ENSC 305W/440W Grading Rubric for Post-Mortem

Criteria	Details	Marks
Introduction/Background	Introduces basic purpose of the project. Includes clear background and motivation for the project.	**/05%**
Body of the Document	Provides a high-level description of main functions and project modules. Outlines materials, costs, and schedule (both estimated and actual).	**/15%**
Problems/Challenges	Outlines major technical challenges encountered. Explains how these were resolved. Details any major changes in scope and design.	**/05%**
Group Dynamics	Includes a discussion of how the team was organized, any problems that arose, and how they were resolved	**/05%**
Individual Learning/Work-load Distribution Chart	Includes a one-page, individually written reflection upon what was learned from the project, both technically and interpersonally (each team member writes a page about their learning experience). **The workload distribution chart outlines major technical, administrative, and support tasks and indicates who participated significantly in those tasks.**	**/25%**
Conclusion/References	Summarizes outcome and evaluates the project. Includes discussion of future plans, if any (or explains why project will be abandoned).	**/10%**
Meeting Agendas/Minutes	Includes an appendix that provides all the meeting agendas and minutes produced by the team over the course of the semester. (NB. Neatness does not count here.)	**/20%**
Presentation/Organization	Document looks like the work of a professional. Ideas follow in a logical manner. Layout and design is attractive.	**/05%**
Format Issues	Includes title page, table of contents, list of figures and tables, and references. Pages are numbered, figures and tables are introduced, headings are numbered, etc. References and citations are properly formatted.	**/05%**
Correctness/Style	Correct spelling, grammar, and punctuation. Style is clear, concise, and coherent.	**/05%**
Comments		

Post Mortem

Vital Band

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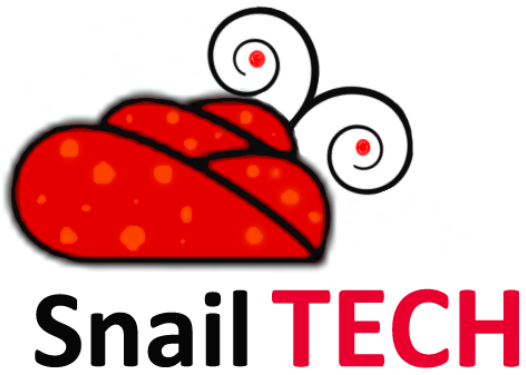

Submitted to
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1.Introduction

Snail Tech was created in September 2013. The team consists of three Systems Engineering and one Computer Engineering students. In September, Snail Tech proposed the Vital Band that is a wristband to measure heart rate and skin temperature.

The Vital Band consists of a pulse sensor, thermistor, microcontroller, LCD and a battery. The pulse sensor measures the heart rate and the thermistor measures the skin temperature. User has to place his fingertip on the pulse sensor for about 5 to 10 seconds to be able to see his heart rate accurately on the LCD. Skin temperature is displayed consistently as long as the device is on, because the wristband is in contact with the user's skin at all times. Microcontroller is used to communicate with sensors and LCD to display the data. A battery is used to power the wristband and an on/off switch will connect or disconnect the battery.

The main focus of designing and building the Vital Band is athletes who want to keep their workout intensity high by monitoring their heart rate while training.

2.Current State of The System

Figure 1 shows the diagram of how the user can interact with the device and measure the heart rate and skin temperature.

