UKRAINIAN CATHOLIC UNIVERSITY

BACHELOR THESIS

Development of a Web Application User Interface for Accommodation Search based on User Experience

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Declaration of Authorship

I, Markiyan LEBYAK, declare that this thesis titled, "Development of a Web Application User Interface for Accommodation Search based on User Experience" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.

- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.

- Where I have consulted the published work of others, this is always clearly attributed.

- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.

- I have acknowledged all main sources of help.

- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

_____

Date:

_____

"However difficult life may seem, there is always something you can do and succeed at."

Stephen Hawking

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Development of a Web Application User Interface for Accommodation Search based on User Experience

by Markiyan LEBYAK

Abstract

The purpose of this bachelor's thesis is to do research on existing web services, which provide opportunities to rent housing, and to create our own UX interface for a web service based on collected insights and solved problems during this research. The result will be a prototype that will meet the requirements of the potential end-users.

Acknowledgements

I want to thank my supervisor Olena Shpilevska for her support and help with the research presented in this thesis. It is difficult to express in words the gratitude for her work, for the time she spent on mentoring and consulting this work...

In addition, I would like to mention the impact of Ukrainian Catholic University, university professors, and the studying environment on my learning path.

Contents

List of Figures

List of Tables

List of Abbreviations

UI	User Interface
UX	User Experience
HCD	Human Centered Design
SWOT	Strenghts Weaknesses Opportunities Threats
HTML	Hyper Text Markup Language
CSS	Cascading Style Sheets
JTBD	Jobs To Be Done
IA	Information Architecture
PRD	Product Requirements Document

Dedicated to my family for their constant support and to Olena Shpilevska for her help in this work

Chapter 1

Introduction

1.1 Motivation

One of the most important things for a person in this world is a piece of land that can be called home. If you ever tried searching for accommodations to rent, you probably faced huge issues with choosing a place, in which you would like to wake up every morning for some period of time. Nowadays, the problem with choosing an apartment or house is so crucial for many Ukrainians because of the war that russia started. Most of them faced issues due to the fact that the amount of vacant housing for rent at normal prices is declining every day. The question arose that people who even have money simply have no place to spend the night.

The motivation to try to solve this problem for me was the experience of people from the East of Ukraine, with whom I had the opportunity to talk about the difficult experience of finding shelter in Lviv. I want to create a solution that will address issues of speed, transparency, pricing in times of panic and disaster, which will be useful not only for people who have been forced to leave their homes, but also for people who are just looking for housing.

1.2 Problem Statement

Nowadays, when the real estate market and the rental market are unable to meet the demand in Western Ukraine, there is a problem with finding housing and pricing. The search process is now complicated by a huge number of factors such as the inconsistency of offerings with real living conditions, deception of customers, and the short period of existence of offerings because good options are bought up very quickly. Many people complain that housing aggregators do not meet the needs of customers, and their interface does not have the necessary functionality to make the process of renting apartments as simple as in Booking or Airbnb.

1.3 Goals to Achieve

1. Conduct an in-depth analysis of existing solutions and competitors

2. Communicate with stakeholders and gain a full understanding of the market and how it works

3. Test usability of competitor's product

4. Develop validation scenarios

5. Create wireframes and working prototype

6. Validate prototype with real users

7. Document the entire research

1.4 Structure of the Thesis

In addition to the whole research documentation, which can be found on GitHub[1], the thesis is also structured to maintain consistency of research and problem-solving. It includes such chapters:

In **Chapter 1**, the idea and problem to be solved are described, as well as the motivation of this work.

In **Chapter 2**, there is a full description of background information and methodologies, which came in handy during the research.

In **Chapter 3**, the proposed research approach description can be found, including strategies and validation steps.

In **Chapter 4**, research results are presented and explained.

In **Chapter 5**, the process of creation and validation of wireframes and the prototype is introduced.

In **Chapter 6**, the work is summarized and further steps are presented.

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[1]https://github.com/LebyakMarki/UCU-Bachelor-Thesis

Chapter 2

Background Information and Related Works

This chapter provides an overview of key techniques, concepts and related works mentioned or used in this thesis. This will allow the reader to better understand the chosen research methods and their results, which are the basis for such kind of research.

2.1 User Experience Ideology

If we speak of design as something visually appealing and understandable to your user: all these colorful buttons, the location of objects, and transitions between them; then we mean the User Interface (further abbreviated as UI). But the UI itself is only a good wrapper, which is visually attractive. However, if we talk about services or applications, it is not enough - you need interaction.

This is where the concept of User Experience (further abbreviated as UX) appears. In a broad sense, UX is what the user faces while using a service, application, website or a similar platform. This is about what he thinks and what he presses during his user session, what emotions he experiences from the interaction, and how well he uses the product. The concepts of UI and UX are very closely related, because to create a effective user experience you need a clear and intuitive design.

The term "User Experience" was popularized by Don Norman's self-selected title of User Experience Architect at Apple Computer, Inc. in 1993 [2]. In continuation of the theme of user experience, an important concept that Don Norman describes in detail in his course '21st Century Design' is Human-Centered design (further abbreviated as HCD). The main idea of this concept is that the designers need to regard the users not as objects, but instead should address them as a separate unit, which has its own customs, history and needs. The problem that arises in this thesis is about people, rather than users, which is why the concept described by Don Norman is so significant in this work. This HCD method is based on four principles (see Figure 2.1):

1. *People-centered.* Center on individuals and their setting in order to form things that are fitting for them.

2. *Understand and solve the right problems, the root problems.*

3. *Everything is a system.* When creating a design, you need to think about the system as a whole, not just improve individual components.

4. *Small and simple interventions.* There is a need to constantly improve and change the product in small steps until the design truly meets the needs of the user.

4 Principles of Human-Centered Design

People-Centered Solve the Right Problem Everything is a System Small & Simple Interventions

FIGURE 2.1: Human-Centered Design Principles [1]

2.2 Stakeholders Interviewing

First of all, when developing or improving an existing product, it is very important to know information about the product area, its nuances and problems, as well as to communicate with people to whom it is close or important. This will prevent you from making the most common mistakes, get the necessary information and get insights, which is why you should first speak to stakeholders.

Stakeholders are people or organizations, who are interested in the field you are researching and in the success of the project you are working on. It often happens that stakeholders may not all have similar objectives, that is, there is a need to identify areas of difference and reject expectations that cannot be met.

There are several advantages in involving stakeholders in research and interviewing them. First of all, it will save money and time in the early stages of the project because, upon the communication with them, it is easier to determine the real scope of the project and anticipate difficulties. Another great advantage in communicating with stakeholders is the subsequent creation of acquaintances and communities, which provide new opportunities for further cooperation or assistance in launching the product. The ultimate benefit is gaining a view from another perspective, which often reveals problems and solutions that were difficult to come up with yourself.

2.3 Competitors Identification

In the wonderful book "From Zero to One" by Peter Thiel, the author mentions that for success it is very important not to look for your market, but rather to create it. However, sooner or later, in the new market you will have competitors who in some way will try to bypass you. Your direct opponents will always try to find new opportunities to capture more users and this is acceptable because, as Mike Krzyzewski said:

"Great rivalries don't have to be built on hatred. They're built on respect, on a respect for excellence."

Thus, the next important step in the study is the identification of competitors and their division into direct and indirect. With direct competitors, it's easy to research the market and find a company, whose product is the same as yours. With indirect competitors it is much more difficult because analyzing the market will not be enough to identify them, you just will not find them. Here you need to search for keywords or advertising, because their product is not the same as yours, but still

competes with it and can replace it. After identifying the largest competitors, there is a need to identify marketing opportunities, so that your product will be able to outperform and outrank them.

2.4 SWOT

The next important methodology for researching your competitors is SWOT analysis. The SWOT acronym is delivered from Strengths, Weaknesses, Opportunities, Threats. An important term in conducting this analysis is the *factor* - relevant information. The rows in the SWOT chart represent external (which the company does not control) and internal (which the company controls) factors. The columns show the factors that are harmful (block success) and helpful (help to lead) [3].

SWOT's review of competing companies provides a load of insights to improve your product, such as (see Figure 2.2):

- **Strengths.** These factors will help you understand what competitors are doing better in the marketplace.

- **Weaknesses.** Knowledge of what mistakes competitors continue to make and where they are doing poorly in the marketplace.

- **Opportunities.** It is important to know what opportunities your competitors have for growth and development, what their next steps are and what possible partnerships they might have with other companies.

- **Threats.** These factors will show you the potential dangers of your competitors. After a good analysis, you should pay attention to the threats of your competitors, because you will most likely have the same ones.

Another crucial point is that while conducting such an analysis, there is a must to look at competitors' sales processes. Here appears the possibility to understand why consumers are not purchasing from competitors or why they ended cooperation with them. During the analysis, one should not compare the products of different competitors. Assessment should be independent because there is a need to evaluate the product as fairly as possible in order to get the necessary information and ideas for improvement.

FIGURE 2.2: SWOT Analysis Diagram

2.5 Audience Study

The next important step in conducting research is the stage of getting to know your audience - who will use your product? There is a huge number of techniques by which you can form the image of your client, such as Proto-Personas, Personas and Jobs-to-Be-Done.

Proto-personas are generated on the stakeholders interviewing assumptions, and further checked upon the real-life data. The result of the proto-personas analysis method will look like a blueprint/sketch, similar to wireframes, which can be acquired from a brainstorming session, and is often used to align stakeholders' views.

The next step after creating a proto-personas will be to complete the image of your user by such methods as Personas and Jobs-to-Be-Done. Both of these methods help you to understand your users and what their needs are. When using personas technique, you will be able to identify your users as real people and understand their goals for using your service. Jobs-to-Be-Done technique is more focused on goals and opportunities to achieve them. In order to get a complete picture and continue working on your product, the best solution is to combine these two methodologies and conduct a full audience survey.

2.6 Usability Scenarios and Competitor's Product Testing

The next important step is to study the behavior of representatives while they use the product. The main goal of usability testing is to reveal areas of problems while using the product and determine improvements for overall user experience. Observing the new real users testing your product, and meanwhile watching how effectively they are interacting with it are the ways to understand whether:

1. Users are not lost and whether they understand the inherent flow of the product

2. Bugs are present in your service

3. Other usability issues are present

Before conducting testing, you need to develop usability scenarios for proper communication with participants and consistent research. Prepared scenarios focus on real problems and needs of end users and remove artificiality from testing. There is a big problem with the fact that users rarely read the text before performing any actions on the website. The reason is they want to act, and if the site violates their previous experience and expectations of key elements (see Figure 2.3), the user often does not use your functionality. Therefore, it is important to write a test script using words that are clear to any user. After briefly and clearly describing the task, you can start the experiment.

By evaluating your competitors with usability scenarios and users' feedback, you can discover the strong side of competing products. In addition, you can unveil existing problems within them, which can become your advantage once you solve them. Competitor's product testing is often a good initial research activity before designing your project because it can help determine the direction of the design.

FIGURE 2.3: Common Web Objects Components [5]

2.7 Information Architecture

Having gathered all the ideas after testing and research, we could essentially start creating a design and prototype. It is necessary to understand that design without content and well-thought-out user flows is just a decoration. However, if you start creating a design without thinking about how the user can interact with the service, you can lose your customer forever. After all, according to statistics, about 88% of people do not return to sites where they have had a negative or unsatisfactory experience. To solve this, you need to create a comprehensive information architecture (further abbreviated as IA) that will be based not on conjecture, but on insights and discoveries, which will allow users to return to your service again and again.

So what is this information architecture? There is no strict definition for this architecture yet, as it includes a large number of processes and professions required for creation. In general, it is about how to help the user understand where he is now and deliver to him what he is looking for. In our case, information architecture is about the structure of the site, how to help the user quickly find the necessary functionality or easily navigate it. Our task when creating IA will be to structure all the ideas / features and visualize that in a form of a site map.

