

## Abstract

**Develop improvements for a previously designed device** taking into consideration memory storage, circuit design, signal to noise ratio, and compatible software to analyze signal outputs from the device to create an accurate pulse transit time measurment insturment.

## Problem Statement

**Current instruments used in the measurement of** pulse transit time are inefficient for home use. The primary goal will be to optimize an existing setup for use at home. This will be performed by increasing portability, optimizing the performance of the circuit, and improving of the existing software.

## Motivation

The client is interested in studying sleep apnea and its effects in children. The current method of study involves expensive sleep labs, therefore a small portable device needs to be developed.

## Background

**Sleep apnea is a sleep disorder** characterized by pauses lasting long enough so one or more breaths are missed, occuring repeatedly throughout sleep. The pauses can be indirectly measured by pulse transit time; the time it takes for the pulse pressure wave to get from the heart to the finger.

# Pulse Transit Time Measuring Device J. Baran, K. Chen, W. Stanford, M. Yarmarkovich

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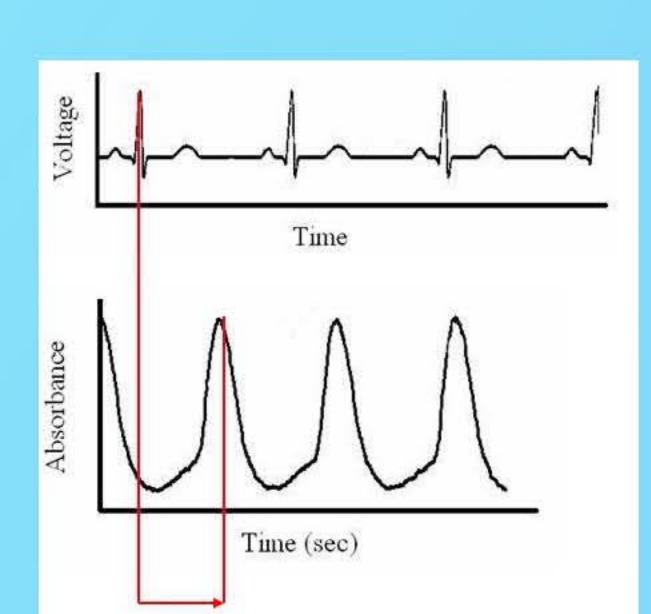


Figure 1: Pulse transit time (PTT) - The time difference between and ECG wave and finger plethysmograph wave. The wave on the top shows an ECG wave, and the wave below shows the finger plethysmograph wave. PTT is equal to the time difference between the peaks of the graphs.

home.

transit time.

