ENSC 305W/440W Grading Rubric for Project Proposal

Criteria	Details	Marks
Introduction/Background	Introduces basic purpose of the project. Includes clear background for the project.	**/05%**
Scope/Risks/Benefits	Clearly outlines project scope. Details both potential risks involved in project and potential benefits flowing from it.	**/15%**
Market/Competition/ Research Rationale	Describes the market for a commercial project and details the current competition. For a research project, the need for the system or device is outlined and current solutions are detailed.	**/10%**
Company Details	Team has devised a creative company name, product name, and a logo. Outlines relevant skills/expertise of team members.	**/05%**
Project Planning	Details major processes and milestones of the project. Includes Gantt, Milestone, and/or PERT charts as necessary (MS Project).	**/10%**
Cost Considerations	Includes a realistic estimate of project costs. Includes potential funding sources. Allows for contingencies.	**/05%**
Conclusion/References	Summarizes project and motivates readers. Includes references for information from other sources.	**/10%**
Rhetorical Issues	Document is persuasive and could convince a potential investor to consider funding the project. Clearly considers audience expertise and interests.	**/10%**
Presentation/Organization	Document looks like a professional proposal. Ideas follow in a logical manner. Layout and design is attractive.	**/10%**
Format Issues	Includes letter of transmittal, title page, executive summary, table of contents, list of figures and tables, glossary, and references. Pages are numbered, figures and tables are introduced, headings are numbered, etc. References and citations are properly formatted.	**/10%**
Correctness/Style	Correct spelling, grammar, and punctuation. Style is clear concise, and coherent.	**/10%**
Comments		

September 26, 2013

Mr. Lakshman One
School of Engineering Science
Simon Fraser University
Burnaby, BC V5A 1S6

Re: Ensc 440 Project Proposal For Vital Band

Dear Mr. One,

Enclosed is the proposal for our device, the *Vital Band*, which outlines our Ensc 440 capstone project. Our goal is to design and build a wristband that can measure heart rate and body temperature. This device will eliminate the need for manual pulse palpation and thermometer.

This proposal will introduce the existing problem and describe our product and proposed features. As well, it will compare our device to some other possible solutions. It will further state our budget and funding, schedule and company's structure and members.

Snail Tech consists of four skilled and hard working fourth year engineering science students: Ardavan Kalhori, Amir Kassaian, Sepehr Sheikholeslami, and Ghazal Saray-sorour. If you have any questions or concerns about our proposal, please feel free to contact us by phone at 604-374-8116 or by email at aka66@sfu.ca.

Sincerely,

Ardavan Kalhori,
CEO
Snail Tech

Enclosure: Proposal for Vital Band

Project Proposal:

Vital Band

Project team
Ardavan Kalhori
Amir Kassaian
Sepehr Sheikholeslami
Ghazal Saray-sorour

Contact Person
Ardavan Kalhori
Aka66@sfu.ca

Submitted to
Mr. Lakshman One – Ensc 440
Mike Sjoerdsma – Ensc 305
School of Engineering Science
Simon Fraser University

Issued Date
September 26, 2013
Revision 1.1

Executive Summery

An aging population, increasing stress levels, and decrease in physical activity in modern days have caused people to become more health-conscious. The effect of this fact could be seen in the tremendous increase of health related products in the market. Since the two most prominent determinants of health are cardiac function and body temperature, we are seeking to introduce a product that would make heart rate and body temperature measurement convenient not only for the elderly, but also for young athletes.

In order to appeal to the masses, the product needs to be very easy to use and relatively cheap. Therefore, we propose a wearable wristband capable of both heart rate and body temperature monitoring. While the market is filled with similar products, we seek to differentiate *Vital Band* in its capability of being individualized, accurate and competitively priced. This is to be done by a group of four talented, ambitious and hard working engineers who plan to make Snail Tech a leading brand in this niche market in near future.

Heart rate is to be measured via an optical sensor situated at the top, so that the user could place his/her fingertip on the sensor and read an accurate measurement within seconds. Another feature is detecting skin temperature, an indicator of body temperature, using IR temperature sensor or an adhesive mounted surface temperature sensor. The temperature and heart rate could be monitored in real-time, so that Athletes can use this to monitor their body temperature while training to control the exercise intensity.