Turning to the case, the process of creating an IA consists of the following sorting processes:

- **Classification and Hierarchy.** Your service will most likely consist of several pages, each of which will have additional windows, pop-ups and other visual content dividers. In order for the user to find what he is looking for in all this, you need to classify the elements and create a hierarchy of what the user expects to see based on them.

- **Labels and Tagging.** Your service or site will contain pages and functional elements, such as a button, which should contain text. This text is quite crucial for the user, because with the help of this text the user navigates the site and finds the necessary information or functionality.

- **Navigation and Wayfinding.** The structure of how users can navigate a site and where they can navigate on each individual screen must be well thought out and predictable.

- **Search.** This is a complex system that should allow the user to find what he needs on your site, and the easier it is to do so the faster the person will get what is wanted.

2.8 Wireframing

After all the necessary research and analysis, you can proceed to the final steps of creating a product. One such step is to create the first sketch of your design based on IA, namely the wireframes (see Figure 2.4). A wireframe is the basic blueprint that illustrates the basic form and functions of the web pages. Accuracy of these wireframes will be increased in detail during further work [4]. Creating wireframes is a perfect way of getting to know how a customer interacts with your interface through the navigation, text positioning, buttons and menus on these design sketches.

Before you start sketching, you should know the following key aspects:

- **Navigation.** Although this is not a working prototype now, navigation between wireframes must be well thought-out to bring the sketch closer to the actual user flow.

- **Add important elements.** During your research and conversations with the stakeholders, you will be able to identify a list of key elements that will differentiate you from your competitors. If these elements are critical, be sure to add them to the wireframes page.

- **Real text and buttons.** Although this is not your real product right now, the validation of your wireframes requires real text, not the 'Lorem Ipsum', and the buttons must have some meaning and functionality.

- **Spacing.** It is very important to place the elements correctly on your page so that you can visually separate and understand them. The reason is that your future real website will look very similar.

Once the mockups have been generated, the next step before proceeding to prototyping using code or tool design is to conduct usability testing with your prospects. This will allow you to identify problems with the basic functionality and quickly make any changes if needed. Afterward, it is desirable to repeat testing until the interaction with the user reaches the anticipated level.
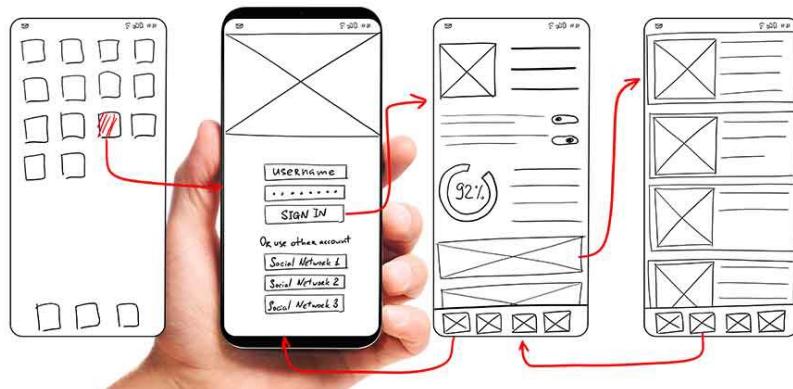
FIGURE 2.4: Example of Wireframing

2.9 Prototyping

Therefore, the final step or result of our research is the creation of a prototype. You can create a prototype using Figma or similar applications, or you can create a real website with the help of web development. Speaking of prototyping in Figma, one important advantage is the simplicity of the process because you can create transitions between pages and demonstrate the user a "real" application with the help of colors and geometric shapes, as well as actions that can be added to your "buttons". However, the user does not get to experience the real product, which can result in inaccurate user experience.

Instead, you can create a prototype closer to reality with a full-fledged web development. With HTML and CSS, you can create a website / application, (with no back-end code necessary), which you can then use as a foundation when launching the product. Understanding how to code design leads you to a better affinity with the developers because they will demonstrate greater appreciation for your ideas. Coding also has a benefit in that you can utilize the full advantage of what web development has to offer. In addition, coded prototypes can adapt to the width of the browser window (see Figure 2.5), which you will not be able to do in Figma.
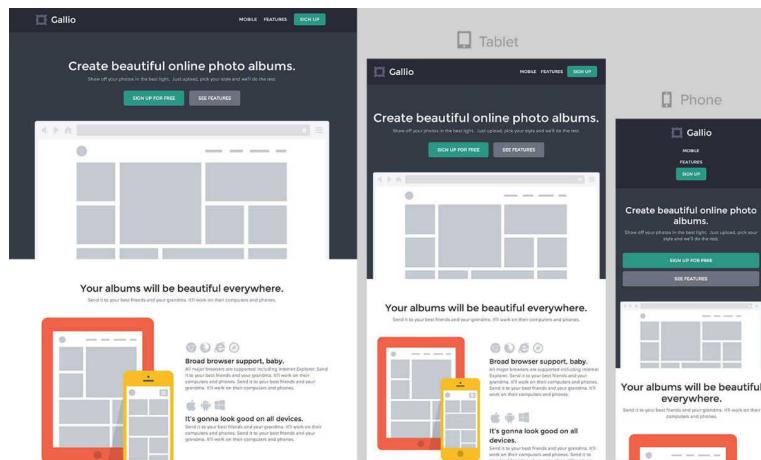
FIGURE 2.5: Adjusting Screen Size of the Prototype

Chapter 3

Research Approach

This chapter provides a blueprint - general plan and structure of actions related to this work. It serves to better understand the sequence and results of the research, as well as to understand the relationship between individual results that emerge in the prototype as a solution to the problem.

3.1 Analysis

It is impossible to do something useful or convenient without knowing who is your end user. This is why for any product, in its early stages of origin, you first need to conduct an in-depth analysis. This analysis should give you an understanding of who your stakeholders are, who your users are, what their needs are, and what inconveniences there are in existing solutions to this problem, if such solutions exist at all.

   The first stage of this research was communicating with stakeholders - people possess an interest in this research and in improving existing products and solutions. This step will give a general understanding of the market and its problems.

   Since this market has existed for a long time, it was not necessary to re-create a bicycle, because today there already exist quite a number of solutions. This is why the next step in this analysis was to study the strengths and weaknesses of the competitors, the high-performing functionality in their product and what can be adopted in our solution.

   The last step will be the SWOT analysis of the competitors, which will allow us to summarize all four aspects of the competitors' product that reveals this methodology. Namely, if we can find a solution to their weaknesses and threats, it will give us an advantage in the market and allow us to create a competitive product.

3.2 Research Strategy and Improvement Ideas

Now that we have general information about the market, how it works and who we need to compete with, we are proceeding to the second stage of the study. After the analysis, we need to delve deeper into the problem to further solve it. Here we are interested in real users of such services, their background and existing difficulties.

   So, in order to fully form a picture of our end user, we need to conduct a survey. Properly asked questions will allow us to understand the age, gender, location and a number of other critical points of information that will deliver on how exactly a person found out about our product. Ideally, these surveys should be conducted live, which would allow us to get a more open answers to the questions. Nevertheless, a dozen of answers in the online survey will also allow us to get the full picture.

After the survey, we are ready to start creating our proto-personas - a more detailed description of how we imagine our customers. With the help of surveys, we can identify several "types" of users according to their age and goals, and try to summarize exactly what they need. This general description of users created on the basis of real data makes it possible to unify the path that users take in order to achieve the goals they set when using the product.

The next step is to add "human" factors to the proto-personas we have created, which will allow us to see these people as real users - personas named Ivan or Solomiya, who have their own personality, tasks, goals, fears and risks. Although all these people comprise a collective image, the factors listed before are driven from real life and are not invented, which gives the opportunity to apply Human-Centered design and get to the root of their problems. And in conjunction with Jobs to Be Done, we get the final picture of the user because we additionally incorporate a data field such as "when X, I want Y to Z" which creates the user flow. JTBD prompts us to test competitors' product testing scenarios and come up with ideas for improvements.

The final stage of the research will be the usability testing of competitors' products. This is a necessary step because it generates many ideas for improvements and allows you to check which functionality works poorly or is not needed at all on competitors' product. After testing this on several users, you can also ask their opinion on what is the most annoying functionality or what is difficult for them to do. It is the solution of these problems that will give you an advantage in the design of your own product.

3.3 Design and Implementation of the Prototype

After the research - a logical continuation of the work will be the visualization of all the insights and functionality we came up with. This means creating a design for our product that will contain the full flow of the user and that will cover all existing needs. The process of creating a design, which is later turned into a prototype, consists of several steps (see Figure 3.1).

FIGURE 3.1: Design Creation Steps

First of all, because we create a product in an existing market, where we already have competitors, we need to understand that we do not need to be innovators. Creating a design from scratch is not a necessary step, which is why the analysis of competitors was made. It allowed us to see how our competitors solve the existing problems. Inspiration can be found in them, which is why we form the initial ideas and sketches from the design of analog sites.

After the sketches, comes the time for a more detailed and functional visualization of our ideas - the creation of wireframes. With their help, you can visualize all

the necessary pages in more detail, which will then be translated into a prototype. They do not contain styles, colors or photos, it looks more like a skeleton of a product that we need to build correctly in order to stick to a visually pleasing component of the site.

As we can see, the next step is to create mockups of pages, but this is not a critical point if we are creating a site from scratch. Testing for styles and colors requires a lot of resources and was not included in our plan, but rather we can consider it as the next step of this project.

Now, we come to the logical conclusion of the project. The product of this work is a prototype site, constructed by the use of code, rather than a clickable project in Figma. This prototype will also be tested with the help of potential users to see if we have managed to solve the identified problems.

3.4   Validation

The final stage of the website design process is the creation of a prototype, which allows us to proceed to the test our ideas and discoveries - validation and testing. Just as our competitors' products have been tested, we need to test the product in the real world on a few respondents, which will reveal shortcomings and confirm our assumptions about potential improvements.

By setting similar tasks for test participants, it is possible to find out whether their user flows have improved or at least changed for the better. It is also possible to check whether we have managed to gain an advantage over competitors and to form the next steps for product development.

Chapter 4

Exploration Results

This chapter will provide an overview of the results obtained from the field study and user surveys. As you will see, the insights and information we received from potential users and stakeholders help to devise the appropriate functionality, as well as to identify the problems to be solved.

4.1 Research Documentation

This work includes a significant number of steps and sub-experiments, which are needed for building a big picture. Each methodology used in these experiments requires proper notation and structuring, which is why every individual study document was saved in a separate file. Research such as SWOT analysis was done in the text form, instead of the schematic one. The research report was also divided into subsections in order to simplify the process of searching the necessary research information on each individual competitor.

4.2 Stakeholders Interview Discoveries

The first step of this study was to communicate with people who are quite close to the topic of renting / buying a home and who are interested in solving problems related to this market. That's why, on the first place, we tried to speak with stakeholders - representatives of companies that already exist in this market. We were able to talk to representatives of two major Ukrainian companies - Riel and Lun.

The first company - Riel, was founded in 2003. During its existence, it has become the leader of the Lviv real estate market and a national developer with a portfolio consisting of 103 commissioned and new facilities in both Lviv and Kyiv, with a total area of over 1.1 million sq.m. Although the company is not a direct competitor because it does not offer leasing services, it is one of the main players in the real estate market in general.

The second one - Lun is a company, which collects and organizes information so that you can see the whole truth about the real estate market, without fantastic renderings and advertisements such as "5 minutes away from subway". We are not very interested in Lun as a project, they have a subsidiary called Flatfy - an international vertical real estate search engine. Developed by the team of the Ukrainians, search engine Lun has been working since 2016. Currently, the search engine is successfully operating in 30 countries. Flatfy aggregates advertisements of various real estate objects (apartments, houses, land plots, etc.) from bulletin boards, real estate companies' sites and real estate portals, and provides search based on the location of Internet users. Results collected from many sources can be viewed in one place and sorted by relevance, novelty and other parameters.

