Exploring the Latest Front-End Development Trends

Ramona Stefanova

Haaga-Helia University of Applied Sciences

Bachelor of Business Information Technology

Thesis

2024

Abstract

Author Ramona Stefanova	
Degree Bachelor of Business Information Technology	
Thesis Title Exploring the Latest Front-End Development Trends	
Number of pages and appendix pages 36 + 4	

The thesis explores and discusses the newest trends in the field of software development focusing on the front-end development technologies and their evolution. The idea of the study is to bring together all emerging technologies in front-end development from the last years. The study will conduct research on how necessary and used by professionals those new technologies are and how preferred are they by the developers. The study is meant to provide a comprehensive analysis of the trends at the time of research.

As the topic of the software development from all aspects is one that has many different angles and is often part of different studies and academic work for this paper it was considered the descriptive literature review as a methodology for execution of this project, because of it suggests systematic collection of qualitative data from existing literature, its analysis and interpretation. The research integrates literature from diverse sources, including studies made on subtopics included, books, and major survey studies. The collected sources are in the process categorised and analysed unfolding the research process. With this it is aimed preparation for a systematic review of the literature and forming key findings that answer the questions within the idea and the research questions of the thesis, what are the trends in front-end development. This approach results in enrichment of the current state of knowledge, highlighting key trends and insights and identifying areas that can be researched further.

The theoretical framework consists of the paper structure, and the historical context of front-end development, following its progress over time. The empirical part provides the research methodology, including the research approach, data collection methods, and analysis techniques, key technologies as JavaScript, React.js, CSS, and HTML, and in the second part of the empirical part are examined the technologies of the present with potential for the future like Progressive Web Apps and Single Page applications, as well as the future implementation of Artificial intelligence and Machine learning into the development and delivery processes.

This study provides value for people interested in career change and are maybe leaning toward a career as a Front-end developer, as well as for experienced developers who may need to get familiar with newer technologies with which they have not been working before, it can be used as a base for future academic work and research. Future research may focus more deeply into the consummption of AI tools from developers and how this in details benefits their work or as a client-side profession, how it supports the experience of the end-users.

Contents

Abbreviations

GUI – Graphic user interface

CSS – Cascading Style sheets

HTML – Hypertext Markup Language

UI – User Interface

UX – User Experience

DHTML – Dynamic HTML

SPA – Single Page Application

PWA – Progressive Web Application

Wasm – WebAssembly

AI – Artificial Intelligence

ML – Machine Learning

SSR – Server-Side Rendering

JS – JavaScript

RWD – Responsive Web Design

RQ – Research Question

Figures

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1. Introduction

Nowadays Front-end development is undividable part of software development. This is the practice of developing the user interface of a website or and application, as well as the user experience involved in the creation of those mentioned. Front-end work incorporates all the work that needs to be done in order to be able to interact with a website or an application, including all of their visuals, layout, interactivity. The moment in the technology era when front-end development starting arising was the moment of the grow of the internet in 1990, when the society felt the need to use more web pages and craved to be able to work with more images, rather than only text pages. This is when the primary and fundamental language used for creating websites was not anymore enough for the users. This is because it provided only the fundamental structure of the webpage but was not utilised enough to face all the needs of the use, because of the static mode of the pages, that consisted only of text and some images. The front-end part of software development's aim was to visualise and create interactive components of a website or application, that the users can interact directly with.

Front-end development is everything that provides the user with the chance to be the link between user's need and the operations that a user would like to accomplish. If any of those components is missing it will be a challenge to have a working and/or satisfying and preferred software product. But in case they are both aligned and wrong, developers get the opportunity to interact and make use of the software for the reasons that they have. Said in other words this is the face of the logic because every software application, website, or program, needs the two most important things, functioning logic and the face for the end user. The technology corner is the field with the fastest grow and has the most rapidly developing kit of tools and technologies in each of its branches.

The libraries and frameworks are infinitively increasing all the time and are often a reason for confusion among new developers, arising talents in the field or the developers being in the field for years, but find it difficult to keep up with all the news, developments, and trends within the industry. As mentioned in the work of Dihn & Wang, already in 2020 they state that it is of big importance to understand why they appear. (Dihn & Wang 2020.) This has not changed and will not change. As important as it is to understand the reason of their emerge in the IT world, we need to understand which of those technologies frameworks and utilities are the most respondent the stage of the front-end development we are situated in, as well as to have the ability to research them, understand them and this way choose the correct ones for the current purposes of our work. Here we get to the importance of keeping up with the trends.

We live in a digital era and technologies in every context are progressing developmentally in a rapid pace. All the changes and improvements benefit to decrease the time consumed for

production, distribution, and delivery. By benefiting those aspects products are brought on lower costs with higher productivity, which also impact the innovativeness and technological development overall.

This pushes up the economic growth and is improving the intellectual transformation of humanity and technological intelligence. It is important to mention the changes that impact how digital products and services are produced, impact exactly right proportionally the way that digital services are perceived and consumed by the end users.

This research has the aim to close the gap between the fact that new trends had emerged and emerge all the time and the fact that they are in use already. This paper is going to look into the need of those trends, are they really necessary, if some of them are proved to be necessary, which are those and why. What are the factors that has to do with the development of the field and what and why people end up using as developers of the front-end components of a digital product and service. The ultimate objective this paper is to dive deeper into the question of why the front-end development suffers so constant and big transformation in the sense of how things are done and what tools we use to accomplish our front-end engineering goals. Is there a need for that and a reason, or may it be a fruit of nonobjective needs and artificial ambitions for evolution and growth. The thesis will look into the evolution of the front-end development and will point out whether within the timeline the changes and evolvements were/are justified, and they are real support and breaking through the issues of front-end development or are there points in the front-end development story where the changes serve for more confusion and affect the quality of the production of engineers. The have the best of conclusions in the end with most relevance and accuracy we are going to explore the issues that were mentioned above. What are the issues of the front-end development and showcase how the industry tried to work on those, eliminating them with a certain library, framework, or another tool. We will follow the path from need to solution analysing the connection between the issues, the idea of troubleshooting, the technology stack that emerged and the aftermath overall.

1.1 Overview – purpose and paper outline

Every research project aims to explore a topic and conduct a study which would connect the available information and knowledge on a certain topic with the questions arising considering this topic, which the author wants to answer. The gathering of the information and literature the paper is going to be based on are seen as critical part of it, regardless of the field of research in order the same to be considered as reliable and credible. (Taherdoost 26 April 2023.) In the next chapters there will be presented the purpose of this paper as well as outline for what it consists of.

1.1.1 Purpose and research question

The main goal of this paper is to provide a historical overview, summarize current knowledge in the field of front-end development as overall practice and to extract the most current trends and present the newest ways, means, processes and procedures in the field. In this paper are reviewed the frameworks, methodologies, best practices, and advancements in the front-end development as a discipline.

The review will have beneficial value for academic use, as well as for persons who are employed in the field, for practitioners or students in the field of IT, it may be comprehensive guide for front-end development and for people already practicing the profession it may introduce new tools and methodologies. For researchers this may be a support when identifying new research problems and defining new research questions.

The study can be useful for personas with different professional background but will be the most relevant for current and future front-end developers to understand the trends which will bring efficiency in their work performance and better evaluation of security variables, issues with optimisation of the performance and increase the user experience and satisfaction.

The study addresses the following research question (RQ): What are the trends in front-end development? The research question branches into the three following investigative questions (IQ):

IQ1: How front-end development evolved in the past 100 years?
IQ2: What are most used technologies in front-end development at the moment of this research?
IQ3: What are the technologies emerging in the field with a big potential to become more commonly used in the near future?

