

Hands On ECG

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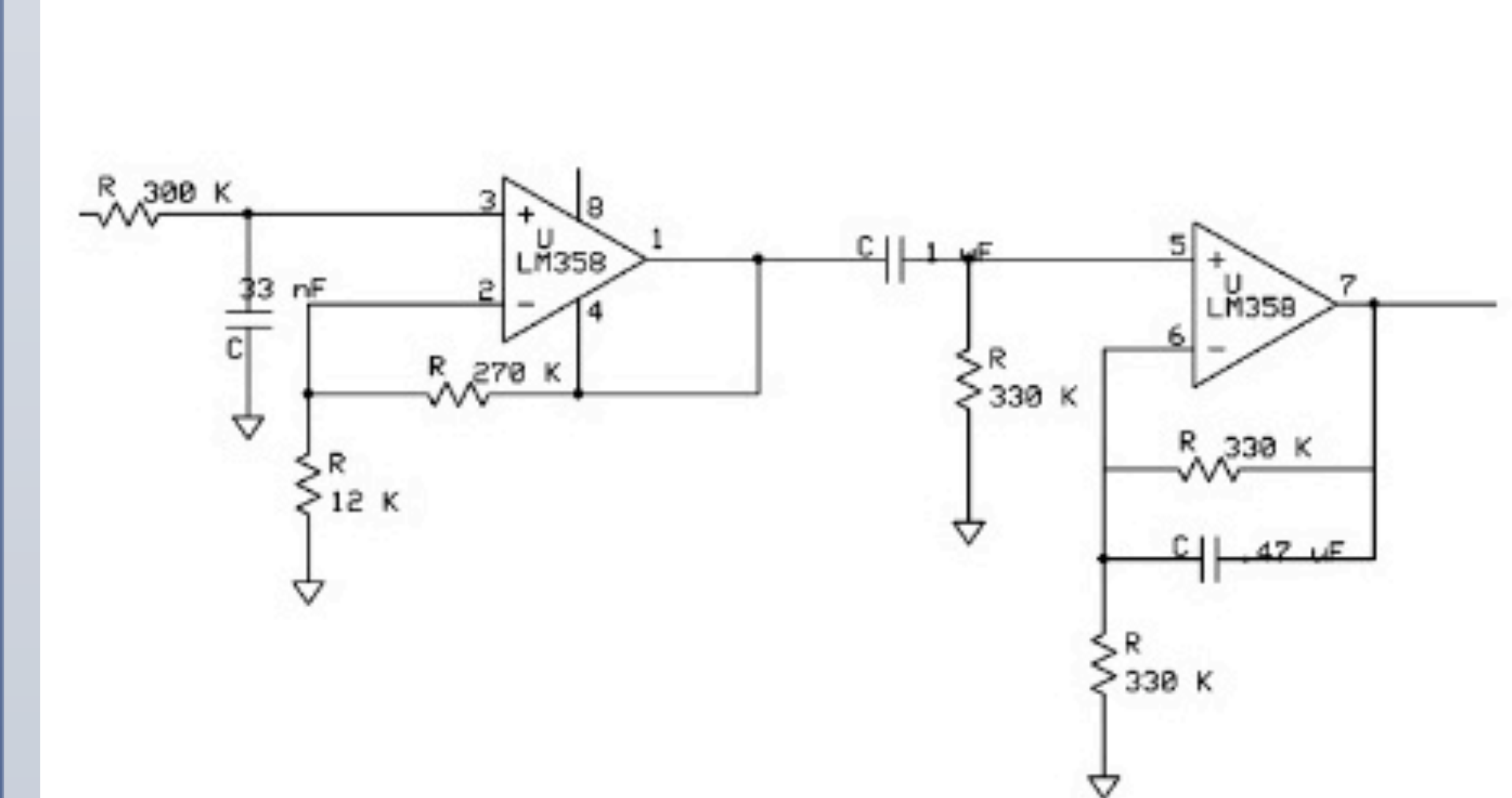
