임베디드컴퓨팅

Embedded Computing
## (0009488)

Passive Infrared sensor

2022년 2학기

정보기술대학 정보통신공학과

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Passive Infrared sensor

- **(HC-SR501) sensor** provides the feature of the human body detection, also called a ⬛⬛⬛⬛ sensor.
  - to detect human movement up to 7m within an angle of 110˚.

- Consists of three pins
  - **VCC**: A pin that applies + power.
    - Operating voltage = 5 ~ 20V, connect it to the **5V pin** of the Arduino.
  - **GND**: A grounding pin
    - Connected to the **GND pin** of the Arduino.
  - **Out** : A pin that generates the output signals when a motion is detected.
    - Connects it to the **digital pin** of the Arduino.

(HC-SR501)

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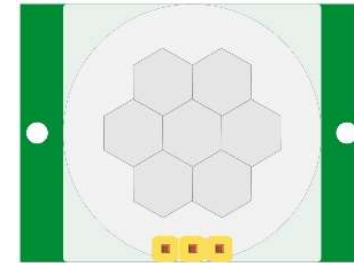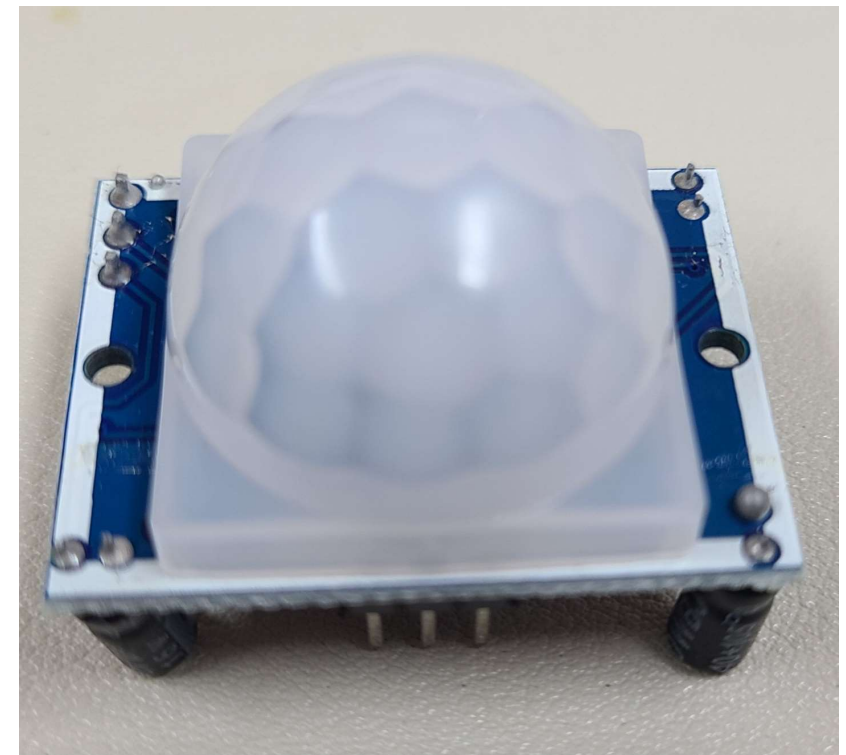
Two adjustment controls (potentiometers)

- HC-SR501 generates a **HIGH signal** output when motion is detected.

