Simon Fraser University
Burnaby, BC
V5A 1S6

***e***AR Inc.

# ***e***AR™ Functional Specifications

**Submitted by** ***e***AR™ Inc:
George Tsai, MinHong Zhou, Rick Liu,
Daniel Tang, Aaron Lee

**Contact** George Tsai
School of Engineering Science
Simon Fraser University
ctsaia@sfu.ca

**Submitted to** Andrew Rawicz
School of Engineering Science
Simon Fraser University

Steve Whitmore
School of Engineering Science
Simon Fraser University

**Date** January 14, 1999

Simon Fraser University
Burnaby, BC
V5A 1S6

# *e*AR Inc.

February 14, 1999

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

**RE: ENSC 370 Project *e*ARä Functional Specifications**

Dear Dr. Rawicz:

The attached document is the Functional Specification for an assistive device for the hearing impaired. This project is to design a pager that uses vibration to notify hearing impaired people in cases of doorbell ring, incoming phone calls or even in case of fire or toxic gas.

This document details the required functionality of our system and technical specifications of the various components. It provides an overview on the usability and operating conditions of our system, therefore assists in the designing and implementation stages later in this project.

`

***e***AR™ Inc. is a team of five creative, motivated, gregarious, versatile SFU engineering students. They are George Tsai; Minhong Zhou; Rick Liu; Daniel Tang; Aaron Lee. Regarding to any questions or concerns about our project, please contact me by phone at 294-2290 or by email at ctsaia@sfu.ca.

Sincerely,

George Tsai
CEO of ***e***AR Inc.

**Executive Summary**

Hearing-impaired or deaf people often have to face unnecessary challenges in daily life. Their disabilities prevent them from responding to some of the incidents occurring around them, such as the doorbell ring, telephone ring or smoke alarm. These difficulties severely handicapped hearing impaired people's ability to communicate with their surrounding environment.

Many devices have been invented to help people with hearing disability. Often lights are installed on the ceiling or along with the telephone and the smoke detector. When these devices are activated, the lights will flash to get people's attention. However, there are often situations where this approach is inconvenient or not effective at all. What happens if the deaf person is sleeping? What if he lives in a big house with lots of rooms? What if it is a bright sunny summer day and all the windows are open? Obviously, there are a lot of downsides for these light-oriented solutions.

Our company is proposing to develop a device, called ***e***AR™ (***e***lectronic eAR), that will overcome those disadvantages and at the same time, provide more convenience and affordability to a hearing impaired user. This device will consist of a receiver that will vibrate whenever it receives a signal, and a transmitter that will send the signal when it is activated by an external device such as a doorbell or telephone. The receiver will also have a LCD display to inform user the source of the signal. With the help from this device, a person can move around freely in the house and concentrate on his work without worrying about missing any of the signals.

***e***AR™ Inc. consists of five senior engineering students with experiences in programming, signal processing and circuit design. Our budget is estimated to be $530, and we will try to get financial support from several funding organizations. The project is scheduled to be completed in twelve weeks.

## TABLE OF CONTENTS

## LIST OF FIGURES



## LIST OF TABLES

## Introduction

In 1991, 5.5% of the total Canadian population are hearing impaired[1]. They do not have the luxury of using things that most people take for granted. For instance, if you have a smoke detector installed, you will know when the alarm goes off. However, for hearing-impaired people, they do not know when the disaster strikes. For another instance of the doorbell, the hearing-impaired people have to look at a special light (which goes on when doorbell is pressed) installed above the door to know whether there is a guest at the door. What if they have diverted their attention away from the light, e.g. watching TV? Then the guest would be left waiting outside. This could apply to many other situations, such as carbon monoxide detector ring, telephone ring, etc.

The list of examples could go on and on. The point that we are raising here is that the light oriented solutions provided by the companies today are not practical solutions. These devices cause not only inconveniences but also possibly endanger users' lives in extreme cases.

The objective of our project is to develop a pager that will allow hearing-impaired people to be notified by devices that use radio signal as the carrier. The pager will receive a signal from the devices and inform user which device transmitted the signal. The user will then be able to respond to that event.

