



POST-MORTEM
SOLAR REAL TIME TRANSIT
DISPLAY SYSTEM
SUNLINK INC.

Issue Date: December 14, 2015
Revision: 1.0



SUNLINK

Post-Mortem



ensc440-sunlink@sfu.ca

778-235-4757

Simon Fraser
University,
8888 University Dr.
Burnaby, BC

Contact Person:

Zachary Kaarvik
zkaarvik@sfu.ca

Submitted To :

Dr. Andrew Rawicz-ENSC 440W
Steve Whitmore -ENSC 305W
School of Engineering Science
Simon Fraser University

Date Issued:

December 14, 2015

1 INTRODUCTION

The following document provides a high-level description of the functionality of Solarity as well as hardware and software designs, details costs and materials used, shows the schedules our team followed, and talks about group dynamics and challenges encountered. The agendas with meeting minutes for each group meeting is also included.

2 SYSTEM OVERVIEW

This section outlines the main functionality of our project, with a high-level look at the system and how it works. Figure 1 diagram shows how the four subsystems of our project work with each other.

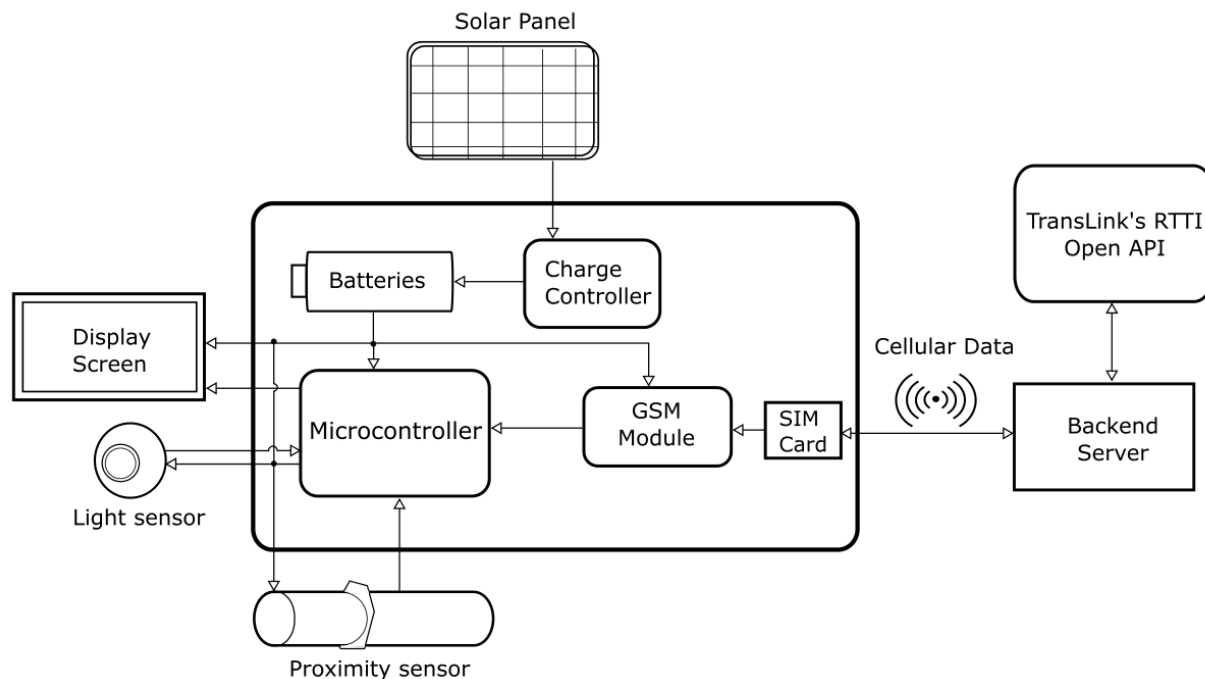


Figure 1: Block Diagram of the overall Architecture of Solarity.

2.1 PROJECT MODULES

The first subsystem involves the interface of bus numbers and times onto a low power e-paper display. The bus numbers and times are retrieved from a backend server which obtains the data through Translink's RTTI Open API system. Solarity's backend server sends the data to the device through a cellular data line. This cellular connection is provided by a GSM/GPRS modem which the microcontroller can use to access the internet. The microcontroller will be interfaced with a display where the information will be presented in a user friendly format.

The second subsystem is the power module. The system will require a battery large enough to power the microcontroller, the GSM module and the display throughout the daytime and nighttime. The battery capacity will have a high dependency on the active time of the device and will be charged continuously with a solar panel mounted on top of the bus pole. A battery charge controller will be wired between the batteries and the solar panel to prevent overcharging and pose as a safety measure.

The third subsystem utilizes sensors. In order to minimize the power consumption, proximity sensors will be added to the system to help detect when transit users are nearby. Solarity will generally remain in sleep mode during the night when busses are no longer in service and traffic is low. In addition, Solarity requires a light sensor. The e-paper display does not contain a backlight and will be difficult to see with low ambient light. The light sensor will be used to track when to turn on the backlight for the screen to aid with visibility.

The fourth subsystem involves Solarity manager backend server. Each Solarity device will be assigned a unique ID and a bus stop location for installation. The backend server will store the locations of all installed Solarity devices and the corresponding device ID. When a request is sent, the server will look up the ID and location and relay the appropriate bus numbers and times back to the device.

2.2 USER EXPERIENCE

For the transit users Solarity accompanies, they will enter within range of its sensors, Solarity then will be in active-mode. Translink's real-time data will be pulled from Sunlink's server, and the display will be refreshed with current bus info. If the user stays within the sensor range, Solarity will keep updating with new bus info every minute.

