Attempt to Provide Web Accessibility for Low vision and Color Deficient People

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ABSTRACT
The requirement/need for the development of accessible web site and web application for the disability people is vital, especially for the people with vision disabilities. In this context, this work proposes a browser based accessibility model which converts the web page which is received from a server into a web page that can be accessible by the low vision user. The browser processes the actual web page and displays it according to the accessibility capabilities of a particular low vision user. In order to know a particular user's accessibility capabilities, different tests are conducted before the start of the session, and these capabilities are applied to the browser dynamically before the web page is displayed. For hearing impaired users, if any audio content is found then it is conveyed to the users in the textual form. The final web page which is obtained after this process is validated using the W3C standard web page validators.

General Terms
Accessibility for the deficiency people, low vision users accessing the internet, color blind users,

Keywords
Accessibility, Web browser, Visual impairment, Hearing impairment, Usability.

1. INTRODUCTION
Accessibility is the fundamental issue for the development of every application either it is a software or hardware. Nowadays the number of people with disabilities is increasing in accessing the World Wide Web to get the web contents. The National Census of India has estimated around 21.9 million visually disabled people in the country [1]. This is considered to be the highest among all other disabilities. There are three types of visual impairments that web designers generally consider when developing web sites: Total blindness, low vision and color blindness [2]. Accessibility for the Blind people is providing using the screen readers like 95Reader, Blindows, JAWS, Homepage Reader [1] etc and using voice recognition browsers like eGuideDog, Mg Sys VISI, pwWebSpeak [3] etc, and many researchers have discussed about the problems related to the usability of web sites for blind people and the consequent requirements for Aural web sites i.e., web sites accessible with voice [4]. But for low vision and the color blindness people the accessibility means are not adequately proposed and they are not efficient. Low vision is a visual impairment, not correctable by standard glasses, contact lenses, medicine, or surgery, and most of the times it is genetic in nature. So, providing the accessibility means for the low vision and color blindness people would be greater impact on the community.

In this context my browser based web accessibility model enables low vision and color blindness users to access the web contents easily and efficiently. Hearing impairment disabilities vary in type and severity. People who have a hearing impairment may have a diminished ability to hear certain frequencies (pitches), or they may have difficulty hearing at all frequency levels. Hearing impairments may also result from tinnitus (ringing) [2]. In order to access all the information available to the normal users, the Hearing impaired user should be able to access the same audio information that is available to non-disabled learners. Consequently, designers of websites should provide real-time text captioning for all audio, video, and multi-media presentations that are placed on the web sites. If these requirements are not met, my approach provides the access to the audible content by converting it into textual form. While processing a webpage if any audio content or multimedia content has been found then it is converted into the text, except this issue the remaining process is not necessary for the hearing impaired user. My proposed model has the main modules like Secured User authentication, testing the individual users to know their visual capabilities, processing module for changing the actual webpage into the webpage that is accessible by the low vision or color blindness user. For hearing impaired users there are hardware techniques for changing the strength and frequencies of the audio waves but there are no software assistive techniques which converts the audio into the textual format. My browser based application model provides all these facilities. The remaining paper is organized in the following manner, in the next session I explain about my proposed model's architecture and the formulae used in calculating the color combinations, then the visual capabilities testing, output evaluation and the future work. In output evaluation we have given some images which shows the web pages after applying the user specific color combinations and the visible font size and font style and using which the users have accessed the webpages in an efficient and easy manner.

2. LITERATURE SURVEY
Kevin L.Crow summarizes disabilities into fmy major categories: Visual Impairments, Hearing Impairments, Motor Impairments, and Cognitive Impairments [2]. Many research works have been done and some of them are still in progresses which are intended to provide disability users easy and efficient access to the World Wide Web. Halimah Badioze Zaman, David Kennedy, Choo W.O., et al have developed Voice Recognition Browser for the Visually Impaired Learners (Mg Sys VISI)

which comprises of five modules Automatic Speech Recognition (ASR), Text-to-Speech (TTS), Search engine, Print (Text-to-Braille) and Translation (Braille-to-Text) module [5]. Carmine Cesarano, Anna Rita Fasolino et al. proposed two different approaches for dynamically transforming web pages into Aural web pages i.e. pages that are optimized for blind people [6]. The approaches exploit heuristic techniques for summarizing Web page's contents and providing them to blind users in order to improve the usability of Web sites. . All the information is available to the disability people similar to the normal users but the accessibility differs from one another.

