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April 18, 2016

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 305W/440W Post-Mortem Report for *PortableHUD*

Dear Dr. Rawicz:

The attached document from SafeVision is the post-mortem report for a Safety System for Snowboarders/Cyclists/Motorcyclists, *PortableHUD*. *PortableHUD* includes Heads Up Display (HUD) which shows GPS information, speed, temperature, and time. With the *PortableHUD* mounted on helmets, users could get the required information without losing their focus on their current activities. The *PortableHUD* could also communicate via RF radio within a group.

This document demonstrates the current stage and future plan of *PortableHUD*. It also provides financial review of the project and outlines some problems and challenges occurred during the whole project cycle.

SafeVision consists of six hard working, detail-oriented, and motivated fourth-fifth year engineering students: Pak Lun Hoi, Xuemeng Monica Li, Amina Qurban, Anastasia Suprun, Yifeng Xie, and Qing Zhuang. If you have any questions or concerns about the Design specification, please, feel free to contact our CEO by phone at (778) 828-6433 or e-mail at aqurban@sfu.ca.

Sincerely,

Amina Qurban
President and CEO
SafeVision
Enclosure: *Post-Mortem Report for PortableHUD*

Post-Mortem Report for PortableHUD

Project Team:	Amina Qurban Anastasia Suprun Pak Lun Hoi Qing Zhuang Yifeng Xie Xuemeng Monica Li
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Submitted to:	Dr. Andrew Rawicz – ENSC 440 Steve Whitmore – ENSC 305 School of Engineering Science Simon Fraser University
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Executive Summary

People have a tendency to use cell phones while performing physical activities or driving which usually results in less focus and, as a result, causes accidents. Over the years, several law regulations were introduced but they never resulted in any improvement. People still tend to use cell phones thinking that they can multitask with distractions. As a result, multiple companies introduced their solutions including the iWatch [1], Google Glass [2], and Recon Goggles [3]. For our capstone project, we decided to make portable heads up display that can be used with all types of helmets to ensure that people are aware of the surroundings while providing them with the needed information.

One of the main features of *PortableHUD* is the ability to locate a user on the map, provide the current time, and speed. As a result, that eliminates the need of multitasking using cellphones. By displaying the speed on the screen, *PortableHUD* can notify a person of over speeding which could potentially prevent an accident. One of the situations where the feature can be used is while snowboarding. If the snowboarder goes too fast near the bottom of the hill, the alert would be activated informing that the speed is too high.

Also, *PortableHUD* has a temperature sensor which informs the user the current temperature for him to decide whether it is safe to continue the activity. For example, it is not recommended to cycle at low temperatures because bicycles tires lose the traction on the icy roads. It can become even more dangerous if a person cycling in the city on the busy roads due to automobiles and pedestrians.

Our radio frequency communication feature allows group of people to chat while doing other activities. The feature can be particularly useful for the motor bikers. When a group of bikers drives on the highway, people among the same group can be informed when to exit the highway. The device also has ability functionality to play the radio when desirable. Finally, features such as GPS tracking is always useful when trying to get around the town or travel places. The GPS saves the previous locations of the user allowing monitoring the trajectory.

The device can be easily mounted on any helmet using a Go Pro mount. It has five degrees of freedom allowing a user to adjust the position for the best fit. If desirable, the device can be mounted either on the top or on the side of the helmet.

SafeVision team consists of six engineering students with various background including mechanical, electrical, systems and computer options. Throughout the semester the Modified Waterfall Model was used to ensure successful completion of the project in 13 weeks. The actual cost of the prototype ended up to be approximately $360 which is just slightly over the received fund from ESSEF ($300). The rest expense is shared by all team members.

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Glossary

ABS: Acrylonitrile butadiene styrene

CSA: Canadian Standards Association

dB: decibel

GPS: Global Positioning System

HUD: Heads Up Display

IEC: International Experience Canada

IEEE: The Institute of Electrical and Electronics Engineers

LCD: Liquid Crystal Display

MCP: Master Control Panel

PCB: Printed Circuit Board

RF: Radio Frequency

SCP: Slave Control Panel

SQ: Square wave

TFT: Thin Film Transistor

1. Introduction

This documentation provides the post-mortem report of *PortableHUD*, which consist of software, hardware, and mechanical challenges encountered during implementation of proof-of-concept model, and appropriate solutions to the issues. A comparison between the estimated schedule and cost is also provided in the document. In addition, group dynamics, individual reflections on the project, and all meeting minutes can be found in Appendix.

1.1 Project background

Some of the most preventable accidents in sports are caused by distraction due to use of electronic devices. In addition, helmets are commonly used in many activities including snowboarding, motorcycling, and cycling as it provides additional protection. The goal of the SafeVision team is to produce an attachable device for helmets that could provide GPS location, speed, temperature, and RF communication. *PortableHUD* allows providing information while minimizing distractions to the user. *PortableHUD* does not require any modifications of the helmet nor glasses by mounting the product to the side; thus, making our product unique compared to other HUD products in the market. By using a Heads Up Display (HUD) attached to a helmet, SafeVision team is designing and implementing a device that would be portable and easily mountable to any type of helmets utilized for sports. *PortableHUD* consists of Master and Slave Control and extendable mount. Figure 1 illustrates the CAD model of *PortableHUD*.
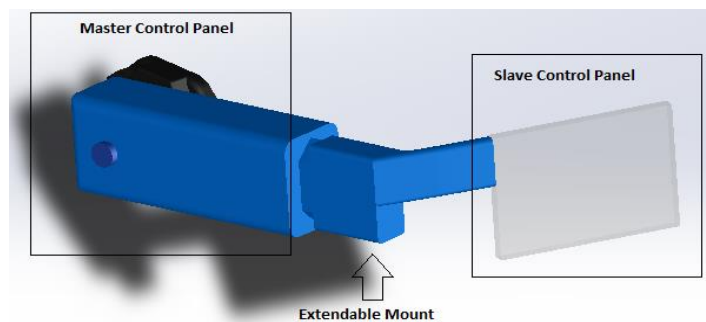

Figure 1: Front view of *PortableHUD*

In addition, due to wireless connection between Master and Slave control panels, users could use the Slave part as GPS inside their cars. For example, since both the Master and Slave control panels are wirelessly connected, as long as they are within range *PortableHUD* would still function accordingly.

2.   Schedule

The following Figure 2 is overall original schedule, including the assembly milestone and paper work deadlines. We found out the most efficient way to work on the project is by working in pairs. Therefore, we decided to work on multiple modules in parallel to increase productivity and to meet the deadline outlined in the schedule.
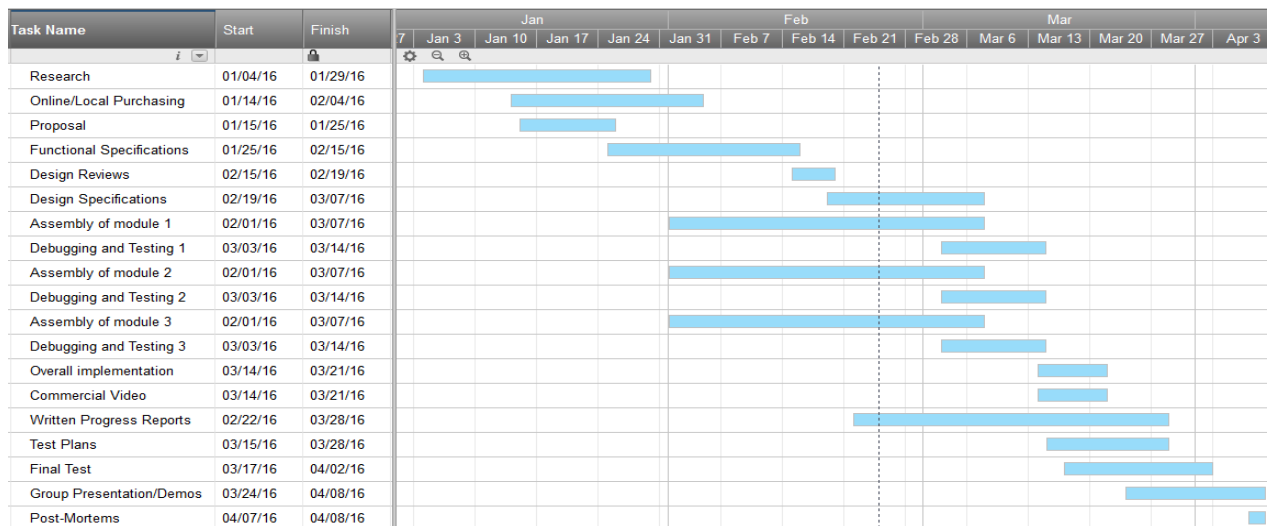
Task Name	Start	Finish
Research	01/04/16	01/29/16
Online/Local Purchasing	01/14/16	02/04/16
Proposal	01/15/16	01/25/16
Functional Specifications	01/25/16	02/15/16
Design Reviews	02/15/16	02/19/16
Design Specifications	02/19/16	03/07/16
Assembly of module 1	02/01/16	03/07/16
Debugging and Testing 1	03/03/16	03/14/16
Assembly of module 2	02/01/16	03/07/16
Debugging and Testing 2	03/03/16	03/14/16
Assembly of module 3	02/01/16	03/07/16
Debugging and Testing 3	03/03/16	03/14/16
Overall implementation	03/14/16	03/21/16
Commercial Video	03/14/16	03/21/16
Written Progress Reports	02/22/16	03/28/16
Test Plans	03/15/16	03/28/16
Final Test	03/17/16	04/02/16
Group Presentation/Demos	03/24/16	04/08/16
Post-Mortems	04/07/16	04/08/16

Figure 2: The overall original schedule

The following shown in Figure 3 is the actual overall schedule. We started to integrate each part when the modules arrived. The actual integration time varies from module to module. As you can see, the temperature sensor and RT Clock took only two days but RF communication pair took one and a half month. In the middle of March, we start to integrate everything together. And during the integration time, the mechanical support took two weeks to finalize.

