ENSC 305W/440W

Project Proposal:

Customizable LCD Keyboard

Team Members:

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Submit to:

Dr. Andrew Rawicz – ENSC440W
Steve Whitmore – ENSC305W
School of Engineering Science
Simon Fraser University

Issue Date: 25/01/2016

Revision: 1.1

January 25, 2016

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

Re: ENSC 305/440 Project Proposal for a Smart Display Keyboard

Dear Dr. Rawicz,

The following will be a proposal for a Smart Display Keyboard that will outline our project for Capstone. The goal of our group is to design a keyboard with programmable key displays, allowing the user to fully customize the language and position of letters on the keyboard.

The purpose of this proposal is to provide an overview of the problem, an analysis of the market, a tentative budget, a projected timeline for various components as well as a completion date, and a look into whom we are as a group.

Breakthrough Innovations Group (B.I.G) has six very talented engineering students: David Pallmann, Chase Kwak, Steven Liu, Steven Timotius, Steven Luu, and Frank Tran. If you have any questions or concerns about our proposal, please feel free to contact me by email or phone at dpallman@sfu.ca or (604)-928-9269

Sincerely,

DPallmann

David Pallmann
President and CEO
Breakthrough Innovations Group (BIG)

EXECUTIVE SUMMARY

We live in a world where everything is customizable, from that triple shot, extra hot, peppermint mocha morning coffee, to the picture of your kids as the lock screen on your phone. So why then do we settle for a keyboard that has no ability to adapt to the user's needs or preferences?

In Canada alone a 2011 survey from Statistics Canada found that 5.8 million people spoke at least two languages at home (17.5% of the population) [1]. However, when writing emails or doing work in their mother tongue they are forced to use the same keyboard while trying to memorize the positions of all the letters and characters with no visual guide. That is not the only area Canadians struggle with the keyboards however. Canada, in 2015 had over 1 million people working in the professional, scientific, and technical services sector with another 1.7 million students going to universities [2][3]. What keyboard do all of these people use to write their technical papers with integral, summation, and a plethora of other symbols? That's right! It's the same old QWERTY keyboard. Now maybe you aren't one of those people in a technical job or speaking multiple languages, but you may like to just sit back relax and play a casual game of World of Warcraft. But how are you going to get that perfect hit combo when you can't remember what hotkey you assigned to the 'Ice Staff of Derringer'? Clearly a change needs to be made and we hope our breakthrough design will allow everyone to have the customization they desire.

The following proposal outlines our plan to design an innovative prototype keyboard that will give users visual feedback when typing characters and symbols from all around the world.

Our team at Breakthrough Innovations Group (BIG) are well suited to take on this challenge as we have been trained in the field of computing science, analog/digital circuit design, and embedded systems. Our previous work placements have taught us how successful companies are run which will help us in designing a realistic timeline and meeting deadlines.

In the next 13 weeks we plan to do research, design, and construct a working proof of concept prototype to be presented at the end of April. Our initial estimates for the cost of building this prototype are placed at $1100, which will be funded by the ESSS, Wighton Fund, and private sources.

Table of Contents

List of Tables

List of Figures

1. Introduction

Devices are continuously getting smarter. Phones are improving, and household objects are embedded with microprocessors and sensors. Yet, the keyboard has remained largely unchanged from the IBM Model M keyboard in 1986. Early keyboards merely adopted designs from the typewriters of the 60's.

Due to this stagnation, a deficiency has been identified in the traditional keyboard: keyboards are too static. There is no visual feedback from the keyboard (aside from a couple lights telling you if Numlock or Capslock is on). The same keyboard is used in the context of many different applications. The A key doesn't always input the letter 'a' into a textbox. In one situation, it may be used in combination with the control key to select all text; in another, it may move your virtual avatar to the left. It may even type 'q' if the French keyboard layout is used.

Our objective is to design a dynamic display keyboard, called the OmegaKey (ΩKey), with re-programmable controlled displays acting as labels on each key. The symbols displayed on the labels will change depending on the context of the user's application. We aim to redesign the keys and add a small LCD screens to the top of each key. The screens will be connected together and are controlled by a central microprocessor. This will all be connected to the computer by USB and function in place of a regular USB keyboard. This will require us to develop firmware for the microprocessor to control the LCDs and be able to communicate with the computer as a keyboard. Also, there will need to be software and drivers for the computer to communicate with the microprocessor and control the dynamic displays.

The new visual provided by the displays aims to improve user efficiency and learning. When using shortcuts or typing with a different layout, the display will reduce the likelihood of mistakes. It also relieves the user from having to memorize associations between arbitrary letters and actions. As well, users may be exposed to useful new key shortcuts. The technology can be expanded to add extra buttons, which users can preconfigure to execute custom macros or functions.

This proposal document provides the rationale, design, and implementation plan of our product, as well as a benefit and risk analysis and market and cost assessment.

2. Scope

Our keyboard layout can change into three major settings:

- Language: Depending on user's preference, keyboard layout will change into different languages (Chinese, Korean, Arabic, etc...)
- Symbols: Users can change the small section of the keyboard layout into different symbols they want. I.e. Mathematical symbols, Roman Numerals, etc..
- Gaming Mode: User can select their favorite keys and move them anywhere they want on the keyboard

