Arterial Actuator

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Client: Prof. John Webster

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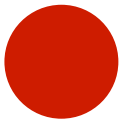
Outline

- Problem statement
- Background information
  - Blood pressure & arterial stiffness
  - Current methods
- Proposed system components
- Preliminary data
- Proposed designs; design matrices
  - Actuator and overall system
- Future Work

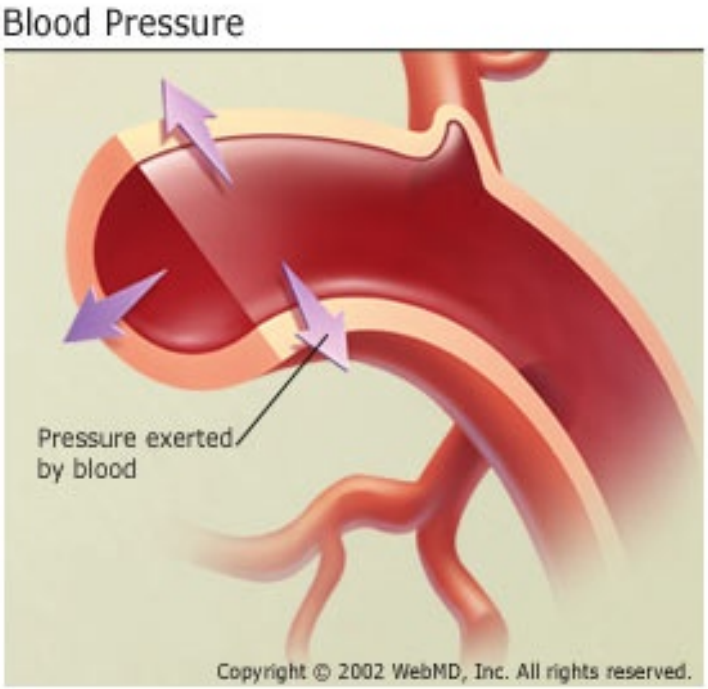
Problem Statement

- Cardiovascular disease is a top killer
- Blood pressure and arterial stiffness are indicators of cardiovascular health
- Long-term goal: design a system that quantitatively measures blood pressure and arterial stiffness on a single artery
- Semester goals:
  - Design an actuating mechanism
  - Assemble the system comprised of an ultrasound probe, a pressure sensor, and the actuator



Blood Pressure & Arterial Stiffness

- Blood pressure is the force of blood pushing against walls of the arteries
  - Systolic/diastolic
- Arterial stiffness is the elasticity of artery walls
  - Arteries stiffen as a result of age, atherosclerosis, and fraying of elastic fibers



Current Methods

- Auscultatory method
  - Mercury Sphygmomanometer & Korotkoff Sound Technique
- Oscillometric method
  - Electronic transducer records oscillations

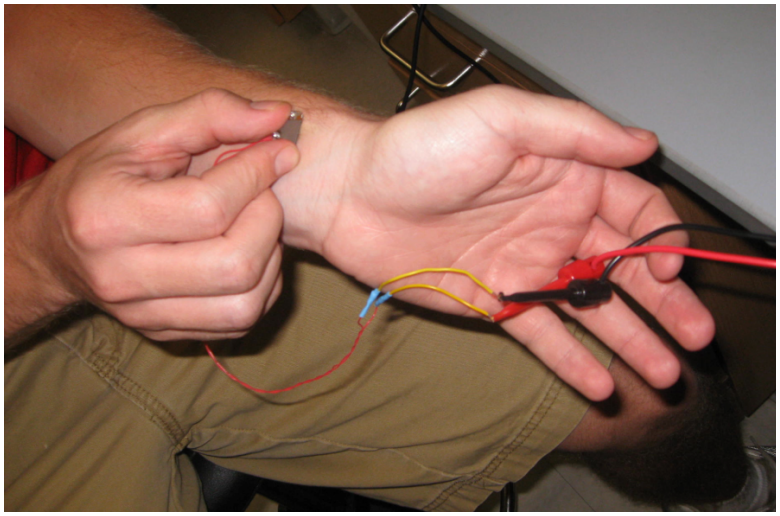
- Arterial stiffness is measured via pulse wave velocity (PWV)
  - PWV is measured between carotid and femoral arteries

