GIVELIFE Systems

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October 6, 2003

Dr. Andrew Rawicz
School of Engineering Science
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Burnaby, British Columbia
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Re: Functional Specification for an Emergency Response System

Dear Dr. Rawicz

The attached document, *Functional Specification for an Emergency Response System*, lists the functional specifications our ENSC 340 project. We are developing a device that will help people with medical conditions obtain assistance under emergency situations.

The functional specification describes in detail the goals we plan to achieve for this project. The functions of each component of our system, as well as overall system operational specifications, are discussed. The specification provides details of functional specifications for both the prototype development (that will be completed within the timeframe of the course) and a final product version.

GiveLife Systems was formed in September of 2003 by four motivated, innovative, and talented engineering students: Tristen Georgiou, Yang Pan, Hashina Parveen, and Melody Guo. If you have any questions or concerns about our functional specification, please feel free to contact me by phone at (604) 771- 6089 or by e-mail at givelife-systems@sfu.ca.

Sincerely,

Y Pan

Yang Pan
President and CEO
GiveLife Systems, Inc

Enclosure: *Functional Specification for an Emergency Response System*

GIVELIFE
Systems

Functional Specification for an
Emergency Response System

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EXECUTIVE SUMMARY

GiveLife Systems' (GLS) goal is to produce *Intelli-Alert* ™, an emergency response device that can also assist the elderly to monitor their heart rate.

Intelli-Alert ™ consists of pulse sensor, RF sub-system and the base station. The pulse sensor detects pulse in the wrist as blood flows beneath the sensor. The RF sub-system, which consists of a RF transmitter, a transmitting antenna, a receiving antenna and a RF receiver, will be responsible for communicating the signal between the pulse sensor and base station. When the microcontroller detects something goes wrong or when the user pushes the buttons on the wristband, the base station will be activated to call the default number stored in its memory.

This document provides an overview of our system and details the functional requirements of the system hardware, software, and safety.

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1. INTRODUCTION

GiveLife Systems (GLS) will use off-the-shelf sensors, microcontrollers, and wireless technology to develop *Intelli-Alert* ™. The system improves upon existing technology by monitoring and acting upon if necessary, pulse rates from the wrist. As well, use of the device will not require a subscription service, or central monitoring station. The calls will go direct to the source, saving valuable time, and possibly lives.

1.1 Scope

This document outlines the functional specifications of the components required to create *Intelli-Alert* ™. Each component's operation is briefly described and has its necessary and ideal requirements listed. These requirements may change slightly as the design process moves forward to final completion. This document will act as a guideline for product completion by the GLS team.

1.2 Intended Audience

This document is to be used by all members of the GLS team. The engineers will use it as a manual for product completion. Project leaders will use it to assess project progress. Marketing personnel will use it to evaluate the product's position in the market, and even assess what market is should reside within. Finally, patent lawyers will use it to identify any intellectual property that should and can be protected.

1.3 Requirement Notation

The requirements for each component listed within this document are separated into two sections: minimum and ideal. Minimum requirements are those that will be accomplished by the middle of December, and ideal are those that we wish to implement, time permitting. For further ease of identification, each requirement has the following tag associated with it:

[Rα-β]

where α will signify the requirement number and β will either be an *m* for minimum or *i* for ideal.

2. SYSTEM OVERVIEW

Figure 1 shows the system block diagram of the major components required to make *Intelli-Alert* ™. The pulse sensor detects the pulse of the user. When the sensor detects the user's irregular pulse beat or the panic buttons are pressed, the RF transmitter sends a radio signal to the RF receiver at the base station located in the house. The telephony system dials the pre-programmed numbers for help. Once the call is answered, the base station will play a pre-recorded message stating the address where help is needed.

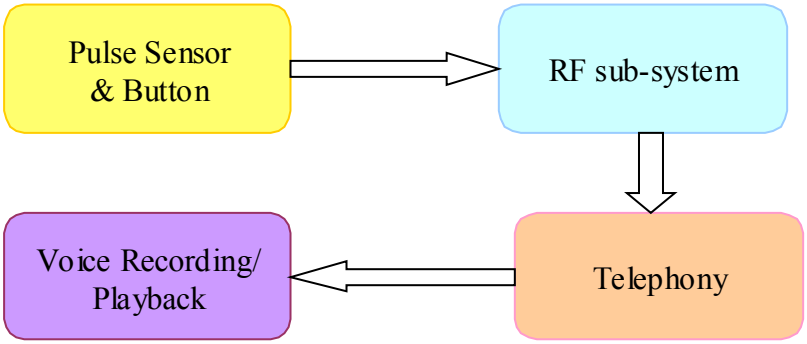

Figure 1 System Block Diagram

3. PULSE SENSOR & BUTTON REQUIREMENTS

The sensors on the wrist device consist of 2 momentary push buttons and a pulse sensor. Both will be interfaced with a small microcontroller. The push buttons are placed in series, such that a connection is made only when both are depressed (See figure below).

