Progress Report

Dear Dr. Rawicz,

This document summarizes the progress of Biomedical Engineering Solutions (BES) in making HeartMon™, a heart monitoring system, from its conception up to its realization.

This report summarizes the progress of the company on various aspects such as: research; design and implementation of hardware, software, and system; business; group dynamics; and the action plan for the remainder of time from now up to our demo date. This report takes into consideration the progress from January to March of 2011. The action plan considers the tasks to do prior to the demo date on April 2011.

The topic was researched prior to the start of the ENSC 440 class in January. Frequent meetings were held with Dr. Andrew Rawicz to seek guidance on finding a feasible and effective product for which there is a need in the health care industry. The technical analysis of the project was done early on, and the parts were ordered shortly after. Thereafter visits were arranged to find the end users' needs for our product, in order to take that into consideration in our design and implementation. These visits consisted of a meeting with a cardiologist at Royal Columbian Hospital (RCH), Dr. Rupka, and a meeting with doctors at Vancouver General Hospital (VGH). During these visits doctors and nurses who frequently use heart-monitoring systems were interviewed and their input was taken into account in our design.

Hardware

One of the first designs that was finished was the hardware. An electrocardiogram (ECG) circuit was constructed to take in the ECG signal, perform various filtering, and apply signal amplification before outputting it to our microcontroller, the Arduino. The ECG circuit was tested independently from the rest of the system, and based on oscilloscope readings it was verified that the results were within an acceptable range. The Arduino was also tested independently to take in an analog signal, convert it to a digital signal, and transmit it to the phone via Bluetooth. The test results indicated that the Arduino is configured correctly.

Software

In parallel with hardware progress, software development was taking place. First, it was established that the Arduino can perform reliable, bi-directional communication with the Android cell phone via Bluetooth. Second, an Android application was created to take in the ECG signal and display it on the cell phone screen. Next, GPS and acceleration feedback features were added to the HeartMon™ application. An error analysis algorithm was also implemented to notify the user if the ECG signal value surpassed an arbitrary threshold value. This analysis worked for a simple linear analog signal, and also for simple cases of an ECG signal going above that threshold. Meanwhile, A data logging system was tested along with displaying the signal. The data received on the phone are logged automatically in the phone's internal SD card storage for the purpose of future

diagnostics. Although the ECG hardware includes signal filtering and amplification, it is not entirely capable of filtering out noises at certain frequencies. For this purpose, a digital filter implementation was incorporated within the software application. This filter normalizes the values of the digital samples obtained from the ECG signal using a proportional weight variable.

Integration

Finally, when the various hardware and software parts of the project were tested independently and in parallel, the whole system was put together and tested as a singular system. Three integration camps have taken place in an attempt to have all members at the same place and same time to test the whole system at once. The longest, most intensive, and productive of these integration camps took place over the reading break, where many integration issues were addressed. Currently most of the category I and II requirements mentioned in the Functional Specifications document have been satisfied.

Budget

Currently the development of the HeartMon™ is under the budget of $500 obtained from the Engineering Science Student Endowment Fund. Biomedical Engineering Solutions has spent approximately $421 on the HeartMon™. The excess funds may be spent on replacement parts, a protective case for the device, and to build a PCB.

Future Steps

The action plans for progression of the project from now until our delivery on April 10, 2011 is as follows: improve the accuracy of error analysis; fix current bugs; properly measure amplitude, period, and ST segment; build a PCB as a more reliable testing device; create a Java server to store data; and extract data from the server onto a spreadsheet and perform more accurate analysis there.

Various resources were sought after for progression of the business side of the project with very little return. An SFU business professor who teaches a course in Business Venture Planning was approached to seek partnership with his students to build the business side of our company. Eventually he refused further work on the grounds that our idea is not distinctive and innovative enough. SFU Venture connection was also contacted and fell short of assisting or guiding us in any significant way. Two Oxford MBA students were also contacted, and we are in the process of obtaining help to develop our business plan in order to join various competitions and attract investors.

Our group dynamics have been fantastic. Most of us have not worked or known each other prior to ENSC 440. We have a very diverse group both culturally and intellectually, which translates to having very diverse work habits that needed to be correlated. Fortunately, our team has done an excellent job both in working individually and as a group. The trust, communication, and working relationship have continuously grown over the course of this project and everyone has made clear commitment to being part of the company beyond the ENSC 440 course.

