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October 15th, 2001

Dr. Andrew Rawicz
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Re: ENSC 340 Functional Specifications for the Phon-E-Mail System

Dear Dr. Rawicz:

The attached document, *Functional Specifications for the Phon-E-Mail System*, outlines the requirements for our Phon-E-Mail System. Our intended project is to create a stand-alone device that allows visually impaired and blind individuals, as well as those who do not own a computer system, to utilize the power of electronic mail (E-mail) through the use of a standard Public Switch Telephone Network (PSTN) telephone system.

Our functional specification outlines the requirements, functionality and purpose of our unit. A high-level system overview is presented as well as a summary of the operational use of the Phon-E-Mail system from a user's standpoint. The various system components and requirements of our unit are discussed in detail

Fawg Technologies is comprised of five highly dedicated, ambitious, and intelligent engineering students. Each student brings a unique skill set to the project team that will allow us to work in a fast and efficient manner. Group members include **Marvin Tom**, President and CEO; **David Ciampi**, CFO; **Raymond Ngun**, COO; **Calvin Ling**, VP Marketing; and **John-Paul Costales**, VP Operations. Should you have any questions, concerns, or comments about our specification, please feel free to contact me at (604) 431-6508 or via the Internet at my-aplio@sfu.ca. Thank you for your time.

Sincerely,

A handwritten signature in black ink, appearing to read 'Marvin Tom'.

Marvin Tom,
President and CEO
Fawg Technologies

Enclosure : Functional Specifications for the Phon-E-Mail System

Functional Specifications for the Phon-E-Mail System

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EXECUTIVE SUMMARY

Electronic mail has become a worldwide standard for daily communications between people from different walks of life. Electronic mail is essentially free and an individual can be left a message or compose a message 24 hours a day, 7 days a week. E-Mail is now second nature to business people, teachers, students, children, and even the elderly. For some individuals, however, their fear of technology or lack of technical skill may stop them from using a computer system in general, let alone utilizing the power of electronic mail.

Curtis Chong, president of the National Federation of the Blind in Computer Science, states that when blind people first got onto the Net in the early '90s with the help of assistive technologies like WebSpeak or JAWS, "the first big boom was email, because you could now see and send mail without having to pay someone to read it." The problem, of course, with this technology is the need for a complex computer system accompanied with a monitor, video card, and other graphical related equipment that is essentially useless for blind users. In addition, these assistive programs are very expensive and require extensive technical knowledge in order to install and to use. As such, the learning curve on these software systems is long and the length of learning time and effort can be frustrating for average users, and scare off individuals who are not technologically inclined.

The vision of the Phon-E-Mail system, developed by Fawg Technologies, is to allow consumers in the above categories to use electronic mail easily and cost-effectively. Instead of utilizing an expensive computer system, the Phon-E-Mail system consists of a standalone device that connects to an existing telephone, and includes all of the necessary software and hardware to access the power of E-mail. Since the Phon-E-Mail unit interfaces with a regular telephone, the user need only know how to use a telephone and interact with user menus, similar to those of existing voice mail systems. Hence, the system requires a very short learning curve and can be easily adopted by the consumer. In short, the Phon-E-Mail System is truly an all-in-one, e-mail accessing system solution that introduces electronic mail to consumers without the complexity and requirements of a classic computer system.

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1 INTRODUCTION

Electronic mail has become a worldwide standard in communications. An individual can e-mail large corporations and receive e-mail and online help and instructions for everything from C++ software programming to French Cuisine culinary dessert recipes to specifications for a Boeing 747 Commercial Airplane. However, due to their fear of technology or lack of technical skill, some people still cannot and have not used a computer system, let alone utilize the power of electronic mail. These individuals have been seriously hampered by not being able to actively participate in the electronic mail phenomenon.

