

A Cost-Effective Portable Telemedicine Kit for Use in Developing Countries

by

Ari T. Adler

B.S., Physics
Brandeis University, 1996

Submitted to the Department of Mechanical Engineering
In Partial Fulfillment of the Requirements for the Degree of
Master of Science in Mechanical Engineering

at the
Massachusetts Institute of Technology
May 2000

© 2000 Massachusetts Institute of Technology
All rights reserved

Signature of Author

Department of Mechanical Engineering
May 19, 2000

Certified by

Joseph A. Paradiso
Principal Research Scientist, Media Laboratory
Thesis Supervisor

Certified by.....

Woodie C. Flowers
Professor, Department of Mechanical Engineering
Thesis Reader

Accepted by

Ain A. Sonin
Chairman, Department Committee on Graduate Students

A Cost-Effective Portable Telemedicine Kit for Use in Developing Countries

by

Ari T. Adler

Submitted to the Department of Mechanical Engineering on May 19, 2000, in partial fulfillment of the requirements for the Degree of Master of Science in Mechanical Engineering

Abstract

Telemedicine is currently being used to bridge the physical distance between patients in remote areas and medical specialists around the world. Developing countries have had little experience or success with telemedicine, in part because of the prohibitively expensive equipment and connectivity costs involved. Developing countries require low-cost, sustainable telemedicine solutions for the local delivery of primary healthcare and efficient access to medical expertise when needed. A low-cost (approximately \$8,000 in small quantities) portable telemedicine kit was designed and built to address these needs. The kit was developed as part of the Little Intelligent Communities (LINCOS) project, which is bringing satellite telecommunications, education and telemedicine services to underserved areas of Latin America and the Caribbean. This is accomplished through the use of modified ISO shipping containers that become 'digital town centers.'

The telemedicine kit consists of a durable case that houses a portable computer and several medical peripherals: a digital stethoscope, an ECG recorder and a medical imaging system. The kit allows a health practitioner in a remote area to capture patient data in the form of audio, video, and images in an asynchronous fashion and forward them over the Internet to a doctor for a diagnosis.

This document addresses various aspects related to the implementation of a low cost telemedicine kit. It also explores some of the technologies that will enable the creation of new types of telemedicine devices in the future, not only for remote diagnostic applications, but also for home health monitoring. A wireless transceiver board was also designed and built so that it could be embedded into consumer medical and electronic devices in a general fashion. It allows the devices to communicate wirelessly with a base station either for home health monitoring applications, or for a cordless version of the portable telemedicine kit.

Thesis Supervisor: Joseph A. Paradiso

Title: Principal Research Scientist, MIT Media Laboratory

Acknowledgements

First, I would like to thank my advisor **Joe Paradiso**, who in addition to offering me a great amount of help, encouragement and advice over the past two years has also been a great person to work for.

I would also like to thank **Woodie Flowers**, my departmental thesis reader, for spending the time advising me and always giving me interesting things to think about.

I would like to acknowledge and thank **Nisha Checka**, who worked endless hours with me on this project as a UROP. She has made significant contributions to the research described in this thesis.

I would like to thank **Leslie Regan** in the M.E. department for all of her help and administrative advice over the past two years.

I would also like to thank **Sandy Pentland** and **José María Figueres** for promoting my involvement, and always keeping me enthusiastic about the LINCOS project.

I thank **Glenn Vonk** at Becton-Dickinson and **Jim Sheats** at Hewlett-Packard for providing medical devices and computing equipment for my research.

I would like to thank **David Boor** and **IBM** for sponsoring me through the IBM Media Lab fellowship.

I thank **Juan Barrios**, director of the LINCOS project for all of his help, advice and friendship over the past two years. It has been a pleasure working with him.

I would like to acknowledge **Alejandro Valerio**, **Don Armando Bonilla**, **Franklin Hernandez** and **students** from the TEC for the many contributions that they made to this project including the software, electronics and graphical design for the telemedicine kit.

I would like to thank my office-mates **Ari Benbasat** and **Ara Knaian** for their company, and their expert help and advice about pretty much anything. I have tremendous respect for both of them.

I also thank the other members of the **Responsive Environments Group**, and my friends and colleagues at the **Media Lab** and **MIT** for making my experience stimulating and rewarding.

Finally, I would like to thank **Melissa** for her encouragement and understanding, and my **family** for all of their love and support.

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.