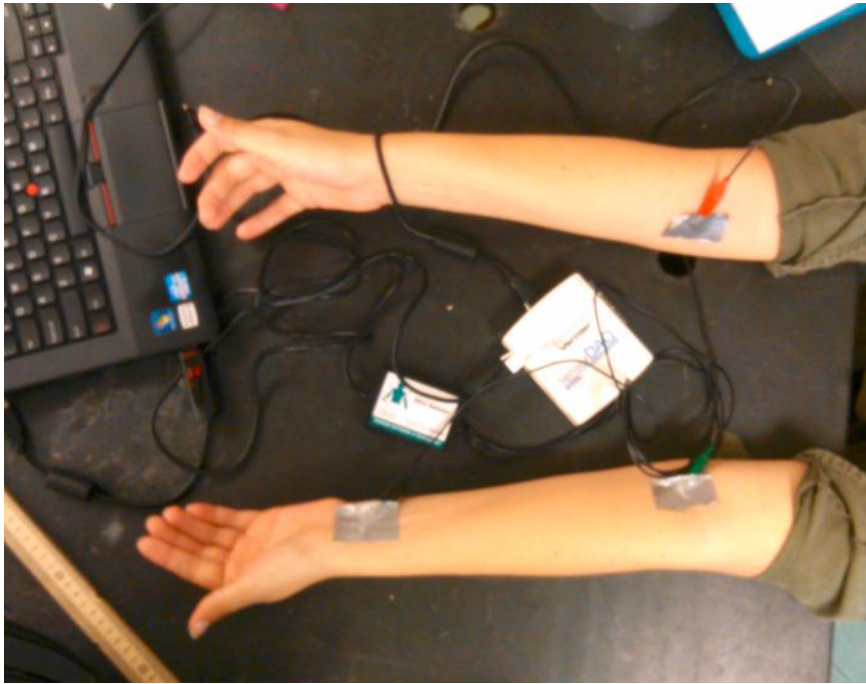


Analyzing the Heart with EKG

Name Lucia, Maria, Julia



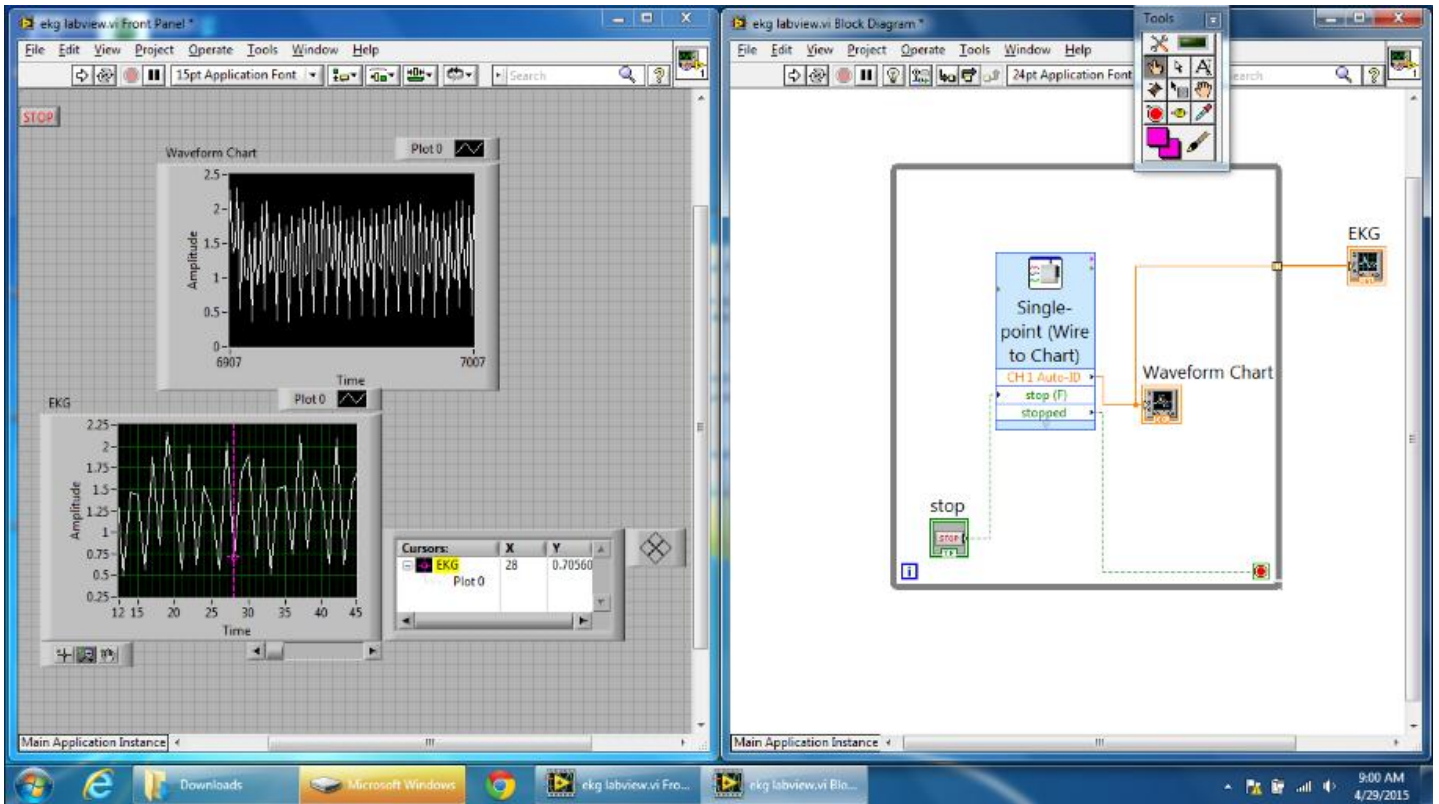
An electrocardiogram (EKG) is a graphical recording of the electrical events occurring within the heart. In a healthy heart there is a natural pacemaker in the right atrium that initiates an electrical sequence. This impulse then passes down natural conduction pathways between the atria to the atrioventricular node and from there to both ventricles. The natural conduction pathways facilitate orderly spread of the impulse and coordinated contraction of first the atria and then the ventricles. The electrical journey creates unique deflections in the EKG that tell a story about heart function and health. Doctors and other trained personnel can look at an EKG tracing and see evidence for disorders of the

