

Implementation of 3d graphics on the web – a case study of experience development, optimisation and qualitative evaluation

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Introduction



The primary advantages of using a Content Management System (CMS) include ease of use, as the graphical interface makes it user-friendly even for those without technical knowledge. Efficient information retrieval is another benefit, with built-in search engines enabling quick access to content. CMS platforms also simplify content management, providing tools for organizing and maintaining digital assets effectively. CMS platforms support collaborative workflows, enabling multiple users to work simultaneously on content management tasks with varying permission levels.

Usability and user experience (UX) are crucial considerations in the development and refinement of a CMS. Usability refers to the quality and simplicity of the user interface, which directly impacts how effectively and efficiently users can achieve their goals. It encompasses aspects such as learnability, efficiency, memorability, error management, and satisfaction. Usability testing is a vital part of the design process, helping identify strengths and weaknesses in the current design, exploring competitive approaches, and refining ideas through iterative testing of prototypes. Empirical measurement of UX can be conducted through standardized questionnaires such as User Experience Questionnaire (UEQ). The UEQ assesses aspects like attractiveness, perspicuity, dependability, efficiency, novelty, and stimulation, providing valuable insights for interpreting usability tests and enhancing the overall design experience.

Problem Description



The aim of the work was to design, develop and publish a website that focuses on a three-dimensional object. The special feature of the implementation is the use of the CMS platform and open-source functionalities for viewing the 3D models. This allows the user to view a 3D object from any angle, to zoom in or out and to experience it interactively. After the creation and publication of the website, the subjective usability metrics based on the standardized UEQ questionnaire was used to analyse and evaluate the information on possible improvements, shortcomings, additional features and the quality of the user experience.

Methods



The experimental part included following phases, which overlap at certain points: analysing the existing websites to determine the core functionalities and layout of the pages; definition of end users and target groups, determining the basic functionality and information architecture of the website; design wireframes of the website; design of a non-functional website prototype, development of a website for a personal computer (desktop), checking, correcting and finalising elements; development of a website for a smartphone (mobile) and a tablet computer (tablet), usability test with the UEQ questionnaire. Usability was measured using a combined method. i.e. standardised quantitative usability metrics and open-question questionnaire. The actual user experience was measured with a standardized UEQ questionnaire and open-ended questions were used to search for problem areas. The test examined the quality of the user experience in six areas (UEQ, 2022): Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation and Novelty. The questionnaire already contains a tool for analysing the results and a benchmark.

Questionnaire with two open questions provided us with information that directly indicated problems with the use of the website, i.e. "Comment on your experience of using the website." and "Suggest improvements and/or new functionalities that you think would improve the performance of the website."

The web solution with the integration of 3D viewer was tested on a PC and with browsers: Google Chrome, Safari, Mozilla Firefox, Microsoft Edge; and on mobile devices and with browsers: Google Chrome, Safari, Vivaldi.

Results



The website was designed in Wordpress.org platform. The functionalities offered by the website platform were divided into two categories: 1. The main functionalities represent the goal of the website: 3D model that the user can interactively view and zoom from any angle and a gallery with static photos and renderings of the objects. 2. Auxiliary and secondary functionalities that enabled the user to learn and navigate the website or the 3D model, i.e. Presentation and purpose of the website; Selection gallery from which the user can choose any 3D model; Description of the facility.

Information architecture, basic wireframe and short code with CSS component of the 3D object that displays the website logo are presented in Figure 1.

