

Development of a Usable and Accessible Interface for the Cognitively Impaired Aged

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Abstract— *The aged often have difficulty in using the computer in order to facilitate their day to day activities. A lot of designers sacrifice usability and accessibility for fashionable design, hence resulting in poorly designed interfaces. It was found that most of the existing interfaces do not comply with the standards set forth by W3C and that older adults are not often included in usability studies of web design. This paper focuses on the development of interface that will enhance the user experience of the aged (65years and above) who suffers from cognitive impairment. It also compared the degree of efficiency of the interface with the existing interface.*

The methodology employed included the involvement of users throughout the process. A focus group of 5 elderly persons were selected based on their response in an interview conducted and questionnaires administered at a reputable geriatric centre in Nigeria. The system was designed and implemented using PHP, MySQL and HTML. Concepts of World Wide Web Consortium (W3C), a global centre for web usability design standard and Web Content Accessibility Guide (WACG) were employed.

The system was tested and evaluated by collecting the performance measures: time taken for successful task in seconds and number of errors. Then, questionnaires were administered and mean results were obtained. The results showed that the system developed had the mean time taken for successful task to be 42sec and the mean number of errors due to manipulation to be 1.22. Also, based on the mean results by questionnaire, the system was successful for the aged who are cognitively impaired.

Keywords— *Accessibility, usability, focus group, cognitively impaired, HCI, aged.*

I. INTRODUCTION

Human-Computer Interaction, often called HCI is a discipline that is concerned with designing software that allows a user to use the software, hardware and the environment with ease, in a pleasant, efficient and effective way to be able to achieve their goals. It has to do with the study, design, construction and implementation of human-centric interactive computer systems. It is a branch of Computer Science that makes life easier for users of computers and associated devices.

II. WEB-INTERFACE DESIGN FOR THE AGED

Designing for the aged is relatively easy and in most cases requires only a few stylistic changes to the code in order for a website to be considered aged friendly. Moreover, it has been noted by several usability experts including Ginny Reddish, Dana Chisnel and Jacob Nielsen that designing websites for the aged makes the usability better for all other user groups and enhances the users overall Internet experience. (Chisnel et al., 2006) also make an interesting point by stating, “Web sites that these older adults go to are usually developed by people

who are much younger, who have had greatly different experiences both offline and online, who have learned about the Web at a different time in life and in greatly different ways” (p.39). As a result of younger designers building websites and past usability studies, the following design heuristics should be considered when developing websites and Internet applications:

- Use conventional interaction elements by using standard treatments for links.
- Make it obvious what is clickable and what is not.
- Make clickable items easy to target and hit.
- Minimize vertical scrolling; eliminate horizontal scrolling.
- Ensure that the Back button behaves predictably.
- Provide clear feedback on actions such as on error messages.
- Clearly label content categories.
- Make the pages easy to skim or scan by using bullet points and large headings.
- Make elements on the page easy to read by using at least a 12-point size font or larger.
- Use adequate white space.
- Use the users’ language and minimize jargon and technical terms.

From the review of related works, it is found that the aged suffering from cognitive impairment often have problems with memory recall of web content, where they are within the context of websites and navigation around websites. This work addressed the above stated issues.

III. INITIAL REQUIREMENTS AND USER ANALYSIS

The requirements analysis began with a literature research exercise. The initial analysis determined that most currently available interface tend to be aimed at younger technologically knowledgeable audience and lack consistent user interfaces. The fundamental objective at this stage is to identify the specific needs that elderly people with cognitive impairment have. To take care of this, open interviews of elderly people was conducted at the Chief Tony Anenih Geriatric centre UCH to identify the problems encountered by users with limited abilities while using the interface. Questionnaires were also administered and the records were collected then analyzed.

After the interviews, a focus group of 5 elderly persons were selected. Typical usage scenarios were identified and described by the parties involved. Here, candidate user interface was selected to be: Facebook.

The focus group came in handy, and this facilitated the next activity, where a task analysis using task flow diagrams, activity diagram and use cases helped to verify the shared understanding of how users with cognitive impairment might interact with the interfaces.