The initial prototyping is estimated to cost around $750, which is to be covered by a variety of available funds. Upon final usability and design testing, the finished prototype is to be mass-produced, which would decrease the cost substantially to around $150, making *Vital Band* not only technologically, but also price-wise competitive in the market.

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1. INTRODUCTION

The 21st century is categorized by a demanding lifestyle, full of distractions. People simply pay less attention to their health as they go along their busy lives. The result of which could be attributed to the steady increase in the number of heart attack related hospitalizations.[1] This fact is mostly caused by increased stress levels[2] and lack of sufficient physical activity in our time.

This, of course has alarmed scientists and engineering alike in order to look for solutions. A great variety of health monitoring products are designed to measure human vital information in a continuous manner nowadays. The aim of this project is to develop such a product, namely, a non-invasive heart rate and body temperature monitoring wristband, called *Vital Band*. Elderly and athletes alike could use this wristband to get information about the most two prominent physiological parameters about their bodies. Body temperature and heart rate both indicate exercise intensity, which is important for an athlete to be aware of constantly. An abnormal heart-rate also indicates the onset of an heart attack or cardiac arrest, and thus it is important for elderly to be aware of it constantly.

Vital Band consists of two sensors that measure heart rate and skin temperature (an indicator of body temperature) on demand. What differentiates this products from other similar solutions is the fact the two parameters are actually *measured*, rather than *derived.* Most of the competitors used accelerometers and pre-programmed algorithms to derive and calculate these two parameters from motion. Using a generalized formula often yields erroneous and un-individualized results, especially for people that do not fall within 'normal' physiological categories.

Snail Tech is comprised of four highly motivated 4th year Engineering students who plan to not only design a highly individualized and imperative health product, but also to produce it with a cost that remains competitive in the existing market.

[1] http://www.heartandstroke.com/site/c.ikIQLcMWJtE/b.3483991/k.34A8/Statistics.htm#stress

[2] http://www.health.am/psy/more/stress_may_be_behind_unexplained_cardiac_arrest/

2. System Overview

Vital band is a wristband that allows the users to measure their heart rate and body temperature on demand. This wristband consists of two sensors, an Arduino as the processing unit, a LCD, a switch, a battery and a battery charger.

2.1. Sensors

2.1.1. Heart rate

The sensor that measures heart rate is an optical sensor called *PulseSensor*, which measures the heart rate from the fingertip. When the fingertip is placed on the sensor (situated on top face of the wristband), a light pulse is emitted through the capillary system situated on the fingertip, and the reflection is detected by the sensor. This mechanism observes the periodic blood volume changes caused by each heartbeat, and thus generates a pulse each time a beat is recorded.

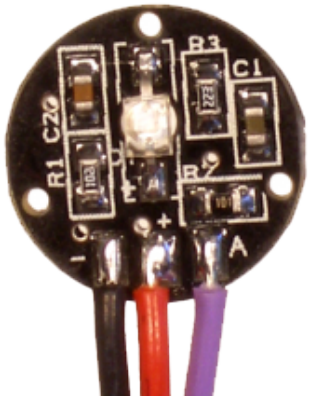

Figure 1: PulseSensor

2.1.2. Skin Temperature

In order to make this device non-invasive, skin temperature is measured as an indicator of body temperature. Two different types of sensors are chosen to do this. One is an infrared (IR) temperature sensor that can record the body temperature from a distance of 10cm or less (Figure 2). The second is an adhesive-mounted surface temperature sensor (Figure 3), which has a corresponding temperature versus resistance curve. The IR temperature sensor is Arduino friendly, meaning no signal processing is required and can be directly mounted on the board. The surface temperature sensor requires signal processing and further circuitry, however it requires far less power than the IR sensor since it is a passive element. In the end, further testing for functionality will determine which sensor will be chosen for the final prototype.

