Web Accessible for the Deaf and Blind People

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Abstract—the World Wide Web is used nowadays by a variety of normal users and users with disabilities in order to gather information look for resources and access services. Many web sites are designed and improved to be easy for the majority of people who are without disability. However, the percentage of disable people in the society has been quickly increasing today. Researchers and governmental leader have to pay little attention to their requirements and needs when planning, design, and improve Web sites. Therefore, this paper is a collection of some research papers representing by some scientists or researchers in Web System Evolution conferences and other conferences to give some suggestions and advice on how to access the Internet and improve the accessibility of hearing impaired and sight impaired people. Thus, people with disabilities can understand, navigate, perceive, communicate with other people and interact with the web.

Keywords— hearing impaired, sight Impaired, W3C, WAI.

I. INTRODUCTION

Web accessibility today is one of the essential issues for the improvement and usability of web sites and applications. Web sites today are mostly inaccessible to the disabled people. According to what Geoff Freed, the director of the Web Access Project for Boston-based, has said, "Only 1% of web developers have taken any action to make their sites more accessible to the disabled [1]." Therefore, this shows a critical issue. The proportion of disabled people today has been quickly growing in the world. For example, In the United States of America, the population of people with different kinds of disabilities (the hearing impaired, the sight impaired or others) has been evaluated to be about 40s millions. In addition, the number of people who face challenges to see words, letters, or to distinguish between colors on computer screens has been evaluated to be in range of 4 millions [1].While, web sites and applications today continue to improve, and evolve, disabled people are increasingly finding themselves at a disadvantage.

As a graduate student and developer, I would like to present their problems in how to deal with computers. In addition, developers may need to be aware, and to pay attention to those disabled people in order to make their life easier. Disabled people have to feel comfortable and a member of the world's society. Thus, web accessibility has been reported and regulated by the World Wide Web consortium, which has boosted the Web Accessibility Initiative in order to improve strategies, resources, guidelines in order to support disabled people to make their lives better [2]. Moreover, in the last ten years, there are some researchers and developers have discussed the issues related to the usability of Web Sites and how to make them accessible to disabled people.

In this paper, I divided it to two major topics. The first major is how to make Web Sites accessible for hearing impaired or deaf people. The second major is how to improve usability of Web Sites for blinds or sight impaired. In addition, the paper is organized as follows: in section 2 a synopsis paragraph about Web Accessibility. Then, in section 3 I talk about the hearing impaired and the sight impaired in general. After that, in section 4 and 5 I go deep to define each of them, find some solutions, and define some tools that being used today.

II. WEB ACCESSIBILITY

Web accessibility is the way of making Web Sites easy, available, and accessible for all users, including people with disabilities (e.g., blind and deaf people) [3]. In addition, Web Sites need to be improved and designed using easy tools and techniques, so that all users could have the equal right to browse, access, and search over the Internet. Therefore, people with disabilities can navigate, perceive, understand, and interact with Web, and that they can communicate with other people, contribute to the Web and share knowledge with others.

Many disabled people today have disabilities that could affect their lives and ways of using Web. Moreover, most Web sites nowadays are inaccessible which make it complicated and hopeless for many people with disabilities to access the Web. As more accessible Web sites available, people with disabilities are eligible to use, share, and contribute to the Web more effectively.

A. Why to make the Web Accessible

It is very imperative that the Web Sites be accessible for all kinds of users, including users with disabilities in order to provide equal rights and equal occasion. Accessible Web Sites can also help people with disabilities more lively contribute in the society. In addition, access to information makes opportunities and empowers all people to participate. Therefore, this will help people with disabilities more than others, so that they can benefit from huge services, information, resources available on the Internet. In fact, there is one of five people disabled [1]. This percentage will increase as the number of population has obviously increased.
B. How to make the Web Accessible

There are some limitations and barriers may make moving to accessible Web Sites more difficult. The World Wide Web Consortium lists seven common accessibility barriers [1] which are:

1. Pictures with no alternate text.
2. Image map without alternative text.
3. Do not know how to reorganize the element on pages.
4. Uncaptioned audio or undescribed video.
5. Scarcity of information for users who cannot access frames or scripts.
6. Complicated tables.
7. Building sites with poor color contrast.

However, the World Wide Web Consortium (W3C) has countered the issue of the accessibility of Web sites by regulating some rules and guidelines to follow and creating the Web Accessibility Initiative (WAI) [4]. Therefore, WAI guidelines and rules are considered the international standard for Web accessibility. In addition, to make your Web Site accessible, WAI states that accessibility must be achieved and considered when Web Site designed. Web sites' content has to be practicable, functional, perceivable, easy and understandable by the majority possible range of users and convenient with a wide range of assistive technologies, now and in the future [4].