This document is the functional specifications of our proposed device. It provides an overview on the usability and operating conditions of our system, therefore assists in the designing and implementation stages later in this project.

[1] Source: Statistics Canada, Health and Activity Limitation Survey, 1991

**System Overview**

Figure 1 shows the basic function of ***e*AR™**. Transmitters will be implemented into the desired devices, and the pager will act as the receiver. The device will transmit the signal when there are input signals. For example, if the phone (device) rings (input signal), the transmitter connected to the phone will broadcast out a signal. The pager will receive the signal and vibrate to let the user know there is a device requiring immediate attention.

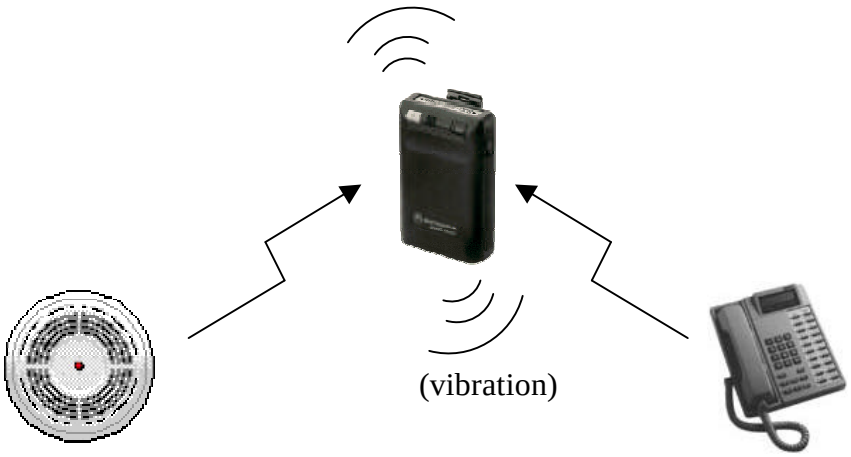


**Figure 1 System Overview**

Figure 2 illustrates the basic control blocks of this system.

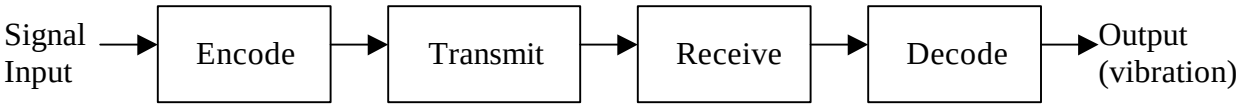


**Figure 2 System Block Diagram**

The reason that encoding and decoding processes are required is to be able to distinguish which device is sending the signal since there are more than one device. Also, it will not pick up noise at that particular frequency and treat it as a signal.

**Practical Analysis**

Below is the breakdown of the costs for the transmitter circuit.

**Table 1 Cost Breakdown for the Transmitter Circuit**

| NAME OF COMPONENTS | COST ($ CDN) |
|---|---|
| Transmitter (LC series from Linx Technologies) | $8.4 |
| Smoke Detector | $15 |
| Encoder | $2 |
| Misc. Electrical Components (e.g. resistor, PCB) | $10 |
| Antenna (PW series from Linx Technologies) | $7.46 |
| **Total** | **$42.86** |

Below is the breakdown of the costs for the receiver.

**Table 2 Cost Breakdown for the Receiver Circuit**

| NAME OF COMPONENTS | COST ($ CDN) |
|---|---|
| Receiver (LC series from Linx Technologies) | $17.7 |
| Decoder | $2 |
| Misc. electrical components (e.g. resistor, PCB) | $10 |
| Enclosure | $10 |
| LCD | $20 |
| Vibrator | $5 |
| Micro-controller | $5 |
| Antenna (PW series from Linx Technologies) | $7.46 |
| **Total** | **$77.16** |

The hearing-impaired products available on the market now costs about $40 for each transmitter. The total costs for the transmitter and receiver are $42.86 and $77.16 CDN receptively, and are quite affordable to the consumers. The cost for the receiver is dramatically higher than the receiver because of the liquid crystal display panel (LCD). If we decide to mass-produce the transmitter and receiver, the costs for the components can be reduced by at least 20%, which makes them even more attractive to the consumers.

