



EVOLVING COMPUTER ERGONOMICS FOR THE DISABLED IN THE SOCIETY

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**KABARAK UNIVERSITY 4th
INTERNATIONAL CONFERENCE**

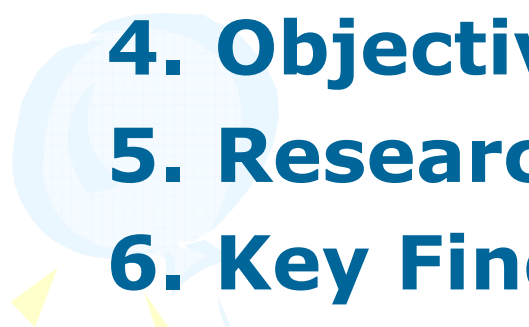

Evolving Computer Ergonomics for
the disabled in the society

17-7-2014

July, 17th 2013



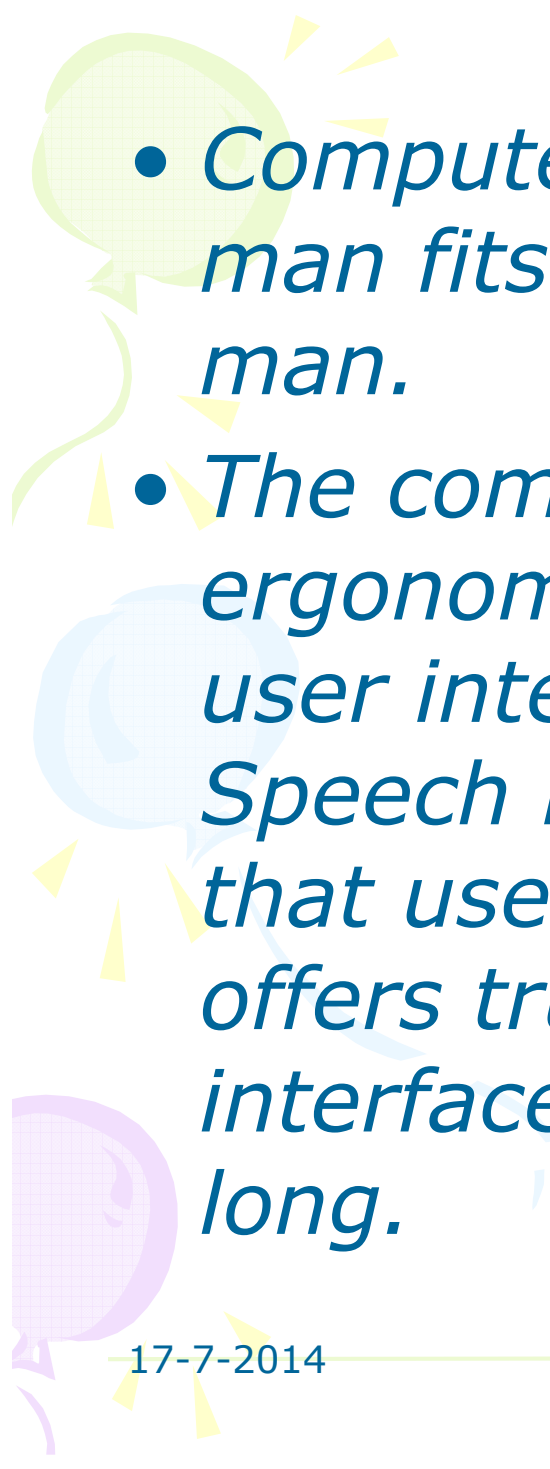
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Background

- *Human Computer Interaction (HCI) is the key to the user interfacing with the computer system.*
- *Some individuals using computers have physical, cognitive and sensory impairments. The needs of the physically challenged are never factored when Research & Development departments are designing state of the art inventions.*

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- *Computer ergonomics looks at how man fits work and not how work fits man.*
 - *The comfort of the user is key in ergonomic designs. Speech-based user interfaces like Automatic Speech Recognition (ASR) Services that use artificial intelligence and offers truly hands-free, eyes free interface that has evaded us for too long.*

