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January 19, 1999

Dr. Andrew Rawicz
School of Engineering Science
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Re: ENSC 370 Project Proposal for a Physiological Signal Data Logger

Dear Dr. Rawicz,

The attached document, *Proposal for a Physiological Signal Data Logger,* briefly outlines our project for ENSC 370. Our project is to design a signal data logger for the **Living Laboratory**, a joint venture between SFU and BCIT. This device is to be used as a part of the Living Laboratory to record various physiological data during a study session.

We are proposing to design and fabricate a portable signal data logger that is capable of monitoring and recording of 16 different input signal simultaneously. The data logger is programmed through a personal computer with a software tool. After recording, the data collected will be transferred to a PC and analyzed. This proposal includes our team organization, a preliminary schedule, a proposed budget and our source of funding, and an overview of our system

Versatile Innovations consists of four third-year engineering students – Fiona Chan, Karen Chan, Andy Jien, and Sean Shieh. If you have any questions or concerns, feel free to contact Andy Jien at 420-0782 or yjien@sfu.ca.

Sincerely,

Andy Jien, Chairperson
Versatile Innovations

Enclosure: *Proposal for a Physiological Signal Data Logger*

VERSATILE INNOVATIONS

Proposal for a Physiological Data Signal Logger

Submitted by:	Versatile Innovations Fiona Chan, Karen Chan, Andy Jien, Sean Shieh
Contact:	Andy Jien School of Engineering Science Simon Fraser University yjien@sfu.ca
Submitted to:	Andrew Rawicz School of Engineering Science Simon Fraser University Ivan Li Project Leader Health Applied Research and Development Technology Centre Steve Whitmore School of Engineering Science Simon Fraser University
Date:	January 19, 1999

Executive Summary

In any scientific study, the analysis obtained from data is crucial to the success of the experiment. In many experiments, data are obtained from signals of various sources. For example, meteorological experiments often need weather information from remote locations. The reliability and capability of the data-recording device play important roles in obtaining raw data. In many life science fields like medicine and kinesiology, subject being studied such as brainwave often emits signals that are hard to measure. Moreover, the signals from various sensors sometimes have drastically different characteristics. Data loggers for these signals have to be differentiated from other industrial standard data loggers.

Living Laboratory is a human factor research facility. It is a join venture between Simon Fraser University (SFU) and British Columbia Institute of Technology (BCIT). In the study of human factors, dozens of conditions of a human body are often being monitored at the same time. Dr. James Watzke is the Project Leader of the Living Lab. Through a presentation during our lecture time, Dr. Watzke reveals their need for a signal data logger to facilitate the study of human factor. After meeting with the project leader of the Living Lab, Mr. Ivan, Li, we agreed to design a signal data logger to meet their demand.

We propose to develop a signal data logger system that will solve the problems that the Living Lab is currently facing. Data loggers from various manufacturers are available commercially. Nevertheless, many loggers in the market do not offer the functions desired by the Living Lab. Moreover, many of the existing products are not engineered to record physiological signals. Our signal data logging system will be specially designed with the needs of the Living Lab in consideration.

We are Versatile Innovations, a team consists of four third year engineering science students. We propose to develop the system with a $2500 budget. The Living Laboratory will be the main source of funding for materials necessary for construction of our first functional prototype. Such a prototype for the signal data logger is scheduled for completion by April 6, 1998.

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List of Figures and Tables

Introduction

The Living Laboratory is a joint venture between SFU and BCIT that concentrates on human factors research. The main goal of this research is to improve the relationship between people and their daily living and working environments. The Living Laboratory's research focuses on the study of people's interaction with devices, environmental features, and assistive technology.

Currently, the Living Laboratory is having difficulties collecting physiological signals (blood pressure, muscle activities, nerve stimulation, etc.) for further research. The researches require a lightweight portable device that is able to collect and store these physiological data collected. The commercially available signal data loggers do not meet their requirements in size, price, and functionality.

Mr. Ivan Li and Dr. James Watzke presented us with this problem and asked for our help. We feel that this Physiological Signal Data Logger has the potential to become a great product. Such a device can greatly assist physiological research, which will bring forth improvements to our lives.

This document is a proposal providing an overview of our project, a brief system overview, a proposed budget and source of funding, sources of information and our team organization. Also included with this document are a preliminary Gantt chart and a milestone chart, which includes all the deadlines for documentation.

System Overview

Users

In the lab, both the research staff and the test subjects will both use the signal data logger. On one hand, research staff will configure the device as well as analyze the information collected by the logger. On the other hand, test subjects will wear the data logger during a lab session. Our goal is to develop a system that provides both types of users with all the necessary components.

