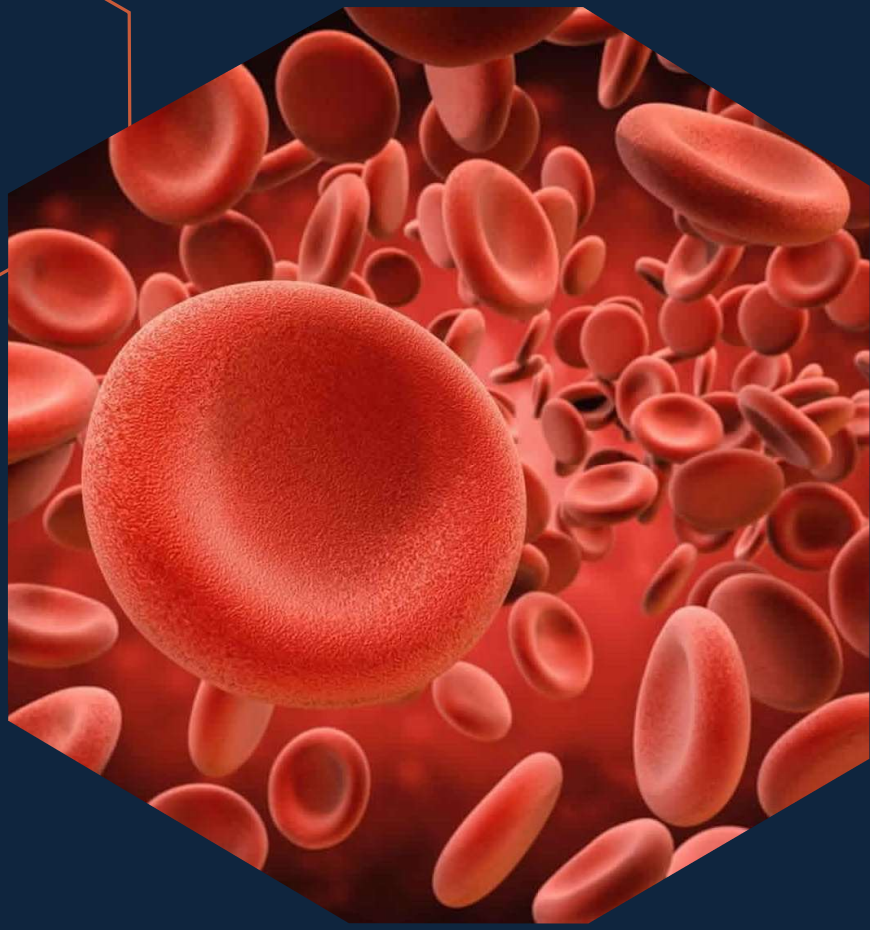
Oximeter

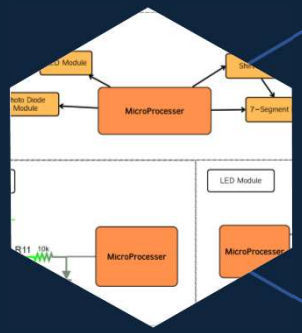
Noe Sheridan

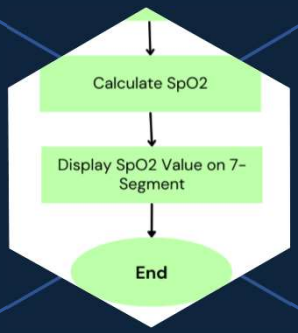
Introduction

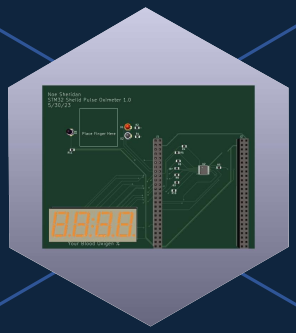
An oximeter is a device which measures the proportion of oxygenated hemoglobin to non-oxygenated hemoglobin in the blood. Typically done by shining two LEDs through a small extremity and analyzing the light received on the other side of the appendage.

