PH-4502C Sensor DIYMORE: How To Use and Calibrate using Arduino UNO R3

Aflah Agus Rizkika · Follow

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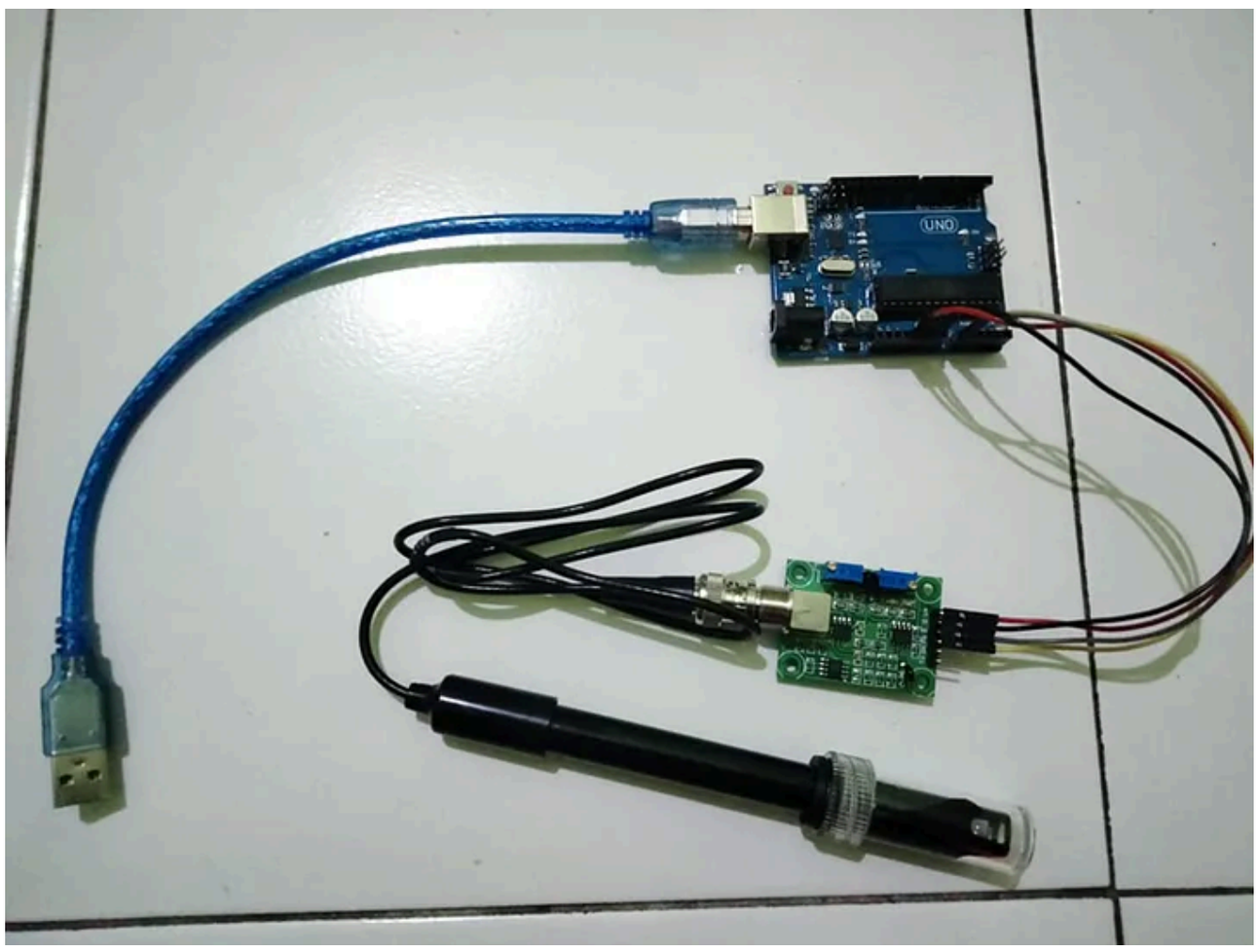
Description

Water is a necessity for every living thing. The importance of knowing the quality of water so that our lives are healthier is something that should be done. One way to find out whether drinking water is fit for drinking is to measure its physical parameters, namely ph. pH itself is the level of acidity of a solution or water, where a good pH value for drinking water according to WHO is 6.5–8.5.



PH-4502C and Probe connected with Arduino UNO R3

Lately, I made a college project, which is to make a pH sensor that used to measure the amount of pH in a solution. This project aims to produce finished goods in the form of sensors that can be applied in real life. Enjoy!

