

For previous results and a little confusion, see pages 90 - 92 of Book 1.

→ Previously using the adafruit library.

Objective

Write our own I₂C code to get a heading from the BNO055. See if the error that occurs in the adafruit library still exists.

Operating Modes

Table 3-3: Operating modes overview

Operating Mode		Available sensor signals			Fusion Data	
	Accel	Mag	Gyro	Relative orientation	Absolute orientation	
Non-fusion modes	CONFIGMODE	-	-	-	-	-
	ACCONLY	X	-	-	-	-
	MAGONLY	-	X	-	-	-
	GYROONLY	-	-	X	-	-
	ACCMAG	X	X	-	-	-
	ACCGYRO	X	-	X	-	-
	MAGGYRO	-	X	X	-	-
Fusion modes	AMG	X	X	X	-	-
	IMU	X	-	X	X	-
	COMPASS	X	X	-	-	X
	M4G	X	X	-	X	-
	NDOF_FMC_OFF	X	X	X	-	X
	NDOF	X	X	X	-	X

We are going to use the IMU mode since we won't have to worry about noisy magnetic fields, and it provides a relative orientation.

The operating mode can be selected by writing to the OPR_MODE register, possible register values and the corresponding operating modes are shown in the table below.

Table 3-5: operating modes selection

Parameter	Value	[Reg Addr]: Reg Value
CONFIG MODE	CONFIGMODE	[OPR_MODE]: xxxx0000b
Non-Fusion Mode	ACCONLY	[OPR_MODE]: xxxx0001b
	MAGONLY	[OPR_MODE]: xxxx0010b
	GYROONLY	[OPR_MODE]: xxxx0011b
	ACCMAG	[OPR_MODE]: xxxx0100b
	ACCGYRO	[OPR_MODE]: xxxx0101b
	MAGGYRO	[OPR_MODE]: xxxx0110b
	AMG	[OPR_MODE]: xxxx0111b
Fusion Mode	IMU	[OPR_MODE]: xxxx1000b
	COMPASS	[OPR_MODE]: xxxx1001b
	M4G	[OPR_MODE]: xxxx1010b
	NDOF_FMC_OFF	[OPR_MODE]: xxxx1011b
	NDOF	[OPR_MODE]: xxxx1100b

OPR_MODE is at address 0x3D

To set IMU mode, we will write 1<<3 to register 0x30.

Unit Selection

The measurement units for the various data outputs (regardless of operation mode) can be configured by writing to the UNIT_SEL register as described in Table 3-9.

Table 3-11: unit selection

Data	Units	[Reg Addr]: Register Value
Acceleration, Linear Acceleration, Gravity vector	m/s ²	[UNIT_SEL] : xxxxxxx0b
Magnetic Field Strength	Micro Tesla	NA
Angular Rate	Dps	[UNIT_SEL] : xxxxxxx0xb
	Rps	[UNIT_SEL] : xxxxxxx1xb
Euler Angles	Degrees	[UNIT_SEL] : xxxxx0xxb
	Radians	[UNIT_SEL] : xxxxx1xxb
Quaternion	Quaternion units	NA
Temperature	°C	[UNIT_SEL] : xxx0xxxxb
	°F	[UNIT_SEL] : xxx1xxxxb

I want degrees
0<<2

Important Notes From the data sheet:

Table 3-13: Rotation angle conventions

Rotation angle	Range (Android format)	Range (Windows format)
Pitch	+180° to -180° (turning clockwise decreases values)	-180° to +180° (turning clockwise increases values)
Roll	-90° to +90° (increasing with increasing inclination)	
Heading / Yaw	0° to 360° (turning clockwise increases values)	

Table 3-28: Compensated orientation data in Euler angles format

Parameter	Data type	bytes
EUL_Heading	Signed	2
EUL_Roll	Signed	2
EUL_Pitch	Signed	2

Table 3-29: Euler angle data representation

Unit	Representation
Degrees	1 degree = 16 LSB
Radians	1 radian = 900 LSB

Our headings will be from 0-360°.
However, we will have to divide the value from the registers by 16.

