Simon Fraser University
School of Engineering Science
Burnaby, BC V5A 1S6
contact@eva-controls.com

Sep 17, 2012

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

Re: ENSC 440 Capstone Project Proposal for Smartphone Voice Control Home Automation System

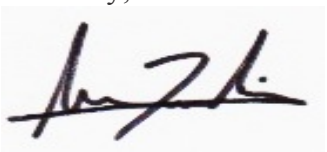
Dear Dr. Rawicz,

We are writing in regards to our project proposal for a Smartphone Voice Control Home Automation System, attached for your ready reference. The objective of our project is to design a system that provides individuals with disabilities easier access to basic home electrical devices. This technology can also be successfully designed for use by the general public in order to conserve energy. The approach method for our project is first, through voice commands for smartphones (iPhone), and second, through the automatic adjustment of light intensity according to the level of natural light.

The attached proposal provides an overview of our product outlining the design, cost, and implementation of the project. The market target is primarily focused on individuals with disabilities and the elderly, since the equipment and services are designed to enable these potential users to gain independence and mobility. Moreover, homeowners and the general public can be considered as part of the market environment. The proposal further describes in detail the composition of our company and its executive structure, as well as the expected timeline of the project's process.

EVA Controls is composed of six innovative and motivated engineering students. The executive team brings together electronic, system and computer engineers. We would be delighted to hear from you in order to further discuss our proposal. If you have any questions or concerns regarding our product, please contact us by email at contact@eva-controls.com

On behalf of the executive team,
Sincerely,



Adam Franklin, LEED® Green Associate
Co-founder and CEO
EVA Controls

Enclosed: Proposal for a Smartphone Voice Control Home Automation System

Proposal:

Smartphone Voice Control Home Automation System

Project Team: Adam Franklin
Alex Girtonea
Bryon Long
Alex Lung
Mark Ma
Mahyar Yousefi

Contact: Adam Franklin
contact@eva-controls.com

Submitted to: Dr. Andrew Rawicz – ENSC 440
Steve Whitmore – ENSC 305
School of Engineering Science
Simon Fraser University

Date: September 17, 2012

Executive Summary

"For all people, both with and without disabilities, a home is the cornerstone of a person's independence and provides a sense of belonging."
- 2010 Federal Disability Report

In 2006, Statistics Canada released "Disability in Canada: A 2006 Profile", a report which explores how many Canadians are faced with some form of disability. The report mentions that the most common types of disabilities among adults are pain-, mobility- and agility-related [1]. As of 2006, there were approximately 2.9 million citizens over the age of 20 who reported having some form of mobility disability. Furthermore, 5.2% of adults with disabilities experience some form of difficulty with carrying out everyday activities due to the inaccessible design and layout of their residences [2]. One solution to this accessibility issue is to remodel one's home and living space. Renovations, however, can be very expensive and time consuming, and that is why we are proposing a more inexpensive, eco-friendly alternative.

Imagine not being able to perform even a simple task, such as turning a light bulb on or off, because of a debilitating disability that prevents you from getting up to reach for the switch. It is this type of circumstance that we at EVA Controls aim to eliminate with the development of our home automation system. Our goal is to give control back to those individuals who have lost it, or perhaps never did have it, and to enable them to adjust their home living space to meet their personal needs and level of comfort.

This document proposes the development of a system that will efficiently and economically interface with existing homes and living spaces. Our proposed system will allow users to easily control various components in their homes through the use of a mobile device or by way of voice commands. The system will also offer users the option to fully automate the program, effectively creating optimal conditions in order to reduce energy consumption. The prototype system will utilize an iPhone as the main software control device, consist of voice recognition and daylight harvesting circuitry, and focus primarily on the control of home lighting systems. Future developments will incorporate other components and systems.

EVA Controls was co-founded by six engineering students from the Simon Fraser University. These individuals bring a wide range of engineering expertise, including electrical circuits, commercial lighting, as well as software and microcontroller programming.

A development schedule – including a number of preset milestones - has been prepared with the aim to present a fully functioning prototype system by early December 2012. Preliminary planning has also allowed us to develop a projected budget of $595, $500 of which has been secured from the SFU Engineering Student Society Endowment Fund (ESSEF).