## Previous Design

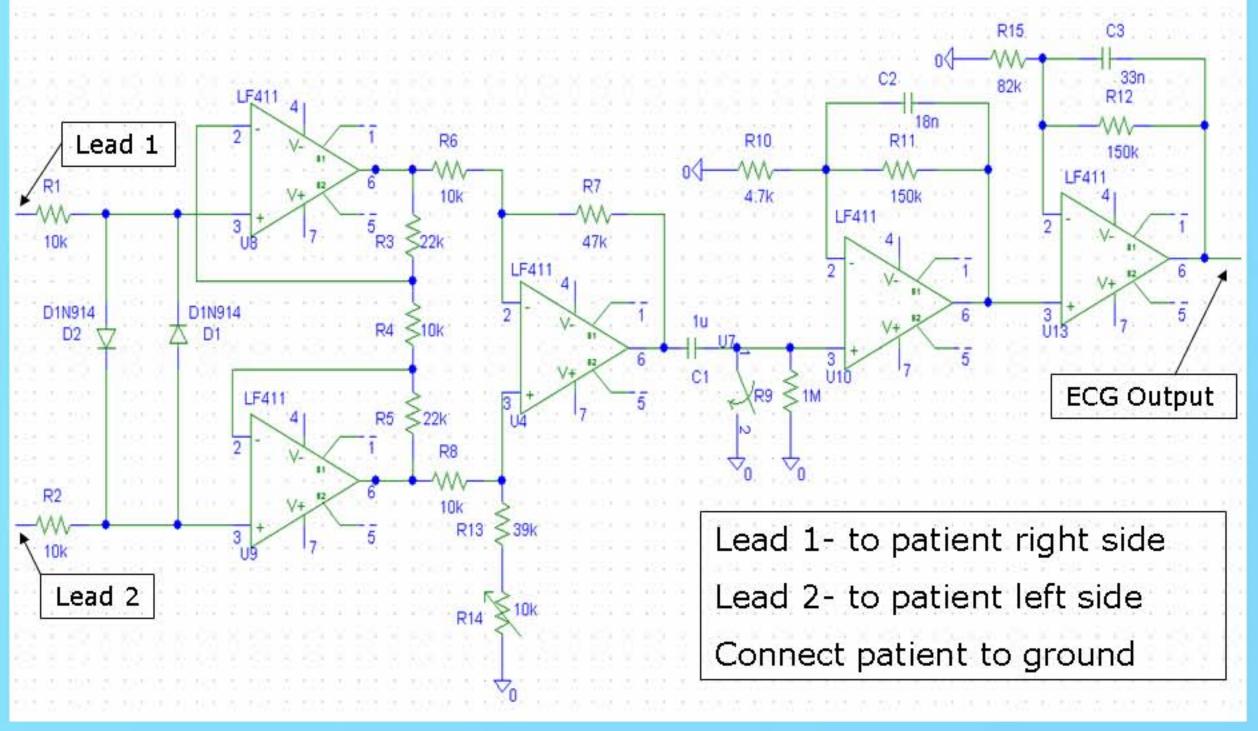




Figure 3: The set up of the previous and new device. Note the elimination of the lapto from the previous design. The laptop is replaced by a data logger that immediately stores the data output from the circuit.

LabVIEW tutorials. (2005). Retrieved October 5, 2006 from Carlson, S. (2000, The amateur scientist: Home is where the ECG is. http://www.upscale.utoronto.ca/GeneralInterest/LabView.html Scientific American Labview. (2006). Retrieved October 1, 2006 from http://en.wikipedia.org/wiki/LabVIEW Magazine, (June) 3. Retrieved October 17, 2006, Pagani J, Pia M, Calcagnini G, Alterio A, Ambrosio R, Censi F, Ronchetti R. 2003. Circuit ED. (2006). Retrieved October 22, 2006 from Pulse Transit Time as Measure of Inspiratory Effort in Children. Chest. http://www.circuit-ed.com/ Electrocardiogram (ECG) project for DrDaq. (2006). Retrieved October 12, 124:1487-1493. PSoCDeveloper. (2006). Retrieved October 20, 2006 from 2006 from http://www.picotech.com/applications/ecg.html#cct http://www.psocdeveloper.com/news.html Information from your family doctor: Sleep apnea.(2005). American Family Sleep apnea. (2006). Retrieved October 9, 2006 from http://en.wikipedia.org/wiki/Sleep\_apnea Physician, Smith R, Argod J, Pépin JL, Lévy P. 1999. Pulse Transit Time: an appraisal of potential 72(7), 1319-1320. Retrieved October 15, 2006, from the Proquest clinical applications. Thorax. 54:452-458. database Karas, A., Hondl, B., Olson, M., & Cohen, Z. (2005). Measurement of pulse transit time. Unpublished manuscript. Retrieved September 25, 2006,

Katz E, Lutz J, Black C, Marcus C. 2003. Pulse Transit Time as a Measure of Arousal and Respiratory Effort in Children with Sleep-Disordered Breathing. Pediatr

53:580-588.