For other groups of people, such as the visually impaired and blind communities, complex computer systems that are largely graphically based and have components such as monitors, mouse, and video-related hardware and software, are simply a waste of money and desk space. Existing audio software, such as JAWS and WebSpeak, have allowed visually impaired and blind individuals to use computers systems, but are very expensive and require extensive technical knowledge in order to install and to use. As such, the learning curve on these software systems is long and can be frustrating for average users, and scare off individuals who are not technologically inclined.

The Phon-E-Mail system, developed by Fawg Technologies, is a sophisticated piece of equipment that allows an individual to send and receive e-mails without the need of a computer. The Phon-E-Mail system is not actually a phone in itself, but rather a phone attachment that can be connected to existing phones to make them E-mail ready and enabled. With this system, even individuals with no computer skills can easily receive and compose E-mail messages freely, and the learning curve is very short since they will be interfacing directly with the telephone and a user menu system, similar to existing voice mail systems. The main vision of the Phon-E-Mail system, however, is to allow visually-impaired and/or blind individuals to yield the full advantages of the technological age, and utilize electronic mail without the need of a complex computer system.

This document outlines the specifications for the functionality of the Phon-E-Mail System. A detailed system overview is provided, and the different physical, electrical, environmental, and safety requirements of the Phon-E-Mail system are discussed. The intended audience of this document is Dr. Andrew Rawicz, Steve Whitmore, Roch Ripley, Maria Trinh, and the Engineers of Fawg Technologies.

2 SYSTEM OVERVIEW

The Phon-E-Mail system operates as part of the regular telephone system standard telephone call is received. However, when an email is received, the system will provide a distinct ring to indicate incoming email. An audio confirmation is needed so that visually impaired individuals will know that an incoming e-mail has been received. In addition to the audio confirmation, a blinking LED on the Phon-E-Mail unit will indicate that a new e-mail message has been received. Figure 1 below shows this functionality.

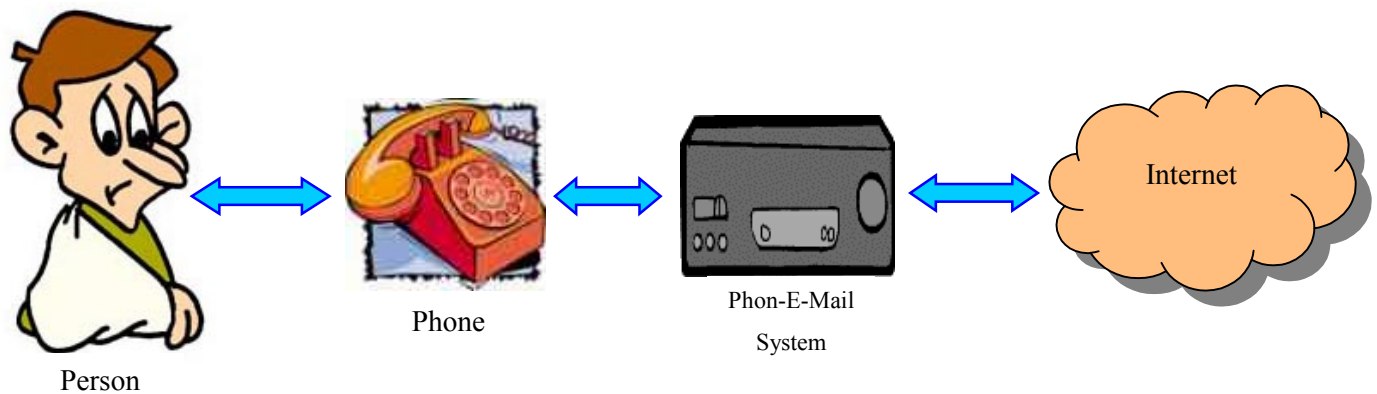


Figure 1: System Overview

Note that the system works in both directions. Once an e-mail has been received, the user then has the option of replying to the message. The system can then send emails via an Ethernet connection or via a modem. Since the popularity of appliances being Internet ready is increasingly more available, our initial prototype will contain an Ethernet interface. A block diagram of the system is given below in Figure 2.

