HeartAware

pulse oximetry system

6.111 Final Project, Fall 2015

Michael Holachek and Nalini Singh

Motivation

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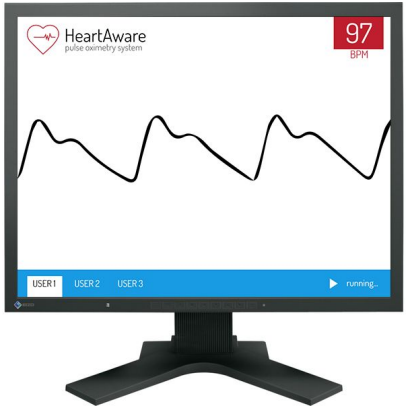
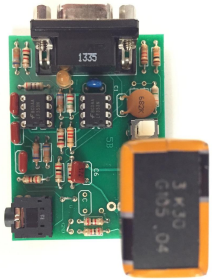
- Develop variety of skills involved in FPGA design
- Explore medical applications





System at a Glance

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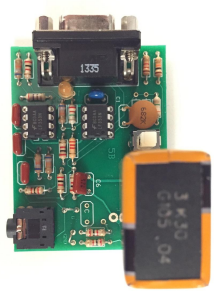

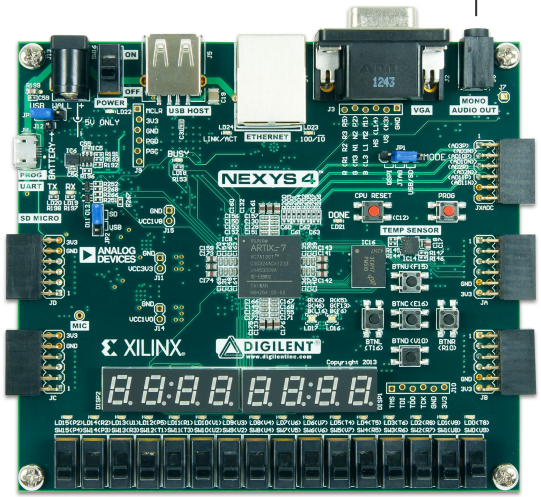

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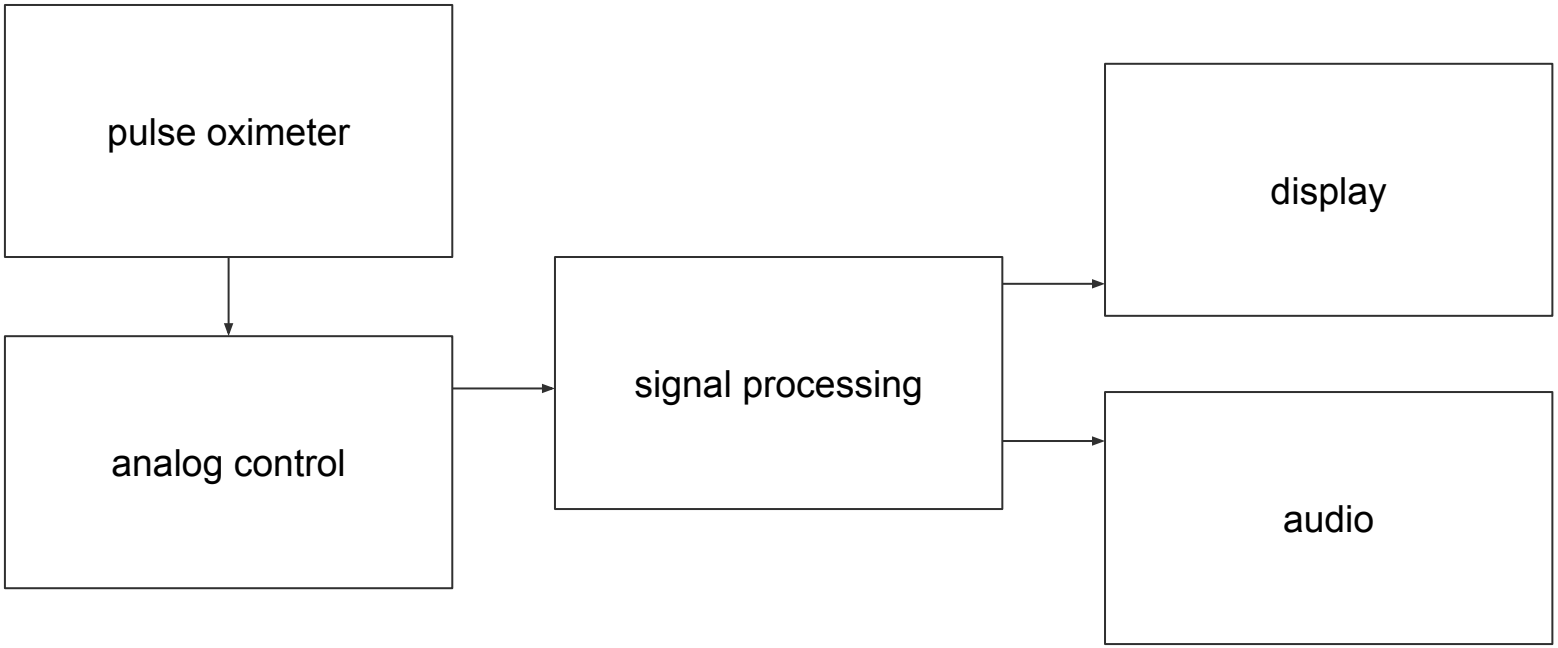

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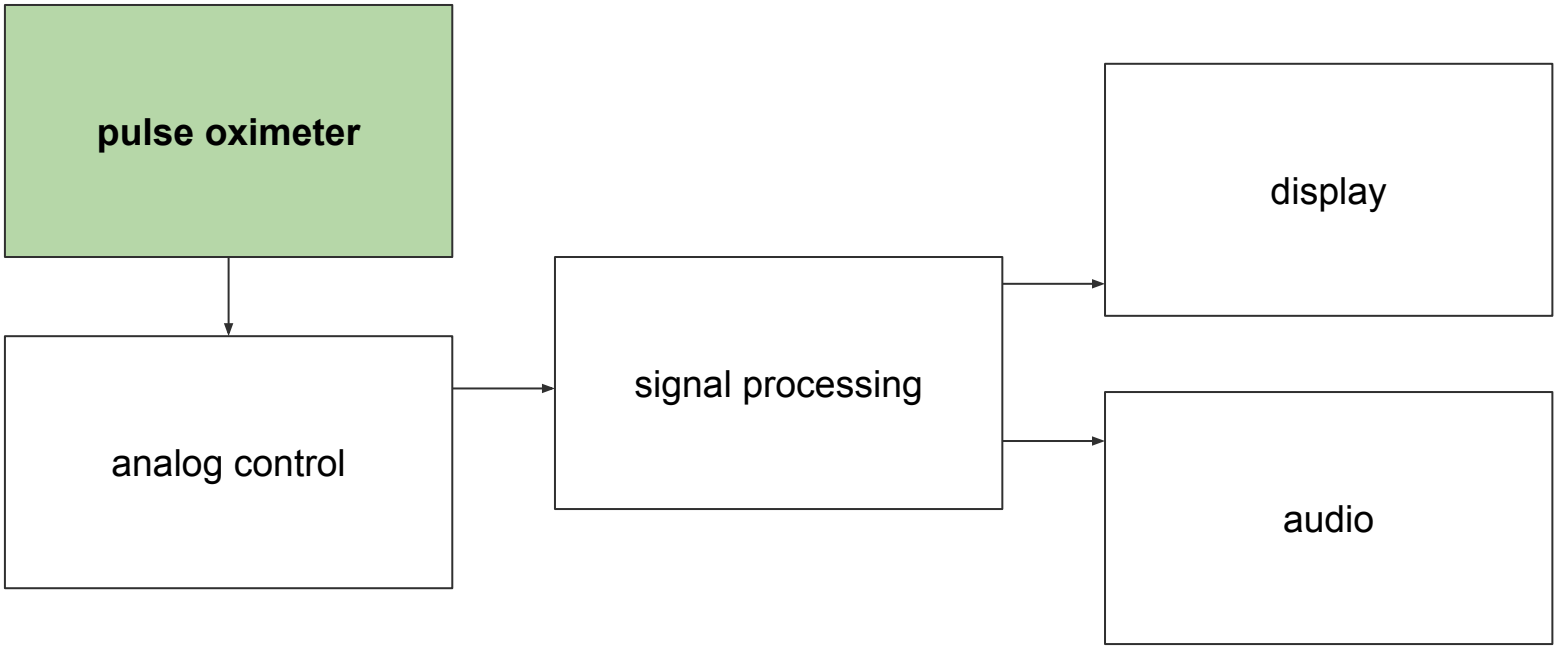

