TEXAS
The University of Texas at Austin

HOME-BASED NON-INVASIVE LUNG COMPLIANCE MONITORING DEVICE

Enable non-invasive measuring of lung compliance to monitor and characterize diseases that alter lungs' mechanical properties.

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PROBLEM STATEMENT

- Over 16 million U.S. adults have lung diseases affecting the pulmonary parenchyma, costing over $52 billion annually[1,2,3].
- **Lung compliance (LC)** measures lung's ability to expand at a given pressure, serving as a key indicator of disorders that alter lung's mechanical properties.

	Common pulmonary parenchymal disorders		
	COPD (Chronic Obstructive Pulmonary Disease)[2, 4]	**ILD (Interstitial Lung Disease)[3,5]**	**RP (Radiation pneumonitis)[6]**
Prevalence/ Incidence	16M (diagnosed) 24M (undiagnosed)	200K	15-40% of thoracic radiotherapy patients
Cost (USD annually)	50B	2B	10M
5-year survival rate (%)	40-70%	56% (Overall) 41% (IPF)[5]	-
ER visits (in the US annually)	1.5M	13.7%-19.4% of cases	-

CURRENT SOLUTION OR ALTERNATIVES

- Current lung compliance measuring tools are either **invasive** or **involve radiation exposure from CT imaging**.
- Clinical Unmet Need: No **non-invasive**, **home-based** solution for regular lung disease monitoring is currently available on the market.

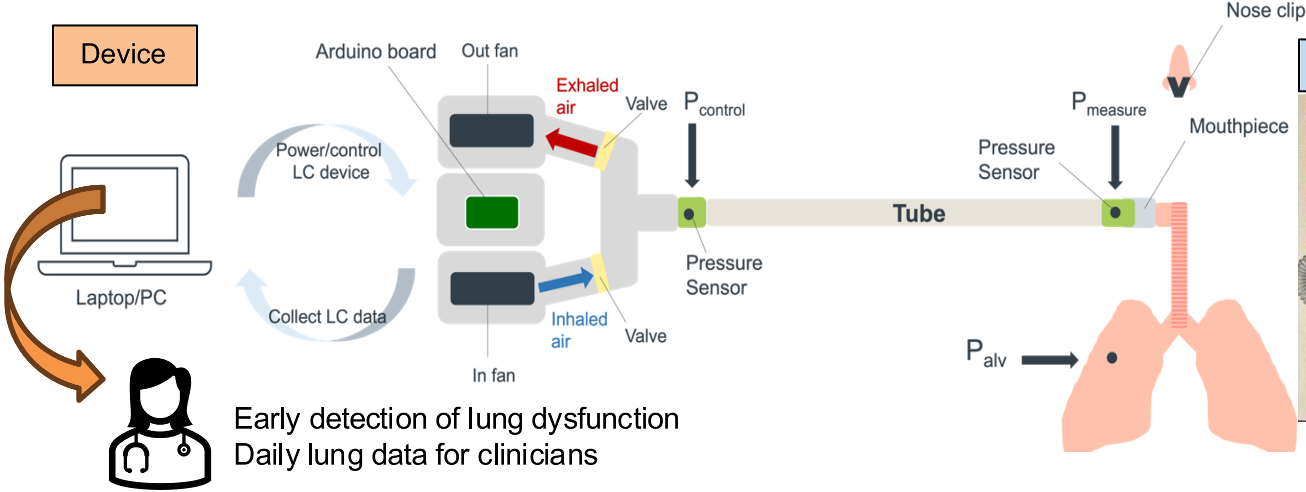
Current LC measuring tools:	**Non-invasive?**	**Precise, consistent pressure control**	**Frequent monitoring**	**One-time setup cost**	**Cost per exam**
Mechanical ventilation[1, 2]		✓		$2.5K – 5K	$1,522
Pleural manometry[2, 3]				N/A	$1,038-1,189 (Thoracentesis)
Esophageal manometry[4]				N/A	$924-1,391
4DCT imaging[5,6]	✓			$300K -3M	$6,773
Our Solution	✓	✓	✓	**$700***	**$ 0.75**