- ☐☐☐☐ **Adjust**
  - Adjust the time delay of HIGH signal from 3 sec to a max. of 5 min.
  - Turning it clockwise: increases.
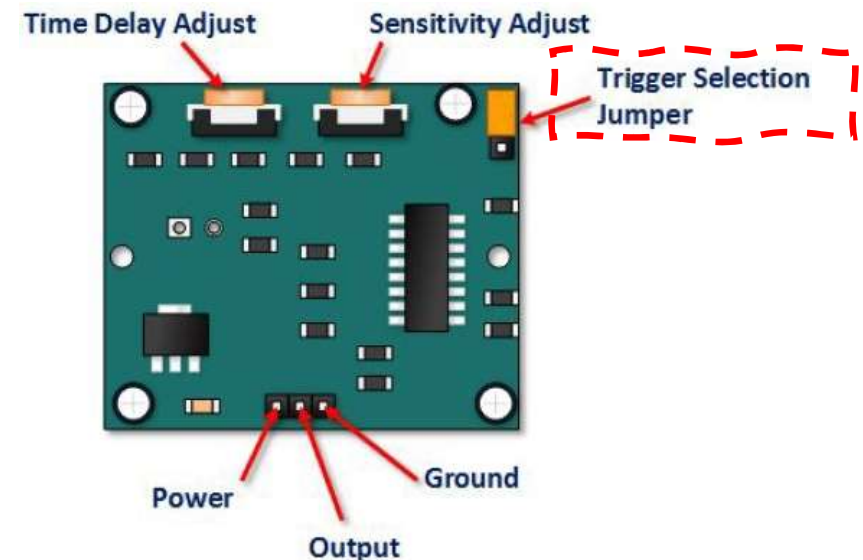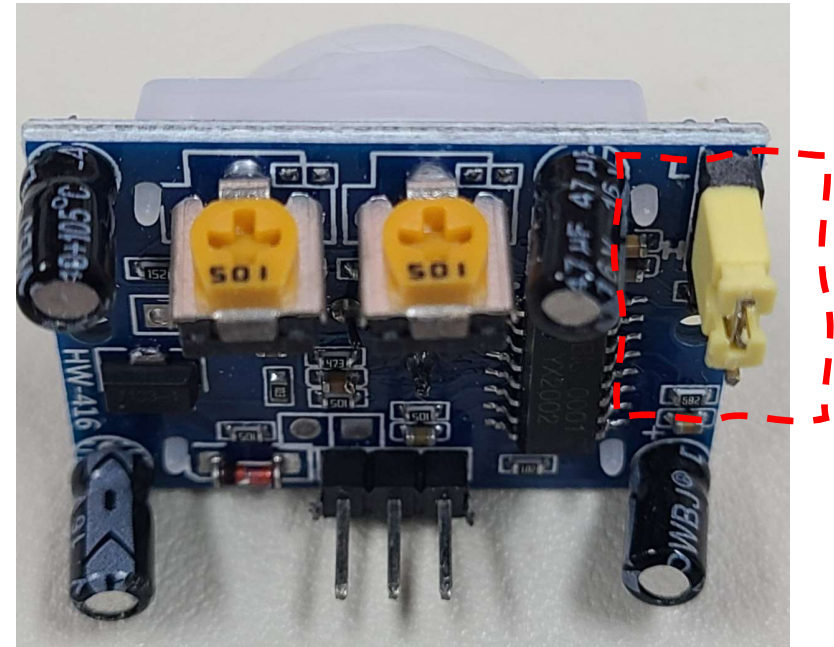 - Turning it counterclockwise: shortens.

- ☐☐☐ **Adjust**
  - Adjust the detection range from 3 to 7m.
  - Turning it clockwise: shortens.
  - Turning it counterclockwise: increases.