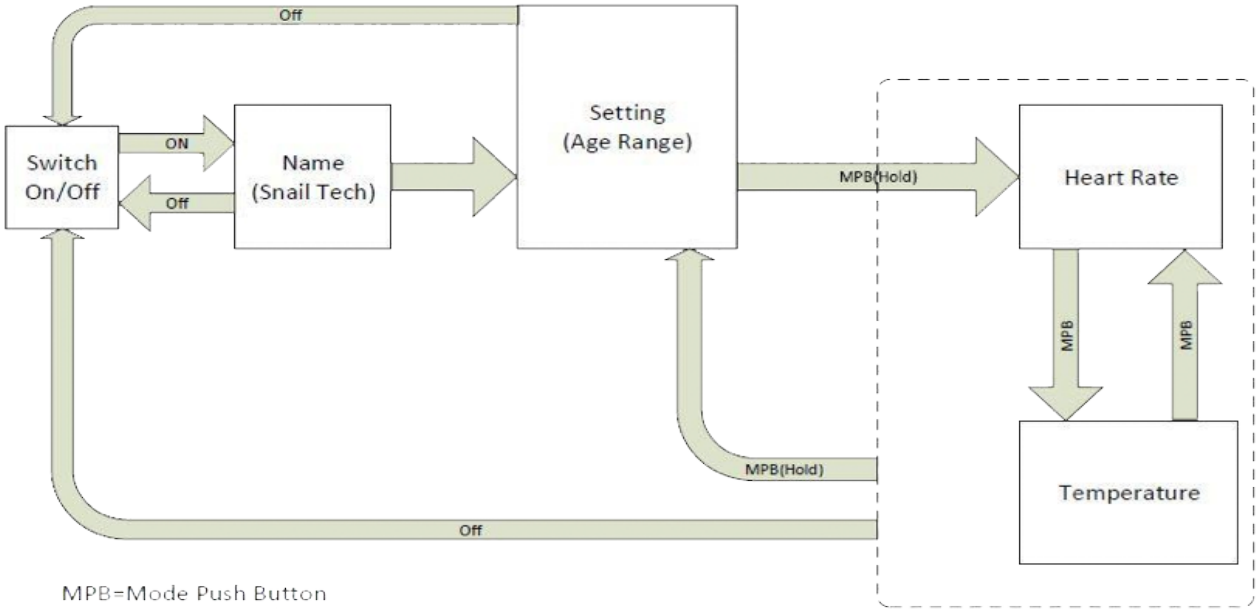


Figure 1. User Interface Diagram

The demo system prototype consists of two parts, heart rate measurement and skin temperature measurement.
A pulse sensor that it is placed on top of the wristband measures the heart rate. The microcontroller receives the signal and processes it and sends it to the LCD to be displayed.

A thermistor is placed underneath the wristband to be in contact with the user's skin. There is a variable resistor in the thermistor, which changes proportional to the skin temperature. The variation in the resistor changes the voltage going through the voltage divider that is passed to the microcontroller to convert to Celsius and is displayed on the LCD.

A rechargeable battery is placed inside the wristband to power the microcontroller, which powers the whole system. The battery can be charged using the charger that comes with the wristband. In future, the charger can be placed inside the wristband, which is more convenient for users.

The sliding switch is used to turn On/Off the device at anytime and the push button is used to change the mode between heart rate and temperature measurement. The push button is also used to select the age group in the settings page. Figure 2 shows the overall system and how the components are places in the wristband.