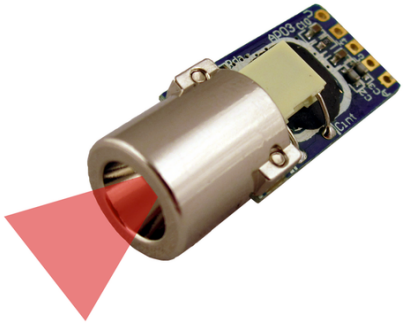

Figure 2: IR Temperature Sensor

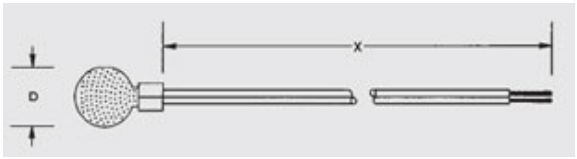

Figure 3 : GE Adhesive-Mounted Surface Temperature Sensor

2.2. Processor

Arduino Pro Mini 3V3 is used to process the information collected by the sensors and display it on the LCD. *Vital Band* is to be worn on the wrist, and thus in needs to be relatively small and light. This very small (1.7 X 3.3 cm) processor has all the processing power we need, while it requires a minimal amount of power (minimum of 3.3 volts). Additional functionality could be added via programming the Arduino, such as battery meter, exercise level indication, heart-rate danger zone indicator and etc.

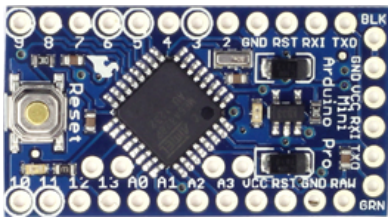

Figure 4: Arduino Pro Mini 3V3

2.3. LCD

A Sharp Memory Display Breakout (Figure 5) is used for display of information such as: battery charge, hear-rate, body temperature and etc. It is Arduino compatible, very light (8 g) and relatively small (4 X 4 cm) and thus is suitable for *Vital Band*'s purposes.

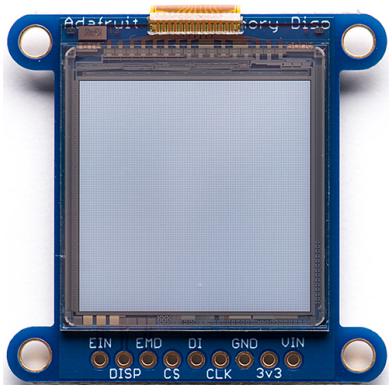

Figure 5: Sharp Memory Display Breakout

2.4. POWER

For the power requirements, a rechargeable Lithium Ion Polymer Battery 3.7 V is chosen (for now). 1200 mAh supplies 21 hours of power to the 40 mA Arduino. However, the exact power requirements of the whole system combined is not known. The exact value will be derived from testing, and thus is expected to change in the power consumption and thus the choice of battery. The product also comes with a USB powered external battery charger (Figure 6).

Figure 6: Lithium Ion Polymer Battery

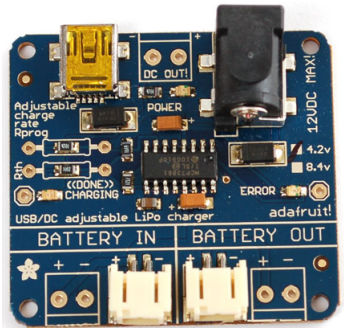

Figure 7: USB/DC Lithium Polymer Battery Charger

3. PROPOSED DESIGN SOLUTION

3.1. HEART-RATE MEASUREMENT

As discussed briefly above, heart rate is to be measured via an optical sensor called *PulseSensor*. The sensor is to be put on top face of the wristband (the heart shape illustrated in Figure 8), so that the user could easily place the fingertip of his other hand on the sensor for 5-10 seconds and read the measurement on the display. An alternative to this would be to place the sensor at the bottom face, so that it would measure the blood volume fluctuations in the main artery situated in the wrist (where manual pulse palpation is performed). Further testing would confirm which method would yield the most accurate results.

Figure 8: Heart-Rate Monitoring on Vital Band (the band around the wrist is not shown)

3.2. Skin Temperature Measurement

There are two proposed methods to measure body temperature through skin temperature. The first is via the IR temperature Sensor, which can be attached anywhere on the wristband because it can measure the temperature in the range of 10 cm or less (Figure 9). The second method is to use adhesive-mounted surface temperature sensor, attached at the bottom face such that the sensor is in direct contact with the skin (Figure 10).