Time Delay Adjust   Sensitivity Adjust   Trigger Selection Jumper
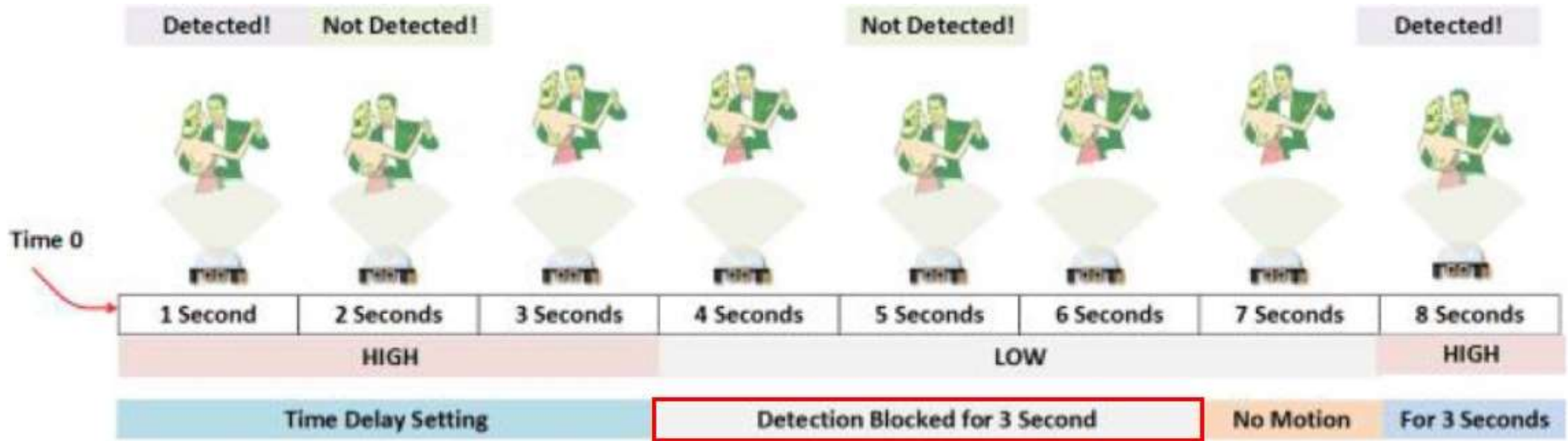
Power   Output   Ground
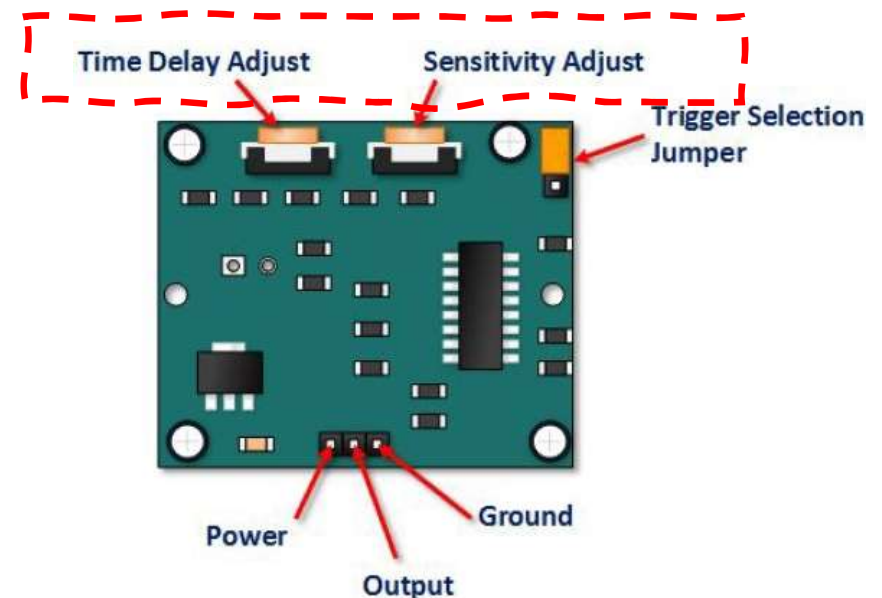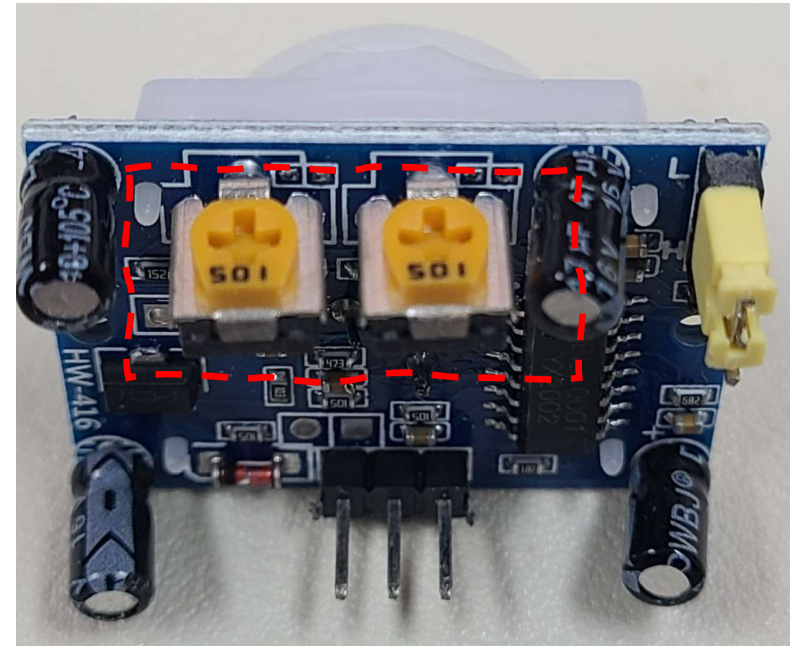
A jumper to select between two trigger modes

- Single trigger or repeating trigger.
  - For both modes, the output will turn HIGH as soon as motion is detected.
  - The signal will stay HIGH for the time-delay adjusted by the potentiometer.
- Single trigger mode
  - Further movement is not processed during the time delay period
- Repeating trigger mode
 - Any further movement is processed and time-delay is started again

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Output signaling

Detected!	Not Detected!			Not Detected!			Detected!

| 1 Second	2 Seconds	3 Seconds	4 Seconds	5 Seconds	6 Seconds	7 Seconds	8 Seconds
HIGH			LOW				HIGH
Time Delay Setting			Detection Blocked for 3 Second			No Motion	For 3 Seconds

Time 0

- Phase 1: A motion detection
  - It outputs a [HIGH signal] for a set time delay.

- Phase 2: Detection blocked
  - It outputs a [Low signal] for about 2.5 to 3 sec.
  - No motion is detected. Depending on setting the time delay adjustment, it is set to 0 to tens of seconds.

