HCI Guidelines for Designing Website for Blinds

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ABSTRACT
This Paper discusses that Computers and computerized applications had emerged as a household product. But, it's sad that computer has reached everywhere but not to everyone. Not because of its cost or other physical attributes but due to lack of innovation in interaction technology. You need to direct this research and development towards interaction with technology. There are 285 million people across the globe with vision impairment and to achieve the maximum efficiency of human race you can't ignore such a huge number. HCI is often termed as design oriented field but you need to understand the importance and rediscover the canvas of HCI. This paper intends to specifically understand the HCI in the arena of visually impaired people keeping the available theories, psychological, social, biological and physical factors of the target audience (visually impaired) in mind. In conclusion this paper discusses HCI guidelines that will direct us to design and develop computing applications and solutions for visually challenged people specially blinds.

Keywords
Computing, Visually Impaired, Interaction Design, Design Guidelines, Communicate Design, Theory, Methodology, Sketching, Prototyping, Design-oriented Research, Research-oriented Design

1. OVERVIEW
(as per the facts provided by WHO)

- Today 285 million people of the total are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision.
- Roughly 90% of the worlds visually impaired live in developing countries.
- The total quantity of people visually impaired from infectious diseases has greatly reduced in the last 20 years.
- Number of blinds and visually impaired people has increased to roughly double. (Chart 1)
- Mainly people of age group 20-25 have been affected. (Chart 2)
- Various Screen Readers and Virtual Audio Displays have been developed to facilitate blinds for certain computing operations, but have never been able to reach the key demographic.

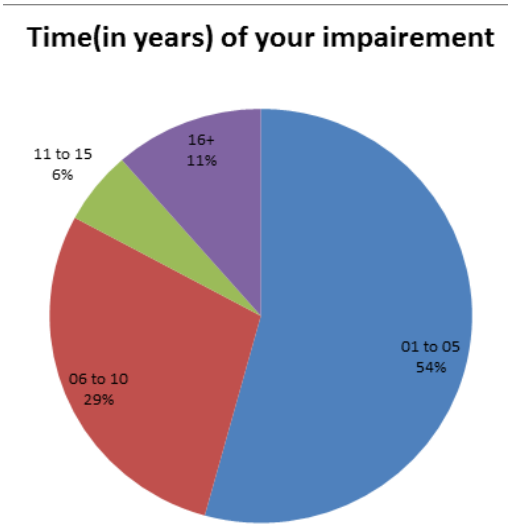


Fig 1.1: Time of your impairment.

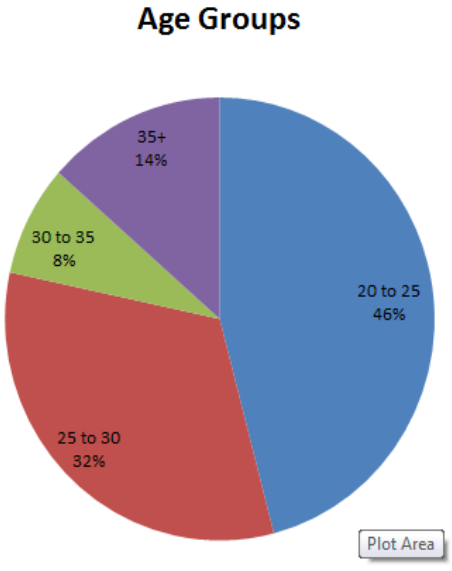


Fig 1.2: Age Groups

2. LITERATURE SURVEY

Earlier investigations tried to establish different auditory interfaces and environments for the visually impaired as early as the 1990s. The *Sonic Finder* [8] was an Apple program which tried to integrate auditory icons into the operating system for file handling, but it was not made commercially available primarily because of memory usage considerations. Mynatt and colleagues presented a transformed hierarchical graphical interface, utilizing auditory icons, tactile extension and a simplified structure for navigation in the *Mercator* project [4]. The hierarchical structure was thought to best to capture the underlying structure of a GUI. The project focused on text-oriented applications such as word-processors, mailing programs but neglected graphical applications, drawing programs etc. The TTS module was also included. A basic set of sounds were presented to users as depicted in Table 1.

Furthermore, they used filtering and frequency manipulations to portray screen events, e.g. appearing of pop-up windows, selecting items or the number of objects.

