harmony innovation

Post Mortem for the

# Musical Rehabilitation Assistance System


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# 1. INTRODUCTION

Over the past semester, Harmony Innovation, a group of engineering students, James Thomson, Adam Prochazka, Elnaz Heidari, Sam Chu, and Ryan Colter, have striven to develop a concept into a viable proof of concept. The following document summarizes and reflects upon the worthwhile experience that the group has gone through. This will be stated in a more general scope as well as from the perspective of each individual partner.

The Medical Rehabilitation Assistive System (MRAS) is a wearable device designed to supplement the ambulatory rehabilitation process. The MRAS tracks and analyzes a patient's limb movements and provides useful audio feedback to the patient and therapist. Learning to walk or wheel can be a difficult experience. The hours required to regain mobility can be taxing, and at times unrewarding. The MRAS introduces continuous, real-time feedback, which gives positive reinforcement, every step of the way.

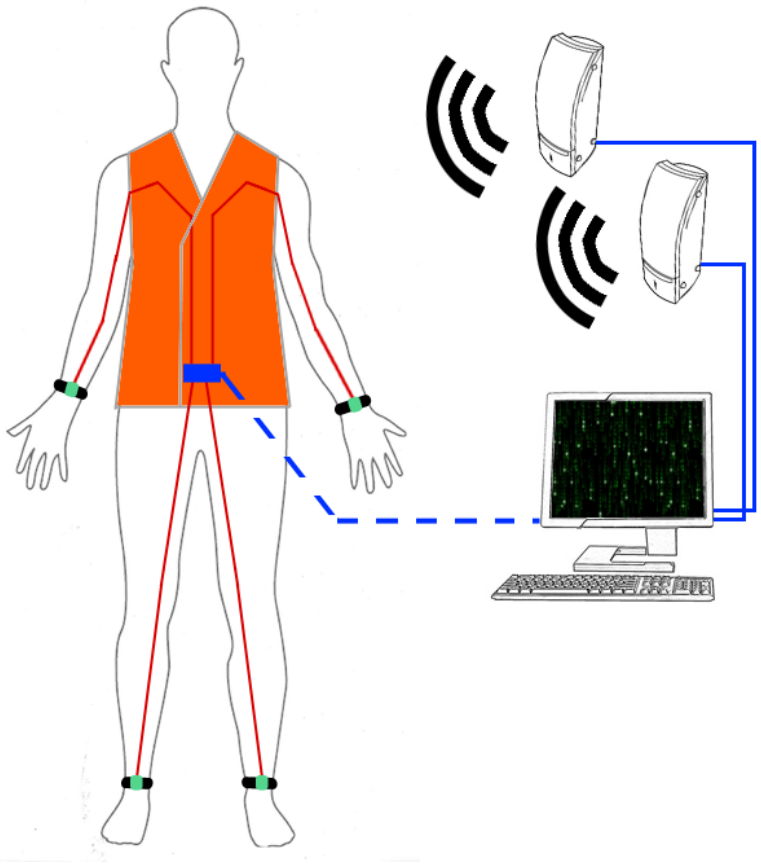

**Figure 1: High level system design**

The MRAS proof-of-concept consists of a wearable vest, modular sensor units (MSUs), a Controller, and a Software package. As seen in Figure 1, the MSUs (green) are worn on the wrists and ankles, and send positional data to the Controller (blue), housed in the vest. The Controller transmits data to the Software via Bluetooth wireless protocol or USB. The Software analyses the data by comparing it to a preset positional envelope, and plays back useful auditory feedback based on that analysis. Each limb is analyzed independently, controlling a unique part of the feedback so that, as the patient regains synchronous motion of their limbs, they receive increasing positive feedback.