· The detection concentration range: PH 0–14

· The detection range of temperature: 0–60 centigrade

· The response time: ≤ 5S

· Stability time: ≤ 60S

· Power consumption: ≤ 0.5W

· The working temperature: -10~50 centigrade (the nominal temperature 20 centigrade)

· Working humidity: 95%RH (nominal humidity 65%RH)

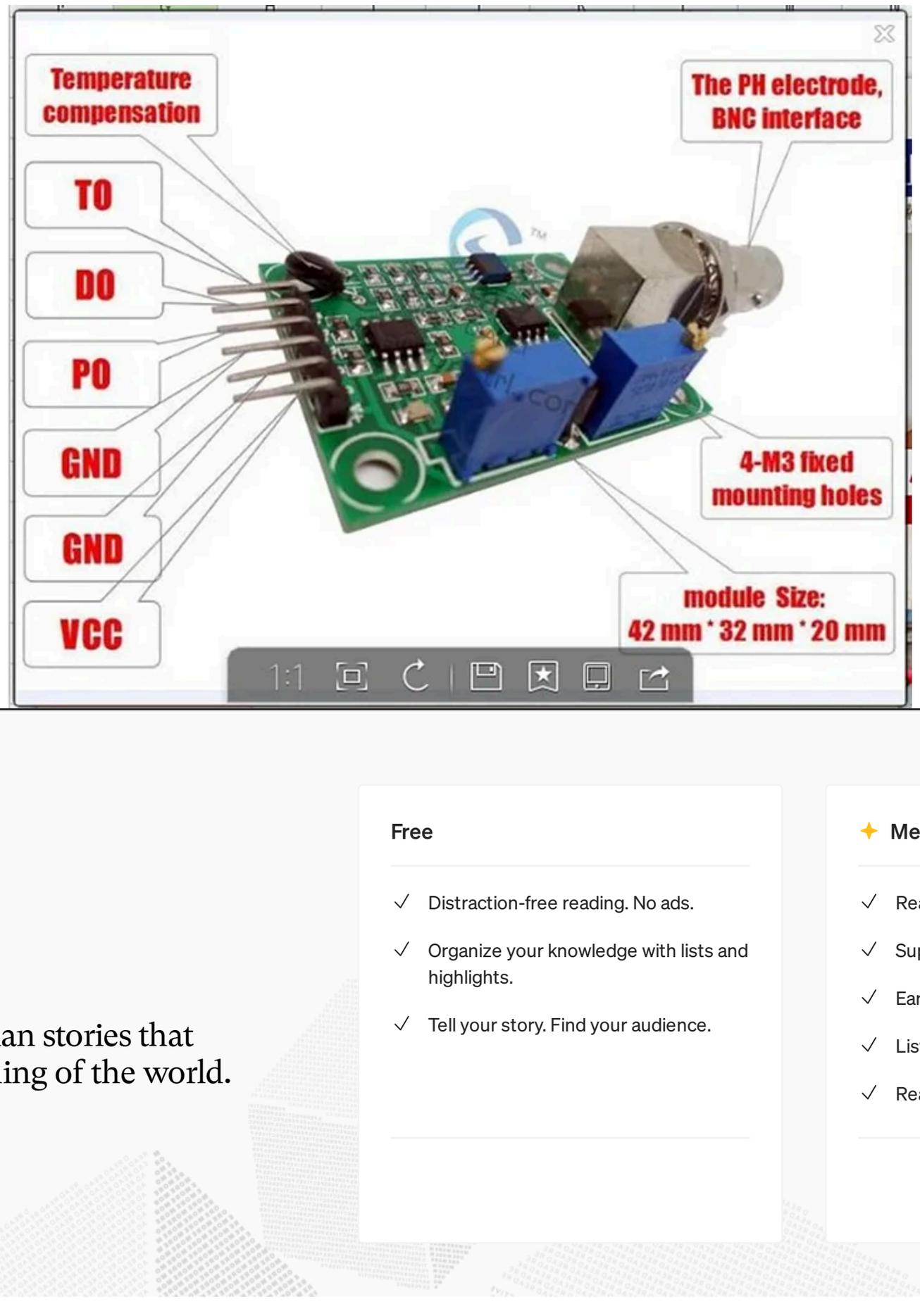
· Service life: 3 years

· Size: 42mm x 32mm x 20mm

· Weight: 25g

· The output: Analog voltage signal output

What you must underline is **detection concentration range** (it will used, soon!). This PH sensor has an Analog value output. This value will later be converted to digital during the calibration process. The PH Sensor board has several pins as shown in the picture.