By talking to representatives of these companies, you can highlight the following key points and insights:

- Large construction companies that previously sold real estate, shortly before the war, were already thinking about launching their own rental site, which would enlist real estate positions that they could not sell for a long time.

- Although demand is now unrealistically high and property owners rented a lot of money at the beginning of the war (which is now considered looting), the real estate market has not grown in the same proportion. On the contrary, the sales market fell to zero because the State Register of Real Property Rights was closed during the first days of the war.

- Rental companies were affected by the large influx of people, and with the start of the war, all of their normal internal processes were disrupted. Many owners and developers refused to cooperate, so the company LUN tried to be the first one to restore previous capacity (which later began to happen).

- The biggest problem in the field of rental housing, as it once was, is fraud. And now, their activities have only increased in magnitude due to the huge consumer demand. More of that, it is getting harder and harder to combat them today. Solving this problem will raise the level of trust for housing search sites, realtors and owners directly.

To sum up the results of these interviews, we can highlight a key argument - the market was not ready for such a level of demand and not all companies have managed to adapt to new realities. Demand will decline over time, but even those products that were quite helpful before the war could not help in these difficult times. That's why we decided to continue our research and move on to the analysis of our competitors.

4.3   Competitors and SWOT analysis

After confirming our assumptions on the problems and opportunities of the rental market via communication with stakeholders, we can begin to analyze our competitors. The first step in completing the research report was to analyze the audience. An existing website, where we could track human traffic, their age, gender, etc., would help with the analysis. However, due to lack of our own user data, we decided to analyze the site of our biggest competitor - dom.ria.

We used the online application Semrush, with which you can explore information about the users of any website in great detail. The first thing we learned was the distribution of users by age and gender, and we learned that the largest age group is 25-34 years (see Figure 4.1). The distribution of men and women is also not equal, men are more likely to use rental sites. Also a very important discovery was about the social networks users prefer: most have accounts on Facebook, YouTube, Instagram and Twitter. Also, with the help of such service as Google Trends, we managed to find out that after February 24, the word "rent" began to appear in the search engine of Google 3-4 times more frequently. In addition, the theme "Apartment" stood out at the top of Google Search and gained 1500 percent popularity. The decisive factor in the analysis of the competitor was that the users prefer to use the desktop version of the website, which is why we decided to design a desktop version of our own site, called Penaty.

The next direction of the analysis is to study the users traffic: how exactly they got to the website and what they did next, the location of the users, and the sources
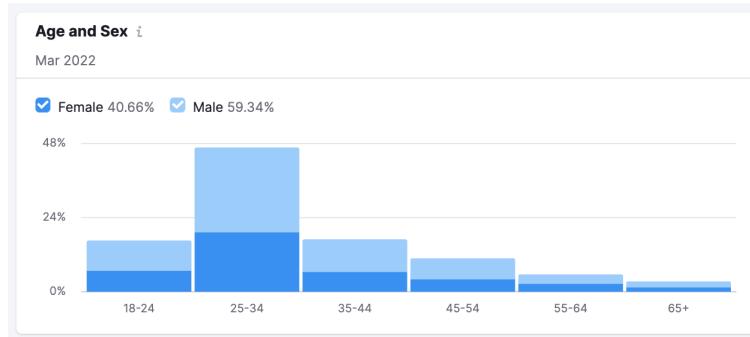
FIGURE 4.1: Age and Sex Distribution of dom.ria Users

of traffic. So, first of all, we can see that the largest amount of incoming traffic come from direct Google queries, direct links to the site, and the transitions from a competing service called Flatfy (see Figure 4.2). After visiting dom.ria, we see that many users return to the homepage of the search engine, which leads to the conclusion that the service does not meet the needs of all users or that the users move to other, similar sites such as olx.ua and a site with free shelter prykhystok.in.ua. Another interesting fact is that for the first time, on dom.ria, the number of visits to the site prevailed through search and not through direct conversions, which was the case in February. Semrush also notes that the search for housing in cities such as Lviv, Ternopil, Ivano-Frankivsk and Uzhgorod has the largest number of requests, as well as about 20 thousand unique users made it. Since the service is designed for the Ukrainian market, about 90 percent of users are from Ukraine.
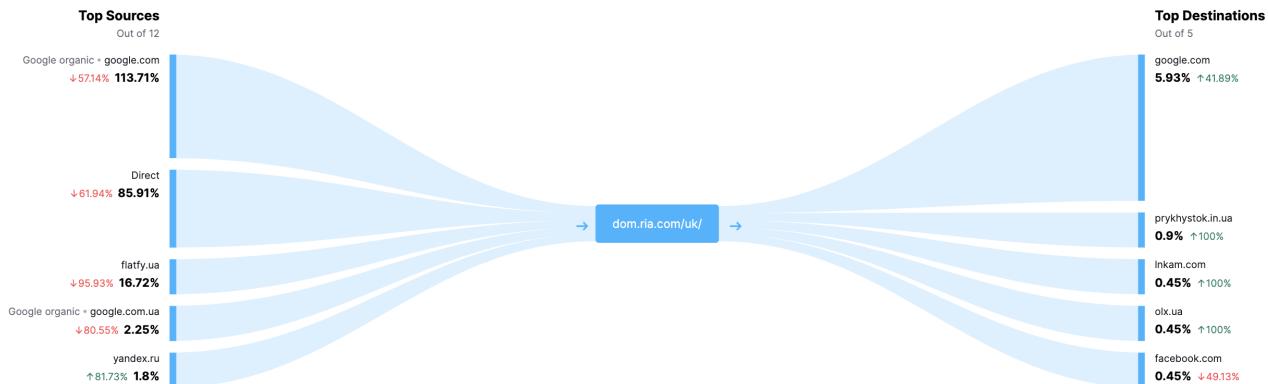
FIGURE 4.2: Traffic Journey of dom.ria Users

The next stage of the research report was the analysis of our competitors: namely, the analysis of statistics of their sites with highlighting their strengths and weaknesses, and the analysis of user comments about these services. Thus, the following competitors were considered in the analysis:

- **dom.ria** - Ukrainian site for selling and renting all types of real estate from individuals, developers and real estate agencies. The site ranks 27th in popularity in the Ukrainian segment of the Internet. Some statistics on the site: bounce rate of about 37 percent, 1.7 million site visits and an average of 7 minutes spent on the site. The site is the biggest competitor and today has the most advanced functionality and the best offering verification. However, there often

appear negative reviews on the work of the support team. Additionally, false offerings are sometimes found on the site.

- **flatfy.ua** - the site, mentioned earlier, which is an international vertical real estate search engine. Some statistics on the site: bounce rate of about 45 percent, 1 million site visits and an average of 3.5 minutes spent on the site. The site does not contain information about the apartments themselves. Instead, it redirects to the site of another company, where the apartment was located. Due to the fact that the site uses artificial intelligence to select offerings from partner sites, fraudsters often appear.

- **domik.ua** - a company that acts as a bulletin board for both the sale and rental of real estate in Ukraine. It should be noted that you cannot find housing in all regions of Ukraine. The company hardly spreads information about itself and has virtually ceased operations after February 24. Some statistics on the site: bounce rate of about 62 percent, 179 thousand site visits and an average of 1.5 minutes spent on the site. The site cooperates terribly with customers, is overloaded with fraudsters and has very stingy functionality. The number of offerings is very small and there are no guarantees they are authentic. Therefore, it is unlikely to call this company a competitor.

- **olx.ua** - online advertising platform that brings people together to buy, sell or share goods and services. As of 2018, 1.5 million sellers have been registered on the site, more than 11 million offerings have been placed and about 100 new ones are being added every minute. Some statistics on the site: bounce rate of about 29 percent, 30 million site visits and an average of 8.5 minutes spent on the site. Real estate is a part of the company, but it is not noticeable that this is a priority for the company. The company allows anyone to place offerings, which is why the user has so many options to choose from. But the number of scoundrels is growing in an arithmetic progression. Very sparse information and unreliable prices do not make olx.ua a competitor as a product.

- **krysha.ua** - a search engine for offers on the real estate market, making information comprehensively accessible and useful. The krysha.ua project is based on the principles of maximum savings of time and effort in finding real estate for users. It provides information on prices for apartments, and data on new buildings in different cities with map locations. Some statistics on the site: bounce rate of about 39 percent, 130 thousand site visits and an average of 4.5 minutes spent on the site. This site is somewhat similar to Flatfy, but the implementation is worse. It has got obsolete design, it is complicating to use, and the lack of reviews does not give confidence in this service.

So we managed to form an opinion about each individual competitor. We collected all the necessary statistics and analyzed user feedback. Now we can move on to the next step in the study, namely, conducting a SWOT analysis of each individual competitor. It can be used to identify their strengths, vulnerabilities and external factors that contribute to or hinder the achievement of a common goal. Mostly this analysis is visualized, but since we will analyze 5 competitors at once, we have gathered all the categories of this methodology in the form of text. This way we will be able to understand the available improvements that our competitors have in terms of weaknesses and threats. Here is a compiled SWOT analysis table of five of our competitors:

- *Strengths:*

1. Photos of the apartment are taken on a 360-degree camera, which gives confidence that users will not be deceived
2. The system uses algorithms to calculate the average price in the area where you are looking for housing
3. Verification of property rights, information on seizure of property or credit, and verification of information from the seller
4. Artificial Intelligence engine, which analyzes partner sites and publishes information about the offerings placed there
5. The site has a forum and news section, which is useful for both the owners and customers

- *Threats:*

  1. A huge number of fraudsters and moderators do not fight them
  2. Low level of trust in the reliability of the owners
  3. The site works as an analyzer of other sites' offerings, which allows it to develop only along with the development of its partners

- *Weaknesses:*

  1. Poor technical support and customer service, long chat wait times
  2. No verification of owners, which leads to a large number of fraudsters
  3. Bulletin board is not a full-fledged site for finding housing
  4. There is no map with the location of available apartments
  5. The feedback feature is not available

- *Opportunities:*

  1. Perform employee training for fast and high-quality support
  2. Add a rating and feedback system for both owners and customers
  3. Develop algorithms or artificial intelligence engine to combat fraud

Summing up, after the SWOT analysis of our competitors, we can see that they have a huge number of important features that are noted in the strengths section. However, there are many improvements that users need. Since these are our competitors, we can consider their weaknesses as opportunities for us, which is why we have identified the following among the functional capabilities:

- Tags for offerings, which show the advantages of housing

- Functionality to add accommodation to "Favorites"

- A separate section of the site should contain information about free shelters

- Advance filter system, containing area, number of rooms, appliances, etc.

- Competently developed system of feedback about owners and customers

- There must be a filter regarding the duration of the lease (the owner is ready to rent the apartment for a day / week / month / year)

- Ribbon with available options, should be divided into right and left sections. On the right, there will be a map, and on the left - the options themselves

4.4 Audience Study: Proto-personas, Personas, Jobs to Be Done

After analyzing the competitors and their customer base, it was time to interview regular users. This is necessary in order to form proto-personas, realistic personas and JTBDs from real life. The best option for conducting a survey is to communicate in person because this is the only way to get the most comprehensive and complete answer from people. However, due to the impossibility of conducting an interview, it was decided to conduct a Google survey and we managed to get more than 25 answers.

So, let's first analyze the gender of the people we interviewed. With the help of Semrush, we analyzed a competitor's site and found that there is a slight quantitative advantage in men looking for housing for rent. The results of our survey confirmed this and we have a distribution of six men to four women (see Figure 4.3).