heart such as abnormal slowing, speeding, irregular rhythms, injury to muscle tissue (*angina*), and death of muscle tissue (*myocardial infarction*). By looking at several beats, you can also calculate heart rate.

PROJECT DESIGN REQUIREMENTS

Write a LabVIEW program to graphically record an EKG tracing of heart activity. You will use a Vernier interface and an EKG Sensor for data collection with a sampling time of 10 seconds and a sampling rate of 100 samples per second. You should make two graphical displays – the first plotting the data in real time on a chart, and the second displaying the plot on a graph after all data have been collected. The second display should incorporate the graphical analysis tools available with the use of a Waveform Graph. After creating your VI, follow the steps in the Project Setup to properly attach the EKG to a test subject and run your the electrode leads (e.g., by twisting them together) can reduce noise somewhat.

Labview VI Screen Shot

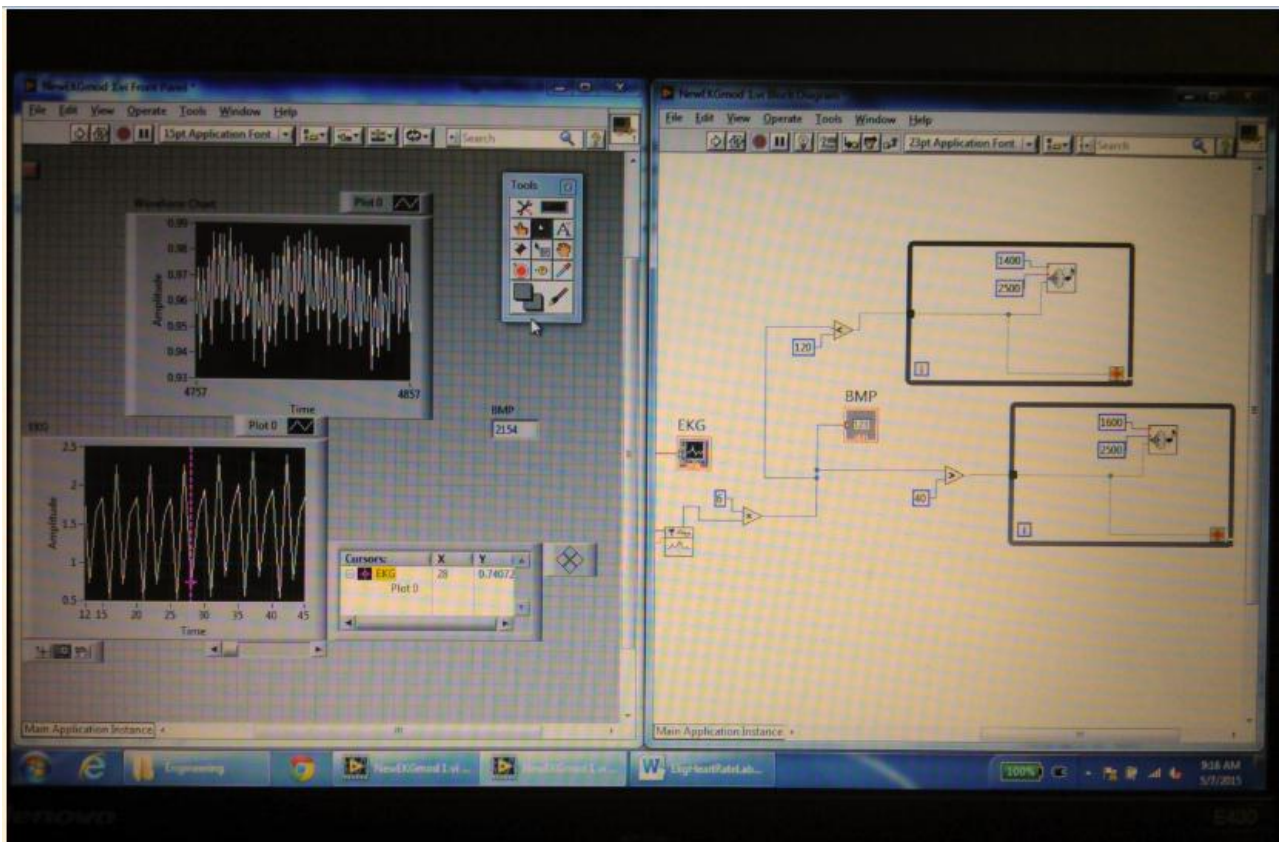


MODIFICATION 1- DISPLAYING HEART RATE

Note: Do not attempt this modification until you have completed the Project Design Requirements.

Modify your VI created in the Project to compute and display heart rate in beats per minute (bpm) from the signal readings of the EKG Sensor.

