uControl Solutions

uControl: Home Automation System

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Submitted To: Dr. Andrew Rawicz
             Mike Sjoerdsma

Date Submitted: January 27, 2011
Re: ENSC 440 Project Proposal for UControl Solutions

Dear Mr. Rawicz,

We at Universal Control Solution aim to create a product which extends far beyond improving the luxury and comfort of the user. We aim to create a device which could potentially be used to control your entire home all the touch of your fingers. Our device aims to take a firm hold of the rapidly expanding tablet market and allow the users to control their lights, heating/cooling systems, and various multimedia systems all at the touch of your fingers from ONE place, your personal computer!

Our team consists of 3 highly talented electronics engineers and a senior biomedical engineering student who will be responsible for integrating the user interface in a simple and “sexy” way that allows users to quickly access all of our product features. One other major component of our product is that we will attempt to integrate it with environmental control systems and could potentially replace the currently existing X10 systems. This plays a huge factor for assisting those with physical disabilities who have some form of access to a PC.

People live busy lives and having the ability to come home, relax, and be able to control their light, TV, audio systems all at the touch of their fingers is something that would be greatly appreciated. Furthermore, we plan on designing this for people with disabilities who have some access to a computer. Because our device can be accessed thru any PC, a physically disabled individual will be able to use our device. The benefits this offers are tremendous in that not only can you control your lights and TV’s all in one place; we plan on creating modules for heating and cooling systems.

We believe that things should be made simple, effective and reliable. uControl is easy to use, inexpensive, portable and effective. Furthermore it is expandable and could be used by a wide demographic. We truly believe that once complete, this device will revolutionize the way users interact with their homes.

Thank you for attention.
Sincerely,

Ivan Petrov
CEO – Universal Control Solution
ivp@sfu.ca
604-588-5429

Enclosure: uControl Solutions’ proposal is attached below
Executive Summary

“Your home at your command”! This is the goal of uControl Solutions. What we are offering is the best solution for affordable home automation. Our product “uControl” will not only bring ease to the user in their everyday life but also greatly assist physically disabled people.

Simple, Elegant, and Effective is the best way to describe uControl. This is not your typical ‘universal’ remote. In the Home Automation Industry, the term ‘universal remote’ usually only refers to controlling home entertainment systems. At uControl Solutions our aim is to develop a truly universal remote control. One that is not overloaded with features but does everything you ask it to do. The uControl system will revolutionize the term ‘universal remote’. People are no longer bounded by having to point at their TV to change a channel. People no longer have to disturb their quality TV time by standing up and turning off their lights. No more screaming across the room to ask someone to turn off the lights.

uControl Solutions consists of three highly talented 4th year electronics engineering students and one 5th year biomedical student. Together they form a complex and diverse team that has strengths in different areas of engineering and should be able to undertake any difficult task.

The duration of this project is estimated to take around 4 months to complete, starting from January 4, 2011 to April 4, 2011 which includes researching, designing and building prototypes, and debugging. The overall projected cost is $330.00 with a 20% contingency plan.
Introduction

“Things should be made as simple as possible, but not any simpler. “ - Albert Einstein.

Hundreds and thousands of electronic devices are created on a daily basis. Some are quickly discarded while others suddenly become the leaders of their industry. What separates the products that succeed and those that fail? We believe that if a product is designed with the user and their comfort in mind, it is one step closer towards succeeding. A successful product needs to be simple to the user, easy to use, expandable, and inexpensive and it must offer much more features than its competitors.

What we have proposed is just that. uControl is a universal control system for your home. Not only that, but it could be used in conjunction with the rapidly expanding tablet market. Imagine being able to control your home utilities, entertainments systems, heating systems, and much more all at the touch of your fingertips. Doesn’t that sound like something interesting? What the users sees and experiences is everything and what goes on the inside is irrelevant to them. What matters the most is that our product is effective and provides the ease of use and luxury to the user. uControl is the product that will provide the next step in universal home control systems.