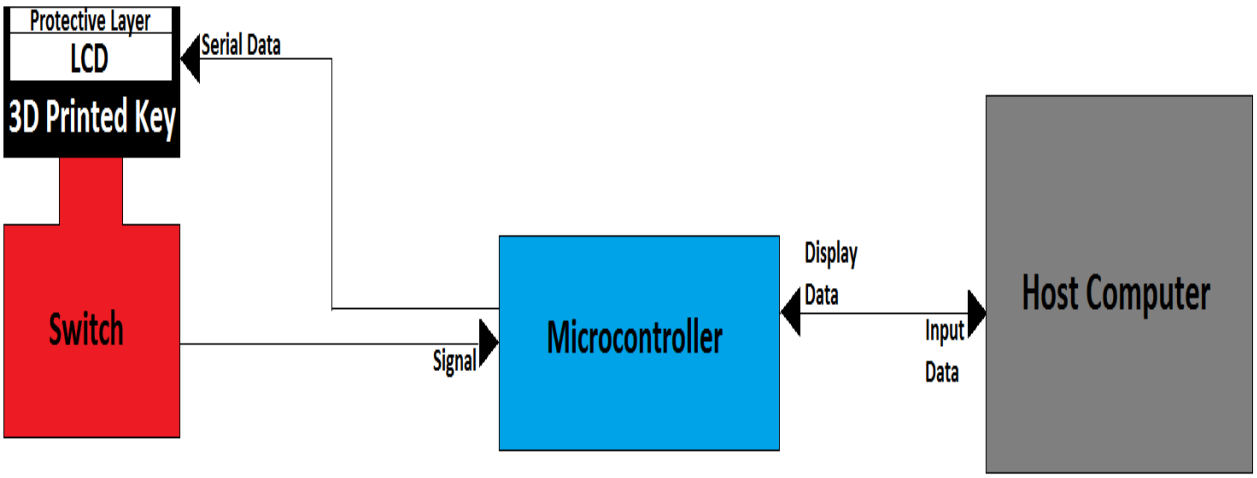

Figure 1: System concept diagram

2.1. Proposed solution

Our proposed system consists of three major parts: **LCDs, Microcontroller and mechanical switches.** Each key would have a small sized LCD screen on top to display character or symbol as set by the user.

When the user presses the pre-set button to select one of the preferable keyboard layouts, the microcontroller will retrieve layout data from the memory, which had been set up beforehand. Microcontroller will then transmit data serially to the corresponding LCDs in order to change the letters/symbols displayed on the LCDs to be the same as the pre-set layout.

Aside from three major components of our design, additional hardware such as **controller adaptors/add-ons, Mechanical keyboard and 3D Printed Keys** will be integrated with major components in order to develop a final prototype.

Raspberry Pi was picked over Arduino as our microcontroller because it is more suitable for the hardware and software integrated project. Both Raspberry and Arduino are cheap, robust and easy to do projects with; however Arduino is more suitable for hardware projects. Raspberry Pi is much faster, has more memory space than Arduino. Also it can run an actual operating system in Linux.

This solution is chosen since it provides the tactile feedback of traditional keyboard, as well as customizable keys like a touch screen keyboard.

2.2. Alternate solution

If key sized LCDs are not available, as an alternative, we could use a bigger LCD screen to display for multiple keys, and have the transparent keys on top. The biggest drawback is that we would have to design customized switches to work with the key and the wiring, which would have to be done on top of the screen.

3. Risks and Benefits

3.1. Benefits

The main benefits from this design compared to a traditional keyboard are the time and stress saved from trying to memorize keys that aren't displayed. However there is also benefits over combining the effects of a touchscreen keyboard (which is customizable) with the tactile feedback and more ergonomic benefits of a more traditional keyboard. We would also plan on coming to market significantly under the cost of some existing customizable keyboards such as the $980USD Optimus Popularis Keyboard [4].

3.2. Risks

The product itself is fairly benign and doesn't yield any inherent risk. As a keyboard it is unlikely to cause any physical injury. However, as an immature product customers will be warned not to use it in any highly critical system where safety or large sums of money are at stake. We try will mitigate any failures in our design, such as ensuring that key inputs to the computer continues to function despite any failures in other parts of the system.

Development wise, most of the risk is financial. The hardware parts, such as the LCD and Raspberry Pi, our prototype uses tend to be expensive. Any damage will be costly if the part needs to be replaced. The risk of going over budget is high. We believe that we have researched and planned this project well, but there is also the risk that the final product will be too expensive and therefore not be economically feasible to market.

4. Market

With the increased of digital mediums in recent years, computer skills are vital in schools and the workplace. Keyboards are the most commonly used computer input devices however they are not user friendly to new users especially those who do not speak or read English. Our Dynamic Display Keyboard is designed to improve the typing experience and efficiency by providing visual information.

4.1 Target Consumers

The Dynamic Display Keyboard is aimed towards computer users that want an improved typing experience. Computers are being used now more than ever for work, education, and recreation, and keyboards are vital as an input device. Our product provides visual information through the displays on the keys which are able to be configured to provide different layouts. The displays can potentially be used to assist in learning new software as well as being configure to display shortcuts for dedicated programs. This feature is especially beneficial to multilingual consumers as different languages have different language layouts as shown in Figure 2. Additionally the keyboard uses mechanical switches that will appeal to consumers that spend hours on a keyboard such as writers, typists, and gamers. The Dynamic Display Keyboard's features are aimed to appeal to novice and veteran computer users.

