REMOTE MEDICAL INC.

School of Engineering Science
Simon Fraser University
Burnaby, BC, V5A 1S6
ensc440-rabbit@sfu.ca

January 25th, 2005

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

RE: ENSC 440 Project Proposal for a Remotely Controlled Health Monitoring System Through Internet

Dear Lucky,

The prevalence of individuals with chronic illness is growing at an astonishing rate. This growth resulted in overloaded health-care systems and revealed the deficiencies in the delivery of care to patients with chronic illness. Our project is to help manage chronic disease effectively, which help in reducing the rate of inpatient hospitalization, the number of physician office visits, and medical costs. It also allows patients to stay at home enjoying independence and better quality of life while being closely monitored by the physicians. The attached document outlines our project idea for ENSC 440.

The proposal provides an overview of our project, which discusses design approaches, a tentative plan for funding, budget, scheduling as well as a detailed explanation of our team organization.

Remote Medical Inc. consists of four experienced and enthusiastic 3rd and 4th year engineering students: Dong Zhang, Calvin Che, Marian Chang, and Lotus Yi. If you have any questions or concerns, please feel free to contact us through the email at ensc440-rabbit@sfu.ca.

Sincerely,

Lotus Yi

Lotus Yi
Chief Executive Officer
Remote Medical Inc.

Enclosure: *Proposal for Remote Health Monitor*

REMOTE MEDICAL INC.

Proposal for
Remote Health Monitor

Project Team: Marian Chang
Calvin Che
Lotus Yi
Dong Zhang

Contact Person: Lotus Yi
ensc440-rabbit@sfu.ca

Submitted to: Lucky One – ENSC 440
Mike Sjoerdsma – ENSC 305
School of Engineering
Simon Fraser University

Issued Date: January 25, 2005

EXECUTIVE SUMMARY

Management of patients with chronic conditions is a long-standing challenge for health care organizations. These conditions include diabetes, chronic heart failure, Asthma, HIV / AIDS, and cancer. Patients are required to adopt lifelong diet and drug control to maintain optimal health and avoid the complications of the disease. These complications can arise suddenly and can be life threatening. Therefore, patients with chronic diseases should be monitored constantly.

We propose to implement the monitoring into a single stationary device that collects data for physicians via internet connections. Our solution, Remote Health Monitor (RHM), measures a patient's medical conditions and sends the measurements to the hospital database. The design of a stationary device ensures consistency of environmental under which measurements are taken. The database can be accessed either by the physicians or patients with specific login identifications to keep information confidential.

Our major competitor is a device manufactured by Philips [1]. The Telemonitoring Services transmits information through the telephone system, and requires physicians to phone patients for discussion of their health conditions. This would require the patients to be available at the time the physicians want to make phone calls thus induces inconvenience. However, with RHM, patients can access their own medical history whenever they want, and appointments can be made when doctors examine undesirable measurements.

Remote Medical is comprised of four senior engineering science students with experience in analog and digital circuit design, programming of GUI interface, wireless communication, and database implementation.

This document proposes a 10-week engineering cycle for the completion of our project, encompassing the research, development, implementation, integration, and demonstration of RHM. We carefully select functionalities to be implemented into our device that will prove to be most economical and realizable within the proposed timeline. The development of RHM prototype will cost $585, and funding will be obtained through sources such as Engineering Science Student Endowment Fund (ESSEF).

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1. INTRODUCTION

Today, chronic disease is among the most common and costly of all health problems. Seven of every ten people in North America who die each year die of a chronic disease. Chronic disease develops slowly, and usually lasts for a lifetime [2]. The long-term effects are difficult to predict, and some conditions cause new problems. To control or manage the chronic diseases, frequent monitoring leading to more accurate diagnose is essential.

One of the chronic diseases, diabetes, affects 30 million people worldwide and is one of the leading causes of death in Canada. Researches show that two million Canadians live with diabetes today and more than three million Canadians will develop diabetes by 2010 [2]. Because of the limited health care resources, we believe that there will be a demand for the internet-based chronic disease management service.