Pulse Oximetry

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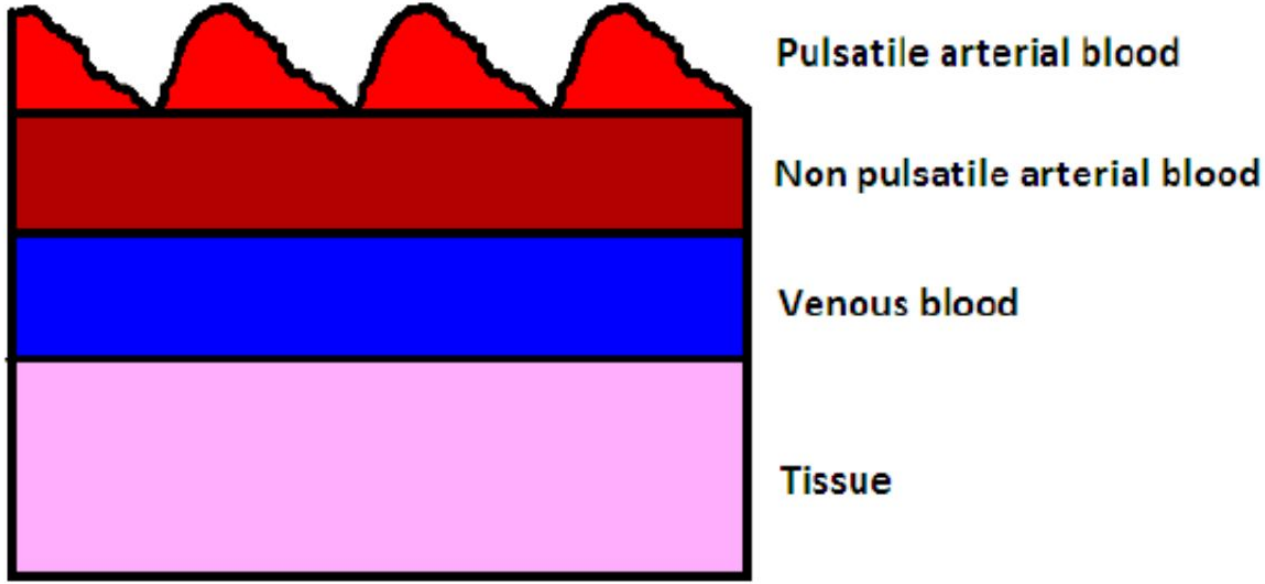

Figure 4. Light absorption diagram

Figures courtesy Freescale “Pulse Oximeter Fundamentals and Design”

Pulse Oximetry

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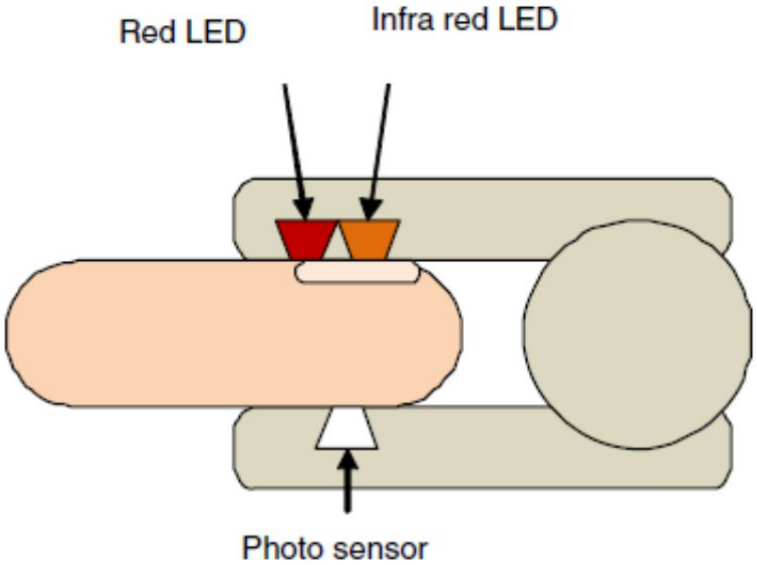

Figure 14. Pulse oximeter sensor

Figures courtesy Freescale “Pulse Oximeter Fundamentals and Design”

Pulse Oximetry

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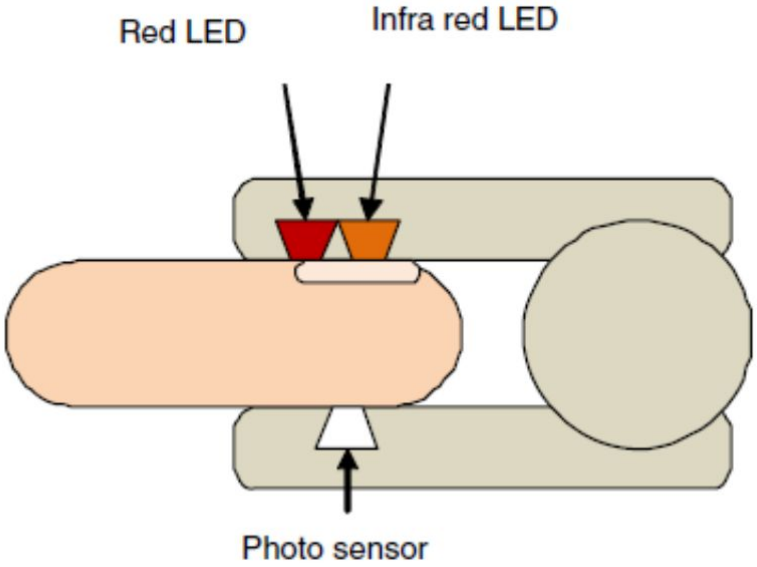

Figure 14. Pulse oximeter sensor

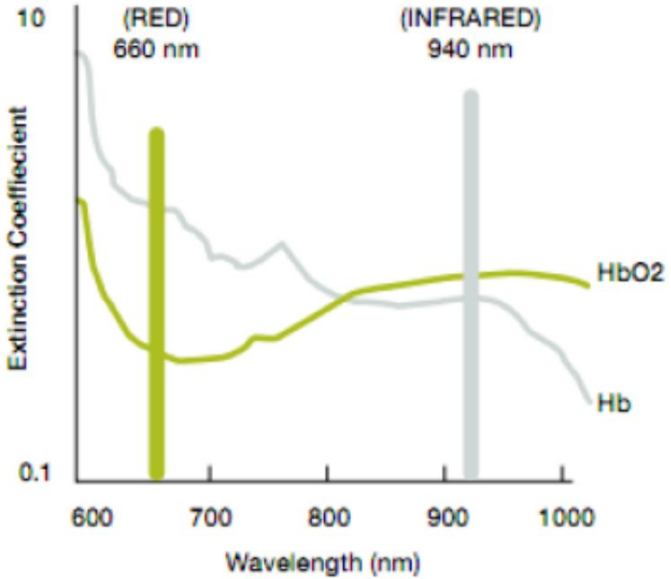

Figure 3. Hemoglobin light absorption graph

Figures courtesy Freescale “Pulse Oximeter Fundamentals and Design”

Pulse Oximetry

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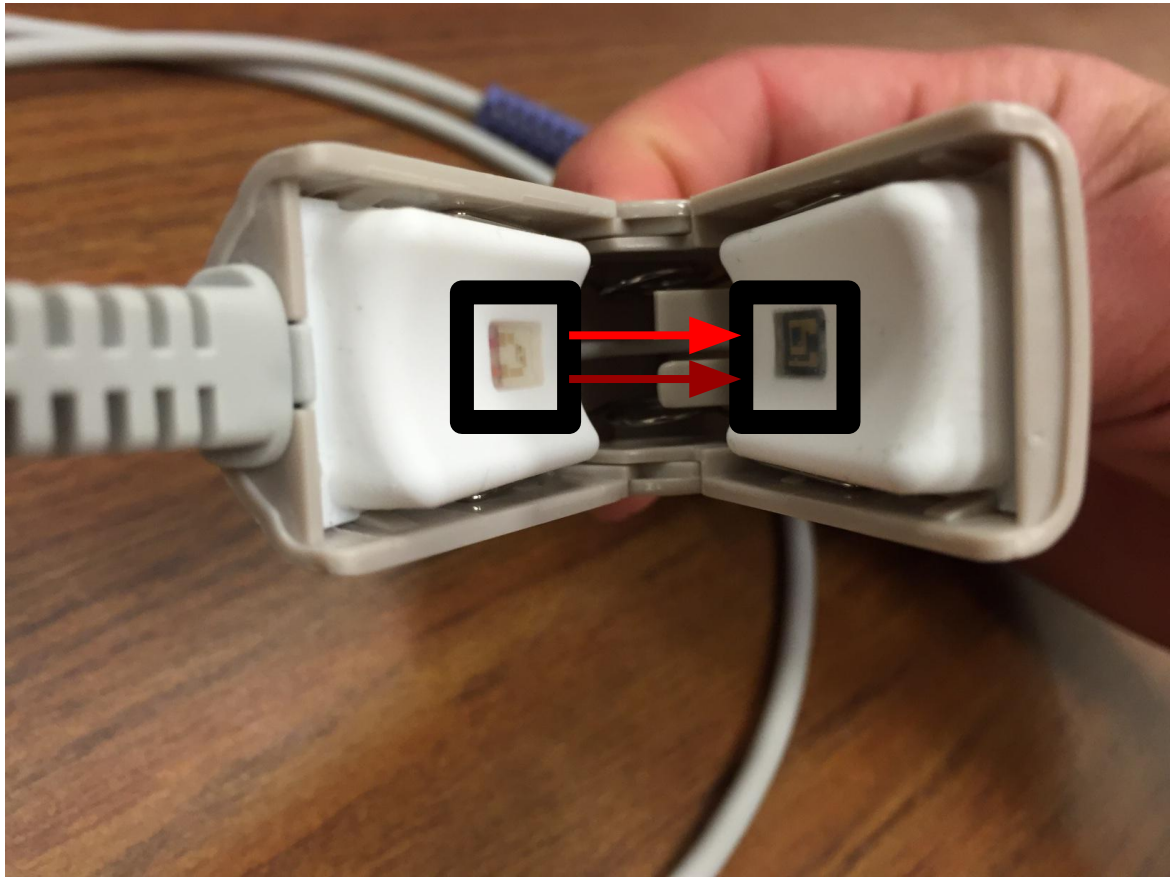

