Wearable Sensor for Infection Detection

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Background

➢ 1.5-2.0 million European patients and 2.4-2.5 million American patients have non-healing wounds [1].

➢ An increase of temperature by 2°C at a local wound site is a sign of infection and leads to decreased efficiency of neutrophils, fibroblasts, and epithelial cell activity [2, 4, 5].

➢ Wound infection diagnosis is heavily reliant on patient feedback and makes it difficult to diagnose. Clearly defined clinical parameters will make diagnosis easier and more accurate [3].

➢ Most infections occur in the first 30 days after surgery [7].

Product Design

➢ Our wearable technology will be a disposable temperature patch that will take readings from a open wound site.

➢ By continuously taking temperature readings, the patch will be able to sense when the temperature of the wound rises by 2°C, and thus indicate infection.

➢ This is advantageous for post surgery wounds that will be wrapped and not visible

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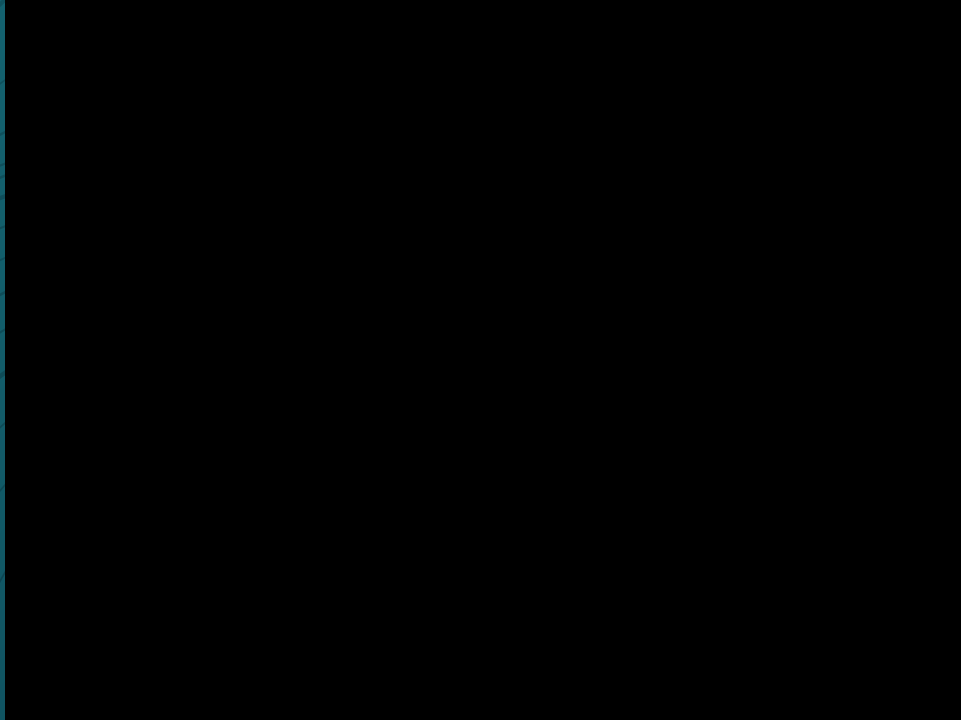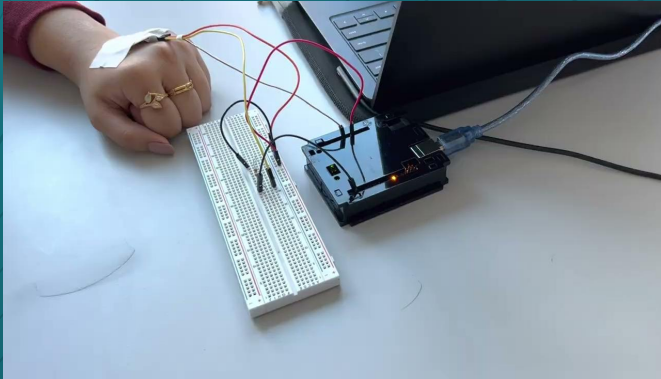
Arduino Code

```
1  /****************************************************************/
2  //  include the libraries
3  #include <OneWire.h>
4  #include <DallasTemperature.h>
5  /****************************************************************/
6  // Data wire is plugged into pin 2 on the Arduino
7  #define ONE_WIRE_BUS 2
8  /****************************************************************/
9  OneWire oneWire(ONE_WIRE_BUS);
10 /****************************************************************/
11 // Pass our oneWire reference to Dallas Temperature.
12 DallasTemperature sensors(&oneWire);
13 /****************************************************************/
14 void setup(void)
15 {
16  // start serial port
17  Serial.begin(9600);
18
19  // Start up the library
20  sensors.begin();
21 }
22 void loop(void)
23 {
24  // call sensors.requestTemperatures() to issue a global temperature
25  // request to all devices on the bus
26 /****************************************************************/
27
28  sensors.requestTemperatures(); // Send the command to get temperature readings
29
30 /****************************************************************/
31  Serial.print(sensors.getTempCByIndex(0));
32
33   Serial.print(" \n");
34  ;
35 }
36
37
38
```