Our product has features that extend far beyond luxury and comfort. It could be used by persons with disabilities to control their environment. As long as the person has access to a computer or a Tablet, they would be able to use it. The luxury and efficiency of our product provides is unmatched and in the sections below we hope that you share our ideas truly understand the unlimited potential our device offers.
Systems Overview

The design methodology we have is that everything should be controlled from one central location. The user should input through a simple and elegant user interface and how we handle the command must be completely hidden from the user. The command handling is done through the central unit which is also responsible for identifying the number of modules (or components) and their type that are available and are connected.

After the central unit identifies the number of components and their type, this information is supplied to user interface for the user to control. Each component will communicate to the central unit independently and must have no interaction with the user interface. What the user interface is responsible for is sending commands to the CU and data regarding the states of the available components. In this way, regardless of how we communicate with the central unit (whether it’s from a PC, Tablet, Cell phone, or even a remote web service) the central unit is the part that is responsible for controlling all components.

The design overview is shown in the Figure 1 below.

As you can see, the central unit acts as a hub between all components. This allows our system to be portable for different operating systems and devices. Furthermore, if one device malfunctions and stops receiving input, the CU will identify this and eliminate the access from the user interface. This way the user will be able to see immediately what has been disabled and can be either replaced or repaired.

The best part about this design methodology however is the fact that our system could be expanded simply by installing more uControl modules. Each module will be relatively inexpensive and easy to install. Later on, more and more modules can be added as the user desires. Having the ability to control as much as you desire with as little effort as possible is something that we strive to achieve.
Alternatives Solutions

A truly universal remote control has not yet been realized. The products on the market are too complicated and too expensive for effective use. A current device that offers similar functions is the "Logitech Harmony 1100" [1]. This is a touch screen device that can be used to control home entertainment systems. It offers RF communication at an extra price, but it however does to allow the users to control their lights. Most common complaint is the complexity and knowledge required to use. Something we aim to avoid.

Another such existing solutions are the 'X10 systems' [3]. These solutions however lack the ability to control your home entertainment systems [3]. Also, they are expensive and require professional installation, phasing out the ‘average user’. Due to the expandability of the uControl system, any future possible solutions can be implemented with relative ease.

Proposed Solution

There are several apparent problems that all of the pre-existing ‘universal remote controls’ on the market fail to address. The first is their inability to actually allow a user to universally control their home. Most enable the user to control several TV’s and other entertainment systems but do not allow them to control the lights in their house or their kitchen appliances. They also fail to offer their ‘services’ at an affordable rate, meaning average users would not have access to their systems. Another problem is their complicated interfaces which leave most users confused and frustrated. This is where uControl Solutions comes in. Its intuitive design, expandability, unique features, simple user interface, and affordability are what set it apart from the competition.

Home entertainment

uControl’s central unit will be able to record and transmit all of the infrared communication protocols. This allows it to be used with any device that uses IR as a means to communicate, such as your TV, DVD player, and Audio systems. The ‘simple to use’ user interface will allow any user with little to no technical knowledge to be able to use the system as a ‘regular’ remote control.

Lighting control

Your home at your command! Nothing is more annoying than getting up to turn off your lights during your favourite movie or TV program. So why do it? The uControl system will allow an unlimited amount of lights to be controlled with just a light touch of your fingers. Meaning, you can control every light in your house effortlessly.
Power Saving Modes
The uControl system will feature power saving modes that automatically turn lights off at night or at pre-programmed times. Furthermore, each module will be programmed to send the central unit daily power usages, monitored using the built in analysis tools, which the user can then react to accordingly. Future developments may include sensors to turn lights on and off depending on whether or not a user is in the room.

Expandability
As previously mentioned, one of the key elements of our product is that it can be easily expanded. We view it as potentially having no limits. Because of the design structure, consisting of a central unit (CU) that interacts with its components, the number of components that can be added can be unlimited.