* USD 700 covers the cost of the device and the mouthpiece

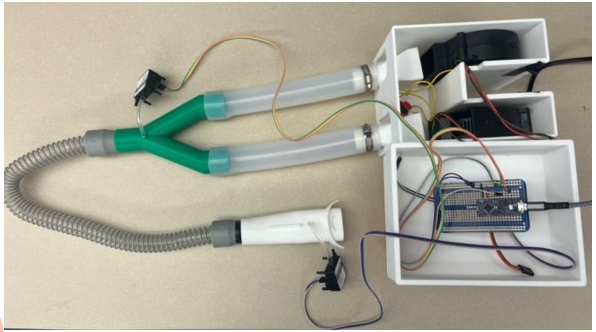
HIGH-LEVEL SOLUTION

- Solution: A **non-invasive** system that calculates lung compliance (LC), an important metric in overall lung health, in an **easy-to-use**, **at-home** package that can be set up and used in minutes.
- Current developmental statue: **Prototyping**
  - Prototype **physical design**
  - Fine-tune **algorithms** for pressure regulation and measurement

Device



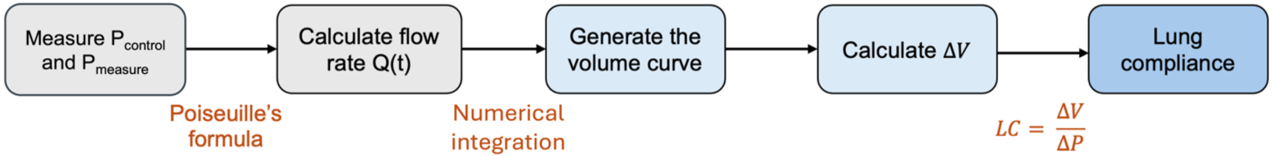
Current prototype



DETAILED SOLUTION

- $LC = \frac{\Delta V}{\Delta P} = \frac{\text{Lung volume change}}{\text{Pressure change}}$ ← Calculated using our numerical pipeline ← $P_{control}$ across different time points
- Numerical pipeline to estimate airflow rate at all points in the breath cycle
- PID control to regulate pressure during normal breathing cycles

Numerical pipeline



Poiseuille's formula:

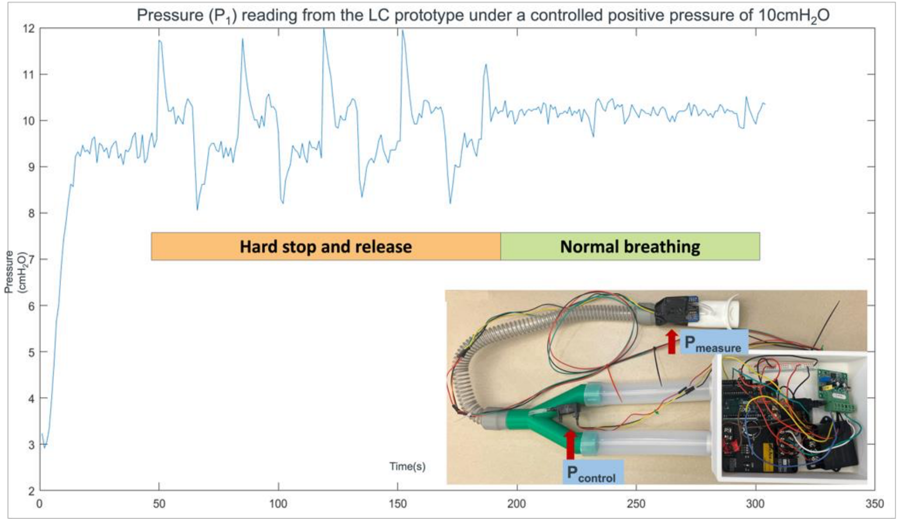
$$Q(t) = \frac{P_{control}(t) - P_{measure}(t)}{Res}$$

Numerical integration:

$$Q(t) \cong \frac{dV(t)}{dt} = \frac{V(t+\Delta t) - V(t-\Delta t)}{2\Delta t}$$

Lung compliance calculation:

$$LC = \frac{\Delta V}{\Delta P} = \frac{V(t_1) - V(t_2)}{P_{control}(t_1) - P_{control}(t_2)}$$



APPENDIX A: ADDITIONAL SCIENTIFIC/TECHNICAL SUPPORT

- Our team has demonstrated significant difference in 4DCT-derived lung compliance (LC) in **healthy** and **IPF** patients[1].
- We observed **significant decrease** in 4DCT-derived lung compliance over 6 months.