eart Guard Technologies

SEPTEMBER 24, 2007

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

RE: ENSC 440 PROJECT PROPOSAL FOR PORTABLE HEART RATE MONITOR

Dear Dr. Rawicz,

The attached document provides preliminary overview of our ENSC 440 project. The goal of our product is to assist lifeguards in rescue situations by monitoring the victims pulse rate.

This document provides an overview of the system and why it is advantageous for use in the field. In addition, an outline of the budget, project schedule, funding, and a description of previous designs of similar products are included.

Heart Guard Technologies consists of 4 talented engineering students: Bryan Schurko, Stephen Czerniej, John Azer, and Vahid Shababi. Our members stem from various disciplines including electrical, computer, systems, and biomedical engineering. With our diverse knowledge in engineering, we believe our team is capable of completing this project successfully and on time. We can be reached by telephone at 604-817-0036 or at email bn3@sfu.ca.

Sincerely,

Bryan Schurko
Chief Executive Officer

ENCLOSED: PROPOSAL FOR HEART GUARD PORTABLE HEART RATE MONITOR

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INTRODUCTION

When it comes to medical rescue situations, the most important aspect in treating the victim is timely assistance. This is why we at Heart Guard Technologies know that our portable heart rate monitor "Heart Guard" will be an incredible asset to professions such as lifeguards, paramedics, and firemen. With every second counting, we hope that the time wasted on checking the victims pulse will be alleviated by Heart Guard. With the advancement of technology, it is now possible to build a device like this to help the injured. We at Heart Guard Technologies plan to provide the medical rescue community with a product that will advance the lifesaving community to a new level never seen before.

The primary goal of the Heart Guard portable heart rate monitor is to measure a victims pulse in chaotic situations. Since the product will be used in various environments and situations, the following aspects will be considered in the design phase.

- Waterproof and robust enclosure
- Internal re-chargeable battery
- Visual display of heart rate (beats per minute)
- Real-time display of each heart beat
- Low cost for high volume distribution

The Heart Guard portable heart rate monitor will measure the victims pulse rate using a small ear clip similar to those used in hospitals and exercise equipment. The ear clip will measure the pulse rate using infrared light to increase noise immunity. This ear clip will then attach to the handheld reader device via an appropriately sized wire. The reader will display the heart rate information in a clear and simple way to avoid any confusion in a chaotic situation.

Due to the widespread use of pulse sensing equipment used for exercise means, the cost to complete this project will be kept to a minimum. It is hoped that the low cost will allow recreational facilities to purchase multiple devices for each staff member on duty. With these actions taken, the market for a device such as Heart Guard could be very large.

This document is planned to give an outline of our current design for Heart Guard. In addition to our design overview you will find a plan for funding, project scheduling, funding, team overview, and our research resources.

TEAM ORGANIZATION

The Heart Guard Technologies team consists of four talented engineers, who are willing to make a difference in the biomedical field of engineering. The members of the team undertaking the project are:

- Bryan Schurko (5th year Electronics engineering)
- Stephen Czerniej (4th year Systems engineering)
- Vaheed Shababi (5th year Biomedical engineering)
- John Azer (5th year Computer engineering)

All members of the group come from different concentrations in the field of engineering science. This advantage of diversity will enable us to produce a top quality product, since every team member will concentrate in his area of expertise. Bryan Schurko, and Stephen Czernie are professional lifeguards, and have been guarding for several years. Aside from their brilliant engineering background, Bryan and Stephen will use their past experience in life guarding to help outline the exact features needed in the product which would enable the lifeguard performing the rescue to easily determine the pulse.

2.1 CORPORATE STRUCTURE:

Bryan Schurko will act as the President and Chief Executive Officer (CEO), who is responsible for the progress of the project, and resolving any organizational conflicts that may arise throughout the duration of this project. Stephen Czernie will act as the Chief Financial Officer (CFO). Stephen will make sure that the project remains with in the bounds of the preset budget, and seek financial funding if necessary. John Azer will act as the Vice President of Operations. John will study the various technical aspects of this project, and will suggest and resolve technical difficulties experienced throughout the design phase. Vahid Shababi will act as the Vice President of Marketing, who is responsible for marketing our product, to gain capital.