Task Name
Research
Online/Local Purchasing
Proposal
Functional Specifications
Design Reviews
Design Specifications
Code and Debugging of LCD
Code and Debugging of RF Communication
Code and Debugging of Wireless Transmission
Code and Debugging of Temperature Sensor and RTClock
Code and Debugging of GPS
Overall Implementation on Slave
Overall Implementation on Master
Written Progress Reports
Test Plans
Final Test
Commercial Video
Group Presentation/Demos
Post-Mortems

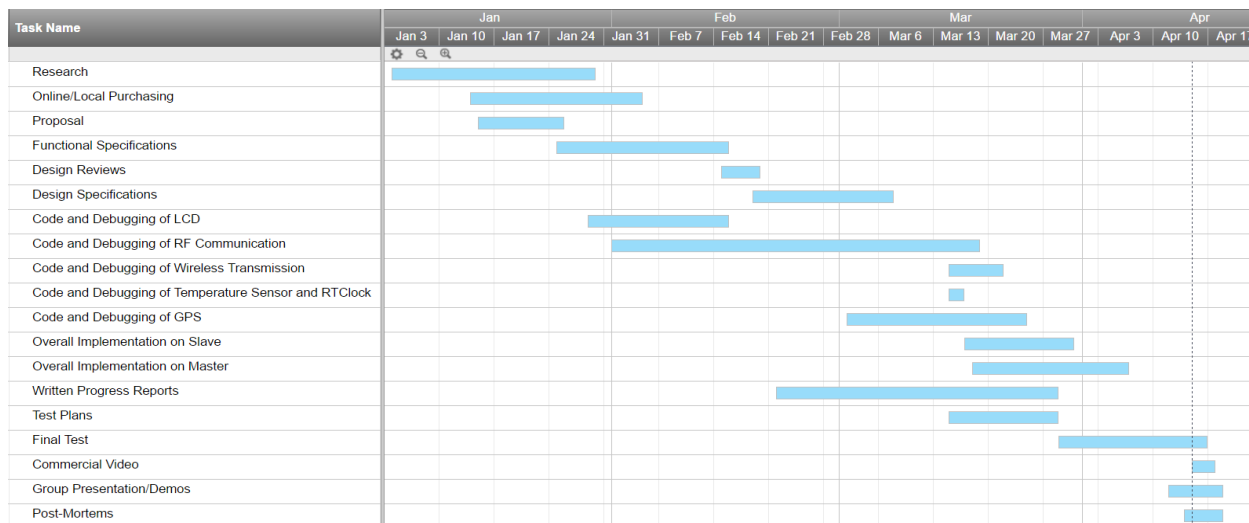**Figure 3: The overall actual schedule**

Figure 4 (a)(b)(c) shows the state on assembly milestone on February 26, March 28 and Apr 18.
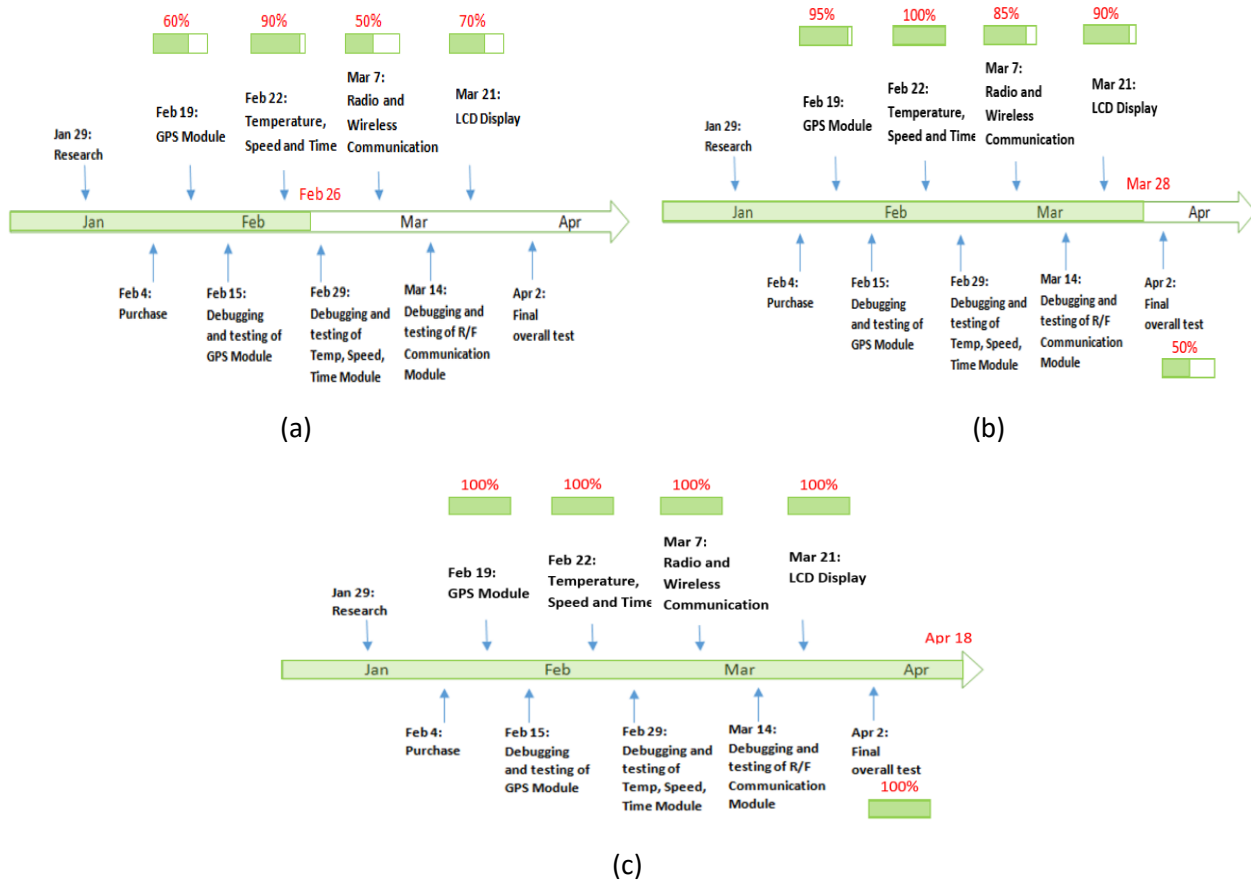

(a)

(b)

(c)

Figure 4: Key Time Milestone Percentage Progress

3. Product design process

The following section will cover the challenges encountered while designing the prototype and the solutions to them. Challenges are divided into Hardware, Software, and Mechanical sections.

3.1 Hardware design challenges

There were a couple of challenges that we faced during the design of Radio Frequency communication function. At the beginning, the microphone didn't provide any input to the transmitter. After researching online and talking with our colleagues, professor and TA, we realize that our microphone doesn't have its own phantom power. Later we ordered an electret microphone, and built up a circuit to provide it with the necessary power using the Arduino 5V output. The next challenge was to reduce the noise that went through microphone and amplified by the speaker. After consulting with Lakshman One about the noise problem we learned that the noise was originating from the input device. Using knowledge from microelectronics we built

a low pass filter to filter out the majority of the noise. We placed the low pass filter before the input of the RF transmitter to get rid of the noise.

For the wireless communication, the main challenge was that the wireless module able to transfer a maximum of 32-bits data each time. Through discussion within the group, we decided to use the three most significant bits in the data as a way of identifying data for each module. Setting up and recognizing the most significant bit took the most effort. But by doing this, we were able to transfer as many types of data as possible. During the development of the wireless communication, we had to take into account the different types of data such as when GPS direction, negative or positive temperature, and AM/PM for time.