1.1.2 Paper outline

To give a clear idea in the beginning and help the reader to easily navigate and have better understanding of this work, in this subchapter a graphic and written representation of the content is outlined. In Figure 1. Below is show the graphic map of the content, called Content Overview Map. And right after that part there is text outline of each chapter and subchapter that will be discussed further.
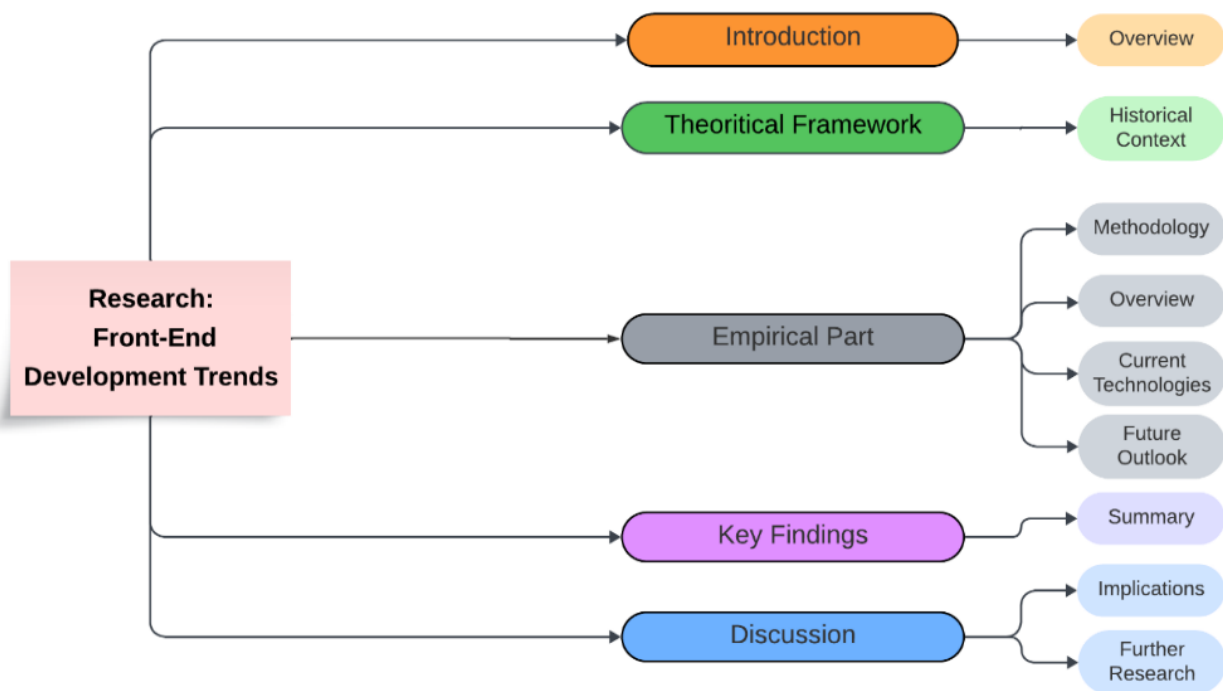
Figure 1. Content Overview Map

Chapter 1. Introduction

Subchapter 1. Overview – purpose and paper outline

Chapter 2. Theoretical part

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2. Theoretical framework

2.1 Historical Context

For a research like that one to have a solid and strong base it is very important to incorporate historical context already in the beginning and from there to continue with the development of the topic and the work on the research. For successful and fair response to the research questions it first it is needed to dive into the historical aspect of the topic. Or everything that has happend and has been already proven to be truth and a fact. It is necessary to understand the timeline, the evolution and how things evolved up to the current time of discussion in order to sucessfully identify patterns and give wider context to base the findings on, compare and conclude. In addition to above mentioned turn back to the historical context adds depth and credibility, and may have educational value to some readers.

2.1.1 Evolution of Front-End Development

The timeline of evolution is a secure method to go over and visualize the development path from the beginning to nowadays, which is the period which this research looks into. In the table below, see Table 1., this timeline is comprehensively put together in the form of a table with the different periods of time, certain transformations that happened for that period of time and description in more details.

Period	Transformation	Description
1190s – Early 2000s	The Static HTML Era	Simple pages with plenty of text, little to non interactivity. The lack of visual and interactive elements forces CSS to gain popularity (Case J. 12 January 2024).
1990s – Early 2000s	JavaScript arises DHTML, Dynamic HTML	Again due to need of interactivity here was welcomed the rise of JavaScript. This was the time when for the first time technologies a DHTML appeared. DHTML allowed developers to develop dynamic web pages and animated content. (Case J. 12 January 2024.)
1990s – Early 2000s	Browser Wars	Different web browser providers were competing to have bigger share of users. The "first browser war," (1995–2001) was between Internet Explorer and Netscape Navigator. (Tracie Masek, Medium, 2019)

Mid – 2000s	The Web 2.0 Revolution Ajax (Asynchronous JavaScript and XML)	With the Web 2.0 revolutions came the more user-centric design of the websites and te bigger interactivity. Ajax (Asynchronous JavaScript and XML) became a key technologies (Case J. 12 January 2024).
2010s	Responsive Web Design Bootstrap and Foundation	After different devices started to become more and more common part of all people's life, with their different sizes and properties there was crucial to be developed approach which was going to accommodate all of them no matter of their specifications (Case J. 12 January 2024).
2010s - Present	The time of Java Script Frameworks Angular, React, and Vue.js	Some JavaScript Frameworks were very transformative for the front-end development. Virtual DOM and architecture based on components appeared because of new frameworks. With those frameworks it was now more more accessable to develop more complex web pages. In this period the SPAs because very popular. (Case J. 12 January 2024.)
2010s - Present	The Game Changer - The Progressive Web App (PWA) Movement	Allowing developers to create websites that work on different devices, were able to function offline, can be accessed via browser or installed on device (Case J. 12 January 2024).
Present - Future	WebAssembly and Beyond	Allows developers to build high performance web applications.

Table 1. Evolution of Front-End Development. (Case J. 12 January 2024.)

It is generally accepted that the front-end development appeared more boldly with the advent of HTML and CSS. So, it's fair to say that the first front-end developers emerged in the early 1990s. At that time the profession was not present as interesting to people or promising for professionals, before it gained more important role in the web programming, with the development of the internet, the world wide web and the main languages used to create web content HTML and CSS. The new chapter of the Front-end development as a profession come to reality when the programming language JavaScript was invented and firstly appeared. If before the work of the front-end developer was to mainly create static websites and make them look pleasantly for the website's visitor's eye, with the appearing of JavaScript the whole new world of possibilities opened it's doors for the front-end developers and this career path. (Pineda 19 September 2021.)

JavaScript appeard on the surface in 1995. The person bringing it to thw world is Brendan Eich. Initially it was designated for Netscape 2 and handed to ECMAtwo years later, before it emerged

the front-end developers were mainly thought of as the designers in the computer progreming process. (w3chools JavaScript History). In the next several years up to the beginnig of the 21st century JavaScript has gained a lot of popularity, which in contrast didn't make it widely used amongs the front-end developers, still considered web designers. The thing that finally changed that was the emerge of jQuer, which opened the possibility for web designers, to do more and tranform too front-end programmers or the poeple who are developing the web, web developers. This was the time when the websites were not only static anymore. jQuery was a cross-platform JavaScript Library which allowed developers to add many new features to a website and make them dynamic, having dynamic components. Of course this was only evidential that even more can and should be done, and ECMAScript continued to grow. In the next 10 years we had the first frameworks appear, which we use to this day – Angular and Backbone. They were different with how they were implemented, because libraries and framewoks are implemented differently. Using a library allows the developer to call the functions that are written and predefined and use them in their own workspace, but the frameworks gives you guidelines, set of rules, frameworks in which applications and websites can be created with many more variables. Full-stack developers, as well as front-end and back end developer have always been aiming to learn how to do more with writing less lines of code. This eagerness to do less code brought to us the CSS preprocessors which have functions in CSS, and using variables as whole pieces of code that can be reused in different places, meaning that is dividing the code into a little fractions that can be used at more than one places. One of the most popular frameworks available is Angular, followed by Vue and React. With a little bit of retrospection, going back on the timeline it is important to be mentioned that in the late 2000s there yet another step forward. The CSS was used from the very beginning in 1990s to be used to create complexity and variety in a web design, but with some very limiting functionalities requiring long lines of code. It was necessary but not optimal concept for styling the web pages. The first CSS specification was proposed by a Norwegian and Dutch programmer in 1994, Hakon Wium Lie and Bert Bos. They had the idea of splitting the HTML from the CSS code, which was making the code more flexible and simplify the front-end development, as differentiating the two languages, one, HTML responsible for creation of content and structuring it and the other, CSS, responsible for the styling and the formatting of the content. The first official specification was announced in 1996 and allowed the developers to do basic stylings. (Pineda 19 September 2021.)

Implemented was change of the colour of a text, change of background of a web page, change of fonts. This specification had limitations in the sense of controlling the layout. The next one was released in 1998, CSS2. This one came with many new features, including positioning, improved control over the layout. Not too long after that was introduced the CSS2.1 in 2002 which focused on improving the CSS2. In 2011 CSS3 comes as a collection of modular specifications, which allows the developers to achieve better looks with advanced styling and better interactivity. In 2020s

we have CSS4 in development, coming with even more advanced features. (Raj 30 October 2023.) Of course, the development of CSS on its own showcases the ever-changing nature of the web.

As a conclusion to this part, we can summarize the work of a front-end developer and its growth throughout the years. Nowadays, front-end developers' job is much more robust and complex. Front-end developer's job usually includes creating and arranging big structure of the website and applications, giving the structure vitality, functionality, logic. They are manipulating the DOM to create all possible user interactions, and also create a virtual DOM and manipulate the content displayed on the screen. All these operations with the outcomes make the role of the front-end development of a crucial role for the overall development of the web and the entire web programming process. (Pineda 19 September 2021.)