Our objective is to create a link between patient and caregiver that enables patients to supply a steady stream of valuable health information. For example, diabetics can report their blood glucose readings and creates a history in the hospital database, which caregivers can use to evaluate the impact of a therapy or the need for a different treatment. Conversely, caregivers can provide their patients with information and feedback on the management of their disease. Therefore, by using this system, patients can gain more control and understanding of their disease while living at home. Research shows that being able to stay at home instead of in the hospital helps patients reduce depression and obtain a better quality of life [2]. With Remote Health Monitor (RHM) installed, chronic patients can minimize their hospital visits that on average cost 35.6 dollars per visit and receive an adequate health care at home [3].

The goal of RHM is to collect a patient's health data and manage them in a low cost, scaleable, and user-friendly fashion. Patients can be monitored from anywhere that has Internet access. The RHM measures parameters such as temperature, pulse, weight, blood pressure, and blood glucose. It then transmits the readings to the hospital's database through Internet for health care professionals to monitor and interpret a patient's health condition. Patients can also access their personal clinical information to gain awareness of activities that affect their health. When their health condition falls outside of preset limits, physician will call the patients immediately to discuss a resolution thus increasing the interaction between the patients and the physicians. With these health care advantages and an increase of chronic patients in our society, RHM will become the leading product in the medical supply market.

The proposal provides an overview of our project, which discusses design approaches, a tentative plan for funding, budget, scheduling as well as a detailed explanation of our team organization.

2. SYSTEM OVERVIEW

Figure 1 shows the high level structure of the system. The database server is located in the hospital; the Rabbit 2000 and measuring devices are installed in the patient's house; the user access can be done from any PC that have the client software installed, and can be logged in as doctor or patient mode.

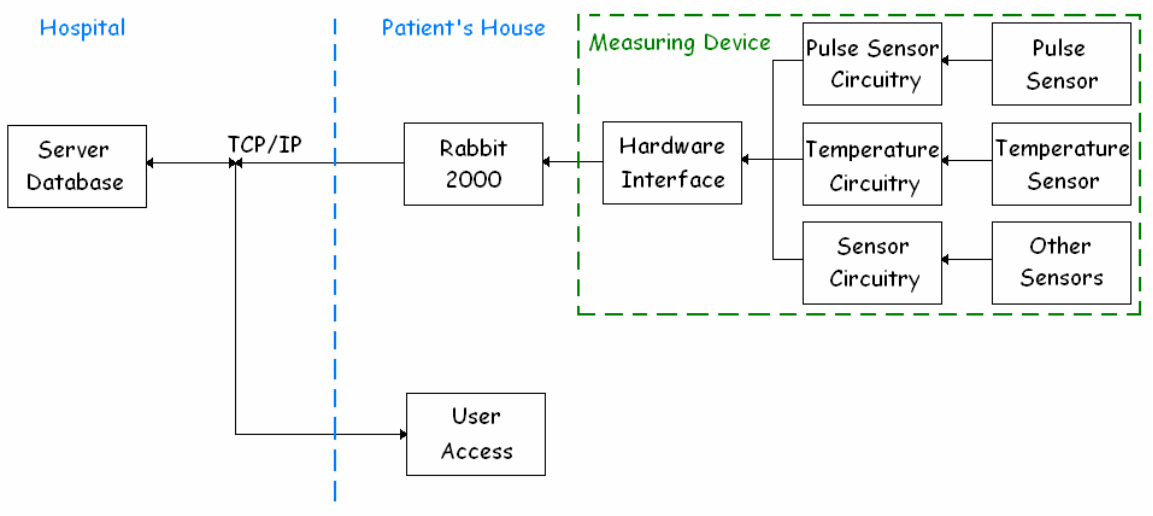


Figure 1: System Block Diagram

Figure 2 presents the basic functionality of RHM in a graphical manner.