The original design for slave control panel consisted of Arduino Uno as a microcontroller. However, during the integration of LCD and wireless data receiver, the team encountered problems such as low memory availability and insufficient amounts of interrupt pins. As a result, the Arduino Mega was used as a replacement for the slave control panel which has more memory available and interrupt pins allowing us to have additional functionality on LCD.

Since the GPS module is on the Master Control, the coordinates are being transferred through wireless data transmission. As a result, there is a delay in updating the location. To solve that, GPS can be moved to the Slave side. Finally, because a good quality GPS module was too expensive, the team decided to buy a cheaper version. It resulted in the lower speed accuracy.

3.2   Software design challenges

The memory of RF communication was occupied to 93% of Arduino Uno memory on master control panel before integrating other components. Stability problems may occur when low memory is available. During the integrating stages of master control panel, global variables were replaced by local variables in order to reduce dynamic memory. As a result, the dynamic memory now on master side is reduced to 77% which can ensure correct outputs. As mentioned in section 3.1, the slave control panel had similar problems. In the slave control panel, the libraries of the LCD occupied most of the memory of the Arduino Uno resulting in the LCD becoming unstable. Also, since the Arduino Uno only consisted of two interrupt pins, integrating the code for both the LCD and the wireless receiver was a challenge since both modules require the use of the same pins. By switching to the Arduino Mega, we solved both the limited memory issue and the lack of interrupt pins available.

During the first stages of the LCD functionality implementation problems were encountered due to the fact that the LCD module was purchased from China. It resulted in the lack of proper library availability on the official website. The problem was solved by debugging the code and reading library files to find the key identifier. Once identifier was found, team that was working on LCD was able to search for the similar problems online and find the proper library.

3.3   Mechanical design challenges

When designing the mechanical parts for *PortableHUD*, the precise dimension, size for various openings, and hole locations on the enclosure were the challenges faced. Since all the modules were soldered together onto breadboard in two layers, there is no specific margin or clear boundary to measure from. In order to solve this problem, rough estimations were made to draw the SolidWorks model and the first attempt of 3D printing was to observe how much error we have in order to reach the correct dimension and opening locations. During the process of using Trial-and-Error method, we conquered the challenge and printed the prototypes that can be used for *PortableHUD*.

4.   Financial

PortableHUD has reached its financial goal by keeping the cost lower than the estimated cost from the beginning of this project. Attached is the cost summary of all the components and modules we have used for *PortableHUD*.

Table 1: Current project costs

Items	Actual Cost ($)	Estimated Cost ($)
Arduino Uno	28.41	20
Arduino Mega	71.06	60
2.8' TFT LCD display	9.67	55
TEA5767 FM stereo radio	6.22	30
FM transmit	27.45	30
Micro phone amplifier	10.26	10
Ball speaker	13.51	10
GPS breakout	49.78	60
RTC	13.96	20
Digital temp sensor	6.36	15
RF wireless trans & receiver	13.55	25
Solderable breadboard	9.47	25
Jump wires	15.15	15
9V battery *2	9.47	30
GoPro mount	2.50	10
3D printing enclosure	20.00	60
extendable support	10.00	10
tax & shipping	48.53	50
Total	365.35	525

5.   Business case

There are couple types of HUD for helmets out there on the market, such as a one side folded screen by BMW and projector outside the gaggle by NUVIZ. Multiple start-up companies are racing to be the first ones to make this idea functional including Skully, BMW and Bell. Table 2 shows the prices between those existing products.

Table 2: Prices comparison between existing products

Company	Product	Price
Google [2]	Google Glass	USD 1500
Recon [3]	SNOW2	USD 399
SKULLY [4]	SKULLY AR- 1	USD 1499
BIKESYSTEMS [5]	BikeHUD	N/A

Most of these companies are doing motorcycle helmets, which is big and heavy on motorcycle applications. As for Google Glasses, it is portable and convenient to wear onto regular glasses, but the price is very high. Instead of competing head to head with these companies or start-ups, our product focuses on not only motorcyclists but also cyclist and snowboarders. This provides *PortableHUD* with a unique feature, as it is compatible with multiple types of helmets by utilizing the GoPro mount attached on helmets.

Once we put all circuitry into PCB design and make the products into massive production, we estimated that the cost of our product would be lower than $100 including materials and labor cost. We are aiming the selling price at $150.

6.   Team dynamics

SafeVision team consists of 6 students from electronics, computer, and system engineering programs. All individuals are highly enthusiastic, innovative, and believe in success of the project. Throughout the term, all team members were treated equally with respect and professional judgment. Contrasting personalities and various experience resulting in shifting team members into different roles. Roles are demonstrated in Table 3.

Table 3: Group members' roles

Amina Qurban	Anastasia Suprun	Yifeng Xie (Wendy)	Xuemeng Li (Monica)	Qing Zhuang (Francis)	Pak Lun Hoi (Joel)
Leader Facilitator CEO	Initiator Devil's Advocate COO	Specialist CFO	Critic CTO	Supporter Specialist Lead Mechanical Engineer	Listener Mediator Lead Software Engineer

To ensure consistent forward progress and enhance team dynamics, we set up a minimum of three weekly meetings to discuss progress, introduce new goals, and propose ideas for improvement. During the meetings minutes were recorded and approved by all team members. These meetings typically took place at the SFU Burnaby Mountain in either Lab 1 or Lab 4. In addition to that, most of the immediate questions were discussed through cellular phone application WhatsApp.

Few weeks into the term the group was divided into subgroups to improve team progress and increase productivity. Subgroups were formed voluntarily based on the best suitable work schedule. The subgroups division is demonstrated in Table 4.

Table 4: Subgroups Division

Subgroups		
Amina Qurban and Anastasia Suprun	Yifeng Xie(Wendy) and Qing Zhuang(Francis)	Xuemeng Li (Monica) and Pak Lun Hoi (Joel)

The subdivision was introduced to increase productivity by improving tasks distribution between group members. Each individual subgroup was able to be an expert and deliver best possible results in the assigned to them tasks rather than rely to the deliverables of the teammates. Table 5 shows the workload distribution among team members with respect to relative effort across various tasks. The maximum workload represented by xxx.

Table 5: Workload distribution among group members

High-Level Task	Amina Qurban	Anastasia Suprun	Yifeng Xie (Wendy)	Xuemeng Li (Monica)	Qing Zhuang (Francis)	Pak Lun Hoi (Joel)
GPS module implementation	xx	xxx	xx		x	x
RTC module implementation		xx	xx			
Temperature implementation			xxx		x	
RF module				xxx		xxx
Wireless data transmission			xxx	xxx		xxx
LCD	xx	xxx				
Integration of parts (software)		xx	xxx	x		
Assembling and Soldering	xxx	x		xxx	xx	
Mechanical design	x				xxx	
Module and System Testing	xx	xx	xx	xx	xx	xx
Documentation	xx	xx	xx	xx	xx	xx
Administrative Task	xx			xxx		
Meeting Minutes	xx	xx	xx	xx	xx	xxx

7. Conclusion

SafeVision had been researching and designing a HUD display for the past 4 months. Through multiple challenges and problems faced, we had to make some changes compared to our initial proposal. By following closely to the Gantt schedule created in the beginning of the semester, we were able to integrate multiple modules in parallel to build a proof-of-concept model in 13 weeks.

For future development of RF, we could add more channels for customer to choose from. We could also implement a string transfer and image transfer to increase the efficiency of the data being transferred. A camera could also be added to the slave control panel in order to increase the market value of *PortableHUD* to have a similar functionality of a GoPro camera. In addition, a transparent display could be used to prevent the vision from being blocked. Also, a transparent screen could fix the glare problem that the LCD has during a sunny day. Furthermore, we could also make the casing waterproof making it possible to use *PortableHUD* in all weather conditions.

SafeVision also would like to thank Andrew, Steve, Ash, Lucky, Jamal, Hsiu Yang, Mahssa, Mona, and Soroush for all the support that was provided from them.

References

[1] "iWatch," Apple, [Online]. Available: http://www.apple.com/ca/watch/. [Accessed 24 Jan 2016].

[2] "Google Glass," Google, [Online]. Available: https://developers.google.com/glass/distribute/glass-at-work. [Accessed 24 Jan 2016].

[3] "Recon Jet," Recon, [Online]. Available: http://www.reconinstruments.com/products/jet/. [Accessed 24 Jan 2016].

[4] "Skully AR-1," Skully, [Online]. Available: http://www.skully.com/. [Accessed 24 Jan 2016].

[5] "Bike HUD," Bike Systems, [Online]. Available: http://www.bike-hud.com/#bikehud. [Accessed 23 Jan 2016].

Appendix A: Individual Reflections

INDIVIDUAL REFLECTION: AMINA QURBAN

"Coming together is a beginning, staying together is progress, working together is success."

