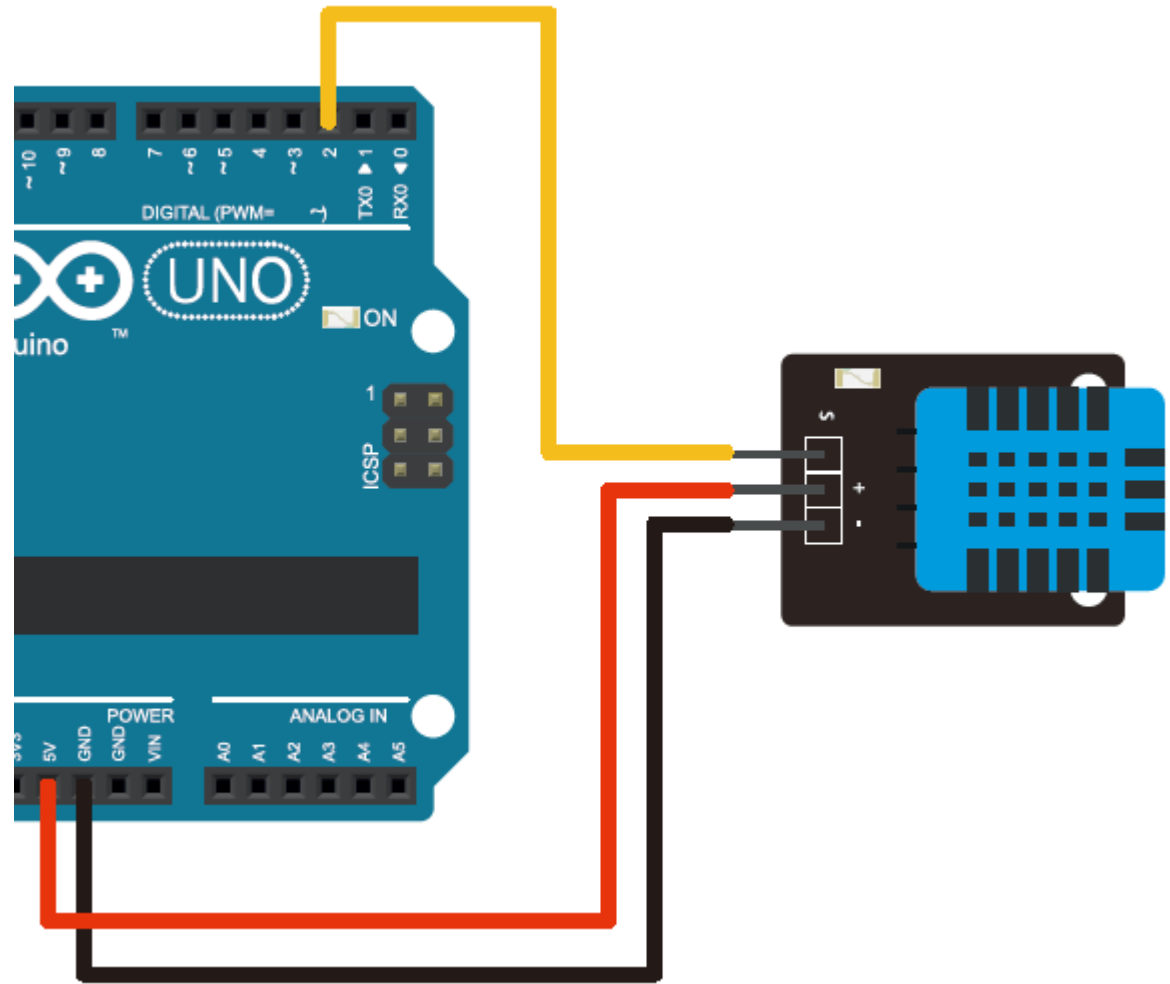


DHT11 라이브러리 사용

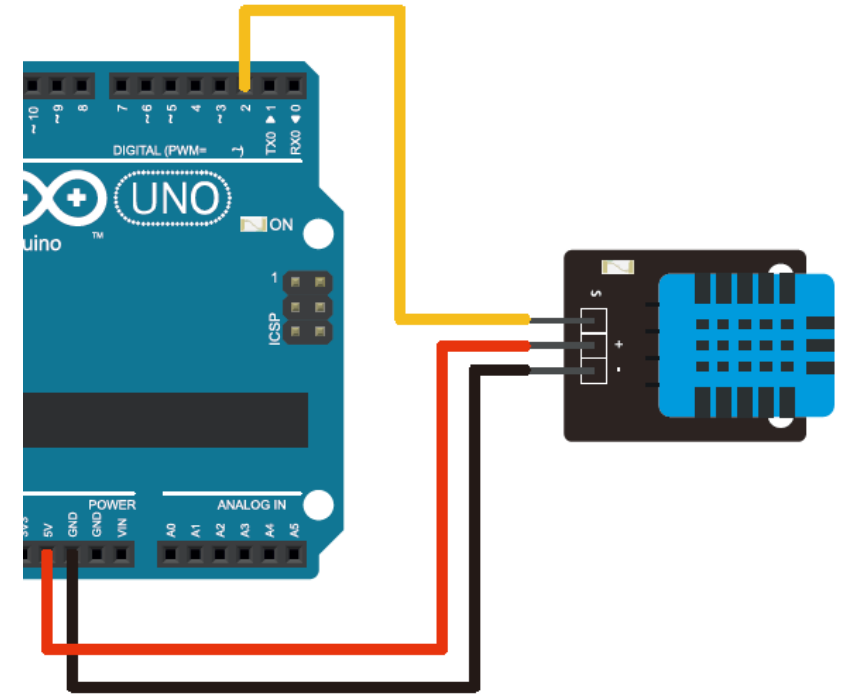
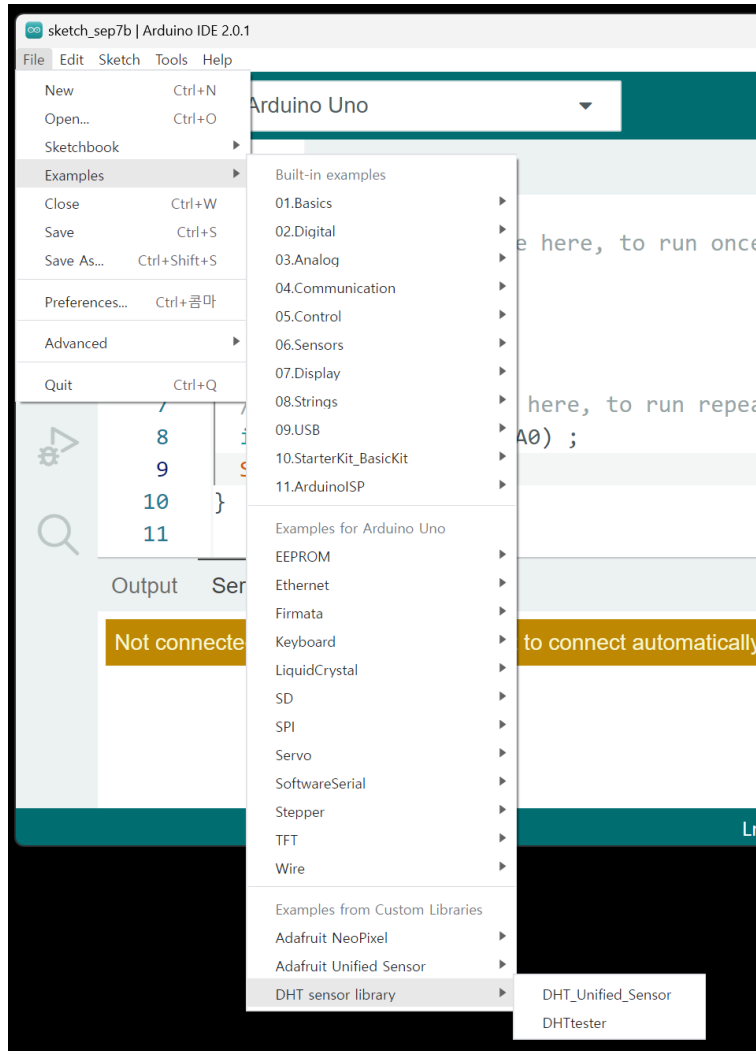


