Design of Web Access Interface Design for People with Neuromotor Disorders

Debashis Mandal
M.Tech Student
IET Alwar
Alwar ,India
deba_biet2005@rediffmail.com

Abstract— A major part of Indian population suffers from different types of motor disorders. A majority of this people has cerebral palsy. People suffering from cerebral palsy have great difficulties for communication. Augmentative and Alternative Communication (AAC) techniques are used to partially solve their problem. Though there is a huge number of modern tools and technologies available, they are all made for foreign socio cultural contexts, costly, and have to be imported. The present work is aimed by developing a computer based Special Access system for the web access for the Indian population suffering from neuromotor disorders, especially those suffering from cerebral palse. Since it is difficult to develop systems for all Indian languages in a short time, the present work focuses on building systems in English initially. However, the system is designed in such a way so that systems for other languages can be developed easily from the existing system. The system described in the thesis is a Special Access System. The system has three components, namely a physical interface, the OS and web browser. With these proposed system, user can access internet through any web browser. The system can be operated with special access switches. The switches are required to make the system accessible to the people with severe motor disabilities.

Keywords-neural network,speech,matrix

I. INTRODUCTION

This Most people today can hardly conceive of life without the internet. It provides access to news, email, shopping, and entertainment, at any hour of the day or night. Some have argued that no other single invention has been more revolutionary since Gutenberg's printing press in the 1400s. Now, at the click of a mouse, the world can be "at our fingertips"— that is, if we can use a mouse... and sees the screen... and hears the audio—in other words, if we don't have a disability of any kind. Though estimates vary, most studies find that about one fifth (20%) of the population has some kind of disability [1]. Not all of these people have disabilities that make it difficult for them to access the internet, but it is still a significant portion of the population. Each of the major categories of disabilities requires certain types of adaptations in the design of the web content. Most of the time, these adaptations benefit nearly everyone, not just people with disabilities. Almost everyone benefits from helpful illustrations, properly-organized content and clear navigation. Similarly, while captions are a necessity for Deaf users, they can be helpful to others, including anyone who views a video without audio.

Web accessibility means that people with disabilities can use the Web**.** More specifically, Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web [2].

In 1996, the World Wide Web Consortium (W3C) established the Web Accessibility Initiative (WAI) initiating a campaign that called for a more accessible Web for persons with disabilities [2]. For the consortium, Web accessibility was defined as “access to the Web by everyone, regardless of disability.” The WAI approach to Web accessibility revolves around three interrelated fronts: First is the content accessibility of websites for persons with disabilities to perceive, understand, and use. Second is making Web browsers and media players usable for persons with disabilities by making them operable through assistive technologies. The third component requires Web authoring tools and technologies to support production of accessible Web content and sites, so that persons with disabilities can use them effectively.

Web accessibility encompasses all disabilities that affect access to the Web, including visual, auditory, and physical, speech, cognitive, and neurological disabilities. Millions of people have disabilities that affect their use of the Web. Currently most Web sites and Web software have accessibility barriers that make it difficult or impossible for many people with disabilities to use the Web. As more accessible Web sites and software become available, people with disabilities are able to use and contribute to the Web more effectively.

II. BACKGROUND

A. Severe Speech and Motor Impairment

Severe Speech and Motor Impairment (SSMI) is a group of disorder [3]. It can be classified into three parts. Those are speech and language impairment, psychomotor retardation, and visual impairment. A speech and language impairment is caused due to disturbances in muscular control-weakness, slowness, or in coordination of the speech mechanism due to damage to the central or peripheral nervous system or both. Psychomotor impairment is the cause of slowing-down of thought and a reduction of physical movements of the suffering person. It can affect in a visible slowdown of physical and emotional reactions, including speech and affect. Visual impairment is vision loss of a person to such a degree as to qualify as an additional support need through a significant limitation of visual capability resulting from either disease, trauma, or congenital or degenerative conditions that cannot be corrected by conventional means, such as refractive correction, medication, or surgery.

