UNIVERZA NA PRIMORSKEM
FAKULTETA ZA MATEMATIKO, NARAVOSLOVJE IN
INFORMACIJSKE TEHNOLOGIJE

ZAKLJUČNA NALOGA
(FINAL PROJECT PAPER)

OBLIKOVANJE IN RAZVOJ IGRIFICIRANE SPLETNE STRANI ZA VATERPOLO (DESIGN AND DEVELOPMENT OF A GAMIFIED WATER POLO WEBSITE)

DANILO RADONJIĆ

2022
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Zaključna naloga
(Final project paper)

Oblikovanje in razvoj igrificirane spletne strani za vaterpolo

(Design and development of a gamified water polo website)

Ime in priimek: Danilo Radonjić
Študijski program: Računalništvo in informatika
Mentor: doc. dr. Vida Groznik

Koper, september 2022

Ključna dokumentacijska informacija

Ime in PRIIMEK: Danilo RADONJIĆ

Naslov zaključne naloge: Oblikovanje in razvoj igrificirane spletne strani za vaterpolo

Kraj: Koper

Leto: 2022

Število listov: 43 Število slik: 9

Število referenc: 20

Mentor: doc. dr. Vida Groznik

Ključne besede: razvoj spletne strani, vaterpolo, igrifikacija, pripovedanje zgodb, spletno oblikovanje

Izvleček:
Število oseb, povezanih z vaterpolom, je v Sloveniji v primerjavi z okoliškimi državami razmeroma majhno. Ob izjemnih plavalnih objektih v državi, ki zagotavljajo idealne pogoje za športnike, je nekoliko presenetljivo, da je med državljani malo ali nič zanimanja za vaterpolo. Uvrstitev Slovenije na evropsko prvenstvo v vaterpolu bi sicer lahko bila priložnost za senzibilizacijo ljudi za vaterpolo, vendar obstaja tudi potencialna slaba stran, da bi bil ta šport zanje zmeden, saj ni bilo priložnosti, da bi o njem pisali. Priložnost za promocijo vaterpola v Sloveniji obstaja z razvojem interaktivne spletne strani, na kateri bi bile predstavljene osnovne informacije. Z uporabo načel interaktivnega pripovedovanja zgodb, in ljudi na vesel in estetski način seznanja z lepotami vaterpola in razumevanjem. Poleg tega je spletna stran zasnovana po ključnih načelih učinkovitega spleta in z namenom preprostosti, od uporabe izrazitih slik do prepričljive vsebine, ki prenaša sporočilo o osnovah vaterpola. Poleg tega je spletno mesto nadgrajeno z igralnimi funkcijami, ki uporabnikom omogočajo napovedovanje izidov tekem vaterpola in jih nagrajujejo za pravilne napovedi. Te funkcije bi prispevale k večji vključenosti uporabnikov, kar bi verjetno povečalo njihovo zanimanje za vaterpolo.

Key words documentation

Name and SURNAME: Danilo RADONJIĆ

Title of final project paper: Design and development of a gamified water polo website

Place: Koper

Year: 2022

Number of pages: 43 Number of figures: 9
Number of references: 20

Mentor: Assist. Prof. Vida Groznik, PhD

Keywords: web development, water polo, gamification, storytelling, web design

Abstract:
The number of people in Slovenia associated with water polo is relatively low, compared to the countries surrounding it. With the country's remarkable swimming facilities that provide ideal conditions for the athletes, it is somewhat surprising that there is little to no interest among the citizens for water polo. While the qualification of Slovenia to the European water polo championship could be an opportunity to sensitize people to water polo, there is a potential downside that the sport would be bewildering to them, as there were no occasions to write about it. There is an opportunity to promote water polo in Slovenia by developing an interactive website that presents basic information. It uses the principles of interactive storytelling, getting the people acquainted with the beauty and understanding of water polo in a joyful and aesthetically pleasing way. Furthermore, the website is designed on key principles of an effective website and with simplicity in mind, from the usage of expressive imagery to having compelling content, conveying the message of water polo basics. Additionally, the website is enhanced with gamified features that provide users with the possibility to predict water polo match outcomes and reward them with. These features would contribute to increased user engagement, which is likely to increase the preference to associate themselves with water polo.

Acknowledgement

I would like to thank my mentor Prof. Vida Groznik for the invaluable assistance, guidance and encouragement. A warm, heartfelt thanks to my lovely, caring and supportive family.

Contents

List of Figures

List of Abbreviations

EWC	European Water polo Championship
HTML	Hypertext Markup Language
CSS	Cascading Style Sheets
DOM	Document Object Model
UX	User Experience
MVC	Model-View-Controller
URL	Uniform Resource Locator

1 Introduction

The popularity of water polo, one of the oldest team sports in the Olympic programme [1], has been rising in Slovenia over the last couple of months. However, according to the major achievements by nations, the number of people associated with it is relatively low compared to the countries and regions surrounding Slovenia [2]. Having played water polo professionally in Slovenia, I have always wondered how in the country, having remarkable swimming facilities that provide ideal conditions for the athletes, there is little to no space among the people for water polo. Moreover, given the emerging presence of citizens from nearby countries that are among the best water polo nations worldwide (namely, Serbia, Croatia, and Hungary), the influence of those nations on the culture of Slovenia, as well as the shared history and similarities in language and origin, the low popularity of water polo in Slovenia is even more puzzling.

One of the reasons for such low popularity could be related to the market that is already reasonably congested with famous team sports (namely, football, basketball, and handball), as well as individual sports, such as skiing, cycling and ski-jumping. Those mentioned above are the sports in which Slovenia has achieved quite remarkable results throughout its history [3] and are therefore more popular among the youth. The presence of famous team sports overseas also leaves less space for engagement in water polo, as it is not considered a global sport.

Another possible reason for the lack of interest among the people in this sport could be water polo not being "ad-friendly". Specifically, water polo is played in four periods, each of eight minutes of actual play, with the interval between two periods of two minutes (three minutes between halftime). In addition, per game, a team may request two one-minute timeouts. These rules leave the water polo game having, in the best case, a total of eleven minutes of breaks, during which the advertisements could be shown. Perhaps, there is a lack of opportunity for television networks to run advertisements during a water polo game.

Nonetheless, the slow rise of water polo in Slovenia could be ascribed to little to no opportunity to primarily introduce the sport to the Slovenes. The last appearance of the Slovenian national water polo team in a significant water polo competition was at the 27th European Water polo Championship, held in Belgrade, 2006 [4], where the Slovenes ended in disenchanted, last place. Since then, there were only a few

significant water polo activities that were potentially interesting for the media to share and spread, due to which the popularity of the sport gradually diminished. Given the historical value of water polo, as well as excellent training conditions and facilities in Slovenia, there is an opportunity to promote water polo and utilize citizens for greater engagement in the sport, contributing to the healthy development and lifestyle of citizens.

1.1 Motivation

The European Water polo Championship (EWC) is the biggest water polo competition in Europe. The tournament's 35th running will be held in Spaladium Arena in Split, Croatia, from 29th August to 10th September 2022 [5]. The tournaments for the qualification to the EWC 2022 were held in February 2022 [6], where seventeen teams, split into four groups, participated in the qualifications. The two top teams from each group qualify for the championship. Intriguing was group A, the only group with five teams in it. Slovenia, one of the participants, was also the host of group A. While relinquishing the favourites to Germany and France, the Slovenes played the tournament quite well, having two remarkable victories over Switzerland and Belgium, which ensured them third place in the group [6].

Due to the 2022 Russian invasion of Ukraine, Ligue Européenne de Natation (LEN), the governing body for water polo, has decided to disqualify Russia [7], the nation already a participant of the EWC 2022. As a substitute, the wild card has been awarded to Slovenia, having the highest average points among nations ranked 3rd in their group [8]. Therefore, Slovenia will participate in the EWC after more than seventeen years.

In addition to the nation's success, this would be an ideal opportunity to introduce water polo to the citizens of Slovenia, encouraging sensitizing the audience to embrace the development of the sport in the longer term. Furthermore, fostering a connection to water people would further increase the association with sport and physical activity, promoting health and well-being and improving community health and productivity.

Several other factors also highlight the importance of participation in the EWC 2022. Namely, the format of the tournament has been changed since the last appearance of Slovenia on the EWC. While the group stage has remained the same (sixteen teams being split into four groups with four teams each), the knockout system has been alternated. The first team of each group is directly qualified for the quarterfinals, whereas the second and third teams compete in a cross-group format to qualify for the quarterfinals [9]. With Slovenia playing in group D with Serbia, Hungary and Israel, the group would offer both attractive matches (Slovenia and Hungary being one of the

most prosperous nations in water polo). Moreover, it would offer Slovenia the chance to proceed to the knockout stage (given the lack of experience of Israel's national water polo team, who will participate in the EWC for the first time [6]).

