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System analysis for museum audio guide web application

Bachelor's thesis

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**Süsteemianalüüs muuseumide audiogiidide
veebirakendusele**

Bakalaureusetöö

Juhendaja: Aivo Olev

MSc

Tallinn 2023

Author's declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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17.05.2023

Abstract

SYSTEM ANALYSIS FOR MUSEUM AUDIO GUIDE WEB APPLICATION

The driving force behind this bachelor's thesis was the author's own interest in museums and their audio guide solutions. The aim of the bachelor's thesis was to create the documentation for the development of audio guide software, which museums would be able to use for free. For this, the author conducted interviews with museum representatives to get an overview of their needs and current experiences with audio guides.

The author divided the application into two subsystems - the museum subsystem and the visitor subsystem. In the work, the author gives an overview of the existing audio guide solutions in Estonia and some examples of other European countries, the business requirements of museums, the system analysis of the museum subsystem, the system analysis of the visitor subsystem, the design of the visitor subsystem and the possibilities to improve the system in the future.

When creating the application documentation, the author's goal was to keep the system as simple as possible and create it with the assumption that the web application will be free for museums to use. The thesis was completed in cooperation with Jan Travnicek, a student at the Czech Technical University in Prague, who will be developing the web application.

The thesis is in English and contains 47 pages of text, 10 chapters, 6 figures, and 1 table.

Abstract

SÜSTEEMIANALÜÜS MUUSEUMIDE AUDIOGIIDIDE VEEBIRAKENDUSELE

Käesoleva bakalaureuse lõputöö käivitavaks jõuks oli autori enda huvi muuseumide ning nende audio giidide lahenduste vastu. Bakalaureuse lõputöö eesmärk oli luua dokumentatsioon audio giidide tarkvara arendamiseks, mida oleks muuseumidel võimalus tasuta kasutada. Selle jaoks viis autor muuseumite esindajatega läbi intervjuud, et saada ülevaade nende vajadustest ja praegustest kogemustest audio giididega.

Autor jagas rakenduse kaheks allsüsteemiks - muuseumite allsüsteemiks ja külastajate allsüsteemiks. Töös annab autor ülevaate eksisteerivatest audio giidide lahendustest peamiselt Eestis, kuid ka mõned näited teistes Euroopa riikides kasutusel olevatest lahendustest, muuseumite ärielistest nõuetest, muuseumite allsüsteemi süsteemianalüüsist, külastajate allsüsteemi süsteemianalüüsist, külastajate allsüsteemi disainist ja võimalustest süsteemi parendada tulevikus.

Rakenduse dokumentatsiooni koostades, oli autori eesmärk hoida süsteem võimalikult lihtsana ning luua see eeldusega, et veebirakendus oleks muuseumidele tasuta kasutamiseks. Lõputöö valmis koostöös Tšehhi Tehnikaülikooli Prahast tudengi Jan Travnicekiga, kes teostab veebirakenduse arenduse.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 47 leheküljel, 10 peatükki, 6 joonist, 1 tabel.

List of abbreviations and terms

GDPR	General Data Protection Regulation The General Data Protection Regulation is a privacy and security law. Though it was drafted and passed by the European Union, it imposes obligations on organisations anywhere, so long as they target or collect data related to people in the EU (European Union). [1]
WCAG	Web Content Accessibility Guidelines Web Content Accessibility Guidelines is an international standard that explains how to make web content more accessible to people with disabilities. [2]
QR code	Quick Response Code A Quick Response code is an array of black and white squares or pixels set in a grid that stores data for a machine to read. [3]
SEO	Search Engine Optimization SEO stands for search engine optimization, which is a set of practices designed to improve the appearance and positioning of web pages in organic search results. [4]
MD5	Message Digest Algorithm The MD5 hashing algorithm is a one-way cryptographic function that accepts a message of any length as input and returns as output a fixed-length digest value to be used for authenticating the original message. [5]
SHA-1	Secure Hash Algorithm 1 Secure Hash Algorithm 1 is a cryptographic hash function. It is most often used to verify a file has been unaltered. This is done by producing a checksum before the file has been transmitted, and then again once it reaches its destination. [6]

Table of Contents

1	Introduction	12
1.1	Background and description of the project.....	12
1.2	Problem.....	12
1.3	Objective.....	12
1.4	Overview of the document	13
2	Methodology.....	14
2.1	Overview	14
2.2	Description of the process	15
2.3	Description of the tools	18
2.4	Cooperation	18
3	Protection of personal data	20
3.1	Personal data.....	20
3.2	Processing of the personal data	20
3.3	Principles of personal data processing.....	21
3.4	Storage of personal data	21
3.5	Processor of the personal data	22
3.6	Impact on the web application.....	22
4	Museums business requirements	24
4.1	Admin side.....	24
4.2	Visitors' side.....	24
4.3	Accessibility	25

4.4 Restrictions of usage.....	25
5 Overview of the web application.....	27
5.1 Overview of the existing systems.....	27
5.2 Objective of the web application.....	28
5.3 Dividing the information web application into subsystems.....	28
5.4 Non-functional requirements.....	28
6 Detailed analysis of web applications admin subpart.....	30
6.1 Objective.....	30
6.2 Solution description.....	30
6.3 Activity diagram.....	31
7 Detailed analysis of web applications visitor's subpart.....	33
7.1 Objective.....	33
7.2 Subsystem administration.....	33
7.3 Solution description.....	33
8 Web application prototype.....	35
8.1 The front page.....	35
8.2 Main menu.....	36
8.3 The museum page.....	36
9 Possible features to add in the future.....	38
9.1 Features proposed to add in the future to the admin side.....	38
9.2 Features proposed to add in the future to the visitor's side.....	38
10 Summary.....	40
References.....	41
Appendix 1 - Non-exclusive Licence for Publication and Reproduction of Graduation Thesis.....	43

Appendix 2 - Prototype views 44

List of figures

Figure 1. Waterfall method.....	16
Figure 2. The flow of registration validation.....	32
Figure 3. Front page	44
Figure 4. Menu	45
Figure 5. Museum page	46
Figure 6. Museum page with button.....	47

List of tables

Table 1. Non-functional requirements.....	29
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1 Introduction

The introductory part provides an overview of the background, problem, and goals of the thesis.