These were mostly chosen intuitively and were sometimes not very helpful at all, because some sounds are ambiguous (closing a pop-up window can have the same sound as "close" or even some speech feedback) or the related events are not really important (pop-up blocking reduces pop-ups to a minimum). *A more general problem is that there are no standards or defined ways to use the simplest modifications in volume, pitch, timbre or spectral content of an auditory event.* For instance, the sound of paper shuffling in Mercator represented "switching between applications" but this sound is clearly not good in Windows, where a similar sound is mapped with the recycle bin. Different operating systems may require different sound-sets, but the overriding concern is to find the most important applications, functions and events of the screen that have to be represented by auditory events.

3. PROBLEM AREA

- Blinds cannot read and take advantage of all the literature available for them until and unless it is in brain.
- Demotivating ambience affects their will to learn and share.
- Due to limited resources for learning their output/ contribution to the society in the field of philosophy, technology, theories etc is also restricted.

3.1 Implementations Required

As per the research on sharpest sense after visual impairment

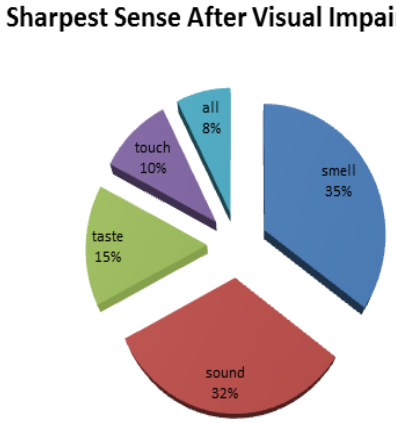


Fig 3.1: Sharpest Sense after Visual Impairment

Out of touch, taste, smell and sound; smell and sound has come up as the sharpest sense after visual impairment in impaired people.

Among smell and sound, sound/voice/speech is the best medium for learning.

Out of the 4 interactions : data interaction, voice interaction, behavioural interaction and image interaction, behaviour and image are eliminated as blinds may not identify it thus best interaction way for blinds is voice interaction.

The main challenges that the previous results faced was a lack of properly documented guideline specifications.

Hence, this paper proposes a way to specify guidelines for the website itself, so as to enable the Screen Readers and Visual Audio Devices to serve their full purpose effectively.

3.2 Proposed Research

Fig: Response time of blinds.

This study (Fig 3.2, Fig 3.3) indicates :

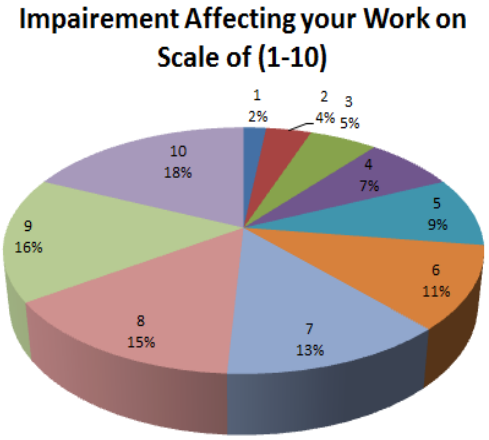


Fig 3.2: Impairment affecting your work.

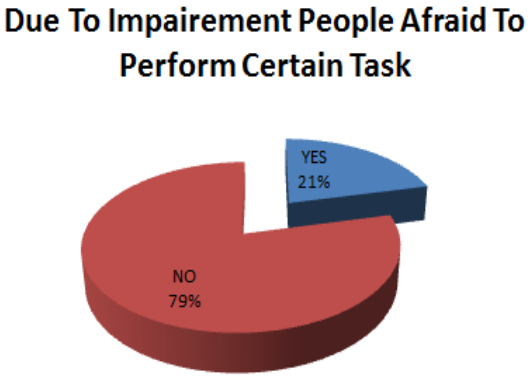


Fig 3.3: Due to Impairment people afraid to perform certain task.

Above data indicates that even people with partial vision are afraid to perform certain tasks in daily life. Thus to provide a solution which is adaptable, learnable, whose antiques are memorable and which is usable without any hassle plus the output of the proposed products should be motivating and encouraging for blinds so that they feel confident and contribute to the knowledge bank actively.

4. CHALLENGES

- To enable resources in various languages for blinds without brain.
- To develop an interface / a medium to interact with blinds and visually impaired which is easily adaptable by blinds even for those with limited technical exposure.
- Design challenges are as follows :
- Voice interaction is the best interaction for blinds.
- Processing power of such systems should be faster.
- Any hardware used should be durable.
- Customization as per the regional preferences should be there.
- Controlling of application should be handy and flexible.
- Feedback system should be highly adaptive.
- Exceptions handling is must.

