

# International internship report

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## 1 Introduction

intro

## 2 Sensors

This section specifies and describes (most of) the sensors included in the Wave-share sensor pack. This sensor pack was used at my internship location.

Many sensors listed below expose the same interface. Therefore, the sensors share almost identical code for reading. One such interface is the one with 3 pins being : VCC, GROUND and DOUT. The DOUT is a simple binary port identifying whether a certain phenomenon is detected. In addition, some sensors expose a fourth, analog pin in order to give some more information such as the distance to a sound or light source for example. The code to read from these interfaces is listed in Listing 1. The lines with ‘ // in case of four pins‘ are

for the 4-pin interfaces mentioned above, and thus may be neglected for 3-pin interface sensors.

As a last note on 3-pin interfaces: There exist sensors with a single analog pin (instead of digital pin). In that case, one must use the analog equivalent version of the given code. To be more clear, this code is given in Listing 2.

Listing 1: Reading in from a 3 or 4-pin interface sensor

```
int digital_in = 2;
int analog_in = A0;
int value;
void setup()
{
  pinMode(digital_in , INPUT);
  pinMode(analog_in , INPUT); // in case of four pins
  Serial.begin(9600);
}
void loop()
{
  value = analogRead(analog_in); // in case of four pins
  Serial.println(value); // in case of four pins
  if (digitalRead(digital_in) == LOW)
  {
    Serial.println("Detected: Value is" + value);
  }
  else
  {
    Serial.println("Nothing detected!");
  }
  delay(500);
}
```

Listing 2: Reading in analog signals

```
int digital_in = 2;
int analog_in = A0;
int value;
int threshold = ...
void setup()
{
  pinMode(analog_in , INPUT);
  Serial.begin(9600);
}
void loop()
{
  value = analogRead(analog_in);
  if (value > threshold)
```

```

{
  Serial.println(" Significant value detected");
}
else
{
  Serial.println(" Nothing significantly detected!");
}
delay(500);
}

```

## 2.1 Infrared Reflective Sensor

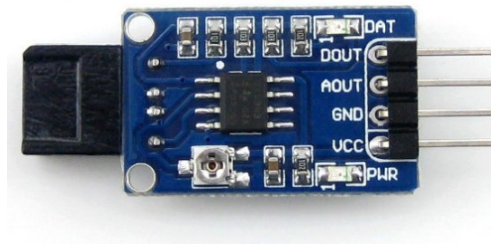


Figure 1: Infrared Reflective Sensor [9]

Infrared Reflective Sensor is used to detect the presence of an object within a specific range. Basically, it emits an infrared signal which is reflected by nearby objects. If the reflected light is detected, a **DIGITAL LOW** output is produced. If not, the output pin stays at **DIGITAL HIGH**. The detectable range of this sensor is 4–16 mm. There is a potentiometer which can be used to adjust the gain of the amplifier, that is, sensitivity of detection [10]. This sensor is depicted in Figure 1. To read from this sensor, one can use Listing 1. You can read more about this sensor at its wiki <sup>1</sup>.

With this sensor, you can build the following (but not limited to) applications: line following robots, optical encoders and object counting applications. One example of such an object counting application is counting the amount of rotation made by a motor.

### Specifications:

- Power: 3.0V ~ 5.3V
- Dimension: 25mm x 15.9mm
- Mounting holes size: 2.0mm

### Pin interface:

<sup>1</sup>[https://www.waveshare.com/wiki/Infrared\\_Reflective\\_Sensor](https://www.waveshare.com/wiki/Infrared_Reflective_Sensor)

- VCC ↔ 3.3V ~ 5.3V
- GND ↔ power supply ground
- AOUT ↔ MCU.IO (analog output)
- DOUT ↔ MCU.IO (digital output)