B. Augmentative and Alternative Communication

The People with SSMI need external assistance in their daily communication. That's why we used AAC systems. Augmentative and Alternative Communication (AAC) is the field of work which totally devoted to the development of systems and techniques for those persons who face difficulties in their normal communication process. It includes all forms of communication (Except oral Speech) that are used to express thoughts, needs, wants and ideas. We all use AAC when we make facial expression, use picture or symbol, writing something for communication [4].

C. Cerebral Palsy

Cerebral palsy is a type of SSMI. It is a disorder that affects muscle tone, movement, and motor skills (the ability to move in a coordinated and purposeful way). Cerebral palsy can also affect to other health issues, including vision, hearing, and speech problems, and learning disabilities. There are several types of cerebral palsy like spastic, ataxic and hypotonic [5].

D. Web Access For The People With Cerebral Palsy

When we want to access the internet normally, we click the mouse on the web browser icon that is present on the computer screens. Then the web browser page is open. Within that page we have done so many operations like url search, keyword search, page save, page print, history, bookmarks etc. Those operations are done using keyboard and mouse.

But those peoples are suffering from neuromotor disorders, especially those suffering from cerebral palse, have great difficulties of communication especially because of the lack of fine motor coordination. Through the use of computers, for these individual are to communicate their thoughts, ideas, emotions, and intellectual potential to the rest of the world. To use the computers, accessibility to its peripherals is a prime necessity. Those peoples are also physically challenged that's why they can't handle computer peripherals like mouse, keyboard. Nowadays, we use some AAC system and Special Access System to communicate for people with cerebral palsy. But using those AAC systems Special Access System, peoples with neuromotor disorders can't access the internet. So, they need some special system to access the internet.

III. APPROACH

A. Co-ordinate Approach

In this type of scanning mechanism, the computer screen is thought of as representing a two-dimensional co-ordinate system and any on-screen element is treated as a point in it. The co-ordinate system can be either polar or rectangular. Accordingly, there are two types of co-ordinate scanning.

In the Cartesian co-ordinate scheme, to get to a specific point, one or both of the axes are moved automatically. The movement of the axis is translational. Moreover, in case of single axis movement, when the point of interest lies on the axis, the movement is stopped and then a cursor moves automatically towards the point along the axis, starting from the origin of the co-ordinate. In case of movement of both the axes, the translational movement continues until they intersect at the point.

In the Polar co-ordinate scheme, usually one of the axis rotates (either of the clockwise or anticlockwise direction) until it passes through the point. Then a cursor moves automatically towards the point along the axis until the point is reached.

B. The Matrix Approach

In this type of scanning, the screen is thought of as representing a matrix. The items that are present on the screen are individual cells of that matrix. There are three variants available for this approach.

In Group-Row-Item scanning or three dimensional matrix scanning, the region of interest is segmented into a set of sub regions, each of which is identified as a block. Each block is further divided into a set of rows to make this region of interest more specific. A row is in turn divided into a few cells which forms final level of this decomposition. In this scheme, the system initially starts a block level scan. During this process, the block that

contains the desired item can be selected by the user. Once a block is selected, the system begins a row level scan inside the block. During the row level scanning, the row in which the desired item lies is selected. Then the cells (columns) of the selected row are scanned. When the scanning reaches the desired item, the item is selected.

In Row-Column scanning or two dimensional matrix scanning or step scanning, the region of interest is broken into rows and cells only. Here the system initially performs the row level scan. Once the user selects the desired row, the system performs the cell level scan. When the scanning reaches the desired item, the item is selected.

In Linear scanning or one dimensional matrix scanning, the region of interest is broken into cells only. Each cell represents an on-screen item. These cells are scanned periodically. When the scanning reaches the cell that holds the desired item, the item is selected.Hybrid scanning mechanisms incorporating both approaches is also possible.