Furthermore, WAI sets some rules and guidelines related to Web Sites accessibility [1] which are Web content accessibility guidelines, authoring tool accessibility guidelines, and user agent accessibility guidelines. Web content accessibility guidelines, which may benefit people with disabilities, builds of two things. First, the Web Site's content should be accessible and clear despite a user's disability and the limitation of any hardware or software he/she uses. Second, the Web Site's content should be understandable and navigable by using plain and simple language and navigation so that people with disabilities could quickly and easily understand the content and able to the orient themselves [1].

Developers and designers should be aware when design and implement Web Sites and follow the fourteen rules and guidelines that set by W3C [1] which are:

1. Provide sensible alternatives solutions to auditory users and visual context.
2. Using alternative and do not base on color alone.
3. Use markup to highlight and style sheets.
4. Try to use easy natural language.
5. Make tables easy to convert.
6. Ensure also that pages featuring are easy to transform.
7. Ensure user control of time-sensitive content changes.
8. Ensure embedded user interfaces are direct to access.
10. Use temporary solutions.
11. Use W3C technologies and rules.
12. Provide context and all information for accessibility.
13. Provide obvious navigation techniques.
14. Ensure that the written documents are evident and simple to comprehend.

III. HEARING IMPAIRED AND SIGHT IMPAIRED

In this section, I will give a brief written essay about the difference between hearing impaired and sight impaired in how to contribute, anticipate, share, and deal with the Internet. For more details, techniques, and case study skips this section and move to the next section. According to what (Daniel M. Berry, [5]) has said, It should be obvious what is perfect for the hearing impaired is not pretty for the sight impaired and vice versa. Nowadays, both HI and SI people complain and ask for their right. It is rare that to find a Web Site offers the most features for both to be in textual and graphical interfaces and at the same time has the features of speech and read the content. It is obvious that the number of W3 Sites that offers pictures, images, graphics, and written plain English language more than the aural Web Sites. However, both of them are enfranchising.

Daniel is a hearing impaired and has a good experience of a blind student who took one of his courses gives us one recommendation on how to make Web Sites accessible. The first recommendation is when designers and developers implement the Web Sites; they should make it possible in two ways sounds and text or pictures. In addition, the sound and text should be synchronized together in order to diminish cognitive interference. The second recommendation is that the computer is to agree input from the user as voice and textual input. Because, many HI people are not capable to speak well, and many SI people find the visual content difficult [5].

To complete what he has said, the output from the machine or computer or any smart electronic devices should be in both sound so that the blind or sight impaired can get the result, and text, graphics or picture so that deaf or hearing impaired can get the output. In addition, if developers do the same what Daniel has said, it will be an original source and other media that generate from the source. If the Web content is text, then the sound can be created by a voice synthesizer which is working on the text. For example, as I mention that Daniel has a good experience that one of his students is blind. So that student could use lip readable or text to read the text and at the same time listen to the generated sound. There is a technique called lip synching; it is a very useful technique that could be used to the synchronized sound with lip reading or text or graphics. On the other hand, if the source is a text in a phonetic alphabet character. Then this text should be clear to read and displayed [5].

One of the most things that Daniel has talked about it is the input. The machine should be built to accept different kinds of input. Some inputs that computers can accept are voice, which powered by voice recognition technology, keyboard, mouse, clicking on a button, typing a direct response, menu entries or
making hand gestures. If the user has difficulty speaking clearly or cannot speak, as many HI people do. Then, voice input may not be the convenient tools, and the other input will be needed [5].

IV. HEARING IMPAIRED AND DEAF

Daniel is an academic teacher, and describes some difficulties that could face hearing impaired people in his paper (Requirements for maintaining Web access for Hearing Impaired Individuals). He is a hearing impaired person from birth and he used to understand the English language by reading lips. Then, he explains how it was his life and how he faces challenges in using a telephone. Moreover, reading lips in the telephone is so hard for him. He is not satisfied with the quality of the telephone. It will be more distortion if the sound is amplified. In addition, he says," the increased use of answering machines, voice mail, and voice-directed menu selection have taken away the possibility of my asking the person on the other end of a call if I understood her or of my requesting her to repeat what she just said. In essence, I have become disenfranchised from the telephone, so much so that I do not give out my phone number anymore [5]."

Therefore, he feels more comfortable with written communication. He used to use the Internet for communication since 1979. However, he was panic after he knew that the computer will have built to accept a different kind of inputs which is a voice interface. At the end, he felt that it is very important for him and hearing impaired people to participate to prevent disenfranchisement form the computer and the Internet and make them accessible.

A. Classification of Hearing Impaired people
First of all, a person who is not able to hear as well as normal hearing person or hearing thresholds of 25dB or better in both ears is considered to be a hearing loss person. In fig 1, Daniel describes his situation.