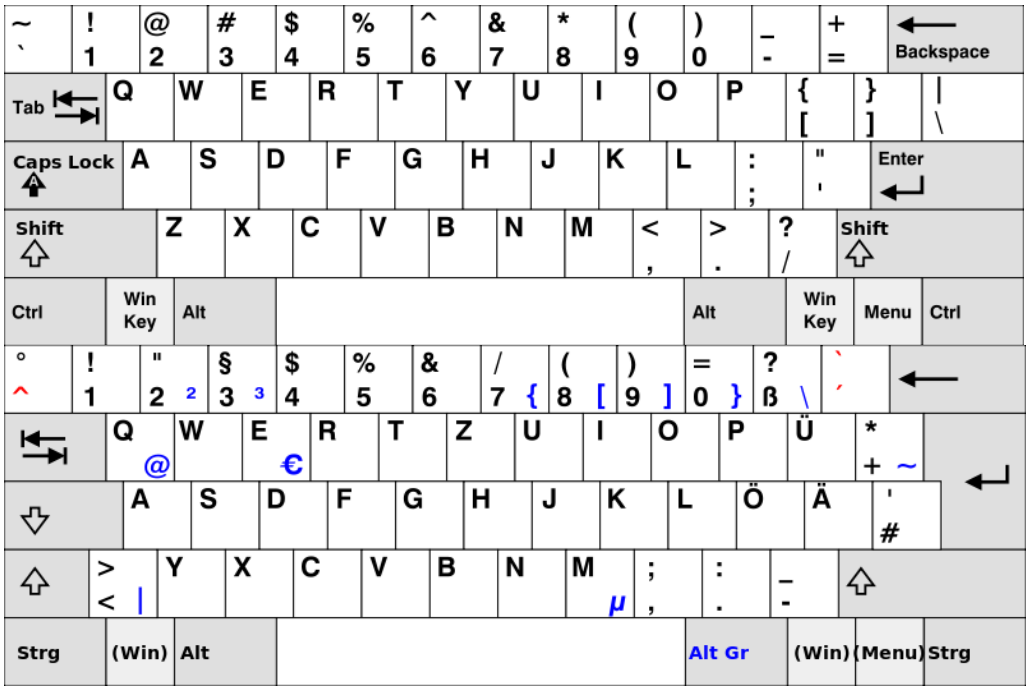

Figure 2: A comparison between US QWERTY layout (top) & German QWERTZ layout (bottom) [5][6]

4.2 Competition

The main competitors for our Dynamic Display Keyboard are companies that produce keyboards and other computer peripherals. Companies such as *Corsair*, *Razer*, and *Logitech* produce peripherals aimed towards gamers that have similar features to the Dynamic Display Keyboard. These features include mechanical switches, and programmable keys through software. However gaming peripherals are known to have an excess of feature that go unused that may be unappealing to consumers. These large companies have the resources and brand recognition that will be difficult to compete against.

The Dynamic Display Keyboard will have an initial prototype that will consist of a 10 key keypad and may be expanded to a keyboard depending on our progress. The company *Razer* has a similar product to our prototype known as the *Razer Orbweaver* shown in Figure 3 below.

Figure 3: Razer Orbweaver Programmable Keypad [7]

This keypad offers customizable inputs, programmable macros, and multiple configurations. This product is aimed towards gamers but it isn't very popular as it doesn't offer much more than a typical gaming keyboard.

A more direct competitor for our product is the Sonder keyboard by Sonder Design, an Australian start-up company formed last year. The Sonder keyboard uses a single E Ink display under transparent keys that can be customized. However the keyboard is not yet released and so there is limited information on the quality and typing experience of the product. This keyboard is expected to be release in the second quarter of this year at retail price of $300 USD.

Figure 4: Sonder keyboard with an E-Ink display underneath the keys [8]

Our product will be compared to a nearly identical keyboard from the company *Art. Lebedev Studio* known as the *Optimus Maximus* keyboard. The Optimus Maximus, produced in 2008, offers a coloured OLED display on each key which can be configured to different layouts. The keyboard was a commercial failure as it had a limited production run, a high retail price of roughly $1600 USD, and stiff keys. The keyboard has now been discontinued and the company has release a new product called the *Optimus Popularis* keyboard. The new product uses transparent keys overs a large LCD display rather than a display over each key, but keeps a high retail price of about $1000 USD.

There are also other similar products to our Dynamic Display Keyboard but the main competition will be from mechanical keyboards from large computer peripheral companies and the Sonder keyboard (figure 4).

5. Budget

Throughout this project, we will require numerous electronic hardware parts. The following table portrays a breakdown of the components required and their purpose.

Hardware	Function
LCD graphic displays	Displaying key identification
Microcontroller	Store and execute embedded software for controlling key function and LCD screens
Controller adapter	Connection purposes between hardware parts including a GPIO shield
Switches	I/O switches for key activation
Mechanical keyboard	For reverse engineering
3D printing	For making the skeleton of the keys to house LCD screens

Table 1: Projects required components

We have researched the market and various vendors. The following sources and their prices were found to be optimal.

Hardware	Price per unit (CAD)	Total price (CAD)	Source
LCD graphic displays x10	4	40	www.buydisplay.com
Microcontroller x2	75	150	Amazon
Controller adapter	varies	100	Amazon/Ebay
Switches x20	2.5	50	Amazon
Mechanical keyboard	150	150	NCIX/Bestbuy
3D printing	6 per cubic inch	60	SFU – Gary Shum
Total		**550**	

Table 2: Components price estimation

From the table above, our total predicted cost of this project is $550 CAD. This cost may vary due to current instability on currency exchange rate as some of the vendors are located in the United States.

Currently, we have obtained $400 from the ESSS and $50 from the ENSC305/440 course. We are in the process of applying for funding from external parties to fund the remaining cost. The engineering department as well as the ESSS has informed us that some parts, such as microcontrollers, may be lent to us for this project which will significantly reduce the expenses required.

6. Schedule

Figure 2 below show the Gantts chart of the expected schedule for various major tasks of the project. Figure 3 shows the major completion milestones for the project.