-Henry Ford

One semester prior to taking capstone course we formed our group, and that is how everything started. Since I knew most of the members from previous engineering courses, I knew I will not regret to be in the same group with them. At the beginning of the semester, from various project ideas we narrowed down our choices to *PortableHUD.* I actually did not have any clue how we are going to start our project. After some research of how we can implement our product, we decided to use Arduino microcontroller. We decided that we will have GPS, time, temperature, speed to show in a heads up display, also giving the user RF communication in case of group activities.

Since we had 6 modules to be integrated in Arduino, we split our group in three based on time and flexibility of individuals: Wendy and Francis for time and temperature, Monica and Joel for wireless transmission and RF communication, Anastasia and I for LCD and GPS. After implementing each part individually, Wendy combined software for master part and Anastasia on slave side. Francis was mainly working on mechanical design of *PortableHUD*. Monica and I assembled and soldered parts together. There were several challenges that we had to go through; fortunately, we resolved most of the challenges due to hardworking and intelligent members of my team. In order to save some money, we bought relatively cheap LCD display, comparing to RP electronics. Because it was from cheap vendor, it was hard to find the right source code. After long researches, Anastasia and I made the LCD working. Then we started implementation of GPS. When Anastasia and I tried to integrate LCD and GPS on Arduino Uno microcontroller, we had memory issues. To solve this issue we found out that we need to purchase Arduino Mega.

The framework of capstone course made us keep going. In other words, every time we did documentation, we had lots of research, and every time we would find out that there some stuff that we cannot make and other stuff that is easier to do. Without doing all the documentation the project would not be completed in just 4 months. So, I would like to thank our professors Andrew and Steve, as well as our TAs Jamal, Hsiu-Yang, Mahssa, Mona, and Soroush for their guidelines

Working on developing *PortableHUD* with SafeVision team has been great opportunity for me. I have learned many technical and interpersonal skills through this project: Arduino products, working in a team, meeting deadlines, organization, etc. Along with all that knowledge we gained throughout the semester, we successfully completed the proof-of-concept model of our product. Every individual in my team is incredible talented, and I would be glad to work with any of them in the future.

INDIVIDUAL REFLECTION: ANASTASIA SUPRUN

When I first started engineering, we were required to take Ensc 100 and Ensc 101; that experience made me think how important to form a group out of talented individuals with various backgrounds in order to have knowledgeable and competitive team. Approximately 8 month before the course start date, the group started to form based on the various experience each team member head. By the beginning of the semester the team head one of each: computer, electronics, and mechanical engineering in addition to 3 system engineering students with quite different work experience. The team had number of interesting and challenging ideas for potential future projects; however, we decided on the portable display that includes multiple important features and accommodates various types of helmets - *PortableHUD*.

The research started by choosing the features needed to be implemented on the device, how they was going to be fulfilled and who was going to be responsible for what. At that point group decided to use Arduino as a microcontroller and acquire necessary modules. At the same time, group was divided into subgroups to improve the productivity of the team. Joel and Monica were working on RF communication and wireless data transmission. Wendy and Francis were implementing RTC and temperature; meanwhile, Wendy was working on the modules integration and helping Monica and Joel on wireless data transmission, and Francis was working on the mechanical design.

Amina and I chose to work on LCD and GPS. Our task was to display data in the designated positions on the screen and show logo on the home screen while information from other modules was loading. We quickly learned that the most efficient way was to research for the available tutorials and spend some time on implementation of simple tasks before we could work on the needed functionality. At first, we had some challenges with LCD library due to the fact that we bought a screen from China to save money. At that point we learned how important reading datasheets is and how research for peoples' solutions to the same issue. We also learned a lot by reading the libraries and examples code before we were able to display any information on the screen. Once the base functionality was implemented, we moved on to the GPS module. Originally, our idea was to save parsed GPS coordinates on the SD card and then display them on the map so the user can see the trajectory. That idea was abandoned due to potential map clattering. Once the GPS was implemented, we decided to introduce additional screen for the map to improve the visibility. Since we had a touch screen, we decided to learn how to implement switch between various monitors. At that point we learned that we can switch between screens by just applying the pressure.

Overall, the group had a great dynamics, people acted as professionals; we all gained great deal of experience both working as a team and individually. Using this opportunity I want to thank Amina, Joel, Monica, Wendy, and Francis for the valuable experience and wish them best of luck! Also, big thank you to Andrew, Steve, Jamal, Hsiu-Yang, Mahssa, Mona, and Soroush for guiding us on that journey.

INDIVIDUAL REFLECTION: YIFENG XIE

SafeVision is a start-up company comprised of six talented and enthusiastic engineers who have different concentrations including electronics, systems and computer engineering. We all had previous co-op work experience in diverse fields which equipped us the knowledge from many fields. I am proud to join the team as an electronics engineer and chief financial officer. To ensure consistent forward progress and enhance team dynamics, we set up a minimum of three weekly company meetings and we have three subgroups of two members.

We set our company name as SafeVision in the beginning of this semester, because our product is a portable Heads Up Display and it provides snowboarders and cyclists the information they need during activities including GPS location, current time, temperature and speed. And it also supports group communication through radio communication. The company logo was designed by me with blue fonts and the key features of our product.

Throughout this semester, we have encountered different tasks and solved various challenges. I was responsible for implementing GPS, Real Time Clock and temperature sensor components. When deciding the key features of our product, real time and temperature were considered as two separate modules. As a result, we bought two separate modules for them. Based on the feedback from mechanical design, we have to minimize the components in order to place in an enclosure with reasonable size. After redoing research about the RTC module, I realized the RTC can be integrated with another temperature sensor within the same module which can save space and reduce wires. I have learned that detailed research can help me make better choices on choosing components for our product. And in order to work efficiently and reduce the cost of the product, I should try to discover more functions from the components we have rather than purchasing multiple components.

Besides, I was responsible for software integration of master control panel, I need to combine the code wrote by other team members and convert the data into the type of wireless transmission. I have learned the efficient way to read and understand other team members' code. Communication played the most important role in combing code. I kept myself in their loop when they were working on separate functions which made me easy to understand code. Also, I consulted my team members regarding to their different coding styles and the libraries being used in order to get the data I need quickly and precisely. During the physical integration, I learned to integrate functions one by one, so that it made circuit or software debugging easier. Once the current integrated functions worked, and then I moved to integrate other functions.

For future projects, I am willing to work as a member of SafeVision with my talented team members. I would like to take other roles in future projects in order to practice my management skills. Overall, delivering the *PortableHUD* as one member of SafeVision Team was a great experience in my life of pursuing the engineering degree.

INDIVIDUAL REFLECTION: XUEMENG LI

Things that I learned the most from this project are how to prepare standard paperwork for an engineer project, go through a standard design cycle of project, use Arduino to work with multiple modules and communicate within a group to work efficiently. Through the project goes on, we managed to integrated multiple functions on a head up display as a proof-of-concept.

Four months before the term start, we found up our group in a group of six, including four systems engineers, one computing engineer and one electronics engineer. Through meetings and talking with Professor Andrew last term, we came up with a list of ideas and chose the idea of an attachable Head Up Display for all type of helmets. This is the start of the fancy journey.

Then it comes to this term. We spent most of our time on paperwork at the first half of our term. During the writing process, we have done a lot of research and logically combine the information into proposal and function specification. To be honest, I thought paperwork is just an extra work on the top of our project at the beginning. However, when it comes to the design stage, the paperwork turns out to be a great resource for us to refer to and helps as a guideline when we go through the rest of the term.

After we finished most of our paperwork, most of the modules that we ordered arrived and we start to integrate modules in subgroups. Joel and I chose the RF radio communication module and wireless data transmitting module to work on. While doing RF radio communication, we started on the radio transmitter by sending a music signal to a FM frequency and testing it with a real radio receiver. Then, by searching around and testing on all kinds of microphone, we chose the electret microphone and built a power circuit for it to provide the input of the transmitter. The electret microphone could use the power from Arduino and send a stable voice input. After the microphone worked, we tested it with our radio receiver and also built up a low pass filter to eliminate the noise. Then we start to work on the wireless module. The data that the wireless module sending is in 32 bits unsigned long format. To organize the data from different modules, I took three most significant bits as a label to distinguish them. By using the conversion between binary and signed integer, we managed to transmit signed integer data with four decimal place. Then it comes to the time of integration, which is the most interesting part. While combining the overall product into one piece, we not only physically combined them, we also combined the code from our teammates. Multiple unexpected problems including insufficient number of interrupt pins, low memory and etc. By solving these problem, we started to know about our teammates' modules and get a clearer overall picture about the whole project.

Now as everything coming to an end, I would like to thank Amina, Joel, Ana, Wendy, and Francis for all the effort they put into this project and the amazing experience that they gave me. Also, I appreciate SFU offer this course to prepare us for the real engineer projects. Last but not the least, I would like to thank the technical support from Mike Hegedus, professor Ash and Andrew, and the paperwork support from all of the TA and especially prof Steve Whitmore.