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Lab 1: A human motion detector

- Let's write a sketch program to display the result of human motion detection via serial comm. and built-in LED.

- Adjust a time delay and detection range as 3 sec and 3m, respectively.
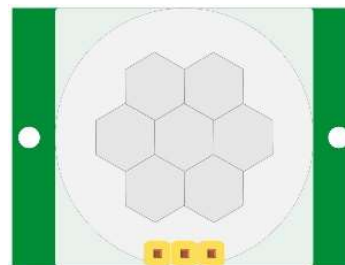
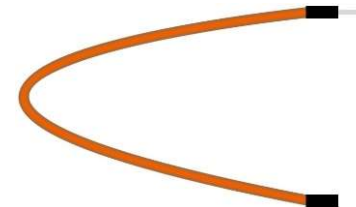- Required H/W components
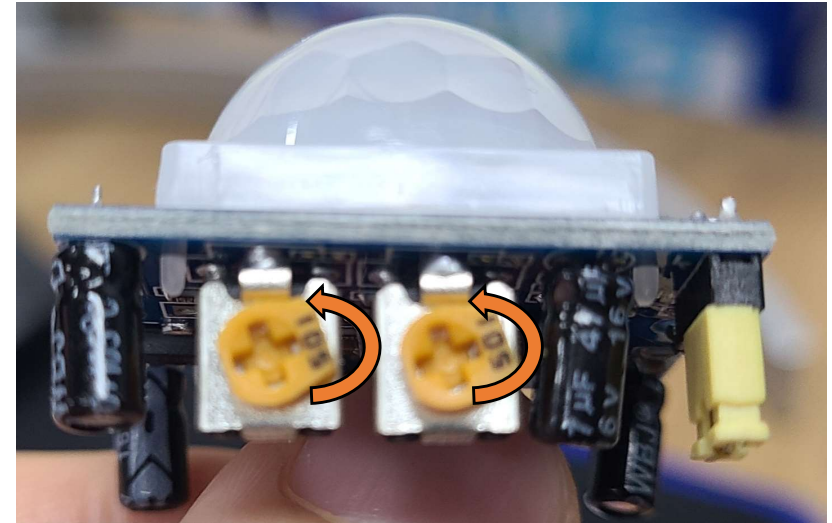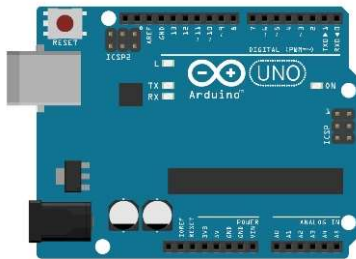
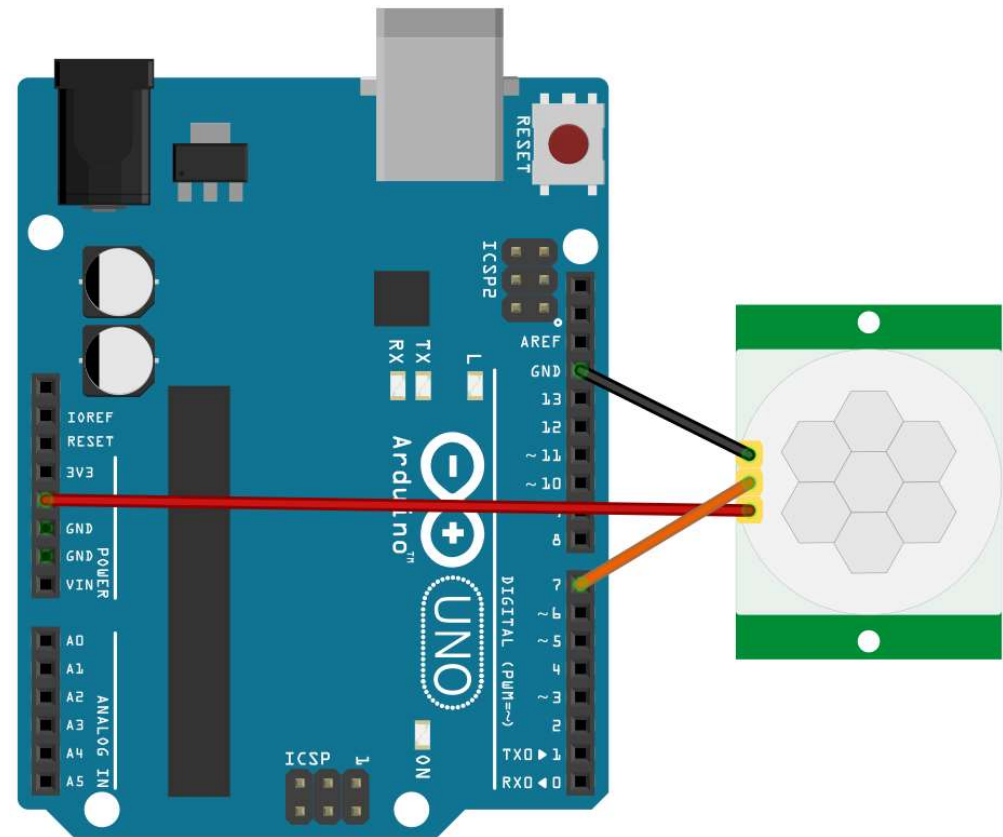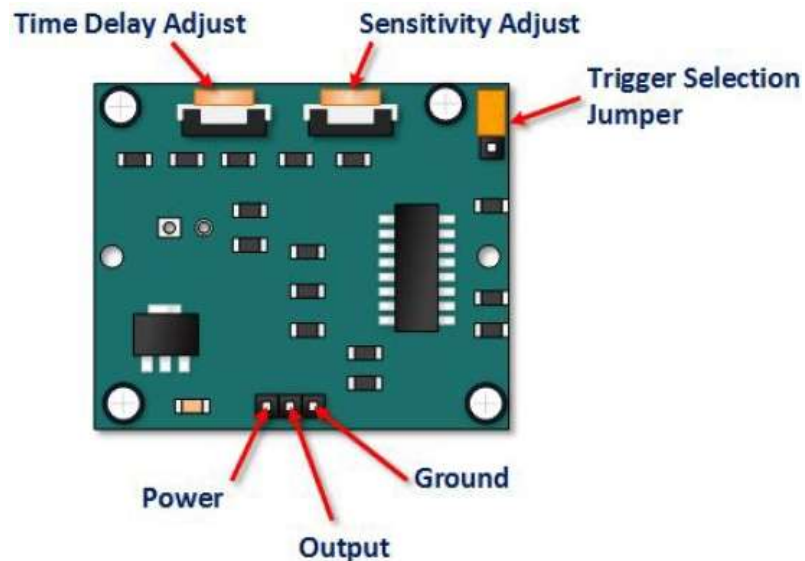| Arduino Uno board	PIR (HC-SR501)	Jumper cable (**Female**-Male)
x 1	x 1	x 3