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Glossary

Daylight Harvesting	A control system that reduces the use of artificial lighting with electric lamps in building interiors when natural daylight is available, in order to reduce energy consumption. [3]

Introduction

The main goal of EVA (Eco Voice Automation) Controls is to bring convenience into individuals' living space and interactions with house electronics. We are aware that patients or individuals with disabilities often have trouble maneuvering light switches, for instance, either in hospitals or at home. Therefore, the focus of our design is to produce an intelligent system that can automatically change the light according to the time of day or the weather, or through attached voice controls. The product will target individuals with disabilities, particularly those housed in long-term care facilities, as well as regular consumers, particularly homeowners. With the installation of our product, users would no longer require the assistance of others to turn lights on or off. Our company will also be developing a remote control system for smart phone application. This technology would allow any user with a smartphone to customize and set light levels according to their preferences. Given the increasing popularity and widespread availability of smartphones, this particular application promises to be very marketable, as well as highly useful and valuable to prospective users.

System Overview

Our proposed system design consists of three main components: the voice recognition control, the daylight harvesting control, and the user interface. A basic graphic representation of the proposed system in use can be seen in Figure 1.

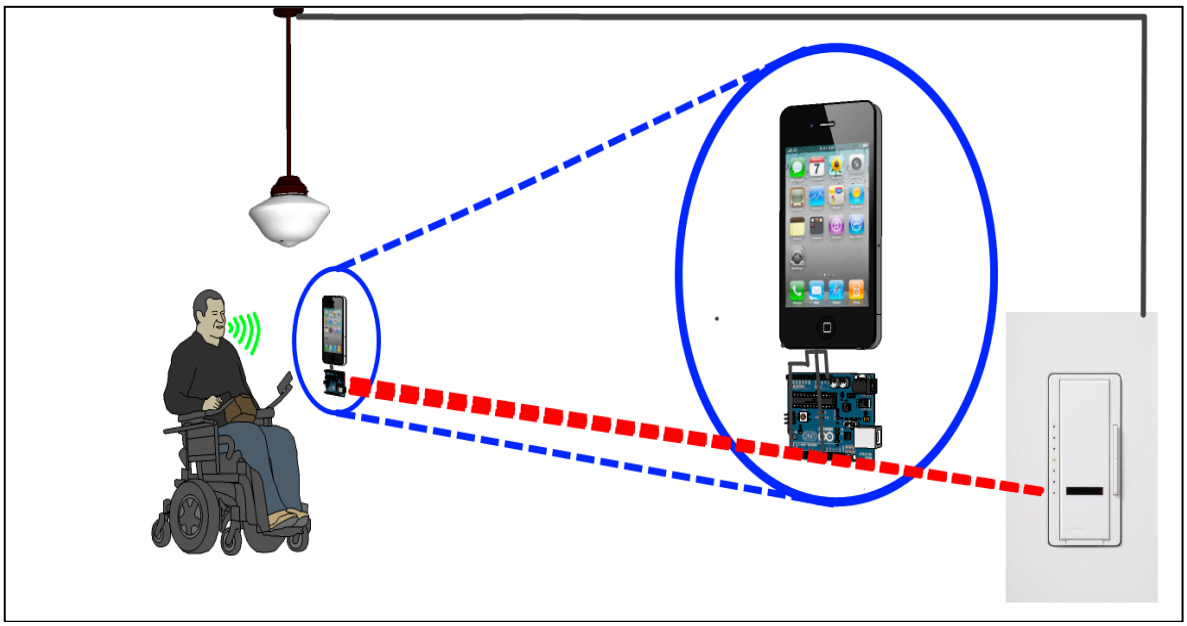


Figure 1: Conceptual System Overview

The user interface is to be implemented as a smartphone app developed on Apple's iOS iPhone. The purpose of the app is to provide the user convenient control through a device that they are likely to have with them most of the time. The app will provide the user control options such as turning on/off any device connected

to the system, control over any device specific options such as light dimming, as well as selection of the system operating mode. The two proposed operating modes are Manual and Eco modes. While in Manual mode, the user will have complete control of the system devices through the smartphone app, along with the option of voice commands - these commands are processed through voice recognition hardware with a built-in microphone. The Eco mode option provides the benefit of hassle free control of various devices through automatic adjustments that optimize comfort levels and energy savings. Currently, the Eco mode is only intended to control lighting systems. However, there is considerable room for future developments, such as an application for window shades. The main concept behind the current Eco mode is daylight harvesting which will be implemented through a photo sensor control circuit. A basic block diagram of the proposed system can be seen in Figure 2.