1.1 Background and description of the project

In today's Europe, it is common to use many digital tools to make people's and organisations' lives easier and more convenient. However, neither Estonia nor Europe currently have a uniform web application for using and managing audio guides. Currently it is not possible to use audio guides in museums from your own device with your own headphones and for free (both for the museum and for the visitor). Currently, museums mostly use physical audio guide devices, paid audio guides applications (the visitor must pay to use the audio guide) or no audio guides at all. This gave rise to the idea of creating a collaborative open-source solution for storing and using audio guides, which also will be made public as open-source software to improve everyone's access to the knowledge shared by museums.

1.2 Problem

The bachelor's thesis will handle and offer a possible solution to the problem of how museums can make audio guides available to their visitors easily and with as low expenses as possible. At the same time, managing audio guides should be easy and free for museums. By keeping the web application simple and free, it sets the stage for audio guides to be widely available to people who own a smart device.

1.3 Objective

The aim of the bachelor's thesis is to perform a system analysis for the creation of the web application for museum audio guides.

1.4 Overview of the document

This document describes the needs of the museums related to audio guides, the system requirements to develop the audio guides web application and the possible design solution for the web application. The document is divided into seven main parts.

Methodology (chapter 2) gives an overview of the web application, completion process, the tools used in the process and the cooperation with stakeholders during the completion of the document.

Protection of the personal data (chapter 3) gives an overview of how the GDPR law is affecting the web application and what is needed to consider while creating the web application and later maintaining it.

Museums business requirements (chapter 4) gives an overview of the business requirements mentioned by the museums during the interviews.

Overview of the web application (chapter 5) gives an overview of the systems, objective of the web application being created, division of the web application into subsystems and non-functional requirements.

Detailed analysis of web applications admin subpart (chapter 6) gives an overview of the admin functional subpart, its objective, and the proposed solution. It also includes an activity diagram of the flow of registration validation.

Detailed analysis of web applications visitor's subpart (chapter 7) gives an overview of the visitor's functional subpart, its administration division, the objective, and the proposed solution.

Web application prototype gives an overview (chapter 8) of the prototype and the design choices made during the design process.

Possible features to add in the future (chapter 9) gives an overview of the possible features that can be added to the application in the future after the first version has been developed.

2 Methodology

This chapter provides a more detailed overview of the project's work process and the tools used.

2.1 Overview

The aim of this document is to provide the information needed to create the audio guides web application.

To improve the web application and to add new functionalities, there will be an increasing need to process personal data, so the author is considering the GDPR law and the processing of the personal data from early on. In this thesis the author has given the overview of the aspects needed to consider during development of the web application.

The web application has been divided into two different subsystems: the admin subsystem and the visitor's subsystem. The author did interviews with museums to find out the business requirements for them to start using audio guides and to find out the current solutions' positive and negative features from museums point of view. Based on that information, the author put together the system requirements for the admin subsystem and for the visitor subsystem. Considering the design practices and the system requirements, the author created a prototype of the visitor's subpart.

After finishing the documentation and proposing the possible solution, the web application will be developed. During the development and testing phases some adjustments may be needed to the functionalities and/or requirements.

2.2 Description of the process

The motivation for this study is the author's personal interest to develop audio guide software that would be used in Estonia and in Europe. While visiting museums all over Europe, the audio guides are often expensive or uncomfortable to use. Author thinks that audio guides are sometimes necessary to understand the museum's exhibits and to experience the exhibitions more deeply. Audio guides are a great alternative for travellers, who do not want or cannot afford a guided tour.

As preliminary work the author first did research on what kind of solutions are in use in Estonia and in Europe. After that, the author sent out an email to museums located in Estonia, asking if they were willing to help understand the requirements and working processes of museums. Out of 16 museums contacted seven responded, out of whom one was not interested in audio guides topic, and one stopped replying during the email conversation. With the other five museums the author conducted interviews to understand which solutions they are using now and how they operate with audio guides. All five museums were interested in the potential audio guides web application.

Based on the information obtained from the museums, the author produced the requirements for the web application and made a potential design for the frontend. The author also used the previous research done by Seung Jae Lee [7] to understand the needs of the museums using audio guides and to form questions for the museums to ask and which applications are in use in other continents.

While doing the research the author used the waterfall method [8]. For example, when the author realised during prototyping that some requirements were unnecessary, the author removed them from the system requirements. The following figure shows the waterfall method. Within the scope of this work, the first three stages were completed.

