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EXPERIMENT REPORT

Measuring and Analysis of Blood Glucose Levels using AS7263 NIR Spectroscopy Sensor

24AIM113 & 24AIM114

Introduction to NN, CNN and GNN

Analog system design

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Objective:

The objective is to create an experimental setup to try and map the analog output of AS7263's 860nm channel to the corresponding blood glucose level.

Pre-Requisites:

While glucose absorption peaks around 950 nm, there are secondary harmonic oscillations at <850 nm range too.

We will be using the 'W-860 nm' channel of the AS7263 NIR sensor because it has the 860 ±20 nm wavelength capability and can capture the intensity differences caused to due glucose molecule's secondary harmonic vibrations at the 850 nm range.

Experimental Setup:

Apparatus:

1. Arduino UNO
2. AS7263 NIR spectroscopy sensor
3. Glucometer
4. Lancelet pricks
5. Testing strips

Hardware Assembly:

AS7263 Pin	Arduino Uno Pin	Description
VCC	3.3V	Power Supply
GND	GND	Ground
SCL	A5	I2C Clock Line
SDA	A4	I2C Data Line

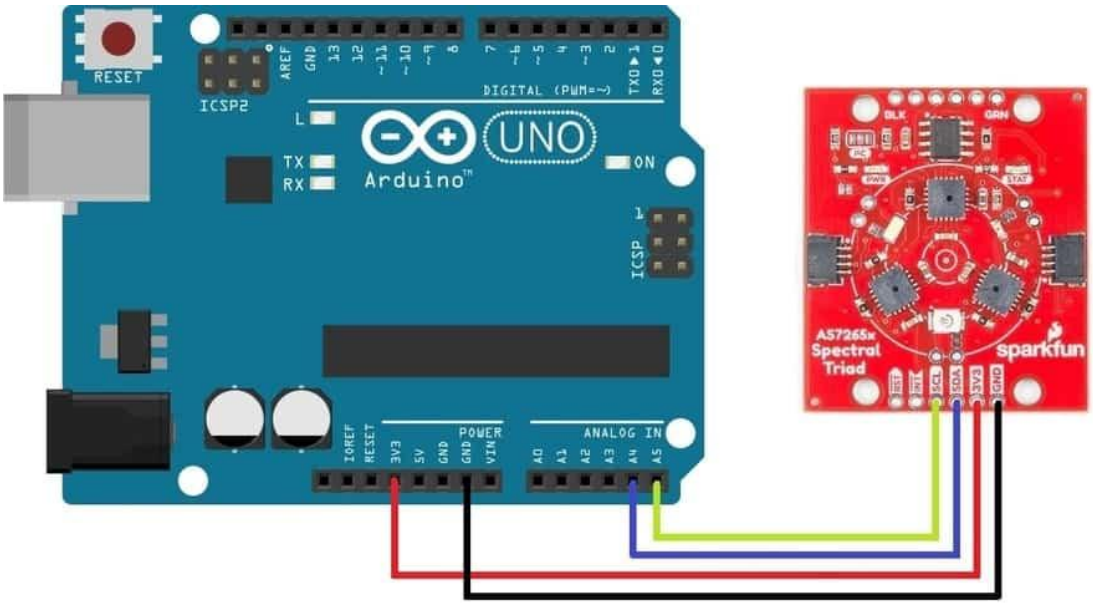


Fig. 1: Circuit diagram

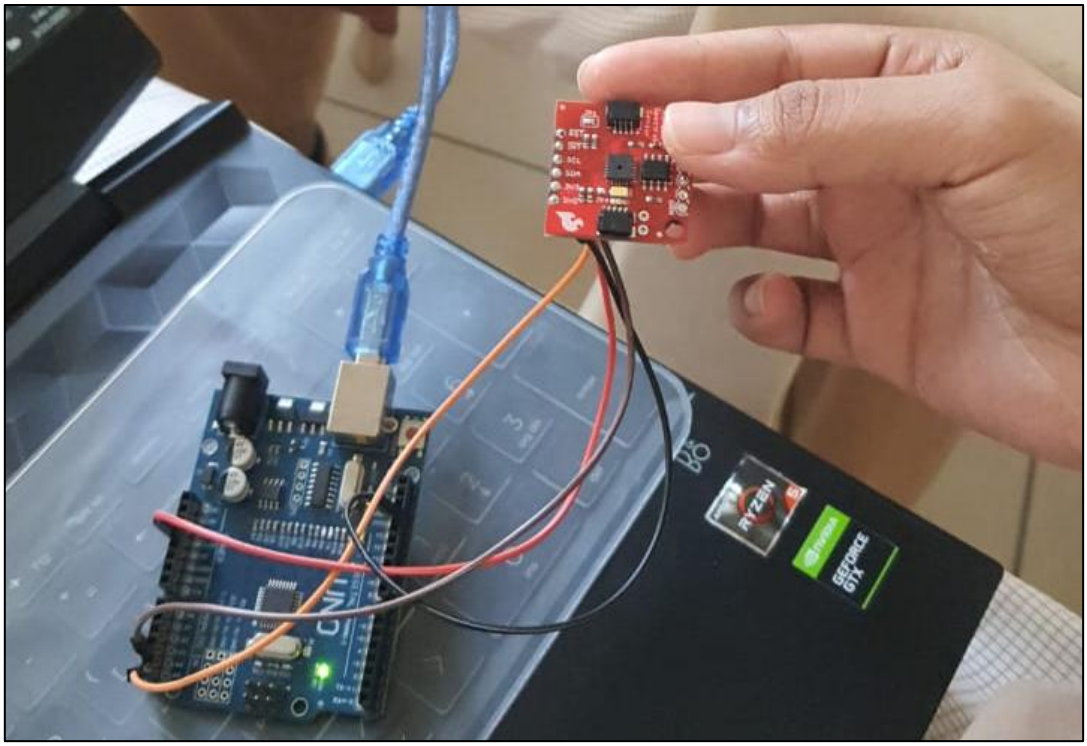


Fig. 2: Hardware assembly

Library overview: Before we got started, we downloaded and installed SparkFun's *AS726X* Arduino library in the Arduino IDE.

Code:

The C code was written in Arduino IDE, and the `takeMeasurementsWithBulb()` and `getCalibratedW()` functions from the *AS726X* Arduino library were used to access the W-860 nm NIR channel and get its readings.

```
#include "AS726X.h"
#include <Wire.h>

AS726X sensor;

void setup() {
  Serial.begin(115200);
  Wire.begin();
  sensor.begin();
  sensor.disableIndicator();
}

void loop() {
  sensor.takeMeasurementsWithBulb();
  int nir = 0;
  nir = sensor.getCalibratedW();
  Serial.print("NIR W-Channel output: ");
  Serial.println(nir);
  Serial.println("-------------");
  delay(3000);
}
```

NOTE: Inaccuracy last time was caused because we used `takeMeasurements()` rather than `takeMeasurementsWithBulb()`. The `takeMeasurementsWithBulb()` function illuminates the onboard bulb, calls `takeMeasurements()` then turns off the onboard bulb.

The measuring surface must be properly illuminated, before taking measurements using the sensor, which was not performed in the glucose solution experiment, leading to very small singular digit values.

Procedure:

