ENSC 305W/440W Grading Rubric for Project Proposal

Criteria	Details	Marks
Introduction/Background	Introduces basic purpose of the project. Includes clear background for the project.	**/05%**
Scope/Risks/Benefits	Clearly outlines project scope. Details both potential risks involved in project and potential benefits flowing from it.	**/15%**
Market/Competition/ Research Rationale	Describes the market for a commercial project and details the current competition. For a research project, the need for the system or device is outlined and current solutions are detailed.	**/10%**
Company Details	Team has devised a creative company name, product name, and a logo. Outlines relevant skills/expertise of team members.	**/05%**
Project Planning	Details major processes and milestones of the project. Includes Gantt, Milestone, and/or PERT charts as necessary (MS Project).	**/10%**
Cost Considerations	Includes a realistic estimate of project costs. Includes potential funding sources. Allows for contingencies.	**/05%**
Conclusion/References	Summarizes project and motivates readers. Includes references for information from other sources.	**/10%**
Rhetorical Issues	Document is persuasive and could convince a potential investor to consider funding the project. Clearly considers audience expertise and interests.	**/10%**
Presentation/Organization	Document looks like a professional proposal. Ideas follow in a logical manner. Layout and design is attractive.	**/10%**
Format Issues	Includes letter of transmittal, title page, executive summary, table of contents, list of figures and tables, glossary, and references. Pages are numbered, figures and tables are introduced, headings are numbered, etc. References and citations are properly formatted.	**/10%**
Correctness/Style	Correct spelling, grammar, and punctuation. Style is clear concise, and coherent.	**/10%**
Comments		

SIGNATUS INC.

School of Engineering Science
Simon Fraser University
8888 University Dr
Burnaby, BC Canada

September 26, 2013

Professor Lakshman One
School of Engineering Science
Simon Fraser University
Burnaby, BC V5A 1S6

Re: ENSC 440 Project Proposal for a Wireless Leak Detector and Inhibitor System

Dear Professor Lakshman One,

The attached document, *Proposal for a Wireless Leak Detector and Inhibitor*, is a general outline for our Capstone Engineering Science Project (ENSC 440). Our company's goal is to build a wireless system that automatically shuts down water sources to properties when a nearby leak is detected.

The purpose of this proposal is to present an overview of a Wireless Leak Detector and Inhibitor. In the following document, our design considerations will be discussed, along with our project budget, funding, tentative schedule, and individual background of each member of Signatus Inc. Additionally, we will evaluate the product's current market potential including the advantages that our product will have with respect to similar existing solutions.

Signatus Inc. consists of four motivated and talented senior engineering students: Petar Arnaut, Olivier Thomas J, Chris Fontaine, and Barry Zou. If you have any questions or concerns about our proposal, please contact me by phone at (604) 328-4996 or by email at paa9@sfu.ca

Sincerely,

Petar Arnaut

Petar Arnaut
Chief Executive Officer
Signatus Inc.

Enclosure: Proposal for a Wireless Leak Detector and Inhibitor

Project Proposal

Wireless Leak Detector and Inhibitor

SIGNATUS INC.

Petar Arnaut
Chief Executive Officer

Olivier Thomas
Chief Operating Officer

Chris Fontaine
Chief Technical Officer

Barry Zou
Chief Financial Officer

Contact Person: Petar Arnaut
paa9@sfu.ca

Submitted to: Lakshman One (ENSC 440)
Mike Sjoerdsma (ENSC 305)

Issue date: September 26, 2013

Executive Summary

Most owners of condominiums or houses are considered inexperienced in successfully safeguarding their homes against property damage. Purchasing property insurance can be expensive and overwhelming as insurance plans can vary greatly between the degrees of coverage each company provides. Therefore, home owners decide to purchase policies based on recommendations, or perhaps none at all. When it comes to property water damage, this can result in the loss of items that cannot be replaced, extensive restoration to the home and in extreme cases, relocation of tenants during the renovation. It is common for most home owners to notice a leak when it is already too late, as water can cause excessive damage in a short period of time. If homeowners do have insurance, the claims can often be tricky and take a lengthy duration before homeowners can collect their funds. Most insurance plans do not provide coverage for all water damage accidents, resulting in a more expensive insurance plan. For large scale water leaks, the damage amount can exceed the home owner's coverage and result in incurring costs even with an insurance plan. Furthermore, it is known that water damage is an increasing problem among home owners in Canada [1].