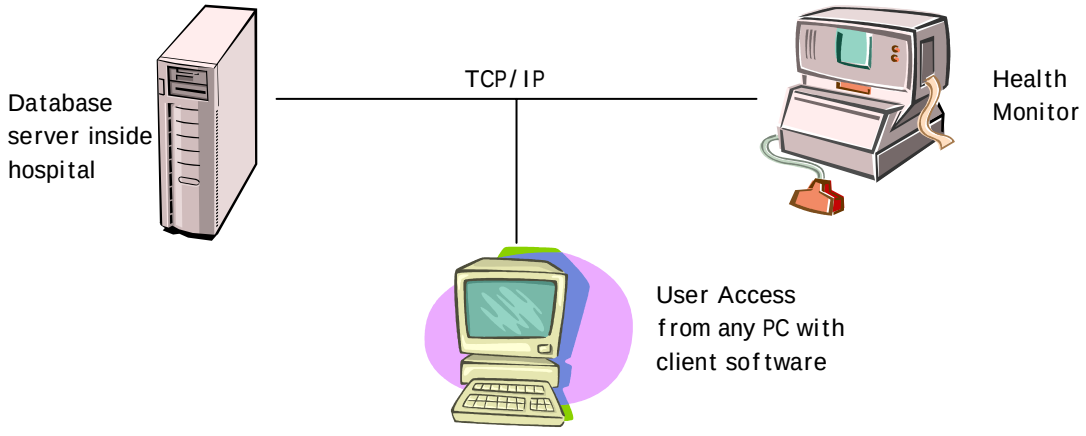


Figure 2: Graphical Diagram of the System

3. POSSIBLE DESIGN SOLUTIONS

3.1 Health Monitoring Devices Connecting to the Internet (Wired)

In this solution, a monitoring unit automatically collects data or readings from the health monitor. It then transmits the data through a cable or standard telephone line without interrupting normal telephone usage. The data is organized in a database where both the physician and the patient have the access for monitoring and feedback.

3.2 Health Monitoring Devices Connecting to the Internet (Wireless)

The wireless system is similar to the solution mentioned above except that the monitoring unit is wirelessly connected to the Internet. It adds the mobility to the system so that patients can take the measurements anywhere in the house. However, wireless technology will add expense to the device. More importantly, consistency of the obtained data can be affected by environmental conditions or various activities the patients undertake at the moment thus making the interpretation of data difficult for physicians.

3.3 Conference Talk with your Physician

Patients are required to take measurements and organize the data by themselves. Then, the physicians and patients have regular conference talk through phone calls to keep track of the therapies and the patients' health conditions. With this solution, patients must be motivated and organized. Since physicians can only provide feedback upon the conference talk, immediate notifications of unreasonable data sometimes are not available.

3.4 Disease Management Using a Website

Health care organization can develop a website with simple questionnaires to obtain a patient's health data. Patients again are required to take the measurements and then enter the data by themselves. Basic computer skills are required. Also, due to the manual entry, data is more prone to error. In addition, the complexity of this approach induces burden on patients, and thus discouraging them from utilizing it.

3.5 Meeting with your Physician Online

Just like visiting your physician's office. The patient and the physician can have a face-to-face communication through the Internet by the utilization of web cameras. The cost of this solution is more expensive than the others. Patients still have to take the measurements by themselves and report the data to their physicians in the meeting.

4. PROPOSED DESIGN SOLUTIONS

Our proposed solution to the limited medical services is to build the Remote Health Monitor (RHM), which monitors a patient's medical conditions and sends the measurements to the database installed in hospital computers. RHM transmits data via Internet connection; therefore, not only doctors can exam the current status of the patient, but also the patients can log onto the system and review their own medical history.

A remote health monitoring system is realizable in the sense that some similar wireless products that transmit data through phone lines exist – Philips' Telemonitoring Services. However, the Telemonitoring Service requires patients to phone the care provider to access information about their health condition, which usually results in long waiting time due to the limited number of physicians. With RHM, patients will each have a unique identification and password to access their own profile online.

Due to the restricted timeline and funding, we limit our scope to implement only two measuring functions – body temperature and heart rate. However, additional functions such as blood glucose level and blood pressure can be built if more time is permitted. Moreover, installation of a web camera would allow doctors to examine and talk to patients who have difficulty going to the hospital on a frequent basis.

