Low-cost Spirometer

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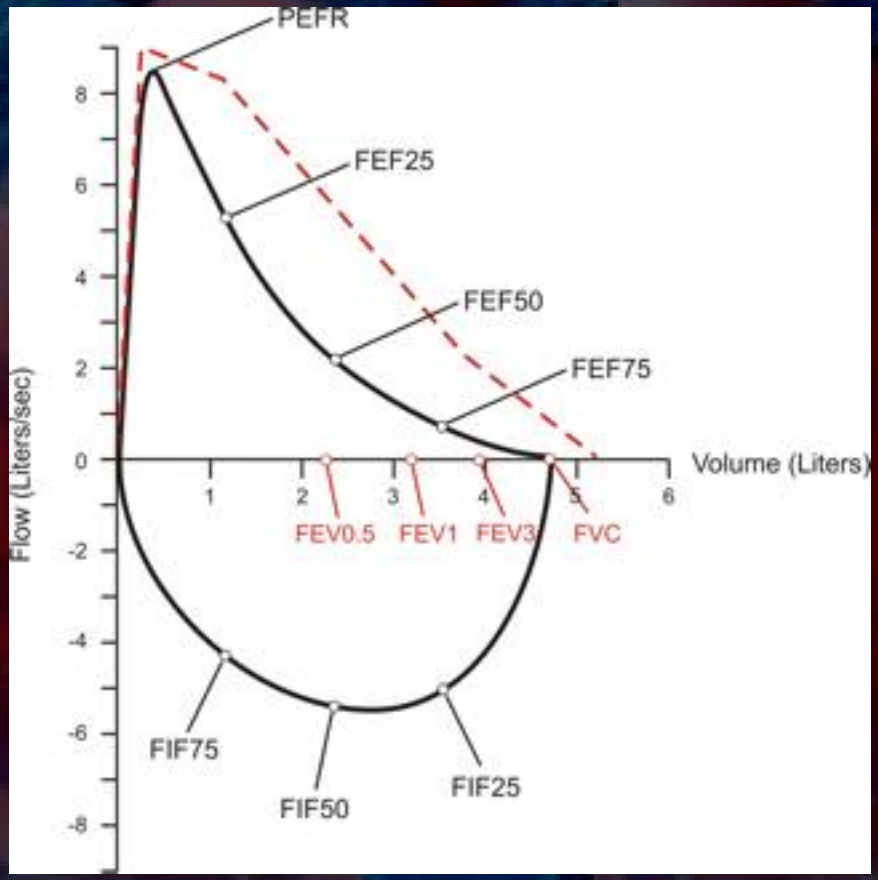
Client: David Van Sickle, PhD

Background

- Common tool for COPD diagnosis
  - Fourth leading cause of death in the world
  - 600 million diagnosed worldwide
  - Many have no treatment available [1]
- Drug efficacy, lung growth and aging [2]

Data Display and Use



Spirogram of the flow volume loop [3]

Problem Statement

- Develop a low-cost, reliable spirometer
  - Affordable in developing nations
  - Standardized A/V coaching for patient
  - Usable without trained technician
  - Connect to computer via USB
  - Evaluate quality of maneuver

Design Constraints

- Measure air volumes up to 8 L
- Accurate function in various conditions
- Durable and portable
- Only factory-set calibration
- Easy to disinfect
- Universal interface, standardized coaching
- Cost under $50

Current Devices

- SDI Diagnostics Spirolab2
  - $2395
- MicroDirect SpiroUSB
  - $1419.55
- spirov Spirometer
  - $195

