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Wireframe Modelling of Web Based Open Data Applications

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Abstract: An essential part of modern software development process is wireframe modeling. For such purpose, it is a crucial step in the design phase, requiring specialized tools. This paper introduces a model for the wireframe modelling, with special focus on understanding the process of wireframing. In order to achieve this, we shortly describe some of the software tools are described, along with description of the various methods and techniques used in wireframe modeling. Moreover, a model is presented for simplification of the process of wireframing. Additionally, a use case of the developed model for wireframe modelling is provided, illustrating how an open data-based web application for cultural institutions can be developed. In the final section of the paper, the work on this topic is concluded, along with recommendations for future work in this area.

Keywords: software wireframe modelling, wireframe modelling tools, web based open data applications.

1 Introduction

Software development includes a number of phases, such as planning, analysis, design, implementation (coding), testing, and maintenance. Software wireframe modelling (SWM) is a key aspect of the early stages of software development and represents the basic structure and functionality of software. In the initial modeling phase, designers focus on creating the software interface. To create a software interface, designers initially use simple shapes to represent the key elements of the interface, such as buttons, drop-down menus, lists, etc. SWM provides a prototyping capability, which also enables testing and uncovering potential problems.

Another key aspect of SWM is collaboration. Teamwork involves the collaborative effort of a group of individuals in relation to achieving a common goal Duffy et al [8]. In

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this way, the desired look of the software is reached, whether it is desktop, web or some other type of application.

In recent years, there has been an expansion of web applications in relation to other types of applications, such as desktop and mobile applications. As a result, wireframe modeling of web applications has expanded. What differentiates the modeling of web applications in relation to other types of applications is that the wireframes of web applications are modeled for several different types of devices, while, for example, this is not the case with desktop applications whose wireframes are modeled in the same way.

In this paper, the focus is on the open data visualization by providing users with the ability to easily search and find information that is important to them. This increases the accessibility of information, enhances interactivity, reveals trends, and more. Many countries have realized these benefits and they are dedicating maximum effort into developing such web applications. Furthermore, a model for wireframe modeling will be provided, along with available methods and techniques for this purpose. The importance of wireframe modeling in the field of open data visualization will be emphasized. Additionally, the discussion will encompass designing web applications that utilize open data via wireframing, along with the presentation of an already designed web application that uses open data to display information about cultural institutions in the Republic of Serbia.

2 Background

As stated in the previous section, wireframe modeling experienced a great expansion, and therefore, the interest in researching this area in the development of different types of applications has increased. This interest has led to the emergence of available literature on the topic of wireframe modeling in the literature.

One of the most famous tools for wireframe modeling is Balsamiq. This tool offers a lot of resources, such as articles, courses, videos. Additionally, it has an official site called ”Balsamiq wireframes”. In addition to Balsamiq, there are other sites that provide detailed documentation on wireframe modeling, such as Figma, Adobe XD and similar.

In addition to tools dealing with wireframe modeling, as we said earlier, there are also numerous papers, articles, books on the subject of wireframe modeling. One of the most interesting articles that deals with UI/UX design is Hamidli [9]. This research provides an overview of the key concepts and principles of UI/UX design. Each concept and principle is defined and explained in detail, with examples provided to illustrate their application.

Similar to that article is Khanal [10]. In addition to design, authors discusses the development of web applications based on wireframes. In Bunian et al [1] authors present VINS, a visual search framework. This framework takes as input a user interface image (wireframe, high fidelity) and retrieves visually similar design examples.

2.1 Analysis of wireframe modeling tools

At the beginning of Section 2, a couple of wireframe modeling tools is described. The advantages and disadvantages of each of the listed wireframe modeling tools are elaborated in the following text.

2.1.1 Balsamiq

This tools enables quick and easy process of the interface designs for websites and mobile applications Campos, Laberiano [2]. Instead of freely sketching on a paper, Balsamiq software mimics various web characteristics in the form of web elements de Oliveria, Amaro, [7]. What characterizes this tool is its ease of use and interactivity. Also, it provides a vast library of structural elements such as buttons, panels, menus and more. This tool is available to users in two versions, namely desktop and cloud version. Both versions can be downloaded directly from the official Balsamiq website.

