Czech University of Life Science Prague

Faculty of Economics and Management

Department of Information Technologies

Bachelor thesis

Responsive design oriented web application UI Specification with face recognition support functionality

Author: Uladzislau Rakita

Supervisor: Ing. Josef Pavlíček, Ph.D.

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Uladzislau Rakita

Informatics

Thesis title

Responsive design oriented web application UI Specification with face recognition support functionality

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Objectives of thesis

Prepare UI specification for responsive design web application. This application has to support the face recognition features. UI Specification must be oriented for main use cases used for Face recognition. Make research at the area of face recognition libraries. Final solution will be UI Specification of system, supporting face recognition functionality.

Methodology

Analyze current state face recognition systems.

Study suitable literature for searching current state face recognition.

From the result of study define current state

of solutions and their ability to support required functionalities.

Define typical Use Cases and prepare UI Specification for responsive design web application

Prepare paper prototype according to the UI Specification and test it.

Describe conclusions for gained results.

The proposed extent of the thesis
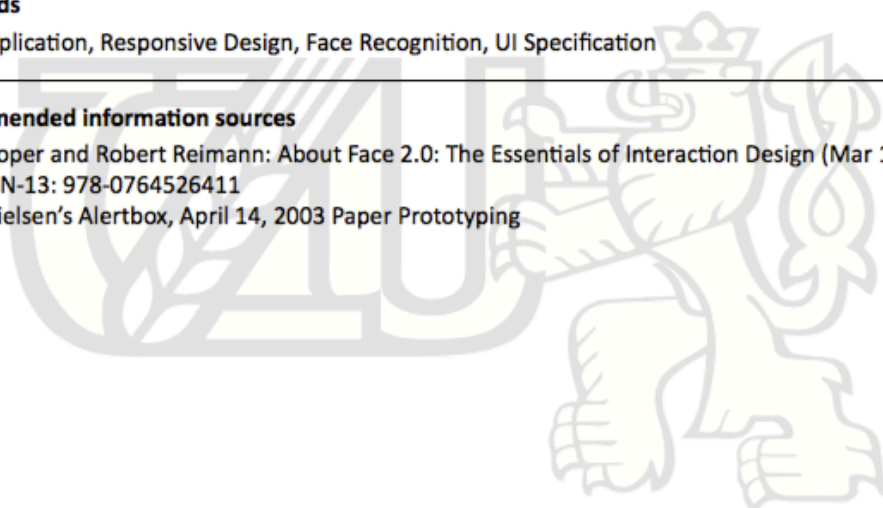
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Keywords

Web Application, Responsive Design, Face Recognition, UI Specification

Recommended information sources

Alan Cooper and Robert Reimann: About Face 2.0: The Essentials of Interaction Design (Mar 17, 2003), ISBN-13: 978-0764526411

Jakob Nielsen's Alertbox, April 14, 2003 Paper Prototyping

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The Bachelor Thesis Supervisor

Ing. Josef Pavlíček, Ph.D.

Supervising department

Department of Information Engineering

Electronic approval: 9. 3. 2018

Ing. Martin Pelikán, Ph.D.

Head of department

Electronic approval: 9. 3. 2018

Ing. Martin Pelikán, Ph.D.

Dean

Prague on 14. 03. 2018

Declaration

I hereby declare to have compiled this final thesis "Responsive design oriented web application UI Specification with face recognition support functionality" entirely myself and in accordance with recommendations of my supervisor, that I indicate all the literature and other supporting materials used in the index of bibliography.

In Prague 15th of March,   _____   Rakita Uladzislau

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Responsive design oriented web application UI Specification with face recognition support functionality

Abstract

The main purpose of my bachelor's degree work is to research the information about the current state of face recognitions systems and create UI Specification for web application, which provides face recognition on the video stream, and test it.

Theoretical part describes main information about face recognition systems, how they work, basic learning algorithms and possible ways how and where to use it.

Practical part focus on UI Specification of face recognition web application. It contains SWOT analyses, goals, use cases and testing of the application.

The thesis consists of six chapters, conclusion, bibliography and list of figures and tables.

Key words

Web Application, Responsive Design, Face Recognition, UI Specification

Specifikace uživatelského rozhraní webové aplikace pro rozpoznávání obličejů

Abstract

Cílem této bakalářské práce je analýza současného stavu vývoje systémů pro rozpoznávání obličejů a tvorba uživatelského rozhraní pro webovou aplikaci, která by umožňovala rozpoznávání obličejů během živého přenosu videa a otestovat ji.

Teoretická část popisuje základní informace o systémech pro rozpoznávání obličejů. Dále se zabývá algoritmy strojového učení a praktického využití těchto systémů.

Praktická část se zaměřuje na specifikaci uživatelského rozhraní webového rozhraní pro rozpoznávání obličejů. Obsahuje SWOT analýzu, případ užití a test uživatelského prostředí.

Práce se skládá ze šesti kapitol, závěru, bibliografie, seznamu obrázků a tabulek.

Klíčová slova

Webová Aplikace, Responzivní Design, Rozpoznávání Obličeje, Specifikace Uživatelského Rozhraní

Contents

1. Goals of Bachelor Thesis

For the last few years people have made a big step in the computer technologies. Now you can find a camera almost on any building and on any street. The time of black and white photos and videos is far behind.

Now people are trying to make new and new features, related to the digital world. Extended reality, virtual reality, many different effects on the video or photo. But the most useful one from them – face recognition.

This technology can help to many people whole over the world. Algorithms can process any picture and find there a person, who is in database of the photos. It can be some wanted criminal or someone who is wanted for a long time.

UI Specification of face recognition web application will provide:

• Useful and user friendly interface to spectate video streams with on-time face recognition and initialization;

• Interface to upload a photo for face recognition and further photo processing and investigation;

• Useful interface to set up the application preferences.

Prepare UI specification for responsive design web application. This application has to support the face recognition features. UI Specification must be oriented for main use cases used for Face recognition. Make research at the area of face recognition libraries. Final solution will be UI Specification of system, supporting face recognition functionality.

2. Methodology

There are the stages for investigation of the topic:

- Make the research of existing face recognition systems and algorithms.

- Analyze literature considering modern face recognition systems.

- Make the research of existing web applications with face recognition system built in.

- Define the current state of the face recognition algorithms and related application.

- Define the typical Use Cases and prepare UI Specification for web-application.

- Prepare paper prototype according to the UI Specification and test it.

- Describe the conclusion.

Analyse current state of face recognition systems. Study suitable literature for searching current state of face recognition. From the result of study define current state of solutions and their ability to support required functionalities. Define typical Use Cases and prepare UI Specification for responsive design web application. Prepare paper prototype according to the UI Specification and test it. Describe conclusions for gained results.

The practical value of this thesis will consist of completed design for face recognition web application with the most optimal algorithms of the search.

3. Research, theory

3.1 Face recognition overview

Face recognition is the science which is connecting the understanding of biological systems and how recognize a face and how you can implement the same by computer. Biological systems involve different types of visual sensors, which were designed by the nature to fit a certain environment. Similarly, computer systems use different visual devices to capture and process faces which were found by some application.

You are going to the elevator and it knows which floor you need. All the doors are opened automatically, computer and phone doesn't need the password. Cars, social networks, internet shops – everything knows your every step. This is how face recognition works. Amazing or scary?

First you can think that all the companies which has access to such a technology are tracking your every step. But actually face recognition technologies are spread whole over the world and promise really great result. They can help you to complete task of any complexity:

- Student identity confirmation on the exam;
- Checking people from the blacklist in any organistation;
- Goods payment in the internet;
- Keep your place in the que for tickets;
- Unlock PC or phone.

For example even in Moscow there is a network with 150 000 cameras. You can't hide from them, and this is scary. But it's not so bad. This system use very powerful face recognition algorithm, but you need a lot of power to make it work. So in the real-time there are about 2-4 thousand cameras working outside.

3.2 How face recognition work

How does it work?

First of all you should ask yourself how do you recognize someone's face? Sure, human's face has some attributes which could be easily described. Space between eyes, position and size of the nose, space of the lips and chin. You notice it automatically, without any thoughts, when you look on someone. Computer is doing it with really good efficiency, it's making some kind of "map" on a face and on the output you are getting the math formula of the face.

Figure 1: Map of the face

Source: https://www.computerworld.com/article/3206725/mobile-wireless/facial-recognition-in-the-new-iphone-would-make-huge-waves.html

It works very good, but make mistakes sometimes. Sometimes you can face with the same amount of wrong and correct results. But even if it's not working with 100% accuracy - it found really wide implementation.