"We strongly encourage homeowners to take matters into their own hands in order to protect their homes." Wayne Ross, vice president of property claims for Aviva Canada stated.

Signatus Inc. has created a solution to assist home owners in taking matters into their own hands. Our proposed Wireless Leak Detector and Inhibitor system will achieve this goal. The system utilizes a water sensor unit to provide a signal when a leak is detected. The signal will be used to shut off an electronic valve attached to the main water source of the property, consequently stopping the flow of water and eliminating any further water damage. Included in this system is management software used to notify homeowners of leak location, battery status, and customization of configuration options.

Signatus Inc. is composed of four senior engineering students with a broad range of skills in computer programming, electrical systems, and mechanical design. The combined experience throughout the team will be crucial in developing and completing this project.

The proposed budget for device prototyping is estimated to be $520. The device will be composed of parts such as water sensors, microcontrollers, an electronic valve, and RF transceivers. The retail version of our product is estimated to have a $100 flat fee and additional $20-30 per leak detector unit. Our main source of funding will be provided by the Engineering Student Society Endowment Fund (ESSEF). If more funds are needed to complete the project, an application to the Wighton Fund will be submitted.

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Introduction

Home insurance is used to help homeowners and renters of condominiums safeguard against various types of damages that may occur to their property. Examples of damages can include fire, lightning, water, vehicle accidents, theft, and general personal property damage. Different types of policies provide differing levels of protection and as the level of coverage increases, and the associated costs of insurance rises.

According to research done in 2011 by InsurEye, an independent Canadian company which provides insurance related services to customers, Canadians on average pay $840 annually for home insurance. In this study, British Columbia spent the most on average with an annual cost of $924 [1]. In recent data released from Aviva Canada Inc. approximately 40% of all home insurance claims are from water related damages [2]. The average cost of water related damage claims rose 117% over 10 years, from $7192 in 2002 to more than $15500 in 2012 [2].

When it comes to water damage claims, some water damage accidents are not covered and need to be specifically added. A key example of this would be “seepage”, defined as the slow movement of water through small openings due to poor maintenance. This is an issue homeowners often face when they realize their claim has been rejected due to misinformed policy coverage. Another issue is the amount of coverage may not provide for the full costs of repairs.

The objective of this project is to develop a system that automatically detects water leakage from various plumbing systems and prevent further water damage to the property. Water sensing units, in the form of mats can easily relocate to possible leak areas. When a leak is detected, a signal is sent to shut off the water source. This is achieved through an electronic valve placed at the main water pipe for the property. The system’s management software will alert the home owner remotely that a leak has been detected and its location. The management software is also able to provide information on detector battery status and allow customization of the system configuration for homeowner customization. This system will be targeted toward retail homeowners with or without water damage insurance coverage, and possibly further improved and scaled to a commercial setting.

This project proposal will provide an overview of our system along with an estimated project schedule timeline, Gantt and Milestone charts, costs and sources of funding. Alternative devices and methods will be discussed to demonstrate the benefits of such a system, the weaknesses of our system, and a brief profile of each member of Signatus Inc.

System Overview

The basic conceptual model of a possible leak detector and inhibitor system is shown in Figure 1 below. A water leak is detected in proximity of the situated detector, and a signal is used to activate the electronic valve installed on the water main. In unison, the system alerts the home owner in a timely fashion in order for inspection to be taken. A manual override option will be available for users that do not want their water usage disrupted and the system shall serve instead as a detection unit. The signal information is also transmitted to the user's personal computer for use with the management software which will provide status of the leak location and battery levels of the devices.

