

The Use of Web Technologies on the Example of the Online Store Application Supporting Graphical Selection of Clothing for Clients

Student project

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Abstract—Building online store with using current technologies should not be a challenge, although the promotion of this type of page without any additional functionalities can be difficult especially with huge competition. Graphical support for selection of clothing for clients would be distinguishing feature.

Index Terms—Java, Matlab, HTML5, CSS3, JQuery, Spring, Hibernate, digital image processing, online store application

I. INTRODUCTION

WITH today's diverse apparel market, the size selection mistake is very possible, especially when there is no possibility to check the size personally on own silhouette. This inaccuracy is practically indispensable part of online stores and it generates high costs and brings together a huge number of people who choose a more expensive item in the store to be sure that it is matched to them, rather than a cheaper version via the internet, where size does not necessarily have to be as it should. This fact implies that practically every cloth company has its own size table which defines the appropriate spacing of the individual parts of the product in centimeters. There are rarely cases where there are different sizes within the same company. There are no solutions in today's market that will anyhow help a customer choose the correct size. In some cases, they are only given, size mapping on the human silhouette in centimeters for example, in the waist. It is also worth noting that with the current number of online clothing stores, the chance to promote store without much financial contribution is practically impossible. The following tool such as graphical support for selection of clothing for clients solves both of the above problems.

II. USED TECHNOLOGIES

A. Java

Java – is an object-oriented language programming to create programs compiled to bytecode, where the next part of operation is executed by virtual machine. The main concepts of this language are: object-orientation and inheritance. It is said about Java, that everything is an object, what is not quite true, because local variables, parameters, generic classes and

methods are not objects. The concepts of object-oriented programming means that if we have class – tree for example, each of instance of this class will be an object. The main purpose of object-oriented programming is encapsulation, which assure that object will not be available to affect other inner objects in any unexpected ways. Inheritance is as much important as object-orientation, because it allow us to avoid repeatability of code, e.g. if we have class – pine and class – oak, we do not have to define same methods and fields for each type of tree, because they can inherit all the same features of trees.

B. Spring

Spring – is a framework for Java programming language, which accelerates and extends creation of applications based on Java. The core of Spring is dependency injection container, which exists for manage all of components and their relationships. Spring framework also offers automatic detection aforementioned relationships without any interference of programmer. What is more, Spring allows us for manual configuration, which is helpful if we need to solve unconventional problem. After latest updates in Spring, new possibility occurred for creating whole configuration based on Java code. Configuration based on Java code, accelerates the process of creating software, compared to difficult configuration based on XML files.

C. Hibernate

Hibernate – is a framework that simplify access to data layer. Hibernate as an ORM(Object/Relational Mapping) assures transfer between relational database and object-oriented world like Java programming language. This framework also allows us to build objects from tables in database, with previous assumption resulted from Hibernate requirements.

One of many advantages of Hibernate is that with using one syntax we can work with many database systems like e.g. PostgreSQL, MySQL, MSSQL etc. The only thing that differentiates this connection between themselves is dialect and provider in connection configuration. Another big advantage of Hibernate is that classes created for his needs have the same features as Java like polymorphism, inheritance etc.

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D. JSP

JSP (JavaServer Pages) are dynamic pages WWW in which we can use Java programming language.

We can find some kind of analogy between JSP and PHP, because Java code in web pages behaves identically as WWW documents with using PHP language.

Advantage of using Java code in WWW pages is that if whole part of program was written in Java, there is no need to learn new technologies by the programmer.

E. Maven

It is a tool to automate software development on Java platform. Convention Over Configuration, is one of the main assumptions of Maven, that focuses on building complicated solutions with relatively small amount lines of code. Maven can manage a project building and its documentation and reports. Main file which Maven is using to build dependency tree is a POM (Project Object Model). In projects without Maven we have to take care about whole libraries manually, what could be oppressive. Instead of this we have dependencies, which are downloaded automatically.

F. PostgreSQL

It is one of the most popular open source system for database management. PostgreSQL is good choice when integrity of data is very important. What is more, PostgreSQL is also a great multiplatform solution. It is available on UNIX and Windows systems. The only disadvantage of it is the read operation speed, which is much worse than other its competitors.