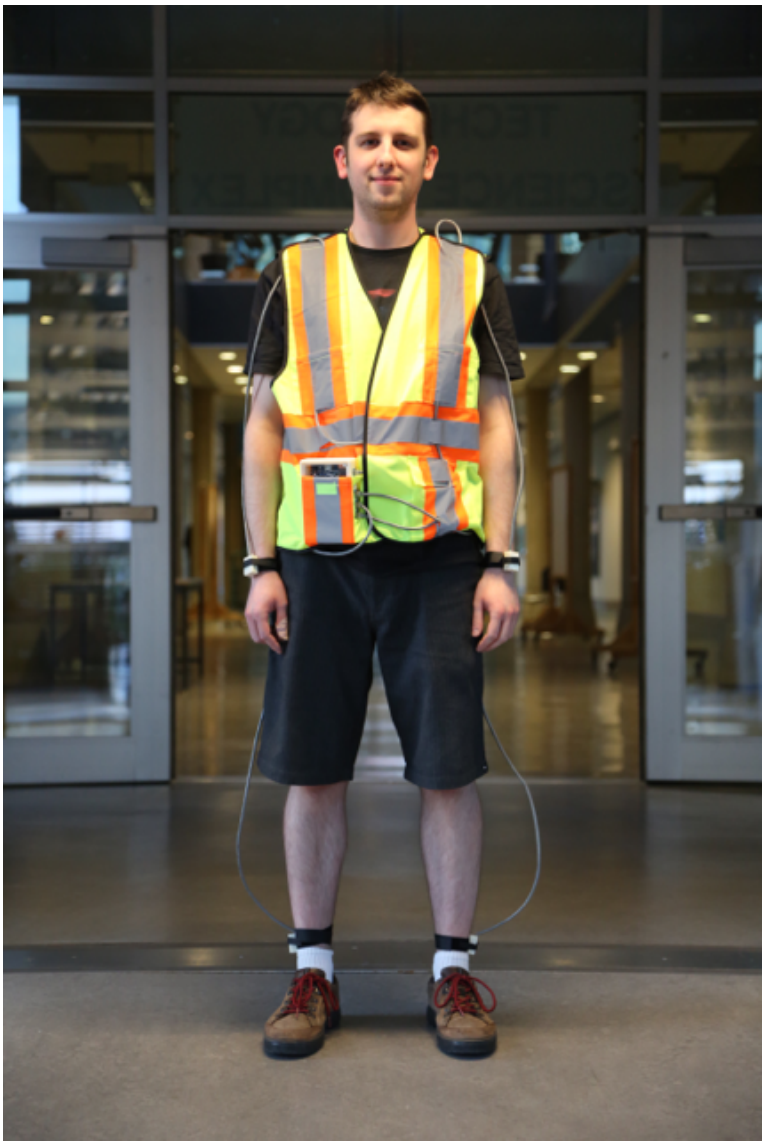

**Figure 2: Proof-of-concept MRAS Kit and Electronics**

# 2. PROJECT DESIGN

The MRAS proof-of-concept (POC) emerges from designs laid out in previous documents. The product as it stands today meets most of the Priority P and Priority A functional requirements unless otherwise stated below. Some Priority F requirements were also implemented. The current state of the MRAS will be elaborated upon in the subsequent sections.

## 2.1 Electronics

As described in our design specifications, the MRAS uses four Modular Sensor Units (MSUs) to transmit acceleration and orientation data to a Controller. The Controller consists of a microcontroller and four CAT5 female plugs, a Bluetooth wireless module and a 9V battery. The MSUs are soldered directly to CAT5 cables, which in turn connect to the microcontroller by male CAT5 plugs. The POC design strays from the plan to use a 9V battery and is instead directly powered by the PC via usb cable. This is a by-product of using a wired serial connection over name connection, rather than using a Bluetooth module to transmit wirelessly.

## 2.2 Kit

The Kit consists of a lightweight traffic vest and five enclosures; one for the Controller and four for the MSUs. The enclosures were designed in SolidWorks and additively manufactured from ABS, except for the Controller faceplate, which was machined subtractively from Plexiglas. Modifications were made to the vest to properly house the enclosures and to conceal the cable runs. This satisfied the requirements of the functional specifications without the necessity to purchase additional materials for the kit. Straps are made from hook and loop fasteners, which allows for easy application and removal of the MSUs.

## 2.3 Software

The Software is the area in which the POC of the MRAS deviates the most from the original design. It consists of a series of functions developed and executed in MATLAB. The Software acquires data from the MSUs and transforms them from their moving MSU reference frames into the static Earth reference frame. It evaluates the data against an array of presets and returns a score for each MSU. That score is then translated into a volume setting, which is fed into a simplified sound generator that plays music in the form of a four-chord progression. Although the key functionalities are satisfied in the POC, the quality of feedback and seamless compatibility between hardware and software was simplified over the duration of the design plan. The audio feedback is currently produced directly in MATLAB via a sequence of 4 simple notes, at different pitches for each limb. This was implemented due to deadline restrictions

preventing us from achieving the MIDI platform providing quality musical feedback in the sound of musical instruments. We also needed to compromise when it came to writing software on the data processing side. The math involved in processing data into interpretable position or acceleration data was less reliable than the algorithm for providing orientation displacement data for the comparison algorithm.