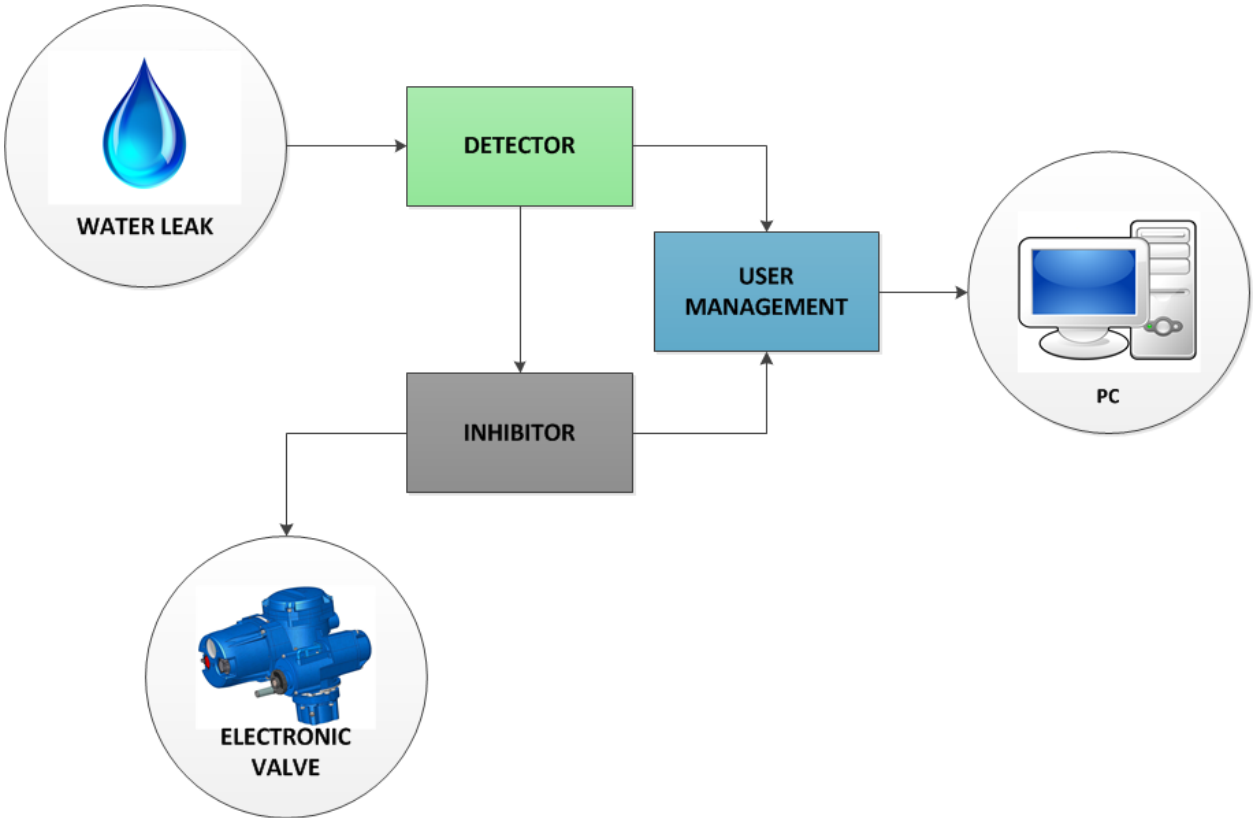

Figure 1: System Overview Diagram

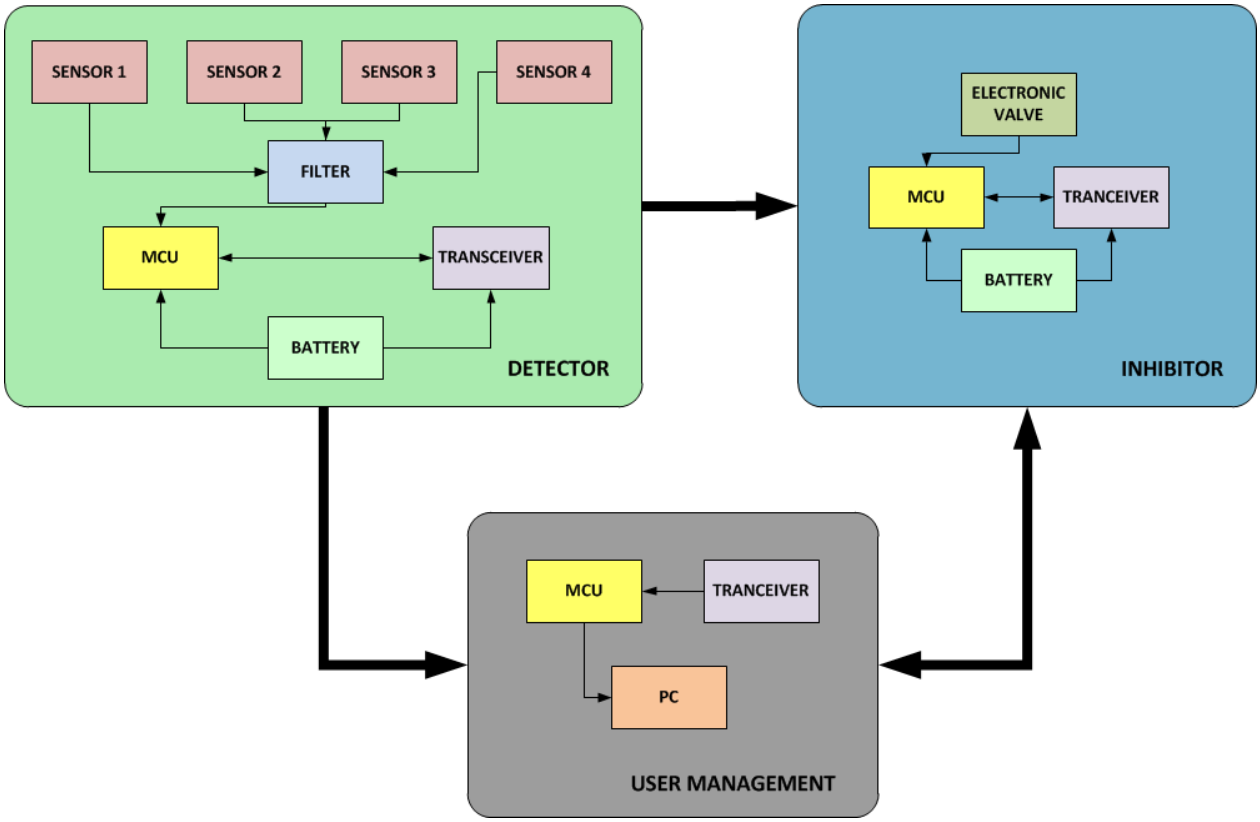

Figure 2: High-Level Block Diagram

The user is able to label detector units with their associated locations for use in notifying the user of a leak. The software will display location and battery status of each individual unit.

Comparable Design Solution

The current market provides homeowners with various water detection systems. One drawback of existing systems is that they only provide a notification when a leak occurs and cannot automatically turn the water source off. This system will not prevent leaks, and therefore lead to excessive water damage. Various products on the market produce false positives due to single sensor detection area. Signatus's Wireless Leak Detector and Inhibitor correctly detects leaks and takes action autonomously. This is particularly useful for properties that are not frequently visited such as storage facilities. Scalability and ease of use is another subject undertaken at Signatus. Current market water detecting alarms can be difficult to install due to electronic and mounting components. By determining the general specifications of the system, possible design solutions were determined.