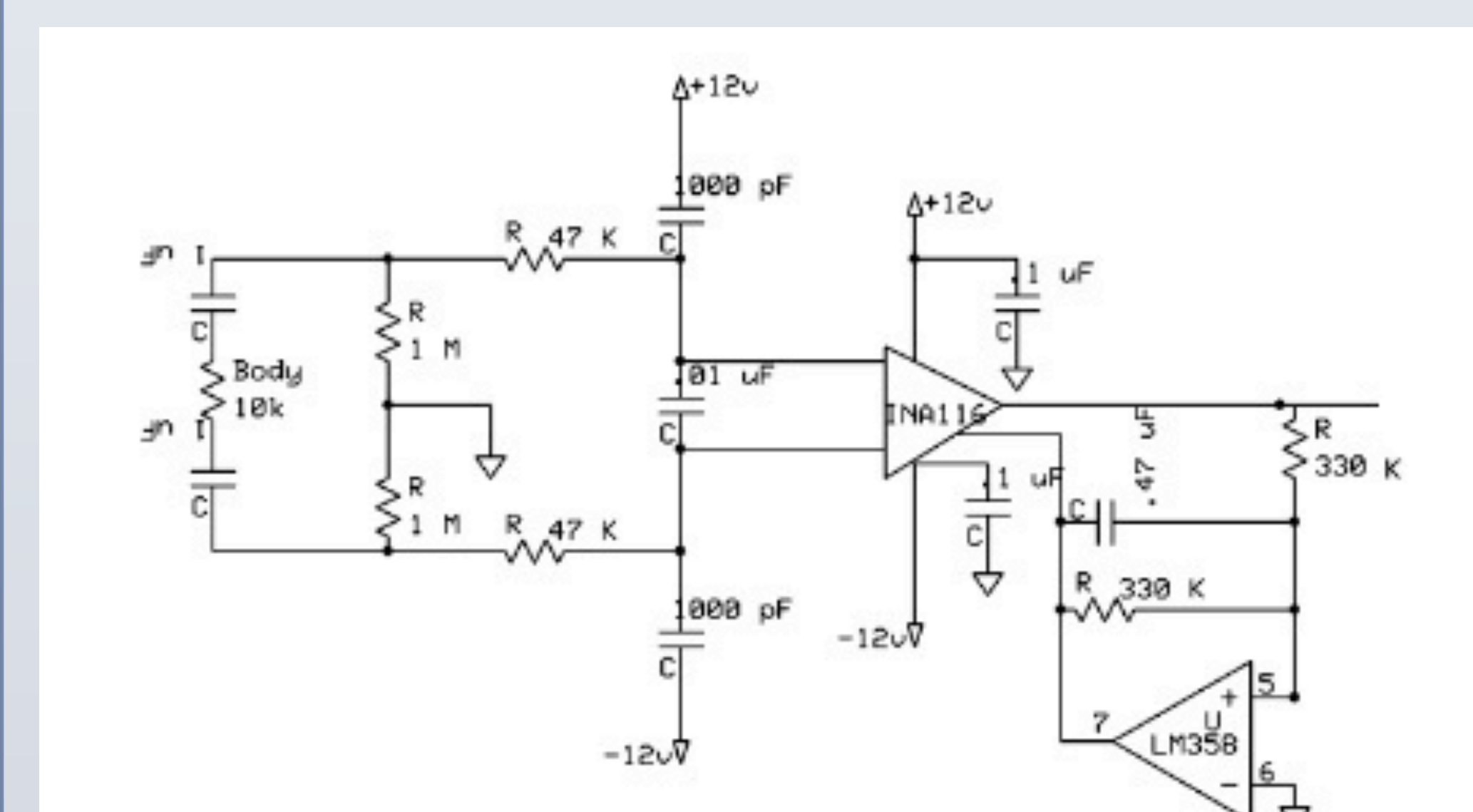
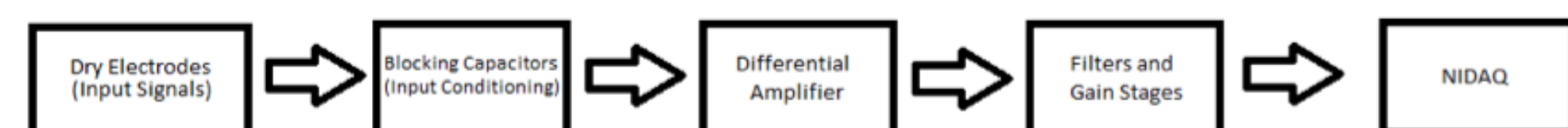