Each person has many distinctive signs (in the world it is impossible to find two identical faces). For example, the some software defines these attributes as node points. Each face contains approximately 80 nodal points, like those we mentioned before: the distance between the eyes, the width of the nose, the depth of the eye cavities etc. These points are measured and create a numeric code face print, which then going to the database.

First of all, it's trying to detect and locate the face on the image/video. At the same time system is trying to align the view (geometric, brightness). After it's calculating all the features data of the face. In the end it's comparing this data with data of some face known in the system already.

Figure 2: Workflow of face recognition process
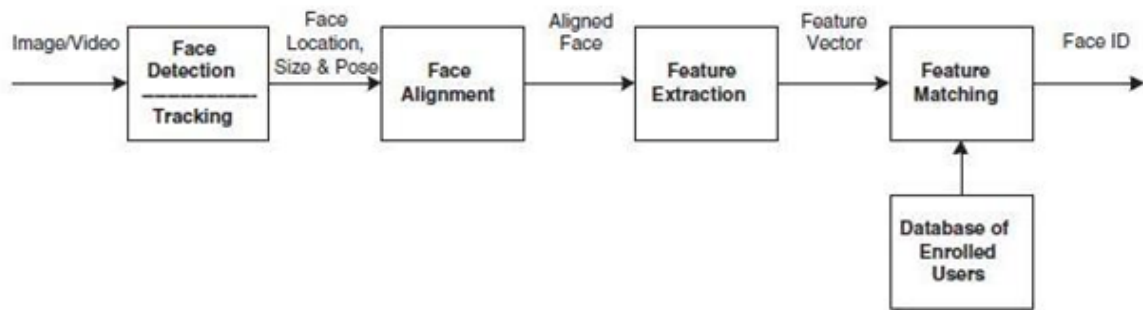
Source: Author

In the past, face recognition relied on two-dimensional images to compare or identify other two-dimensional images from the database. For greater efficiency and accuracy, the image should have been a person looking directly at the camera, with a small dispersion of light and without a special facial expression. Of course, it worked not so good as expected. In most cases images were not created in a suitable environment. Even a small change of light could reduce the efficiency of the system, which lead to the higher failure rates.

On change to 2D came 3D-recognition. This newly emerging trend in software uses a 3D model that provides high accuracy of face recognition. Imprinting a three-dimensional image of the surface of a person's face in real time, the software highlights the distinctive features - where hard tissues and bone are produced most, for example, curves of the eye socket, nose and chin - to identify the subject. These areas are unique and do not change with time.

Using the depth and the axis of measurement, which is not affected by the lighting, the 3D face recognition system can even be used in the dark and recognize objects from different angles (even in profile). Such software passes through several stages, identifying a person:

- Detecting of the image (getting the image from the 2D scan or life video);
- Alignment (when system found the face it's checking position of the head, size);

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- Processing (system processing the face and measure the curves);

- Representation (system transferring the data to the unique numeric code to compare);

- Comparing (if system is 3D and DB contains data – it will just find it. If in the DB you have just info about 2D images – system will divide the 3D image to the set of 2D images);

- Verification and identification.

After selecting the most successful shots, the system starts to recognize the face and compare it with the existing base. As a rule, the program is allocated about 100 points. The most important measurements for face recognition programs are the distance between the eyes, the width of the nostrils, the length of the nose, the height and shape of the cheekbones, the width of the chin, the height of the forehead, and other parameters.[1]

There are some cases, how you can use the face recognition: from video or picture. But it can be different type of video also. Face recognition can work not only with simple pictures, but also with thermal views. So thermal cameras are also valid for it.

Figure 3: Thermal camera

Source: https://www.instrumart.com/products/43731/fluke-tix580-infrared-camera

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1 Neural network in pictures: from one neuron to the huge architecture [online]. [cit. 2018-02-15]. Avaliable from:
https://daily.afisha.ru/brain/2551-kak-rabotayut-neyronnye-seti-i-chto-takoe-mashinnoe-obuchenie/

The human face emits thermal radiation which can be sensed by sensors that are sensitive in the thermal infrared band of the electromagnetic spectrum. Due to the presence of highly distinctive and permanent physiological characteristics under the facial skin, thermograms contain important information which can be exploited for face recognition.

Figure 4: Security video camera

Source: http://superbizdishwasherwallpaper.blogspot.com/2012/12/security-cameras.html

Video-based face recognition is finding out the identity of one or few persons present in a video, based on their facial characteristics. Given the input face video, a typical video-based face recognition approach combines the temporal characteristics of facial motion with appearance changes for recognition. This often involves temporal characterization of faces for recognition, building 3D model or a super-resolution image of the face, or simply learning the appearance variations from the multiple video frames. The ability to generalize across pose, illumination, expression, etc. depends on the choice of combination. Video-based face recognition is particularly useful in surveillance scenarios in which it may not be possible to capture a single good frame as required by most still image based methods.

3.3 Neural networks overview

There is a lot of methods to recognize the face, but the most famous one – neural networks.

There are dozens types of neural networks. One of the most widely used options is a network built on a multi-layer perceptron, which allows you to classify the input image/signal in accordance with the pre-setting/learning network.

Perceptrons were developed in the 1950s and 1960s by the scientist Frank Rosenblatt, inspired by earlier work by Warren McCulloch and Walter Pitts. Today, it's more common to use other models of artificial neurons - in this book, and in much modern work on neural networks, the main neuron model used is one called the sigmoid neuron.[2]

Figure 5: Perceptron input/output schema

Source: http://neuralnetworksanddeeplearning.com/chap1.html
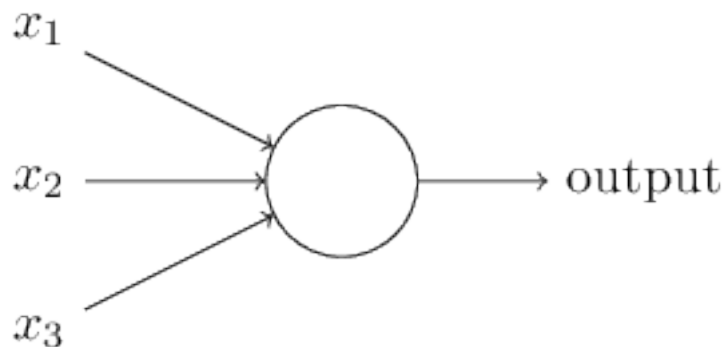
Perceptron takes few binary inputs and after it produce a single binary output.

For sure this picture is not representing a complete model of human decision-making model. It shows principle of perceptron decision weighting (every input has weight).

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2 Using neural nets to recognize handwritten digits [online]. [cit. 2018-02-15]. Avaliable from:
http://neuralnetworksanddeeplearning.com/chap1.html

More complex network may look like this:

Figure 6: Neural network example
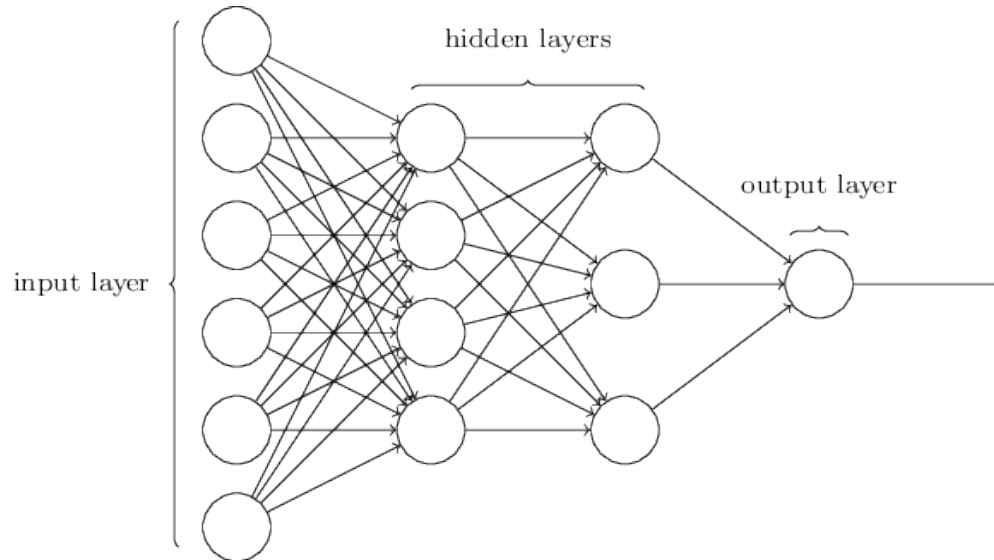
First column in this network is called layer of perceptrons. It's making three simple decisions considering input. The second layer of the perceptrons is making decisions considering the results from the first layer. Second layer can make more complex level then perceptrons in the first layer.