DHT11 아두이노 테스트

- S(signal) : 아두이노 2번핀
- + : VCC(5V)
- - : GND(0V)

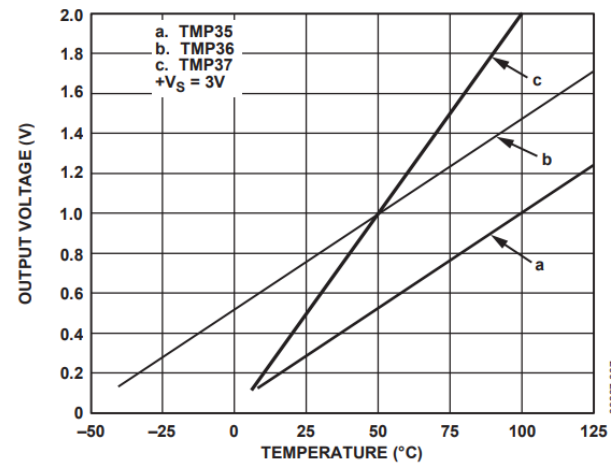


DHT11 아두이노 테스트(Example 코드 활용)

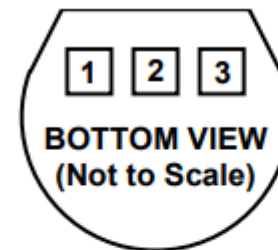
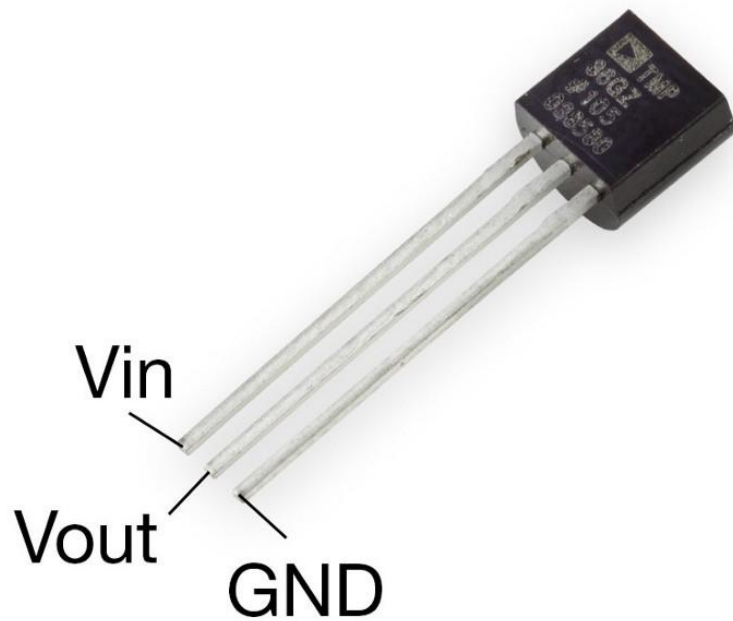


TMP36

- 온도센서는 온도를 감지해 전기신호로 바꿔주는 센서를 의미
- TMP36
 - 상온에서 대략 750mV를 출력
 - 온도 1 °C가 변화하면 10mV의 출력 전압이 변화 함
 - 정밀도는 ± 1 °C로 정밀한 온도 감지는 어려움.
 - 사용하기 쉽고 저렴하여 정밀한 온도 감지가 필요 없는 어플리케이션이 많이 사용 됨.