# 3. Project Execution

## 3.1 Schedule

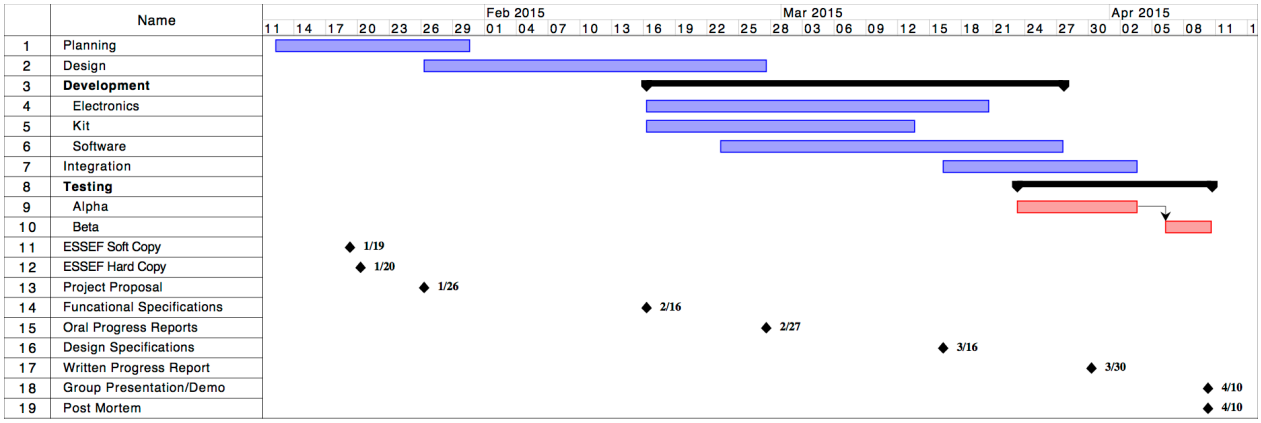


**Figure 3: Proposed project schedule**

Figure 3 shows the proposed schedule as defined during the design phase. This schedule modified the original schedule, which followed an Agile Management style with no overlapping phases and phase gates. This schedule was modified through the development phase, as challenges with the software emerged. Figure 4 shows the actual project schedule. It is important to note that the Group Presentation was delayed by a full week due to issues integrating the electronics and software. These problems are discussed in the Project Challenges section.

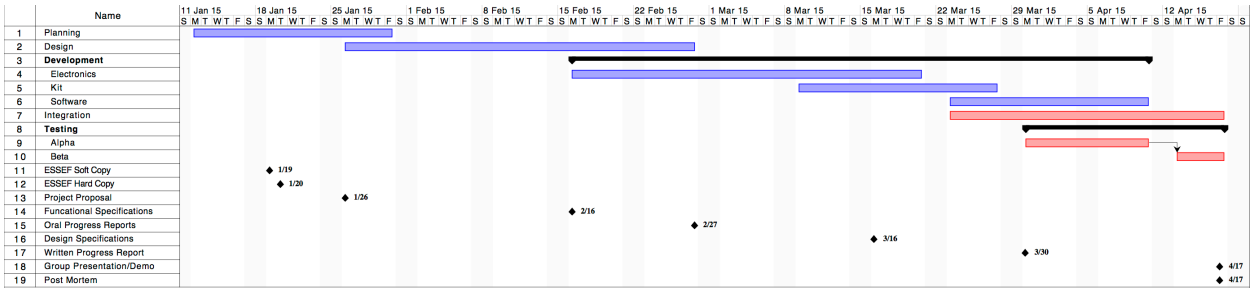


**Figure 4: Actual project schedule**

### 3.2 Budget

Table 2 shows the expenditures and funding sources for the MRAS.

| PROPOSED EXPENDITURES | $662.00 |
|---|---|
| Gyroscopes x 12 | 96.00 |
| Accelerometers x 12 | 96.00 |
| Controller | 150.00 |
| Wireless Network Card | 150.00 |
| Wire | 20.00 |
| Fuses | 50.00 |
| LEDs | 30.00 |
| Fabric | 70.00 |

**Table 1: Proposed project budget**

| ACTUAL EXPENDITURES | $282.78 |
|---|---|
| Arduino UNO R3 Mega 2560 | 68.87 |
| Arduino Wireless Bluetooth Transceiver Module | 12.97 |
| 9V Batteries | 11.16 |
| Kootek Arduino GY-521 MPU-6050 Module x 8 | 60.54 |
| Manufacturing of Controller and MPU Enclosures | 82.85 |
| CAT5 Connectors | 38.08 |
| Kit Fabric and Materials | |
| Miscellaneous | 8.31 |

**Table 2: Actual project budget**

As demonstrated, the team has been successful in keeping costs down. The MRAS is required to retail for less than $500, and this is clearly possible. Further savings can be found by switching from additive manufacturing to injection moulding to reduce the cost of manufacturing the Controller and MPU enclosures, and purchasing components in bulk to reduce the cost of the electronics. The only items not accounted for in the budget above are the vest and the wiring, which were salvaged or received with no cost to the project.

## 4. Project Challenges

### 4.1 Electronics

Deciding how good each of these requirements performed determined our hardware and software options, as well as our physical components and constraints. This *good enough* requirement additionally decided our timelines for each project component, and our cutoffs for when we needed to drop, add, or redefine features.