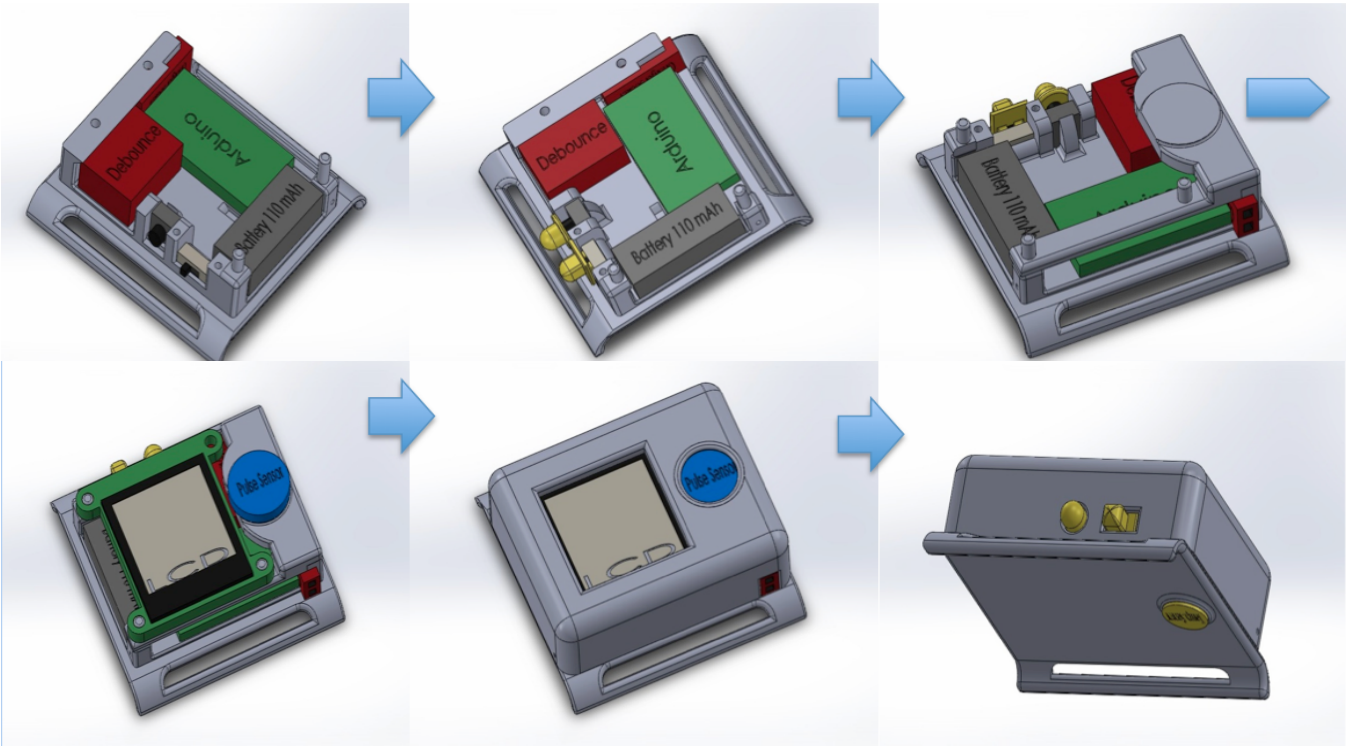


Figure 2. Overall System

3.Future Work

In the future, Snail Tech team would like to expand the market by adding a Bluetooth to the device, where the user can save the heart rate and skin temperature on his/her smartphone to manage the workout intensity. The Bluetooth feature makes the wristband suitable for clinical trial as well. Doctors can keep track of the heart rate of patients with heart conditions and prescribe the right drugs accordingly. Figure 3 shows the Vital Band App on smartphone that receives the data from the Bluetooth.

Figure 3. Vital Band App

4.Budget and Timeline

4.1 Budget

Table 1, shows the estimated cost that we proposed in September and table 2 is the actual cost of our project.

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. Estimated Cost

Equipment List	Unit Cost
LCD: Sharp memory display breakout – LS013B4DN04	$40
3D Printing	$150
Skin Temp Sensor – GE M1000	$1
Pulse Sensor	$25
Arduino Pro Mini 3V3	$10
Lithium Ion Polymer Battery 110 mAh	$8
USB/DC Lithium Polymer Battery Charger	$30
Electronics (Push Button, Switch, Schmitt trigger, etc)	$10
Equipment	$40
Shipping	$120
Total Prototype Cost	**$474**
Extra Costs: -Bluetooth Low Energy Module ($35) - IR Temp Sensor ($55)	$120
Total	**$524**

TABLE 2.Actual Cost

As we can see from the tables above, we over estimated the cost of our project. One of the reasons of overestimation was the shipping cost of the parts. We also overestimated the cost for 3D printing, which we found a less expensive shop to print the wristband for us.

4.2 Timeline

The Gant Chart below is the schedule that Snail Tech team came up with in September.

	Task Name	Duration	Start	Finish
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**
3	**Company Info**	**2 days**	**Wed 13-09-11**	**Thu 13-09-12**
4	Name	1 day	Wed 13-09-11	Wed 13-09-11
5	Design Logo	1 day	Thu 13-09-12	Thu 13-09-12
6	Cost Estimation	4 days	Sat 13-09-14	Wed 13-09-18
7	Solid Work Model	3 days	Tue 13-09-17	Thu 13-09-19
8	Power Point Presentation	2 days	Wed 13-09-18	Thu 13-09-19
9	**Proposal**	**14 days**	**Mon 13-09-09**	**Wed 13-09-25**
10	Research	9 days	Mon 13-09-09	Wed 13-09-18
11	Parts List	9 days	Mon 13-09-09	Wed 13-09-18
12	Proposal Document	7 days	Tue 13-09-17	Wed 13-09-25
13	Order Parts	2 days	Mon 13-09-23	Tue 13-09-24
14	Functional Specification	15 days	Fri 13-09-27	Thu 13-10-17
15	Oral Progress Report	4 days	Sun 13-10-20	Wed 13-10-23
16	Design Specification	15 days	Fri 13-10-18	Thu 13-11-07
17	Integration	17 days	Fri 13-10-25	Mon 13-11-18
18	Debugging & Prototype Modification	8 days	Tue 13-11-19	Thu 13-11-28
19	Meeting Minutes	42 days	Mon 13-09-09	Sat 13-11-02
20	Written Process Report	22 days	Fri 13-11-01	Mon 13-12-02

