

IEEE Phoenix Capstone Project, Spring 2013

Blood Pressure Sensor Utilizing a Pulse Transit Time Technique

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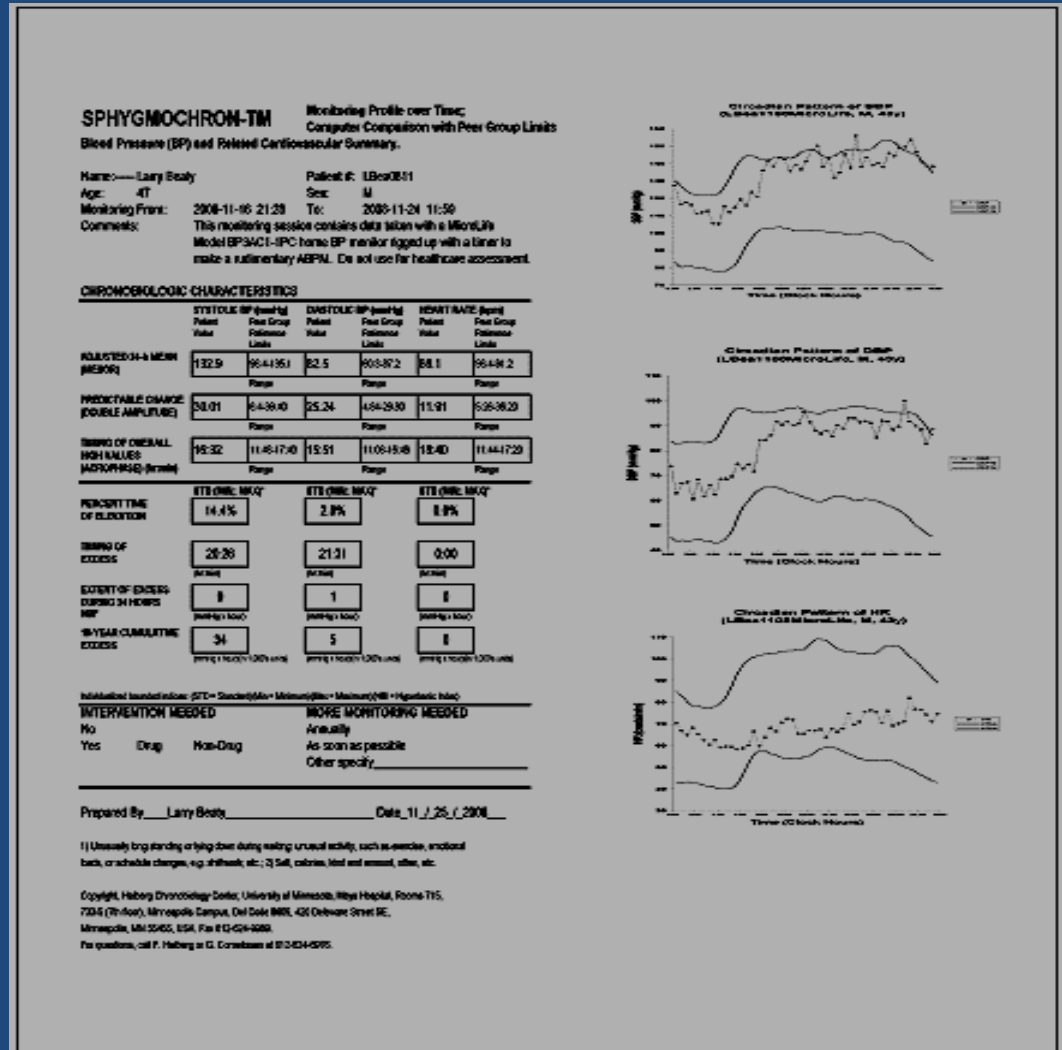
Who Are We?

- Twin Cities IEEE Phoenix Project
 - Volunteer electrical/mechanical/software engineers
 - Our group was assembled to **productize results of research** done at the Chronobiology Lab and elsewhere
 - Open Source hardware project to **design and build a blood pressure monitor** that is inexpensive, unobtrusive, easy to use and collects a week of blood pressure measurements.
- UMN Halberg Chronobiology Lab
 - Dr. Franz Halberg, “Father of American Chronobiology”
 - Chronobiological Interpretation of Blood Pressure
 - Vascular Variability Disorders more important than hypertension
 - Our “customer”