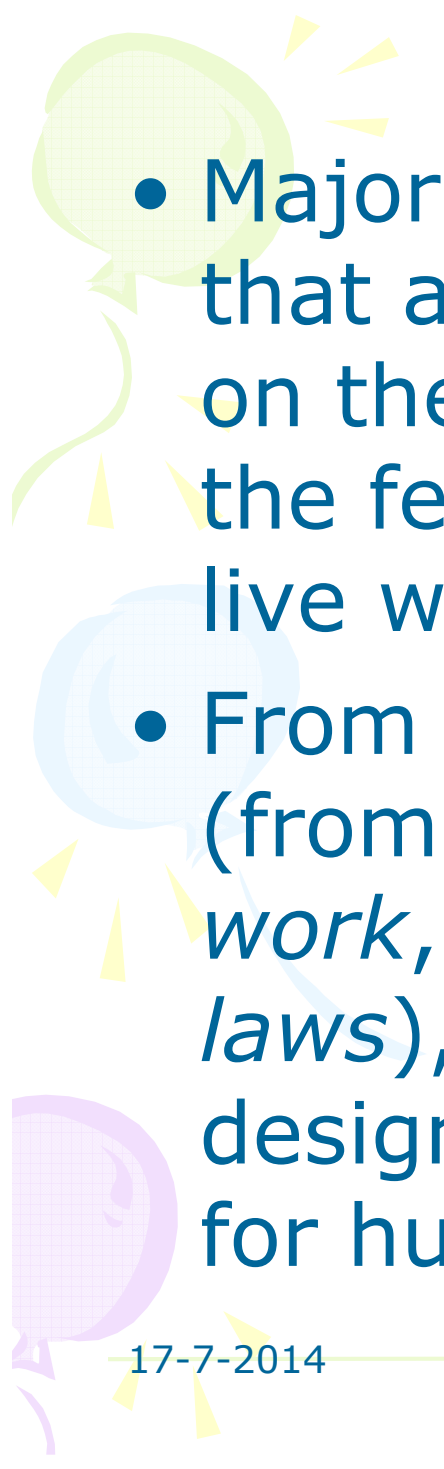
- *The paper examined the diverse innovations that manufacturers have used to ensure that they cater for the communication needs of the physically challenged persons in the society.*
- ***Simplicity in design of ICT systems for the disabled enhances their usability.***
- *The paper covers text entry devices, pointing devices, switch access, automatic speech recognition, and web accessibility.*


- *The study found out that technological innovations are today factoring in design and manufacture of computers for the disabled as evidenced by the like **Braille keyboards, Microphone & voice recognition software, Loudspeaker & text reading software and Braille printer.***
- *Others are **Mouth stick, Puff-suck switch, Tongue activated joystick, Eye-typer, Foot mouse and computer assessment software** among others in order to communicate effectively.*

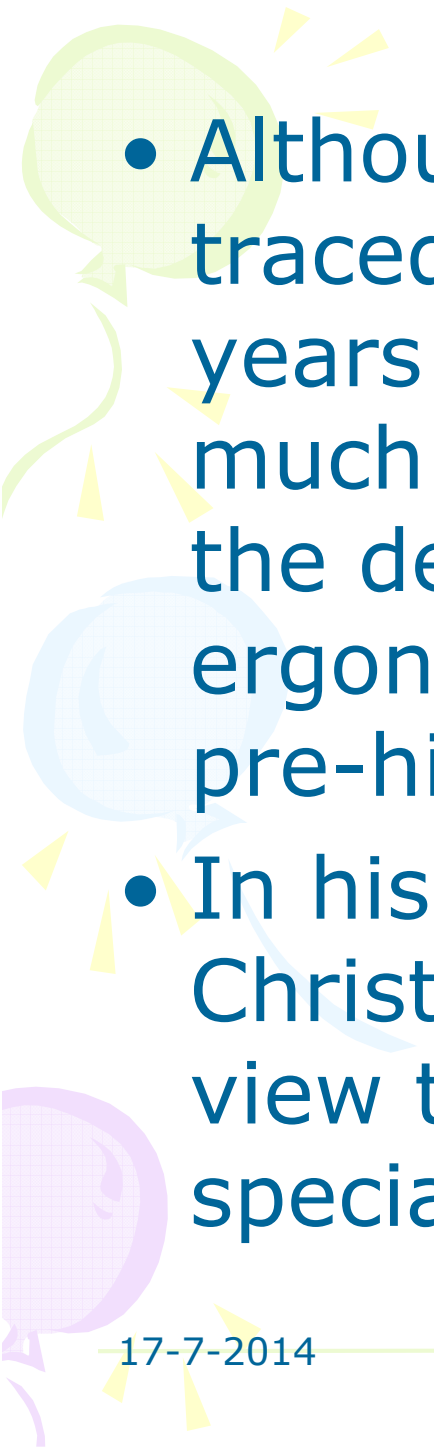



Introduction

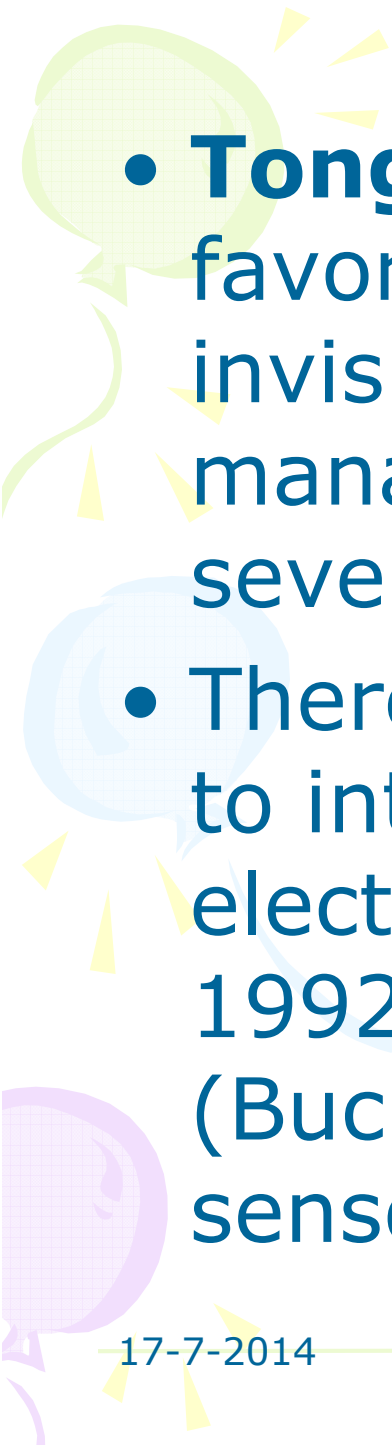
- We are living with people who suffer from impairments' all over around us.
- As we go around our daily chores, some of them are so disadvantaged that they are just struggling to do what their able bodied colleagues can do without a wink.