1. Using the invasive glucometer, we first observed our actual blood glucose value.

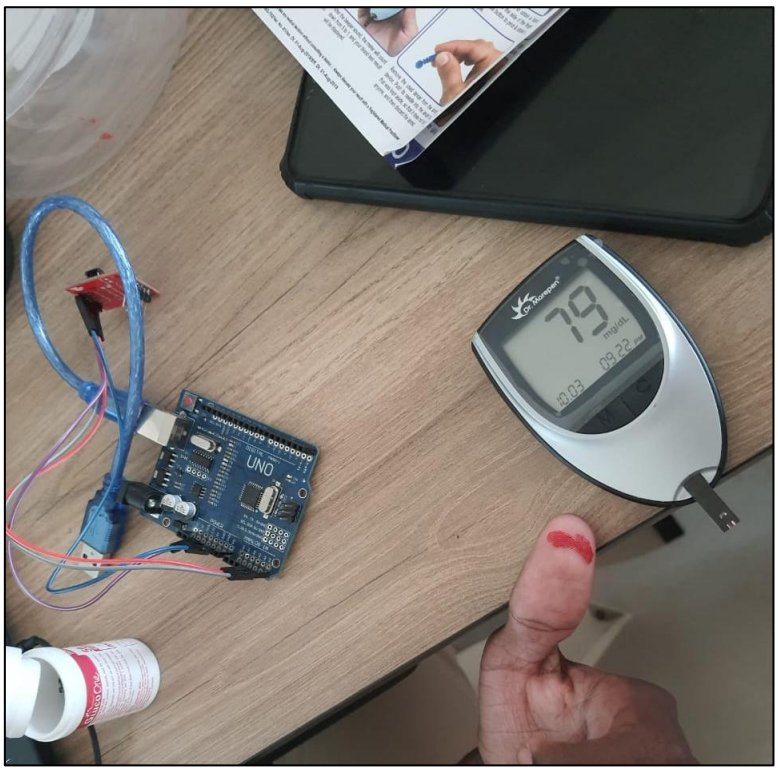


Fig. 3: Measurement of actual blood glucose level

2. The same was performed on multiple people to record a range of blood glucose levels.

Fig. 4: A few other samplings

3. Once the actual blood glucose level was measured from one person, we immediately recorded the readings from **AS7263's W-860 nm channel** while the sensor's photodiode array was placed directly on their thumb.

4. The outputs were recorded from the serial monitor of Arduino IDE.

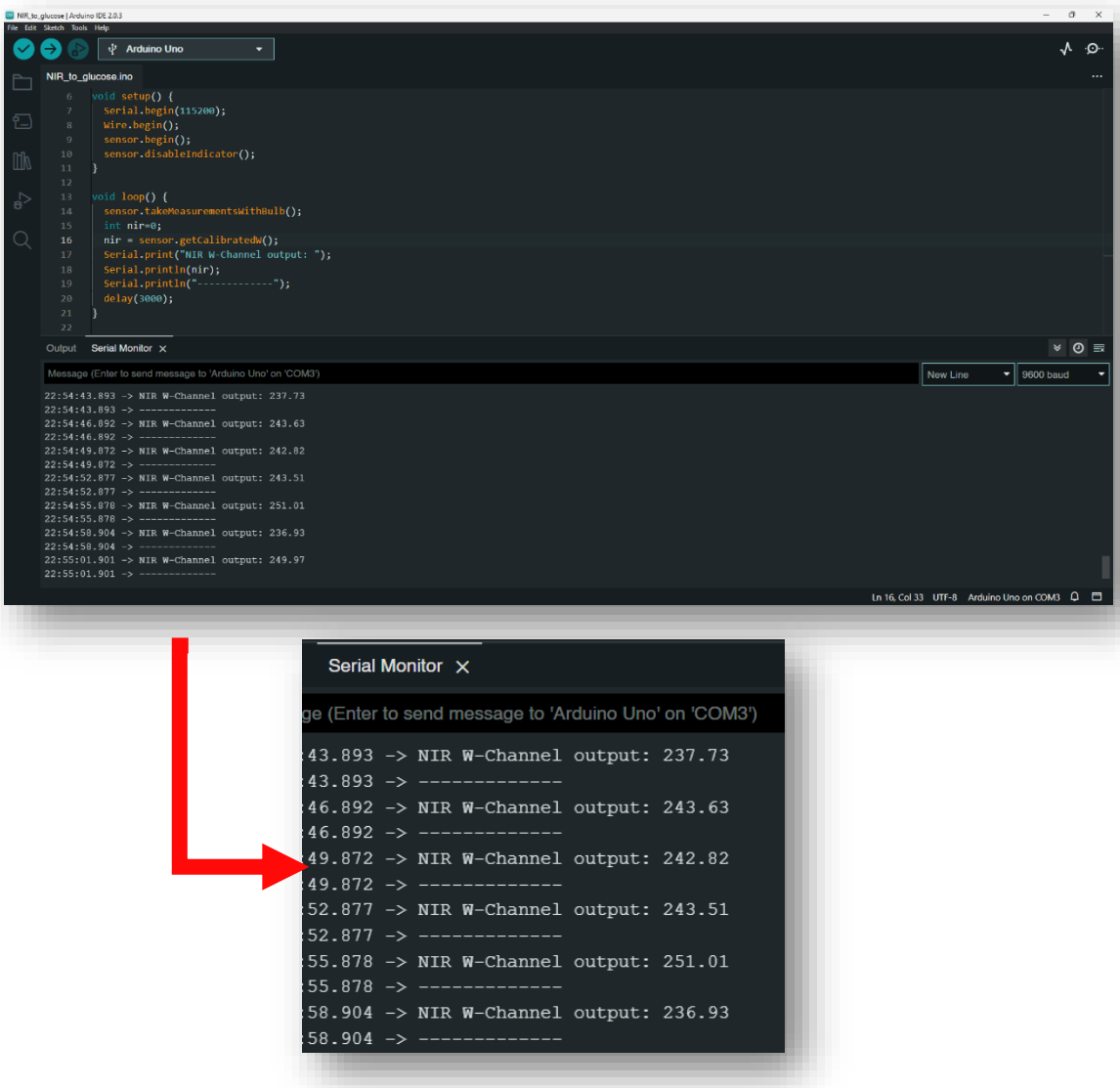


Fig. 5: Serial Monitor output [W: 243.51]