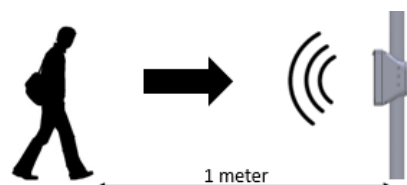


Figure 2: User interacting with Solarity

3 SCHEDULE

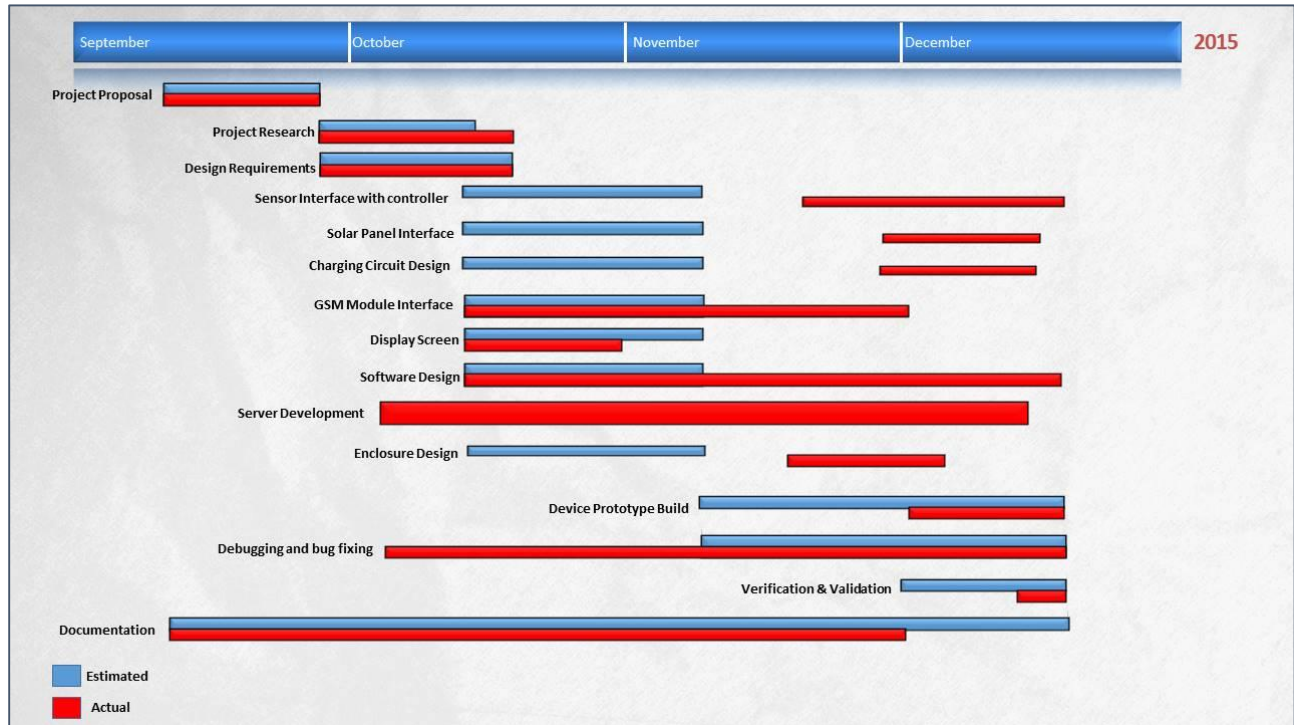


Figure 3: Development Schedule

Figure 3 depicts the planned development schedule as well as the actual schedule for Solarity during the design stage. From the inception of the design process, the team understood that overlap between stages was inevitable and created a schedule plan accordingly. There was some deviation from the schedule as expected but our team stuck to plan for the majority of development. The design was on time in many areas but slower in others. Specific areas are the development of the battery/charging circuit and the sensors (proximity and light). Even though this task was somewhat delayed, it was no cause for concern. The initial development schedule was a rough estimation, and no parts should be rushed for proper development to happen. With proper planning and work, we were able to complete our project on time.

4 FINANCIAL

Table 1 compares our original estimated budget, with our actual current budget. We did not seek any funding from an external source as all costs were covered by the internal team members. From the table it is clear that we are about \$190 lower than our initial estimated budget. We have been consistent with the purchases and have found relatively cheap prices from different sources. Most of the parts for our project have been purchased - excluding the wiring and housing - therefore the amounts in the table below reflect the final budget. Additionally, we have been generously provided with several parts free of charge from family members.



Table 1: Budget Breakdown

Component	Estimated Cost	Actual Cost
Microprocessor (TI MSP430)	\$ 20.00	\$ 17.73
MPico Display	\$ 175.00	\$ 166.66
Solar Panel	\$ 175.00	\$ 0 (Already own one)
Battery and Charging Circuit	\$ 50.00	\$ 50.40
Sim 800c GSM Shield	\$ 75.00	\$ 80.44
Cables and Miscellaneous Electronics	\$ 50.00	\$ 106.34
Housing	\$ 75.00	\$ 120.00
Subtotal	\$ 620.00	\$ 553.56
Contingency (25%)	\$ 155.00	(Duty) \$ 43.84
Total	\$ 775.00	\$ 585.40

5 CHALLENGES

5.1 SOFTWARE

Our team faced some challenges regarding debugging software with the microcontroller controlling the GSM module. This slightly delayed our projected time to completion but Tim was able to debug the problem on his own after we took a day to relax and think it over.

We also had problems with how long it took to update and refresh the information on the screen; our code for interacting with the GSM was not optimized to potential, and so we had to quickly work on more efficient functions near the deadline. We managed to half the time it took to send the AT commands to the GSM.

Timing

The microcontroller we chose met our needs, but was difficult to use. The documentation and online support was less than we hoped for and this made it more challenging and time consuming work for programming software. It forced us to really understand our code and come up with new code as well.

5.2 HARDWARE

Our enclosure was 3D printed which was a relatively simple process, but we encountered a small problem with moisture in the printing material. After leaving it out the enclosure was leaking water and this was dangerous with our electronic parts nearby. We noticed the problem and decided to let it air dry for some time, we then blow-dried it for an hour and waited to see that the problem was fixed.