Matlab Code

biohack.m

```matlab
1    clear all
2    close all
3
4    data = [];
5    infec_vec = [];
6    i = 1;
7
8    while i >= 1
9    s = serial('com4','baudRate',9600)
10   fopen(s)
11   val = fscanf(s)
12   val = str2num(val)
13
14   if val > 31 % Threshhold for Temperature based off Literature
15       infec_vec(i) = i
16       if numel(infec_vec) > 5 % consistent reading greater than thresh for 15 sec
17       fprintf('Wound Risk Infection Alert \n')
18       else
19       end
20
21   elseif val > 33 % Higher risk for infection alert
22       if numel(infec_vec) > 5
23       fprintf('Wound Risk Infection High Alert \n')
24       else
25       end
26   else
27       infec_vec = []
28   end
29
30   data(i) = val
31
32   figure(1) % plot temperature vs time
33   plot(data,'r-'); xlabel('Time (sec)'); ylabel('Temperature (C)')
34   ylim([15 45])
35
36   i = i+1;
37   fclose(s)
38   pause(3)
39   end
```

Command Window

Future work

➢ Connect the sensor wirelessly to an app that can monitor the temperature at the wound over time.

➢ The doctor gets notified if the temperature at the wound site increases by 2℃ or more for 5 minutes or more.

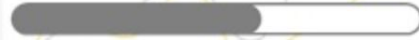➢ The patient can also access the app for notifications on their sensor.

Market Analysis

Attractive Opportunities in Temperature Sensor Market

5.9 USD BILLION 2021

8.0 USD BILLION 2028

CAGR of **4.5%**

The temperature sensor market is projected to grow from USD 5.9 billion in 2021 to USD 8.0 billion by 2028, at a CAGR of 4.5% from 2021 to 2028.

The temperature sensor market in APAC is likely to be driven by the evolving automotive, medical, and industrial manufacturing companies and the rising demand for temperature sensors from overseas markets of North America and Europe.

The growth of the temperature sensor market can be attributed to the increasing penetration of temperature sensors in advanced and portable healthcare equipment, growing demand for temperature sensors in the automotive sector, and the rising adoption of home and building automation systems.

Leading countries, such as the US and China, as well as emerging economies, including India and other Asian countries, are expected to be the major markets for temperature sensors during the forecast period.

References

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4. Author links open overlay panelP.SalvoaV.DinibF.Di FrancescoaM.RomanellibPersonEnvelope, P.Salvoa, a, V.Dinib, b, Francescoa, F. D., M.RomanellibPersonEnvelope, AbstractAcute and chronic wounds have a tremendous impact on patients' life conditions. As wound healing involves a huge number of biochemical processes, Sharp, D., Sridhar, V., Armstrong, D. G., Silverman, R. A., Sawchuk, W. S., Surinchak, J. S., Wallace, H. J., Song, E., Bandodkar, A. J., Dargaville, T. R., Martin, P., ... Coyle, S. (2015, March 26). *The role of biomedical sensors in wound healing.* Wound Medicine. Retrieved November 20, 2022, fromhttps://reader.elsevier.com/reader/sd/pii/S2213909515000105?token=3FC1EC62F5AEF421844E4B79649A92B6E1CD65A533F060152A0B8F020D178F73D8DEAF6BD8D4813E4232E9E08DD81726&originRegion=us-east-1&originCreation=20221119170612

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