The user requirements was obtained from the problems of existing system (through interview and questionnaire)

IV. PROBLEMS OF THE EXISTING SYSTEM

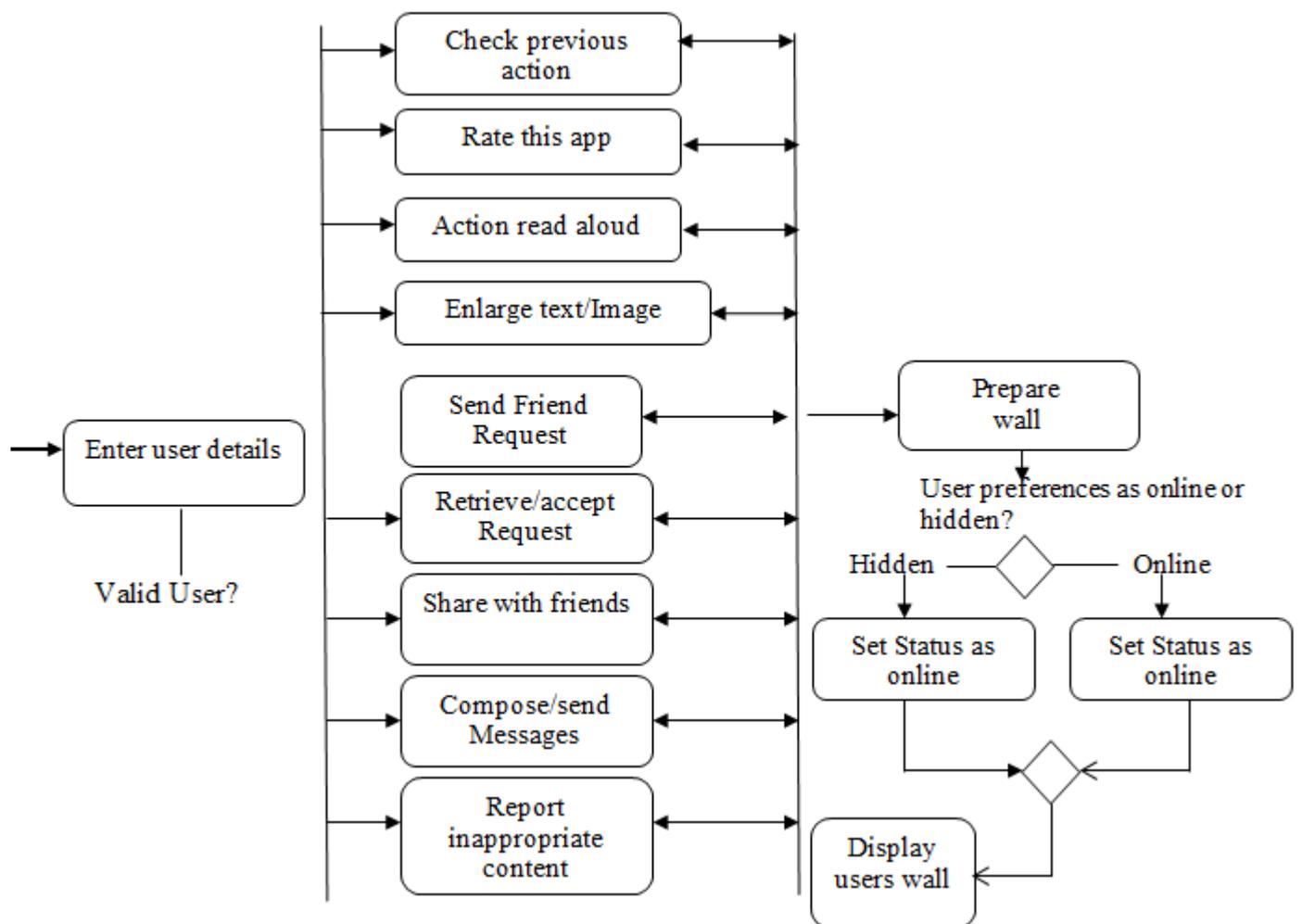
The problems of the existing interface for older users are:-

- Most older adults have problems navigating around websites, either due to small text fonts, small form pages, small link fonts, icons etc. and as a result of that, they spend a lot of time on the website.
- Older adults tended to be more cautious when interacting with websites such as clicking a link and spent a lot of time reading information before clicking a link.