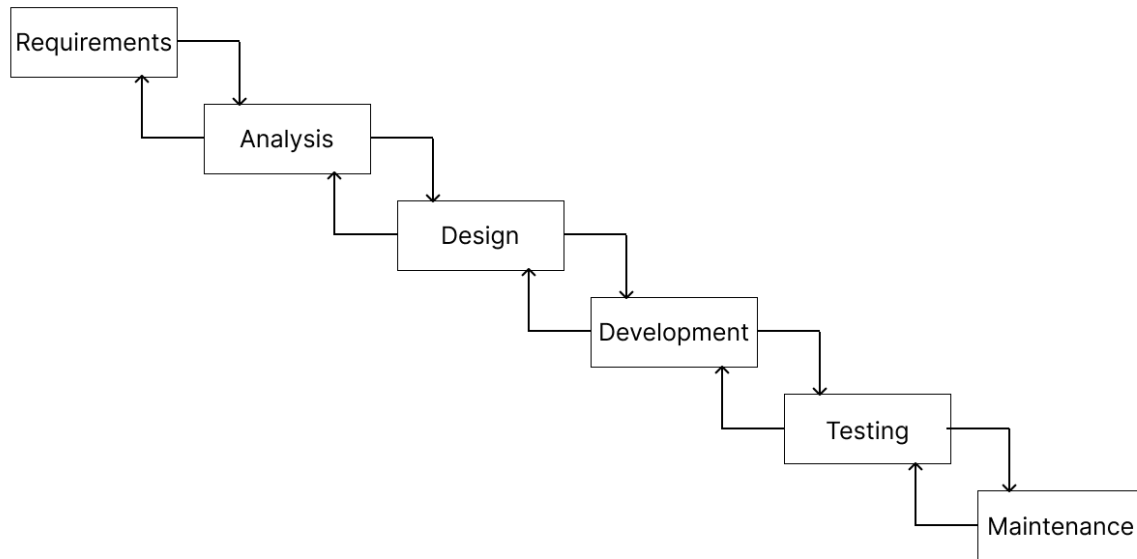


Figure 1. Waterfall method.

The system analysis was conducted following the guides for strategic and detailed analysis [9]. Within the scope of this thesis the author conducted the detailed analysis of the subsystems and planned out the potential design views for the visitor’s subsystem. The designs were created following the mobile-first design principle because the aim was to provide a system that can be used in the visitor's own device, so it is expected that a vast majority of the users are using it on mobile phones.

In the design phase, the user interface was designed based on Adobe's user experience architect Nick Babich's four golden rules of user interface [10]:

1. Place users in control of the interface.

It is recommended to give the users the “undo” opportunity. This is the reason on every page of in the web application, there is a visible menu button. In the menu one can clearly distinguish the cities being the categories and the museums belonging to the categories. On the museum pages clickable breadcrumbs are shown, where users can easily go back to the home page and the title is easily distinguishable.

2. Make it comfortable to interact with the product.

The author tried not to add any unnecessary information or features to the design or

the features that are not necessary at this moment. Author used as few colours and different tones in the design as possible, so the web application does not strain the eyes of the users and does not take the focus away from the information. The colours used are black, grey, and white to consider the comfort of the people who are not able to distinguish colours from each other. For the information provided in the web application to be reachable for everybody, the web application must be at least on the WCAG 2.0 Level AA.

3. Reduce cognitive load.

To reduce the cognitive load, the author has kept whitespace between different information on the page so that it would not be overwhelming. The author tried to make the web application design as informative as needed while keeping it minimalistic.

4. Make user interfaces consistent.

The author used as many of the same elements and colours as possible to keep the user interface consistent throughout the pages. The elements used by the author were traditional to keep the possibility of user's confusion as low as possible.

The possible designs for the visitor's frontend were made by the author using a tool named Figma. The designs are stored in the author's personal Figma account and are reachable to everyone with a link.

To realise the web application, the author recommends using some more flexible methodology, such as for example Scrum. In retrospect, it could also have been used in this work flexible methodology, where the development would have been divided into small cycles, that is for iterations. Waterfall methodology was used because the author did not think it was necessary to use scrum until she reached the middle of the project and realised that changes needed to be made.

2.3 Description of the tools

Author used Google search engine to find the potential museums interested in the audio guides. Author contacted the museums through their public general emails, because the author was not sure who in each museum is dealing with the matter of audio guides. In case of one museum the questions were sent in Microsoft Word document and in case of another museum the questions were sent in Google Forms documents.

With two of the museum's representatives the author met live and used a Samsung Voice Recorder to record the audio. With another two museum's representatives the author met in Microsoft Teams. To record the meetings, the built-in tool in Microsoft Teams was used. With one of the museum's representatives the author met in Google Meets. To record the meeting, Google Chrome web browser extension was used because of the technical issues with Google Meets.

For the creation of the prototype the author used a tool named Figma. This tool was chosen because the author was a bit familiar with the tool before and tutorials how to use it were easily reachable on the internet. Additionally, a lot of templates were available to get inspiration from and a lot of elements are premade to be used on the platform.

To create the activity diagrams of the web application the author used a tool called GenMyModel. The tool was chosen because the tool is free of charge for everyone, there was no need to download an application and the tool is connected to GitHub which makes it easier to share the diagrams if needed to others on GitHub.

2.4 Cooperation

To write this bachelor's thesis, there was cooperation done with Jan Trávníček, master's student at Czech Technical University in Prague majoring in Human-Computer Interaction, who is developing the audio guides web application in this bachelor's thesis as his master's thesis. During the cooperation, the first idea was discussed in January 2023 and there was written communication during writing this bachelor's thesis and online meetings held to discuss the topics related to the thesis.

It was important for the author to keep the developer of the web application up to date about the progress because the information in the thesis needs to be relevant and feasible to develop the actual web application. Also, Jan Trávníček is more experienced in web application design and the advice from him was considered while drawing the possible designs for the web application.

To understand the business requirements of the museums that are potential users of the web application, the author did interviews with five museums located in Tallinn. The museums that the author did the interviews with were Tallinn TV Tower, St. Nicholas' Church and Museum, Estonian Health Museum, Vabamu Museum of Occupations and Freedom and Tallinn City Museum. The Computer Museum was not interested in the audio guides and Tallinn Botanic Garden did not respond after sending the questionnaire.