System at a Glance

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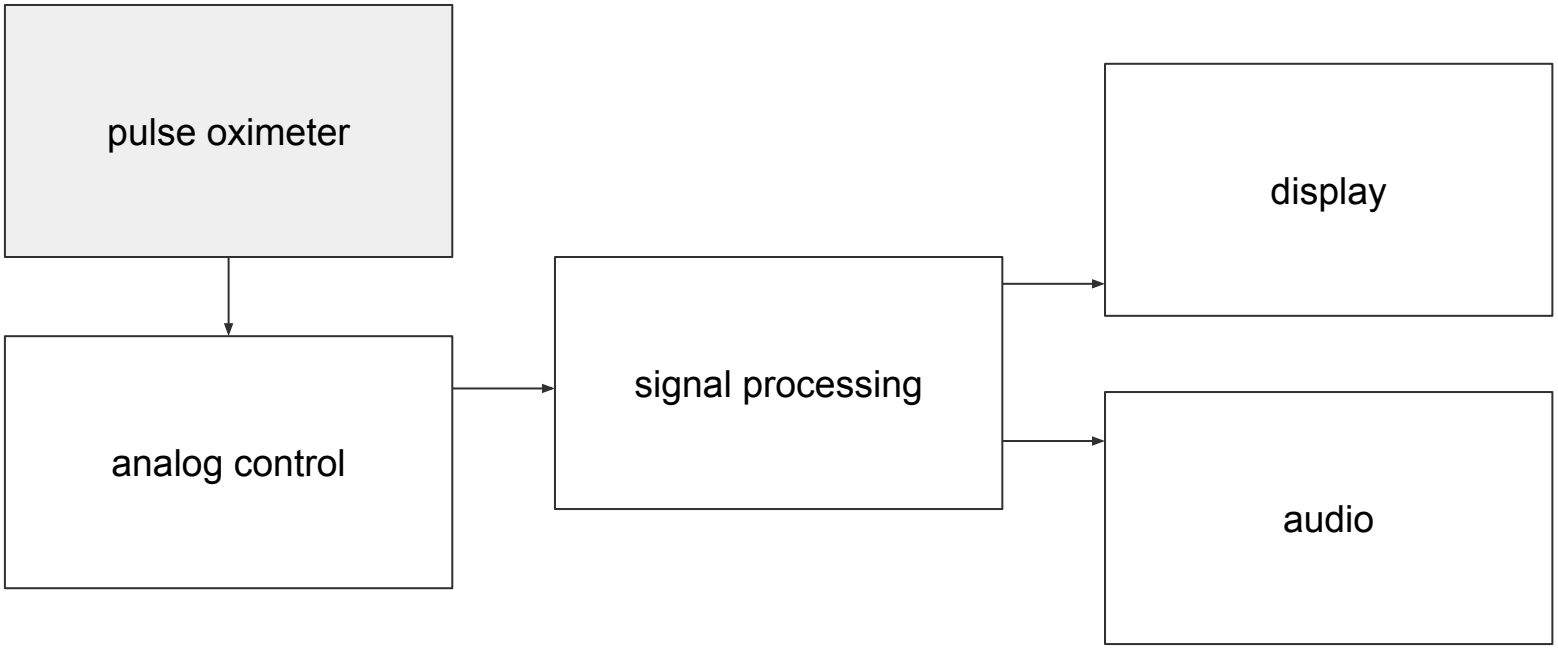

System at a Glance

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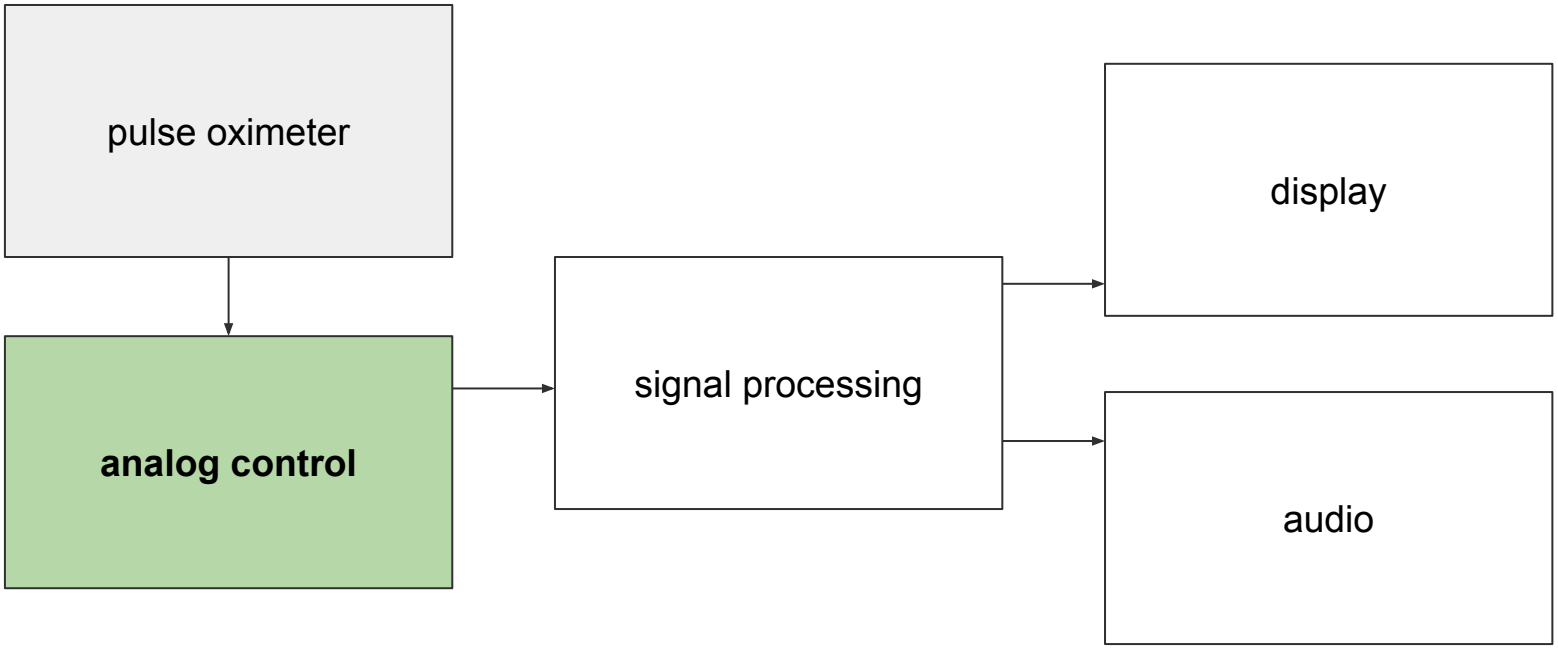