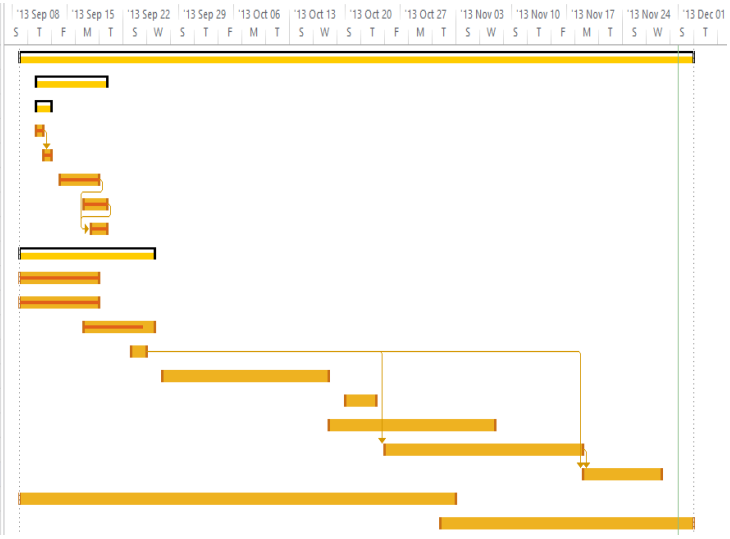
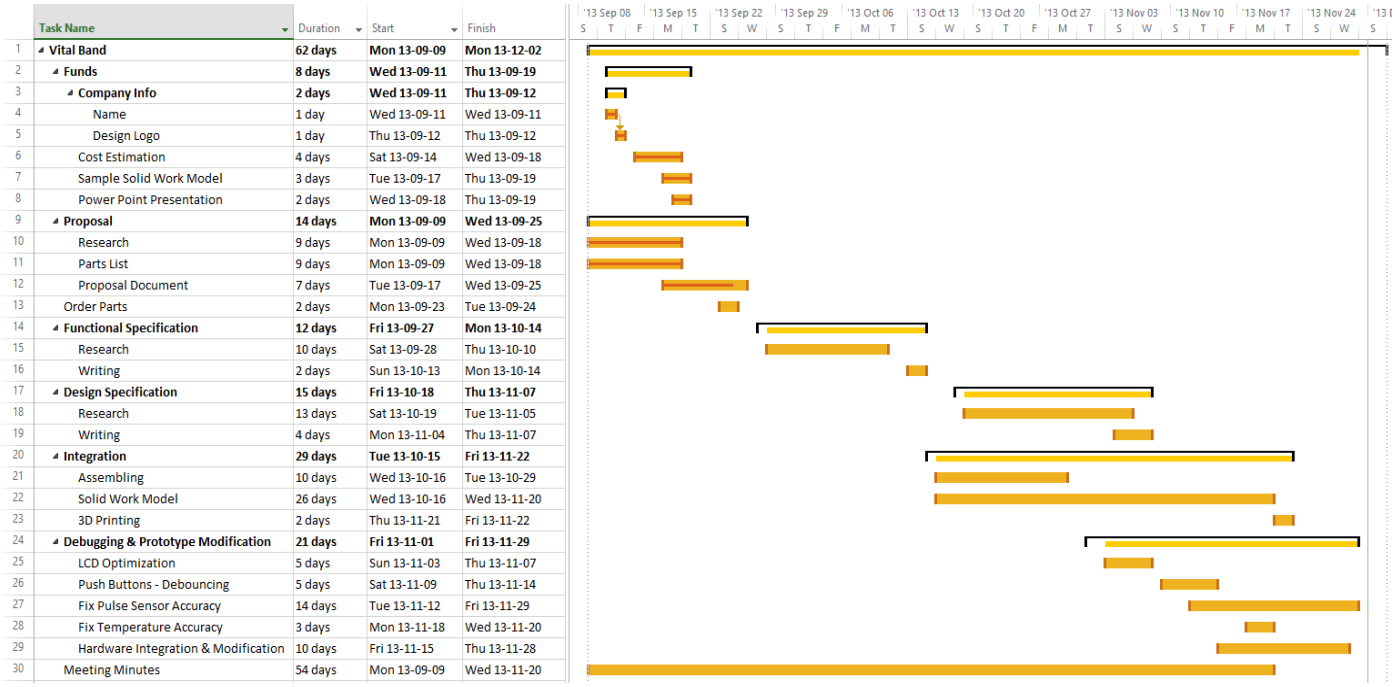


