# FINAL PROJECT MVP PROGRESS: 3D MODEL





## INPUT DEVICE HealthCare Clinic

Kassia's Tuesday Section 10.10.2023

## TODAY'S LAB

We are setting up a healthcare clinic with limited resources. We brought our Arduino board, some resistors, basic sensors, copper tape, and a 3D printer. Let's make some basic devices to help with our wellness check-ups!

Voltage Divider Sensors



IR Heart Rate Monitor **B** Capacitive

Sensors





**Breathing Monitor** 



Object-Oriented Programming

## **VOLTAGE DIVIDERS**



#### WHAT IS IT?

- It is a circuit setup that generates an output voltage that is a fraction of the input voltage
- A simple example is 2 resistors in series, with the output reading in between them

**Replace with 'resistive'** sensor. It's resistance changes based off of the thing that it is sensing



### **EXAMPLES**

- Light
- IR
- Force/Flex
- Temperature

	<b>Replace with 'transistor-</b>
	type' sensor. It's changes
	output current based off
ut	of the thing that it is
ut	sensing
$\frac{R_2}{1}$	

# BUILD A HEART RATE MONITOR



## **PULSE OXIMETRY**





#### **PULSE (FOCUS OF TODAY)**

When the heart beats, more blood is pumped into the finger, making the finger absorb more light.

With more light absorbed, less light is being reflected to the detector.

02

### **OXYGEN SATURATION**

Deoxygenated and oxygenated hemoglobin absorb light at different wavelengths Shine a red led on the finger, the light travels through your finger to the sensor. Sensor algorithm converts sensor value to amount of oxygen in blood.

## **IR SENSORS**



## **IR SENSORS**







CODE

int sum; int N samples = 500; int cur val; void setup() { Serial.begin(9600); } void loop() { sum = 0;//Add N samples of data together to smooth the signal for (int i=0; i<N samples; i++){</pre> cur val = analogRead(A0); sum += cur val; Serial.println(sum);



## **3D PRINT A CASE**





## **CAPACITIVE SENSORS**



#### WHAT IS IT?

- Simply, two conductors with a dielectric material between them
- Conductor: a substance or material that allows electricity to flow through it

- plates



## **CAPACITIVE SENSORS**



#### **HOW IT WORKS?**

- By changing the capacitance through distance, area, or dielectric material
- Send pulses of voltage to charge and discharge one of the conductors and see what the other conductor senses. If there is a change in capacitance, it will 'sense' this change.





- TX: Transmitter
- RX: Receiver

# BUILD A BREATHING MONITOR



## **CAPACITIVE SENSORS**

One copper tape plugged into A0, this is the receiver

One copper tape plugged into pin 4, this is the transmitter









1	<pre>int tx_pin = 4;</pre>
2	<pre>int rx_pin = A0;</pre>
3	<pre>int read_high;</pre>
4	<pre>int read_low;</pre>
5	<pre>int read_result;</pre>
6	int sum;
7	<pre>int N_samples = 100;</pre>
8	
9	<pre>void setup() {</pre>
10	<pre>pinMode(tx_pin, OUTPUT);</pre>
11	<pre>Serial.begin(9600);</pre>
12	}
13	
14	<pre>void loop() {</pre>
15	sum = 0;
16	
17	<pre>for (int i=0; i<n_samples; i++){<="" pre=""></n_samples;></pre>
18	<pre>digitalWrite(tx_pin, HIGH);</pre>
19	<pre>read_high = analogRead(rx_pin);</pre>
20	<pre>digitalWrite(tx_pin, LOW);</pre>
21	<pre>read_low = analogRead(rx_pin);</pre>
22	<pre>read_result = read_high - read_</pre>
23	<pre>sum += read_result;</pre>
24	}
25	<pre>Serial.println(sum);</pre>
26	
27	}



# OBJECT ORIENTED PROGRAMMING



## DOING THINGS AT THE SAME TIME

Not too bad, however, since there are for loops involved, and Arduino does tasks from top to bottom, the readings will be off!