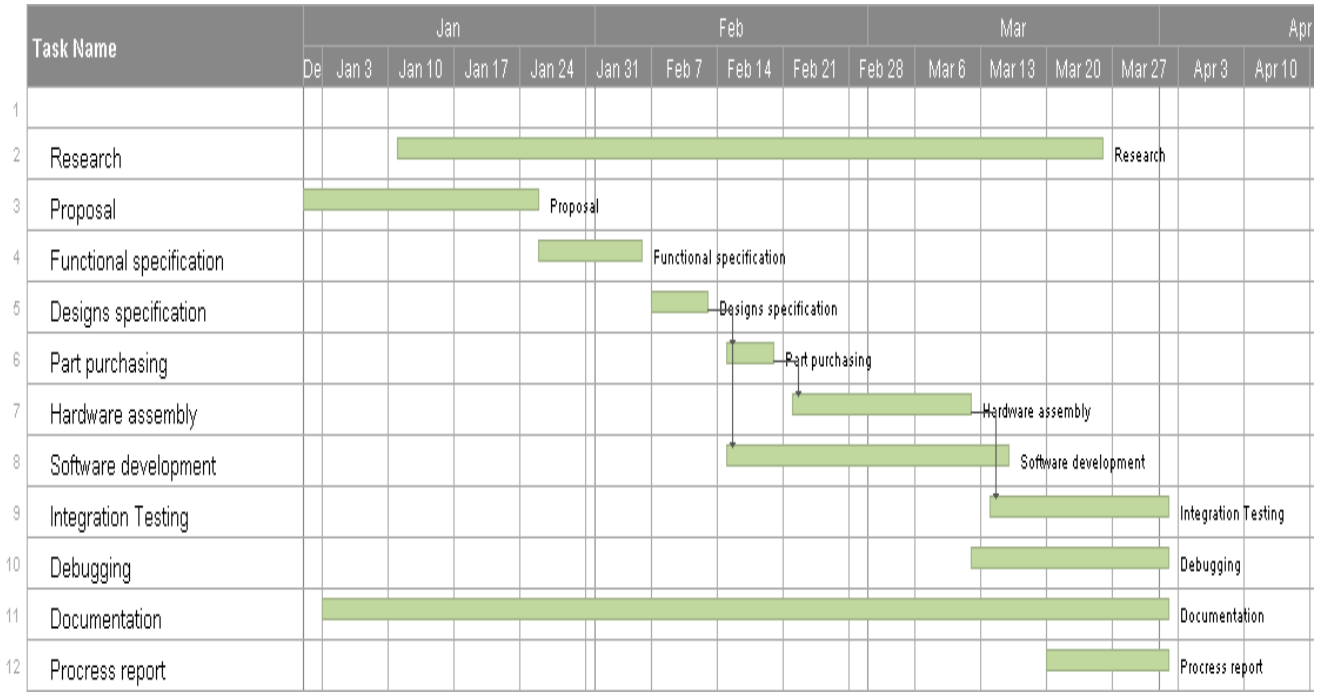

Figure 5: Gantt chart

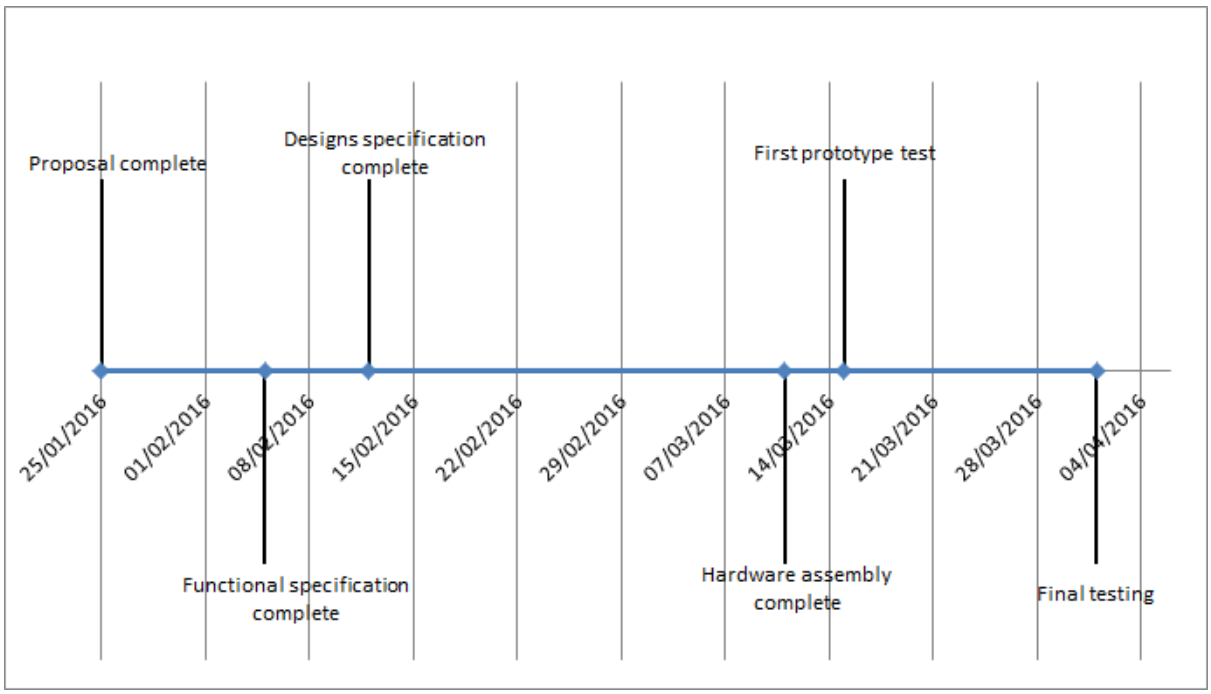

Figure 6: Milestones chart

7. Conclusion

At Breakthrough Innovations Group (BIG), our mission is to improve the quality of life of everyday individuals. We achieve this by redesigning household objects to be better and more effective. In this project, we identified an overlooked device, the keyboard, and redesigned it to produce the ΩKey.

This new keyboard will improve the user experience of the consumer by increasing their efficiency and learning capabilities. The ΩKey will unlock a new vector of visual feedback, responsive to the dynamic needs of the user. The ΩKey's functionality can be leveraged in a wide range of applications, from regular office work to highly technical documentation requiring specialized keyboard interaction. Further applications exist in the varied contexts of multilingual text input, computer assisted design, digital graphics design, and computer gaming.

Our ΩKey will provide the users the convenience of rapid switching between different keyboard layouts, while at the same time also allowing for user customization. Our approach has potentially lower cost than other existing similar products and ideally has improved functionality.

The figures and outlines provided in this document demonstrate that the ΩKey is feasible within our allotted time frame and budget. We have highlighted our potential risks and benefits, and stated our market and economic analysis.

With the ΩKey, go BIG or go home.

References

[1] Statistics Canada 2011 Census https://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-314-x/98-314-x2011001-eng.cfm

[2] Students going to university http://www.univcan.ca/universities/facts-and-stats/

[3] Technical Jobs Sector http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ40-eng.htm

[4] Optimus popularis http://www.amazon.com/Art-Lebedev-Optimus-Popularis-keyboard/dp/B0089XDG3I

[5] QWERTY. Retrieved from https://en.wikipedia.org/wiki/QWERTY

[6] QWERTZ. Retrieved from https://en.wikipedia.org/wiki/QWERTZ

[7] Razer Orbweaver. Retrieved from http://www.razerzone.com/gaming-keyboards-keypads/razer-orbweaver-stealth

[8] Pre-order Sonder Keyboard. Retrieved from https://www.sonderdesign.com/product/sonder-keyboard/

DAVID
PALLMANN

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Burnaby, B.C.