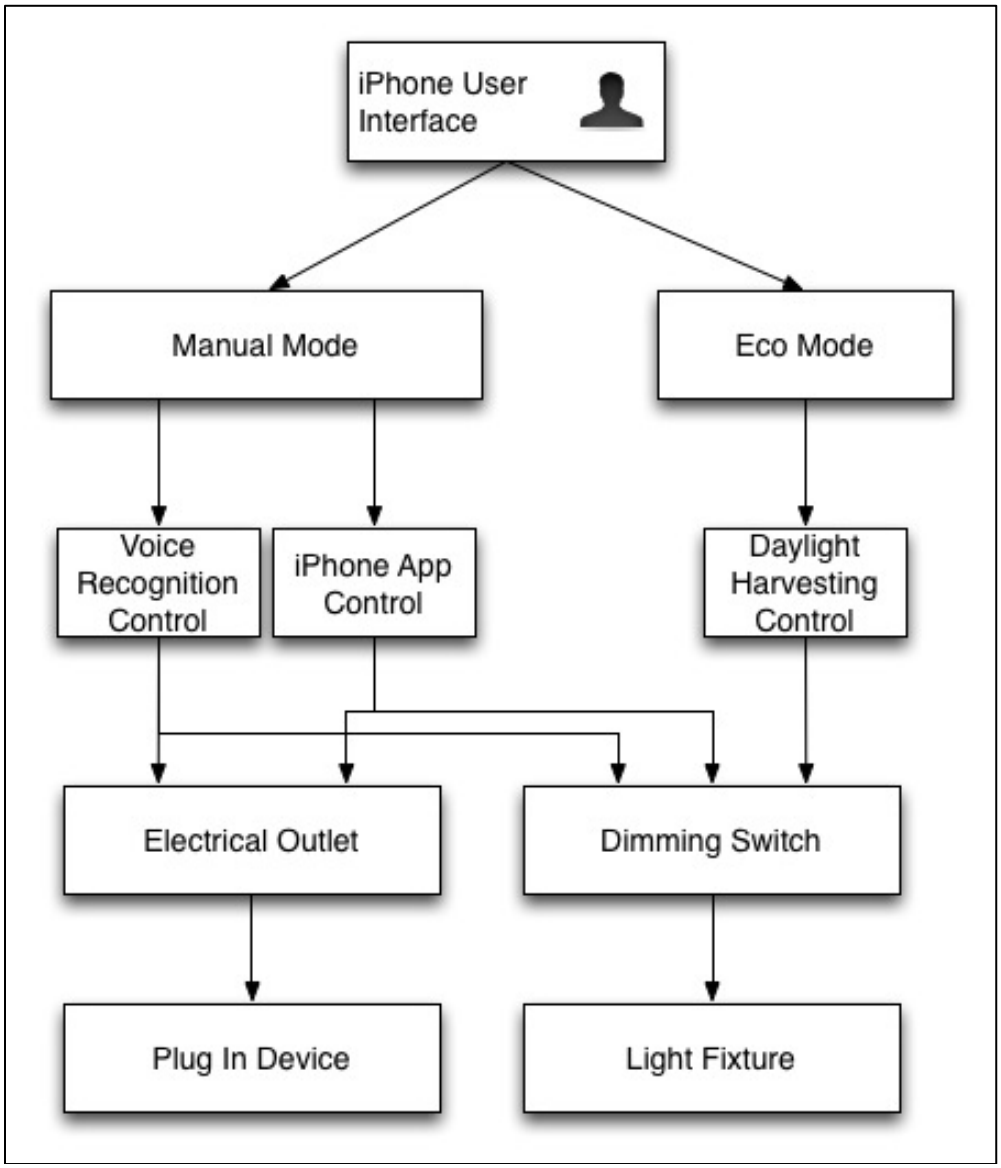


Figure 2: Preliminary System Control Diagram

Existing Solutions

There are some companies, particularly Lutron and VOS Systems, that currently offer simple solutions – and products that are already on the market – for different aspects of our proposed system. The most common voice control solutions are removable modules that connect lamps or other electronic devices to wall outlets – Figure 3. Although simple in principle, these modules are bulky and inefficient; only one lamp or electronic device may be operated by one module at a time and does not allow room for a second module to be connected to the wall outlet. Other solutions include modules that replace the household light switches such that the user can operate the built-in lights in the user's home via voice commands – Figure 4. There are also various other devices on the market for daylight harvesting. However, most existing solutions are modules that are standalone and do not interact with each other. Because of these characteristics, the user can accidentally enable multiple lights in a room, or find himself or herself unable to operate all switches from a convenient central control unit.

Figure 3: Removable module – voice dimmer

Proposed Solution

Our solution is to integrate all the built-in room lights, the plug-in lamps, and electronic devices. There are two types of units to this system: the master and the slave units. The master unit is the main control unit that will contain the microphone and voice recognition system, as well as a wireless system to receive iPhone inputs. By having only one unit that receives the user input, we can eliminate the possibility of the user unintentionally enabling other lights and electronic devices. This unit is the minimum requirement for our solution. Figure 4 shows the simple concept of the master unit. Rather than having a simple on/off switch, the master unit will have a dimmer switch. We decided to incorporate the physical switches into our design as a redundancy, in case our system fails to recognize voice commands or if no iPhone is available.