Another reason for utilizing the involvement could be chalked up to the location the EWC 2022 would take place. Given that Split, the host of the tournament, is nearby Slovenia, it could be assumed that more Slovenians would use the occasion to travel to the city of the Croatian Mediterranean and be more engaged with water polo.

1.2 Objective

There is an opportunity to promote water polo in Slovenia by developing an interactive website that presents essential information and rules of the sport. Considering the increasing popularity of digital products and services, a website would be a suitable platform for showcasing the basics of water polo, with the descriptive imagery, visual storytelling and interactive on-site features.

In Chapter 2, the Planning stage has been described, elucidating and discovering the approach on finding a feasible solution for the digital product. Moreover, this Chapter provides the defined functionalities of the user. Chapter 3 discusses common design principles, as well as their integration to the water polo website, with the on-page provision. In Chapter 4, the development phase is explained, along with the code snippets of some of the important functionalities. Chapter 5 explains the revision stage, during which visual style and functionality of the website were further investigated, correcting any errors. Lastly, Chapter 6 summarizes the achieved work and concludes remarks and recommendations on further improvement of the project.

2 Planning

The fast-paced digital world has brought many possibilities for developing the needed products and services. In addition, today's technology has eased information sharing, offering many opportunities for businesses to improve innovative approaches, have efficient market promotions, and establish new communication channels. These opportunities, in turn, give the businesses the chance to showcase their achievements, skills and loyalty.

Having a digital product through which the clarity and vision would be provided to the user is one of the possible approaches to promoting water polo. In addition, the product would assist in establishing a trustworthy relationship with users, fostering them to have a new perspective on water polo.

There is a wide selection of digital product choices by which the desired aim would be achieved. Considering its popularity and usefulness, however, the website was a feasible solution that provides the option for further improvement and progressive enhancement. The discovery phase would help define the features, content and details and provide a possible approach for arranging such information.

2.1 Discovery

At this phase, the initial goal is further revised, emphasizing acquiring more information to showcase to users. Details about water polo as a sport (namely, its basics, rules, and objective) are acquired through the official documentation published by Fédération Internationale De Natation (FINA), an international water sports federation. The documentation containing the water polo rules was a guideline when defining which content should be included and used for the water polo website [10].

The content for the website was formed by the published collection of water polo rules. This information should be relevant and trustworthy while simultaneously simplified and self-explanatory. Therefore, the website showing the basics of water polo includes information on the field of play, objectives and the sport's rules. Furthermore, the content was written in terms of the upcoming EWC 2022, highlighting the appearance of the Slovenian national team in the tournament. Therefore, while no previous knowledge is assumed, the additional feature of predicting the outcome of the EWC

2022 was implemented for those already grasping the sport. Additionally, this novelty could not be found on any other platform, especially on the Slovenian market.

2.2 Exploration

After the platform choice and the content are defined, the exploration phase initializes in which possible approaches to showcasing the content. By assumption, little to no water polo activity in the past years resulted in a lack of understanding and following this sport. The presentation would, therefore, need to be as simple and cascading, with simplicity being the priority. Additionally, the website should be engaging and joyful, using storytelling and gamification principles.

2.2.1 Storytelling

Storytelling [11] is the art of conveying ideas, thoughts and messages joyfully and engagingly as a story. Through storytelling, users could get utilized and devoted to the content, paying close attention to the evoked emotions.

As such, storytelling is a convenient feature to use in the water polo website, through which otherwise abstract information about water polo would be presented more appealingly. Nonetheless, presenting the information in a particular, organized manner makes the website more compelling and adds to the interactivity and satisfaction. By chronological sequence, users would scroll down the web page and stay on track with the details and information about water polo basics and rules.

2.2.2 Gamification

Gamification [12] is the integration of game principles, characteristics, and elements into non-game challenges and environments. The gamification principle makes the content more engaging and descriptive due to the addition of interactivity and novelty in showcasing the details. Moreover, gamification fosters users to participate in the information acquisition and aims to leverage motivation.

The opportunity for adding playfulness to the water polo website could be accomplished through the game elements (namely, points and leaderboards). Information about water polo the user should gather would require the user's activity to be completely conveyed. Its form would be simplified and purposely made intuitive, avoiding difficulties and obstructing the users. This could be implemented as an interactive quiz, where users must fill in the missing space in a sentence, selecting one of the possible options. Along with the intuitiveness, the choice would further be simplified with the descriptive images serving as adjuncts. For the correct answer, a certain amount of

points would be added to the user's score, with the final score displayed at the end of the Storytelling.

Additionally, the website would provide users with the possibility to make a group and knockout stage predictions of the upcoming EWC 2022, where, after the tournament finishes, points would be awarded for each correct standings prediction. The user's final score would be allocated on the public leaderboard of all users, with the user with the highest score being put at the top of the leaderboard. By competitive placement and with the possibility of awarding the best-ranked users, the website would potentially reach a broader audience and keep the users motivated and committed to active involvement in water polo.

2.3 Identification

Identifying standard functionalities the user would be provided with is beneficial as they describe the user's behaviour and access to the features. The website's pages, related to the user's functionalities, assist in having a more transparent way of approaching the design and development of the website, considering the user's scope and functionalities.

2.3.1 Functional requirements

The website should enable the following functionalities:

- The user should be able to navigate through the landing page, completing interactive quizzes that could be found in the specific sections of a page.
- Registered members can use the prediction game on a website. Therefore, it should allow the user to sign in and sign out. Furthermore, the user should be able to register, for which the required information is an e-mail address, username and password.
- The users should be able to edit their profile. They should also have an option to delete their profile.
- The user should be able to browse through the list of guidelines for playing the prediction game.
- The user should be able to make predictions for the group stage of the tournament. The user should also be able to reset the current progress.
- The user should be able to make predictions for the tournament's knockout stage only after the group stage predictions are completed. The user should have an option to reset the predictions at any time.

- The user should have access to their current score, as well as to the public leaderboard.

2.3.2 UX Sitemap

UX Sitemap [13], often referred to as an information architecture diagram, is a visual representation of web pages of a website, whose purpose is to showcase the relationship of the individual web pages. A UX sitemap is the website's foundation, providing a more comprehensive and well-structured content organization in the upcoming stages. On figure 1, the organization of web pages on the website is shown.