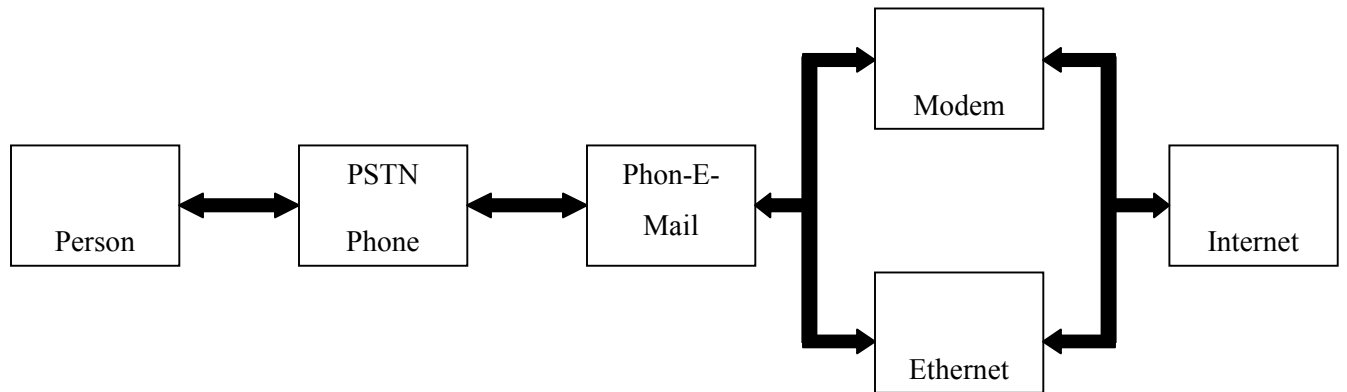


Figure 2: System Block Diagram

Now that we have explored the conceptual vision of the Phon-E-Mail System, we will take a closer look at the functional level implementation of such processes.

The software component of this project is to reside on the Rabbit 16-bit microprocessor. The Rabbit is connected to a Real Teck Ethernet Controller which allows the Rabbit to be used for TCP/IP (Transmission Control Protocol/Internet Protocol) applications.

2.1 DATA ACQUISITION

Specific to this project, the Rabbit is used to retrieve emails and send emails via the Ethernet controller using TCP/IP protocols. This Rabbit to Ethernet to Internet connection is shown in Figure 3.

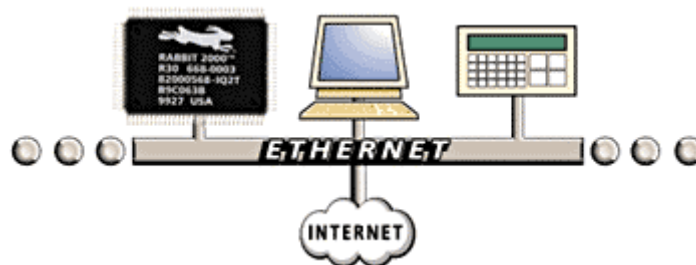


Figure 3: Rabbit Ethernet Connection

The Rabbit itself will not be used as an email server and thus an external server is used. To access the remote server, a couple of standardized protocols are used. To retrieve email, Post Office Protocol version 3 (POP3) is used. The POP3 protocol is a fairly simple text-based chat across a TCP socket, normally using TCP port 110. To send email, SMTP (Simple Mail Transfer Protocol) is used. Like POP3, SMTP is a simple text conversation across a TCP/IP connection. The SMTP server usually resides on TCP port 25 waiting for clients to connect. The software on the Rabbit will have to periodically check the POP3 email server for new messages. An architectural view of the Rabbit microprocessor and evaluation board is shown in Figure 4.

