PROPOSAL
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Financial Assistance Program
American Society for
Engineering Education Design Engineering in Education Division and NISH

Title: A Reading Device for People with Low Vision

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1 Project Objective

The Internet is becoming more and more important for nearly everybody. Electronic devices, web-based content, multimedia and computers are things we have to deal with everyday. However, current Internet technologies lack in considering the needs of people with visual impairments. For example, most web pages are crammed with dense text on screen, which are difficult for visually impaired people to read. On the other hand, approximately 14 million Americans–about one out of every 20 people–have low vision. About 135 million people around the world have low vision. The goal of the proposal is to design a computer system prototype to help visually impaired people to access digital information, such as emails,web-based content, and electronic documents.

Many reading devices have been designed to help people with low vision, ie., TOPAZ and OPAL from Freedom Scientific, and ZoomText. Existing solutions can be classified into two categories: hardware-based and software-based solutions. The hardware-based solutions, such as closed-circuit television (CCTV) system and TOPAZ, use a camera to project a magnified image onto a video monitor or a television (TV) screen so that they are in large print. Those hardware-based systems provide easy-to-use magnification solutions. However, current hardware-based solutions cannot be used to read electronic documents, such as web pages and email. To read electronic documents, the software-based applications, such as ZoomText and Windows XP's Magnifier, have to be used. These softwares enlarge everything on a user's computer screen. However, screen magnification softwares lack easy-to-use interfaces and feature too many options. For example, users have to use menu driven interface to select functions, which requires hand-eye coordination to move mouse to enlarge text.

In this proposal, we are going to design an ebook reading device prototype for people with vision impairments. The system provides screen magnification function and easy-to-use interface. To implement easy-to-use interface, we are going to design a new simplified user interface, which is based on an icon driven interface. At the same time, the magnification functions are controlled by hardware. For example, instead of using software control buttons, the system supports sliding controllers and joysticks to control magnification, such as changing font size. So using hardware to provide easy to use interface is the unique feature of the system.

The system can help people with visual impairments to access more information, such as receiving email, visiting web pages, and reading other electronic documents. The importance of this system is that it can help persons with low vision gain in reading abilities and keep their independence.

2 Work Scope

We plan to design this system based on an embedded computer system (M-X270 embedded system from CompuLab). The main reason for using the embedded system is that it can shorten the design cycles. Nowadays, embedded systems incorporate both hardware and software so that we can shorten the hardware and software implementation.

Figure 1 shows the system architecture based on the M-X270 embedded system. The system will implement a keypad and joystick which are used to control the screen magnification software. The system contains a portable camera, which can magnify material under the camera and display the image on the monitor. The system also has audio modular, which could be used as user input

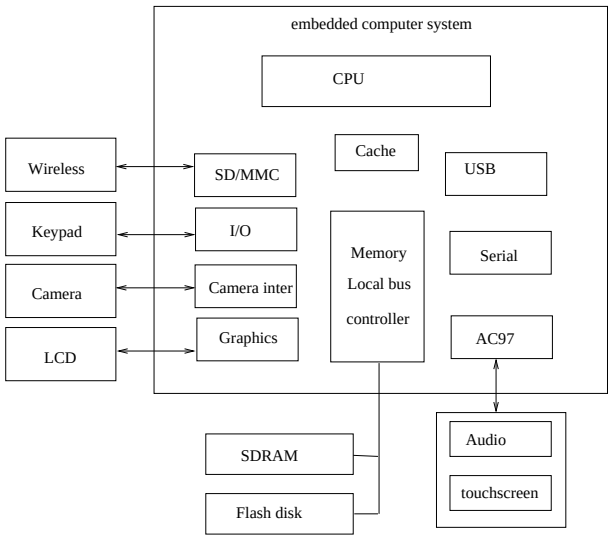

Figure 1: The embedded computer system architecture.

device. For example, users can utilize IBM VoiceType to write emailb. We plan to design a new graphical user interface based on the embedded Linux system. Most current applications support pull-down and right-extending types of menus, which need multiple operations to complete one task. We plan to design an icon driven user interface so that users need a single operation to complete a task.

Our first plan is to design a desktop reading device. In the second phase, we plan to extend the system to a portable device. We plan to take the following steps to implement the system:

1. Implement the system based on EM-X270 embedded system.
2. Implement the operating system, which is based on embedded Linux system.
3. Implement device drivers (keypad and joystick).
4. Investigate and design the user interface.
5. Implement user applications.

3 Schedule

- The first two months: install and implement the embedded system and operating system.
- From the third month to the forth month: implement Linux device drivers.
- From the fifth month to the seventh month: design the user interface.
- From the eighth month to the tenth month: develop applications.

4 Budget and Department Co-funding

Our system consists of the following components:

1. CompuLab's EM-X270 ($300.00).
2. Digital video camera ($500.00). The camera is used to provide magnification function for non-ebook readers.
3. Joystick ($100.00) and keypad ($10.00).
4. LCD display ($100.00) and HDTV ($1,099.99)
5. Battery ($10.00)

With the grant funds, we plan to purchase an EM-X270 system board. Other components will be supported by our department.

5 Project Team

The project team consists of 1 student and 2 faculties.

- Students:
  - Stephen J. Konyndyk, a junior in computer science.
- Faculty
  - Dr. Feng Wang. Assistant Professor of Engineering.
  - Dr. Ronald T Sones. Professor of Management Information Systems.

6 External Collaboration

We will obtain advice from Liberty University Office of Disability Academic Support and Central Virginia Area Agency on Aging, Inc..

7 Faculty Advisor-Contact Information

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