2.2 TEAM MEMBER'S ROLES:

The team has come to a decision of having a rotating chairperson role in the weekly meetings, during the duration of the design of this project. The person, who is to be the chair in an upcoming meeting, will be responsible for preparing an agenda of topics to be discussed during the meeting, as well as assigning tasks appropriately to team members in the meeting. Along with the chairperson, will be a note taker who will carefully write down action items, discussion topics, and conclusions of the meeting. The role of the note taker will also rotate among all group members. Each team meeting will be allotted a certain amount of time, according to the chair's judgment. The chair is to make sure that the group stays on topic, and meetings do not exceed their allotted time. Easier tasks will be assigned to individuals, whereas more difficult tasks will be assigned to partners. In the first meeting, we will discuss a contingency plan, in the case that we run into unexpected situations in the future.

Each member of our team is a creative and ambitious engineer. A few of us have worked together in the past, and have had a great experience. We will work hard, and develop this project, in the hopes that one day we may save a life with heartguard.

COMPANY PROFILE

BRYAN SCHURKO – CHIEF EXECUTE OFFICER (CEO)

Bryan Schurko is a fifth year Electronics Engineering student at Simon Fraser University in his second to last semester. Before coming to SFU, Bryan completed two engineering technology diplomas at BCIT in 'Computer Control' and 'Electrical Power and Industrial Control' with honours. At BCIT, Bryan was responsible for leading a small project for the YVR in ground fault detection. He also completed his first coop term at BC Hydro where he gained experience in project management and project delivery. While going to school, Bryan works as a professional lifeguard for the City of Port Coquitlam. Past experience and diverse education has given Bryan a strong background in people management and technical design that can be used to help Heart Guard Technologies proceed to success.

STEPHEN CZERNIEJ – CHIEF FINANCE OFFICER (CFO)

Steve Czerniej is currently a fourth year Systems Engineering student at Simon Fraser University currently employed as a professional lifeguard for the City of Port Coquitlam. He has programming experience in C with Real Time and Embedded Systems, C++ with data structures and image processing, and Assembly Digital Hardware Code pertaining to HC11 and HC12 FPGA programmable boards. He has used MATLAB, PSPICE and Eagle software in dealing with Signal Processing and micro circuit analysis. He is familiar with the operations of all electronics equipment used in the lab such as oscilloscopes, power supplies, function generators, and digital multi-meters. He thrives in a group environment and is very excited to work with all the other team members.

JOHN AZER –VICE PRESIDENT OF OPERATIONS (VP OPERATIONS)

John Azer is currently a fifth year Computer Engineering student at Simon Fraser University. He has an extensive background in a variety of programming languages such as Java and C++. In previous project courses, He had the chance to learn and follow the software life cycle through group projects. He also has experience with low-level assembly language. He has used assembly language to program a digital alarm clock using the Motorola M68HC12 microcontroller. Aside from his software skills, he also has an extensive knowledge of computer hardware and digital design experience. John has previously done a coop term with Getronics, where he gained excellent troubleshooting skills improved his teamwork and communication skills.

VAHID SHABABI–VICE PRESIDENT OF MARKETING (VP MARKETING)

Vahid Shababi is currently a fifth year Electrical Engineering student at Simon Fraser University. He has a background in business and marketing and he has been working as Marketing director for Darvak Digital Solutions .Vahid will be able to help this team with his research and marketing abilities beside his knowledge in electronic and technical aspects.

System Overview

The main objective of the Heart Guard Detection Device is to be a robust mechanism that finds a pulse signal quickly and accurately on a victim in the water. Figure 4.1 below is the conceptual view and general setup of the Heart Guard Pulse Detector. The detachable ear sensor attaches to the victim's ear lower lobe (lobule) and is then connected to the input of the device console. The system is then switched to the "On" position to detect the victim's pulse and display the pulse rate. The two green LED lights are implemented to show that the system is "On" and whether the Pulse is detected. The seven segment display displays integer values of the pulse rate in the middle of the console. The red LED will light if there is no signal detection.

