Automatic Conversion of Image Design into HTML and CSS

Mariya Zhekova, Nedyalko Katrandzhiev, and Vasil Durev

Abstract The article offers a method to automatically convert web design into HTML/CSS code, a task typically performed by web application developers. The research's purpose is to save programmers time to iterate the logic from the design. The used approach extracts and recognizes a list of graphic components—structures, types, sections, elements, and their styles, as well as information about their location in the graphic template. The presented solution automatically converts the pre-built web interface into HTML and CSS code using Adobe XD and existing scripts inside him. Several conversion graphics tools are reviewed and the advantages and capabilities of three of the tools are shown in a comparison table. This is how Adobe XD stood out from the other two and was chosen when prototyping the initial design. The proposed solution can help people who are just starting in graphic design and want to learn how to easily transform their ideas into HTML/CSS source code.

Keywords Image conversion · Design prototype · Image design to code · Graphic to code · Generate web code · Web interface

1 Introduction

Computer graphics deals with the generation of images using computers. Today, she is a core technology in digital photography, movies, video games, cell phone and computer displays, etc. Traditionally, the graphical user interfaces (GUI) of web-based applications are initially created by designers who express their ideas in the form of digital images (mockups) that visually describe their structure and content in

M. Zhekova (✉) · N. Katrandzhiev · V. Durev
University of Food Technology, Plovdiv, Bulgaria
e-mail: m_jekova@uft-plovdiv.bg

N. Katrandzhiev
e-mail: n_katrandzhiev@uft-plovdiv.bg

V. Durev
e-mail: v_durev@abv.bg

P. P. Joby et al. (eds.), *IoT Based Control Networks and Intelligent Systems*, Lecture Notes in Networks and Systems 789, https://doi.org/10.1007/978-981-99-6586-1_13

specialized graphic creation tools. Next comes the programming of the application's functionality, work that is performed by specialists, and programmers who have developed the business logic of the website. This is a process that takes time and a lot of money.

There is a continuous increase in interest and investment in automating the processes of creating and testing program code [1], as well as in reducing the costs of its creation, because the final result and the quality of the website, as well as the time and means of its creation characterize it as a quality service.

The article offers a method to automatically convert a graphic design into HTML/CSS code, a task typically performed by web application developers. The aim is to automate the code-generating process from image design mockups and save programmers time to iterate the logic from the design and redirect the complexity in performing the tasks to a faster and more efficient method. Automation in the method is achieved by using software that automatically converts a created graphic design into HTML/CSS code.

The approach retrieves a list of graphic components—structures, types, sections, elements, and styles, as well as information about their location in the graphic template. Our solution automatically converts a pre-built web interface to program code.

2 Related Work

Current search algorithms focus more on text queries and less on the content and GUI structure of web documents. This article proposes a solution that takes an image from a built-in GUI as input and transforms it into web content.

There are web applications developed with deep learning models that combine the following approaches:

- An approach that collects a set of data, HTML and CSS, and trains models with deep learning. Using Recurrent Neural Networks (RNN), web components are detected and transformed into HTML code [2];
- Object detection by area proposal, appropriate feature representation as characteristics vector and determining its type, and area classification;
- Supervised approach using a function that maps an input to an output based on labeled training data. Using supervised learning methods, for example, the k-nearest neighbors (kNN) algorithm stores all available cases and classifies new cases based on a similarity measure [3];
- An approach focused on the spatial component of the considered problem and includes the YOLO network and layout algorithm [4];
- An approach that uses an object detection model to detect the presence and location of various components that shape and segment an input layout [4];
- An approach that uses keywords such as stylistic features (such as color, and style attributes) [5, 6] or image metadata (such as subject, media, date, location, shape);

- By uploading a screenshot or a Sketch file recognizes components, such as tags, styles, attributes, different types of sections on the image, and based on that data creates the main layout of the webpage and generates the final code [12];
- Using Microsoft Cognitive Services to train custom computer vision with millions of images and enabling object detection for a wide range of types of objects.