Results

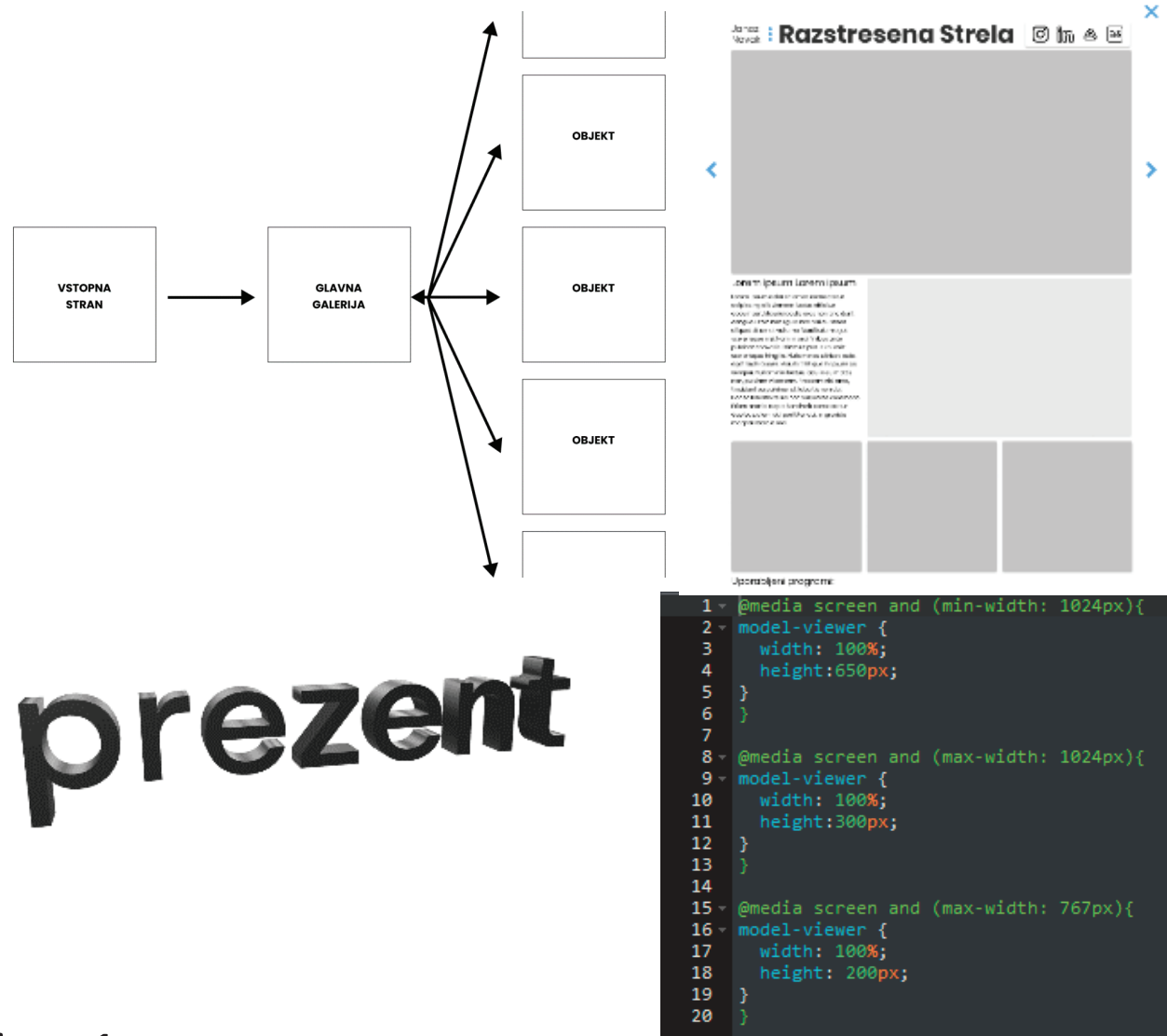


Figure 1

Information architecture, basic wireframe and the short code and CSS component of the 3D object that displays the website logo

The main purpose of the gallery was to support the model viewer and extend the accessibility of the bottom to view objects. Unlike the model viewer, the image gallery was part of the basic set of Elementor components. WooCommerce plugin. Therefore, the component did not have to be subsequently adapted in the program code for the dynamics within the template. Figure 2 shows the appearance of the final form of the rendering gallery on a selected 3D model within the editor in the Elementor plugin.