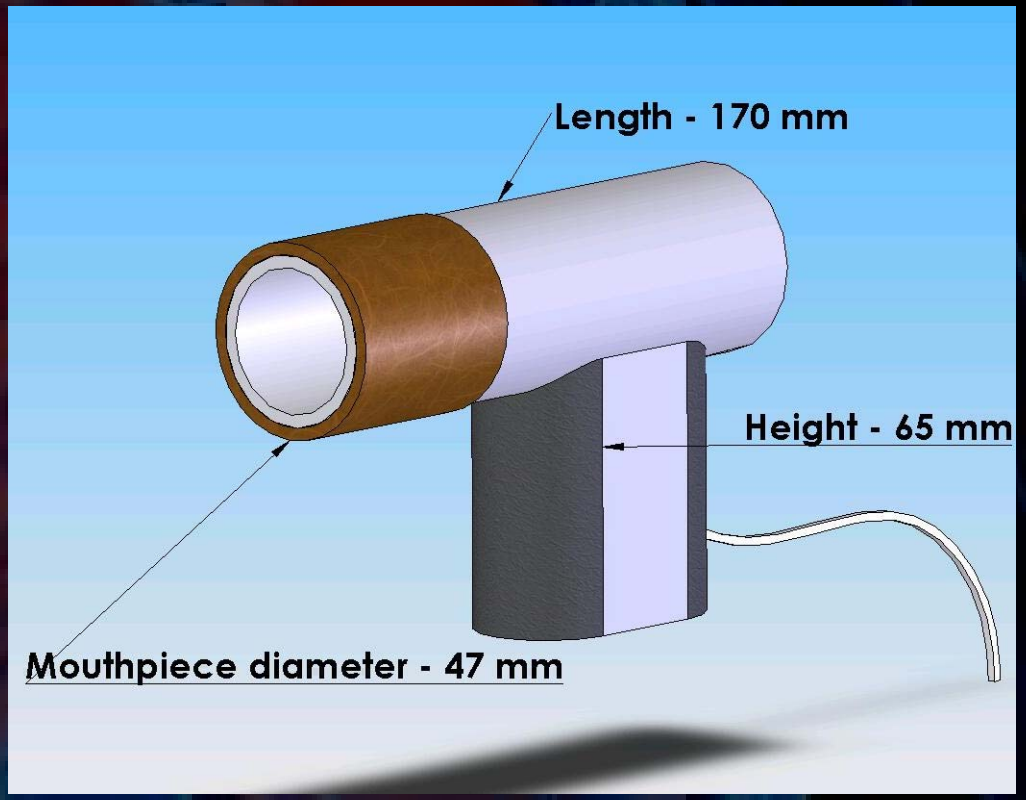
SDI Diagnostics [4]

MicroDirect SpiroUSB [5]

spiro√ Spirometer [6]

Design 1: Pressure sensor

- Pros
  - Portable
  - Manufacturing cost
  - Ergonomics
  - Calibration
- Cons
  - Operating cost