G. HTML5

HTML5 language belongs to languages family called markup languages. Currently this language is used to create web pages.

One of the biggest differences between current and older HTML version like HTML4 is that HTML5 introduce one common interface to implement elements in easier way. For example, if we are using HTML5, we do not need to install Flash plugin apart, because it has been already embedded. Not only this was fixed. Standardization of code for all browsers also has changed, what means that if we tested our code on one internet browser, we had to do it also on other browsers in older edition of this language. Currently we do not have to worry about it, thanks to wider compatibility.

In HTML5 language syntax, markup is a string which is surrounded by angular brackets. Most of the markups need to have their pair, what means being opened and closed at the end, for example: `<html></html>`. These markups give to this fragment specific meaning. For example, if we are using markups ``, the text between them will be bold.

H. CSS3

The appearance of WWW pages is dependent from two factors. One of them is the code of the page, written in HTML language. The second one is a format which is given by browser to different elements. The structure and whole content

WWW documents we describe, by using HTML elements, like paragraph(markup `<p></p>`), or markup which creates reference to other sources(markup `<a>`). Format of these elements is defined in CSS language (Cascading Style Sheets).

CSS was designed to simplify and improve clarity of HTML documents. Before CSS was invented, all information about page appearance were included in HTML markups. Export of CSS code to separate files, caused that need to repeating of code was disappeared. We can use CSS styles in HTML document, on three other ways:

- By *style* attribute,
- By outer styles,
- By inner styles.

In practice Cascading Style Sheets allow us to create page appearance in many ways. This ways are:

- Appearance of single element (color, border, opacity),
- Text formatting,
- Positioning elements on page,
- Graphic presented on the page.

With new specification CSS3 language, @media rules have been expanded. The next part of this article will bring us to this point.

I. RWD

In current mobile technology development, web pages had to be redesigned in a way to exclude necessity for creating the same page for stationary devices(with larger screen) and for mobile devices(smaller screen). RWD technology was the answer for this issue.

RWD – Responsive Web Design is a WWW page, which was designed mainly for adjusting to screen resolution, without losing main graphical theme and majority function.

Media Queries in third version of Cascade Style Sheets (CSS3) were invented for creating responsive web design. Media rules define in what way specific page elements should behave. For example, if we design a menu, which stretch on whole 21” screen, on small screens this menu should be smaller and designed like „hamburger” menu. Thanks to media rules we can define which element will be displayed on specific screen resolution.

J. Bootstrap

It is a framework to CSS, which includes huge amount of useful functionalities. This framework is a set of different elements packed in one tool. Bootstrap focus around responsive web design. With using few CSS classes, we are able to program main modules of our WWW document, more precisely – their behavior during changing screen resolution.

The biggest advantage of this tool is simplicity of its use, because thanks to a few code lines we can quickly create responsive views.

K. jQuery

It is a programming library for JavaScript. It allows us achieve interesting results like: animation, AJAX communication and allows dynamically change the page, with low decrease of performance (compared to the pure JavaScript).

The main advantage of the above library is broad community that uses it. Consequently, thanks to get access to a large quantity of various plugins, so that the programmer can save a lot of time.

III. PRESENTATION OF SOLUTIONS SUPPORTING SIZING CLOTHES

The title tool for the graphical support for the selection of the size of the clothes to the customer, is mainly based on image processing. There are two conditions that user must fulfill to allow algorithm measure various elements figure from a photo. The first of these is to provide a photo according to the description, and the second condition is to outline the key points in this case it is the determination of the arms. The user has two ways to deliver images, the first of them is the message from the local data storage, the second, making it by a webcam. Identify key points on the body user is accomplished by manual indication and clicking the desired location on the image.

Due to the above, classified size of the user will be used to suggest to him the right cloth size. In the clothing industry, each piece of clothing that has a size (e.g. L / XL or 36/38) also has its dimensional table. Dimensions table is nothing else than to determine the dimensions of the individual compartments of clothing items (Table I). In order to minimize the load user interaction with a tool to assist the selection of size, a sufficient condition is the distance between the arms, so that the algorithm selects the correct suggestion sizes.

