January 26, 2012

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

Re: ENSC 440 Project Proposal for a Wireless Waterflow Monitoring System

Dear Dr. Rawicz

The outline of our ENSC 440 project has been attached including all necessary information regarding the completion of each milestone.

The attached document includes the following information: Scope of the Project, System Overview, Cost Breakdown, and the timeline for completion of project milestones.

The project objectives are to design and implement a wireless waterflow monitoring system which can remotely send the measurement signal to a PC keeping track of flow rate values recorded at a certain frequency. The system can be installed on any given pipe assembly and would identify any possible leakage resulting from a higher than normal flow rate. In doing so, the system will employ several features including an ultrasonic flow sensor, transceiver and a microcontroller with an analog to digital conversion function.

Sincerely,

Timbo Yuen
Product Manager
GreenSense Systems

Proposal

Wireless Ultrasonic Waterflow Monitoring System

Project Team:

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Submitted to:

Dr. Andrew Rawicz – ENSC 440
Steve Whitmore – ENSC 305
School of Engineering Science
Simon Fraser University
Issued date: January 2012

Executive Summary

GreenSense Systems is a new company comprised of engineers that will provide high quality, efficient, and eco-friendly systems. GreenSense Systems will target many different industrial markets with our systems for convenience, ease of usage, and the ability to integrate with existing devices. The first product will be providing a solution in the environmental industry.

Almost all water providing companies are looking at methods to reduce the amount of water loss due to leakage in their pipeline systems. The first product is the "Wireless Ultrasonic Waterflow Monitoring System", which provides high accuracy monitoring of water flow in pipeline systems. This system provides consistent, reliable, and accurate information about the water flow. All its data will be convenient to access through wireless transmission using Wi-Fi signal. The user interface will be intuitive and easy to use. It will be simple to understand the sensor's location, its alarms, and its data of pipeline systems. Furthermore, there will be differences in between using an external ultrasonic sensor or internal ultrasonic sensor. From the design stage, we will determine which mounting solution will be proving to be the optimal solution.

The proposed budget of all the product components costs is estimated to be a total of $580 CAD. This amount will be primarily funded from our sources, ESSEF and the company, Enginuity. We have researched and acknowledged the process of patenting our intellectual properties, which will add financial security to GreenSense Systems investors.

The market for our monitoring systems can expand to include usage for homes, offices, hotels, schools, hospitals, and recreation centers. For this, we will design with portability, size, cost, and reliability in mind. With our "Wireless Ultrasonic Waterflow Monitoring System", the high running costs of water can be reduced and this kind of investment cannot be overlooked, therefore long term costs can reach its optimal. Also, the market has been identified to have increasing demands for high precision water sensors, and will an increasing awareness for its category. Therefore, our first product, "Wireless Ultrasonic Waterflow Monitoring System", will be a highly valued and useful product on the market.

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1. Introduction

Water is a natural resource essential to the existence of our being. We recognize that there are limited water resources supplying the world and hence we strive to conserve water in any way possible. The major objective of our project revolves around this important issue and ensuring that building owners and managers are aware of the amount of water consumption in their properties.

"To support their current lifestyle, Canadians consume about 1.5 million cubic metres (MCM) or approximately 4,400 litres-per-capita-per-day, making Canada one of the highest per capita users in the world. In 2001, this average residential water use dropped to 335 litres per day. Nonetheless, Canadians still rank as one of the world's most profligate people in terms of water consumption. "

The proposed system of measurement for water consumption is suitable for commercial as well as residential buildings where a large amount of water is consumed on a daily basis. A collection of water-consuming units installed in buildings contribute to the total amount of water being used. These may include toilets, showers, kitchen sinks, laundry and yard hoses.

Regardless of the unit, each pipe in the building can be pinpointed and its water use tracked using an ultrasonic flow meter or sensor. The readout from the sensor will be input to a microcontroller with an analog to digital conversion capability. The digital output will then be transmitted to a PC via a transmitter/receiver resulting in various plots corresponding to the amount of flow. These plots may then be studied appropriately for further information.

2. System Overview

1. System

The prototype we are trying to build is called “Wireless Ultrasonic Waterflow Monitoring System”. The system is consisted of several parts, an ultrasonic waterflow sensor, a transmitter, a receiver, a microcontroller and a personal computer. Figure 1 demonstrates the block diagram of the system whereby the sensors will be attached inside the water pipe with screws. The sensor will measure the velocity and the amount of water passing through pipe at a specific time period, and the data that is collected will be sent wirelessly to the microcontroller through a transmitter and receiver channel. The microcontroller will be implemented to control the status of the sensor such as sleep(indicates the sensor is temporarily turned off) or work(indicates the sensor is working). The microcontroller will perform analog to digital signal conversion and transfer the data/signal to the computer. The graphic user interface on computer will show a graph of water consumption versus time.

