CENTURY SOLUTIONS

January 16, 2012

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

Re: ENSC 440 Project Proposal for *Fall Assist*, a device to detect elderly people who have fallen

Dear Dr. Rawicz:

The enclosed document is the proposal for our product *Fall Assist*. This product is in correspondence with the ENSC 440 project. Our objective is to help elderly people who are prone to falling via a device that will contact appropriate assistance.

The following proposal outlines the system overview of our product, product design, budget information, project scheduling and organization, and information regarding our company and its constituents.

Our company, Century Solutions, consists of five senior engineering students: Ashish Agarwal, Richard Cho, Mahsa Dabirvaziri, Paven Loodu, and Alysha Sue. If you have any questions or inquiries of our proposal please feel free to contact our designated contact person Alysha Sue by phone at (778) 688-7412 or by email at ams34@sfu.ca

Sincerely,

Ashish Agarwal

Ashish Agarwal
Chief Executive Officer
Century Solutions

Enclosure: Proposal for *Fall Assist*

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A Proposal for Fall Assist, a device to detect elderly people who have fallen

PROJECT TEAM
Ashish Agarwal
Richard Cho
Mahsa Dabirvaziri
Paven Loodu
Alysha Sue

CONTACT PERSON
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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 16, 2012

Executive Summary

Falls are of major concern for elderly people living on their own. Statistics show that approximately one in every three adults 65 years old or older fall each year and 30% of the falls result in serious injury. The United Nations predicts that by 2035, 25% of the world population will be aged 65 years or older as the baby boomers age. Quick detection of a fall can lower the rate of mortality and increase chances of survival.

Current devices already exist in monitoring and being able to detect falls. One of the devices requires the person to push a button after they have fallen to notify an emergency contact. This can have serious consequences since the person may not be able to push the button due to lack of mobility or conscious. Another device involves an accelerometer being installed in the floor that will monitor vibrations that can detect when someone falls. However, *Fall Assist* is intended to be affordable and automatic in notifying an emergency contact of the fall.

Our objective is to design and develop a device that will monitor and determine when someone has fallen. *Fall Assist* will consist of an accelerometer to measure the acceleration during a fall, a processor to determine if the collected data from the accelerometer is indeed a fall, and a transmitter and receiver to notify an emergency contact that someone has fallen. Motion detectors will also be set up in the vicinity to monitor any movements. The receiver in this design will consist of a smart phone.

The main goals of this design are described below:

- Collect data on acceleration versus time profiles of everyday actions, such as walking, walking down stairs, sitting on a chair, etc
- Collect data on when a fall occurs and compare the data to the above
- Process the signal from the accelerometer and determine whether a fall has occurred
- Design a smart phone application that will notify an emergency contact when a fall has occurred via Bluetooth

The team involved in the project consists of two electronic engineering students, two systems engineering students and a computer engineering student. We plan to take careful consideration when scheduling and keeping to the budget. The estimated cost of the design is $688 and sources of funding will be explored throughout the semester. We have planned the development cycle by setting milestones within the four month timeframe and will progress from a concept to a working model in 13 weeks.

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1. Introduction

One third of people aged 65 and older fall at least once a year. These falls cause serious injuries and sometimes lead to death. Because of the frequency of this occurrence, falls have become the most common cause of injury and the 6th leading cause of death in seniors.

Last November, the BC Ministry of heath launched the 5th annual Seniors' Fall Prevention Awareness Week to highlight fall prevention initiatives to give seniors back their independence. With Fall Assist, seniors can keep their independence of living alone without having to worry about lying on the floor for hours or days waiting for help in the event of a fall.

The objective of our project is to create a device, which will give seniors immediate access to help incase of a fall. The device will detect a fall using an accelerometer that will be worn on the person. Sensors located in all rooms of the house will then detect that the person has fallen and is unable to get up without assistance. If the person is unable to get up after a few minutes, the device will send a call for help to an emergency contact such as a relative, friend, neighbour, or social worker. The notified contact can then ensure that the necessary help is given to the fallen person immediately.