Another issue about the practicality is the difficulty of using the device. The operation of the receiver will be exactly the same as a page and fairly simple to use. The only thing that the user has to worry about is changing the battery periodically. A long-life 3V lithium battery by Duracell can last up to five years under normal operation. Since the receiver needs to vibrate which requires significant amount of power comparatively to the rest of the components, the power consumption will be significantly higher. The amount of batteries that are required for a reasonable operation time duration will have to be decided during the testing stage.

**User Interface**

The user interface can be categorized into the following areas: Graphical Display, LED Indicator, and Vibration Indicator.

*Graphical Display*

The graphical display will be the LCD panel on the receiver. It will display the messages of the devices that require immediate attention, such as “Phone”, “Door”, or “Smoke Detector”. Special lighting can be added to the receiver to contrast the black LCD characters. Also, the characters can be programmed to flash at a comfortable and readable speed due to the urgency of the device. For example, the characters for “smoke detector” will be made to flash.

*LED Indicator*

There will be a couple of LED’s to let the user know about the condition of the receiver itself. For example, a LED will be designated to be the POWER ON indicator. Another will be used as the LOW BATTERY indicator to alter the user before the device runs out of power. The color of the LED’s for the POWER ON and LOW BATERY will be green and red.

*Vibration Indicator*

When the pager has received signals from the devices, it will vibrate to let the user know about the event(s). Depending on the urgency of the device, it can be programmed to vibrate at a different speed and time duration. For example, a smoke detector event can be programmed to vibrate faster and for a longer period of time.

**Physical Specifications**

*Operating Condition*

The ***e*AR**™ paging system is a wireless paging solution for hearing impaired. For the best performance, the system is required to operate under the conditions as shown in Table 3.

| Absolute Parameters | Min. | Max. | Suggested | Units |
|---|---|---|---|---|
| Supply Voltage (VDC) | +4.0 | +6.0 | 4.5 | Volts |
| Operating Temperature | -30 | +70 | - | °C |
| Storage Temperature | -45 | +85 | 20 | °C |
| **NOTE**<br>Exceeding any of the limits of this section may lead to permanent damage of the device. Furthermore, extended operation at these maximum ratings may reduce the life of this device | | | | |

**Table 3: Operating Environment for the *e*ARä**

The ***e*AR**™ is packaged in a compact material, which is strong enough to be resilient to common human handling or mistakes, such as dropping it on cement from pocket. Current, it is not designed to be water resistant due to budget limitation. It is strongly recommended that users avoid direct water contact with the***e*AR**™ (e.g., shower or bath). Generally, the normal daily environment in most of the hemisphere will fit under the environmental operating requirements. To achieve maximum performance and lifetime, use the device in recommended range of parameters specified above.

*Physical Attributes and Performance Review*

The ***e*AR**™ paging system is consisted of an***e*AR**™ pager (the receiver) and several transmitters, the number of which depends on each individual's need. Basically, the transmitter modules are connected with the devices such as phone, doorbell and fire alarm. The modules shall signal the***e*AR**™ pager to alert the user by vibration. Also, there is a LCD screen for visual message display. The***e*AR**™ pager is packaged in a small but strong case, whose dimensions are distributed in Figure 3, on the following page.

