

## Overview

- Low-cost, USB-based ultrasound probes:
  - Are FDA approved and CE-Marking approved
  - Attach to Windows XP/Vista computers
  - Attach to Windows Mobile cell phones
- A Software Development Kit (SDK) is available:
  - OEMs may build custom applications around the USB probes.
- Supplied application allows basic diagnostic imaging and data archiving for later analysis.
- Computers and cell phones may be part of a larger network:
  - Archived data can be transmitted to specialists many miles, or even continents, away.
  - Minimally-trained technicians can provide medical imaging to remote populations.
  - Specialists can view the data without having to travel to each location.

## Motivation

- 75% of the world population have no access to medical imaging (World Health Organization).
  - Most of these people are poor and live in remote areas.
  - There is a shortage of trained medical professionals in these remote areas.
- Medical imaging devices need to be more affordable to be deployable in greater numbers
- Medical imaging devices are not very portable, and even if they are, many require substantial power and cannot be used in many remote locations.

## USB Probe and System Cost

- Current probes cost as little as \$2000 each
- We are actively working on ways to reduce cost:
  - Volume production would bring the price down to less than \$1200 in the next year.
  - Additional development could bring this price under \$1000
  - Completely new designs could bring the cost to a few hundred dollars.
- A \$299 laptop (1.6 GHz Atom processor, 1 GB RAM, Windows XP Home) can host this system:
  - These systems can replace current portable ultrasound systems costing well over \$25,000.
  - Easy to use and lower power.
  - Open software development environment due to the availability of the SDK for OEMs.
- Any Windows Mobile cell phone or Windows CE device with a USB host port can host this system.

## Objectives

- Enable more people to have access to medical imaging:
  - Enable low-cost, portable and customizable ultrasound-based systems to be built.
  - Create an open development platform for customization of applications
  - Create an open-source development community around the SDK to shorten development cycles and lower total system cost.
  - Enable remote diagnosis and viewing applications.

## Under Development

- Bringing the probe cost down to a few hundred dollars requires some additional development:
- New, low-cost ultrasonic scan head
  - Lower cost transducer technology
  - Better integration of electronics for lower electronics and assembly costs
  - 100% Plastic design



Prototype low-cost scan head that costs 75% less than current generation heads.