More functionality can be implemented into our device; however, for our ENSC 440 project we limit ourselves to two functionalities to ensure completion within the proposed deadline.

5. SOURCE OF INFORMATION

Our project research will consist of, but not limited to, sources such as chronic disease research literature, medical publications, electrical component specifications, circuit design textbooks, and various Internet resources.

Much of the statistical data on the shortage of medical supplies are obtained from Statistics Canada. Publications devoted to the research of chronic patients found via scholar.google.com are useful in determining patients' needs.

In designing the hardware components of the system, we also seek the help from Dr. Albert Leung and Dr. Ash Parameswaran from the Engineering Science Department of Simon Fraser University. Both of them are expert in the design of microelectronic devices, and sensors. They will provide us with the direction to choose appropriate circuit design solutions for our hardware implementation.

Furthermore, we have reviewed all the online documentations for the microcontroller development solution we have chosen, thus providing us with a solid background of efficient software design strategy.

6. BUDGET AND FUNDING

6.1 Budget

Table 1 provides the preliminary budget of each component for the project.

Table 1: Tentative Budget

Components	Estimated Price
Rabbit2000 TCP/IP Development Kit	$250.00
Pulse Sensor	$80.00
Temperature Sensor	$60.00
Breath Sensor	$90.00
Cable/Wires	$25.00
Case	$30.00
USB Serial converter	$50.00
Total Cost	**$585.00**

Since the research and development phase in any product design requires a significant amount of capital. To compensate for any emergent situations that require extra cost during the future development process, we include a 15% head margin in the total cost of the project.

6.2 Funding

We considered many sources of funding; the most applicable organization is ESSEF. According to the information provided on their website, the total funding is 153,040 [4]. Considering the number of groups, we are certain of obtaining the amount of money that we need to implement our device.

After a discussion with our group members, we agree that if the initial funding can not cover the overall project cost, the remaining difference will be equally distributed among the group members to ensure on time completion of the project.

7. SCHEDULE

The expected time for completion of each task is shown on the Gantt chart attached at the end of this document, and the due date for each deliverable is shown in Table 2. The corresponding expected completion date for the various tasks is shown in Figure 3.

Table 2: Due Dates for the Deliverables

Project Deliverables	Due Date
Project Proposal	January 24
Written Progress Report	February 7
Functional Specification	February 21
Design Specification	March 7
Oral Progress Report	Mid-March
Lab Journal / Project File	April
Group Presentation / Demo	April
Post-Mortem	April 2

