Lab Report for Milestone 2

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Introduction

By using an infrared light emitting diode (IR908-7C-F) and a photodetector with integrated trans-impedance amplifier (OPT101), we can detect one's heartbeat using light oximetry approach. Then, use MCP3001 ADC module to convert analog signal into digital signal. We connect IR908, OPT101 and MCP3001 on CC3200 board. The specific wire is shown in figure.1 and figure.2. The circuit design algorithm is shown on figure 3. At first, we cannot see the output voltage wave on the oscilloscope. The voltage changes in a very small range of tens of millivolt, which is hard to get the useful information, because typically the noise is as the same level as the signal. To solve this problem, we change a lower current-limiting resistance from 1K Ohm to 330 Ohm, by which means we successfully increase the power of the IR LED. At the same time, we use the clothe to cover the whole board, so that the experiment environment will be in the dark. This can minimize distractions.

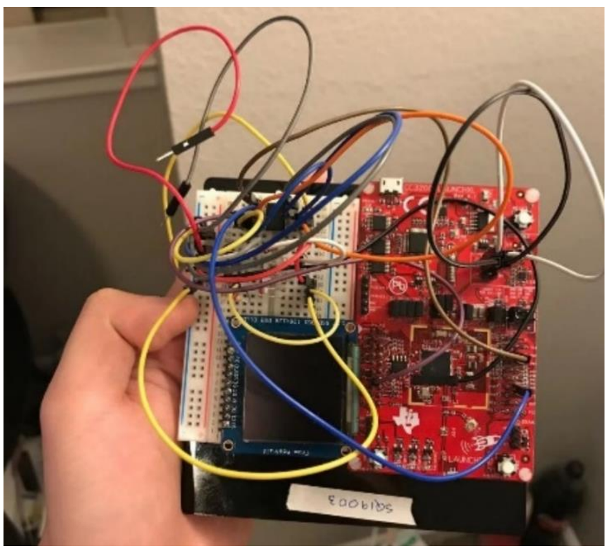


Figure. 1

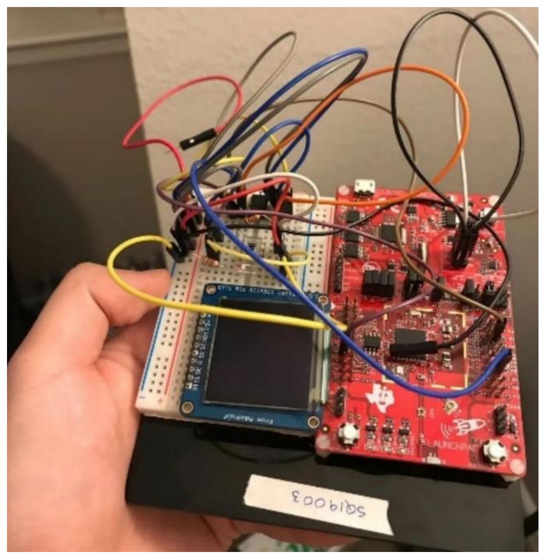


Figure. 2

Then we connect the CC3200 with computer and upload the program into the board. We can read the ADC value and voltage in PuTTY terminal. Now we have a usable voltage wave. By observing the captured values of ADC, we find that the noise cannot be ignored. We try to use software filtering to lower the noise distractions. We store the ADC value into .dat file. Then we process the file in Python to get the heartbeat.