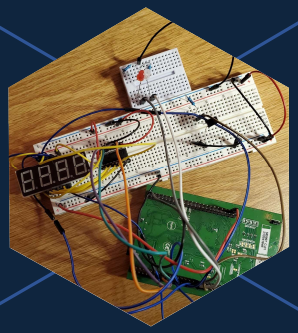


Design/Implementation Process









General Design

The general idea for the project and its requirements

Code Design

How the project would complete its tasks, signal communication

PCB Design

Design an STM32 shield PCB for the current design

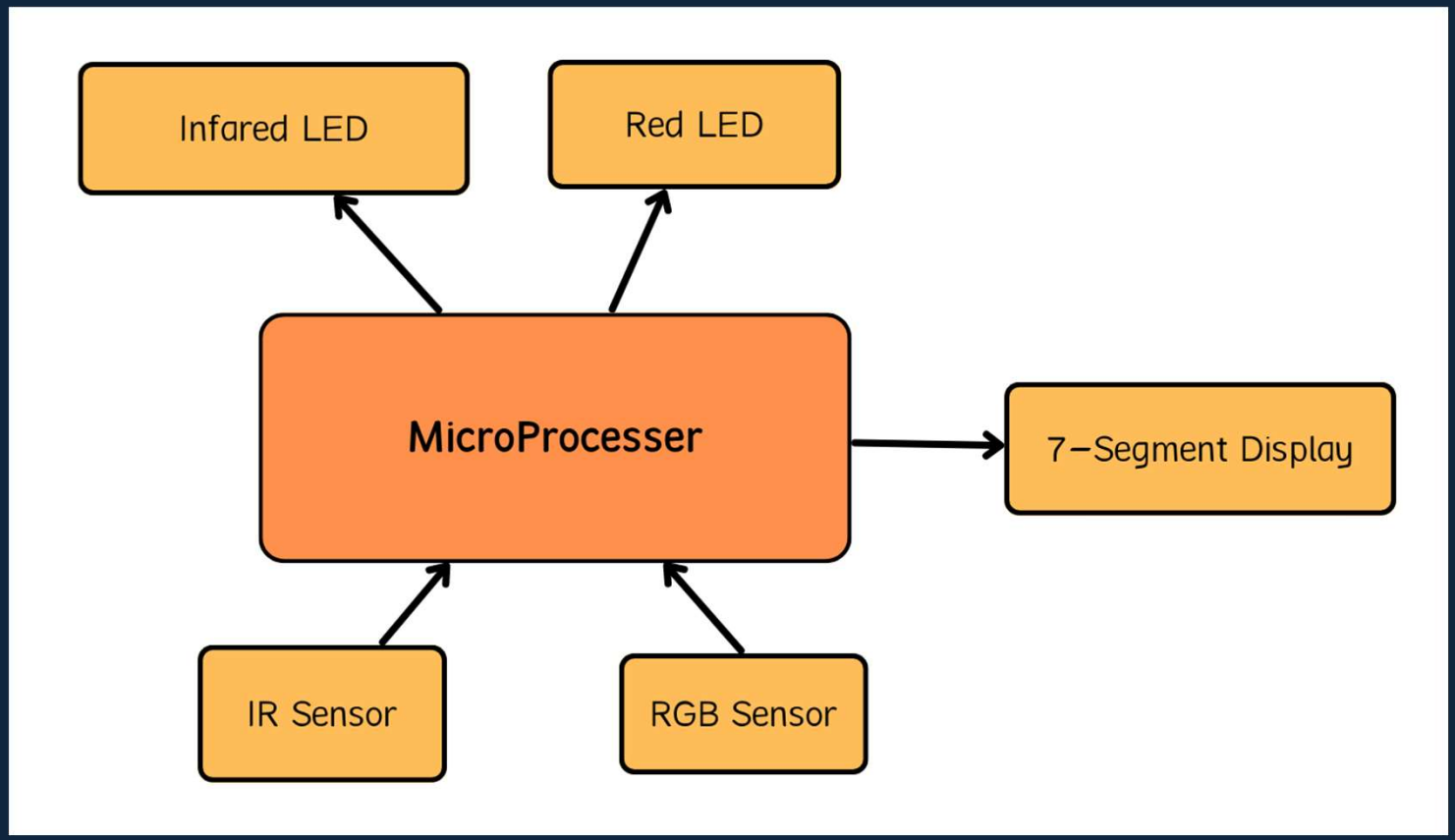
Prototype Build

Acquiring and wiring the necessary components

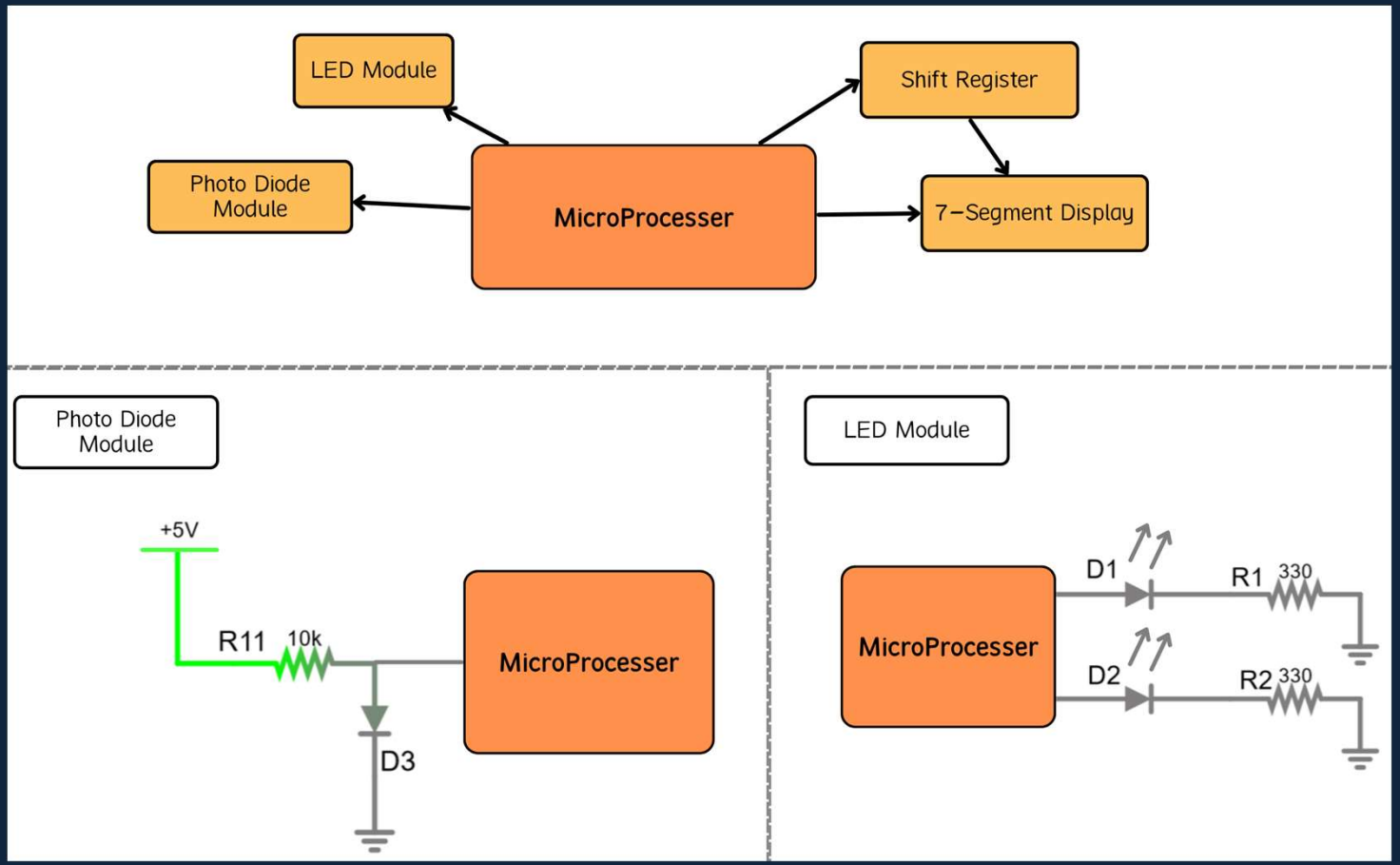
Code

Writing the STM32 code for the prototype build, testing functionality

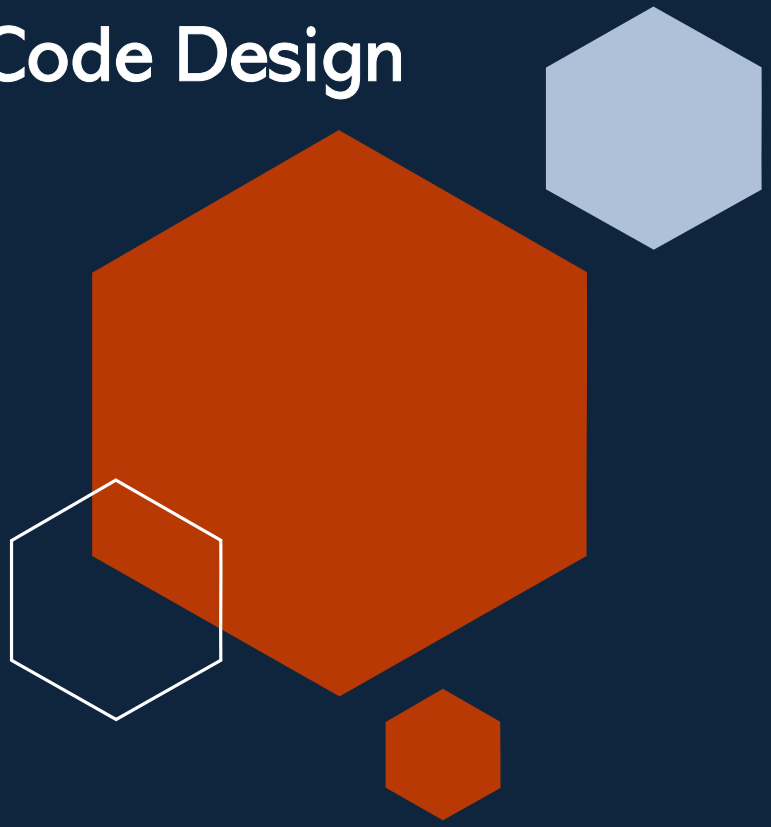
