Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Information Technologies

Bachelor Thesis

Mobile application for students - design and prototype

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Doszhan Kambarov

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Thesis title

Mobile application for students – design and prototype

Objectives of thesis

The main objective of the thesis is to design and prototype a student's guide as mobile application. The thesis has following partial goals:
- To make a current literature review of public electronic services;
- To design and prototype mobile application that will serve as a student's guide;
- To evaluate and compare proposed mobile application.

Methodology

The methodology of the research work is based on the literature review in domains of e-government, online public services and mobile application development. In the practical part, a proposal of new mobile application serving as online service provided by a higher education institution will be developed by using latest software development methods and tools. The practical recommendation and conclusion will be formulated and presented further.

The proposed extent of the thesis

30 – 40 pages

Keywords

Information technology, prototyping, mobile application development.

Recommended information sources

Cordova Apache Documentation. Documentation – Cordova Apache [online]. USA: Cordova Apache, 2016 [cit. 2016-06-15]. Dostupné z: https://cordova.apache.org/docs/en/latest/

Designing Mobile Apps – Tips And Techniques, Smashing Media GmbH, Freiburg 2013. ISBN: 3944540239

MCWHERTER, Jeff. Professional mobile application development. Indianapolis, Ind.: Wiley, 2012.

PhoneGap Documentation. PhoneGap [online]. USA: PhoneGap, 2015 [cit. 2016-06-15]. Dostupné z: http://docs.phonegap.com/

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Declaration

I declare that I have worked on my bachelor thesis titled "Electronic public services: mobile application development" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on March 15, 2017 _____

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Mobilní aplikace pro studenty - design a prototyp

Souhrn

Hlavní cíl mě bakalářské pravé je vytvořit mobilní aplikaci pro vysoké školy, aby zlepšily svoje on-line servisy.

Předmětem výzkumu byla telefonická zatížení s IOSem a Androidem, nástroje pro modelování mobilních aplikaci, oficiální mobilní aplikace CZU "Moje CZU". Teoretická informace ve výzkumu se týká e-servisů, rozvoje mobilní aplikace, modelování rozhraní.

Klíčová slova: mobilní aplikace, e-servis, modelování rozhraní, rozhraní pro uživatele, rozvoj aplikace

Mobile application for students - design and prototype

Summary

The main purpose of the bachelor's degree work is to develop mobile application for higher education institution to improve its online services.

The Object of research were mobile device operating systems IOS and Android, tools for prototyping of mobile application, official mobile application of CULS "Moje CZU". Theoretical information of research were the e-services, mobile application development, interface prototyping.

Keywords: mobile application, e-service, interface prototyping, user interface, application development

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1 Introduction

The beginning of twenty first century became the time of analysis. The objects of the analysis are boundless opportunities provided by Information and Communication technologies in all walks of life. Modern achievements in the development of global Information and Communication technologies (Internet technologies) led to the prompt growth of such economic activity, as "Public electronic services".

Spreading and expanding the range of services, public e-services (short for electronic service) become the integration instrument of individuals, entities, industries, public institutions and states into united community. An interaction processes within the ——-– integrated community are effectively and freely realized by means of Information and Telecommunication. Application of modern Information technologies and systems of communications (electronic data exchange, the Internet, e-mail, electronic payments) is capable to lift all aspects of public service provision on qualitatively new level.

Further development of electronic services and expansion of a sphere of its influence are followed by positive changes in social and economic well-being of the societies. There are some examples of the results: first of all, higher quality of service channels, operative receipt of information, inspectability and efficiency, activity of population involvement, reduce in direct and indirect costs, etc.

Nowadays, the topic of automotisation of routine procedures are exetremely actual. In modern conditions, questions of assistance to broader access to the international electronic services often pass into the category of priority. Elimination of any possible manual mistakes by succesful implementation of e-service technologies is fact, which is admitted by the majority of governmental systems and public organisations. From my point of view, each rather developed country should actively participate in the global development processes of the Internet and electronic services.

2 Objectives and Methodology

2.1 Objectives

The main objective of the thesis is to develop mobile application for higher education institution to improve its online services. Besides, the thesis has following partial goals:

- To make a current literature review of public electronic services;
- To evaluate and compare proposed mobile application with same purposes.

2.2 Methodology

The methodology of the research work is based on the literature review in domains of e-services, online public services and mobile application development. In the practical part, a proposal of new mobile application serving as online service provided by a higher education institution will be design and prototype by using latest software design and prototype methods and tools. The practical recommendation and conclusion will be formulated and presented further.

3 Literature Review

The chapter contains accumulative definition of the concept "public electronic services". The notion is observed from the range of prospective. However, it can be effectively used for further forecasts and defining of previous and recent issues. The research work structures the path of development and implementation of e-services. Following the main objectives, the chapter reveals advantages and disadvantages of the topic.

3.1 Introduction to public e-services

Active use of information technologies in the development of e-services is a prerequisite for ensuring compliance with government expectations and needs of population. Relations are arising in connection with the provision of state and municipal services in each country are regulated by certain legislative acts.

3.1.1 Definition

Electronic services are state services rendered on the basis of modern information and communication technologies, allow to reorganize the work of authorities and achieve a new quality of management, observing the rules of servicing business and society, and increasing the effectiveness of decision making. In this case, electronic services can be viewed as an instrument in increasing the quality of interaction between the state, business and society. At the same time, such an important function of the state as ensuring timely access of citizens to the official information of individual authorities, on the base of which the interaction of state and municipal structures with civil society institutions and business is built, works to increasing the quality and efficiency of the implemented solutions. (1)

The level of interaction between government, business and society is an important indicator of condition of society as a whole.

Today, the concept of "electronic service" is defined as the use of information and communication technologies, especially the Internet as a tool to achieve more effective management.

Electronic services are a tool or as an executive mechanism in the system of qualitative interaction of government, business and society.

3.1.2 The objectives of e-services

The tasks of e-services are to increase the reliability and to improve the performance of public service systems; to provide the necessary information and services to the general public. The result of practical introduction of electronic services within the e-government program at the broadest level is better management.

3.1.3 Advantages and disadvantages of public e-services.

This chapter contains information on positive and negative sides of definite public electronic services in the sphere of education. Proceeding from this information, it will be possible to analyze on what it is necessary to focus attention and what should be escaped to provide trouble-free service work.

Electronic government is a system of electronic document management of public administration, based on automation of all the administrative processes at the national scale and aimed at significantly improving the efficiency of public administration and reducing the costs of social communications for each member of society.

E-government has the following main objectives:

• optimization of provision of government services to the public and business;

• Increasing the participation of all voters in the government and governance of a country;

• support and expansion of self-service opportunities for citizens;

• growth of technological awareness and qualification of citizens.

The means to achieve a set of goals are new technologies, namely the global Internet, the use of which will help for relationship and development of relations between public services and citizens.

Intercalation of e-government in many countries will improve the attitude of authorities and population, will reduce dissatisfaction with authorities. As a result, a new state management view will be formed, based on the interaction of all structures and institutions of the society: civil servants, business, active citizens, educational and research institutions, public groups, civil organizations, etc.

The actualization of the issue of intercalation of e-government in many developed countries is related to today, not simply with fashion for an "electronic" way of life, but primarily with the fact that it brings savings to the state treasury and economic advantages

for the whole country. Projects of electronic states operate in many countries. A simple example is Estonia, where you can access social benefits, driver's licenses and other public services with an ID card via the Internet.

Despite on the obvious advantages of e-government, there are certain problems associated with its activities. It is also necessary to solve the problem of correct organization of the interaction for our own information systems, which agencies used, with the sphere of electronic services that are on the Internet and provide access to citizens. It should be kept in mind that only those who have access to the Internet can access the e-government directly.