![Daniel M. Berry's Audiogram](image)

**Figure 1**

He says," An audiogram shows two plots, one for each ear. The plot for an ear shows for each frequency, the hearing loss of the ear at the frequency. The loss of an ear at a frequency is measured by determining the minimum volume required for the ear to hear a tone of the frequency. The more of the speech-understanding rectangle that lies below the plots for an ear is the more that the ear can help understand human speech [5]."

There are many ways to classify hearing impaired people to. The first way depends on the severity of the hearing loss. The second way is the length of time he has had the hearing loss. The last one is what kind of inputs hearing loss person requires in place of pure voice.

1. The severity of loss classification:
The author divided them to three groups [5]:
   a) The first group is a person who has less than a 50db loss in all frequencies; that is, he can hear some frequencies.
   b) The second group is a person who has greater than 100 db loss in all frequencies; that is, he is considered completely deaf.
   c) The third group is a person who is neither in the first group nor in the second group. He has usable hearing in some ranges of frequencies and is totally deaf in other ranges of frequencies.

So that, people who are in the first group speak well and wear some hearing aid tools that amplify all frequencies. Nevertheless, people who are in the second group always cannot speak and they only sign and do not wear any aid tools since aids are useless. People who are in the third group sometimes they use aid tools to help them to hear or could use lip reading or only sign.

2. Length of time of Hearing loss:
Here we can classify Hearing impaired people depend on the long of time of being hearing loss [5]:
   a) The first group is a person who has loss his hearing since before he could talk.
   b) The second group is a person who has loss his hearing after he learned to talk.

So that, a person in the second group has already learned how to speak since he became hearing loss after he has learned to talk. In addition, he could make the sound correctly. However, a person in the first group could not understand the speech and they use to sign.

3. Kind of input classification
Here, the author classified hearing loss into three groups depend on what kind of inputs they used [5]:
   a) The first group is a person who requires signing.
   b) The second group is a person who wears residual hearing aids and uses lip reading to understand speech as it is spoken.
   c) The third group is a person who wears only residual hearing.

The most group that is considered to be hearing loss is first group. Signers are the largest group of hearing impaired how uses the Internet. Moreover, it is very hard for non hearing impaired to understand them.
B. How to help Hearing Impaired People:

One of the common techniques that are being used today is signed language. Signing language will be a significant contribution to the development of the Web accessible to deaf people. In addition, it would mean a great deal to their daily uses to the Internet. There are different variants of sign language American Sign Language (ASL), Greek Sign Language (SYENNNOESE), South African Sign Language (SASL-MT), Arabic Sign Language (ArSL-TS), Spanish Sign Language, Italian Sign Language, Japanese Sign Language, British Sign Language [7].

There are different well-known writing systems for singing language. The first one called Stokoe Notation. The stokoe notation system [8] is the world’s first phonemic script that has been developed by William Stokoe for writing American Sign Language (ASL). The original language notation contains of 55 symbols. In which it divided into three groups. Moreover, each group represents one of the important aspects of sign: (“tab” or sign location), (“dez” or handshape & orientation), and (“sig” or movement). For example, Stokoe notation for the American Sign Language for the term “don’t know” can be seen in Fig 2.

![Stokoe Notation of “don’t know”](image)

Figure 2

The second one called HamNoSys Notation [8]. The Hamburg Sign Language Notation System or HamNoSys is a phonetic transcription system which has its root in the Stokoe notation. The hamNoSys notation system includes about 210 iconic characters to represent the different sign aspects. It is more accurate that the Stokoe notation system. The third one called Sign Writing Notation, [8] which was originated from a choreographic notation system called Dance Writing. There are intuitive graphical symbols to record every sign and to represent hand shapes, palm orientation, movements, body locations, facial expressions and punctuation.

One of the most effective techniques that could be used to help to communicate is Singing Avatar System. An avatar system gives us a visual language alternative to displaying spoken massages within educational settings or workplaces that include deaf, and hearing loss. The first step is a speech recognition. This step is to convert an audio stream containing spoken words to a stream of text. Then, the text is converted into sign language phonetics, which consists of a combination of manual and non-manual signals including hand shape, position, orientation, as well as facial expression and body motion [7]. After that, the avatar system is instructed. Finally, all user motions are captured, and stored.

V. SIGHT IMPAIRED

According to the World Health Organization [9], the proportions of people who are estimated to be complete blind are 39 million people, and 246 million people are considered to be low vision. In addition, the percentage of blind or visually impaired people who live in modern countries is rated to be about 90%. Moreover, blindness is defined to be unable to see, look for or lacking the sense of sight. There are many reasons to cause blindness which are uncorrected refractive errors, which is considered the main cause of visual impairment, cataract, and glaucoma.