TMP36 핀 연결



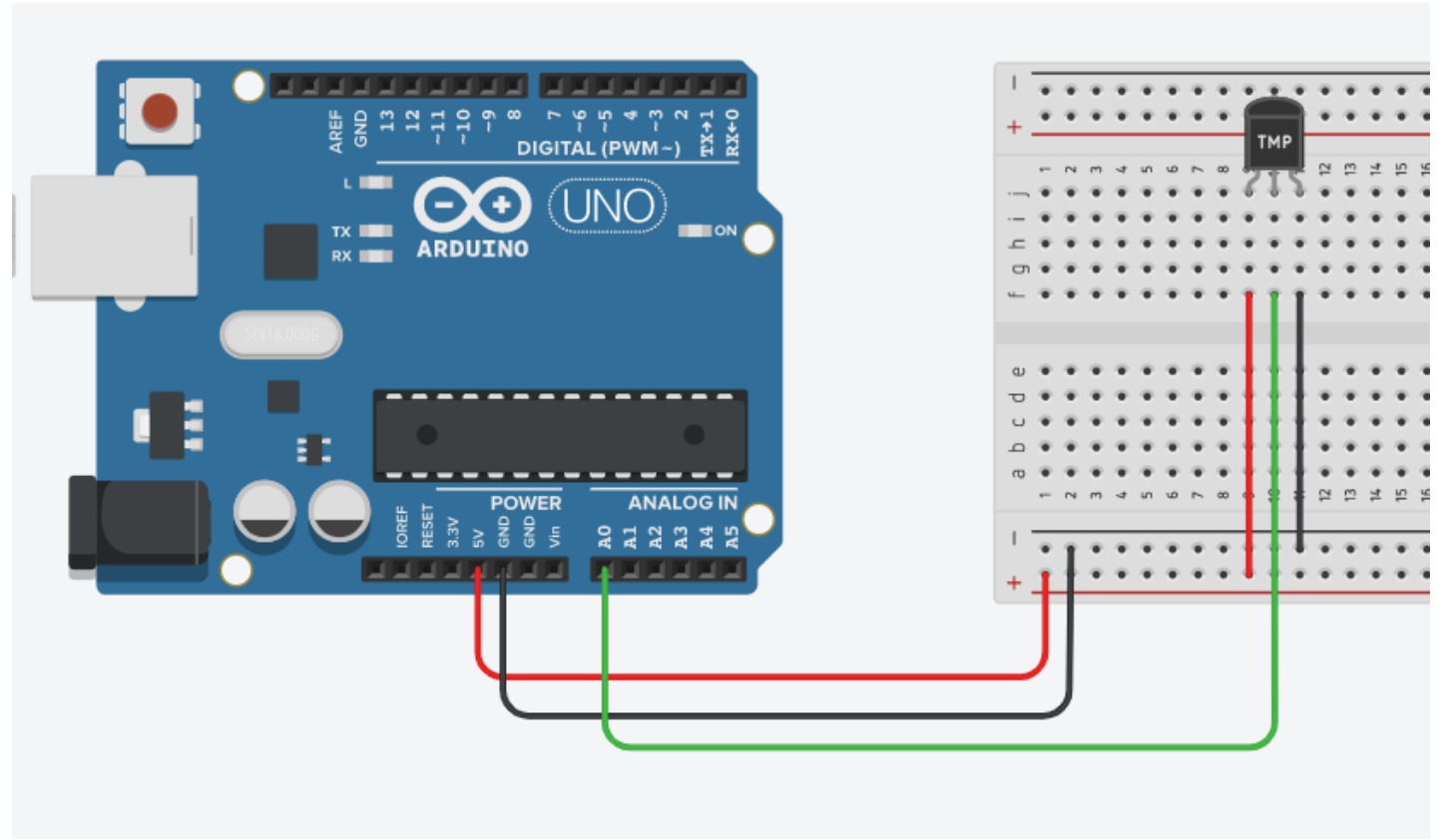
PIN 1, +V_S; PIN 2, V_{OUT}; PIN 3, GND

003337-004

Figure 4. T-3 (TO-92)

TMP36 + 아두이노 실험

- TMP Vin <> 아두이노 5V
- TMP Vout <> 아두이노 A0
- TMP GND <> 아두이노 GND



코드 작성

void setup()

```
{  
  Serial.begin(9600);  
}
```

void loop()

```
{  
  int reading = analogRead(A0);  
  Serial.println(reading);  
}
```

The screenshot displays an Arduino IDE interface. At the top, a blue header reads '온도 센서 [TMP36]' (Temperature Sensor [TMP36]). Below it, a text box contains '이름 온도센서' (Name: Temperature Sensor). The central part of the image shows a breadboard circuit. A TMP36 temperature sensor is connected to a breadboard. Its VCC pin is connected to a red wire leading to a 5V pin on the breadboard. Its GND pin is connected to a green wire leading to a GND pin. Its AO pin is connected to a black wire leading to an A0 pin on the breadboard. A potentiometer is also connected to the breadboard, with its wiper connected to a black wire leading to an A1 pin. The bottom right of the image shows the Arduino IDE code editor. The code is for an Arduino Uno R3 and includes the following:

```
1 void setup()  
2 {  
3   Serial.begin(9600);  
4 }  
5  
6 void loop()  
7 {  
8   int reading = analogRead(A0);  
9  
10  float voltage = reading * 5.0;  
11  voltage /= 1024.0;  
12  
13  Serial.print(voltage); Serial.println(" volts");  
14  
15  float temperatureC = (voltage - 0.5) * 100;  
16  Serial.print(temperatureC); Serial.println(" degrees C");  
17  
18  float temperatureF = (temperatureC * 9.0 / 5.0) + 32.0;  
19  Serial.print(temperatureF); Serial.println(" degrees F");  
20  
21  delay(1000);  
22 }
```

Below the code editor, the '시리얼 모니터' (Serial Monitor) window is open, showing the following output:

```
0.00 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F
```

코드 작성

void setup()

```
{  
  Serial.begin(9600);  
}
```

void loop()

```
{  
  int reading = analogRead(A0);  
  
  float voltage = (reading / 1024.0) * 5.0;  
  
  Serial.print(voltage); Serial.println(" volts");  
  
  delay(1000);  
}
```

The screenshot displays an Arduino IDE interface. At the top, a blue header reads '온도 센서 [TMP36]'. Below it, a text box contains '이름 온도센서'. The main workspace shows a breadboard circuit with a TMP36 temperature sensor connected to an Arduino Uno R3. The sensor's VCC pin is connected to a 5V pin, GND to a GND pin, and the output pin to analog pin A0. A potentiometer is also connected to the 5V and GND pins. The code editor on the right contains the following code:

```
1 void setup()  
2 {  
3   Serial.begin(9600);  
4 }  
5  
6 void loop()  
7 {  
8   int reading = analogRead(A0);  
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10  float voltage = reading * 5.0;  
11  voltage /= 1024.0;  
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13  Serial.print(voltage); Serial.println(" volts");  
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18  float temperatureF = (temperatureC * 9.0 / 5.0) + 32.0;  
19  Serial.print(temperatureF); Serial.println(" degrees F");  
20  
21  delay(1000);  
22 }
```

At the bottom, the '시리얼 모니터' (Serial Monitor) window is open, showing the following output:

```
0.00 volts  
33.01 degrees C  
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0.83 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F
```

코드 작성

void setup()

```
{  
  Serial.begin(9600);  
}
```

void loop()

```
{  
  int reading = analogRead(A0);  
  
  float voltage = (reading / 1024.0) * 5.0;  
  
  Serial.print(voltage); Serial.println(" volts");  
  
  float temperatureC = (voltage - 0.5) * 100 ;  
  Serial.print(temperatureC); Serial.println(" degrees C");  
  
  delay(1000);  
}
```

온도 센서 [TMP36]