Through research from reviews and component datasheets, we found that an Arduino microcontroller worked with these specific sensors well. They met our requirements for accuracy, precision, and amount of data transferred. MATLAB can be passed data from Arduino decently enough too. We went ahead with this combination, but later encountered issues that haven't been addressed before, and had to break new ground to integrate these systems the way we needed. This was attributed to using 6-axis sensors when upgrading to 9-axis would have caused far less limitations for us when it came to Software. This was where the majority of our work was. We also wanted a Bluetooth chip that could make our system wireless, which is a very attractive feature. However, data speed limitations and integration problems caused us to resort to a wired serial connection, as previously mentioned

## 4.2 Kit

Having the enclosures printed saved a significant amount of time for the group, but it also introduced an interesting problem. ABS, the material used in the 3D printers, is hydroscopic in its raw form, meaning it will draw moisture from the atmosphere. T technician informed us that our parts were using the last of the current material in the printer, and as a result, the material had accumulated a significant amount of water. To rectify this, the enclosures were baked in a toaster over at 200°F for 4 hours, which removed the moisture.

The design of the sensor enclosures was not effective for additive manufacturing. The design called for two thin teeth that secured the lid to the body of the enclosure. These teeth had poor shear strength due to the nature of the additive manufacturing process, and snapped off immediately. To replace them, tape was applied.

Our original design for the Controller enclosure called for a laser cut two-tone acrylic lid that could be etched with port names. This part was not made because we could not secure time on a laser cutter to produce the part. We mitigated by manufacturing a clear acrylic lid. This proved to be more effective for the proof-of-concept, as it allowed observers to look inside the enclosure without having to open it.

## 4.3 Software

We went through a similar process with MATLAB. With it being software, and our group not being as comfortable with software, we spent a bit longer on certain unexpected issues than we wish we would have. We started a bit later than planned, and this caused issues. If our software component wasn't functional at a basic level, our project wouldn't work, and all the other time spent on other project components would seem wasted come demo time. This was a big stressor for us, which ultimately generated my motivation to work harder and for longer hours to complete the software component. Our goal of demonstrating our concept, proving that our idea works and would benefit many individuals, was on the line.

# 5. PROJECT LEARNINGS

## 5.1 Workload Distribution Chart

| Task | Sam | Ryan | Elnaz | Adam | James |
|---|---|---|---|---|---|
| Electronics Design | A | R | C | A | C |
| Electronics Integration | A | A | C | R | C |
| Kit Design | C | C | R | C | A |
| Kit Integration | C | C | R | A | C |
| Software Design | R | A | C | R | A |
| Software Integration | R | R | C | A | C |
| Documentation | A | A | A | A | R |
| Project Management | C | C | A | C | R |

**Table 3: Workload responsibility assignment matrix**

Table 3 details the workload distribution, categorized using a modified responsibility matrix. The designations are defined as follows:

- R – Responsible: this person was the authority in the execution of this area. Should questions arise from outside sources or there be a need to consult outside the partnership, this person would handle those duties.
- A – Assisting: this person executed significant work in this area. Their workload could be equal to that of the Responsible, but they would not be required to deal with individuals outside of the partnership in matters relating to this area.
- C – Contributor: this person provided input in this area. Their workload was generally less than the Responsible or Assisting, but they provided input and helped in the planning and execution of this area.

All members at least contributed to all areas of the project. This was a team effort.

## 5.2 Individual Learning – Sam Chu

My first thought of the capstone project was to simply design and build a presentable project. My initial impressions were that it would be a simple and easy task. I quickly realized it was much more than I initially thought. The capstone project took my groupmates and I along a complicated journey which involved researching and writing detailed design documents as well as building product prototypes. I imagine this would be similar to how a real product would be designed from the initial concept stage to a final consumer product release. The experience was a great eye-opener in terms of what it would be like to go through a real design cycle and exposed me to many things I hadn't considered.

The hardware side of this product was great for me. Having never worked with Arduino boards before, it was a great learning experience for me and further increased my exposure to industry related programs which could end up being useful. Throughout the whole hardware design, from wiring the Arduino board, to the sensors, to designing sketches for the Arduino firmware, the process has taught me many things. Besides being exposed to a new platform, I have also gained new knowledge about how to use existing hardwire. Like when one of my teammates suggested we use ethernet cables to wire the sensors, which I hadn't even considered before. This is valuable to me, as I would like to go into a field related to hardware, and everything I learned I will be able to take with me and give myself a better chance to realize my goals.

On the software side, having been exposed to new functionalities and designing algorithms has further increased my expertise with Matlab and problem solving skills, which is very valuable in the engineering field. Many of the issues we encountered while writing the software for our project was expected by me, having been exposed to a fair amount of programming languages and scripting thanks to previous experiences. So although, I hadn't learned as much, it was still a great opportunity to further my expertise in Matlab which I'm sure can be helpful.

One of the most important things I learned was group dynamics. Although I had worked with two out of the four of my groupmates before, it was still a valuable experience as I had two new people I had to communicate and work with. Another valuable experience for me was having been exposed to fresh new perspectives on ideas and problem solving. One of the major positives that I was thankful for, was that my group had amazing teamwork and got along great, even when exposed to stressful situations. From my knowledge, I know these issues can break the group, and can impede the product design. In the real world, there are many times where we will have to work with random people, and it's comforting to know I can work well with people of different personalities and ideas.