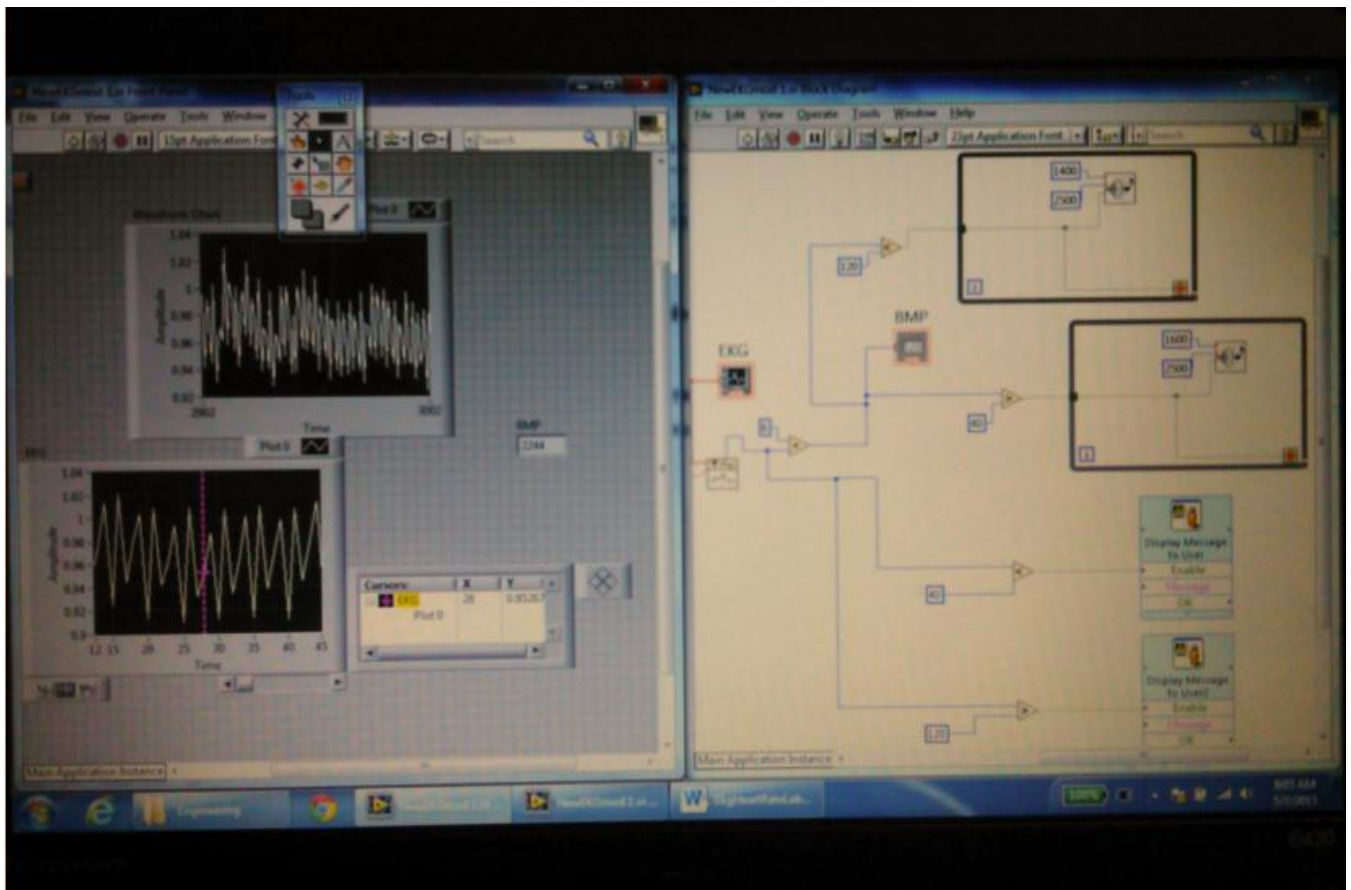
Labview VI Screen Shot



MODIFICATION 2- THRESHOLD AND WARNING

1. Modify your VI for displaying a warning when the signal is either above or below a certain threshold. The message should display “normal” when the signal is in the normal range. You may need to review the Exercises in Introduction to Labview with Vernier. The values you choose should be very close to the range of your graph values.
2. Modify your VI to beep continuously if the signal goes above or below threshold.