3 Tools for Creating and Converting the Design into Code

Before a graphic image is converted into HTML/CSS code, it needs to be designed in advance using graphic tools and technologies. There are a wide variety of tools, such as Sketch, Figma, Fronty, InVision, Adobe XD, Photoshop, Illustrator, and more, to rapidly prototype user interface and user experience (UI/UX) with high fidelity. They perform multiple functions from designing and prototyping to testing, but coding web design mockups is still required of developers. Creating a digital design mockup using design tools simplifies workflows and timelines for software developers.

Photoshop and Illustrator create web and print designs, providing many features for editing raster images. Photoshop manipulates images using a layer-based system that allows the creation and modification of images with multiple overlays that support transparency [7]. Layers act as masks or filters, changing primary colors in the mockup.

There are also many other tools (editors) for creating web content. Some of them are paid, such as—Adobe Dreamweaver CC, Froala, Setka Editor, and CoffeeCup HTML Editor, others are free—HubSpot, CKEditor, Editor.js, TinyMCE, Bubble, Quill, Summernote, ContentTools, Brackets, etc. If we have to compare them, some of them customize pre-made template modules (HubSpot), others are advanced text editors with built-in plugins (SKEditor), others allow editing blocks of content that can be moved and rearranged similar to WordPress (Editor.js), fourths provide rich libraries of visual elements to add interactivity (Bubble) and last but not least editors for mobile applications.

There are editors compatible with other connecting products such as Evernote, and Atlassian and frameworks such as Angular, React; tools providing cloud security functions, JSON web tokens, and private RSA keys (TinyMCE, Quill); an environment which is loaded with Bootstrap and jQuery and can be used with other frameworks Django, Ruby or Rails, Angular, etc. On the other hand, modern integrated development environments like Eclipse, Visual Studio, or Android Studio have powerful interactive tools for UI and UX code. Let's look at a few applications for creating and converting GUI to source code.

Dreamweaver is a software that is part of the Adobe Creative Cloud family and can be used to design, create, manage, and deploy websites. It provides the ability to build a website entirely through the visual editor, only through code, or combined. The resources needed to recreate the web content in a given website from the initial layout are: overall graphic design of the page; the images that participate

in it, including banners, drop shadows, social media icons, logos, and the conversion result. The methodology of the process consists in:

- Create a mockup (graphical user interface);
- From the mockup using the "slice" technique, the images composing it are cut out—logos, social media icons, banners, shadows, pictures, etc. They are saved in.png format.
- Create the structure of an HTML file, <html>, <head>, <body>;
- Adding <title> Title </title>, <link href = "css/style.css" rel = "stylesheet" text = "text/css"/>, <link rel = "shortcut icon" href = "images/favicon.ico">;
- Create a container that will house all the psd content of the file;
- Save the received file in the project folder [8].

Sketch is a popular paid vector graphical user interface and/or digital design tool designed exclusively for MacOS. Sketch offers plugins for almost every functionality, incl. animation, translation, adaptation to another format, screens, layouts, prototyping, etc. Unlike Adobe XD, Sketch does not offer responsive resize, component states, repeat grids, 3D transform, cloud integration, video, voice, and other app integration [9].

Sketch2code is a solution from Microsoft which uses AI to transform hand-drawn user interfaces Sketches into valid HTML markup code or prototypes [10]. This tool is a simple deep learning model that takes hand-drawn web mockups and converts them into working HTML code. Custom vision service in this app trains models to detect HTML objects, then uses text recognition to extract handwritten text in the design. By combining the object and the text, Sketch2Code generate HTML snippets of different design elements. Sketch2Code produces HTML snippets that accurately depict pertinent areas of the website. For some elements, it predicts their size and location on the page [11].

The algorithm in Sketch2Code is:

- Create a mockup;
- Upload the mockup;
- Custom vision model predicts what elements are present in the image and their location;
- A handwritten text recognition service reads the text inside the elements;
- A layout algorithm uses the spatial information from all the bounding boxes of the predicted elements to generate a grid that accommodates all;
- An HTML generation engine uses all these pieces of information to generate an HTML code reflecting the result;
- Save, download or share the code.

Fronty is an AI-based web page design to source code conversion service. It generates clean HTML/CSS code from an image, screenshot, design, or mockup [12]. The methodology in Fronty is as follows:

- All small images (logos, icons) are cut from the .psd and saved in .png;

- Separate HTML structures, types, sections, elements, and their styles (text-color, background-color, background-type, etc.) are recognized;
- A code-clearing algorithm is applied;
- Content integration;
- Check the quality, and look of the resulting HTML/CSS source code.