## 2.2 Sound sensor V2

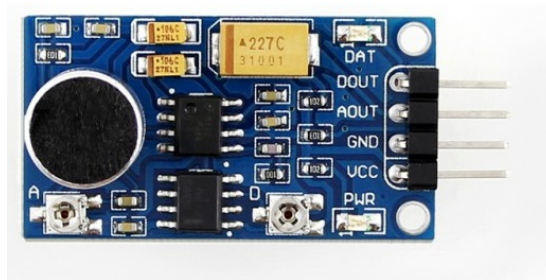


Figure 2: Sound sensor V2 [16]

Sound Sensor can detect the sound intensity of the environment. The main component of the module is a simple microphone, which is based on the LM386 amplifier and an electret microphone[11]. This module's output is analog. This sensor is depicted in Figure 2. To read from this sensor, one can use Listing 1. You can read more about this sensor at the wiki<sup>2</sup>.

This sensor can be used for audio amplifiers and ambient sound detection.

### Specifications:

- Mic sensitivity : 52dB
- Frequency range : 50Hz ~ 20KHz
- Power: 3.3V ~ 5.3V

### Pin interface:

- VCC ↔ 3.3V 5.3V
- GND ↔ power supply ground
- AOUT ↔ MCU.IO (analog output)
- DOUT ↔ MCU.IO (digital output)

The digital output identifies whether there is sound (HIGH when sound is detected) whilst the analog output changes according to the measured distance to the sound source. **Note that there is a mistake in the example code: You need to change `if(digitalRead(sound_din)==HIGH)` to `if(digitalRead(sound_din)==LOW)`.**

<sup>2</sup>[https://www.waveshare.com/wiki/Sound\\_Sensor](https://www.waveshare.com/wiki/Sound_Sensor)

## 2.3 Color sensor

en cites ook

## 2.4 Temperature-Humidity sensor

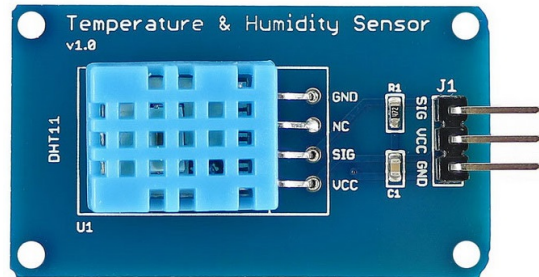


Figure 3: Temperature-Humidity sensor [1]

This is a calibrated digital temperature and humidity module with onboard sensor DHT11. It can be used for detecting ambient temperature and humidity, through the standard single-wire interface[12]. This sensor is depicted in Figure 3. This sensor can be used for weather stations, humidity controller tests and detection devices.

Note that you will need the DHT11 sensor library from to work with this sensor. This library is included in the code example at the sensor's wiki page<sup>3</sup>. The library can also be downloaded at <https://github.com/adafruit/DHT-sensor-library>. To install the library, place the *.cpp* and *.h* file in Arduino's */libraries* folder. You may also need to install *Adafruit Unified Sensor Library* because this library will be used by the *DHT sensor library*.

When the libraries are installed and the example code from the wiki is uploaded, one can open the serial terminal and verify that the sensor emits output every 2 seconds. An example of one such output is:

```
Read sensor : OK
Humidity (%): 59.00
Temperature (oC): 28.00
Temperature (oF): 82.40
Temperature (K): 301.15
Dew Point (oC): 19.26
Dew PointFast (oC): 19.23
```

### Specifications

- Temperature

– Resolution :  $1^{\circ}\text{C}$

<sup>3</sup>[https://www.waveshare.com/wiki/DHT11\\_Temperature-Humidity\\_Sensor](https://www.waveshare.com/wiki/DHT11_Temperature-Humidity_Sensor)

- Accuracy :  $\pm 2^{\circ}C$
- Measuring range :  $0^{\circ}C \sim 50^{\circ}C$
- Humidity
  - Resolution :  $1\%RH$
  - Accuracy :  $\pm 5\%RH(0 \sim 50^{\circ}C)$
  - Measuring range :  $20\%RH \sim 90\%RH(25^{\circ}C)$
- Operating voltage :  $3.3V \leftrightarrow 5.5 V$
- Recommended storage condition
- Temperature :  $10^{\circ}C \leftrightarrow 40^{\circ}C$
- Humidity : 60% RH or below