Operating modes

The signal data logger operates in three different modes: Configuration, Logging, and Upload.

In Configuration Mode, the system allows the users to program the device. Specifications related to the data logging can be specified and recorded onto the device under this mode. Examples of such specifications are signal types (signal for EEG, EMG, pressure sensors, etc.), clock, recording time, duration, and signal resolution.

In Logging Mode, the device receives signals from its inputs and records the data in storage. Moreover, users can control as well as monitor the status of the device in Logging Mode.

The third operating mode of the physiological signal data logger is Upload Mode. Under this mode of operation, data stored in the device can be ported to a personal computer. Users can then perform analysis with the information gathered.

With these three modes, the system allows users to collect data. A typical trial utilizes these three modes sequentially. Users first setup the device in Configuration Mode. After the device is properly configured and tested, it can then start to record data in Logging Mode. Upon the completion of data collection, the data can then be uploaded for further analysis. After the data has been transferred from the signal data logger to a computer, the device is available for a recording session of either the same arrangement or a new configuration. The following figure illustrates the life cycle of the system under typical usage.

Figure 1 Typical activities of the system

After introducing the three modes of operations, we can discuss the different overviews of the system under the three modes.

Configuration Mode

In Configuration mode, the signal data logger is connected to a personal computer. Users can configure the device with the software tool included in the system. The figure below is a system overview under Configuration mode.

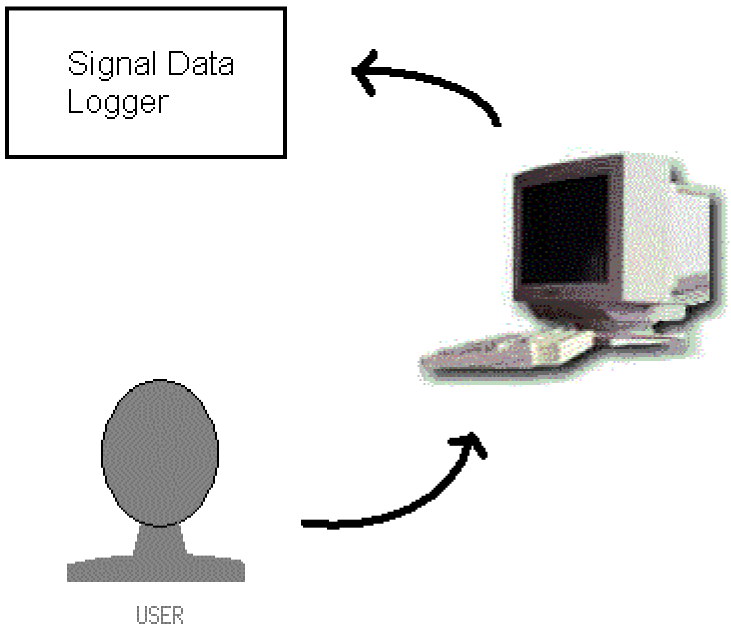

Figure 2 Configuration mode

Logging Mode

In Logging Mode, the device is connected to one or more signal source. Although the users cannot configure the signal logger in this mode, they have the options of resetting, pausing, resuming, and stopping the device. The built-in display on the data logger also provides feed backs to the users on the status. Different types of information are available in this mode. Some examples are battery condition, recording progress, and storage capacity. Figure 3 is a representation of the system in Logging Mode.