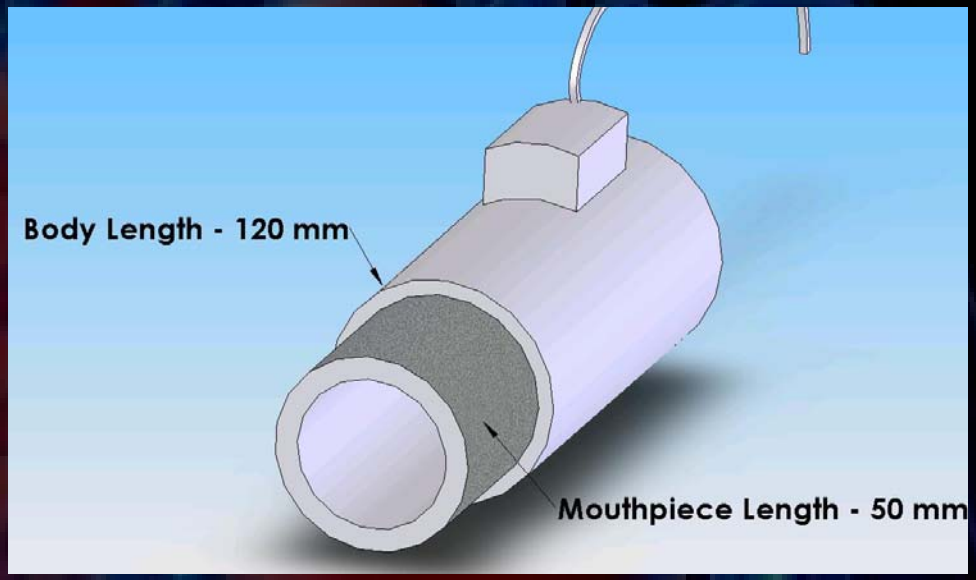
Design 2: Volume Sensor

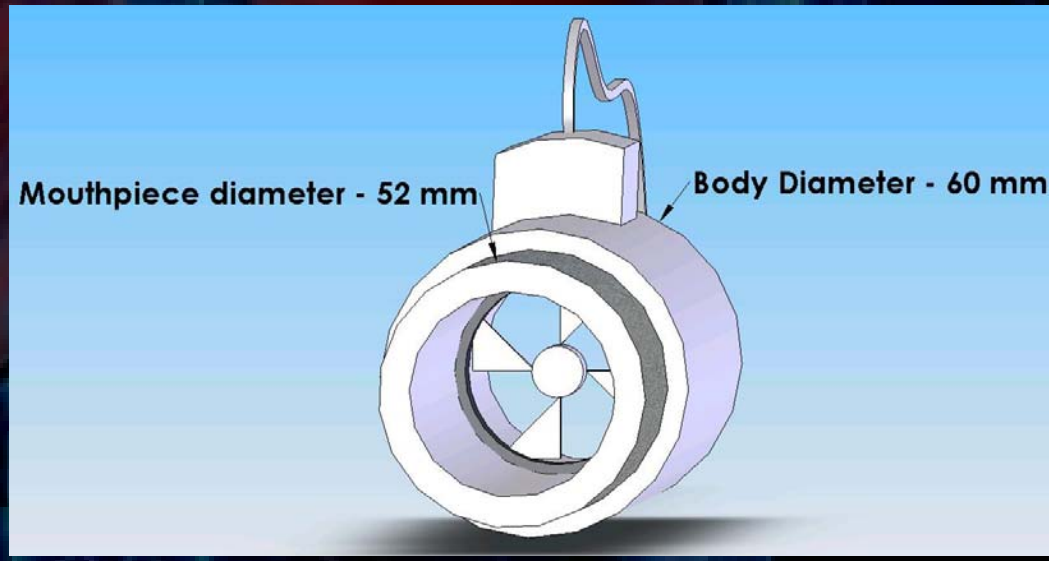
- Pros
  - Operating Cost
  - Simple design
  - Direct measurement
- Cons
  - Portability
  - Reliability

Volume-based spirometer.
Size: 30″H x 18″L x 18″W, 9 L capacity. [7]

Design 3: Anemometer

- Pros
  - Portability
  - Direct flow measurement
- Cons
  - Durability
  - High maintenance cost