Revisiting the BNO055

06/04/24
Wednesday
Week 1

```

1 #include <Wire.h>
2 #define BNOAddress 0x28 // Found using I2C scanner
3 #define OPR_MODE 0x3D
4 #define UNIT_SEL 0x3B
5
6 void setup()
7 {
8     Serial.begin(115200);
9     Wire.begin();
10
11    // I2C Scanner -> 0x28 found
12    for(int add=1; add<=127; add++)
13    {
14        Wire.beginTransmission(add);
15        int reply = Wire.endTransmission();
16        if (reply == 0)
17        {
18            Serial.print("0x");
19            Serial.print(add, HEX);
20        }
21    }
22
23    // Configure the BNO to IMU mode
24    // OPR_MODE is 0x3D
25    // IMU setting : xxxx1000b
26    Wire.beginTransmission(BNOAddress);
27    Wire.write(OPR_MODE);
28    Wire.write(1<<3);
29    Wire.endTransmission();
30
31    // Unit Select Register
32    // Set Degrees xxxxx0xxb
33    Wire.beginTransmission(BNOAddress);
34    Wire.write(UNIT_SEL);
35    Wire.write(0<<2);
36    Wire.endTransmission();
37 }

```

Search for
an address

Operating Mode

Unit Selection

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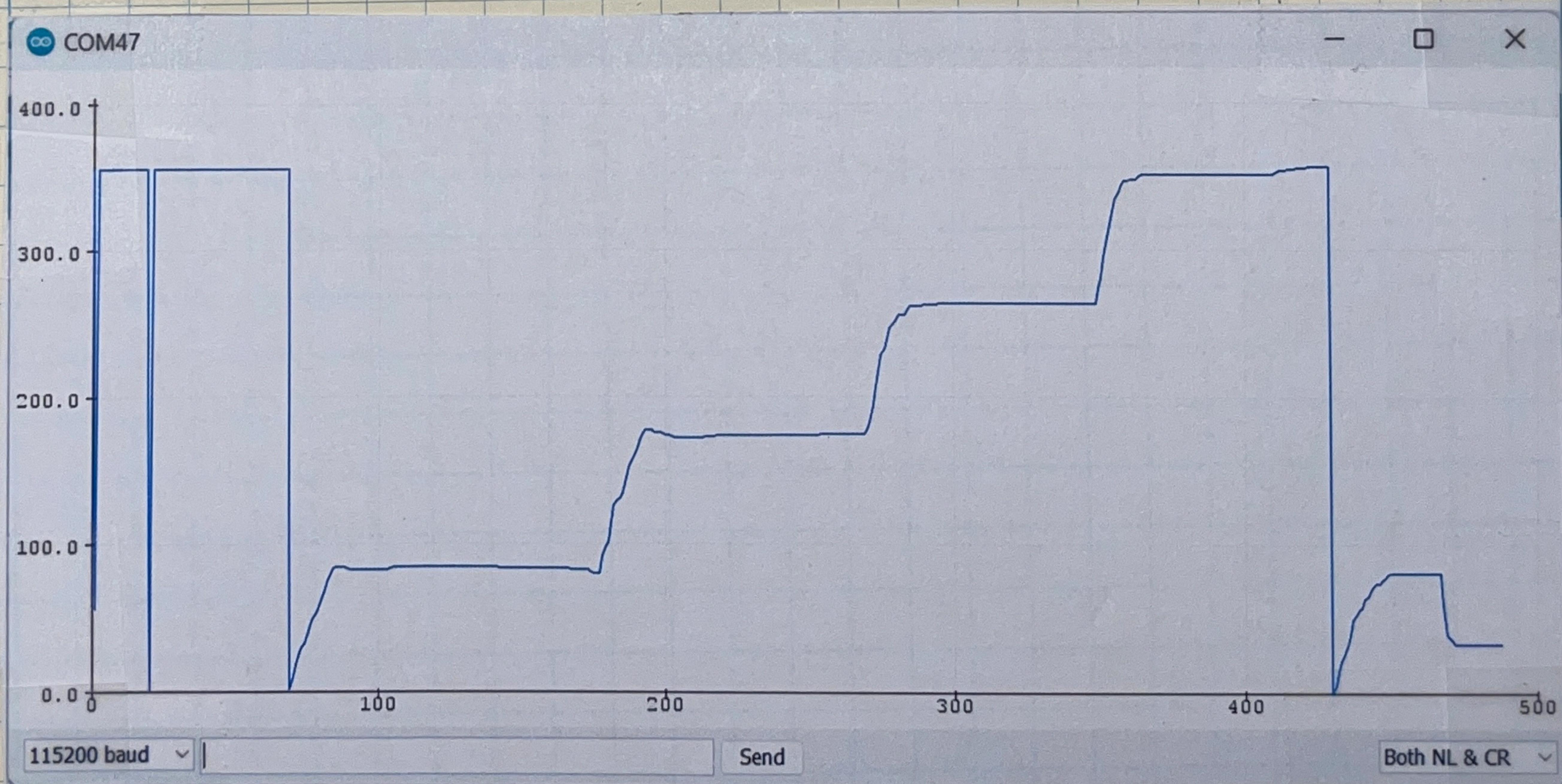
Revisiting the BNO055