이름 온도센서

```
1 void setup()  
2 {  
3   Serial.begin(9600);  
4 }  
5  
6 void loop()  
7 {  
8   int reading = analogRead(A0);  
9  
10  float voltage = reading * 5.0;  
11  voltage /= 1024.0;  
12  
13  Serial.print(voltage); Serial.println(" volts");  
14  
15  float temperatureC = (voltage - 0.5) * 100 ;  
16  Serial.print(temperatureC); Serial.println(" degrees C");  
17  
18  float temperatureF = (temperatureC * 9.0 / 5.0) + 32.0;  
19  Serial.print(temperatureF); Serial.println(" degrees F");  
20  
21  delay(1000);  
22 }
```

시리얼 모니터

0.00 volts
33.01 degrees C
91.41 degrees F
0.83 volts
33.01 degrees C
91.41 degrees F
0.83 volts
33.01 degrees C
91.41 degrees F
0.83 volts
33.01 degrees C
91.41 degrees F
0.83 volts
33.01 degrees C
91.41 degrees F

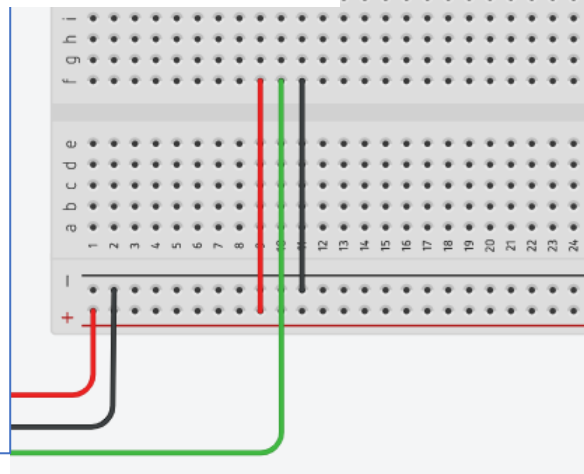
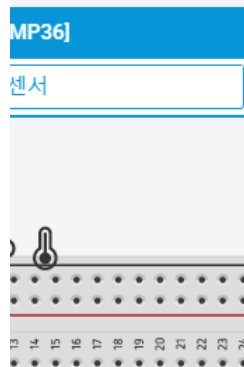
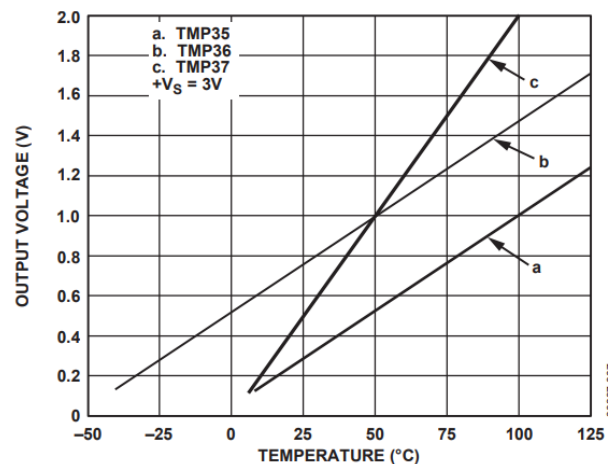
코드 작성

```
void setup()
```

```
{  
  Serial.begin(9600);  
}
```

```
void loop()
```

```
{  
  int reading = analogRead(A0);  
  
  float voltage = (reading / 1024.0) * 5.0;  
  
  Serial.print(voltage); Serial.println(" volts");  
  
  float temperatureC = (voltage - 0.5) * 100 ;  
  Serial.print(temperatureC); Serial.println(" degrees C");  
  
  delay(1000);  
}
```



```
1 void setup()  
2 {  
3   Serial.begin(9600);  
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5  
6 void loop()  
7 {  
8   int reading = analogRead(A0);  
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13  Serial.print(voltage); Serial.println(" volts");  
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15  float temperatureC = (voltage - 0.5) * 100 ;  
16  Serial.print(temperatureC); Serial.println(" degrees C");  
17  
18  float temperatureF = (temperatureC * 9.0 / 5.0) + 32.0;  
19  Serial.print(temperatureF); Serial.println(" degrees F");  
20  
21  delay(1000);  
22 }
```

시리얼 모니터

```
0.00 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F  
0.83 volts  
33.01 degrees C  
91.41 degrees F
```

- TMP36은 10mV에 1°C
- 50°C일때 1.0V → 0°C 일때는 - 10mV * 50 = 500mV를 빼줘야 한다. 500mV는 0.5Volt
- 10mV당 1°C → 100을
- 10mV : 1 °C = yV : x °C → x °C = (y*1000mV * 1 °C) / 10mV → **x °C = y * 100**

코드 작성

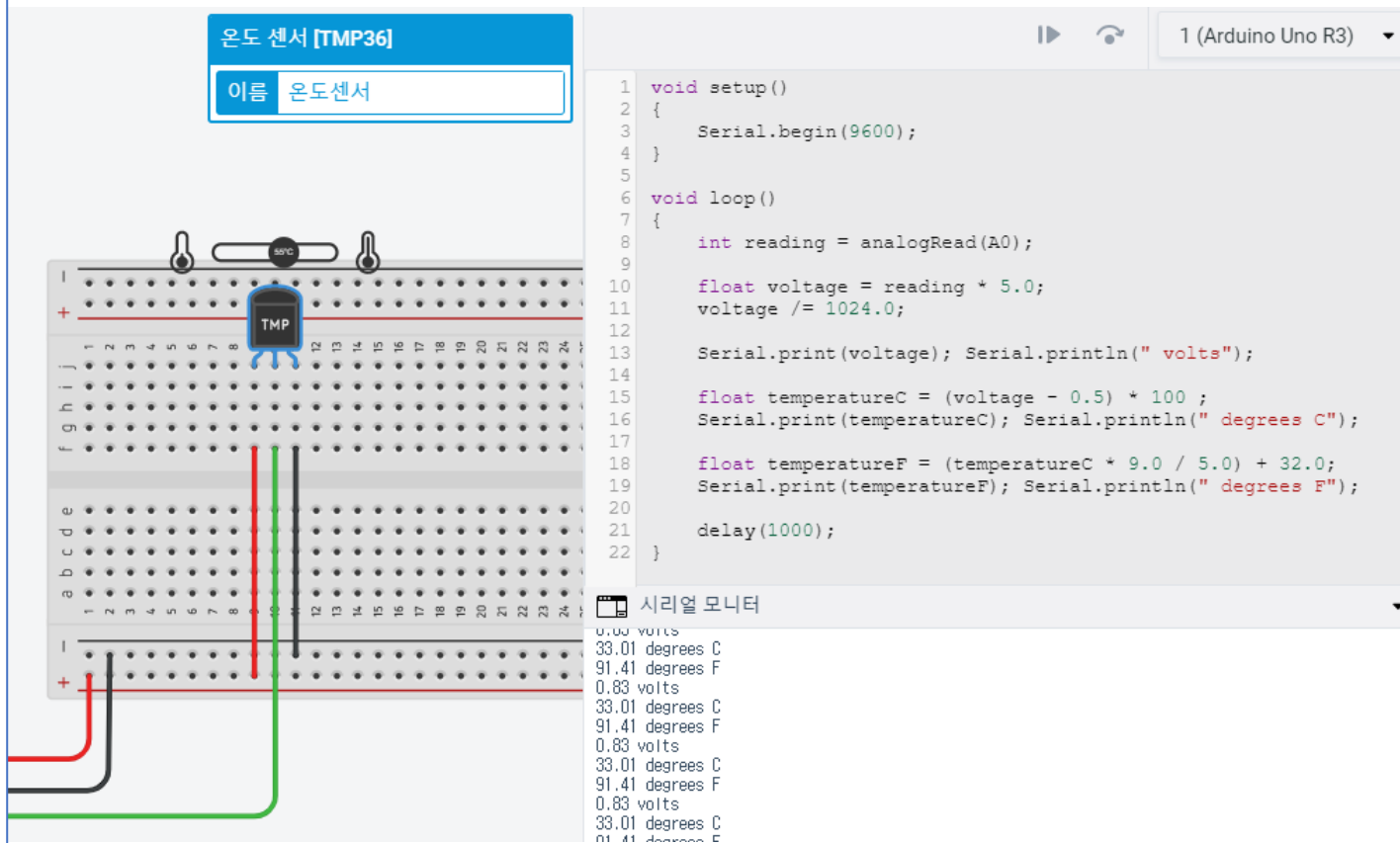
void setup()

```
{  
  Serial.begin(9600);  
}
```