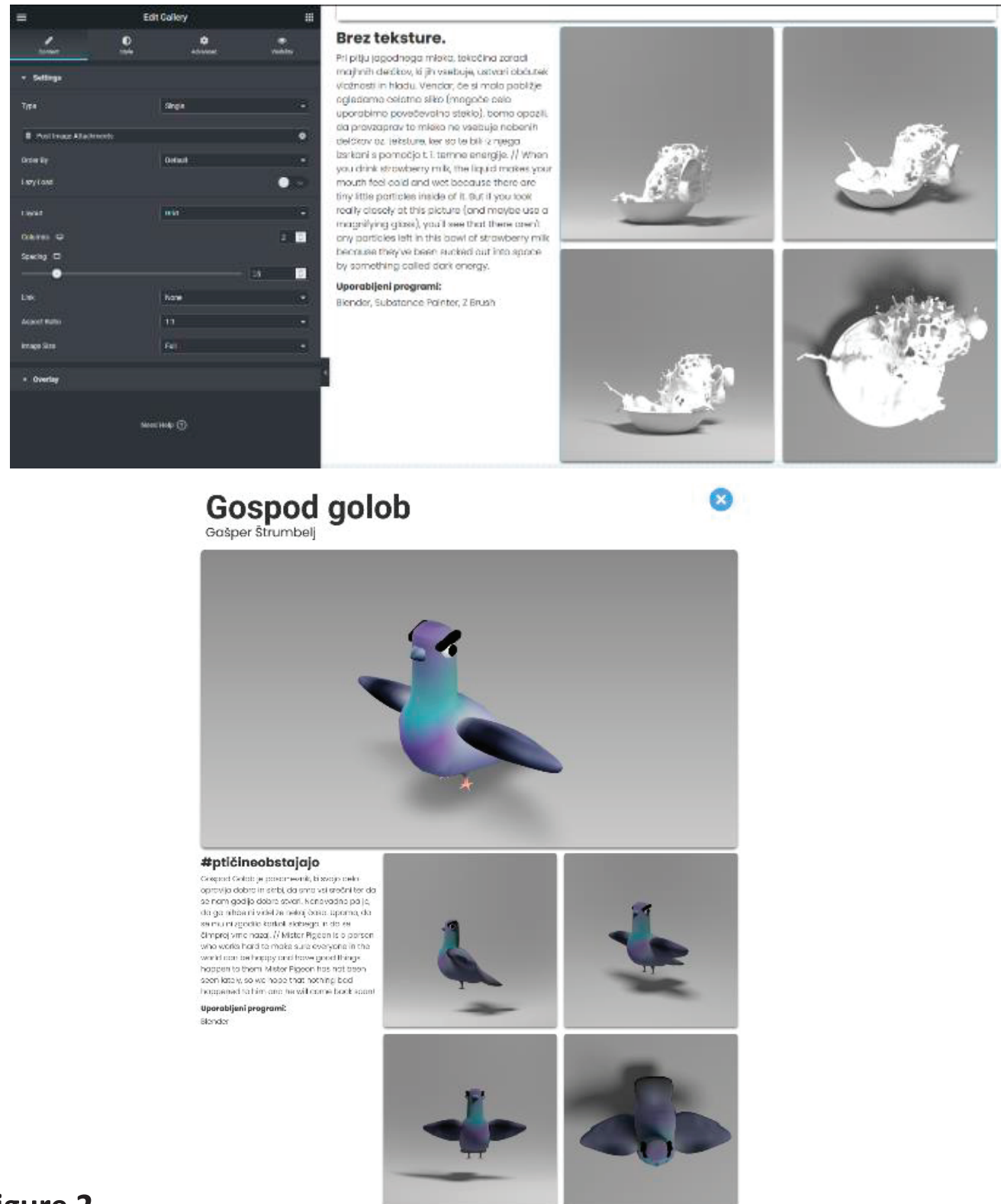


Figure 2

Image gallery layout of the Strawberry model in the Elementor plugin and the final layout of the object page

Figure 3 presents summarized results of UEQ testing of the websites with the 3D viewer and Figure 3 the visualisation of the UEQ results.