You can build network of almost any complexity. And each level can make more and more complex decisions.

On the picture you can notice that perceptrons have more than one output. But in fact it's the same output everywhere. Graph is just representing that output is going to each perceptron in the second level. This is more wise decision than write single output and then split the arrow to all the perceptrons on the next level.

That architecture is called back-propagation architecture.

The feedforward, back-propagation architecture was developed in the early 1970s by several independent sources (Werbor; Parker; Rumelhart, Hinton, and Williams). This independent co-development was the result of a proliferation of articles and talks at various conferences that

stimulated the entire industry. Currently, this synergistically developed back-propagation architecture is the most popular model for complex, multi-layered networks. Its greatest strength is in non-linear solutions to ill-defined problems.[3]

The basic back-propagation network should have an input layer, an output layer and at least one hidden layer. In theory there is no limits in hidden layers, but in fact there are just one or two. Some studies have shown that you can solve problem of any complexity with five layers (input/output and 3 hidden layers between). Every layer is fully connected with the last layer.

The number of the layers and how many elements in it – is very important decision. There are some rules in the network building:

• If complexity in relationships between the input data and the output you expect increases – the number of perceptrons in the hidden layer will also increase.

• If your process is separable into few stages – additional hidden layer(s) maybe be required. If not – additional layers can simple turn on the memorization of the training set.

It's pretty hard to predict how many hidden layers you are going to have. In fact it's not possible to sum up the design process for the hidden layers with a few simple rules. Many neural network researchers wrote plenty of guides and designs of networks, which help people get the behavior they want.

Sometimes backpropagation will define new hidden layer features that are not explicit in the input representation, but which capture properties of the input instances that are most relevant to learning the target function. Since the last layer is a linear function over these features, trained hidden units can be seen as newly constructed features that re-represent the examples so that they are linearly separable.[4]

3 Neural networks classification [online]. [cit. 2018-02-15]. Avaliable from: https://www.solver.com/xlminer/help/neural-networks-classification-intro

4 Machine learning fall [online]. [cit. 2018-02-15]. Avaliable from: http://l2r.cs.uiuc.edu/Teaching/CS446-17/LectureNotesNew/neuralnet1/main.pdf

There is an example of neural back-propagation network for digits recognition:

Figure 7: Example of digits recognition neural network
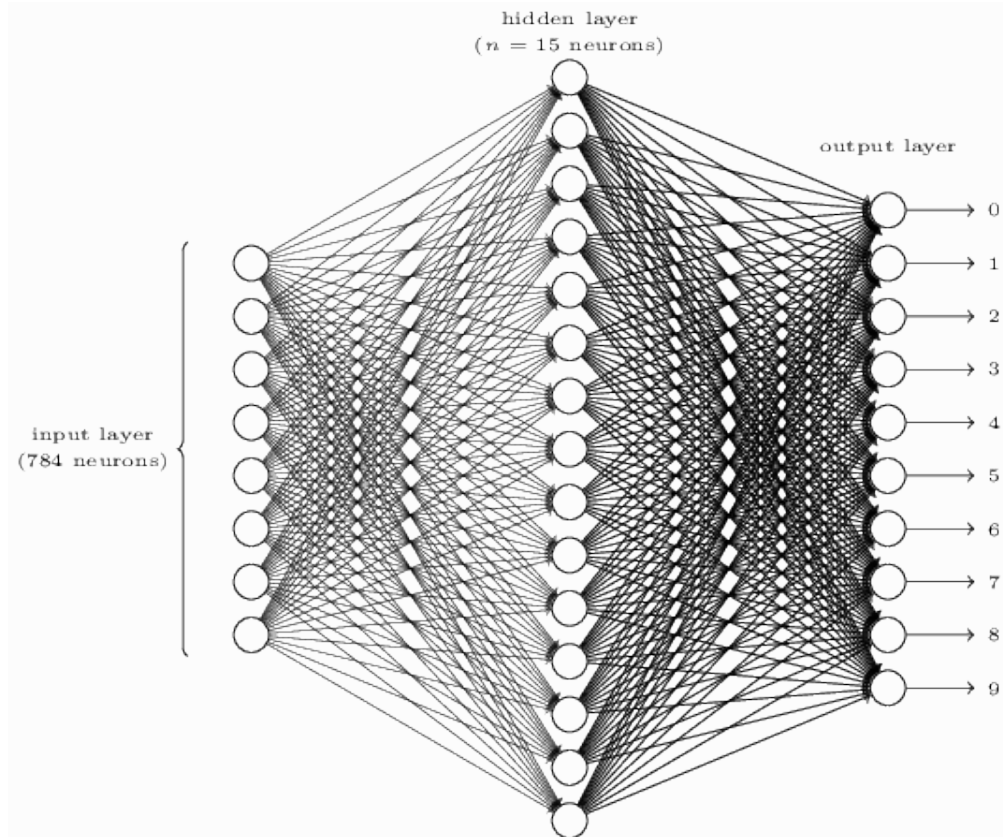
3.4 Neural networks training algorithms

Neural networks are trained on a set of learning examples. The essence of training is reduced to tuning the weights of inter-neural connections in the process of solving the optimization problem by the method of gradient descent. In the process of learning the key features are automatically extracted, their importance is determined, and the relationships between them are constructed. It is assumed that the trained network will be able to apply the experience gained in the training process to unknown images due to generalizing abilities.[5]

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5 Face recognition: how it works and where it leads to [online]. [cit. 2018-02-15]. Avaliable from: https://hi-news.ru/technology/raspoznavanie-lic-kak-eto-rabotaet-i-chto-s-nim-budet-dalshe.html

The weight in the neural network are highly interdependent. If you change the weight of one input – it is going to affect not only the neuron it propagates to directly, but also all the further successors layers. And it's affection the output.

In this case we can't obtain the best set of weights by optimizing just one at time. We will have to search the entire space of possible weight combinations.

There are 5 main algorithms to train the neural network:

- Gradient descent
- Newton's method
- Conjugate gradient
- Quasi Newton
- Levenberg Marquardt

Gradient descent (also maybe be called steepest descent) is the most simple algorithm. It takes information from the gradient vector and hence it is a first order method.

Figure 8: Diagram of the training process with gradient descent method
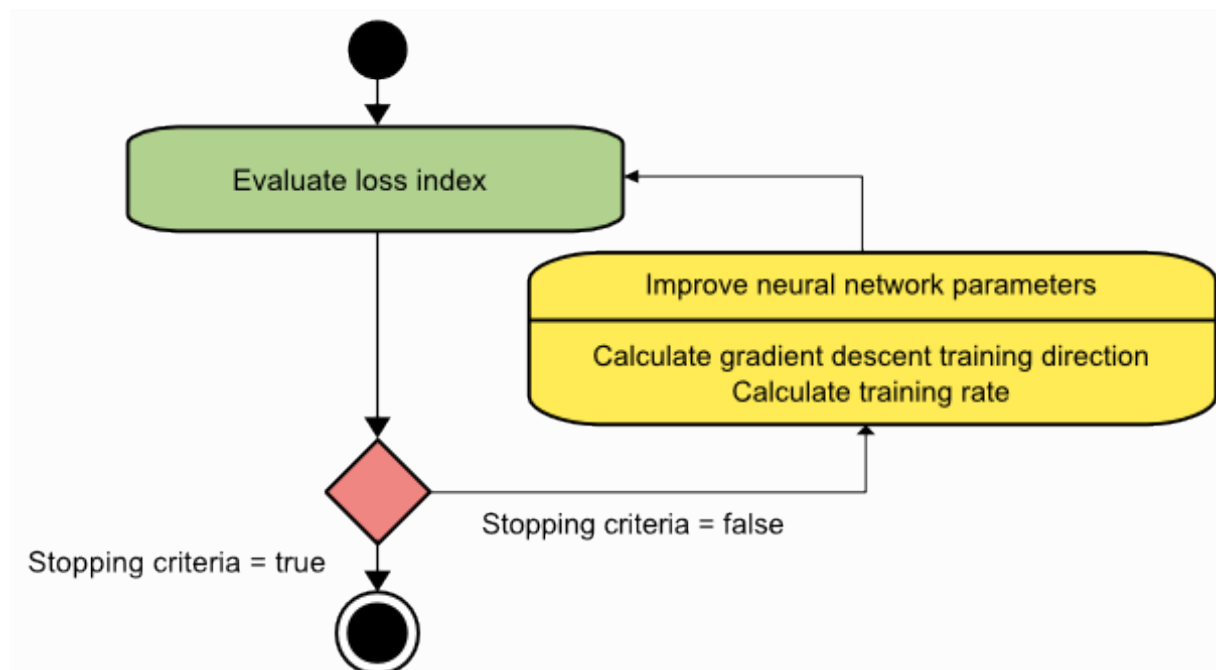
This is the most famous algorithm to use, especially in study. First we start with a random guess at the parameters. We then figure out which direction the loss function steeps downward the most (with respect to changing the parameters), and step slightly in that direction. To put it another way, we determine the amounts to tweak all of the parameters such that the loss function goes down by the largest amount. We repeat this process over and over until we are satisfied we have found the lowest point.[6]

The Newton's algorithm use the Hessian matrix. It's a square matrix of second-order partial derivatives of a scale-value function. This algorithm is used to find better training directions by using the second derivatives of the loss function.