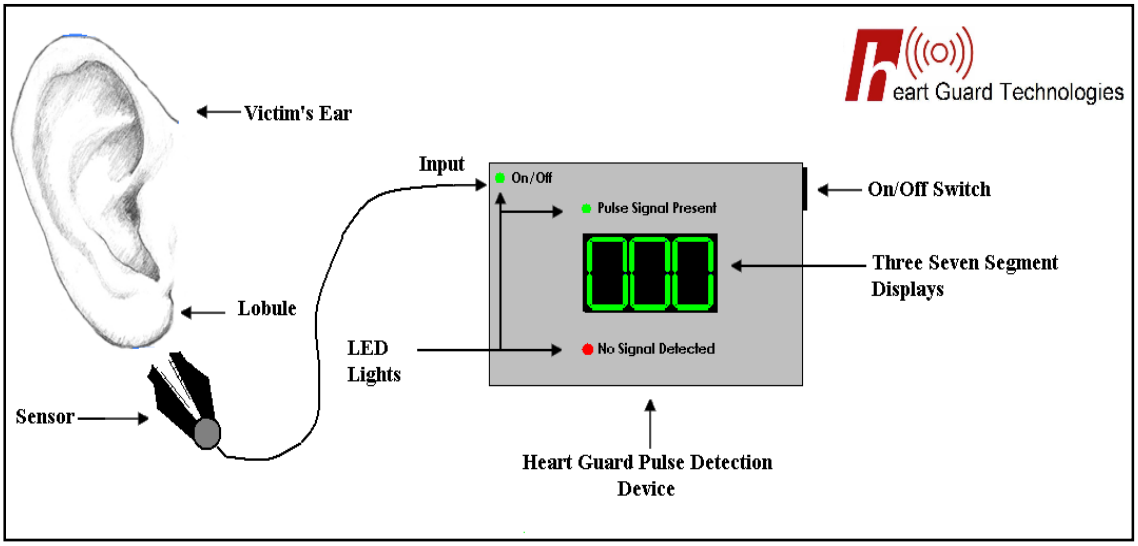

Figure 4.1 – Conceptual Setup View of Heart Guard Pulse Detector

With an easy foolproof display and quick application of the device, a victim's pulse can be effectively detected. The systems process is displayed in the System Block Diagram in Figure 4.2. By viewing the block diagram it is seen that the system is continuous and never ends when activated. This is purposely done to continuously check for a pulse signal due to not having the ear piece attached to the victim or due to dynamic circumstances in the rescue situation present. Triggering the LED is used to show the user if any signal is found at any time. This is a crucial step in the system due to the fact that this is the fast detection initial display of the pulse signal from the victim's ear.

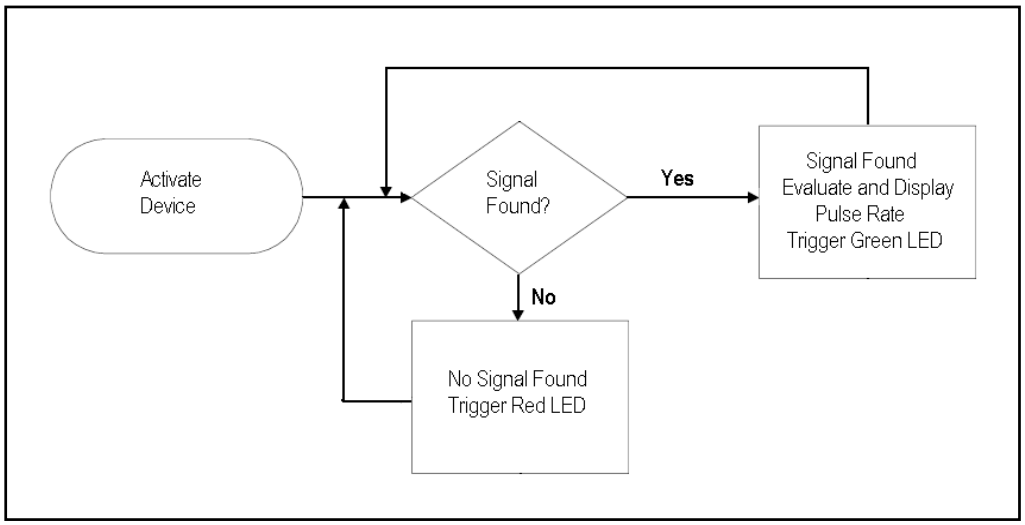

Figure 4.2: System Block Diagram

POSSIBLE DESIGN SOLUTIONS

Currently there are many heart and pulse rate monitors in the market that are targeted for medical and sport monitoring/enhancement markets. These mechanisms range from large rigid complex devices to small hand held devices. In terms of the Aquatics environment involving city and private pools with lifeguards and lifesavers present, there are very few pulse detection methods and devices. These inclusively include finger pulse detection and the Automated External Defibrillator or AED.

5.1. FINGER PULSE DETECTION

Finger pulse detection is a very weak and limited way of detecting pulse. This is done by placing two fingers below the wrist on the thumb line, neck area under chin or the middle of the arm. During body shutdown in an emergency situation, the victim's body will shut down peripherals (arms, legs, hands, feet, etc...) and it is almost impossible to sense a pulse by feel. The neck provides a better pulse strength, but a weak victim can have a very weak pulse undetectable by any person's sense of feeling. In emergency cases, rescuers are nervous and are stressed. This will lead to a error factor when trying to find a slight pulse on a victim's body.