6 GROUP DYNAMICS



The team at Solarity is organized so each member can contribute to the project in their best way. With a group of 6 we needed to efficiently distribute work to each member and also organize meetings every week. We kept each other up-to-date with the progress on each of our modules and always communicated any problems when they occurred.

7 WORK DISTRIBUTION

Table 2 shows the workload distribution between technical, administrative, and other tasks and indicates the participation levels in those tasks.

Table 2: Workload Distribution Chart

TASKS	Dejan	Rohan	Karen	Rob	Zach	Tim
Documentation	XX	XXX	XX	XX	XX	XX
Software Development	XXX	XX	XX	XX	XXX	XXX
Server Development					XXX	
Hardware Development	X	X	XXX	X	XX	XXX
Solidworks					XX	XXX
Debugging/Testing	XX	XX	XX	XX	XX	XX
Assembly	XX	XX	XXX	XX	XX	XX
Team Management	XX	XX	XX	XX	XX	XX
Meeting/Minutes	XX	XXX	XX	XXX	XXX	XX

8 INDIVIDUAL LEARNING

ZACH KAARVIK - CEO

For the past five years I have been thinking about Capstone. It seemed like an insurmountable obstacle in the way of obtaining my degree. I heard the stories of students spending months in the lab, not having the time to go home and take a shower. For the first three years of school it was terrifying - but as time went on and my classmates and I furthered our skills through projects and co-op it looked like we might actually be able to execute a real engineering project. Now, after four months of working with my team on our project, Solarity, I can say that we have conquered capstone and learned more along the way than I would have imagined.

Our idea to create a self-sustaining real time bus display has gone through many revisions and adaptations to new information as we did more research. We never



originally planned to integrate a backend server, but eventually decided to implement one as its benefits outweighed the downsides. We figured that development of image manipulation, and a wider flexibility of image creation was possible on a server. Additionally, the limited memory of the TI MSP432 microcontroller we are using would prove to be difficult to both create and then parse an image into EPD format, which is used by the display controller.

My main contributions to the development of the project are the display firmware, as well as the server software. The display firmware proved to be very tricky. We found a very limited number of e-ink displays available to consumers, and displays that were of a reasonable size for our project generally run into the thousands of dollars for a development model. Luckily we found an appropriately sized 7.4" e-ink display from pervasive display. It was the only e-ink display found that fit our budget and size requirements, it even came with a controller which managed the screen's functions. I developed the display firmware alongside Karen, and we had a lot of trouble along the way. Mainly, we did not handle the enable pin properly, and did not account for delays and timings required by the controller. As for the server software, it was developed with NodeJS as a backbone, on top of which we used AngularJS for the configuration interface, and several npm image manipulation libraries to create the image that is used on the display.

If we were to start this project again there are a couple of things I would like to change. First of all, for the display, we would have had a much easier and faster development time if we would have properly read and understood the datasheet. Once we properly implemented the delays required the display worked perfectly. Secondly, I would like to implement a graphical example of advertisements incorporated on our display. This would greatly help us market our product to the customer.

I've learned a great deal about real engineering work throughout the semester. I understand the importance of good documentation and proper revision. My ability to improvise and think of alternative solutions has certainly improved as well. We are considering approaching industry with this product as we feel it has so many more applications outside of transit – it can be used to display any content in nearly any location. From the feedback we have received from the professors and others we know we have the potential to market this product.

ROHAN THOMAS – CTO

This has been a unique four month project period, having the opportunity to create the Sunlink team with the five other members was an experience like none other. I learned so many things, some bring not technical from the five other members. The overall experience was entertaining and beneficial as we were able to take our vision as a group and worked to making our actual product. Unlike independent work, group work requires a lot of commitment and communication for the end product to succeed.



Initially when we started planning the group, it consisted of Dejan, Rob, two other members and myself. Those two other members found co-op placements at the start of the semester and our group quickly reduced to 3 members. We were able to find a group that consisted of 3 members (Karen, Zach, Timmy) and decided to merge with them. We had opportunities to merge with other groups but I am truly thankful that we chose this group. As a new group of 6 we started brainstorming on many ideas but eventually agreed to create a solution to improve the current transit display system in Vancouver.

I have previous software Co-op experience, but none in embedded systems or hardware engineering. I learned a lot through the development of Solarity. I discovered that with a microcontroller, you could connect it to the web and program it to do multiple features. I contributed to helping with the GSM and electronics of the project. In terms of datasheets, it was confusing at times to get the needed information. Sometimes it is hard to create a solution to a problem when we made the problem ourselves. We went away from the schedule at times but put in extra hours to eventually get certain tasks done.

Control software really helped us communicate and up-to-date with all aspects of the project. Slack was very effective with team communication and Git was useful to keep all source code controlled. We didn't necessarily have to be together as a group to be productive. Many times we were able to do tasks independently.

In reflection capstone has been a benefit to me as I begin my engineering career. It enabled me to think above the low level technical details associated with engineering and think about the overall production of an engineering project. I am very pleased of what the team was able to accomplish in four months and would love to work with them in the future.

TIMMY NGUYEN – Director of R&D

During ENSC 305W/440 I have gained many valuable skills to help my career begin. This is my second project where I have been heavily involved in from conception to prototype. This project was significantly more complicated and further my knowledge in many different areas. I learned many important skills throughout the design of our project.

This project had improved my confidence level in my programming skills. Before the project I had little confidence in my programming skills, but due to my past co-op at Sierra Wireless I had knowledge in telecommunication. I decided to take a role in programming the microcontroller to communicate with the GSM as I have the most knowledge in that field due to my past co-op. After many nights of little to no progress I was finally able to control the GSM module. The number one lesson I learned was timing is everything. Some components could not keep with the speed of the microcontroller; therefore delays were needed to make the microcontroller to wait for the other components. I would want to thank Dejan as my emotional support, as without him I would have not made such progress in the software for the GSM module.