Each component will identify itself to the CU and as a result the CU will be able to sends commands that are activated from the user interface (UI). Upon the addition of a new component, the CU will send a signal to the UI making sure that the new component can now be accessed. This methodology allows us to have as many components as the hardware can handle.

There are NO products currently available that support this functionality. What we will be able to do is add as many components as we want and control ALL from one place. For this project, we plan on support only a few components, such as ON/OFF light switch, dimmable light switch, and one or two universal remote controls. The restrictions are because of time. In the future, we plan on adding components for controlling indoor thermostats as shown in Figure 2 below:

Figure 2: Ordinary heater control
The **Figure 2** above shows a mechanical controller for a thermal system. This could easily be replaced with one of our modules which will be controlled wireless with a tablet or PC. The beauty of this is that each different component has its own unique id. Therefore, all mechanical switches in the house could be replaced by our modules which would be uniquely identified and all controlled through one user interface. Of course, if the user desires to manually control manual air conditioning controllers as shown in **Figure 3** could also be replaced by our modules. Being able to control all this and having the ability to expand to even more devices is exactly what makes our product so intriguing.

![Figure 3: Thermostat control unit](image)

But controlling mechanical switches (light switches, heating controllers, etc.) is one thing. What is more impressive is the fact that our system would be able to be integrated with the user’s home entertainment systems. We would potentially offer unlimited number of programmable remote controls for all of the user’s media appliances. You would be able to control your TV’s, Audio Systems, DVD, Blue-ray players all the touch of your fingers.

Functionality like this has been up until unheard of especially considering the cost effective solution that our product offers. Furthermore, since most physically disabled people have some form of access to a computer (through their wheelchair) they would be able to easily integrate our product with their existing devices. There are environmental control systems (such as X10), however, it does not come close in the functionality or expandability (or even cost) of our product.

The ability to control your home as well as media and entertainment systems is a KEY component to what separates us from the rest.
Budget and Funding

The estimated cost for our project is provided in Table 1. The cost of the central unit includes the cost of the entire component needed for the unit such as microcontroller, serial real time clock module, Bluetooth module, transmitters and receivers. We chose DFrobot ATMega1280 USB microcontroller as the microcontroller for the central unit because of its key features such as 54 digital input/output pins, 4 UARTs (hardware serial ports), enough memory, a USB connection and the ability to work with multiple power options. For the control switches we estimated the total cost of making 4 switches together which includes cost of microcontrollers, transceivers, and PCB designing and printing. The cost of the central unit and switches interfacing includes the cost of the all the small parts we need for interfacing the circuitry inside the product. Finally, a 20% contingency plan is included in case any of the costs have been underestimated.

<table>
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<tr>
<th>Equipment</th>
<th>Estimated Cost</th>
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<tbody>
<tr>
<td>Central Unit</td>
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<tr>
<td>Control Switches (x4)</td>
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<tr>
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<td>Project Enclosure</td>
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<td>Total Cost</td>
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Table 1: Projected Cost for making uControl prototype

Funding is a very crucial for the progress of our project. Various sources of funding have been considered. We have already applied for the Engineering Student Society Endowment fund (ESSEF). There are other possible sources of funding as well such as the School of Engineering Science and the Wighton Development Fund. The reason we think we should be able to receive some funding from the Wighton Development Fund because we believe our final product of this project has the potential to become marketable and benefit society. uControl is very comforting and elegant solution for controlling everyday home appliances. We are also thinking of writing letters to several electronics distributors such as Texas Instruments, Atmel etc. asking for free samples of the components we need for our project.
Scheduling

The Gantt chart below describes the project development timeline. Problematic systems are to be finished first, allowing us more time to test and perfect them. Reasonable amount of time has been given to systems integration. The Central unit is comprised of various systems, and has been designated the longest development time. Some of the final dates may have to be rescheduled as the project moves forward. A complete timeline will be available in the final report.
Team Organization

uControl Solutions is comprised of three fourth year engineering students, Stoyan Petrov, Sajib Saha, and John Kenyon, and one fifth year, Ivan Petrov. Together they form a complex team that has strengths in many different areas, providing a well-rounded team that will be able to handle any difficult task. The team is able to work as a single unit in all areas of the project but any given task can be equally split among the individuals. They share a common background in electronics and science, allowing members of different specialities to elaborate on ideas.