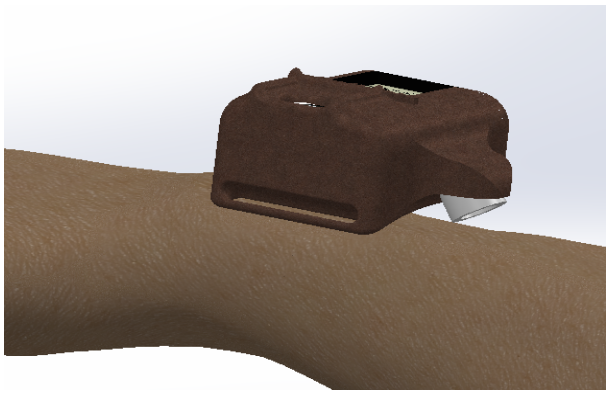

Figure 10: Side View of Vital Band with Surface Sensor (Shown in gray at the bottom)

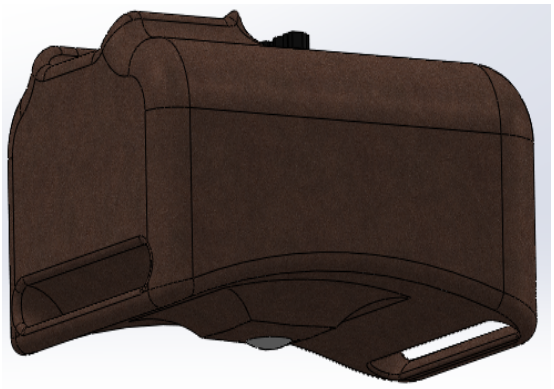

Figure 9: Side View of Vital Band with IR sensor (shown in gray)

5-Budget and Funding

Following is the estimated cost breakdown required to design and implement *Vital Band*. All the prices for each component are based on the research done by members of the company. Since the wristband is still in the design stage, the actual cost might vary at the end of the development.

Equipment List	Estimated Unit Cost
LCD: Sharp memory display breakout - LS013B4DN04	$40+ ~ $35 Shipping
3D printing	$350
PCB printing	$33+ ~ $20 Shipping
Skin Temp Sensor – GE M1000	Waiting on the price
IR Temperature Sensor	$35+ ~ $20 Shipping
Optical Sensor - Pulse Sensor Amped!	$25 + ~ $20 Shipping
Arduino - Nano	$45 + ~$20 Shipping
Lithium Ion Polymer Battery – LP-503562	$10
USB/DC Lithium Polymer battery charger	$30 + ~$20 Shipping
Miscellaneous	$50
Total Cost	$618 + ~$135 Shipping

Table 1: Initial Prototyping Cost Estimation

As you can see from the table above, about 50% of the cost is comprised of 3D printing and prototyping. Therefore, the estimated price of the product, if mass-produced will be approximately 100-150$. This is relatively a competitive price compared to the other similar products in the market which range from 200 to 650$.[3]

Snail Tech has applied for the ESSEF and Wighton Development funds, which are still in process. Hopefully, these funds combined will cover the entire cost of initial prototyping as outlined in the table above.

[3] http://www.mec.ca/shop/heart-rate-monitors/50344/

6-Project Planning

In this section, the planning of numerous tasks, milestones and the duration of each action item is described. The Table below summarizes these tasks:

ID	Task Mode	Task Name	Duration	Start	Finish	Resource Names
1		**Vital Band**	**62 days**	**Mon 13-09-09**	**Mon 13-12-02**	
2		**Funds**	**8 days**	**Wed 13-09-11**	**Thu 13-09-19**	**Amir,Ardavan,Ghazal,Sepehr**
3		**Company Info**	**2 days**	**Wed 13-09-11**	**Thu 13-09-12**	**Ardavan,Sepehr,Amir,Ghazal**
4		Name	1 day	Wed 13-09-11	Wed 13-09-11	Ardavan,Sepehr
5		Design Logo	1 day	Thu 13-09-12	Thu 13-09-12	Ardavan
6		Cost Estimation	4 days	Sat 13-09-14	Wed 13-09-18	Amir,Ghazal
7		Solid Work Model	3 days	Tue 13-09-17	Thu 13-09-19	Sepehr
8		Power Point Presentation	2 days	Wed 13-09-18	Thu 13-09-19	Ardavan
9		**Proposal**	**14 days**	**Mon 13-09-09**	**Wed 13-09-25**	**Amir,Ardavan,Ghazal,Sepehr**
10		Research	9 days	Mon 13-09-09	Wed 13-09-18	Amir,Ardavan,Ghazal,Sepehr
11		Parts List	9 days	Mon 13-09-09	Wed 13-09-18	Amir,Ardavan,Ghazal,Sepehr
12		Proposal Document	7 days	Tue 13-09-17	Wed 13-09-25	Amir,Ardavan,Ghazal,Sepehr
13		Order Parts	2 days	Mon 13-09-23	Tue 13-09-24	Amir,Ardavan
14		Functional Specification	15 days	Fri 13-09-27	Thu 13-10-17	Ghazal,Sepehr
15		Oral Progress Report	4 days	Sun 13-10-20	Wed 13-10-23	Amir,Ardavan
16		Design Specification	15 days	Fri 13-10-18	Thu 13-11-07	Amir,Sepehr
17		Integration	17 days?	Wed 13-09-25	Thu 13-10-17	Amir,Ardavan,Ghazal,Sepehr
18		Debugging & Prototype Modification	8 days?	Fri 13-10-18	Tue 13-10-29	Ardavan,Sepehr
19		Meeting Minutes	42 days	Mon 13-09-09	Sat 13-11-02	Ghazal
20		Written Process Report	22 days	Fri 13-11-01	Mon 13-12-02	Amir,Ghazal