**Pin interface:**

- $VCC \leftrightarrow 3.3V \sim 5.5V$   $GND \leftrightarrow GND$
- $DOUT \leftrightarrow MCU.IO$

## 2.5 Hall sensor

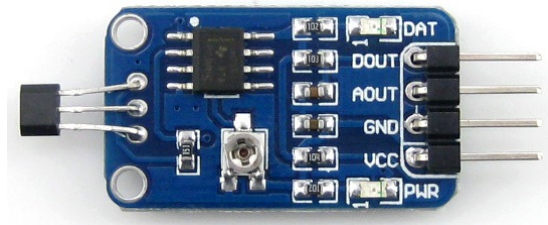


Figure 4: Hall sensor [2]

The Hall sensor is based on Hall Effect, which is the production of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current. There is a continuous-time switch on this Grove. The output of these devices switches low (turns on) when a magnetic field (south polarity) perpendicular to the Hall sensor exceeds the operate point threshold BOP, and it switches high (turn off) when the magnetic field disappears. The twig can be used to measure RPM [13]. This sensor is depicted in Figure 4.

This sensor can be used for motor speed measurement, object position detection, smart cars and electronic bricks.

**Specifications**

- Power:  $2.3V \sim 5.3V$

- Dimension: 27.0mm x 15.5mm
- Mounting holes size: 2.0mm

**Pin interface:**

- VCC: 2.3V ~ 5.3V
- GND: power supply ground
- AOUT: MCU.IO (analog output)
- DOUT: MCU.IO (digital output)

## 2.6 Flame sensor

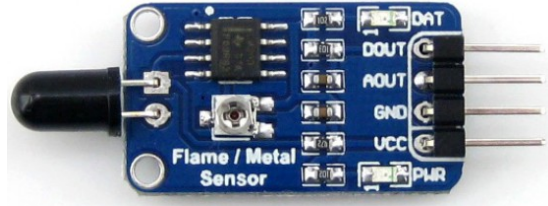


Figure 5: Flame sensor [3]

The Flame Sensor can be used to detect fire source or other light sources of the wavelength in the range of 760nm - 1100 nm. This sensor is depicted in Figure 5. To read from this sensor, one can use Listing 1. You can read more about this sensor at [https://www.waveshare.com/wiki/Flame\\_Sensor](https://www.waveshare.com/wiki/Flame_Sensor). This sensor can be used for fire robots and alarms.

**Specifications**

- Spectrum range: 760nm 1100nm
- Detection angle: 0 - 60 degree
- Power: 3.3V 5.3V
- Operating temperature: -25 85
- Dimension: 27.3mm \* 15.4mm
- Mounting holes size: 2.0mm

**Pin interface:**

- VCC: 3.3V ~ 5.3V GND : *power supply ground*
- AOUT: MCU.IO (analog output)
- DOUT: MCU.IO (digital output)

## 2.7 UV sensor

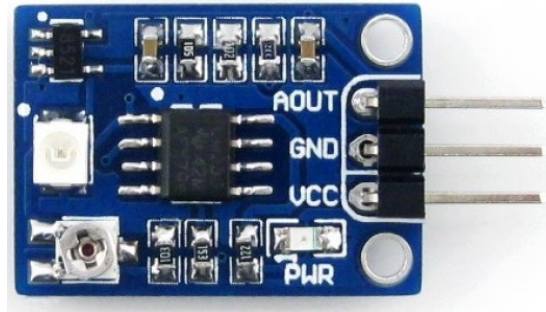


Figure 6: UV sensor [4]

The UV Sensor is used for detecting the intensity of incident ultraviolet(UV) radiation. This form of electromagnetic radiation has shorter wavelengths than visible radiation. This sensor is depicted in Figure 6. To read from this sensor, one can use Listing 2. You can read more about this sensor at [https://www.waveshare.com/wiki/UV\\_Sensor](https://www.waveshare.com/wiki/UV_Sensor).