Analog Circuitry

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pulse ox

Pulse oximeter analog driving circuitry designed by Prof. Hom

Analog Circuitry

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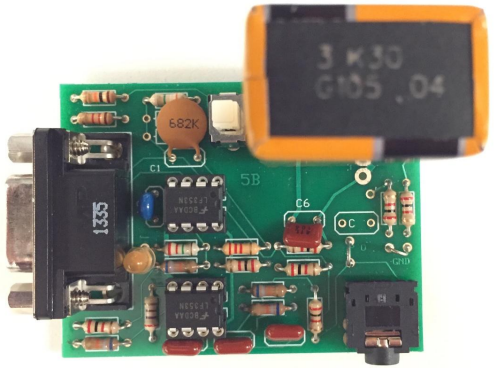
pulse ox



driving circuitry

Pulse oximeter analog driving circuitry designed by Prof. Hom

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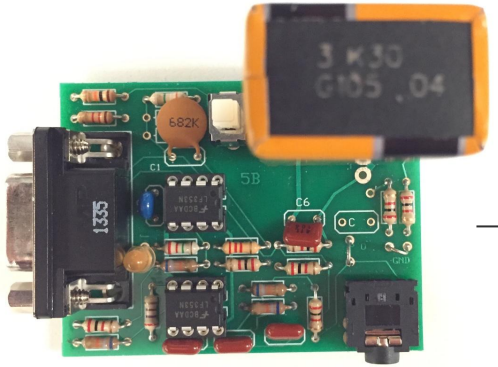
pulse ox



driving circuitry

filtering op-amp

Pulse oximeter analog driving circuitry designed by Prof. Hom

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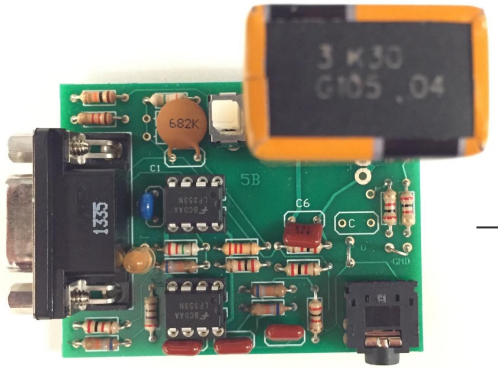
pulse ox →



driving circuitry →

filtering op-amp →

ADC

Pulse oximeter analog driving circuitry designed by Prof. Hom

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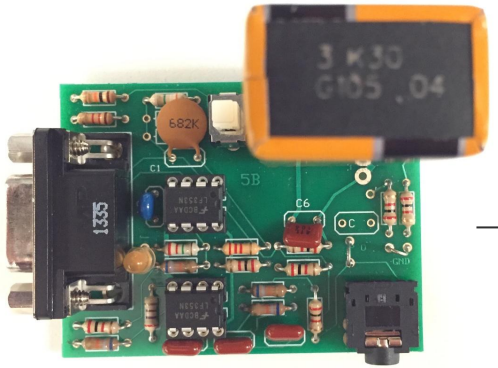
pulse ox →



driving circuitry →

filtering op-amp →

ADC → nexys 4

Pulse oximeter analog driving circuitry designed by Prof. Hom

Analog Circuitry

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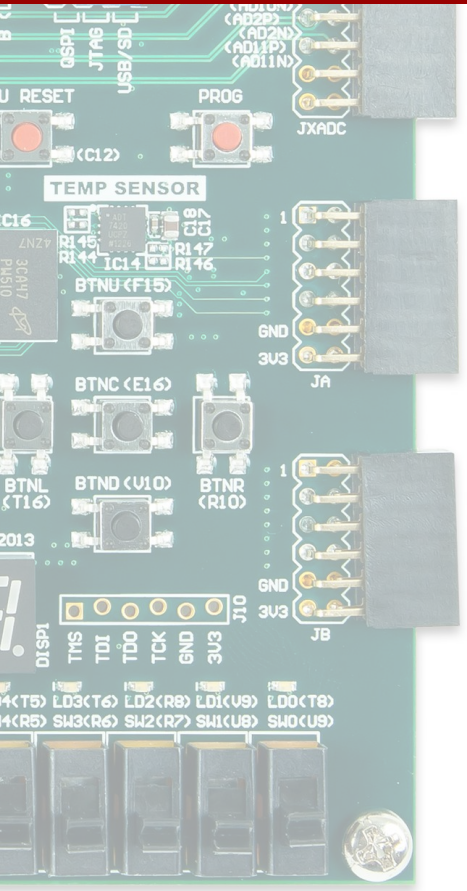

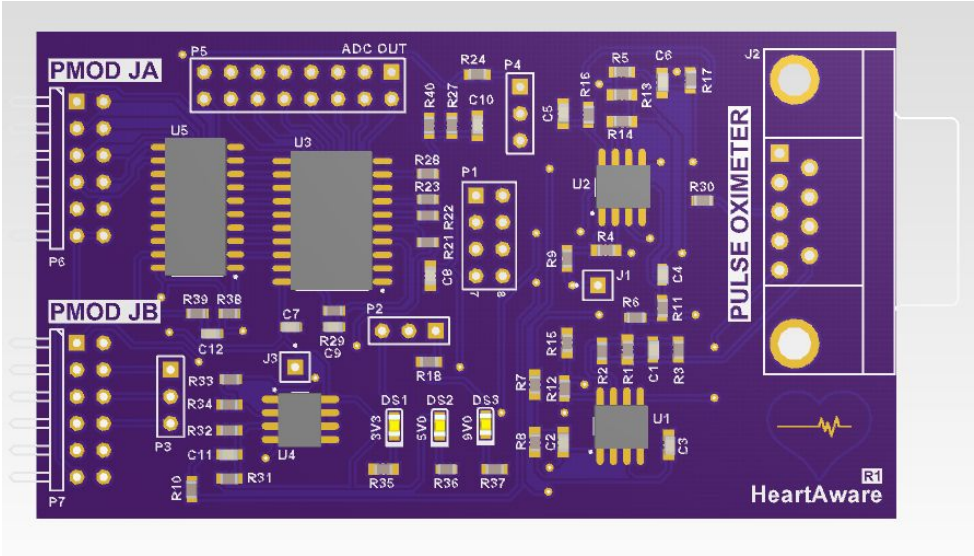

custom HeartAware PCB

System at a Glance

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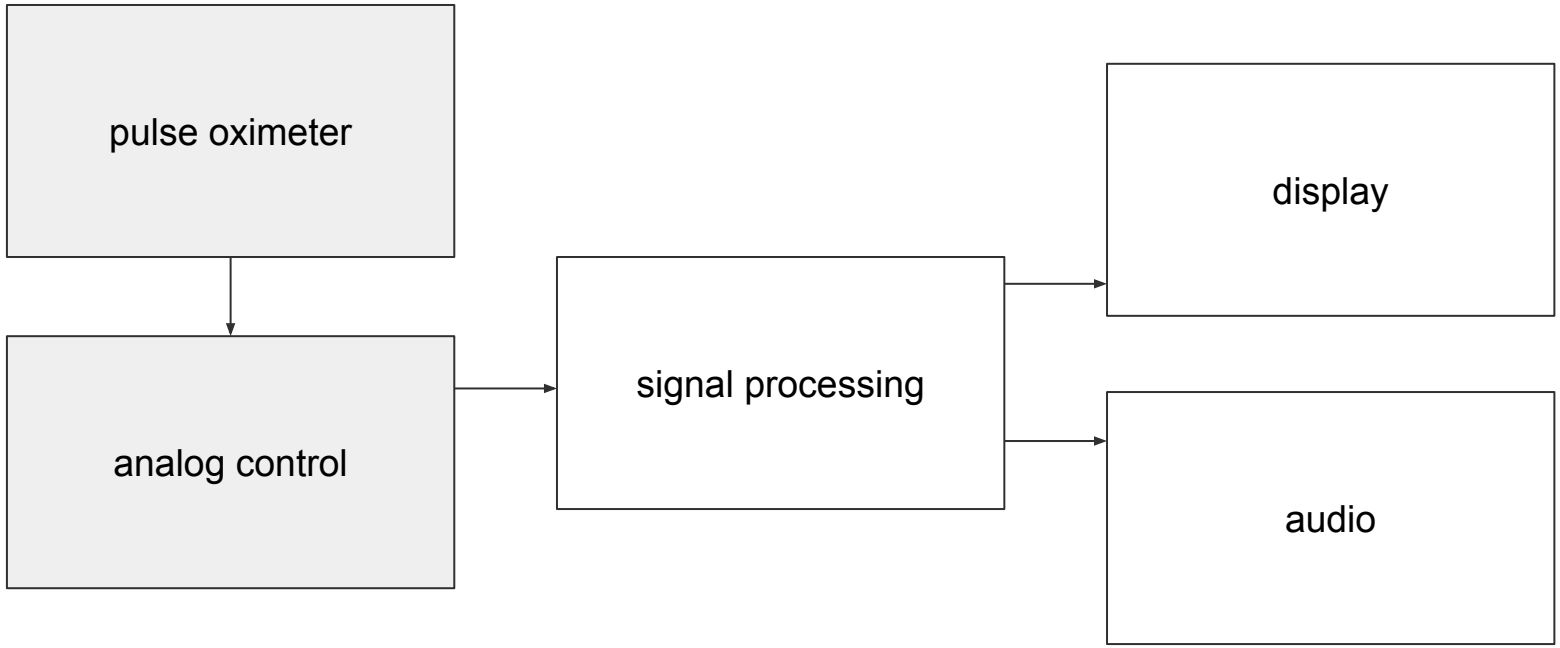