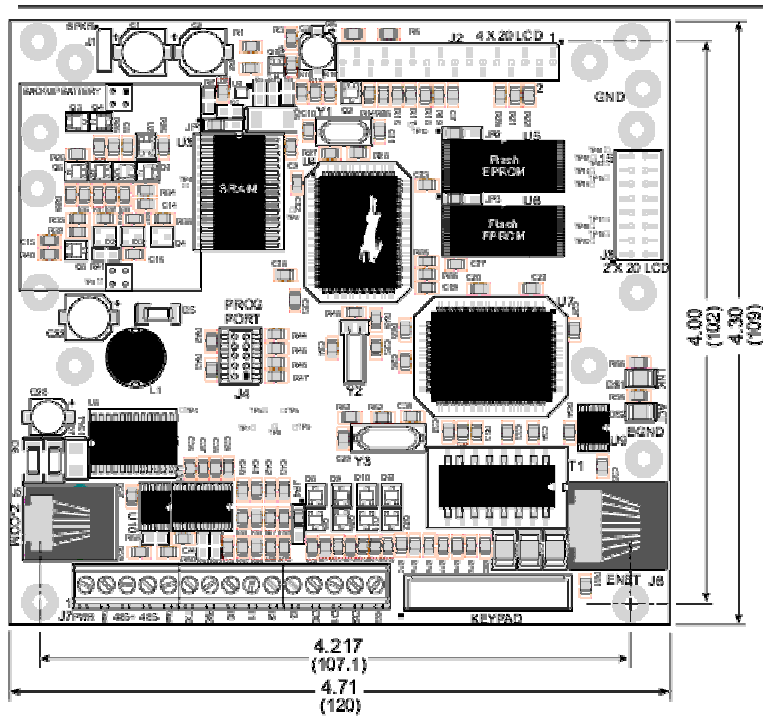


Figure 4: Rabbit Evaluation Board Architecture

2.2 DATA PROCESSING

When a new message arrives and is retrieved by the rabbit, the text from the body of the server is sent to a second server that converts the text to speech using text-to-speech software. On receipt of the speech version of the email, the Rabbit stores this information in memory. The Rabbit is to then signal to the user a new message has arrived by ringing the phone.

When the user is ready to listen to the new message, the message is retrieved from memory and sent to a DAC at the rate of 125us per 8 bit sample. If and when the user wants to reply or send a new email, the Rabbit enables the ADC to digitize the user's analog voice signal from the phone. At a rate of 125us per sample, the data is read by the Rabbit and stored into memory. Upon the completion of the email (triggered by the pound key on the phone), the data is packaged into an email and sent using the SMTP protocol. This sequence of data acquisition and processing for receiving and displaying in e-mail message can be summarized in Figure 5.

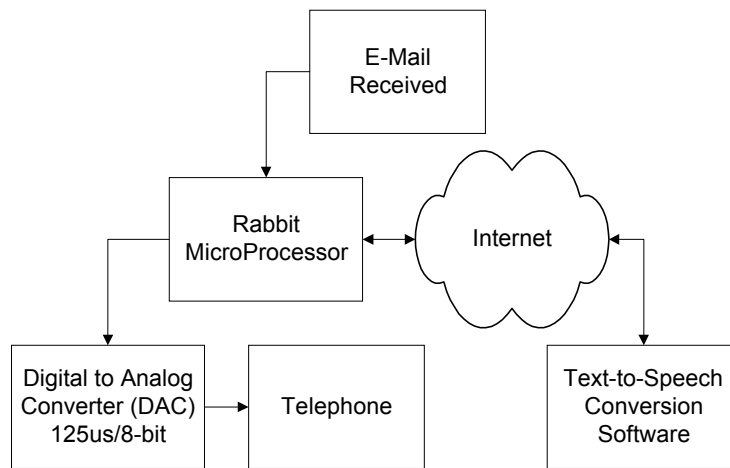


Figure 5: Data Acquisition and Processing

2.3 USER INTERFACE

As previously mentioned, the Rabbit Evaluation Board will be used as the hardware component of our system. A DTMF hardware circuit will also be used extensively in the Phon-E-Mail System. DTMF or Dual Tone Multiplexed Frequency detection will be used for the purpose of menu navigation for the user interface. Each key in a conventional touch-tone telephone produces a mixture of two frequencies. Table 1 outlines the frequencies of the standard telephone keys that will be used in this project.