void loop()

```
{  
  int reading = analogRead(A0);  
  
  float voltage = (reading / 1024.0) * 5.0;  
  
  Serial.print(voltage); Serial.println(" volts");  
  
  float temperatureC = (voltage - 0.5) * 100 ;  
  Serial.print(temperatureC); Serial.println(" degrees C");  
  
  float temperatureF = (temperatureC * 9.0 / 5.0) + 32.0;  
  Serial.print(temperatureF); Serial.println(" degrees F");  
  
  delay(1000);  
}
```

$$^{\circ}F = \left(^{\circ}C \times \frac{9}{5}\right) + 32$$



TMP36과 DMT11 데이터 비교

- TMP36과 DMT11 섭씨온도 데이터를 확인하고
- 아래와 같이 비교한 결과를 출력하시오.

```
TMP33 - 25.20, DHT11 - 27.70  
TMP33 - 25.20, DHT11 - 27.70  
TMP33 - 25.20, DHT11 - 27.70  
TMP33 - 25.20, DHT11 - 27.70  
TMP33 - 25.20, DHT11 - 27.70  
TMP33 - 25.20, DHT11 - 27.70  
TMP33 - 25.20, DHT11 - 27.70  
TMP33 - 25.20, DHT11 - 27.70
```



센서로 소리의 방향을 알수 있을까?

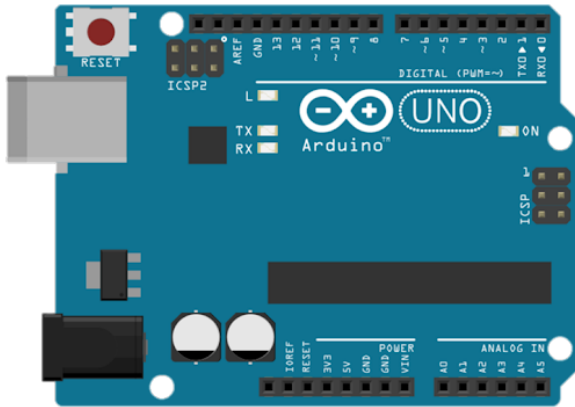


전체 구성

소리 감지(마이크1)



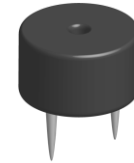
소리 감지(마이크2)