3. Empirical part

3.1 Methodology

Ideally a research should follow a structure and plan of execution that is going to be of contributive nature and provide a new perspective stepping on a existing knowledge trying it in a different circumstances, being it theoritical or empirical, to enrich the knowledge that is established. Of course this is only achievable by filling the gaps between the existing conclusions and the new finding by relating them naturally. To execute a successful research, bringing new knowledge stepping on the solid base of previously brought information and conclusions, literature review is crucial. There are different types of literature review and in the next paragraphs it is discussed the methodology used for building this paper. It is an introduction and explanation of the research approach, way and sources of data collection, analysis techniques, scope and key milestones.

3.1.1 Research Approach

Every research needs to be performed under the pattern and tools of a systematic approach (Bairagi & Munot 2012, 77). As mentioned in the beginning of this chapter one type of research is the literature review. This research discipline supports research in various of ways. Literature review goes over findings that have been concluded in other studies that cover the same area of research and are beneficial and supplement the in-question study. Literature reviews provide the convenience of accumulating big batches of data from other research, which indicates more reliability, because is evidence by itself that many studies have gone in the same direction and the conclusions are complimenting each other, as well as the research implementing this discipline of research. (Taherdoost 6 April 2023.)

For building this work and enhancing its value as a research it was critical to provide the reader with a comprehensive understanding of each discussed aspect. To accomplish this the literature review as approach allows to gather wide range of materials such as academic works, reports which insight from the industry leaders, articles from people with expertise in the discussed topics. This paper aims to investigate technologies that are part of the front-end development today and back in the time, and literature review comes in as a handy way those to be systematically identified and discussed. There are several types of literature review that may support differently the outcome of a project and if chosen correctly can strongly support the aftermath. Descriptive research one of those and it is a method which gives the researcher an opportunity to give answers to many questions in an accurate manner and consistent order. In continuation of summarizing my personal understanding of this methodology in this paragraph I will add that I perceive the purpose of this methodology as a tool to answer the questions like 'What, 'Where', 'How' or/and 'When'.

Descriptive literature review summarizes the individual research of the author aiming in creation of a map of the existing literature reviews, generating research methodology and research conclusions. How this type of literature review is implemented is by searching, analysing, filtering and categorization of existing reviews, done in a systematic way supporting the creating of in-depth picture of the intended field of interest and consequently the author to get to new, unexplored horizons of potential research. (Taherdoost 26 April 2023.)

In a systematic way it will describe what is the situation in the field of front-end development in the context of this study, buy will not answer to questions of type 'Why'. The objective of this search will be supported by the specifics of this research design, with the use of many diverse methos to investigate all needed variables. With this type of research, the researcher is limited to the observation and measurement of the same, mentioned above and does not control or manipulate any of the variables. The use of descriptive research approaches is best suitable when the focus of the research is on identifying certain features, frequences, sequences, events. We need the information relative to the questions 'What, 'Where', 'How' or/and 'When' to be able to in the future answer to the question 'Why' with further researched on the same and similar topics. (McCombes 15 May 2019.)

Summarizing my thoughts, the objective of the thesis is to briefly review the history of the front-end development as discipline and to follow its development until nowadays, in order to then in more depth point out the changes occurred throughout the process and the newest approaches, methods and means that should be part of a person's executing this profession work. A descriptive literature review builds research to be a strong base for further research. In the context of front-end development, especially when the researcher wants to review trends and forecast the trends of the future, understanding the current situation, and providing the opportunity this research to be a brick in next studies and scientific work.

3.1.2   Data Collection

The data for the paper was carefully gathered collection of diverse range of sources, according to their type and date of publication, which was a main factor for providing comprehensive and accurate information, as well as relevant such. Academic journals will present the theoretical insights while the online articles contribute with the most up-to-date data and modern points of view. Surveys with primary collected data directly from relevant target groups will ensure that real-world data, examples and opinions are considered throughout the research. Detailed analysis and information will be provided by books published by the experts in the certain topics discussed in this paper, to give stable base and foundation.

The approach in which numerous and various sources are utilized will give satisfying robust nature of the study and will augment it by integrating different knowledge and views from different aspects. All the sources used for the finalization of this study are gahered in the table below, see Table representing summarised the literature reviewd and used for this research is available in Appendix 1, Literature Summary. The table consists of 6 columnes – Name, Author, Year, Type, Published by, Role in this study. The rows are ordered by alphabetical order and color-coded by type. Where Survey Report and Research data rows are in green, Published Books are in blue, Articles from the Web are in yellow, Academic Journals and Research are in red. They are color coded by main type, but the more narrowed type of literature is also mention in the column ''Type'', supporting the claim of the author for diverse sources of literature. Important to be mentioned is that due to the nature of the topics researched in this work as part of the IT field, are one of the most rabidly developing ones, which explains the need information on the topics to be provided in the most fast and effective way, which often is via web articles, this is why those take the biggest part of the collection of literature here. Each of the sources play crucial role for the success of this research. Survey Reports used as sources of information in this study bring information that is gathered purposfully from specific target groups, which can contribute with their professional opinion to the topic discussed – what technologies they use, what technologies they prefer to use, how different phenomens in the field impact them and their work. Books present the ideas and the expertise that experts in the IT industry have been developing throughout the development of their careers as IT professionals, which is anothervaluable source if information enriching the real experience and preferences of Developers. Web sources as articles in diital medias are one that bring the information in the most scientifically popular, synthesized way and are often very up to date, as one article can be written in several weeks, but bigger works are much more time consuming and this may be contraversial with the nature of IT, which is very rabidly moving forward and developing headlong. Reserach data is another way to present structured and tidy data, providing insights on particular questions.

3.1.3   Analysis Techniques

The data will be categorised by relevance to the topic and carefully evaluated in synthesized to detect and recognise the patterns and the trend in the front-end development.
After that the information will be meticulously cleaned to again relevance and value to the study are ensured. The data will be subjected to content analysis to extract insight needed.
These techniques will be beneficial for the comprehension of the state now and the direction

towards which the front-end development is moving forward, integrating theoretical data as well as empirical analysis to conclude with detailed and comprehensive analysis.

3.1.4   Scope

The study will focus on developments and publications from the past decade explaining the progress of the processes and tools in front-end development, the emerge of new technologies during the time frame and lull of others. The paper will review the evolution and history of the discipline since its first appearance.

3.1.5   Key Milestones

Troughout the years the industry has witnessed many changes which have been remarkable and of extreme importance for the field and the way digital products are designed and developed. There have been some bigger transformations which we will refer to as a key milestones in this section which have impact to a greater extent the development and the forming of the front-end development as it is know to us today. Those improvements and transformations bring us from the early days of teh HTML static pages to the dynamic and highly interactive websites that the user visits and uses today. In the figure below, look Figure 2. there is a visualization of the key milestones base on the article of Coleman. (Coleman 14 August 2023.)

Figure 2. Key Milestones in Front-end Development (Based on the information in the article by Coleman 14 August 2023)

3.2   Overview of front-end development

What is fron-end development as a discipline, what was the need of creating this technological field and how did it all started. Those are the questions that are going to be answered in the next paragraphs following the structure of historical information followed by the definition and exaplanation of this discipline.

3.2.1 Where it all started?

When we look back in the history, what looks like a computer today has nothing to do with how it all started. In the past computers were designated to mostly complete mathematical tasks, an those computers were humans, not machines. Those humans has the funstion to perform calculations. This was good enough for the moment, but there was the continious idea that more thing need to be automated so human mistake can be eliminated and to speed the process also.

Computers, as we know them, are a much more recent development (Myers 2020, chapter 1). Following his thoughts I will add that as much as the computers were the humble beginning of technological revolution and people were curious about them, computers were still too far from the initial human understanding of how things work, and they were way too far away from the adopted ways and approaches and what people have been used to in that point of time in eternity.

The people were the earliest computers, not machines. When using the word "computer" before 1613 it referenced to a group of people that were executing the profession. They were performing big and complex calculations, usually performing the tasks of bookkeepers or mathematicians and this was their job description, but their actual job title was ''computer''. For the first time the word has been used in reference to a machine in 1897. (Rose Barfield, 2020.)

The first users of the computers have been exactly the ones that were supposed to understand it the most but turns out that even the programmers and developers at those times were struggling with it. All that they were to work with were the zeroes and ones. And their job was with the little at that times tools that they must fit complex mathematical issues and different concepts within that frame. In other words, with every task, they were working on making progress in what the machine will understand. It was like perfectly fitting a circle into a triangulate form.

At this point we did not even have the tiniest screen, but a huge machine that required a lot of room, a lot of finances to be maintained and enormous infrastructure. Nevertheless, this was just the beginning and even with all the costs that those newly invented machines required they were undoubtedly much less costly than a group of smart people, mathematicians. In addition to that it was unquestionable who is going to make less mistakes, of course the machines, and this was the huge promise for the future. More time efficient work and accuracy.