Table 2: Task List

The following Gantt chart (Figure 11) visualizes the time duration of each of these action items:

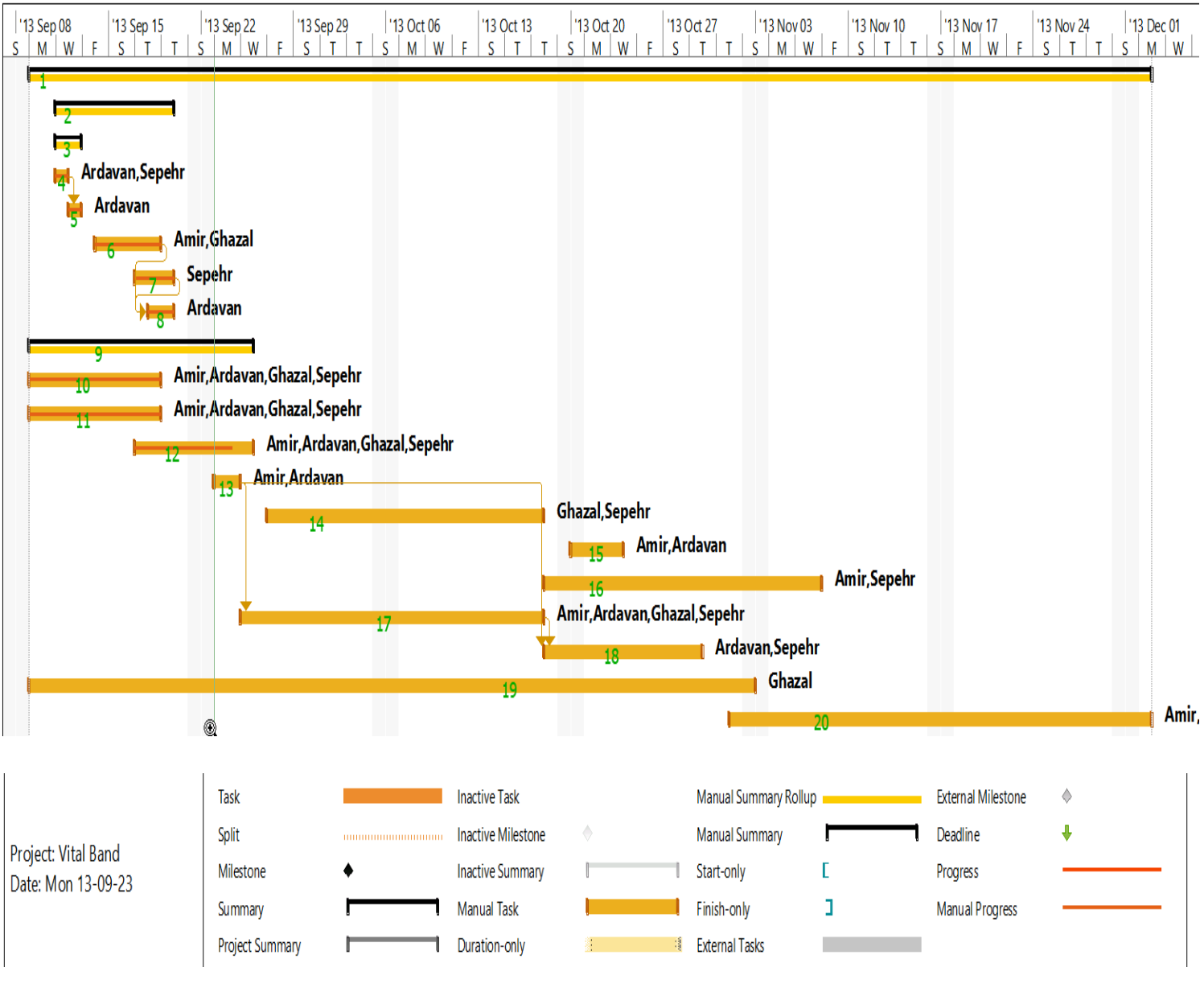

Figure 11: Gantt chart specifying tasks with their tentative time durations.

7-Team Organization

Snail Tech was established in September 2013 and consists of four members: Ardavan Kalhori, Amir Kassaian, Sepehr Sheikholeslami and Ghazal Saray-sorour. The team is comprised of one computer and three systems engineers. All members contribute to the project based on their skills and knowledge and will be assigned to complete a task every week in each company meeting.

The corporate structure of Snail Tech has four executive positions. Ardavan Kalhori, the chief executive officer who manages all operation within the group. Amir Kassaian, the chief financial officer who is in charge of the financial planning. Sepehr Sheikholeslami, the chief technology officer who is responsible for technological issues. Ghazal Saray-sorour, the chief operation officer who is in charge of organizing meetings and daily operation of the company. These roles are filled according to ability and experience of each member.

Snail Tech believes that "the whole is greater than the sum of its parts" where all members are assigned to different tasks but they work closely together to achieve their goal.

Figure 12: Snail Tech Company Organization

8-Company Profile

Ardavan Kalhori – CEO

Ardavan is a fourth year Computer Engineering student at Simon Fraser University with three co-op work term experience at Alcatel-Lucent and Electronic Arts. He has more than 8 years experience in web and mobile software development. In addition, he has experience in agile project management and has successfully managed several projects such as UV-Suite mobile application, which was the winner of summer 2013 Simon Fraser University best application award.

Amir Kassaian – CFO

Amir is a fourth year System Engineering student in Simon Fraser University. He has acquired both research and industry experience during his coop experiences in SFU and Autopro Automation. His research interests are robotics (exoskeleton design, rehabilitation for stroke patients, motion assistive devices and etc.), control systems and sensor design. In addition, his industry experience has helped him develop cost estimation and project management skills suitable for this position.