The conjugate gradient is something between gradient descent and Newton's algorithm. This method has proved to have better performance than gradient descent in training. Also it's not require the Hessian matrix, so it's recommended to use in very big neural networks.[6]

Newton's method is very expensive (considering machine time), because it requires many operations for evaluation of the Hessian matrix and then inverse it. But in Quasi-Newton method instead of these calculations it's making an approximation to the inverse Hessian at each iteration. It's computed only from information on the first derivatives of the loss function.[6]

The Hessian matrix is composed of the second partial derivatives of the loss function. The main idea behind the Quasi-Newton method is to approximate the inverse Hessian by another matrix G, using only the first partial derivatives of the loss function.[7]

The Levenberg-Marquardt algorithm (damped least-squares method) was made to work specifically with loss functions in form of a sum of squared errors. It's not computing the Hessian matrix, but it works with gradient vector and the Jacobian matrix. This matrix of all first-order partial derivatives of a vector function.

6 How neural networks are trained [online]. [cit. 2018-02-15]. Available from:
https://ml4a.github.io/ml4a/how_neural_networks_are_trained/

7 5 algorithms to train a neural network [online]. [cit. 2018-02-15]. Avaliable from:
https://www.neuraldesigner.com/blog/5_algorithms_to_train_a_neural_network

All the methods are good in particular cases. It means that every all of them has pluses and minuses. Most of all it's reflected to the training speed and required memory for it. On this graph you can see all the methods compared to each other:

Figure 9: Speed/Memory requirements for neural network training methods
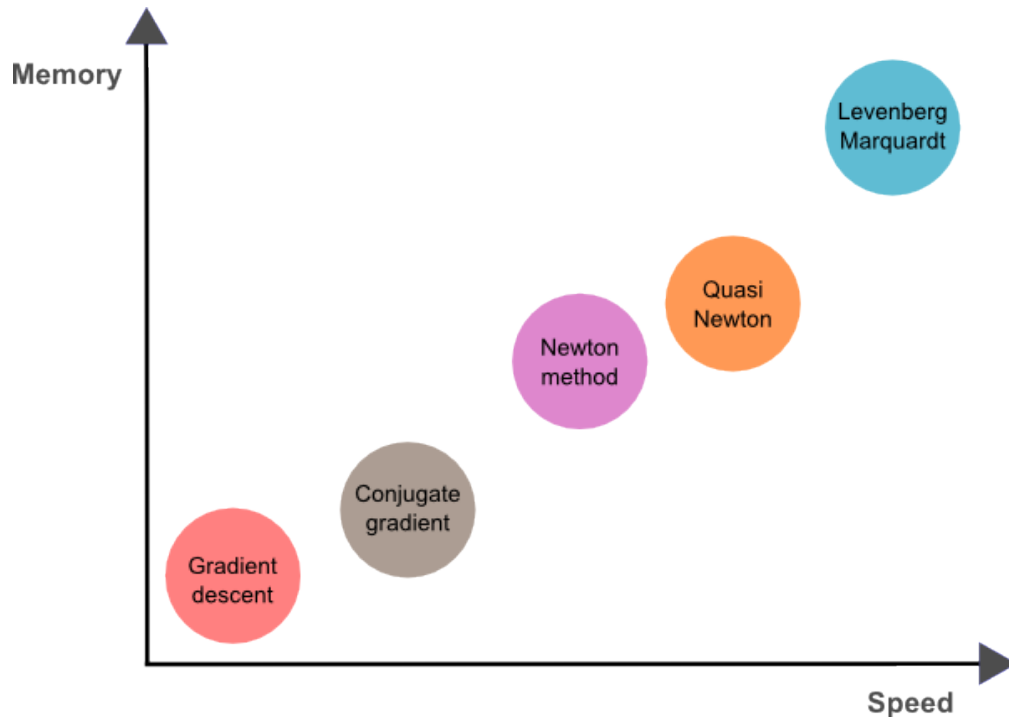
As you can see – the slowest algorithm is gradient descent, but it requires much less memory. But on the contrary – Levenberg-Marquardt is very fast, but requires a lot of memory to use.

If out network has thousands of parameters – we can use gradient descent or conjugate gradient. It will save memory.

But if we have many neural networks to train with just a few thousands of instances and hundreds of parameters – the best choice could be the Levenberg-Marquardt algorithm. In all the different cases you can use the Quasi-Newton method.

In my application I'll describe "high" level network education. User just have to upload images of the persons – and network will make all the calculations. We can add 2 photos of the same

person and one photo of different one and check the results. It's huge amount of ways how to train this network.

Basically, after user upload the photo to the system it will save results like this:

Figure 10: Image processing result
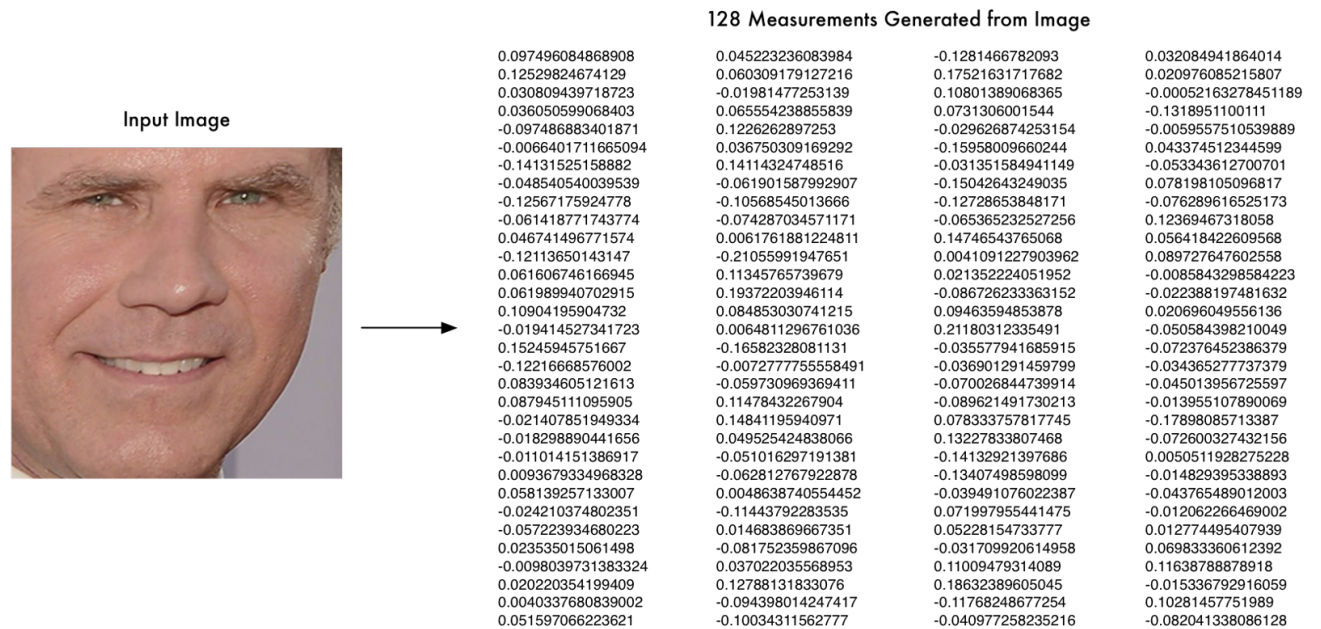
4. Implementation

4.1 SWOT analysis

Table 1: SWOT analysis

Strengths	Weaknesses
1. Access to functionality from any device and any place 2. All the processes are made on the server machine, so user can access the app even from weak device	1. Big amount of similar apps 2. Technology is new and not spread in the market
Opportunities	**Threats**
1. Big interest among users due to the very easy design and functionality 2. App can be extended in many ways in order to provide more functions and produce more data	1. Low interest to the unknown app among users 2. Low internet connection

Source: Author

Strengths

1. Access to functionality from any device and any place

As soon as this is web application – you can access it from any place where you can access internet. This application is fully responsive, so user can access the app from any device.

