ENSC 440 – WRITTEN PROGRESS REPORT

The CVI Analytical Stethoscope is an electronically controlled auscultation device that wirelessly synchronizes with an iPad application. The user is presented with a visual read-out of transferred data where an analysis algorithm detects any abnormalities in a patient's heart rhythm. Any collected patient information is stored in a central secure database where additional authorized health professionals may access the information. It is common for basic auscultation techniques to miss potential heart ailments that the CVI Analytical Stethoscope detects. Through rigorous design and testing procedures, CVI establishes intuitive and reliable equipment for the rapidly expanding medical market.

PROJECT COMPONENT PROGRESS

1. **Hardware**

   The stethoscope hardware required for this project consists of an electret microphone and all the signal amplification, processing, and filtering circuitry required to condition the signal for listening on headphones as well as input into an Arduino microcontroller for wireless transmission. Once received by the Arduino microcontroller, the signal will be passed to an Arduino Ethernet Shield and then to a small router for wireless data transmission to a connected iPad device. The amplification, filtering, and processing circuitry were assembled on a solderless breadboard and extensive testing and configuring was undertaken to obtain an acceptable signal. It was decided by our group that the final design would be implemented on a printed circuit board (PCB) with surface mount components in order to minimize some of the noise seen from the breadboard circuit. The PCB has been designed and fabricated by AP Circuits and all required components have been procured from DigiKey. At this time, initial soldering of the surface mount components has been completed with subsequent testing to take place in the coming week.

2. **Hardware Packaging**

   The hardware packaging for the wireless auscultation device will consist of a plastic case, a rubber tube with stethoscope head and embedded microphone, and a neck lanyard for hands-free use of the device. The conceptual design of the case has been completed and it will most likely be purchased as an off-the-shelf item and then modified to suit our application. This will include the drilling of holes for connection of external devices and controls. In the case that a suitable case cannot be found, one will be constructed from raw materials. The rubber stethoscope tubing and head with embedded microphone has already been constructed from a donated stethoscope, and all that remains is to attach it to the case. A neck lanyard will also be purchased and attached to the case. This will allow the user to operate the device without having to hold the case in their hands.

3. Software System

The software for supporting this product includes four major components: a general user interface, wireless communication of the auscultation signal, signal processing and visual representation, and store, forward and retrieval of the recorded signals. The following is a breakdown of the progress on these components.

Currently the interface allows for the addition and retrieval of patients, patient sessions and recordings from a database. Sharing this information between health care professionals along with account authentication has also been fully supported. Further work for synchronization amongst multiple devices and encryption of information is currently undergoing. In addition, testing on an actual device is also pending.

The design for wireless data transmission from the stethoscope system and iPad interface is completed and implementation is undergoing. We are currently implementing a TCP wireless transmission of a 100 Hz data signal and are focused on integrating this capability with the user interface. The design for plotting and analyzing the signal retrieved is complete and we are currently implementing these features.

FINANCES

As reported previously CVI has received full funding from the ESSS in the amount of $800.00. This amount has proved to be sufficient and no further sources of funding will be needed. The following is a list of all parts that have currently been purchased:

Part Description	Part #	Price($)	Shipping($)
Ethernet Shield	DEV-09026	68.77	
Wireless Router	TL-WR702N	20.37	
Electronic Components Assorted - DigiKey	Assorted	62.18	
PCB Fabrication		112.78	30.00
SD Card	AUSDH16GCL10-RA1	11.19	
Raspberry Pi		55.94	
Software License		100.00	
Soldering Equipment		54.03	
Battery	DB-Tech 8000	30.00	11.00
Case - TBA		50.00	
TOTAL EXPENSES		**606.26**	

The case will be purchased at a future date and is estimated at no more than $50. As shown in the figure above the total cost currently sits at $606.26 for all expenses, leaving about $200 for any unexpected costs.

SCHEDULING

With the original project schedule set to end on the first week of April, our project is behind the original scheduled time plan; however, with our group's presentation being scheduled for the 23rd of April, we have readjusted the schedule to take advantage of the extra two weeks.

In light of this update, our hardware portion of the project is ahead of schedule: fabrication has been completed, and will be ready for testing this week (the week of April 1st. Communications between the hardware and the device stands at 50% completion, which is on schedule. Data representation and analysis both stand at about 30% completion, with data analysis requiring significant testing before final signoff. These sections are slightly behind schedule, but will be the focus of work in the upcoming two weeks. Data transfer from the hardware into the GUI's data representation is expected to be confirmed for this week. The GUI stands at 90% completion, with only minor debugging and aesthetic changes to be made. Database support is 50% complete, which is on schedule for completion one week prior to the project end.

With the hardware components near completion, and software becoming capable of using the live streams of experimental data, the software and hardware teams are finally able to work together to ensure front-to-back functionality of data transfer and representation. The focus going forward will be data representation, storage, and processing.

REMEDIATION

Remediation is already underway for the sections that are falling behind in our project: as focus shifts from hardware to software, we will allocate more resources to data analysis, and work together to ensure complete end-to-end functionality. We anticipate complete project completion one week prior to the project presentation date.

CONCLUSION

As stated in the above sections, the overall design progress is essentially on track despite some minor expected hiccups. The hardware aspect meets our design criterion well ahead of schedule. The construction of a hardware enclosure is the only major milestone left in the hardware as the PCB is fabricated and in the process of being soldered and tested. The software is slightly behind schedule, but we left an ample amount of testing time in the event of such an issue. The software systems should be completed on time, as we cannot see any foreseeable major issues arising in the future. Prudence on our part let us incorporate any potential obstacles into our design scheduling ensuring the final deliverable work as expected.