INDIVIDUAL REFLECTION: QING ZHUANG

Being part of SafeVision makes me proud because we have talented team members and we delivered a wonderful product. Our group was formed four months before this semester, and we brainstormed different ideas for the capstone projects. We came up with 13 ideas, and presented to Andrew for advice. In the end, we decided to go for a Heads Up Display for snowboarders and cyclists.

In the beginning of this semester, we named our product *PortableHUD*, and came up with company logo and managements. We discussed our project with professor and TAs, and decided to include different features in our product. I am responsible for sourcing components and modules for our project, and provide mechanical designs and prototypes for our product. I learned how to control cost and quality of supplies by comparing different venders with their price and customer feedbacks. My co-op experience helped me in doing this project, because I am familiar with hand tools, mechanical design, and fast prototyping technology. In the design of our product, I came up with different revisions of mechanical designs that demonstrate the appearance of *PortableHUD*, which gave a visualized impact to the TA and potential customers.

Mechanical design is my main role in this company, and throughout the whole term I am using my mechanical background to assist the hardware development team. For example, when we were trying to figure out the layout of modules, I suggested using two layers of solderable breadboard because it can save us some space on the horizontal plane, and keep the master control panel as compact as possible.

During the design process of the mechanical system, I have encountered several failures of the 3D printer and the printed prototypes. As for the 3D printer, it pulses feeding the filament during the printing process, so that leaves layers unprinted and reduces the strengths of the layer bounding. I have fixed that issue through firmware restoring and pushing the filament towards the extruder. And to help improve the bounding between each layers, I changed the firmware of the 3D printer to let it extrude more materials for each trace. Before having anything physically on hand, I estimated the locations for each hole and opening, and then draw the SolidWorks model based on the rough estimation. I printed out the models and tried to fit onto the circuit. After a couple trials, I realized the offsets of the old designs and I adjusted the dimensions and reprinted. Since it is not possible to design a perfect product in the first attempt, I should start building something and then try to improve it to reach my goal. And this is one of the most important things I have learned from this capstone project.

Beside the technical improvement, I also learned how to handle conflicts and clearly present my opinions to team mates. Communication within team environment is very important, because it can help other people understand what I am doing and show my effort and contribution to the project, and provide technical advices for team mates when we need to make decisions. Besides, a good sense of humor is also a plus for the team because it can relief the stress for everyone.

INDIVIDUAL REFLECTION: PAK LUN HOI

During the past 4 months, my experience with the development of *PortableHUD* had been unique as it offered me a chance to use everything I had learned from my previous courses. For example, capstone had been about solving the problems encountered during the process of creating a proof-of-concept model. Before the beginning of the semester, we had formed a group consisting of 4 systems engineers, 1 electronic engineer, and 1 computer engineer each with their own unique set of skill and experiences. By consulting Dr. Andrew before the beginning of the semester we had narrowed down our list of potential ideas to a HUD display.

The research of building a Heads up Display was not an easy task as the technology is fairly new. One of the main things that I had learned during capstone is that working in a team is essential in creating a project. Regardless of level of technicality, it is important to remember that everyone in the group has something important to contribute to the overall completeness of the project. After weeks of research, we had concluded that using the Arduino board would be suitable to ensure that we could control each microcontroller. To increase efficiency, we worked in pairs to ensure that everyone had an area to focus on. For example, I and Monica were tasked with radio frequency components and wireless; Amina and Anna were tasked with LCD and GPS; Wendy and Francis were tasked with the mechanical design and integration of the system.

The documents required in the first part of the semester were initially time consuming but it provided us with an opportunity to clearly define the functionality and design our HUD project. Eventually, the documentation became a valuable resource that we could refer to ensure that the specification and functionality were met. During the second half of the semester, we started the integration phase of our project. Monica and I started working on the RF communication. We initially tested using the MP3 player to ensure that the radio could be broadcasted successfully using my cell-phone built in radio as a receiver. However, while working on the RF component we faced one of our main challenges. When choosing a microphone we did not take into consideration the phantom power (a power source needed to power up 3.5 mm microphone to make it work). By consulting Prof. Ash about our problem we realized that we needed an electret or dynamic microphone to provide the transmitter with sufficient power to listen to the audio. By using the skills we acquired from previous electronic engineering courses, we were able to create a circuit to provide the microphone with the needed phantom power using the power coming from the Arduino. We later worked on the wireless module, where we sent carefully designed packages to ensure that the receiver of the wireless modules knew how to organize the information. By solving problems for each module, we were eventually able to create a proof-of-concept model, the *PortableHUD*.

Lastly, with such a great experience I would like to thank the people who helped us throughout the semester such as Prof. Andrew, Prof. Steve, Prof. Ash, Jamal, Hsiu Yang, Mahssa, Mona, and Soroush. I would also like to take the opportunity to thank my group mates: Amina, Anastasia, Monica, Wendy and Francis for providing me with a wonderful experience.

Appendix B: Meeting Minutes

SafeVision Ltd.

AGENDA

January 8, 2016

10:30-11:30

Library

Purpose of Meeting: Brainstorming Ideas for product

Items for Discussion:

- Decide whether we are using microcontroller (Arduino) or microprocessor (Raspberry Pi)
- Decide features for the product

SafeVision Ltd.

MINUTES

January 8, 2016

10:30-11:30

Library

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: Brainstorming Ideas for product

Minutes:

Pak Lun Hoi called the meeting to order at 10:30 AM

A. Approval of the agenda and minutes

N/A (First meeting)

B. Business Arising

Arduino or Raspberry Pi for product

Discussion: Discussed the advantages and disadvantages of each device including cost

Action: Agreed to use Arduino since modules (sensors) are available off the shelf.

C. Features for product

Discussion: Agreed that majority of the features should be focused on Snowboarders and less on Motorcyclist and Cyclists

Action: Agreed that the list of features is the following:

- GPS Receiver
- Weather Alert
- Current velocity (accelerometer)
- LEDs
- External Power Source for product (Batteries, Solar Panels, Dynamo)
- SOS Signal

D. Next Meeting Date

Next meeting date is agreed to be on Jan 15, 2016 (10:30AM)

E. Other Business

Agreed to have weekly meetings at 10:30AM on Fridays

SafeVision Ltd.

AGENDA

January 15, 2016
10:30-11:30
Library

Purpose of Meeting: Discussing problem of the project

Items for Discussion:

- Discuss whether if list of features created is possible
- List of products to buy for product

SafeVision Ltd.
MINUTES
January 15, 2016
10:30-11:30
Library

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis
Zhuang
Absent: None

Purpose of Meeting: Discussing problem of the project

Minutes:
Pak Lun Hoi called the meeting to order at 10:30 AM

A. Approval of the agenda and minutes of Jan 8, 2016 meeting

Agreed by everyone

B. Business Arising

Discuss whether if list of features created is possible

Discussion: Refine list of features for making helmet safer and more functional for
snowboarding. Made sure list could also apply to motorcyclist and cyclist also.

Action: Agreed to meet with TA that afternoon to check if features are possible to create

C. List of Products to buy

Discussion: Agreed to make a list of items to buy for the prototype

Action: Agreed that the list of items to buy is the following:
- USB To RS232 TTL UART PL2303HX Auto Converter USB to COM Cable Adapter Module
- Raspberry Pi Model B with extra links
- Goggle
- Battery to power the Board
- Cable to connect to sensor
- Power Cable to connect battery with Raspberry Pi
- RF Components (Radio)
- LEDs to wrap around helmet

D. Next Meeting Date
Next meeting date is agreed to be on Jan 22, 2016 (10:30AM)

E. Other Business
Split up work equally for Proposal Document due the following week.

SafeVision Ltd.

AGENDA

January 22, 2016
10:30-11:30
Library

Purpose of Meeting: To discuss completion of the Proposal document

Items for Discussion:

- Combination of all parts for the proposal into single document
- Dropbox as a way to ensure all documents are in one location

SafeVision Ltd.

MINUTES

January 22, 2016
10:30-11:30
Library

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss completion of the Proposal document

Minutes:

Pak Lun Hoi called the meeting to order at 10:30 AM

A. Approval of the agenda and minutes of the Jan 15, 2016 meeting

Minutes were approved by everyone.

B. Business Arising

Combination of all parts for the proposal into single document

Discussion: Agreed to meet with TA to review parts of the proposal to ensure that we are meeting expectation. Discussed on ways to combine and review proposal documentation.

Action: Set a meeting to see TA at 11AM. Divided work of reviewing the combined proposal document into 3 separate groups to maximize efficiency.

C. Dropbox as a way to ensure all documents are in one location

Discussion: Agreed that Google Drive was not a good way to share documents due to incompatibility with Word Documents.