- GND: Ground pin
- GND: Ground pin, actually this two GND have similar function as ground. But, this pin is connected directly to Arduino.
- VCC: Power Input pin, use 5V DC in Arduino.
- Blue Potentiometer close to BNC: PH offset value Pin.
- Blue Potentiometer close to pins: Limit adjustment pin.

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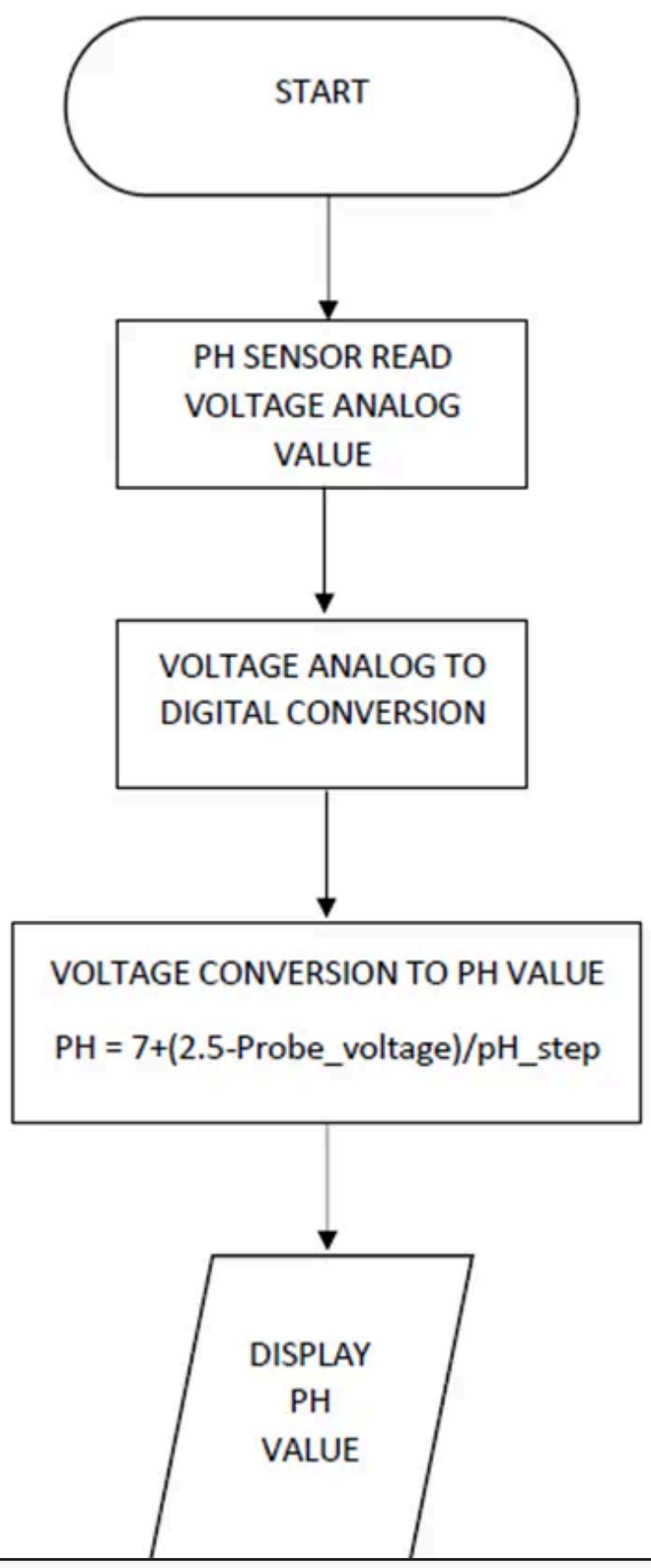
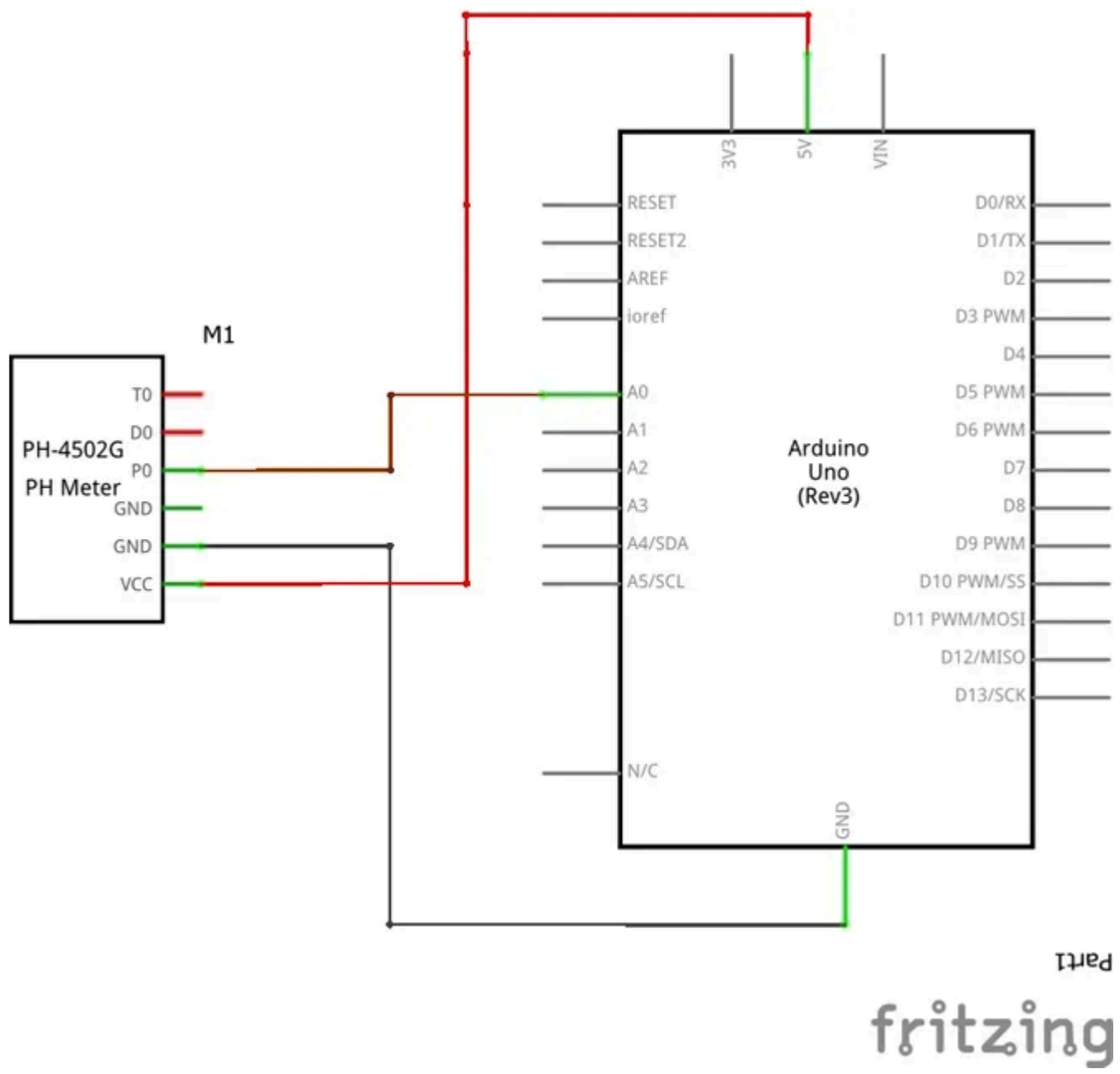
Flowchart and Wiring Diagram