Cornell University



Overview

The goal of our project was to design and fabricate a low cost ECG. The rationale behind this project was to utilize cheap materials for a low cost ECG that could be used to measure a person's heart rate. Our interest in further developing our previous labs about ECGs was a key influence in doing this project. Since the idea behind this project was a treadmill heart rate monitor, the main goal for this project was to safely detect a heart rate without any wet contact. Sources for this project idea were academic papers on the IEEE site, our professor Bruce Land, and previous labs that spurred interest in doing an ECG related project.



Materials

INA116 (differential amplifier), two LM358 (op amps), several capacitors (one 0.47 uF, three 1 uF, two 1000 pF, one 33000 pF), two 4" chrome plated brass, and several resistor values.

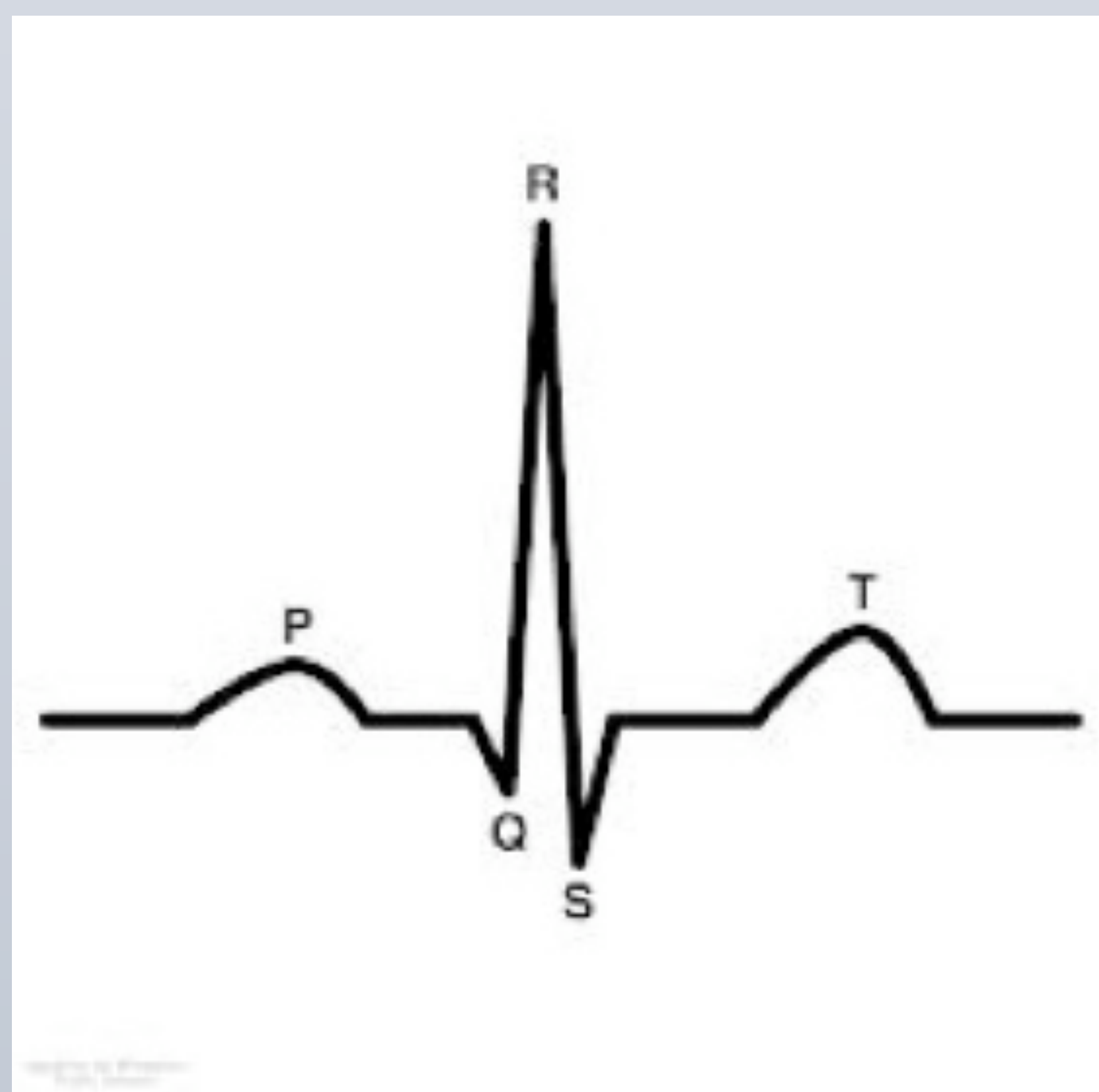
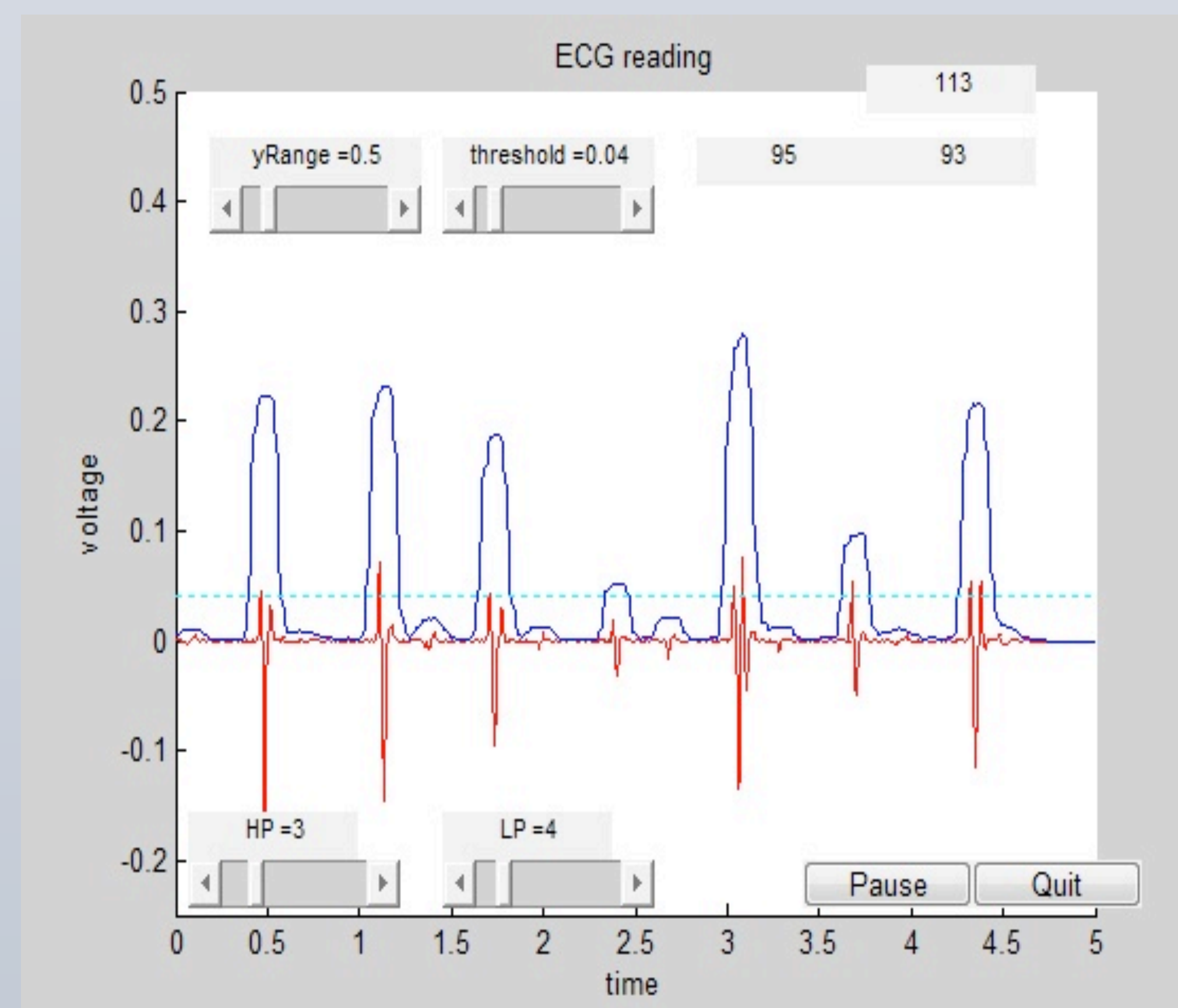
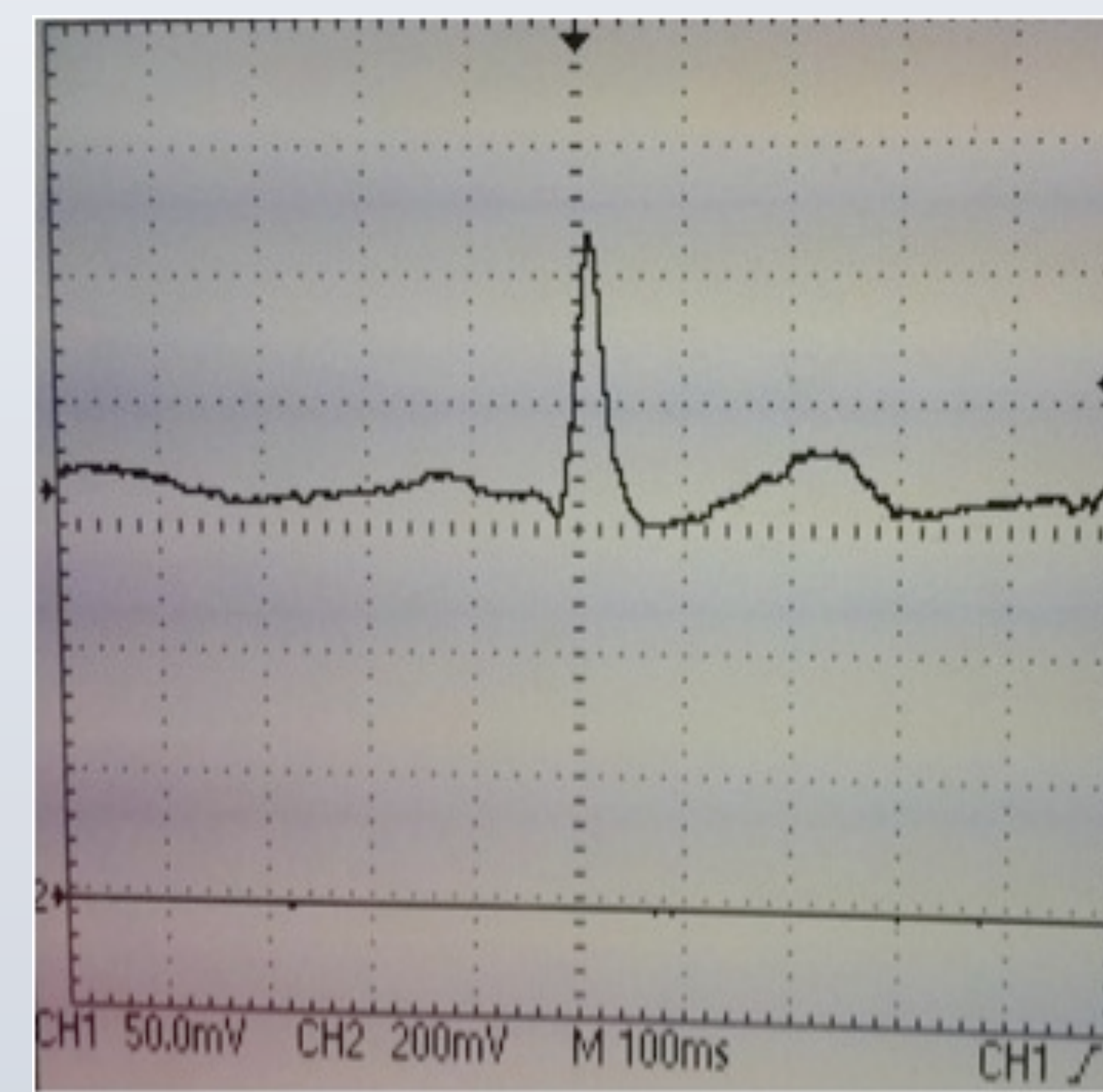
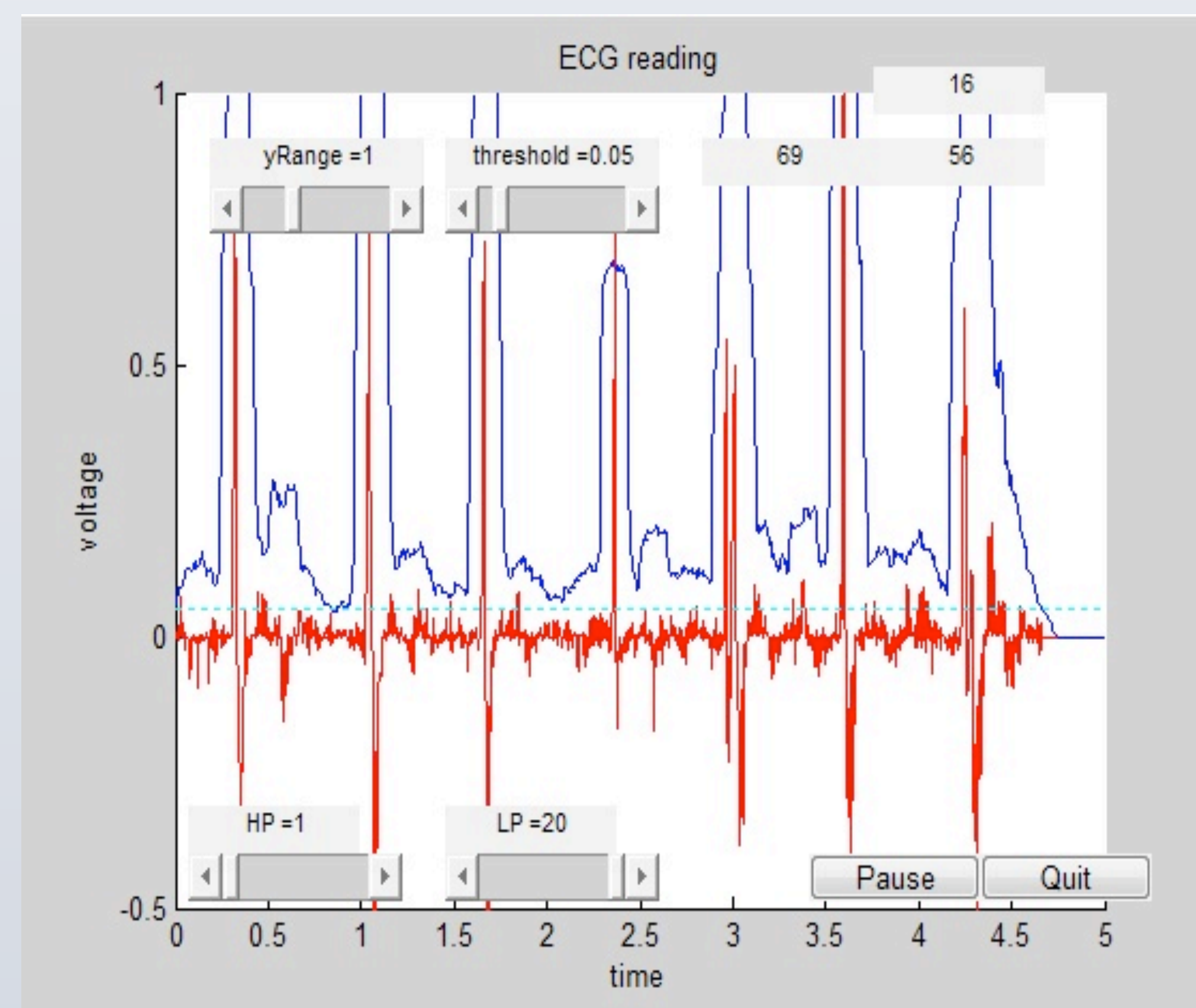
Methods