According to statistical data for 2015 of information's portal "Eurostat Statistics Explained" not all population in the gap of age from 16 to 74 years uses the Internet. (2)

Figure 1 – Individuals who used the internet in 2015 (% of individuals aged 16 to 74)
(Source: http://ec.europa.eu/eurostat/statistics-
explained/index.php/Digital_economy_and_society_statistics_-_households_and_individuals)

It must also be taken into account that older people do not have experience with the Internet, therefore, they are not prepared for electronic communication with the authorities.

Another problem is that electronic services are more expensive than conventional ones. At a minimum, the user must have a computer connected to the Internet. Currently, the main work in many countries on the introduction of electronic document management is reduced to the modernization of the office, i.e. to transfer data from paper to electronic format.

Its implementation depends on degree of involvement of all structures in this process. Some data has already been transferred, for example, in fact all tax data of practical services of all countries already exist in electronic form, unlike passport services. Many other agencies also need to create a database, which will take a lot of time and money.

Also, for the development of an electronic information exchange system between ministries, unified standards are necessary in the areas of reference information and document circulation.

3.1.4 E-government in different States

The United Nations twice a year conducts an "e-government" survey, which includes a section called "e-government" readiness. This is a comparative rating of the countries in the world at two main indicators:

1. State of e-government readiness;
2. Degree of electronic participation.

The review assesses 191 UN member states in accordance with the number of aggregate e-government readiness index based on the evaluation of websites; telecommunication infrastructures and human resources of the Fund.(3)

E–Government Development Index - Top 10 Countries	
Country	*Index*
United Kingdom	0.9193
Australia	0.9143
Republic of Korea	0.8915
Singapore	0.8828
Finland	0.8817
Sweden	0.8704
Netherlands	0.8659
New Zealand	0.8653

E–Participation Index Top 11 Countries	
Country	*Index*
United Kingdom	1.0000
Japan	0.9831
Australia	0.9831
Republic of Korea	0.9661
Netherlands	0.9492
New Zealand	0.9492
Spain	0.9322
Singapore	0.9153

Denmark	0.8510	Canada	0.9153
France	0.8456	Italy	0.9153
		Finland	0.9153

Table 1 - UN E-Government survey in 2016 year

(Source: https://publicadministration.un.org/egovkb/en-us/reports/un-e-government-survey-2016)

3.2 Mobile application development.

The chapter includes the basic principles and the most popular technologies used for the development of mobile applications. It will consider technical specifications of different platforms on which development of mobile applications is conducted. The comparison between different technics will be carried out in order to choose the most suitable technology for this thesis. The examples of already existing mobile applications for electronic services will be mentioned. Further it will research in detail the basis of the technologies they are constructed on. The chapter will be concluded by defining specific technologies and methods, which are necessary for the development of a mobile application in this thesis. The reasons of refused and chosen methods are highlighted here.

3.2.1 Introduction

First, let's define what a mobile application is.

Mobile application is a software specifically designed for a specific mobile platform (iOS, Android, Windows Phone, etc.). Designed for using on smartphones, phablets, tablets, smart clocks and other mobile devices.

Mobile applications are written in high-level programming languages, and then compiled into machine code of operating system for maximum performance. Development of applications has its own characteristics: mobile devices run on battery and are equipped with less efficient processors than personal computers. In addition, modern smartphones and tablets are universally equipped with additional devices, such as gyroscopes, accelerometers and cameras, giving unique opportunities for expanding the functionality of the application.

Usually mobile devices are already selling with some pre-installed applications. The rest can be downloaded (both paid and free) by the user wants on specialized services: Apple AppStore, Google Play, Windows Phone Store and others. The first application stores, such as the Apple AppStore and Android Market, which later became Google Play, appeared in 2008. Two years later, the American dialectical society called the term "app" the word of the year.

Figure 2 - Google Play Logo
(Sourse: https://play.google.com/intl/en_us/badges/)

Figure 3 - Apple Store Logo
(https://thesourceblog.emc.com/apple-store-logo-png/)

At the end of 2015, there were about 3 million applications in the catalogs of the two largest markets. The number of downloads for one year exceeded 300 million. (4)

3.2.2 The main stages of developing mobile applications.

In this chapter, special attention is paid to the recruitment of typical steps in the creation of a mobile application from scratch, which is practiced by most of the IT companies specializing in creating mobile applications.

Business analysis of the target market

At this stage, the customer should decide how he plans to use application, what is the final goal of developing a mobile communication tool with the audience. Here is a list of tentative questions on which is necessary to find answers, before formulating the terms of reference and starting the development of the application: Which goals do you plan to achieve by creating and releasing your own mobile application?

- Do you plan to make sales / transitions of convertions into sale of goods and services within the application?
- Who is your target audience and with whom it can be replenished?
- How high the competition in the sphere in which you plan to work (including with the application) is?

- Which applications does your audience and audience of your competitors use, do they overlap? Are they ready to use your application instead of analog applications?
- What is the budget for developing and promoting the received application?

Development of an agreed solution

Before the development, it is necessary to put a specific technical assignment.

After receiving the technical assignment, you can start prototyping and compiling user profiles to evaluate the capabilities of the final product.

Based on the designer's vision, business evaluation and coordination of the details of technical assignment, you can start the development process.

Prototyping

Prototypes develop by designer and can be both are static and interactive. A more detailed consideration of this stage will be in the next chapter, since the main task of my work is precisely this stage - prototyping.

Static prototypes and interactive layouts should be compiled with consider technical and software base that I plan to use in creating the application.

Writing code and implementing technologies

With prepared design, the application goes to developers: they have to create a mobile application based on the programming languages, frameworks and various technologies in accordance with the technical specification and approved prototype.

Testing

At various stages of application development, internal testing of the application is mandatory, both on simulators and on real devices. The purpose of the test is to make sure that the application's interaction with the hardware and software platform of smartphones and tablets will be exactly as expected at prototyping stage.

Creating a pre-release version

As a result of a series of tests and modifications of the application, a working version of the application should be obtained. This version has to be added to the app store: Apple App Store, Google Play (depending on which platform was being developed) or any similar service for distribution of applications.

Publication an application to the store

The final stage of the studio - adding an application to the review in one of the above application stores.

Technical support and marketing promotion of the application

At this stage, we are talking about additional work at already created and working mobile application, such as technical support for the application, further release of new versions for the updated versions of mobile OS, as well as marketing promotion.

3.2.3 Prototyping a mobile application

After the team of developers and the project manager had found each other, they face an arduous task: to learn to speak the same language. And no matter how detailed the technical task was written, there is always a great risk to disperse in the content of notion "obvious" or simply forget to indicate some details. Just in order to see as soon as possible how the system of interaction between the mobile application and the user will be built, and a prototype is must to be.

The prototype is, in essence, a painted application. To make prototype interactive, the designer draws out all the screens of the future application, and a special program collects these screens into a single model, establishing relationships and links. The output is a model of the application, in which, for example, buttons work. An interactive prototype can be compared to 3D model of a future building, which the architect designs long before the start of construction works.

The prototype allows in early stages (before programming and testing) to try the application in action. The project manager can see all screens, it is possible to evaluate (to click) buttons and other interface elements. At this stage, you can and need to understand whether the scheme of interaction of the application requires some improvements.

Why does a manager need a prototype of a mobile application?

The prototype allows:

- to see the application in action and to understand how correctly developers understand the idea and technical assignment;
- to evaluate the application from the user's point of view;

- to determine whether you need to make changes of application's interaction with the user;
- to avoid additional financial and time costs if inconsistencies are identified.

To have a ready-made application model at hand is also useful if:
- You act as an intermediary and must to show a prototype to your superiors;
- The future mobile application is the foundation of your start-up, and the working prototype will be an advantage in finding funding sources for the further steps;
- You want to test the application in a focus group before you start the most expensive - programming and testing.

Realizing that a prototype is mandatory, it remains to understand the choice of tools for prototyping.

What are the tools for creating a prototype?