Figure 4.Old Schedule

Since one of the team members had experience in project management, He suggested using the agile management and recreating a schedule every two weeks based on the progress of each member and overall project. At the end of the project, the team followed the Gant chart below, which was created using the agile management.



	Task Name	Duration	Start	Finish
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**
3	**Company Info**	**2 days**	**Wed 13-09-11**	**Thu 13-09-12**
4	Name	1 day	Wed 13-09-11	Wed 13-09-11
5	Design Logo	1 day	Thu 13-09-12	Thu 13-09-12
6	Cost Estimation	4 days	Sat 13-09-14	Wed 13-09-18
7	Sample Solid Work Model	3 days	Tue 13-09-17	Thu 13-09-19
8	Power Point Presentation	2 days	Wed 13-09-18	Thu 13-09-19
9	**Proposal**	**14 days**	**Mon 13-09-09**	**Wed 13-09-25**
10	Research	9 days	Mon 13-09-09	Wed 13-09-18
11	Parts List	9 days	Mon 13-09-09	Wed 13-09-18
12	Proposal Document	7 days	Tue 13-09-17	Wed 13-09-25
13	Order Parts	2 days	Mon 13-09-23	Tue 13-09-24
14	**Functional Specification**	**12 days**	**Fri 13-09-27**	**Mon 13-10-14**
15	Research	10 days	Sat 13-09-28	Thu 13-10-10
16	Writing	2 days	Sun 13-10-13	Mon 13-10-14
17	**Design Specification**	**15 days**	**Fri 13-10-18**	**Thu 13-11-07**
18	Research	13 days	Sat 13-10-19	Tue 13-11-05
19	Writing	4 days	Mon 13-11-04	Thu 13-11-07
20	**Integration**	**29 days**	**Tue 13-10-15**	**Fri 13-11-22**
21	Assembling	10 days	Wed 13-10-16	Tue 13-10-29
22	Solid Work Model	26 days	Wed 13-10-16	Wed 13-11-20
23	3D Printing	2 days	Thu 13-11-21	Fri 13-11-22
24	**Debugging & Prototype Modification**	**21 days**	**Fri 13-11-01**	**Fri 13-11-29**
25	LCD Optimization	5 days	Sun 13-11-03	Thu 13-11-07
26	Push Buttons - Debouncing	5 days	Sat 13-11-09	Thu 13-11-14
27	Fix Pulse Sensor Accuracy	14 days	Tue 13-11-12	Fri 13-11-29
28	Fix Temperature Accuracy	3 days	Mon 13-11-18	Wed 13-11-20
29	Hardware Integration & Modification	10 days	Fri 13-11-15	Thu 13-11-28
30	Meeting Minutes	54 days	Mon 13-09-09	Wed 13-11-20

Figure 5.Actual Schedule

As we can see, most of our time was spent on the integration and testing part of the project, where we underestimated the time needed to complete these parts at first.

6.Personal Reflections

Ardavan Kalhori - CEO

Over the last three months, our team has put a great effort working on this project. Our focus was to design, implement and build a prototype that actually works and has all the features that we specified in our design and functional specifications.

As the project manager for this project, I had the opportunity to improve my project management skills. I applied the agile project management methodology. Agile gave us the flexibility to split different task to different group members based on the deadlines and progress of the project.

I was also responsible for coding our microcontroller to communicate with the sensors and LCD. We decided to choose Arduino Pro Mini as our microcontroller and I had a chance to familiarize myself with this popular microcontroller not only with its built-in software functionalities, but also with its hardware in details.