One of the greatest attribute to this team is communication. Online tools have been setup to organize the project planning, documentation and development, making product development, communication of ideas, and documentation a breeze. Trust is earned, and every member in this team has proved to be trustworthy. Disagreements are always confronted in a professional manner, and resolved as such. Every member's opinion is at equal value, no individual is better than the team. The team is willing to spend the time and effort required to make uControl Solutions as outstanding as possible. Four outstanding members, one outstanding team.

Ivan Petrov, Chief Executive officer (CEO), is in charge of the overall management and organization of the company. He is the most experienced among the team members, having already worked in the professional field for several years, making him the natural choice to lead the team. In this project, he is responsible for coding and designing the overall user interface of the product. John Kenyon, Chief Operational Officer (COO), is accountable for managing the day to day technical activities that have to be performed in order to complete the project’s milestones. He’s had numerous experiences designing wireless systems and working with design software, designating him the role of designing the enclosures required for the uControl system to fit in. Stoyan Petrov, Chief Technology Officer (CTO), will be carrying out the research needed to successfully complete the project. For the current project “uControl Systems” he is responsible for the integration of the whole system and setting up the radio frequency communication between the modules, due to his knowledge and experience working with microcontrollers, radio frequency transmitters and receivers. Sajib Saha, Chief Financial Officer (CFO), is the authority concerning the company’s financial conditions and allocating funds required for projects. He has various experiences in the field of event management and customer service which makes him the ideal choice for this role.

Individual commitment to a group effort -- that is what makes a team work, a company work, a society work, a civilization work.”--Vince Lombardi
Company Profile

Chief Executive Officer (CEO) - Ivan Petrov
Ivan is a fifth year biomedical engineering student. He is experienced in working with people and meeting their needs both through personal interests and work related experiences. His expertise in Biomedical Engineering design will greatly improve the efficiency and appeal of this product with respect to the user.

Chief Technical Officer (CTO) - Stoyan Petrov
Stoyan Petrov is a fourth year electronics engineering student at Simon Fraser University. His expertise in embedded systems design and general electronic circuit design make him a great asset to the team. He has worked with various microcontrollers, in both school and professional projects. His current courses in digital communication will prove to be useful.

Chief Operating Officer (COO) - John Kenyon
A fourth year systems engineering student currently studying at Simon Fraser University, John Kenyon brings his hands-on experience to the uControl Solutions team, having worked in several different engineering environments throughout his life. He's worked with software design tools ranging from the likes of AutoCAD, all the way down to specialized radio testing programs. His knowledge and experience with wireless protocols will be especially advantageous when building the wireless network for the uControl system.

Chief Financial Officer (CFO) - Sajib Saha
Sajib Saha is a fourth year electronics engineering student currently studying at Simon Fraser University. He has gained a firm grasp on understanding of various analog and digital electronics circuits/components, communication theories, lab equipment from working in numerous projects and labs. He is also very good at programming, and designing efficient algorithm is one of his very strong qualities. In addition to his technical skills, he also has many soft skills that will play a large role in performing his duties successfully and professionally. Through many years of customer related service in his employments he has profoundly improved his ability to communicate and organize effectively.
Conclusion

Simple, Elegant, and Effective is the best way to describe uControl. The ability and freedom it provides in controlling your environment ALL from one place at the touch of your fingertips is unprecedented. With our product, you can enjoy your favourite TV shows, set the mood by playing music and dimming your lights and most importantly is you who control all this and much more. Our device is expandable, portable and usable by anyone with access to a computer. Furthermore it can also be used for individuals with physical disabilities to interact with their environment. This is one of the major factors in developing this product. Every existing system falls short behind uControl. The features we offer all in ONE place are unprecedented. uControl is all that and more!
References