Circuit wiring setup

PIR (HC-SR501)	Arduino board
VCC	5V
GND	GND
OUT	digital 7

Basic setup for motion detector

```
#define PIR_PIN 7
#define BUILTIN_LED 13
void setup() {
  pinMode(PIR_PIN, INPUT);
  pinMode(BUILTIN_LED, OUTPUT);
  Serial.begin(9600);
}
void loop() {

  int value = digitalRead(PIR_PIN);
  if(value == HIGH){
    digitalWrite(BUILTIN_LED, HIGH);
    Serial.println("Detected!");
  } else {
    digitalWrite(BUILTIN_LED, LOW);
    Serial.println("Not Detected!");
  }
  delay(1000);

}
```

Connect to
Digital pin No. 7

INPUT mode for digital read

Read the signal of HC-SR501

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Check results

- When a motion is detected

  - For a set time delay, a message "detected"

    is shown.

  - Built-in LED turns on.

- When a motion is not detected

  - A message "Not detected" is shown.

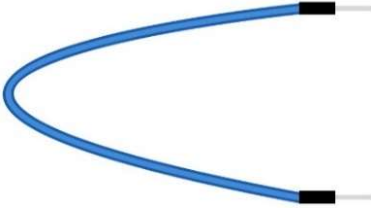 - Built-in LED turns off.
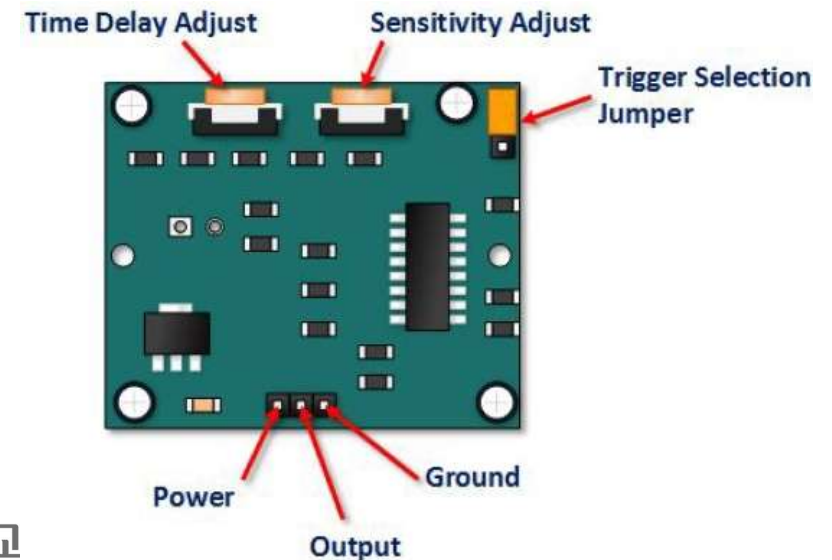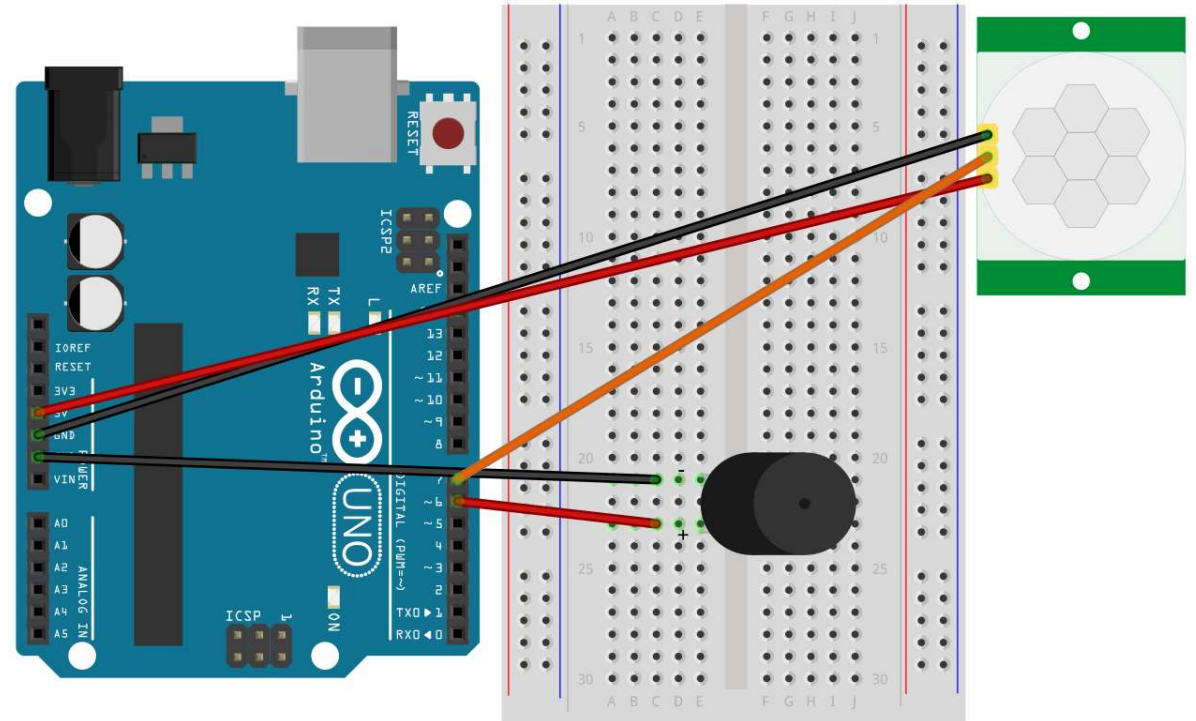
Lab 2: Intrusion alarm

- Let's write a sketch program to alarm when a human motion is detected
- Time delay and detect range are same as Lab 1 (3sec, 3min)
- Required H/W components

Arduino board Uno	Breadboard (400pin)	PIR (HC-SR501)	Piezo speaker (passive)
x 1	x 1	x 1	x 1

Jumper cable Female-Male	Jumper cable Male-Male		
x 3	x 2		

Circuit wiring setup

PIR (HC-SR501)	Arduino board
VCC	5V
GND	GND
OUT	digital 7

Piezo speaker	Arduino board
+	digital 6
-	GND

Time Delay Adjust

Sensitivity Adjust

Trigger Selection Jumper

Power

Output

Ground

Basic setup for intrusion alarm

```
#define PIR_PIN 7
#define PIEZO 6

void setup() {
  pinMode(PIR_PIN, INPUT);
  pinMode(PIEZO, OUTPUT);
}
void loop() {

    int value = digitalRead(PIR_PIN);
    if(value == HIGH){
      for(int i = 0 ;i < 3 ; i++){
        tone(PIEZO, 523, 240);
        delay(200);
       tone(PIEZO, 783, 250);
        delay(200);
      }
     }

}
```