4.1 Normal website challenges:

The biggest challenge in defining HCI design principles for blinds is to implement few of the key principles of Human-computer Interaction:

- Use of default terminologies- For a GUI-based interface, certain terms and metaphors can be used to make the environment familiar to the user, and for obvious reasons user has some expectations from the website environment.
- However, in your case expectations are narrowed to learn-ability and accessibility. In fact, to implement default terminologies, you need to develop a language library, knowledge-base, inference engine, voice synthesizer and mouse emulator
- Correlating the website with user's expectations-
- Generally, user's have a mindset before using any website based upon the real world experiences and other machine interfaces. For example, a person accessing YahooMail will find the same operations such as Send, Forward, Draft etc. in other mailing services like Gmail or RediffMail. The priciple of familiarity holds true here, as the person does not need to redefine or re-learn new paradigms while migrating in-between websites.
- The same concept may apply to a blind person, as he would not want to familiarize himself repeatedly while migrating to a new website.

4.2 Actions-

- A GUI-based website has distinct set of displays to define and distinguish instructions. The user, in this case, does not need to learn or memorize the operations or commands as he can review them on-screen at any time.
- A blind person does not have such luxury. All information is voice-oriented and hence it is difficult to define and distinguish instructions in a speech-based pattern.

4.3 Control Over Website-

- Whenever a visually equipped user opens a desired website. He feels a sense of control over it, as he can see and determine the parameters leading to the success or failure of that operation.
- A blind person on the contrary lacks this sense of control over the loading website as he depends on only the definite feedbacks. It is therefore vital to define in-transaction feedbacks too.

4.4 Consistency-

- Usually the design of a website is defined by consistent interface, predefined color schemes, and interactive graphics. They however, do not serve a meaningful purpose to the blind person. And therefore a lack of consistency definition for the visually challenged often leads to extremely confounding and inconvenient accessibility.

5. GUIDELINES FOR WEBSITE DESIGN

Now scientists from the UCLA Department of Neurology have confirmed that blindness causes structural changes in the brain, indicating that the brain may reorganize itself functionally in order to adapt to a loss in sensory input.

5.1 Proposed Guidelines

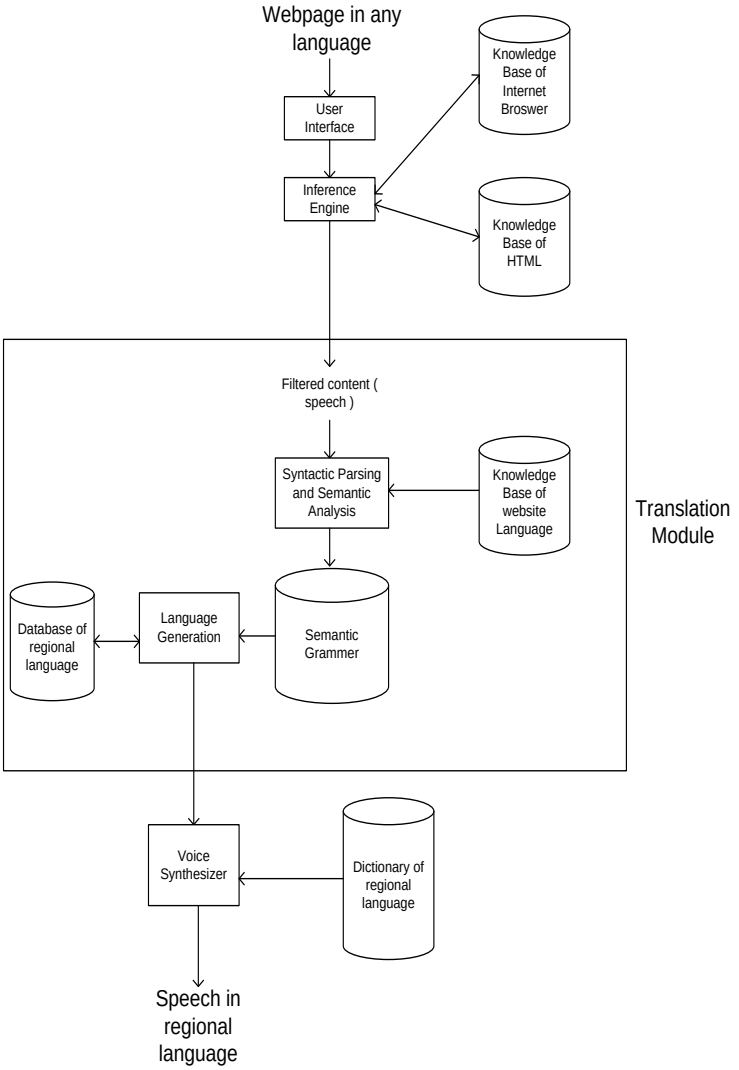
- Hands-free navigation: Each and every control of the website must have an identifiable sound and some Meta data, so that you can achieve hand free navigation with the help of voice emulators and voice synthesizers.
- Distribution of data at discrete intervals, so as to avoid tedious clustering: As this paper is proposing all the content of the website in the audio format you must understand that a continuous or a lengthy speech might lack the learn-ability. Thus, the content should be divided into small paragraphs.
- Separate recognition paradigms for image and text with higher preference to textual data: sometimes images and any other multimedia content is placed between the text keeping the visual appearance of the website in mind, but in order to implement web accessibility for blinds and to enhance the performance of screen readers or any other tool you must keep all the related data together and place images separately that also with an appropriate tool tip or description that can be converted into speech.
- Detecting and eliminating non-essential background information: All the Websites contains plenty of icons, eye catchy multimedia content which might create an exception for over inference engine to generate results, or narration.
- Unnecessary blank spaces must be avoided: In context to the previous point you must also consider avoiding unnecessary blank spaces and white spaces.
- Icons or images are to be used solely from the predefined libraries or should be equipped with appropriate tool-tip.
- Navigation must be simple and linear in structure. Nested navigation should be avoided. User might face certain issues in memorizing the menu or information architecture of the website. Thus you have to keep in mind that your navigation should be as simple as possible.
- Pop-ups must be avoided. Pop ups should be blocked, It could be message box or a form, but it should be avoided as it will break the flow of the narration and it might confuse the user.