Ваша стать?
27 відповідей

● Чоловік
● Жінка
● Утримуюсь від відповіді

37%

63%
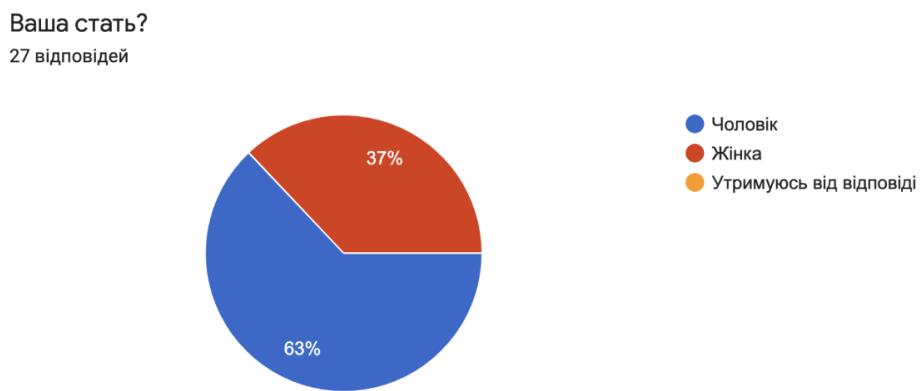
FIGURE 4.3: Survey Gender Distribution

The next question we had was the demographic distribution of people we interviewed. According to statistics, about 40 percent (the largest group) have moved from central Ukraine to the western regions. The next large group were people, displaced from eastern Ukraine, seeking housing in the Polish border region. They accounted for about 33 percent of those surveyed. There are two smaller groups of people from the South and West of Ukraine who have a little more than 10 percent in the distribution. The questionnaire also included questions about citizenship, and all respondents said they are Ukrainian. This survey brought together people from ten large Ukrainian cities, and this diversification allows us to get a complete picture of what people in a difficult situation want.

The key point of our research of users was age. From Semrush statistics about the competitor site dom.ria, we learned that the largest group of users are people aged 25-34 years. Looking at the results of our survey (see Figure 4.4), we can see that about 50 percent stands for the group of people aged 21-30, and followed by about 40 percent of 31-40 age people. Hence, the conclusion is that we are researching approximately the same group of people as our competitors' customers and that we can target a relatively "young" audience.

After analyzing who our potential users are, we will move on to the study of the use of web services by our respondents. Regarding the social networks that users prefer, we can highlight the interest in Facebook, Instagram and YouTube. As for the choice of gadget, with which people were looking for housing to rent, we see a clear

Ваш вік?

27 відповідей
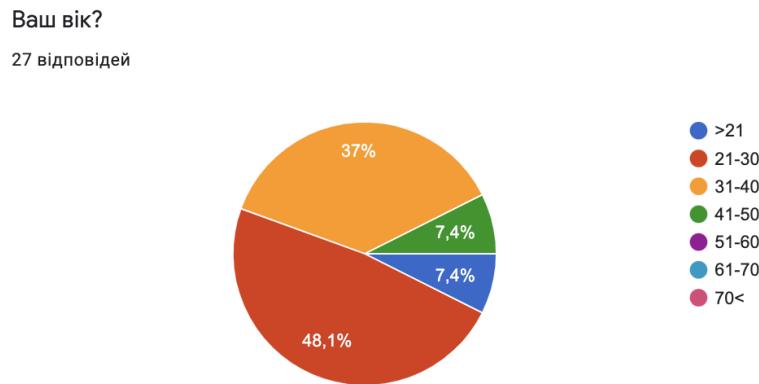
FIGURE 4.4: Survey Age Distribution

advantage of computers over mobile devices with nearly 93 percent. Nevertheless, a large group of respondents still used phones - 52 percent (see Figure 4.5).

Яким гаджетом Ви користувалися шукаючи житло?

27 відповідей
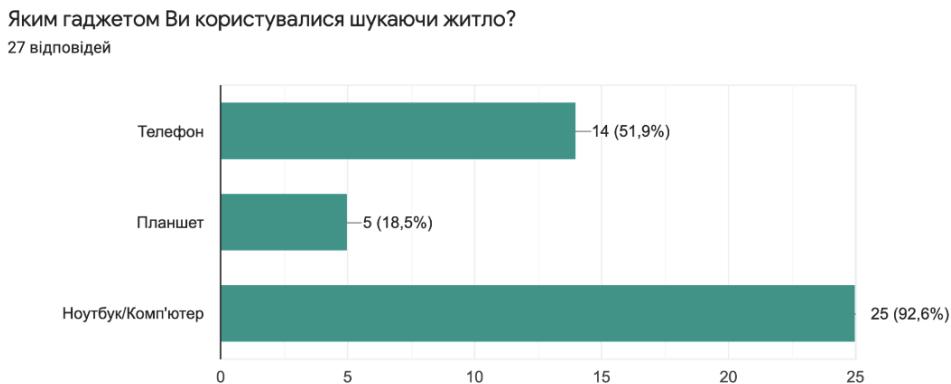
FIGURE 4.5: Survey Gadget Preferences

Next, we were interested in what services people used to find shelter or housing. As you can see, the largest number of answers stands for olx.ua (see Figure 4.6). The next most popular option is social networks offerings. The next three options, which demonstrated similar user preference - familiar owners / realtors, Booking and dom.ria. Each of them was chosen by about half of the respondents. However, few people know the homeowners in the West of Ukraine and so they are looking for hotels. As for the Flatfy service, we can see that a very small percentage of people knew about it.

The final questions to our users were about what they like or do not like using the aforementioned sites that allow for contacting homeowners. These questions had pre-suggested answers, including a field for a different answer.

Let's start with the bad news, namely, that users are annoyed while looking for housing. Respondents were offered the following options: "Inappropriate offerings", "Price mismatch", "False photos of apartments", "Poor support", "Difficulty navigating the site", "Incorrect description of the apartment" and "Fraud by the owner". Users note that they have encountered all the problems in approximately equal proportions and simultaneously, except for the option with support and site navigation.

Now let's move on to the positive points and the things that users like about our competitors. Here, we also gave the users available options to choose from and a

Шукаючи житло, якими сервісами ви користувалися? (якщо Ви використовували сервіс не
зазначений у списку, можете вписати його в поле "Інше")

27 відповідей
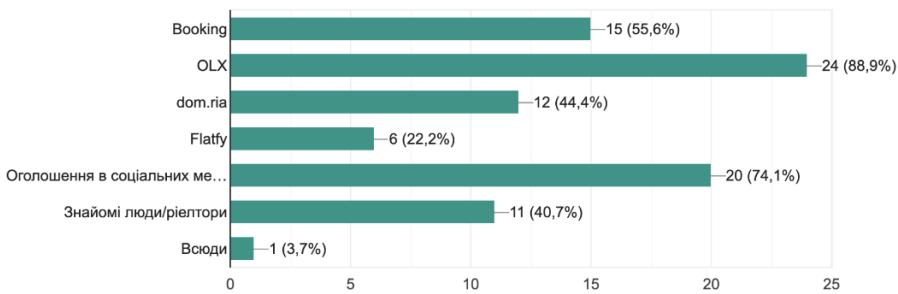
FIGURE 4.6: Survey Renting Services Preferences

separate field where they could specify their own option, but no one took advantage of this. So, looking at the options, you can see that about 75 percent of people need more offerings filtering. This is understandable because on olx.ua you can just get lost without the ability to weed out irrelevant results (see Figure 4.7). The next most popular option chosen by six out of ten respondents was the "owner and user feedback system", which should solve the acute problem of fraudsters and unscrupulous owners. The next three options: "Panoramic photos of the apartment", "Schedule of changes in the price of each home" and "Current information on possible rental terms", all received the same amount of support from users, which accounted for about half of all votes. This can be explained by the fact that users were interested in finding long-term rent for adequate funds. They also wanted to be able to choose housing without visiting in person, as many users sought housing while traveling for several days after leaving their city. There was also a lot of support for an interactive map to help people choose housing with visual cues, and this option received forty percent of responses. As for the design option and the ability to add to "Favorites", users have not shown much interest.

Що Вам подобається у веб сервісах з пошуку житла? (у варіанті "Інше" можете зазначити Ваші
варіанти відповіді)

27 відповідей
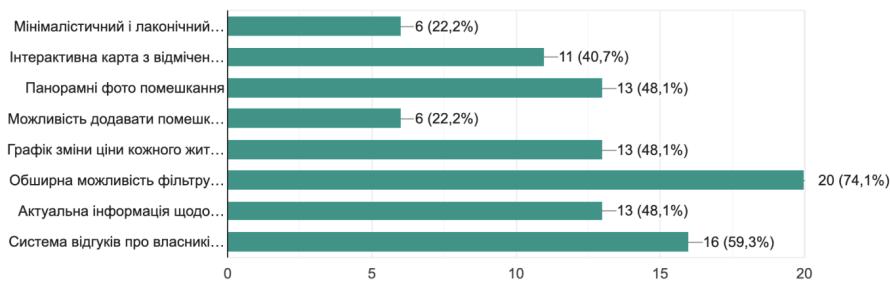
FIGURE 4.7: Survey Preferences in Functionality of the Website

After analyzing the survey, we are ready to create an image of our end user. All the information obtained allows us to avoid creating proto-personas as a separate step, because we already have enough information to highlight the types of our users. That's why we singled out four proto-personas and filled them with information from the questionnaire. This is the reason they resemble real life personas

as closely as possible. The questionnaire also allowed us to add realistic Jobs to Be Done.

Now we can consider four personas we were able to identify after the study and the survey:

1. **Maksym, 21-30y.o.**

   - *Gender:* Male
   - *City:* Kyiv
   - *Language:* Ukrainian
   - *Gadgets:* Mobile phone and computer
   - *Web browser:* Google Chrome
   - *Motive of relocation:* He worried about his own life and health because of the war
   - *Goal:* Get used to and organize life in new conditions
   - *Risks:* Inflated prices, lack of real offerings, deception from realtors
   - *JTBD:* When I find myself in a new city, I want to quickly find an apartment for adequate money, so as not to overpay looters and have a place to spend the night

2. **Mykhailo, 41-50y.o.**

   - *Gender:* Male
   - *City:* Kyiv
   - *Language:* Ukrainian
   - *Gadgets:* Tablet and computer
   - *Web browser:* Microsoft Edge
   - *Motive of relocation:* He saved himself and his loved ones from the war
   - *Goal:* Get to the western regions and start living there
   - *Risks:* The small number of offerings, high prices, the process of finding housing with the necessary conditions takes a long time in such difficult conditions
   - *JTBD:* When I look for housing in a new city, I want to find housing with the necessary infrastructure around so that me and my family can feel comfortable

3. **Solomia, >21y.o.**

   - *Gender:* Female
   - *City:* Cherkasy
   - *Language:* Ukrainian and russian
   - *Gadgets:* Computer
   - *Web browser:* Safari
   - *Motive of relocation:* She worried about her own life and health because of the war
   - *Goal:* Get to the western regions and start living there
   - *Risks:* Deception from the owner, prepayment, inflated prices

- *JTBD:* When I come to a new city, I want to find shelter or cheap housing so I can feel safe and comfortable and not be deceived

4. **Ivanka, 31-40y.o.**

  - *Gender:* Female
  - *City:* Kharkiv
  - *Language:* russian
  - *Gadgets:* Mobile phone, tablet and computer
  - *Web browser:* Google Chrome
  - *Motive of relocation:* She saved herself and her loved ones from the war
  - *Goal:* Run away from the aggressive offensive and settle in a new city
  - *Risks:* Bad description of housing, false photos of apartments, deception by the owner
  - *JTBD:* When I travel to Lviv for a few days, I want to quickly find housing with the necessary parameters so I can make my family comfortable to live

4.5   Usability Scenarios Development

The final step before moving on to creating our own design, sketches and wireframes is to analyze the competitor's product. As previously mentioned, our biggest opponent is the site dom.ria, where we will conduct usability testing. The essence of this test is to identify problems in the functionality that is already embedded in the site and find out what difficulties users experience, how they envision solutions to these problems or what improvements they can offer themselves. This step will prevent these problems in the course of creating our own prototype and making the design more customer-friendly, which will give an advantage in the rental market.