Connect PIR and Piezo to Digital pin No. 7 and 6, respectively
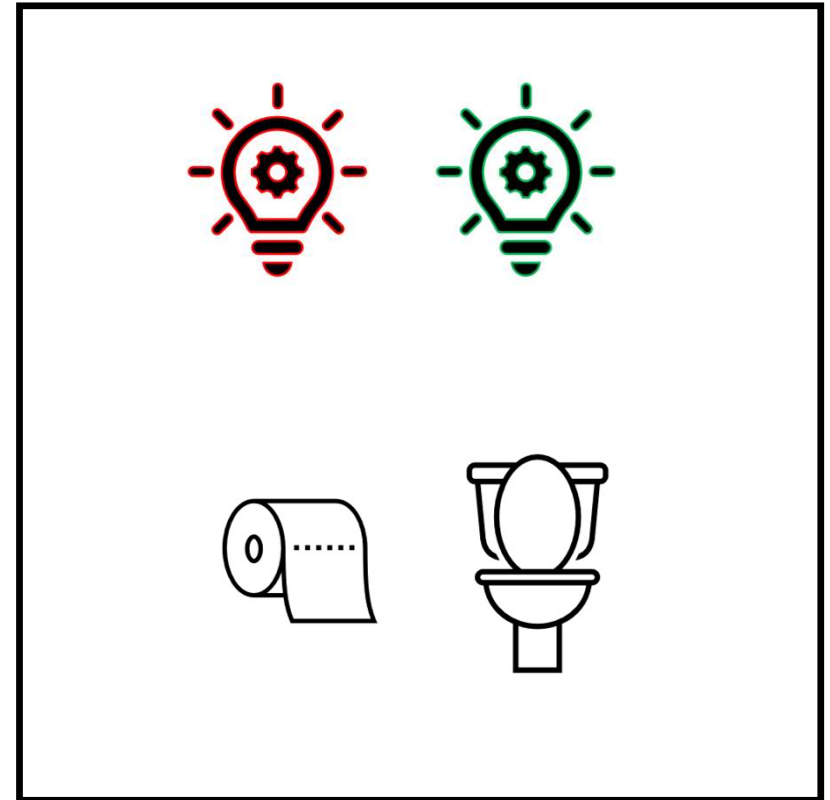
INPUT mode for digital read
OUTPUT mode for digital write

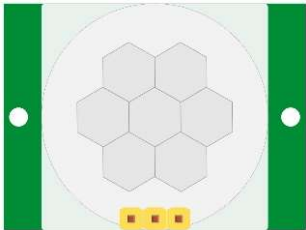Read the signal of HC-SR501

Alert by beep sound

Check results
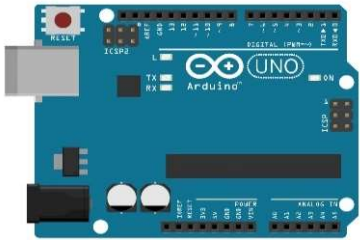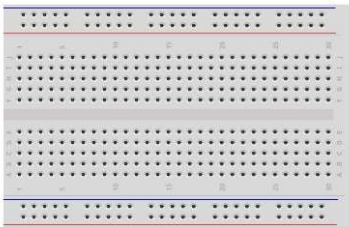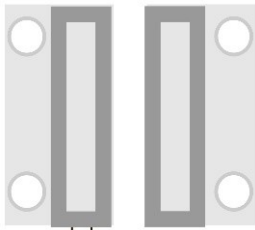
- When a motion is detected

    - For a set time delay, a message "detected" is shown.

    - A beep sound repeated three times.

- When a motion is not detected

    - A message "Not detected" is shown.

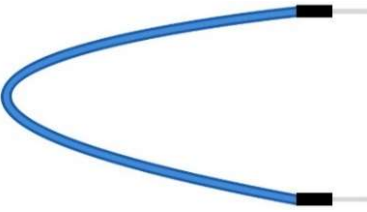   - No beep sound.

Assignment: Smart Toilet

- In the restroom, you can see a system that changes the color of the LED installed in front of the door depending on whether the toilet is used.

- Let's implement a smart toilet using a PIR and a magnetic switch.

- Requirements
    - When the toilet is in use, LED turns red.
        - No motion AND the door is closed
    - When it is empty, LED turns green.
        - Otherwise
    - A block-type comments in the top of source code w/ "your student no., your name, writing date, etc."

- Results
    - (a source code file) sketch source code (*"sketchfilename.ino"*)
   - (a Arduino board capture file) a photo capture showing how you setup your circuit (max. 1GB file).