Overall capstone has been a great learning experience for me, taking me through a journey of the initial realization of a concept, and turning that into fruition. I believe capstone was a needed experience in helping me grow in my journey to become a professional engineer.

## 5.3 Individual Learning – Ryan Colter

The capstone project was an unexpected four month struggle. Problems arose from places you wouldn't expect, and solutions came from a multitude of sources. At some points throughout the semester, I thought our project wouldn't come to fruition, and at other times, I thought we were almost done, even though completion was a long way off. I was challenged with questions that weren't easily answerable, especially the big one, "How do we choose how to build our idea?".

This question was inevitable, understood, and had to be mostly answered during the first few weeks, which was incredibly difficult. Part of that question involved the amount of work needed, another about what resources we used, and a third, how well those different pieces worked with each other. Two of these were answered fairly quickly, but the third required a different kind of thinking altogether. The third question turned into our capstone project.

How do we make our idea possible? Well, we drew ideas from our past classes, outside experience, and external help. Individual research was done too, as expected. We needed to find a way to track motion *well*, process this data *well*, and give feedback that is *good enough* for a patient using our device. These kinds of constraints don't come up very often in normal course work, but they did here, and in a very important way. Throughout this semester, I figured out a handful of new ways to answer these questions, and methods to combine them with previous skills and knowledge.

I learned the details of how our electronic components worked, and lots more about the capabilities and limitations of MATLAB. The motion sensor we chose, the MPU6050, had a fairly standard datasheet, but also a register map document that I learned to use very effectively. I've become more comfortable with extracting useful information out of technical documents such as that one, as well as working through technical challenges when given constraints. These experiences are a large part of the overall learning I've gained from our project.

Certain problems needed to be looked at from multiple angles, and I became more comfortable at weighing different solutions. These solutions needed to be evaluated carefully, but still in time to meet deadlines. As I continue to work in my career, I'll always keep a thought in the back of my mind that a solution can be found quicker, and more efficiently. It has become an active part of my design process. This additional thought process was highlighted by our project, and will become an invaluable lesson from university.

Our team worked incredibly well together, and our already strong teamwork skills did benefit. However, the majority of my learning came from that original question. "How do we choose how to build our idea?". I've become better at answering that question. Ideas were pulled from each individual constantly, and our meetings with industry professionals were invaluable. Each of us questioned and challenged each other cordially, and we all became much better at listening. I am proud of our team and project, and would love working with each member again in the future.

## 5.4 Individual Learning – Elnaz Heidari

During the last term, I had the pleasure of being part of harmony Innovation where we developed a product for rehabilitation. I have found the project quite enjoyable and working with my teammates has been a great experience; one in which I hope to bring

what I learned too many more products in my professional career. Being part of this group has led to many discoveries of working in a group as well as personal discoveries.

I am a fourth year student at Simon Fraser University, I have had the privilege of working in many groups and this has been by far the most challenging as well as the most rewarding project. The group started with James and I, and then later we formed a group with another three members on the first week of class. From the very beginning we had ideas and thoughts on what to develop and it was clear that the project we chose was the winner of all these discussions. We have not always had success in this project by the final project was the success of all the previous failures and triumphs.

In this project I was able to be involve and work on a wide range of areas; these include software and hardware and more specifically the kit design. From the electronics perspective, I got introduced to the Arduino board and learned the process in which we can use this electronic component to gather the data we needed. I also helped to navigate the wiring and the connections. The software came later on into the play. We decided to use MATLAB to analyze the data collected, as we thought MATLAB would be straightforward to deliver for the proof of concept. This helped me broaden my software skills, and get more comfortable analyzing data with MATLAB. For the kit design, simplicity, cost and safety, as well as efficiency was considered. One of the challenges we faced, was the math involve to get our algorithm to work and receive feedback, after spending some time we realized we need to get help and can't afford to lose more time. After speaking to few instructors and TAs, the math issue was resolved.

While the project had software and hardware components; the most valuable component would be communication. The group was able to communicate very well together by use of Google drive and many physical meetings at the school. With technology we were able to work together when everyone was in a different city and at different times of the day.

My experience working with my teammates has been one that I will always hold at a high level in my educational experiences. I would not hesitate to give a reference for anyone that everyone that I worked with and now have a special bond with all of these individuals. I would like to personally thank my teammates as well as the instructors and teachers that helped on this project; without you we would not have succeeded. I found this project based program to be beneficial to my studies and think it should always be part of the curriculum here at SFU.

 

## 5.5 Individual Learning – Adam Prochazka

First of all, I would like to express how pleased I am with the group members I have worked with, for these past 4 months. I have heard horror stories regarding group dynamic problems and am extremely thankful that such an issue was not a factor for our group. The following is a reflection of my experience from working on the ENSC 440 capstone project.