Background

The Sphygmochron Report

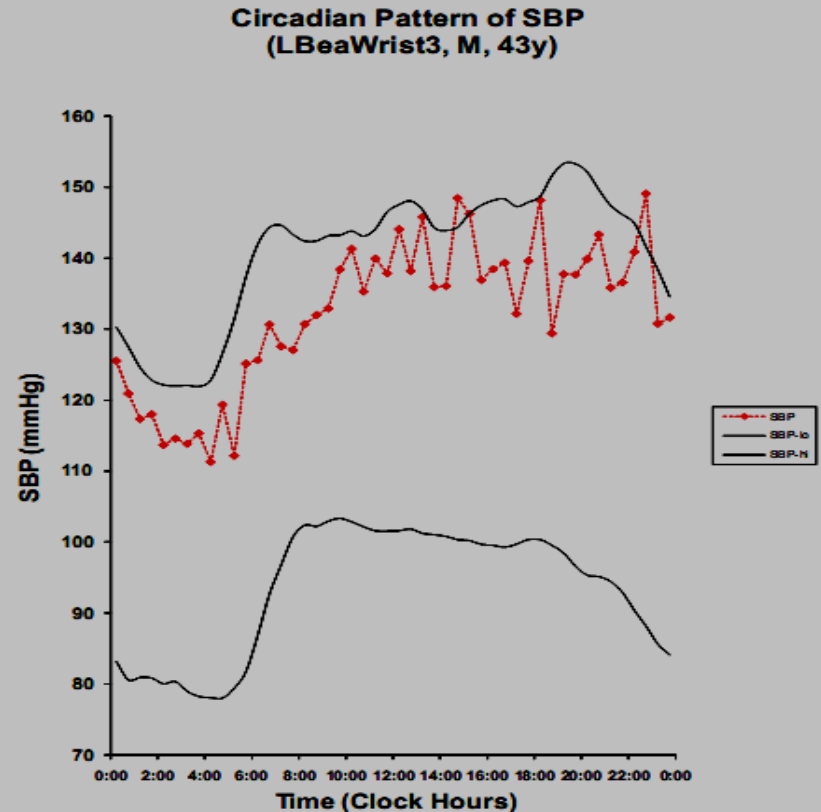
Results from Continuous Monitoring



Background

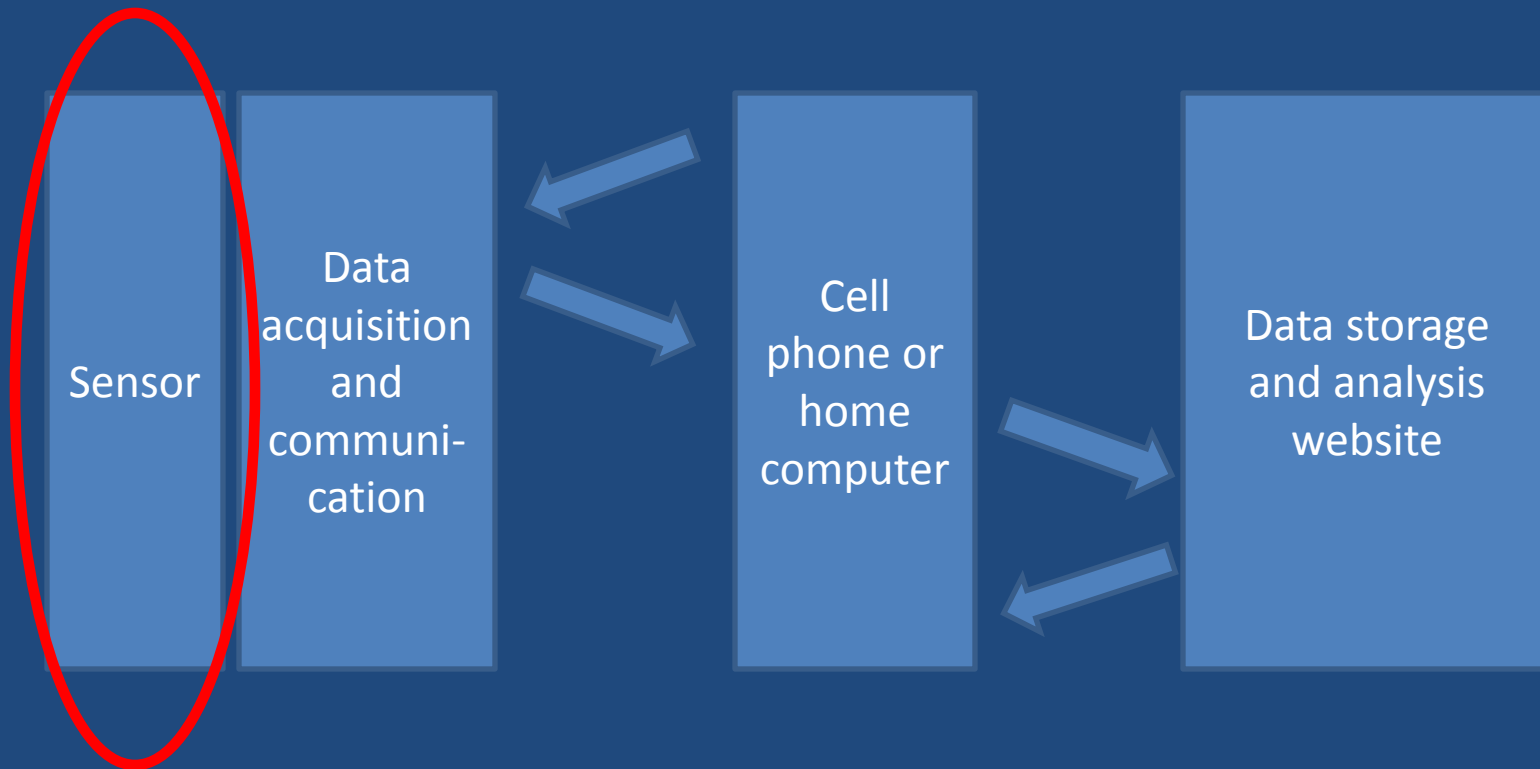
The Sphygmochron Report

Results from Continuous Monitoring



Where the student project fits in

- Over-Simplified Block Diagram of the System



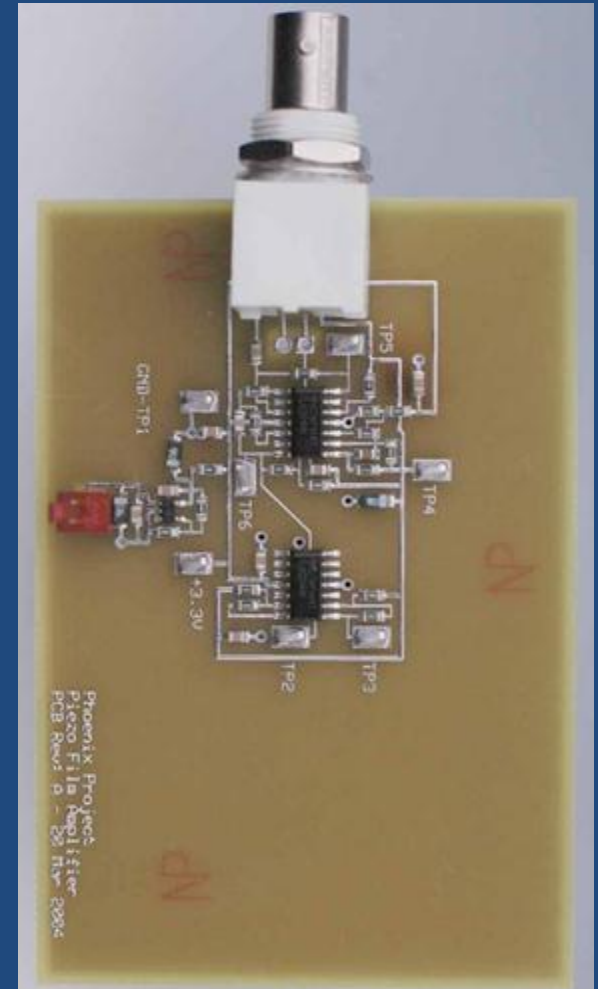
What is Pulse Transit Time (PTT)?

- The heart beats every 1 second or so
- It takes a couple of hundred milliseconds for a pulse (pressure wave) to travel (transit) from the heart to extremities
- The pulse's **velocity is related to blood pressure** (and other things such as compliance of the artery)
- Also called Pulse Wave Velocity (PWV)
- In theory, you **put two pulse sensors along an artery, calculate the transit time (velocity), then derive the blood pressure.**

Activities in the sensor project

- **Design, build, and test** a *non-invasive* sensor system to record pulse waveforms at two locations on the body (e.g. forearm and wrist), using four sensors.
 - Perform experiments using an array of sensors, using differential pairs of sensors, and using different electrical or mechanical interfacing to the skin.
 - Extend previous Phoenix projects.
- Publish a final **report** that will be posted on the Phoenix Project website. (Can be the same as your class report.)
- Additional “stretch goals” available