The desktop version of this software does not require an internet connection, allowing users to utilize the software without an internet connection after downloading and installing it.

On the other hand, the cloud version is a variant of this tool accessible through the user's web browser. The advantages offered by the cloud version include the ability to save projects on the cloud and to share them with other team members working on the project.

2.1.2 Figma

Another tool that finds wide application in wireframe modeling is Figma Staiano [16]. At the very beginning, Figma introduced a new concept in the field of wireframe modeling, real-time collaboration among multiple users on a single project. Users have the possibility to see the index of other users while working together on the project. Such functionality has elevated the standards in the field of wireframe modeling. In addition to that functionality, what differentiates Figma from other wireframe modeling tools is its vector networks. In other vector graphic tools, vector has every specific characteristics and is distinguished in open and closed paths. A path considered closed when the first point coincides with the last of a shape, thus generating a filled area. Figma, however, introduces a new concept - vector networks - a unique feature that pushes the boundaries of vectors even further Staiano [16]. Complex objects can then be created within the same object and with the same properties much faster than they could be drawn using traditional vector path tools. Like other wireframe modeling tools, Figma has its own building blocks. However, in addition to basic elements, Figma allows the creation of components within components, enabling customization of even the most complex groups of elements such as icons.

2.1.3 Adobe XD

Adobe XD is a user experience design tool that is completely vector-based. Adobe XD helps the user to create the design for both web apps and mobile apps. It is developed and

published entirely by Adobe Inc Sharma, Tiwari [15]. Adobe XD is a recent addition to the growing list of Creative Cloud apps and services. Adobe XD helps user experience designers to rapidly create and iterate the design for mobile apps and websites. Being part of the Adobe Creative Cloud ecosystem, XD seamlessly integrates with other Adobe tools like Photoshop, Illustrator, and After Effects, making it easy to transfer assets and designs between applications Usmani [18]. Also, Adobe XD offers advanced prototyping functionality. The prototyping feature allows designers to simulate the flow of the UI by allowing pages to be connected and animations between the pages created. This way, it is possible to run fixed-path prototype simulations da Silva Solino [5].

2.2 Analysis of methods and techniques for wireframe modeling

At first glance, wireframe modeling may seem like an easy process. However, upon deeper exploration, it can be seen that the process includes different methods and techniques that are used to achieve the desired goal. Each of these methods and techniques represents one stage in the wireframe modeling process. In the continuation of this paper, several methods and techniques that play a key role in wireframing will be explained.

2.2.1 Sketching

One of the first techniques in the wireframe modeling process is sketching. Sketching has been widely used as a means to create prototypes Carter, Hunhausen [3]. The ability to quickly iterate and communicate high-level ideas has made sketching a common tool for the early UI design process Landay, Myers [11] Newman, Landay [14]. As such, prototyping tools for sketch-based designs have been created to take advantage of sketching while also allowing the interactivity of prototyping Lin [12] Lin, Thomsen, Landay [13] Coyette, Vanderdonckt, Limbourg [4]. Designers are able to use these tools to rapidly brainstorm, develop, and iterate through ideas for UI designs Lin [12]. Finally, these sketching tools are able to refine the UI with input from designers, developers, and other stakeholders Coyette, Vanderdonckt, Limbourg [4].

2.2.2 Prototyping

Prototyping is the process of creating an interactive model of a design, allowing designers to test the functionality and usability of a product before it is launched Hamidli [9]. In the prototyping stage, designers create a low-fidelity prototype of the design, allowing them to test and refine the design before investing in high-fidelity prototypes Hamidli [9]. Prototyping can take many forms, such as wireframes, mockups, or interactive prototypes Hamidli [9]. The goal of prototyping is to test the design with users and identify any issues or areas for improvement Hamidli [9].