Conditionally, all instruments can be divided into 3 groups according to the type of carrier:
- on paper;
- on computer screen;
- on mobile device.

Advantages of paper prototyping are obvious - this is the fastest way to create a layout of the future application. However, the shortcomings, in my opinion, outweigh the scales. The prototype on paper does not allow to see the application in action, it is extremely inconvenient when it is necessary to demonstrate through the Internet, it requires calligraphic handwriting and great accuracy.

Use a prototype on computer is reasonable, if the desired device is not to have. However, in fact, there may be some inaccuracies, and you will have to improve the ready-made application. For example, on a computer it is unlikely that it will be possible to fully test all control elements. Most likely, you need to know how easy it is to apply gestures and use the application while holding the phone in one hand. And you also want to check if buttons are large enough so that the user can hit them at first time. To adhere to the

principles of UX-design will be completely, if you test the prototype exclusively on the mobile device, under which your application is created.

Programs for prototyping.

To perform the practical part of my work, I need to select a program with which I need to create a prototype of a mobile application.

Programs for prototyping are the link between creative idea and final product. More recently, in the field of UX / UI design, the main tool was Photoshop or the most primitive kind of prototyping was on paper. But over time, more advanced programs and even whole software system solutions began to appear that cover the entire prototyping process adhering to the basic principles of UX / UI-design.

I want to give some popular examples of tools for prototyping and give them a little description:

Axure RP

Axure RP Pro is software for creating prototypes, layouts, website specifications and applications. The program allows you to insert widgets by drag and drop, and change their size and format. Axure RP Pro is a full-fledged UX tool that allows developers to design complex interactive prototypes, but it takes time to master it. If you are a professional developer, using Axure RP Pro you can create more complex interactive prototypes.
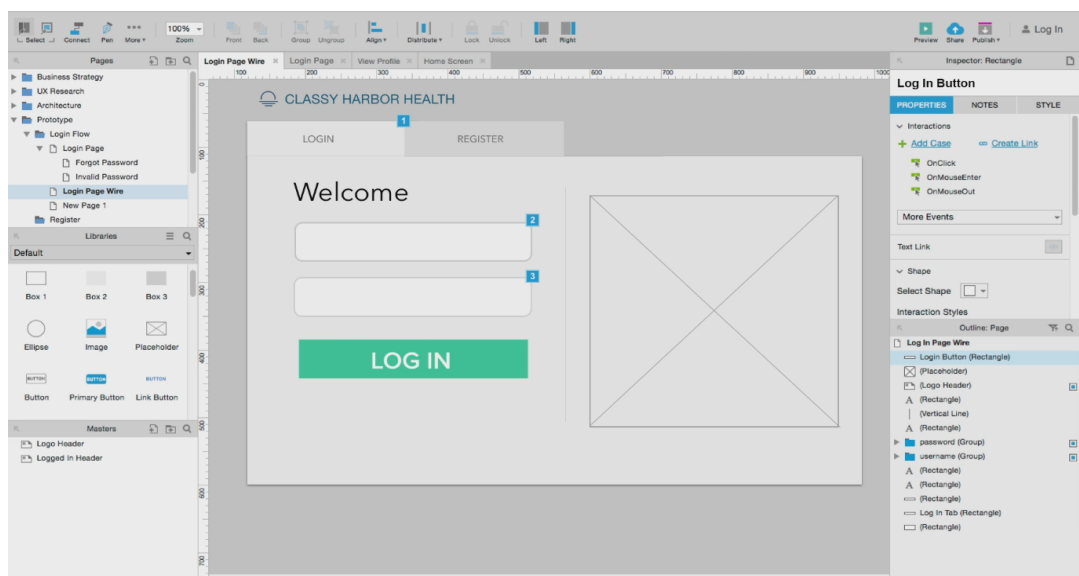

Figure 4 – Axure RP

(Sourse: https://www.axure.com/)

Mockplus

Mockplus is a simple prototyping tool was created by the fast-growing innovative company Jongde Software LLC. The program is designed for offline use and supports prototyping software for all major platforms: PCs, mobile applications and web applications. This is a good choice for users of any level of training, because the program is easy to learn and intuitive interface. The program has the necessary set of UI-widgets and icons - everything you need to work with your widgets. It is possible to preview a prototype by exporting an HTML / image, or by testing it on an existing device using a QR code.
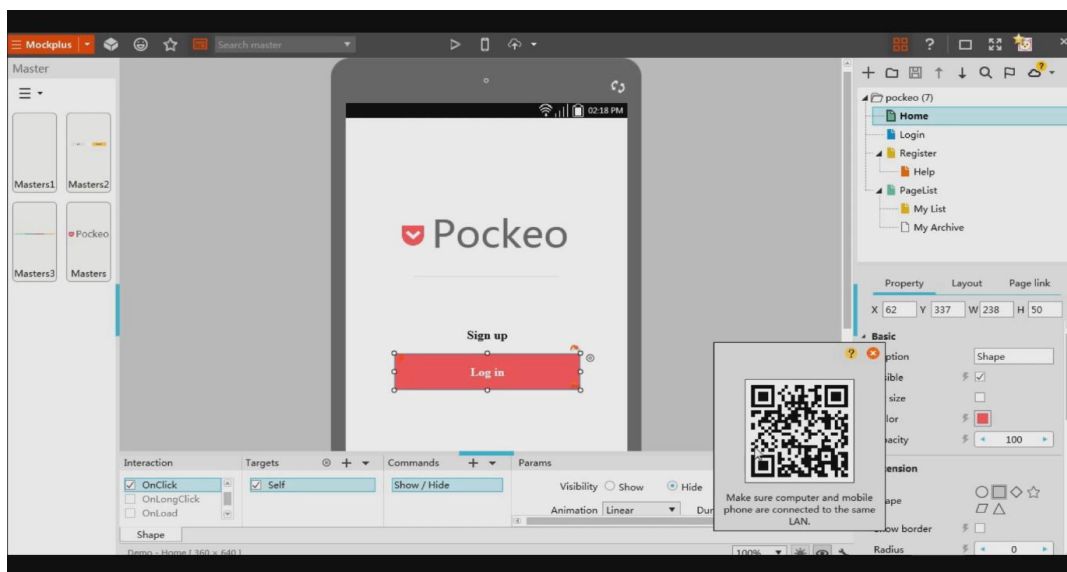

Figure 5 – Mockplus

(Sourse: http://doc.mockplus.com/?p=433)

Justinmind

Justinmind is a UX tool for creating prototypes for mobile and web applications, as well as high-quality site layouts. The program is equipped with standard functions: dragging objects with the mouse, changing their size and format, as well as exporting and importing widgets. In addition, you can add notes to the widgets and provide them with interactive functions, such as links, including conditional, animation, calculations, a set of tabs, hidden elements, and modeling databases with real data.
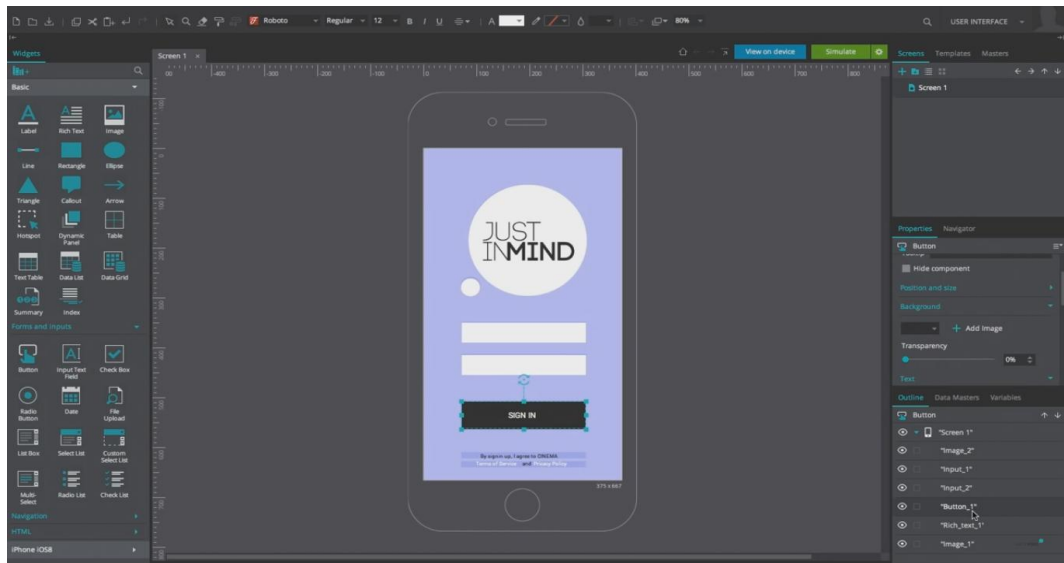
Figure 6 – Justinmind

(Sourse: https://www.justinmind.com/overview)

3.3 Interface prototyping

3.3.1 Definition

Interface - a set of opportunities, techniques and methods of interaction between the two systems.