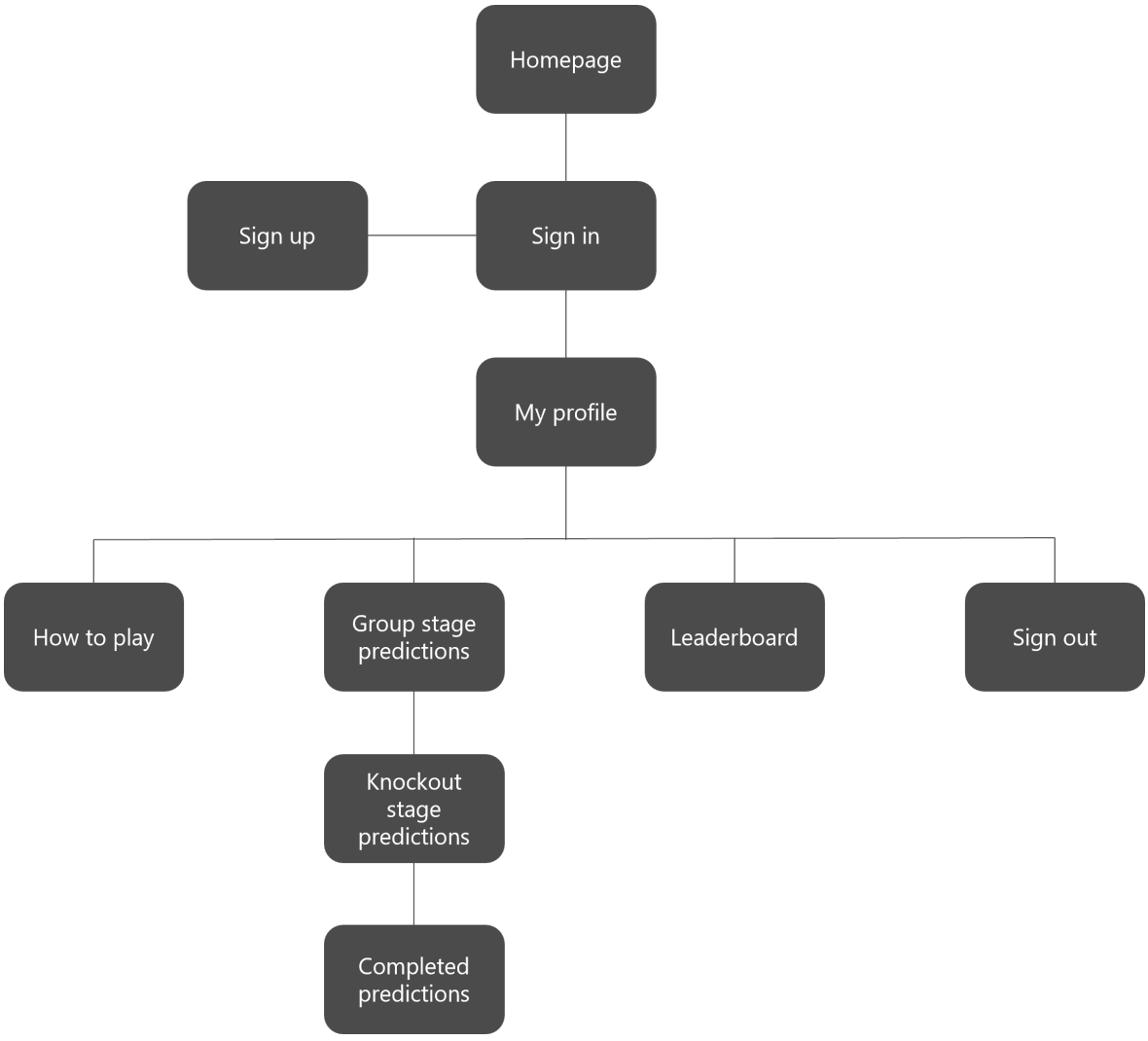

Figure 1: User experience sitemap for the water polo website.

In the next stage, the website's visual style is created, considering some of the modern design principles and trends. The details on the design are given in Chapter 3.

3 Design

Designing a website is the process of designing a website's visual presentation, considering the appearance features (such as color, composition, and imagery). A well-designed website ensures usability, higher engagement, and better user experience, further improving the user's satisfaction and association with the website. Furthermore, a well-designed website may be perceived as more credible, convey a clear, coherent message, and establish a strong brand identity.

The website developed for this thesis aims to present the basics of water polo and introduce this sport to the audience. Considering the current low popularity and understanding of water polo in Slovenia, the website should contain no extraneous information and functionalities that may bewilder users. Instead, the website should focus on simplicity and attractiveness. Below are the design features recommended to have on a website.

3.1 Layout

Layout is a structure representing the arrangement of components of a web page. It defines the relationship and the position of the elements, structuring the information presented on the page. There are several reliable, well-established and effective layouts the majority of websites are structured upon. Each layout provides numerous benefits in conveying information and providing a pleasant user experience, depending on the brand's identity and the target audience.

In the case of the water polo website, a *holy grail* layout type [14] is predominant. This layout contains a header and footer and three equal-height columns between them. The main content takes a more significant proportion of the inner content, while the header and footer complement the layout with additional information. The figure 2 shows the usage of holy grail layout on the water polo website.

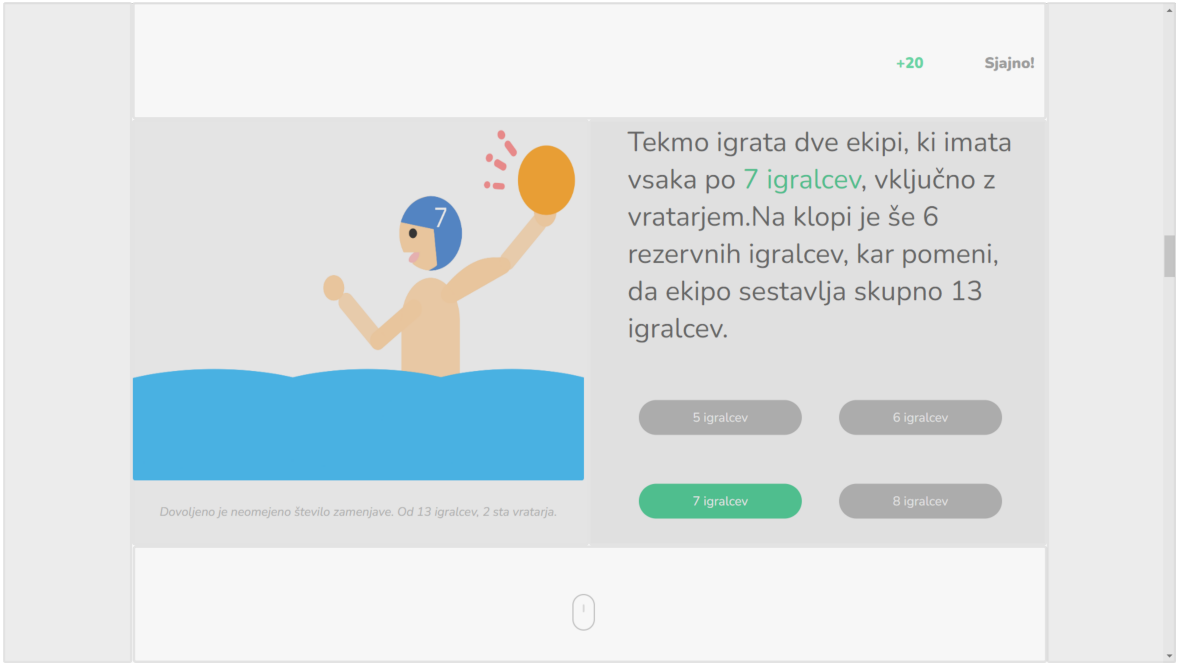

Figure 2: Holy grail layout on the water polo website.

3.2 Colour

Colour has one of the most significant impacts on the users of a website, helping them navigate and process the content more efficiently than it would be in the case of colourless elements. With the right combination of colours, they could express and convey a more coherent message, evoke the desired emotions, and influence the user's perception of the content.

In the case of the water polo website, a monochromatic, grey colour scheme has been used, blending well with the background and being used in the content definition. Using light tints and dark shades adds to the richness and break down a website's monotonicity. Due to its neutrality, grey Colour was the suitable choice as it is soft, calm and versatile while ensuring warmer colours stand out. Additionally, richer, playful colours (red, green and blue) created a pleasing contrast and were used to emphasize 'call-to-action' buttons and important content. The figure 3 shows the colour scheme that is used on the water polo website.

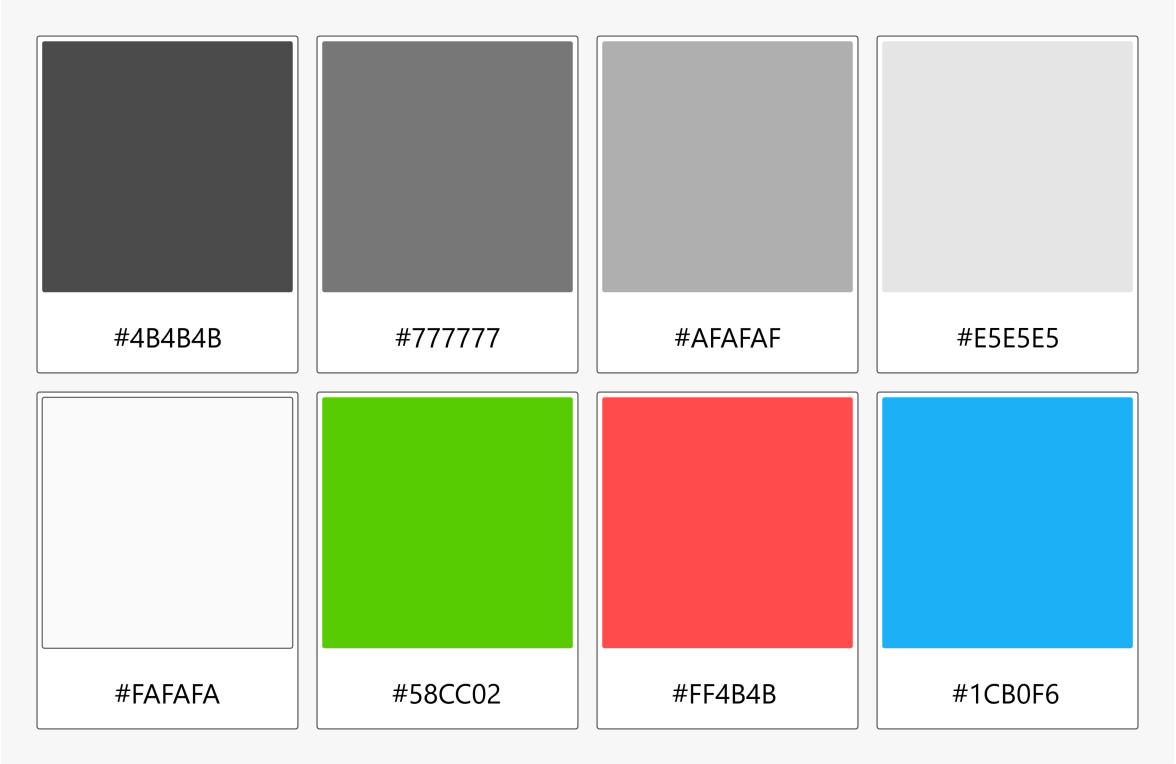

Figure 3: Colour scheme on the water polo website.