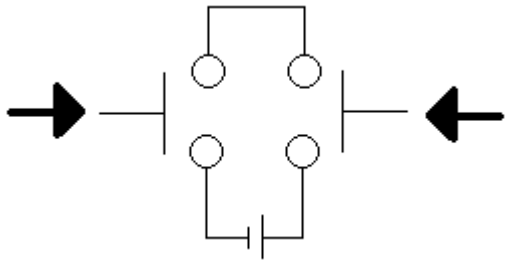

Figure 2 Button Circuit Diagram

The pulse sensor will simply detect pulse in the wrist or finger as blood flows beneath the sensor. It will simply produce an on-off signal in response to blood flow (on when blood is flowing, off otherwise). The microcontroller will count each "on" pulse over a period of time to determine pulse rate.

3.1 General Requirements

- **Minimum Requirements**

[R1-m] The sensors and microcontroller will operate from –20 to 50 degrees Celsius, 0-90% humidity, and regular atmospheric pressures.

- **Ideal Requirements**

[R2-i] The sensors and microcontroller will be encased in a water resistant package such that the user can wear the device while bathing.

[R3-i] The heat dissipation of the sensors and microcontroller will be low enough that the subject cannot discern a temperature difference between his/her skin and the sensors.

[R4-i] The sensors and microcontroller will run from a small power supply (two button batteries) on the wristband.

3.2 Physical Requirements

- **Minimum Requirements**

[R5-m] Both sensors and microcontroller will be integrated onto a small circuit board and require minimal external components.
[R6-m] The pulse sensor will be held securely against the skin by a small piece of tape.

- **Ideal Requirements**

[R7-i] The circuitry of the components will be enclosed to prevent damage through handling as well as damage through use.
[R8-i] The total weight of both sensors and microcontroller combined will be less than 15g.
[R9-i] The sensors and microcontroller will be enclosed in a small protective package together with other functional blocks (such as RF components) that can be worn on the wrist.
[R10-i] The pulse sensor will be held securely against the skin by a wristband.

3.3 Interface Requirements

- **Minimum Requirements**

[R11-m] A yellow LED will illuminate if pulse rate is being monitored successfully.

- **Ideal Requirements**

[R12-i] A red LED will illuminate when batteries need changing.
[R13-i] A green LED will illuminate when both push buttons are depressed.
[R14-i] A port will be available upon the wrist device to download/upload firmware.

3.4 Performance Requirements

- **Minimum Requirements**

[R15-m] The pulse sensor will be sensitive to wrist or finger pulses from healthy students.
[R16-m] The pulse sensor signal will be amplified if necessary, up to 5V peak-to-peak.
[R17-m] Both push buttons must be depressed to activate the emergency signal; this helps prevent false alarms that could occur with a single button.

[R18-m] The microcontroller will be able to monitor heart rates up to and including 100 pulses per minute, through the pulse sensor.

[R19-m] The microcontroller will automatically signal an emergency if pulse rate exceeds 90 pulses per minute or is less than 50 pulses per minute.

[R20-m] The microcontroller must be able to recover from any hardware or firmware errors by resetting the power.

- **Ideal Requirements**

[R21-i] The pulse sensor will be sensitive to wrist pulses from anyone.

[R22-i] The microcontroller will be able to detect and identify irregular heart rates and signal an emergency if necessary.

[R23-i] The microcontroller will be able to monitor heart rates up to and including 150 pulses per minute, through the pulse sensor.

4. RF SUB-SYSTEM REQUIREMENTS

The RF sub-system consists of a RF transmitter, a transmitting antenna, a receiving antenna and a RF receiver. Figure 4.1 shows the block diagram of RF sub-system.