I think what I have learned the most over the duration of the course is how multifaceted the engineering process is - and how much better the capstone project represents the professional field than the typical engineering course. To be a successful engineer requires dealing with various personalities and communication as much as technical and theoretical knowledge.

The technical experience that I have gained from working on this project has been invaluable as well. Although the practical hands-on background I had going into the project payed off, I built experience in other areas that would qualify as weaknesses of mine. The first big surprise of the project was how much pure research was required in the planning phase. This came in the form of discovering details from one facet of research, which thereby required extended research. This realization occurred mainly during the phase of speccing electronics and hardware but also during algorithm development for the software side. Naturally, I tend to avoid venturing outside of my comfort zone, and the fact that I was forced to research new things will certainly be beneficial for me here on out. This involved doing research in both hardware and software aspects in regards to Arduino microcontroller environment and its applications.

The other major experience I take from the project is the design, implementation, and testing processes in software. This came in the form of programming in MATLAB to integrate the project. I possessed knowledge of the basics of the software going into the project; I have learned an invaluable amount about the capabilities and limitations of software and the importance of compatibility between hardware and platforms when it comes to integrating a system. Achieving successful progress in the software was undoubtedly the biggest challenge of the capstone project from a technical standpoint, and I value every lesson I have gained from dealing with all issues.

What I can say with outright certainty is that I will be much better off when working with a team of professionals (engineers and any other profession), having gone through the ENSC 305/440 course. I feel that I have gained technical knowledge that would prove to be beneficial to a team's workload, as well as having gained non-technical skills that improved my ability to work with a group. I find it an impressive feat that I have not only contributed to a valuable and worthwhile project with this group, but developed a few new friends as well.

### 5.6 Individual Learning – James Thomson

Of all the partners in this group, I arrived with the most experience. Before returning to school, I had worked for seven years as a sound designer, both freelance and as an employee of a multi-national corporation. I have done a lot of group work, and I am pleased to say that this was among the better groups that I have worked with.

Technically, I learned a great deal about electronics. My focus is engineering physics, which tends to be more theoretical than practical. By working with my partners, I learned a great deal about the architecture of electronics, and how to work with them to create control systems like the one we devised for this project. I am truly grateful to Sam, Ryan and Adam for being patient with me, taking the time to explain things so that I really understood what was going on.

Interpersonally, I had the pleasure of managing this group. What I learned most from this group was to trust someone to get the job done. It has been my experience in the past with student that assigned work does not always get done, and I have spent more than a few late nights doing work that should have been done by others long ago. I am happy to say that this never happened during the run of this project, as much as I was waiting for it. No one dropped the ball, and that's a big deal. For as much work as this project was, the amount of work I had to do was significantly less than what I expected I would have to do.

Everyone on this project was exceptional. Everyone pulled their weight, delivered on their promises, and performed at a high level at all times. They all deserve high praise, and I am happy to have gone through this experience with them. I hope to remain in contact with every one of them.

## 6. Conclusion

Harmony Innovation took the Musical Rehabilitation Assistance Device from idea to proof of concept. We successfully demonstrated the core functionality of the product, learned a lot of lessons, and had a good time along the way. The MRAS has been submitted for consideration for the MDDC Awards for Excellence in Biomedical Engineering Student Design & Innovation. Beyond this, Harmony Innovation as it currently exists has no plans to carry the MRAS further. The agreement is that, should any partner wish to pursue further development, the other partners will be consulted, and there will be a fair and equitable division of the intellectual property rights.