Common to all designs

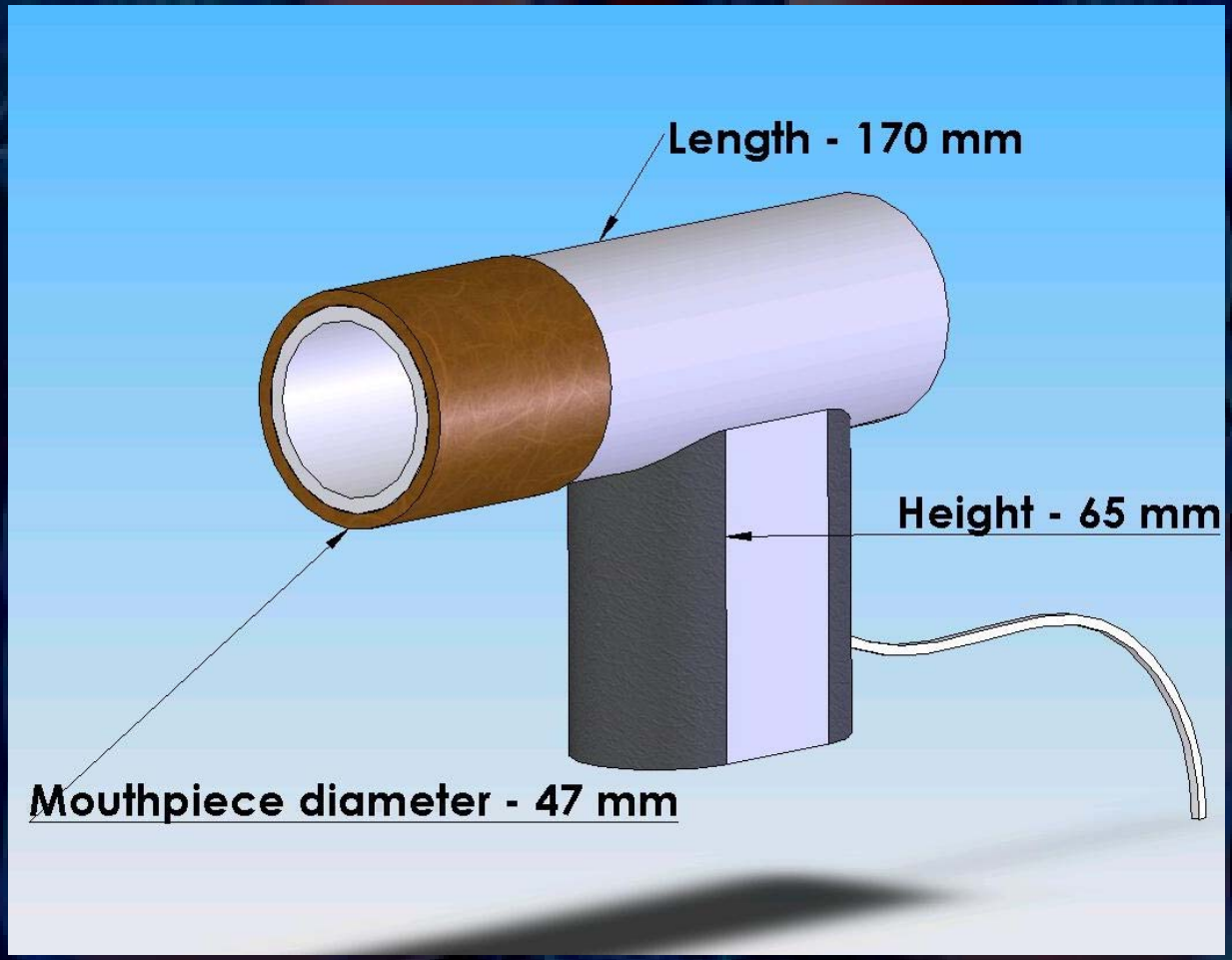
- Analog → Digital conversion
- Signal Processing
- Software & Coaching

Subject performing maneuver with technician coaching. [8]

Design Matrix

	Weight	Pressure	Volume	Anemometer
Manufacturing cost	15	10	7	6
Operating cost	15	7	12	8
Functionality	20	15	8	10
Calibration	10	9	7	9
Safety	10	8	6	8
Ergonomics	10	8	6	6
Durability	10	7	5	3
Portability	10	7	2	9
Total	100	71	53	59

Final Design



Future Work

- Order materials
- Build prototype of final design
- Test prototype
- Work on coaching tools

Acknowledgements

- Dr. David Van Sickle
- Professor Mitch Tyler
- Amit Nimunkar
- Jon Baran

Questions?

References

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[8] ConsumerReportsHealth.org. 2009. Chronic obstructive pulmonary disease. <http://www.consumerreports.org/health/treatment-centers/lungs-and-breathing/copd/diagnosis/spirometry.htm>