3.3 Typography

Typography is the art of using fonts the right way to ensure higher legibility and better appearance. It involves adjusting the font size, letter spacing, line height and word spacing to style the chunk of the text content. A suitable typeface on the website adds to the visual appearance and inclusion, ensuring that the text is legible and its style is intriguing. Furthermore, determining how the user would perceive the text is a vital part of typography for the web. Typography is a complex art that considers many features, such as accessibility and sizing. Regarding typography for the web, choosing the right type and setting the appropriate size of a text are among the top priorities when it comes to styling the text. One of the critical aspects of web typography is choosing the right font face.

In the case of the water polo website, two typefaces have been used, respecting the current website design recommendation trends on the number of typefaces. The typeface used mainly for body and paragraph elements is *Nunito*, a well-balanced, legible typeface. At the same time, headlines and titles were styled in *Fredoka One*, a playful font suitable for larger text. Such fonts pair well on web pages, providing higher contrast and emphasis while not being obtrusive and demanding for users to read. These fonts have been imported from *Google Fonts*, a free, self-hosted, open-

source library of fonts [15]. The figure 4 shows typefaces that were used on the water polo website.

Figure 4: Typeface on the water polo website.

3.4 Imagery

Imagery, or the usage of images, plays a vital role in enhancing the user's experience on the website. Images are often more visually descriptive and are perceived faster than words, so they assist in grabbing users' attention and directing their focus. Furthermore, images may condense otherwise overwhelming essential data into a bite-sized structure, helping users convey the correct information.

In the case of the water polo website, the usage of images is of high priority. The website is designed with the principle of storytelling, guiding the user through the basics of water polo. Therefore, the custom, descriptive illustrations have been designed with simplicity. These illustrations were designed in *Inkscape* [16], a professional quality vector graphics software. Moreover, the source of inspiration for the minimal, simple and flat style of the illustrations was through *Dribbble* [17] and *Behance* [18], global community websites for showcasing the work of designers and creative professionals. The figure 5 shows some of the custom-designed illustrations that are used on the website.

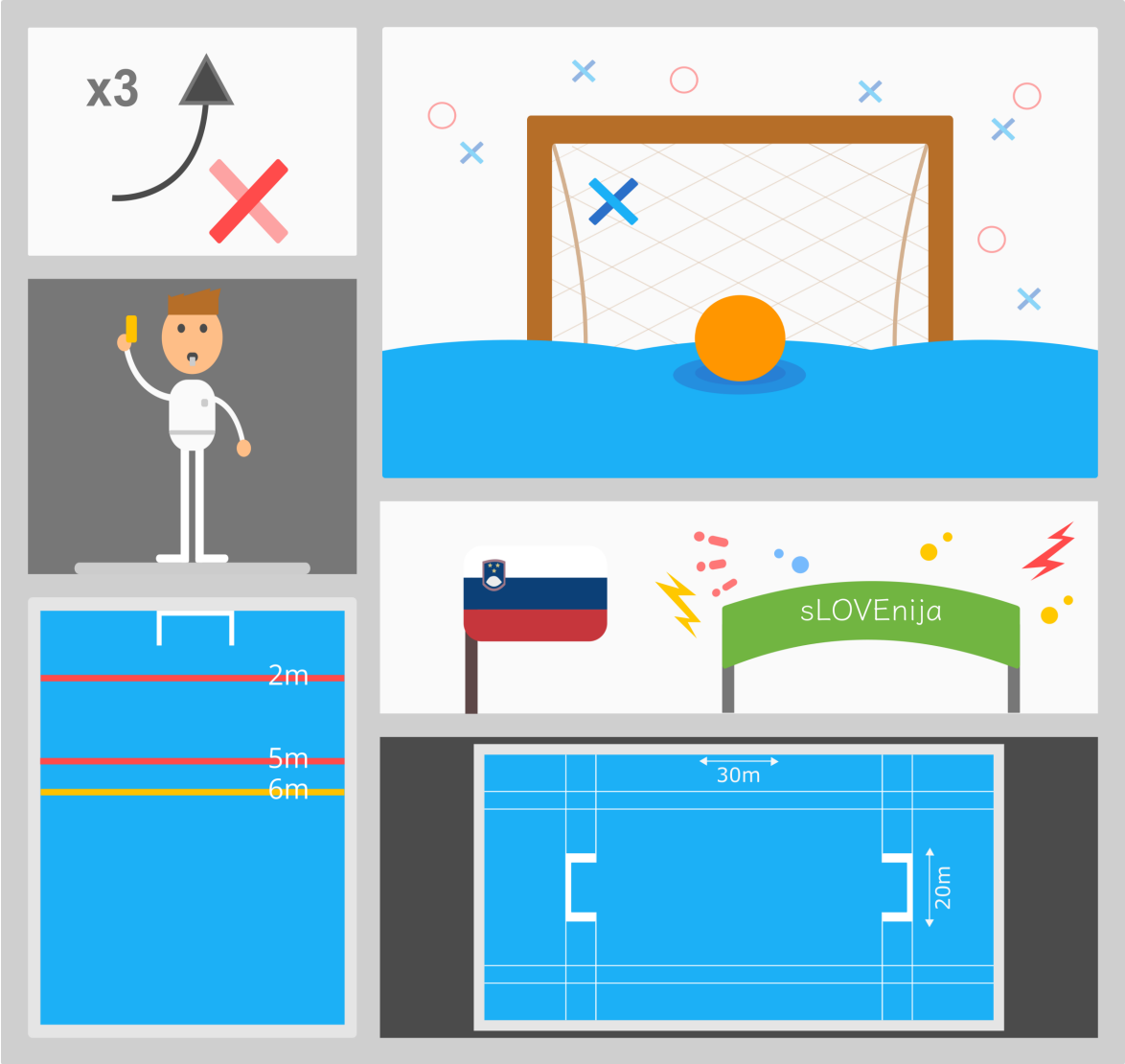

Figure 5: Example of an illustration on the water polo website.

3.5 Composition

Composition is the foundation of web design, as it describes the structure and placement of design elements. It represents the balance between the function and form and provides another decorative arrangement of website components. These guidelines are often found on many websites; whether added wittingly or inadvertently, their combination yields the desired effect and grabs the user's attention.

The principles that are used on the water polo website are balance, proximity and continuance.

3.5.1 Balance

Balance is the proportion of visual weight across the section. In our case, the split screen design on the web pages achieves a sense of balance, despite the parts not having equal visual height. In our case, pages are split in half by an imaginary line, with the content on both halves being approximate of equal weight. The figure 6 shows the usage of balance principle on the water polo website.

