SIMPLE HEART RATE MONITOR FOR ANALOG ENTHUSIASTS

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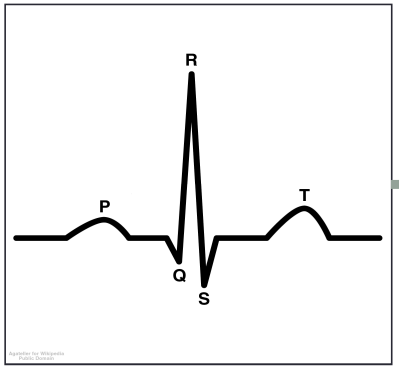
6.101 Project Presentation

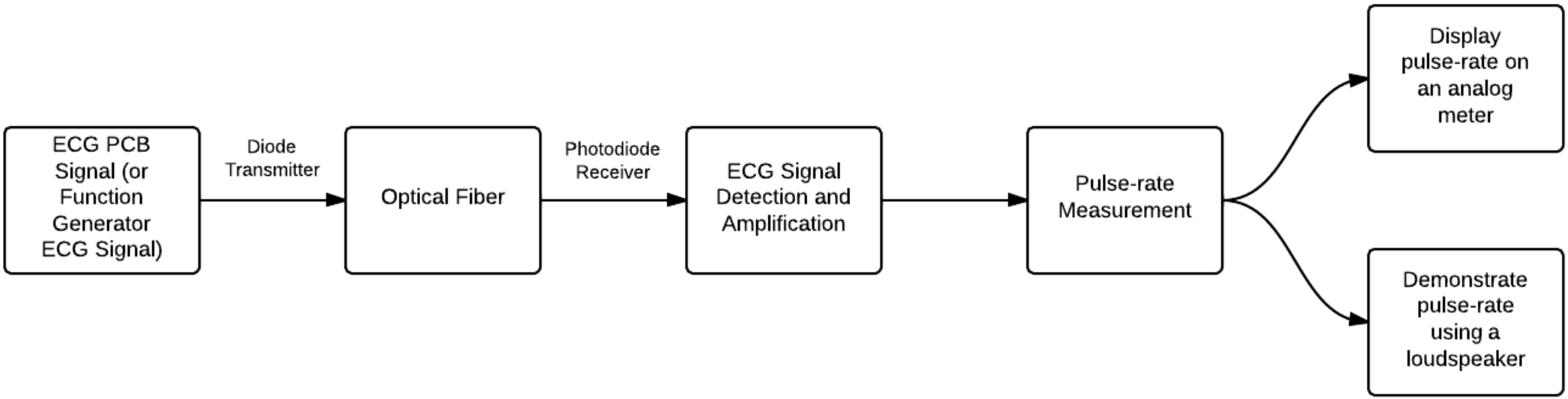
April 15, 2014

ECG Transmission and Display Overview

- What is an ECG?
  - Simple, non-invasive way of measuring the heart's electrical conduction system
- Why did we chose this project?
  - Cheap method of visually and audibly displaying the pulse rate
- How will we transmit and display the ECG signal?
  - Convert electrical signal to an optical signal, transmit along optical fiber, convert back to an electrical signal, amplify, detect pulse rate, and display on analog meter and using a speaker

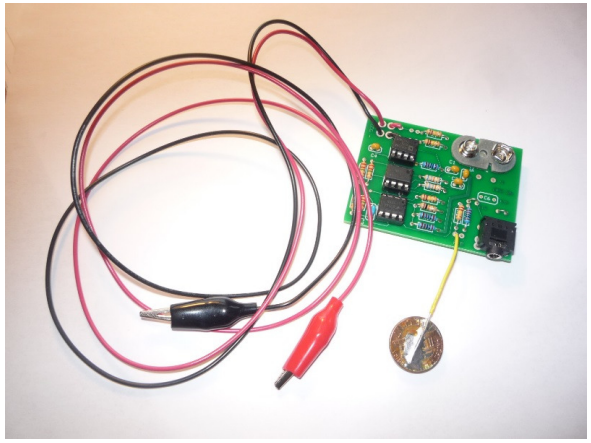


Block Diagram



ECG Signal Generation

- Two methods:
  - PCB made in 6.101 lab 5
  - Function generator
- Signal from ECG board is characterized such that the function generator ECG matches PCB signal as closely as possible