Block Diagram V1.0

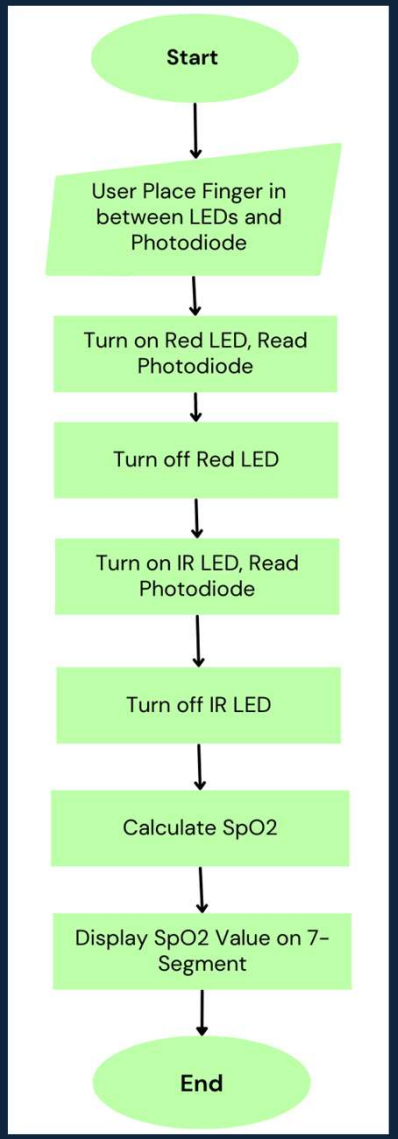


Block Diagram V2.0

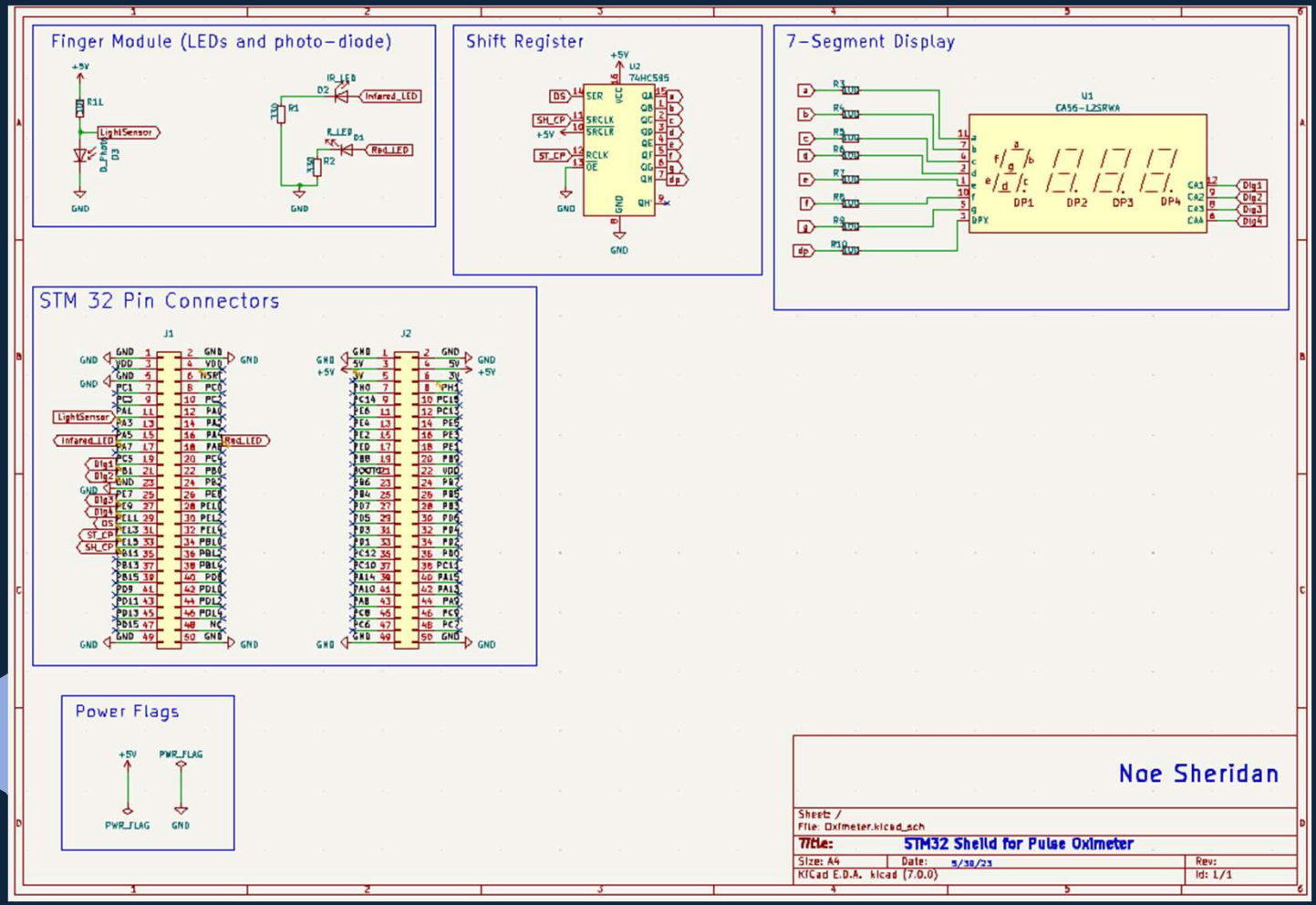


Code Design

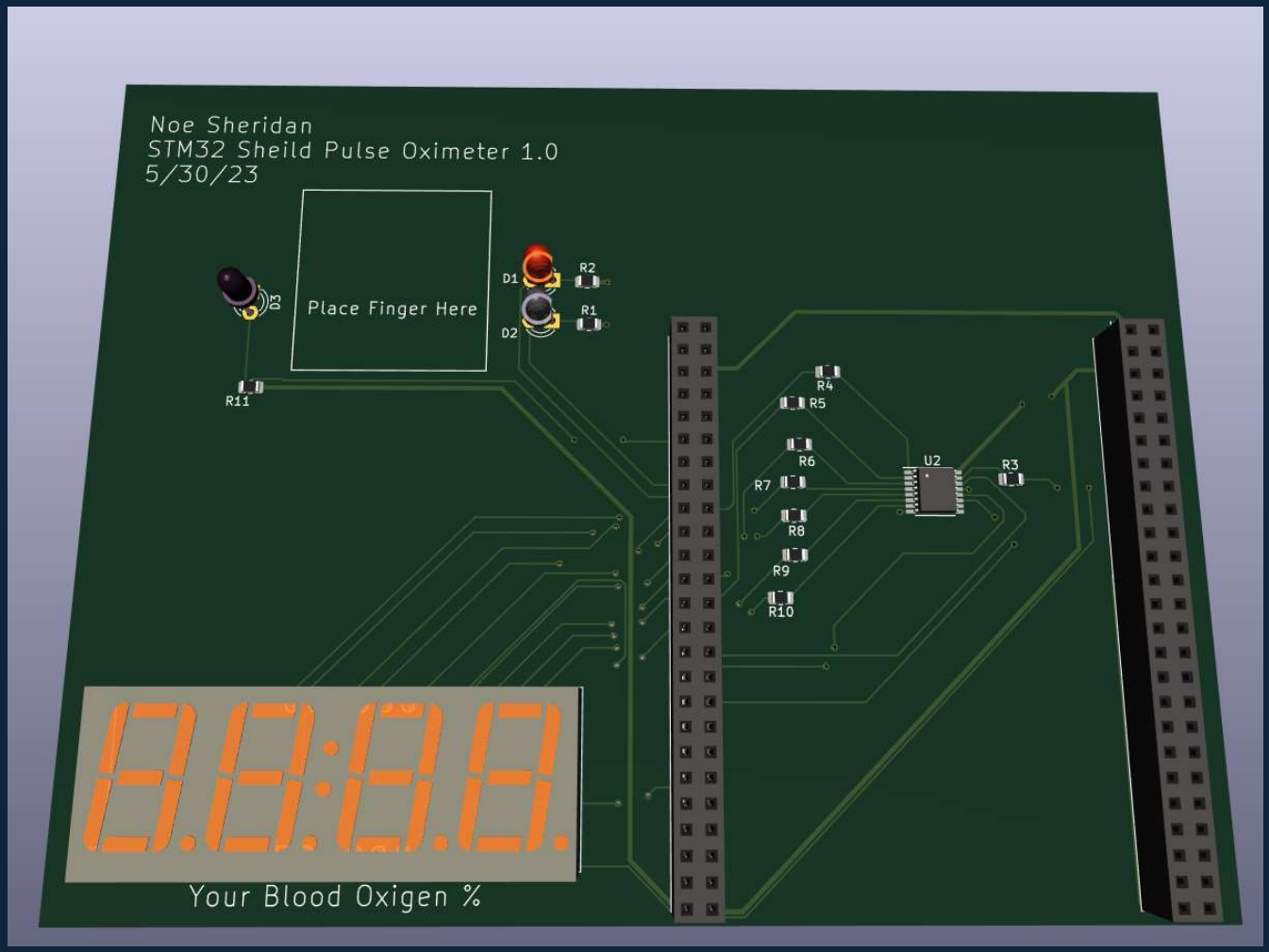



Start
User Place Finger in between LEDs and Photodiode
Turn on Red LED, Read Photodiode
Turn off Red LED
Turn on IR LED, Read Photodiode
Turn off IR LED
Calculate SpO2
Display SpO2 Value on 7-Segment
End

PCB


Finger Module (LEDs and photo-diode)
Shift Register
7-Segment Display
STM 32 Pin Connectors
Power Flags
Noe Sheridan
Sheet: /
File: Oximeter.kicad_sch
Title: STM32 Shield for Pulse Oximeter
Size: A4
Date: 5/30/23
Rev:
KiCad E.D.A. kicad (7.0.0)
Id: 1/1

PCB


Noe Sheridan
STM32 Sheild Pulse Oximeter 1.0
5/30/23
Place Finger Here
D1
D2
D3
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
U2
Your Blood Oxigen %