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| MEETING MINUTES | | | | | |
|---|---|---|---|---|---|
| Meeting Date | 01/09/15 | | | Order at | 12:40 |
| Meeting Chair | James | | | Adjourned at | 13:45 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Meet and greet | | |
| Information | | Hello World<br>- Exchange contact information | | |
| Action | All | Come up with ideas for the project | 01/13/15 | Closed |
| Decision | All | Meet Jan 13 to discuss ideas and decide on project | | Closed |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 01/13/15 | Order at | 12:30 |
| Meeting Chair | James | Adjourned at | 14:00 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam |
| Regrets | Sam |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Present project ideas<br>- Decide on project | | |
| Information | Adam | Ideas<br>- Port Mann bridge de-icing system<br>- BC Place stadium roof repair<br>- Smart mouse trap | | |
| Information | Elnaz | Ideas<br>- Smart litter box | | |
| Information | James | Ideas<br>- Rail gun<br>- Rehab device that plays music when patient perfects motion<br>- Media controller<br>- Discrete self-inflating emergency PFD | | |
| Decision | All | Wait to hear Sam's ideas before making decision | | |
| Action | Elnaz | Set up meeting with Dr. Rawicz to discuss validity of idea(s) | 01/15/15 | Closed |
| Tabled | | Decide on project | 01/15/15 | |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 01/15/15 | Order at | 11:30 |
| Meeting Chair | James | Adjourned at | 13:00 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Hear Sam's project ideas<br>- Decide on project<br>- Set up meeting with Dr. Rawicz | | |
| Information | Sam | Ideas<br>- Improving batteries<br>- Car scanner<br>- Car HUD | | |
| Discussion | | Result of voting on ideas<br>- Musical Therapy = 5<br>- Card HUD = 4<br>- Discrete PFD = 3<br>- Smart Litter Box = 2<br>- Smart Trap = 1<br>- BC Place Roof Fix = 1<br>- Alternative Energy = 1<br>- Car Scanner = 1 | | |
| Decision | All | Project will be Musical Therapy or Car HUD, depending on meeting with Dr. Rawicz | | |
| Action | Elnaz | Meeting with Dr. Rawicz at 13:30 | 01/15/15 | Closed |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | | | |
|---|---|---|---|---|---|
| Meeting Date | 01/16/15 | | | Order at | 11:30 |
| Meeting Chair | James | | | Adjourned at | 12:30 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Discuss meeting with Dr. Rawicz<br>- Gather information for ESSEF funding proposal<br>- Set up meeting with Dr. Robinovitch | | |
| Information | | Meeting with Dr. Rawicz<br>- Strongly favoured Musical Therapy<br>- Advised we speak with Dr. Robinovitch in BPK | | |
| Discussion | | ESSEF Funding<br>- Created shopping list for ESSEF funding proposal form<br>- Budget estimated at $662 | | |
| Information | Elnaz | Dr. Robinovitch holds office hours from 12:30 | | |
| Decision | All | Meet with Dr. Robinovitch during his office hours directly following meeting | | |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 01/29/15 | Order at | 11:30 |
| Meeting Chair | James | Adjourned at | 13:00 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Post Mortem on Project Proposal process<br>- ESSEF funding issues<br>- Functional Specifications | | |
| Discussion | | Post Mortem<br>- Google Docs worked as a way to get information out to the group and to discuss ideas<br>- Scramble at the end caused by lack of ownership of each part; no one was responsible for making any given section was done, so some sections fell through the cracks<br>- Need to assign roles and responsibilities going forward to ensure work gets done | | |
| Action | Ryan | Issue with ESSEF Funding (GPA), need to make James lead contact | 01/29/15 | Closed |
| Discussion | | Functional Specification<br>- Engineering Standards: Adam, Ryan<br>- Sustainability/Safety: Elnaz<br>- Process Details: All | | |
| Decision | James | Roles and Responsibilities<br>- Electronics: Adam, Ryan, Sam<br>- Software: Ryan<br>- Kit: James, Elnaz<br>- Music Playback: James<br>- Documentation: James, Ryan | | |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 02/06/15 | Order at | 11:45 |
| Meeting Chair | James | Adjourned at | 12:20 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | ESSEF Funding<br>Functional Specification discussion<br>Meeting minutes | | |
| Action Item | James | Meeting minutes<br>- to be communicated to James for coalation into a single document | 03/31/15 | Closed |
| Information | | Project funding<br>- Received $650 from ESSEF (requested $662)<br>- Funds to be managed by Ryan | | |
| Information | | Functional Specification<br>- Due Feb 16<br>- Soft deadline Feb 12: deliver content to James<br>- Figures can be described or hand-drawn then uploaded to be rendered by James | | |
| Decision | All | Meet Feb 9 at SFU to work on project | | |
| Decision | All | Meet Feb 10 at Elnaz to discuss Func Spec | | |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 02/11/15 | Order at | 15:10 |
| Meeting Chair | Adam | Adjourned at | 17:00 |

| | |
|---|---|
| Attendees | Ryan, Adam, Sam, James |
| Regrets | Elnaz |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Discuss parts purchasing<br>- Define Electronics Specifications | | |
| Discussion | | Arduino<br>- Mega: more expensive, more inputs<br>- Uno: less expensive, enough inputs | | |
| Information | | Bluetooth transmission of data from Controller to PC via wifi | | |
| Information | | MSU = Modular Sensor Unit<br>- All MSUs combined form out "sensor array" | | |
| Information | | Bluetooth adapter plugin for the Arduino to be able to communicate with PC | | |
| Discussion | | Proto boards for testing purposes | | |
| Discussion | | Standard 9V battery<br>- Works with Arduino<br>- Less expensive than rechargeable battery | | |
| Decision | | Make sure high frequency Arduino | | |
| Decision | | Arduino Mega for input port leniancy | | |
| END OF MINUTES | | | | |