User interface is a kind of interface in which one side is represented by a person (user), another is a machine / device. It is a set of tools and methods by which the user interacts with different machines, devices and equipment.

3.3.2 Approaches to design of interfaces

1. Machine-Centered
2. Human-Centered

These two approaches, in fact, represent an automated system at the highest level of detail and consider the process of developing the interface either from the position of human operator, either from the functionality of a computer.

Machine-Centered approach to creating a user interface is based on the assumption that a person works with a computer like a computer itself, that is, according to a certain algorithm. The GOMS (Goals - Operators - Methods –

Selection rules) algorithm, representing this approach, assumes that the result obtained when the user performs a task is the main goal. To achieve it, the user can perform basic actions - operators. The sequence of operators that makes it possible to achieve a goal is called a method. Selection rules based on the "if-then" principle allow you to change the flow of control. (5)

In view of the fact that the engineering and technical approach to designing the interface is focused on functional characteristics of the program, the user working with it has to "think like a developer".

Human-Centered approach, which replaced algorithmic modeling, considers the user as a central figure of the process of interaction with the system. Orientation to the characteristics of the user, the study of perceptual and cognitive abilities and human limitations allowed us to identify the patterns of human interaction with an automated system. Considering the processes and patterns of perception, information processing and decision making, cognitive psychology identified factors that determines success of the task by operator. And it did not turn out to be the functional characteristics of the system, as was supposed by the engineers before, but the quality of providing and managing information in terms of human capabilities and limitations.(6)

3.3.3   Interface development methodologies

However, as it turned out, the analysis of perception and processing of information by a person is not enough to design an ergonomic interface, because it does not allow to determine the composition and sequence of information displayed on the screen. This led to emergence of a number of UI design methodologies based on the cognitive approach.

Activity-Centered Design

This methodology considers the "human-computer" system as a complex of related activity concepts and ideas. The theory of activity, which underlies this

approach, represents a computer as a tool by which person solves various tasks and it is human activity that exactly affects on interface.

According to principles of the theory of activity, the entire stream of user activity can be decomposed into a sequence of related tasks and sub-tasks, logical steps. This allows you to analyze goals, external and internal tasks, order and type of user operations performed to achieve the final result, and based on analysis, to develop the interface is most suitable for this type of activity.

Goal-oriented design

This methodology for developing user interfaces, the ideology of which is Alan Cooper, is based on assumption that a careful study of the user's goals and understanding for what he aspires, to solve the problem of "cognitive friction".

Cognitive friction is a concept was introduced by A. Cooper and characterizing the relation of a person to a complex thing (for example, to a computer) as to another person. This attitude arises in situations where a person can not understand how and why this thing works (or does not work).

User-Centered Design

User-centered design is a methodology that has become well-known in popularity and is used not only for software development. Its essence boils down to studying the needs and capabilities of end users and adapting the product to their needs. In other words, this is a concept of creating products, including software, that people would like to use.

3.3.4 Standardization

In 1992, the International Organization for Standardization (ISO) introduced the group of standards ISO 9241 "Ergonomic requirements for office work with

visual display terminals" (VDTs). In 2006 they received a more general name "Ergonomics of Human System Interaction".(7)

Examples of some ISO 9241 standards:

- ISO / TR 9241-100: 2010 Ergonomics of human-system interaction. Part 100. Introduction to the standards for the ergonomics of software
- ISO 9241-110: 2006 Ergonomics requirements related to the use of ISO 9241-129: 2010 Ergonomics of human-system interaction. Part 129. Software manual ISO 9241-143: 2012 Ergonomics of human-system interaction. Part 143. Forms
- ISO 9241-154: 2013 Ergonomics of human-system interaction. Part 154. The use of interactive voice reciprocity (IVR)
- ISO 9241-210: 2010 Ergonomics of human-system interaction. Part 210.

User-centered design of interactive systems.

These and other standards related to ergonomics, anthropometry and biomechanics are managed by ISO Technical Committee 159 (Technical Committee 159) and are available on the official website www.iso.org.

For independent developers, standards are no more than recommendations. Large companies and developer communities often use their own regulatory documents and user interface design guides, used, as a rule, in a particular technology or system. For example, the W3 consortium promotes the Web Accessibility Initiative (WAI) - a set of recommendations, adhering to which webmasters can create sites tailored to users with disabilities. Google, Microsoft, Apple and other companies present their own specifications and guides for application developers to create user interfaces for their platforms.

3.3.5 Rules for designing the user interface

There are many recommendations from experts in designing the user interface. These recommendations are more or less applicable for creation of desktop and mobile applications, and to web development.

Ben Shneiderman, an American researcher in the field of human-machine interaction, in his book "Designing the User Interface" formulated 8 "golden" rules, which can be briefly presented in the following form:

1. **Strive for consistency**. Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus, and help screens; and consistent commands should be employed throughout.

2. **Enable frequent users to use shortcuts**. As the frequency of use increases, so do the user's desires to reduce the number of interactions and to increase the pace of interaction. Abbreviations, function keys, hidden commands, and macro facilities are very helpful to an expert user.

3. **Offer informative feedback**. For every operator action, there should be some system feedback. For frequent and minor actions, the response can be modest, while for infrequent and major actions, the response should be more substantial.

4. **Design dialog to yield closure**. Sequences of actions should be organized into groups with a beginning, middle, and end. The informative feedback at the completion of a group of actions gives the operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds, and an indication that the way is clear to prepare for the next group of actions.

5. **Offer simple error handling**. As much as possible, design the system so the user cannot make a serious error. If an error is made, the system should be able to detect the error and offer simple, comprehensible mechanisms for handling the error.

6. **Permit easy reversal of actions**. This feature relieves anxiety, since the user knows that errors can be undone; it thus encourages exploration of unfamiliar options. The units of reversibility may be a single action, a data entry, or a complete group of actions.

7. **Support internal locus of control.** Experienced operators strongly desire the sense that they are in charge of the system and that the system responds to their actions. Design the system to make users the initiators of actions rather than the responders.