2.2.3 Usability Testing

Usability testing involves testing the usability of a design by observing users as they

interact with a product Hamidli [9]. Usability testing helps designers to identify usability issues and areas for improvement in a design, allowing them to create a better user experience Hamidli [9]. To ensure the maximum usability result, designers need to execute the test throughout the development process such as from the wireframe stages to the final deliverable product (Interaction Design Foundation) Trieu [17].

2.2.4 Iteration

Based on the feedback from testing, the design is refined and iterated upon, with new prototypes created and tested until the final design is achieved. The goal of iteration is to continuously improve the design and ensure that it effectively meets the user's needs and preferences Hamidli [9].

3 Wireframe modelling of open data applications

In this section of the paper, we present a model for developing open-data based web applications consisting of four phases. The first phase defines client requirements, the second phase deals with beginning of wireframing. The Third phase curates and conducts fine-tuning of the wireframe modelling, and finally the fourth phase focuses on finalizing the wireframes.

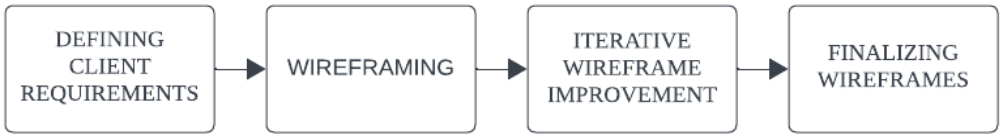

Fig. 1. Model for wireframing of the open data applications

3.1 Defining client requirement

The first stage in development is defining the client's requirements. The client can be a natural person or a company. The client, whether a person or a company, in order to offer something new, conducts a market research before engaging with another party responsible for developing a product.

This step is all about information gathering. It is crucial to understand more about the clients business and industry, their target audience and customers, the ultimate goal for the website and its purpose [6].

In order to gather as much information as possible about the target audience, it is necessary to conduct as deep an analysis as possible of demographic, geographic and other characteristics of potential users. For example, demographic data analysis includes factors

such as age, gender, education, while geographic data analysis includes location, language, and more.

In addition to the analysis of the target audience, it is necessary to do an analysis of the competition on the market. This involves identifying competing applications. After identifying such applications, it is necessary to do a deeper analysis of their advantages and disadvantages on the market. By solving disadvantages, the application will be listed high on the market.

3.2 Wireframing

After collecting the necessary information, the phase of sketching wireframes begins. Sketching wireframes can be done using a pen and paper, on which wireframes with the desired specifications or characteristics will be presented. Additionaly, sketching can be done with the help of the previously mentioned tools for wireframe modeling. Sketching on paper has advantages over sketching with software. For example, when sketching on paper, we do not have to search libraries with structural elements, change the color of the pen and so on.

The main goal of this phase is to present the structure and elements of the user interface. This involves displaying the layout within the interface. The arrangement of elements within the interface should be logical, which will enable easy use of the application. The structural elements used for sketching are tipically of a simple design, which in the last phase of this process can be improved based on the suggestions of developers, designers and interested parties.

In addition to displaying the structure and elements of the interface, it is very important to pay attention to how users will navigate through the application's interfaces. This means that users should be provided with an easy way to navigate between interfaces.

After showing the schedule of interfaces and showing how users will move through the interfaces, the functionality of each interface should be shown. This means displaying the behavior of various interface elements on click, hover and more.

3.3 Iterative wireframe improvement

This phase represents an important part of the wireframe development process, as it focuses on design improvement and addresses potential problems that may not have been noticed during the wireframe phase.

A phase consists of a certain number of iterations. The first iteration can be considered the initial version of the wireframes, which will be analyzed by other designers, developers, and stakeholders. Based on the feedback from the aforementioned development participants, changes are made to the wireframes. The iteration is repeated until the ideal solution is reached.

In order for the team to stay consistent with the design, it is very important to archive the sketches in each iteration. After each iteration, sketches should be archived to allow the team to stay consistent in design. Also, archiving sketches allows the development team to

follow the development path and record key iterations that represent milestones or decisions that influenced the final design.