Now, let's move on to developing the test scenario itself. Since one of the fields of the survey was "Are you ready to share contacts for further assistance in the study", we managed to get several contacts of people, from which the proto-personas and personas emerged directly. Although such tests mostly require a larger number of respondents, detailed tasks can compromise the lack of people.

The wording of Jobs to Be Done for all respondents was the basis for the development of test tasks, as this can be considered the main purpose for which the users visit the site. In general, you can see the trend that these JTBDs are often repeated and users do not have a lengthy list of needs for using the service (e.g. finding shelter or daily rent). Also, in the formation of the tasks for usability testing, we used insights from the responses to the survey and personal stories of respondents. We managed to identify 6 tasks (see Table 4.1), with a goal and initial conditions formed for each, as well as the evaluation metrics.

	Task text	Task goal
1	You need to find free shelter in Lviv on the dom.ria website	Check out the possibility of finding free shelters on the site
2	You need to find an apartment in Lviv that can be rented for one day on the website dom.ria	Check the convenience of finding apartments for daily rent
3	You need to find an apartment in Lviv which is located on the 1st floor and costs less than UAH 15,000	Check the convenience of finding apartments with filtration
4	You need to find an apartment in Lviv and add it to your favorites. Then view it in your list of selected apartments	Check the convenience of adding apartments to favorites
5	You need to find an apartment in Lviv which is located in the city center	Check the convenience of finding apartments on the map
6	You need to find any apartment in Lviv and leave a review about the owner or ad	Check the convenience of evaluating the apartment

TABLE 4.1: Competitor Usability Scenarios

4.6 Competitors' Product Usability Testing

Having formed the tasks for our respondents, we are ready to start testing. As mentioned earlier, we managed to get some answers from users who left their contacts for further cooperation, and turned to them for usability testing of the site dom.ria. There was an opportunity to conduct this test with three people, namely Roman from Kyiv, Oleg from Cherkasy and Oleksandra from Kharkiv, all of whom now live in the Lviv region and were forced to leave their homes due to the war for the safety of themselves and their families. They all looked for housing in different ways and visited many rental sites, some of them even had experience with the service of this company. But as we can see later, not all of the tasks were successfully completed (see Table 4.2).

Let's start with the first task. The site dom.ria includes functionality for finding free housing, but it is not so easy to do because the main page does not offer a link to the page with shelters. This is also confirmed by the test results, as only one respondent was able to complete the task without prompts, but none were able to complete the task perfectly - the users explored almost all of the functionality until they could find the right one.

Users handled well with the second task, but after the interview, respondents said that they were able to complete it only with the help of the first task. Daily rent is marked on the main page in a separate menu and if the user does not explore it, he / she will not learn about this "hidden" functionality.

The third task seemed difficult for users due to the need of filtering by the price and floor. Although users quickly figured out where to look for filters, one of the respondents did not see the required filters and opened the extended menu. Also, everyone made a mistake in the filter with the indication of the floor.

Everyone coped with the next task very quickly and almost without mistakes, because with the addition of offerings to "Favorites", most people were familiar before using social networks and other sites.

The penultimate task for users turned out to be the most difficult, because we asked people from other regions of Ukraine to find an apartment in a foreign city. Although there was no "downtown" tag in the extended menu, many users searched for it on the site, which is why not everyone was able to complete the task. However, there were two ways to look for an apartment correctly - on the map and indicate the distance in kilometers. One person suggested that Taras Shevchenko Street was in the downtown, and although he was right, he did not succeed.

The final task was to test the ability to leave feedback on owners and offerings, because in the SWOT analysis of competitors, the issue of fraud was the most common. This task turned out to be impossible to perform without prompts, because this feature is not visually distinguished and all respondents simply scrolled through it.

Summing up the results, we can see that users have successfully coped only with adding offerings to "Favorites" because this feature is intuitive and simple. It is difficult to say the same with all the other tasks, which is why we understand what we need to work on and what needs to be improved.

	Task text	Average time	Average num. of errors
1	You need to find free shelter in Lviv on the dom.ria website	110 seconds	1.7
2	You need to find an apartment in Lviv that can be rented for one day on the website dom.ria	30 seconds	0
3	You need to find an apartment in Lviv which is located on the 1st floor and costs less than UAH 15,000	80 second	1.3
4	You need to find an apartment in Lviv and add it to your favorites. Then view it in your list of selected apartments	30 seconds	0.3
5	You need to find an apartment in Lviv which is located in the city center	170 second	2.7
6	You need to find apartment in Lviv and leave a review about the owner or ad	80 second	1

TABLE 4.2: Competitor Usability Testing Results

Chapter 5

Prototype

This chapter will provide an understanding of how the prototype of our service was built step by step. First, we should start with the creation of informational architecture, which organizes and structures content of the websites. Next, by creating wireframes of individual functional pages of our service, we can imagine the conditional blueprint of what the result will look like. Also, tasks for testing our prototype, the prototype itself and usability testing will be developed to check whether we have achieved the desired goals and improvements. Finally, requirements documentation will be developed for the future full-fledged development of this site.

5.1 Information Architecture Development

After we have analyzed our competitors and learned all their strengths and weaknesses, as well as forming our end users, we are ready to move on to creating our own prototype. Through the analysis of competitors and usability testing of one of them, we learned that the services of competitors work well and it is worth adopting their ideas and solutions, and learned what problems users had using their site. Also, after surveying people with Google forms, we learned the wishes of our respondents and what improvements they would like to see. All these "ideas" allow us to create a better, more thoughtful and functional version of the site that will take precedence over other rental services.

So, we need to start creating a prototype by structuring our website, namely to start creating informational architecture. Designers and developers are responsible for building content and navigation systems that match the perception of the users. IA starts with people and the reason they come to your site or use your app: they have an information you need [6]. Creating an IA consists of several steps and the subsequent visualization (see Figure 5.1):

1. *Group and label the content* - First, we create a list of all of our content, prioritize it, and group it. We use a card sorting technique to group the content. Ultimately, group names can be narrowed down to menus and sitemaps.

2. *Define navigation and create site map* - Then we get the content and create meaningful groups. The information architecture, which is not really visible to the visitor, represents the backbone of the website and can be visually represented in spreadsheets and various types of diagrams, called a site map.

3. *Visualize and test with users* - This step is based on wireframes and is described in the next section.
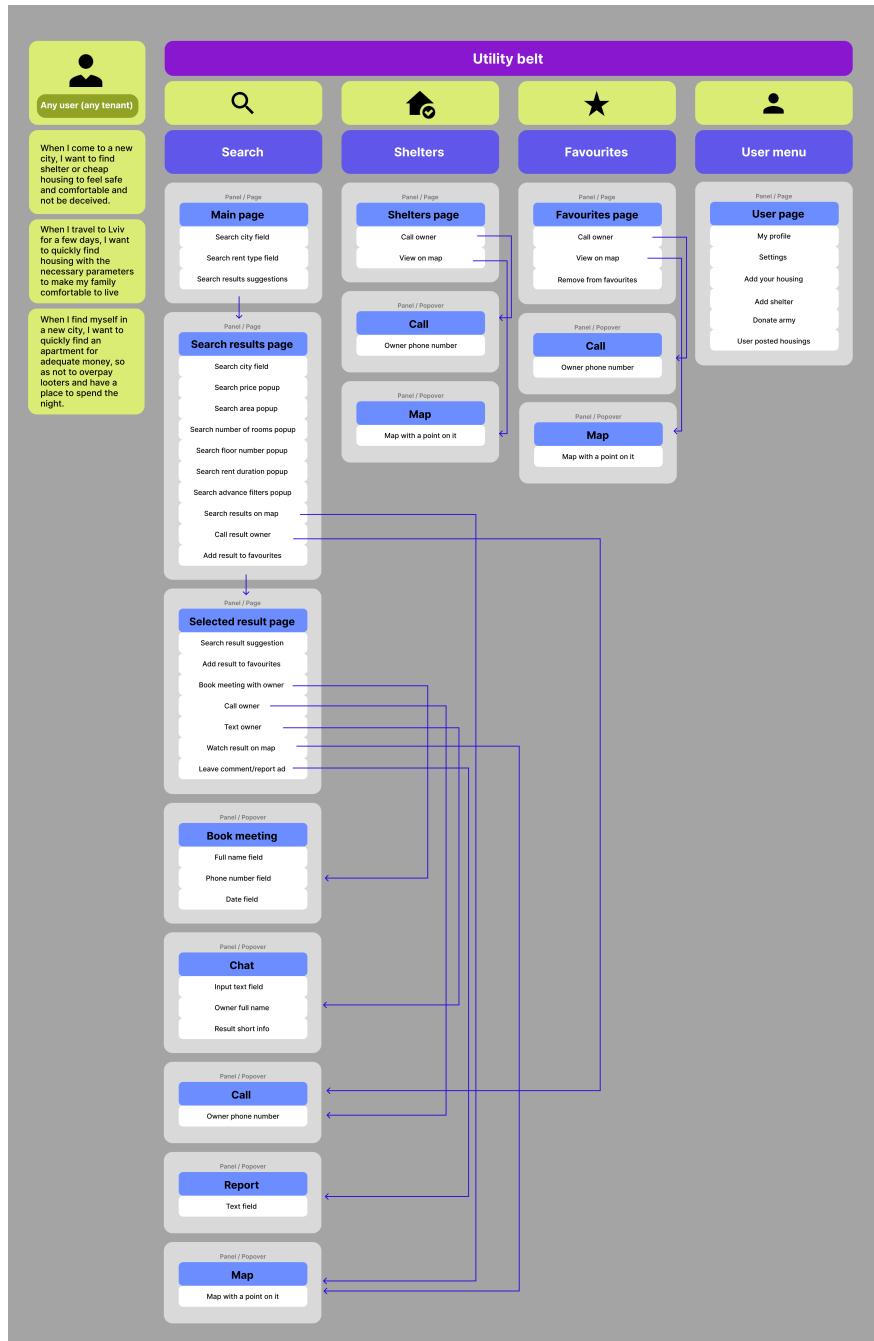
FIGURE 5.1: Information Architecture of Prototype

5.2 Wireframes

All these ideas and decisions from IA were drawn as sketches, a kind of generalization of our vision. So, as mentioned earlier, we are not innovators in this market and we are not coming up with a new unique service that has no analogues. Since we already have many competitors who were able to test and shape their service prior to us, we will take the overall appearance from their product. Each individual competitor had some advantages over others, and our task was to combine the most successful solutions in symbiosis with unresolved issues that we wanted to solve. The structure of the pages on search, type of housing and other pages, although not perfect according to the results of surveys, but it contains elements with the correct positioning and functionality. After looking at the infrastructure of the sites dom.ria, flatfy.ua and their analogues, we managed to identify which pages are needed in our prototype and we first started to sketch them:

- *Main page* - the page that the user first sees when he visits our site. Competitors had a problem with the fact that some of the functionality for which users accessed the service was not displayed on the home page and users wandered until they could find it.

- *Available options page* - a page that gives users results on their query. The analogues had a problem with the filtering system and as we were able to find out, the services that allow you to view the apartment on the map help the user to visually find an apartment in a new and unknown city.

- *Selected option page* - page showing the option the user liked from the offered ones. There are a lot of ideas for this page, including the possibility to book an overview of the apartment, tags that would allow the user to quickly understand the main aspects of the apartment, the ability to complain about offerings, reviews from real people, etc.

- *Shelters page* - a page that users can go to right from the home page and find free shelters. In other services, this option was simply absent.

- *Liked options page* - a page with the apartments liked by the user. This page is not our advantage because our competitors also have it and it works as it is supposed to.

- *Person page* - homeowner's page where you can view own offerings, settings, etc. This page was designed for completeness of service and future implementation, so far it is like a stub not to confuse the users.