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- Majority of the computing gadgets that are mass produced today focus on the able-bodied as compared to the few people in the society who live with disabilities.
 - From the whatis.com's, Ergonomics (from the Greek word *ergon* meaning *work*, and *nomoi* meaning *natural laws*), is the science of refining the design of products to optimize them for human use.


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- Human characteristics, such as height, weight, and proportions are considered, as well as information about human hearing, sight, temperature preferences, and so on.
 - Ergonomics is sometimes known as *human factors* engineering.
 - From work place ergonomics, second edition ergonomics is the field of study that seeks to fit the job to the person, rather than the person to the **job.**

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- Although ergonomics can only be traced back formally for about 50 years there is evidence that it is much older than this, especially in the design of hand tools, where ergonomics input can be traced into pre-history.
 - In his 1976 review of ergonomics, Christensen (1976) expresses the view that the fact that early man specially selected pebbles,


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- ...made scoops from bone and fashioned tools and utensils in general, is an indication that those early hominids showed *'specific, intelligent reactions to the interactions between man and his environment'*, something that he considers is the very essence of ergonomics.
 - Computers should be **adaptive to suite the individual users** at all times

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- **Tongue-computer interfaces** are favorable since they are practically invisible and they are often manageable for people with even severe motor disabilities.
 - There have been different attempts to interface the tongue, including electrical contacts (Clayton et al, 1992), hall element techniques (Buchhold, 1995) and pressure sensors.

- The ***tongue is the future for disabled people***; Danish scientists have developed a groundbreaking product that enables paralyzed people to control wheelchairs; computers and TVs with their tongue.
- **Palatal plate with sensor:** The product is based on a so-called '*wireless tongue control system*' in which a dental palate with sensors can help paralyzed people control their wheelchair, mobile phone or their

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- ...metal plate which is fastened to the tongue. “The system offers paralyzed people more freedom and a higher quality of life as it makes it easier for them to switch between operating the wheelchair, the computer or other forms of assistive devices,” says the researcher behind the product, Lotte N. S. A. Struijk, an associate professor at the Center for Sensory-Motor Interaction (SMI) at Aalborg University, “

- In the long run, ***the appliances you can control with your tongue will only be limited by the imagination.*** "The tongue is as mobile as a finger".
- The *tongue's precision and the fact that it doesn't easily get tired are also advantages*, Ghovanloo adds.
- Most often, **good ergonomics is good economics**. In fact, that the **ergonomics of economics is the economics of ergonomics**.


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- Research on interfaces aims at improving interface utility, accessibility, performance and safety, and usability.




Statement of the Problem

- Total worldwide computers in-use was 1.67B units in 2011 and is projected to reach 2.55B in 2016.
- It had taken 27 years to reach 1 billion computers in use and market researchers say it will take only 5 years to reach the next billion (<http://www.etforecasts.com/pr/pr020112.htm>)

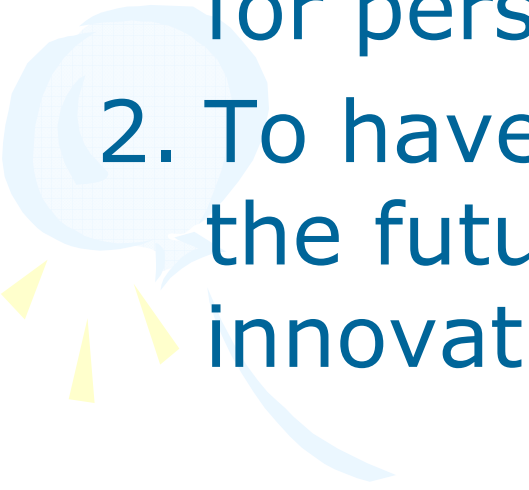
- People who use technological inventions will **meet barriers** of all types.
- However, ***assistive technology*** is helping to lower many of these barriers. By using computing technology for tasks such as reading and writing documents, communicating with others, and searching for information on the Internet, students and employees who are capable of handling a wider range of activities independently.