The most challenging part of this project was to make it as efficient as possible so, the user won't notice any delay in the calculation and displaying the result on the LCD.

Overall I enjoyed working on this project with all the challenges that we faced during the implementation of this prototype. I also really enjoyed working with my group members and I think that was one of the reasons that we were successful in designing this product.

Sepeh Sheikholeslami – CTO

Vital band is a device that was built by our talented and hard working team members. First month was not as challenging as I thought; but after that we realized that there are a lot more work to do for designing and implementing a prototype.

The most important factor of our design was our device to be compact. My main responsibility during these past months was mostly hardware implementation. I had to design a small wristband that is similar to an everyday use watch. The hardest part I have encountered was to manage to place all required electronic components in a way that they occupy the least amount of space in our device. I had used a Casio G-Shock watch as a reference for the size of my device, and eventually I accomplished this goal and designed the vital band with similar dimensions to my G-Shock watch. Designing the charger housing was another task I had to do, but it was not as challenging as the main device.

Another important challenge I had faced was to assemble the device. I had to do a lot of modifications (like sanding and drilling) in order to properly place and fix our electronic components in the 3D printed housing I have designed. Then soldering was another task, which Ghazal and me had to handle. Soldering the components properly with the right amount of cable was another important factor to properly place the components in the housing. It is worth mentioning that my coop job has helped me a lot in designing this device.

After everything was assembled and working. I had to start to think about how to make the device look attractive. So I covered the wristband with carbon fiber cloth and our company logo and then covered them with resin epoxy in order to give it a nice shiny look.

During these past few months I have learned how to work in a team. I have also learned that the most important factor in working with a team is to be able to

communicate with each other and do not make any decisions based on false assumptions that just comes in to my mind.

Amir Kassaian - CFO

The preceding 3 months contained within itself a variety of new but challenging lessons in store for me. Naturally, there are numerous challenges in the process of designing a product from the ground-up, however, a team composed of friends and long hours of hard work proved to me that these challenges were not impossible to overcome.

Time and budget estimation is essential in order to have a well-organized product design and prototype manufacturing. As the CFO of Snail Tech, one of my main responsibilities was to keep an eye on our budget and thus avoid unnecessary delays in our project due to lack of funds.

Because the Vital Band is biomedical device primarily aimed at monitoring exercise intensity and health in general, we needed to have sufficient knowledge about the related human physiology and biology. Therefore, I made sure we had all the necessary information by doing a sufficient amount of research not only in human physiological response to exercise, but also on the available technology and methods to measure the indicators (e.g. heart rate monitoring via ECG electrodes or peripheral capillary tissue). In order to avoid being overwhelmed with these new information, I was responsible to document and incorporate my findings in the engineering reports required for this course.

On the more technical side, I was responsible in interpreting the signal from the pulse sensor and converting the data received into recognizable BPM measurements. This not only coincided with my research, but also required my experience in programming a microcontroller and sensor noise mitigation techniques (e.g. choosing proper insulation for wiring).

All else aside, perhaps the most important skill I acquired during the course of this project is teamwork and time management. The building of the Vital Band would not be possible without my knowledgeable and hardworking peers, from whom I learned many valuable lessons, for which I am grateful beyond bounds.

Ghazal Saray-sorour - COO

Throughout this project, I was glad that I am working with people that I know since I started my undergraduate studies at SFU. Working with friends, made this project fun and less stressful.

I was responsible to organize the meetings and prepare the meeting agenda and meeting minutes to keep track of the project's schedule. For my technical responsibility, I designed a part of the hardware, which encloses all the components using SolidWorks. I was involved in research and documentation of the project. I researched on common techniques used to measure heart rate and skin temperature to finalize which technique to use in our wristband that can fit our budget and design.

During the completion of the project, I learned how to work in a group, where every person has experience and knowledge in a specific subject. We all used our experiences and knowledge we gained during our undergraduate studies to design and build a project for people who don't have engineering skills.

6.Conclusion

During the Fall 2013 semester, Snail Tech was able to produce a working prototype of the Vital Band, which met most of the functional requirements specified in the functional specification document. The main goal was to build a device that is compact and has the main functionalities to measure heart rate and skin temperature for the prototype.
While designing and building the Vital Band, every member of the team has gained technical and non-technical experience throughout the project.