## Examples of FDA Approved, CE-Marking Approved Probes



GP 5 MHz Probe



Vascular Access 7.5 MHz Probe



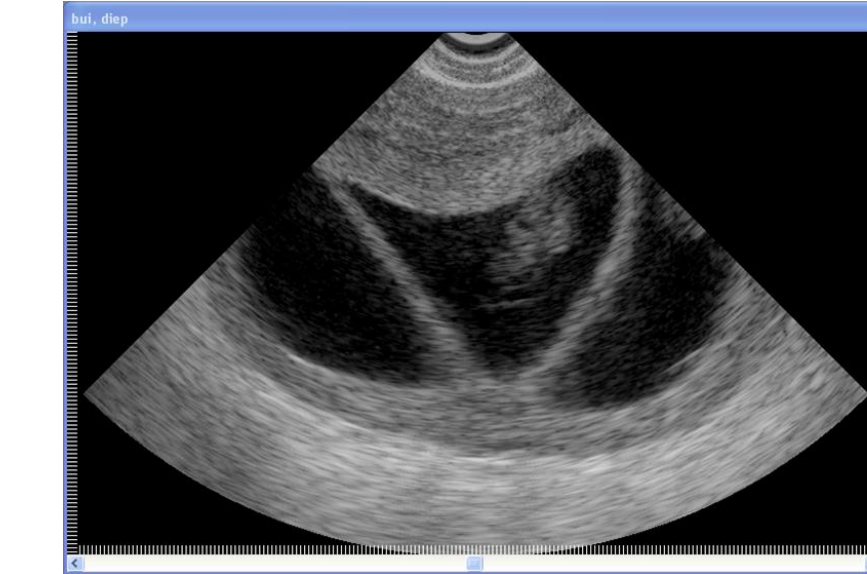
EC 8 MHz Probe



OP 12 MHz Probe

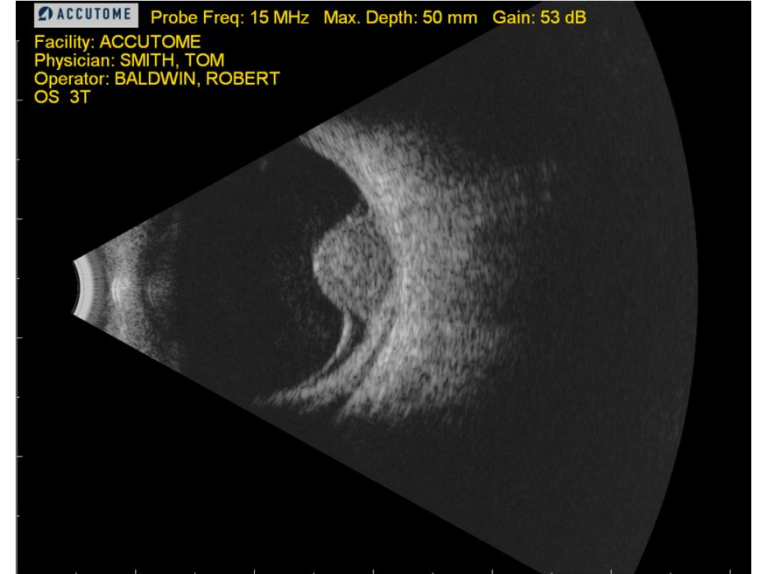
## Current Applications and Deployments

### Gynecology



Endocavity probe: Triplets  
(Photo courtesy Direct Medical)

### Ophthalmology



OP Probe: Eye with tumor  
(Photo courtesy Accutome)

### Vascular Access



Escalon VasuVu with VA probe: Used to start IVs and central lines  
(Photos courtesy Escaloon)

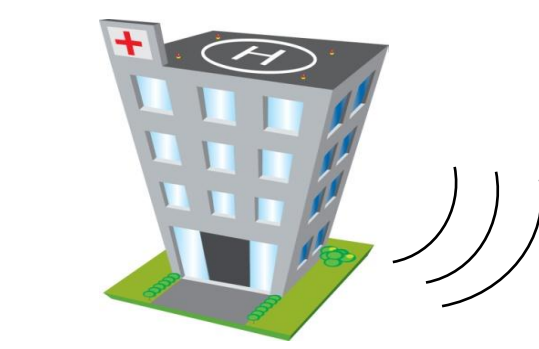
Other areas include: Urology and specialized applications (3D prostate imaging, catheters, etc.) and veterinary medicine.

## Remote Diagnostics and Viewing

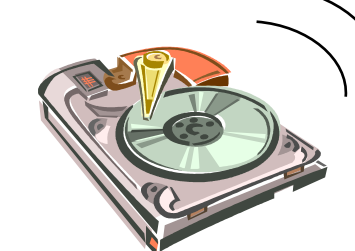
### Case Study in Africa



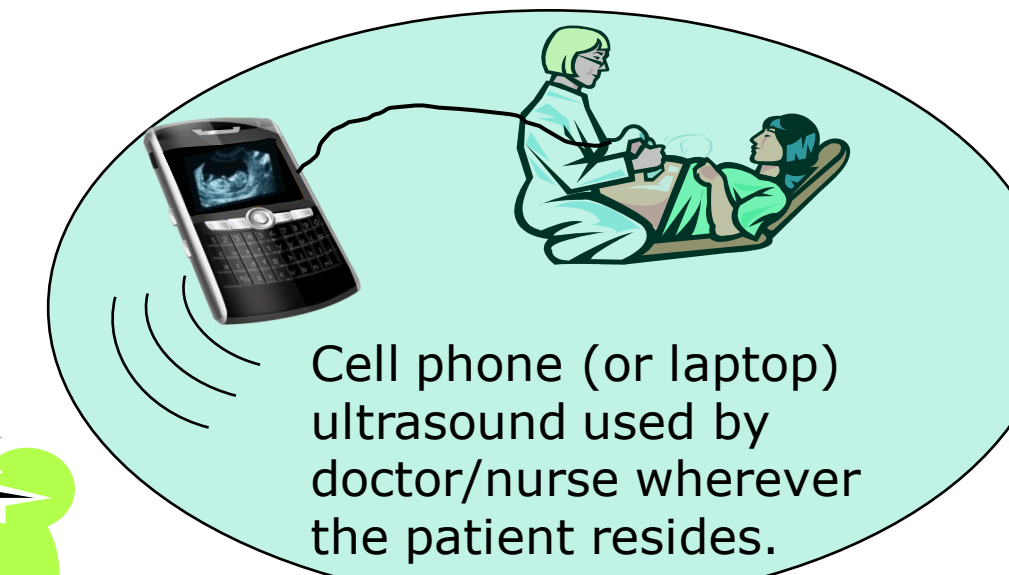
"In the field, we found the unit to be reliable, easy-to-use, and having good image quality and clarity. It proved especially valuable in the evaluation of an anterior cervical neck mass, as well as in the evaluation of the fetuses in pregnant women." – Dr. Thomas Flowers, ER Physicians & Medical Director of World Missions Possible



Send image and patient data to hospital for diagnosis.



Store data anywhere (HealthVault, GoogleHealth, OpenMRS, etc.)