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- These barriers can be grouped into three functional categories: *barriers to providing computer input, interpreting output, and reading supporting documentation.*
 - Hardware and Software tools (known as adaptive or assistive technologies) have been developed to provide functional alternatives to these standard operations.

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- Whereas the physically impaired people are with us all their lives, they seem to be left behind when it comes to computer designs as the production output majorly targets the able bodied.



Objectives of the Study

1. To determine how computer ergonomics have evolved to cater for persons with disabilities.
 2. To have a clear understanding of the future trends of such innovations
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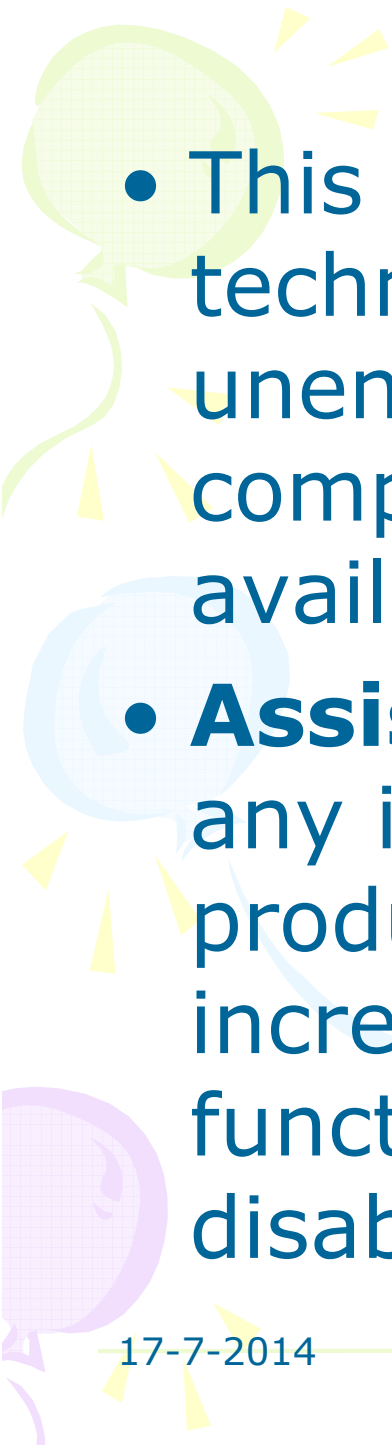
RESEARCH METHODOLOGY

- *Grounded theory methodology was used to guide collection and analysis of empirical data for this study.*
- *The study involved content analysis of existing literature from the manufacturers of computer systems and peripheral devices with a bias to those that target the ergonomics of the disabled.*



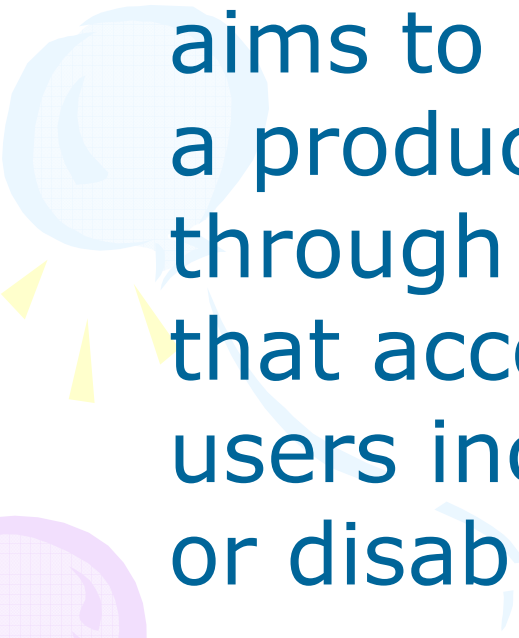
Key Findings


- i) Over the last several years, advances in microcomputer technology and computer programming have given rise to a new generation of methods for providing computer access.

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- This new generation of assistive technologies provides full and unencumbered access to virtually the complete range of commercially available microcomputer software.
 - **Assistive technology** devices are any item, piece of equipment, or product system (software) used to increase, maintain, or improve the functional capabilities of a user with disabilities.




ii) **Accessible design** is being promoted through concepts such as '**Design for All**'.