2. All the processes are made on the server machine, so user can access the app even from weak device

When user press the button – application on the server is getting data from the video stream. This data has been processing on the server side and after user just getting the result and apply it.

Weaknesses

1. Big amount of similar apps

Great number of similar apps on the market may affect the interest of the user.

2. Technology is new and not spread in the market

Most of the users may have low level of confidence in something new, especially apps in internet. It's narrowing the target audience of the app.

Opportunities

1. Big interest among users due to the very easy design and functionality

Application has easy understandable and intuitive design, so user just should upload the photo of necessary person to the system and assign it to the person. After that user can check, if system can recognize this person on the real video.

2. App can be extended in many ways to provide more functions and produce more data

There are a lot of ways to improve the app. It can make a lot of statistics considering data which it got. Show data related to the concrete photo and it's accuracy.

Threats

1. Low interest to the unknown app among users

User which has already used some different similar app may have low interest in downloading this application.

2. Low internet connection

User should have some minimum speed to have proper work of the application. Low internet connection can turn user away from the app.

4.2 Results from the research

Considering research, we can highlight the most important parts in the application, which we should pay attention to.

First – user has primitive understanding of what he wants. He just wants to see face recognition on the video, so his task just to upload the photos and see the result. In this case design should be very easy and understandable for the average middle-age person. User every time try to find free solution, so from all the applications he is going to choose between free one first. In current application all the functions are for free.

Another important thing, what user look in application – face recognition. In this app user can upload many photos to train the system and after he can see the matches on the video with frames around the face and name of the current person.

Another important thing – neural network architecture and learning algorithm. Speed of the recognition and learning depends on this. In this application we use 2 hidden layers architecture. It fits to all the requirements considering face recognition calculations. And Newton method is used like learning algorithm for the network. It has optimal speed and memory usage for the web application of common use.

4.3 Goals

1. Log in into the application
2. Change User email
3. List of Libraries
4. Create new Library
5. List of Persons
6. Create new Person
7. Upload photos for the Person
8. Watch online video stream with face recognition ongoing

9.   Deactivate Library

10.   Leave the Feedback

11.   Log out

4.4 Personas

Name: John Smith

Age: 30

Gender: Male

Background: not so long time ago John finished his Mastery degree on Economics. He is working like consultant for big IT company. He helps to client to make best solution for their business with help of company tools. John knows how to find a way with people, he is doing his job good. He doesn't have really strong IT background, but he is interested in new technologies. He has some reparation works in his country house, which is made by some builders.

Typical day: every morning John wake up and after shower he is going to work by metro, because he hates to go by car in the morning due to huge traffic. On the way he is buying sandwich for fast breakfast before morning meeting. After meeting John used to read some news and then get to work. During the day he has many calls and meeting with clients, but he feels really good and comfortable. Most of the time he spends with his laptop. When client complains on something, John is creating user stories for the developers' team. After work John used to go home to take a rest or meet with his friends in bar.

Name: Simon Noxwel

Age: 43

Gender: Male

Background: He has Bachelor degree on Economics. From childhood he was dreaming about his own shop, so his dream came true. He likes to keep order in the shop, come up with some

shares for people in need. He used to help to government in search of some people. Many suspicious people likes to visit small shops. Sometimes police can search for someone from this people.

Typical day: in the morning Simon have breakfast with his wife and daughter. After that he drives his daughter to school. In the morning at work he fills in forms for products order, checking if acceptance of goods is going well. After lunch Simon usually sit in his office and checking cams for violence. After work he is going home to get dinner with his family and help his daughter with homework.

Name: Katarina Timaseva

Age: 19

Gender: Female

Background: Katarina studies for Bachelor degree on Informatics. She has typical student live and environment. She lives in university's dormitory, which is not good, unfortunately. She has 3 more neighbors in one room, common toilet and kitchen for whole level. Sometimes she notice that some stuff from her table are disappearing.

Typical day: every morning Katarina wakes up and going to school. She likes to study so she is doing it with pleasure every day. For lunch she is going to canteen and opens her cute plastic box with animals picture on it. She usually cooks food for every day at home. After school she is going to training – Katarina doing ballet. After training she is going home to take a rest or sometimes she can go with her friends for a small walk. Before sleep she likes to read some book for 15 minutes, it helps her to fall asleep very fast.

4.5 Use cases and scenarios
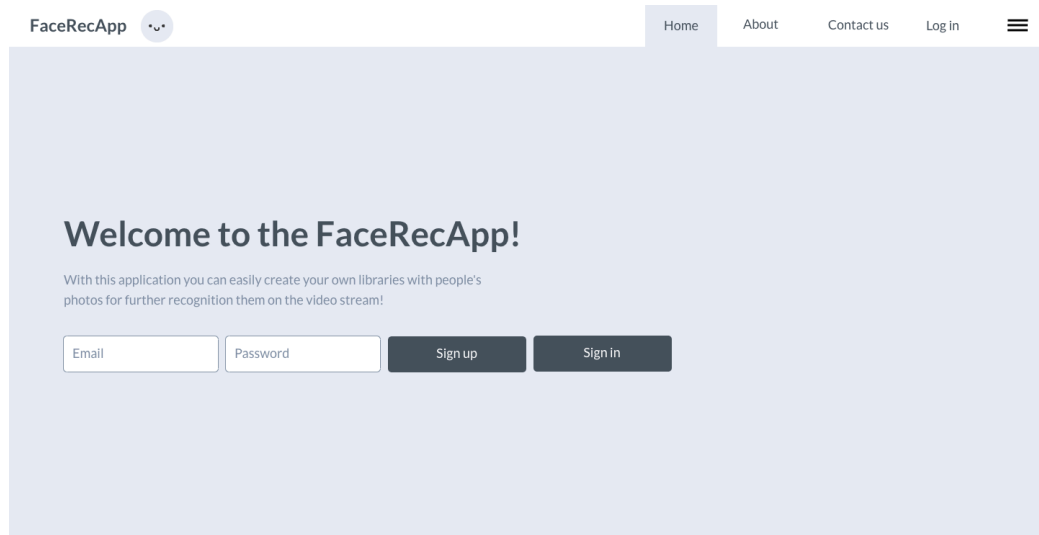
4.5.1 Log in Use Case

User wants to start making experience with the application. In order to make it user expects to see the login form.

Log in Scenario

The system provide user with log in and register form on the home page. It also provides user with link to separate login page with the same form.

Figure 11: Main page login form

Figure 12: Log in page

### 4.5.2 Create Library Use Case

User want to create Library record for further work with it. He expects to see list of all Libraries and button to create the new one. In case if user has a lot of records he expects to see Search Input Field and pagination, to find the necessary record.

User expect to see the Create Form for Library with related to it Persons. Also user expect to see the form for Person assignment.

List of Libraries Scenario

The system allows user to see the list of all Libraries he has on the separate page. User allowed to edit or delete a record from the list or create a new one. Also system provides user with Search functionality and pagination.