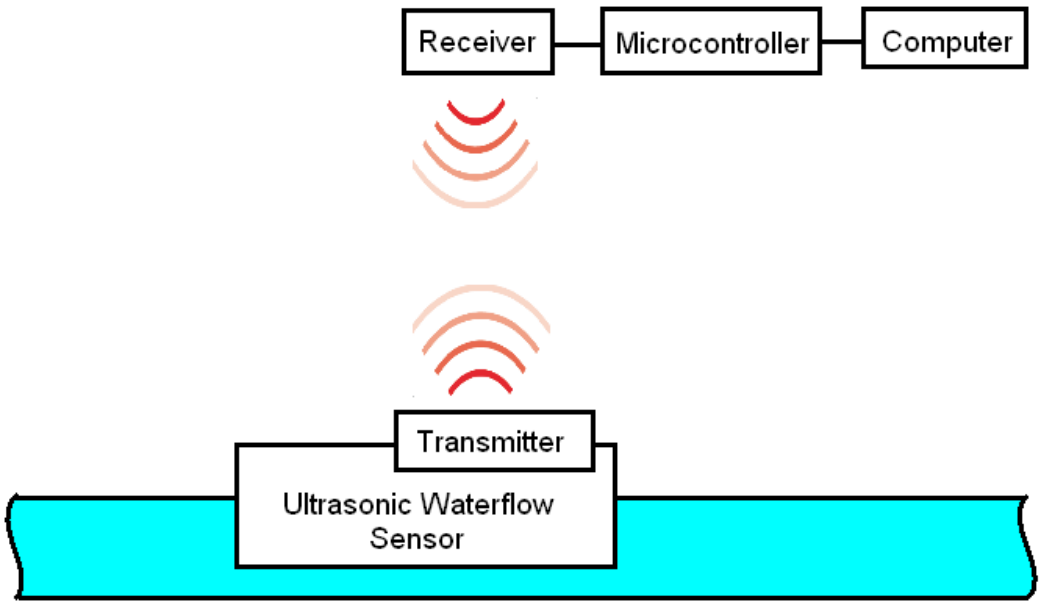


Figure 1.System Diagram

The product is mainly designed for industrial purposes. We want to install the sensor in different pipes and observe all of the waterflow simultaneously.

2. Alternative Solution Available for the Ultrasonic Sensor

According to our research, there are two kinds of ultrasonic flow meters in the market: Doppler ultrasonic flow meter and Transit time ultrasonic flow meter.
In the first method, ultrasonic sensors, which are placed outside the pipes, use reflected ultrasonic sound to measure the fluid velocity.

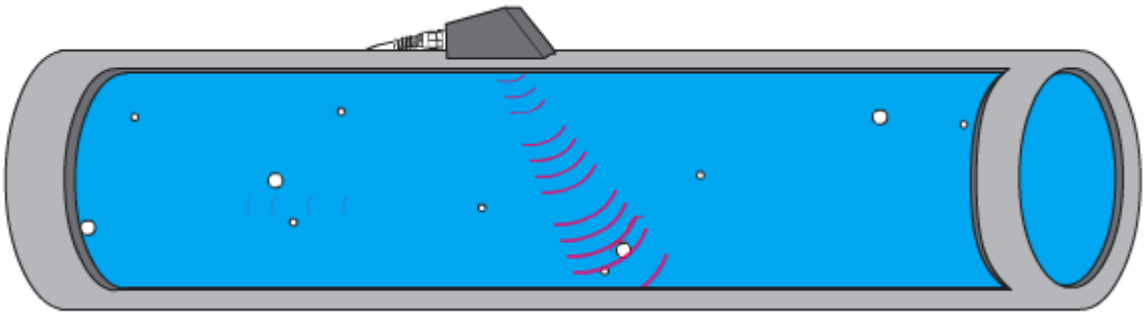


Figure 2. Doppler ultrasonic flow meter retrived from (http://www.greyline.com/howitwk.htm)

However, this technique is only suitable for liquids with solids or gas bubbles such as slurries, sludge, and wastewater which may damage regular flow meters.(Greyline Instruments, http://www.greyline.com/howitwk.htm)

Our project is based on transit time ultrasonic flow meter and with this technique the ultrasonic sensors may situate inside or outside the pipes which the latter is more common.