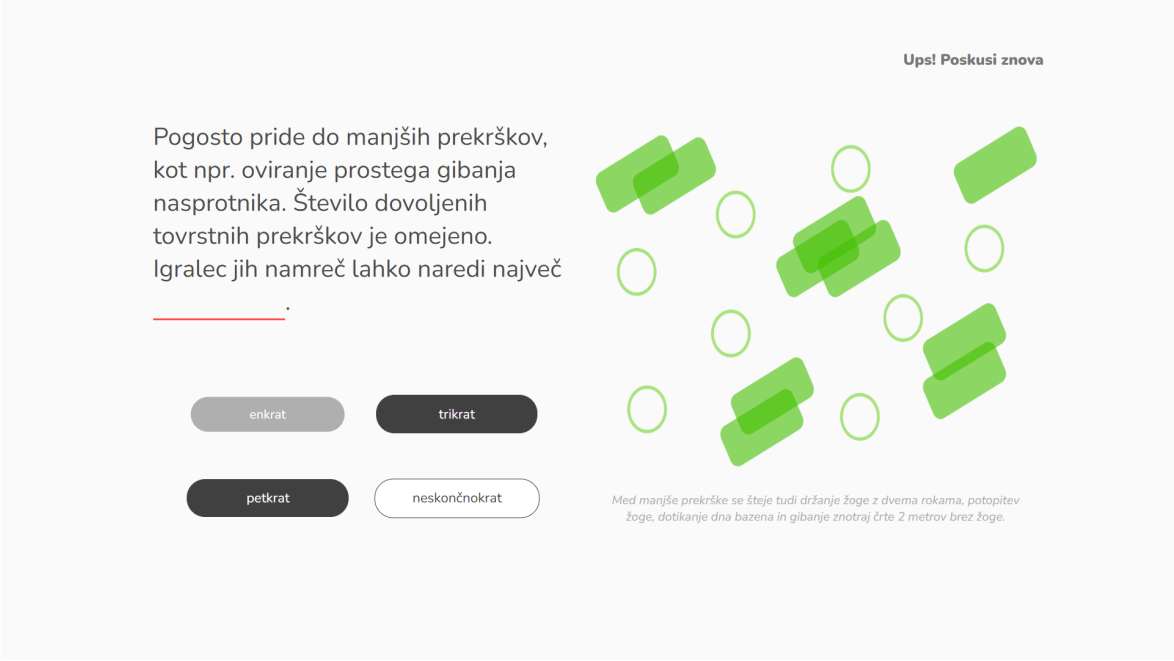

Figure 6: Balance principle on the water polo website.

3.5.2 Proximity

Proximity is the principle by which elements similar in design are perceived as a unit. This way, elements are placed close together and form a group. In our case, the page on which users define their group stage predictions contains four containers of the same style. These containers are aligned and centred and lay on the same baseline, being perceived as a whole group. The figure 7 shows the usage of proximity principle on the water polo website.

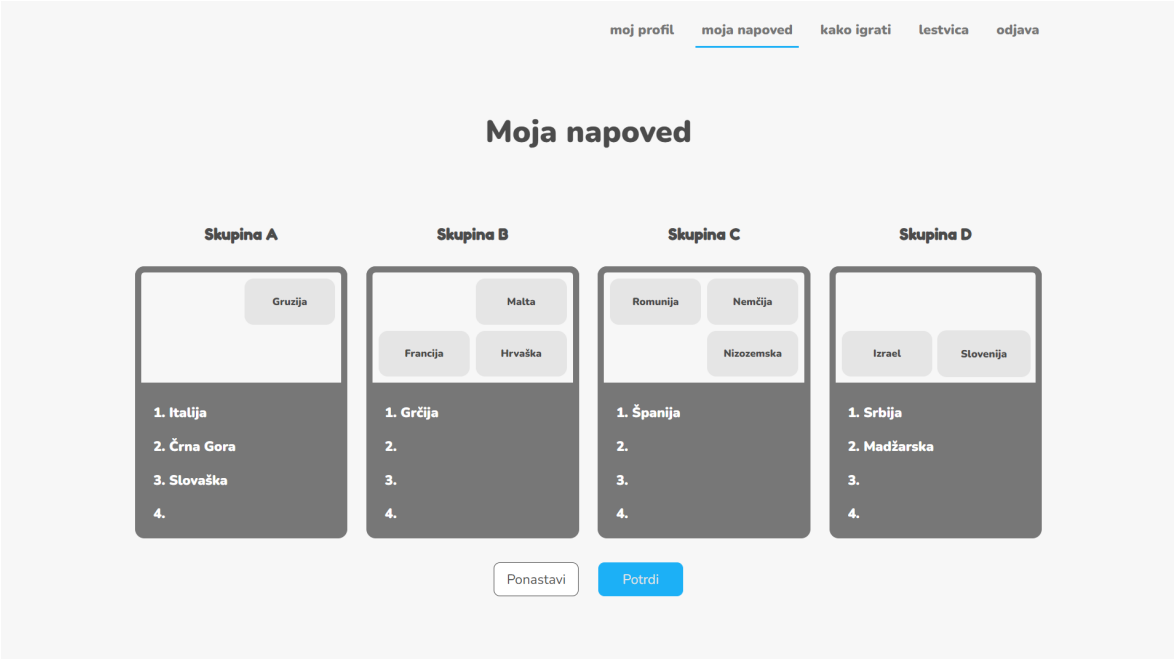

Figure 7: Proximity principle on the water polo website.

3.5.3 Continuance

Continuance dictates how our eyes are led to specific parts of an element with the help of additional edges and alignments. This way, the relationship between the elements is well established, whereas the vertical alignment on the page on which users define their knock-out stage predictions directs the attention towards the bottom, where the final prediction is made. The figure 8 shows the usage of continuance principle on the water polo website.

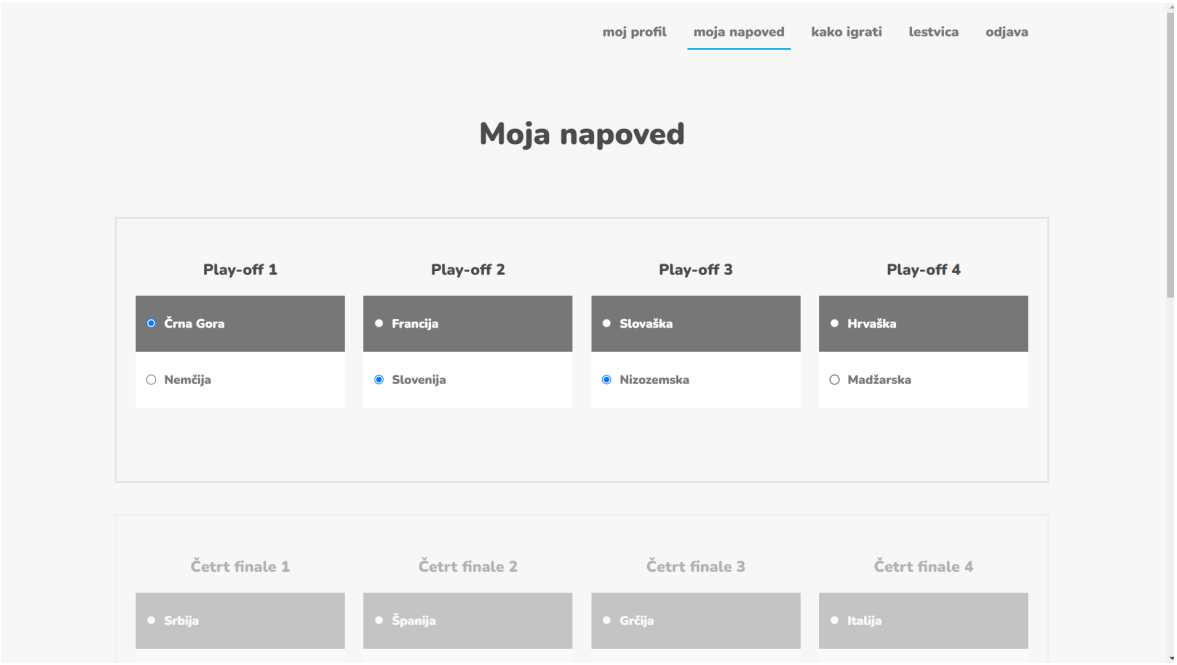

Figure 8: Repetition principle on the water polo website.

4 Development

After defining the design and the visual elements, we proceed to the implementation of the website. There was no need to use any front-end languages framework, as the language stack is sufficient to achieve the desired outcome. For the back-end development, however, the framework's usage has ensured faster set-up, higher security level and easier server maintenance.

4.1 Technology stack

The following languages, frameworks and software tools, all of which comprise the technology stack, were used in the water polo website: HTML, CSS, JavaScript, CodeIgniter and phpMyAdmin.

4.1.1 HTML

Hyper Text Markup Language (HTML) is the markup language that provides the basic site structure. It was used throughout the project to define the structure of the water polo website and was part of all site web pages.

4.1.2 CSS

Cascading Style Sheet (CSS) is another core technology used in the website implementation, providing style to the web documents. With CSS, a visual hierarchy of site structure is controlled through space, scale and colour. Additionally, this styling language has eased the need for creating a two-dimensional layout with the *display: flex* property.

4.1.3 JavaScript

JavaScript is the lightweight scripting language many websites and non-browser environments rely on their functionality. With JavaScript, the *Document Object Model (DOM)*, a programming interface, was effectively manipulated, mostly when preparing the array of input to be sent to the database. Moreover, the language of the Web enhanced the user's experience with the additional confirmation activities prior user's

execution of sensitive functionalities. The language also helped in toggling the visibility and access to the sections before validating the quizzes.