Action:
- Switched to Dropbox so that it is compatible with Word and to ensure all parts of the documentation is in a central location.

D. Next Meeting Date

Next meeting date is agreed to be on Jan 29, 2016 (10:30AM)

E. Other Business
None.

SafeVision Ltd.

AGENDA

January 29, 2016
10:30-11:30
Library

Purpose of Meeting: To discuss functional specification report

Items for Discussion:

- How we will split up the work
- Technical Parts for building prototype
- Review on other items we have to order and buy

SafeVision Ltd.

MINUTES

January 29, 2016
10:30-11:30
Library

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis
Zhuang

Absent: None

Purpose of Meeting: To discuss functional specification report

Minutes:

Pak Lun Hoi called the meeting to order at 10:30 AM

A. Approval of the agenda and minutes of the Jan 22, 2016 meeting
Minutes were approved by everyone.

B. Business Arising
How will the work for Functional Specification be broken up?

Discussion: Agreed that an outline of the documentation would be written first. Work will
then be split up equally among the 6 members of the group and uploaded to Dropbox as a
central location to combine the document.

Action: Xuemeng Monica Li will be writing an outline so that format of Functional
Specification document will be consistent when combining the parts together.

C. Technical Parts for Prototype

Discussion: Agreed that we could split up into smaller groups to work and research on
different features of the product to increase efficiency.

Action:
- Xuemeng Monica Li and Pak Lun Hoi will be working on RF components and Bluetooth
  wireless connection.
- Yifeng Xie and Francis Zhuang will be working on GPS module, Accelerometer (Speed), Time
  Display
- Anastasia Suprun and Amina Qurban will be working on SOS Signal and LCD Display
- Everyone will be working on mount for attaching device and design of device

D. Next Meeting Date
Next meeting date is agreed to be on Feb 19, 2016 (10:30AM)

E. Other Business
None.

SafeVision Ltd.

AGENDA

February 19, 2016
12:00-1:00
Lab 1

Purpose of Meeting: To discuss Design Review and prepare for Design Specification

Items for Discussion:

- Prepare presentation for Design Review next week
- Split up parts for Design Specification

SafeVision Ltd.
MINUTES

February 19, 2016
10:30-11:30
Library

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis
Zhuang

Absent: None

Purpose of Meeting: To discuss completion of the Proposal document

Minutes:

Pak Lun Hoi called the meeting to order at 12:00 PM

A. Approval of the agenda and minutes of the Jan 22, 2016 meeting

Meeting was postponed to reading week due to BCIT Speed Dating

B. Business Arising

To discuss Design Review and prepare for Design Specification

Discussion:

Action:

C. Prepare presentation for Design Review next week

Discussion:

Action:

D. Split up parts for Design Specification

Discussion:

Action:

E. Next Meeting Date

Next meeting date is agreed to be on Feb 22, 2016 (12:30AM)
F. Other Business

None.

SafeVision Ltd.

AGENDA

February 22, 2016
12:30-14:30
Lab 4

Purpose of Meeting: Design Review preparation

Items for Discussion:

- Decide which pair is responsible for each part of the Design Review
- Decide details of the individuals slides

SafeVision Ltd.
MINUTES
February 22, 2016
12:30-14:30
Lab 4

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis
            Zhuang

Absent: None

Purpose of Meeting: Preparation for Design Review

Minutes:
Anastasia called the meeting to order at 12:30 PM

A. Approval of the agenda and minutes

   Minutes were approved by everyone

B. Business Arising

   Components to present on the Design Review

   Discussion: Discuss the slides for the presentation on Feb 26th

   Action: Agreed to include the following sections:
   - Introduction and Conclusion
   - Outline
   - Mechanical Support
   - Individual Modules
   - Financial situation
   - Schedule

C. Division of the product's features between group members

   Discussion: Discuss the preferences of the group members towards individual modules abd
   sections
   Action: Agreed to divide slides as follows:
   - Temperature, Financial: Wendy
   - Introduction and Conclusion: Amina
   - RF and Wireless: Joel
   - LCD, Time: Anastasia
   - GPS, Mechanical support: Francis
   - Schedule, Wireless: Monica

D. Next Meeting Date
      Next meeting date is agreed to be on Feb 24, 2016 (12:30PM)
E. Other Business
      N/A

SafeVision Ltd.

AGENDA

February 24, 2016
12:30-14:30
Lab 4

Purpose of Meeting: Design Review preparation and individual modules implementation

Items for Discussion:

- Go over individual slides to check the content and grammar
- Discuss the progress on the individual components

SafeVision Ltd.
MINUTES
February 24, 2016
12:30-14:30
Lab 4

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: Preparation for Design Review Presentation and progress on the individual modules

Minutes:

Anastasia and Amina called the meeting to order at 12:30 PM

A. **Approval of the agenda and minutes**

Minutes were approved by everyone

B. **Business Arising**

Design Review Presentation preparation and progress on the individual modules

Discussion: Discuss the slides for the presentation on Feb 26th, grammar corrections and practice

Action: Agreed to correct some section and finalized the sides:
- Introduction and Conclusion
- Overview
- Background
- Schedule
- Financial Status
- High level design
- Low level design
- Progress
- Remediation
- Questions

C. **Correction of grammatical errors and practice**

Discussion: Get a feedback from all group members on the presentation content

Action: Go over the slides and discuss content. The sections for the presentations were divided the following way:
- Introduction, Overview, Background and Conclusion: Amina
- Schedule, Progress, RF: Monica
- Remediation, Financial Status: Wendy
- High level design, Wireless: Joel

- LCD, Time: Anastasia
- GPS, Mechanical support: Francis

D. Next Meeting Date

Next meeting date is agreed to be on Feb 26, 2016 (12:30PM)

E. Other Business

N/A

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AGENDA

February 26, 2016
12:30-14:30
Lab 1

Purpose of Meeting: Design Review preparation preparation

Items for Discussion:

- Get ready for the Design Review at 15 PM

SafeVision Ltd.

MINUTES

February 26, 2016
12:30-14:30
Lab 1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: Design Review preparation preparation

Minutes:

Anastasia and Amina called the meeting to order at 12:30 PM

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Business Arising

Design Review Presentation preparation

Discussion: Get ready for the presentation at 15 PM

Action: Practiced the slides:
- Introduction, Overview, Background and Conclusion: Amina
- Schedule, Progress, RF: Monica
- Remediation, Financial Status: Wendy
- High level design, Wireless: Joel
- LCD, Time: Anastasia
- GPS, Mechanical support: Francis

C. Next Meeting Date

Next meeting date is agreed to be on Feb 29, 2016 (12:30PM)

E. Other Business

N/A

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AGENDA

February 29, 2016
12:30-14:30
ASB Lab1

Purpose of Meeting: To discuss design specification report

Items for Discussion:

- How we will split up the work
- Technical Parts for building prototype
- Integration of parts alone

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MINUTES

February 29, 2016
12:30-14:30
ASB Lab1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss design specification report

Minutes:

Amina Qurban called the meeting to order at 12:30 PM

A. **Approval of the agenda and minutes of the Feb26, 2016 meeting**

Minutes were approved by everyone.

B. **Business Arising**

How will the work for Design Specification be broken up?

Discussion: Agreed that an outline of the documentation would be written first. Work will then be split up equally among the 6 members of the group and uploaded to Dropbox as a central location to combine the document.

Action: Amina Qurban and Anastasia Suprun will be writing an outline so that format of Design Specification document will be consistent when combining the parts together.

C. **Technical Parts for Prototype**
Discussion: Agreed that we could split up into smaller groups to work and research on different features of the product to increase efficiency.

Action:
- Xuemeng Monica Li and Pak Lun Hoi will be working on RF components and wireless connection.
- Yifeng Xie and Francis Zhuang will be working on GPS module, Speed, and Temperature
- Anastasia Suprun and Amina Qurban will be working Time and LCD Display
- Everyone will be working on mount for attaching device and design of device

D. **Next Meeting Date**

Next meeting date is agreed to be on March 3rd, 2016 (12:30AM)
E. **Other Business**
None.

SafeVision Ltd.

AGENDA

March3rd, 2016
12:30-14:30
ASB Lab1

Purpose of Meeting: To discuss design specification report in details

Items for Discussion:

- How we will split up the work in details
- Test plan for our design
- Integration of parts alone work in pairs

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MINUTES

March3rd, 2016
12:30-14:30
ASB Lab1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis
Zhuang
Absent: None
Purpose of Meeting: To discuss design specification report

Minutes:

Amina Qurban called the meeting to order at 12:30 PM

A. Approval of the agenda and minutes of the Feb29, 2016 meeting

Minutes were approved by everyone.