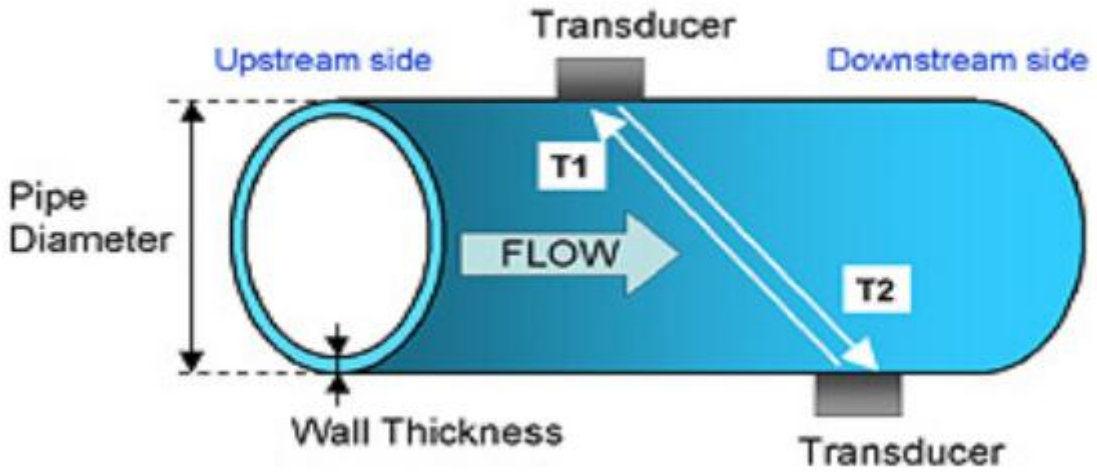


Figure 3. Transit time ultrasonic flow meter retrived From (http://www.yokogawa.com/fld/reference/fld-us-principle-01en.htm)

An ultrasonic transmitter-receiver pair is used in a typical transit-time flow meter. The flow meter operates by measuring the time for sound to travel between the medium. The velocity and the frequency can be calculated from the time difference. (Shenitech.http://www.shenitech.com/flow-meas-ultrasonic-transit-time-flowmeter.htm)

3. Plan

The task is divided to serveral parts.

1. Microcontroller implementation: Programming the microcontroller by C language.
2. Hardware installation: Sensor assembly, Transmitter/Receiver assembly, Microcontroller and computer assembly.
3. User interface: Building graphic user interface on the computer.

4. Integration of software and hardware: Connecting microcontroller to the computer.
5. Testing: Performing a test after each steps are completed.

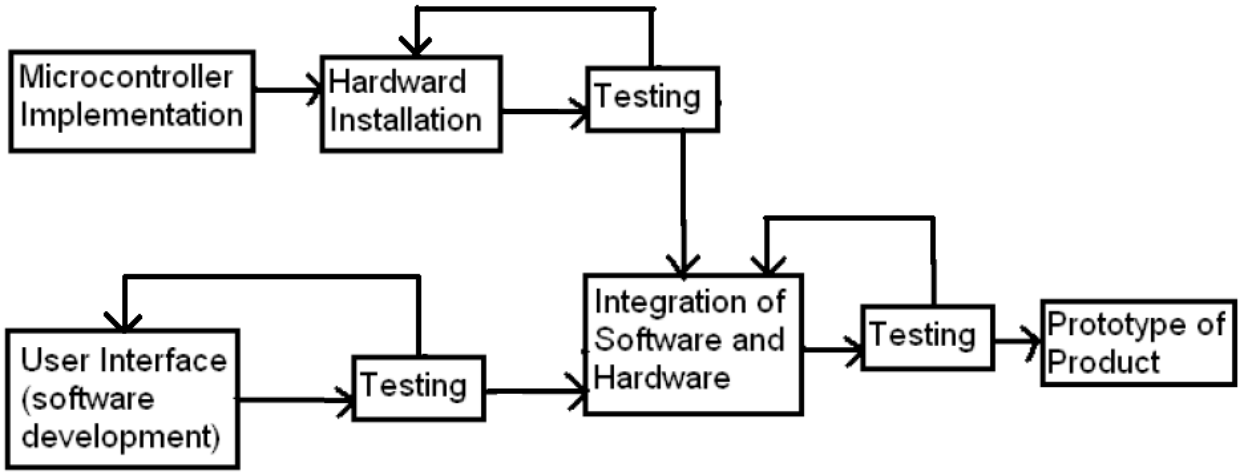


Figure 4.Implementation Plan

3. Budget

The list below includes the components we need for the product. The price might be slightly varied due to minor changes of the project design. Also, there will be additional shipping fees (approximately $10CAD) for each component.