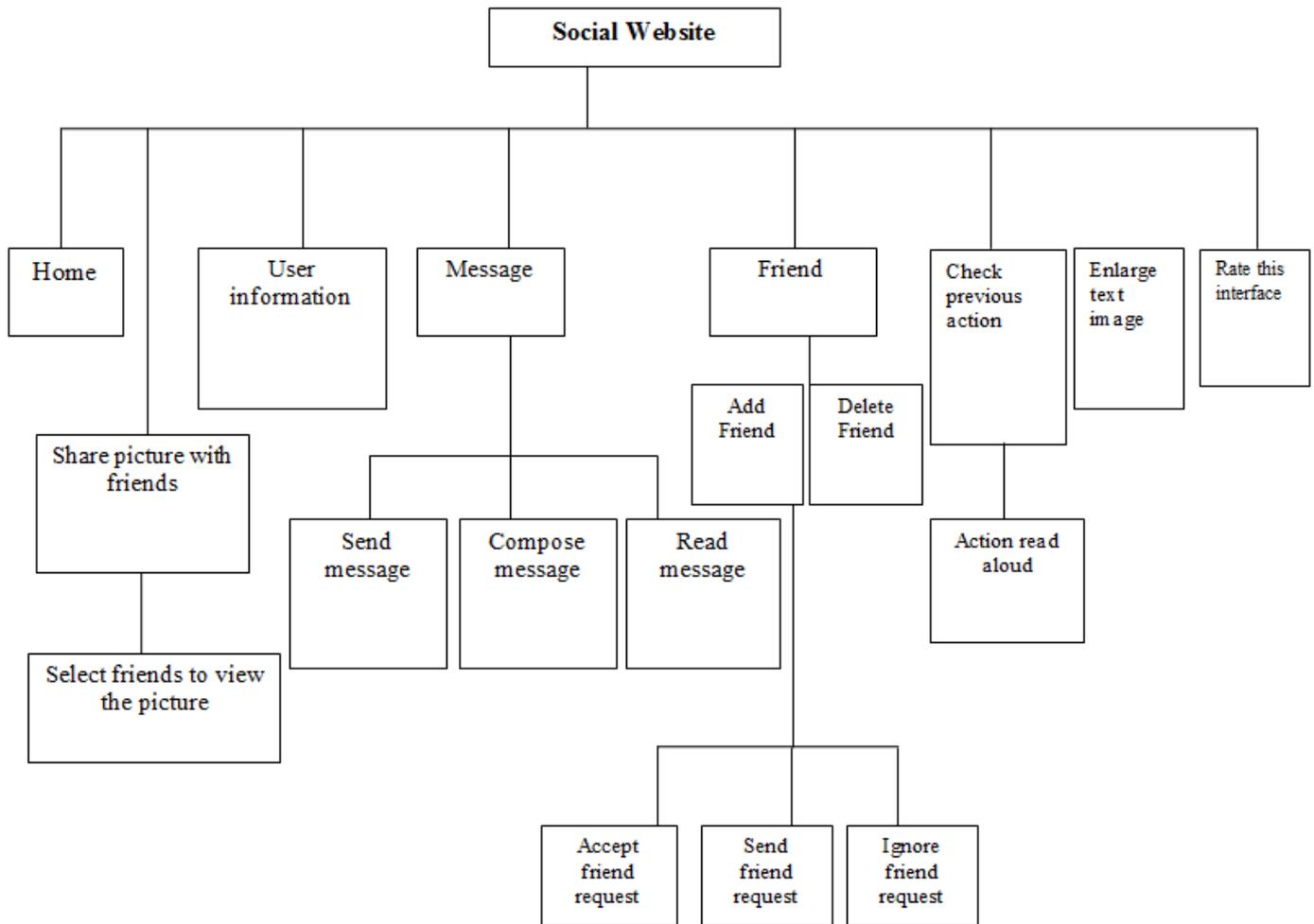
- Also, older users were often confused as to where they were within the context of websites several times they clicked on a link when they were already on that page.
- Accurate movement of the mouse was physically challenging.
- Another problem with older users was memory recall of web content, especially those with cognitive decline.