3 Protection of personal data

The web application must consider the requirements arising from the data protection law of the European Union under the General Data Protection Regulation (GDPR). [11]

3.1 Personal data

Personal data is any information about an identified or identifiable physical person who can be directly or indirectly identified. Anonymous data is not within the meaning of the general regulation personal data. [11]

Examples of personal data:

- First name, last name.
- E-mail address, personal or work related.
- Phone number, personal or work related.
- Passwords.
- Location.
- Bank account information.
- Physical, physiological, genetic, mental, economic, cultural, or social characteristics.

3.2 Processing of the personal data

Processing of the personal data is any operation performed with personal data. Processing of personal data involves viewing, collecting, storing, organising, modifying and disclosure, providing access to the data, making inquiries and extraction, use transmission, cross-use of the data, connection, closure, deletion, or destruction. Personal data may only be processed if the purpose is not achieved in other ways. [12]

3.3 Principles of personal data processing

The processor of personal data is obliged to follow the following principles when processing personal data [12]:

1. The principle of legality – personal data may only be collected in an honest and legal way.
2. The principle of appropriateness of purpose – personal data may only be collected to achieve defined and legitimate purposes, and they may not be processed in a way that is inconsistent with the purposes of data processing.
3. The principle of minimality – personal data may be collected only to the extent necessary to achieve the defined goals.
4. The principle of restriction of use – personal data may be used for other purposes only with the consent of the data subject or with the permission of the competent body.
5. The principle of data quality – personal data must be up-to-date, complete, and necessary to achieve the set goal of data processing.
6. The principle of security - security measures must be implemented to protect personal data to protect them from unintentional or unauthorised processing, disclosure, or destruction.
7. The principle of individual participation - the data subject must be informed about the data collected about them, they must be granted access to the data about them, and they have the right to demand the correction of inaccurate or misleading data.

3.4 Storage of personal data

According to the law, the term of personal data storage must be determined by the processor. The storage time for the web application is not yet decided, it will be decided according to the functionalities that use personal data now and it may be changed if there is a need for it due to changes in functionalities.

3.5 Processor of the personal data

A processor of personal data is a physical or legal person, a branch of a foreign company or a state or local government institution that processes or on whose behalf personal data is processed.

The personal data processor determines:

1. Purposes of personal data processing.
2. Composition of processed personal data.
3. Procedure and manner of personal data processing.
4. Allowing the transmission of personal data to third parties.

The processor of personal data may, by administrative act or contract, authorise another person or institution to process personal data (hereinafter the authorised processor), unless otherwise provided by law or regulation.

The processor gives mandatory instructions to the authorised processor for the processing of personal data and is responsible for ensuring that the authorised processor fulfils the requirements for processing personal data.

The authorised processor may further authorise the processing of personal data only with the written consent of the responsible processor and on the condition that the scope of the authorised processor's powers is not exceeded. [12]

3.6 Impact on the web application

The users of the web application are museums and physical persons. In the first version of the web application there is no data collected from the users nor from the museums, but since there are probable future functionalities that need to process personal data of users or museums and its workers, then the author finds it necessary to take this matter into account from the beginning of the web application development. In the future, when additional features are added to the web application that are collecting personal data, the GDPR will be a huge factor on how the web application needs to process the data and how to maintain it.

The audio guides application developers are not the hosts of the application and are not the processors of the data according to the GDPR law.

4 Museums business requirements

4.1 Admin side

The museums brought out during the interviews following business requirements:

- Museum's employees can manage the content pages by themselves.
- Museum's employees can change whether the content page is accessible for public use, only while being in the museum or not at all.
- Museum's employees can generate the QR codes for the content pages and send them to print from the web application.
- Museum's employees can operate the web application easily, there should not be knowledge needed about information technology.
- Museum's employees can contact the technical support in order they need help with managing the content pages.
- Museum's employees can add text, audio files and videos to the content pages.
 - Museum's employees can add audio files and videos whose length is not limited by the web application.
- Museum's employees can add information to the content pages in many languages.
- Museum's employees can add audio tours that consider the visitors location.

4.2 Visitors' side

- Visitors do not need to download the application to use the web application.
- Visitors can access the web application on any device.
- Visitors can reach the content pages either publicly or via QR codes.
- Visitors can read and listen to the content added to the content pages.
 - Visitors can choose the speed of the audio files and videos.
- Visitors can fast forward and rewind the audio files and videos.

- Visitors can give feedback to the audio guides.
- Visitors can subscribe to the newsletter of the museum.
- Visitors can close the screen of the device while listening to the audio files.
- Visitors can browse and read about the museums before and after the visit.
- Visitors are suggested to visit other museums.
- Visitors can zoom in and out the content pages.
- Visitors can easily distinguish the elements added to the web application.

4.3 Accessibility

Museums brought out that it is important to include everybody and have it accessible for everybody. To do that, the museums mentioned that it would be necessary to have the possibility to add texts, videos, and audio files. It was also brought out that the text should be with high enough contrast so it would be as readable to everybody. Additionally, they would like to add videos with sign language to have guides accessible for the hearing impaired. It was also brought out that the audio files should be able to contain longer audio files so it would be possible to put detailed descriptions of the exhibits there for the visually impaired and it would be nice to add text for people, who do not like audio guides or something that was not understood during the audio guide, so it would be multipurpose.

4.4 Restrictions of usage

The museums brought out different wishes for usage restrictions. One of the museums would like that the content with guides would be reachable only for the people who have purchased a ticket and for a limited amount of time. It is also important to consider that the time it takes to visit a museum varies a lot so the museum is expecting that they could regulate how long the guides are available after getting the access. Another idea was proposed that the usage of the web application could be restricted to the grounds of the museum, for example the user's device must use the Wi-Fi of the museum. Additionally, it was mentioned that some of the museums would prefer that all the materials are freely accessible to everybody because the

museum might have exhibits that need some research before or after the visit and they would like that all the visitors have all the info they need.