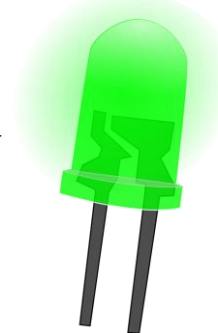
모터를 이용하여 카메라 방향 이동



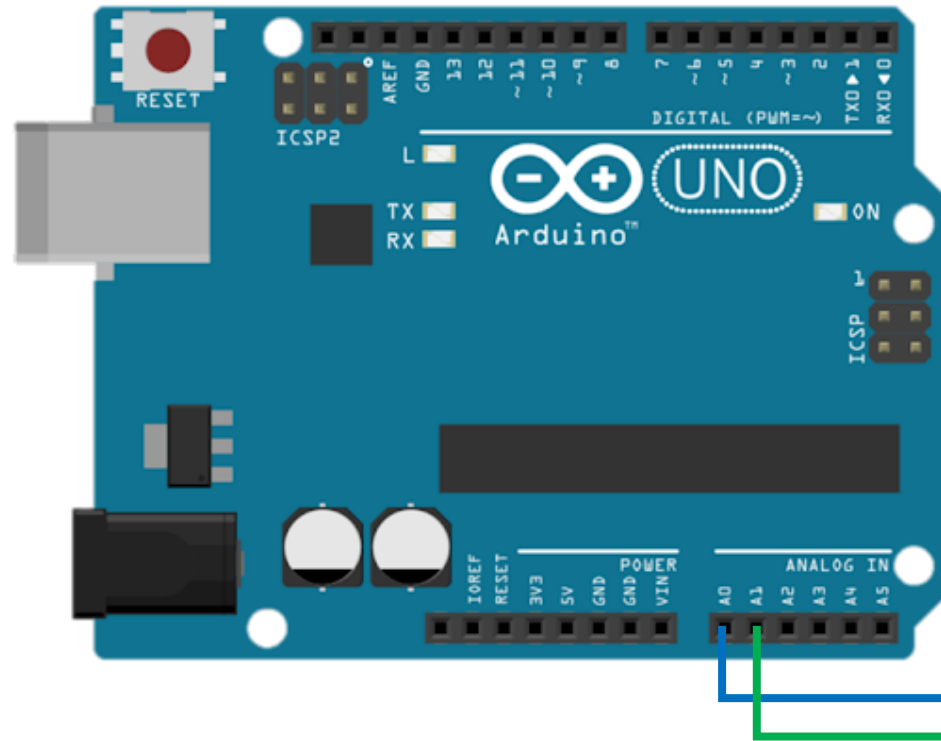
측정 완료 경고음 발생



LED 인디케이터



소리 감지 센서 실험



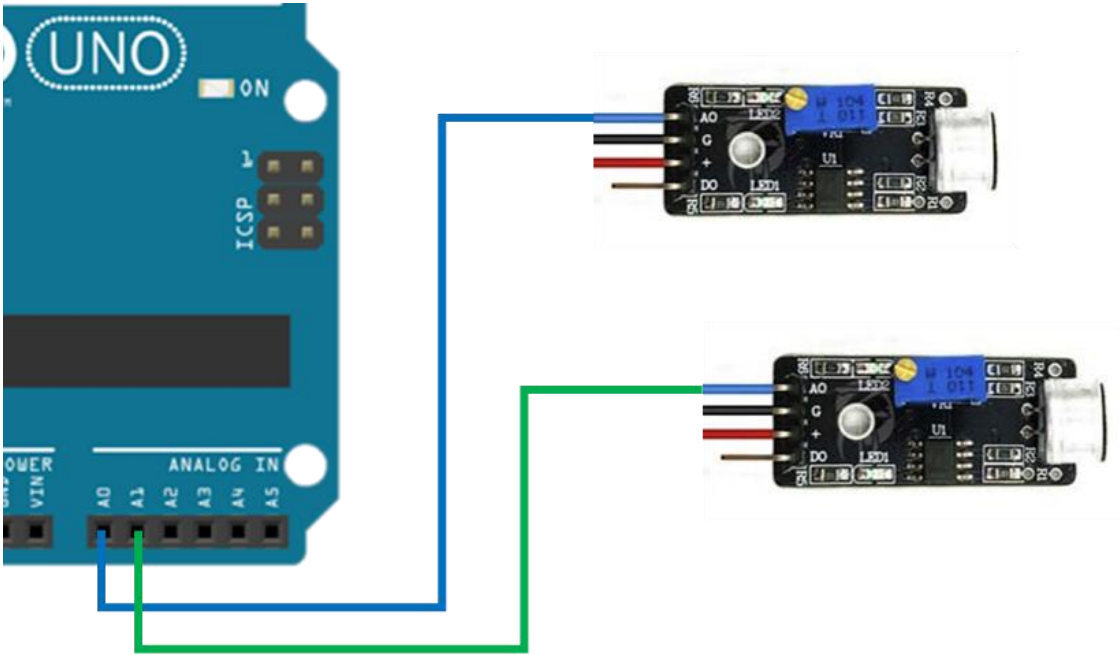
소리 감지(마이크1)



소리 감지(마이크2)