TABLE I
SAMPLE DIMENSIONAL TABLE

	XS	S	M	L	XL	2XL	3XL
1/2 Chest width	45	47	51	55	59	63	67
1/2 Waist width	42	44	48	52	56	60	64
1/2 Hip width	48	50	54	58	62	66	70
1/2 Bottom width	48	50	54	58	62	66	70

IV. CHOICE OF SOLUTION

Reading the various dimensions of the image, unfortunately, it is conditioned by many factors. The most important of these is the focal length of the lens of the camera. During the shooting, where the default recording format is JPG, the focal length of the lens can be downloaded using the dereference the relevant information from the EXIF metadata (Exchangeable Image File Format). Metadata is simply telling data about data, in this case, they store information about the photos. Unfortunately, webcams usually have a different default file save format than JPG. For this reason, a solution based on the information stored in the EXIF was rejected.

The second option to get the focal length of the lens is the camera calibration. However, the assumption that the user will

want to devote his time to calibrate the webcam using the proposed print is utopian. Considering the above, the best choice was to use a pattern to analyze the dimensions of the image correctly. The pattern should be the object of known size, possibly close to the figure shown on the picture. Among the wide range of choice, the choice fell on the use of the phone's display as a pattern. This solution has its great advantages. The first of these is the ease of detection of the display where the user will display a bright green color. The second advantage is that the vast majority of phone owners know the size of the display of their phone. Another positive is properly positioned figure through adequate way to hold the phone (Figure 1).

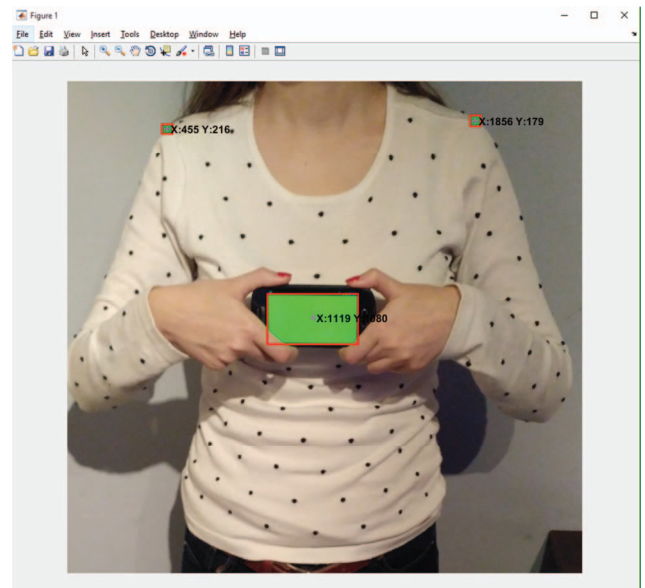


Figure 1. View of correctly identified objects.

The next step is to recognize the human figure in the picture. Developing an algorithm that would do this without any additional requirements (such as pointing points on the body) came out to be redundant. With this solution, the user would have to remove the top part of the clothing, or completely get rid of the upper part of the wardrobe. Such action probably would have raised negative feelings about the whole portal, because it would be trespassing in the intimacy of the user. For this reason, the model was chosen in which the user indicates arms by two simple clicks of its figure in the picture. This solution is a valuable, if we assume that the user is e.g. in a jacket and by himself without any problem can with a sufficiently large approximation indicate above two points.

V. DESCRIPTION OF THE USE AND CHARACTERISTICS OF MATLAB

Matlab name comes from the words **Matrix Glassware**. Matlab is an interactive package used for the calculation of science and technology. It is interactive because it works on the principle of commands issued by the user and response received from the system.