5 Overview of the web application

This chapter provides an overview of the web application and provides background about existing systems.

5.1 Overview of the existing systems

There are many different methods being used in Europe for audio guides, but these can be grouped. The author categorises the current solutions into three categories:

1. Audio guides on a separate device provided by the museum. For example, there are companies, that are offering audio guides in Estonia: Audioguide Ltd (<https://www.audioguide.ee/en/>) and ImExpo OÜ (<http://www.audiogiid.ee/en/>), and there are also global providers, for example Orpheo Group (<https://orpheogroup.com/>). Depending on the museum, it might be free, or the visitors need to pay for them.
2. Audio guides in downloadable applications. For example, the British Museum uses this option (<https://www.britishmuseum.org/visit/audio-app>) and there is a separate service provider VoiceMap PTE LTD, where everyone can earn money by uploading their audio guides on selected objects. (<https://voicemap.me/>) One of the global providers for this service is Orpheo Group (<https://orpheogroup.com/>). Depending on the museum, it might be free, or the visitors need to pay for them.
3. Audio guides on museums websites. For example, this is offered by the Estonian Nature Museum (<https://www.loodusmuuseum.ee/en/audio-guide>). Depending on the museum it might be free, or the visitors need to pay for them.

5.2 Objective of the web application

The web application has two subsystems. The first subsystem is the admin view, that is meant for managing the audio guides and information related to it. Every museum has their own admin view, where they have access to their content pages and can change them. Also, the admin view needs to have an ability to store audio guides that are not available for visitors. The second part is the visitors view, where the museum's visitor can listen to the audio guides and read the additional information provided by the museum. Visitor's side is a view only website, where every museum has their own displayable content page.

The web application uses web technologies so it would be accessible and usable on every smart device and computer, so the audio guides are available to as many people as possible.

5.3 Dividing the information web application into subsystems

The web application will be divided into two subsystems. Admin subsystem and visitor view subsystem. The admin functional subsystem allows the museum to store audio guides in the web application and to manage the content pages(s) of the museum shown on frontend to the visitors. The visitors view subsystem allows the visitors to access the audio guides for the museum and discover the museums that use this web application.

5.4 Non-functional requirements

A non-functional requirement is an attribute that dictates how a system operates. It makes applications or software run more efficiently and illustrates the system's quality. [13]

Table 1 is showing the non-functional requirements of the web application.

Table 1. Non-functional requirements.

Type	Description
Speed	Page loading time must be less than 3 seconds [14].
Accessibility	The web application must be accessible to everybody, including the visually impaired. The text must be zoomable and listenable with text readers. The web application must meet at least WCAG 2.0 Level AA. [15]
Privacy	According to the GDPR regulations a web page cannot collect any data about the visitors without their permission [12].
Security	<p>The web application must automatically save the data to records about the time of entry and change.</p> <p>MD5 or SHA-1 hash functions must not be used to find the hash value of a password, because it is too easy to find out the original password with a dictionary attack</p>
Security	At least one capital letter, one lowercase letter, one number, one punctuation mark and at least 12 characters long [16].
Email validation	Email must contain at least one “.” symbol and only one @ symbol.
Phone number validation	Phone number must consist of only numbers and maximum one “+” symbol, that must be the first symbol.
Portability	The web application must be usable in smart devices, including mobile phones, tablets, and computers.
Portability	The web application must be accessible in Firefox, Google Chrome, Microsoft Edge, Apple Safari, and Opera browsers [17].

6 Detailed analysis of web applications admin subpart

This chapter provides an overview of the web applications admin subpart and provides background about existing systems.

6.1 Objective

The objective of the admin functional subsystem is, that the museum can manage the content pages(s) of the museum shown on frontend to the visitors.

6.2 Solution description

- Museum's employee can download the application from the web.
- Museum's employee can create an account.
 - For account creation the museum's employee must fill information:
 - Museums name.
 - Museums company name.
 - Museums company registry number.
 - Museums email.
 - Password.
 - Re-enter password.
 - Re-enter password needs to match with the previous entered wanted password.
 - Museums address, that consists of fields:
 - Street name.
 - House number.
 - City.
 - Country.
 - Postal code.

- Museums phone number.
 - The workspace is accessible only in the device that created it.
 - Museum's employee can add, remove, and edit content pages.
 - Museum's employee can change the displaying order of the content pages.
 - Museum's employee can make the content pages visible for the public, visible only on museum grounds and hide the pages.
 - Museums can choose the option for every content page separately or do it as a bulk action.
 - If content page is visible only on museum grounds, then the visitor must be connected to the museum Wi-Fi to use the audio guides.
 - Museum's employee can add audio guides to the content pages.
 - Museum's employee can add pictures to the content page.
 - Museum's employee can add text to the content page.
 - Museum's employee can generate QR code for every content page.
 - Museum's employee can send the QR codes to print from the web application.
 - Museum's employees have different scopes for every language.
 - Museum's employee can make a new scope by choosing the language from given values.
 - Museum's employee can link the pages between different scopes.

6.3 Activity diagram

The author drew an activity diagram to represent the validation flow that is being followed when the museum's employee is creating an account. The diagram was drawn to make the flow clearer for the developer and for the documentation reader could be with better overview.

