

Creation of an Interactive and Accessible Online Learning Environment

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Abstract— In our project www.kaikille.fi, we planned and created an interactive online learning environment, the purpose of which is to create a pedagogical model for the development of an accessible online service. The site includes accessibility-related articles written by experts in this field and the site's graphic design and programming was carried out by using accessible solutions.

Keywords: *accessibility, usability, responsive design, data transfer, Content Management*

I. INTRODUCTION

The main objective of this website project was to support the equality of citizens in society. In order to achieve this objective, the online site acts as an interactive and accessible online learning environment, which provides wide-ranging information about accessibility. At the same time, the site design is based on the principle of accessibility and the idea that its users become our partners in the design project. The site will provide expertise in accessibility for all sections of society both nationally and internationally.

The content is divided on the basis of different target groups, and the site users are able to search the site for concrete information, educational packages or, for example, useful links and contact information. In addition, the users can determine their own competence level, search information of accessibility and find tools for work and everyday life and learn about new accessibility solutions and network with professionals working in the field of accessibility. [1]. "Accessibility means that people with disabilities can use the Web. More specifically, Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. It also benefits others, including older people with changing abilities due to aging" [2]. At this step we concentrated in our project for users with visual disabilities.

Interaction arises from discussions between the users and the accessibility experts. In short, the site's accessibility is wide-ranging and multilevel, and it includes sections such as social, cognitive and physical accessibility and accessible technology. The project will also produce new empirical knowledge about the implementation of an accessible online service.

The technical development was done to satisfy usability and accessibility issues with mobility and persons with visual disabilities such as color blindness. The most Wordpress themes are designed for blogging and the content production. Wordpress is a user-friendly content management system (CMS) for publishing web sites and blogs. We wanted to combine the easiness of content management, responsive design with one page web design, which supports better UX (User Experience) amongst mobile users. One page design simply means that the entire content of the site is gathered into a one website.

Our idea was not use alternative theme design other than the default theme because we created our own solution for data transferring from Back end to Front end side. Final way to produce the website is an independed solution which is separated from Wordpress common framework. The only reason why we used Wordpress is the easiness of writing articles, adding images, editing, etc.

A. Related works

There has been similar theme design development work where CSS and Javascript framework like Twitter Bootstrap [3] were used, with different content management systems like Wordpress to boost site functionality quickly. However, we did not copy other existing techniques like using specific commercial plugins Bootstrap CSS plugins. Also the keypoint in our work was not only to use Bootstrap, but the aim was to develop specific information retrieval and processing *between* Wordpress and our Front End solution (website). It is hard to say about the novelty of our work. Creating the website dynamically without reloading existing page elements again we aimed more efficient way to perform a web site when the one page design principle is used. This is especially important when there the entire website material is gathered into a single webpage for supporting better mobile users.

In other words, we have only a single page, not a traditional website, but it includes all educational content (written in Finnish) about accessibility. Technically, our method was not generic because the alternative, common way is just use Wordpress default work with its own themes. Further explanations about technical issues are explained later in this paper.

II. METHODS

To achieve the project goals, we have utilized responsive web design for the site layout. Responsive web design enables one visual solution across a wide range of users and their devices. It makes the website more flexible with different screen resolutions or browser window’s width. We decided to use Bootstrap for developing responsive, mobile site on our project. Bootstrap also “provides a toolkit simple and flexible HTML, CSS, and JS for popular UI components and interactions.” [3] The graphical design itself was based on work of our own design [Fig.1].

The site layout is deliberately left plain and simple and its colour scheme takes into consideration the needs of users suffering from different types of colour-blindness. To make the site layout appear similar to every user, we opted for blue on a white background, since colour-blind users see the colour blue in a fairly similar way as other users [4].

A. Information retrieval between Back End and Front End

The aim of this implementation was to create a website, where the content to be presented is searched from the content management system (Wordpress) and where the website is modified into its final form with the help of dynamic technologies in responsive web design. The sole task of this implementation was to create a user-friendly and accessible way of producing content for websites. We did not use the default site template of Wordpress for the production of the content of the website at all.



FIGURE 1. SITE GRAPHICAL DESIGN

The aim was to create a faster technical solution, which would create the website in a more efficient way than the present system of content management.

To begin with, we created a separate index.html file, which included the frame of the HTML code of the website. The frame included a variety of definitions such as UTF sign coding and a definition for the recognition of the size of the user’s display. The style files defining the layout and Bootstrap.css were also loaded in this file. Bootstrap.css enables responsive web design. After that our own style definitions were loaded to complete the layout of the

website. In other words, several well-known web technologies were used in this solution: content management, CSS style definitions, JSON, JavaScript and responsive web design with Twitter Bootstrap. When the styles had been designed, we also created our own JavaScript and Bootstrap libraries, which collect, parse and forward information to the frame file (index.html). The above-mentioned technologies form an entity known as Front end.