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EDUCATION

Simon Fraser University Sept 2011-May 2017
Faculty: Electronics System Engineering Senior
Extended Minor: Economics

HARDWARE SKILLS

>>Use a variety of different lab equipment such as DMMS and oscilloscopes
>>Create neat and easily diagnosable circuits
>>Able to solder parts together cleanly
>>Basic machine tools: table saw, band saw, and drill presses
>>Able to use a semiconductor parameter analyzer to perform characterization of MOSFETS, BJTS, and diodes

CODING ABILITIES

C++
Matlab
Assembly Language
Understanding of Machine Code
VHDL

SOFTWARE SKILLS

Testing and quality assurance
Solidworks
Visual Studio
Microsoft Office Suite
LT Spice

TECHNICAL WORK EXPERIENCE

Survey Assistant **Wade and Associates Land Surveying** Jun -Sep 2014
Jul - Sep 2009

>>Maintained and set up survey equipment such as back sights and Leica total stations
>>Conferred with clients about project details
>>Conveyed a high level of information by keeping neat and concise field notes which results in an easier time to draft it in the office
>>Performed building layouts, property line and topographic surveys in rural, urban, and industrial areas with a high degree of accuracy

TECHNICAL PROJECTS

CPU Queue Model **Data Structures and Programming** Jan-Apr 2014

>>Constructed flow diagrams to determine how to model the CPU, which resulted in smoother and faster implementation of the programming
>>Used the concept of inheritance and encapsulation to create a model in C++ for the CPU and received an A grade for the assignment

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TECHNICAL PROJECTS (CONTINUED)

Hockey Playing Robot **Mechanical Design** Jan – Apr 2014

>>Modeled the robot in Solidworks with precision so that when we made it, we were able to quickly cut out all of the parts and assemble it easily

>>Constructed parts of the robot out of wood using table saws, jig saws, and drill presses, which resulted in the robot to be of a higher quality than average

>>Wired the controller using precise soldering and colour coding techniques which resulted in a robust and easy to understand final product

Embedded Systems **Real Time Embedded Systems** Jan - Apr 2014

>>Applied QNX momentics development suite tools (in C++), to simulate the transferring of data between threads

>>Through troubleshooting the programs established different methods of dealing with the corruption of the data in order to ensure optimal user performance and reliability

De-noising Video **Multimedia Communications** Oct – Dec 2015

>>Developed a program which utilized Matlab to de-noise a video in a YUV file format

>>Created a combination of temporal and spatial filters to better deal with the moving and still parts of the fame

>>Detected whether or not a part of a frame was in motion with a bilateral three step search to estimate motion and then a comparison

Butterworth Filter **Electronic Circuits II** Jan - Apr 2015

>>Designed a filter to a very specific set of requirements including the cutoff frequency and the slope of the gain

>>Utilized Matlab to determine the appropriate transfer function of the circuit which led to us being able to choose the components very easily with almost no trial and error

AWARDS & INTERESTS

>>Engineering Science Admission Scholarship Sep 2011

>>Employee of the Month award at Silvercity Mission May 2011

>>Have worked in many different places part time throughout my degree and developed great people skills such as teamwork, customer service, and conscientiousness

>>Regularly play drop in volley ball

>>Love to cook and have people over all the time to try my creations

>>Avid Seattle Seahawks fan

Chase Kwak

244 Sherbrooke Street, New Westminster V3L 0A3
778 859 8023 | ckwak@sfu.ca

EDUCATION

Simon Fraser University (SFU), Burnaby, BC — Sep 2009 - Jan 2016
Fourth year, Systems Engineering

SKILLS

Software

- Proficient in C/C++
- Advanced user of Microsoft Office Suite: Word, Excel, PowerPoint and Adobe Acrobat
- Intermediate user of Modelsim-Altera (VHDL)
- Comfortable with using SOLIDWORKS
- Proficient with HTML
- Experienced in using MATLAB and LTSpice

Hardware

- Trained how to use circuit board and electric components from projects dealing with oscilloscope, function generator, DC power supply
- Competent with interfacing PC with hardware platform called ZEDBOARD (Xilinx) using C
- Capable of setting up wireless Router connection and wireless security protocol
- Familiar with coding in microcontroller assembly language using Motorola HC12 FPGA board

CO-OP EXPERIENCE

Junior Maintenance Planner — Jan - Aug 2015
Sleeman Breweries Ltd.

- Created procedures for in-brewery equipment by researching OEM (Original Equipment Manufacturer) and collaborating with tradespeople (millwrights, electricians and pipe fitters) in order to contribute to the company's preventive maintenance system
- Became very familiar with production flow and how in-brewery equipment works while working closely with tradespeople
- Acquired strong communication and organization skills through regular meetings with supervisor

TECHNICAL PROJECTS

SOLIDWORKS Project & Experimental Lab — Sep - Dec 2015
ENSC 385: Statics and Strength of Materials, SFU

- Learned basic concepts of mechanics, vectors and analysis of rigid bodies through lectures, labs and tutorials
- Performed static analysis of the structure consisting of trusses and beams with *SOLIDWORKS*
- Graphed stress distribution of the structure using *SOLIDWORKS* and calculated the maximum allowed force that can be applied to the structure before it fails
- Analyzed properties of given materials by performing an experimental lab with stress strain apparatus, rotary motion sensor interface and torque wrench

TECHNICAL PROJECTS CONTINUED

Technical Report from Lens Experiment Sep - Dec 2014

ENSC 470: Optical Engineering and Laser Application

- Investigated identification of unknown lens by performing lens experiment with optical components such as lens holders, posts and rail mounts
- Calculated the orientation, magnification and light intensity of the image created and used error analysis to check if my answers agree with the theoretical values
- Undertook formatting of the final paper using **Microsoft Word** and **Excel**