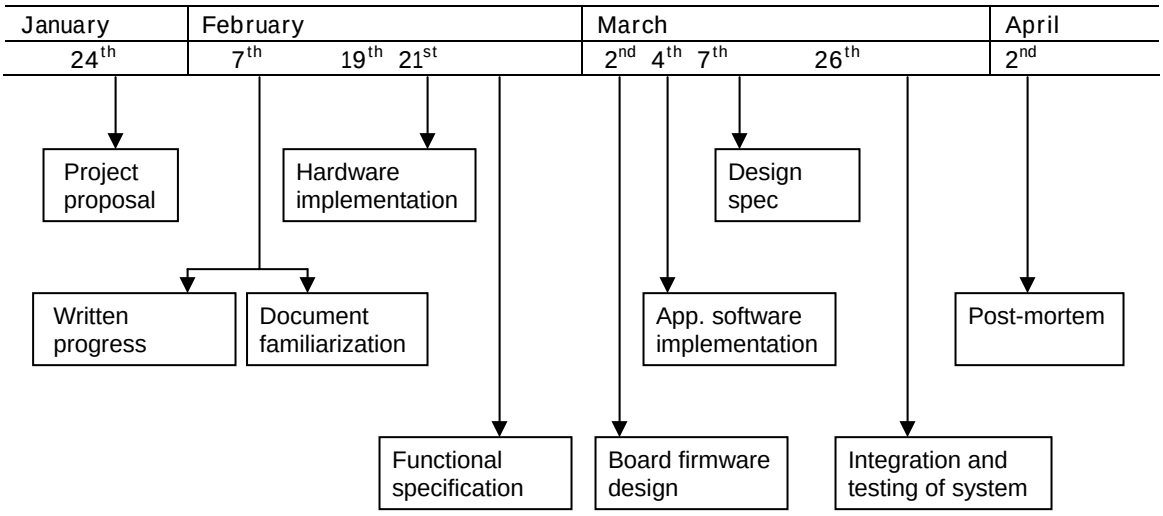


Figure 3: Milestone Chart

8. TEAM ORGANIZATION

Marian Chang

Marian is a fourth year Electronics Engineering student at Simon Fraser University. She is competent with Windows and UNIX operating environments, and structured programming languages such as C/C++, and Java. Through her previous Co-op experience at AcBel Polytech, she acquired skills in hardware quality assurance, and through course work, she gained design experience in digital and analog circuitries. She is motivated by technical challenges, and her organizational skills will help to keep the team focused and unified.

Calvin Che

Calvin is a third year Systems Engineering student at Simon Fraser University. He has a vast interest in programming, and had developed various software and plug-ins as hobbies using Visual Basic, C/C++, and Java. He is especially experienced in GUI programming using Windows API, which is useful for writing the client software that access the database and analyze the data. Other programming experience includes OpenGL and various install scripts. He also has knowledge of electric circuit design, which is also useful for the hardware section of this project.

Lotus Yi

Lotus is currently a final year Electronics Engineering student at Simon Fraser University. Throughout her courses of study, she has developed a keen interest and a strong knowledge in the field of telecommunication. In this project, she is responsible for the firmware part. In addition, she has previously worked in a cordless phone company as a hardware technologist; therefore, she can also help with the hardware implementation. With her practical experience and great interpersonal skills, she can keep our team motivated.

Dong Zhang

Dong is currently a third year Computer Engineering student at Simon Fraser University. Personally, he is interested in programming; in the past few years, he completed several software projects using Java, C/C++, DirectX, OpenGL either for school project or leisure. He is also equipped with hardware design abilities. Even though he is responsible for the software part, his knowledge accumulated through electronics design courses will allow him to work on the hardware implementation as well. Above all, he is a team player, making him easy to work with even under stressful conditions.

9. CONCLUSION

Remote Medical Inc. is dedicated to creating a cost effect way to reduce the burden of disease and increase the quality of life for patients. Our flagship product, the Remote Health Monitor (RHM), provides a link between patient and caregiver that enables a transfer of medical data without the hassle of face-to-face meeting, manual data recording, and traveling. Our commitment is to bring convenience to patients who are not required to be hospitalized but still obligated to constant monitoring from the doctors. As a medical product company, we emphasize on the accuracy of our product, as well as the price performance ratio, which allow our customers possess a versatile yet affordable medical care. As Remote Medical engineers, our mission is to develop the most reliable product through intensive research and development process.

The Gantt chart and milestone chart exhibit the capability of our company in finishing the project with the given time frame. We will strictly follow the development paradigms to ensure the efficiency of the development process and the accuracy of our product, which are crucial factors for a medical company to survive in a competitive market.