Possible design solutions for specific features are:

1. **Mechanical motor connected to valve:**

   Originally, our company proposed a motor that would be connected to a device that would fit around an existing valve. While this could be advantageous in the fact that the original valve would not have to be replaced, the costs associated with implementing a motor sufficient to turn existing valves would outweigh the benefits of such a system. Also, the size of the motor would have to be quite larger than using an electronic valve and the fitting requirements of installing such a motor could become cumbersome.

2. **Multiple electronic valves installed at various locations :**

   The use of multiple electronic valves would allow for the prevention of leaks without disrupting the water usage for the rest of the homeowner's space. By placing electronic valves underneath sinks, bathtubs or other locations, the leak source could be isolated. The drawback of such a system is the additional installation requirements as well as the additional costs associated with multiple valves. Therefore, our design will only include a single electronic valve at the main water source of the homeowner's residence.

3. **PC connection and management interface:**

   The current water detection systems on the market do not have a graphical user interface for customization of the system. In order for our system to be marketable to multiple types of users, our design will include a GUI to assist in notifying the users about leak locations, battery status of devices and will allow for the electronic valve to autonomously turn the water off or to only notify the user of a leak.

Proposed Design Solution

Our proposed solution is able to accurately detect a leakage at specific locations on the property deemed important by the user. The detection unit shall be created using four water sensors spread over an area to prevent false positives. These sensors will be spread out around the edges of a rubber mat, for ease of usability in placing mats underneath potential leak sources. At least 3 positives will be required to determine a leak has happened, to reduce the possibility of false positives. Determining that a leak has occurred will involve the design of a filter and programming an Arduino Microcontroller. Once the mat has detected a leak, the microcontroller will utilize the RF transceiver on the mat to send out a signal to the Inhibitor and Manager. The Inhibitor which is attached to the electronic valve located at the main water source of the property would shut off the water. Turning the valve off will require another microcontroller to handle the logic involved with undertaking such a task and to prevent false positives. Different electronic valve options will be made available for use with different size water mains, and the microcontroller / transceiver pair for use with the electronic valve will be mountable onto the valve, for use with universal sizes. Using a wireless system will ease installation requirements, as once the electronic valve is installed, multiple sensors on the mats can be added to the system or moved around without having to reconfigure the entire system. This ensures that the system is easily scalable to provide additional mats as required or to cover any future renovations that require leak detection.

User management software will be an additional feature to the system. It will allow for an interface for the user to label different leak detector units and check battery and leak location. When a new leak detecting unit is activated, the software should detect the transceiver ID and prompt accordingly for the user to provide a location label associated with the device. This information is relayed through an attached microcontroller and transceiver system (Manager) that is connected to a personal computer through USB port. As with any wireless system, reliability is a large factor, so as to prevent wireless transmission malfunction from Detector to Inhibitor, a backup system is placed in the Manager. It will overlook the status of the reception, and if a malfunction is detected, the management software will resend the valve shutoff instruction. The number of leak detector units possible for a single system depends on the number of channels available by the transceiver chosen. Superior transceivers can be used for larger scale infrastructure, providing the capabilities to handle more sensor devices.

Budget and Funding

Time and funding are important constraints for this project. Limited funding requires that we have fewer options to explore for hardware components we choose to use. Our goal is to produce a working prototype showing a functional system and create a framework for further development.

The estimated cost of developing a prototype Wireless Leak Detector and Inhibitor is broken down in Table 1 below.

Table 1: Prototype Budget Breakdown

Equipment List	Estimated Cost
3 x Arduino Microcontroller Boards	$100
3 x Transceiver Modules	$80
4 x Moisture Sensors	$40
1 x Electronic Valve	$50
3 x Enclosures	$50
3 x Rubber Mat	$30
Water Proofing Material (Seals, Covers, Enclosures, etc.)	$20
Miscellaneous Electronics (Wires, Switches, Resistors, etc.)	$80
Contingency Fund	$70
Total Cost	**$520**

The Arduino Microcontroller was chosen for its price, size, and ease of programming. Transceivers were chosen for compatibility with the Arduino Microcontrollers. Moisture sensors were selected for their accuracy and cost. Rubber mats are expected to be used to enclose the detector unit; however alternatives may be chosen during development.