Part Name	Part Number	Cost
Arduino Microcontroller	Uno	$40
Ultrasonic Sensor	LVU-150-R	$275
Transmitter/Receiver	UWTC-REC1	$235
Connecting wire/USB	N/A	$30
Testing Apparatus	N/A	$100
Miscellaneous	N/A	$50
Total Cost		$730

Table 1. Budget

4. Sources of Funding

Since the cost of project is high, we have been continuously seeking the source of funding. We have applied to Engineering Science Student Endowment Fund. Also, due to the fact that we cooperate with a company called Enginuity, we will be able to borrow the lab equipment and receive funding from Enginuity.

5.Sources of Information

For the stages of planning, developing and implementing the project, our sources include manufacturer's technical documentations, SFU professors/graduate students in the related specific specialization, industrial experts, SFU publications, similar past course projects, our group members and course textbooks.

Our group member, Ehsan Arman, has contact with industrial experts to help further enhance our design for better industrial usage. Our professors for contact will be professors Lucky One for electronics questions, and Kamal Gupta or Mehrdad Saif for control and systems questions.

After the project was technically defined, consultations were made for meeting proper requirements and standards set by safety and regulation bodies, such as CSA (Canadian Standards Agency) and other government websites for licensing and safety.

6. Marketing Opportunities

Since the flow monitoring system can easily measure the rate of flow, therefore there is a high demand in the industry for the device. It can also be used in drainage industry where it is necessary to control the amount of sewage in the pipes. To be more environmental friendly, the drainage department needs to control the water flow because it would save them money that would go towards purifying larger amounts of sewer. Furthermore, our product can detect leakage in the pipes. Urban municipalities can be a potential consumer of our product. They can easily use our product to monitor the rate of flow in their pipeline grid to figure out if there is any leakage.

7. Gantt chart & Milestone

Below is the combination of Gantt chart and the Milestone chart of our project. It shows the timetable of each step and its start and finish date. The date on the left hand side indicates the end of the week in which the finish date of each step drops in. from the chart below we concluded that our project starts at January 6th 2012, ends at April 8th 2012.

Task Name	Duration	Start	Finish	Status	owner
Reseach	62 days	1/6/2012	3/8/2012		All team memb
Evaluate Design and optimize	92 days	1/6/2012	4/8/2012		All team memb
Project proposal	6 days	1/6/2012	1/12/2012		All team memb
Design specification	24 days	1/13/2012	2/6/2012		All team memb
Buying parts	14 days	2/1/2012	2/15/2012		All team memb
Sensor module assembly	5 days	2/15/2012	2/20/2012		All team memb
Transmitter and Reciver module	5 days	2/15/2012	2/20/2012		All team memb
PC and MCU module assembly	5 days	2/15/2012	2/20/2012		All team memb
Microcontroller programing	30 days	2/20/2012	3/20/2012		All team memb
GUI programming	19 days	3/20/2012	4/8/2012		All team memb
Demo presentation	0.5 days	4/8/2012	4/8/2012		All team memb

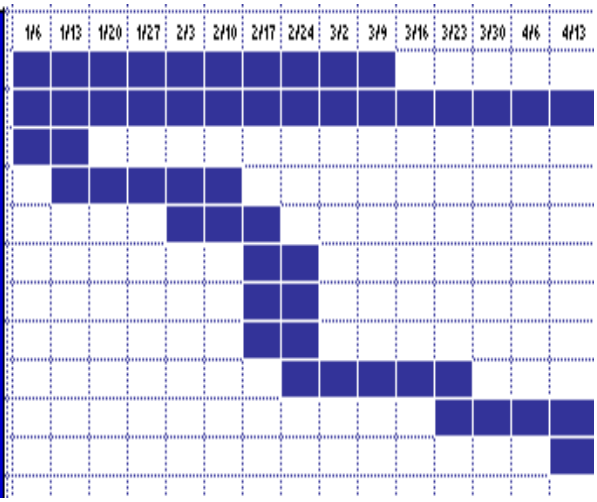


Table 2. Gantt chart & Milestone

8. Duties of Members

To complete the project within 4 months it requires that we have very clear and reasonable responsibility on each member's part in our group. We need to keep a good relationship in our team and overcome any difficulties together. We need to take advantage of skills of each member and try to become familiar with each other. At the same time, we have to prudently organize our group structure to have the most stable and risk-resistant team. Thus, we generally treat this project as two categories. The first one is the non-technical part and the second is the technical part.