소리 라인감지 센서 실험

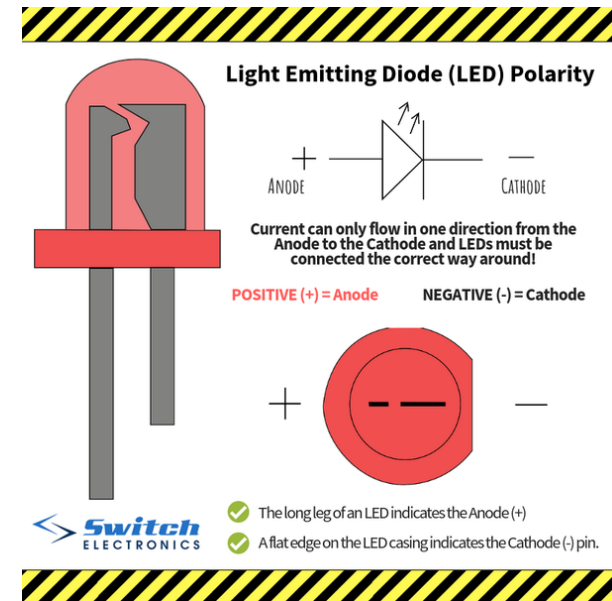
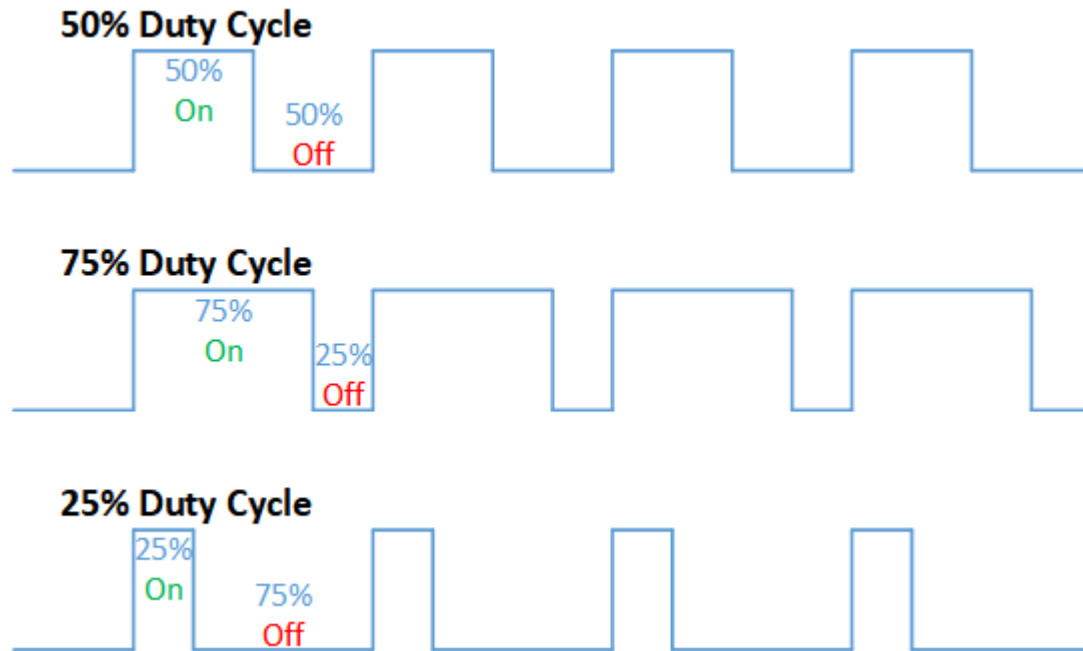


```
void setup()
{
    Serial.begin(9600) ;
}

void loop()
{
    int left = analogRead(A0) ;
    int right = analogRead(A1) ;

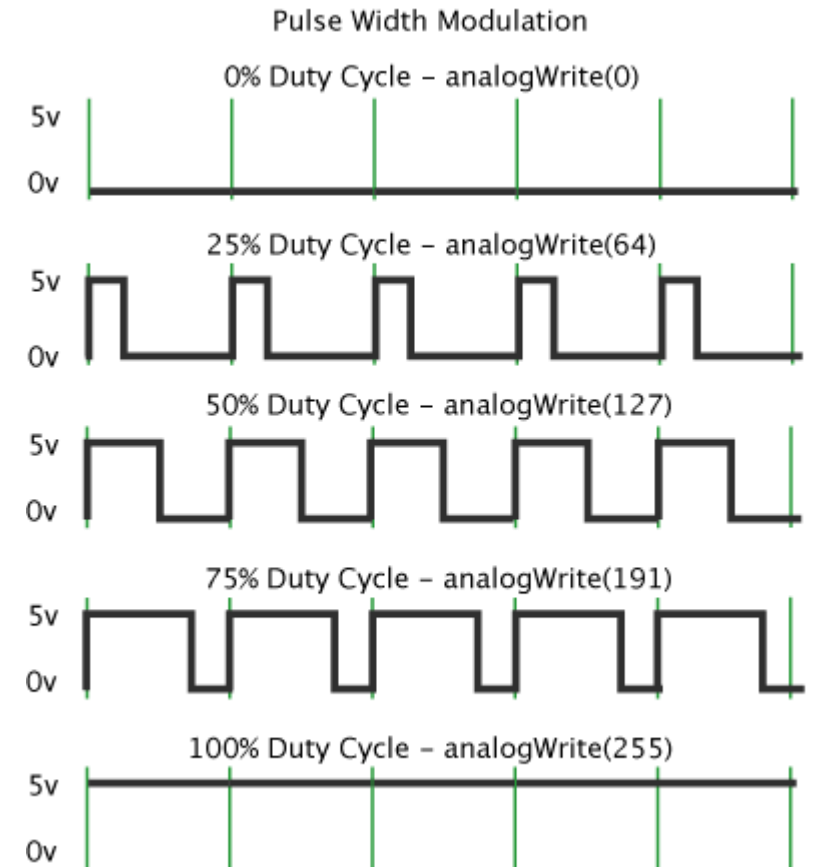
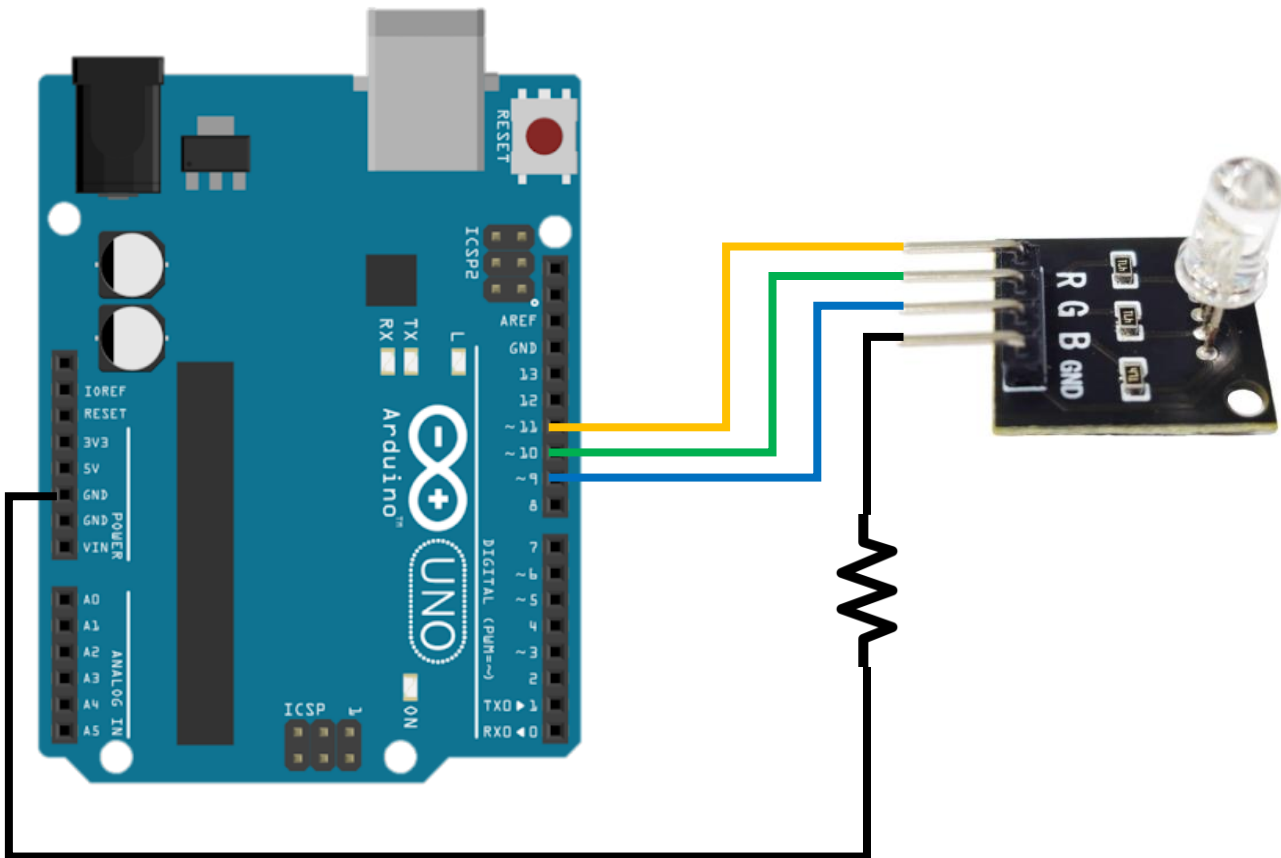
    Serial.print(left) ;
    Serial.print(" , ") ;
    Serial.println(right) ;
}
```

PWM을 이용한 LED 밝기 제어 (analogWrite)