This proposal provides an overview of the design of our device. Projected financial requirements as well as sources of funding are discussed and examined. Furthermore, our projected time schedule – in the form of Gantt and milestone charts – are included as well.

2. System Overview

The system involves three parts – the first part is the actual device which the user will wear on their body. This can either be a collar/necklace or a waist belt. The device will have an accelerometer, an analog to digital converter, a microprocessor and a Bluetooth chip. This part of the device is used to detect if the user has fallen.

The second part of the system is the motion sensor on the wall of the room that communicates with the device attached on the user's body. This part of the system will have a motion sensor, a microprocessor and a Bluetooth chip. This part is used to eliminate any false positive readings that the device will detect.

The third part of the system is a smartphone application which will communicate with the device using Bluetooth. The application will initiate a call to an emergency contact if an actual fall is detected.

The block diagram in the figure below shows an overview of how the different components of the system work together.

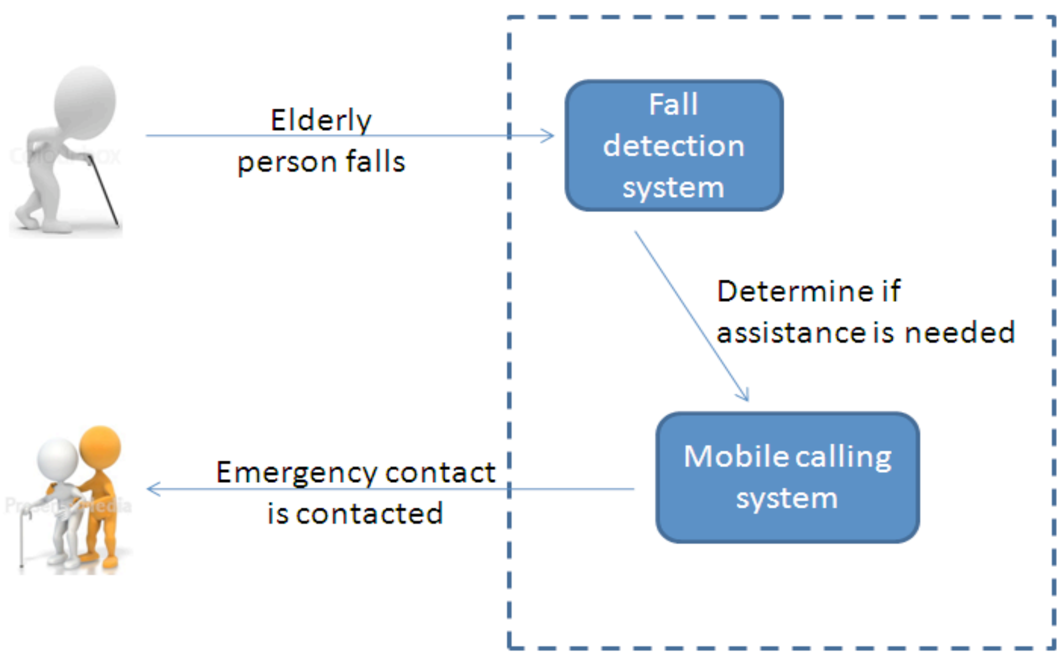

Figure 2.1: An Overview of *Fall Assist*

2.1 Determining a Fall

The main issue is determining whether a fall has occurred as opposed to everyday activities such as someone walking down the stairs or sitting down. Using an accelerometer, an acceleration versus time profile will be collected on various everyday things such as walking, walking down a flight of stairs, sitting on chair, etc. When acceleration close to that of gravity is detected a signal will be generated and the microcontroller will process the information to determine if an actual fall has occurred. The data obtained from the acceleration versus time profiles can then be compared to the data collected when a fall has occurred and a decision can be made to alert an emergency contact that a fall has occurred and that their assistance is needed.