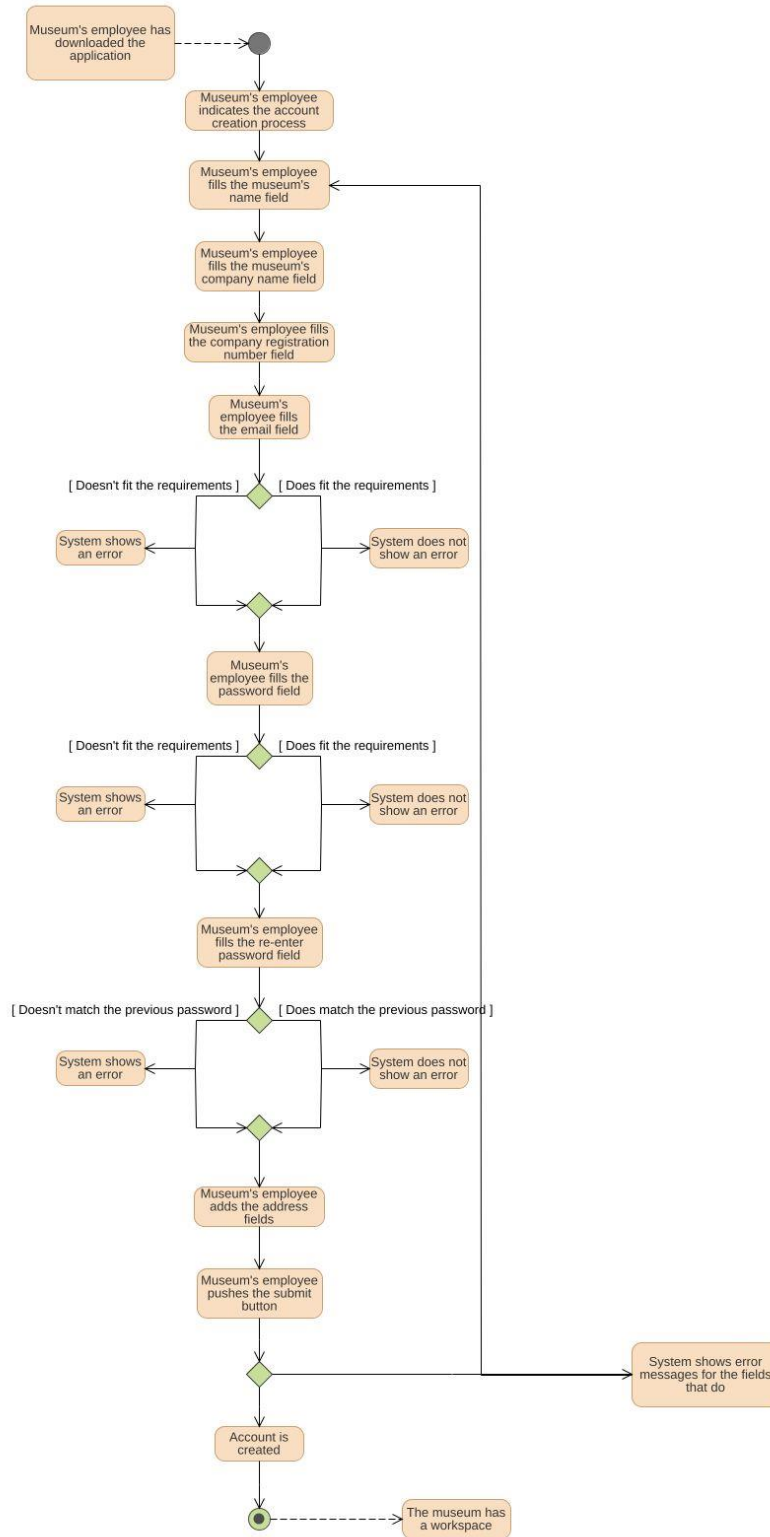


Figure 2. The flow of registration validation.

7 Detailed analysis of web applications visitor's subpart

7.1 Objective

The objective of the visitor's functional subsystem is that the visitor can reach the information and audio guides if those have been made available for the visitor.

7.2 Subsystem administration

The web application is partly administered by the creators of the web application and partly by the museums' employees. The web application's main page, general information pages about the museums and the pages in the footer are administered by the creators of the web application and the pages containing the museum's content are only administered by the museums' employees.

7.3 Solution description

- Visitors can see the main page.
 - The main page includes:
 - Menu opening button.
 - Logo of the web application.
 - Widget with museums using the web application.
 - The widget is displaying up to seven museums using the web application. The museums are chosen randomly.
 - The information which museums are displayed is requested from the database.
 - Clicking on the widget the visitor will be directed to the museum's general page.
- Visitors can see the menu.

- The menu includes:
 - List of the cities, where the museums using the web application are located.
 - After clicking on a city, the list of museums appears, that are using the web application in that city.
 - After clicking on the museum, the visitor will be directed to the museum's page.
- Visitor can close the menu either clicking the closing button or clicking outside of the menu area.
- The information which cities and museums are displayed in the menu is requested from the database.
- Visitors can see the museum's page.
 - The museum page includes:
 - Menu button.
 - Breadcrumbs.
 - The previous pages displayed are clickable.
 - Illustrative picture of the museum.
 - Name of the museum.
 - Introductory text about the museum.
 - If the museum has made its content page(s) publicly accessible, then the button directing to the content page(s) is shown.
- Visitors can see the footer on every page.
 - The footer includes:
 - Link to the contacts content page.
 - Link to the company information page.
 - Link to the feedback page.
 - Link to the GDPR page.
- Visitors can fast forward and rewind the audio files and videos.
- Visitors can slow down and speed up the audio files and videos.

8 Web application prototype

The objective of this chapter is to introduce and explain the possible design of the web application and give an overview of the design process. The prototype is available on this link: <https://www.figma.com/proto/twfE4aGy1pPPm68YNoP1Q1/Museum-Audioguides-Prototype?node-id=204-4>.