B. Information Retrieval and Processing

Transmission of data objects between our own solution and Wordpress was carried out by JSON (JavaScript Object Notation). JSON is a simple data-interchange format, which is suitable for several software environments. When the user presses the button on the website, Front end will send inquiries to Back end. The information is retrieved from Wordpress on the basis of these questions. The backend.php file operates as Back end and it includes functions taken directly from Wordpress. These functions are used to carry out the inquiries. Therefore, Wordpress is not used at all. The inquiry outputs will be forwarded to the backend_wp.php file. Backend_wp.php unpacks the echo of the outputs of specific functions, saves the outputs in variables and collects them into a table. JSON is used to send them further to the JavaScript file in backend.php, which placed the inquiry in the first place.

C. Turning Information into a Webpage

The above mentioned JavaScript file will process the information, which is in JSON form and saves it into variables with additional HTML tags. Later on, these tags are needed for detailed layout and styles. These variables are merged into one variable, whose content is placed in the HTML frame (index.html) in a dynamic way. The menu element (user interface menu) is placed separately only when it includes submenus. The functions of the website are then added by inviting JavaScript functions from a separate JavaScript file. When you click the menu, you perform Back end searches again. In other words, that part of the website is emptied of its content and refilled by the outputs of the search.

All information is searched dynamically and the HTML frame (index.html) does not include ready-made elements, but everything is created dynamically on the basis of the needs. Wordpress only exists to make content producers’ work easier and we did not use its presentation themes at all. All information is retrieved into the new solution we created, and the content changes take place automatically. Our final aim is to reduce the amount of page elements and as a result speed up the presentation of the website to users.

III. EVALUATION OF ACCESSIBILITY AND USABILITY

The evaluation of the site's usability and accessibility is based on the guidelines on the accessibility of online services published by the Web Accessibility Initiative WAI (W3C). In addition, we conducted two online surveys with the visually impaired and people with learning disabilities as target groups. The inquiries included a few of tasks and multiple-choice questions related to usability and user experience as well as accessibility. The online survey was broadly based on the questionnaire designed by Lund [5] and the WAMMI questionnaire [6] on a website's ease-of-use. However, the survey was conducted in such a way that we could receive feedback on accessibility. Further, the website was tested by Apple's own screen reading programme. The testers were requested to give feedback on how they had succeeded in using the site with different kinds of assistive aids. The aim of the surveys was to find out how to make the website more user-friendly and accessible.

Both surveys were answered by a very small number of users. However, there was not a lot of dispersion in the answers, and in both surveys some of the answers were very similar. Participants were invited from different groups of people with disabilities but most of the testers were visually impaired. Also, most of them were men. There were 10 participants in the first survey and 11 in the second one.

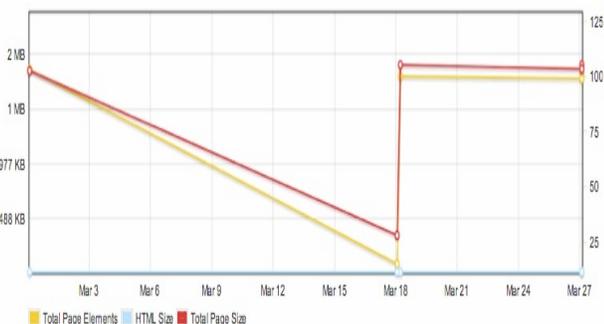


FIGURE II. PAGE SIZES AND REQUEST COUNTS BASED ON GT METRIX SITE LOADING SPEED ANALYSIS

A. Technical evaluation

Based on our observations in simulations, the fact that the colour blue appears to be darker to most colour-blind users enhances the visibility of white text on a blue background.

We evaluated the function of the layout by using online services simulating colour-blindness [7] and web page screen resolution test services like Webconf [8]. In addition, we tested the site with a variety of data terminal equipment, such as tablets and smart phones. The site's design takes the visually impaired into account by offering screen readers for different parts of the user interface or, alternatively, by providing access to different page texts in

an audio format. We also tested site loading speed efficiency like GT metrix [9]. Based on our tests the page loading time was first reduced, but it also varied when the site was updated [Fig. 2]. We are continuing the site optimization work.

IV. RESULTS AND DISCUSSION

It is difficult to assess the efficiency of the website, since the devices used are of different quality. However, on the basis of the usability tests, our solution can be used with a variety of web browsers and data terminal equipment. None of the testers who answered the questions on usability used a mobile device. Positive feedback was given, in particular, on the user interface and its efficiency with different assistive aids. However, this does not necessarily mean that the website in itself functions well but it might indicate that the assistive aids, e.g. the speech synthesis programme works well. Yet, the testers thought that the user interface mostly works well. The testers mentioned as deficiencies the complex dropdown-menus which demand good motor skills from their users. The website also has some other deficiencies, and therefore, it does not yet conform the definitions of W3C A-level accessibility [10]. W3C defines three web accessibility levels from the lowest A to the best AAA accessibility level. On the other hand the visually impaired users only criticised the dropdown-menus but not the accessibility or usability of the website. The participants also gave positive feedback on the content of the website.

V. FURTHER WORK

In a context of iterative design process, development work is done step by step after every feedback session from users. Our project is still on early stages. There is still a lot of work with providing equivalent alternatives to auditory and visual content for peoples with disabilities. Also clarifying the usage of natural language must be done as described W3C Web accessibility guidelines. [10]. At the same time, a lot of work has been done for designing the site independence from devices. After early phases a lot of data optimization has been done especially reducing image sizes.

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