IV APPLICATIONS

A. IBM Home reader

IBM Home Page Reader is a self voicing web browser for the users who are blind and visually impaired [28]. The web browser has different features. Those features are:

a) Voice-prompted installation enables a person who is blind or visually impaired to set up HPR independently.

b) Different gender voices used for reading text and making differentiation of content easier. The user can specify which voices read which page elements.

c) Fast forward function enables users to skim web pages.

d) Page summary and "Where am I?" commands tell number and location of elements on the current web page.

e) Six different language versions available: U.S. English, French, German, Italian, Japanese, and Spanish.

f) Most language versions can read web pages in any of these languages: American or British English, French, German, Italian, or Spanish.

B. Sanyog

Sanyog is an ACC system for multilingual communication for people with speech and motor impairments [29, 30]. The system describe is an Iconic Communication System where the user communicates by selecting icons.

Through an iconic interface, this system can accept icons as input. Those icons possible represent a word or a phase. Special access switch are provided for selection of icons for the neuro-motor disordered. The iconic interface operates based on a query-response-based interaction mechanism to make the selection of icons easy and intuitive. The user first selects a verb icon from the interface to initiate communication in this mechanism. For each verb, this system internally stores a set of possible questions. Those questions can be asked with that verb. In a sequential way, the system gives those questions to the user. For each question, a set of possible answers is shown to the user. The user can select one or more from this answer set or can ignore and proceed to the next question. The questions and answers are represented in the iconic form. On clicking the icons, the system can automatically form natural language sentences that are syntactically and semantically correct. In this system, generated sentence can be spoken out.

An on-screen keyboard is available in this system. Through the special access switch, the keyboard can be operated. This keyboard has a special type of word prediction mechanism. Apart from the above two methods of communication, the user of Sanyog can also communicate using presorted messages. This implies that the icons or the presorted messages can be changed according to the preferences and needs of the user. The underlying technology of the system includes (a) natural language processing such as morphology synthesis, grapheme to phoneme mapping and sentence generation using semantic frames; (b) speech synthesis; (c) human computer interaction principles. Nowadays, this system works in three languages. Those are Bengali, Hindi and English.

C. SweepSticks

It is an adaptive virtual mouse, is a special access system [2]. SweepSticks has been provided alternative mouse access to people with neuromotor disorders, especially those suffering from cerebral palsy. The movement of the mouse on the computer screen resembles the sweeping action of two sticks that’s why it is known as SweepSticks. SweepSticks tries to emulate most of the features of a mouse.

The main interface of SweepSticks has some modules. Those modules are homing module, coordinate selection module, repeat module, adaptation module, button click module. In SweepSticks, mainly two types of scanning mechanism are used. Those mechanisms are coordinate scanning (polar and/or Cartesian) and matrix scanning[6]. Coordinate scanning is used to navigate on computer screen. On the computer screen, every

element is treated as a point. One or both axes of the coordinate system are made to move automatically as if sweeping the entire screen area to get a specific point. Matrix scanning is used to navigate on the main interface of SweepSticks[7].

V SYSTEM ARCHITECTURE

In my proposed computer based Special Access System contains three major components. These components are,

a) The Physical interface through which the user makes some selection (s).
b) The processing unit (OS) that works on the selection (s) made by the user to produce some output.
c) The browser on which all the operation are done and shown the output.