The tool detects the different types of sections on the image (e.g., navbar, header, footer). It detects also their styles (e.g., texts, images). Based on that data creates the main layout of the webpage and generates HTML/CSS code [12].

Adobe XD is a powerful multiplatform vector-based UI/UX design tool and can be used to design almost everything [13]. Adobe XD contains features that do not exist in Photoshop for example Components (for reuse), States (for effects, variations, live preview), Padding (for space between elements), Stacks (dynamic content), Repeat Grid (for tables, carousels, gallery), responsive Resize (new devices, e-gadgets), etc. [14]. Some of the famous plugins for processing graphic images and their transformation to code are Anima, Web Export, and Lightning Storm plugins.

Anima plugin is one kind of solution for exporting Adobe XD to CSS and HTML code. Anima characterizes by:

Automatically adapt between screen sizes;
Turns layer into a video, GIF, or animation and enables settings like looping;
Animates layers—include grow, move, blur in, and fade;
Embeds all kinds of code onto pages—interactive maps, 3rd party forms, etc.;
Create forms—include fields, and submit buttons for collect submission.

Web export plugin give many options for applying styles and classes to existing design mockups, as well as settings for how the page scales and the elements within the page. The plugin can also apply settings like styles, classes, tags, and more, directly to any element in graphic design. This gives the users all the control to structure web pages in a way that can adapt existing CSS files or styles [13]. Exporting creates the HTML, CSS, and JavaScript files—basic structure blocks of every web page. The plugin is a kind of bridge between designers and developers. It has a few goals: to create an accurate representation of the design; to allow developers to add subtract or replace that model; and to preserve development work throughout design changes.

Export Kit—Lightning Storm plugin can convert any design mockup to source HTML/CSS code with support for multiple pages, custom styles and dynamic elements. The tool can export one or all layouts as individual HTML pages and can maintain the parent/child relationship of layers, along with attributes and properties to the corresponding HTML element. The final HTML/CSS files are clean, easy to read, and ready to use immediately in the browser [13]. The plugin contains some rules and limits to submitting a good result such as no layers without names, no text layer without text, no folder without child layers, layers which belongs to a menu should group and name, content margin space, layers ordering, etc. [15].

Table 1 Comparison of the capabilities of graphic editors

	Sketch2code	Fronty	Adobe XD
Platform	MacOS	Apple iOS, Android	MacOS and Windows
Languages	English and Chinese	English, German, French, Dutch	English, Spanish, French, German, Japanese, Chinese, Korean, Brazilian, Portuguese
Plugins	∨	∨	∨
Components	∨	∨	∨
Component state			∨
Vector manipulation			∨
Content-aware layout	∨		∨
3D transform			∨
Responsive resize	∨	∨	∨
Cloud integration		∨	∨
App integration		∨	∨
Shared libraries	∨	∨	∨
Convert into HTML/CSS	∨	∨	∨
Price	Paid	Paid	Paid

The comparison table of the capabilities of the three converting graphic tools (Table 1) shows the advantages and capabilities of the Adobe XD product over the other two. This is the reason why Adobe XD was chosen when prototyping the initial design.

For all considered environments, it can be generalized that they provide a simple and user-friendly interface and help to customize websites quickly and easily, which is the purpose of our research. All of them are designed to work for different use cases with different technical settings. After the research was done, we concluded that the most suitable option for our research—to create and automatically transform the graphic design to source HTML/CSS code is Adobe XD.

4 Converting Image Design into HTML/CSS

Our approach presents a short way to rapidly design templates, ultimately reducing the time and cost of developing websites. The steps in the algorithm for the automatic conversion of image design to HTML/CSS code are as follows:

Step1. Creating a graphic design mockup. Existing screenshots, pictures, and image files can be added, or a digital design can be created and saved in some of the graphics tools by dragging and dropping widgets into the user panel or manually.

Step 2. Converting the mockup into HTML/CSS code.

4.1 Step 1—Create a Graphic Design Mockup

Special attention is paid to the design of the graphic layout—the choice of colors and the arrangement of elements. A light, simple, modern, and convenient design was chosen for process visualization.