- *Chat pop-up* - screen that will appear when the user tries to contact the owner of the offering. Not all competitors provide this option, although this feature is mandatory.

- *Report option pop-up* - screen that will appear when a user tries to complain about the owner or the offering. As we have learned from a survey and analysis of our users, the issue of deception and dishonesty of homeowners is very acute and not all services can fight fraud. This feature allows you to collect user feedback on the apartment and prevent fraud, if any.

- *Book meeting pop-up* - screen that will appear when the user tries to book an overview of the apartment. We have not seen such functionality in our competitors, but we consider it appropriate. As we learned from personal stories

during the survey, many people spent several days trying to get to the western regions of Ukraine and tried to find housing on the way. This simple feature allows users to book a meeting with the owner to immediately initiate the process of negotiations and subsequent rental of the apartment. It also gives the owners an advantage and shows interested in housing users.

Once the structural component of the site has been approved and the basic layout of the prototyping pages has been sketched out, we are ready to work on a more detailed appearance of our site, namely, the creation of wireframes. To do this, we chose a tool such as Figma because it is quite simple to use with the help of geometric objects, colors and text. All the wireframes described above can be viewed on GitHub. Here, we will consider the most critical and important ones.

We start with the wireframe of our homepage, which is the first page users see when visiting our service (see Figure 5.2).

FIGURE 5.2: Wireframe of Main Page

At first glance, what distinguishes our site from the competitor's site is a map that shows available accommodation in the selected city. In general, we do not expect the user to simply select the accommodation on the map without setting filters, but instead to view all available accommodation in the area of the map where he wishes. The next important feature that users often turn to for rent-seeking sites is finding shelters. While competitors either did not develop such a feature at all or added it as dom.ria in obscure places, we decided that this feature should meet the user on the main page. Also, in our opinion, the page with shelters should come as a separate page, not a filter in the usual search for rental housing. The next important feature contained on the main page is the hot offers, which in terms of the number of views, price-performance ratio and area are the best options, which users might be immediately interested in.

As already mentioned, a huge number of people went to the sites of competitors and had one goal - to find shelter or cheap housing in a completely new city for them. The locals were well aware of which schools / gyms / premises had been converted into shelters, but the displaced did not have such information and tried to find a safe place to sleep. That's why we decided that the site should contain this information and so we created this page (see Figure 5.3).
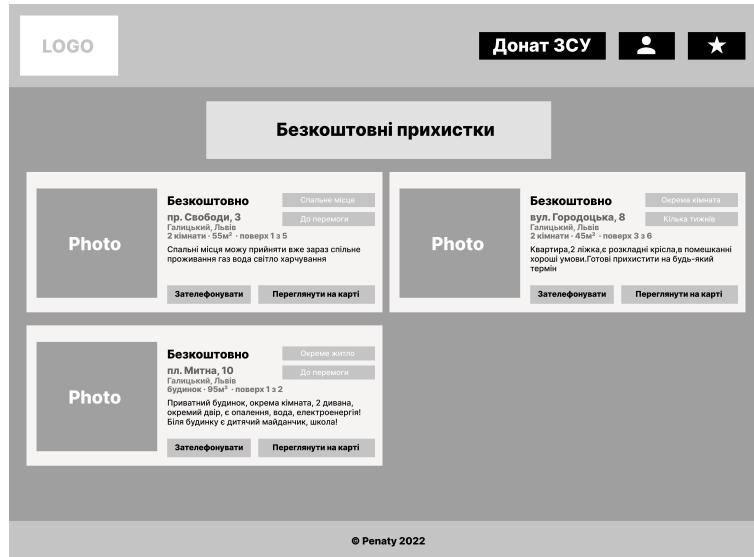
FIGURE 5.3: Wireframe of Shelters Page

In our view, this page should look like a list of available "cards" with information about free shelters because the question of the map is not very acute here - in this situation, people are just looking for shelter, not choosing an apartment in a particular area. The general appearance of options is the same as for ordinary rental housing, except that there is no price. Still, such important information as address, city area, shelter area, floor and a brief description of the shelter are preserved because this information is crucial when finding shelter. An important feature that is designed specifically for shelters are tags that allow you to quickly understand whether it suits you or not. The first tag is about the type of apartment, and users can choose between a separate home, a separate room and a bed. The second tag is also quite defining and it refers to the period of time for which a person can be allocated a free apartment. For users, there is a choice between "a few days", "a few weeks" and "to the victory". The functionality of these options is limited, and it is not possible to open the shelter as a separate page. This is a reason why the additional necessary functionality for the shelter "card" was developed, namely, "View on the map" and "Call". With these two buttons, a person can find out exactly where this shelter is and the opportunity to immediately call to ask if there is still a vacancy.

The next page that most users will go to after clicking the "Search" button on the main page is the search results for available accommodation options on request in Lviv. When creating it, we were inspired by the best solutions of our competitors, took the most necessary things and combined them, which should result in a functional and user-friendly solution. So you can identify three main components of this page - a map, a list of available options and a tab with filtering (see Figure 5.4).

As we have seen, in conducting usability testing of a competitor, some tasks could not be completed quickly or at all, which led to the development of a separate system of filtration with all the necessary parameters and tags. The first possible
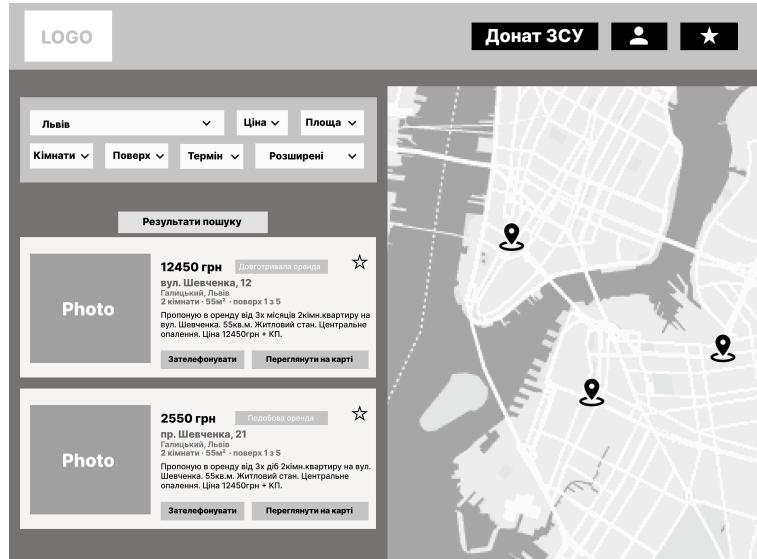
FIGURE 5.4: Wireframe of Available Options age

filtering available to the user will be filtering by the name of the city, in which the user would like to rent a home. The next parameter for filtering is not new - price filtering. The operation of this filter is quite simple, the user can set the minimum and maximum price in UAH. There are two more filters that work very similar to price filtering, namely, the filter "floor" and "total area" of the apartment, where the user also specifies the minimum and maximum limit. However, in the floor filter, we removed the parameter "Number of floors in the house", which only interferes the users from their task. The next important parameter is the number of rooms. The filtering of this parameter works like radio buttons, where the user can easily choose from the predefined one-, two-, three- and four+ rooms parameter. The user can filter the lease term, if he needs an apartment for a few days, or choose a long-term lease. The final filtering feature is called "Advanced", and it contains all the necessary tags that users can search for when choosing a home in a city unknown to them. Often users are looking for housing on such parameters as "In the city center", "Near the school" and "Near public transport", which can be crucial when choosing housing. The next component of the page is a list of available apartments, which is familiar to us from the page with shelters, which in appearance do not differ much. Out of the functional differences, it is only possible to add an apartment to the "favorites" and then view it later. The last component is a map, which shows the available apartments for rent, which we will try to implement in the prototype.

Let's move on to the final wireframe, which the user gets to if he / she is interested in the apartment and wants to know more about it. Specifically, this is a separate page for an available apartment information (see Figure 5.5).

So, starting from the structure of this page, we can see that the upper right corner contains all the necessary information, which is also displayed in the apartment card when viewing the results page. The button that allows you to add an apartment to "favorites" is also present here. Below this information about the offering is a button that allows you to immediately order a tour of the apartment with the owner and thus avoid calls to "inquire". When you click this button, a pop-up window should appear, which contains a small form that you need to fill out - name, phone number and date when it would be convenient for you to inspect the apartment. On the left side, you can see photos of the apartments, which in the future are planned to be
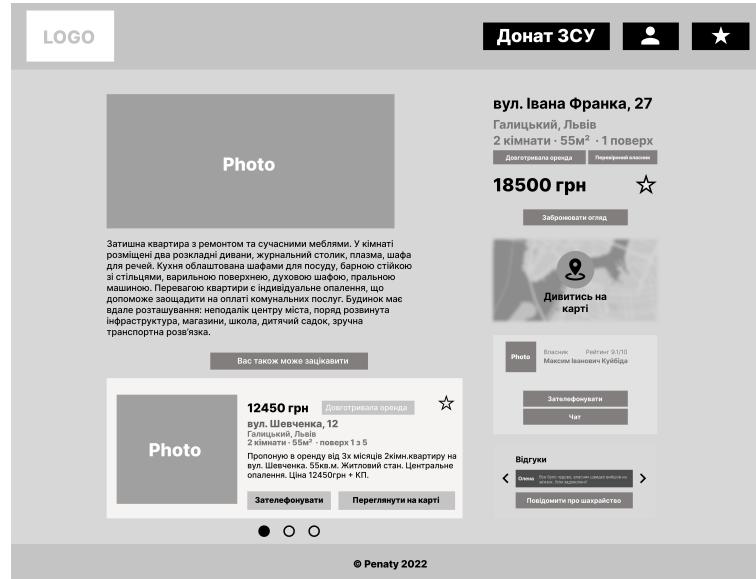
FIGURE 5.5: Wireframe of Selected Option Page

panoramic, which will avoid deception from the owner when the user cheats with what the house looks like. Below the photo is a description of the apartment from the owner. Below the text, the user can find a carousel with other available accommodations, which may also interest him / her. Under the button with the ability to book a tour of the apartment, one can find a large number of important features. Below, there is a tab with information about the owner of the apartment - what is his name, his rating and if users complained about him. You can also immediately call the owner or open a chat window and write to him/her. The final feature on the page are the reviews about the owner and the opportunity to complain if you have information that the owner is not fraudulent. After clicking the "Complain" button, a window will appear with the ability to leave an extensive comment, which our employees will analyze and apply measures to the owner, if necessary.

In summary, all pages contain a number of improvements over other services and now, after creating wireframes, we are ready to move on to the implementation of the prototype. We will need to create tasks to test our Penaty service, implement and host the site and test the service with real people.

5.3 Validation Scenarios Development

In parallel with the development of the prototype, we need to develop a testing scenario for our website to assess whether we have managed to solve the problems of competitors. For the sake of fairness, we take the same tasks, with which we tested the competitor dom.ria. We slightly change the text of the questions, so that in addition to the functionality testes of the competitor service, we added additional features testing. It is going to be tested with the help of the same three respondents and the following questions (see Table 5.1).

Now let's move on to what we expect to see when testing each of the tasks. In the first question, we are interested in how well the button with shelters is located and whether the user will be able to quickly navigate the functionality of the main page.

The next task is based on the ability of users to quickly navigate and find a filter with daily rent on the site.

The third task for the respondents will be to check whether we have managed to simplify and make clearer the system of filtration by price and floor on which the apartment should be located.

Moving on, in the fourth task last time we checked whether all users understood the system of adding apartments to the "favorites" and found that this functionality is intuitive for everyone. Now this task is formulated in the same way, in addition, we want to check the functionality of our "Advanced" parameter in the filter menu and check whether tags such as "next to school" will be functionally understandable to the users.

Last but not least, the penultimate task immediately combines testing of two of our innovations - its advanced filtering options and functionality with booking an overview of the apartment. We expect the user to quickly find the necessary filters and test whether the visually correct button is placed with the possibility of booking.