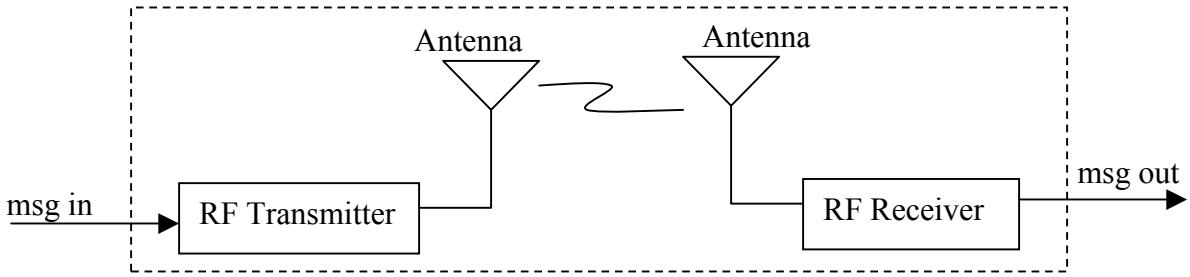

Figure 3 RF Sub-system Block Diagram

4.1 General Requirements

- **Minimum Requirements**

[R24-m] The RF sub-system will operate from –20 to 50 degrees Celsius, 0-90% humidity, and regular atmospheric pressures.

- **Ideal Requirements**

[R25-i] The RF sub-system will be water resistant against splashes and rain.
[R26-i] The heat dissipation of the RF transmitter will be low enough that the subject cannot discern a temperature difference between her skin and the transmitter.
[R27-i] The RF transmitter will run from a small power supply (two button batteries) on the wristband.

4.2 Physical Requirements

- **Minimum Requirements**

[R28-m] A pair of RF evaluation boards from Linx Technologies will be used to implement the RF sub-system in our prototyping process.

- **Ideal Requirements**

[R29-i] The RF sub-system will be integrated in two chips (one transmitter and one receiver) with minimum external components.
[R30-i] The device components will be enclosed to prevent damage due to handling such as electrostatic discharge.

[R31-i] The two antennas will be printed on PCB.
[R32-i] The total weight of the RF sub-system will be less than 30g, 15g for the transmitter side and 15g for the receiver side.
[R33-i] The RF sub-system will be enclosed in a small protective package together with other functional blocks (such as sensors) that can be worn on the wrist.

4.3 Performance Requirements

• Minimum Requirements

[R34-m] The transmitter will broadcast in the ISM frequency band.
[R35-m] The transmitter will operate up to 15 meters away from the receiver.
[R36-m] The power output by the transmitting antenna will be less than 1W, in compliance with FCC rule 47CFR15.
[R37-m] The RF sub-system must be able to recover from any hardware or firmware errors by resetting the power.

• Ideal Requirements

[R38-i] The transmitter will operate up to 30 meters away from the receiver.

5. BASE STATION – TELEPHONY SUB-SYSTEM REQUIREMENTS

The telephony sub-system of the base station is mainly responsible for calling for help when triggered. In order to do this, it has the ability to store multiple emergency phone numbers.

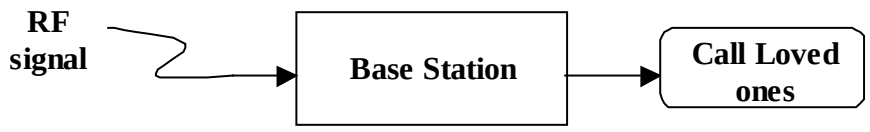

Figure 4: Telephony system block diagram

5.1 General Requirements

- **Minimum Requirements**

[R39-m] The telephony sub-system will operate from –20 to 50 degrees Celsius, 0-90% humidity, and regular atmospheric pressures.

- **Ideal Requirements**

[R40-i] Heat dissipation must be low to prevent the base station from heating up.
[R41-i] The casing design will be as such that the components won't fall apart even if dropped a few times.

5.2 Physical Requirements

- **Minimum Requirements**

[R42-m] The telephony sub-system will be implemented using a computer and a modem.

- **Ideal Requirements**

[R43-i] The telephony sub-system of the base station is embedded on a PCB. A microcontroller will be responsible for dialling and storing phone numbers.
[R44-i] The device components will be enclosed to prevent damage due to handling such as electrostatic discharge.

5.3 Interface Requirements

- **Minimum Requirements**

[R45-m] A graphical user interface is provided on computer screen. User is able to perform designated tasks using computer keyboard and mouse.

- **Ideal Requirements**

[R46-i] A keypad on the base station is used to control the telephony sub-system.
[R47-i] During non-emergency situations, it is a normal answering machine.

5.4 Performance Requirements

- **Minimum Requirements**

[R48-m] Once triggered, the telephony sub-system will call for help after a delay of 30 seconds so that the user has time to cancel an accidental trigger.
[R49-m] It is able to call the pre-programmed emergency numbers immediately via the phone line if the emergency buttons are pressed again within 30 seconds.