## Design Criteria

## The device must be small, portable, and capable to be used at

Software that processes the digital signals and calculate the pulse

## The circuit must be optimized to increase the signal to noise ratio.

## New Design

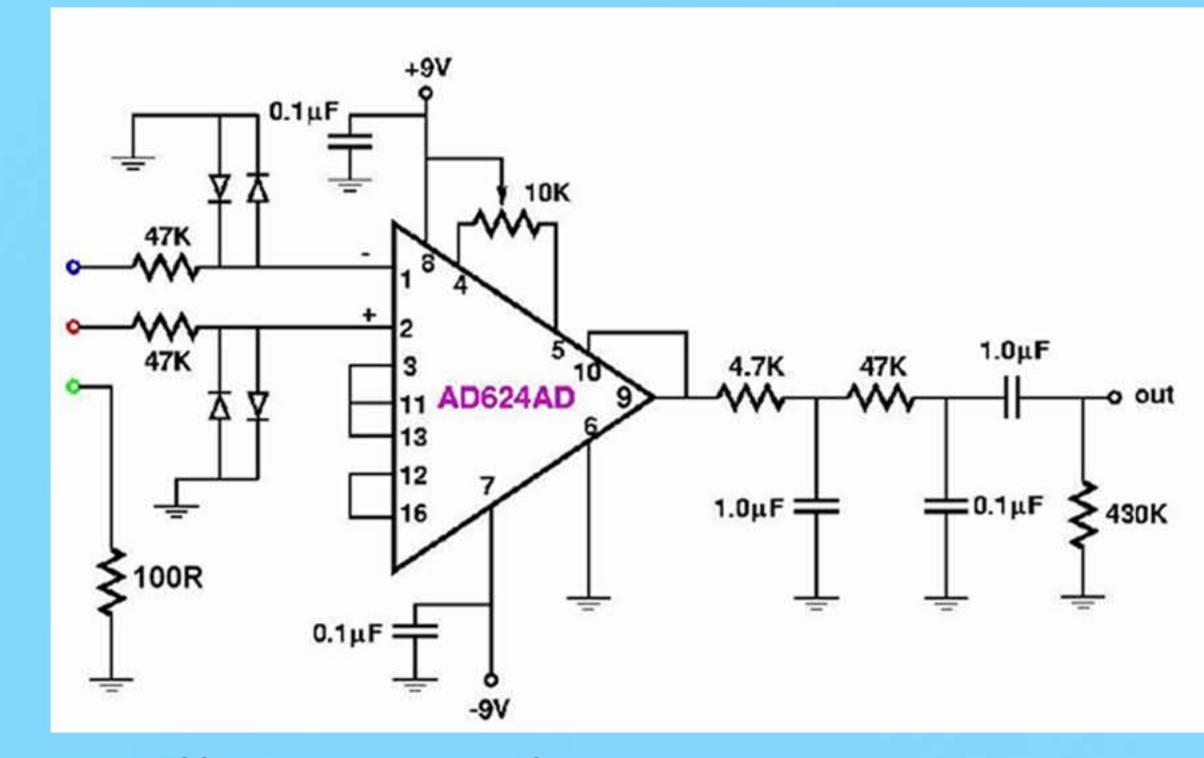
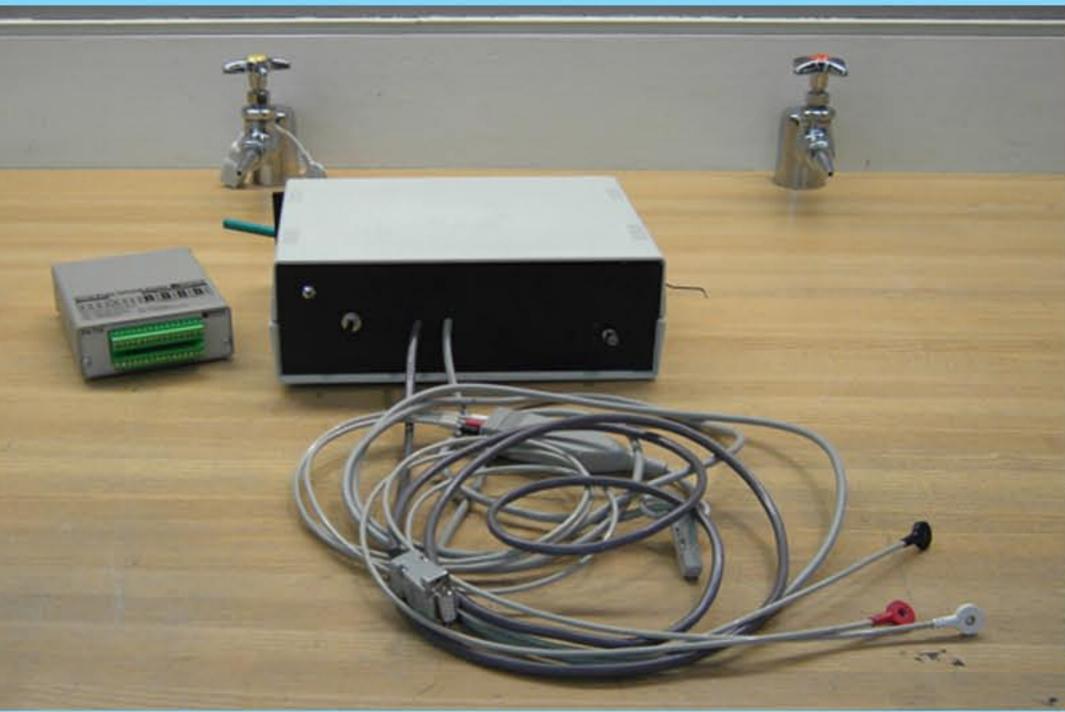