The final task for users will be to test the ability to leave feedback on the offering or owner. This feature was hidden on the competitors' website, and the users often went to the owner's page, which did not allow them to leave feedback. We have placed this button immediately under the feedback menu and we want to check whether this placement will allow users not to get lost in the search for the necessary functionality.

	Task text	Task goal
1	You need to find free shelter in Lviv on the prototype website	Check out the convenience of finding free shelters on the site
2	You need to find an apartment in Lviv that can be rented for one day on the prototype website	Check the convenience of finding apartments for daily rent
3	You need to find an apartment in Lviv which is located on the 1st floor and costs less than UAH 20,000	Check the convenience of finding apartments with filtration
4	You need to find an apartment in Lviv located near school and add it to your favorites. Then view it in your list of selected apartments	Check the convenience of adding apartments to favorites
5	You need to find an apartment in Lviv which is located in the city center and book a meeting with the owner	Check the convenience of finding apartments on the map and booking meeting with owner
6	You need to find any apartment in Lviv and leave a review about the owner or ad	Check the convenience of evaluating the apartment

TABLE 5.1: Prototype Usability Scenarios

5.4   Application Prototype

At this stage, having compiled IA and created wireframes based on them, we are ready to create a more realistic visualization of our ideas. Now, we start to create a prototype, but as we noted earlier in this work, we will not make a working prototype in the figure, but will create a more or less full-fledged website. This will allow the user to fully experience the use of the site during usability testing.

So let's start creating a website by determining the technical stack for it. The easiest way to create a prototype is to layout the necessary pages using HTML and stylize the components using CSS. At first, we also wanted to, but this approach to the creation of the prototype deprives it of "interactivity". In our case, the purpose of this thesis was not the visual appearance of the site, because we did not create a UI but a UX interface. Let's move on to the technical stack we have chosen and later justify their choice in more detail:

- **Javascript framework:** Vue.js

- **Server-Side Rendering framework:** Nuxt.js

- **Vue.js data management library:** Vuex

- **CSS framework:** Tailwind

- **UI elements library:** Element UI

Our first step was to choose a JavaScript framework, because this is the basis on which we will create our prototype. To begin with, it is worth explaining why we need a framework, because you can try to create a prototype without it. You need to understand that creating everything from scratch is very difficult, and one way or another with the help of ready-made libraries and a little code you can create something "working". After all, each framework already contains a built-in structure of your application and allows you to use already collected libraries, so from the beginning you already have a ready-made structure and setup to create your product. As much as we would like to simplify the service of finding housing, but the user interface itself is essentially complex. Therefore, we had to choose from such frameworks as Vue, React, or Angular. While they are all good choices, Vue has several significant benefits, such as a few simple steps you can quickly add this framework to your project. Another important plus is that each part of your web page is a component in Vue. These components can be written in CSS, JavaScript, and HTML without having to break them down into separate files. The ease of creating the site contributed to our choice, the project uses Vue2.

Next, I would like to talk about the Nuxt.js framework, which simplifies the creation of one-page or universal sites on Vue and works as an add-on to it. This framework gives us a huge number of useful features, because when you install Nuxt, you immediately provide a project structure that consists of four components:

- *Components* - includes our Vue components, such as AppFooter and AppHeader

- *Layouts* - includes our page layouts

- *Pages* - includes all pages of our website

- *Store* - includes Vuex files, which are our "database"

Apart from the fact that this structure is convenient and shares our code, there are also huge advantages in these components. So, first of all, programmers know that the important issue in creating sites is setting up routes, and Nuxt does it for us. Nuxt reads files inside the Pages directory, generates HTML for each file and builds the web application router. The next important component is the Store, because it contains all our Vuex files. Vuex is a data management library that is installed together with Nuxt and, in our case, will serve as a database. All information about apartments and shelters we will store with it and the functionality of this library allows you to call the necessary array of information anywhere in the code.

The last thing I want to mention in terms of technical stack is stylization. Let's start with Tailwind CSS, which allows you to style HTML code much faster. Since our goal is to create a functional prototype and not a "visually beautiful" solution, this framework suits us despite its limited capabilities compared to writing a pure CSS. Lastly, we have a library of UI elements that allows us not to create shapes, buttons, layouts and other visual structures ourselves, but to use ready-made ones that are very easy to style and add to your code.

Now let's move on to what we managed to create within our prototype. Consider the same four pages that were presented in the wireframes section, but many things such as pop-ups or forms you can see by going to the site of our prototype which we hosted on Netlify[1].
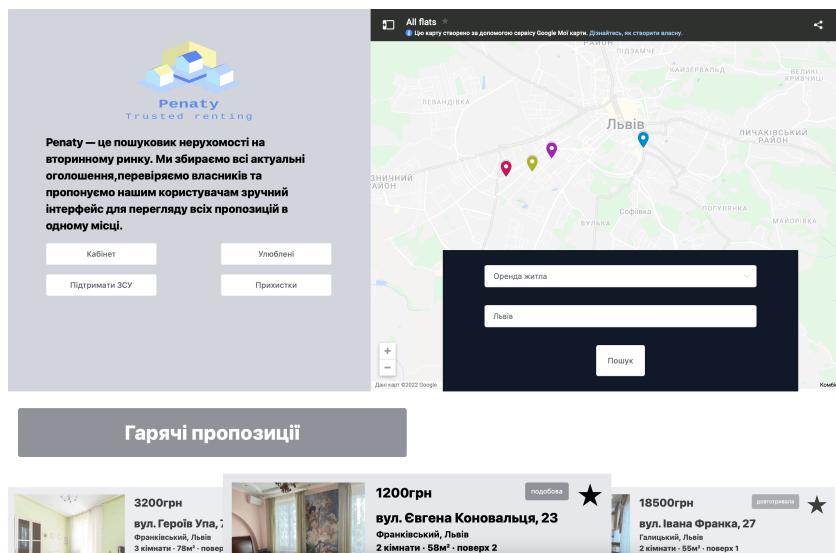

FIGURE 5.6: Prototype of Main Page

So let's start with the first page that users will see for the first time using our service (see Figure 5.6). First of all, a map is catchy, which is intended to provides the user with such functionality as "hot deals". Since this is only a prototype and this feature we will not test in our study, this map was created by us with the help of Google services and this applies to all other maps that are in this prototype. This page also contains several buttons that serve as links to other pages and to the site where you can help the Ukrainian army. The last item on this page is a carousel with apartment options, which allows the user to immediately view the proposed accommodation, and it is worth noting that the carousel and buttons we took from the Element UI library.

[1]https://coruscating-axolotl-72e7a8.netlify.app/
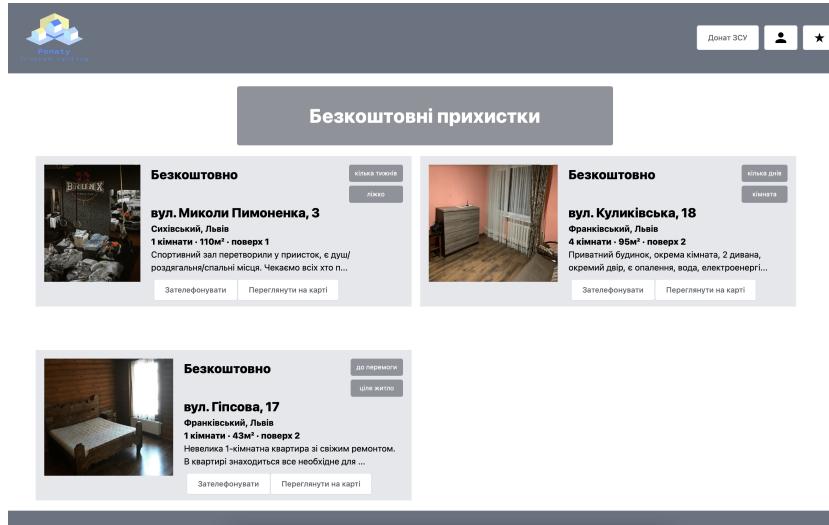
FIGURE 5.7: Prototype of Shelters Page

The next page is the page with shelters (see Figure 5.7), which we highlight separately and do not add to the regular search page. The functionality of this page is very simple, each "card" is not clickable, because in this case, users do not need more detailed information and photos. In our opinion, they are looking for shelter quickly and in difficult conditions, so here was added a function with a phone number for quick contact with the owner and a map so that the user can quickly find where exactly this apartment is located. Tags have also been added for the period for which you can be given shelter and sleeping conditions, which is sufficient minimum information to search.
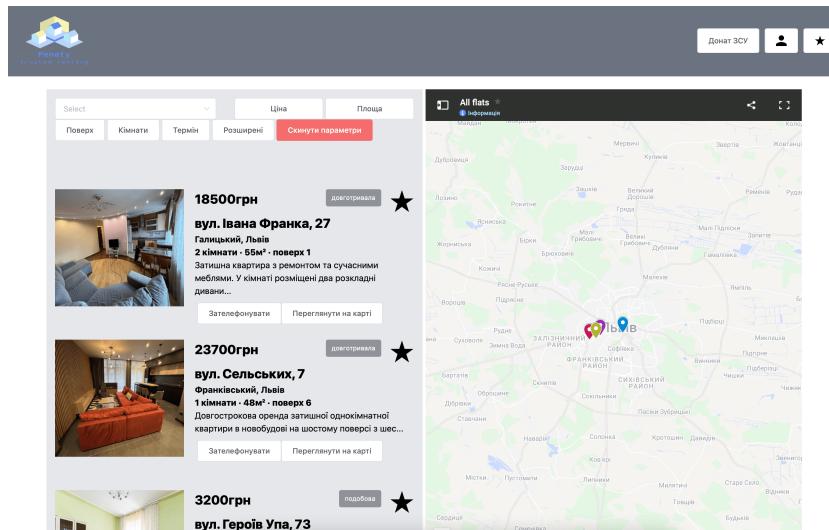

FIGURE 5.8: Prototype of Available Options page

The next page is a results page (see Figure 5.8), the functionality of which is usually used in similar services. The most important feature on this page is the filtering of available options, with which users have problems using other web services. From testing, we learned that users would like to be able to apply filters only after clicking the "apply" button, so it was necessary to add functionality to reset the specified filters. In addition, users can add the offering they like best to their "Favorites",

and then view it on a separate page, which can be accessed using the button in the page header.

In conclusion, we turn to the most elaborate and functional page, which is the page with the apartment information. Here we used such elements from the UI library as form and notification, as well as the already familiar carousel with the recommended options. There is also a function with chat, phone and feedback, which also looks like a pop-up and allows you to immediately contact or complain about the owner on the same page.
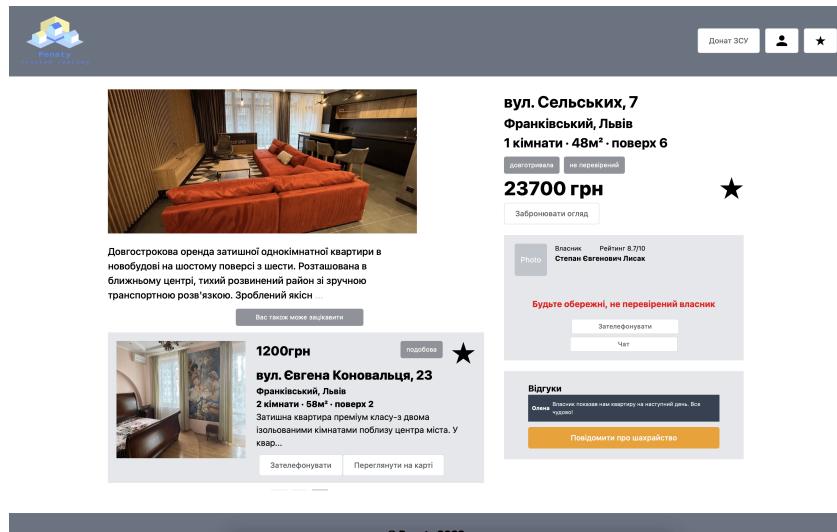

FIGURE 5.9: Prototype of Selected Option Page

5.5 Validation Usability Testing

Having created a prototype, we can not call the work complete because the purpose of it was to understand whether we managed to develop a better user interface than other services. It is important for us whether people will avoid the difficulties they had in the past and when testing our competitor. However, I would like to note that the most important aspect in the design and creation of the prototype for us was the functionality and user flow, not the selection of colors and font. Stylization of the site and creation of identity is a further step. So, the testing of our product was attended by the same three participants who responded to the validation of our competitor's product and they showed much better results (see Table 5.2).