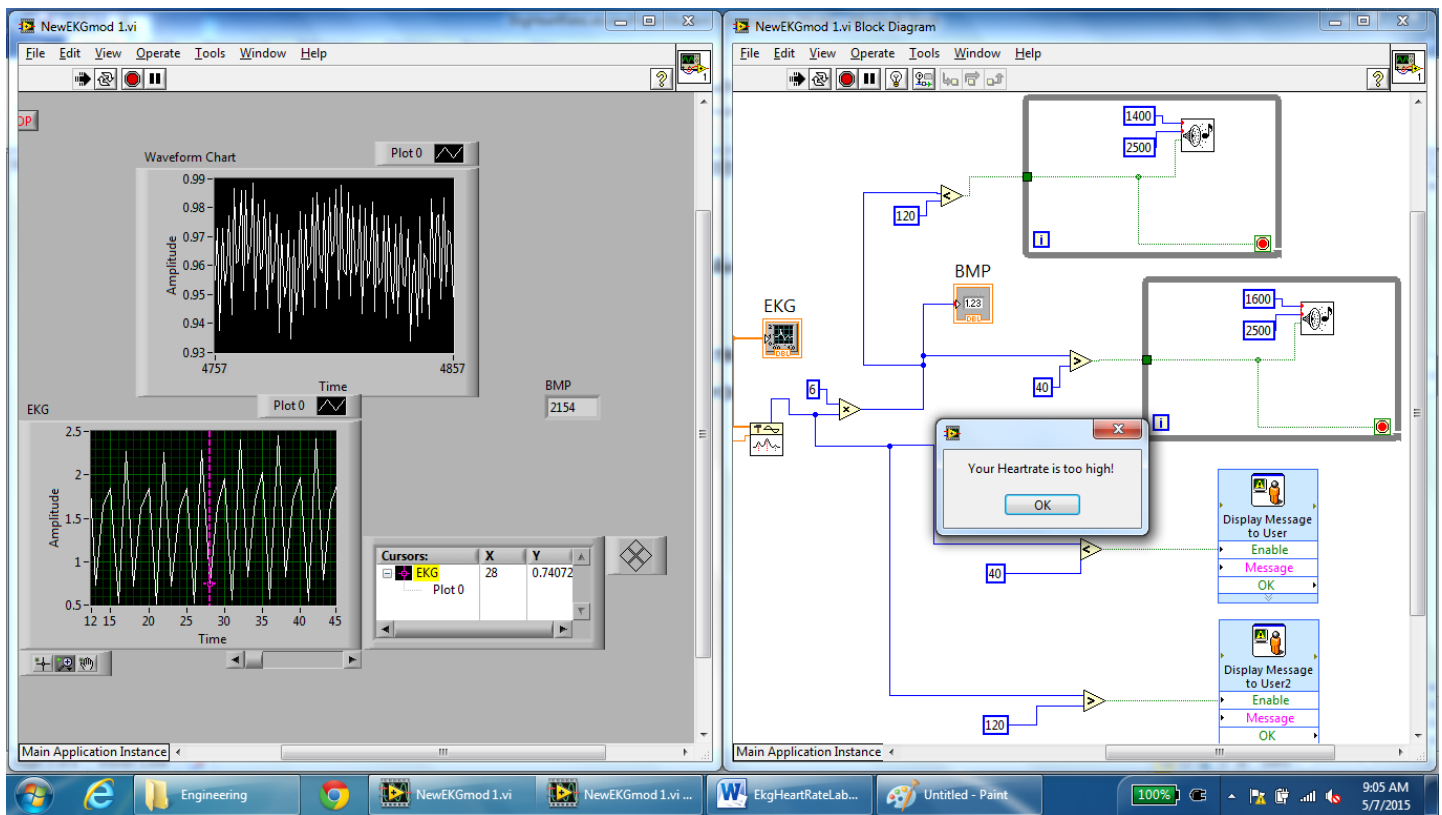
Labview VI Screen Shot



MODIFICATION 3- THRESHOLD AND WARNING

1. Modify your VI to beep continuously if the heart beat rate goes above 100 bpm or below 40 bpm.

2. **Labview VI screen shot**



Project 8

Extreme challenge design requirements

While an EKG sensor is normally used to record the muscle activity of the heart, it can also detect other electrical changes in your body, even motion of your eyes. Build a device that switches a bipolar LED from one color to another when you look left or right. Use the EKG Sensor to detect the motion of the eyes, and the Vernier Digital Control Unit (DCU) to power the LED.

ADDITIONAL MATERIALS

Vernier Digital Control Unit (DCU)	220 Ω resistor
Vernier LabQuest or LabPro power supply	breadboard
bipolar LED	jumper wires

EXTREME CHALLENGE SETUP

Connect the sensor to the interface

1. Connect the EKG Sensor to Channel 1 of the interface.
2. Connect the interface to the computer.

Connect the DCU to the interface

1. Connect the DCU to the DIG port on the interface.