As Myers says the potential was there, but in order to accommodate as soon as possible return of investments fast progress and transparent growth was needed. To achieve that the familiar computer users were supposed to do so that the computers will undertake specific tasks, tasks that are going to be profitable in some way. This was transforming those original users into specialist developers. They were the ones programming the machines to execute certain pieces of work. This

made them to be something like and early form of interface between the user and the computer. (Myers 2020, chapter 1)

Nowadays there are many professions falling into the box of the people, who work towards making the end user's life easier and creating for them computer programs that are going to multiply their productivity. The different specialists do this in one form or another. Those has different duties and goal and have different titles depending on their impact to the final product.

3.2.2 What is front-end development and front-end developer?

In the early years of the computers as machines the need of someone who would interpret the user needs to the developer, so he can program or execute the program which is going to deliver the expected result was very strongly advocated. That was inevitable part of the work with computers. However, the requirement for an interpreter was there, the one who will be the touchpoint between the user and the developer. But it was very wide term, there was a need of specialists with narrower scope, to make this work in the most efficient way for its time. This is how the professions of system analyst.

The system analysts were the specialists that were aware with the requirements and the needs of the potential users of the system, and accountable for the full design of the system. But in order to be fully responsible for the design, they were required to understand the needs and requirements of the users as well as to have perfect understanding of how the user will interact with the system, so they can design it. As this was not as narrow, to bring the best outcomes to the role of the front-end developer. The work of the front-end developer brings to life the face of a digital product, software, or web program. Front-end development develops the GUI, graphical user interface. The duty of the front-end developer is to create the aspect of a program that the user sees and interacts with. The aim of a front-end developer is to create intuitive, fast, accessible pages and interfaces that will have positive impact on the people's understanding of how to use and will be supportive towards the positive human-computer interaction and encourage users to utilize the functionalities with no hesitation in the outcome. The successful client-side of a development must deliver accuracy and clarity between the communication of the user with the system and every functionality must produce the excepted or labelled results when interaction is initiated by the user.

3.3 Current technologies in Front-End Development

3.3.1 JavaScript

In the past developers have been using JS only for the purpose of adding interactive components to their web pages, but today JS has developed to levels where it is used for much more complex

developments, as applications and video games, even (Narayn 2022, Chapter 2). JS is different and preffer with that it can run directly in the browser. In Figure 3. below is represented the relation between the three main technologies and their main roles, see Figure. 3.
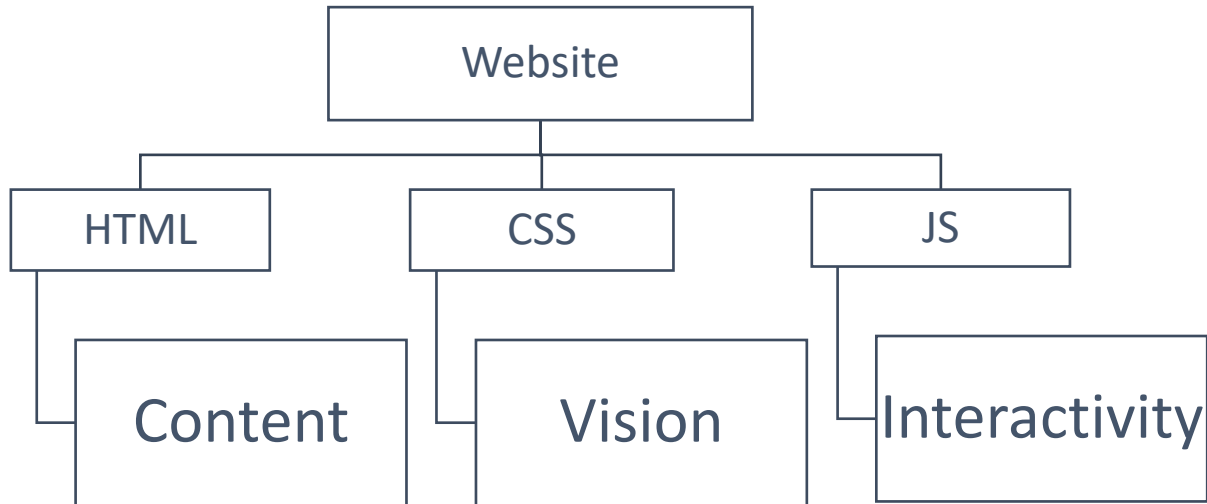
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                          ┌─────────────────┐
                          │     Website     │
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        ┌──────────────────────────┼──────────────────────────┐
   ┌─────────┐                ┌─────────┐                 ┌─────────┐
   │  HTML   │                │   CSS   │                 │   JS    │
   └─────────┘                └─────────┘                 └─────────┘
        │                          │                           │
   ┌──────────┐              ┌──────────┐               ┌──────────────┐
   │ Content  │              │  Vision  │               │ Interactivity│
   └──────────┘              └──────────┘               └──────────────┘
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Figure 3. Role of JS in a website

Base building components and fundamentals of everywebsite are the technologies JavaScript, CSS and HTML. Combined, those elements form the skeleton of most websites and aplications that users use nowadays. JS is used to create interactivity and dynamic components like pop-ups, animations, different embeds and many others. According to W3Techs, Web Technology Surveys in 2024, 98,3% of all websites used JavaScript. (Paruch 21 March 2023.) In the figure below, see Figure 4., is shown the market position of JavaScript on 7th of May 2024. The diagram shows the status in terms of popularity and traffic. JavaScript is compared to some of the most popular front-end side programming languages.
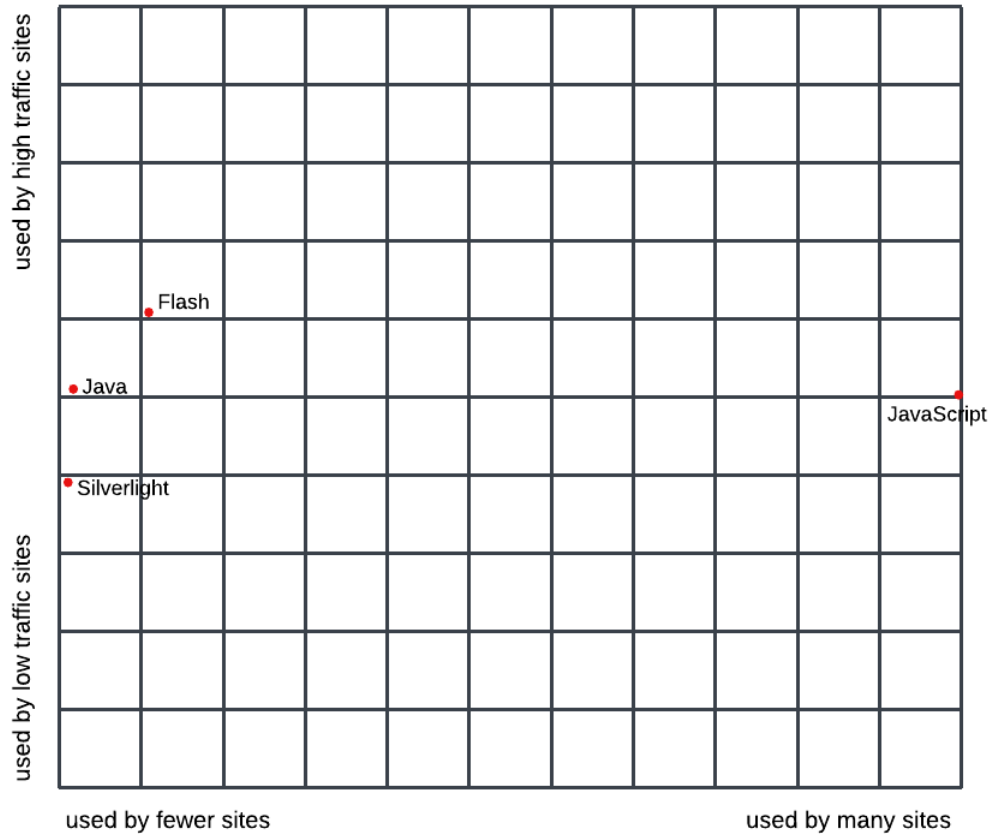
Figure 4. JavaScript Market Position (adapted from an article by W3 Techs, representing the usage in website of JavaScript, W3Techs Web Technology Surveys, 2024)

From the chart we see that JavaScript is used by many sites and those can be website of low traffic as well as website of high traffic. Some of the popular websites using JavaScript are Google.com, Facebook.com, Microsoft.com, Apple.com, Twitter.com, Instagram.com, Linkedin.com. (W3Techs Web Technology Surveys, 2024.)