**Figure 13: List of Libraries page**
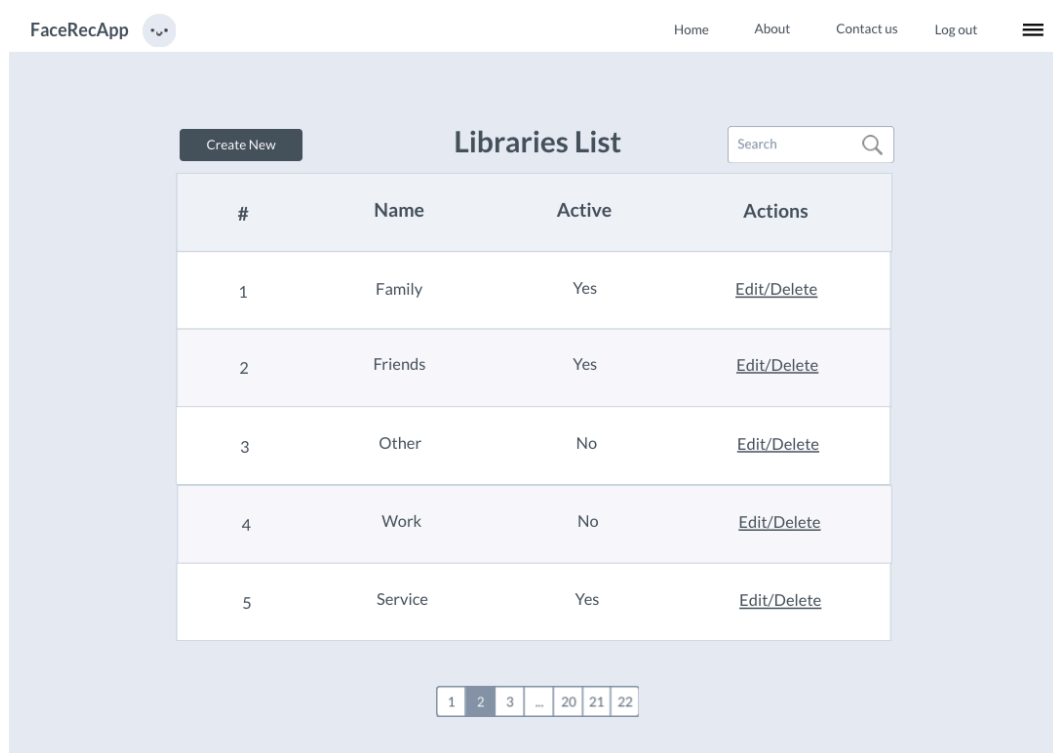
Source: Author

Delete Library Scenario

User expect to see the confirmation message before record deletion, with information about the record. The system provides user with confirmation message with number of related to Library Persons.

Figure 14: Delete Library Confirmation Message

FaceRecApp ⌄·

Home   About   Contact us   Log out   ☰

Libraries List   Search   🔍

#	Name	Active	Actions
1			...ete
2			...ete
3			...ete
4	Work	No	Edit/Delete
5	Service	Yes	Edit/Delete

Are you sure you want to delete "Family" Library?

It has N Persons assigned!

Yes   Cancel

1 2 3 ... 20 21 22
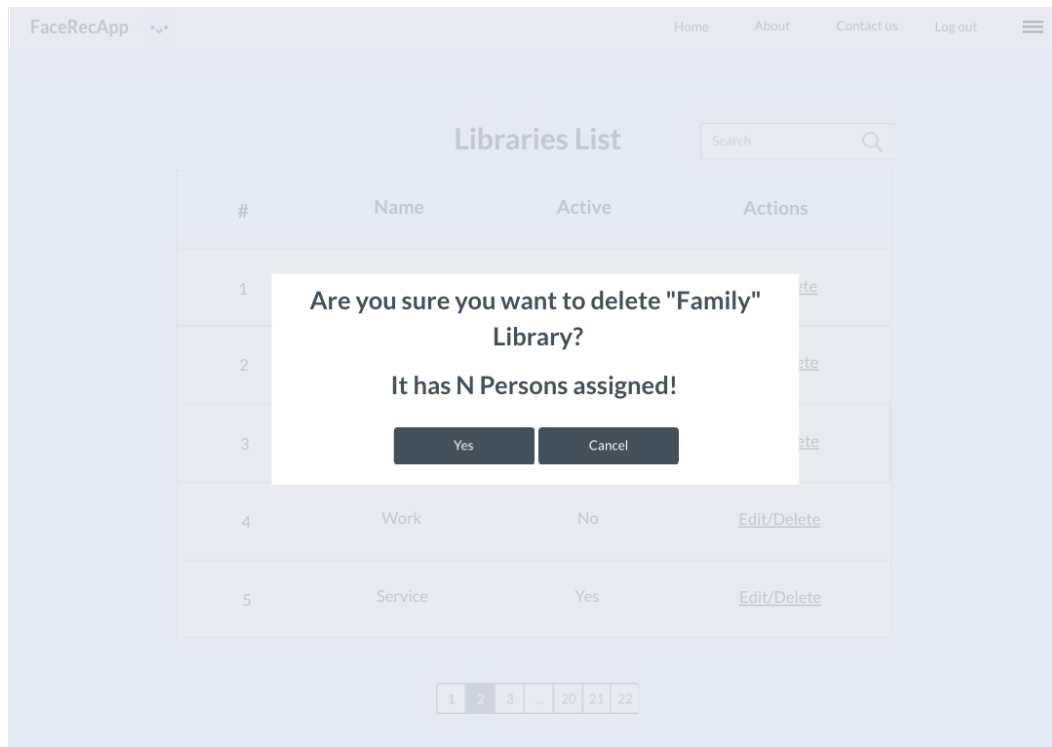
Create Library Scenario

The system allows user to insert data in Create Library form to create a new library.

Figure 15: Create/Edit Library Form

Source: Author

Also the system provides user with special form for Person Assignment.

Figure 16: Assign Person To Library Form

Source: Author

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System redirects user to List of Libraries page after record Saved.

4.5.3 Create Person Use Case

User want to create Person record for further work with it. He expects to see list of all Persons and button to create the new one. In case if user has a lot of records he expects to see Search Input Field and pagination, to find the necessary record.

User expect to see the Create Form for Person with related to it Library. Also user expect to see the form for Library assignment and button to add a new photo to the Person.

List of Persons Scenario

The system allows user to see the list of all Persons he has on the separate page. User allowed to edit or delete a record from the list or create a new one. Also system provides user with Search functionality and pagination.

Figure 17: List of Persons Page
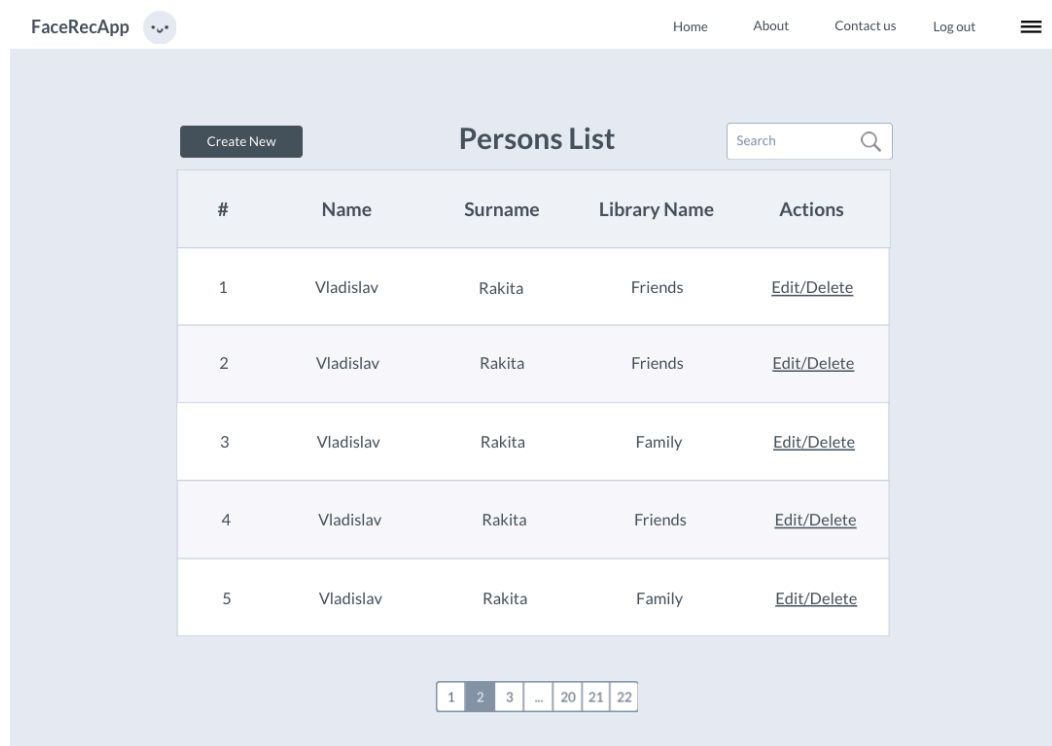
Source: Author

Delete Person Scenario

User expect to see the confirmation message before record deletion, with information about the record. The system provides user with confirmation message with number of related to the Person photos