B. Business Arising

Discuss Design Specification in details and assign work for individuals

Discussion: Agreed that we will split the Design Specification to different parts: Introduction,
System Specification, Hardware design, Firmware design, Mechanical design, Test Plan, and
Conclusion.
Action: Pak Lun Hoi and Xuemeng Monica Li write Introduction, RF component, and wireless
connection in Hardware/Firmware design, Amina Qurban takes System Specification part and LCD in
Hardware/Firmware design, Anastasia Suprun writes Safety and Sustainability of System
Specification as well as RTC part in Hardware/Firmware design, Yifeng Xie takes Temperature and
GPS in Hardware/Firmware design, and Francis Zhuang writes about Mechanical design and
Conclusion.

C. Technical Parts for Prototype
Discussion: Agreed that we could split up into smaller groups to work and research on
different features of the product to increase efficiency.
Action:

- Xuemeng Monica Li and Pak Lun Hoi will be working on RF components and wireless
  connection.
- Yifeng Xie and Francis Zhuang will be working on GPS module, Speed, and Temperature
- Anastasia Suprun and Amina Qurban will be working Time and LCD Display
- Everyone will be working on mount for attaching device and design of device

D. Next Meeting Date
Next meeting date is agreed to be on March4th, 2016 (12:30AM)
E. Other Business
None.

SafeVision Ltd.

AGENDA

March4th, 2016
12:30-14:30
ASB Lab1

Purpose of Meeting: To discuss the questions we have for TA about design specification report

Items for Discussion:

- What questions we have for TA
- Deadline to finish individual parts of design specification and assigning times for reviewing the report
- How far we got in integration of parts separately

SafeVision Ltd.

MINUTES

March4th, 2016
12:30-14:30
ASB Lab1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss the questions we have for TA about design specification report

Minutes:

Amina Qurban called the meeting to order at 12:30 PM

A. Approval of the agenda and minutes of the Mar3, 2016 meeting

Minutes were approved by everyone.

B. Business Arising

Discuss the questions we have for TA about design specification report

Discussion: What questions we have to ask TA: if we split the parts of report correctly, how many details should we include, ask about test plan

Action: Meeting with Mona at 3PM in room 8813ASB

C. Technical Parts for Prototype

Discussion: How far we got integrating parts individually

Action:
- Xuemeng Monica Li and Pak Lun Hoi finishe on RF components and waiting for wireless connection to be delivered
- Yifeng Xie and Francis Zhuang integrating Speed, and Temperature
- Anastasia Suprun and Amina Qurban LCD Display works, need to think a way to use different pins
- Everyone will be thinking on how to mount device and design

D. Next Meeting Date

Next meeting date is agreed to be on March 7th, 2016 (12:30AM)

E. Other Business

None.

SafeVision Ltd.

AGENDA

March 7, 2016
12:30-14:30
Lab 1

Purpose of Meeting: Design Specification Wrap Up

Items for Discussion:

- Files merging
- Grammar check
- Formatting
- Test plan

SafeVision Ltd.

MINUTES

February 26, 2016
12:30-14:30
Lab 1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: Design Specification Wrap Up

Minutes:

Anastasia and Amina called the meeting to order at 6:30 PM

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Business Arising

Design Specification Wrap Up

Discussion: Get ready for the design specification and hand in

Action: Wrap Up and Finalize the Report:
- More explanation and other fixed with TA's advice: Everyone
- Files Merging: Anastasia
- Gramma Check: Joel
- Test plan: Amina and Wendy
- Reference: Monica

C. Next Meeting Date

Next meeting date is agreed to be on Feb 11, 2016 (9:00AM)

E. Other Business

N/A

SafeVision Ltd.

AGENDA

March 11, 2016
9:00-14:30
Lab 1

Purpose of Meeting: Circuit Design

Items for Discussion:

- Microphone to RF transmission side
- RF channel changing button
- Nano testing
- GPS shows on LCD

SafeVision Ltd.

MINUTES

March 11, 2016
9:00-14:30
Lab 1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: Circuit Design

Minutes:

Joel and Monica called the meeting to order at 9:00 AM

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Business Arising

Circuit Design and Integration

Discussion: Working Details on Each Module

Action:
- Microphone to RF transmission side: Joel and Monica
- RF channel changing button: Joel and Monica
- Nano testing, decided to stay with UNO: Wendy and Francis
- GPS shows on LCD: Anastasia and Amina

C. Next Meeting Date

Next meeting date is agreed to be on March 14, 2016 (12:30PM)

E. Other Business

N/A

SafeVision Ltd.

AGENDA

March 14, 2016
12:30PM – 2:30PM
Lab 1

Purpose of Meeting: To discuss progress for the each components

Items for Discussion:

- Possible Solution for Microphone
- Using the GPS Temperature Sensor instead of Temperature Sensor
- Not enough SRA, SRL pin outs for the different modules

SafeVision Ltd.

MINUTES

March 14, 2016
12:30 – 2:30
Lab 1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss what to do for each part and written progress report

Minutes:

Pak Lun called the meeting to order at 12:30.

A. Approval of the agenda and minutes
Minutes were approved by everyone

B. Current stage of progress

Discussion:
Possible Solution for Microphone:
1) Buy Dynamic or Electric Microphone (lack of Phantom Power)
2) Use new module. Input to RF might be a potential problem

Temperature Sensor:
1) Deciding to use GPS build in temperature sensor or current temperature sensor

Lack of SRA, SRL Pins for integration:
1) Agreed to modify the .cpp file to find a way to change the pin numbers used for SRA and SRL to make room for integration

Action:
- Qing Zhuang and Yifeng Xie will be going to RP Electronics to look for alternative for microphone.
- Pak Lun Hoi and Xuemeng Monica Li will try and create phantom power for the current microphone.
- Anastasia Suprun and Amina Qurban will be looking into the lack of pins problems (SRA, SRL)

C. Next Meeting Date
Next meeting date is agreed to be on March 16, 2016 (12:30PM)

D. Other Business
Decided on a schedule to work on the boards since there are not enough boards for everyone at the same time.

SafeVision Ltd.

AGENDA

March 16, 2016
12:30PM – 2:30PM
Lab 1

Purpose of Meeting: To discuss progress for the each components

Items for Discussion:

- Electric Microphone for Phantom Power problem
- GPS Map
- LCD Rewrite

SafeVision Ltd.

MINUTES

March 16, 2016
12:30 – 2:30
Lab 1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss what to do for each part and written progress report

Minutes:

Pak Lun called the meeting to order at 12:30PM

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Current stage of progress

Discussion:
Electric Microphone for Phantom Power Problem:
3) Going to be trying to use electric microphone to solve the phantom power problem to use the RF Components

GPS Map:
1) Finding a way to save the map file and displaying the position on it

LCD Rewrite:
2) Overwriting on LCD causes the previous background of the screen to remain the same making issue noticeable.

Action:
- Qing Zhuang and Yifeng Xie will be looking into the GPS Map and potential ways to solve it
- Pak Lun Hoi and Xuemeng Monica Li will try and use the Electric Microphone to make the RF Component work
- Anastasia Suprun and Amina Qurban will be looking into Fixing the Rewrite Problem by clearing the background each time LCD has to be overwritten

C. Next Meeting Date
Next meeting date is agreed to be on March 18, 2016 (12:30PM)
D. Other Business
None.

SafeVision Ltd.

AGENDA

March 18, 2016
12:30PM – 2:30PM
Lab 4

Purpose of Meeting: To discuss progress for the each components

Items for Discussion:

- Space for board during integration
- Lack of memory space on board with Google Maps
- Mechanical Design
- I2C Bus for solving SRA, SRL Problem

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MINUTES
March 18, 2016
12:30 – 2:30
Lab 4

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss what to do for each part and written progress report

Minutes:

Pak Lun called the meeting to order at 12:30PM

A. Approval of the agenda and minutes
   Minutes were approved by everyone

B. Current stage of progress
   Discussion:
   Space for board during:
   4) Lack of space makes it difficult to combine GPS and LCD on Slave Panel due to lack of space in pin outs
   5) Potential Solution is use to a Mega Arduino

   Lack of memory on board with Google Maps:
   1) Adding Google Maps on the LCD caused lack of memory issue on Arduino for other parts

   Mechanical Design:
   3) How to secure Master and Slave Panel properly on the helmet

   I2C Bus for solving SRA, SRL Problem:
   1) Using I2C Bus to solve the SRA and SRL problem by running multiple modules in parallel
   Action:
   - Qing Zhuang will be looking into the Mechanical Design to secure the Slave while it's attached on the helmet
   - Yifeng Xie, Pak Lun Hoi and Xuemeng Monica Li will be looking into the I2C Bus to verify that it could solve the SRA, SRL Problem and begin integration of Master Control Panel
   - Anastasia Suprun and Amina Qurban will be looking into the lack of memory issue on the board and to find enough space for the wireless receiver code on Slave Control Panel

C. Next Meeting Date
   Next meeting date is agreed to be on March 21, 2016 (12:30PM)
D. Other Business
   None.

SafeVision Ltd.