Having a diverse set of engineering student completely balanced the workload throughout the project, and our group dynamics were the closest possible case to being ideal. Though originally built with pre-existing friendships, I have also gained a new friendship with my team members Dejan, Rohan and Rob. I feel lucky to have worked with such a great group of people, sharing a common goal.

If I were to face a project like this again, I would do much what I did the same, but perhaps I would dedicate more time to learning and understanding other parts of the project in order to help make the final integration more seamless. I perhaps changed how we should have picked our parts earlier and brought them earlier as well. During the late stages of our project, some components were changed which the enclosure was not designed for.

Overall I would consider this project a success. Although there were a fair share of problems along the way, overcoming them was part of the experiences. In the end I am confident that we developed a product that has a high market value. If I ever had a chance to work with any of this people in a project, I would not hesitate to take the opportunity.

DEJAN JOVOSAVIC - CEO

During my 4 month doing capstone I had an awesome time. I took what I knew and was very strong in and brought it to the group. From my group members I learned so much new material, it was fantastic. We had a great group dynamic. I remember from the early lectures of 305 Steve mentioning how important a solid group effort is, thus I did everything I could to fulfill my part. And wouldn't you know it so did everyone else creating a fantastic working environment.

I started off my plans for 440 with Rohan and Rob as I work great with them. When a few of our members left Rohan found another group which had 3 members also; it was Zack, Tim and Karen. I can't explain how pleased I am with Rohan's choice as this was possibly one of the best groups I have ever worked with.

I worked mainly on the GSM with my new friend Tim, it was difficult and I probably lost a decent amount of hair from the struggles we endured, but it was also so much fun. Tim is a much better programmer than I, but he helped me understand how to program the Microcontroller to the point we could actually work on it. I learned so much from him, but also had a great time doing so. We made the GSM work effectively and complete all the necessary tasks, there were obviously changes made along the way as with any long-term project but we did it 😊.

The business aspect of the course was not my first time thinking about our world from a selling standpoint so I was able to provide insight in certain areas. However one thing I learned not too long ago is that it is vital to listen to other people's ideas. This is what made our presentation and selling point so strong; everyone shared and everyone listened. Karen, Zack, Tim, Rob and Rohan all contributed their ideas about



how we should structure our presentation as to show people what our product is in an effective way.

If I were to do this project again I would probably start working on the actual product earlier. We started a little bit late because the part that took the longest was to actually get things working for the first time. What I mean by this is like getting the GSM to receive commands and issue replies, or getting the display to respond. This is the hardest part of any process, nothing works no one knows why and all you can do is keep on going. It's not like an assignment where there is a solution; you have to figure everything out on your own. Therefore in the future I would predict more time for this part, the countless hours you have to spend with no results. Once you get through this phase you pretty much know where approximately the finish line is.

As I stated earlier working in this group was just so solid. Even at the end when things weren't fitting into our enclosure everyone kept relatively calm, obviously there was some painting but most importantly there was no finger pointing. I can honestly say we worked for 4 months on this whole thing and not once was there any altercation between group members. Considering under what pressure we constantly were I found this absolutely amazing. I would definitely work with them again and who knows we might actually take our product to the market 😊.



KAREN LY-MA - CIO

Over these past four months, I have had the pleasure of working with my group members of Sunlink as we worked hard to design and develop Solarity, a self-sustaining real time bus display. Being part of a team that was hard working, focused and committed definitely made these months more manageable. We were able to split up the work load more easily since each member of Sunlink had different areas they were strong in.

My primary role for this project was focused on working on the hardware design of Solarity. From the beginning we wanted to integrate sensors into our design and wanted to be able to have the system wireless to be essentially a plug and play product. Integrating sensors into Solarity was more difficult as it required implementing firmware. My past co ops have all been solely focused on hardware and FPGAs so programming was more of a learning curve for me. Debugging took up a lot of programming time. We definitely challenged ourselves by choosing to work with a Texas Instrument microcontroller, the MSP432P4x, rather than a simple Arduino. In the end this microcontroller worked better for our system with the various low power standby modes which we utilized to optimize the power consumption of Solarity. I also helped implement firmware for the E ink display with Zach. Since neither of us have worked with an E ink display, the firmware took up considerable amount of hours at the beginning to just try and refresh the screen.

I feel like I have learnt a lot from this project because our team was not afraid to challenge ourselves and work with devices we had no prior experience with. Although one of our major concerns when starting Capstone was ordering parts in late, I realized that it was better that we did not rush this process. Since power is such a crucial aspect of our design, it was very important to go about selecting components carefully. By having meetings and discussions on the system design, doing power estimations and doing ample amounts of research to find the most ideal components for our applications, we did not encounter major hardware design flaws.

If we had more time to work on this project, I would want to spend the time to try and further optimize Solarity to consume even less power. Many of the devices we selected for our design, such as the GSM and the microcontroller, have low power modes. We managed to put our microcontroller into a low power mode when not in use. The GSM draws the most current in our system, having it in power down mode rather than idle would also greatly reduce the power consumed within Solarity.

Despite all the horror stories I have heard about Capstone, I would say my experience has been quite the opposite. I have learnt many technical and soft skills from this project and have had the privilege to work with such a hardworking and motivated team. I can earnestly say I am satisfied and proud of the product we were able to design and develop within just a four month span. Starting off with a passing idea and then having a working prototype has made all many hours in Lab 1 pulling our hairs out, in the end, all very worthwhile.



ROBERT CORNALL - COO

The past 4 months have been busy, working with Sunlink was a whole new experience for me and I learned the most out of this project than any other work I have done in school. I found it quite enjoyable and satisfying as our plans came together and things started to actually work. Being a part of this group has been a different experience from other group work as it required lots of communication and work.