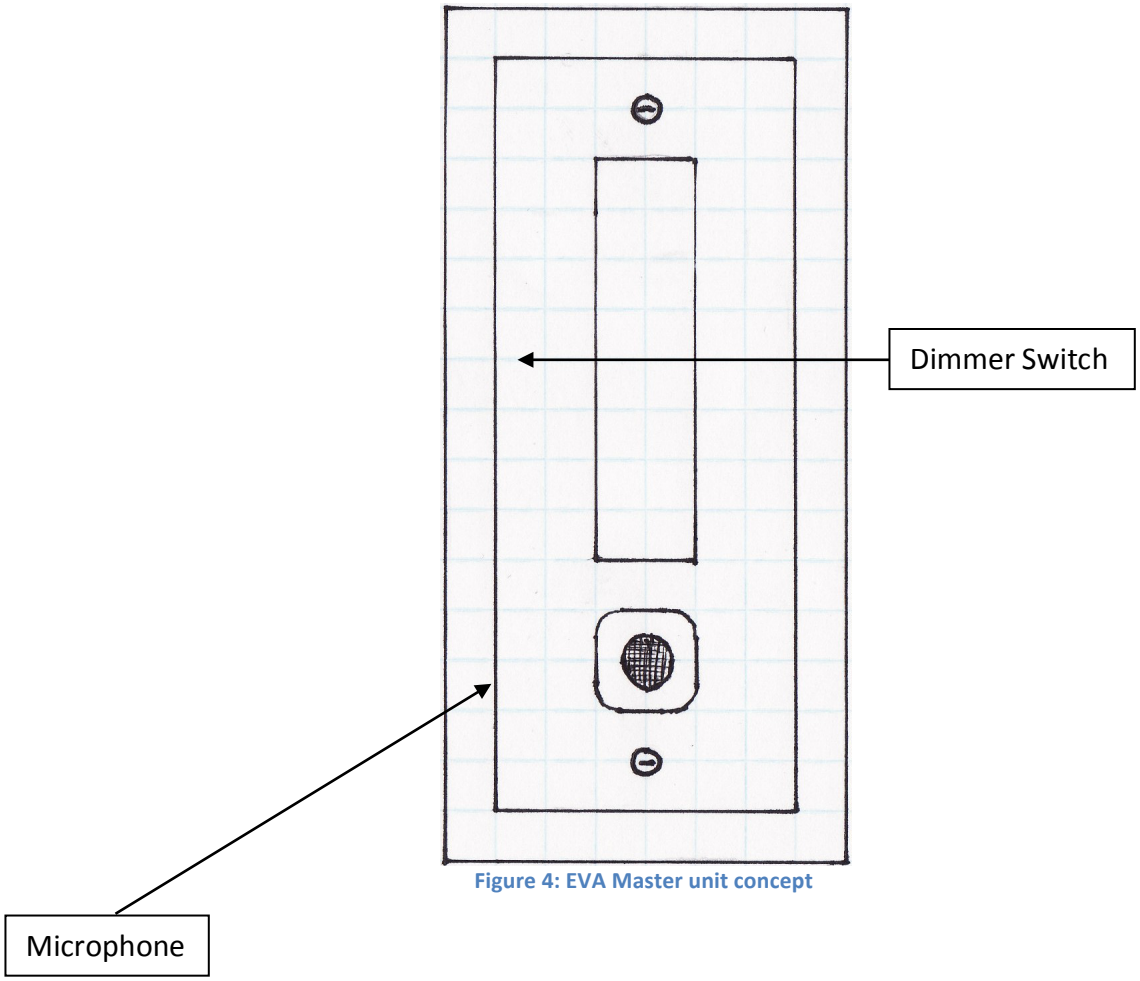


Figure 4: EVA Master unit concept

The slave unit is a module that, depending on the user's requirement, will either replace other light switches or wall outlets. This unit will be controlled wirelessly by the master unit and will enable the specific light or the attached electronic device, when the master unit receives the voice input from the user. Figure [] shows the unit that would replace light switches. It will be identical to the master unit with the exception that the

microphone is replaced by an LED to indicate the module is receiving wireless commands from the master unit. Figure 5 shows the unit that would replace wall outlets.