3.4 Finalizing wireframes

The wireframe modeling process concludes with the finalizing wireframe phase. This phase begins with the completion of the last iteration of the previous phase. At this stage, an additional check of the wireframes is performed to ensure that everything is done according to the client's requirements. This review includes checking every interface, element, navigation, layout of elements and more. In addition, an analysis of user interaction with various interface elements, such as buttons, forms and others, should be performed. Special attention should be paid to the interaction between the user and the navigation. As we said before, it is very important that the movement between the interfaces is do very intuitively. Also, in this phase, it checks compliance with standards in the design of the user interface and user experience. Additionally, if there are any ambiguities or concerns, at this stage it is possible to organize consultations with the client to ensure full understanding. After resolving any ambiguities and concerns, the interfaces are forwarded to the development team.

4 Use case study - Web based open data application on cultural institutions

As we could see in the previous section, the wireframe modeling process consists of four phases. Each of these phases is dependent on the previous one, so it is impossible to skip any phase of a given model. We used the presented model to develop applications for displaying cultural institutions in the Republic of Serbia.

In the first phase, the currently available competing applications were discussed. Based on competing applications, it was concluded that it is necessary to provide a good source of information about cultural institutions in one place. Cultural institutions include museums, cinemas, galleries and libraries. In addition, the geographical area, script and language of the users were discussed. After the collected information, the designers made a web application design proposal that was accepted.

In the second phase of the model, user interfaces were created. Balsamiq was used to create user interfaces. In order to ensure that users can get to the desired information as easily as possible, we achieve this through an intuitive user interface that includes a drop-down list with all available types of cultural institutions and a city search field and interactive map that is the key element of this application.

In the third phase, after the completion of the first version of the user interface, which represents the first iteration, the simplification of certain data such as the number of cultural institutions was discussed. The proposal is to add a chart that will adjust to the filters. In the second iteration, a chart was added as shown in Fig 3.

