

A Smartphone Kit for Point-Of-Care Pulmonary Diagnosis

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TATA CENTER
TECHNOLOGY + DESIGN



Clinical Need

- Pulmonary diseases account for more than 14% of deaths worldwide [1]
- These diseases are also the single largest cause of lost disability adjusted life years [2]
- In many parts of the world, diagnosis is inaccurate because physicians have limited training in pulmonary diseases or diagnosis is made by nurses and health workers
- The machines required to improve diagnosis are expensive (>\$50,000) and require trained technicians

Proposed Solution

Use a suite of low-cost, lightweight sensors to capture patient information. Combine this information using signal processing and machine learning implemented on a smartphone to provide diagnostic guidance to a physician or health worker at the point of care

Sensors:

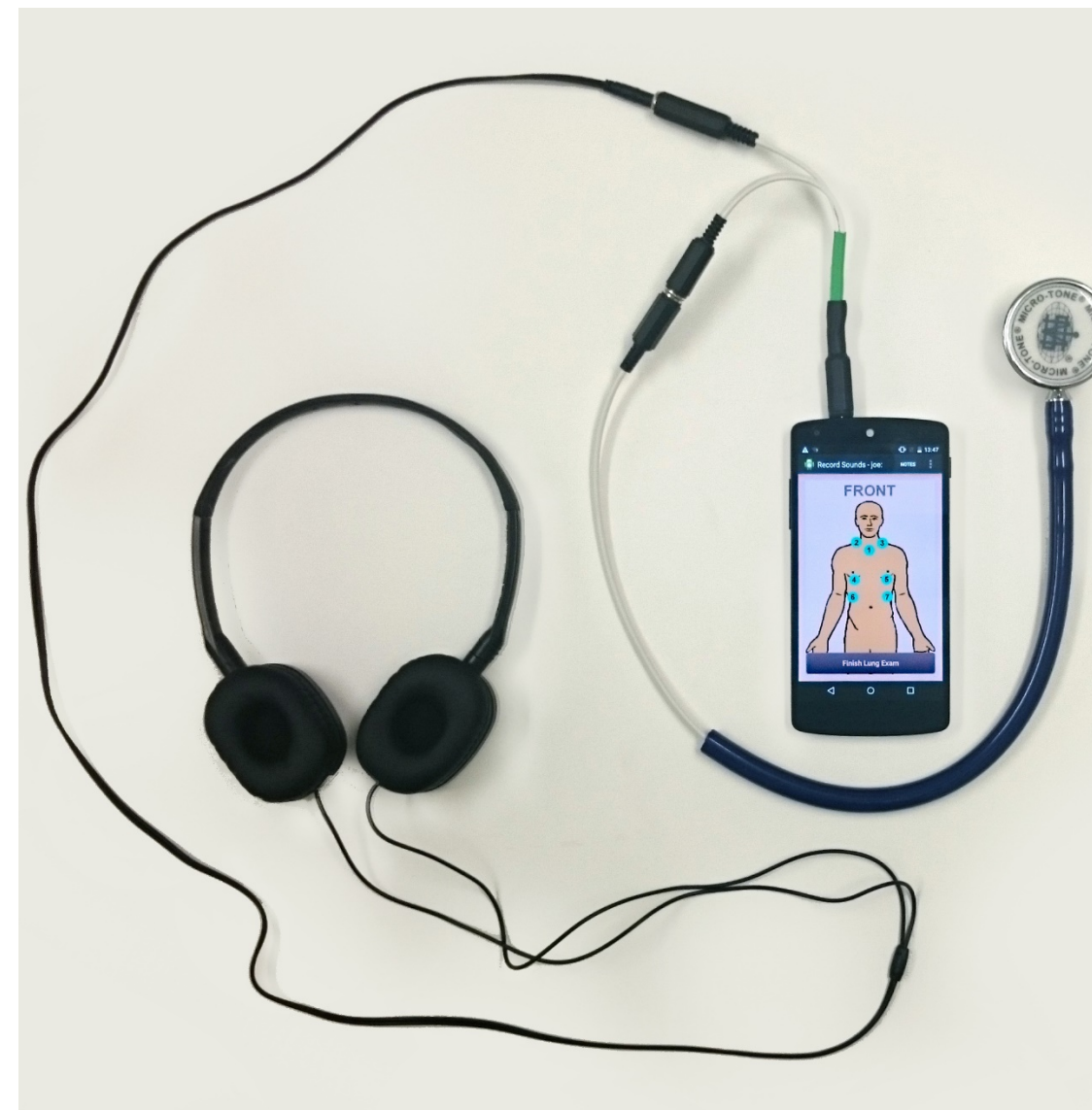
- Electronic stethoscope – Record and automatically identify abnormal lung sounds
- Augmented Reality Peak Flow Meter (AR PFM) – Measure patient lung volumes digitally using a preexisting analog device
- Electronic patient questionnaire – Collect information about patient symptoms and risk factors