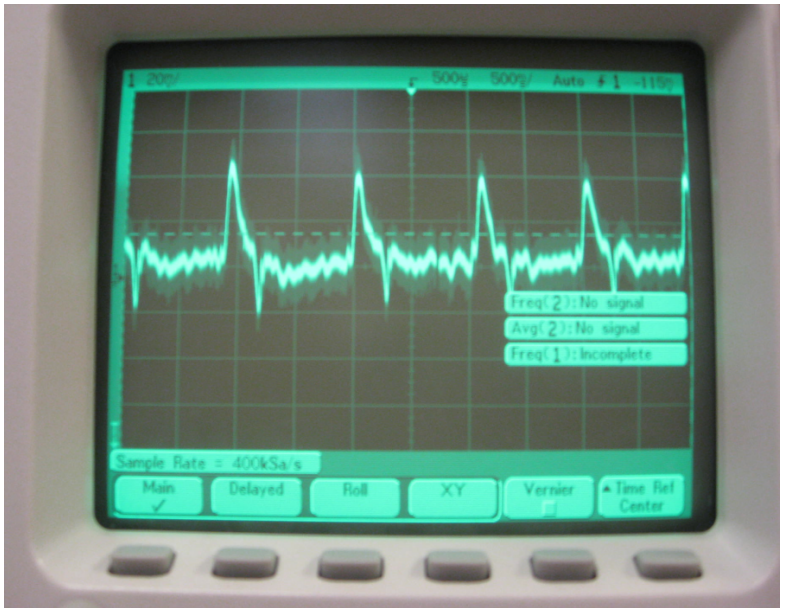
Proposed System Components

- Ultrasound
  - Used to find exact artery location
  - Determine artery compression
- Pressure sensor
  - Measures blood pressure
  - Outputs pressure waveform
- Actuator
  - Induces a step input
  - Pressure sensor measures artery response
    - Evaluated to determine arterial stiffness

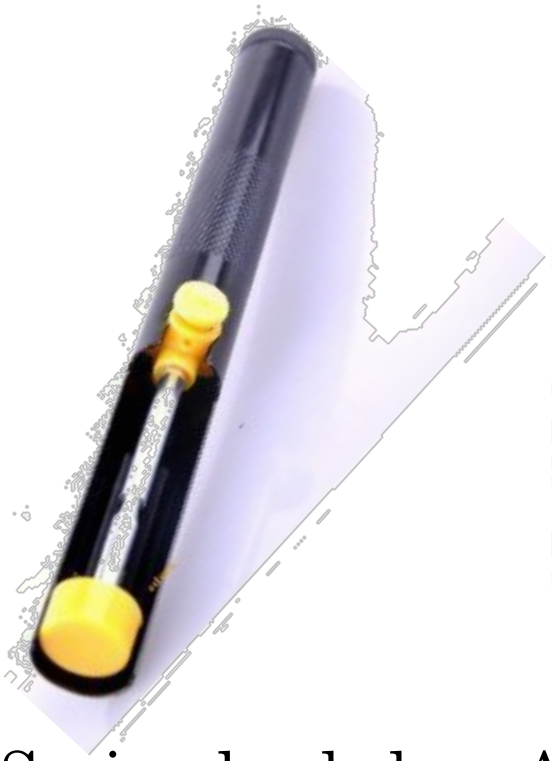
Preliminary Data

- Connected piezoelectric sensor to an oscilloscope
- Found pulse waveform using sensor
- Measured brachial, radial, and carotid arteries

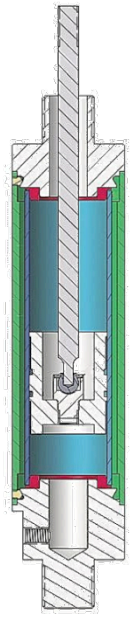




Proposed Designs – Actuator

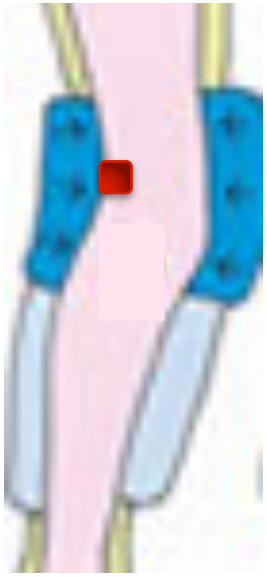


- Spring-loaded



- Air-loaded

- Air jet



- Protrusion in cuff

References: laptopcompareprice.com, directindustry.com, made-in-china.com,drlife.co.uk

Proposed Designs – Overall System

- Portable brace
- Mounted sleeve
- Surface strap

References: vqorthocare.com, elderluxe.com, cnmonline.co.uk

Design Matrix – Actuator

Weight	Criteria	Spring-Loaded	Air-Loaded	Air Jet	Protrusion in Cuff
30	Performance	24	28	14	14
20	Adjustability	12	**17**	**17**	15
20	Patient Comfort	13	13	**17**	14
12	Ease of Fabrication	9	8	11	11
10	Durability	**7**	6	9	8
8	Size	6	5	5	**7**
100	**Total**	**71**	**77**	**73**	**69**

Design Matrix – Overall System

Weight	Criteria	Portable Brace	Mounted Sleeve	Surface Strap
30	Patient Comfort	24	21	15
20	Stability	10	18	16
20	Ease of Fabrication	17	16	19
20	Ease of Clinical Use	18	16	16
10	Aesthetics	6	7	5
100	**Total**	**75**	**78**	**71**

Future Work

- Order materials:
  - Piezoresistive pressure sensor
  - Actuator components
  - Raw system components
- Ensure functionality of ultrasound and sensor
- Test actuating mechanisms
- Assemble components
- Test entire system

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