- This is an approach to design that aims to maximize the accessibility of a product, environment, or service through the provision of a solution that accommodates the needs of all users including those who are older or disabled.
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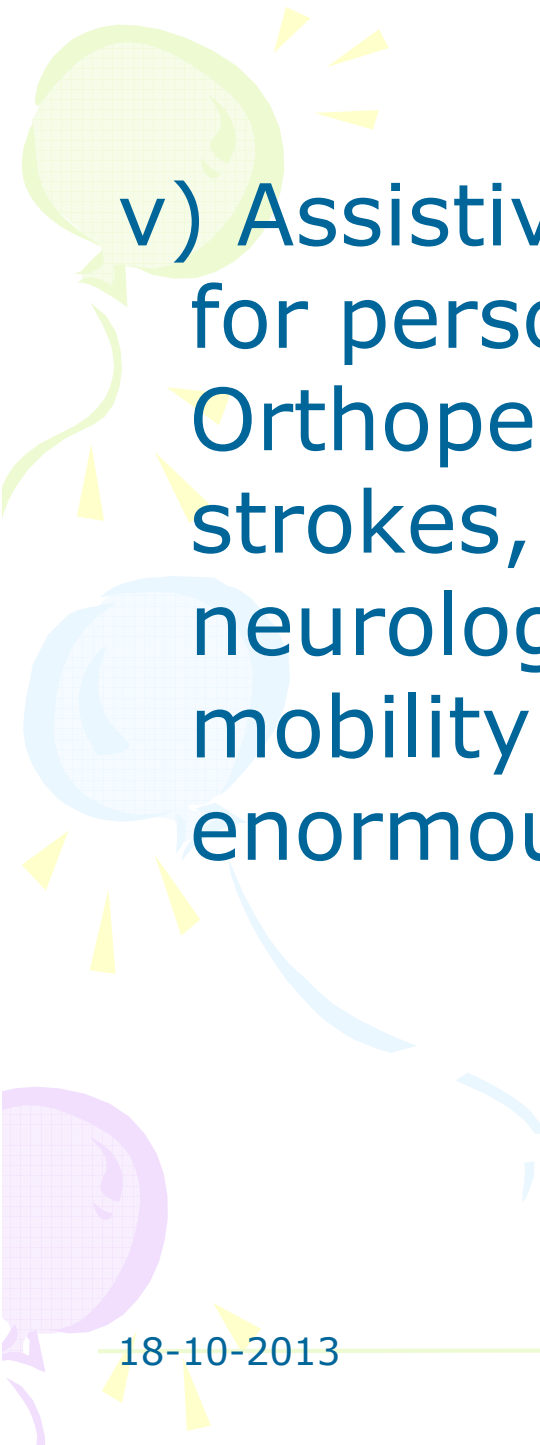


iii) The use of a Scanner and Optical Character Recognition (**OCR**) Software allows the blind computer user access to almost all printed material.

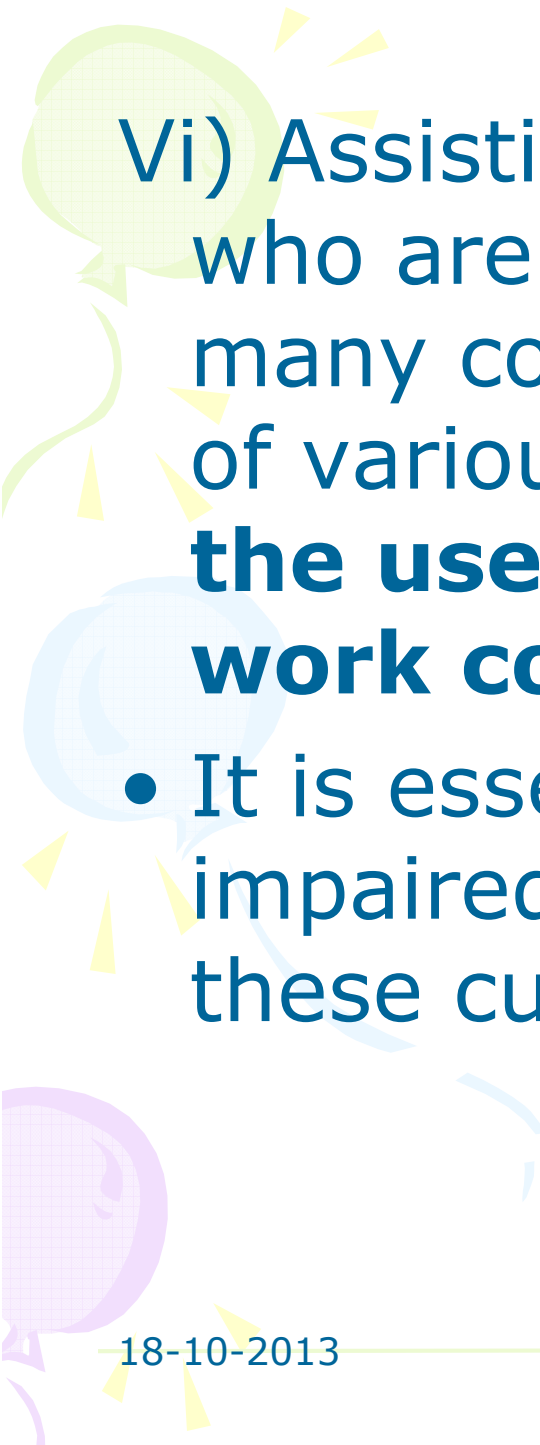


iv) Assistive technology for persons with low vision; the problem is easily defined: the normal computer screen is far too small to be read easily by individuals with limited vision. The solution is to **enlarge the text on screen.**

- Software based Large Print programs allow the low-vision computer user unlimited access to all software applications either text or graphics based.