2.2 Eliminating False Positives

One of the major problems we will be facing is the elimination of false positives. These are the different activities that will cause the device to think that the user has fallen even though they are perfectly fine. Some of the false positives are – the user dropping the device, the user lying down, and the user falls down but is able to get back up without needing any help. These are just a few of the many false positives that may be detected. To eliminate most of these false positives we will have motion sensors in different rooms of the house. Once the accelerometer detects a fall, it will use Bluetooth to communicate with the nearest motion sensor to detect for motion in the room. If the motion sensor detects activity in the room, the alarm will not be triggered. However, if there is no activity for 5 minutes, the device will interpret that the user has fallen.

2.3 Contacting the Emergency Contact

Once the device determines that the user has fallen, it has to send a message to the emergency contact of the person. This consists of a smartphone application that we will be using. The device will send a message via Bluetooth that the user has fallen and upon receiving the message, the phone will contact the user's emergency contact.

3. The Design Solution

The user's activities such as walking, sitting, climbing stairs, etc. will generate readings in the accelerometer. These readings will be in analog format originally and will be converted to digital by the analog to digital converter that is attached to the accelerometer. The converter will also be attached to the microprocessor that will constantly analyze the signal. If the microprocessor determines that the activity corresponds with a fall, the microprocessor will communicate with the motion sensors on the walls using Bluetooth to check for the following false positives:

1. Did the user really fall or drop the accelerometer?
2. Is the user able to get back up without any help?

If it is determined that the user really did fall, the microprocessor will communicate with a smartphone using Bluetooth and make a phone call/send a text message to the person's emergency contact.

4. Budget and Funding

Figure 4.1 shows the cost of the components required to build the *Fall Assist* system. An accelerometer is used to detect the fall and motion sensors are required to minimize the occurrence of false positives. We decided to choose the ADXL345 accelerometer since it is sensitive enough to detect a person falling. We have also chosen high-end analog to digital converters since they have to be capable of converting a lot of data very fast for the microprocessor. Our choice of microprocessors will depend on microprocessor's ability to perform complex signal processing.

Equipment List (Include brand and model # if possible)	Estimated Unit Cost
2 x (microcontroller evaluation board + USB to serial TTL cable + resistors + mosftets + switches + LEDs)	$220
1 x Accelerometer (EVAL-ADXL345NZ-ND)	$50
3 x PIR Motion sensor (EKMA1202120)	$123
3xBluetooth chips (MSP430BTS190IZQWR)	$45
2 x Analog-Digital converter (AD9637BCPZ-80)	$200
Miscellaneous (batteries + plastic pieces, etc)	$10
Shipping	$40
Total Cost	$688

Figure 4.1: Tentative Budget

The cost for this project is estimated to be around $700. The availability of funds is crucial for the completion of the project. The team has applied to the Engineering Science Student Society Endowment Fund (ESSSEF). The other sources of funding being considered are the Simon Fraser Student Society and the Wighton Development Fund. Also since the potential market for Fall Assist is huge, the team will also consider looking for sources of funding in the gerontechnology community.

5. Schedule

Figure 5.1 shows the approximate time line for our project, presented in the form of a Gantt chart. Figure 5.2, the milestone chart, illustrates the length of time expected for completion of each step of the project.