8. **Reduce short-term memory load**. The limitation of human information processing in short-term memory requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced, and sufficient training time be allotted for codes, mnemonics, and sequences of actions.(8)

4 Practical Part

4.1 Introduction

Every year thousands of students enter state-owned Czech universities. For example, only in 2016 the Faculty of Economics and Management at the Czech Agricultural University accepted 2,078 students for a bachelor's degree and 1,428 students for a master's degree program (9). For the university it is very important to correctly inform the new student. Give information about the most important aspects of the learning process and help them quickly learn in university itself. The same information will be very necessary for students coming to the different student exchange program. Such information exists, and each student can get it in the form of a small booklet.
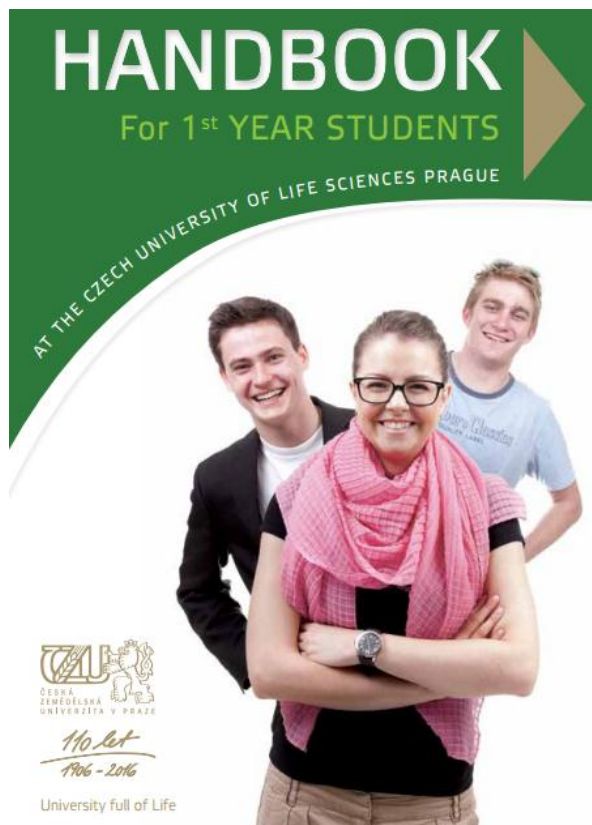
Figure 7 - Handbook for 1st year students
(http://www.hroch.czu.cz/en/?r=103&i=23611&os=1)

The main task of this work is to develop a design and prototype of a mobile application based on booklet information for first-year students.

The main objectives of the practical part of my work will be the following:

1. Analysis:

   a. Find disadvantages of Handbook for first year students;

   b. Use CATWOE analysis to identify all stakeholders of the service;

2. Application design and prototype for mobile devices.

4.2 Analysis

4.2.1 Disadvantages of Handbook for 1st year students

Handbook for first year students is a paper carrier of all the most important information for enrolling students and also for foreign students who came for different exchange programs. This content includes information on the following:

1. Basic information
   a. Short history of CULS
   b. Your studies at CULS
   c. Parking at the campus
   d. Regulations concerning your studies
   e. Scholarships, insurance
   f. International Student Identity Card (ISIC) and Electronic Wallet (UEP)
   g. IT Systems
   h. Internet access
   i. Study Information Centre (SIC)
   j. Department of Sports and Physical Education
2. Map of CULS campus
3. Faculties and institute
   a. Faculty of Economics and Management
   b. Faculty of Agrobiology
   c. Food and Natural Resources
   d. Faculty of Engineering
   e. Faculty of Forestry and Wood Sciences

      f.   Faculty of Environmental Sciences

      g.   Faculty of Tropical AgriSciences

      h.   Institute of Education and Communication

4. Student life

      a.   Halls of Residence / Dormitories

      b.   Dining Hall / Mensa

      c.   Extra-mural activities /Leisure

5. Contacts

The main drawback of all paper data carriers is updating of its contents when any data is changed in it. Specifically, in our example, these changes are made every year. For example, each year, faculties update their curriculum and requirements for them, as well as contact information or updating the university's information system, the schedule of administrative services of university may change. This brings with it not only money costs for the university, but also time consuming since printing out hundreds of new booklets will definitely take a lot longer than simple fixes in one application.

4.2.2 CATWOE analysis

CATWOE analysis help us to find the answers to the main project questions.

Customers:

- Final user of our application is a first students and exchange program students.

Actors:

- Main persons are an administration of the CZU and students;

- For both of them it is an additional possibility.

Transformation process:

- Main cost will be spent on the creation of the application, little marketing campaign and future support of the application;

- As a result we will have more comfortable and available source of information for our new students, and save time and budget of university ;

- Expected main benefit of this application – more comfortable and available source of information for students and save time and budget of university.

World view:

- Huge amougth of universities take thouthands of new students each year;

- This application will give them all main information about university.

Owner:

- University will own this app and will be able to control it anywhere and anytime.

Environmental constraints:

- The main problem is how to do it modern and comfortable for users.

4.2.3 Potential Strategies for Growth

1. When user will visit all web sites of CULS, he or she will see a banner that will offer him to try new mobile application;

2. Also users will see banners at some online portals like studenta.cz;

3. We will place a lot of posters at the university;

4. If we will have students emails we can send a newsletter to everybody who study at CULS;

5. Partner universities will recommend the application for their outgoing students to CULS
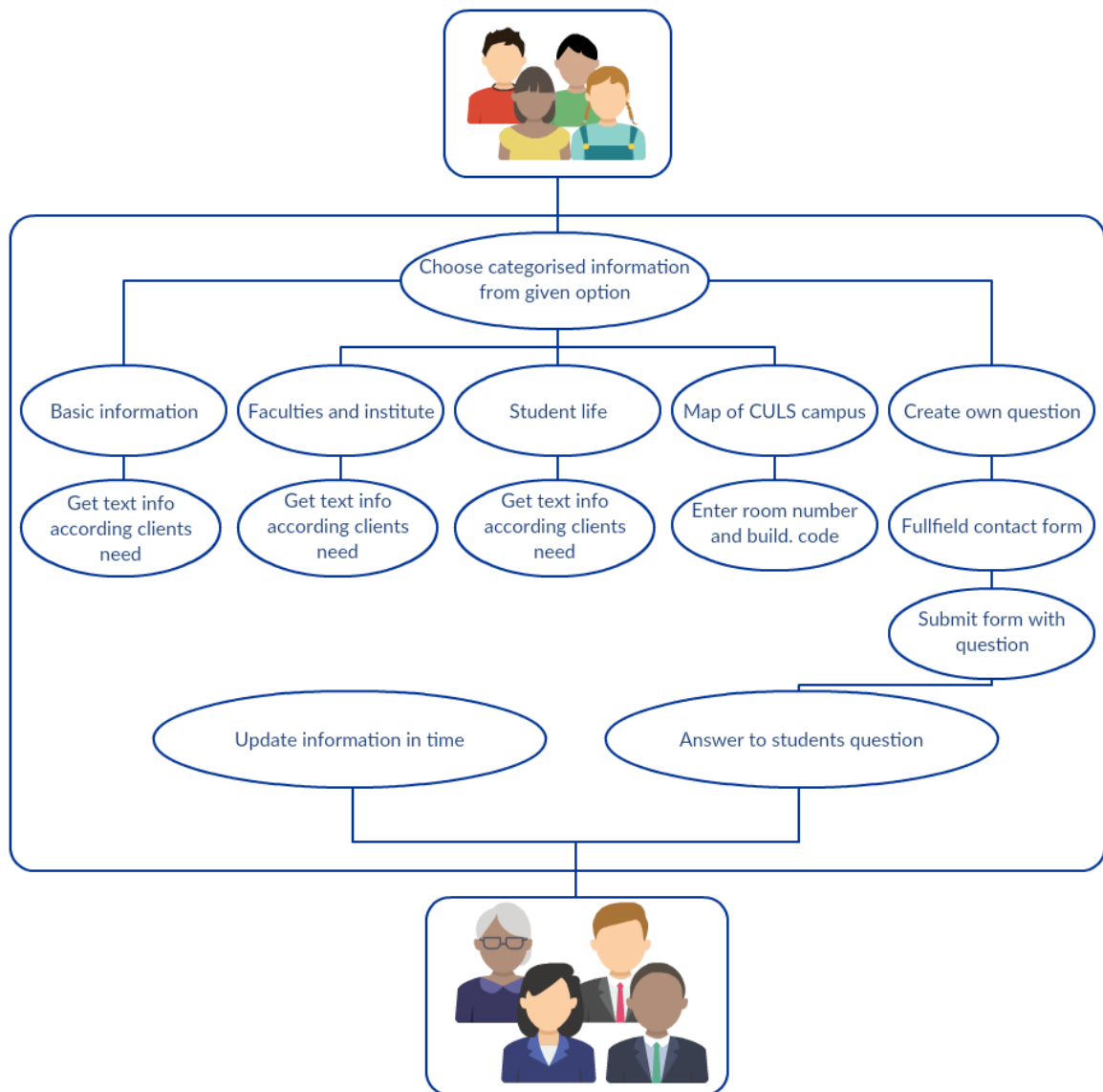
4.3 Use Case Diagram

Figure 8 - Use case diagram of mobile application
(Source: online tool - https://creately.com/app/?tempID=gc7qvpsj1&login_type=demo)

Explanation

According to diagram above (Figure 8), a user (student) expects to find information about study process or university. If information is not available, there is a posibility to create a question and get answer to his/her university email.