4.1.4 CodeIgniter

CodeIgniter is an open-source PHP framework for developing web applications. The framework provided a set of commonly used libraries for accessing and manipulating the data. Moreover, the application is well-structured through the default directories, enabling easier access.

4.1.5 phpMyAdmin

phpMyAdmin is an open-source software tool used for managing and interacting with MySQL databases. The MySQL database has been created through this application, along with the data tables and their relations.

4.2 Database design

Collection and storage of the data is a vital part of the development. The created database for the water polo website is a purely relational MySQL database whose benefits are ease of use and speed. The database schema has been defined by the following database tables: Users, Group_A, Group_B, Group_C, Group_D, Quarterfinals, Semifinals and Final. The model from our Model View Controller (MVC) architecture handles the received data and is used for creating, retrieving, updating and deleting the data. Figure 9 represents the physical database model.

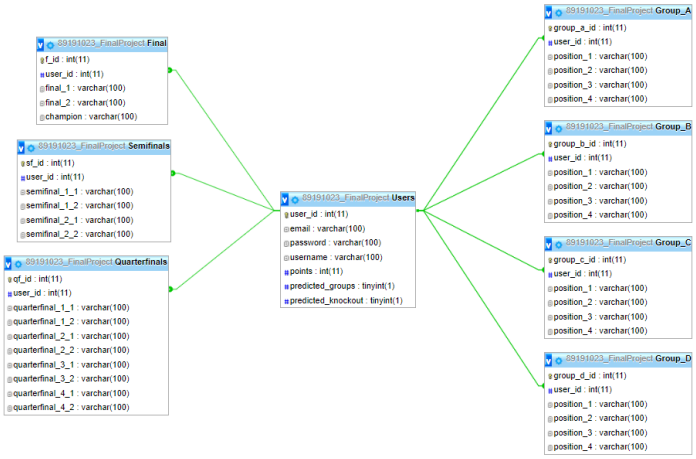

Figure 9: Physical database model

4.3 Implementation

The already defined functional requirements are being implemented by using the technology stack. The implementation of some requirements is shown below, along with the written code.

4.3.1 Registration

The prediction game on the website can be accessed only by registered members; hence, the user registration. The necessary data, which should be of the correct type, is provided through the input form. Furthermore, the user should agree to the terms and conditions. Once the user submits the data, the `saveuser()` method is called. The code used for implementing the registration functionality is given below.

```
// Saving account data to the database
   public function saveuser() {
      if ($this->input->post('sign_up')) {
         // Array of user information
         $data = array(
            'email' => $this->input->post('email'),
            'password' => md5($this->input->post('password')),
            'username' => $this->input->post('username'),
            'points' => 0,
            'predicted_groups' => 0,
            'predicted_knockout' => 0
         );
         // Check whether the account already exists
         $query = $this->User_model->check_if_exists($data);
         // If it does not, then save the user information to the database
         if ($query == FALSE) {
            $this->User_model->save_user($data);
            $this->session->set_flashdata('success', 'Profil je ustvarjen.');
            redirect('sign-in');
            // Otherwise, display user sign up error
         } else {
            $this->session->set_flashdata('error', 'Profil obstaja.');
            redirect('sign-up');
         }
      }
   }
```

```
public function check_if_exists($data) {
   $condition = "email = " . "'" . $data['email'] . "'";
   $this->db->select('*');
   $this->db->from('Users');
   $this->db->where($condition);
   $this->db->limit(1);
   $query_user = $this->db->get();

   return ($query_user->num_rows() > 0) ? TRUE : FALSE;
}

public function save_user($user) {
   $this->db->insert('Users', $user);
}
```

4.3.2 Updating and deleting profile

The user can edit and delete the profile as well. The `updateprofile()` method is called for editing the profile, which updates the user's record in the database. The code used for implementing the functionality of updating profile is given below.

```
// Updating user profile
public function updateprofile() {
   $user_id = $this->session->userdata['user_signed_in']['user_id'];
   if ($this->input->post('update_profile')) {
      $data = array(
         'user_id' => $user_id,
         'email' => $this->input->post('email--new'),
         'password' => md5($this->input->post('password--new')),
         'username' => $this->input->post('username--new')
      );
      // Updating the query
      $this->User_model->update_profile($data);
      // Destroying user session
      $this->session->unset_userdata('user_signed_in');
      // Let the user know that the account is successfully updated
      $this->session->set_flashdata('success', 'Profil je posodobljen.');
      redirect('sign-in');
   }
}
```

```
   public function update_profile($data) {
      $this->db->set($data);
      $this->db->where('user_id', $data['user_id']);
      $this->db->update('Users');
   }
```

Should the user want to delete the profile, the `deleteprofile()` method is called. The code used for implementing the functionality of deleting profile is given below.

```
// Deleting user profile
   public function deleteprofile() {
      $user_id = $this->session->userdata['user_signed_in']['user_id'];
      $this->User_model->delete_profile($user_id);
      // Destroying user session
      $this->session->unset_userdata('user_signed_in');
      // Let the user know that the account is successfully deleted
      $this->session->set_flashdata('success', 'Profil je izbrisan.');
      redirect('sign-in');
   }

   public function delete_profile($id) {
      $this->db->where('user_id', $id);
      $this->db->delete('Users');
   }
```

As updating and deleting profiles are sensitive actions, the additional step of confirming such actions is required before the execution, hence acknowledging the user's certainty. The code used for implementing the confirmation of action is given below.

```
// Receiving user's confirmation for completing the action
function confirm_action() {
   let message = prompt("Opozorilo: Ta postopek je trajen. Odjavljeni boste
      s spletne strani.\nProsimo, vtipkajte 'POTRDI' da nadaljujete s
      postopkom:");
   return message === "POTRDI";
}
```

4.3.3 Making group stage predictions

The user predicts the final standings of the four groups of the tournament. Each group has four nations which the user should allocate in the final standings. Once all group predictions are completed, the user then submits the predictions. The `savegroupppredictions()` method is called, which writes the user's group stage selections to the database. The code used for implementing the functionality of saving user's group stage predictions is given below.

```
// Getting user's predictions (group stage)
   public function savegroupppredictions() {
      $id = $this->session->userdata['user_signed_in']['user_id'];
      $this->session->userdata['user_signed_in']['predicted_groups'] = 1;

      if ($this->input->post('submit_group')) {
         // Arrays of group information
         $groupA_data = array(
            'user_id' => $id,
            'position_1' => $this->input->post('A_pos1'),
            'position_2' => $this->input->post('A_pos2'),
            'position_3' => $this->input->post('A_pos3'),
            'position_4' => $this->input->post('A_pos4')
         );

         $groupB_data = array(
            'user_id' => $id,
            'position_1' => $this->input->post('B_pos1'),
            'position_2' => $this->input->post('B_pos2'),
            'position_3' => $this->input->post('B_pos3'),
            'position_4' => $this->input->post('B_pos4')
         );

         $groupC_data = array(
            'user_id' => $id,
            'position_1' => $this->input->post('C_pos1'),
            'position_2' => $this->input->post('C_pos2'),
            'position_3' => $this->input->post('C_pos3'),
            'position_4' => $this->input->post('C_pos4')
         );

         $groupD_data = array(
```

```
            'user_id' => $id,
            'position_1' => $this->input->post('D_pos1'),
            'position_2' => $this->input->post('D_pos2'),
            'position_3' => $this->input->post('D_pos3'),
            'position_4' => $this->input->post('D_pos4')
        );

        $QF_data = array(
            'user_id' => $id,
            'quarterfinal_1_1' => $this->input->post('A_pos1'),
            'quarterfinal_2_1' => $this->input->post('B_pos1'),
            'quarterfinal_3_1' => $this->input->post('C_pos1'),
            'quarterfinal_4_1' => $this->input->post('D_pos1')
        );

        $user_data = array(
            'predicted_groups' => 1
        );

        // Saving predictions (group stage) to the database
        $this->User_model->save_group_predictions($groupA_data,
            $groupB_data, $groupC_data, $groupD_data, $QF_data, $user_data,
            $id);
        // Let the user know that the prediction is created successfully
        $this->session->set_flashdata('success', 'Napoved je narejena.');
        redirect('User/getgrouppredictions');
    }
}

// Retrieving group stage predictions from the database
public function getgrouppredictions() {
    $id = $this->session->userdata['user_signed_in']['user_id'];
    $data['group_predictions'] =
        $this->User_model->get_group_predictions($id);
    $this->load->view('pages/my-predictions-knockout-stage', $data);
}
```