Table 1: DTMF Frequency Combinations

	1209 Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	1	2	3	A
770 Hz	4	5	6	B
852 Hz	7	8	9	C
941 Hz	*	0	#	D

DTMF Detection is a key functionality in the operation of the Phon-E-Mail system. Without it, the telephone and Phon-E-Mail unit would not be able to properly communicate. When a key is pressed in the telephone, a DTMF tone is generated. It is this unique combination of frequencies that will determine what action the Phon-E-Mail unit will execute. A diagram of the DTMF detection circuit is shown in Figure 6.

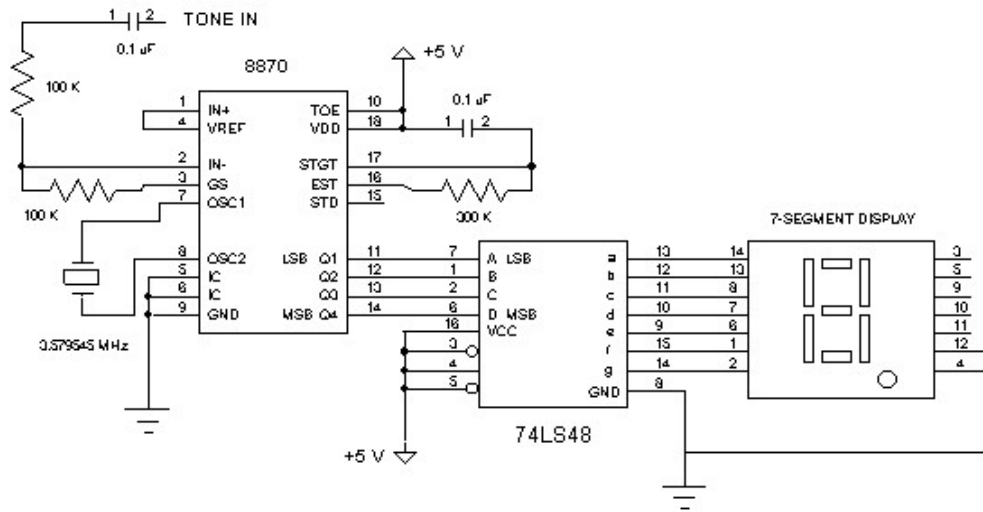


Figure 6: DTMF Detection Circuit

The Phon-E-Mail system will feature an audio-based user interface similar to that of a voice mail menu system. The main menu items will include options to either listen to new messages, listen to saved messages, or compose a new message. The production version of the Phon-E-Mail System will have full voice-to-text and text-to-voice capabilities. However, for the prototype version, in order to meet the required deadlines, the main functionality that will be aimed for completion is shown in Figure 5. Consequently, there may only be the one menu option to listen to new e-mail messages. However, the Phon-E-Mail prototype will still adhere to the following Menu Requirements.

- Ability to recite both new e-mail messages and old, saved e-mail messages
- Recite an e-mail in its entirety using a corresponding audio message that is coherent to the user
- Can save, sort through, and process at least two e-mail messages at one time
- Ability to either save or delete the message after it has been listened to



- Will allow the user to reply to the message and compose a new e-mail message
- If a new e-mail message is composed, the ability to send the new e-mail message

3 SYSTEM RELIABILITY

In order to be functionally useful, the Phon-E-Mail System must be reliable and operate correctly when used by an individual. Accuracy of execution of the electronic mail decoding, text-to-speech conversions, audio playback, and user menu options with the correct system responses is key to the reliability of the system. Equally as important is the Phon-E-Mail System durability.