3.3.2 React.js

React was introduced in 2015 and since then its use has been growing rapidly. It is a front-end open-source JavaScript library developed by Facebook. It is preferred because of his simplicity and effectiveness in the development process (Rawat & Mahajan 2020, 1). Also, it's short and easy learning curve according to Naimul Islam Naim (Naim 2017, 2).

3.3.3 CSS in 2024: Emerging Trends

Initially CSS was written for web designers with limited programming skills and background. Therefor it did not include some programming constructs like variables, conditional and repetitive blocks, and functions, which led to excessive code reuse and the styling code. As was mentioned in the introduction chapters CSS is also part of the front-end development evolution and evolves hand in hand with the other features building the front-end development and the first line visuals and functionalities of a website or an interface of a software. In 2024 CSS comes with new features that aim to make web design more flexible, more responsive, and more user-friendly. We have cross-browser support for nesting, :has(), container queries provide a way to examine the size of a container, and accordingly to implement CSS to the content of that container. (Kramer 2 April 2024.)

Contaner queries

With container queries our website will adjust how it appears as whole, but also the same programming can be done for smaller sections, giving us broader flexibility. Figure 5. and Figure 6. show an example of that feature.

```
.card {
  container-type: inline-size;
  container-name: card-container;
  padding: 1rem;
  border: 1px solid #ccc;
  border-radius: 5px;
  background-color: #f9f9f9;
}
```

Figure 5. Container queries

```
10 ▾  @container card-container (max-width: 40em) {
11 ▾    .card-title {
12         font-size: 1.8rem;
13         color: #333;
14       }
15
16 ▾    .card-content {
17         font-size: 1rem;
18         line-height: 1.5;
19         color: #666;
20       }
21
22 ▾    .card-footer {
23         text-align: right;
24         margin-top: 1rem;
25       }
26     }
```

Figure 6. Container queries

The relatively new feature allows styles to be applied based on the size of the container and not only to the width of the viewport, giving developers the chance to create even more responsive designs. In the first figure we see how we define the type and the name of the container. In the second figure, withing the block of the container we can see the parts of the content that are going to be modified in a certain way, following the rules defined in the code. In the given example the title will change it's colour and font-size when width of the container gets less than 40em. The content of the card will change it's font size to 1 rem, the line height to 1.5 and the colour to #666. The footer will be modified with text alignment to the right and additional 1rem margin on the top. (Kramer 2 April 2024.)

Pseudo classes - has() and :is() Selectors

Those clasess are new features with the help of which we can more easily search and target certain elements on the page.

For example, **a:has(img)** selects all **<a>** elements that contain an **<img> child.**

:is() class unravels CSS selectors uses a selector as an argument and choses each element that is relevant.

CSS nesting

Is now available across major browsers. It helps us to write cleaner code and create nested structures giving relative between each other selectors to the child and to the parent rules. This was before possible only with CSS pre-processors.

CSS Variables Enhancements

The variable in CSS have been also call Custom Properties. They have been introduced in 2015 and have been developed since. With the use of variables developers have been able to store values of certain things, those things may be colors, sizes, fonts or combination of those and are used as a shortcut for assigning them to different part and modules within the code. Helping code be clean and the websites to look seamless and consistent from a styling point. In 2024 CSS variables bring more freedom for creativity for the creators. It is predicted that varibles will get more and more important. They are set to bring more engaging and interactive websites, that are going to be more fun and unpredictable, thank to the varibles being able to be used spontaneously, on the spot in paralel with the user actions, creating really dynamic and alive pages. Developers are working towards more and more browsers being able to support the CSS variables, which make the webbrowsing more an more limitless. With those limitation being removed step by step, developers are walking towards even bigger oppotunities to create dyamic styling and personalitation of the styles and responses to human interaction. (Kramer 2 April 2024.)

New color models and color functions

CSS in 2024 delivers us new color systems that fix problems that have been experienced with RGB in the past and give programmers more control:
We are introduced to HWB, LAB and LCH. Being supported in more web browsers. The **clamp()** situates a value between a range of values. This function works with three parameters: a minimum value, a target value, and a maximum value allowed. **min()** and **max()** sets the diapason between the smallest and the biggest desired values. In addition to the introduction of the new color system we have those tools which alltogether enable the developers to create more pleasing colors without a lot of code work, with just several settings in the lines. (Mdn web docs CSS: Cascading Style Sheets.)

CSS Subgrid

Starting from September 2023 we have the CCS feature Subgrid is available across most of the latest devices and browsers.

Level 2 of the CSS Grid Layout specification includes **subgrid value.**

Subrig enables developers to create more consistent layouts. Grid is more challenging when using with a columns and row that consists of different content. This will change the layout depending on the font size, length of the content etc. With subgrid we have all the containers with different content behaving the same way, because all subgrids are positioned on the parent grid. Instead of setting up grid template colums, we use set up a subgrid on the parent grid. Subrid brings us more consistency across breakpoints, allows the nesting to be much more flexible and less issues with maintenance. (Kramer 2 April 2024.)

CSS Preprocessors

Currently the most used CSS preprocessors are SASS, LESS and Stylus.

The preprocessors are the tools making it possible and easier to maintain large, complex style sheets, making the lines od code more organised, supporting faster, efficient workflow with minimization of the mistake a developer would eventually allow to appear in the code. How preprocessing works is using its own stylesheet languages like the ones that were mentioned, SASS, LESS, that are going to be converted into pure CSS. CSS preprocessors are very powerful, and they can help streamline the development flow of a front-end programmer. (Queirós 2018, 17.) Summarized, developments in CSS allow us to use CSS and achieve same results as we did before, but without the external tooling that we had to use.

3.3.4   HTML

It is important to be mentioned another building unit of the Front-end development here.

Over the years HTML has evolved a lot so today we have HTML5. HTML5 is much more powerful then its intial and first version.

3.3.5   User Experience and Accessibility

UX Design is all about the process of creating experiences for the users of those experiences. At its core, UX Design covers several key elements that make up an experience – usability, usefulness, desirability, brand perception (Conta 2024, Chapter 1).

There can not be user experience without at least one user. As professionals user experience designer's job is to provide the user with functional, intuitive and simple designs and the users experience can vary from user to user in dependance of their nderstanding. The job of a good design is to minimase the gap as much as posisble between the provided UX and UI and the actions, and understanding of the user. Icons, navigation, use of words, tabs and pop-up windows

all those must be as self explenatory as possible, and this has to be from the persepective of the users and not the prespective of the designer.

This is how important a design is; It can stimulate the usage of a product by serving the expectations of the user or it can significantly decrease the usage of digital product or product overall, by misleading the user or creating obstacles for them and in thi sceanrio discouraging people to utilize the product.

For the purpose of this paper it would make sense to review the article written by the infamous Jakob Nielsen, who is co-founder of Nielsen Norman Group with Dr. Don Norman. The article is titled "A 100-Year View of User Experience" where Jakob Nielsen, 2017, reviews 100 years of the UX as an industry, starting from the 1950s with the Dawn of UX and developing his ideas for the future of the field until the 2050s. His timeline starts with the company Bell Labs, working on the UX design of the touchtone keypad, design that has been used for many years afterwards. To accomplish this successful idea and design from Bell Laps siply studied ways to make the telephone easier to use. Giving his opinion the professional in the the field Jakob Nielsen states that UX has come a long way since 1990 is less than 10% of what it should look like and still remains too complicated for the average people. (Nielsen 24 December 2017.)

Jakob Nielsen, 2017, has chosen to the variable: the number of user-experience professional in the world for the period of time he is including in his article to measure the progress of the discipline. He combines this information in a chart, see Figure. 7., visualising data from 1950 to 2017 mentioning that those are best estimated values, as there is no agreement that defines who is a UX specialist and they can be under various different titles at their workplaces. The data from 2018 to 2050 are forcasts. (Nielsen 24 December 2017.)
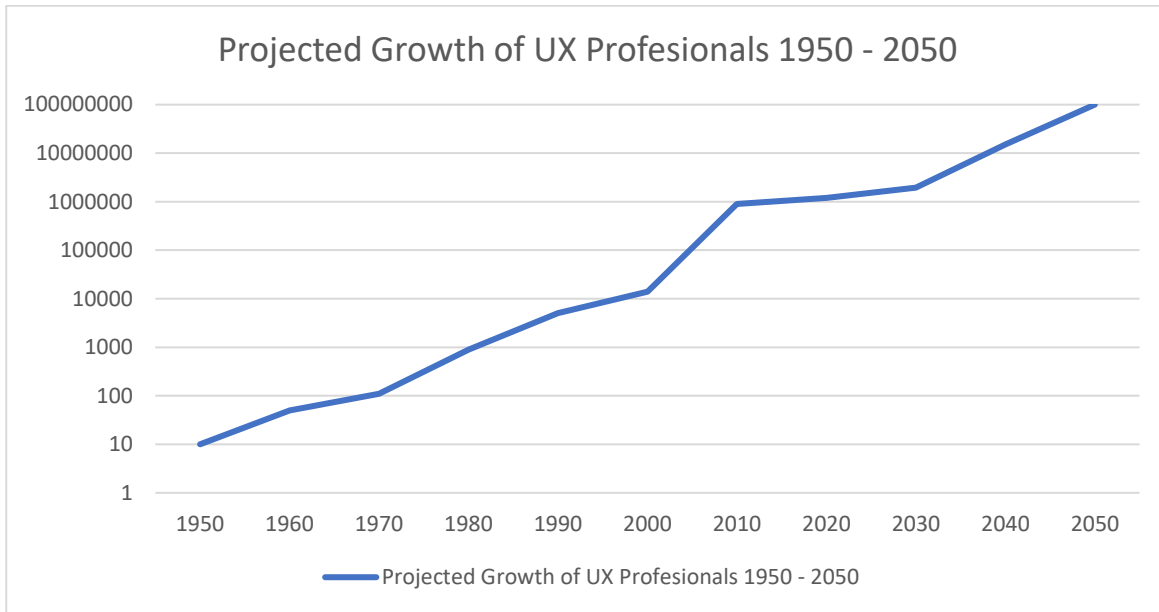
Figure 7. Projected Growth of UX Profesionals 1950 – 2050 (adapted from the article from Nielsen 24 December 2017)