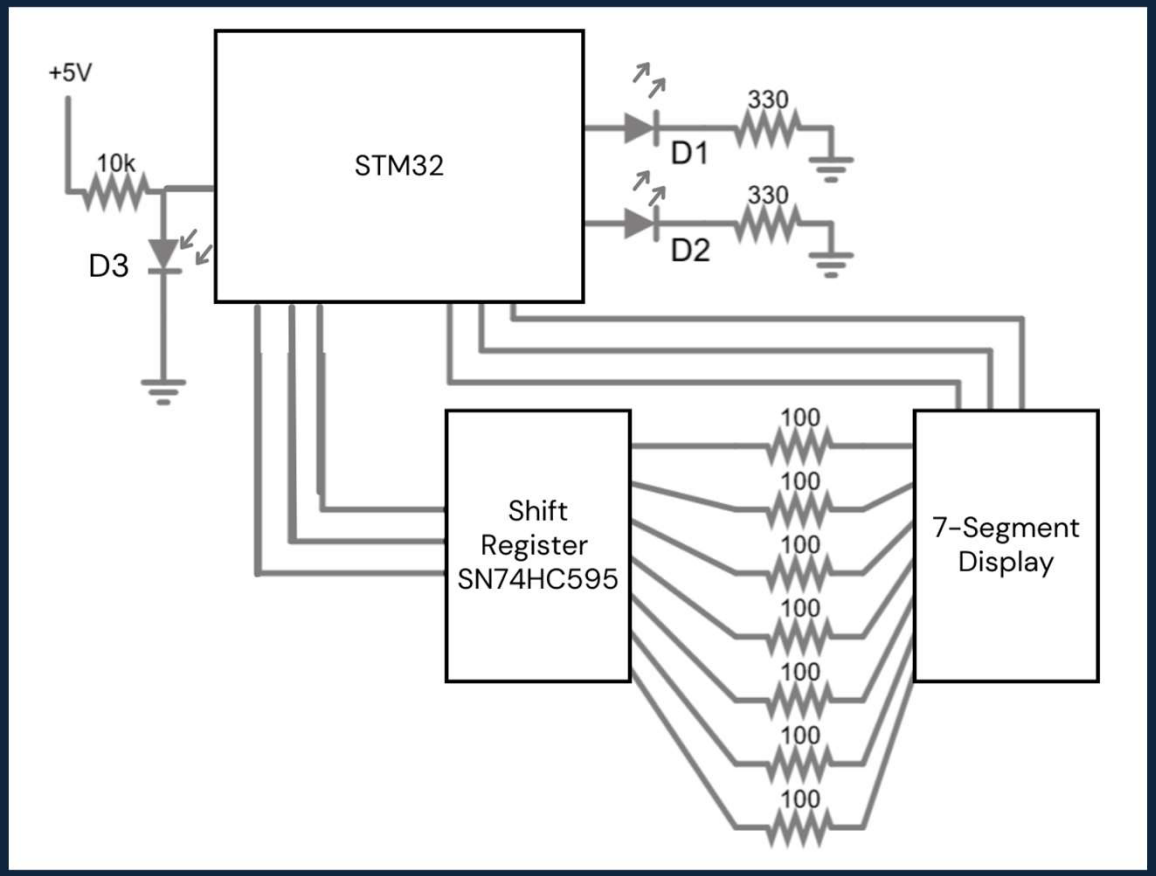
Code

```
if(counter2 == 0){
    //calculate R and SpO2
    IR_Max = 0; //8 bits on adc
    IR_Min =255;
    R_Max = 0; R_Min = 255;
    for(int i =0; i< 4000;i++){ //for the 4000 data samples
        if(dataR[i]< R_Min && dataR[i] > 0){
            R_Min = dataR[i]; //if less than minimum, reset minimum
        }else if(dataR[i] > R_Max){
            R_Max = dataR[i];//if more than maximum, reset maximum
        }
        if(dataIR[i] < R_Min && dataIR[i] >0){
            IR_Min = dataIR[i];
        }else if(dataIR[i]>IR_Max){
            IR_Max = dataIR[i];
        }

        R=((R_Max - R_Min)/(R_Min))/((IR_Max - IR_Min)/IR_Min); //the ratio of red to IR light


        SpO2 = (-19*(R) +99)*100; //blood oxygen calculated from the ratio
        //x100 to make a percent value
        int SpO2int = SpO2*100; //integers easier on the code for 7-segment?
    }
```