Required H/W

Arduino board Uno	Breadboard (400pin)	PIR (HC-SR501)	Magnetic Switch (MC-38)
x 1	x 1	x 1	x 1

Tri-color LED (Common cathode)	Jumper cable Female-Male	Jumper cable Male-Male	Registance (100Ω)
x 1	x 3	x 5	x 1

Registance (160Ω)
x 1

Circuit wiring setup (1)

Magnetic Switch (MC-38)	Arduino board
Wire 1	digital 7
Wire 2	GND

PIR (HC-SR501)	Arduino board
VCC	5V
GND	GND
OUT	digital 8
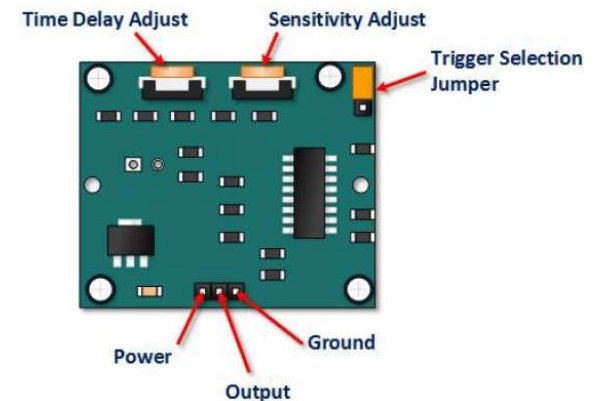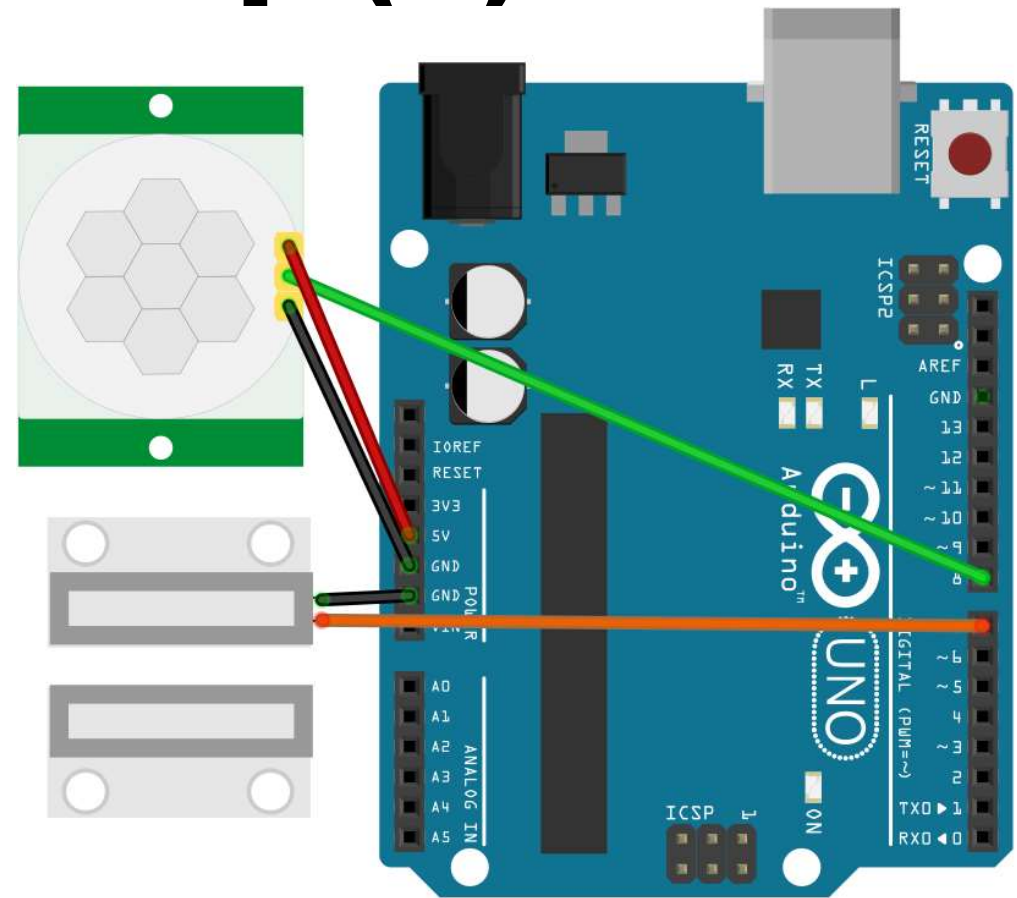
Circuit wiring setup (2)

Tri-color LED	Arduino pin
Red (Pin 1)	13
GND (Pin 2)	GND
Green (Pin 3)	12
Blue (Pin 4)	-