Following this Nielsen, 2017, recognises differences in the growth rate for each third of the 1000-year period and for the years from 2017 to 2050 he presents estimated growth in the UX profession from about 1 million people to about 100 million people. Which is a significat growth for the marked period of time concidering that the growth of professionals corresponds to 1% of the world's population. (Nielsen 24 December 2017.)

3.3.6   Importance of responsive and adaptive design

Responsive design is an important topic when the evolution of front-end development is discussed. The concept of responsive web design is a key concept in the background of web development. During the Information Age society have witnessed intense appearance of more and different devices, as well as enormous increase of the internet usage. Those new devices mentioned above have been from different types, smartphones, tablets and subseqentially from same types, but with huge variety of sizes, which understandably applies with the same force to the screen sizes respectively.

As discussed in the paper of Almeida and Monteiro the increasing number of Internet users and mobile devices, such as smartphones and tablets, has caused a need to adapt the content displayed on each device (Almeida & Monteiro 2017, 57). Following their toughts in my opinion it would have been quite challenging for developers and designers to work on developing each

digital product for a every design size available out there, as those are nowadays impossible to count and also to predict f ever a certain digital project will be used on particlar device. This would have cause a lot of unnessessary work, costs for development and realisation of projects, increasing the manual work and decreasing the unique value provided with a product, when designers and developers are able and encouraged to focus their attention in really meaningful tasks and goals.

Due to this issue arising, to the surface appears the idea of solution that is going to cover and resolve this. I would call this solution ''one-size fits all''. This is what the responsive web design brought to the table. Essentially RWD provides the users with the ability to access web content regardless of the screen dimensions particular device has. RWD is be the bridge between base digital product and the device, and will support the user in receiving the content in a acceptable format, not being limited in the level of interaction they get. With the implementation of RWD the end-user got the content with all it's features, with no deduction on quality or design caused by the differense in the type and size of device used by them.

In their study Almeida and Monteiro help to answer the question ''What is the perception of software developers on the main benefits and limitations of responsive design?'', which the first research question in their study. For their study they adopt a quantitative approach based on a questionnaire with 18 questions and 181 respondents, working in private and public companies, as well as working as freelancers. From the point of view of the developers Almeida and Monteiro destinguished equal amount of main advantages and main disadvantages of responsive web design. In the part of the study covering this research question they found out that the three main advantages were that responsive web development is benefitial for creatinf better user experiences in an easier manner, support the better accessibility and contributes to higher effectiveness and productivity. Adversely some of the major disadvantages highlighted from developers were browser compatibility, higher loading time and optimization of the user experience. (Almeida & Monteiro 2017, 54 - 57.)

In the recent years we start to access internet content on more and more devices, which was not that common in previous years. Nowdays it becomes a standart to access the web via smartphones, tablets, TVs and numerous other devices. Only this aspect show the crucial role that RWD has in web development into create web pages that are adaptable and responsive to the device they are accessed from. In this subchapter we looked into the positive and the negatively addressed side of the RWD, summarising as biggest advantages the improved user experience and accessibility, decrease of resources in development processes and maintenance, smaller costs, but there is still the shadow of the criticism which referes mostly to he longer loading times,

suitability for different types of projects and issues with browser compatibility regarding older versions of browsers. (Almeida & Monteiro 2017, 57.)

3.4 Future Outlook and Predictions for front-end development trends

There is one certain thing acompaning the software develpment and this is the unstoppable evolution. The creation of new tools and emerge of new technologies. One constant thing are the always changing trends and new technologies. Those changes are especially manifested in the front-end development world, because of the transpiring new types and variations of devices, and followed by the increasing expectations and changing demands of the users. (Jacito 8 February 2023.)

3.4.1 Artificial Intelligence and Machine Learning

Arificial Intelligence Report published in 2023 by GitLab brings the highlights of the state of AI in software development. Artificial intelligence is an umbrella term referring to computer software that simulates human capabilities such as logic and problem solving. Machine learning (ML), a subset of AI, is the use of complex mathematical models to enable a computer to identify patterns and make predictions based on existing data. The study investigates how DevSecOps teams have been utilizing artificial intelligence in software development in the year 2023. In the surveys based on which is the data in the reports took part 1001 people, individual contributors and leaders in development around the world and from more then eighteen different indursties. The data shows that AI in software development gains traction and 23% of the respondents said that their organizations are currently using AI in the software development cycle and another fraction of 67% stated that they are planning integration of AI in the same way in their organizations. 49% of therespondents' organisations are using AI within their development processes multiple time a day on a daily basis. (GitLab 2023.)

According to 2023 survey of 1,001 DevSecOps professionals by GitLab and the information gathered from professionals, 55% identify improved efficiency, 44% faster cycle times and 41% increased innovation due to the implementation of Artificial Intelligence in their processes, see Figure 8.
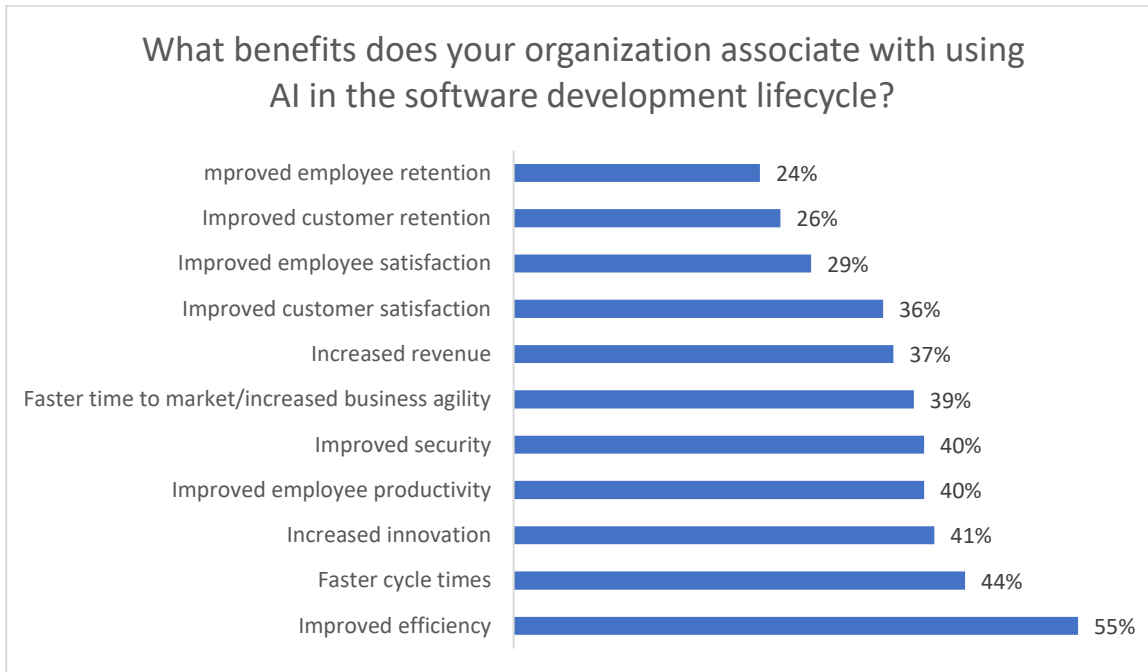
Figure 8. Benefits associated with AI (adapted from the Gitlab's report, The State of AI in Software Development 2023).