System at a Glance

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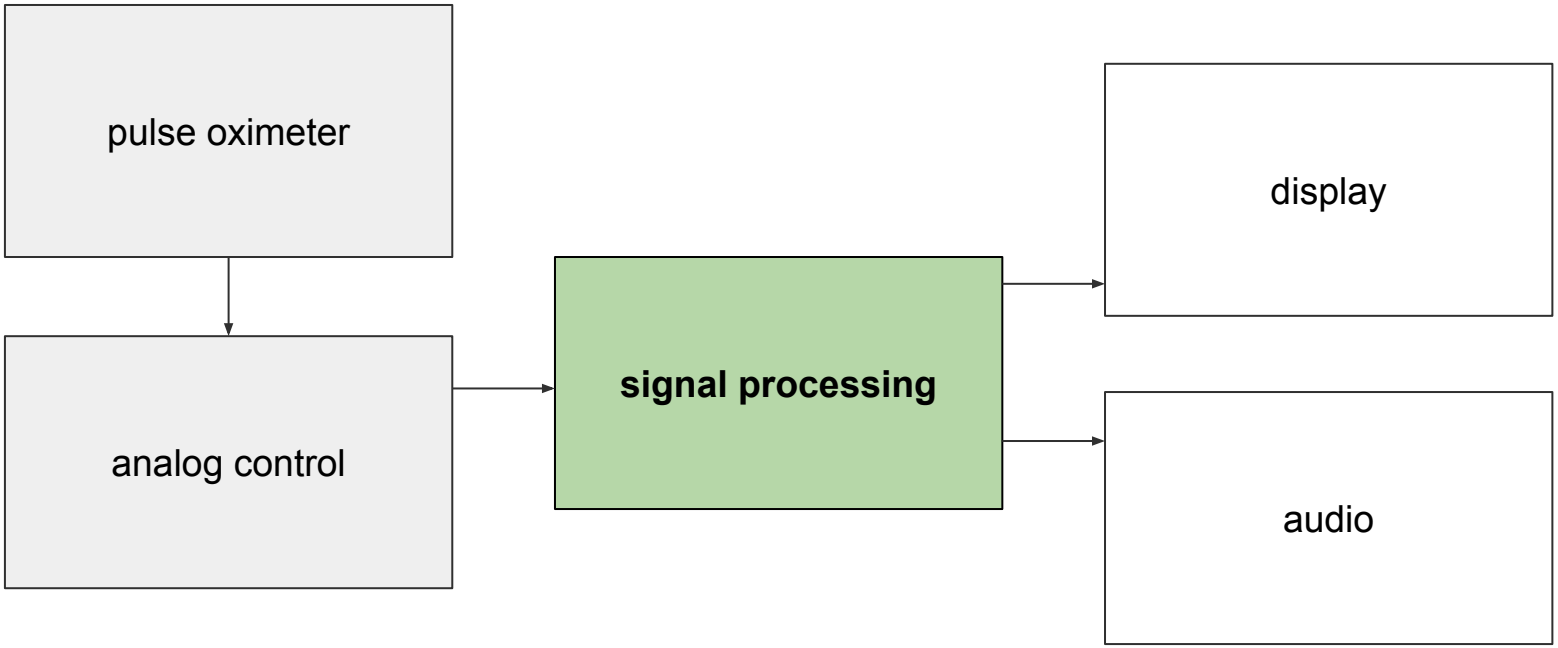

Signal Processing

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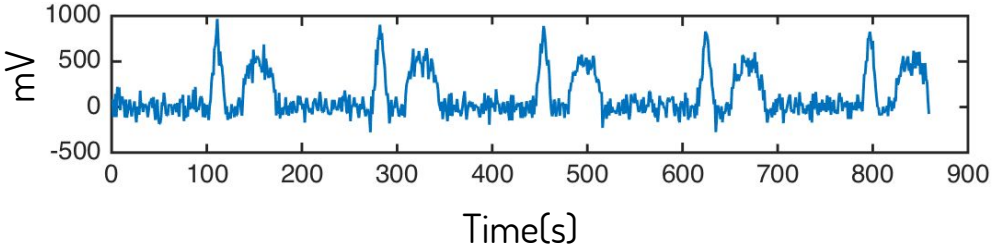
Noisy Input Signal



Signal Processing

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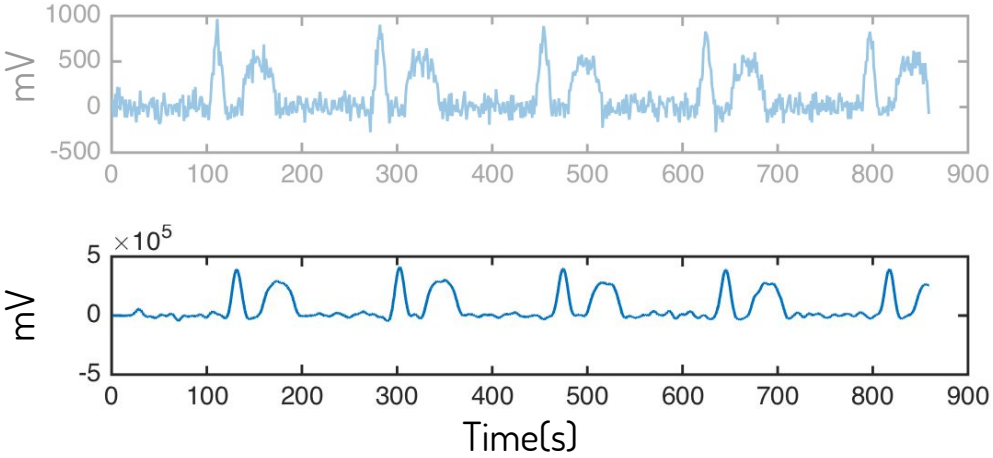
Noisy Input Signal

Filtered Input Signal



Signal Processing

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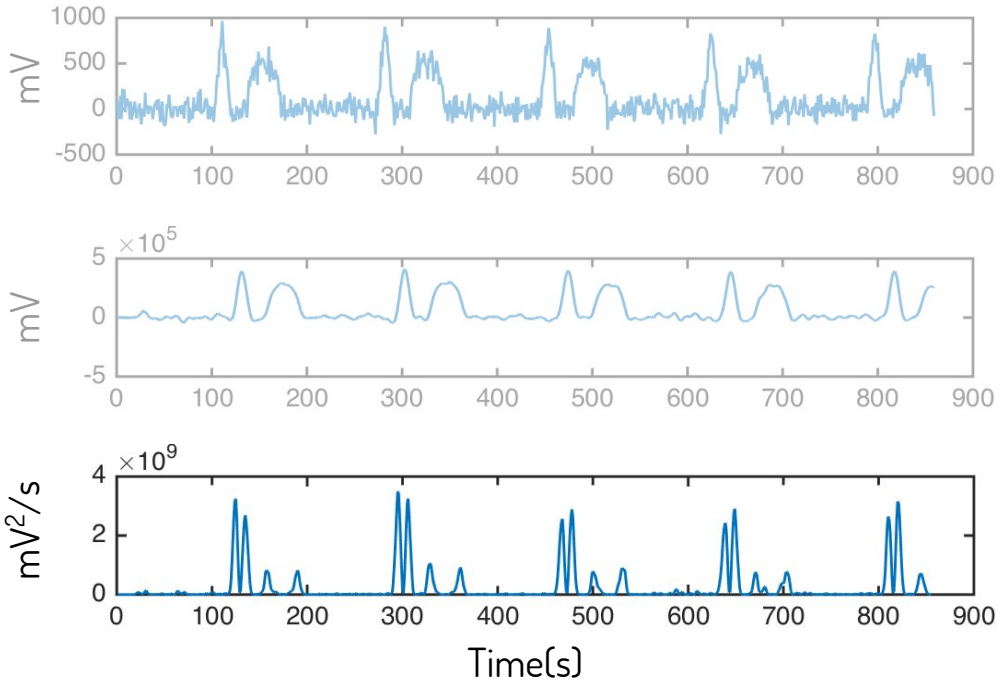
Noisy Input Signal

Filtered Input Signal

Squared Derivative



Signal Processing

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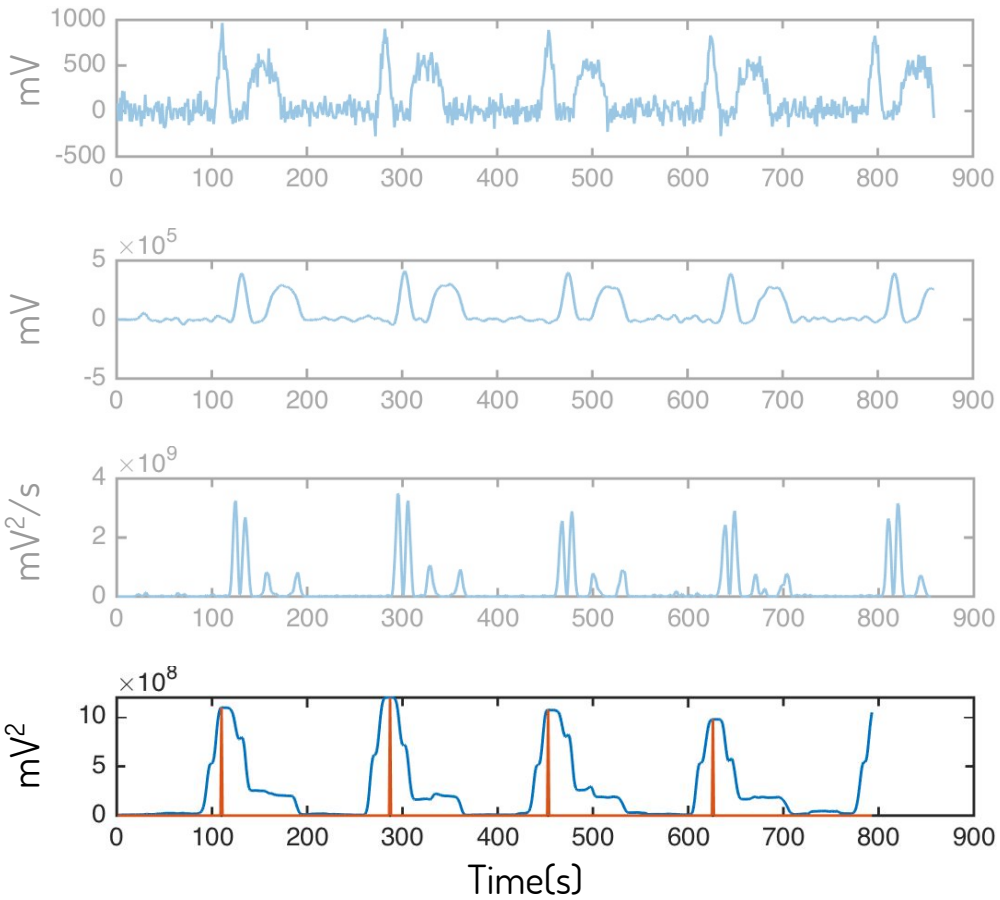
Noisy Input Signal