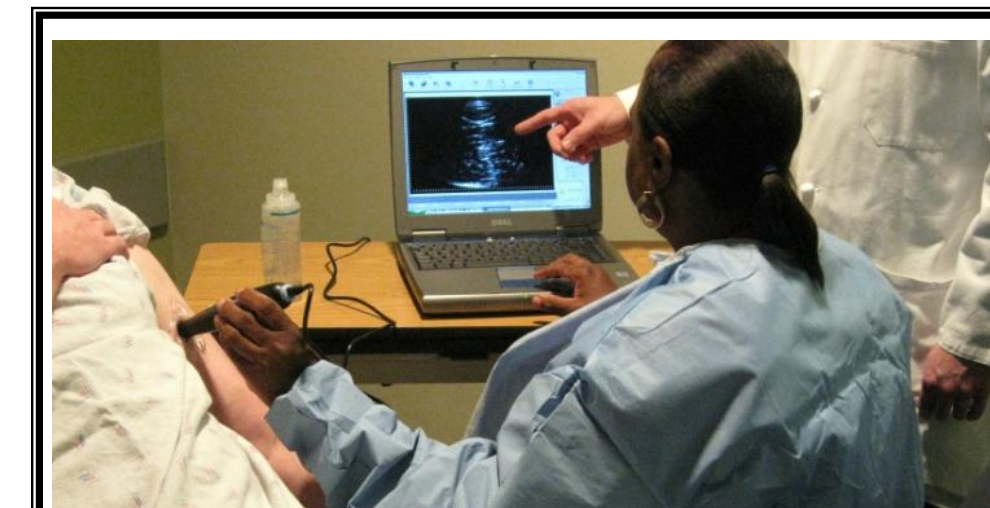


Cell phone (or laptop) ultrasound used by doctor/nurse wherever the patient resides.



Remotely view data or retrieve it from databases.

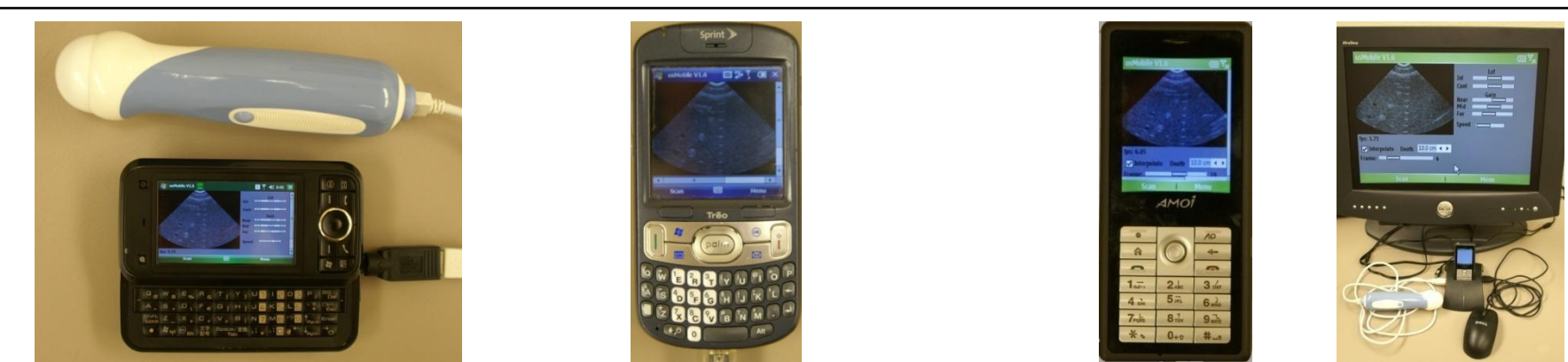
### Drug Efficacy in DMD Patients



Duchene's Muscular Dystrophy (DMD) is a degenerative disease that has no cure. The leading treatment to slow its progression is a dose of steroids several times a week. Researchers at Washington University in St. Louis monitor physical changes in muscle tissue with ultrasound. Physicians can then adjust the dosage to the lowest amount necessary for a good outcome with many fewer side effects. As these scans need to be done on a daily basis, low-cost, portable scanners are a must as they will be deployed in the patients' homes.

## Example Low-Cost, Portable Systems

### Smartphone with a USB probe directly attached



- Probe is modified:
- Ultra-low power (< 0.5 W)
  - Lower data rate (10 Mb/s vs. 480 Mb/s)
- Optimized Software:
- Small screens
  - Smartphone keyboards/touch screen

### Laptops/Desktops



Standard laptop/desktop supports high-resolution imaging and higher performance:

- Many specialized probes available (endocavity, open-tip, etc.)
- RF probes available
- Very high resolution with zoom
- Save very large image sets
- Patient database
- Image annotation

## SDK and Open-Source Software

- A free Software Development Kit (SDK) is available to enable fully-custom applications to be developed for various platforms.
- To enable low-cost development of new and customized applications based on these probes, there is a project underway by students at Washington University in St. Louis to create an open-source imaging application, based on this SDK, that works with all of the available low-cost, USB-based ultrasound probes.
- The sample application being written for the cell-phones will also be made available along with the SDK to support the probes. This will allow an easy development path for Windows Mobile/CE based devices.

## Current Funding

Cell phone integration is supported by a grant from Microsoft Research: *Cell Phone as a Platform for Healthcare*. In addition, they have provided the Fone+ platform for development.