- **Ideal Requirements**

[R50-m] The telephony sub-system is able to distinguish unwanted responses such as busy tones or answering machine message so that it can keep calling until a person answers the phone.

6. BASE STATION – VOICE RECORDING / PLAYBACK SUB-SYSTEM REQUIREMENTS

The voice recording and playback sub-system is responsible for recording voice message and play back the recorded message over the phone in emergency situations.

6.1 General Requirements

- **Minimum Requirements**

[R51-m] The sensors and microcontroller will operate from –20 to 50 degrees Celsius, 0-90% humidity, and regular atmospheric pressures.

6.2 Physical Requirements

- **Minimum Requirements**

[R52-m] The voice recording and playback sub-system is implemented on a computer.

- **Ideal Requirements**

[R53-i] The voice recording and playback sub-system is embedded on a PCB. A microcontroller is used to perform the tasks.

[R54-i] User's voice message will be recorded and converted into digital form before being stored in embedded non-versatile memory.

6.3 Interface Requirements

- **Minimum Requirements**

[R55-m] A graphical user interface is provided on computer screen. User is able to perform designated tasks using computer keyboard and mouse.

- **Ideal Requirements**

[R56-i] User is able to perform desired tasks using a keypad on the base station.

6.4 Performance Requirements

- **Minimum Requirements**

[R57-m] Once the number is dialed and the phone on the other side is picked up, the recorded voice message will be played automatically and repeated till the call is terminated.

7. REGULATORY & SAFETY REQUIREMENTS

The *Intelli-Alert* ™ will comply with the following standards:

7.1 Minimum Requirements

[R58-m] The packaging of all system components will protect the user from electrical shock and physical injury.

7.2 Ideal Requirements

[R59-i] IEC 60601-1-1 — Medical electrical equipment - Part 1-1: General requirements for safety - Collateral standard: Safety requirements for medical electrical systems.

[R60-i] International Electro-technical Commission Sub-Committee 62D (IEC/SC62D): Electro-medical Equipment standards for patient monitoring equipment.

[R61-i] The regulations set forth for medical devices in the Canadian Food and Drugs Act - Medical Devices Regulations (SOR/98-282).

[R62-i] The standards set forth for medical devices by the U.S. Food and Drug Administration Center for Devices and Radiological Health.

[R63-i] ANSI/IEEE Std 602-1986 Standard for Electric Systems in Health Care Facilities.

[R64-i] Title 47, chapter 1 (Federal Communications Commission), section 18 of the Code of Federal Regulations regarding ISM device requirements.

[R65-i] Title 47, chapter 1 (Federal Communications Commission), section 15 of the Code of Federal Regulations regarding Radio Frequency devices.

[R66-i] The packaging of all system components will protect the user from electrical shock and physical injury.

[R67-i] CSA and UL requirements for medical devices.

8. DOCUMENTATION REQUIREMENTS

A complete set of documentation will be provided for investors, developers and users of the *Intelli-Alert* ™ emergency response system.

8.1 Minimum Requirements

[R68-m] A proposal will be available for potential investors and developers.
[R69-m] A functional specification will be available for potential investors and developers.
[R70-m] A design specification will be available for potential investors and developers.
[R71-m] A post-mortem report will be available for potential investors and developers.
[R72-m] A company website will be available for potential investors, developers and users.

8.2 Ideal Requirements

[R73-i] A user manual in English, French and Chinese will be available for users.
[R74-i] The user manual will instruct the user in installation and set up of the device and proper use of Intelli-Alert™.
[R75-i] The user manual will include a troubleshooting guide.
[R76-i] A manufacturer's warranty card will be included with the system.

9. CONCLUSION

This document outlines the functions, requirements and standards that must be completed for *Intelli-Alert* ™ to be a useful tool for the elderly.

Given these specifications, we are confident that we will satisfy our minimum requirements and more by the end of December 2003.

These functional specifications are the blueprint for the future development of Intelli-Alert ™. By examining all relevant issues, we are positioned to produce a first-rate design specification and ultimately a successful prototype and product.

10. REFERENCES

- ENSC305/340 Website (http://www.ensc.sfu.ca/users/whitmore/public_html/courses/305/305.htm)
- Dr. Andrew Rawicz, School of Engineering Science, Simon Fraser University
- U.S. Food and Drug Administration - Center for Devices and Radiological Health (http://www.fda.gov/cdrh/devadvice/313.html)
- FCC Wireless Telecommunications Bureau – Rules and Regulations (http://wireless.fcc.gov/rules.html)
- Canadian Standards Association (http://www.csa.ca/standards/Default.asp?language=English)

