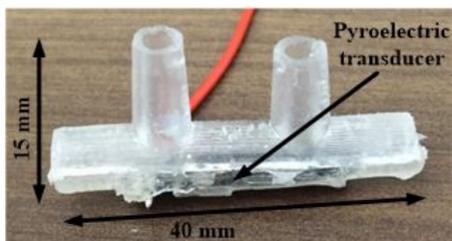


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INTRODUCTION

- Apnea of prematurity (AOP) is a potentially-fatal condition in which under-developed infants stop breathing as they sleep.
- This condition is difficult to diagnose in babies because their fragile bodies cannot easily tolerate the detectors that are currently used.
- A new kind of detection system is needed to diagnose AOP without harming the patient and to alert caretakers of life-threatening apneic episodes.



- A pyroelectric transducer was placed inside a cannula to detect a breathing signal based off changes in breath's temperature.

METHODOLOGY

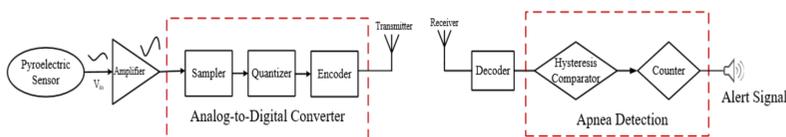
MATLAB was used to create and implement codes to perform the following functions:

- Convert analog signals into digital signals
- Sample, quantize, and reconstruct data
- Plot data and evaluate errors
- Convert respiration signals into pulses with a hysteresis comparator
- Record time with a counter
- Alert of apneic occurrences

```

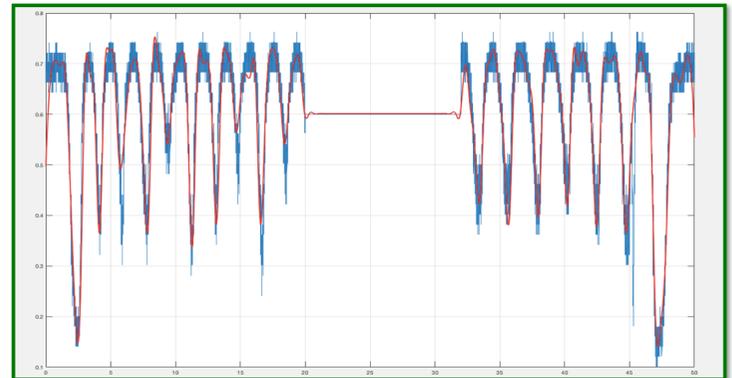
1 clc
2 close all;
3 clear all;
4
5 Array=csvread('ota_tst7csv.csv',2,0,[2 0 62501 1]);
6 t = Array(:, 1);
7 ts=(t+5) .*5;
8 V1 = Array(:,2);
9 V1(25000:40000)=0.6;
10 plot(t, V1);grid on; hold on;
11
12 ts=0.4;
13 [Vs,t1]=sampler2(V1,t,ts);
14 stem(t1,Vs,'r'); grid on; hold on;
15
16 Vn= Vs/max(Vs);
17 bit=6;
18 xbin=quantizer1(Vn,bit);
19
20 xcc=decoder1(xbin,bit,min(Vn),max(Vn));
21
22 xc= interp1(t1,xcc,t,'spline');
23 xc= max(Vs)*xc;
24
25 figure(2);
26 plot(t,V1, hold on, plot(t,xc,'r','linewidth',2); grid on;
  
```

A coding entry from MATLAB.

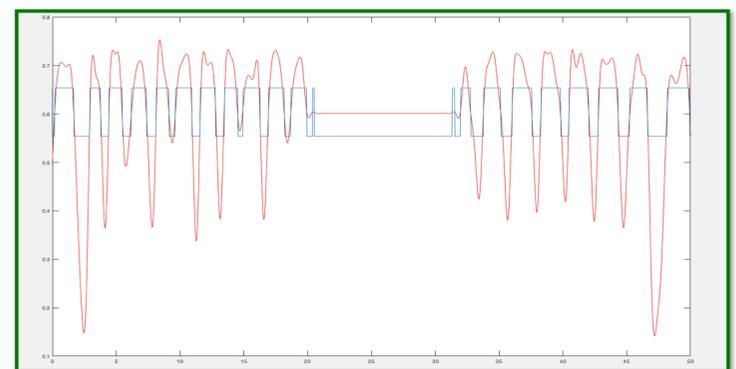


The process by which apnea is detected can be demonstrated with a block diagram. First, the sensor picks up a signal. Then, the signal is converted from analog to digital. It is sampled, quantized, and decoded. The hysteresis comparator converts the signal into a series of pulses and the counter tracks the time between them. The detector alerts of apnea when the counter records an interval of time without activity.

RESULTS



Overlapping analog and digital respiration signal plot shows error between original and reconstructed data.



```

1 %apnea detection
2 f=0;
3 tbegin=0;
4 for i=2:length(h)
5     if h(i)= h(i-1)
6         f=0;
7     else
8         f=1;
9     end
10    if f==1
11        tduration=t(i)-tbegin;
12        if tduration>=10
13            s=['apnea detected from t=', num2str(tbegin), 's to t=', num2str(round(t(i))), 's.'];
14            msg = msgbox(s,'ALERT','warn');
15        end
16        tbegin=t(i);
17    end
18 end
  
```

The flat-line between 20.525s and 31s on the graph comparing the analog breathing signal to the hysteresis comparator-generated pulses prompted the alert of apnea.

CONCLUSION

- **Objective:** to test if the pyroelectric sensor could detect apnea of prematurity and alert others of its presence.
- Converting the analog respiration signals to digital enabled it to be converted into pulses, and, thus, show occurrences of no activity
- Apnea was detected between the 20.525s and 31s, prompting an alert.
- The pyroelectric sensor is an effective apnea detection method and a reliable warning system.