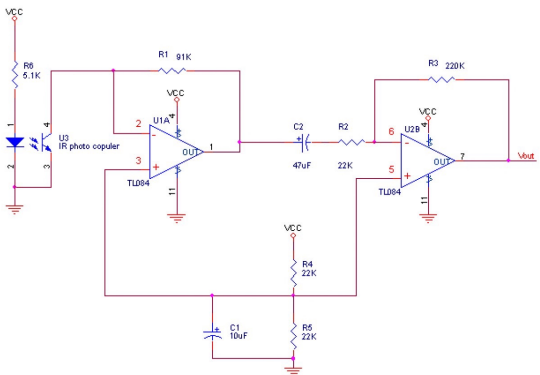
Lab7 Optical Heart Rate Measurement

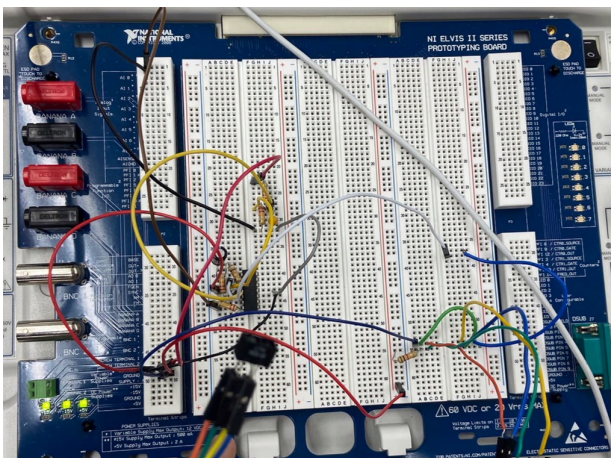
0811562
何祁恩

< Phase 1 >

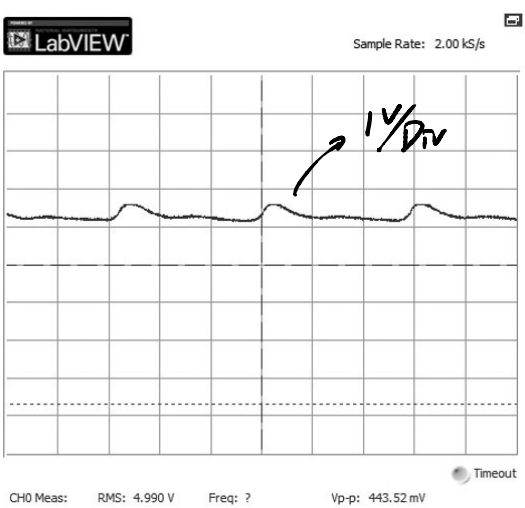
Circuit (Vcc = +10V)



