New Haptic device to use computers for blind persons

Lecturer Saad H. Abid*

Abstract

A number of haptic devices have been developed that give one the sensation of touching something literally... while it is basically a mechanical or digital control mechanism that relays tactile sensations between the toucher and the touched object. This technology will allow blind people to be able to touch the scene or object displayed on the screen, using a matrix of steel rods to represent each bit of information displayed on the screen to be a physically touchable object instead of virtual information can only be seen on the screen. One to explore a number of avenues with tactile feedback mechanisms they will allow us to feel things we have never felt. It also is going to make dramatic changes in education, medical practice, surgery, training in various disciplines.

* AL-Mansour University College

1. Literature review:

This paper presents our work to date on a haptic interface whose immediate aim is to provide access for blind computer users to graphical user interfaces. In this presentation, we describe the hardware and supporting software which together reinterprets a Microsoft Windows screen for the haptic senses. Screen objects such as windows, buttons, sliders, and pull-down menus are mapped to the workspace of a two-axis haptic interface called the Moose where they emerge as patches and lines of varying resistance. The Moose operates much like a mouse except that it is able to move under its own power and thereby make apparent touchable virtual objects. Thus presented to the hand. interface objects may be located. Identified, and even manipulated or activated. Using Microsoft Windows as a test bench, we have proven the feasibility and usefulness of the haptic interface approach for non-visual computer access. Extensions to haptic browsing of the Web are discussed, figure 1 describe a typcal haptic device[1].

Figure 1: a typical haptic device

Assistive technology (AT) is an umbrella term used to describe any product or technology-based service that helps disabled people to live, learn, work and enjoy life. In the context of on-line education, assistive technology refers to hardware and software technologies that enable people with disabilities to use computers more effectively. The following is a brief overview of the main categories of these assistive technologies[1,2,3].

1.1 Screen Readers

Screen readers are software products designed for blind users, but they are also useful to users with learning disabilities. Screen readers locate information seen on the computer screen and vocalize it using text-to-speech software and, occasionally, hardware. Most screen readers work in close concert with the operating system, relying on the computer's built-in capabilities. Applications and software that conform to the standards of the operating system are more likely to be accessible. Applications and software that ignore the requirements of screen readers and the operating systems that support them may well prove unusable for some disabled people[3].

1.2 Refreshable Braille Displays

A refreshable Braille display is a tactile device that raises or lowers dot patterns on command from an electronic device, usually a computer. The result is a line of Braille that can change from moment to moment. Current refreshable Braille displays range in size from one cell (six or eight dots) to an 80-cell line, most having between 12 and 20 cells per line. Braille displays are the primary means of access to computers for users who are deaf-blind[5].

1.3 Screen Magnifiers

Screen magnifiers are software solutions for people with low vision. These products allow the user to enlarge the size of images and text displayed on screen. Screen magnifiers may also permit the user to change the default colors of the display.

Compatibility between screen magnifiers and software can be a problem for developers. Typical screen magnifiers track the cursor or the active region of the screen and will automatically enlarge that portion of the display. Applications that use a custom cursor design may cause the magnifier to enlarge the wrong portion of the screen. Developers can avoid this problem by relying on standard interface practices, particularly those that apply to cursor control and display[2,5].

1.4 Adaptive Keyboards

Adaptive keyboards are designed for users with physical disabilities who cannot use a standard keyboard. Users with reduced range of motion may require smaller keyboards. Conversely, those without fine motor control may require a keyboard that is somewhat larger. Keyboards that offer fewer choices are helpful to users who benefit from a more structured learning environment and one-handed keyboards are helpful for those who can only type with one hand.

For users who are only able to use a mouse (or assistive technology that emulates a mouse), the keyboard itself can be represented on screen using software. Pointing at individual letters replaces the physical act of typing.

Developers can take steps to support users of these technologies. Applications and software that employ the operating system's standard methods of reading input from the keyboard should be compatible with all adaptive keyboards. Those applications that bypass the operating system and attempt to interrogate the keyboard directly will probably not be accessible to users who wish to substitute an adaptive keyboard[1,6].