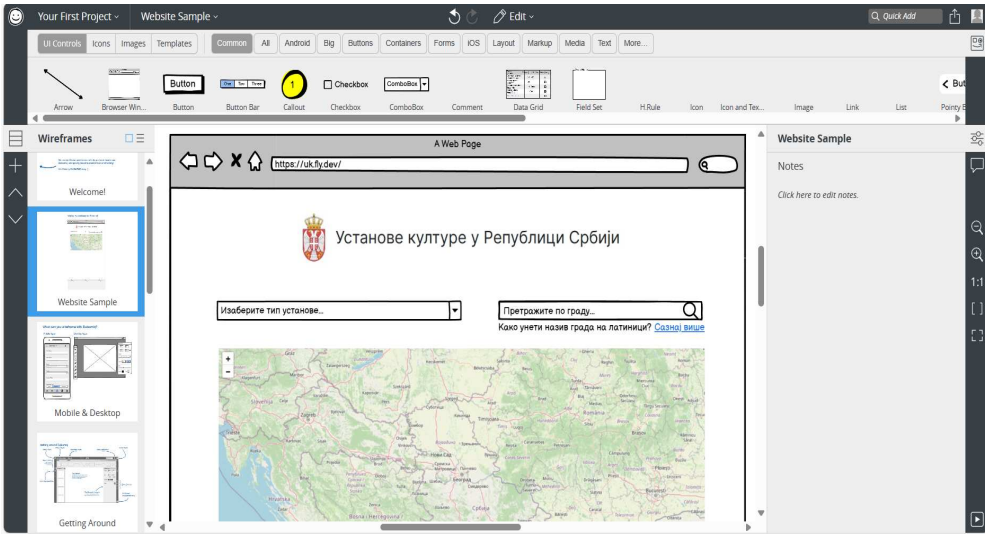

Fig. 2. Wireframing in Balsamiq

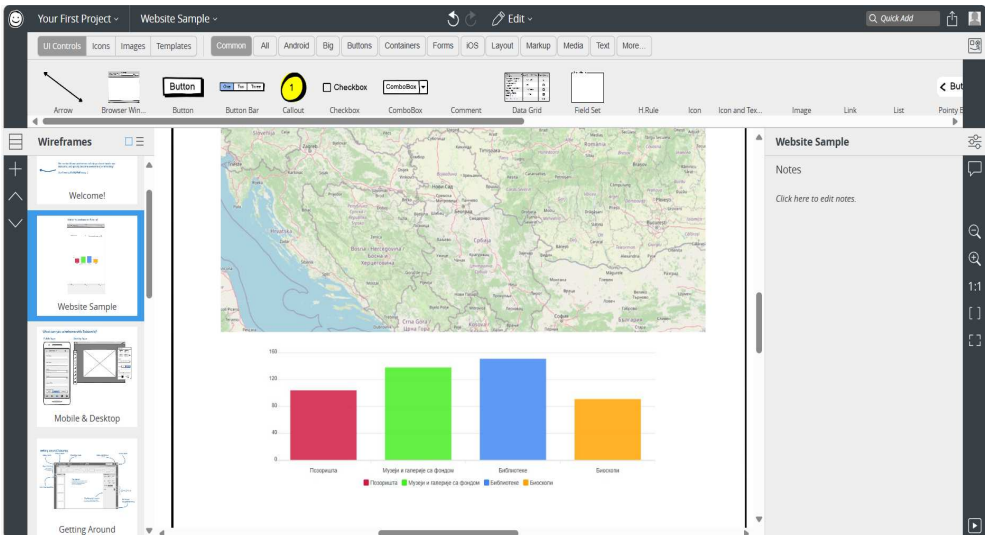

Fig. 3. User interface after second iteration

In the fourth phase, after the last iteration was completed, all elements of the web application were checked. All the requirements that were defined in the first phase are fulfilled and that the user interface can be forwarded to developers for development. After the completion of the development of the application, the application was published on the website for open data of the Republic of Serbia.

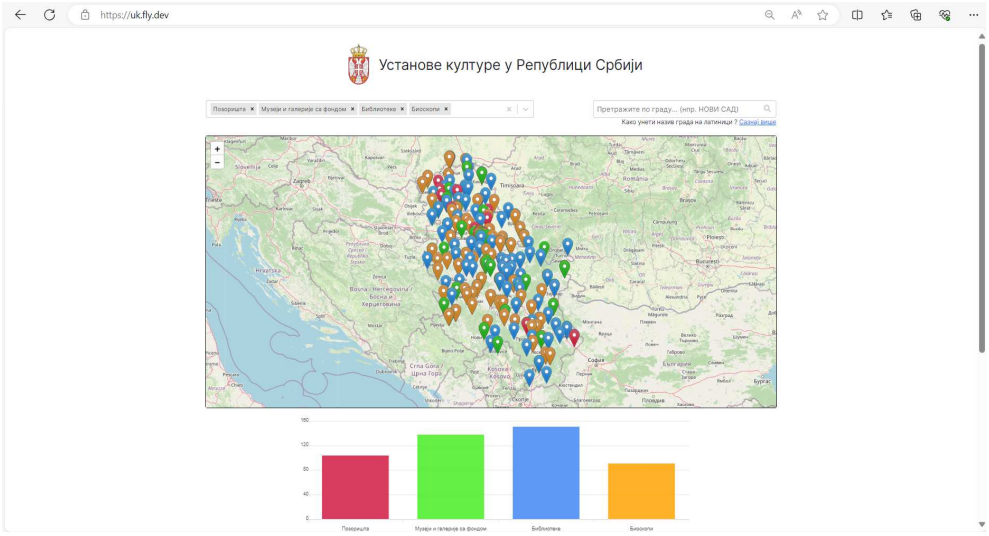

Fig. 4. User interface of a web application for cultural institutions

4.1 How to use the application

When accessing the application, the user is presented with a user interface with filters, located at the top. One filter is for the type of cultural institutions, while the other is a filter for the city. Below the filters, there is a map where pins will be displayed depending on the selected filters. Depending on which filter is selected, different colored markers will be displayed on the map. Below the map is a chart that also works dynamically like the map and shows bars in different colors depending on the selected filters.