Sepehr Sheikholeslami – CTO

Sepehr is a 4th year Systems Engineering student currently finishing his last term of studies at Simon Fraser University. Throughout his education, he has become skilled in using different lab equipment such as Oscilloscope, DMM, soldering, as well as hardware debugging and testing. School projects have helped him to gain experience in C++ and Java. He also has designed and assembled an assistive exoskeleton device in MENRVA group using SolidWorks and LabView.

Ghazal Saray-sorour – COO

Ghazal is a fourth year engineering science student majoring in systems. She is doing her last term of undergraduate studies at SFU this term. She has got some experience in image processing in C++ and MATLAB. She worked at Blackberry for her coop and gained experience analyzing and verifying logs and reporting bugs to development teams. She has prepared trend reports and also set up meetings while working as a beta software tester.

9-Conclusion

Snail Tech's goal is to design and implement a device to help elderly and athletes maintain their health condition. The main reason to use this device is that it is comfortable and easy to use, which is suitable for any person without any technical knowledge.

Snail Tech hopes that by end of November 2013 *Vital Band*'s first prototype would be ready and functioning as planned. Possible design changes are expected as discussed in this proposal, however thus far the goal is well defined and the scope is well within reach. Snail Tech contains a multi-disciplinary board of executives who hope to effectively combine their software, hardware, project planning and teamwork skills to the test and to create a product that is both useful and profitable.

10-Reference

- http://www.heartandstroke.com/site/c.ikIQLcMWJtE/b.3483991/k.34A8/Statistics.htm#stress
- http://www.health.am/psy/more/stress_may_be_behind_unexplained_cardiac_arrest/
- http://www.mec.ca/shop/heart-rate-monitors/50344/