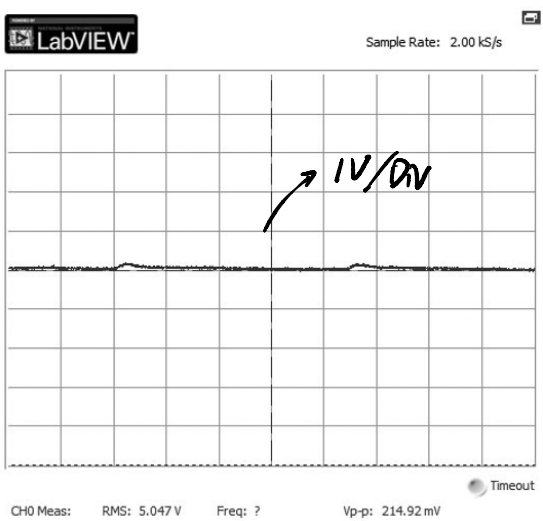
↑ fig 1 circuit schematic



↑ fig 2. circuit implementation

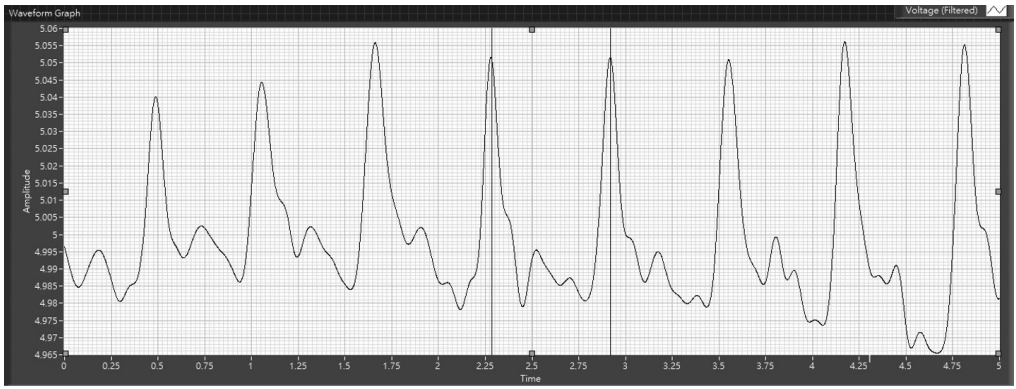


↑ fig3 finger on IR sensor



↑ fig4. palm on IR sensor

<Phase 2>



∟ fig5 finger by Labview

Cursors:	X	Y
Cursor 0	2.2856	0
Cursor 1	2.9189	0

$$BPM = \frac{60}{2.9189 - 2.2856} \approx 95\ BPM$$

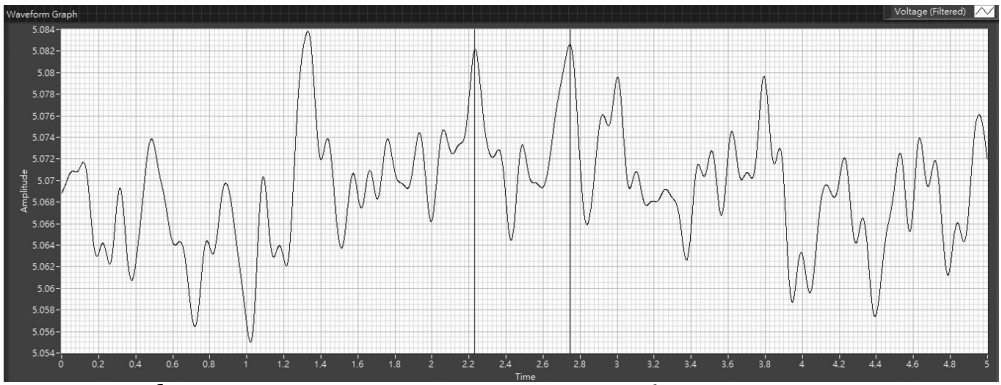
<Phase 3>

∟ fig6 finger after running

Cursors:	X	Y
Cursor 0	1.4083	4.3096
Cursor 1	1.7977	4.3096

$$BPM = \frac{60}{1.7977 - 1.4083} \approx 154\ BPM$$

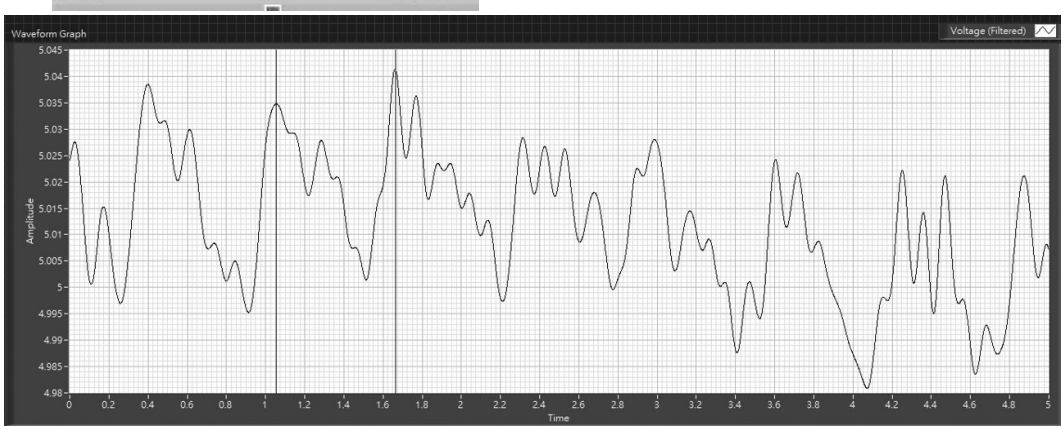
<Phase 4>



↑ fig 7 other body part (forearm) with caffeine

Cursors:	X	Y
Cursor 0	2.2305	4.3652
Cursor 1	2.7458	0

$$BPM = \frac{60}{2.7458 - 2.2305} \approx 116 \text{ BPM}$$