I started with Dejan and Rohan, until we found another group of 3 to merge with. We had some ideas but when our group was formed they told us of an idea for real-time bus displays and it seemed like a smart and useful idea. We have all had experience with buses before and to improve the current system in Vancouver was a relatable idea for all of us.

As someone with no previous Co-op experience I learned lots during my time with Sunlink. I learned how you can pickup a random microcontroller and with some hard work and digging through the internet, I could program it to do what I wanted which is really cool. I learned it is confusing to look for datasheets and help online, sometimes you need to figure the problem out completely alone. Another thing I learned is how long it takes to solve problems when you are the creator of the problem. We needed to allocate lots of extra time for unexpected bugs and mishaps so that we stayed on schedule.

Technology really helped us communicate easily and control our software versions, but meeting in person was the main way we got any work done. When we are all in the lab we can be productive and bounce ideas off each other, and solving problems is much easier with the whole group.

Overall capstone has been a positive learning experience for me. I feel much more qualified to work as a professional engineer in the future, and happier about this career choice. I am proud of what our team was able to accomplish in such a short time with our different busy schedules, and would be grateful to work with them in the future.

9 CONCLUSION

Our team at Solarity was able to bring the idea of Sunlink from a vague idea, to a fully functioning prototype. We had a mostly positive experience overall and we were pleased with the product of our hard work. Solarity looks and works better than expected, and really achieves our initial goals set 4 months ago regarding efficiency of power, cost, and self-sustaining capabilities. Solarity believes in the future of public transit and created this product with that in mind. Attracting more riders and easing the use of bus transportation is important to us to create a better future.

APPENDIX A - MEETING AGENDAS & MINUTES



Sunlink

AGENDA 1

September 15, 2015

6:30-7:30

A. ASB (Outside Renaissance)

Purpose of Meeting: To discuss the project and items related to the Project Proposal

Items for Discussion:

- Discuss project high level technical details, components required, estimate cost
- Translink connection - prepare an email to state the purpose of our project
- Funding possibilities – Wighton Fund, ESSEF, Translink, other companies
- Discuss Project Proposal
 - Division of tasks
- Company name and logo, product name

Sunlink

MINUTES 1

September 15, 2015

6:30-7:30

B. LAB4

Present: Karen, Tim, Rob, Rohan, Dejan, Zach

Absent:

Purpose of Meeting: To discuss the project and items related to the Project Proposal

Minutes:

- C. Discuss project high level technical details, components required, estimate cost**
- a.** Possible microcontroller: TI MSP430, TIVA Launchpad
 - b.** GSM Module (must support at least GPRS): SIM900
 - c.** Battery
 - d.** Solar Panel (charging circuit)



- e. Display (1-2): Bistable display aka e-ink is low power
 - i. We need a long display, reasonably large – might be hard to find
- f. Housing
- D. Translink connection - prepare an email to state the purpose of our project**
 - a. Rohan's dad knows the head of Translink IT
 - b. We will prepare an email to get their opinion on our project and ask for any comments on feasibility etc
 - c. We want to see if they already have something in process in R&D
 - d. Ask how they have implemented the current live-bus displays in some locations (e.g. near science world)
- E. Funding possibilities – Wighton Fund, ESSEF, Translink, other companies**
 - a. Wighton fund – wants projects with a benefit to society. We should apply to this as the application is simple but not guaranteed to receive funding.
 - b. ESSEF – Not going to apply, we don't want to give up our project at the end
 - c. Translink – explore this option once our project is better defined
- F. Discuss Project Proposal**
 - a. Division of tasks**
 - i. Introduction - Rohan
 - ii. Scope/Risks/Benefits - Karen
 - iii. Market/Competition/Research Rationale - Dejan
 - iv. Company Details - All
 - v. Project Planning - Tim
 - vi. Cost Considerations – Zach
 - vii. Conclusion/References - All
- G. Company name and logo, product name**
 - a. Name – Sunlink
 - b. Product name – Take a look at other documents, do we need a specific product name?
 - c. Logo – Everyone come up with something if you want
- H. Other Items**
 - a. Request that Steve Whitmore keeps our documents private for two years
 - b. Slack – Zach will set up

Meeting adjourned at 7:15

Sunlink Inc.

AGENDA 2

September 21, 2015

6:30-7:00

1. Lab 4

Purpose of Meeting: To discuss the first deliverable, the project proposal. Due Monday, September 28th

Items for Discussion:



- Project proposal status
 - Document template provided by Rohan
 - Discuss when assigned parts of document must be completed
- Team name / logo
- Product Name
- Team Member Positions (CEO, CTO, CFO, etc)
- Translink Response



Sunlink Inc.

MINUTES 2

September 21, 2015

6:30-7:00

2. Lab 4

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: To discuss the first deliverable, the project proposal. Due Monday, September 28th

Minutes:

Zach called the meeting to order at 6:32.

3. Project proposal status

a. Document template provided by Rohan

i. Template from design firm

b. Discuss when assigned parts of document must be completed

i. Assigned parts should be completed by Thursday morning

ii. Each person must write a short descriptive paragraph about themselves – look at examples

c. Etc

i. Document format should follow rubric instead of the sample, as grading is based on the rubric

ii. VitaMoto (2015) is a good example

4. Team name / logo

a. Logo is great! We will use this version as our logo

b. Located in the OneDrive shared folder

5. Product Name

a. Name the product after a star? Sirius?

6. (CEO, CTO, CFO, etc)

a. CEO - Zach

b. CTO - Rohan

c. CFO - Dejan

d. CIO - Karen

e. COO - Rob

f. Director of R&D - Tim

7. Translink Response

a. Slightly disappointing response, the team at Translink simply wished us good luck and pointed us to the documentation for the API

b. Seems there was some miscommunication as to what we wanted to get out of contacting them



- c. We should consider responding to them and asking if we can work more closely with them if they are interested in such a partnership
- 8. Etc
 - a. Market
 - i. Dejan has been looking into the market for such a design, many articles are negative due to the high cost of implementing such a system. However if we can come up with a cost effective design without requiring additional infrastructure we can overcome these negatives
 - b. Karen will try and come up with a SolidWorks model tomorrow

Meeting was adjourned at 7:15.