AGENDA

March 21, 2016
12:30 – 2:30
Lab 4

Purpose of Meeting: To discuss what to do for each part and written progress report

Items for Discussion:

- Discuss current stage of each part of the product
- How we will split up the written progress report

SafeVision Ltd.

MINUTES

March 21, 2016
12:30 – 2:30
Lab 4

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss what to do for each part and written progress report

Minutes:

Qing Zhuang called the meeting to order at 12:30.

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Current stage of the product

Discussion:
Mechanical: The design of the enclosure is partially done. The material used for 3D printing was PLA which has very rough surface.

RF component: New library need to be implement in order to get mute or adjust volume function.

LCD: The display occupied almost all pins on UNO, only expect one analog pin. Work need to do on reducing pins.

RTC, temperature, GPS: Work need to convert GPS data into wireless transfer format. After that, GPS can be integrated on RTC and temperature circuit.

Action:
- Qing Zhuang will replace PLA with ABS for 3D printing.
- Pak Lun Hoi and Xuement Monica Li will implement new library on RF component.
- Yifeng Xie will be working on converting GPS data into wireless transfer format and integrating it on RTC and temperature circuit.
- Anastasia Suprun and Amina Qurban will be working on LCD Display

C. Written Progress Report
Action:

- Amina Qurban will be working on introduction and conclusion
- Xuemeng Monica Li will be working on schedule report
- Yifeng Xie will be working on financial support
- Pak Lun Hoi and Anastasia Suprun will be working on remediation
- Qing Zhuang will be working on mechanical integration progress and remediation
- Everyone will be working on hardware integration progress

D. Next Meeting Date

Next meeting date is agreed to be on March 23rd, 2016 (12:30AM)

E. Other Business

None.

SafeVision Ltd.

AGENDA

March 23th, 2016
12:30-14:30
ASB Lab1

Purpose of Meeting: To discuss the Mechanical challenges we are facing in the 3D printing result

Items for Discussion:

- Mechanical design for Extendable support
- Test printed parts problem analysis
- Possible solution for solving the printing quality of 3D printer

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MINUTES

March4th, 2016
12:30-14:30
ASB Lab1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis
 Zhuang

Absent: None

Purpose of Meeting: To discuss the Mechanical challenge for our design and 3D printing quality

Minutes:

Amina Qurban called the meeting to order at 12:30 PM

A. Approval of the agenda and minutes of the Mar3, 2016 meeting

 Minutes were approved by everyone.

B. Business Arising

 Discussion about the structure to hold the system

 Discussion: In order to solve the z-axis printing quality, we have to provide enough strength on the x-
 y plane printing. So we can use solid structures instead using tube design. And using saw tooth design
 to lock the rail in place.

 Action: Change design in SolidWorks and export to STL files for 3D printing

C. Technical Parts for Prototype

 Discussion: How far we got integrating parts individually

 Action:
 • Xuemeng Monica Li and Pak Lun Hoi finished on RF components
 • Yifeng Xie and Francis Zhuang finished integrating speed and RTC
 • Anastasia Suprun and Amina Qurban LCD Display work, and trying to connect wireless receiver
 • Everyone will be thinking on how to mount device and design

D. Next Meeting Date

 Next meeting date is agreed to be on March 24th, 2016 (1:30PM)

E. Other Business

 None.

SafeVision Ltd.

AGENDA

March 23th, 2016
12:30-14:30
ASB Lab1

Purpose of Meeting: Continue working on Mechanical system, and integration of modules

Items for Discussion:

- Mechanical design for Extendable support
- Wireless receiver problem
- Integrating wireless receiver with the LCD display

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MINUTES

March4th, 2016
12:30-14:30
ASB Lab1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To discuss the integration of different modules

Minutes:

Amina Qurban called the meeting to order at 1:30 PM

A. Approval of the agenda and minutes of the March 23th, 2016 meeting

Minutes were approved by everyone.

B. Business Arising

Discussion about the integration of the system including different modules and assemblies

Discussion: Microphone can be integrated close to user's cheek to receive the sound from the user. Design structure to hold the microphone in place. How to integrate GPS module to RTC and temperature sensor and make them work.

Action: Integrate GPS module, modify mechanical design for the system. Get Arduino Mega for our slave control panel for larger memory space.

C. Technical Parts for Prototype
Discussion: How far we got integrating parts individually
Action:
- Xuemeng Monica Li and Pak Lun Hoi finished on RF components
- Yifeng Xie has integrated the GPS module, RTC, and Temperature sensor together.
- Francis Zhuang has designed mechanical structure using saw tooth rail system to lock the extendable support in place.
- Anastasia Suprun and Amina Qurban works on integrating LCD and wireless receiver to Arduino Mega microcontroller.
- Everyone will be thinking on how to mount device and design

D. Next Meeting Date
Next meeting date is agreed to be on March 28th, 2016 (12:30PM)
E. Other Business
None.

SafeVision Ltd.

AGENDA

March 28, 2016
11:00 – 3:30
Lab 1

Purpose of Meeting: To work on wireless receiver and written progress report

Items for Discussion:

- Verify the new wireless receiver works
- Finish and combine each part into written progress report

SafeVision Ltd.

MINUTES

March 28, 2016
11:00 – 3:30
Lab 1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: To work on wireless receiver and written progress report

Minutes:

Yifeng Xie called the meeting to order at 11:00.

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Wireless receiver

Verify the new wireless receiver works well with old wireless transmitter.

C. Written Progress Report
Action:
- Amina Qurban and Anastasia Suprun combined each part into one document
- Xuemeng Monica Li and Pak Lun Hoi worked on the hardware integration progress and remediation
- Yifeng Xie updated financial report
- Qing Zhuang worked on mechanical integration progress and remediation
- Everyone reviewed written progress report and submitted

D. Next Meeting Date

Next meeting date is agreed to be on March 30th, 2016 (12:30AM)

E. Other Business

None.

SafeVision Ltd.

AGENDA

March 30, 2016
12:30 – 2:30
Lab 1

Purpose of Meeting: Work on integration of master side and slave side

Items for Discussion:

- Transfer data through wireless module from master side and slave side

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MINUTES

March 30, 2016
12:30 – 2:30
Lab 1

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: Work on integration of master side and slave side

Minutes:

Yifeng Xie called the meeting to order at 12:30.

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Integration of master side
Master side transferred data through wireless transmitter.

Action:
- Yifeng Xie, Pak Lun Hoi and Qing Zhuang combined the code of wireless module and integrated part.
- Yifeng Xie, Pak Lun Hoi and Qing Zhuang verified the data of information can be transferred through wireless module.

C. Integration of slave side
Slave side received the data transferred through wireless module and displayed temperature value on LCD display.
Action:
- Amina Qurban, Anastasia Suprun and Monica worked on modifying code of slave side in order to receive and display temperature value transferred from master side.
- Amina Qurban and Anastasia Suprun will work on modifying code of slave side in order to display other parameters.

D. Next Meeting Date
Next meeting date is agreed to be on April 1st, 2016 (10:30AM)

E. Other Business
None.

SafeVision Ltd.

AGENDA

April 1, 2016
10:30 – 5:30
Lab 1 and outdoor

Purpose of Meeting: Work on integration and test the product outdoor

Items for Discussion:

- Solder LCD display and wireless receiver
- How to assemble components of master side

SafeVision Ltd.

MINUTES

April 1, 2016
10:30 – 5:30
Lab 1 and outdoor

Present: Anastasia Suprun, Amina Qurban, Pak Lun Hoi, Xuemeng Monica Li, Yifeng Xie, Francis Zhuang

Absent: None

Purpose of Meeting: Work on integration and test the product outdoor

Minutes:

Yifeng Xie called the meeting to order at 10:30.

A. Approval of the agenda and minutes

Minutes were approved by everyone

B. Test the product outdoor
Temporarily connected all components of master side together.

Action:
- Yifeng Xie, Qing Zhuang, Amina Qurban, Anastasia Suprun and Monica tested the connected product outdoor.
- Verified all information transferred and received properly.
- Yifeng Xie and Qing Zhuang will verify the correctness of speed by testing by car.

C. Integration of master side and slave side
   Discuss that temperature sensor (RTC), antenna of radio receiver, GPS and buttons need to be on the top layer to ensure their functionalities.

Action:
- Amina Qurban and Anastasia Suprun modified code on slave side and displayed all information properly.
- Amina Qurban and Anastasia Suprun soldered wireless receiver with LCD display
- Qing Zhuang, Yifeng Xie and Monica soldered designed the layout of master side and soldered GPS, RTC on one solderable breadboard.

D. Next Meeting Date
Next meeting date is agreed to be on April 4th, 2016 (12:30AM)

E. Other Business
None.