For the purposes of developing a working prototype within time and budget constraints, a few changes from the original functional vision of the Phon-E-Mail System were made. The true vision of the Phon-E-Mail System is to have an all-in-one, independent unit that contains all necessary hardware and software to execute all functions necessary by the system. Unfortunately such a solution is not within our budget capabilities. Nevertheless, the unit will follow the accuracy and durability requirements outlined below.

3.1 ACCURACY

The Phon-E-Mail prototype will adhere to the following accuracy requirements shown in Table 2.

Table 2: System Accuracy Requirements

Data Acquisition	The prototype will be able to receive short e-mail messages from a specified e-mail account
Data Conditioning	The system will be able to execute text-to-speech conversions so that the speech recordings are audible and coherent to the user
Data Processing	The playback of the audio messages from the telephone unit will be audible and coherent to the user
User Interface	The user menus will be easy to understand and follow

3.2 DURABILITY

The Phon-E-Mail system should be as reliable and durable as outlined below.

- Resistive to relatively harsh physical contact
- Be able to resist minimal water contact and condensation
- Must operate for a reasonably long period (7 days) without failing
- Upon failure of operation, the unit should be able to recover by cycling power

4 SYSTEM REQUIREMENTS

The Phon-E-Mail system will adhere to strict requirements of operation as outlined in the sections below. Such functional requirements will ensure that the unit will operate properly and as advertised, as long as the operational boundaries set forth in the following requirement specifications are not surpassed.

4.1 PHYSICAL REQUIREMENTS

The Phon-E-Mail unit shall be enclosed in a box-like structure. This enclosure shall be strong enough to protect the unit against some light physical force, rigid enough to ensure reliability, yet also light and compact enough to be easily portable. The Phon-E-Mail enclosure will adhere to the size and weight specifications outlined in Table 3 below.

Table 3: Enclosure Specifications

Length	20cm Maximum
Width	20cm Maximum
Height	10cm Maximum
Weight	4.0kg Maximum

In addition to the physical measurements and weight noted above, there will be two LEDs (Light Emitting Diodes) on the device. One LED will flash and indicate when an e-mail message has arrived, and the other LED will flash and indicate that the system has been activated from the connected telephone. The unit enclosure will have three input ports:

1. Telephone Jack connection from the Phon-E-Mail unit to the wall
2. Telephone Jack connection from the Phon-E-Mail unit to the phone
3. Ethernet Jack to connect to the internet

4.2 ELECTRICAL REQUIREMENTS

The Phon-E-Mail System will have a variety of electrical requirements. The power, voltage, and current considerations of the unit are described below.

- The user will only need to worry about plugging the unit into a conventional wall socket 120VAC
- Most digital circuitry is running off 5V with 500mA of operating current
- The telephone itself is DC Biased at 24mV with 2mA of operating current
- The Ringer circuit is 12V DC at 400mA when ringing
- The Semiconductor Evaluation Board runs off 16V DC at 100mA

4.3 ENVIRONMENTAL REQUIREMENTS

The Phon-E-Mail System will adhere to the environmental requirements noted in Table 4.

Table 4: Environmental Requirements

Operating Temperature	5°C to 45°C
Storage Temperature	-10°C to 60°C
Heat Dissipation	Minimal
Elevation	Industry Standard Levels
Humidity Tolerance	Industry Standard Levels

4.4 SAFETY REQUIREMENTS

The Phon-E-Mail unit will follow safety standards as outlined by the Canadian Safety Association (CSA), the American National Standards Institute, the Consumer Product Safety Commission, and Health Canada. The enclosure corners will be pointed, but will not be sharp enough to seriously harm the user. The telephone cables and Ethernet cables will be no longer than necessary to complete the connections between the Phon-E-Mail unit, telephone, wall, and Ethernet connection. Such a set-up will ensure that no cables are in danger of harming adults, or small children. The Phon-E-Mail unit and adjoining cables



will be surrounded in protective shielding so as to protect the user from electrical shock, and also the device from static discharge.