We based our hardware design on a design by Emile Richard and Adrian Chan (see references). After modifying this design to meet our needs and specifications we were able to achieve an incredibly accurate and clean ECG signal. The key to the circuit is using a differential amplifier to measure an individual's dipole moment.

The software component takes this signal and processes it to both display the data in real time and to calculate a person's heart rate. The algorithm for calculating heart rate was developed by us and is both robust and accurate.

Results

The system is responsive, robust, accurate, and most importantly, safe. The program responds to GUI commands within 100 ms, which is instantaneous from the user's point of view. The heart rate value is accurate even when the system misses a heart beat or random noise appears. In addition to accurately measuring heart rate, the hardware system accurately captures the user's heartbeats and detailed QRS complex (as seen below). And finally, the circuit is extremely safe. Contact with a 110 V AC line will produce so little current that the user will not feel it. The circuit will arc and fry before the user even feels a painful shock.



Conclusion

Overall, this project met our goal of creating a safe, easy to use, and easy to build dry contact ECG system. In total, the cost of all hardware materials was under \$15. We believe that in its current state the system is an excellent project for introductory to intermediate electrical engineering classes.

Possible Improvements

Some possible improvements would be to connect this to a battery source and incorporate a microcontroller with a small television so that it could be portable. Or another modification could be to improve the signal processing in Matlab to ensure even more accuracy and better time frames for retrieving the user's data. We would have also liked to have packaged our system to make it more aesthetically pleasing and portable.

References

- We used a template provided by Bruce Land as the basis for our code.
- *Design of a Gel-less Two-Electrode ECG Monitor*, Emile Richard, Adrian D. C. Chan, Medical Measurements and Applications Proceedings, April 30 2010-May 1 2010

Acknowledgements

We would like to acknowledge the paper writers of "Design of a Gel-less Two-Electrode ECG Monitor," who gave us a circuit template to build off of our project. We would also like to thank our instructor, Bruce Land, for the support provided in this assignment and for the opportunity to design a product to expand our own personal interests. In addition to this, we would like to thank our TA Akshay Dhawan.