To know how the sensor works, we must know what logical thinking behind it. Here's flowchart to demonstrate how actually sensor works by logical thinking process:



Thereafter, we convert the value of voltage to the pH value, by using equation above. If you want to know what's the point of equation above, you should check *calibration* part. From now on just understand that after we get the voltage, we convert it so we have pH value then display it in Serial Monitor or LCD (if you have one).



Wiring Diagram

For the diagram above, we just need three jumper cable. One for the +VCC, GND, and Analog Input Pin A0. The GND we use is actually the same for both GND (either analog GND or supply GND), so it comes to just one GND at a time in Wiring Diagram.

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Calibration

This part is divided by two parts, first is **hard calibration** by adjusting potentiometer in the BNC connector. Second is **soft calibration** with analytical pH for knowing pH step.

Hard Calibration

First, connect all wiring needed to the Arduino Board (use both GND).

Afterwards, make sure to have 2.5V value on the Serial Monitor by adjusting potentiometer (close to BNC).

If you ask, “why must 2.5V?” , the answer is because the detection concentration range is 0–14 and the Arduino Voltage (or range of measured voltage) is around 0–5V. Which means, median value for concentration range is 7 and voltage is 2.5. So, 2.5V means the exact value of pH7 and if you had exact value of PH 7 mean the probe will outputs 0 millivolt.

Soft Calibration

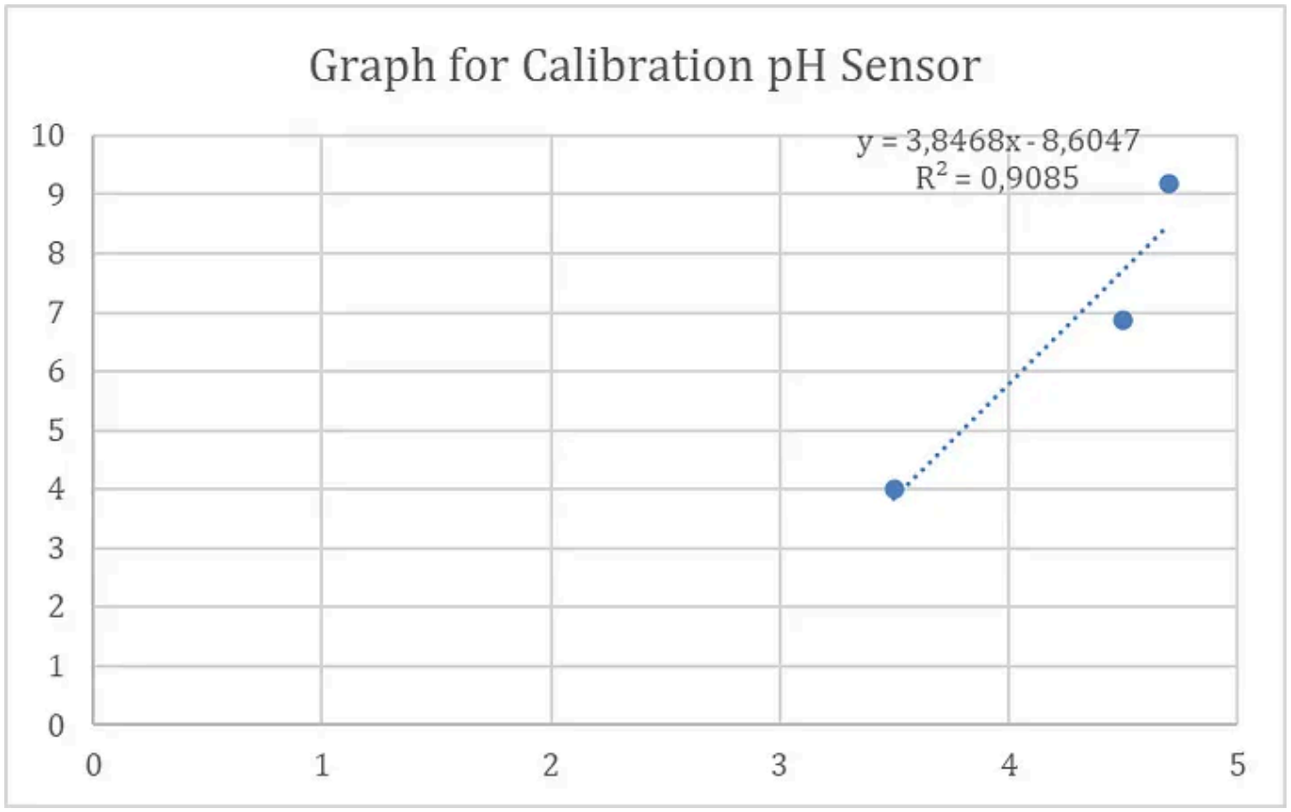
After Hard Calibration, we moved into Soft Calibration. The purpose of this part of calibration is to knowing what is the value of pH step. pH step is some kind of value which explains the relationship between pH and voltage.

Now, we need one or more buffer solutions depending the range and precision we want. For my case, water (between PH 5 — PH7), buffer (PH 6.81), and buffer (PH 4.01). Connect the probe and put in the buffer then let it stabilize for a minute. If the value in Arduino IDE have same value, indicating that the sensor is stable, then take a note for the voltage value. Here’s example of my data while calibrating:

Voltage (pH = 6.86) (Volt)	Voltage (pH = 4.00) (Volt)
2.40	3.05
2.47	3.05
2.47	3.06
2.47	3.05
2.40	3.06
2.49	3.05
2.46	3.05

Calibration Data

After we get the data, we do a linearity test to find out the limits of the range that our pH sensor can measure. We used Regression Linear to know what is



Microsoft Excel Graph for pH Calibration

Based on the graph above, it can be concluded that the R^2 value obtained is quite good (close to 1), but this value can only be used in the pH range < 7. To determine the pH step value for pH values above 7, a buffer solution with an amount higher. For now, the sensor I'm calibrating has an effective measurement range of 0–7 pH.