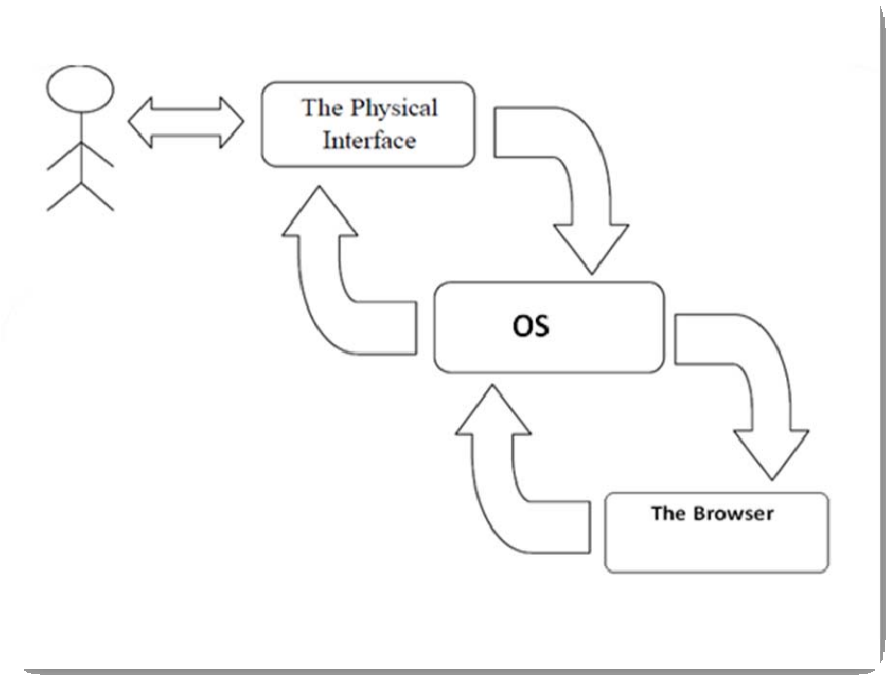

Fig.1: A Schematic of Proposed Special Access System

However, to make the proposed Special Access System in India, other components are required to be added with the top level architecture.

The present system consists of some major modules. A brief description of each of the module shown in the figure is given below.

A. Special Access System

This module is used to make the system accessible to severely disabled users[8]. It has two components. The software component, known as Scanning and the hardware component consisting of special hardware access switches. The scanning component is used to make the system accessible with the special hardware devices[9].

The mechanism that has been developed during the course of the present work is a matrix scanning mechanism. The scanning mechanism is supported by specially designed access switches but the switches will not be discussed any further in this chapter since the development of the switch hardware was done independent of this work. Though internet access is the main focus of the present work, the present system accommodates many forms. In this system, variants of the matrix scanning mechanism are used[10]. Those are two dimensional matrix scanning, block-row-item scanning and linear scanning.

B. Physical Interface for Communication

From the user's point of view, the most important module of the system is the physical interface. In the present system, the interface shows to the user a set of operation and allows the user to select from them[11]. The interface works in an interactive way where it poses some operation to the user and the user responds by selecting some icons from the interface. The selections made by the user from the interface are sent directly to the processing unit.

C.Level 0: The Choice of Operation

In level 0, there are six operations presen[12]t. Those are Url search, Keyword search, Educational search, Music & Video, Others and Exit. Every operation has an own specific task for accessing web browser.

VI CONCLUSION & FUTURE WORK

Design and implementation of a computer based Special Access System for the web access for the Indian population suffering from neuromotor disorders, especially those suffering from cerebral palse. Since it is difficult to develop systems for all Indian languages in a short time, the present work focuses on building systems in English initially. However, the system is designed in such a way so that systems for other languages can be developed easily from the existing system. Moreover, the system can be easily extended to incorporate new features. Those features along with the future course of action to be taken to make the system more attractive and usable are discussed below.

The system described in the paper is a Special Access System. The system has three components, namely a physical interface, the OS and web browser. With these proposed system, user can access web through any web browser. The system can be operated with special access switches. The switches are required to make the system accessible to the people with severe motor disabilities.

REFERENCES

[1] Albacete, P. L., Chang, S. K., & Polese, G. (1998). Iconic language design for people with significant speech and multiple impairments. In Vibhu O. Mittal, Holly A. Yanco, John Arnois, & Richard Simpson (Eds.), Assistive Technology and Artificial Intelligence, Application in Robotics, User Interface and Natural Language Processing (pp). LNAI 1458, Springer Verlag.