아두이노를 이용한 LED 밝기제어 예제

- 함수 : `analogWrite(핀번호, duty cycle)`

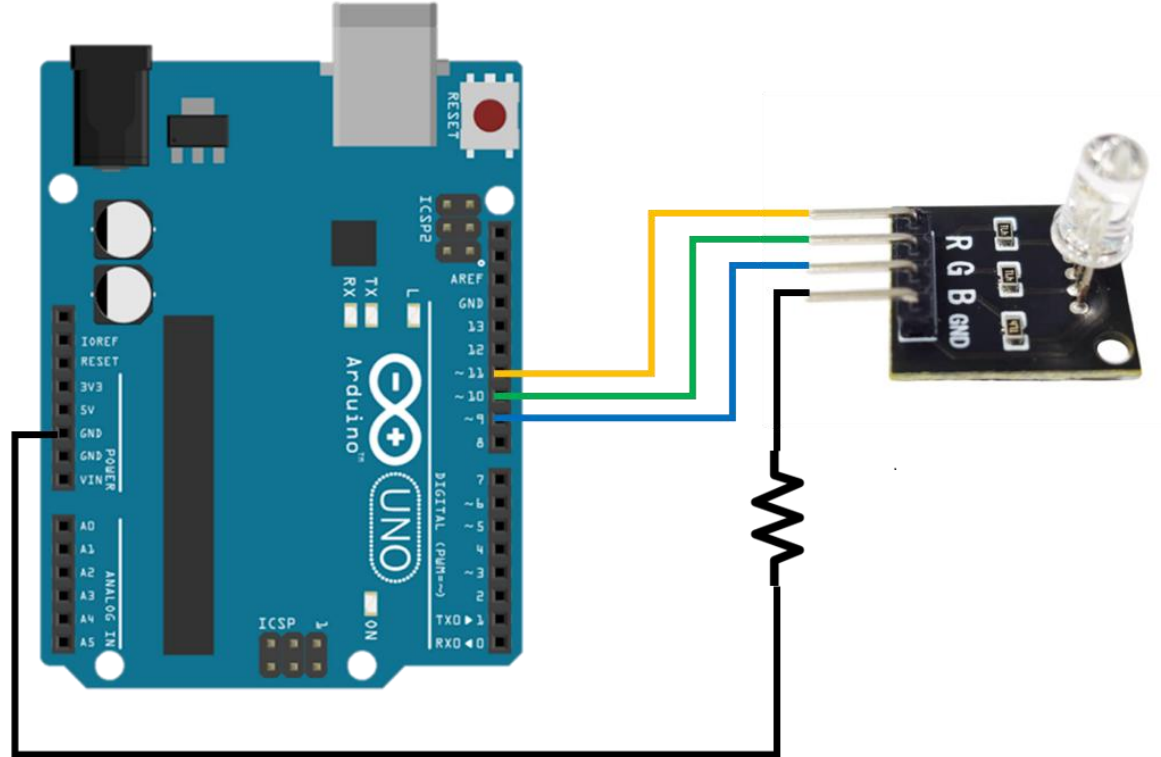


아두이노를 이용한 LED 밝기제어 예제

- 함수 : `analogWrite(핀번호, duty cycle)`

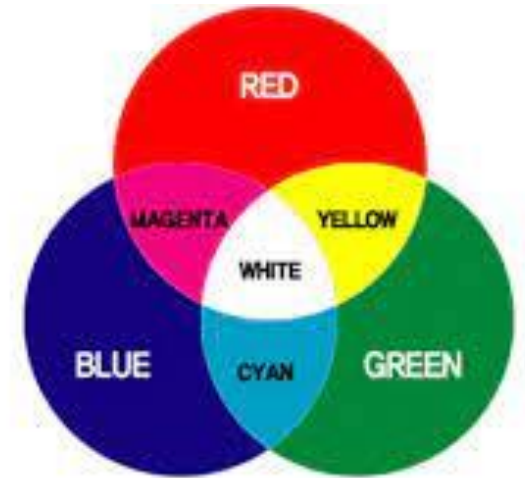
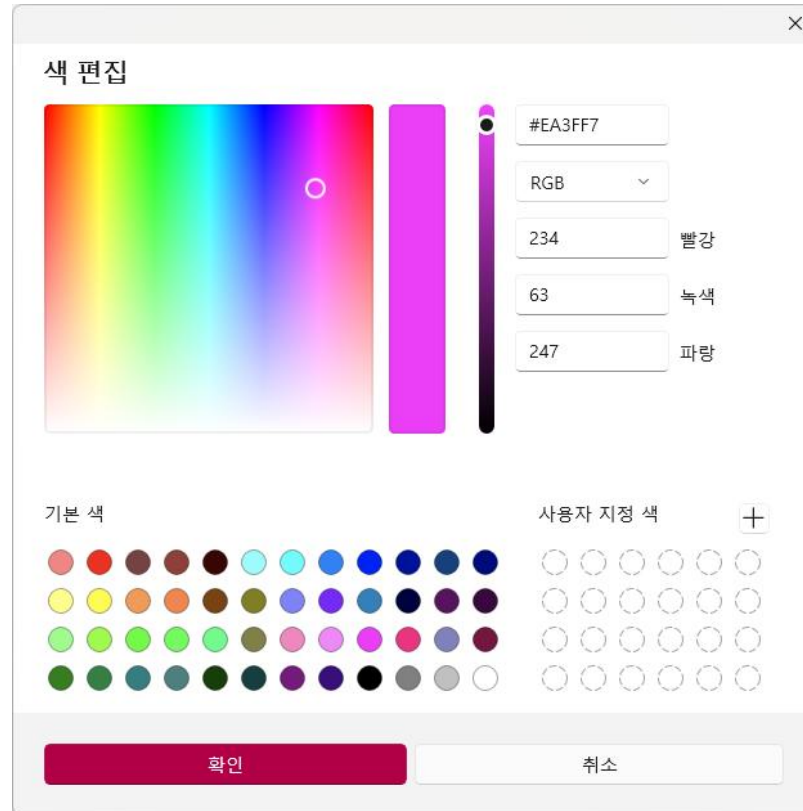
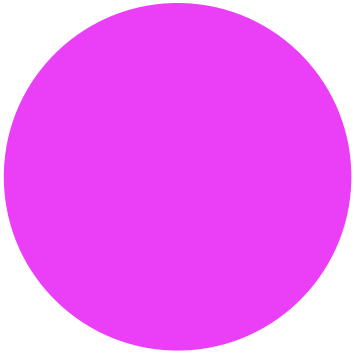
```
void setup()  
{  
  pinMode(9, OUTPUT) ;  
}  
  
void loop()  
{  
  analogWrite(9, 0) ;  
}
```

```
void setup()  
{  
  pinMode(9, OUTPUT) ;  
}  
  
void loop()  
{  
  analogWrite(9, 255) ;  
}
```



QUIZ : 다양한 색상 표현하기

- 3색(RGB) LED를 이용하여 아래의 색을 표현하시오



[그림 1] 빛의 3원색인 Red, Blue, Green. 세 가지 색상을 조합하면 White가 된다.