The Administration recieves each new request and then a administration staff will answer to students question. Also main responsibility of the university administration is to update information.
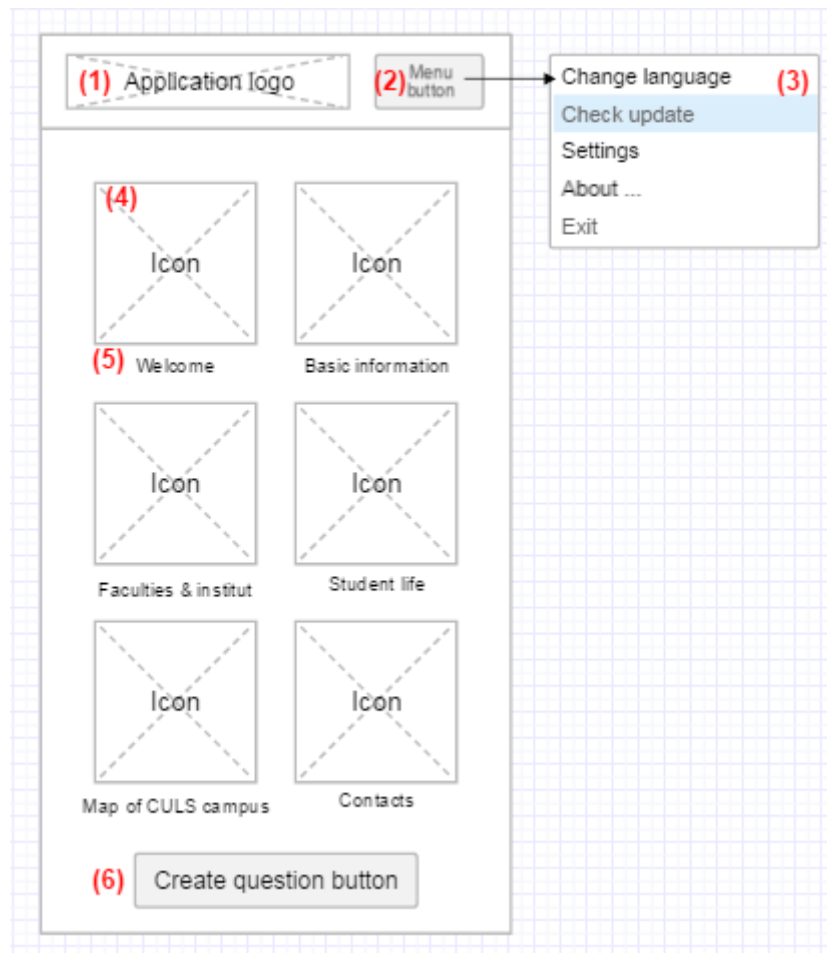
4.4 Wired model

Figure 9 - Wired model of main page
(Source: online tool - https://www.gliffy.com/)

With help of weird model esier to explain main futeres and functionality of application. The most important thing in application is the ease of management and everything starts from main page. In the figure above (Figure 9) you can see the main page of mobile application on which red numbers indicate the main functionality. As with any application, the logo and the name of application are placed at the top (1). Under the number (2) is menu button, which opens when you click on it. The expanded menu (3) contains such items as change the language, check the latest application update and update

it, install application (enable / disable automatic update, enable / disable sound in the application). The next menu item is basic information about application and the documentation for use. The last application to close. In the center of the screen, the user can click on the button with the icon (4) and open information category necessary to him / her. Under each button with an icon there is a brief description of category (5). If user does not find the required category, he can click on the "Create question" button (6), which will transfer him / her to page with the contact form. On the "create question" page, the user specifies his data (Name, Surname, Faculty, Training program), enters his / her question of interest and presses the submit question button.
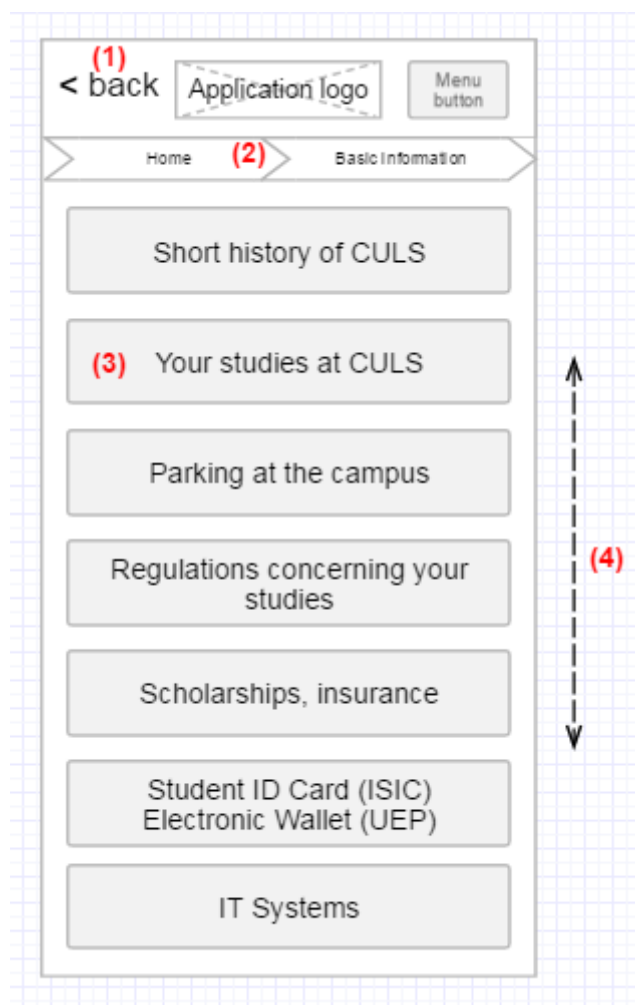

Figure 10 - Wired model of Basic Information page
(Source: online tool - https://www.gliffy.com/)

The user clicking on "Basic information" icon will redirect to page for this category (Figure 10). As a standard button in many applications developed for the operating system IOS in upper left corner is the back button (1). That user could easily navigate with the

sequence of pages in application is "breadcrumbs" (2). The main part of the screen is occupied by buttons with an inscription about specific information (3). The user can also scroll up or down to see the following buttons (4).
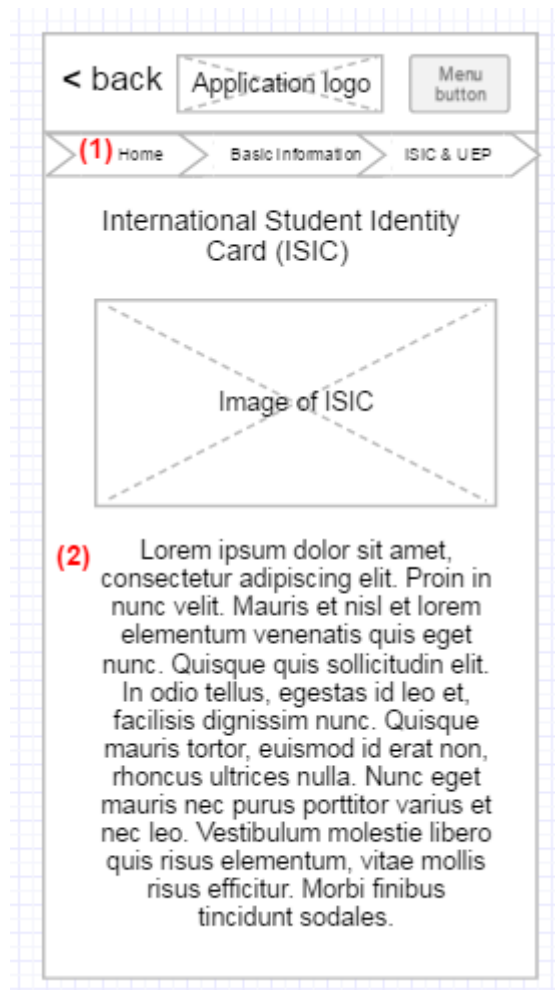