When launching the application, the map and chart are initialized by the values of all cultural institutions. In case the user wants to cancel the initial values, he can do so by clicking on the ”x” button located on the right side of the drop-down list with cultural institutions. Once the user clicks on the ”x” button, the selected values are reset, allowing the user to freely chose the types as desired.

One of the first steps the user can take is to choose which type of cultural institution he wants to display on the map. By clicking on the drop-down list, the user is presented with a list of cultural institutions (theatres, libraries, cinemas, museums, galleries) that can be searched.

When the user selects one of the culture types, in this case (theaters), pins are displayed on the map, while the number of the institution of that type is displayed on the chart.

After selecting a type of cultural institutions, the user is shown pins on the map indicating the locations of all cultural institutions of the selected type (in this case, theater locations). For more information about the selected cultural institution (director, email, contact person, parent institution, place, mobile phone, institution name, district, municipality, area code, region, telephone, type of institution, street and number, website), the user can click on the pin and a popup window will appear that will appear displaying detailed

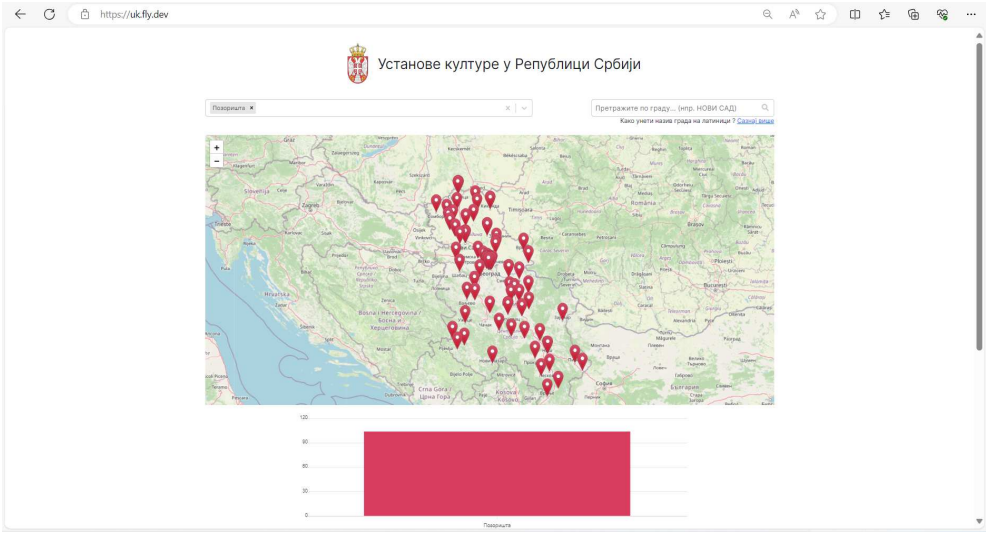

Fig. 5. Filtering by type of cultural institution

information about the specific cultural institution.