V. TASK ANALYSIS

This is the process of understanding the user’s task thoroughly enough to help design a system that will effectively support users in doing the task. Task here means difficult or tedious activities, what the user is attempting to accomplish. This was done using activity diagram, task flow diagram and use case.



Activity Diagram of the New System



Function Hierarchy Diagram of the New System

VI. EVALUATION

The performance of the model developed was evaluated using the following evaluation method/ approach:

- Observing users and asking users through interview and questionnaire.
- Field studies i.e. knowing what people do naturally and how the new interface intercede their activities.
- Then, comparing the results with what was obtained at the beginning of the research based on usability metrics: - effectiveness, efficiency and satisfaction.

VII. FEATURES OF THE NEW SYSTEM

The existing system (Facebook interface) did not cater for the aged users in areas of speaking text/narration, setting agenda, zoom in/zoom out. The new system has been developed to accommodate these. Therefore, the features of the new system are:

1. Message: This menu has other sub-menus i.e. compose message, send message and read message.
2. Home: This serves as the main/first page of the application.

3. Friend: This also have sub-menus viz;1)add friend 2)send friend request 3)delete friend.
4. Check previous action: This enables the user to know his/her last action at the interface. This is to facilitate memory recall
5. Speaking text/narration: This enables the user to have access to text/image in auditory form.
6. Agenda: This serves as reminder for intended tasks i.e users can add tasks and set a reminder against that date.
7. Increase/Decrease Font: This enables user to increase/decrease the size of text. This is to aid their processing ability.
8. Zoom In/Zoom Out: This enables user to increase/decrease the size of images. This also aids their vision and processing ability
9. Search: This allows the user to locate their friends.
10. Share picture with friends: This allows user to share pictures with those on their contact.
11. Express your mind: This is linked to the home page and it allows users to pass their feelings.
12. Rate this interface: This enables the user to rate the interface on a scale of range 0-10

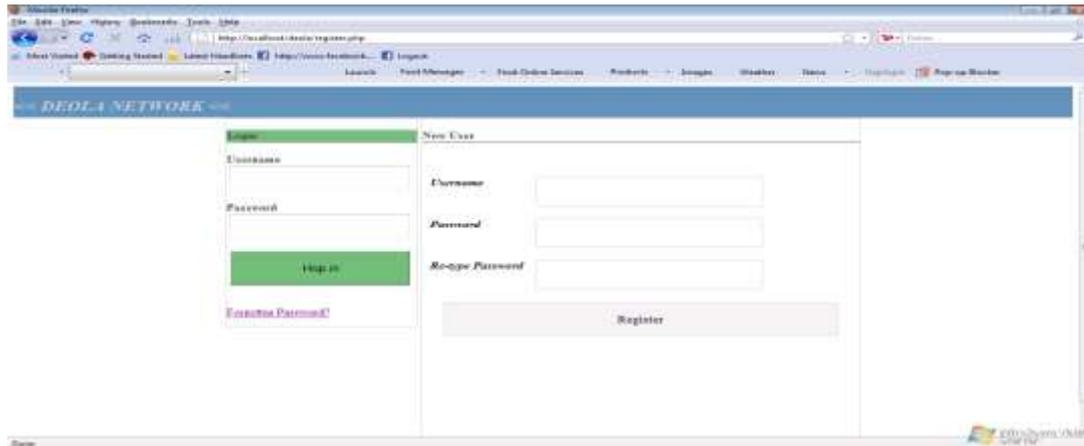


Fig. 7.1. The login interface.

The aged user logs in with their desired username and password combination.



Fig. 7.2. User makes use of the *Increase Font* feature of the system.

This feature enables user to increase/decrease the size of text. This is to aid their processing ability.