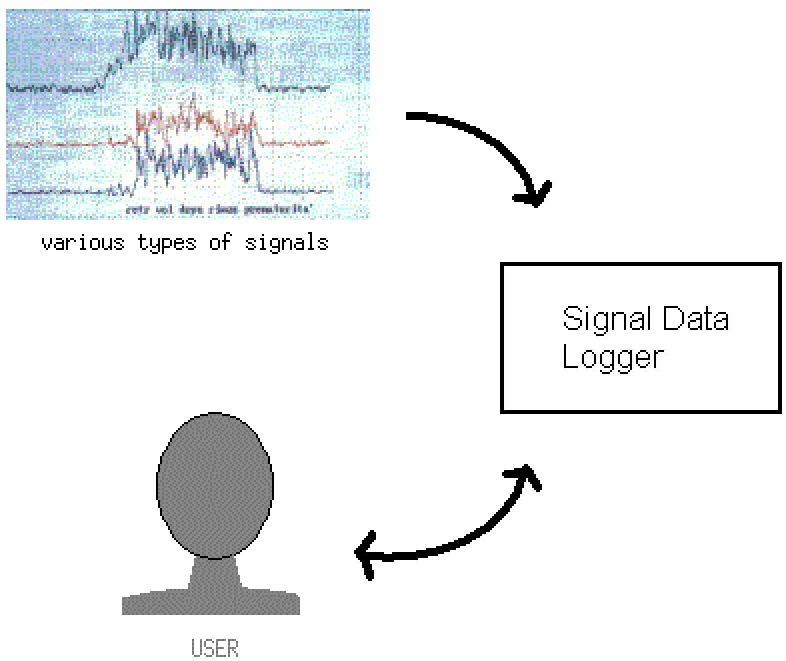

Figure 3 Logging mode

Upload Mode

After the logging session ends, users can transfer the data stored in the logger to a personal computer for analysis or storage. To achieve this, the device will be connected to the personal computer (similar setup as in Configuration Mode). Using the software tool developed by Versatile Innovations, the users can upload the data from the logger to the PC. In this mode, the system resembles that of Configuration Mode. However, instead of "downloading" programs from the PC to the logger, information is uploaded to the PC. The next figure (Figure 4) is an overview of the system under such mode.

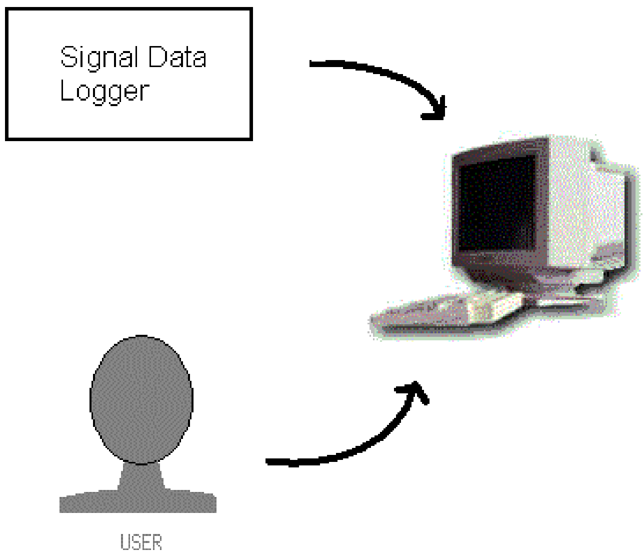

Figure 4 Upload mode

Sources of Information

In order to achieve the objective of the project, we will get information from a variety of sources. One of the main sources would be technical literature of the relevant fields. Also, Internet is another source of information. Due to the popularity of the web, many companies have marketed similar devices on the web. By analyzing the advantages and disadvantages of the existing data logger, we have a greater opportunity in designing a physiological signal data logger that is both high in quality and reasonable in price.

In addition, people in the Living Laboratory and the Department of Kinesiology can provide us with their expertise in the biomedical field. Dr. James Watzke, an expert in gerontology and psychology, can provide us with input to the user-interface of our device. We are also looking into the possibility of borrowing the necessary bioelectrodes from the Department of Kinesiology at SFU.

Budget

Table 1 shows our proposed budget for this project.

Table 1 Proposed budget

Required Components	Estimated Cost ($)
Microcontroller(s)	150
Prototype Board(s)	100
Memory Storage Device	200
Casing	140
Power Supply	120
LCD Display	100
A/D Converter(s)[1]	250
Data Acquisition Card	900
Miscellaneous	250
Total Cost	2210

Funding

Since our project team works in collaboration with the Living Laboratory to develop this Physiological Signal Data Logger, our major source of funding is from the Living Laboratory. Funding will be provided by the Living Laboratory on the basis that we only purchase the necessary components for this project.