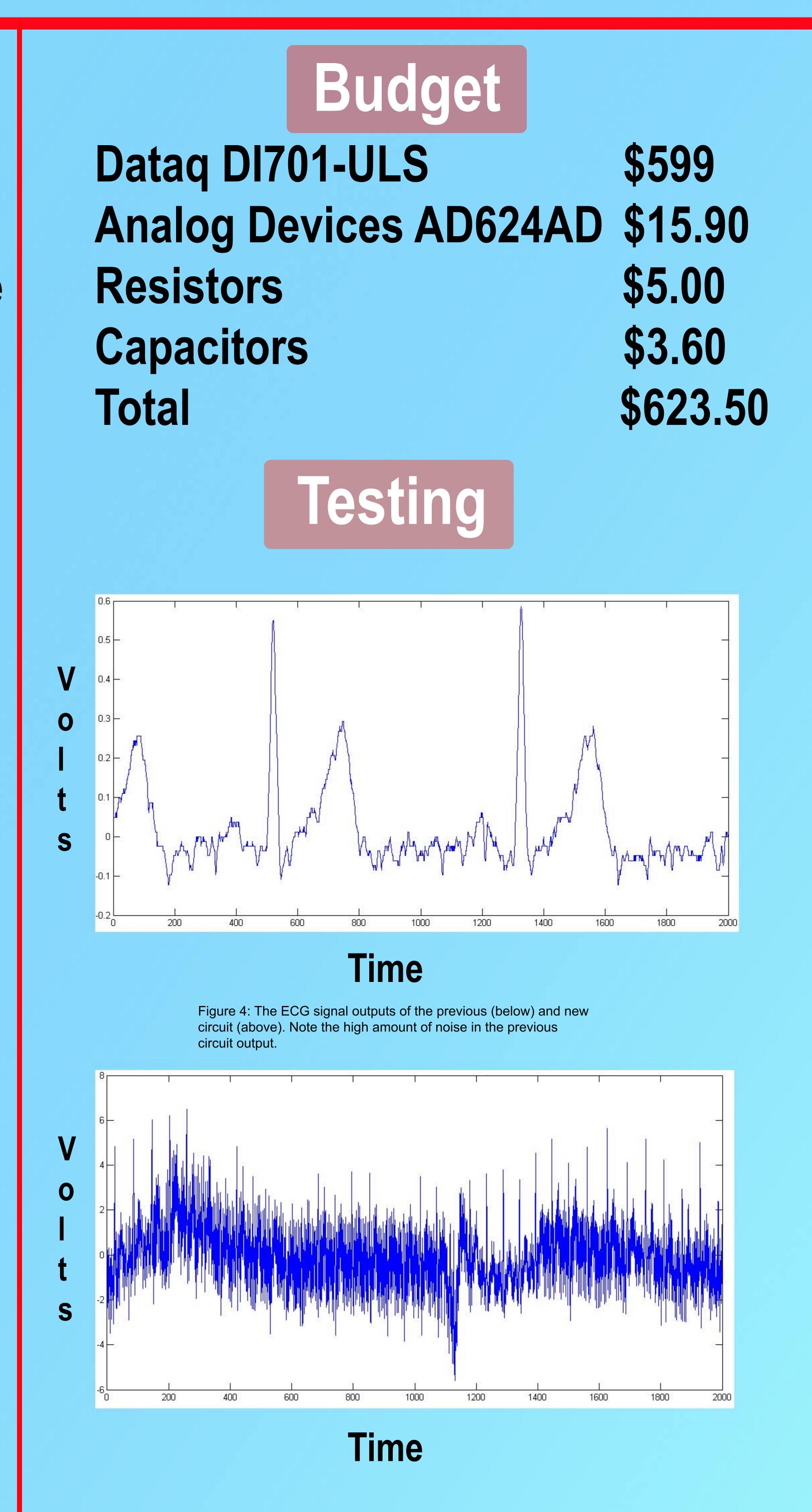


Figure 2: The previous ECG schematic compared with the new ECG schematic. Note the use of an instrumentation amplifier in the new ECG schematic compared with operation amplifiers in the old



## References





Future Work

Design printed circuit board Continue to improve software Assemble device into one unit