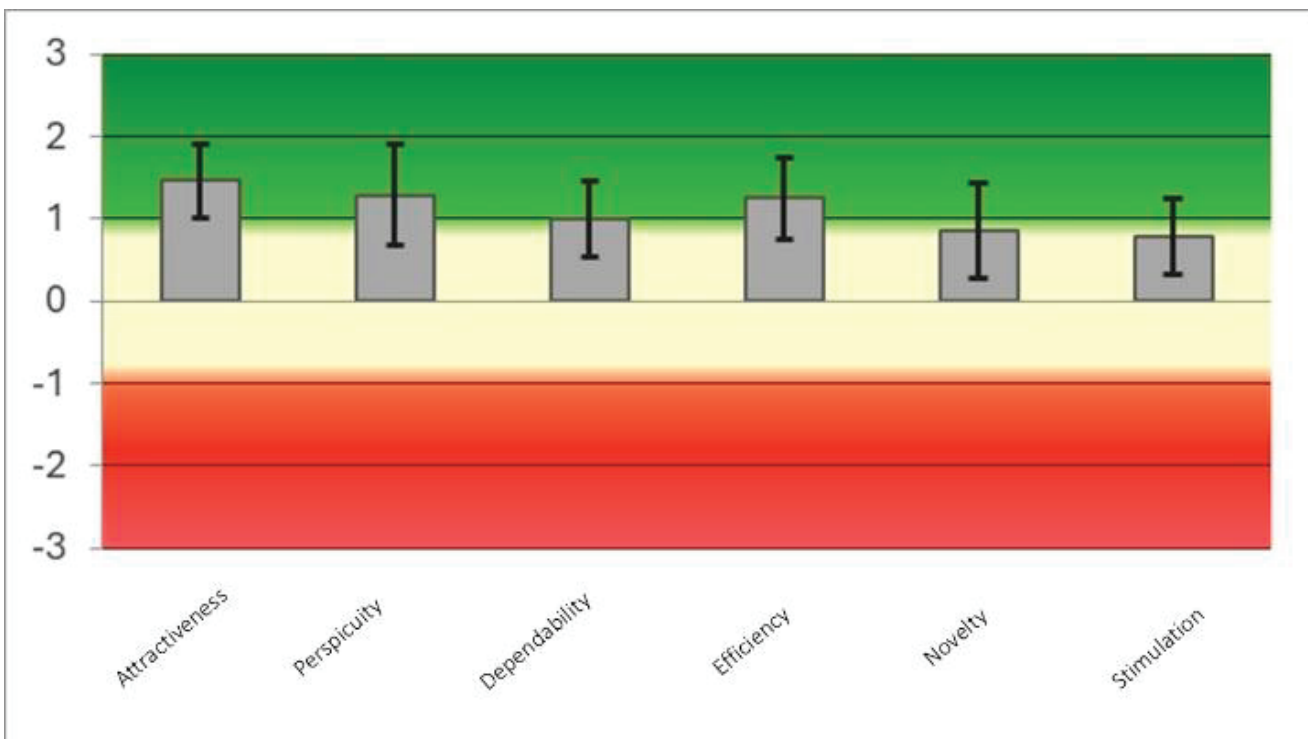


Figure 3

UEQ values of areas with standard deviation obtained with the UEQ questionnaire data analysis tool

The tool for analysing the UEQ results also contains a benchmark. The purpose of this benchmark is to compare the results with other usability tests that have already been completed. It is based on the results of 468 different tests conducted with a total of 21175 people (UEQ, 2022). The UEQ test performance is shown graphically in Figure 4.