Examples of previous projects



Examples of previous projects

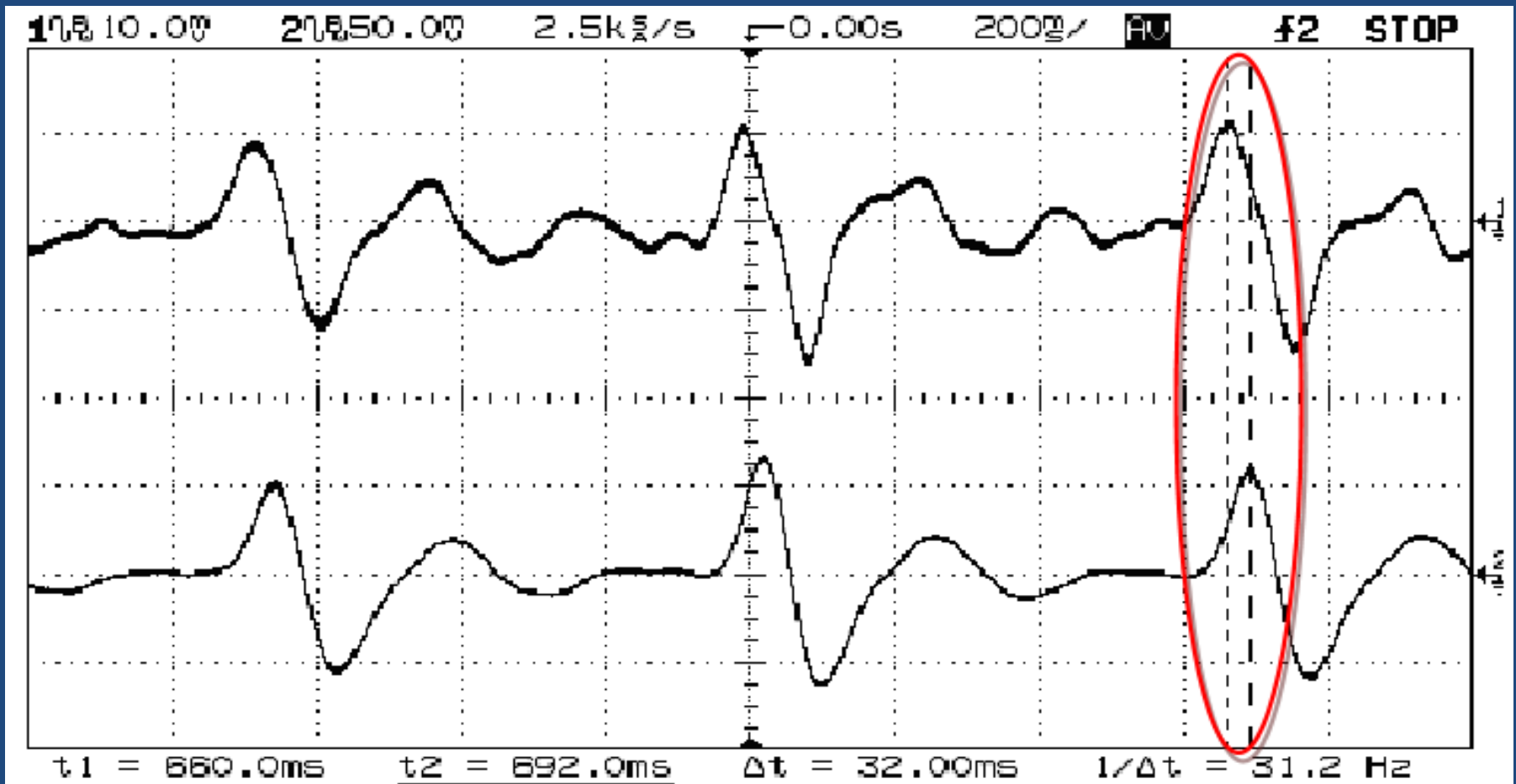