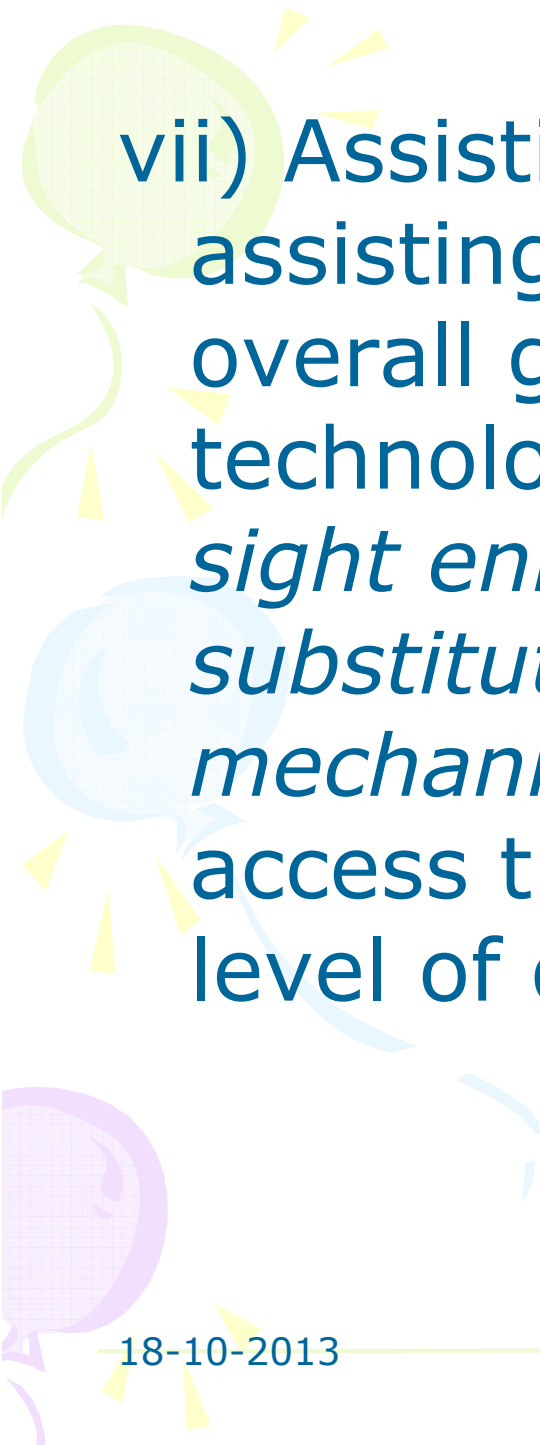


v) Assistive technologies are available for persons with orthopedic. Orthopedic resulting from accidents, strokes, birth defects and neurological disorders have range of mobility impairments that are enormously varied.

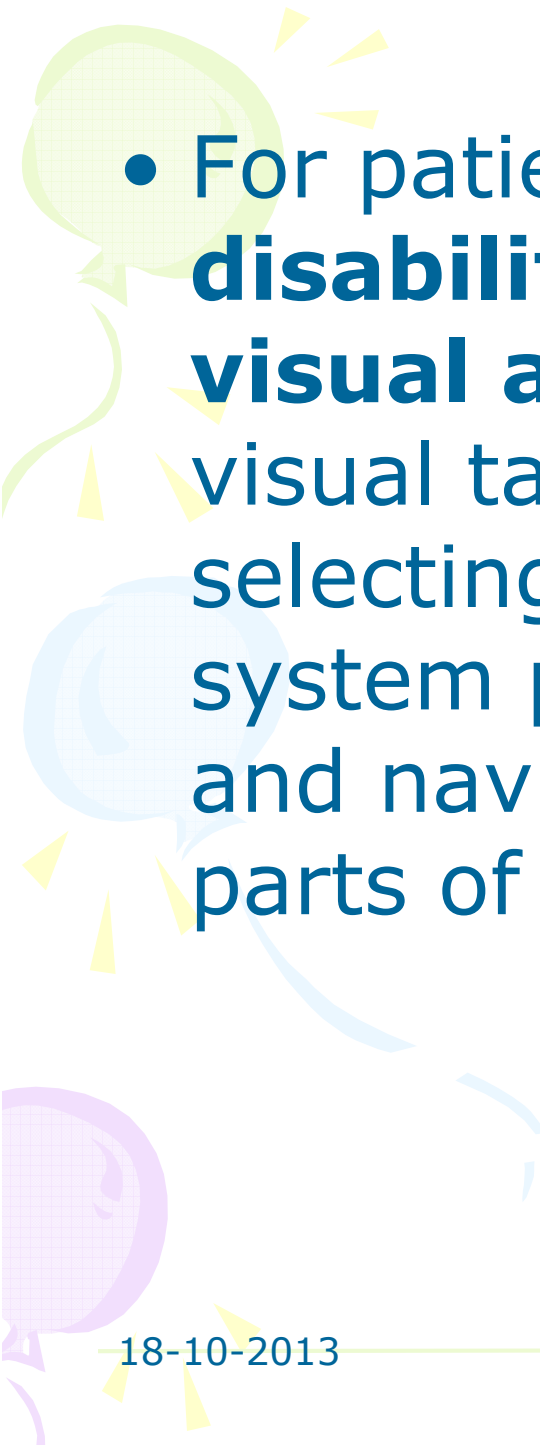


Vi) Assistive technologies for persons who are **deaf or hearing impaired**; many computer programs make use of various **tones or beeps to alert the user to error conditions, work completion or other events.**

- It is essential that deaf or hearing impaired persons have access to these cues.