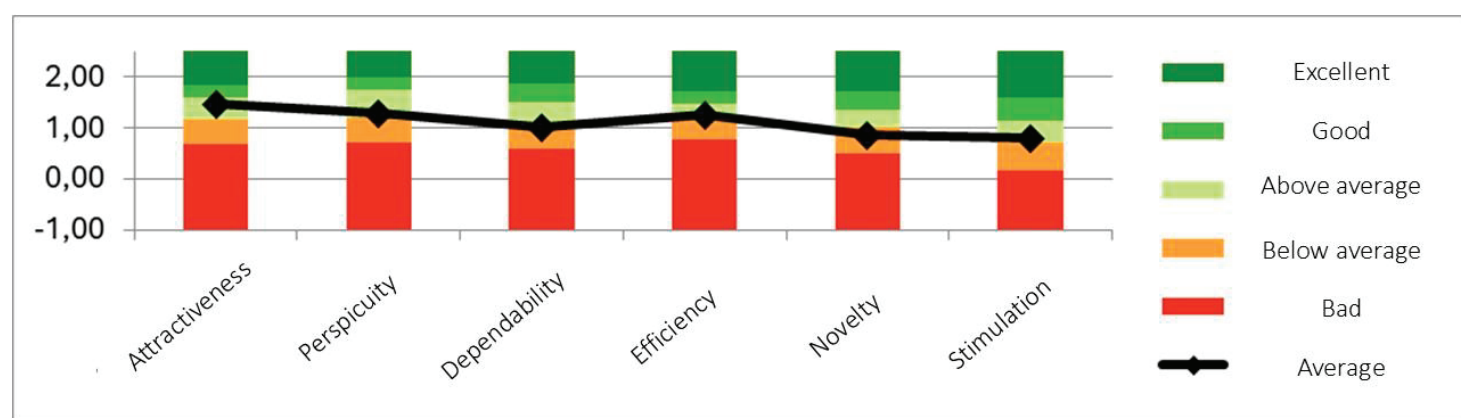


Figure 4

Graphic representation of the UEQ questionnaire test measure obtained with the UEQ questionnaire data analysis tool performance

Table 2 shows that most problems occurred in the category of practical quality, due to problems with individual webpage components, with the overall experience with the website or with a specific limitation of the browser.

Positive	Negative comments
Appeal and attractiveness: <input checked="" type="checkbox"/> engaging interactivity	Appeal and attractiveness: <input checked="" type="checkbox"/> visual sophistication <input checked="" type="checkbox"/> additional features within the viewer
Practical: <input checked="" type="checkbox"/> intuitive navigation	Practical quality: <input checked="" type="checkbox"/> unintuitive navigation <input checked="" type="checkbox"/> problems with the main gallery <input checked="" type="checkbox"/> problems with the browser <input checked="" type="checkbox"/> problems with more sophisticated models <input checked="" type="checkbox"/> difficult to launch
Hedonic quality: <input checked="" type="checkbox"/> responsiveness of the site	Hedonic quality: <input checked="" type="checkbox"/> visual sophistication
Other: <input checked="" type="checkbox"/> fast loading of the models	

Discussion / Conclusion



Attractiveness. From the results of the questionnaire on comments and suggestions in the attractiveness category, we can conclude that users like the interactive 3D model viewer and that they would like to see additional features in this area, such as: 1. more options within the navigation, such as changing the pivot point and zoom level, 2. opening the viewer in an additional window, 3. technical inspections of installations (e.g. cross-sections of installations), 4. 3D objects with animation.

Practical quality. From the comments and suggestions in the Practical quality category, it can be concluded that users are largely satisfied with the use of the website in terms of transparency and manageability, but somewhat less so in terms of efficiency. This can be seen in both the positive and negative comments and suggestions from users where problems occur throughout the website: 1. problems with the browser, 2. problems with the main gallery, 3. problems with more sophisticated models, 4. problems with loading objects, 5. non-intuitive navigation.

Hedonic quality. From the comments and suggestions in the hedonic quality category, we can conclude that users are not surprised and are on average satisfied with the use of the website in terms of originality and stimulation. This can be seen mainly from the lower test score, as the results are much lower compared to the other two categories. The number of user comments and suggestions in this area, on the other hand, is very low and indicates a lack of both negative and positive reviews.

Creating a modern website that features an interactive 3D model using a CMS platform is a highly complex project, requiring expertise in multiple areas. Although the final website performs above average in terms of practicality and attractiveness based on UEQ testing criteria, adjustments are needed according to feedback received during testing. To improve the user experience, the development team must expand their technical knowledge, which may necessitate adding more members to the team.

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