The main source of funding will be received from the Engineering Science Society Endowment Fund (ESSEF). Additional spare parts are calculated into the project budget estimates, contingency funds are added to cover our budget estimates. If the company's costs rise over project estimates, Signatus Inc will approach The Wighton Fund for additional funding. In addition, if insufficient funds are received, Signatus Inc. members have agreed to cover additional cost equally.

Schedule

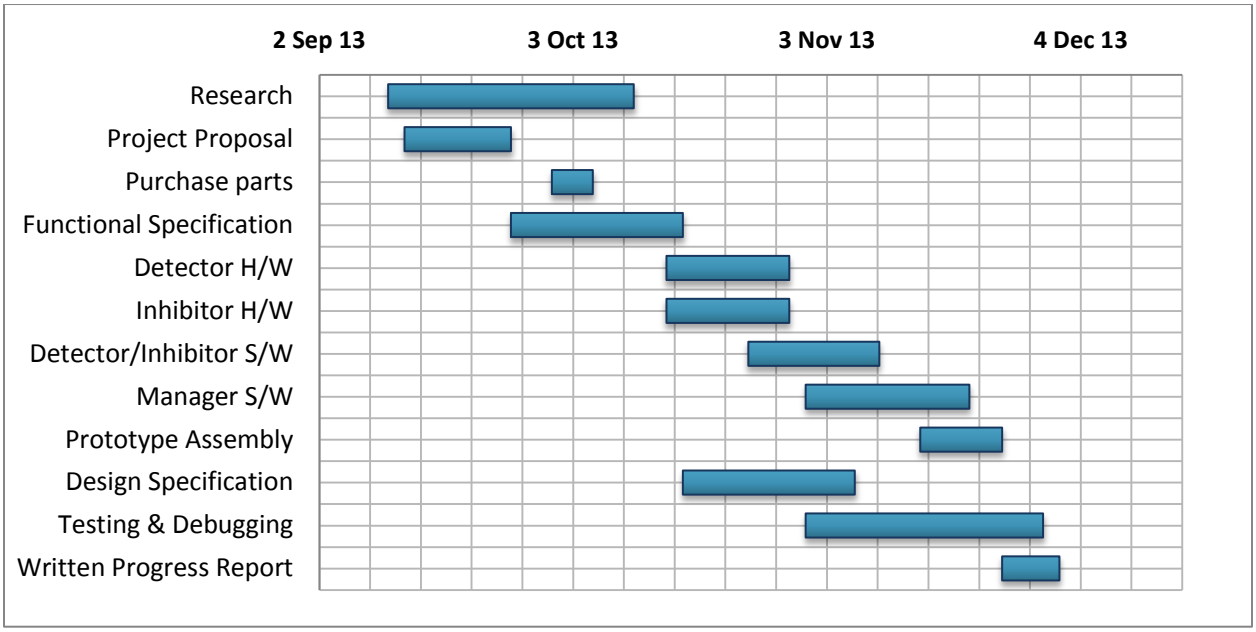

Figure 3: Gantt Chart

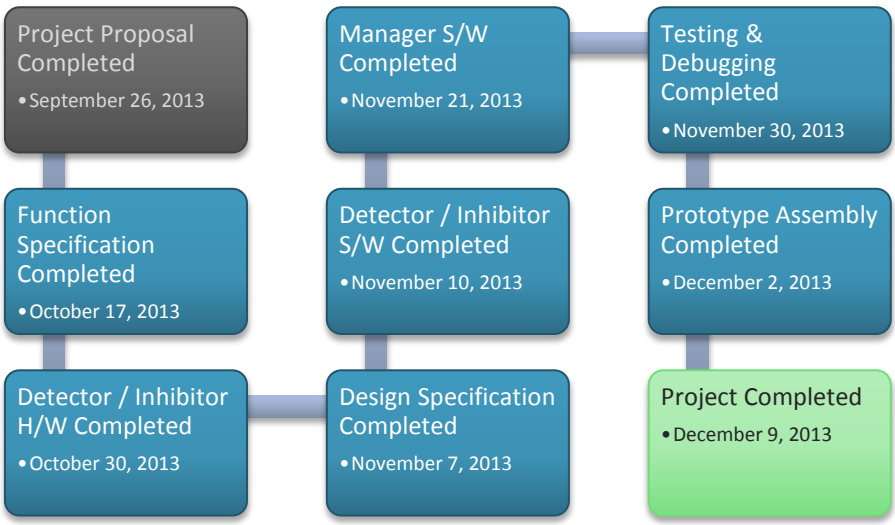

Figure 4: Project Milestones

Company Profile

Petar Arnaut – Chief Executive Officer (CTO)

Responsible for organizing the structure of roles for each member of the company, weekly minutes, reports and electronic circuit design.

Petar Arnaut is a fifth year electronic engineering student and had experience working as a camera development engineer and software designer at Blackberry and Ericsson Canada, respectively. His acquired skills throughout school and co-op will help the company successfully complete the project as envisioned.

Olivier Thomas – Chief Operating Officer (COO)

Manages day to day operations, by means of overlooking scheduling, deadlines, progress reports, document formatting, and initial system design.

Olivier is in his final year of Systems Engineering at Simon Fraser University (SFU). His past projects have given him the expertise needed in designing systems which require multiple engineering disciplines. His experience at Ericsson Canada Inc. in designing hardware frameworks for embedded systems has demonstrated his ability to design software on a large-scale. Olivier's proficiency in systems design, dedication, and ability to deliver results will be a strong addition to the Signatus team.

Chris Fontaine – Chief Technical Officer (CTO)

Responsible for understanding all technical aspects of the various devices used in our system, ensure that all independent devices are designed for seamless integration and performing testing of all devices.