4.3.4 Making knockout stage predictions

Having predicted the outcome of the group stage, the user can proceed to the knockout stage. Here, the user chooses the winner of four 'play-off' pairs formed by cross-pairing the final standings from the group stage. To prevent accessing the round of the next stage, their container is hidden until the outcome prediction of all pairs in the current round is completed. Once the user chooses the winner of the final round (that is, the champion of the tournament), the user can then submit the predictions. The `saveknockoutpredictions()` method is called, which writes the user's knockout stage selections to the database. The code used for implementing the functionality of saving user's knockout stage predictions is given below.

```
// Getting user's predictions (group stage)
   public function saveknockoutpredictions() {
      $id = $this->session->userdata['user_signed_in']['user_id'];
      $this->session->userdata['user_signed_in']['predicted_knockout'] = 1;

      if ($this->input->post('submit_knockout')) {
         // Arrays of knockout information
         $QF_data = array(
            'user_id' => $id,
            'quarterfinal_1_2' => $this->input->post('po4'),
            'quarterfinal_2_2' => $this->input->post('po3'),
            'quarterfinal_3_2' => $this->input->post('po2'),
            'quarterfinal_4_2' => $this->input->post('po1')
         );

         $SF_data = array(
            'user_id' => $id,
            'semifinal_1_1' => $this->input->post('qf4'),
            'semifinal_1_2' => $this->input->post('qf3'),
            'semifinal_2_1' => $this->input->post('qf2'),
            'semifinal_2_2' => $this->input->post('qf1')
         );

         $F_data = array(
            'user_id' => $id,
            'final_1' => $this->input->post('sf2'),
            'final_2' => $this->input->post('sf1'),
            'champion' => $this->input->post('final')
         );
```

```
            $user_data = array(
                'predicted_knockout' => 1
            );

            // Saving predictions (knockout stage) to the database
            $this->User_model->save_knockout_predictions($QF_data, $SF_data,
                $F_data, $user_data, $id);
            // Let the user know that the prediction is made successfully
            $this->session->set_flashdata('success', 'Napoved je narejena.');
            redirect('User/getchampionprediction');
        }
    }

    // Getting user's champion prediction
    public function getchampionprediction() {
        $id = $this->session->userdata['user_signed_in']['user_id'];
        $data['champion_prediction'] =
            $this->User_model->get_champion_prediction($id);
        $this->load->view('pages/my-predictions-completed', $data);
    }
```

4.3.5 Accessing leaderboard

After the knockout stage predictions are made, the user has completed all predictions. After the tournament finishes (10 September), the score for all users is calculated, comparing the final and the predicted outcome. The user's final score will be updated based on the number of correct predictions. Then, the user can access the public leaderboard, which displays all the users in descending order by their score. To access the leaderboard, the `getleaderboard()` method is called, which displays the sorted user's score. The code used for implementing the functionality of accessing leaderboard is given below.

```
/* Get user's ranks (leaderboard) */
    public function getleaderboard() {
        $data['leaderboard'] = $this->User_model->get_leaderboard();
        $this->load->view('pages/leaderboard', $data);
    }

    public function get_leaderboard() {
```

```
        $this->db->select('*');
        $this->db->from('Users');
        $this->db->order_by("points", "desc");
        $this->db->limit(5);
        $query = $this->db->get();

        return $query;
    }
```

5 Revision

Revision of a website occurs after the development phase and involves the product review. In this stage, the developed website is being examined, seeking possible defects, design imbalance and incapability. To further simplify the process and ensure reliable results, our revision stage consisted of a design and functionality review.

5.1 Design audit

Design audit [19] is an activity that reviews all visual elements and accessibility features of a product to ensure their consistency and continuity. Its features are evaluated to avoid any user experience obstruction on a website, resolving any style quirks. During the design audit, the water polo website was appraised from the perspective of the style guide, ensuring continuous experience across all web pages and sections. The following issues have been discovered and corrected during the design audit:

1. Button style inconsistency: This issue occurred on the page where the user makes knockout stage predictions. The button with which the user submits their predictions had the style of the button that resets the current progress. Despite the low impact on the user's experience, the issue was promptly resolved by assigning an `id` attribute and modifying the CSS selector.

2. Cluttered text display: This issue was found on the page where the user makes the group stage predictions. The button text, displaying the name of the nations participating in the tournament, wrapped itself on a new line. This inconsistency has hardened the user's recognition of the nation. The issue was resolved by removing the button's `font-size` property, whose value was set to `1.25em` units, keeping the default value of `1em` units.

3. Low color contrast: This issue was found on multiple pages whose elements had the `background-color` property value set to the custom variable `var(--tertiary-gray)`. The contrast with the white, the colour of the elements' text, was low and thus not legible. The issue was resolved by changing the colour of the element's background to darker, `var(--primary-gray)` colour.

5.2 Functional testing

Before the website is officially released, the functionalities are revised to ensure the actual functionalities correspond with the defined functional requirements. Any ineffective, unusable functionalities may affect the user's experience on the website, which further impacts the performance and user retention over a longer term [20].

The following issues have been discovered and corrected during the functional testing:

1. *Incorrect page linking*: After completing the group stage predictions, the user is redirected to the page on which the knockout stage predictions are to be made. However, the page for making group predictions is shown upon creating a new user session. Not only is the user not entitled to make predictions of the knockout stage, but the user can also make another group stage predictions.

2. *Unprivileged page accessing*: Similarly, the user can access desired pages directly by their URL. Therefore, the user could access the page on which knockout stage predictions are made without the previous completion of group stage predictions.

These issues were of high priority, as the effect on the database may be harmful in terms of the bloat. To resolve the inconvenience, the *Users* database table has been alternated, adding two additional fields: `predicted_groups` and `predicted_knockout`, both of type *TINYINT*, whose values are initially set to 0. The value of the former field is updated to 1 once the user completes the group stage predictions. In contrast, the latter's value is updated to 1 once knockout stage predictions are completed.

The following condition is checked before predictions pages are accessed:

```
<?php
if (($this->session->userdata['user_signed_in']['predicted_groups'] == '0')
    && ($this->session->userdata['user_signed_in']['predicted_knockout'] ==
    '0')) {
   redirect('my-predictions-group-stage');
} else if (($this->session->userdata['user_signed_in']['predicted_groups']
    == '1') &&
    ($this->session->userdata['user_signed_in']['predicted_knockout'] ==
    '1')) {
   redirect('User/getchampionprediction');
}
```

To access a page without signing in, the following condition, which checks whether the session has been initialized, is checked:

```
if (!isset($this->session->userdata['user_signed_in'])) {
   redirect('restricted');
} ?>
```

The functionalities, considering their objective, have been tested thoroughly. However, while no other issues have been found, the website cannot be claimed to be free of errors. Due to the water polo website being developed individually, it is necessary to perform system tests by the users of the website, considering the suggestions and feedback. Moreover, there is a need for conducting quality assurance tests to broaden the number of test cases, which would further increase the chance of spotting an error and low-performance factors.

6 Conclusion

In the diploma thesis, an interactive, gamified water polo website's implementation has been showcased, from the initial discovery phase, over the revision stage. The website has been implemented to reach a broader audience and foster engagement with water polo in Slovenia. The website could be accessed via the following link: `https://www.studenti.famnit.upr.si/~89191023/spoznaj-vaterpolo`.
A significant limitation to emphasize is the time constraint: the decision of the LEN to provide the Slovenian national water polo team with the wild card has been announced on April 10th [8], due to which the project had to be completed in four months (until the beginning of the EWC 2022). The gamified water polo website has allowed users to acquire more information about the basics of water polo and enhance a competitive environment by having the opportunity to try a prediction-based game. While the objectives have been met, there is an opportunity for further improvements:

- *Support for more devices*: The website has been designed to support users with personal computers. As such, it excludes users with a different type of device. Designing the website to be responsive would support other device types, thus reaching a broader audience.

- *In-game features*: The prediction-based game is associated with the upcoming EWC 2022. After the tournament, there would be no possibility of playing the game; hence the association with water polo might be lowered. On the other hand, expanding the game to support other tournament types (namely, club-based competitions) would add to the time users would use the website. Moreover, the broader support to other competition types would potentially acquire new users.

- *Website optimization*: During the development phase, little to no optimization techniques have been used. Considering the code efficiency and loading of assets would result in better memory usage and web performance, providing users with a more pleasant experience.