Sunlink

AGENDA 3

September 28, 2015

6:30-7:00

9. Lab 1

Purpose of Meeting: To discuss the first deliverable, the project proposal. Due Monday, September 28th

Items for Discussion:

- Review Project Proposal

Sunlink

MINUTES3

September 28, 2015

6:30-7:00

10. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: To discuss the first deliverable, the project proposal. Due Monday, September 28th

Minutes:

Zach called the meeting to order at 6:32.



11. Review Project Proposal

- a. Document is complete

Meeting was adjourned at 7:15.

Sunlink

AGENDA 4

October 5, 2015

6:30-7:00

12. Lab 1

Purpose of Meeting: To discuss the second deliverable, the functional specs. Due Monday, October 21st

Items for Discussion:

- Discuss what content we should include in our functional specs
- Assign writing tasks to each group member

Sunlink

MINUTES4

October 5, 2015

6:30-7:00

13. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: To discuss the second deliverable, the functional specs. Due Monday, October 21st

Minutes:

Zach called the meeting to order at 6:35.

14. Discuss what content we should include in our functional specs

- a. Main sections:
- i. Introduction
 1. Scope



- 2. Audience
- ii. System Overview
 - 1. Usage
 - 2. High level design
 - 3. Functionality justification
- iii. Requirements:
 - 1. Hardware
 - a. Power Requirements
 - b. Charging
 - c. Reliability
 - d. Sensors (light, proximity, etc?)
 - 2. Software
 - a. Response times (gsm communication)
 - b. User interface
 - c. Configuration (how to change bus stop etc)
 - d. Lots more
 - 3. Housing
 - a. Heat dissipation (mostly gsm module, maybe charging cct)
 - b. Sizing
 - c. Weight
 - d. Mounting (enclosure on pole, solar panel mounting)
 - e. Materials (weatherproofing)
 - 4. Sustainability / Safety
 - 5. Engineering Standards
- iv. Conclusion

15. Assign writing tasks to each group member

- a. Introduction
 - i. Scope - **Rohan, Rob, Dejan**
 - ii. Audience - **Rohan, Rob, Dejan**
- b. System Overview
 - i. Usage – **Karen, Zach**
 - ii. High level design – **Karen, Zach**
 - iii. Functionality justification – **Karen, Zach**
- c. Requirements:
 - i. Hardware
 - 1. Power Requirements - **Rohan, Rob, Dejan**
 - 2. Charging - **Karen**
 - 3. Sensors (light, proximity, etc?) - **Karen**
 - ii. Software
 - 1. Response times (gsm communication) - **Zach**
 - 2. User interface – **Zach, Tim**
 - 3. Configuration (how to change bus stop etc) - **Zach**
 - 4. Lots more - **Zach**
 - iii. Housing
 - 1. Heat dissipation (mostly gsm module, maybe charging cct) - **Rohan, Rob, Dejan**



- 2. Sizing - **Rohan, Rob, Dejan**
- 3. Weight - **Rohan, Rob, Dejan**
- 4. Mounting (enclosure on pole, solar panel mounting) - **Tim**
- 5. Materials (weatherproofing) - **Tim**
- iv. Sustainability / Safety
 - 1. Sustainability (incl. Reliability) - **Rob**
 - 2. Safety (incl. Reliability) - **Tim**
- v. Engineering Standards - **Tim**
- d. Conclusion

Meeting was adjourned at 7:22.

Sunlink

AGENDA 5

October 14, 2015

6:30-7:00

16. Lab 1

Purpose of Meeting: To discuss the second deliverable, the functional specs. Due Monday, October 21st

Items for Discussion:

- Discuss progress made so far in the document. Make sure group members have accomplished what was assigned
- Identify and assign remaining tasks

Sunlink

MINUTES 5

October 14, 2015

6:30-7:00

17. Lab 1

Present: Rob, Tim, Karen, Dejan, Zach

Absent: Rohan

Purpose of Meeting: To discuss the second deliverable, the functional specs. Due Monday, October 21st

Minutes:



Zach called the meeting to order at 6:38.

18. Discuss progress made so far in the document. Make sure group members have accomplished what was assigned

- a. We should remove the exact enclosure size dimensions

19. Identify and assign remaining tasks

- a. Executive summary – reuse from proposal (reword)
- b. Letter of Transmittal
- c. Finish all requirements – **BY FRIDAY!**
- d. Conclusion
- e. Combine table of figures and tables
- f. Finalize Requirement Numbers
- g. Page Numbering
- h. Revision Number

Meeting was adjourned at 7:04.

Sunlink

AGENDA 6

October 14, 2015

6:30-7:00

20. Lab 1

Purpose of Meeting: To discuss the second deliverable, the functional specs. Due Monday, October 21st

Items for Discussion:

- Discuss progress made so far in the document. Make sure group members have accomplished what was assigned
- Identify and assign remaining tasks

Sunlink

MINUTES6

October 14, 2015

6:30-7:00

21. Lab 1

Present: Rob, Tim, Karen, Dejan, Zach



Absent: Rohan

Purpose of Meeting: To discuss the second deliverable, the functional specs. Due Monday, October 21st

Minutes:

Zach called the meeting to order at 6:38.

22. Discuss progress made so far in the document. Make sure group members have accomplished what was assigned

- a. We should remove the exact enclosure size dimensions

23. Identify and assign remaining tasks

- a. Executive summary – reuse from proposal (reword)
- b. Letter of Transmittal
- c. Finish all requirements – **BY FRIDAY!**
- d. Conclusion
- e. Combine table of figures and tables
- f. Finalize Requirement Numbers
- g. Page Numbering
- h. Revision Number

Meeting was adjourned at 7:04.