2. Connect a power supply to the DCU.

Construct a bipolar LED circuit

1. Plug the 9-pin cable into the side of the DCU.
2. Insert the bipolar LED and resistor into a breadboard, and then wire the components to the DCU cable as shown in the figure below. You can find the color-coded pin-out for the DCU cable on the label attached to the cord.

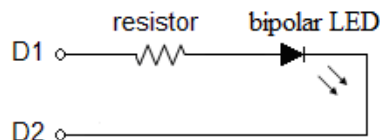


Figure 8 Wiring diagram for connecting a bipolar LED to the DCU cable

Note: Wait until your VI is written before performing the rest of the Extreme Challenge Setup.

Attach the EKG electrodes to subject

1. Place three fresh electrode tabs on the subject as shown in the figure below. Place a tab to the side of each eye, and then place a third tab on the neck.

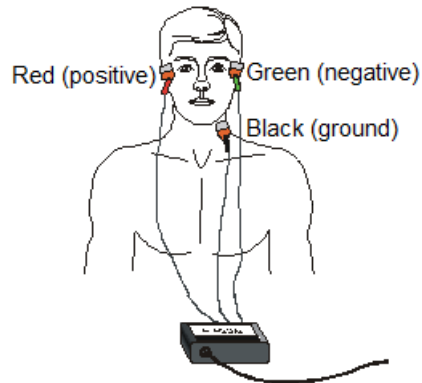


Figure 9 EKG electrode placement for eye movement

2. Connect the red (or positive) alligator clip to the right eye electrode, connect the green (or negative) clip to the left eye electrode, and connect the black (or ground) clip to the neck electrode. The subject should be seated and remain relaxed.