1.5 Voice-Recognition Software

Voice-recognition software allows the user to input data or control the computer by speaking. Voice-recognition software benefits users who have difficulty typing or using their hands. Generally, applications and software that allow full access through keyboard commands are well suited for use with voice-recognition software[3].

1.6 Single Switches

Single switches are hardware solutions for users with physical disabilities who can control the computer only with one or two specific movements. Single switches are used with software scanning preset options on screen. The user triggers the switch when the option he or she wishes to choose has been highlighted during scanning. Single switches can be used in conjunction with on-screen keyboards and word prediction software. Scanning software can be used to create customized screen layouts for use with a variety of applications. However, every clickable spot in the layout must be identified in advance in order for the scanning software to find it[6].

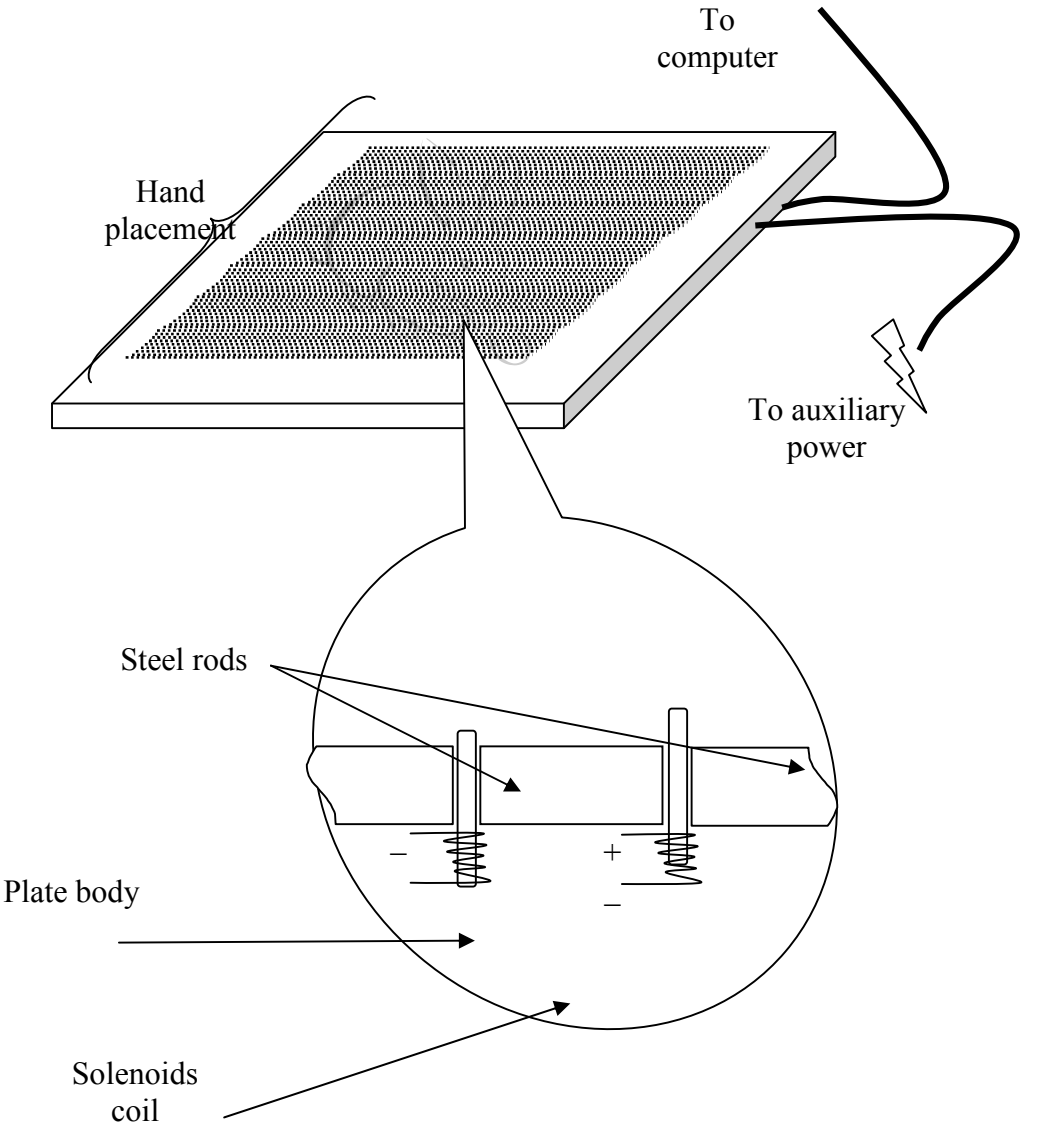
Objective of study:

- The advantage of this system is that it will be platform-independent and will thus allow blind people to use the same access device for any number of computers running any type of operating system
- With this touchable pad, a blind user can navigate and interact through an application's window. Sighted users may also realize advantages in speed and dexterity
- The software simply gathers information and displays it haptically. HTML code also contains the descriptive information necessary to create a haptic rendering of a web page. The real advantage of our haptic interface over a speech, screen reader is that information about the window or web page topology is presented directly and immediately rather than through time-consuming descriptive language.
- Even for non blind person the usage of such system gives him the feel of the content of the image for medical and scientific reasons such as an anatomy picture of a human skull, liver, etc

The proposed system:

In the following figure we show the hardware components of our present haptic panel interface, The puck or plate under the user's hand is an NxN matrix of steel mounted rods controlled by a magnetic coil or what is known as solenoid that if the electricity current flows into it, then the steel rod will rise outside the plat and vice versa see figure 2.

Figure 2: block diagram of the proposed system



The workspace is about 20 cm by 30 cm i.e 600 cm square. The effective mass in each direction is 95 grams while the maximum force output is about 6 Newtons. The workspace of the current is limited by the solenoids. Future designs will utilize rotary motors and capstan drives, realizing large workspaces yet maintaining a low profile package.

The unique feature of our hardware design is the ability to mechanically simulate a digital image depending on its gray levels. Thus the input image is first transformed in an equivalent 256 gray levels then these levels are mapped to the panel to represent the image. Furthermore, the workspace is flat, square like a mouse pad, and free of singularities. The entire workspace is also naturally counterbalanced. This approach will increase display capabilities to incorporate touchable images rather than just 2D displayed figures.

A simple Digital I/O card provides for PC-bus communication to four 12-bit DACs and four quadrature counters. The voltage outputs of two DACs, ranging +/- 5 Volts, feed to NxM transconductance amplifiers based on the LM12 power op amp and in turn to the solenoids.

Other digital switch inputs such as buttons can be polled from software.

Finally, a speech synthesizer linked through the serial port is available for text output.

We will try to use also heat variation to indicate other features of the screen such as color or coolness, also a built in text recognition system would be convenient to give closer idea to the user along with artificial intelligence and neural network for reasoning and decision making this device will help more blind people to benefit of the visual information. The following figure will show the different stages of processing inside our system see figure 3.