Chris is in his final semester of studying systems engineering at SFU with an interest in control systems. He has demonstrated his aptitude in designing electronic systems for large-scale commercial construction projects through his work experience at both Applied Engineering Solutions and Prism Engineering. His expertise in a fast-paced, project driven environment along with his broad technical background will be a valuable asset throughout this project.

Barry Zou – Chief Financial Officer (CFO)

Responsible for organizing the project budget and ordering the correct equipment needed for the project. Will also be drafting initial revision of documentation.

Barry is in his final school semester at Simon Fraser University. As a Computer Engineering major he has worked with C/C++, VHDL programming languages. His work experience at Broadcom Corporation as a Quality Engineer allowed him to become knowledgeable of Software Engineering process as a whole, as well as demonstrating excellent teamwork, communication, and organizational skills.

Conclusion

Signatus Inc. is devoted to applying technology in solving the issue of water related damage to homeowner's property. Water related damage is an increasing issue that has become a large part of all home insurance claims. Our Wireless Leak Detector and Inhibitor System will assist the home owner in early detection of water leakage and inhibit the source of the leak before any significant damage has been realized.

Our proposed solution will be cost effective and efficient to both retail home owners and renters with or without home insurance. Furthermore, the basic framework of this system with proper future development can be used as the foundation for an industry standard for broad commercial structures.

At Signatus, we are confident that with our expertise and experience in the field of engineering we will design a working prototype suitable to demonstrate proficiency at detecting water leaks and mitigating water damage when a leak occurs.

References

[1] *Your Eye in a Complex World of Insurance* [Online]. Available: https://insureye.com/news_and_insights/view/canadians-pay-840-average-annually-for-home-insurance

[2] (2013, Apr 10). *40% of all home insurance claims are due to water damage, insurer says* [Online]. Available: http://www.canadianunderwriter.ca/news/40-of-all-home-insurance-claims-are-due-to-water-damage-insurer-says/1002216855/