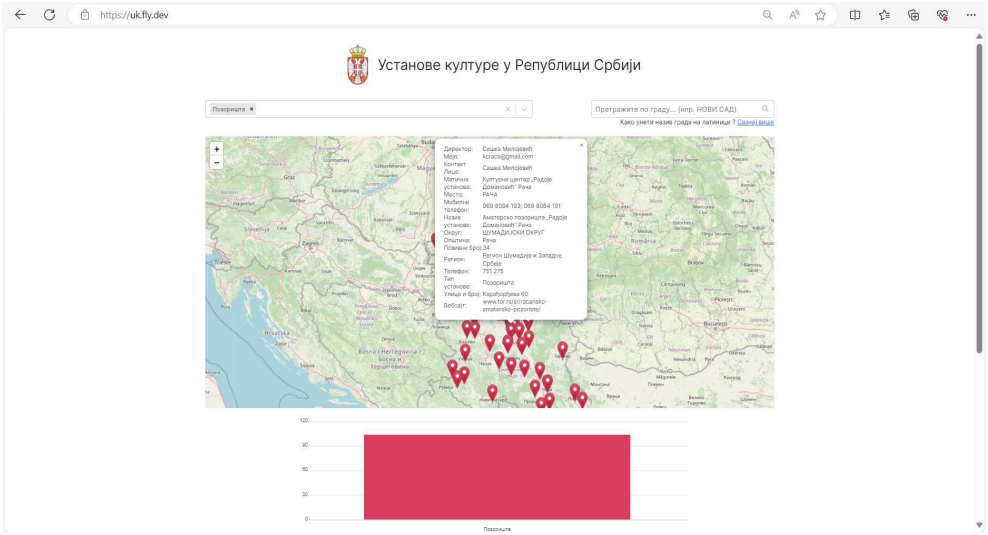

Fig. 6. Detailed information about the specific cultural institution

In the next step, the user can filter by city name by entering the name of the city he wants to search in Cyrillic. Another useful functionality is autocomplete, which helps the user to enter the name of the city they want. As the user starts entering the name of the city, a list of suggested cities will appear below the input field based on the current value in the city name field.

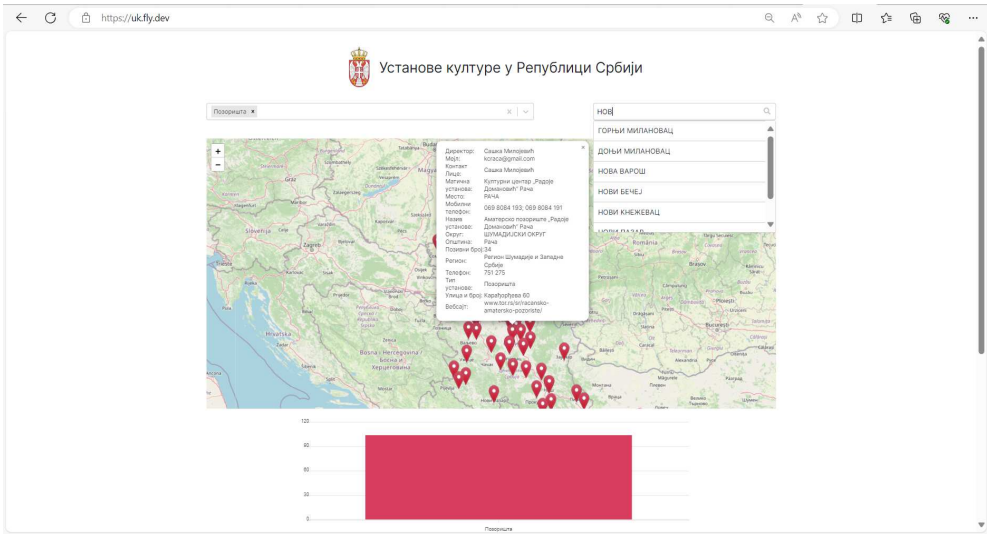

Fig. 7. Filtering by city name

5 Conclusion

This paper researches the topic of wireframe modeling, which is one of the important processes in software development. As an important process in software development, it requires the attention of designers, programmers and stakeholders in order to arrive at a better solution. Because it is an indispensable part of the application development process, it has expanded with the appearance of new types of applications, such as web applications and mobile applications. The process of wireframe modeling requires the application of various methods and techniques, such as sketching and prototyping. With the development of this field, there has also been development of more advanced wireframe modeling software that offers ease in the wireframe modeling process.

The project presented in this paper is a web-based open data application designed for cultural institutions in the Republic of Serbia. With this application, it is easier for users to find information about the desired cultural institution. Additionally, this application demonstrates the possibility of wireframe modeling of web-based open data applications.

The rapid development of this field has prompted research aimed at improvement, such as the simplified process of wireframe modeling, wireframe design. One of the future research directions in this area is the application of artificial intelligence in wireframe modeling. Artificial intelligence can improve process automation, efficiency, and personalized displays based on previous designs and user feedback.

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