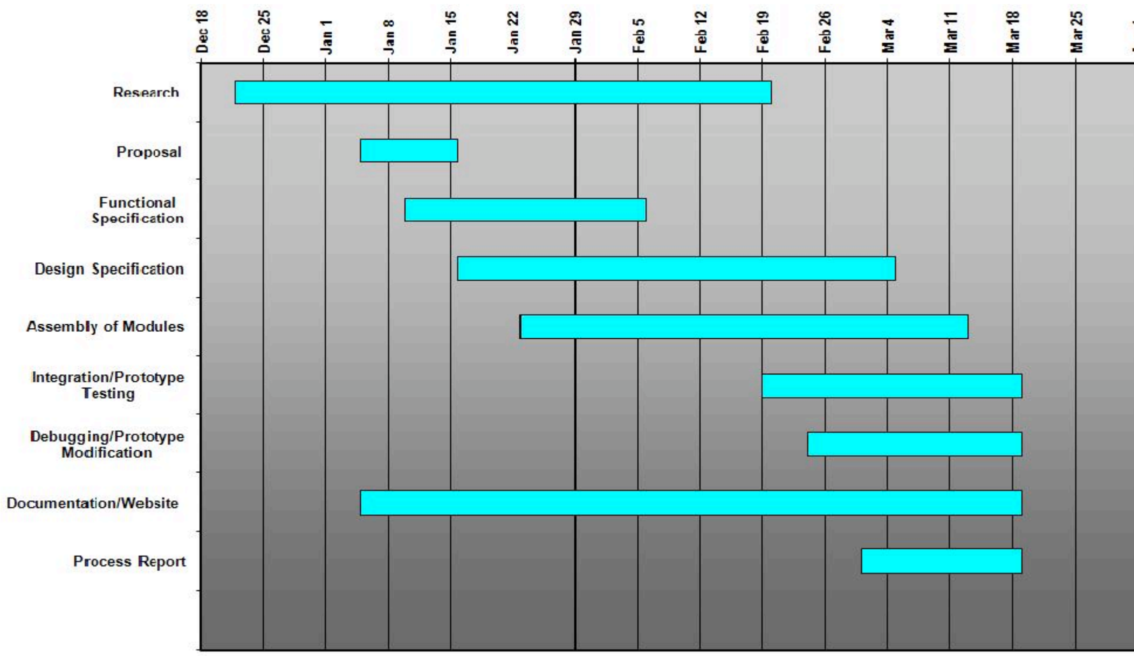

Figure 5.1: Gantt Chart

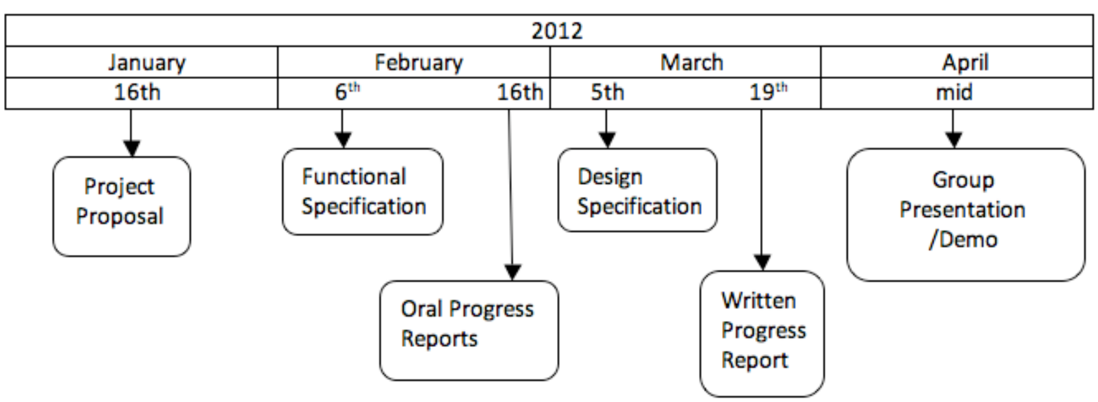

Figure 5.2: Milestone Chart

6. Team Organization

Century Solutions is composed of five talented engineers: Ashish Agarwal, Richard Cho, Mahsa Dabirvaziri, Paven Loodu, and Alysha Sue. All members are in their final years of completing their engineering undergraduate degree at Simon Fraser University. The group contains of a diverse range of specialized engineers. This variety allows each member to bring their own talents, specialties, and knowledge to the company. Below is a brief description of each member and their area of expertise.