- Animations and Videos should be avoided; If included, must be embedded with proper description. Multimedia content is definitely not accessible by blinds but you cannot eliminate it from the designs as these websites will have normal users too thus these kind of content should be placed only if required to provide any necessary information but in order to make it accessible for blinds it must have some description which can be accessed by blinds through speech.
- Text and subsequent background must be in contrast to each other. This is useful only in the case where user is using any tool that is based on patter recognition but it is certainly very useful for the users with visual impairment or poor vision.

6. RESOURCE REQUIREMENTS.

- Separate libraries for identifiable sounds, sounds for icons and other predefined objects, auditory feedback/tool-tip: The only source of information to the blind person is the auditory feedback. Therefore, it is essential that the sounds providing feedback are from a predefined set of libraries. For instance, the sounds like successful button click, or a page currently loading, or a page successfully loaded must be from a predefined set of libraries.
- Knowledge-base for Language specifications: Accessibility must be compatible with regional languages, and hence, a knowledge-base must exist to define the regional language specifications.
- Inference Engine: The inference engine acts as the main processing component in converting the website to adequate itself to a blind man's understanding by sentence creation and language recognition etc.
- Contextual Grammar Error Detection and Correction Engine: An automated algorithm must be embedded to detect and correct incorrect grammar in both input and output.
- Voice Recognition Engine: The main purpose of this engine is to take an audio input from the user and convert it into an executable instruction. For example, if a user says, 'send the mail', it should initiate the operation of sending the mail.
- Voice Synthesizer Engine: Integrated with a text-to-speech converter, this engine will assist the blind person in accessing and understanding certain content.
- Specifications for recognizing basic HTML: Distinguishing between headers, footers, or main body of a website's content can be comprehended only if some specifications for recognizing basic HTML is available.
- Mouse Emulator: This one is the most integral part. It emulates a corresponding mouse signal and passes it to web server to execute an instruction.

7. IMPLEMENTATION OF PROPOSED GUIDELINES AND RESOURCES



8. CONCLUSION

This paper covers the diverse operation done so far in the field of screen readers and text to speech convertors and the usability analysis of blinds and visually impaired from their day to day activities to their work activities. A computation of surveys and interviews with visually impaired people was done to draw minimum requirements for any computing application for them. Based upon the persona drawn, our understanding of HCIU was utilized, and through thorough research of existing paradigms in the TTS and screen readers, the drawbacks of such efforts were identified. It was found that there are no standards or defined ways to work in the field of HCI for blinds. Thus, subsequently combining these three analyses, HCI guidelines for web design for blinds are proposed. In order to achieve maximum flexibility in website navigation for blinds and developing a bridge of language conversion and auditory interaction to implement usability of these guidelines and to also make it efficient for existing or previously developed website, an analysis of required resources and the possible algorithm for the implementation was done as a part of this research. To summarize, if you implement required resources in browsers and proposed guidelines in websites you might achieve hands free navigation of all the future websites in any language for blinds.

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