Also, this is for 1 patient, what if I had 5 patients to measure at once? The code would be a mess  $@_{0}$ 

```
int tx pin = 4;
int rx_pin = A0;
int read high;
int read_low;
int read result;
int sum breathing;
int N samples = 500;
int sum heart;
int cur val;
void setup() {
  pinMode(tx pin, OUTPUT);
  Serial.begin(9600);
void loop() {
  sum breathing = 0;
  for (int i=0; i<N samples; i++){</pre>
    digitalWrite(tx pin, HIGH);
    read high = analogRead(rx pin);
    digitalWrite(tx pin, LOW);
    read low = analogRead(rx pin);
    read_result = read_high - read_low;
    sum breathing += read result;
  Serial.print(sum breathing);
  Serial.print(",");
  sum heart = 0;
  for (int i=0; i<N_samples; i++){</pre>
    cur val = analogRead(A1);
    sum heart += cur val;
  Serial.println(sum heart);
```

## LET'S CODE: A CLASSY SOLUTION

We will create the heart rate monitor Class today. I challenge you to do the breathing monitor Class on your own~



## **DEFINE THE CLASS**

1

2

3

4

5

6

7

8

class HeartRate{ //Class Member Variables int N\_samples; int sum; int cur val; int pin; };

### ADD A CONSTRUCTOR

1	$\sim$	class HeartRate{
2		//Class Member Variables
3		<pre>int N_samples;</pre>
4		int sum;
5		<pre>int cur_val;</pre>
6		int HRpin;
7		
8		//Constructor - creates
9		<pre>//and initializes the me</pre>
0		public:
1	$\sim$	<pre>HeartRate(int pin){</pre>
2		HRpin = pin;
3		<pre>pinMode(HRpin,OUTPUT);</pre>
4		N_samples = 500;
5		}
6		
7		};

#### S

## a HeartRate

j,

![](_page_23_Picture_0.jpeg)

```
class HeartRate{
  //Class Member Variables
  int N_samples;
  int sum;
  int cur val;
  int HRpin;
  //Constructor - creates a HeartRate
  //and initializes the member variables
  public:
  HeartRate(int pin){
    HRpin = pin;
    pinMode(HRpin,OUTPUT);
    N samples = 500;
  int read(){
    sum = 0;
    for (int i=0; i<N_samples; i++){</pre>
      cur_val = analogRead(HRpin);
      sum += cur val;
    return sum;
```

1 🗸	class HeartRate{		
2	//Class Member Variables		
3	<pre>int N_samples;</pre>		
4	int sum;		NOV
5	int cur_val;		
6	int HRpin;		
7		07	
8	//Constructor - creates a HeartRate	27	HeartKate pa
9	<pre>//and initializes the member variables</pre>	28	HeartKate pa
10	public:	29	
11 \	HeartRate(int pin){	30	int p1;
12	HRpin = pin	31	int p2;
13	ninMode(HRnin OUTPUT)	32	
14	$N_{\text{samples}} = 500$	33	void setup(
15	1	34	Serial.be
16	1	35	}
10		36	
1/ \	int read(){	37	void loop()
18	sum = 0;	38	p1 = patie
19 🗸	<pre>for (int i=0; i<n_samples; i++){<="" pre=""></n_samples;></pre>	39	p2 = patie
20	<pre>cur_val = analogRead(HRpin);</pre>	40	
21	<pre>sum += cur_val;</pre>	41	Serial.pr:
22	}	42	Serial.pr:
23	return sum;	43	Serial.pr:
24	}	44	Serial.pr:
25	};	45	}

## W USE THE CLASS

patient1(A0);
patient2(A1);

() {
egin(9600);

) { ient1.read(); ient2.read();

rint(p1);
rint(",");
rint(p2);
rintln(",");

## WHAT INPUT SENSORS WILL YOU NEED IN YOUR FINAL PROJECT?

![](_page_26_Picture_0.jpeg)

https://nathanmelenbrink.github.io/ps70/06\_i nput/index.html

https://learn.adafruit.com/multi-tasking-thearduino-part-1/overview

Canva presentation template by Olmos Carlos