7 Povzetek naloge v slovenskem jeziku

Priljubljenost vaterpola, najstarejšega ekipnega športa v olimpijskem programu, se je v Sloveniji v zadnjih mesecih povečala. Vendar je število oseb, povezanih z njim, v primerjavi z državami in regijami, ki obkrožajo Slovenijo, relativno nizko. Ob izjemnih plavalnih objektih v državi, ki zagotavljajo idealne pogoje za športnike, je nekako presenetljivo, da je med prebivalci premalo ali skoraj nič zanimanja za vaterpolo. Glede na tesno povezanost z državami, ki si delijo podoben jezik in poreklo, čudi majhna priljubljenost vaterpola v Sloveniji, glede na to, da so povezane države med najboljšimi vaterpolo narodi na svetu. Ker se je slovenska vaterpolska reprezentanca po več kot 15 letih uvrstila na evropsko prvenstvo 2022, je pričakovati, da se bo priljubljenost vaterpola v Sloveniji vztrajno povečevala. Takšen dogodek bi lahko bil priložnost za osveščanje ljudi o vaterpolu kot športu in dodatno povečanje njegove priljubljenosti v Sloveniji. Obstaja pa tudi skrb, da bi bil lahko vaterpolo in njegova pravila za nove gledalce nekoliko zmedeni, saj ni bilo priložnosti, da bi ta šport predvajali na televiziji in o njem pisali v medijih.

Priložnost za promocijo vaterpola v Sloveniji se ponuja z razvojem interaktivne spletne strani, ki bi predstavila osnovne informacije in pravila tega športa. Spletna stran bi se uporabljala za nadaljnjo predstavitev tega športa in bi služila kot platforma za nadaljnjo popularizacijo. V fazi "odkrivanja" je obravnavana vsebina spletne stran v povezavi s pravili in smernicami Fédération Internationale De Natation (FINA), mednarodne organizacije za vodenje tekmovanj v vodnih športih. Nato se začne faza "identifikacije", v kateri so obravnavana nekatera načela, na katerih je spletna stran zasnovana. Spletna stran uporablja načela interaktivnega pripovedovanja zgodb, tako da ljudi na vesel in prijeten način seznanja z lepoto vaterpola in razumevanjem njegovih pravil. Poleg tega je spletno mesto nadgrajeno s funkcijami igrifikacije, ki uporabnikom omogočajo napovedovanje izidov vaterpolskih tekem in jih za vsako pravilno napoved nagradijo s točkami. Te funkcije bi prispevale k večji udeležbi uporabnikov, kar bi verjetno povečalo željo po spremljanju vaterpola. V fazi "raziskovanja" je opredeljen načrt uporabniške izkušnje, ter funkcionalne zahteve, ki jih mora imeti spletna stran. Po določanju funkcionalnosti, ki naj bi jih uporabnik lahko uporabljal, se začne

faza "oblikovanja", v kateri so pojasnjena vizualna načela in njihova uporaba. Spletna stran je zasnovana na podlagi ključnih načel in smernic učinkovitega in uporabnega spleta, ter z upoštevanjem preprostosti, od uporabe izrazitih oblikovanih slik, preko izbrane barvne palete in pisave do prepričljive vsebine, ki prenaša sporočilo o osnovah vaterpola in poteku igre. Po opredelitvi zasnove in vizualnih elementov je sledila faza razvoja. Najprej je bil izbran tehnološki sklop, sestavljen iz običajnih programskih jezikov, ogrodij in knjižnic. Poleg tega je bila opredeljena struktura podatkovne baze, v kateri se bodo shranjevali in iz katere se bodo pridobivali podatki. Dostop do baze podatkov, potreben za shranjevanje podatkov o uporabnikih, je bil urejen s programskim orodjem *phpMyAdmin*. Za izvedbo spletne strani je bilo uporabljeno ogrodje *codeIgniter*, ki podpira običajne jezike celotnega paketa (*HTML*, *CSS*, *JavaScript*, *PHP* in *MySQL*). To poglavje vsebuje kodo, uporabljeno za izvajanje funkcij, opredeljenih v fazi raziskovanja. Po razvoju spletne strani sledi faza "revizije", v kateri se spletna stran dodatno preveri. Ta faza se začne z revizijo zasnove, v kateri se pregledajo vizualni elementi in funkcije dostopnosti, da se zagotovita doslednost in kontinuiranost na vseh spletnih straneh. Ko se revizija zasnove konča, se pregledajo funkcionalnosti spletne strani, da se zagotovi njihova želena skladnost s funkcionalnimi zahtevami. Po testiranju in popravljanju potrebnih elementov je spletna stran izboljšana, saj je bolj celovita in dostopna. Povzetek celotnega dela vsebuje priporočila in pripombe za nadaljnje izboljšave, kot so optimizacija spletne strani, njeno prilagodljivost, ki zagotavlja nemoteno delovanje za več naprav, in podpora za druge vrste vaterpolo turnijev.

8 Bibliography

[1] *History of water polo*, https://en.wikipedia.org/wiki/History_of_water_polo. (Viewed on: 4/8/2022.) *(Cited on page 1.)*

[2] *Major achievements in water polo by nation*, https://en.wikipedia.org/wiki/Major_achievements_in_water_polo_by_nation. (Viewed on: 4/8/2022.) *(Cited on page 1.)*

[3] *Slovenia has a sporting heart!*, Slovenian Tourist Board. https://www.slovenia.info/en/stories/slovenia-has-a-sporting-heart. (Viewed on: 4/8/2022.) *(Cited on page 1.)*

[4] *Belgrade 2006 and Malaga 2008*, EWPC 2022 Split. https://split2022.len.eu/belgrade-2006-and-malaga-2008/. (Viewed on: 4/8/2022.) *(Cited on page 1.)*

[5] *35th LEN European Water Polo Championships*, EWPC 2022 Split. https://split2022.len.eu/. (Viewed on: 4/8/2022.) *(Cited on page 2.)*

[6] *2022 European Water Polo Championships, Qualifications – Summary*, The LEN Bureau. http://www.len.eu/?p=19148. (Viewed on: 5/8/2022.) *(Cited on pages 2 and 3.)*

[7] *LEN agrees not to invite Russian and Belarusian teams and supports Ukrainian athletes*, The LEN Bureau. http://www.len.eu/?p=19198. (Viewed on: 5/8/2022.) *(Cited on page 2.)*

[8] *Članska reprezentanca na EP v Splitu*, Zvezda vaterpolskih društev Slovenije. https://zvds.si/clanska-reprezentanca-na-ep-v-splitu/. (Viewed on: 5/8/2022.) *(Cited on pages 2 and 30.)*

[9] *European Water polo Championship Regulations*, The LEN Bureau. http://www2.len.eu/wp-content/uploads/2019/05/12-EUROPEAN-WATER-POLO-CHAMPIONSHIP-1.pdf. (Viewed on: 5/8/2022.) *(Cited on page 2.)*

[10] *FINA Water Polo Rules*, FINA. https://resources.fina.org/fina/document/2021/01/12/a13c160d-b94a-4b63-93aa-a06fa370433f/2019_2021_wp_rules_congress_amended_06012020_0.pdf. (Viewed on: 5/8/2022.) *(Cited on page 4.)*

[11] *Digital storytelling*, https://en.wikipedia.org/wiki/Digital_storytelling. (Viewed on: 5/8/2022.) *(Cited on page 5.)*

[12] *Gamification*, https://en.wikipedia.org/wiki/Gamification. (Viewed on: 5/8/2022.) *(Cited on page 5.)*

[13] G. Guthrie, *What is a UX sitemap, and why is it important?*, https://cacoo.com/blog/what-is-a-ux-sitemap-and-why-is-it-important/. (Viewed on: 8/5/2022.) *(Cited on page 7.)*

[14] *Holy grail (web design)*, https://en.wikipedia.org/wiki/Holy_grail_(web_design). (Viewed on: 5/8/2022.) *(Cited on page 8.)*

[15] *Google fonts*, https://fonts.google.com/. (Viewed on: 5/8/2022.) *(Cited on page 11.)*

[16] *Inkscape*, https://inkscape.org/. (Viewed on: 5/8/2022.) *(Cited on page 12.)*

[17] *Dribbble*, https://dribbble.com/. (Viewed on: 5/8/2022.) *(Cited on page 12.)*

[18] *Behance*, https://www.behance.net/. (Viewed on: 5/8/2022.) *(Cited on page 12.)*

[19] D. Silveira, *What is a UX Design Audit?*, https://xd.adobe.com/ideas/process/information-architecture/ux-design-audit-templates/. (Viewed on: 8/5/2022.) *(Cited on page 27.)*

[20] *The Trillion Dollar UX Problem*, Amazon Web Services. https://s3.amazonaws.com/coach-courses-us/public/theuxschool/uploads/The_Trillion_Dollar_UX_Problem.pdf. (Viewed on: 5/8/2022.) *(Cited on page 28.)*