[2] Animesh Mukherjee, Koushik Chakraborty, and Anupam Basu. SweepSticks: An Adaptive Virtual Mouse for People With Neuromotor Disorders.

[3] Beukelman, R. D., & Mirenda, P. (1998). Augmentative and Alternative Communication (2nd Ed.). Baltimore, MD: Brookes publishing Co.

[4] Bertrand, D. (1998). AAC users profiles and related software selections. Proceedings of the Technology and Persons with Disabilities Conference (CSUN- 98). Los Angeles, CA.

[5] Burkhart, L. J. (1994). Organizing vocabulary on Dynamic Display devices: practical ideas and strategies. Proceedings of the 6th Biennial Conference of the International Society for Augmentative and Alternative Communication, 145-146. Hoensbroek: IRV.

[6] Cawsey, A. (1989). Generating Explanatory Discourse: A Plan-Based, Interactive Approach. PhD thesis, University of Edinburgh.

[7] Cook, A. M., & Hussey, S. M. (1995). Assistive Technologies: Principles and Practice. St. Louis: Mosbey-Year Book.

[8] Cross, R. T., Baker, R. B., Klotz, L. V., Badman, A. L. (1998). Semantic compaction in both static and dynamic environments: a new synthesis. Proceedings of the Technology and Persons with Disabilities Conference (CSUN-98). Los Angeles, CA.

[9] Glennen, S. L., & DeCoste. D. C. (1997). Handbook of Augmentative and Alternative Communication. San Diego: Singular Publishing Group.

[10] [10] McCoy, K. F., Demasco, P., Penington, C. A., Badman, A. L. (1997). Some interface issues in developing intelligent communication aids for people with disabilities. Proceedings of the 2nd international conference on Intelligent user interfaces, 163 – 170.

[11] McCoy, K. F. (1998). Interface and Language Issues in Intelligent Systems for People with Disabilities, In Vibhu O. Mittal, Holly A. Yanco, John Arnois, & Richard Simpson (Eds.), Assistive Technology and Artificial Intelligence, Application in Robotics, User Interface and Natural Language Processing (pp. 1 – 11), LNAI 1458. Springe r-Verlag.

[12] Reichle, J., York, J., & Sigafoos, J. (1991). Implementing Augmentative andAlternative Communication. Baltimore: Paul H. Brooks Publishing.

Dummy unit illustrating the design of a BrainGate interface. In 2002, Jens Naumann, also blinded in adulthood, became the first in a series of 16 paying patients to receive Dobelleâ€™s second generation implant, marking one of the earliest commercial uses of BCIs. The second generation device used a more sophisticated implant enabling better mapping of phosphenes into coherent vision.Â This procedure is often required for people with tumors or epilepsy that do not respond to medication.[146] During this procedure, electrodes are placed on the brain to precisely identify the locations of structures and functional areas.Â (2003) Chapter III: Design Principles of a Neuromotor Prosthetic Device in Neuroprosthetics: Theory and Practice, ed. The disease, disorder, syndrome, illness, or injury that is being studied. On ClinicalTrials.gov, conditions may also include other health-related issues, such as lifespan, quality of life, and health risks. Contact.Â a history of neuromotor disorders (CP or DD). a maximum age of 18 years. a minimum ability to actively grasp an object. Most low vision aids are designed to help people access detailed information through magnification and contrast enhancement. There are optical tools, such as handheld magnifiers and bioptics for magnification [21, 38, 53].Â Another approach is increasing visual field for people with limited field of view. One optical device is prism glasses [31], which expand peopleâ€™s vision by optically shifting objects from outside the userâ€™s visual field to a functional area.Â For instance, many web proxies have been designed to improve web accessibility [7, 8, 60]. Zhang et al. introduced interaction proxies [81], which improved the accessibility of mobile apps by adding an overlay that modified the input and output of the underlying app.