5. Observation was done for 5 blood glucose level corresponding to their respective W-860 nm NIR channel analog output value.

6. The results were then tabulated.

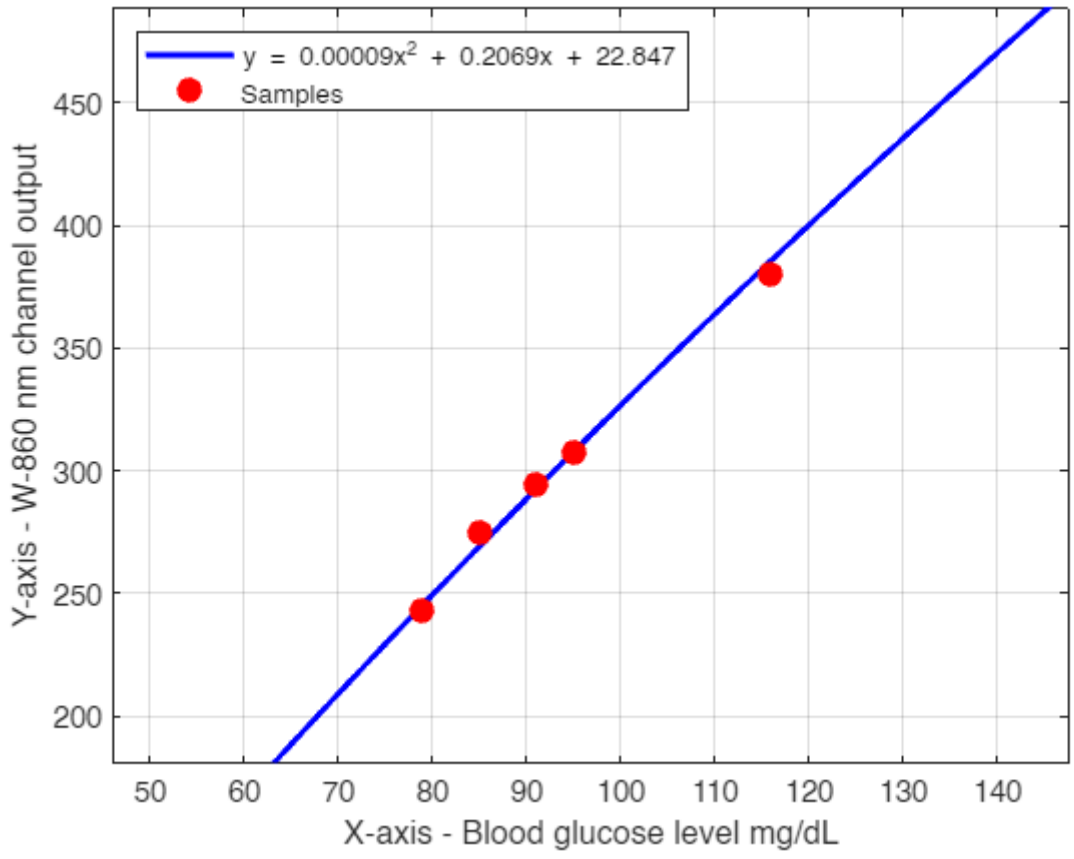
Results:

S. No.	Blood Glucose Level	W-860 nm NIR channel analog output
1	79 mg/dL	243.51
2	91 mg/dL	294.38
3	85 mg/dL	274.43
4	116 mg/dL	379.83
5	95 mg/dL	299.71

After fitting a quadratic curve through the points:

$$y = 0.00009x^2 + 0.2069x + 22.847$$

Plot of results



Conclusion:

i. We have successfully performed the mapping of known blood glucose levels to output intensity of NIR sensor at W-860 nm channel.

ii. Having mapped the two values, we have plotted the values. The points have been further used for curve fitting and neural network training.