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Implementation

The pH sensor is immersed in water

After the calibration process is over, now is the time of implementation. Before starting, we need the value of the pH step, the value of the pH step can be calculated using simple mathematical calculations, with the following equation:

After that, we just enter into the code as follows:

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

void loop() {
  float measure = analogRead(A0);  //Read pin A0
  double voltage = measure*5/1024; //Analog-to-Digital Conversion

  // PH_step (Voltage/pH Unit) = (Voltage@PH7-Voltage@PH4)/(PH7 - PH4)
  float pH = 7+((2.5 - voltage)/0.1841); // PH_probe = PH7-((Voltage@PH7-Voltage@pro
  Serial.print("PH: "); //Print word pH in Serial Monitor
  Serial.println(pH); //Print pH value in Serial Monitor

  delay(1000);  //Gives delay 1 second
}
```

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Thus, an article on how to calibrate the pH-4502C sensor. There are still many deficiencies in calibration that can be improved, such as increasing the measurement range of the sensor by using a buffer solution with a pH value greater than 7.

For source code and wiring diagrams in the form of Fritzing, you can access them via my GitHub link here. Thank you!

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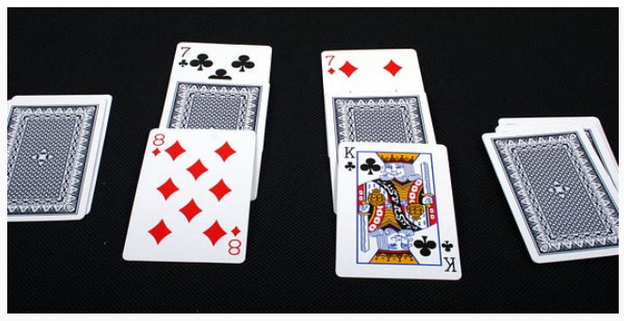

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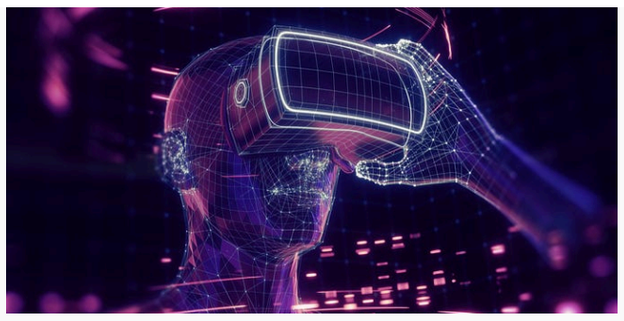

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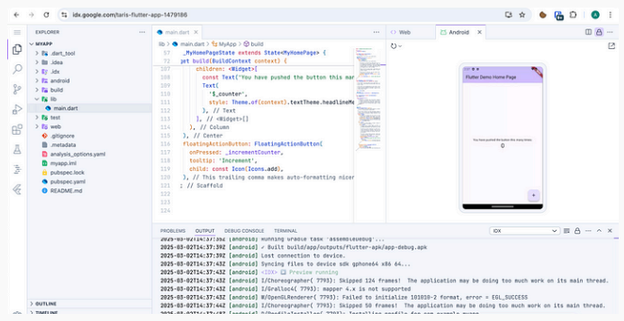

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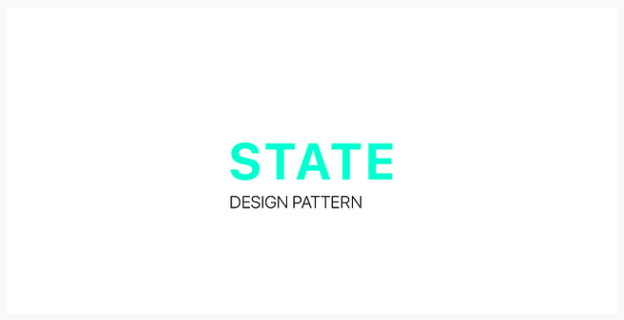

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