Adobe XD was used to implement the process. At first, a new project is created in Adobe XD. Several components are grouped into a group named "Delivery data".The top of the mockup is divided into three smaller parts that are filled with three components (button, logo, and small image). No added background to the design. Designs are shown in Figs. 1, 2 and 3.

The color of some elements has been changed for greater contrast in the design. White color is selected for the background of the pages. The graphic design on another page of the project is in the next figure (Fig. 4).

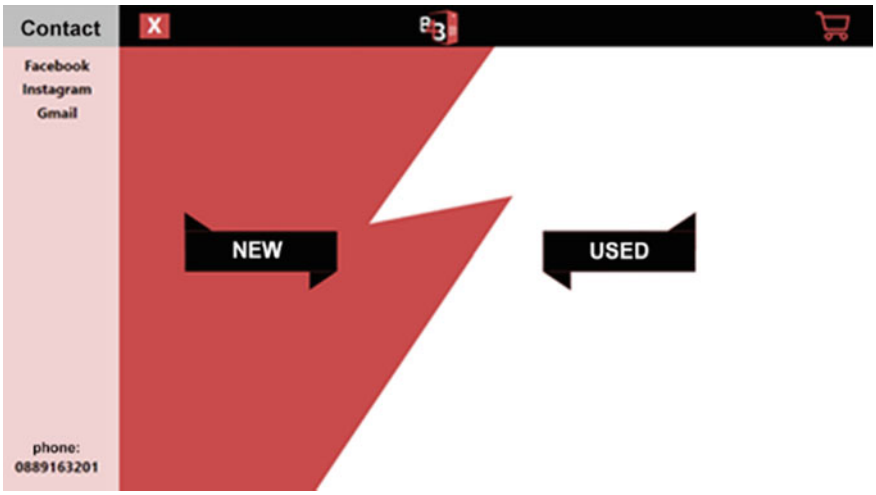

Fig. 1 Simple design of one page

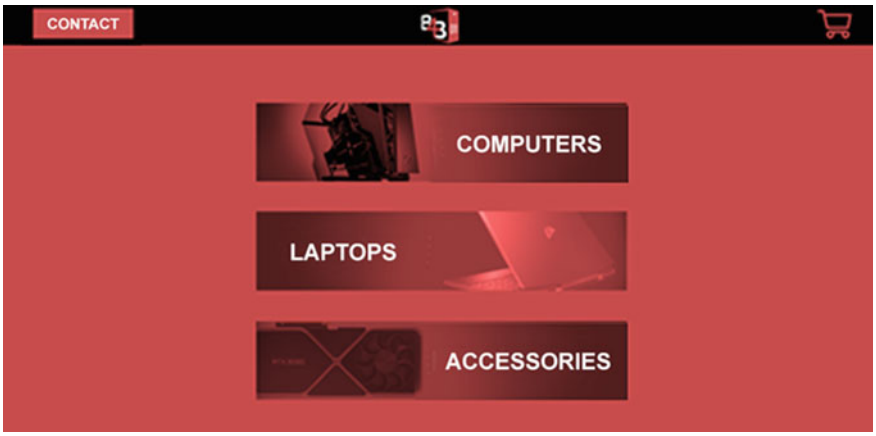

Fig. 2 Design of another page

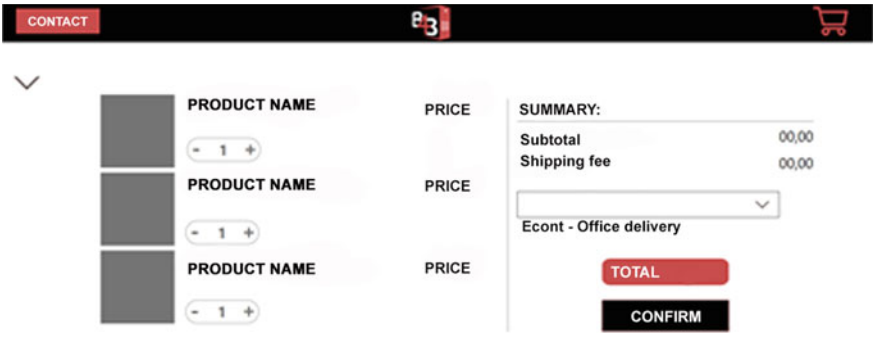

Fig. 3 Graphic design of one of the pages in the project—shop page

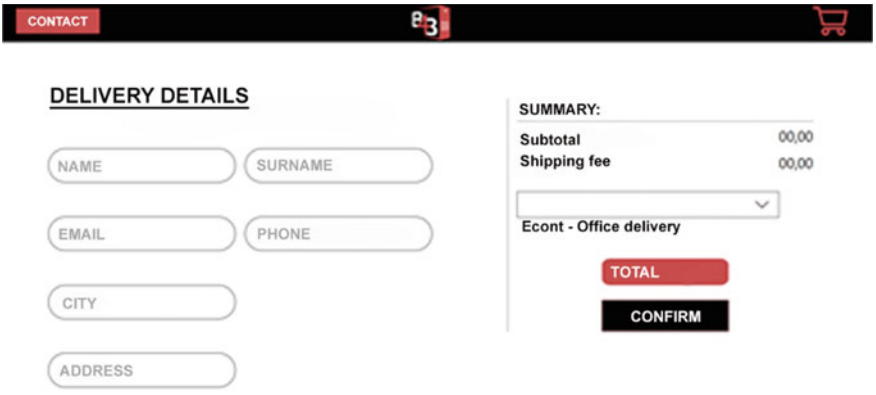

Fig. 4 Graphic design of the delivery page

Fig. 5 Graphic design of product page

Adobe XD allows the graphic design to be converted into a website, resulting in HTML/CSS/JavaScript construction. The tool includes plugins for integrations that improve the design workflow by automating complex and repetitive tasks. Adobe XD will help developers share their prototypes by saving time by increasing the speed of creating website designs.

4.2 Step 2—Convert a Graphic Design Mockup to HTML/CSS

A **Web export script** created by Velara-3 was used to convert the created mockup and export it from Adobe XD to HTML and CSS code. The plugin Web export is free to download from the Adobe Cloud Desktop app. In it, developers can add or remove styles, replace tag names, add attributes and classes, replace the output of elements, use page structure, customize a page template, add their code or styles, and reuse in the project. The plugin supports several types of export—to a single page, to multiple pages, and the slideshow.

The Web export is installed in the plugins menu of Adobe XD. After installing the script, it is located in the project folder from where it is accessible. When the script is launched, fields appear that must be filled in (Fig. 6).

The fields to be filled in the advanced screen are:

- Name—the name of the HTML file
- Stylesheet—the name of the CSS file
- Script—the name of the JavaScript file.