37

```
39 void loop()
40 {
41     // Heading Registers 1A LSB , 1B MSB
42     Wire.beginTransmission(BNOAddress);
43     Wire.write(0x1A);
44     Wire.endTransmission();
45     Wire.requestFrom(BNOAddress, 2); // Go Get 1A, 1B
46
47     uint8_t LSB = Wire.read();
48     uint8_t MSB = Wire.read();
49
50     // Combine the data and divide by 16
51     Serial.println(((int)MSB<<8 | LSB)>> 4);
52     delay(100);    Or ((float)((int)MSB<<8 | LSB))/(16.0);
53 }
```

Results

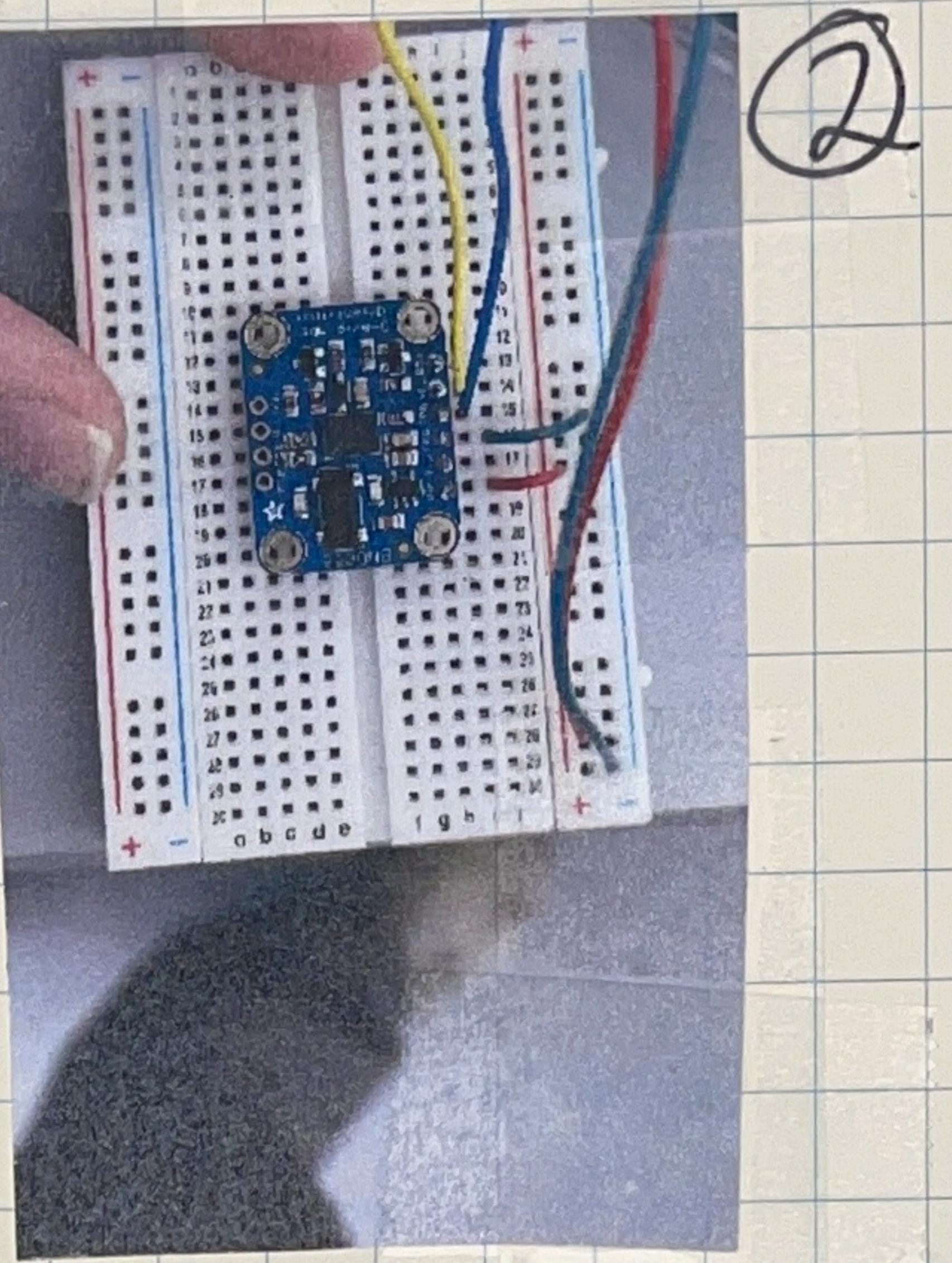
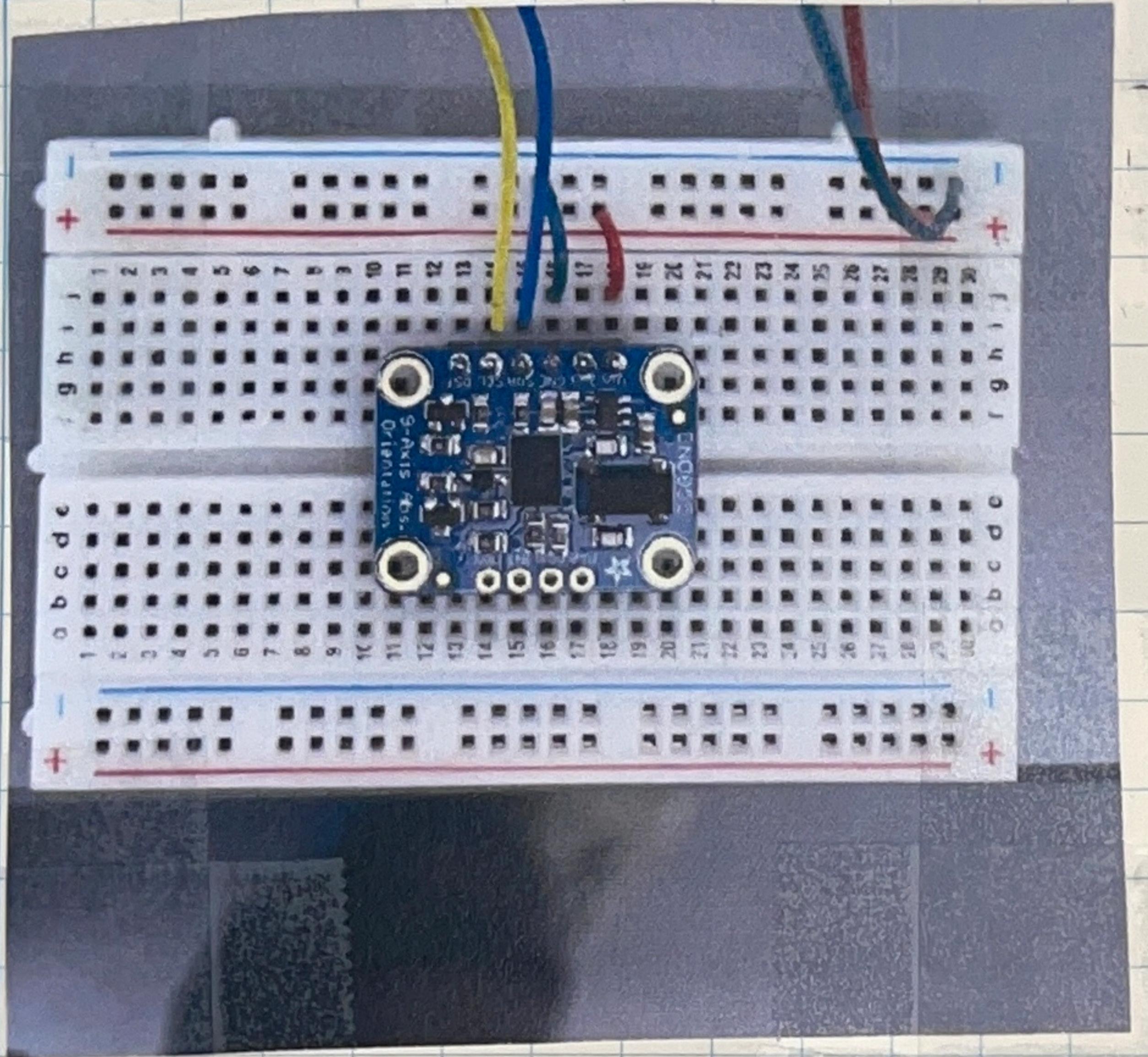
Rotating the board clock wise? No weird jump!