Mercedes Macías, Fernando Sánchez have explained that availability and accessibility are not synonyms [7]. Most of the research works and products are mainly concentrated to provide the web accessibility to blind people. Unfortunately there are large numbers of people who are suffering from the color blindness and low vision compared to total blind people, but the research works related to the web accessibility for the color blindness and low vision people are very less. Some applications are developed for blind can be used for the low vision users but the low vision is also considered as the blindness. Even though there are assistive tools for low vision users like Text Magnifier, zone clipper, zoom text 9.1, these tools cannot provide individual user specific visualizations and are not efficient. My application is aimed to provide the easy access of the WWW to the color blind and the hearing impaired users, in addition to the principles of the W3C (World Wide Web Consortium).

3. PRPOSED MODEL

This proposed model uses the standard formulae given by W3C (World Wide Web Consortium) for calculating the color brightness and the colors combinations on the web page. The formula used for selecting the color brightness difference is given below.

((Red value * 299) + (Green value * 587) + (Blue value * 114)) / 1000)

The difference between the background color brightness, and the foreground color brightness should be greater than 125. While displaying the web page, internally it calculates the values of the brightness of background and foreground colors and checks if the difference is greater than 125. If the difference is greater than 125 then it displays the web page. Color difference of the web page colors is determined by the following formula.

(maximum (Red value 1, Red value 2) - minimum (Red value 1, Red value 2)) + (maximum (Green value 1, Green value 2) - minimum (Green value 1, Green value 2)) + (maximum (Blue value 1, Blue value 2) - minimum (Blue value 1, Blue value 2))

The difference between the background color and the foreground color should be greater than 500. It calculates these color brightness and color difference values for the available colors on that web page. Proposed model aims at providing the web access without necessitating the assistance from third person to get started of browsing.

In order to achieve this, from the starting window onwards I have provided color setting, font setting, brightness, contrast options which he can change any number of times to get a clearer appearance. New user has to undergo some visual capabilities testing if the displayed web page is still in-accessible to him. These tests are to capture his visual capabilities like background color, foreground color, font, font style, font size, and the amount of RGB values in the color mixture. These settings are stored in the database to provide automatic adjustment of visual characteristics when he logs in again. If the user logs in again the visual characteristics stored previously in the data base are taken as the default characteristics for that particular user and are applied directly without going for the visual capabilities testing modules.

Once the testing module seizures the visual capabilities of a particular user, the user is asked for storing them in database. If the user wants to store the values in database, then he needs to select and enter his User name and Password with which those values are stored. After the user login the web browser starts with the predefined settings of a particular user. When the user requests for any webpage, the webpage is taken from the server in its original form, but before displaying it to the user it is processed to apply the color combinations that are calculated by the formulae. If the user is unable to access it easily then the web page is processed with the visual capabilities of that user. If the user is still unable to view the webpage contents clearly and satisfactorily, then again he can go to the settings window by clicking on a "SETTINGS" link which displays the visual capabilities testing widow. This process is iterative until the user satisfies with the displayed appearance of a webpage. For the hearing impaired user, if any audio content is found it prompts the user for displaying it in textual form. The hearing impaired user can also ignore the audio content if he does not need it. Unlike other available assistive tools for visually impaired people, this browser based web accessibility model provides the usability services prior to the start of browsing. Before starting the application, the browser itself incorporates the main color combinations which are clearly visible to the visually impaired users; this facility provides the independent browsing for disabled people.