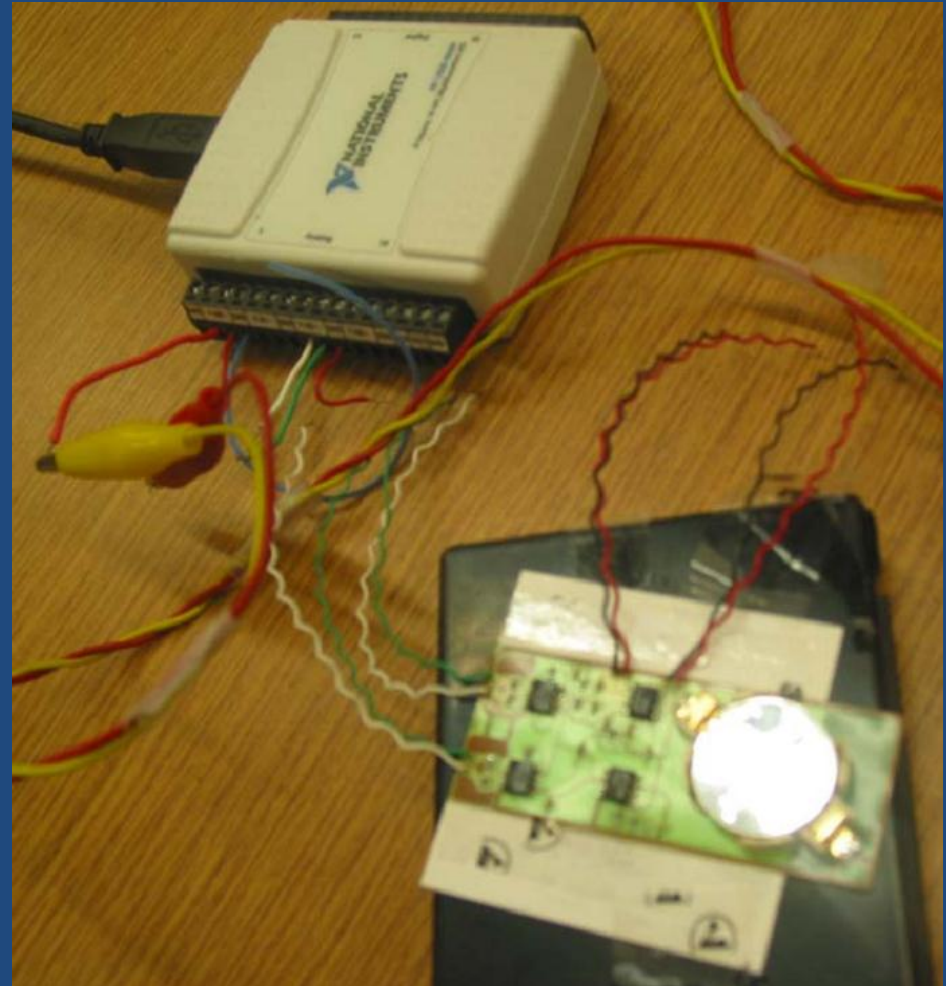
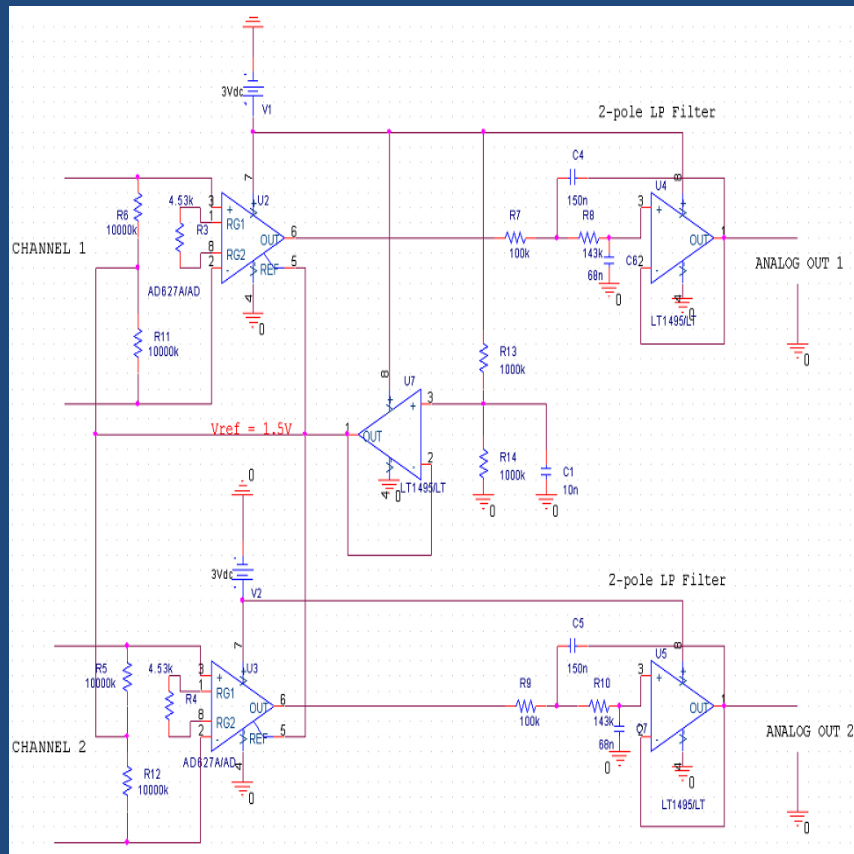
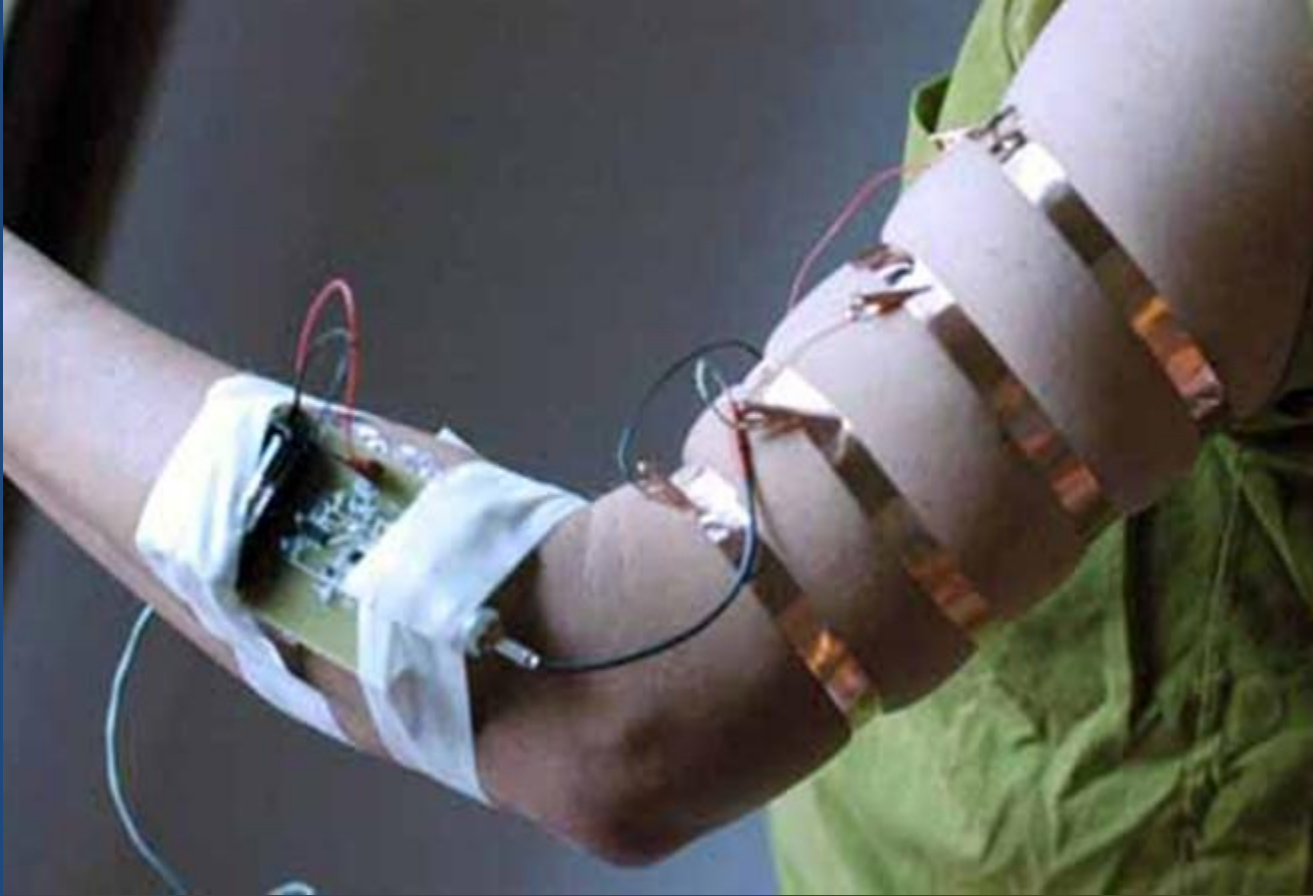