Filtered Input Signal

Squared Derivative

Window Integration



System at a Glance

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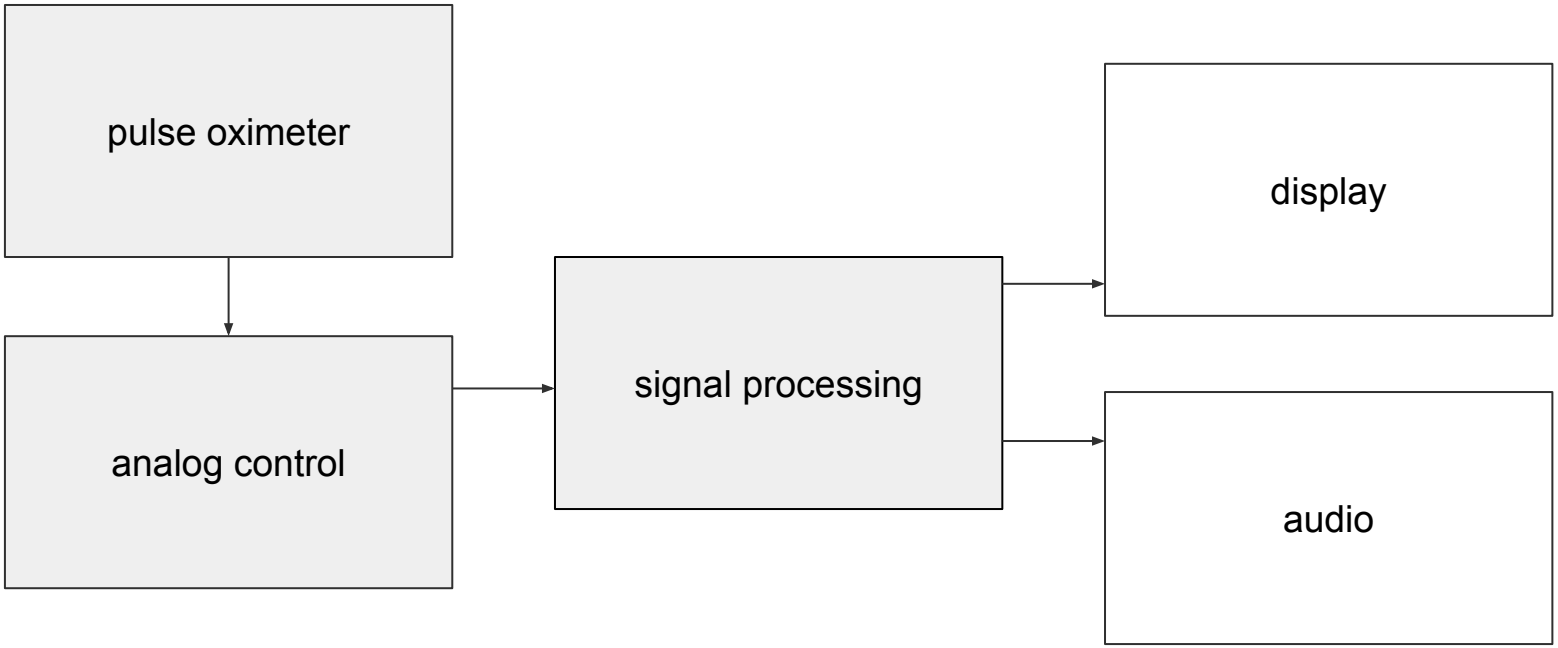

System at a Glance

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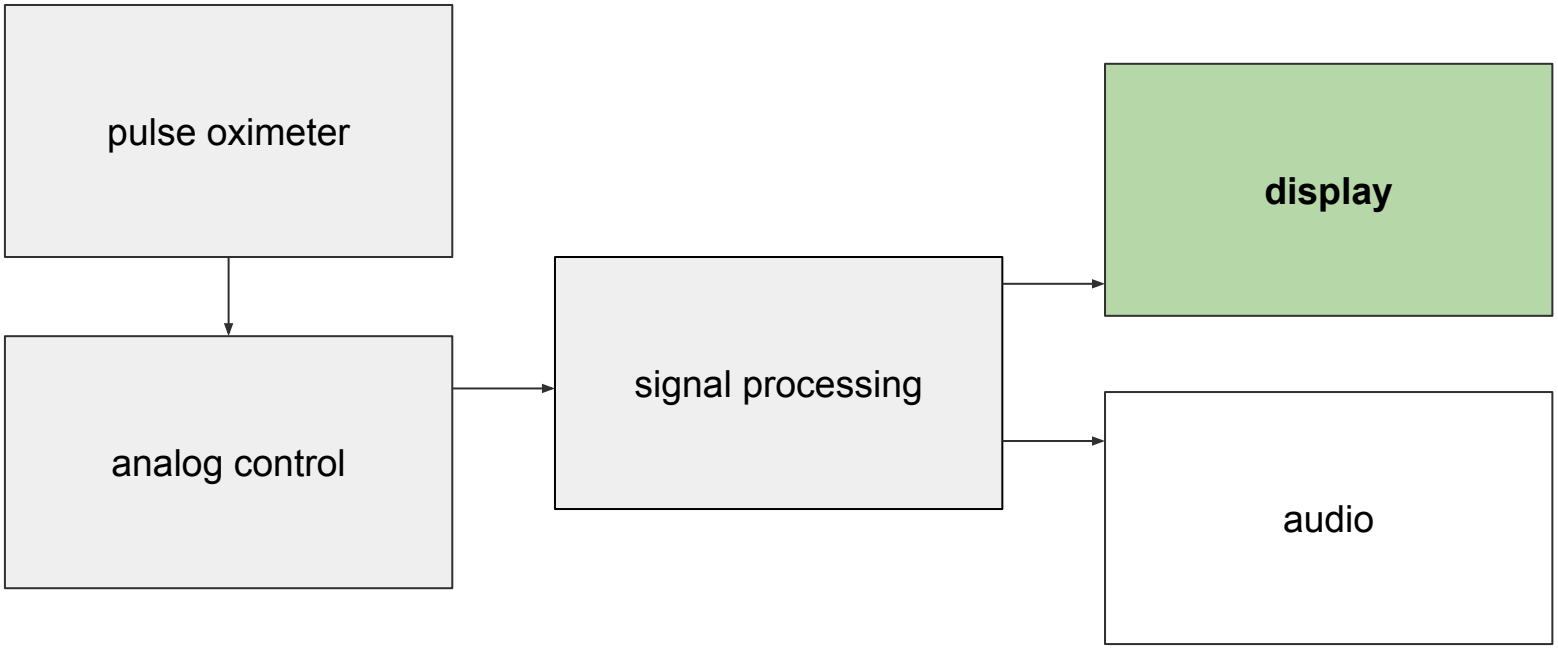