Learning Embedded Software on ZEDBOARD Sep - Dec 2014

ENSC 351: Embedded and Real Time System, SFU

- Learned how to access memory space and peripheral interfaces of the ZEDBOARD (microcontroller) using C++ in Linux environment by going through assigned labs
- Composed device drivers for Timer and Interrupt Service Routine to have interrupts upon clock signals by fixing and testing existing C code
- Managed to create and use a shared memory space between two processes through group discussions

Building an Active Filter May - Aug 2014

ENSC 320: Electric Circuit 2, SFU

- Designed fourth order Butterworth filter using different capacitors, resistors and TL074CN operational amplifiers to reduce the noise in the voice signal
- Simulated the designed filter with LTSpice to ensure our design meets the specification given
- Built the designed circuit on breadboard using scaled capacitors with mismatched capacitance
- Measured the frequency response of the designed circuit using MATLAB by generating a wide range of sweep of function generator and oscilloscope

VOLUNTEER WORK AND EXTRA-CURRICULAR ACTIVITIES

Frosh, SFU, Burnaby, BC Aug - Sep 2014

Frosh Leader

- Participated in both organizing and planning steps of Frosh events
- Motivated group of 15 Froshees to engage in events which were designed to help them to familiarize with school facilities and other fellow engineers

Data Structure Course, IT BANK (Private IT academy), Seoul, South Korea Jan - Mar 2014

- Programmed student information system which can register, edit, delete, show students' data (name, subject, grade) using Visual Studio 2013
- Developed and tested C++ code for Tree, Sorting and De-queue assignments using constructors, destructors and classes

INTEREST

- Soccer
- Snowboarding
- Photography

Frank Tran

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Vancouver, BC V5M 4W8
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EDUCATION

- **Simon Fraser University** Jan 2012 – Present
  Majoring in Computer Engineering (CGPA 4.02)

- **British Columbia Institute of Technology**
  - *Aircraft Maintenance Technician Category E/B2* Apr 2010 – May 2011
    Graduated with distinction (GPA 92/100)

  - *Electronics Technician Common Core* Aug 2008 – Apr 2009
    Graduated with distinction (GPA 92/100)

QUALIFICATIONS

- **Hardware:**
  - Experienced in working with Printed Circuit Board and Integrate Circuit devices
  - Proficient with simple electronics circuits analysis, electronics circuits assembly, soldering and de-soldering
  - Strong Laboratory experience working with oscilloscope, function generator, DMM, LCR bridge, SPA
  - Familiar with testing procedure on unit and system level
- **Software:**
  - Familiar with software development process
  - Good basics of C/C++, HC12 Assembly programming language, VHDL
  - Familiar with operating Windows 2000/XP/7, Linux Ubuntu
  - Knowledge of multithreaded programming in embedded environment such as QNX
  - Good knowledge of Microsoft Visual Studio, Words, Excel, Design Work 5, P-Spice, LT-Spice, Quartus II, Model Sim, QNX Momentics IDE, SVN usage

SIERRA WIRELESS INC.

- **Firmware developer co-op** May 2014 – Apr 2015
  - Worked in a team with 5-9 people in developing firmware for the next generation embedded wireless module

General development work

- Mainly worked in conjunction with other team members on importing AT commands features (or implementing new features) from old model to the new product while making changes (or re-writing) to fit with the new system framework.

Personal responsibilities

- Was responsible for managing Jenkins server for project code integration. This includes:
  - Setting up and maintaining the Jenkins server as a test run (to be officially adopted) for my duration in the team.
  - Configuring build jobs for various Firmware Projects
  - Writing scripts for automated build testing
  - Updating build jobs and test scripts to keep up to date with the projects' progression

SIERRA WIRELESS INC. -- continue

- Re-designing memory download tools for capturing crash dumps:
  - Rewrote the GUI tool to command line tool for ease of automated testing
  - Added support for the new file transfer protocol used by the new model to allow memory capture for both new and old devices
  - Modified the code to allow the tool to be compiled and used on both Windows and Linux OS

SFU PROJECTS

- **Streamlined grading system – CMPT275:** May – Aug 2015
  Software development project
  Programmer
  - Worked in a team of 9 people to develop a Windows GUI application to assist Instructor/TAs with grading exams and assignments for a Course
  - Was responsible for developing the major part of the initial framework for the application prototype
  - Was involved with assisting other team members and managing the team workload during the coding phase

EXTRA/PERSONAL PROJECTS

- **Simple Mario Game -- Digital Design: Free Group Project** Jan – Apr 2014
  Lead designer
  - Designed circuitry to allow playing a simple Mario game on the DE2-115 FPGA board. The player can control the Mario character to move left, right, jump or swing a hammer to hit the baddies floating around. The game is displayed on a VGA capable screen
  - Implemented circuits to display the Mario character and moving baddies on the screen
  - Utilized the controller (state machine) and data-path design scheme to implement various digital circuits such as the jumping motion controller, collision detector, character motion animation controller (moving, jumping, swinging weapon)
  - Designed circuit to generate sync signal according to the VGA specification (640x480 @ 60Hz)

- **Diode characteristic analyzer -- Microelectronics: side project** Jan – Apr 2014

  - Constructed the OPAMP circuit for analyzing the forward V-I characteristic and to some extent, the reverse V-I characteristic. The characteristic curve is display on the oscilloscope
  - Verified the correctness of the characteristic obtained by comparing with the result from the Semi-Conductor Analyzer.
  - Analyzed the circuit to obtain the quantitative values for the V-I characteristic

INTERESTS

- Exercise: Badminton, Table Tennis, Swimming
- Entertainment: Comics, Light Novels, Video games

Steven Timotius

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mobile: 778.322.6724 2515 Quartz Pl, Coquitlam, BC, V3E 3K9

Education

Simon Fraser University - 4.12 CGPA (on a scale of 4.33) (Sep 2012 - Apr 2017)
Bachelor of Applied Science - Computer Engineering Major