In the context of Front-end development AI is used more in two forms at the moment. AI features can be added to a website or AI is used in the development process in the form of AI-powered tools for development. Within the results of the study of Gitlab in June 2023 is concluded with the analisys of the data collected that Chatbots that allow users to ask questions in documentation using natural language is presented with 48% by the respondents, in the list of software development use cases where they were interested in applying AI. (Gitlab, The State of AI in Software Development, 2023).

AI-powered tools for development – there are technologies that support the help of the developers, by performing tasks that otherwise would be needed to be performed by the human creator, affecting their time and efficiency. Tasks where AI is mostly used in daily tasks according to the Survey of GitLab 2023, The state of AI in Software Development are writing or improving existing code, meetings and administrative tasks, understanding what code does, testing, code maintenance and identification and mitigation of security vulnerabilities, see Figure 9. below.
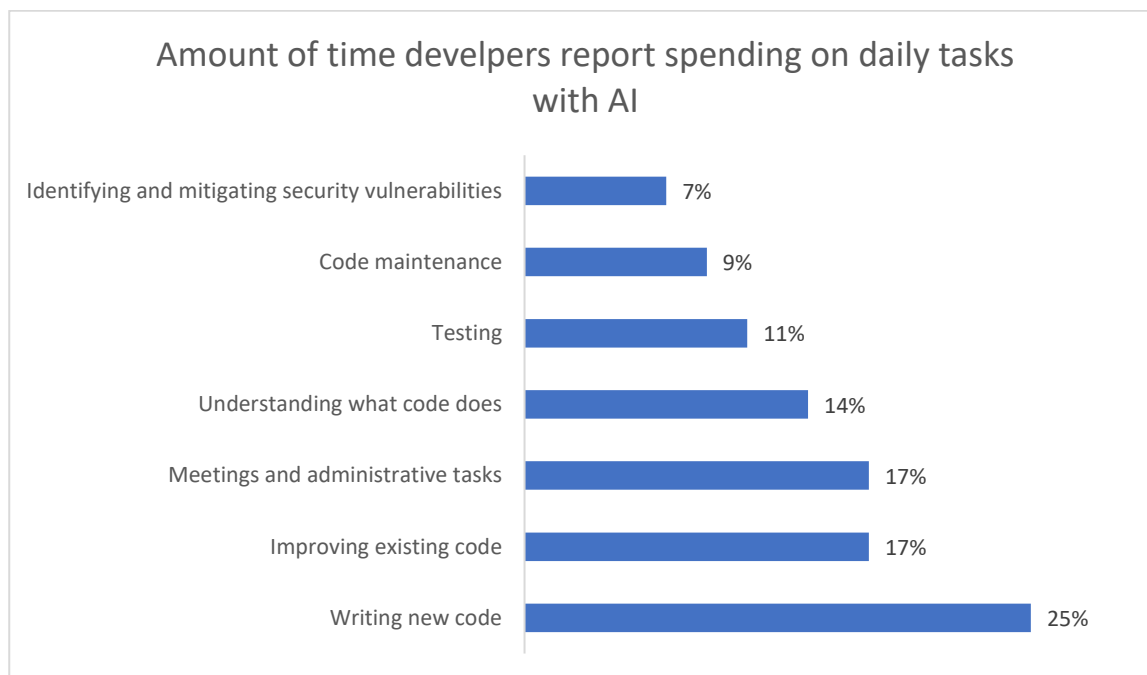
Amount of time develpers report spending on daily tasks with AI

Task	Percentage
Identifying and mitigating security vulnerabilities	7%
Code maintenance	9%
Testing	11%
Understanding what code does	14%
Meetings and administrative tasks	17%
Improving existing code	17%
Writing new code	25%

Figure 9. Amount of time developers report spending on daily tasks with AI (adapted from the Gitlab's report, The State of AI in Software Development 2023)

Example for AI tool is Microsoft's Sketch2Code, which is an AI-based program that converts a sketch of wireframe into a prototype. Sketch2Code works by using computer vision to detect HTML objects and text recognition to process handwritten texts. The HTML code is then generated by combining these objects and sentences. (Jacito 8 February 2023.) Another degenerative UI tool is Vercel's v0 which returns a user interface triggered by a prompt. The tool aim is to support the developer with the first iteration of their product. Vercel's v0 tool can create a complete UI with a one sentence prompt. The tool creates three variations relative to the prompt given. As detailed and specific the prompt is, as satisfying is the result given. It also provides the code for the interface which can be used as a starting point from the developer. Or to visualize how changes would apply. A creator can also use the code to add certain component to their project. AI and ML will be more an more utilized by front-end developers in the next years. With the AI revolution in 2023, this seems to be an undividable part of all software development. In the context of front-end development, AI will be included in the digital products in the form of features and also implemented as a background method for understanding the end-user better. The AI and ML will help developers to automate many of the repetitive tasks they have in the development process. According to a 2022 survey of 5,001 DevSecOps professionals by GitLab, 31% revealed that they now apply AI/machine learning in their code reviews. (Gitlab, The State of AI in Software Development, 2023). It goes to show that front-end developers are starting to embrace the power of AI and ML technologies (Jacito 8 February 2023).

3.4.2   Progressive Web Applications (PWAs)

PWAs offer smooth experience for the users combining the best of native and web apps. Progressive web apps start off as simple websites, but as the user engages with them, they progressively acquire new powers. They transform from a website into something much more like a traditional, native app (Ater 2017, Chapter 1).

PWAs are websites that act like apps and have similar features to the applications. In his book Building Progressive Web Apps, Tal Ater gives a list of some of the advantages and benefits of the PWAs. Availability regardless of connection is important feature provided by PWAs do not need web connection like traditional websites. PWAs can provide the same experience and features to the users that have no connection, those with excellent connection and the once with unstable network connection. PWAs have fast load times. Not dependant of the connection, this fast launch is noticed for the first time. PWAs often load faster even compared to native apps. Push notifications are another good feature of the progressive web application, imitating the native one. Progressive web apps can send notifications to their users (even days after they left the site) and similarly a homescreen shortcut can be added for instant access, as it was possible for native applications only before. PWAs can be difficultly recongnides as such by the end user, having many of the characteristics of the native applications. Many times it is indistinguishable if they are native apps or PWAs due to they similar features and capabilities. (Ater 2017, Chapter 1.) Some of the most well known progressive web applications are Spotify, Telegram, The Washington post and Pinterest. PWAs have plenty of advantages over native apps. For one, they are far easier to develop and maintain than traditional mobile apps, making them a great option for businesses as users are not required to download anything from app store. (Jacito 8 February 2023.)

3.4.3   Single-Page Applications

SPAs is prefered from companies and organisations that do not have a lot of content needed to be on their page. Those applications are getting more and more popular within the industry. SPAs do not require the reload of the page, all of the information is positioned on one page and it is easy to navigate. The products that may be created with this applications are blogs or portfolios, information of organisation that do not need to provide a big amount of information on their page. With the use of frameworks like React, angular and Vue.js, building and deplying of those kind of applications is comparably faster and easier (Jacit 8 February 2023). Some examples for SPAs are Gmail and Facebook. SPAs reduce the requests to the server, creates better engagement with the end-user and is has faster simpler development process and the debiggind process is easier as well.

3.4.4   Serverless architecture

Serverless architecture is getting stronger in 2024. It is a solution to many obstacles that web developers have in their work. This approach excludes the responsibility that a developer has to set up and manage servers and can concentrate on the programming part of the project, it also reduces the dependancy of the front-end developer with the back-end side. It may be incredibly benefitial for smaller project where costs and operational time can be decresed also. (Jacito 8 February 2023.)

4. Key findings

The front-end developent has gone through tremendous changes since the beginning of the internet era started and it's development towards the end-user, who is not a professional developer and there all the improvements and developments appear as a nessecity for the front-end developer having the closes interaction throuh their part of a digital product to the potential and real users.

Summarizing the information in the previous pages brings together the conclusion of the questions why, how and what. There are two aspects forcing the continuous transformations and progress in the field. On side of those catalysts for change and improvement are the users and on the other the developers. The needs of both groups are pushing forward the evolution of the practices forming the front-end development performed by developers and forced by the expectantions and requrements of the end-users.

4.1 Answer to RQ

As years are moving forward technology goes along. The digital product have become an neccessary part of our life in the last 30 years and the evolution has been enourmous. Users and developers are more and more invested to have the best devices and technologies on the table and rapidly the demands change. To satisfy the needs of the market computer scientists work constantly on delivering new tools that can upgrade the development process and speed the delivery processes. In result of that there are changes round-the-clock, but as the research show the changes are continuous, but rarely come as a suprise and in totally unrecognisable form. Technologies that have performed well in tha past will difficultly be replaced, because of their efficiency and usefulnes for the developers. Those examples are HTML, CSS and JavaScript, which do not seem like are leavin the horizon anytime soon.