8.1 The front page

On the front page of the web application the following elements are displayed: the header, widget of museums, introduction of the web application and the footer. The colours used are white, grey, and black to keep the design minimalistic. The only colourful objects are the pictures of the museums to get attention from the visitor directed to the museums. This is also the reason the widget is placed right under the header, so it would be one of the first things the visitor notices after landing on the front page. The author kept gaps between different elements and functionalities so the visitors could distinguish them from each other.

In the header there are only two elements, the menu icon and logo of the web application. For the menu, the author used a well-known icon to indicate the function of the button. Since the design is kept minimalistic, the author divided the header and main content with a separation strip.

The widget contains the heading, pictures of the museums and the names of the museums displayed. The heading is black coloured and bold to indicate to the visitor that it is a heading for the widget. The museum's picture is made big enough that the content of the picture is clearly visible for the visitor but small enough to indicate it is a scrollable widget.

The introduction of the web application contains the heading and the content. The heading is black coloured and bold to indicate to the visitor that it is a heading for the widget. The text

is black coloured so it is easy to read, but in regular format so that it would not draw too much attention from the visitors.

The footer's background colour was chosen grey to distinguish the footer from the page content. The separation stripe was not used because otherwise the white would have dominated the design too much.

8.2 Main menu

While the menu is open, the header is also visible. The description of the header design process is described in chapter 8.1. The menu is separated from the header with a separation stripe.

In the menu there are names of the cities in which the museums using the web application are located. If the user has clicked on the city, then the museums located there are displayed as shown with Istanbul. The font is smaller and aligning more to the right for the museum names to indicate the hierarchy. To distinguish the different cities and museums on the menu, separation stripes are used. The separation stripes were chosen, because they were earlier used on the front page to distinguish the header from the content and the author wanted to keep the same style throughout the whole design. For the separation stripes a lighter grey was used, because there are many of them and the aim was not to take the attention away from the cities and museums but to create the indication of the separation.

The menu does not cover the whole page, so the user has an option to return to the home page while clicking outside the menu. To have the focus on the menu, the author added a shadow to the part of the page, the menu does not cover.

8.3 The museum page

On the museum page there are displayed a picture of the museum, menu button, breadcrumbs, name of the museum, general text, and the footer. If the museum has made at least one content page public, the button directing to the content page is also displayed. The description of the footer design process is described in chapter 8.1.

The picture of the museum is added for illustrative purposes and to create the atmosphere of the museum. The breadcrumbs are added to indicate the path taken for the visitor and give an opportunity to go back the steps taken. The links that are clickable in the breadcrumbs, a line is displayed under it, to indicate the clickable function. The menu button is added so the visitor can open the menu easily if needed.

The name of the museum is in bold and in a bigger font, so it is distinguishable from the content text. The content text can be in regular format or in bold. The museum page has one paragraph in bold and the rest of the text in regular format to show one practical option on how to format the text to bring out more essential information and additional information.

The author has brought out two opportunities for the museum page, first one, where there is no public content page(s) made by the museum and another one, where there are public content page(s) made by the museum. If there are public content page(s), a button is shown after the content text, to direct the visitor to the museum's content page(s). The button has been designed in lighter colour to not draw the attention away from the content text and the arrow has been added to the button to indicate that clicking on the button will direct the visitor to another page.

9 Possible features to add in the future

This chapter contains ideas from museums that do not need to be in the first version of the web application but are business requirements from the interviewed museums and could be added to the web application.

9.1 Features proposed to add in the future to the admin side

The author has proposed additional features to add to the web application in the future starting from the highest priority.

- Museum's employee can add videos to the content pages.
- Museum's employee can access the admin side via many devices.
- Museum's employee can create and remove users that have access to the admin side.
- Museum's employee can create a tour that considers the location of the visitor.

9.2 Features proposed to add in the future to the visitor's side

- Visitor can listen to the features that contain audio only via headphones or through the earpiece speaker.
- Visitors can choose the language, in which the front page, menu and general information are displayed.
 - Only the content, that is added in the chosen language, is displayed to the visitor.
- Visitor can see the museums using the web application that are near the visitor.
- Visitor can see the museums recommended by the web application.
 - The suggested museums list is requested from the database.
- Visitor can see the map with the museums using the web application.
 - Visitor can zoom in and out on the map.

- Visitor can click on the museum's icon and see the picture of the museum, the name of the museum and the link that after clicked directs to the museum's general page.
- Visitor will be given an opportunity to give feedback for the audio guides after finishing the tour.
 - The information will be sent to the museum's admin.
- Visitor will be given an opportunity to subscribe to the museum's newsletter.
 - The information will be sent to the museum's admin.

10 Summary

The goal of this bachelor's thesis was to perform a system analysis to create a web application for museums to display their audio guides, where their visitors can get additional information through their smart devices. For that the author interviewed museums located in Estonia about their business needs for the audio guides. Taking in account the information received from the museums, the author divided the web application into two subsystems: museum's subsystem, and visitor's subsystem, and performed system analysis for both subsystems. Considering the system analysis, the author proposed the possible design solution for the visitor's subsystem. The goal of the thesis was completely fulfilled. The documentation has been written and is ready to be used for the development of the web application. The documentation was written to bring out the first and most important functionalities of the system and the author brought out possible functionalities to add in the future.

Further steps needed to be taken are to develop the web application and to test it. To implement the usage of the system by the museums, potential museums need to be contacted and introduced to the system. To match all the museums' needs, the additional functionalities need to be added. To keep the web application functional and updated, it will need to be maintained.