When the webpage is displayed to the user, it applies the basic color combinations visible for the visually impaired users. While processing the webpage before displaying to the user, it checks the HTML code for HTML tags which contains the color, font, brightness, RGB etc. After finding all the tags containing the above words, it replaces their values with the user specific values. The original form of webpage is also maintained for normal users. For normal users the working process of the application is entirely different, for them it works as a normal web browser. In order to provide the access of audio, multimedia content to hearing impaired users this application contains the voice to text converter. If the audio content is encountered from the system, for example, when the Caps Lock key is pressed intentionally or unintentionally then one notification is shown on the screen to alert or confirm the user's activity along with a beep sound. The key modules of the proposed accessibility model are User authentication,
Visual capabilities testing module, process of applying the visual characteristics to the requested web page dynamically. In the processing module I obtain the original web page code and modify it to suit a user's need.

3.1. Capabilities Testing

Initially the user specific characteristics are identified bye providing them a window form which contains the visible background color, foreground color, font name, font size, and font style etc. User can be able to select the feasible appearance characteristics and those are saved in the database with some user id. These characteristics will be brought automatically into the browser when the user logs in for the next time.

Fig.2. Screen shot of Visual capabilities capturing window

For color blind users the tests of visible color combinations are provided by using the Ishihara test plates. There are many test plates available for checking different types of color blindness.

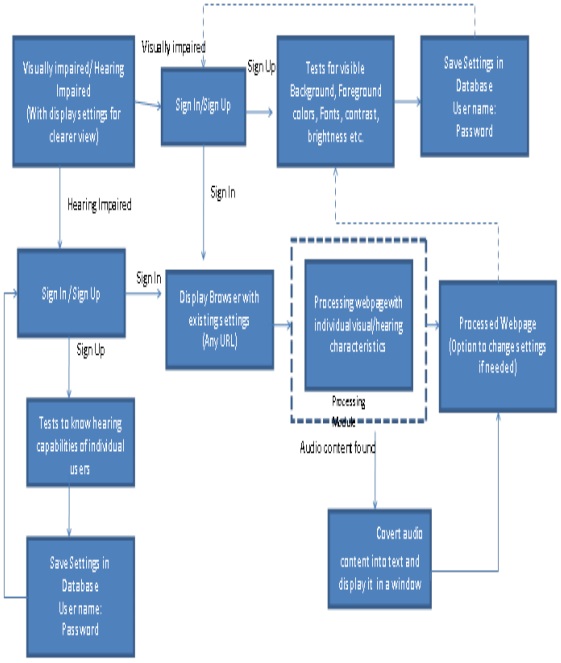

Fig 1. Overall architecture of Proposed model

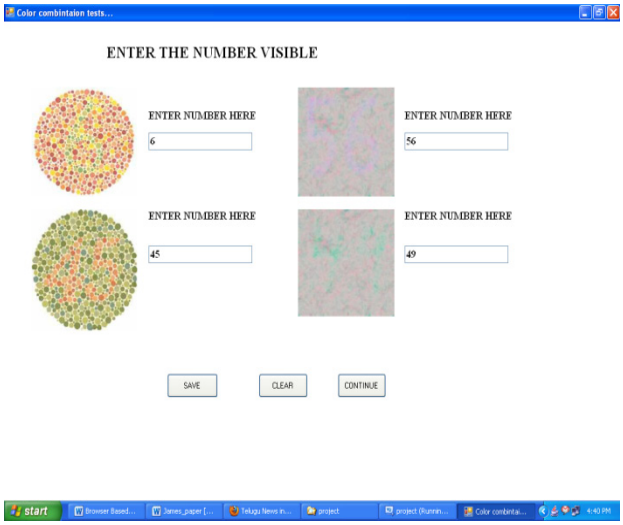

Fig.3. Ishihara test plates

The user needs to enter the number visible in the given images in the provided text box to check his visibility. There will be more number of Ishihara test plates for checking different types of visible color combinations. The values entered by the user are compared and analyzed with the correct values and the type of color blindness will be found out. After finding the type of colorblindness, the same is stored in the database with the user id that has given to the particular user. Whenever the user logs in again for the next time, then the visible characteristics and the type of color blindness is applied directly to the web page without going to the testing window.