Fig 1. An example of pulse propagation delay between forearm and wrist

Examples of previous projects



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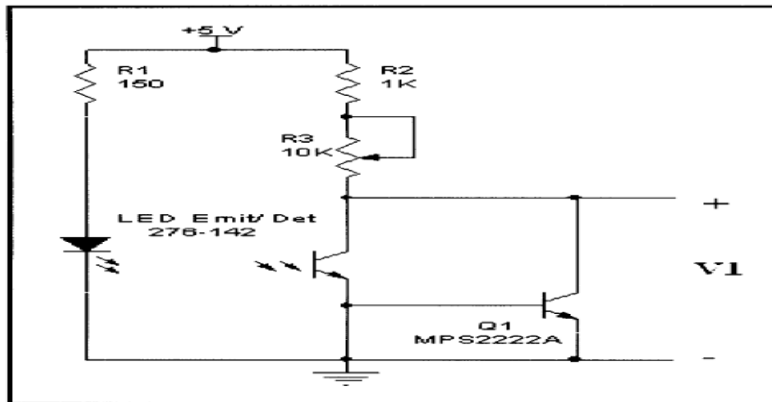
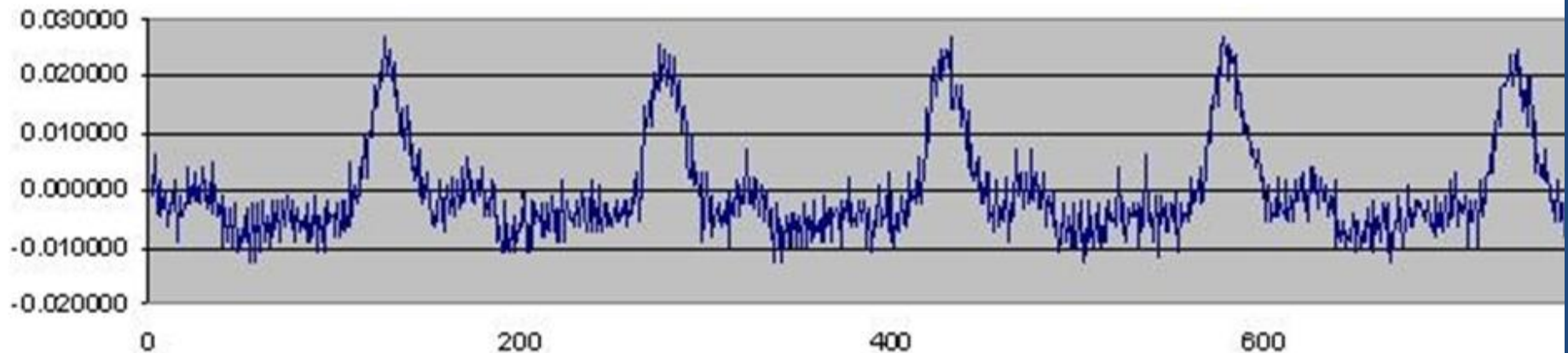


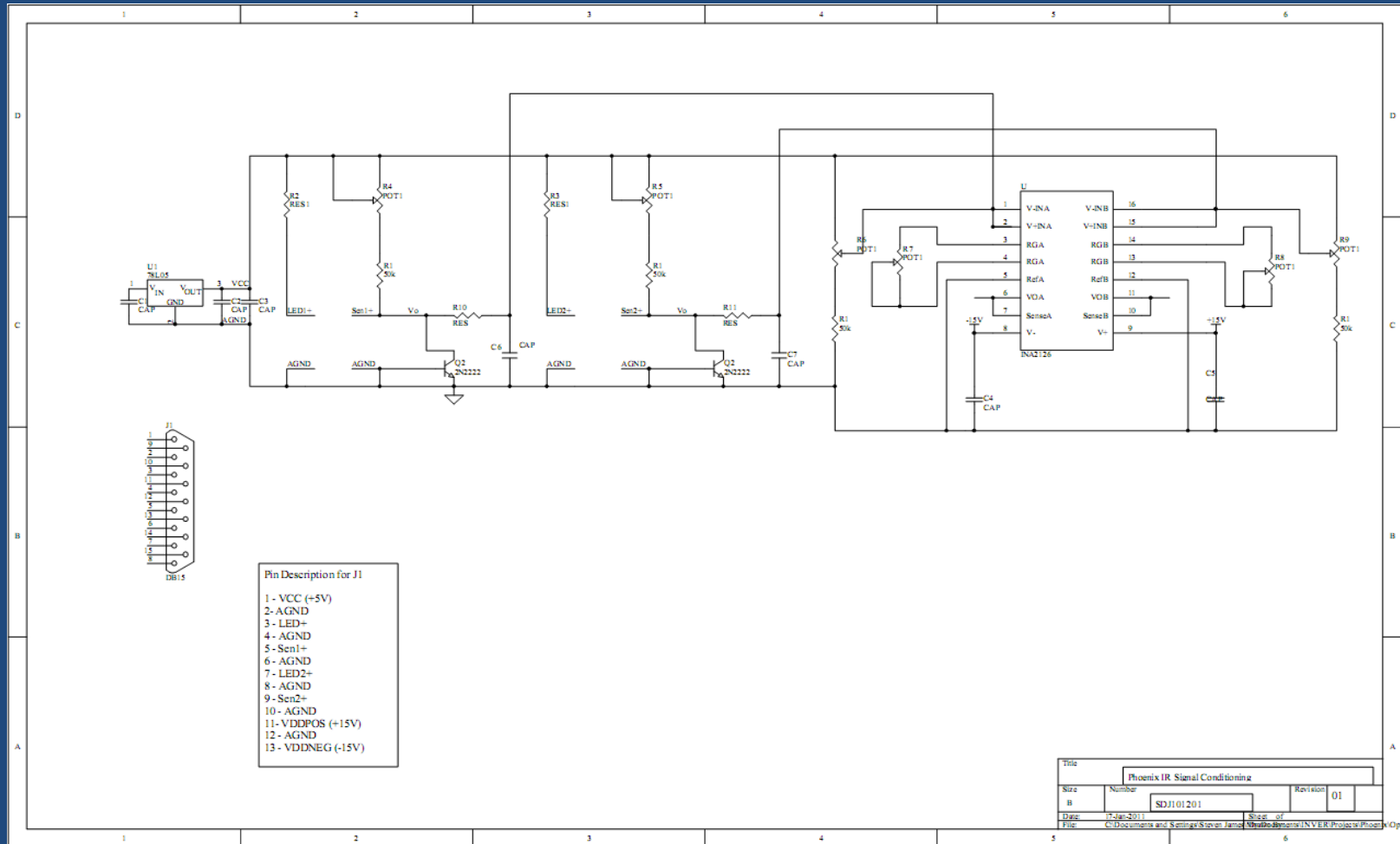
Figure 2: Heartbeat transducer circuit with output V1.