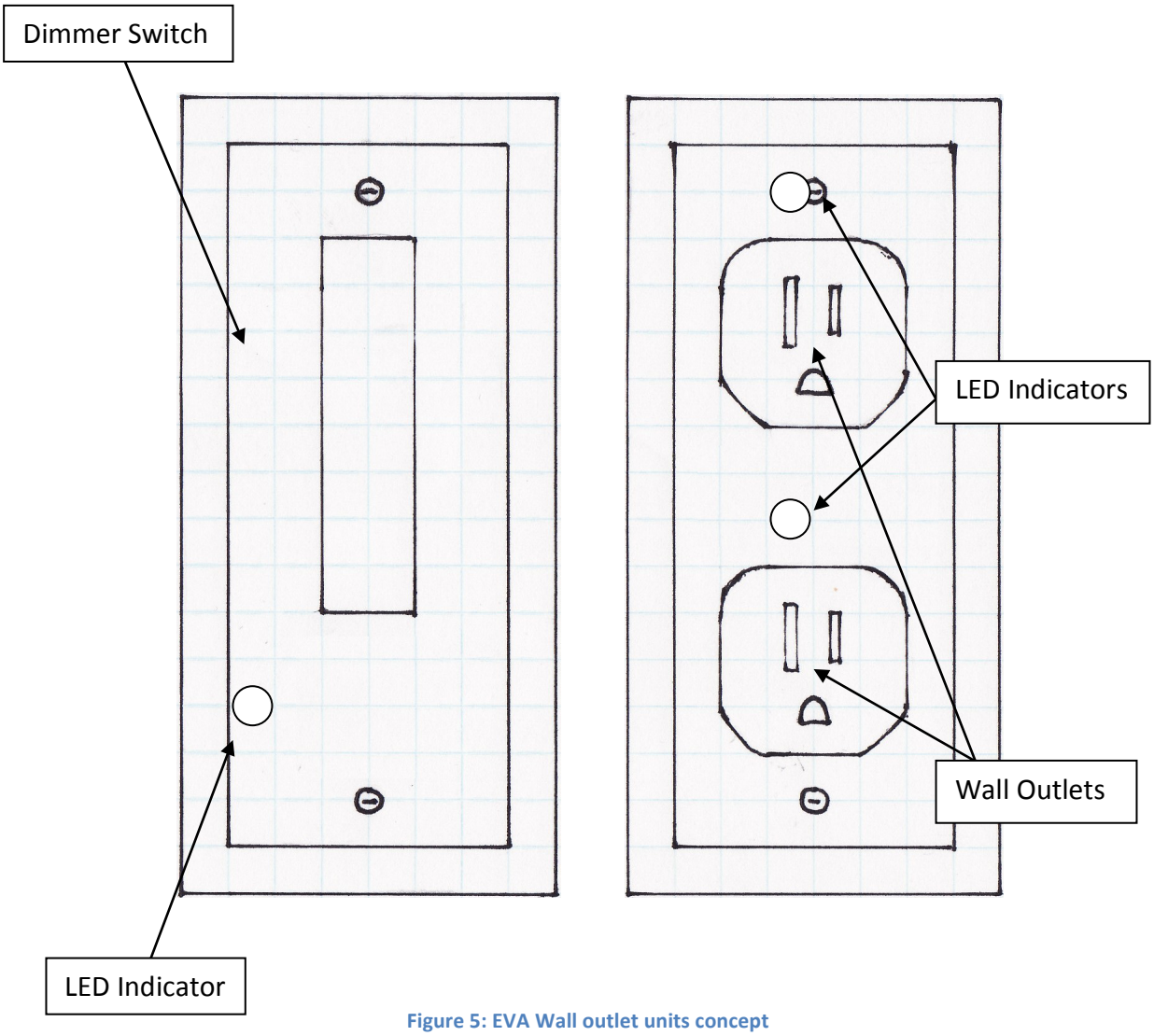


Figure 5: EVA Wall outlet units concept

Every room and user will be different. Our idea is to offer a solution that will conveniently and efficiently tailor itself to the user. Our solution will give the user free reign to set up how he wants to operate his home room lighting system and electronics.

Budget and Funding

Initial budget plans for the design and implementation of EVA Controls can be seen below. The listed items have been determined based on research performed by EVA Controls. All items have been selected based on prices listed by online vendors or local electronic stores. The 'Miscellaneous' section has been purposely overestimated to account for possible additions or changes to EVA Controls. Therefore, it must be noted that the total amount shown below is only a projected development budget.

Budget Components	Cost (CAD)
Hardware:	
Philips 12W LED PAR30 Dimmable Soft White	$40
Lamp holder and Electrical housing	$15
Lutron Maestro IR 600 Watt Single Pole Digital Dimmer	$40
Arduino Ethernet w/o PoE (DEV-11229)	$60
4-Channel Relay Board	$20
LD3320 ASR Voice Module Chip	$20
Printed Circuit Board (PCB)	$100
Software:	
iPhone Developer Enrollment	$100
Miscellaneous:	
Building Materials	$100
Taxes + Shipping	$100
Total	**$595**