harmony innovation

| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 02/17/15 | Order at | 12:15 |
| Meeting Chair | James | Adjourned at | 13:15 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Functional Specification Post Mortem<br>- Development plans | | |
| Information | | Functional Specification post mortem<br>- Major improvement over proposal process<br>- Good communication, good ownership<br>- Happy with the final product<br>- Going forward, set soft deadline and stick to it (James) | | |
| Information | | Development Plans<br>- Electronics is the furthest along, probably to the point that we've missed certain intermediate tasks<br>- Software is furthest behind | | |
| Discussion | | Laid out the development plan for Software | | |
| Action | A, R or S | Set up meeting with Amir (Linear Discriminant Analysis) | 02/19/15 | Closed |
| Discussion | | Laid out the development plan for Electronics | | |
| Action | A, R & S | Development Plan for Electronics | 02/19/15 | Closed |
| Action | J & E | Development Plan for Kit | 02/19/15 | Closed |
| Action | James | Look into Oral Progress Report | 02/19/15 | Closed |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 02/20/15 | Order at | 11:30 |
| Meeting Chair | James | Adjourned at | 12:35 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Electronics: protoboards, sensors<br>- Development plans<br>- Oral Progress Report | | |
| Information | | Electronics<br>- Integrated circuits are sourced, pending orders<br>- Ryan tested Arduino<br>- Looking to borrow protoboards from Fred (Lab 1) | | |
| Action | Adam | Get protoboards from Fred | 02/23/15 | Closed |
| Discussion | | Oral Progress Report<br>- Reviewed expectations/rubric<br>- Identified Plan B<br>- Delegated area to talk about | | |
| Discussion | | Software Development<br>- Development environment: GitHub or Dropbox | | |
| Action | Ryan | Look into GitHub, Google Code | 02/23/15 | Closed |
| Discussion | | Kit Design<br>- Basic shape for Controller enclosure<br>- Laser printing of top board at BCIT | | |
| Action | Elnaz | Email Fabio about LDA, possibly set up meeting | 02/23/15 | Closed |
| Action | James | Contact a therapist (GF Strong), set up meeting to discuss process of rehabilitation | 02/25/15 | Closed |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 02/26/15 | Order at | 10:15 |
| Meeting Chair | James | Adjourned at | 11:30 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Status update<br>- Outstanding action items<br>- Presentation preparation | | |
| Information | | Elnaz procured prototype vest for kit | | |
| Information | | Ryan: ICs and bluetooth board arriving 2/27<br>Wiring should begin next week | | |
| Discussion | | Presentation<br>- Division of labour:<br>-> Intro - Elnaz<br>-> Electronics: Ryan and Sam<br>-> Software: Adam<br>-> MIDI, Project Management: James | | |
| Decision | | Meeting again 2/27 at 11:30 for talkthrough/walkthrough | | |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | | | |
|---|---|---|---|---|---|
| Meeting Date | 02/27/15 | | | Order at | 11:30 |
| Meeting Chair | James | | | Adjourned at | 12:30 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Contacts<br>- Oral Progress Report prep | | |
| Information | James | Contacted Ian Denison (GF Strong) about rehab process. Contacted Jaimie Borisoff (iCord) about software process and technology. | | |
| Discussion | | Oral Progress Report preparation | | |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 03/05/15 | Order at | 13:30 |
| Meeting Chair | James | Adjourned at | 14:00 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Borisoff Meeting<br>- Denison Meeting<br>- Scheduling Demo<br>- Design Specification work | | |
| Discussion | | Borisoff meeting<br>- Good meeting, lots of good ideas, very positive<br>- Maintain contact throughout project | | |
| Decision | | Denison meeting scheduled for 3/6 at 2pm at GF Strong | | |
| Decision | | Demo schedule requested for 4/10 @ 13:30, 4/13 @ 10:30 or 4/15 @ 1:30 | | |
| Discussion | | Design Specification<br>- Need to create schematic assets<br>- Need to create document structure<br>- Need to create enclosure design<br>- Meeting 3/6 before Denison meeting to create document structure and begin writing | | |
| END OF MINUTES | | | | |

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| MEETING MINUTES | | | |
|---|---|---|---|
| Meeting Date | 04/16/15 | Order at | 17:00 |
| Meeting Chair | James | Adjourned at | 18:00 |

| | |
|---|---|
| Attendees | James, Elnaz, Ryan, Adam, Sam |
| Regrets | |

| Item | Owner | Description | Due Date | Status |
|---|---|---|---|---|
| Agenda | | Items<br>- Where did all the meetings go?<br>- Project status<br>- Demo status<br>- Post mortem status | | |
| Discussion | | Where did all the meetings go?<br>- As development ramped up, group split into dev teams<br>- Formal meetings abandoned, replaced by stand-ups and status updates | | |
| Information | | Project Status<br>- Missed delivery date due to issues with software<br>- MRAS is now functional, if buggy<br>- Further issues will be addressed during presentation | | |
| Discussion | | Demo Status - Responsibilities:<br>- James: intro, outro, project level<br>- Elnaz: kit, market analysis<br>- Ryan, Sam, Adam: electronics and software | | |
| Information | | Post Mortem Status<br>- Document is in skeleton form in Docs<br>- Workload, Budget and Schedule figures are in<br>- To be completed after demo | | |
| Information | | MDDC will make decision on finalists for competition on 4/20 | | |
| END OF MINUTES | | | | |