↑ fig 8 Carotid artery

Cursors:	X	Y
Cursor 0	1.0542	9.6595
Cursor 1	1.6640	9.6595

$$BPM = \frac{60}{1.6640 - 1.0542} \approx 98 \text{ BPM}$$

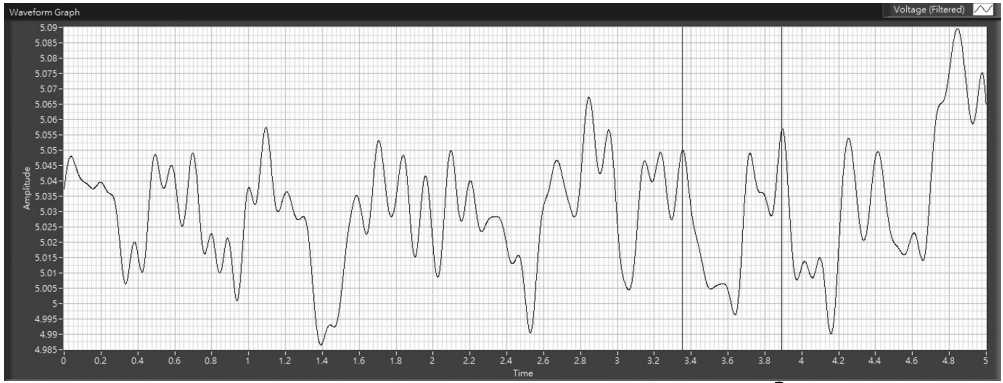
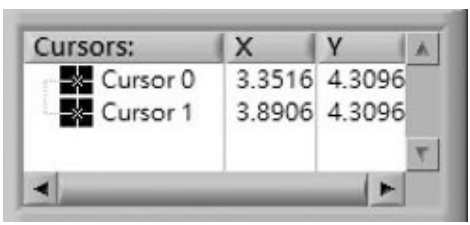


fig 9. Carotid artery after running

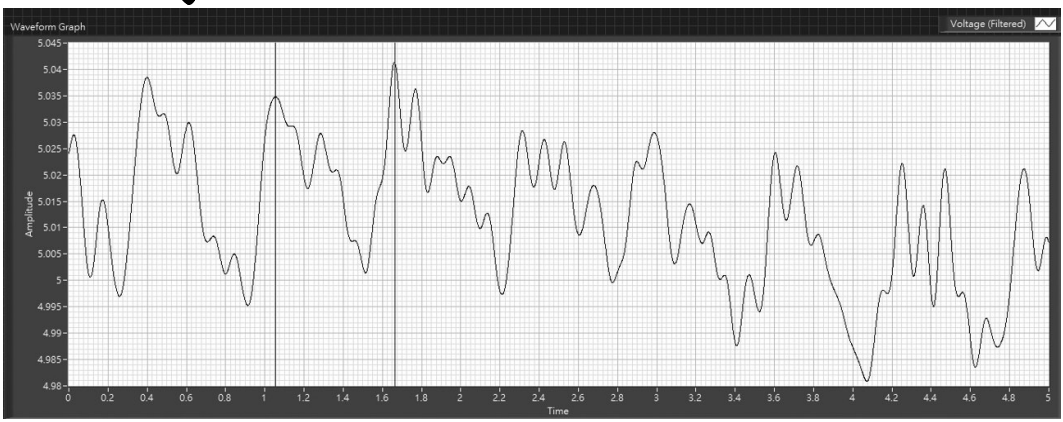


$$BPM = \frac{60}{3.8906 - 3.3516} \approx 111 \text{ BPM}$$

Compare the waveforms of the different body parts before and after exercise.

Compare figure8 with figure 9, the signal is measured from the carotid artery. When the subject is stable, the measured signal in figure 8 is more periodic, and the BPM (beat per minute) is smaller (98). In figure 9, the measured signal is aperiodic, and the BPM is higher (111).