Regarding the first task, all three participants were able to instantly and unmistakably find a button with shelters on the main page and that's where it should be. After all, as we saw in the service of our competitor, not all users are able to quickly find this feature if it is on the results page.

Users also managed the second task as quickly as in the previous test, but now, one of the users made a mistake and was distracted by the tags we added to the options and started looking for the apartments for daily rent with their help, not with filters. This is not a wrong approach, but we did not expect it, so we think it will be worth rethinking these tags in the future.

With the third task, users coped almost twice as fast and made half as many errors when using filters, which allows us to conclude that we were able to help users filter available options. Among the errors, one of the users during the price

filtering decided to specify the minimum price as well. The second mistake is related to the application of filters because, in the previous test, one of the users offered to remove the automatic application of filters and wanted to see it as a button. We added his wishes, but another user was not ready for this and just forgot to apply filters, although he opened them. In the future, we plan to convert to automatic filtering after each parameter is entered by a person.

As for the next task, we were not very surprised by the results because the users coped with it quite well in testing the competitor. Functionality with the addition of options to favorites is intuitive to virtually all participants in the experiment.

The penultimate task impressed us the most, because despite the fact that we asked users to book an apartment in the downtown and book a meeting, they completed it about twice as fast and made 5 times fewer mistakes. The mistake is made by the user who first wanted to view the location of the apartment, but so far the map is not interactive. Although, this is a good signal that the map needs to be researched to improve the user experience.

With the final task, users all coped successfully and were able to quickly find and use the necessary functionality, which reduced the execution duration by four times. In previous testing, this feature was visually hidden and did not catch the eye of users, so they could not do it without a hint.

	Task text	Average time	Average num. of errors
1	You need to find free shelter in Lviv on the prototype website	15 seconds	0
2	You need to find an apartment in Lviv that can be rented for one day on the prototype website	30 seconds	0.4
3	You need to find an apartment in Lviv which is located on the 1st floor and costs less than UAH 20,000	55 second	0.7
4	You need to find an apartment in Lviv located near school and add it to your favorites. Then view it in your list of selected apartments	30 seconds	0
5	You need to find an apartment in Lviv which is located in the city center and book a meeting with the owner	90 second	0.4
6	You need to find any apartment in Lviv and leave a review about the owner or ad	20 second	0

TABLE 5.2: Prototype Usability Testing Results

Summing up, looking at the test results of our prototype and the site dom.ria we can say that, in fact, in all tasks (except where you had to add an apartment to your

favorites) all users showed better results in terms of time and number of errors. It is safe to say that we have managed to improve the experience of users in the use of housing services and bring them closer to successfully finding a roof over their heads. After testing, people were asked what they liked most and the following key aspects can be identified:

1. Users really liked the functionality with booking a review of apartments because they have not seen anything like it in any of the popular services and consider it necessary

2. Users noted that the page with shelters became possible to find much faster

3. Users noted that filtering is very convenient, although it is worth removing this "Apply" button, and suggested adding more tags to the "Advanced" option because of the easement they provide

5.6   Requirements Documentation Development

We've already drawn wireframes, created a prototype and tested our prototype with real people, and it would seem that we can move on to summarizing. However, there is another "final" step that can really be considered the last in this work, namely to summarize with the help of our product documentation. Now we mean the creation of a document that will contain the purpose of the product, its functionality, features and behavior - product requirements document (further abbreviated as PRD). As the launch of any product is quite complex and requires careful planning and analysis, this document is essentially the first step towards the implementation of a full-fledged service. Creating a PRD gives you the opportunity to share it with stakeholders and a team of technicians, and with them to analyze it and begin to create, promote and monetize your idea.

According to Ben Horowitz and David Weiden, they mention that "Good product managers think their Product Requirements Document (PRD) is a big deal. The PRD is the single most important document the product manager maintains and in most cases should be the definitive source of direction from marketing to engineering. Good product managers view the entire PRD as a living ongoing process (engineering has new questions, market conditions change, etc.). If anything changes in the PRD, a good product manager communicates the change clearly to the entire product team." [7].

As we have seen, the great need is to keep your PRD up to date in order to keep the focus on what is your goal. However, we are not currently considering a revision of the PRD, because in order for this document to always be relevant, it is necessary to maintain the relevance of the tasks to be solved. But we will now create it from the scratch, and in that case our first step will be to define the Product Purpose, namely the analysis of who we do it for, what problems we will solve for these people and the general question "Why do we do it at all?". In this first step, we need to discard all technical and correct jargon and ask more critical and realistic questions: "Why?", "Who cares?", and "So What?". Here are the questions and answers we received in the first step:

Who's it for?

- **Customers** - people who are looking for housing. Now the type of clients in Ukraine has shifted to internally displaced persons who, fleeing the war, are trying to find a roof over their heads for adequate money

- **Property owners** - people that want to get money for people renting their property

Why build it?

- It's something we personally will enjoy using

- This is what people will need now and in the future

- The number of customers in the first days of the war increased to the skies and even after the war, people will begin to move to other regions of Ukraine and the service will always be in demand

- Monetizing opportunities in advertising and/or percent from a deal

- Tech-risk not very high

The next structural element of PRD is the analysis of the features of our product. To provide the engineering team the greatest freedom, features must be expressed in terms of interaction design and user experience. More crucially, features must be mapped to product objectives (known as requirements traceability) so that the business impact of removing a feature during development may be easily understood. As you advance in development, ranking these features will also assist you prioritize in case there are any scheduling changes or you discover that some features need to be replaced. In this question, it is important for us to determine which users we are targeting and determine which functionality will be provided for each of them:

User Types?

1. **Non-Registered Viewers** - people who have not registered yet, but they can nearly fully experience website functionality

2. **Registered Viewers** - people that have registered and can report posts

3. **Registered Owners** - people that have registered and can create posts with their housing to rent

4. **Admins** - people who analyze the reports and work on site maintenance

The third element of this document is to define the criteria for readiness for release. Regarding the functional component, the minimum necessary for readiness to take the beta test is a full-fledged development of functionality for homeowners and setting up chat. Thinking of algorithms of "recommendations" of housing on the basis of the applied filters and the analysis of the prices are already steps which will concern future improvements of the site. In the document on GitHub you can see a list of all future ideas. The next component is the usability of our product and we believe that the completed functionality shown in the prototype for ordinary users will be sufficient for the first release. Next, we will talk about reliability, and since the system still works as a bulletin board with advanced functionality and filtering,

we assume that there may be critical situations when the system may stop working. Of course, this is not pleasant and we would like such situations not to happen, but restoring such a product is not something difficult and long-lasting. The penultimate thing we want to mention is performance, and in our product this parameter is quite critical. When testing competitors, we saw how annoying it is for the user to load the page for a long time, which is why one of the reasons for creating a prototype on Vue.js was that the page from the server returns completely ready and speeds up page rendering in the browser. The last component is supportability, so our product should be able to be tested and in the future it is planned to expand the ability to configure the page through settings so that owners and users can use this service with more pleasure.

For sure, many ideas and features were invented during the brainstorming of this project, and even more will emerge as the market develops and new user needs. And we understand and see that not all of our competitors were able to adapt to the realities of war in Ukraine, their services were simply not ready and to be honest, even the biggest competitor dom.ria added a functionary with shelter after several weeks of war. In addition, currently, they do not have free housing on their site, which is a very sad fact. That is why the final part of PRD is the establishment of constraints and scheduling the expansion of functionality. It is very important to us that the first working version is brought to perfection and is ready for any conditions of the surrounding world. Only then we can proceed to the improvement of our product. Such a work schedule will allow us to respond to changes in the market quickly and confidently, albeit in smaller steps, and always maintain the relevance of our service.

Chapter 6

Conclusion

This chapter will provide a complete overview of what we managed to achieve in this work, what problems have been identified and what further steps can be taken to improve or fully develop this service.

6.1 Results Summary

The problem that we described from the very beginning and the one that gave impetus to the study of this topic can be summarized as follows - to simplify the process of renting an apartment. Of course, the emotional component also played a role here because the difficult situation faced by millions of Ukrainians due to the war, started by russia, causes pain and sympathy for those Ukrainians who were not so involved. The urgency and prevalence of this problem simply screamed about itself and continues to do so after several months, which is why it was interesting for me to explore and try to find a solution to it. Among the goals that were set in the beginning, it was noted that in this work we should analyze and test our competitors, interview people involved in the market - stakeholders, create wireframes and a working prototype of our service and test it with real people. In addition, all the steps we took had to be documented and saved, and you can view all the documents, photos and prototype code on GitHub[1]. As for the study itself, we managed to perform all the stages that we identified and achieve certain results. First, after analyzing the competitors, we identified the largest one and conducted testing, which allowed us to articulate the existing problems more clearly. Next, we worked on the design of our application, after which we created a working prototype that we think solved the difficulties faced by the users. Then, we tested it with people who had experience in finding housing in a difficult time. As we can see, comparing the results of the two tests, we managed to reduce the time of approximately the same tasks (even though we made the prototype testing difficult) and significantly reduced the number of errors that users made. We can assume that the goal we set from the very beginning has been achieved, but there is still a lot ahead of us.

6.2 Future Steps

Although our main goal has been achieved and the prototype has improved the user experience, we have also received user feedback on our solution. They believe our service can be further improved. The first step that would be worthwhile in the future is to conduct the same testing of more competitors with a much larger number of people, so that we can identify more problems and work on their solution. Since

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[1]https://github.com/LebyakMarki/UCU-Bachelor-Thesis

this paper considered more UX than UI, the next step should be to develop a full-fledged design that is not only functionally convenient, but also visually pleasing and understandable. For example, it would be more convenient if such things as chat and apartment booking were not in the form of a pop-up, but rather as a side-bar floating on the screen. We also need to develop an interface for working with the website for owners, because these are also our customers without whom this service would not make sense. So, the same cycle of research we conducted within this thesis should be conducted with this category of users. And of course, the technical part of the service, namely database work, filtering, feedback analysis and logic behind the recommendations should be developed and tested. The company is still far from a full-fledged service, but the first step has always been the most difficult, and we have already done it.

Bibliography

[1] Norman, D., Spencer, E. (2019). *Community-based, Human-Centered Design.*, Paper presented at the 2019 World Government Summit, Dubai, United Arab Emirates. https://jnd.org/community-based-human-centered-design/

[2] Papantoniou B., Trepess D., ... Knemeyer D. *The Glossary of Human Computer Interaction*, https://www.interaction-design.org/literature/book/the-glossary-of-human-computer-interaction

[3] Sarsby A. (2016) *SWOT Analysis*, Lulu.com, pages 3-15

[4] Hamm M. J. (2014) *Wireframing Essentials*, Packt Publishing, pages 5-21

[5] Barnum C. M. (2010) *Usability Testing Essentials: Ready, Set...Test!*, Elsevier Science and Technology, pages 85-94

[6] Rosenfeld L. (2015) *Information Architecture: For the Web and Beyond*, O'Reilly Media, pages 39-41

[7] Horowitz B., Weiden D. (2015) *Good Product Manager/Bad Product Manager*, https://a16z.com/2012/06/15/good-product-managerbad-product-manager/