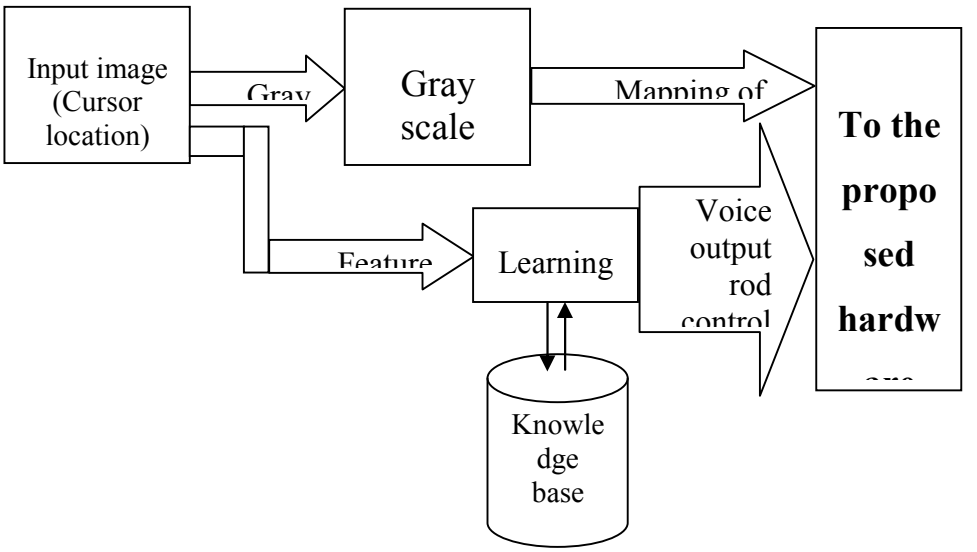


Figure 3: the phases of the system

2. Conclusion:

The visual information of the screen has been transcribed and made available to the haptic senses in which Windows environment enables inquisitive system such as the proposed one to access all information on the screen.

The proposed system simply gathers that information and displays it haptically.

HTML code also contains the descriptive information necessary to create a haptic rendering of a web page. The real advantage of the haptic interface over a speech screen reader is that information about the window or web page topology is presented directly and immediately rather than through time-consuming descriptive language.

5. References

[1] Akamatsu, M., Sato, S. and MacKenzie, I.S. Multimodal mouse: A mouse-type device with tactile and force display, Presence, Vol 3 No. 1,Winter 2004 pp 73-80.

[2] Eberhardt, S.P., et al. OMAR: a haptic display for speech perception by deaf and deaf-blind individuals, Proceedings of IEEE Virtual Reality Annual International Symposium. Held: Seattle, WA, USA, 18-22 Sept. 2003. p. 195-201

[3] Edwards, A.D.N. Soundtrack: an auditory interface for blind users, Human Computer Interactions vol.4, no.1, 2004 p. 45-66.

[4] Frisken-Gibson, S.F., et al. A 64-solenoid, four-level fingertip search display for the blind, IEEE Trasactions on biomedical engineering. (Dec. 2002) vol.BME-34, no.12, p. 963-5.

[5] Kelly, A.J., and Salcudean, S.E. On the development of a force-feedback mouse and its integration into a graphical user interface, in Proceedings ASME Winter Annual Meeting, DSC-Vol. 55-1, 2004.

[6] Kontarinis, D. A. and Howe, R. D. Tactile display of vibratory information in teleoperation and virtual environments, Presence, 4(4):387-402, 2003.

بناء نظام معوقين جديد لاستخدام الحاسوب للمكفوفين

سعد حميد عبد*

مستخلص:

تم بناء وتطويرانواع عديدة من اجهزة اللمس للمكفوفين والتي تعطي الاحساس برؤية الاشياء عن طريق لمسها ، وهي في الحقيقة اجهزة ميكانيكية ورقمية توصل الاحساس بالشيء بين الشخص المكفوف والشيء المراد الاحساس به حيث توفر هذه التكنلوجيا للمكفوفين الامكانية للمس الاجسام المعروضة على شاشة الحاسوب، تم تحقيق هذه العملية بواسطة مصفوفة من القضبان المعدنية الصغيرة والتي بدورها تمثل كل بت من عناصر الصورة المعروضة لكي يمكن لمس الجسم وتحويله من الصيغة الأفتراضية داخل الحاسوب الى جسم ملموس. وذلك عن طريق بناء دوائر سيطرة و برامجيات لتحقيق هذا الغرض، ان هذه التكنلوجيا ستوفر ثورة في العديد من المجالات مثل التعليم والطب و مختلف العلوم وخصوصاً للأشخاص المكفوفين.

* كلية المنصور الجامعة