Display Output

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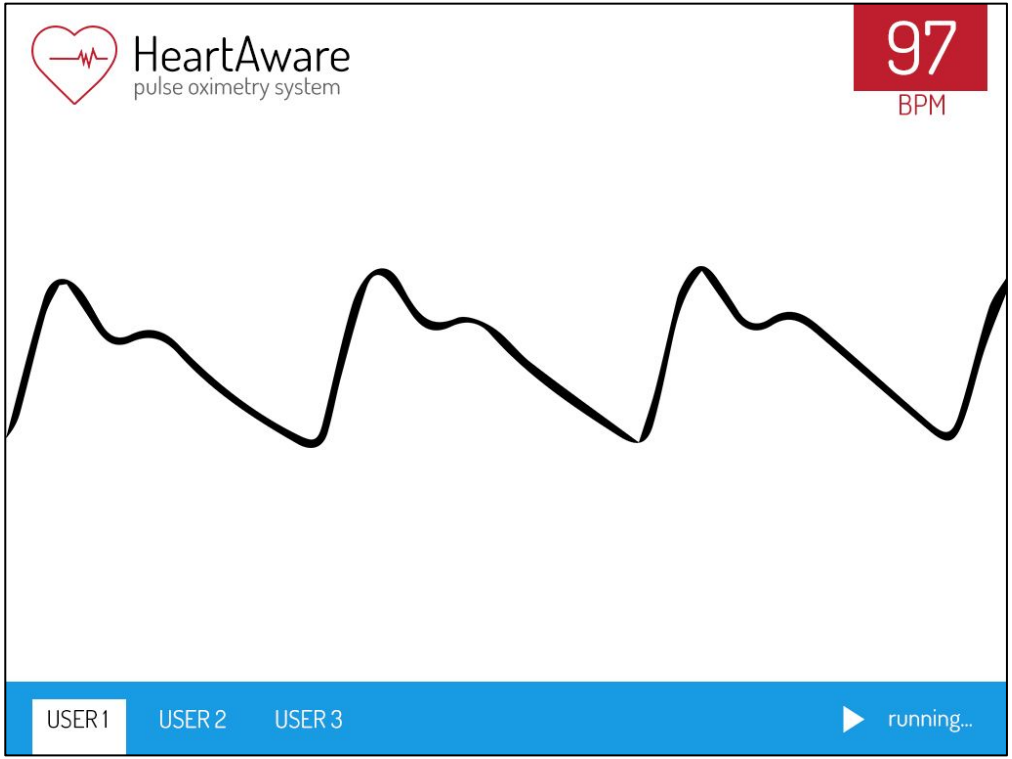
- Current heart rate
- Smoothed oxygen saturation waveform



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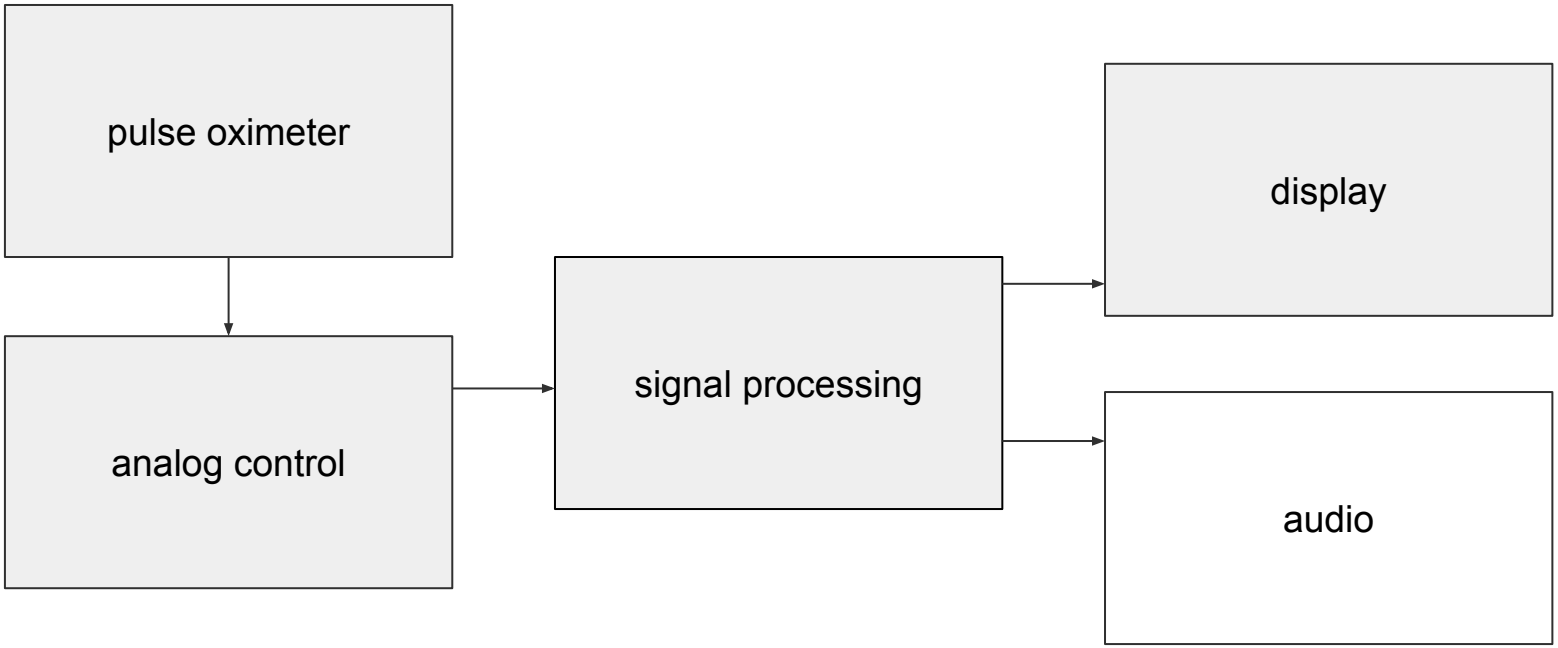

System at a Glance

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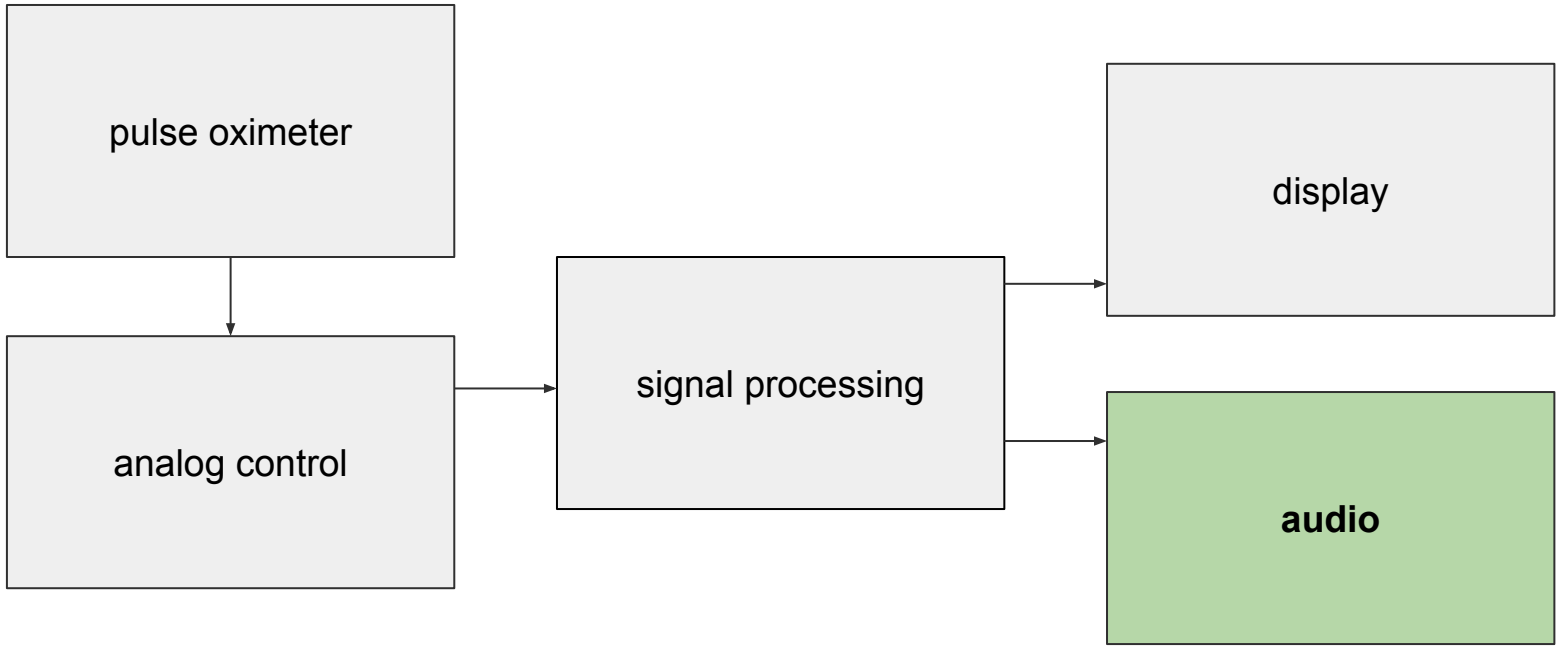