Figure 18: Delete Person Confirmation Message
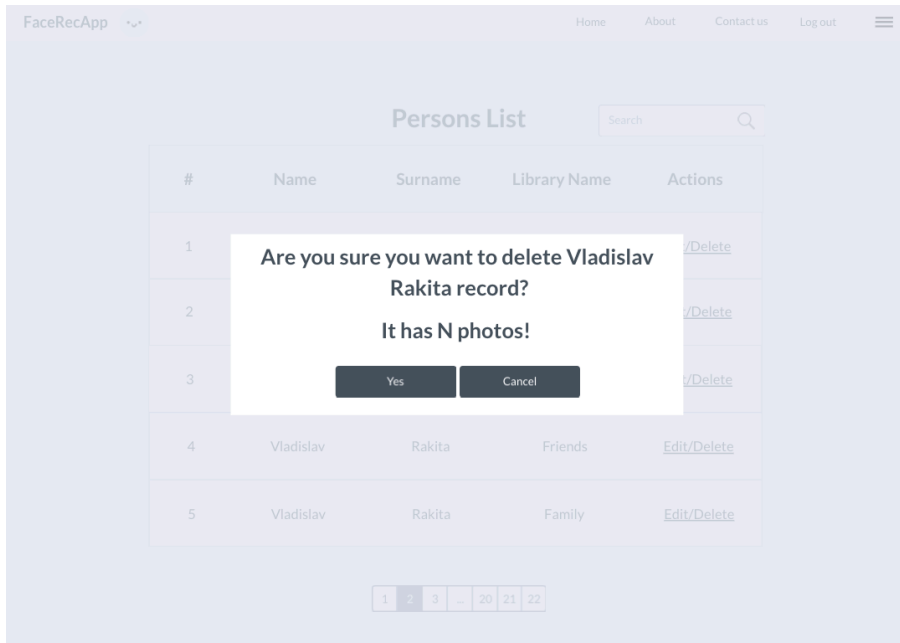
Create Person Scenario

The system allows user to insert data in Create Person form.

Figure 19: Create Person Form Page

The system provides user with special form for Library Assignment.

Figure 20: Assign Library Form

System redirects user to List of Persons page after record Saved.

4.5.4 Watch online video stream with face recognition Use Case

User wants to see the primary function of the application – face recognition. He expects to see a page with video, streamed from his webcam. User expects the system to show him all the Persons, which user has in his active Libraries, if they appear on the video, and show video full screen.

When the video session is stopped – user want to see some statistics about the stream (who was there, how many times etc.). He expects to get email with all the information about the stream.

Start work with video stream Scenario

The system allows user to start his own video stream. It derives separate faces of Persons from active Libraries and show their names right in the video window. The system allows user to stop the stream by pressing the Stop button and make video full screen.

Figure 21: Video Stream Page
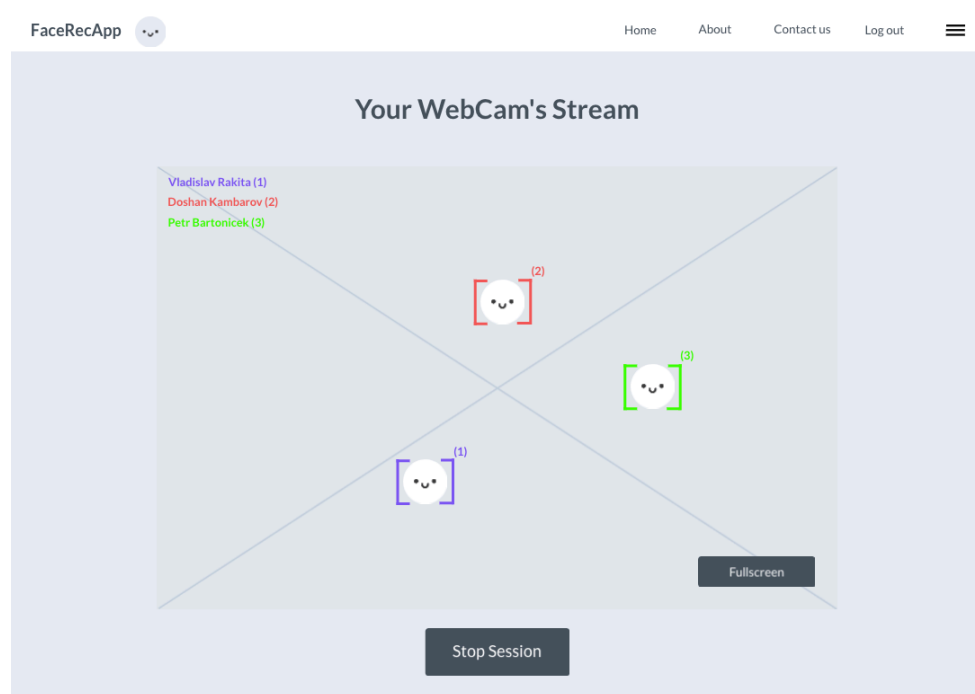
Source: Author

After that system sends an email to the user's email with statistics about the last stream.

Figure 22: Stop Video Session Message
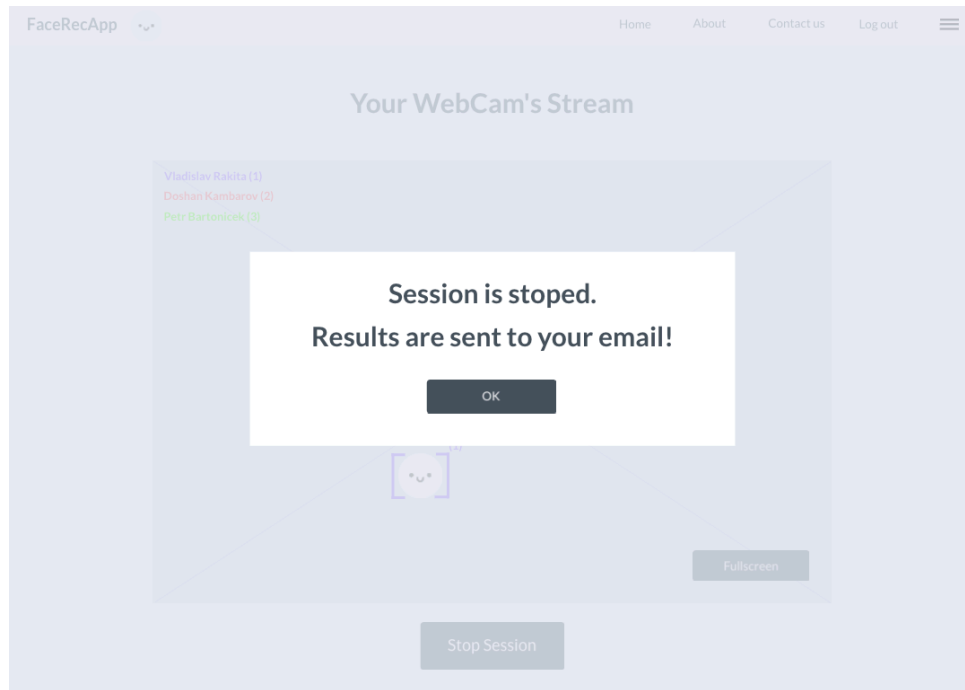
In the end system redirects user to the Home page.

4.5.5 Leave feedback Use Case

User wants to leave a feedback or ask questions from the administrator of the service. He expects to have a page with form, where he can fill in his name, email and text of the message. After message has been sent user expects to see the confirmation message.

Feedback Form Scenario

The system allows user to fill in the Contact form in the separate page to keep in touch with administrator of the service.

Figure 23: Feedback Form

After form submission system shows the confirmation message to the user.

Figure 24: Submit Form Confirmation Message

System redirects user to the same page after form submission.

     4.5.6 Change Profile information Use Case

User wants to change the information about his Profile. He expects to see the page with form, where user can edit his name, surname, email, birth day and avatar photo. User doesn't want to care about date formatting, so he expects to see the form for Birth date field.

Change User parameters Scenario

The system provides user with the form, where user can change his Profile parameters – name, surname, email and birthday. System also provides user with useful date-picker form to change the birth day.

Figure 25: Edit Profile Info Page

The system shows the user a confirmation message about data has been saved.

4.5.7 Read the documentation Use Case

User want to read info about the application and best practices how to use it. User expects to have a link in the navigation menu, which redirects him to the page with necessary info.

Read the documentation Scenario

The system provides user with the link to About page, where user can read all the information about the system and how to use it. If user need something what is not described here, system provides with link to the Contact page on the bottom.