4. OUTPUT EVALUATION

The output of the proposed work is given below for the normal users and as well as for the color deficient users. These web pages are validated using the W3C standard validators and passed the validation test. The following figures show how the web page looks for the normal users and the color deficient users. In case of normal users no changes are done to the actual web page. The following figure shows the original web page,
and the latter figure shows the web page when the back ground color is selected as white and the foreground color as lime. When the background is chosen to be white, then the smyce code which has been saved in a file is searched for the key "background" and if it is found then its value would be replaced with that of the value of the white. In the same way the foreground color is also replaced with the value of the lime. After committing the required changes in the web page processing, the same webpage is displayed to the color deficient user. This processed webpage is validated by the webpage validators and they are found to be most effective and convenient than that of the original web pages.

Fig.4. Original web page

The original web page is shown directly from the server without processing or modifications. All the characteristics of this web page are similar as the developer specifies. When the user has chosen the background color as white and foreground color as lime the web page looks as below.

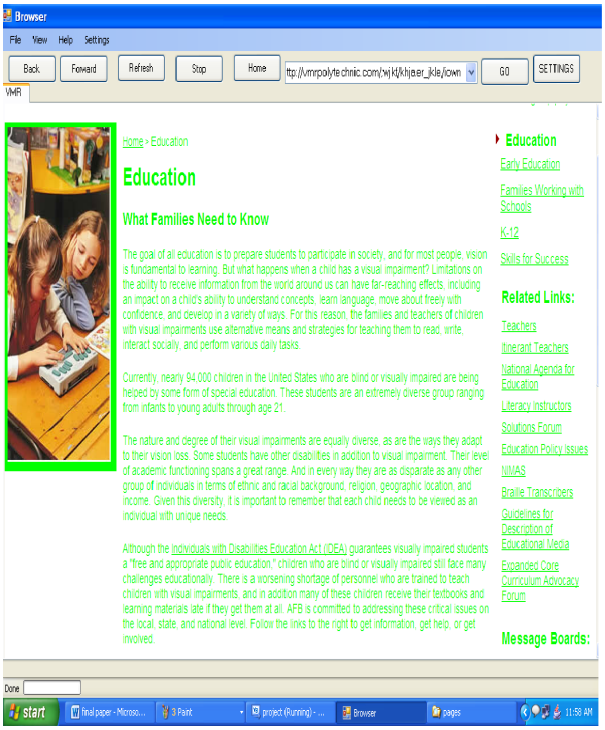

Fig.5. Web page when background color is White and foreground color is lime

If the user has chosen background color as white and foreground as black then the web page is converted as below.

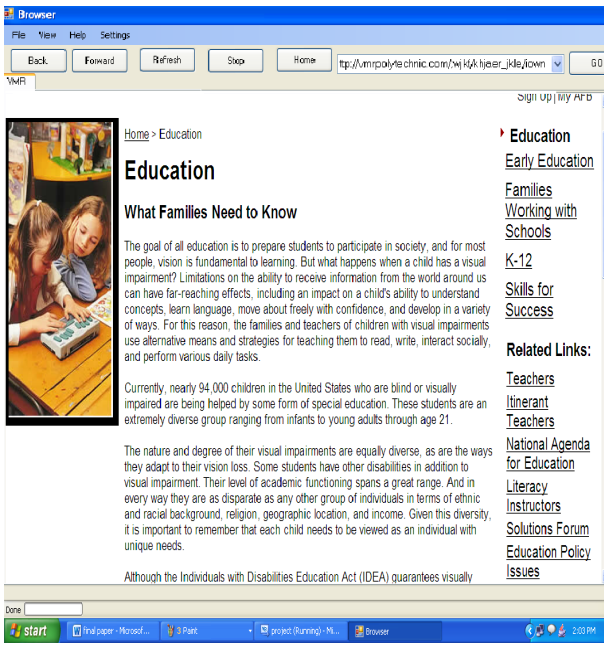

Fig.6. Web page when background color is white and foreground color is black

Users can also specify their visible font size and font style. In case of low vision user, if the text on the web page is not visible and accessible clearly, then the user can change the font size of the whole web page. When the user has chosen the larger font size, then the web page looks as below.