5 SYSTEM EVALUATION

Evaluating and testing the Phon-E-Mail unit is important in determining the reliability and operational readiness of the system. The tests can be broken down into two main categories, functional testing and entire system testing or end-user based testing. Following from end-user based testing, a brief discussion about user training of the system will be made.

5.1 FUNCTIONAL TESTS

Various functional tests are performed during implementation of the Phon-E-Mail System. Each component of our system is tested individually. The types of tests performed will be based on the details of the component being implemented. Some tests that will be performed are functional tests, black box tests, performance tests, and stress tests. Each component must pass our internal company tests before we can start stitching the entire system together.

5.2 SYSTEM TESTS

Once the components of our system are stitched together, a full system test can be performed. The system tests are going to be performed by various people with different backgrounds and knowledge. The people in our company will perform the first system test making sure there are no problems in functionality. We will then ask a few people from the general public to use the phone based on our instruction manual. This will be greatly beneficial to get feedback from someone testing our system that had no part in designing and implementation of the Phon-E-Mail System. Such testing will be valuable when assessing the effectiveness of the Phon-E-Mail System, the accuracy and completeness of the instruction manual or user's guide, the reliability and system tolerance in a true user's environment.

5.3 USER TRAINING

The user will require only a minimal amount of training in order to operate the device. Most of the training effort will be aimed at guiding the user through the user menus, and becoming familiar with the options and functionalities available. Some effort must also be aimed at helping the user to set-up the Phon-E-Mail unit. For the production version of the Phon-E-Mail System, the following specifications will be followed.

- Documentation will consist of a User's Manual written in English and French, and an online help website provided by Fawg Technologies.
- The User's Guide will be aimed at users with little to no experience with electronic devices
- The User's Guide will contain detailed step-by-step information on how to execute each function available on the device
- The User's Guide will contain background information on the operation of the system, and how to obtain more information from a toll free phone number or website, if needed.
- The User's Guide will also contain advanced information such as basic design specifications for more advanced users with superior technical abilities
- The User's Guide will include a list of Frequently Asked Questions, a troubleshooting section and a device characteristics list
- Training for the production device will be provided from the User's Guide Manual and additional online documentation



6 CONCLUSION

There are many visually impaired individuals in society that may not own a computer due to their disability. These people still may want to be a part of the greatly expanding Internet, but have no gateway to it. There may be people only interested in using email and do not want to purchase an entire computer system. These groups may include people who have a fear of technology and do not want to spend thousands of dollars or the blind and visually impaired communities who do not need some of the standard computer equipment such as the monitor, mouse, and video card. These people would like to purchase the minimum amount of equipment to access the world of the Internet and electronic mail.

Our Phon-E-Mail system can provide an affordable means of accessing email via a regular telephone. It will provide a small compact design and provide a seamless link between a phone connected to the telephone company and the Internet. Our product is easy to use, yet has extremely powerful capabilities. The Phon-E-Mail System is truly a complete e-mail accessing system solution that introduces electronic mail to consumers without the complexity and requirements of a classic computer system.



7 REFERENCES

7.1 COMPANIES

Rabbit Semiconductor Inc. Davis, California. <http://www.rabbitsemiconductor.com/>

National Semiconductor Inc. Santa Clara, California. <http://www.nsc.com/>

Motorola Semiconductor Products Inc. Calgary, Alberta. <http://e-www.motorola.com/>

7.2 SFU PROFESSORS

Dr. Andrew Rawicz. *Reliability physics and engineering, VLSI reliability, physical transducers, integrated sensors, film technology, nonlinear optics, materials processing in microelectronics.*

Patrick Leung. *Engineering Lab Instructor.*

George Austin. *Engineering Lab Instructor.*