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Appendix 2 - Prototype views

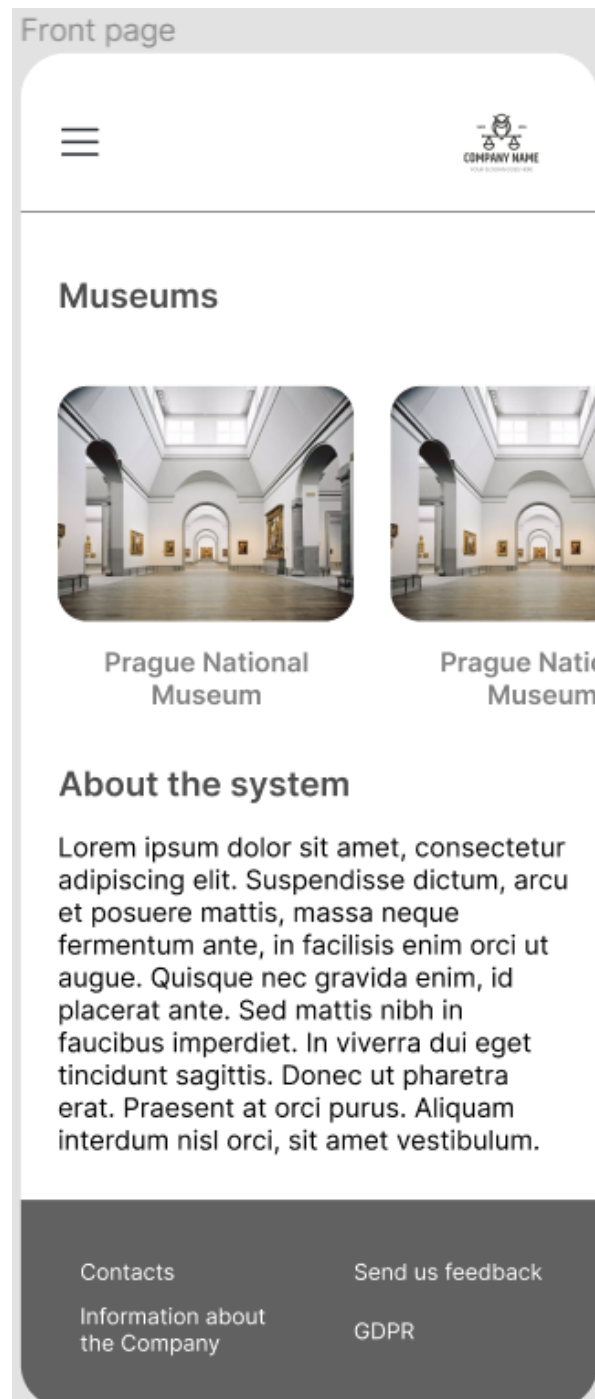


Figure 3. Front page.

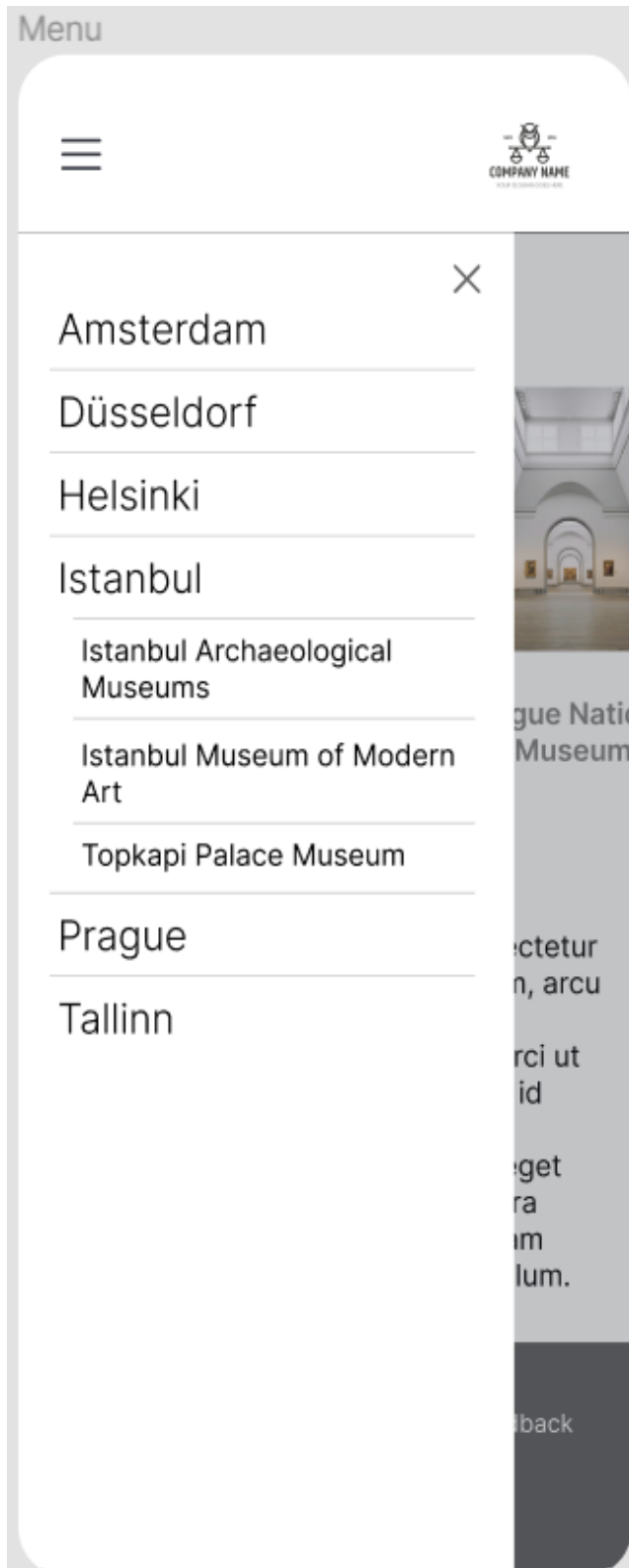


Figure 4. Menu.



Figure 5. Museum page.



Figure 6. Museum page with button.