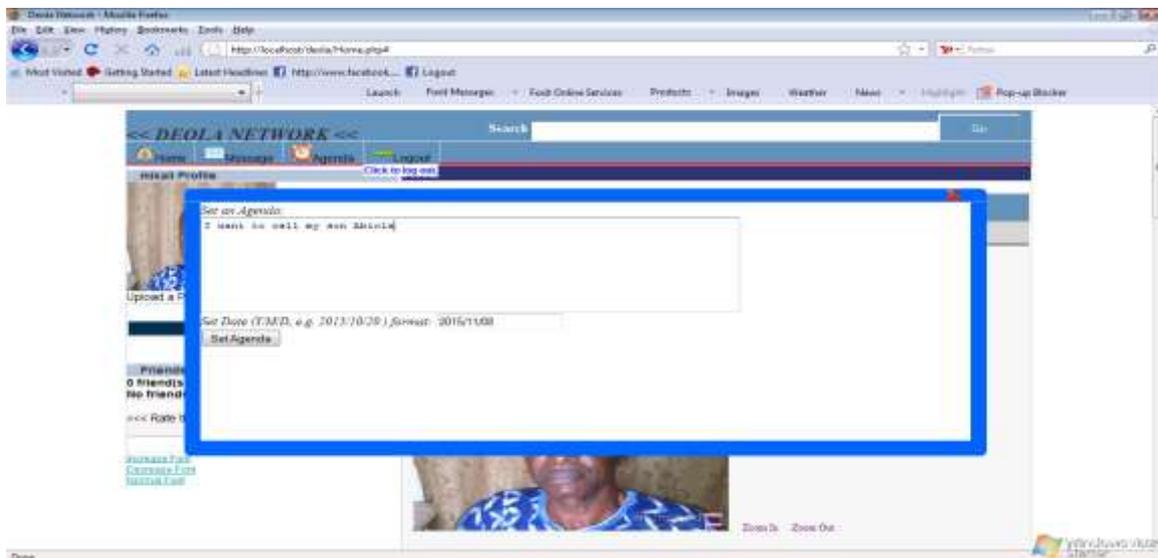


Fig. 7.3. The user sets an agenda.

This serves as a reminder to intended tasks i.e. it enables the user to add tasks and set a reminder against the date. This is to facilitate their memory recall.

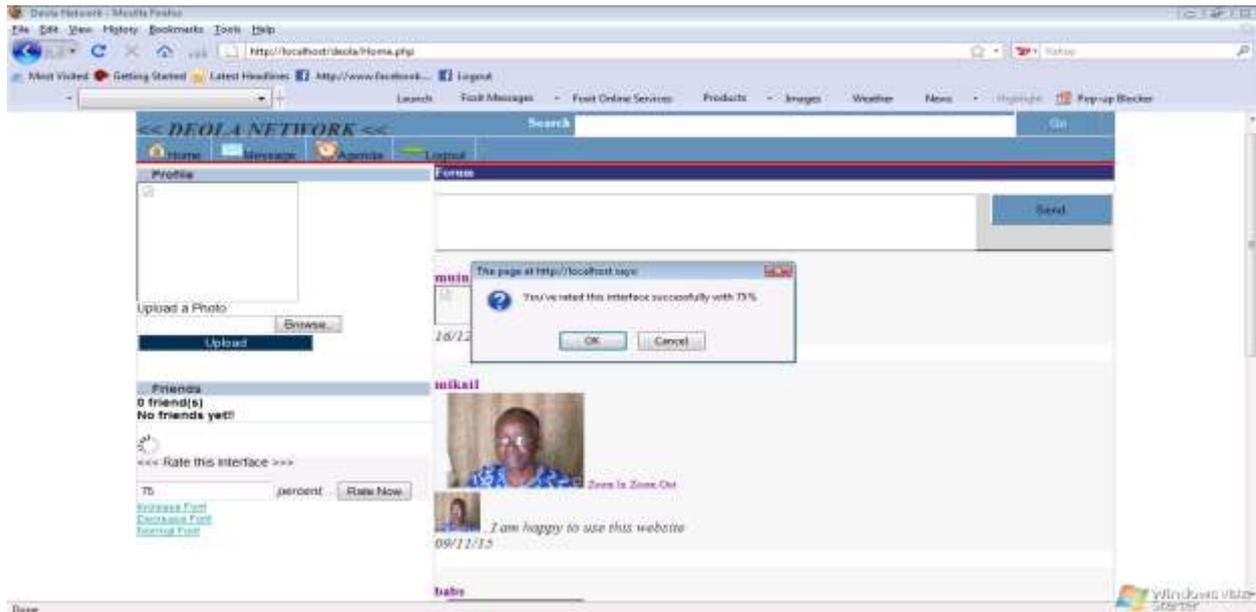


Fig. 7.4. The aged user rates the interface.