* Artery

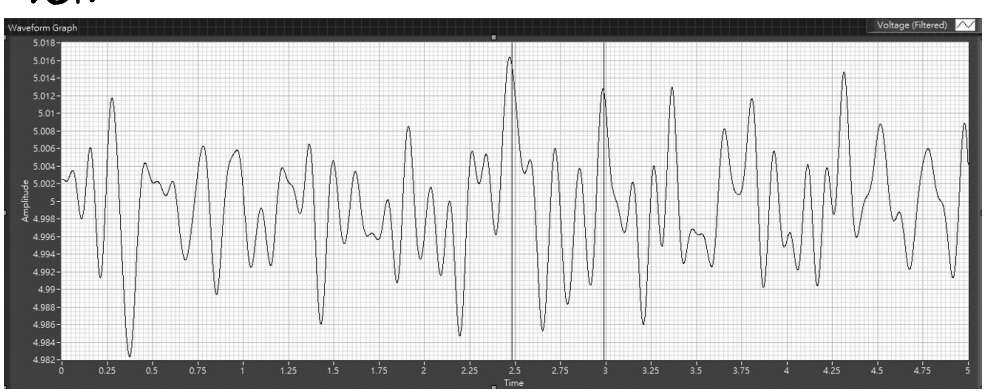


↑ fig 10 Carotid artery

Cursors:	X	Y
Cursor 0	1.0542	9.6595
Cursor 1	1.6640	9.6595

$$BPM = \frac{60}{1.6640 - 1.0542} \approx 98\ BPM$$

* Vein

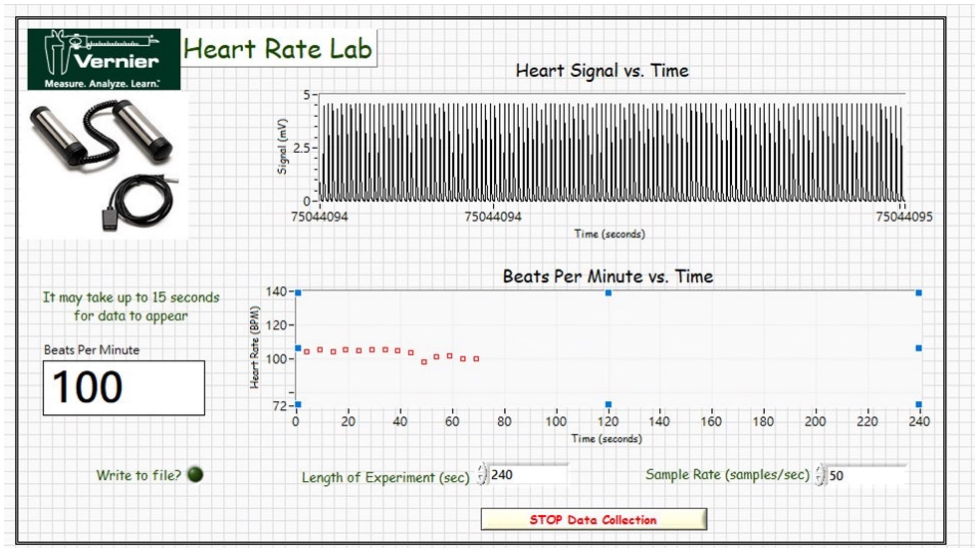


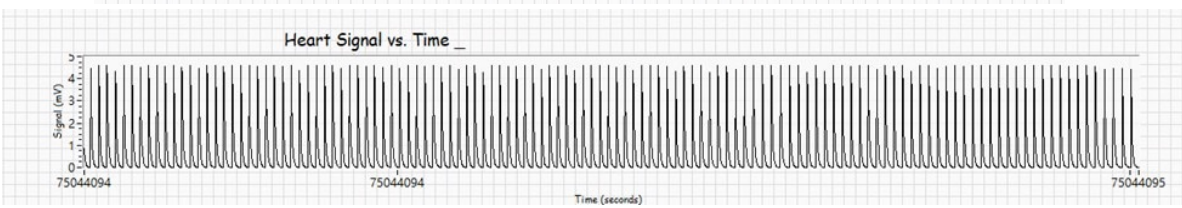
↑ fig 11 wrist vein

Cursors:	X	Y
Cursor 0	2.4822	4.3096
Cursor 1	2.9897	4.3096

$$BPM = \frac{60}{2.9897 - 2.4822} \approx 118\ BPM$$

< Phase 5 > Commercial





< Question and Discussion >

1. Are there any differences between the waveforms of the palm and fingers?

From figure3 and figure4, one can see that the finger's waveform is more obvious than the palms. The peak-to-peak value of the finger is larger than the palm. That's mainly because the skin of palms is thicker than fingers.

2. By measuring different parts of body results in different waveforms. Why?

It depends on the color of the skin, and the surface smoothness. Different parts of the body have different colors and different surface smoothness. Therefore, the waveform will become different.

3. How are the artery waveforms and vein waveforms different from each other? Why?

From figure 10 and figure 11, one can observe that the artery waveform is more periodic. As for the vein waveform, it's almost aperiodic, and hard to determine the pattern in each period. Since the artery contains the blood that comes from the heart, more pressure and pulse can be measured. As for the vein, it contains the blood that goes back to the heart, so less pressure can be measured.

4. Compare how different the heartbeats and measured waveforms are before and after exercise.

From figure 8 and figure 9, one can tell that when the subject exercises, the rate of heartbeats measured in BPM increases. The waveform after the subject exercises is more aperiodic and the amplitude is bigger.

5. What are your thoughts on this lab?

Optical heart rate measurement is more convenient than lab6 to measure ECG signal with the adhesive electrode. However, the result is poor compared to the result in lab 6. Therefore, in our final project: using ECG signals to identify the subjects, we still use 1-lead ECG signals as our dataset.