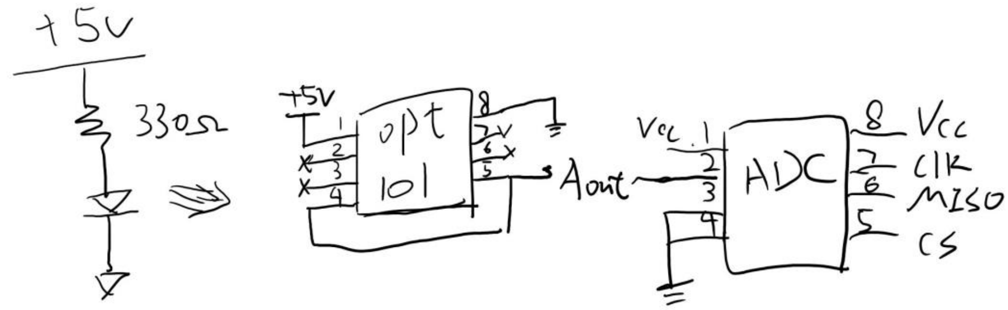
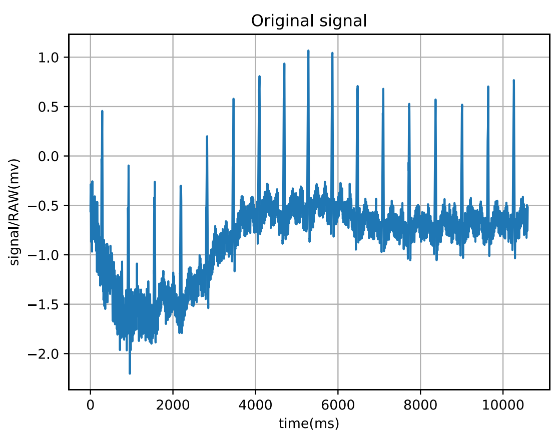
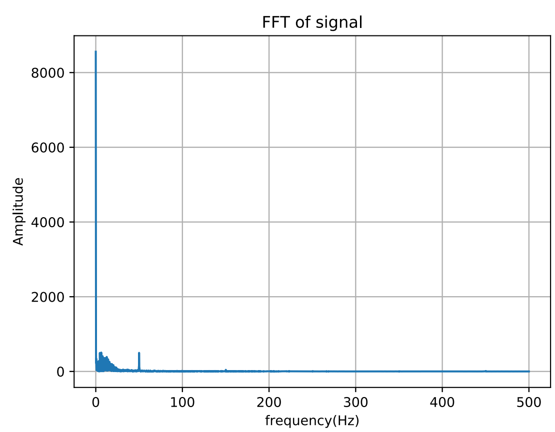


Figure. 3

In Python:

Firstly, we put our ADC value (.dat file) into Python and do the Fast Fourier Transform.





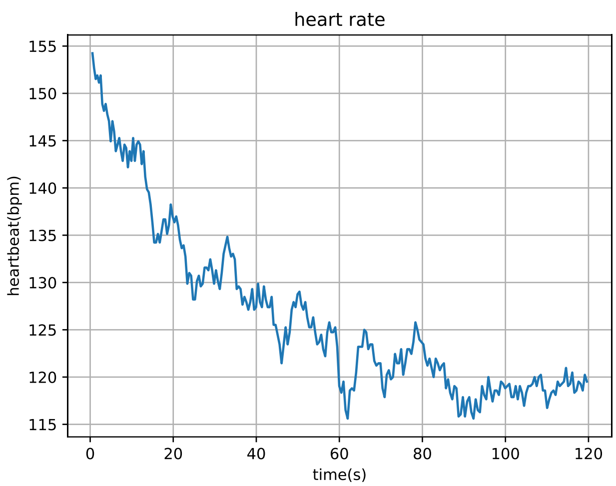
As the figure shown above, the main noise we considered would be DC noise and some contamination in 50Hz. Then I applied a notch filter and removed DC noise. (The Gain we set in Python is 500)

Because Python needs longer time to analysis, we choose a small period of time do the FIR filter and IFFT back to get the heartbeat. The FIR filter algorithm is shown below.

```
import numpy as np

class FIR_filter:

    def __init__(self,_coefficients):
        self.ntap = len(_coefficients)
        self.buffer = np.zeros(self.ntap)
```

```
        self.coefficient = _coefficients
    def filter(self,v):
        output=0
        for i in range(self.ntap - 1):
            self.buffer[self.ntap - i - 1] = self.buffer[self.ntap -i -2]
        self.buffer[0] = v

        for i in range(self.ntap):
            output += self.buffer[i]*self.coefficient[i]
        return output
```

I ran up and down stairs and came back to the lab for testing, the heartbeat versus time plot is shown below.



GitHub Repository link

Repository link: https://github.com/Chensd7/Milestone2-Shudi-Chen-Chengzhi-Fu