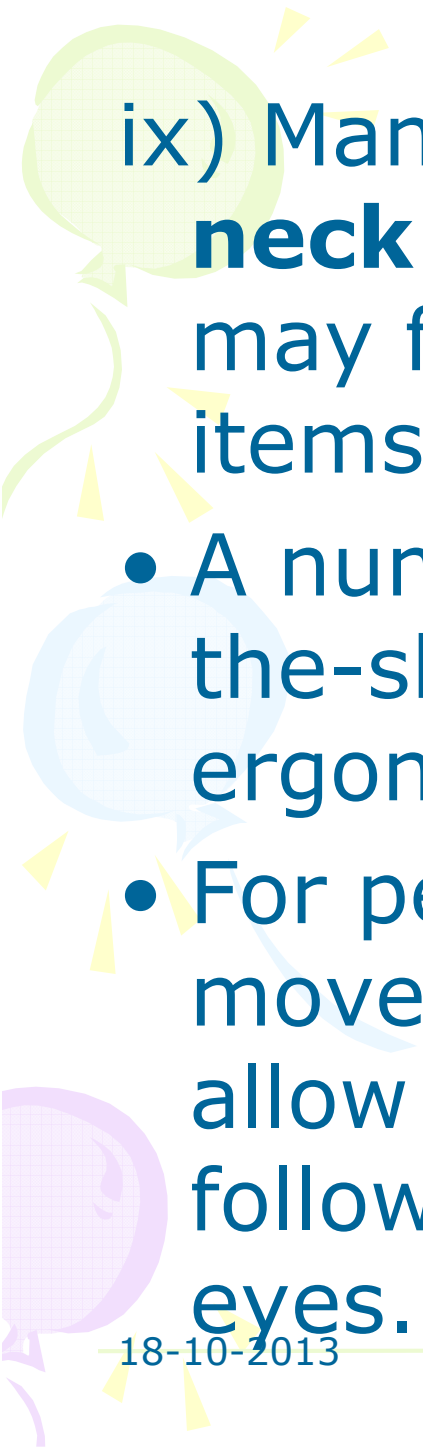


vii) Assistive technology is vital in assisting the disadvantaged; the overall goal of visual assistive technology is to provide equivalent, *sight enhancement or sight-substitution rehabilitation mechanisms* for computer and Web access that are appropriate for the level of disability.

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- For patients with **severe visual disability, this requires non-visual alternatives** for traditionally visual tasks such as reading text, selecting from menus, responding to system prompts, analyzing tables, and navigating between different parts of Web sites.

viii) In general, this is accomplished by **translating the visual screen display into auditory output** (e.g. screen reading software with speech synthesizers), tactile output (e.g. Braille display that echoes the screen display), or a combination of the two modalities.

- The problem of Web access for visually disabled patients is particularly difficult because the Web navigation paradigm is dependent on **graphical interfaces with visual cues.**





ix) Many people especially **those with neck and upper back problems** may find alternative positioning of items more comfortable.

- A number of companies provide off-the-shelf and/or customized ergonomic workstations.
- For people with very limited movement, there are systems that allow control of the computer by following the movement of the user's eyes.

Conclusion

- Assistive technologies that have come to light in this study are -
Puff-suck switch, a kind of switch is excellent for someone with limited physical mobility, Magnet and glue turn the tongue into joystick - A headset that makes it possible for a person to precisely control a wheelchair or computer using only their tongue has begun trials with...