The user rates the interface on a scale of 100%, depending on their user experience pertaining the interface.

VIII. TESTING AND EVALUATION OF THE NEW SYSTEM

The performance of the new system was tested and evaluated. The test was performed on facebook interface and the new interface for the aged. This is to do a performance comparison between the two in relation to the aged who suffer cognitive impairment. The evaluation was done in 2 ways: by using field study and by means of a questionnaire.

Field Study was conducted to find out how the interface was adopted and used by people (focus group) in their everyday lives. The users were given a set of scenarios to follow which

included open application and login, compose/send message, read message etc. They were then observed as they used the facebook interface as well as the new interface for the aged. Performance measures: time taken for successful tasks in seconds and number of errors were taken as they used the two interfaces interchangeably. Table 8.1 shows the result of field study.

After the field study, usability experience questionnaires were administered. The aggregated results from the response indicated a positive outcome for the usability experience questionnaire. All results were higher than the median value of 5. Table 8.2 shows the mean result by questionnaire.

TABLE 8.1. The mean time taken for successful task and mean number of errors due to manipulation.

Social website interface		Open application and log in	Compose / send message	Open message	Post information	Send friend request	Accept friend request	Set/view agenda	Upload picture	Search	Mean time taken/mean number of errors
Facebook interface	Time taken	30 sec	85 sec	15 sec	15 sec	30 sec	52 sec	N/A	107 sec	17 sec	43.88 sec
	Number of errors	00	03	02	02	00	00	N/A	05	01	1.62
New interface for the aged	Time taken	23 sec	80 sec	12 sec	15 sec	32 sec	51 sec	50 sec	90 sec	25 sec	42 sec
	Number of errors	00	02	02	00	01	00	02	02	02	1.12

TABLE 8.2. Mean results by questionnaire (the range was selected from low rating of 0 to high rating of 10).

Usability goals	Facebook Interface	New Interface
Memorability	4.0	6.8
Learnability	5.0	7.5
Utility	6.8	7.0
Effectiveness	7.5	7.5
Efficiency	5.8	7.8

IX. SUMMARY

The purpose of this paper was to evaluate previous interfaces in relation to the aged who are cognitively impaired, highlight the problems associated with the interfaces with the aim of developing one which is more usable and accessible to the aged with cognitive impairment.

Based on the interview conducted with the aged and a focus group selected, the problems deduced were: Most websites do not comply with basic design standard and guidelines set forth by the World Wide Web consortium (W3C), aged users' frustrations with completing some tasks, longer task duration, aged users being more cautious when interacting with interfaces such as clicking on a link, confusion as to where they are within the context of the website, inability of the aged to recall memory in relation to web content, inability of the aged to read text/see images properly even if they have their glasses on. The methodology used was in conformation with the W3C guidelines. The new interface was able to solve the identified problems.

X. RECOMMENDATION

In line with the findings from the research, the following recommendations were made to assist older adults with cognitive impairment:

- All interface developers should consider the cognitively impaired aged while developing interfaces meant for all users.
- All interfaces meant for the aged should comply with the W3C guidelines.
- More robust assistive tools and devices that enhance interactivity and work rate of the users should be employed.

XI. CONCLUSION

The aim of the paper was identified and related to the need for a usable and accessible interface for the aged with cognitive impairment. The objectives were met as outlined. All user groups including the older adults who suffer functional limitations (vision decline, hearing loss, cognitive impairment and motor skill diminishment) must be considered when developing a usable and accessible interface. Finally, all interface developers should comply with the guidelines set forth by the W3C.

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