Fiber Optic Transmission

Modulate ECG signal to a carrier signal

Diode transmitter converts electrical signal to optical signal

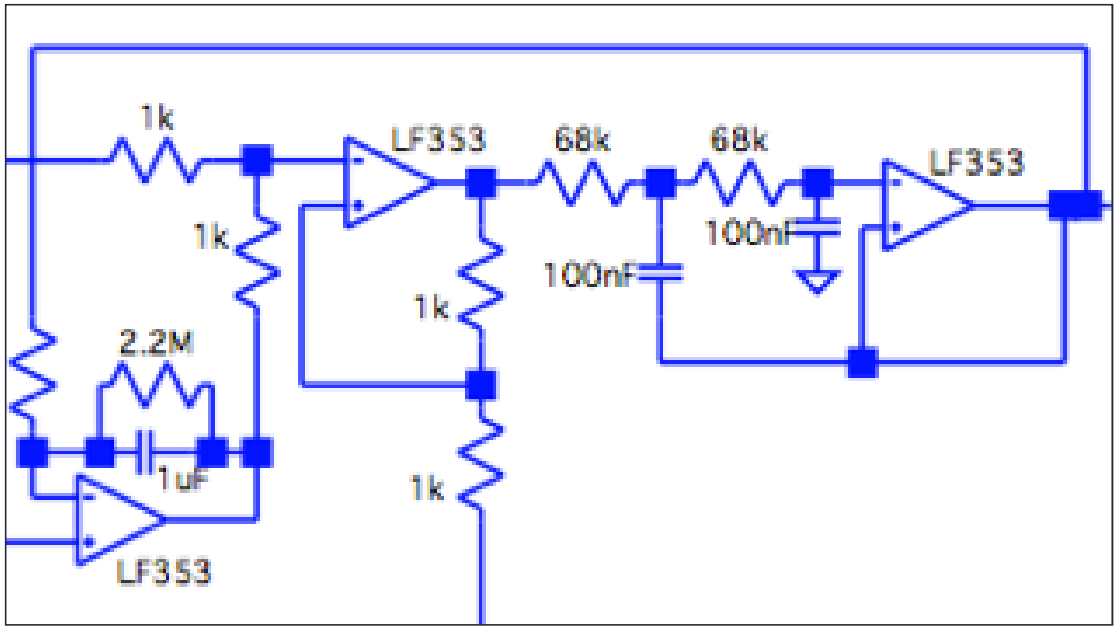
Fiber optic transmits optical signal

Photodiode receiver detects optical signal and converts to electrical signal

Carrier signal demodulated to ECG signal

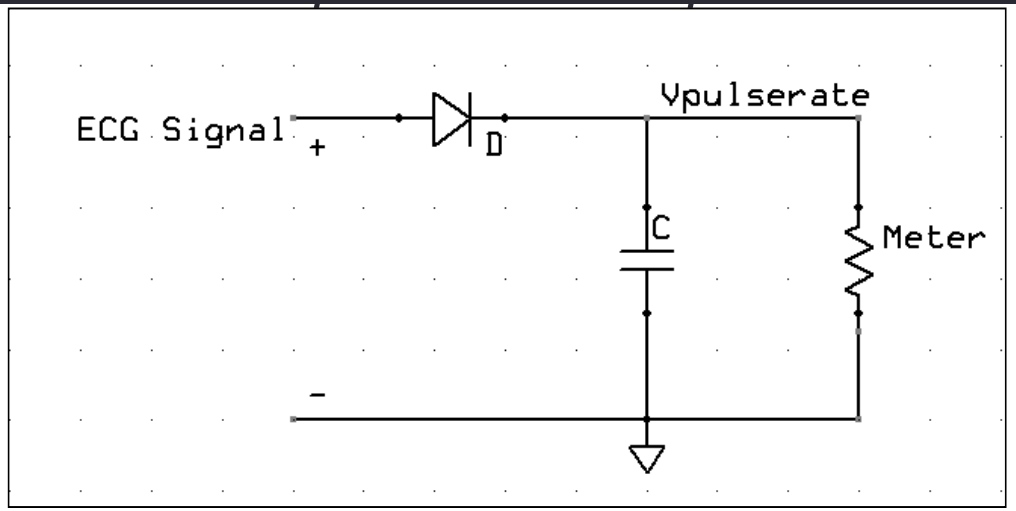
Signal Amplification and Conditioning

ECG signal is amplified → Adjusted for DC offset → Noise is filtered out



Pulse Rate Measurement

- A capacitor is used to measure the pulse rate
- The capacitor charges and discharges at a rate proportional to the pulse rate
- Higher frequencies charge the capacitor to a higher voltage level
- *The voltage across the capacitor corresponds to the pulse rate*

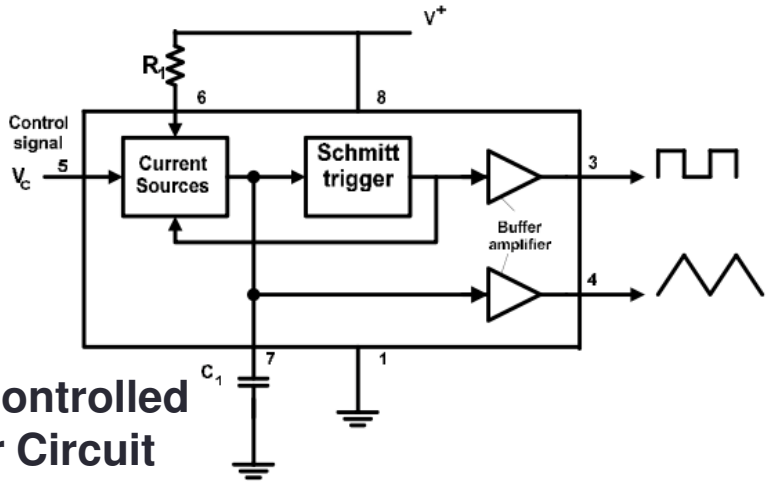


Visual Display

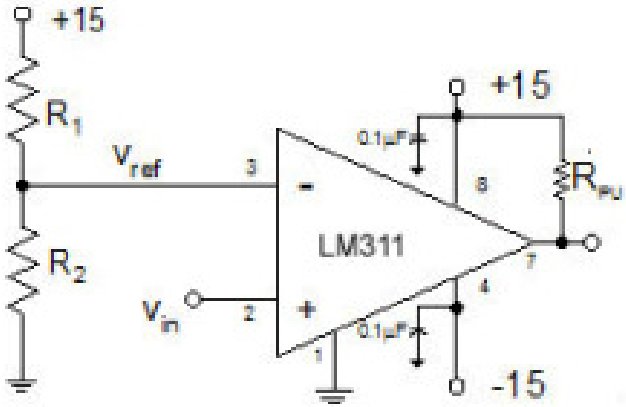
- Heartbeat frequency rate is displayed as a voltage on an analog meter
- Voltage levels are scaled such that the values represent a range of ~30 bpm to ~100 bpm
- Voltages are not linearly related to heartbeat frequency

Audio Display

- Voltage controlled oscillator (VCO) converts a voltage to an oscillation whose frequency is proportional to the voltage amplitude
- Higher pulse rate results in a higher voltage level across the capacitor which corresponds to a higher frequency tone
- Threshold detection circuit also used to produce beeping noise when pulse rate is above or below a certain voltage level
- Speakers produce both the tones of different frequencies and the beeping noise



Voltage Controlled Oscillator Circuit



Threshold Detection Circuit

Timeline

Checkpoint	Date
Completed Circuit Schematic	Wednesday, April 16th
Parts Ordering	Monday, April 14th
Modular Circuit Prototyping	Friday, April 18th
Completed Integration and Testing	Monday, April 21st
PCB Layout	Wednesday, April 23rd
PCB Ordering	Thursday, April 24st (arrives Tuesday, April 29th)
Populated PCB	Friday, May 2nd
Final Testing	Monday, May 5th
Check Off, Project Demo	Tuesday, May 6th - Thursday, May 8th

Possible Extensions

- Adding a second channel to the fiber optic – for example, sending modulated music over the optical fiber cable, demodulating the detected signal and playing back the music over a loudspeaker
- Building our own power supply