This sensor can be used for an ultraviolet tester, an outdoor ultraviolet detector and a germicidal lamp.

### Specifications

- Response spectrum: 200nm-370nm
- Dimension: 22.0mm x 16.0mm
- Mounting holes size: 2.0mm

### Pin interface:

- VCC: 3.3V ~ 5.0V
- GND: power supply ground
- AOUT: MCU.IO (analog output)

## 2.8 Tilt sensor

The Tilt Switch is the equivalent of a button, and is used as a digital input. Inside the tilt switch is a pair of balls that make contact with the pins when the case is upright. Tilt the case over and the balls don't touch, thus not making a connection [17]. This sensor is depicted in Figure 7. To read from this sensor, one can use Listing 1. You can read more about this sensor at [https://www.waveshare.com/wiki/Tilt\\_Sensor](https://www.waveshare.com/wiki/Tilt_Sensor).

This sensor can be used for shake detection, guard alarm, smart cars and electric bricks.

### Specifications





Figure 7: Tilt sensor [5]

- Dimension: 19.0mm x 16.0mm

**Pin interface:**

- VCC: 3.0V ~ 5.5V
- GND: power supply ground
- DOUT: MCU.IO (digital output)

## 2.9 Laser sensor

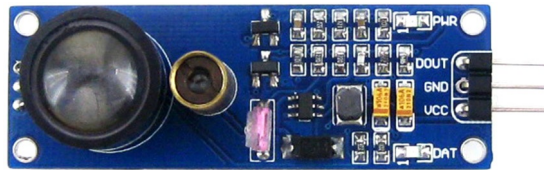


Figure 8: Laser sensor [6]

The Laser Sensor is used for measuring the distance to objects in its environment. This sensor is depicted in Figure 8.

This sensor can be used for obstacle detection, pipeline counter, smart robots and obstacle-avoiding cars. To read from this sensor, one can use Listing 1. You can read more about this sensor at [https://www.waveshare.com/wiki/Laser\\_Sensor](https://www.waveshare.com/wiki/Laser_Sensor).

**Specifications**

- Effective distance: 0.8m(typ), 1.5m(max)
- Power: 2.5V 5.0V
- Dimension: 47.7mm \* 17.9mm
- Mounting holes size: 2.0mm

**Pin interface:**

- VCC: 2.5V ~ 5.0V
- GND: power supply ground
- DOUT: MCU.IO (digital output)

## 2.10 Rotation sensor



Figure 9: Rotation sensor [7]

The rotary angle sensor or potentiometer produces analog output between 0 and Vcc (5V DC with Seeeduino) on its D1 connector. The D2 connector is not used. The angular range is 300 degrees with a linear change in value. The resistance value is 10k ohms, perfect for Arduino use[14]. This sensor is depicted in Figure 9.

This sensor can be used for setting the positioning in industrial controls. E.g. rotation of productions lines in a factory

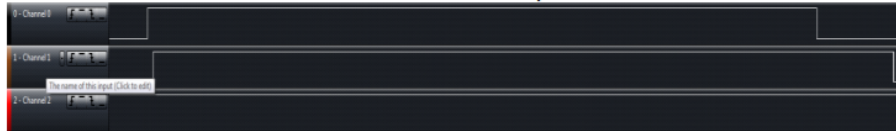
**Specifications**

- Pulses per lap: 15
- Power: 3.0V ~ 5.3V *Dimension : 32.1mm \* 15.4mm*
- Mounting holes size: 2.0mm

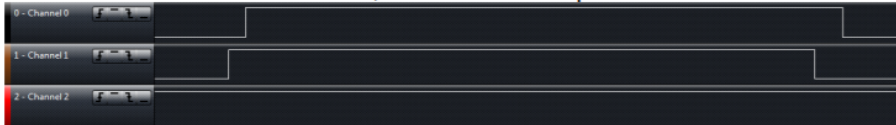
**Pin interface:**

- VCC: 3.0V ~ 5.3V
- GND: power supply ground
- SW: MCU.IO (encoder button status)
- SIB: MCU.IO (output status)
- SIA: MCU.IO (output status)