5.2. ARTIFICIAL EXTERNAL DEFIBRILLATOR (AED)

AED devices are portable electronic devices that diagnose potentially life threatening cardiac disorders. They can re-establish a proper heart rhythm by applying electrical therapy in forms of shocks to a victim. The AED needs to have dry leads on two positions on a victim's body to determine whether there is a pulse or any electrical activity occurring in the victim's body. It takes too long for an AED to be set up and applied to a victim by a rescuer to only find a pulse. These devices are sought when a rescuer knows that there is cardiac arrest or cardiac disorders that are stopping the heart from pumping blood properly. In conclusion the AED system is too time consuming for quick pulse detection.

Proposed Design Solution

Our proposed solution is to create a robust, small, submergible pulse detection device that is built up of existing technologies. This combination of existing technologies will create an unheard of device by lifeguards in the field. This device will be very beneficial to not only lifeguards that are employed, but to lifesavers in general in any emergency situation. The Heart Guard can be added to any standard lifesaving or First Aid Kit, and really help any lifesaver with the least of training. The ease and foolproof prospect of the device will let person pick one up and use it easily.

In the current indoor aquatic environment, there is only the Artificial External Defibrillator that can truly find an electrical signal coming from the heart. However, the prolonged and difficult setup proposed us as a group to create a quick easy to use device. With one "On" switch and a clip to a victim's ear, the Heart Guard will display the presence of the pulse quickly and accurately without drying and shaving a person's chest as the AED acquires. This in turn will decrease stress and give the lifesaver or lifeguard a clear vision to continue with the treatment of the victim in the given situation. Lifeguards are susceptible to lawsuits in the matter of improper treatment of a victim in case of causing more damage or improper treatment from what is in National Lifeguarding Service training. This usually happens in time of stress from a situation the lifesaver is currently in. The use of the Heart Guard will propose proper and better treatment of the victim, and will leave less room for error in the treatment of a victim.

Major constraints on this project include a limited timeline to finish the project within thirteen weeks and possible waiting time for the components to arrive from other manufacturers. The sensor, waterproofing components, wires and amplifier all need to be bought and shipped over to one of the group members to start testing and component design and integration.

With the ten remaining weeks left we will construct a somewhat robust and submergible device for testing. With more time a money we can create a finer professional industrial lifesaving device that harnesses all the original qualities that we wanted it to posses. In terms for Ensc 440 we want to finish a working robust version of our proposed design that will work in an aquatic rescue demonstration.

COST ANALYSIS

Table 7.1 provides a preliminary description of the cost for items that will be used to design and build our project. A contingency of 15% is built into the total estimated cost to account for unforeseen parts that will be needed.

Item	Estimated Cost
IR Pulse detector (x2)	$95
LED Display + Chip	$50
Passive Components	$15
PIC Microcontroller	$20
Enclosure	$40
Waterproof Switch	$15
Waterproofing components	$60
Battery + Charger	$30
PCB	$10
Printing Documents	$50
Current Total	$380
Added 15% Contingency	$57
Total	$437

Table 7.1: Preliminary budget and cost

The estimated costs of parts have shipping charges built into them. It should be noted that for the prototyping phase of the project the cost for a single unit will be far lower than expected due to current possession of needed parts.

FUNDING

In terms of designing any prototype, the capital gain required is more than the actual cost of the finished product. We hope and expect to have appropriate funding for this project through funding and possible team member personal contributions.

From the viewing the proposed budget, the cost of the project with a 15% contingency estimate will be $437. This in general is not particularly expensive and in fact will be relatively more inexpensive due to the fact the PIC and PCB are already owned by Heart Guard Technologies. In terms of finding funding for this project we hope to receive funding from the Wighton Development Fund. We hope that this fund can support our project since it is relatively inexpensive and is directed to saving human life.

Our team members accept that we may not be able to generate enough capital to support the entire project through funding. In such circumstances, our team members are willing to share the outstanding financial costs equally. All receipts will be kept by Stephen Czerniej as the Financial Director and proper reimbursement will be returned to the members.

We hope to compete and engineering competitions, contests and conferences such as WECC (Western Engineering Conference and Competition) and other miscellaneous competitions to receive more funding to further advance this project and reimburse the team members.

APPENDIX 1 - GRANT CHART