Ashish Agarwal – Chief Executive Officer
Ashish is a fourth year Computer Engineering student at Simon Fraser University. He has completed a number of technical internships in the last two years –at Google Summer of Code, at Research in Motion, and Shell Canada. He also has experience in designing apps for the BlackBerry and iOS platforms. He is skilled in C/C++, Java, Objective-C and in a number of scripting languages. In his spare time he plays video games and is also learning salsa.

Alysha Sue – Chief Operating Officer
Alysha is a fourth year Systems Engineering student at Simon Fraser University. She has experience with C++ and VHDL, as well as with creating circuits and basic lab equipment. She has worked as a software test developer at Sierra Wireless. During her time at Sierra Wireless, she gained valuable experience about network technologies and she learned how to work as part of a team. Alysha has excellent communication skills and outstanding organization skills.

Richard Cho – Chief Technology Officer
Richard Cho is a fourth year Electronics Engineering student at Simon Fraser University with previous co-op terms at Research In Motion (RIM). At RIM, he worked as a field test specialist, performing network compatibility tests in CDMA network. While working at RIM he developed a strong interest in wireless technology. Richard also has experience in C++ and C, as well as VHDL and assembly language. He is a self-driven individual who also excels in a team environment.

Paven Loodu – Chief Financial Officer
Paven is a third year Electronics Engineer student at Simon Fraser University. He has done four month co-op terms at Honeywell International and the Communications Security Establishment of Canada (CSEC). During these work terms, he has gained valuable experience in working within a team at Honeywell

and became more familiar with hardware design at CSEC. Paven is familiar with electronic circuits as well as VHDL. He also has good soldering skills.

Mahsa Dabirvaziri – Chief Information Officer
Mahsa is a fifth year Systems Engineering student at Simon Fraser University. She worked in the electrical department of Industrial Projects Management of Iran (IPMI) as an Engineer. Also, she worked for Clarus Educational Centre as a tutor. Tutoring has improved her teaching and communication skills. Additionally, she is familiar with DOS, UNIX/Linux, and Windows operating environments. She has experience with Microsoft Word, Excel, PowerPoint, SolidWorks, and AutoCAD. Also, she is an intermediate user of C, C++, Java, MatLab, and Visual Basic programming. Furthermore, she is competent with basic lab equipment such as oscilloscopes, DMMs, power supplies, and function generators.

7. Conclusion

Fall Assist will give seniors back their independence and ability to live alone. It will eliminate the fear of falling with its affordable and automatic design. With *Fall Assist*, users will be able to receive the quick help that they need after a fall. It will reduce the time between the fall and help and consequently reduce the severity of the injuries sustained in the fall.

Our proposed design will detect a fall and alert an emergency contact – such as a relative, friend, neighbour or social worker – via phone call or text message that their assistance is needed immediately. The device will prevent false calls to the emergency contact by ensuring that false positives are recognized as false alarms and the alert will not be triggered.

Century Solutions is dedicated to reducing the time that elderly people spend waiting for help to arrive after they have fallen. We want to ensure that help is brought to those in need especially when they are unable to call for it themselves. The Gantt and Milestone charts, seen above, illustrate that we will be able to complete this project on time. We have proposed a plan of action that will ensure that this goal is met and that seniors get their independence back.

8. Sources and References

[1] Israel Gannot, Ramat-HaSharon, Dimitry Litvak, Tel-Aviv, Yaniv Zigel. "System for Automatic Fall detection For elderly People". U.S. Patent 0224925, Sept. 10, 2009

[2] "Falls Among Older Adults: An Overview" Internet: http://www.cdc.gov/homeandrecreationalsafety/falls/adultfalls.html, Sept. 16, 2011 [Jan. 12, 2012].

[3] "An Eventful Week for Seniors' Fall Prevention" Internet: http://www.seniorsbc.ca/stayingindependent/fallpreventionresources/awareness.html [Jan. 15, 2012]

[4] "Fall Prevention" Internet: http://www.injuryresearch.bc.ca/categorypages.aspx?catid=1&subcatid=7 [Jan. 12, 2012]