Measuring Exercise Systolic BP Using Finger Laser Doppler in Kids

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Outline

- Introduction
- Problem Statement
- Background Information
- Current Methods
- Product Design Specifications
- Design Alternatives
- Design Matrix
- Future Work
- Acknowledgements and References

Introduction

Dr. Allen Wilson, Pediatric Cardiology

- Conducts treadmill stress testing for children
- Measures blood pressure (BP) with auscultatory cuff
- Has difficulty hearing peak systolic sound
- currently uses Doppler laser technology

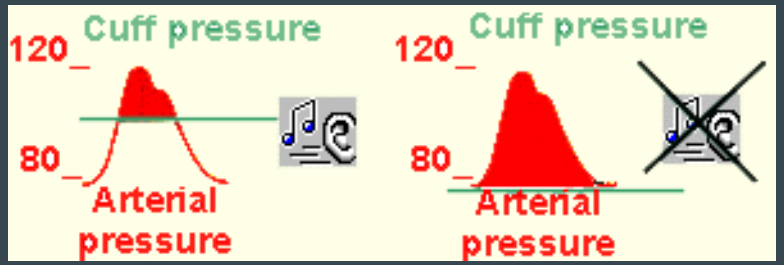


Figure 1-Visual representation of BP [1]

Figure 2- GE Treadmill, T2100 Series [2]

Problem Statement

What are the key problems to identify?

- Peak systolic sound is difficult to hear
- Doppler is extremely **motion** sensitive, **inaccurate signal**

What is the focus of this project?

- Fabricating **motion** stabilizing hand device for thumb
- Will also keep Doppler signal **steady**
- Increased **accuracy of BP systolic peak signal**

Background- Treadmill stress testing

- Used to test for arrhythmias
- **Definition:** irregular heart rhythms
- Also tests coronary artery disease
- Typically test lasts approximately 12 minutes
- 3 minute intervals, measure BP
- Intensity of test gradually is increased

Figure 3- Typical treadmill stress testing setup [3]

Background Information

Figure 4- MLT1010 Piezo Element Transducer [4]

Current Methods

- Stethoscope/cuff used to listen and read on adults
- Difficulty hearing cues in children

Measuring Blood Pressure with Oscilloscope

- Stethoscope no longer used
- Doppler laser that measures blood velocity incorporated
- Cues to start reading Pressure on cuff taken from waveform instead

Design specifications

Client requirements

- The MLT1010 Piezoelectric Pulse Transducer is the preferred laser Doppler for usage
- Adjustable for ages/hand sizes of 6-12 yr olds
- Device must provide oscilloscope with steady signal
- Device should not interfere with stress treadmill testing

Design Specifications Cont.

- Resist movement of probe while pediatric patients are in motion
- Garment should not restrict blood flow or irritate the user
- Device will be used repeatedly for lengths of an hour or more
- Should be manufactured within a budget of $1000

Design 1: Splint

- Mechanical support of thumb
- Velcro adjustable for size
- Probe on thumb

Figure 5- Splint Design [5]

Design 2: Splint with Filter

- Mechanical support of thumb
- Velcro adjustable for size
- Probe on thumb
- Added bandpass filter

Figure 6- Splint design with added bandpass filter [5]

Design 3: Desk with Filter

- 33 cm x 25 cm x 2 cm
- Locking pin mechanism allows for horizontal movement
- Laminate surface
- Three Velcro straps
- Bandpass filter

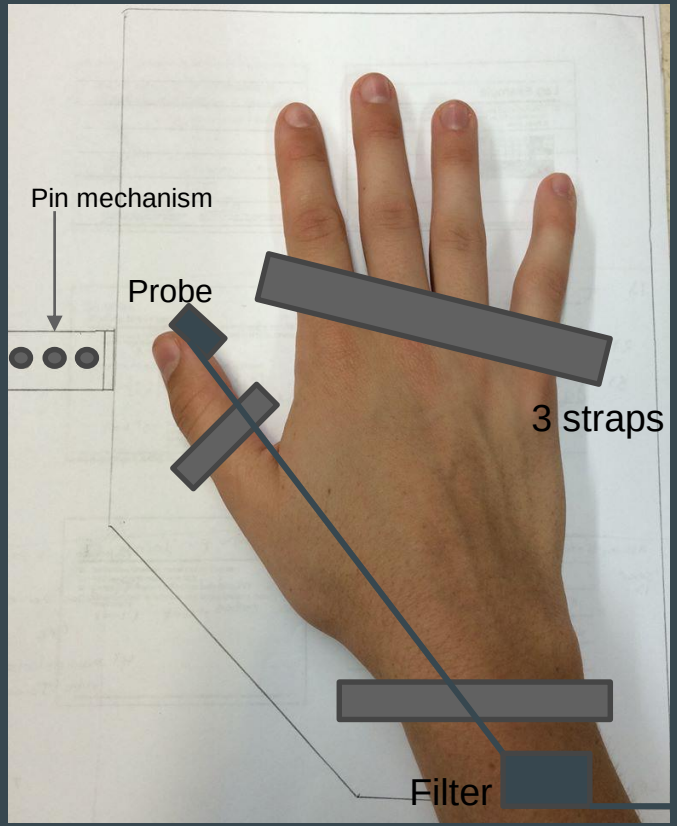
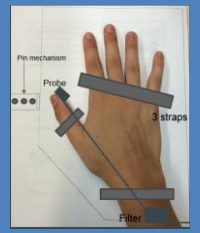


Figure 7- Desk design with added bandpass filter [5]

Design Matrix

Criteria	Design 1: Splint		Design 2: Splint with Filter		Design 3: Desk with Filter	
						
Accuracy of Signal (25)	(2/5)	10	(4/5)	20	(5/5)	25
Feasibility (20)	(3/5)	12	(2/5)	8	(4/5)	16
Ease of Use (20)	(3/5)	12	(3/5)	12	(4/5)	16
Safety (15)	(5/5)	15	(4/5)	12	(3/5)	6
Comfort (10)	(4/5)	8	(4/5)	8	(3/5)	6
Cost (10)	(5/5)	10	(4/5)	8	(3/5)	6
TOTAL		67		68		76

Future Work

- Order respective materials for Desk with Filter design
- Begin fabrication of Desk and design of Bandpass Filter
- Conduct trials of device to ensure accuracy of Blood Pressure waveform

Acknowledgements

- Dr. Allen Wilson
- Dr. Thompson
- Department of Biomedical Engineering (UW-Madison)

References

[1] Welcome to the McGill University Physiology. Virtual Lab (n.d). Retrieved September 10, 2015

[2] GE Treadmill: Service Manual. (2012, May 1). Retrieved September 16, 2015.

[3] Treadmill stress test. (2002, March 3). Retrieved September 8, 2015.

[4] Pulse transducers. (2014). Retrieved September 20, 2015.

[5] DonJoy elastic Wrist Splint. (n.d.). Retrieved September 25, 2015.

Questions?