10. SOURCES AND REFERENCES

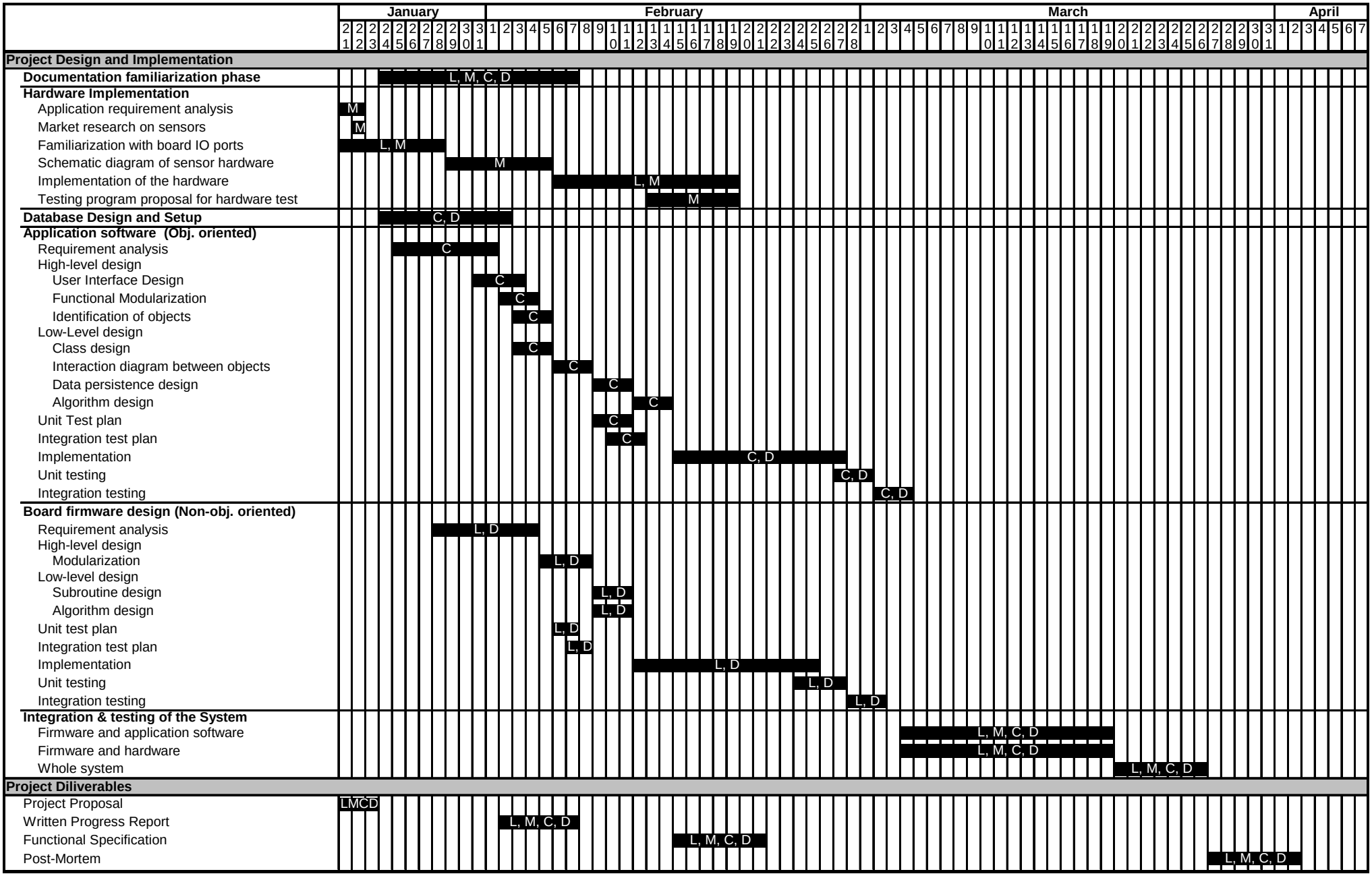
[1] Phillips telemonitoring services, “Blood pressure & pulse measurement device,” 2005, http://www.medical.philips.com/main/products/telemonitoring/products/blood_pressure/.

[2] S. Jolley, “Web-enabled chronic disease management solutions,” November 2000, http://www.ehcca.com/presentations/symposiums/Jolley.pdf.

[3] Statistics Canada, “Average payment per medical care service, by category of service,” January 2005, http://www.statcan.ca/english/Pgdb/health17.htm.

[4] Engineering Undergraduate Student Society, “Engineering science student endowment fund,” 2002, http://www.ensc.sfu.ca/undergrad/euss/essef/index.html.

APPENDIX A GANTT CHART



Legend: L - Lotus Yi M - Marian Chang C - Calvin Che D - Dong Zhang