Sunlink

AGENDA 7

October 26, 2015

6:30-7:00

24. Lab 1

Purpose of Meeting: To discuss the third deliverable, the Design specs. Due Monday, November 9th

Items for Discussion:

- Discuss what content we should include in our Design specs
- Assign writing tasks to each group member



Sunlink

MINUTES 7

October 26th, 2015

6:30-7:00

25. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: To discuss the third deliverable, the Design specs. Due Monday, November 9th

Minutes:

Zach called the meeting to order at 6:35.

26. Discuss what content we should include in our functional specs

- a. Main sections:
 - i. Introduction
 1. Scope
 2. Audience
 - ii. System Overview
 1. Usage
 2. High level design
 - iii. Design:
 1. Hardware
 - a. Sensors
 - b. Display
 - c. GSM Module
 - d. Microcontroller
 - e. Power
 - i. Charging
 - ii. Battery/solar panel
 2. Software
 - a. Solarity device
 - i. Display
 - ii. GSM
 - iii. Sensors
 - iv. Charging (?)
 - b. Solarity Manager Server
 - c.
 3. Housing/Enclosure
 - a. Wiring



- b. Enclosure Design
- c. Materials
- iv. *Test Plan*
- v. *Conclusion*

27. Assign writing tasks to each group member

- i. Introduction
 - 1. Scope
 - 2. Audience
- ii. System Overview
 - 1. Usage
 - 2. High level design
- iii. Design:
 - 1. Hardware
 - a. Sensors **Karen**
 - b. Display **Dejan, Rob, Rohan**
 - c. GSM Module **Karen**
 - d. Microcontroller **Dejan, Rob, Rohan**
 - e. Power
 - i. Charging **Karen**
 - ii. Battery/solar panel **Karen**
 - 2. Software
 - a. Solarity device
 - i. Display **Zach, Karen**
 - ii. GSM **Tim**
 - iii. Sensors **Dejan, Rob, Rohan**
 - iv. Charging (?) **Dejan, Rob, Rohan**
 - b. Solarity Manager Server **Zach**
 - 3. Housing/Enclosure
 - a. Wiring **Dejan, Rob, Rohan**
 - b. Enclosure Design **Tim**
 - c. Materials **Tim**
- iv. *Test Plan- (We be assigned later)*
- v. *Conclusion- (We be assigned later)*

Have all assigned parts done by Monday November 2nd
Meeting was adjourned at 7:05.

Sunlink

AGENDA 8

**November 1, 2015
6:30-7:00**



28. Lab 1

Purpose of Meeting: To discuss the third deliverable, the Design specs. Due Monday, November 9th

Items for Discussion:

- Discuss design specs content
- Gather current progress status

Sunlink

MINUTES 8

November 1st, 2015

6:30-7:00

29. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: To discuss the third deliverable, the Design specs. Due Monday, November 9th

Minutes:

Zach called the meeting to order at 6:35.

30. Discuss design specs content

- i. Introduction
 1. Scope
 2. Audience
- ii. System Overview
 1. Usage
 2. High level design
- iii. Design:
 1. Hardware
 - a. Electrical **Karen, Rohan**
 - i. Power
 - ii. Batteries
 - b. Charging **Karen**
 - c. Sensors **Karen**
 - d. GSM Module **Tim**
 - e. Cellular Antenna **Tim**
 - f. Microcontroller **Zach**



- g. Display Screen **Rohan, Rob, Dejan**
- h. Wiring **Rohan, Rob, Dejan**
- 2. Software
 - a. Solarity device
 - i. Display **Zach, Karen**
 - ii. GSM **Tim, Dejan**
 - iii. Sensors **Karen**
 - b. Solarity Manager Server **Zach**
- 3. Mechanical
 - a. Enclosure Design **Tim**
 - b. Solar Panel
- 4. Standards (?) **Tim**
- iv. *Test Plan- (We be assigned later)*
- v. *Conclusion- (We be assigned later)*

31. Gather current progress status

- a. Display
 - i. Display is working well. We are able to send commands reliably now and can upload new image data. Next step is to display an image that is sent from the server
- b. GSM Module
 - i. GSM Module has been tested with an Arduino and we are able to send AT commands and retrieve data over HTTP. Next step is to port this over to the MSP.
- c. Server
 - i. Server is coming along. Database is set up to store devices and their assigned stops. Web UI works and will display the devices in a table. Image API is being developed. An appropriate image processing library has been found and the image processing is being developed.
- d. Sensors
 - i. Proximity sensor has been acquired. Not yet tested with the microcontroller. Sensors have a lower priority than the main functionality of the device.
- e. Charging / Solar power
 - i. Found charging circuit from Adafruit. Will work well for our needs, can also charge via USB if needed

Have all assigned parts done by Monday November 2nd
Meeting was adjourned at 7:05.

Sunlink

AGENDA 9

November 10th, 2015

6:30-7:00

32. Lab 1



Purpose of Meeting: To discuss the progress of each section so far.

Items for Discussion:

- Discuss GSM/Microcontroller progress so far
- Gather current progress status

Sunlink

MINUTES 9

November 10th, 2015

6:30-7:00

33. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: To discuss the progress of each section so far.

Minutes:

Zach called the meeting to order at 6:30.