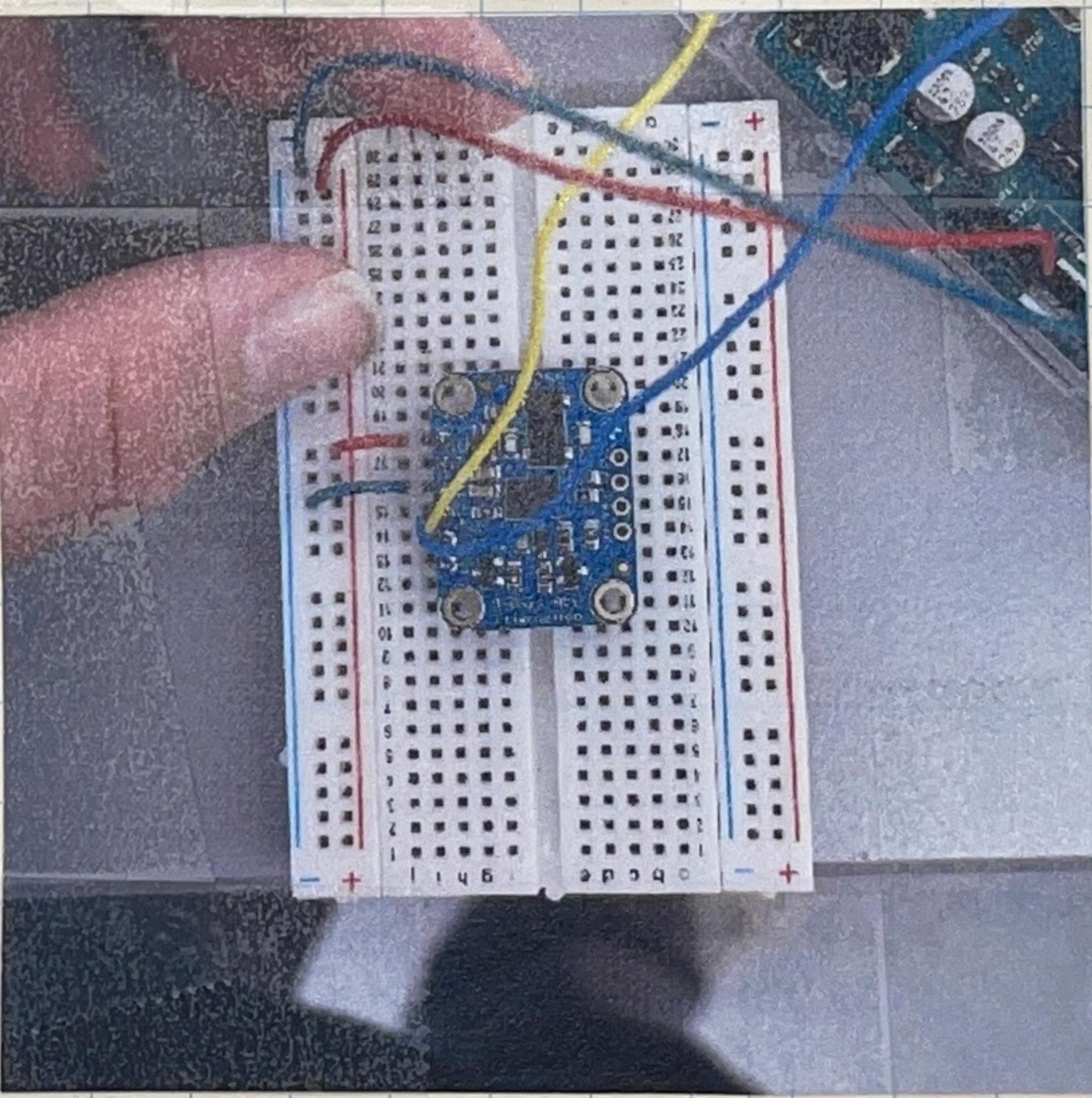
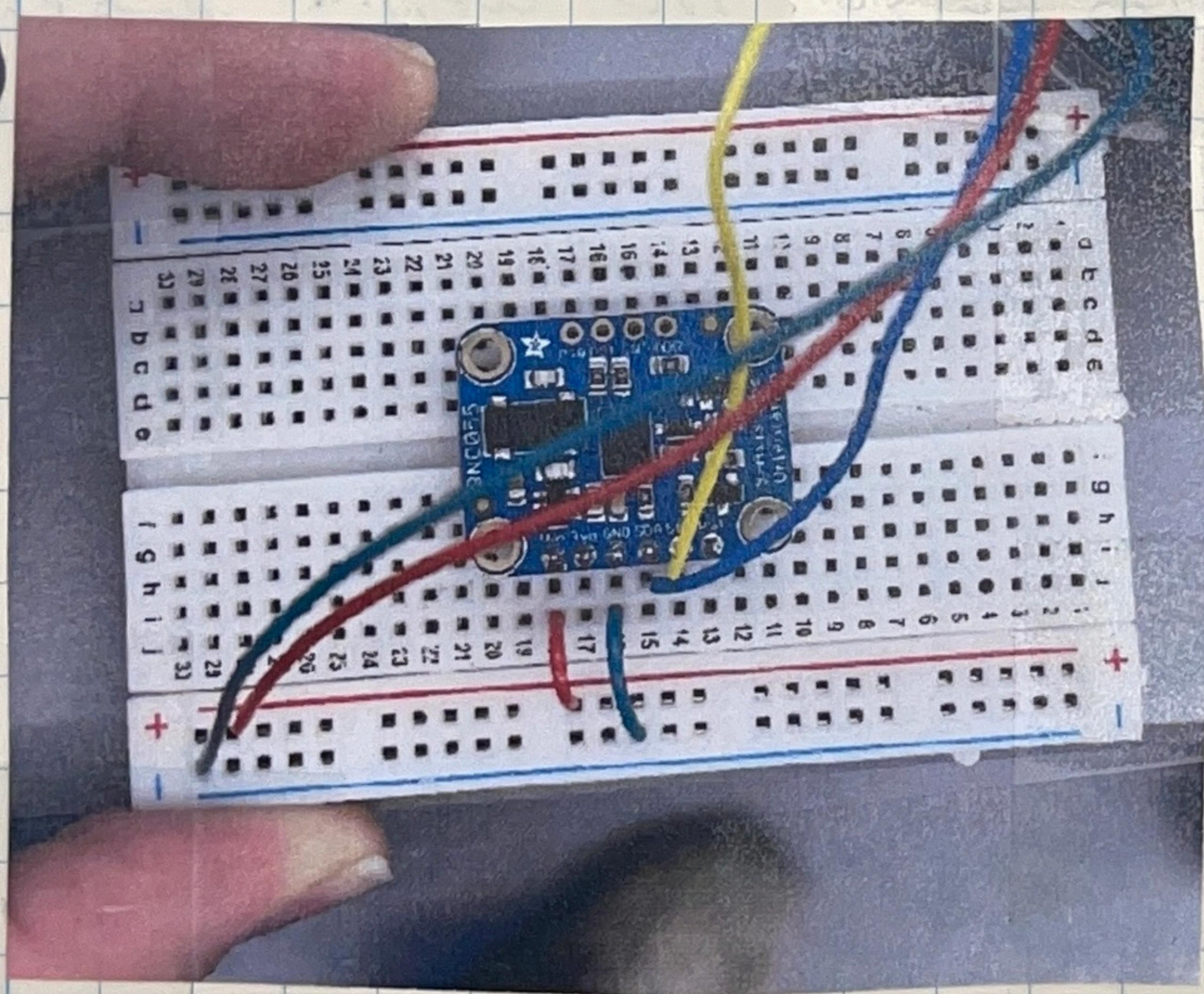
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