ELEC/CENG 499 – Tele-Auscultation System

Progress Report 2

Project Group Number: 2

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Tele-Auscultation System, Progress Report 2
I. Project Summary

In May of 2010, work on a low cost digital stethoscope for eHealth and Telemedicine was started. The primary idea behind the project was the rate of adoption of electronic stethoscopes was impeded by the high cost of the devices. Stethoscopes with telemedicine capabilities cost more than $1000, hence are not affordable for individuals who may wish to take advantage of the benefits of telemedicine. A working prototype was produced and refined with recording, playback, and Bluetooth transfer capabilities. The success of the hardware portion of the electronic stethoscope project has provided the opportunity to complete a full tele-auscultation system by creating a software audio transfer interface for it. By making such a low cost system, telemedicine may become more commonplace both within our healthcare infrastructure and at home.

This software will accept audio data over Bluetooth from the stethoscope and display the waveform on a PC. If the user is connected to the project web server, the audio data will also be transmitted and stored for later sharing and retrieval. The main feature that will make the system suitable for telemedicine is that a clinician can be given access to the patient's data via an eHealth service provider website and thus can listen to the sounds in real time.

II. Introduction

This document outlines the progress completed on the tele-auscultation project as of June 9th, 2011. Much of the groundwork for the windows application, database, as well as some of the website has been produced and our results thus far are positive. Under the supervision of Dr. Poman So we are determined to make a working low cost tele-auscultation system which may be refined for widespread use.

III. Overall Progress of Project

Progress on the project has been slow and much development must be made to realize our goal of having a functional program skeleton by month’s end. With the use of an online project management tool at www.smartsheet.com, we have been able to gauge our progress week by week. Figure 1 is a screen capture mosaic of the individual deliverable progress as of Thursday, June 9th.
Figure 1  Project deliverables tree and progress (dark green bars inside of light green bars) to date of tele-auscultation project.
IV. Progress Reports by Module

a. Windows Software – Christian McMechan

The development of the windows software was at first slow, but full of discovery. The initial steep learning curve of the C# language is leveling off and progress has become much faster. The user interface is now being refined and the next step is to create the waveform visualization algorithm.

The primary challenge was writing software that would enable the audio to be streamed somewhat smoothly. After much trial and error, as well as consulting forums, the firmware on the stethoscope hardware was modified to start every audio frame with an arbitrary “<!” delimiter. Every response to a command sent to the scope from the windows software has a <rep> prefix so the serial received data handler can properly parse the response data. Currently, a transfer rate of 4kHz is achieved using the Bluetooth serial profile. Figure 2 illustrates a functional block diagram of the windows software portion of the project to date.

![Figure 2 Functional program flow diagram of windows software](image)

During development of the desktop software, there were many times where one method to do a task would work, but upon gaining further experience I would go back and refine or completely change the operation of that particular section of code. One such example of that was a tree style layout that was made for the left hand side waveform list window. A tree type structure was created to display various parameters of recorded waveforms, but it was discovered that creating individual controls would not only be more visually pleasing from a user standpoint, but would also aid in the
compartmentalization/operation of the program. It was found that if each waveform was given its own container and method, it would be much better than handling it with a simple list with many methods to handle user inputs.

Care was taken in designing the software interface with ergonomic features to enhance user friendliness and ease of use. This is an ongoing consideration and will certainly be one of the main focuses on the later stages of the software development. Figures 3 to 5 illustrate some sample interfaces present in the program.

Figure 3 Sample output of desktop software login and user profile creation page

Figure 4 Sample main window of windows desktop software.
b. **Web Application –Aaron Patten**

Currently the web application consists of a login page a home page, a registration page, and the functionality necessary to make a new user account. The account does not yet contain all of the fields associated with each user such as birth date, health number, or gender. These fields will be added to the registration and account creation page and user data model. Much of the functionality of the web page to date has been taken from a template available through Microsoft visual Studio.net and allows for data validation upon creating a new user account. Figure 6 shows a sampling of the login screens on the future web site.

![ Figure 5 Sample settings dialog of windows software called from the main window of the windows program](image1)

![ Figure 6 Screenshots of current functioning system Home and Logon views.](image2)

These views will ultimately only be the initial entry point into the web application. Once the user has logged in successfully they will be able to view all of the heart sound recordings they have on record and play any one of them back. There will also be functionality that will allow a user to stream audio...
directly from a Stethlink device to anywhere in the world over the internet to be heard and viewed on the Stethlink web application. The intended layout of the web interface is shown below in Figure 7.

One of the primary goals for the web interface is to allow a user to perform any of the tasks he or she would be able to do in the desktop application with the exception of those tasks which specifically require hardware and/or software to be installed on a workstation or home computer, namely the Stethlink desktop application and the digital stethoscope itself. The result of this is that it will have a very similar layout. According to our timeline this layout is currently late but it should still be possible to meet our web interface deadlines for the end of June.

Figure 8 describes a flowchart depicting how the web application will interface with the rest of the system. The account creation and logon aspects are not shown here and it may be beneficial to remove some of the account creation functionality from the web page once it is out of the unit testing and integration testing phases. At that point it will be ready to be integrated with the rest of the system. The nature of the interface between these devices is made more clear here than in Progress Report 1 because it has become more clear since Progress Report 1 was submitted.
Figure 8 A flowchart describing the web applications interaction with the other system components. (Modified from Progress Report 1)

c. Database - Irina Morozov

XAMPP for Windows has been utilized on this project. The current version version contains: Apache and MySQL. The basis for the code that was used was from the sample program “CD collection” written in PHP using MySQL to write the SQL for our project. The database was named “christia-mytest” and loaded the first version to test on our web server. Our database is located at phpMyAdmin.

There are three type of users:

- web-admins
- patients
- doctors

Web Admins:

- manage the list of patients, doctors and web-admins
- manage upload files (delete old files)

Website Admin Page:

- a website admin page add, delete or edit admin name, e-mail, password (see figure 9 for sample screen output).
- New web-admin will received e-mail validation to confirm the registration to website
Figure 9  Website administrator page for database of project

Patient Administration Page:

- web-admin can add, delete or edit patient name, phone, e-mail, password (see figure 10 for sample screen).

Figure 10  Patient administrator page for database of project
Doctor Administration Page:

- web-admin can add, delete or edit doctor name, phone, e-mail, password (see figure 11 for sample screen).

Figure 11  Doctor administrator page for database of project

Patient

- register a new account
- log-in and edit only their own information
- select from the list their doctors
- upload files (delete old files)
- notified doctor about new file uploads

Patient File Upload:

- browse – select file for download
- upload – upload files to database
- see all files – displayed list-history of all files that was download by this patient
The patient sees a message upon a successful upload. The patient can then go back to patient file upload page and perform more uploads. Figure 12 is a sample of the file upload screen.

Also, the patient can see the list of all files that were download and click on the link to save or open files. The patient can then go back to patient file upload page to perform more uploads. See figure 13 for a sample upload listing screen.
Doctors

- register a new account
- log-in and edit only their own information
- select from the list their patients
- save or open patients files
- add comments to the file after review of the files
- notification of the patient of the next telecommunication setup

V. Conclusion

Development will continue on this system and, as previously mentioned, we hope to have a working skeleton of a system by the end of the month. Through diligence and adhering to the milestones tree, we can realize our goal of creating a basic tele-auscultation system.