EXTREME CHALLENGE BACKGROUND INFORMATION

The retina of the eye is a complex layered structure of neurons, and as such, it maintains a charge across its surface giving the eyeball a small electrical dipole moment. The EKG Sensor is capable of detecting changes in this dipole moment as the eyes rotate. If the eyes rotate to the right a voltage pulse is produced in the EKG Sensor and if they rotate to the left a pulse of opposite polarity is produced.

In the Extreme Challenge, you are asked to control the color of a bipolar LED with eye movement. The behavior of a bipolar LED depends on the direction of current flow. If the current flows in one direction, the bipolar LED will appear green. If the current flows in the opposite direction, the bipolar LED will appear red. Since an LED can be destroyed if too much current flows through it, you should wire it in series with a current-limiting resistor.

The Vernier Digital Control Unit (DCU) can be used to switch between colors in the bipolar LED. The DCU is an electronic device that allows you to control up to six digital output lines for on/off control of LEDs and other DC electrical components. The DCU plugs into the DIG port on the interface and is powered by a separate DC power supply. A 9-pin, D-sub socket cable is supplied with the DCU, with bare wires on one end, for use in building projects. There are connections for all six digital lines, plus a power connection and two ground connections. The color code of the wires is identified on a label attached to the cable.

The bipolar LED should be connected in series with a current-limiting resistor between DCU lines D1 and D2 (there is no ground connection in this setup). To illuminate each color, you must send a numeric output pattern to the DCU to turn on one of the digital lines. The Digital Express VI found in the Vernier functions palette can be used to send these output patterns.

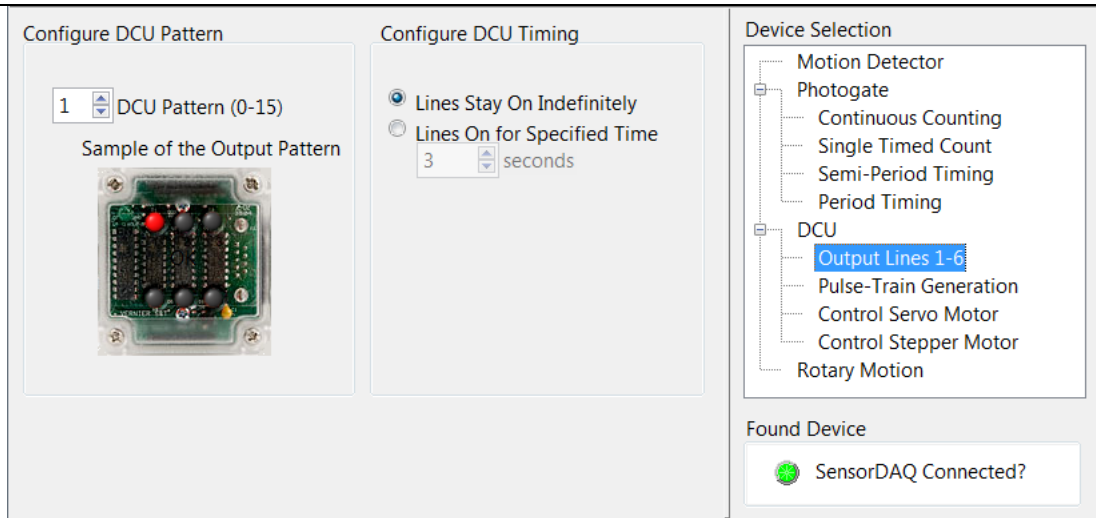


Figure 10 Configuration window for the Vernier Digital Express VI

EXTREME CHALLENGE TIPS

1. A good first step might be to record some data and analyze the waveform. Then you can determine what events occur in the waveform, such as peaks, that can be used in your program to control the output to the DCU.
2. For best results, do not reuse electrode tabs on different areas of the body.
3. Since the exact placement of the electrodes will affect the size of the signal detected by the EKG, you will need to experiment to find an upper and lower threshold to change the LED color that works for your apparatus. You will find the Waveform Graph on your front panel very helpful for this process.
4. When the Analog and Digital Express VIs are used together in the same loop, you should make sure they are connected together via their “stop (F)” and “stopped” terminals.
5. Avoid using the Abort Execution button to stop your VI because some of the DCU lines may remain on.
6. Refer to *Appendix E* for additional information on the Vernier DCU.

EXTREME CHALLENGE TROUBLESHOOTING

1. Make sure the DCU is receiving power. The green LED in the top of the DCU box will be lit when the DCU is powered on.
2. Make sure you are sending the proper output pattern to turn on a digital line. Use the Digital Express VI configuration window to test your pattern and hardware.