The first attempt to record a pulse wave from a lab member's finger looks like the following:

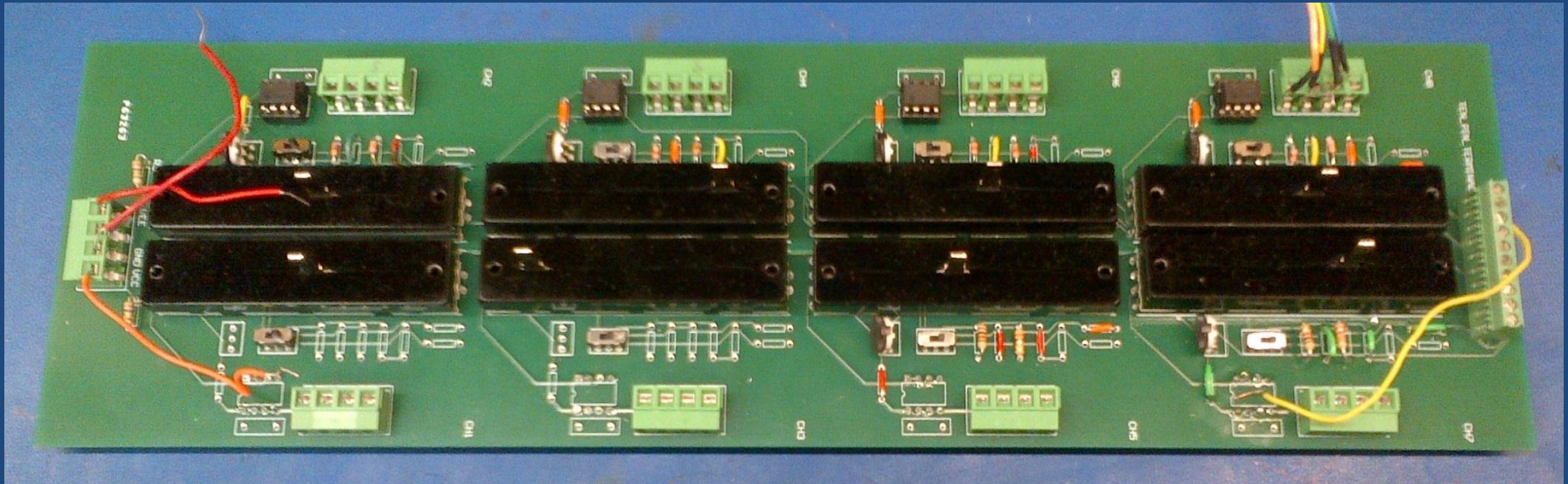
Garrett's First Optoelectronic sensor circuit, 20090822