Figure 11 - Wired model of ISIC and UEP page

(Source: online tool - https://www.gliffy.com/)

When switching from "Basic information" page to the International Student Identity Card (ISIC) and Electronic Wallet (UEP) page (Figure 11), user can get information about these services and also see pictures related to this topic (2). User can also see that this is the third page in sequence starting from the main page (1).
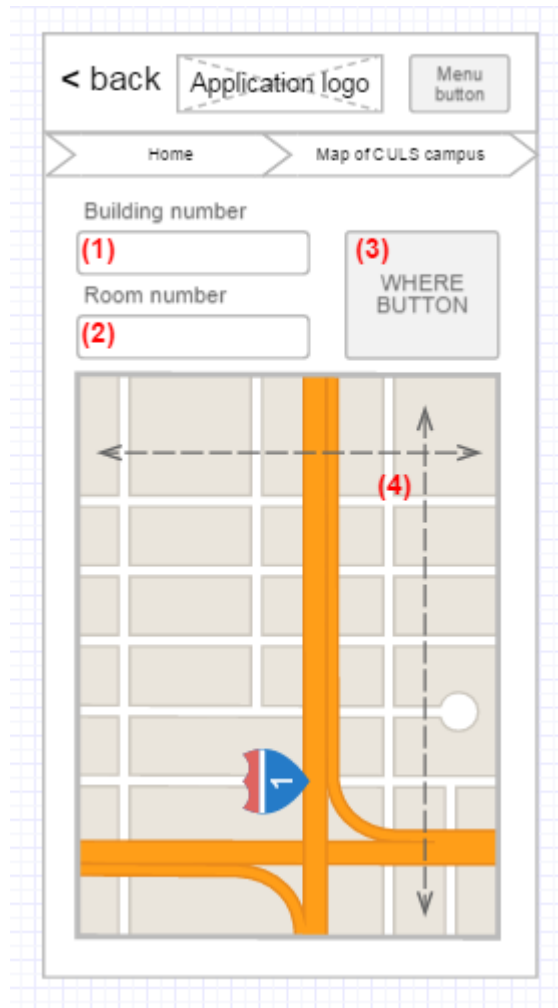
Figure 12 - Wired model of Campus Map page
(Source: online tool - https://www.gliffy.com/)

It is very important that student can quickly find the office where his lectures or seminars should take place. To do this, he can go from the main page to "Map of CULS campus" page (Figure 12). On this page there is a field for entering the building code (1) and the field for entering the cabinet number (2). When you press the "WHERE" button (3) below on the map, you will see a dedicated building where the building you need is located, and from which side you enter this building. The map will also indicate its location, determined by GPS. The map itself has usual functionality, such as "Google maps" or "Mapy.cz" for mobile devices. With the help of familiar gestures with your fingers on the screen "Swipe" you can zoom in and out, move up and down or left and right (4).

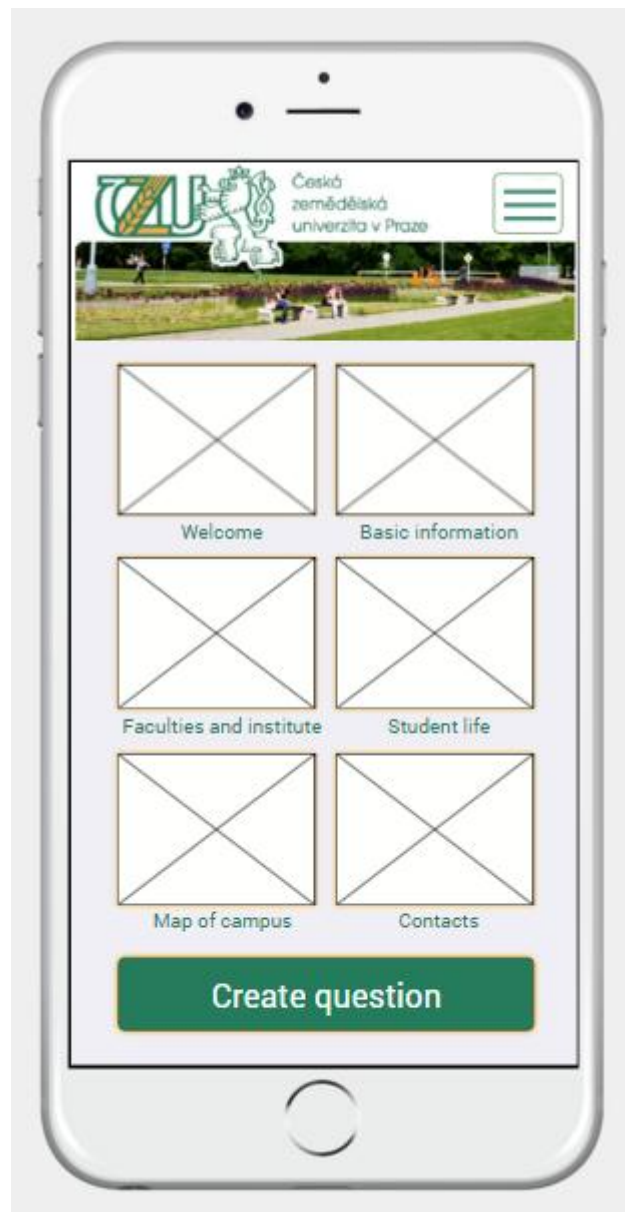## 4.5   Prototype of the mobile application

Figure 13 - Main Page prototype of application
(Source: desktop application Justinmind)

The picture above (Figure 13) shows the prototype of main page with the final design of application, from which it is already possible to estimate how well the designer understood what the final application should look like.

5 Results and Discussion

This chapter will discuss the key points of developing a prototype of mobile application. Brief description of objectives of this thesis and how they were implemented. Also a comparison will be made with similar applications, which is one of the main goals of this work. Identify the strengths and weaknesses of the prototype mobile application for students, using SWOT analysis.

5.1 Main goal of bachelor work and results

The main goal of this thesis is development of a prototype of mobile application for students to improve the services provided by the university.

5.1.1 Theoretical part

In order to achieve the main goal it was necessary:

1. Understand what e-service is;

    A. Define what is e-service

    B. The main purpose of e-service

    C. The positive and negative sides of e-service

    D. By looking at how e-service is developing in different countries

2. The next step was the need to study superficially how mobile applications are developed;

    A. Define the mobile application

    B. Stages of developing a mobile application

    C. Overview of popular mobile application development tools

3. At the third stage of the theoretical part of this work, we focused on the most important stage of developing a mobile application - prototyping;

    A. Define UI and UI desining

    B. Basic approaches to development of design interface

    C. Main methodology

    D. Standards for the development of UI

    E. Shneiderman's Eight Golden Rules of Interface Design

5.1.2 Practical part

In the practical part of the work, the following points were important:

1. Explain how this mobile application will improve the services provided by the university;
2. Consider the resource disadvantages on the basis of which a prototype of mobile application is developed, this is Handbook for first year students;
3. Do a CATWOE analysis;
4. Based on the Use case diagrams, show the interaction between the application user and the application administrators;
5. Show the basis of the functional developed on the basis of Wired models;
6. Show an example of a finished prototype with a graphic design.