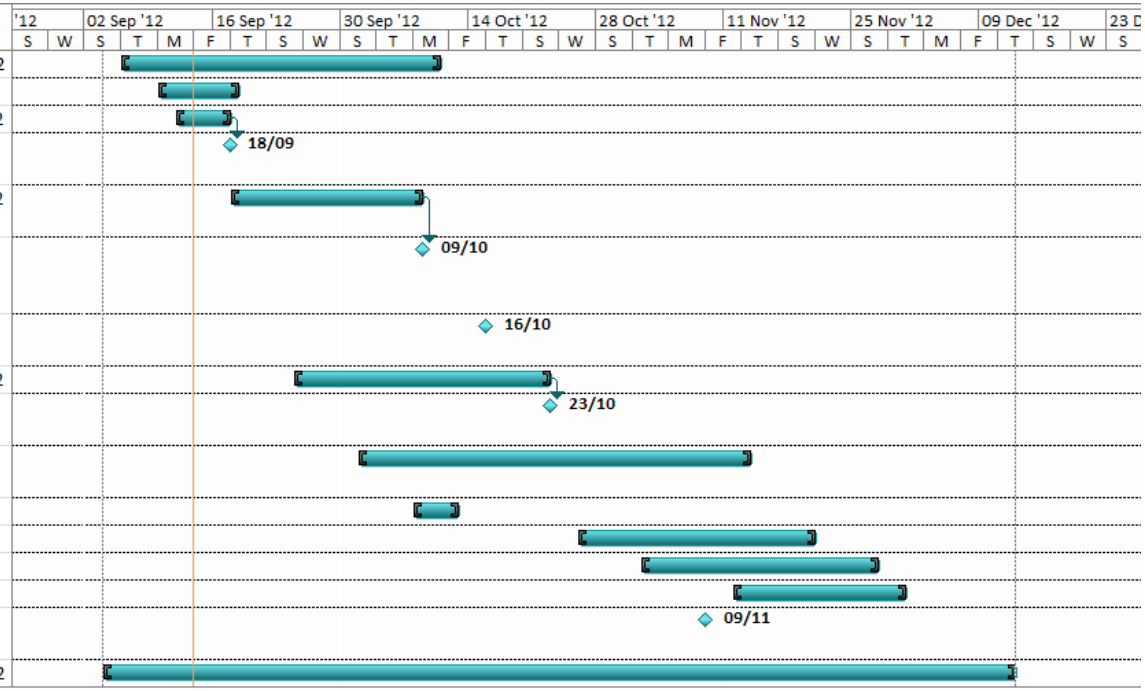
Since the projected amount is beyond the start-up investment that EVA Controls has at hand, the company has sought external funding. A request for funding in the amount of $500 has been approved by the Simon Fraser Engineering Science Student Endowment Fund (ESSEF).

Another possible source for additional financial assistance will be the Wighton Engineering Development Fund. A request will most certainly be made should our project be well over budget, in order to avoid debt for EVA Controls. Any reasonable amount over budget will be covered by contributions from the company executives.

Project Timeline

The figure below is a Gantt chart that illustrates our planned approach in developing our product. The Gantt chart also includes our milestones as represented by the diamond points.

ID	Task Name	Duration	Start	Finish
1	Research	25 days	Thu 06/09/12	Wed 10/10/12
2	Funding	7 days	Mon 10/09/12	Tue 18/09/12
3	Proposal	4 days	Wed 12/09/12	Mon 17/09/12
4	Milestone #1 - Proposal Complete	0 days	Tue 18/09/12	Tue 18/09/12
5	Functional Specifications	15 days	Tue 18/09/12	Mon 08/10/12
6	Milestone #2 - Functional Specifications	0 days	Tue 09/10/12	Tue 09/10/12
7	Milestone #3 - Oral Progress Report	0 days	Tue 16/10/12	Tue 16/10/12
8	Design Specifications	20 days	Tue 25/09/12	Mon 22/10/12
9	Milestone #4 - Design Specifications	0 days	Tue 23/10/12	Tue 23/10/12
10	Hardware/Software Development	31 days	Tue 02/10/12	Tue 13/11/12
11	Parts Acquisition	5 days	Mon 08/10/12	Fri 12/10/12
12	Integration	18 days	Fri 26/10/12	Tue 20/11/12
13	Testing/Defect Fix	18 days	Fri 02/11/12	Tue 27/11/12
14	Verification	15 days	Mon 12/11/12	Fri 30/11/12
15	Milestone #5 - Written Progress Report	0 days	Fri 09/11/12	Fri 09/11/12
16	Documentation	72 days	Tue 04/09/12	Wed 12/12/12



EVA Controls - Company Portfolio

Adam Franklin

Chief Executive Officer (CEO): Adam is a fourth-year Systems Engineering student who has a passion for energy conservation as can be seen through his co-op work experience at the Automotive Fuel Cell Cooperation (AFCC) and BC Hydro PowerSmart, as well as his recent successful completion of the LEED® Green Associate credential exam. After graduation he aspires to utilize his experience and education to pursue a career in the building engineering industry.