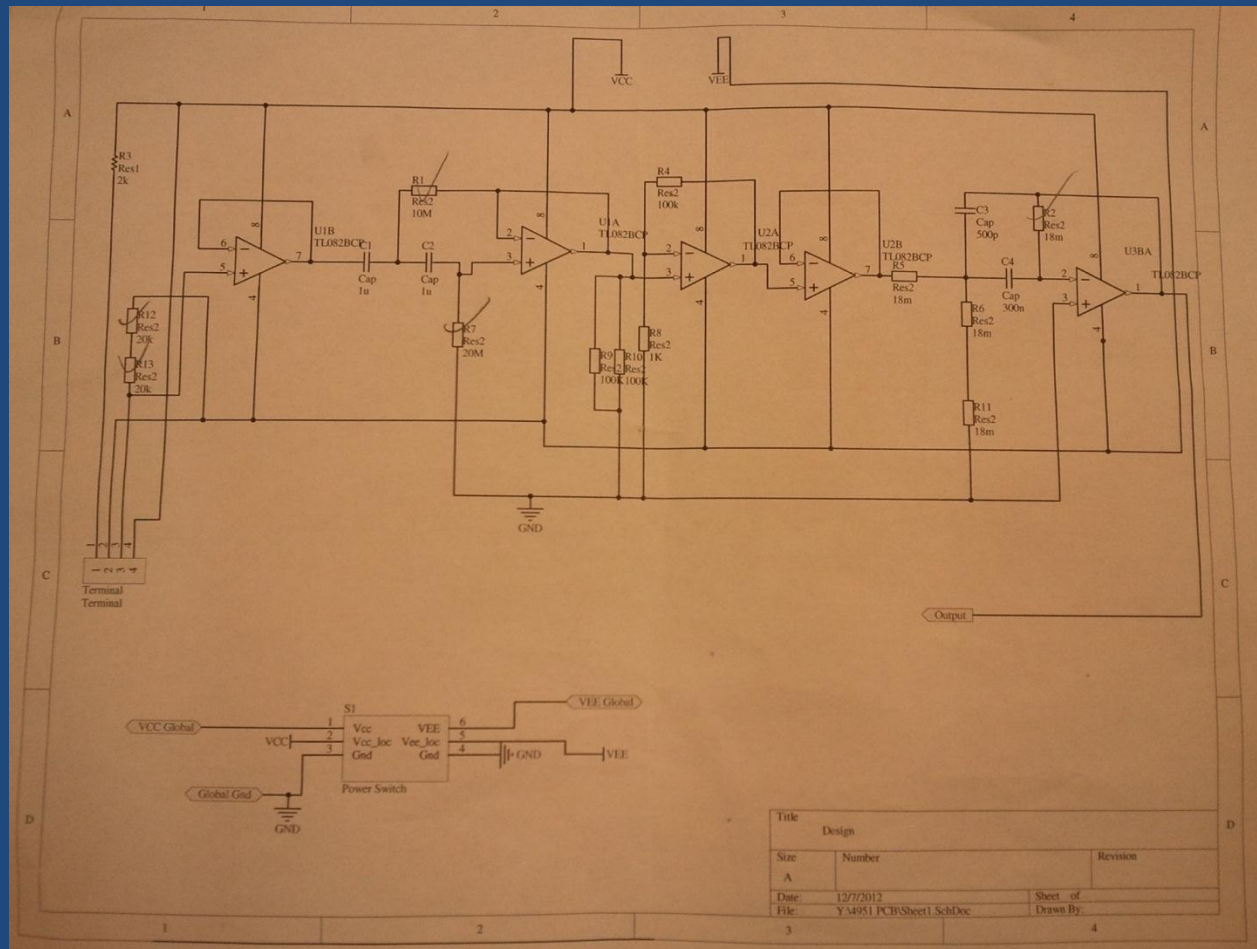
Examples of previous projects



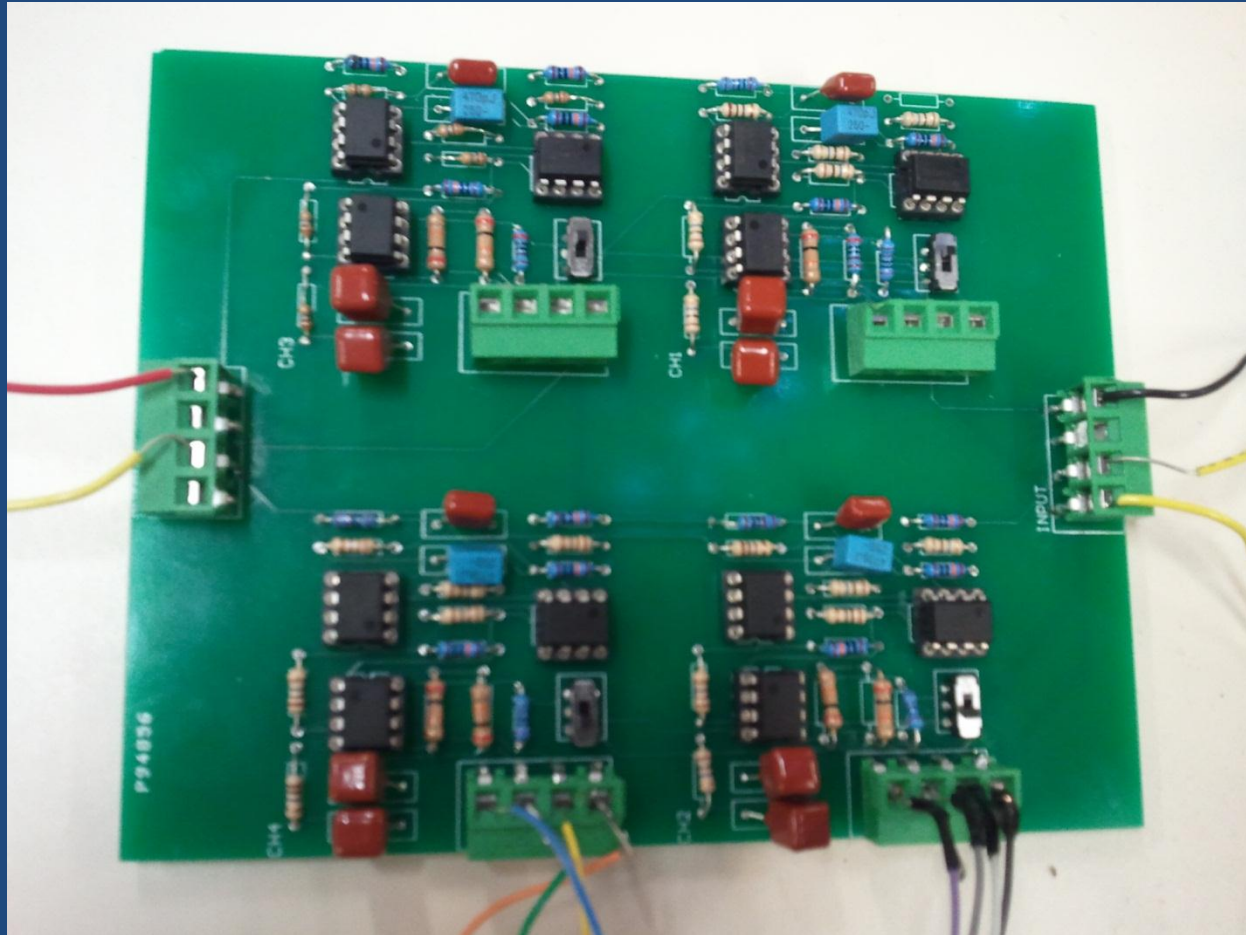
Examples of previous projects



Examples of Previous Projects



Examples of Previous Projects



Conclusion

- We are looking to extend the R&D we've done so far, and then productize something from the ongoing research; the student projects are an important part of that.
- Dr. Halberg expects this to change healthcare in a major way for all 7 billion people on the planet by preventing and diagnosing diseases we can't detect today.
- Would you like to say that you got an “A” for doing your part on an open source healthcare-related project that went from visualization in the academic world to R&D and then to production?
 - *Companies like to hire people who can say things like that.*