5.2 Comparing result of work

To show final result of this work, it is necessary to make a comparison. Comparison between the received prototype of mobile application and its existing analogues. As an example, for comparison, let's take the current official CULS mobile application:

The official mobile application of the Czech Agricultural University in Prague for its students, staff and visitors.

Application modules and their use:

UEP:

- Information on the balance on the card account UEP and JUMBO
- Notification of lack of money on the card UEP
- View transactions on the card account UEP and JUMBO
- Graphical overview of income and expenses on UEP
- Blocking of lost or stolen cards UEP

Contacts:

- Contacts for teachers and staff CULS
- Show the list of employees belonging to the selected object (eg. The Department)

Menza:

- Current canteen menu CULS
- Includes standard and subsidized food prices

Food Point:

- Current list of shops in the university campus
- List of food prices for each store

First steps:

- All the information needed for the study within one application
- All for an easy start in the first days at school
- Important dates, links to student pages, information about accommodation and catering ...
- Current information for new students CULS
- And much more...

Campus:

- Quick and easy navigation through the area using Google Maps
- Easily guide you to building your lessons
- Ability to search by buildings and classrooms

Your opinion:

The possibility of completing the questionnaires regularly updated, in order to improve application

The application requires an Internet connection and use of all functions also student or employee account.
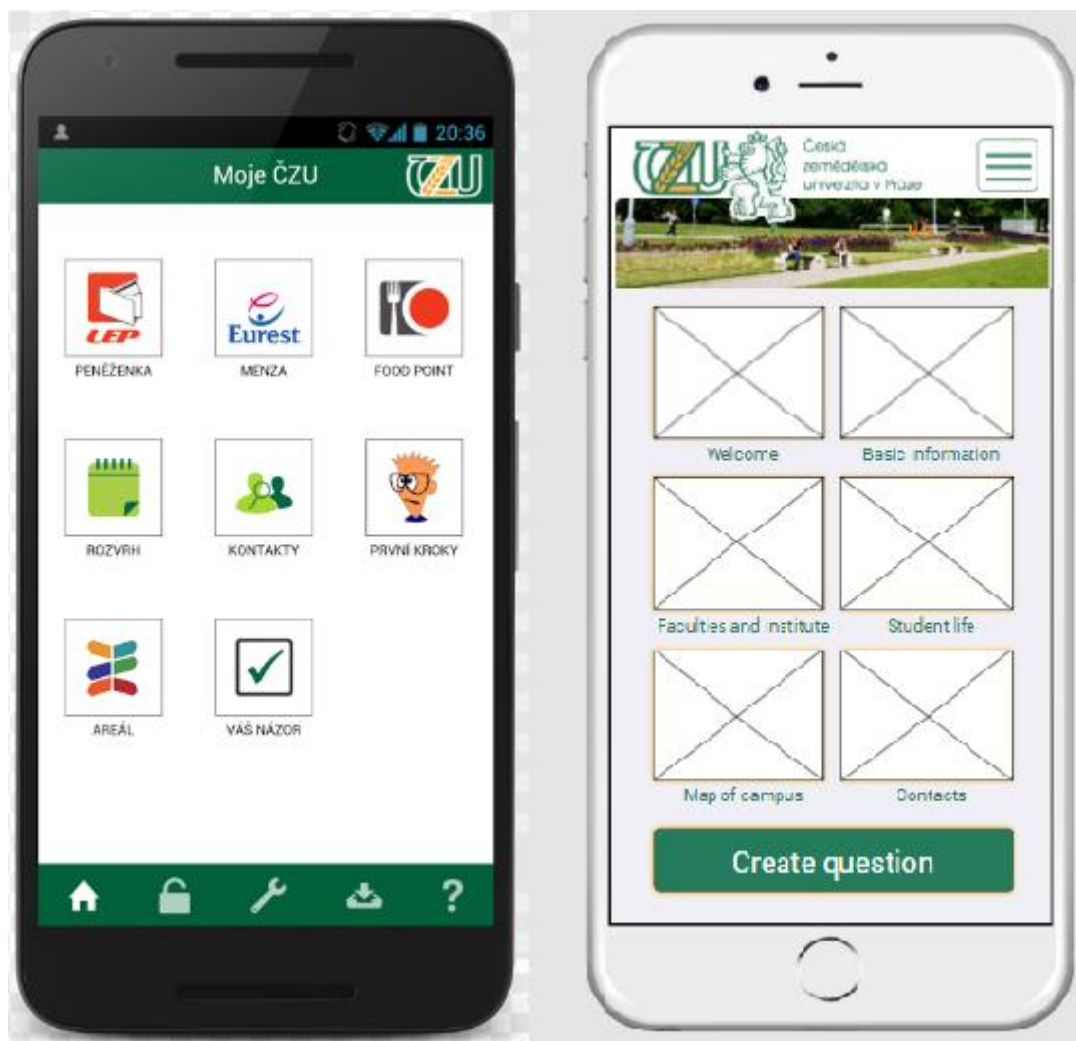
Figure 14 - Main page comparing of two applications
(Source: https://play.google.com/ and desktop application Justinmind)

The primary goal of both mobile applications is to provide information for CULS students. Mobile application "Moje CZU" was created only for students who speak Czech. Also in this application, there are additional modules like UEP, Menza, Food Point, Your Opinion (Váš názor), which provide students with useful information. But to use these modules, mobile device must be connected to Internet in order to receive constantly updated information. Also, there is a module First Steps (První kroky), where user can get acquainted with all the basic information about the first steps of student life in CULS. This module does not require the Internet on mobile device.

Mobile application which is result of this thesis is focused specifically to accompany the new student at the first stages of his / her student life. Just like in

mobile application "Moje CZU" all information about the first steps will be available without connecting mobile device to Internet. The only one exception is the Maps of CULS campus module, where you need to use GPS. Also, the main difference is presence of feedback, where student can send his question, and answer to which could not find in other sections of the application. Then he will receive a notification from the information center to his university email.

In general, you can say that each application has its own pros and cons. But the positive aspects of one application can complement the negative aspects of another application. For example, creating an application for both mobile devices on iOS and Android operating system. Also, adding the ability to select the language of application.

5.2.1 SWOT analysis of the mobile application

Strengths	Weaknesses
- Usability for everyone; - Don't need the Internet connection to use; - Cost Advantages - to make this application only few sources are needed;	- Missing promotion or marketing campaign; - Multiplatform versions are needed; - Accessible only on smartphones and tablets
Opportunities	Threats
- International Expansion - can be adaptable for each university; - New Services;	- Substitute Products; - Government Regulations; - Dependency on platforms

Table 2 - SWOT analysis of the mobile application

6 Conclusion

The main goals of the Bachelor Thesis were to develop mobile application for higher education institution to improve its online services and it would be focused for mobile devices with operating system IOS and Android according to the hard copy of Handbook for first year students.

Besides, the thesis has following partial goals:

- To make a current literature review of public electronic services;
- To evaluate and compare proposed mobile application with same purposes.

Based on study of e-service, interface prototyping and mobile application development, one can draw the following conclusion.

The task, to create the most comfortable interface for users, which will be provide the most effective and functional interface, and thus will be better interact with the user than the hard copy of Handbook for first year students, is completed. Then concluded that my project can be implemented for both operating system of the mobile devices.

Based above goals were done SWOT analysis, which show us disadvantages and anvantages of mobile application prototype:

Based on the comparison of prototype of mobile application of this work and on the official CULS application "Moje CZU", it can be concluded that merging the functionality of both applications will bring an even more advanced application.

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