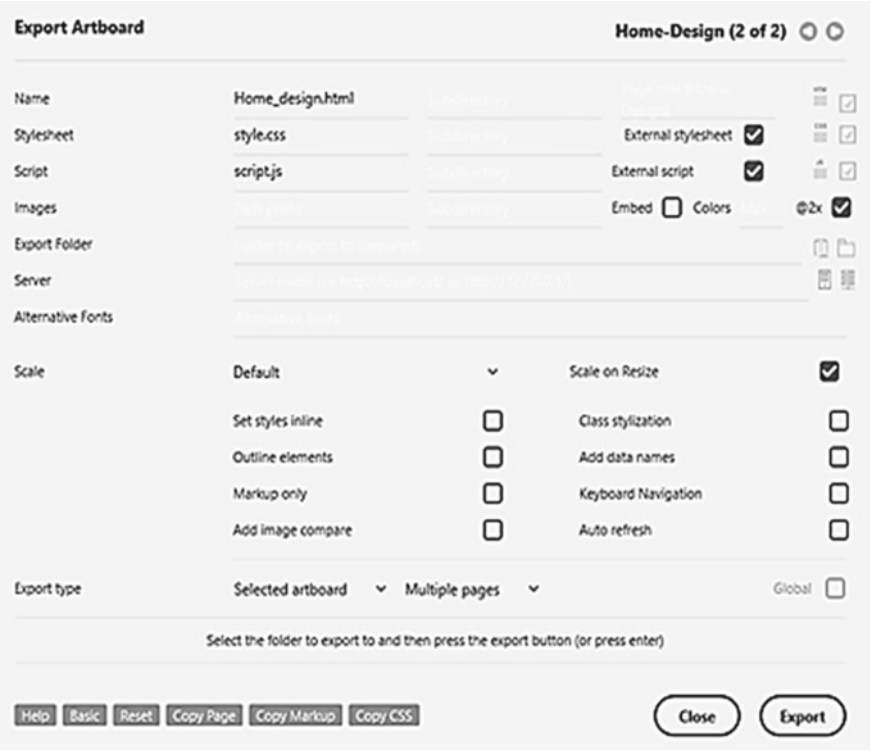

Fig. 6 Web export conversion settings

All names must end with the appropriate file extension. Select a folder where the files will be stored. When everything is marked and filled in, press the "Export" button in the lower right hand (Fig. 6). This will start the export process.

Getting the code is done automatically after creating the design, filling in specific export settings and selecting the export command in the Web export plugin. After exporting, the result should be checked. The export notes are viewed in the browser and the folder where all related resources are saved is checked. If the design that was created in Adobe XD includes animations, the source code will also contain a JavaScript file (Fig. 7).

After conversion, the generated files appear in the selected folder. It contains all the necessary files and photos to create a web page. The HTML file consists of 134 lines of automatically generated code. The path to the external CSS/JavaScript code in the <head> is set. The CSS file is composed of 525 lines of code. Parts of the automatically generated HTML/CSS code can be seen in Figs. 7 and 8. Fragment from CSS file is shown in Fig. 9.

```
self.reverseAnimation = function(target, hide) {
    var lastAnimation = null;
    var style = target.style;

    style.animationPlayState = "paused";
    lastAnimation = style.animation;
    style.animation = null;
    style.animationPlayState = "paused";

    if (hide) {
        var duration = self.getAnimationDuration(lastAnimation, true);
        var isOverlay = self.isOverlay(target);

        setTimeout(function() {
            self.setElementAnimation(target, null);

            if (isOverlay) {
                self.hideOverlay(target);
            }
            else {
                self.hideView(target);
            }
        }, duration);
    }
```

Fig. 7 JavaScript code because a design includes animation

```
.........
<div id="n__">
    <span>DELIVERY DETAIL</span>
</div>
<div id="Component_4__1" class="Component_4___1">
    <svg class="Rectangle_29">
        <rect id="Rectangle_29" width="404" height="73">
        </rect>
    </svg>
    <div id="Text_br">
        <span>SURNAME</span>
    </div>
</div>
<div id="Component_3__1" class="Component_3___1">
    <svg class="Rectangle_30">
        <rect id="Rectangle_30" width="404" height="73">
        </rect>
    </svg>
    <div id="Text_bu">
        <span>NAME</span>
    </div>
</div>
<div id="Component_4__2" class="Component_4___2">
    <svg class="Rectangle_29_bw">
        <rect id="Rectangle_29_bw" width="404" height="73">
        </rect>
    </svg>
    <div id="EMAIL">
        <span>EMAIL</span>
    </div>
</div>
<div id="Component_4__3" class="Component_4___3">
    <svg class="Rectangle_29_bz">
        <rect id="Rectangle_29_bz" width="404" height="73">
        </rect>
    </svg>
    <div id="n__b">
        <span>PHONE</span>
    </div>
</div>
<div id="Component_4__5" class="Component_4___5">
    <svg class="Rectangle_29_b">
        <rect id="Rectangle_29_b" width="404" height="73">
        </rect>
    </svg>
    <div id="Text_b">
        <span>ADDRESS</span>
    </div>
    ...........
```

Fig. 8 Fragment from HTML file

```
.mediaViewInfo {
    --web-view-name: shop;
    --web-view-id: shop;
    --web-scale-on-resize: true;
    --web-enable-deep-linking: true;
}
:root {
    --web-view-ids: shop;
}
* {
    margin: 0;
    padding: 0;
    box-sizing: border-box;
    border: none;
}
#shop {
    position: absolute;
    width: 1920px;
    height: 2160px;
    background-color: rgba(255,255,255,1);
    overflow: hidden;
    --web-view-name: shop;
    --web-view-id: shop;
    --web-scale-on-resize: true;
    --web-enable-deep-linking: true;
}
#product_1 {
    position: absolute;
    width: 308px;
    height: 362px;
    left: 0px;
    top: 0px;
    overflow: visible;
    --web-animation: fadein 0.20000000298023224s snap;
    --web-action-type: page;
    --web-action-target: product_info.html;
    cursor: pointer;
}
.Rectangle_1_gb {
    position: absolute;
    overflow: visible;
    width: 1920px;
    height: 91px;
    left: 0px;
    top: 0px;
}
#Group_6_gd {
    position: absolute;
    width: 181px;
    height: 55px;
    left: 60px;
    top: 18px;
    overflow: visible;
    .......
```