34. Discuss Hardware progress

Hardware

- a. Electrical **Karen, Rohan**



- i. Power
- ii. Batteries
- b. Charging **Karen**
- c. Sensors **Karen**
- d. GSM Module **Tim**
- e. Cellular Antenna **Tim**
- f. Microcontroller **Zach**
- g. Display Screen **Rohan, Rob, Dejan**
- h. Wiring **Rohan, Rob, Dejan**

35. Discuss Software Progress

Software

- a. Solarity device
 - i. Display **Zach, Karen**
 - ii. GSM **Tim, Dejan**
 - iii. Sensors **Karen**
- b. Solarity Manager Server **Zach**

36. Gather current progress status

a. Hardware:

- i. Power and batteries are not on track yet, we found some parts like the charging circuit as well as did research on other parts. More focus has been on Software/hardware at this point.
- ii. Display still functioning receives image data, not priority as we need to get data from server to get new image data and continually refresh the screen..
- iii. Sensors acquired and still not tested with microcontroller.

b. Software

- i. GSM Module – we are currently trying to get data from our server but encountering some problems. We also need to be able to port data onto MSP memory so It can be sent to the display..
- ii. Server – image processing is being worked on, Zachs figuring out how to use the algorithm to format the pixels properly onto the screen. Once that works we can start getting data using the GSM.
- iii. Microcontroller is good right now but we need to get the GSM working properly and figure out how the data can be retrieved from the GSM. Commands are properly being sent but some problems with reading data from the server is giving problems



Continue with GSM/Microcontroller work and hopefully be complete by next meeting Nov 16th.

Meeting was adjourned at 7:00.

Sunlink

AGENDA 10

November 16th, 2015

7:00-7:30

37. Lab 1

Purpose of Meeting: To discuss the progress of each section so far.

Items for Discussion:

- Discuss GSM/Microcontroller progress
- Talk about enclosure design
- Talk about charging/power

Sunlink

MINUTES 10

November 16th, 2015

7:00-7:30

38. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:



Purpose of Meeting: To discuss the progress of each section so far.

Minutes:

Zach called the meeting to order at 7.

39. Progress summary of things

Software

- a. Solarity device
 - i. Microcontroller
 - ii. GSM
- b. Solarity Manager Server

Hardware

- c. Charging/power
- d. Enclosure design

Gather current progress status

- **Hardware:**
 - i. Power and batteries are making slow progress, received parts but have not started setting up circuit, should be fine because its not main priority at this moment.
 - ii. Enclosure design is being made using Solidworks, good progress. We will eventually 3d print it using SFU printers..
- **Software**
 - iii. GSM Module – Can now get data from servers properly displayed on the COM port, so we know we can get the data, just need to store it onto MSP and send to Display.
 - iv. Server – Made a good format to display bus times from data. Algorithm should work theoretically but to test it on display need to get GSM working with microcontroller..
 - v. Microcontroller should be able to retrieve data from GSM, need to store it onto RAM and then send commands to the display later.

Continue with Microcontroller work to send the EPD formatted data to the display. If algorithm works should display properly on screen.. continue with power/battery work .

Meeting was adjourned at 7:30.



Sunlink

AGENDA 11

November 28th, 2015

5-5:30

40. Lab 1

Purpose of Meeting: To discuss the progress of microcontroller software, power stuff, and how much time is left till demo..

Items for Discussion:

- Discuss Microcontroller progress
- Talk about charging/power
- Time management (demo is soon)

Sunlink

MINUTES 11

November 28th, 2015

5:00-5:30

41. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: To discuss the progress of microcontroller software, power stuff, and how much time is left till demo..

Minutes:

Zach called the meeting to order at 5.



42. Progress summary of things

Software

- a. Solarity device
 - i. Microcontroller
- b. Solarity Manager Server
- c. Sensors

Hardware

- d. Charging/power

Gather current progress status

- **Hardware:**
 - i. Power and batteries are making progress now, We have started soldering and connecting parts for the charging circuit, once complete we must test all the parts functionality to make sure they can operate with the current that the batteries supply.
- **Software**
 - ii. Microcontroller can now store data onto RAM and then send that to the screen to update the image. We have problems trying to refresh the image after every minute as it only works the first time(?) we want it to refresh forever every minute, then once the sensors are integrated change that.
 - iii. Server – everything is functional except programming for different bus stops, algorithm works as the display properly shows times on the screen.
 - iv. Sensors – software making progress should be complete soon, then we can integrate with the screen refresh so it doesn't just refresh every minute but only when someone is within the vicinity. Light sensor slow progress.

Time Management: Some more focus will be put on charging/battery as other parts are coming together, need to meet more regularly and put in a little more time for work as we need to be ready for problems when the deadline is coming up.

Continue with battery stuff, figure out sensors.. more work needed..

Meeting was adjourned at 5:30.

Sunlink

AGENDA 12

December 6th, 2015

6-6:30



43. Lab 1

Purpose of Meeting: Discuss how it is all coming together and what major things are left.

Items for Discussion:

- Discuss power progress
- Enclosure
- Final things

Sunlink MINUTES 12

December 6th, 2015

6:00-6:30

44. Lab 1

Present: Rob, Tim, Karen, Dejan, Rohan, Zach

Absent:

Purpose of Meeting: Discuss how it is all coming together and what major things are left.

Minutes:

Zach called the meeting to order at 6.

45. Progress summary of things

Software

- a. Solarity device
 - i. Microcontroller
- b. Solarity Manager Server
- c. Sensors

Hardware

- d. Charging/power



e. Enclosure

Gather current progress status

- **Hardware:**
 - i. Power and batteries are receiving final testing, should be working by tonight, need to check that all functionalities of our devices work with the batteries. Batteries charge properly now after some fixes.
 - ii. Enclosure – Design was sent to Gary, we got a response and should be printed by tomorrow.
- **Software**
 - iii. Microcontroller can now refresh constantly every minute, now just need to integrate the proximity sensor so that it refreshes the screen every minute only when a user is nearby. Should be completed soon(by tomorrow).
 - iv. Server – updated image format for easier to read bus times, as well as added functionality so we can change the bus stop for solarity(instead of only reading from one bus stop) and reprogram whichever stop we want from now on.
 - v. Sensors – Software works sensor can function and so just need to integrate with the screen so that it refreshes properly as stated before..

Continue testing batteries (done by tonight), finish sensor software hopefully by tomorrow, server is perfect now. Need to put It all together once we get the enclosure..

Meeting was adjourned at 6:40.