Matlab also allows the creation of some kind of scripts that are called m-files. These files contain functions and are saved

with the extension "m". For the interaction between Matlab files and Java is the library matlabcontrol version 4.1.0. This library enables calling function and performing calculations in Matlab from Java code. Initially, between a program written in Java and Matlab the session is established. Subsequently, using simple commands it is possible to call a function of Matlab, providing them with arguments and receive return values (Listing 1).

```
public double getSizeBasedOnPhoto(String username, double patternDistance)
    throws MatlabConnectionException, MatlabInvocationException {
    File file = new File(relativePath+username);
    String absolutePath = file.getAbsolutePath();
    MatlabProxyFactoryOptions options =
        new MatlabProxyFactoryOptions.Builder()
            .setUsePreviouslyControlledSession(true)
            .build();
    MatlabProxyFactory factory = new MatlabProxyFactory(options);
    MatlabProxy proxy = factory.getProxy();

    Object[] dist-proxy_returningFeval("measureDistance",1,patternDistance,relativePath+username);
    double distance= ((double[]) dist[0])[0];
    double test = round(distance,3);
    System.out.println(test);
    System.out.println("MATLAB SAYS: "+distance);

    proxy.disconnect();
    return distance;
}
```

Listing 1. The connection between Java and Matlab.

The analysis of images for search for specific items begins by subtracting matrix made from photos in grayscale from an array containing data about green shades appearing in the picture. Thanks to this operation, received information about where on the image are green points (Figure 1). The next step is the function of reducing noise in the image. Afterwards, a binary image is formed, using *imbinarize()*. Binary image is an image that has only two possible values, usually the colors: black and white. Then remove all small objects that appear in the picture using *bwareaopen()*. Before the final step is the connection of components in the binary picture, which are located in extremely close proximity, this operation is performed using *bwlabel()*. After calling all of the above functions, the resulting image only shows interesting points. At the end *regionprops()* function indicates and gives the size in pixels, as specified by the above steps areas (Figure 1). With so designed algorithm (assuming that, the realistic size of the pattern is known, and should be placed at the same depth as human figure in the pictures) using simple mathematical functions, it is possible to determine the length given in centimeters between the previously specified points by the user.

```
data = imread(path);
diff_photo = imsubtract(data(:,:,2), rgb2gray(data));

diff_photo = medfilt2(diff_photo, [3 3]);
diff_photo = imbinarize(diff_photo,0.18);
diff_photo = bwareaopen(diff_photo,300);

regions = regionprops(diff_photo, 'BoundingBox', 'Centroid');
....
for i=1:length(regions)
    if i==index
        continue;
    elseif i<2
        matrix(1,i)=regions(i).Centroid(1);
        matrix(2,i)=regions(i).Centroid(2);
    else
        matrix(1,i-1)=regions(i).Centroid(1);
        matrix(2,i-1)=regions(i).Centroid(2);
    end
end

distanceInPx = sqrt(power((matrix(1,2)-matrix(1,1)),2)+ power((matrix(2,2)-matrix(2,1)),2));
distanceInCm=(patternDistance*distanceInPx)/measureDistance;
```

Listing 2. The algorithm searches for the green color.

VI. SUMMARY

The main purpose of this work was the title tool. It turned out that the key problem is not calibrated camera, which makes impossible to find the distance between interesting points. Therefore, an innovative solution was used, in which the user must provide the pattern to the program, which should be located to user body as close as it possible. After delivering of the pictures user would have to enter, horizontal dimension of his phone screen.

This solution after algorithm optimization has somewhere in the region of 90% accuracy. The main factor that contributed significantly to the quality of the measurement was improper positioning of the pattern. It should be kept in the picture maximally perpendicularly to the surface on which the camera is located. Each tilt of the screen, which is also a pattern, affects the measurement results. I decided on this solution because its triviality made the implementation itself not last long. Moreover, more advanced solutions such as automatic identification of the silhouette would undoubtedly be subject to a greater error resulting from, for example, the thickness of the garment.

The solution, which could be successful, would be to assist in the correct positioning of the phone screen.

REFERENCES

- [1] Prabath Siriwardena, „Mastering Apache Maven 3”, edition Pack Publishing 2014.
- [2] Aleksa Vukotic James Goodwill, „Apache Tomcat 7”, Appres 2011.
- [3] Włodzimierz Gajda, „HTML5 i CSS3 Praktyczne projekty”, edition Helion 2013.
- [4] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, „Digital Image Processing Using MATLAB, 2nd Edition”, Gatesmark Publishing (2009)
- [4] Introduction to Matlab:
<https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf>, 2017-01-22.



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