Work Experience

Agile Developer at SAP Canada (Sep 2014 - Apr 2015)

- Developed SAP Lumira data analysis software as part of data source connections team
- Created sample projects for public documentation of data acquisition extensions
- GitHub URL: https://github.com/SAP/lumira-extension-da-sample
- Produced web applications using Javascript libraries including SAPUI5, JQuery and RequireJS
- Developed business logic backend using Java connected to SAP HANA database
- Exposed to using Maven and Ant to build software with hundreds of OSGi components
- Exposed to many testing methodologies, both manual and automated, including using JUnit
- Experienced working in an agile development environment with structured product lifecycle

Associate Programmer at Relic Entertainment (Jan - Apr 2014)

- Participated in the development of Company of Heroes 2 game as part of network team
- Worked on C++ client networking library to improve code consistency, readability, and efficiency
- Implemented templated classes as a base for many similar classes to reduce code repetition
- Upgraded Java server protocol library to new system with JSON type validation
- Utilized Visual Studio and Eclipse debugging tools to diagnose and resolve bugs
- Used Perforce as source control to store and track code changes
- Implemented hashing and public key cryptography to digitally sign data files

Skills

Programming Languages	• Experience with C++, Java, Javascript, Python, C#, Visual Basic
Integrated Development Environments	• Visual Studio for C++ and VB, Eclipse for Java, Notepad++ • Versatile in learning to use new IDE's • Proficient operating in a command-line environment
Source Control	• Experience using Git, Perforce
CISCO CCNA 1 Certification	• Able to install, configure, and operate medium-size networks
Hardware	• Proven ability to assemble a personal computer from spare parts and troubleshoot basic hardware problems. • Working knowledge of oscilloscopes
Operating Systems	• Experience using Linux-based operating systems as well as Windows

Projects (Academic)

Computer Graphics Course, Simon Fraser University (Sep - Dec 2015)

- Introductory course to 3D graphics rendering using OpenGL 4 with C++
- Learned to use vertex and color buffers and model viewing matrix to render moving 3D objects
- Rendered a scene using ray tracing with shadows, local reflectance model lighting, anti-aliasing by supersampling, recursive reflection, recursive refraction, and optimized ray-polygon intersections

Data Structures and Programming Course, Simon Fraser University (Sep - Dec 2013)

- Examined usage, implementation and behavior of data structures to understand how they translate to low level computer instructions
- Studied how functions and objects are stored in the heap and stack to gain an understanding how they are stored in memory and the effects of memory management
- Created a database application to demonstrate use of data structures such as linked lists and hashmaps

Multiplayer Video Game in Python, Programming 12, Heritage Woods Secondary (Jan - Jun 2012)

- Programmed with Python to create a modified version of the popular Pokemon video game
- Implemented sockets and multithreading to add a unique multiplayer element
- Implemented file reading and writing to create a save system for player profiles
- GitHub URL: https://github.com/byxk/PokemonPython

Projects and Activities (Self Directed)

ACM Pacific Northwest Region Programming Contest (Nov 2015)

- Competed to design programs to solve various math and logic problems
- Collaborated with group members using both C++ and Python
- Used techniques and algorithms such as dynamic programming, Dijkstra, and greedy

CraftBukkit Minecraft Server Plugin (Mar - Aug 2013)

- Created a CraftBukkit server plugin for the popular video game Minecraft in Java
- Modified AI of existing entities to add new behaviors, such as obeying player commands and targeting enemy players
- Integrated support for other third party community plugins for ease of use
- Interpreted obfuscated code and implemented method and field reflection to modify entity AI
- Worked with users to improve features of the plugin and solve any bugs encountered
- GitHub URL: https://github.com/Scyntrus/FactionMobs

Awards

SFU President's & Dean's Honour Roll Fall 2015
SFU Shrum Major Entrance Scholarship
Coquitlam Teacher's Association Merit Award
Graduation Program Examinations Scholarship
2012 Senior Science Achievement Award

STEVEN LIU

112-9150 University High Street, Burnaby, BC
Tel: 778-238-9111 Email: shl16@sfu.ca

Education

Simon Fraser University September 2008 – Present

- Bachelor of Applied Science - Systems Engineering
- Philosophy Minor

Skills

Operating System	Software Apps	Programming Language	Hardware
Windows	MS Word/Excel/PPT	C++	Rohde&Schwarz Systems
Apple OS X	LT-Spice	Matlab	Multimeter/Power Meter
iOS/Android	Dreamweaver	HTML/CSS	Oscilloscope
BlackBerry 10/QNX	Maple	VHDL	Network Analyzer

Technical Experiences

BlackBerry (Formerly Research In Motion), Waterloo, ON Jan – Aug 2012, Jan – Dec 2014

► **Compliance Specialist Co-op (ISO17025 Certified Laboratory)** January – December 2014

- Conducted precise measurements of Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC), and Electromagnetic Interference (EMI) and provided data to the FCC, R&TTE, and Industry Canada (IC) for regulatory compliance certification
- Cooperated closely with antenna designers to ensure all RF transmissions and receptions are legal and complies with industry standards
- Performed detailed analysis on radio frequencies ranging from NFC (13.56 MHz) to WiFi 802.11a/ac (5.0 – 6.0 GHz) for troubleshooting and research/development purposes
- Compiled reports for corresponding government agencies and ensured all data and observations are neatly and accurately presented
- Ensured all laboratory equipment are up to standard according to ISO 17025 standards including calibration, functionality, and environment conditions
- Worked with extreme efficiency, precision, and often extra hours to meet tight deadlines in order to achieve target market release date of cellular devices

► **Software Test Developer Co-op** January – August 2012

- Designed test procedures to thoroughly test new software accounting for all possible conditions a device may encounter and newly added features
- Executed test procedures for various BlackBerry prototype devices using the company's bug tracking software to quickly seek out system defects and generate bug reports
- Suggested UI/GUI changes to yield optimal device performance and user experience
- Conducted both manual and automated tests to achieve maximum accuracy and efficiency