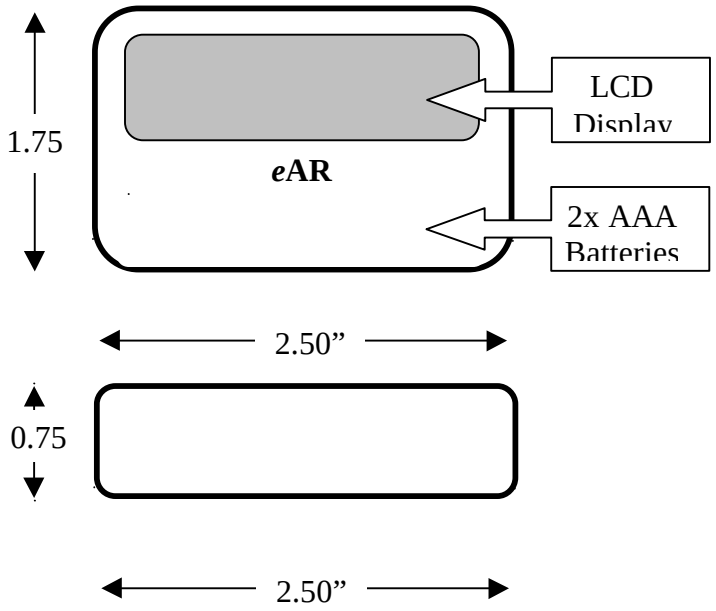


**Figure 3: Front and Top Views of the *e*ARä pager**

Please note that above figure is only a draft, it does not indicate the location of various other LEDs and control buttons.

For convenience, the***e*AR**™ pager shall be lightweight (i.e., < 200 g). Mobility is a crucial parameter that will determine the market acceptability of our device. Table 4 presents a summary of the expected performance of the***e*AR**™ system.

| Device Performance | Min. | Typical | Max. | Units |
|---|---|---|---|---|
| Operating Distance | 200 | - | 350 | ft. |
| Support Data Rate | – | – | 5,000 | bps |
| Operating Voltage Range | 4.0 | 4.5 | 6.0 | Volts |
| Current Continuous | 2.0 | 3.0 | 6.0 | MA |
| Operating Frequency | 315 | – | 434 | MHz |
| Harmonic Emissions | – | – | -40 | DBc |

**Table 4: Capability of the *e*ARä System**

*Power Supply Requirement*

The ***e*AR**™ pager and the transmitter modules require a clean, well-regulated power source. Therefore, both the pager and the transmitter will require three to four 1.5V AAA batteries to supply power. In case of low battery, the***e*AR**™ pager will light up the low battery LED, and the transmitters will send a low battery signal to pager periodically (length of period depends on how low the battery is) to inform user that a battery change is required.

**Reliability Requirements**

The ***e*AR**™ devices shall meet the following reliability requirements:

*Accuracy*
The system will detect and deliver the signals to user correctly 99% of the time.

*Response Times*

The response time for the pager beginning to vibrate after the signals are transmitted will be less than one second.

*Durability*

The expected life span for the pager will be more than three years. The plastic pager will be able to withstand minor shocks and/or drops from one meter high. The holder for the pager will also protect the surface of the pager's LCD display.

**Compatibility with other systems**

The ***e*AR**™ will not designed to be compatible with other systems due to limited knowledge about internal structure of other systems. However, the transmitter should have an adapter that can be plugged into sockets that are designed for light bulbs on many devices specifically designed for deaf person.

**Standard**

The ***e*AR**™ pager system will be ISO, IEEE, CSA, and MilSpec approved.

**Training**

The goal of our project is to design a cheap and simple paging device for targeted user. There will be no significant amount of training required on the user part. User will be required to know how to read various kinds of indicators on both transmitter and pager, and how to use the control buttons embedded on the devices. These instructions will be provided in the user manual in a clear and precise manner.

## Conclusion

At ***e*AR™** Inc, we dedicate our lives to the welfare of the entire human race, especially those with disabilities. We believe our society has not placed enough emphasis on people with disabilities. All we need is to pay a little more attention, together with innovation and technology, we can make this world a better place to live in for people with disabilities. We are amazed that after vigorous search on Internet, we can not find similar products available for hearing-impaired people. Thanks to George, who first came up with this idea, we believe that this will be a project that will not only make hearing-impaired people's life a little more convenient, but possibly also enrich the group members financially. With these two excellent motivations, it will be unthinkable and inexcusable for us not to complete this project in the shortest time possible.