Fig.7. Web page when font size is chosen to be larger than original web page

If the user has chosen to have font size smaller than the original web page, then after processing the web page it looks as below.

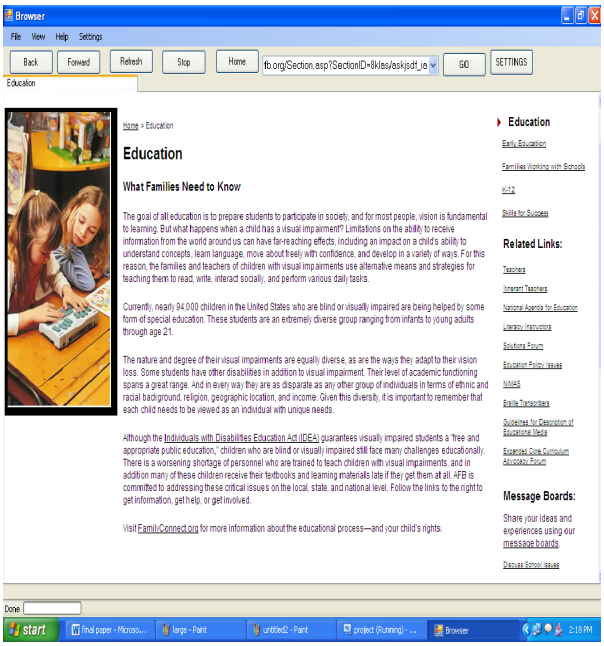

Fig.8. Web page when font size is chosen smaller than original web page

5. CONCLUSION

In this paper we have proposed and developed a web accessibility model which helps the low vision, color blind and easy access to the WWW. The output of this accessibility model is a web page which is converted according to the disabled users specifications and can be easily accessed by them.

6. FUTURE WORK

In future I would like to incorporate Machine Learning concepts and Artificial Intelligence in user interfaces which provides automatic adjustment of the web page user interface according to the user actions.

7. REFERENCES

[1]. Chris Hofstader: Internet Accessibility beyond Disability. Freedom Scientific Inc, IEEE J mynal on Web Technologies, September-2008

[2]. Kevin L. Crow Fmy Types of Disabilities: Their Impact on Online Learning, Volume 52, Number 1, TechTrends , January/February 2008.

[3].Chu.C: Two Dimension Interactive Voice Browser for the Visually Impaired. In: K. Miesenberger eds. ICCHP 2004, LNCS 3118. Berlin: Springer, (2004), 721-724.

[4]. D. Bolchini, S. Colazzo, P. Palolini: Requirements for Aural Web sites, 8th IEEE International Symposium on Web site Evolution, IEEE CS Press, 2006, Pp.:75-82

[5]. Halimah Badioze Zaman, David Kennedy, Choo W.O., Azlina Ahmad and Aidanismah Yahya,: Voice Recognition Browser for the Visually Impaired Learners, International Jmynal of Computers, Issue 3, Volume 1, 2007

[6]. Carmine Cesarano, Anna Rita Fasolino, Porfirio Tramontana: Improving usability of web pages for Blinds. IEEE Conference on Usability Engineering-2007

[7]. Simon Liu, Wei Ma, Dale Schalow, and Kevin Spruill: Improving Web Access for Visually Impaired Users. IT Professional 6(4): 28-33, IEEE Jmynal on Usability-2004

[8]. Lmydes Moreno, Paloma Martínez, Belén Ruíz-Mezcua: Disability Standards for Multimedia on the Web. IEEE Jmynal 15(4): 52-54 (2008)

[9]. Gaurav Kumar Srivastava, Rajan Vaish, Rahul Vaish: Innovative and secured user Authentication Methods for novice Visually Impaired users. ICUMT 2009, IEEE-Conference: 1-6

[10]. Jing Xiao, GuanNeng, and Yong Tang: An Open Smyce web browser for Visually Impaired. ACM Portal-2007

[11]. Kennel, A., Perrochon, L., Darvishi, A., WAB: World Wide Web Access for Blind and Visually Impaired Computer Users, in [6], pp. 297-306