[1] Might not be necessary for this project

Schedule

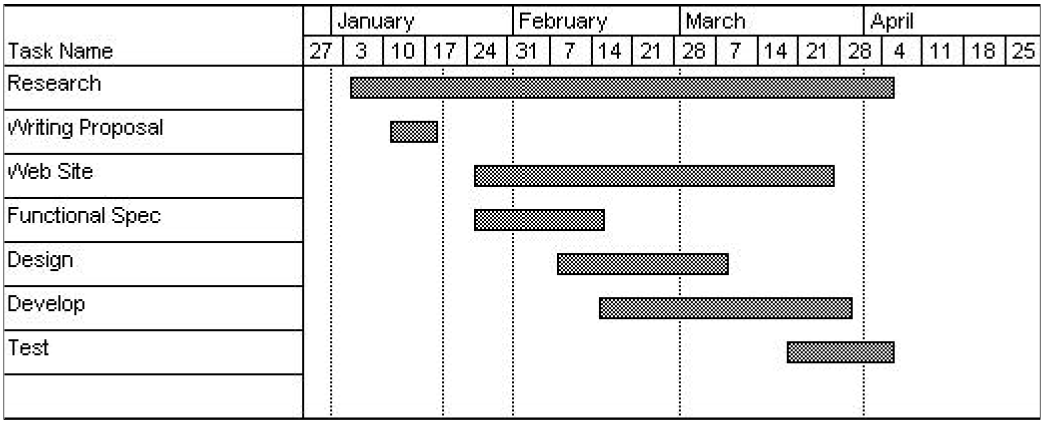

Figure 5 Project Gantt chart

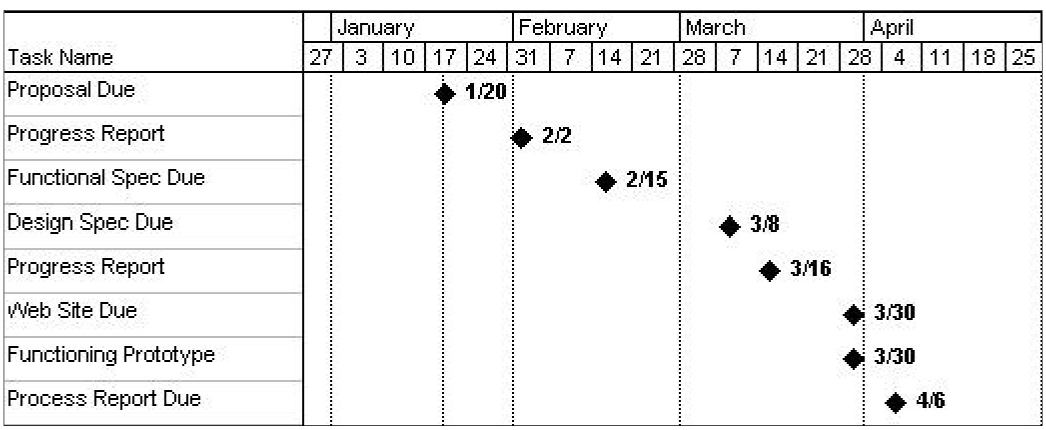

Figure 4 Project milestone chart

Team Organization

The project team consists of four innovative, enthusiastic, and intelligent people —Andy Jien, Fiona Chan, Karen Chan and Sean Shieh. We are all third year engineering students with at least one work term experience. Please refer to the resumes in the appendix for our individual skills and experience.

Besides the technical tasks assigned to each member during the team meetings, each member has an administrative responsibility so as to maximize productivity. Andy Jien, the contact person, is in charge of chairing team meetings. Sean Shieh is responsible for taking minutes during meetings and keeping track of the progress of each member to ensure all the deadlines are met. Karen Chan is in charge of the inventory and budget. Fiona Chan is responsible for maintaining a positive atmosphere within the group.

A team consists of different individuals, so effective communication is necessary. We have meetings twice a week to discuss the progress of each member's tasks and to update future plans for the project. A meeting minute is given as a record to the plans set during the meeting. A brief weekly report, submitted by each member every Friday, allows each member to summarize his or her own achievement during the week. This is to provide each member in the team a basic understanding of the project progress.

We treasure group dynamics. During group meetings, everybody is encouraged to express ideas and listen to suggestions and criticisms. Once an action item is brought up, action will not be passed until a mutual consensus is reached. This way, harmony among team members can be ensured.

This project very challenging to a group of four. As team working is a crucial element in this project course, it is also our best tool to overcome the challenges. We are certain of the success of this project and its contribution to the human factors research.

Conclusion

Versatile Innovations is dedicated to the proposed physiological signal data logger. We strongly believe this device will benefit researches in the area of human performance, ergonomics and occupational health and safety. While our solution to signal data logging is superior to that in the market, we also ensure the cost of the device to be reasonable. We are confident that we can fabricate a working prototype by April 6, 1999.

References

Ivan Li, *Acting Director, Health Applied Research and Development, Technology Centre, BCIT*
private conversation

Andrew Rawicz, *Professor, School of Engineering Science, Simon Fraser University*
private conversation

BCIT Technology Center Home, http://www.bcit.bc.ca/~hard

Glossary

EEG

Electroencephalogram. A diagnostic test which measures the electrical activity of the brain (brain waves) using high sensitive recording equipment attached to the scalp by fine electrodes.

EMG

Electromyography. A test which measures muscle response to nerve stimulation. Used to evaluate muscle weakness and to determine if the weakness is related to the muscles themselves or a problem with the nerves that supply the muscles

Appendix

Resumes