Fig. 9 Fragment from CSS file

5 Conclusion

Theoretically and practically, the analytical study aims to acquire and enrich the knowledge of the conversion to HTML/CSS source code from image design.

The creative cycle, repeating the actions of creating graphic design and programming executable code, takes time and resources for the performers of the individual stages. That's why we strive for automatic code generation from graphic image mockups. The main goal of this research is the automatic conversion of image design into HTML/CSS code.

The proposed solution can help people who are just starting in graphic design and want to learn how to easily transform their ideas into HTML/CSS code. The example in the study demonstrates the process of designing a graphical prototype, automatically converting this prototype to source code (HTML, XAML, and CSS) and running it in the browser, eliminating the need to develop the program code and saving time and money to create it.

Automation in the method is achieved by using software that automatically converts a created graphic design into HTML/CSS code. By automatically converting a design to HTML/CSS instead of the standard method of writing code, the speed is increased. This automatic conversion method allows recreating only the front-end of the site/design. Security is primarily achieved with back-end programming. Code review by a professional web developer is required when performance improvements are needed.

A comparison is made between 3 graphical environments for transforming an image design into HTML/CSS code. The advantages of the considered tools are listed in a comparison table. In the detailed examination of Fronty, Sketch2code, and their methodology of working and transforming the images is also described. During the analysis, Adobe XD stood out from the other two and was chosen when prototyping the initial design. Arguments for its use are presented.

References

1. Pelivani E, Besimi A, Cico B (2022) An empirical study of user interface testing tools. Int J Inf Technol Secur14(1):37–48
2. Xu Y, Bo L, Sun X, Li B, Jiang J, Zhou W (2021) image2emmet: Automatic code generation from web user interface image. J Softw Evol Process 33(11). https://doi.org/10.1002/smr.2369
3. Zhang Z (2016) Introduction to machine learning: k-nearest neighbours. Ann Tansl Med 4(11). ISSN: 2305-5847
4. Bouças T, Esteves A (2020) Converting web pages mockups to HTML using machine learning. In: Proceedings of the 16th ınternational conference on web ınformation systems and technologies, Hungary, Scite Press, pp 217–224
5. Lee B, Srivastava S, Kumar R, Brafman R, Klemmer S (2010) Designing with interactive example galleries. In: Proceedings of the SIGCHI conference on human factors in computing systems. ACM, pp 2257–2266

6. Ritchie D, Kejriwal A, Klemmer S (2011) D.tour: style-based exploration of design example galleries. In: Proceedings of the 24th annual ACM symposium on user interface software and technology (UIST'11). New York, USA, pp 165–174
7. Adobe Photoshop. https://www.techtarget.com/whatis/definition/Photoshop
8. Dreamweaver. Available from https://www.adobe.com/products/dreamweaver.html
9. Sketch. Available from https://www.sketch.com/docs/
10. Byson L, Tiwonge D (2020) Software architecture and software usability: a comparison of data entry form designing configurable platforms. African Conference on Software Engineering
11. Sketch2Code documentation. Available from https://www.microsoft.com/en-us/ai/ai-lab-sketch2code
12. Fronty documentation. Available from https://fronty.com/post/technology/
13. Adobe XD documentation. Available from https://helpx.adobe.com/xd/help/adobe-xd-mobile-faq.html
14. Li J, Tigwell G, Shinohara K (2021) Accessibility of high-fidelity prototyping tools. Proc CHI Conf Human Factors Comput Syst 493:1–17. https://doi.org/10.1145/3411764.344552
15. Velara-3. Available https://velara-3.gitbook.io/web-export/