Code

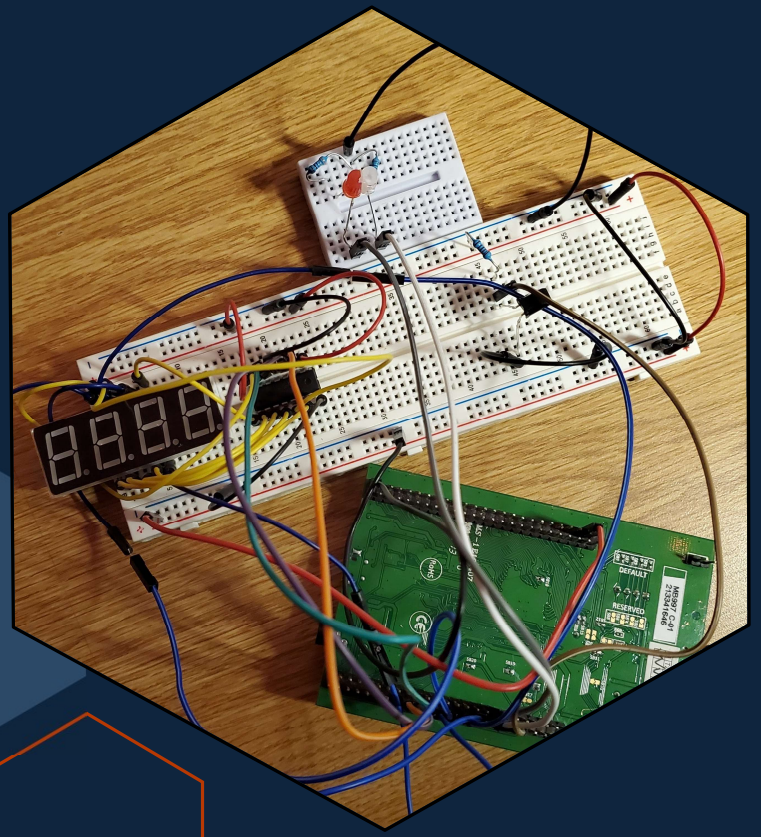
```
while (1)
{
    if(counter == 0){
        //turn on red led and take data from photodiode
        HAL_GPIO_WritePin(GPIOA, RedLED_Pin, GPIO_PIN_SET);
        //call ADC interrupt?
        for(int i =0; i<4000; i++){
            dataR[i] = HAL_ADC_GetValue(&hadc1);
        }
    }else if(counter ==1){
        //turn off red led
        HAL_GPIO_WritePin(GPIOA, RedLED_Pin, GPIO_PIN_RESET);
        //stop taking data?
    }else if(counter ==2){
        //turn on ir led and take data from photodiode
        HAL_GPIO_WritePin(GPIOA, InfaredLED_Pin, GPIO_PIN_SET);
        for(int i = 0; i< 4000; i++){
            dataIR[i] = HAL_ADC_GetValue(&hadc1);
        }
    }else if(counter == 3){
        //turn of ir led
        HAL_GPIO_WritePin(GPIOA, InfaredLED_Pin, GPIO_PIN_RESET);
        //stop taking data

    }
```

Block Diagram For Prototype Circuit Build



Prototype Build

- Sn74HC595 Shift Register
- 4-Digit 7-Segment Display
- 1 Red LED
- 1 IR LED
- 1 Photo-diode
- 3 Resistors (330Ω, 330Ω and 10kΩ)
- 2 Solderless Breadboards



Issues/Setbacks

LED Timing

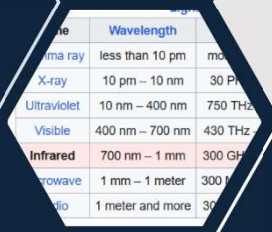
- LEDs turns on and off in cycles of 80ms
- Possibly not enough time to allow LED to turn on and allow photo-diode to collect the correct data

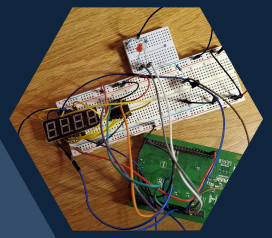
Unfamiliarity with STM32CubeIDE

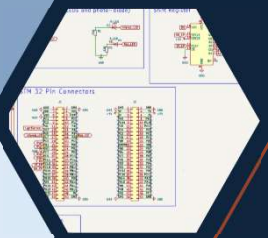
- Not able to work quickly, unfamiliarity with the functions and libraries needed

Communication with Shift-Register

- Though I could find help with interfacing the 4-digit 7-segment display, I could not find any helpful resources for interfacing the 7-segment through the shift register







Thank you

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https://github.com/nnnsheridan