In some cases we have technologies that are completely shaking the scene with innovativenes and show completely new landscapes to the developers and consequently to the users of their digital products and services like AI and SPAs. The trends in of front-end developement this study recognises in the SPAs. PWAs, Sustainbly developing fraworks and libraries, Advanced CSS, Artificial Intelligence, Machine Learning. The trend can be contributing to the experience of the End User or to the productivity, efficiency and work flow of the front-end developer, in this sence I am dividing them in two groups to visualise better the findin of this research.

Contribute to End UX	Contribute to Developer Workflow
Responsive and Adaptive Design	JavaScript Frameworks
CSS Frameworks	JavaScript Libraries
Component Libraries	Build Tools
PWAs	State Management Tools
Advanced Animations and Interactivity	Collaboration tools
Accessibility Tools	AI-Driven Code Assistants
AI Driven Personalization	Automated Testing
AI Chatbots	Tools for Code Review
AI Virtual Assistants	

Table 2. Trend in Front-End Development according to the results from the study

From the presented in the table, Table. 2, its visible that the end user drives forward trends that are ensuring their experience. The end user needs to be secured that they are going to be able to get the same view no matter the device that they are using and the responsive and adaptive design is tool that developers use to accomplish that, as the device sizes available on the market these they may not be counted. Performance and Speed for the end user are provided nowadays by the Progressive Web Apps mostly, as they enhance the user experience having short load times and all of the advantages off the native applications. An lastly supporting the user interaction and accessibility provide Advanced animations, accessibility tools and personalization for each user brought by AI, customizing the views and content based on the user behaviour and profile.

Leading trends developer's productivity and work flow are the JavaScript frameworks which simplify the development processes and streamline them, and other libraries that can be used to manage the application state. Tools that help them build software and automate repetitive tasks. AI and Machine Learning tools that may predict or suggest code lines, or AI-driven tools automating the testing processes that need to be performed.

4.2   Summary of Key Findings

In 2024 a developer has many tools and technologies supporting them in their work with styling their products and creating fun and efficient interactivity for the users. Nowadays developers have in their tools kit over 40 CSS-in-JS libraries, over 40 CSS frameworks and many component libraries across Angular, React, and Vue, giving them the opportunity to decide what tools they are

going to use for their projects in dependence of the scope and goals of the mentioned. In 2023, several new styling tools were introduced, including Shadcn UI, Ark UI, Panda CSS, and Meta's StyleX, and Lemon Squeezy with Wedges, their open-source React UI library. Naturally we see the tendecy troughout the years that not only new solutions are emerging continuously, but also updates to existing ones are regularly made. From the theoretical part of this study transitioning to the emperical and comparing the new variables we can bring to conclusion that the the progress has never been faster, even though present troughout all history of front-end development.

We have new technologies and framework emerging more often then not and they all are being utilized and appreciated by professionals in the field. The base is always apperant and there, develpers continue build using the main components, being those from the very beginnig, and being built over with new features, or new developments are built to accompanie them and give more opportunities to developers to build front part of a digital product more efficiently and with prodigy.

5. Discussion

5.1 Implications for Practitioners and Researchers

The launch of new tools and technologies can only be of full use to practitioners if those are well explained and discussed in the context of professional environment supported by studies explaining what those needs are fulfilling and how they are beneficial for the industry and development processes. This paper looks back into retrospection and slowly moves further to the days where developers face challenges and find solutions by adapting to the new ways, adopting new technologies and creating tools for filling the gaps of what has not been covered by a solution yet. This is a symbiosis that can not be broken, or if will end the long-term progress. This review shows that the merging technologies are needed and rarely we see something that is not really needed and therefor will not be implemented by anyone, or just a few people. Web and Software development are disciplines accompanied with enormous time and resources consumption and those resources are rarely going to be waisted if there is no real existing need.

5.2 Areas for Further Research: Gaps in current literature, emerging topics worth exploring.

As one very technical topic, as is the Front-end development there is usually a gap of documents diving into a certain technology and explaining t from A to Z to fulfill the needs of developers to move fast with the flow, to be educated and develop their professional hard skills. From great value will be more researchers to be done where the studies are focused especially over the trends and their adoption from professional from different rang and professional situation. To be further studied the impact of the rapidly changing environment to the productivity and the willingness of new young talents to get into the profession.

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Appendices

Appendix 1.

Source Name	Author	Type	Published	Publisher	Purpose
A 100-Year View of User Experience	Jakob Nielsen	Article	2017	NN Group, www.nngroup.com	A 100-Year View of User Experience
Building PWAs. Apps Bringing the power of native to the browser	Tal Ater	Book	2017	O'Reilly Media, Inc.	Explaining in details PWAs and compares to other different digital products
CSS in 2024: Emerging Trends	Nimrod Kramer	Article	2024	DailyDev www.dailydev.com	Trending in CSS
Descriptive Research.Definition, Types, Methods & Examples	Shona McCombes	Article	2023	Scribbr, www.scribbr.com	What defines the descriptive research method, types, methods, examples.
DevSecOps professionals by GitLab	GitLab	Survey Report	2024	GitLab	The survey show the status of Software development from different angles
Different Types of Literature Review	Taherdoost, H.	Encyclopedia	2023	Encyclopedia, www.encyclopedia.pub	Different Types of Literature Review
Evolution of Front-End development	Justin Case	Article	2024	Ovidius, www.ovidius-astro-theme.netflify.app	The paper comprhensivly looks into and explains the evolution of Front-end Development from the very basic form to Modern Frameworks.
Front-End Developer	Dominic Myers	Book	2020	BCS, The Chartered Institute for IT	Covers the profession of front-end developer in terms of responsibilities, required skills and relevant tools, work

					approach, technical approach
Frontend developments to expect this 2024	Andrea Jacito	Article	2024	Startechup, www.startechup.com	Methodical explanation of current situation
Gitlab The State of Ai in Software Development 2023	GitLab	Survey Report	2023	GitLab	Survey of professional from the industry responding different questions regarding the status and movements within the software development.
History of CSS, The evolution of Web Design	Anupama Raj	Article	2023	AlmaBetter	Explaining the History of CSS, The evolution of Web Design
JavaScript History	W3schools	Website		W3schools	Brief history of JavaScript
Just React!: Learn React the React Way	Hari Narayn	Article	2022	Apress	React
Mdn web docs	Mdn web docs	Website		Mdn web docs	Tehcnical Documentation
Modern front-end development - How libraries and frameworks transform everything	Dinh, Duong & Wang, Zhuanyan	Thesis	2020	Theseus, www.theseus.com	Libraries and frameworks in front-end development
Naimul Islam Naim	Naimul Islam Naim	Thesis	2017	Theseus, www.theseus.fi	Relatively older article, but very informative about JS
Queirós, R.	Queirós, R.	Article	2018	MDPI	CSS preprocessing
ReactJS: An Open Source JavaScript Library for Front-end Development	Prateek Rawat	Article	2020	International Journal of Innovative Science and Research Technology	Article ecplaining ReactJS as a modern web framework
Research Methodology: A Practical and	Vinayak Bairagi &	Book	2019	CRC Press	Research as process and types of research

Scientific Ap-proach	Mousami V. Munot				
Tech Forecast The top tech trends, tools, and skills to know in 2024	Pluralsight	Survey Report	2024	Pluralsight	Survey with over 3000 participants. Executives, Technologists and tech experts uncover the top tech trends, toold and skills for 2023/2024
The Art and Science of UX Design	Anthony Conta	Book	2024	New Riders	The book is a guide for how to create amazing user experiences.
The evolution of Frontend Development	Eduardo Pineda	Article	2021	Eduardo Pineda, www.epineda.net	Explores the history and changes in Front-end development. Discusses carious new ttechnologies within the topic of front-end development
The Evolution of Front-End Development: From HTML to Modern Frameworks	Matt Coleman	Article	2023	Medium, www.medium.com	The paper comprhensivly looks into and explains the evolution of Front-end Development from the very basic form to Modern Frameworks.
The Future of Frontend Development: What to Expect in the Next 5 Years	Abdullahi Muritala	Article	2024	Abdullahi Muritala	The article very briefly explains the future of front-end development
The Role of Responsive Design in Web Development	Fernando Almeida & José Monteiro	Research	2017	Webology, www.webology.org	Quantitative research approach based on a questionnaire with 181 participants in the face of professionals in the industry. Showing that offering a good user experience and accessibility is on one of first places when it comes to

					success of a digital product.
Usage statistics of JavaScript as client-side programming language on websites	W3Techs Web Technology Surveys	Research Data	2024	W3techs www.w3techs.com	Reports updated daily. The diagrams show the usage statistics of JavaScript
What is JavaScript & What is it used for? A basic guide to JS	Zach Paruch	Article	2023	Semrush, www.semrush.com	JavaScript

Green - Survey Reports and Research data

Blue - Published Books

Yellow - Articles from the Web

Red - Academic Journals and Research