For clockwise rotation, the waveform outputs are shown as below:



For anticlockwise rotation, the waveform outputs are shown as below:



When the reset button is pressed, the waveform outputs are shown as below:

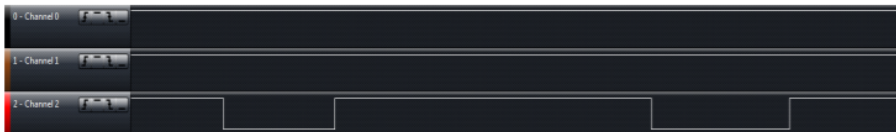


Figure 10: Signals outputted by rotation sensor for each different action[7]

The pins SIA and SIB can be used to detect a rotation movement. To read from this sensor, it is important to note know first how these pins work. The sensor can be rotated clockwise or anticlockwise or can be reset. These 3 actions yield the signals shown in Figure 10. Notice that rotation, no matter which direction, always triggers both pins SIA and SIB. However, clockwise rotation triggers SIA first and vice versa. One can easily use interrupts to handle these events, as done in Listing 3. The time variable is used to prevent the interrupt routine multiple times, because the pins stays HIGH for a certain interval. Also, the time variable is used to make sure that only one interrupt routine will change the count variable. As mentioned before, both pins will become HIGH, and by using the comparison with time, the routine corresponding to the first pin will prevent the other routine from entering the if-clause and changing the count variable.

If you wish to read more or check out the official example code, visit the wiki page at [https://www.waveshare.com/wiki/Rotation\\_Sensor](https://www.waveshare.com/wiki/Rotation_Sensor).

Listing 3: Example code for reading a rotation sensor[7]

```
#define PinA 2
#define PinB 3

unsigned long time = 0;
long count = 0;
long num = 0;
```

```

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

  pinMode(PinA,INPUT);
  pinMode(PinB,INPUT);

  attachInterrupt(0, blinkA , LOW);
  attachInterrupt(1, blinkB , LOW);

  time = millis();
}

void loop()
{
  while (num != count)
  {
    num = count;
    Serial.println(num);
  }
}

void blinkA()
{
  if ((millis() - time) > 3){
    count ++; }
  time = millis();
}

void blinkB()
{
  if ((millis() - time) > 3) {
    count --;}
  time = millis();
}

```

## 2.11 Moisture sensor

This Moisture Sensor can be used for detecting the moisture of soil or judge if there is water around the sensor, let the plant in your garden able to reach out for human's help when they are thirsty. This sensor is very easy to use, you can just simply insert in into the soil and read the data. With this sensor, you can make a small project that can let the plant send a message to you like " I am thirsty now, please feed me some water." [15]. This sensor is depicted in Figure



Figure 11: Moisture sensor [8]

11. To read from this sensor, one can use Listing 2. You can read more about this sensor at [https://www.waveshare.com/wiki/Moisture\\_Sensor](https://www.waveshare.com/wiki/Moisture_Sensor). This sensor can be used for auto watering systems, flowerpot soil moisture detection and auto pouring systems.

#### Specifications

- Detection depth: 38mm
- Power: 2.0V ~ 5.0V
- Dimension: 20.0mm x 51.0mm
- Mounting holes size: 2.0mm

#### Pin interface:

- VCC: 2.0V ~ 5.0V
- GND: power supply ground
- AO: MCU.IO (analog output)

This sensor is used by a simple 'analogRead' as shown below. A zero value represents a very dry ground. The maximum value is near 530.

```
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int sensorValue = analogRead(A0);
  // print out the value you read:
  Serial.println(sensorValue);
  delay(1);          // delay in between reads for stability
}
```

### 3 Diary

dag1 2: Getting to know the components and learning to work with them. Solved configuration issues with uploading my code to the Arduino board. Made a led blink, letting the buzzer make sound and used the potentiometer to adjust the led's brightness level . week3: sensors documenteren

### References

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