Simon Fraser University, Burnaby, BC

► **Website Developer, SFU Career Services Center** May 2011 – January 2012

- Designed the SFU Career Services website using HTML, CSS, Python, and Dreamweaver to offer students an informative and appealing web page

Projects

VHDL/DesignWorks – Design of a CPU Datapath (Solo Project – SFU Engineering) October 2013

- Designed a CPU datapath that implements an instruction set of 8 instructions
- Implemented individual components of the system through programming in VHDL using DesignWorks 5
- Simulated the system using Model Wizard and simulation tools within DesignWorks
- Ensured proper functionalities of each component as well as the integrated system through debugging skills and logic circuit knowledge

Website Development (Solo Project – SFU Computing Science) May – August 2010

- Developed a shopping catalogue website using HTML, CSS, and Python to offer users an appealing and functional set of pages
- Programmed Python to calculate total price including taxes base on region of purchase
- Coded in Python to print purchase receipts and retrieve purchase records for customers
- Project obtained excellent reviews and full marks from the professor

Rail Gun (Team Project – 8 Members – SFU Engineering) September – December 2008

- Designed and built an electromagnetic rail gun through research and knowledge of physics
- Executed various hardware skills including soldering, circuitry design, use of digital multi-meters, and specification calculations to ensure safety and proper functionality
- Built the rail gun using household materials and economical parts to maintain minimal cost
- Received the highest grade in the faculty for the project based on creativity, build quality, and possible applications of the device

Other Work Experiences

Renfrew Community Center Pool, Vancouver, BC September 2006 – June 2008

► **Lifeguard/Instructor**

- Ensured a safe environment for swimmers and rapidly responded to any emergency situations
- Conducted swimming/first aid/lifeguarding lessons for children, adults, and those who sought a future career in lifeguarding
- Reviewed applications and conducted interviews for candidates wishing to seek a position as a Lifeguard/Instructor

Trainings/Certifications

► **Royal Canadian Air Cadet**
► **National Lifeguard Service Award + Certification of Standard First Aid/CPR-C**
► **National Lifeguard Service Instructor / Lifesaving Instructor / Water Safety Instructor**

Hobbies/Interests

► **Hockey** ► **Martial Arts** ► **Guitar** ► **Swimming** ► **Video Games**

Steven Luu

2836 Eton Street, Vancouver, BC V5K 1K5 |778.558.1660 | saluu@sfu.ca

Education

Simon Fraser University (SFU), Burnaby, BC Jan 2011-Present

- Bachelor of Applied Science. Majoring in Systems Engineering

Technical Skills

Hardware

- Familiar with lab equipment including function generators, oscilloscopes, power supplies, multimeters, semiconductor parameter analyzers, and soldering irons
- Adept at computer hardware installation such as hard drives, GPUs, CPUs, RAM, Audio Cards, and power supplies
- Acquainted with handling chemicals and lab equipment such as test tubes, fume hoods, optical microscopes and propane cylinders
- Familiar with taking measurements and testing using position and velocity sensors, and accelerometers

Software

- Familiar with Solidworks, LTSpice, and DesignWorks 15
- Experienced with programming in C++
- Familiar with Python, VHDL, Assembly language, and Matlab
- Proficient with Windows and Microsoft Word, Excel, PowerPoint

Project Experience

Sensor Labs | Intro to Electro-Mechanical Sensors and Actuators | SFU Sept-Dec 2015

- Operated and tested different sensors and actuators with a team to analyze their behavior and applications
- Planned and allocated an appropriate time slot to confirm the availability of each group member
- Reviewed mechanisms and procedures of each sensor and actuator to ensure safe operation during our experiments
- Discussed and calculated findings of each experiment to confirm our results
- Complied our lab work and data of each experiment in a report to be examined

Microelectronic Labs | Microelectronics I | SFU May-Aug 2015

- Constructed and designed various circuits with a team in order to apply knowledge of microelectronic components including MOSFETs, diodes, and transistors
- Discussed overview and results of labs to assign tasks and verify our findings
- Operated a semiconductor parameter analyzer to acquire characteristics of diodes and transistors
- Summarized lab work and results of each lab in a formal report to be reviewed

Steven Luu

Project Experience (Continued)

Air Hockey Robot | Intro to Mechanical Design | SFU Mar-Apr 2015

- Designed and created an air hockey robot that met size and feature restrictions that was able to be used in a game of air hockey
- Discussed design of the robot with a team in order to meet size restriction of 10 mm^3, and design mechanisms to obtain and shoot an air hockey puck
- Crafted and tested the electrical and mechanical component of the robot to ensure each feature is in working order
- Assembled and tested the robot to ensure structural integrity and functionality
- Summarized details of the robot in a report to highlight the design of the each feature of the robot

Low Pass Filter | Electric Circuits II |SFU Mar 2015

- Led a team on the design of a 4^{th} order Butterworth filter to attenuate frequencies above 3400 Hz
- Calculated theoretical value of components to be used in the design of the filter
- Simulated the behavior of the filter using LTSpice to confirm the calculated values
- Constructed and tested the filter with given resources to ensure that it can properly attenuate frequencies above 3400 Hz
- Composed a report that summarizes the details and results of the filter design

Mechanical Device Redesign | Intro to Mechanical Design | SFU Feb-Mar 2015

- Broke down the features of a mechanical device with group members to highlight the main functions of each feature
- Researched patents of mechanism design to create an reference for the new design
- Analyzed and discussed device features using a designer tool as a base for the design
- Modeled and created new designs of each feature using SolidWorks to simplify the overall mechanisms of the device
- Summarized work in a report to showcase the various designs and highlight the best design for each feature

Parser | Software Design & Analysis for Engineers | SFU Sep-Dec 2014

- Developed a simple parser program with a partner written using C++ to separate an input file into tokens
- Worked on the design, development, and implementation of the parser program
- Wrote the program with classmates that separates an input file into tokens
- Included code for a lexical analyzer that classifies each token as a certain type
- Created an interface that prompts the user to pick a list of options that outputs certain statistics of the input file
- Discovered a bug with the statistics option and removed the option

Hobbies & Interests

- Computer Enthusiast
- Model kits