Audio Output

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hr_pulse

beep
440Hz frequency
100ms duration

hr_number

announcer
announces “40-199 beats per minute”

audio mixer
volume controls

SD card
storage of voice samples

System Block Diagram

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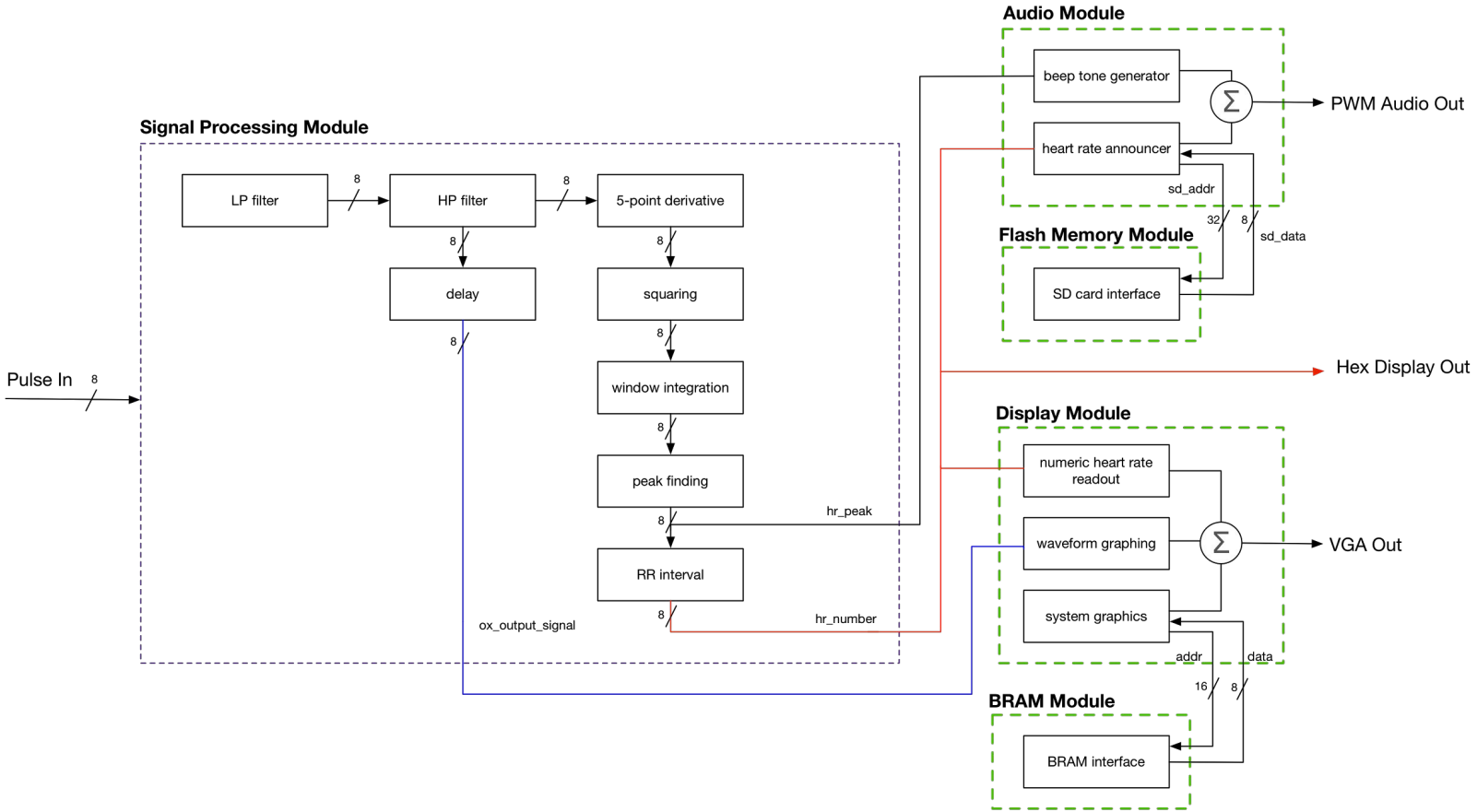

Top Level Finite State Machine

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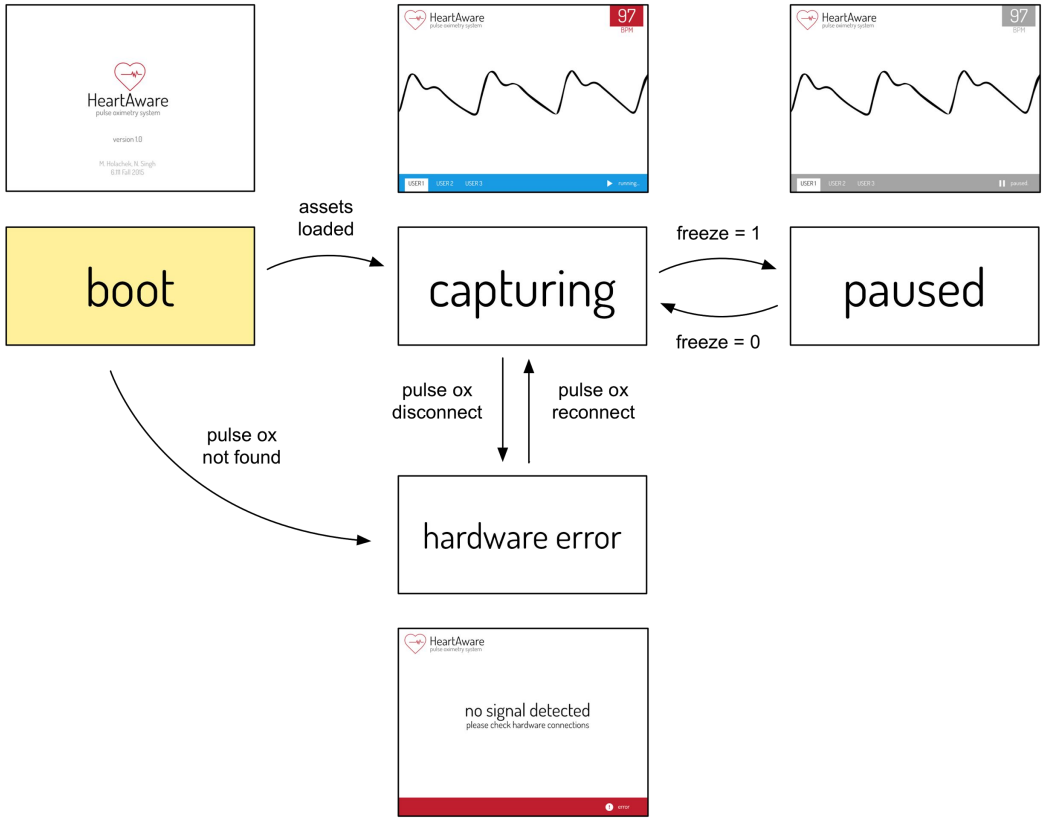

Potential Issues

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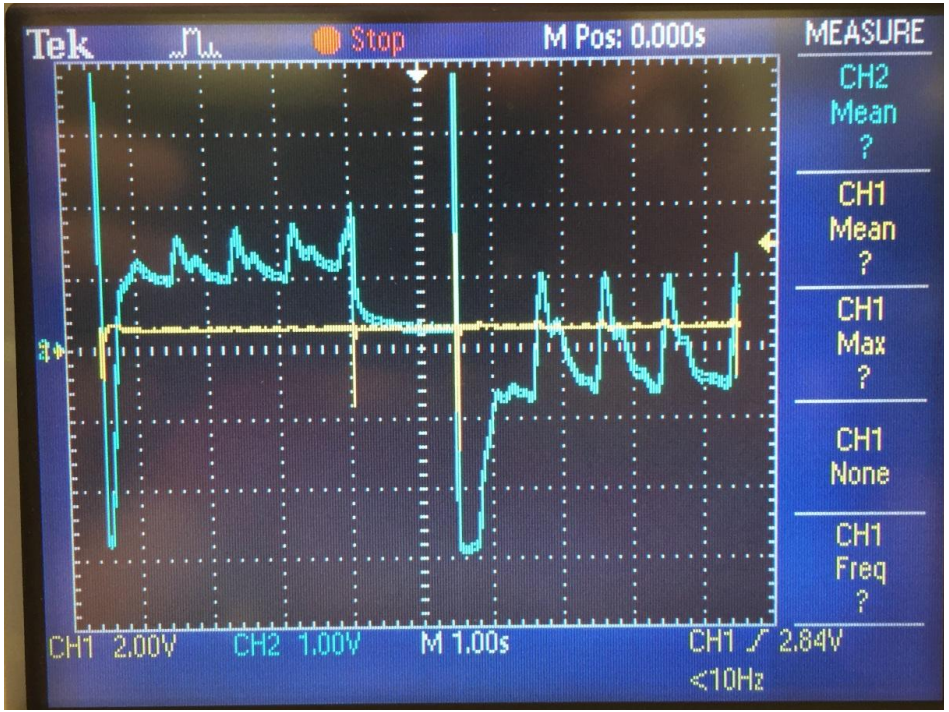
- Signal variations
- RAM sizes / buffering
- Clear VGA graphics



Timeline

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	Week 10/26	Week 11/2	Week 11/9	Week 11/16	Week 11/23	Week 11/30	Week 12/7
Project Proposal & Requirements	Both						
Analog Circuitry & PCB	Michael						
Signal Processing		Nalini					
Display Output			Both				
Audio Output			Michael				
Integration & Testing				Both			
Alternate Filters				Nalini			
UI Improvements, Night Mode						Michael	
Final Testing & Buffer						Both	