The Case for a Portable Open-Source 3D Ultrasound: Issues, Benefits, and Challenges

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Background, Motivation and Objective

We hypothesize that broad accessibility to ultrasound imaging can revolutionize healthcare in developing nations and generate data necessary for training AI- based mobile diagnostic tools. Our research will aid in providing essential knowledge to physicians, engineers, and medical experts. Our mission at Columbia University is to develop a $100-dollar 3D portable open-source ultrasound that others can innovate and improve on.

Statement of Contribution/Methods

Tests were performed with our 3D printed ultrasound probe. Further details on hardware, signal processing, and Tx/Rx piezoelectric circuit construction are available in our second paper. After producing a scan image of the square ultrasound phantom, filters were applied to reduce noise. Details, calculations and results were excluded due to 1-page limit.

Ultrasound imaging probe above the silicone phantom

Results/Discussion

The Columbia University Open-Source Portable Ultrasound project is driven by a growing interest in intelligent, affordable, and complete point-of-care diagnostic imaging. We plan to introduce a portable open-source DIY medical ultrasound that addresses the needs of global users. Our technology will be the first-ever imaging system that generates 3D sonograms for under $100 USD in materials cost, paving the way for ultra-affordable modalities to enter the ultrasound market.

In summary, a portable low-cost three-dimensional (3D) scanning ultrasound, and specifically an open-source system, can provide unbounded opportunities for medical diagnostic technology by: (1) Mitigating logistical complications and reducing the expense of accessing medical care in rural areas, (2) Leveraging Artificial Intelligence (AI) to facilitate image calibration, interpretation, processing, and diagnosis; reducing the dependency on trained staff, (3) Producing ample amounts of data that is sorely necessary for modern AI techniques to flourish, but is now available only to large organizations, and (4) Creating an open platform that is not centrally controlled and therefore incentivizes and catalyzes continuous third-party innovation.

Abstract without image

Ultrasound diagnostic imaging is an essential aspect of modern healthcare, but barriers such as cost, technical training, and access to medical facilities impede global adoption. To tackle these factors, the need for a portable open-source 3D ultrasound is discussed. A portable open-source 3D ultrasound, equipped with artificial intelligence, can provide unparalleled global accessibility to life-saving affordable medical diagnostic care as well as create copious amounts of data needed for training automated systems; however, it may also carry disadvantages. This paper assesses the considerations for and against an open-source approach and draws insights from successful open-source hardware projects in the past.

We discuss the unmet need for readily accessible diagnostic imaging, uses of ultrasound imaging, and implications of features such as portability, 3D imaging, artificial intelligence and open-source approach in increasing operationality and utility of ultrasound equipment. We also discuss ethical considerations and potential negative impacts of openly-accessible ultrasound imaging. We propose to develop an open source ultra-portable 3D ultrasound hand-held device for medical imaging which would require minimal training. (Full-length paper is available to submit)