The non-technical part includes project research in the preliminary stage and all kinds of documentation and purchasing components and etc. For this part, Ye Lin and Eric Lo will take care of the purchasing components. Ehsan Arman and Babak Razzaghi looks after the documentation and presentation. Timbo Yuan is to keep track of our progress and solve any problem that may arise in order to catch up with the schedule.

Technical aspect is the most important part of the project. We all have come here to learn and we do not want to be handicapped by any member at any step. Thus all the members in our group would work together at each step to get everything done and move further. There is no specific role on each individual's part when we get the project going forward. It is more efficient for five people to solve a problem at the same time than one or two people do. On the other hand, in this team structure all the group members are able to gain skills and experience from every corner of the project. We believe if our team is able to function well we will succeed.

9. Company Profile

Eric Lo

Eric Lo is a fourth year electronic engineering student at Simon Fraser University. He had learned good communication and team work skill from doing co-op in summer 2011. He is familiar with C language programming, embedded system, robot design.Also, his experience toward signal processing and analyzing will help the completion of the project of GreenSense System.

Ehsan Arman

Ehsan Arman is a fourth year systems engineering student in his final year of studies at Simon Fraser University. He has gained extensive team-work and communicational skills in his past co-op experiences. He has also taken advanced courses in communication networks, control theory and electromechanical sensors/actuators. He has sound skills in C++, JAVA and Visual Basic programming languages. With his background in these subjects he can contribute to the design aspect of the project.

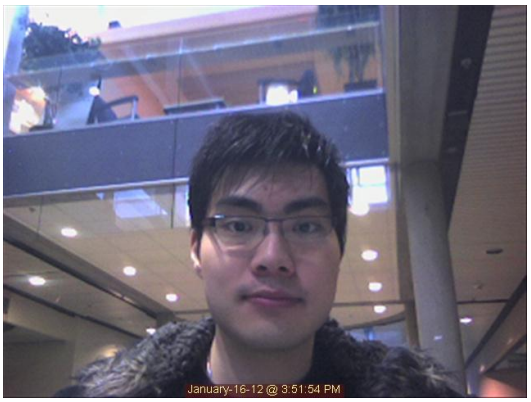
Ye Lin

Ye Lin is in fourth year of electronic engineering at Simon Fraser University. His working experience in Heat Fluid Lab has given him plenty of experience on smart circuit design, build and test and microcontroller programming. He has good skill on signal processing and wireless communication make him well aligned to the design for GreenSense Systems. Also, from his previous working and studying experience he knows how to work in a team and communicate with people which will contribute to GreenSense's success.

Babak Razzaghi

Babak Razzaghi received his B.Sc. in Electrical Engineering-Electronics in 2009 from Islamic Azad University-Tehran South Branch. He has applied for Simon Fraser University to get Master in Biomedical Engineering. His knowledge in C programming language along with his hardworking and communication skills can contribute to the success of GreenSense in this project.

Timbo Yuen



Timbo is in his final year in his Electronics Engineering program at Simon Fraser University. His knowledge in advanced networking technologies, digital and analog electronics design, embedded systems design, and control systems theory make him well aligned to the design for GreenSense Systems. With his previous work experience, he offers good communication and teamwork skills which will contribute to GreenSense's success.

10. Conclusion

Our "Wireless Ultrasonic Waterflow Monitor System" is a product that we are also very excited about and we anticipate with its advanced technologies and its great usability, it will be a great experience for its users and it will be an attractive solution on the market. The "Wireless Ultrasonic Waterflow Monitor System" will be very precise and it will further reduce water loss to the minimum for water supplies for a strong contribution to improve the efficiency and reduce costs.

GreenSense Systems is a company that sets goals for systems that are efficient to help reduce costs, that are reliable with high quality to ensure the best experience for users, and that are eco-friendly because we all have to be responsible to the environment. With the given technical, financial, and scheduling details, we will deliver our first product on time with quality.

Looking forward, the team of engineers here at GreenSense Systems will continue to seek ways to better the environment and design high quality products.

11. References

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