Acknowledgments

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- Vodafone Americas Foundation
- National Institutes of Health

Sensors and Results

Sensors



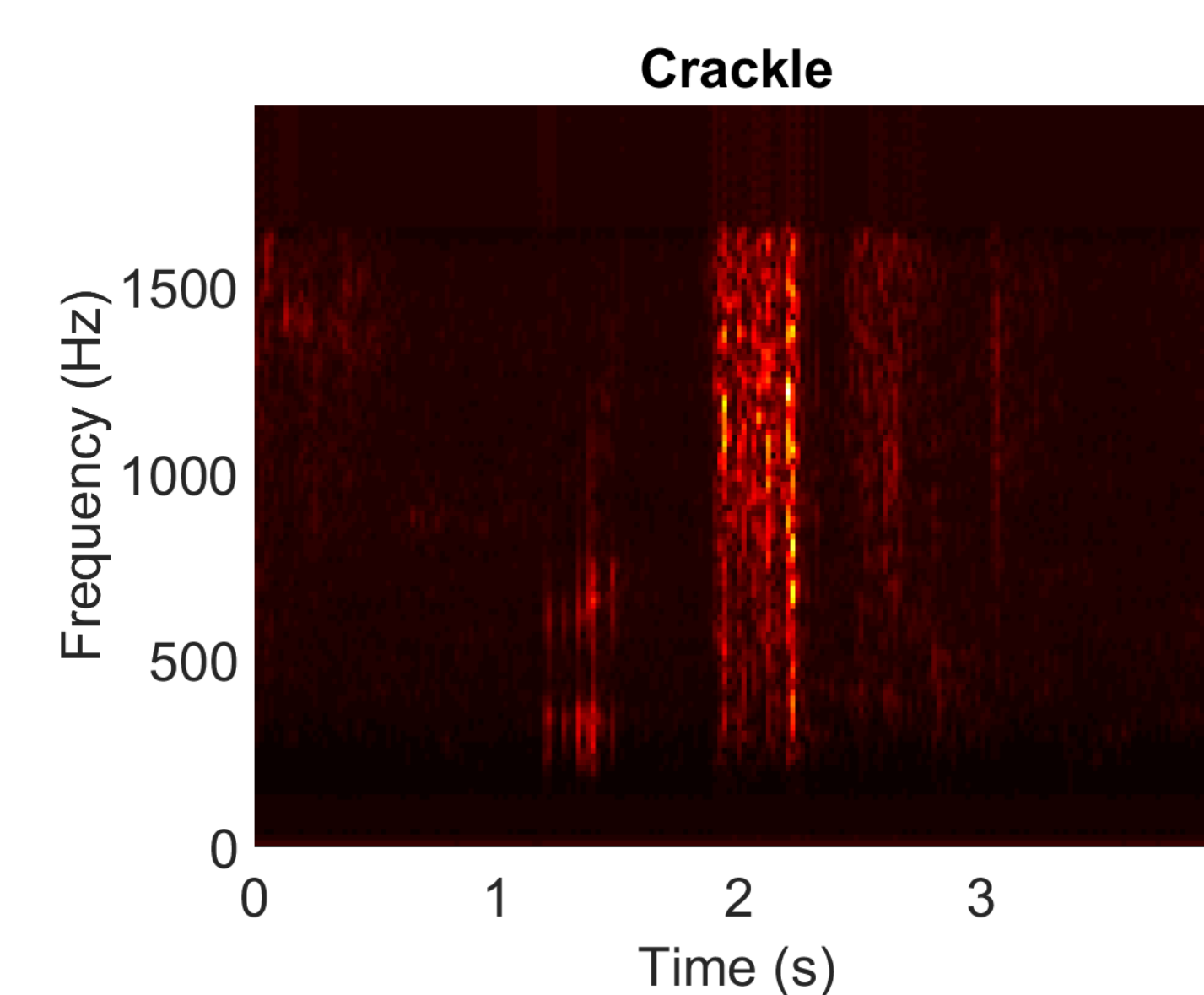
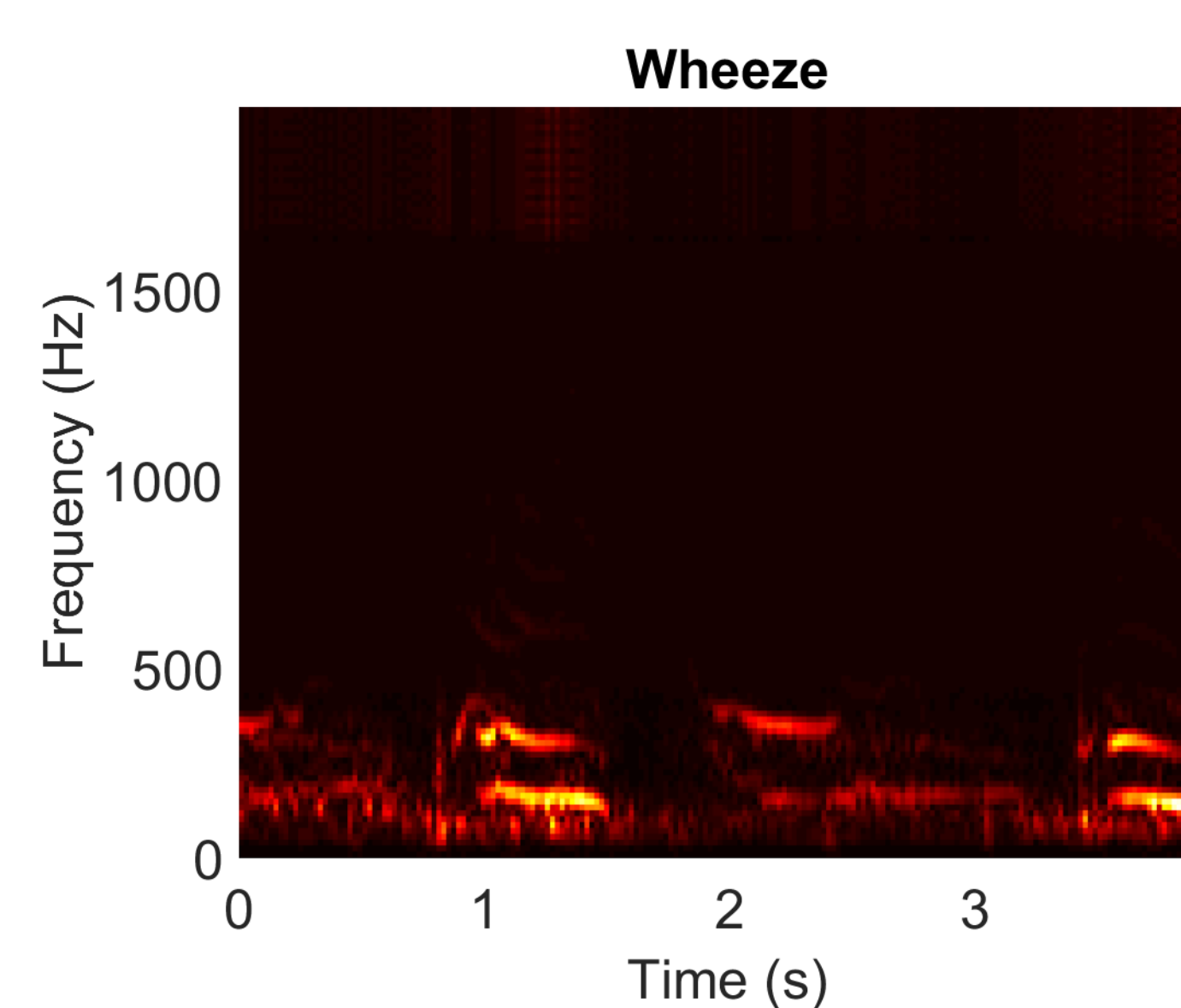
Electronic Stethoscope



Augmented Reality Peak Flow Meter

Abnormal Lung Sound Detection

- Discriminated between healthy and wheeze sounds with 87% accuracy in 57 patients [3]
- Validating this algorithm and a crackle detection algorithm on a 500 patient sample



Conclusions and Next Steps

- We have developed a kit for capturing and analyzing pulmonary diagnostic information
- Algorithms can detect wheezes in patient lung sounds
- Augmented reality for the peak flow meter is being validated
- 500+ subject clinical trials are now underway in Pune and Mumbai to develop diagnostic guidance algorithms

References

- [1] "WHO | The top 10 causes of death," WHO.
- [2] W. H. Organization, *Global Surveillance, Prevention and Control of Chronic Respiratory Diseases: A Comprehensive Approach*. World Health Organization, 2007
- [3] .D. Chamberlain, R. Kodgule, J. Mofor, and R. Fletcher, "Mobile Stethoscope and Signal Processing Algorithms for Pulmonary Screening and Diagnostics," in *2015 IEEE Global Humanitarian Technology Conference (GHTC)*, 2015.