Figure 26: About Page
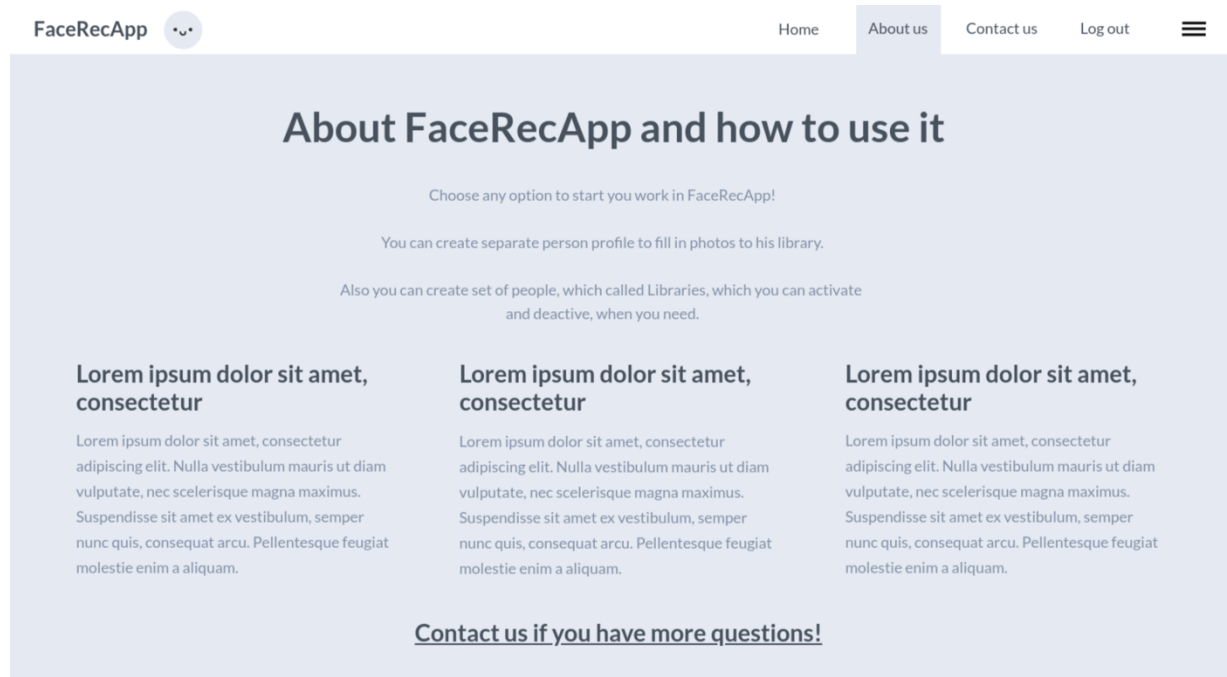
Source: Author

5. Test in Usability Study

For the testing of the application I've created paper prototype of the app. It was done with the use of glue, scotch tape and paper. It fully represents every page which I have in the electronic version of the prototype.

For the test we took just 5 people. Test was done in the Usability Lab of faculty of Economics and Management CULS in Prague. All the users didn't have experience with applications of this type.

During the interview with the testing group, I could understand the main parts they were paying attention on. Everyone was very happy with the main function – face recognition function implementation. They found it very elegant and useful. Especially people liked online face framing.

After all – group mentioned minimalistic and very pleasant design. Everything is visible, there are just few buttons on every page. All the functions and pages are instinctively understandable. Nevertheless, I had to make short speech about Libraries and Persons in the system, but basically user can read it in About section.

It was also the main difficulty for users – before I say about functionality, they couldn't find out why you need Libraries and Persons. But good documentation on the page can solve this problem easily. Few people mentioned that they couldn't find save record button or add related item. It made me to change the design and made buttons "glued" to the top of the screen, if you scroll it down.

Conclusion to the testing – almost everything in design was mentioned positively, nevertheless there were decided to change design of Record Detail layout buttons.

6. Changes at UI Specification

Based on the review from the testing user group, I've decided to change the design of the Record Details page buttons and make them "glued" to the screen top border, if you scroll page down.
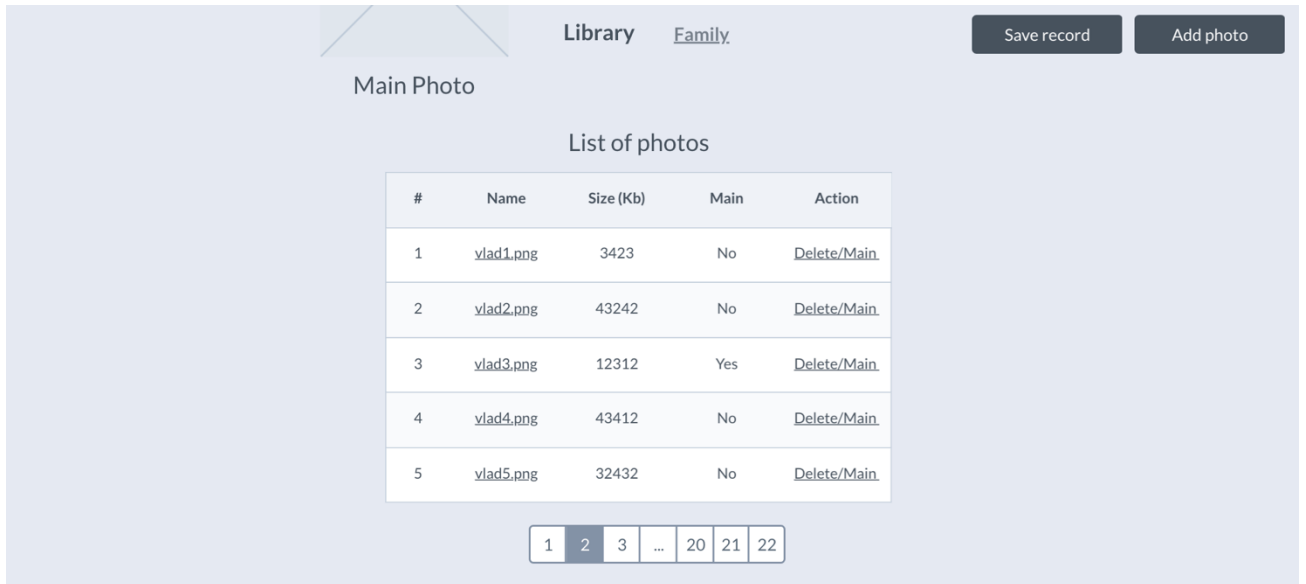
Source: Author

7. Conclusion

In conclusion – all the goals which were set up are done. The User Interface of web application with face recognition function support was created and tested in professional conditions in laboratory made for UX design testing. Also paper prototype of the app was created and tested with the group of people.

The main goal was to create user interface for web application with face recognition support. Interface fit all the conditions described: user can upload photos for further recognition on the video, manage and edit data (libraries, persons), log in function, which allow user to store his own libraries and persons.

During the research, I've observed the current state of face recognition systems and neural networks. Study suitable literature was discovered to have wide overview on the situation. Everything says that these technologies has very big future, both face recognition and machine learning. From the result of the study I've defined current state of the solution and reflected everything on the current application functionality.

For the application test I've created the paper prototype which is reflecting all the functionality and requirements of original application. It was tested by the group of people and after, during interview session, participants shared all the ideas about application improvement.

Artificial intelligence will be able to solve many tasks for the people. There are many skepticism around this topic though: there are many representors of theory that AI can overgrow the humanity soon and decide to get rid of it. But I think that can be easily improved with due care and security.

8. Bibliography

1. Neural network in pictures: from one neuron to the huge architecture [online]. [cit. 2018-02-15]. Avaliable from: https://daily.afisha.ru/brain/2551-kak-rabotayut-neyronnye-seti-i-chto-takoe-mashinnoe-obuchenie/

2. Using neural nets to recognize handwritten digits [online]. [cit. 2018-02-15]. Avaliable from: http://neuralnetworksanddeeplearning.com/chap1.html

3. Neural networks classification [online]. [cit. 2018-02-15]. Avaliable from: https://www.solver.com/xlminer/help/neural-networks-classification-intro

4. Machine learning fall [online]. [cit. 2018-02-15]. Avaliable from: http://l2r.cs.uiuc.edu/Teaching/CS446-17/LectureNotesNew/neuralnet1/main.pdf

5. Face recognition: how it works and where it leads to [online]. [cit. 2018-02-15]. Avaliable from: https://hi-news.ru/technology/raspoznavanie-lic-kak-eto-rabotaet-i-chto-s-nim-budet-dalshe.html

6. How neural networks are trained [online]. [cit. 2018-02-15]. Available from: https://ml4a.github.io/ml4a/how_neural_networks_are_trained/

7. 5 algorithms to train a neural network [online]. [cit. 2018-02-15]. Avaliable from: https://www.neuraldesigner.com/blog/5_algorithms_to_train_a_neural_network

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