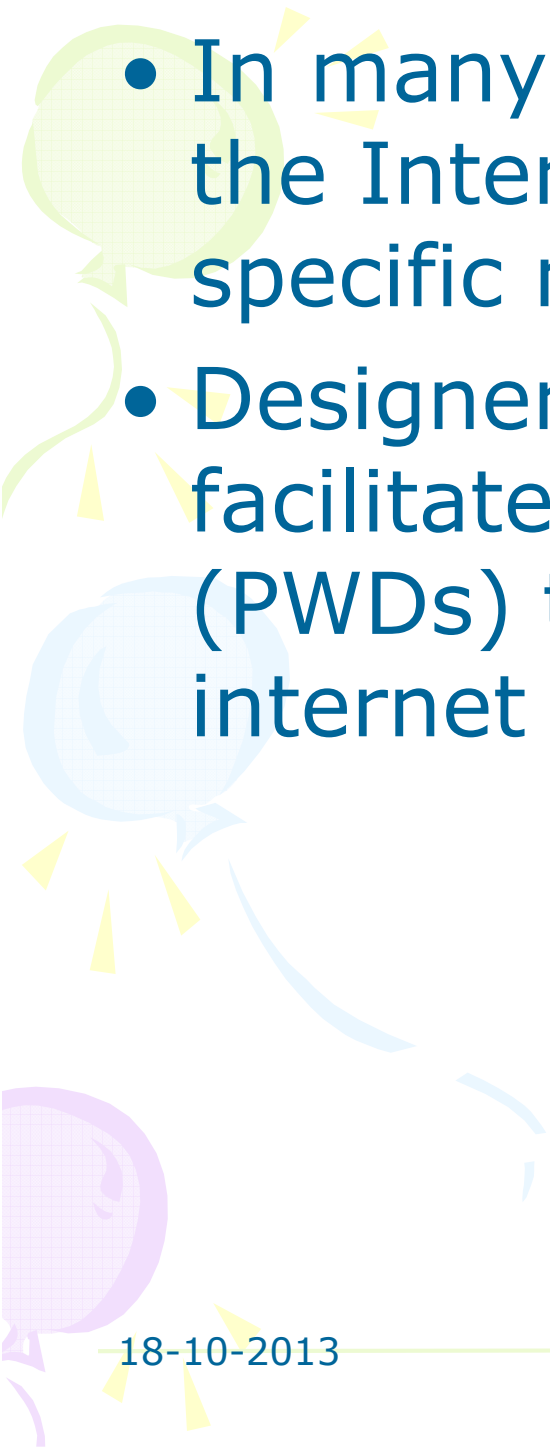
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- ...spinal injury patients in the US, Palatal plate with sensor - The product is based on a so-called 'wireless tongue control system' in which a dental palate with sensors can help paralyzed people control their wheelchair, mobile phone or their computer by using a small metal plate which is fastened to the tongue.
 - From the study, the tongue is the future for disabled people;

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- Danish scientists have developed a groundbreaking product that **enables paralyzed people to control wheelchairs; computers and TVs with their tongue.** A new product, called **iTongue**, aims to **help people with spinal injury regain control of their lives.** The purpose of screen reading programs is to translate text and graphical displays into auditory output for the **blind.**



Recommendations

- The recent information technology revolution has produced rapid social changes.
- Access to computers and the Internet is increasingly required for education and employment, as well as for many activities of daily living and these factors are threatening to widen the existing “digital divide” in our society.


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- In many ways, the rapid growth of the Internet did not account for the specific needs of low vision patients.
 - Designers should design systems to facilitate People with Disabilities (PWDs) to harness the power of the internet and live like normal persons.



References

- A Moray, N, 1995. Ergonomics and the global problems of the 21st century. *Ergonomics*, 1995, Vol. 38, No 83, 1691 – 1707.
 -
 - Adetutu Ijose. " Lessons I Learned the Hard Way"
 - Internet: <<http://computeragehealthrisk.com>>4 October 2009 [10 April 2012]
 -
 - Brown, C. M. L. (1988). Human-computer interface design guidelines. Westport, CT: Ablex Publishing
 - De Moraes, 2002. Why UK ergonomics lost its chance of expansion in Brazil: a contribution to the English ,Ergonomics history. In McCabe, P (Ed) Contemporary Ergonomics 2002. Taylor and Francis.
 -
 - Gaines, B.R. & Shaw, M.L.G. (1986b). A learning model for forecasting the future of information technology. *Future Computing Systems*, 1(1), to appear.
 -
 - Helander, MG, 1997a. Forty years of the IEA: some reflections on the evolution of ergonomics. *Ergonomics*, 1997, Vol. 40, No 10, 952– 961
 - 18-10-2013
-
- Evolving Computer Ergonomics for
the disabled in the society

- Helander, MG, 1997b. in Salvendy, G (Ed) The Human Factors Profession. Handbook of Human Factors 2nd Edition. 1997, John Wiley.
-
- <http://www.etforecasts.com/pr/pr020112.htm>
-
- Howie, A, Macdonald, W and Ferguson, D, 1988. The Ergonomics Society of Australia. *Ergonomics*, 1988, Vol. 31, No 5, 751- 760
- Jan Dul and Bernard Weedmaster, *Ergonomics for Beginners* - - A classic introduction on ergonomics - Original title: *Vademecum Ergonomie* (Dutch) -published and updated since 1960's
- Stephen Pheasant, *Bodyspace* - - A classic exploration of ergonomics
- Kim Vicente, *The Human Factor* Full of examples and statistics illustrating the gap between existing technology and the human mind, with suggestions to narrow it
- Liu, Y (2007). IOE 333. Course pack. Industrial and Operations Engineering 333 (Introduction to Ergonomics), University of Michigan, Ann Arbor, MI. Winter 2007
- Mallett, R. (1995). Human factors: Why aren't they considered? *Professional Safety*, 40(7), 30-32.
-
- Marshall C., Nelson C. and Gardiner M.M. (1987). Design guidelines. In *Applying Cognitive Psychology to User- Interface Design*, eds. M. M. Gardiner and B. Christie (Chichester:



Q&A

Thank You!

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