As I mentioned before, researchers and governmental leader pay little attention to the visual impaired people needs when planning, design, and improve Web sites. They tend to design the Web Sites and application to be visual interface. Web interface in general comprises of three different kinds [10]. The first one is content. Content means all stuffs that are considered to be looked at such as images, graphics, text, videos. In addition, all these contents may involve together in one page. The second is interface semantics. There are different layouts for every Web Sites and different graphics; moreover, users may need to move between Web Site pages and using linking. The third one is navigation. So that, mobile from one page to another page is rely on the activation of links, and the user should be capable to visually identify links, guessing their meaning, and moving the pointer of the mouse directly over one of them.

In the last ten years, "many government and other international organizations such as the United Nations and European Union stat that the accessibility to services and information on the web is a fundamental right for any citizen, so the needs of people with disabilities must be taken into account by Web site and application developers [2].” So that, W3C sets some rules and guidelines in order to make accessible Web Sites. This will include the needs of sight impaired. W3C guidelines are eager to cover all technical aspects in order to make content and functionality can reach and access by users.

A. Requirements for Aural Web Sites:

There are three requirements [10] which are needed in order to make accessible Web Sites. The first one is the information architecture requirement. These requirements will help a user to comprehend and memorize the overall structure of Web Sites. The second is related to page navigation requirements. So that, users may need to comprehend, navigate, and access the content of the Web sites. The third is related to how the Web's contents interact. To accomplish these entire requirements, there are fourteen rules [10] will help developers and designers to make Web Sites accessible for all:

1. At the beginning and whenever necessary, giving a user quick aural glance of the web sites.
2. Besides that, give a user an aural semantic map of the whole application.
3. Provide a synopsis summary of any list.
4. Partition long lists in smaller meaningful chunks.
5. Do not use the sequence of physical pages. Provide a tool to emphasize the history of visited pieces of content.
6. Provide a semantic navigation button to allow a user to go “up” to the last visited list of items.
7. Creating aural page templates.
8. Minimize the number of templates.
9. Give a user a brief talk in how the page is organized and it is structure.
10. Read the first key message of the page.
11. Making accesses to section available whenever needed.
12. Allow a user to move freely (forward and backward) across page sections.
13. Allow the user to pause, and resume the dialogue flow.
14. Allow the user to re-play an item or an entire section.

B. Tools and Techniques to help Sight Impaired people:

W3C recommends some assistive technology software for blind users to use in order to provide highly accessible content. Home Page Reader (HPR) [11] is a computer program. HPR was developed by IBM from the work of Chieko Asakawa at IBM Japan. It was design for blind users, and developers to experience the blind users’ usability. The first step, all text can be spoken loudly so that they can make sure that the visually information in the graphics view corresponds to the information in the text view. It reads aloud the text on Web pages. However, it has some problems and defects [2] as following:
1. There are some contents that cannot be transferred as speech, such as images, flash animations, and other multimedia contents.
2. There are some contents that are difficult to proceed, such as hyperlinks or tables.
3. The listening of the contents of a Web page is very slow, with respect to the cognitive speech of the user so that the usability of Web pages can be very poor.

There is also another technology program called aDesigner. aDesigner is a disability simulator, which was developed for Web developers to help them ensure that their pages are accessible and usable for people with vision disabilities. aDesigner have complete set of tools for color contrast of the page, the font size. In addition, tools also check the page’s compliance with accessibility guidelines. Moreover, each Web page is given an overall score. With this information, Web content developers get immediate feedback and can make the necessary modifications to address these problems before the content is published [11].

In addition, there are several softwares [12] such as JAWS and NVDA for visually impaired people. Most of the software uses screen reading technique. JAWS is one of the common softwares which is used mainly for documents. So that, JAWS read information displayed on a computer monitor loudly. Moreover, it reads aloud text within a document, information within dialog boxes and error messages. It also reads aloud menu selections, text with the graphical icons on the desktop. However, we may face another issue which is related to bilingual language. Are those screen reader softwares able to understand different language such as Arabic or not? It is a perfect idea for researchers to find solutions for this kind of challenge.

VI. CONCLUSION

In summation, making web sites accessible for all people including deaf and blind people is vital. All users should have the same equal rights so that they can access, browse, and research over the Internet. In this novel, I talk about the importance of making web sites accessible for disabled people and how to help them to make their lives easy. W3C sets some rules and guidelines for web sites’ designers and developers to help disabled people to access web sites. After that, I explain the differences between hearing impaired and visual impaired people. In addition, I mention how to make the web accessible for both of them. Then, I talk about both of them. Moreover, there are some tools and techniques that will help disable people to make the Internet accessible and available.

For future work, researchers and scientists may need to think about bilingual tools. These tools just support some languages around the world. We need these tools to aid all different people with different languages. So that, there is a default language which a disable person speaks or knows and there is a popular international language which is English.

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VIII. REFERENCES