Bryon Long

Chief Design Officer (CDO): Bryon is a sixth year Electronics Engineering student at Simon Fraser University with experience in hardware and software development obtained through class and self-directed projects. Some of these projects include an electronic drum set implemented on the Xilinx Vertex II Pro development board and a program developed using OpenGL to simulate the physics of a mechanical system. His interests lie in designing and implementing embedded devices. His most recent project is a 7 segment LED alarm clock built using a Texas Instruments' MSP430 microcontroller. Aside from his hardware and software skills, he has extensive software testing skills obtained from his one-year internship with Research In Motion as a Software Test Associate.

Alex Girtonea

Chief Marketing Officer (CMO): Alex is a fourth year Computer Engineering student who is passionate about automation and energy efficiency. He is interested in real-time operating systems and design, having experienced a successful and rewarding Co-op term with Research in Motion and been part of SFU's "Real-Time and Embedded Systems" engineering class. His favorite word is 'technology' and aspires to be one of the innovators of tomorrow.

Mark Ma

Chief Technical Officer (CTO): Mark is a sixth year electronics engineering student at Simon Fraser University. Mark has co-op experience in STB (set top box) factory environment as test & release engineer and as a software engineer in a STB design company. He has obtained knowledge of designing PCB boards, soldering, and Java programming through his working experience. Mark is a valuable addition to the team through his experience in PCB design.

Alex Lung

Chief Finance Officer (CFO): Alex is a fourth year Electronics Engineering student at Simon Fraser University who is versatile in both software and hardware applications. He has had the opportunity to work with reputable companies like Point Grey Research and Broadcom in the Co-Op program. One of his interests is to work on application development for Android or iOS. Along with his software goals, he strives to find a career where he will be part of a hardware team designing the next revolutionary electronic device.

Mahyar Yousefi

Chief Operating Officer (COO): Mahyar is in his last semester of Control Systems Engineering at Simon Fraser University. He is interested in testing, analyzing, debugging and solving product design. He has spent sufficient amount of time in laboratories, conducting experiments on different subject matters such as electronic circuits and computer programming and he possesses adequate knowledge about the use of various laboratory tools. He has also attended the British Columbia Institute of Technology (BCIT), where he earned a certificate in PLC. This course provided him with a great learning opportunity in PLC, given that almost all electricity dependent jobs, PLC serves as a brain in the controlling process, particularly on machines in the industrial sector.

Conclusion

At EVA Controls, we believe in working on the cutting edge of technology and contributing to products that add value to customers in the marketplace. By designing and creating a prototype for the smartphone voice control home automation system, we are aiming to achieve these goals. For this project, we have considered two different approach methods, and consequently, two different market environments. The first usage is intended for individuals with disabilities and the elderly, through the use of voice commands. The second usage is intended for regular consumers and homeowners in particular, through the automatic adjustment of the house light intensity, depending on the level of natural light. We strongly believe that this product is highly marketable given its practical usage, simplicity, and inexpensive and fast installation. In addition, our society is becoming increasingly environmentally conscious and is, therefore, seeking affordable, eco-friendly products and solutions.

Our two biggest concerns for this product are to increase the independence of people with disabilities by enabling them to have easier access to their home electrical devices, and to conserve energy and minimize the cost of electricity usage. Our project plan and schedule have been set with realistic goals in mind. After achieving a functional prototype and testing it successfully, this model can be custom-made to suit the needs of our clients.

EVA Controls is comprised of six highly motivated engineering students that want to combine their acknowledge and experiences to provide a much more comfortable living environment for consumers, especially those with disabilities, and simplify technology by making it more practical in the most efficient way. Our group will passionately work on this product day and night and we are confident that the project goals will be achieved by the exact provided timeline.

References

[1]ENSC 305/440, Project Documentation and Group Dynamics, accessed 15 September 2012 http://www2.ensc.sfu.ca/~whitmore/courses/ensc305/project.html

[2] Human Resources and Skills Development Canada. (2011). *Disability in Canada: A 2006 Profile*, [Online]. Avaliable: http://www.hrsdc.gc.ca/eng/disability_issues/reports/disability_profile/2011/disability_profile.pdf

[3] Human Resources and Skills Development Canada. (2010). *Federal Disability Report*, [Online]. Avaliable: http://www.hrsdc.gc.ca/eng/disability_issues/reports/fdr/2010/page00.shtml