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VISUAL ACCESSIBILITY PERFORMANCE OF E-SHOPPING PLATFORMS IN TURKEY: A CASE STUDY CONDUCTED ON TRENDYOL.COM, HEPSİBURADA.COM AND N11.COM

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APPROVAL

This thesis/project titled VISUAL ACCESSIBILITY PERFORMANCE OF E-SHOPPING PLATFORMS IN TURKEY: A CASE STUDY CONDUCTED ON TRENDYOL.COM, HEPSİBURADA.COM AND N11.COM submitted by FATİH EMRE SOYLU, in partial fulfillment of the requirements for the degree of Master of Arts in Design is approved by

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PUBLISHING METHODS

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In addition, I acknowledge that any claim of irregularity that may arise in relation to this work will result in a disciplinary action in accordance with the university legislation.

Fatih Emre Soylu

_____

18/07/2023

To My Dearest Family...

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VISUAL ACCESSIBILITY PERFORMANCE OF E-SHOPPING PLATFORMS IN TURKEY: A CASE STUDY CONDUCTED ON TRENDYOL.COM, HEPSİBURADA.COM, AND N11.COM

ABSTRACT

Many online retailers present accessible websites, which can be navigated using keyboard-only commands or assistive technology, such as screen readers. However, developing a keyboard-accessible digital product is very different from producing a digital product that meets universally accepted standards for visual accessibility. Visual attributes of the user interface elements on a web page sometimes become the second priority for the designers and developers when they design e-commerce platforms with an accessibility approach. In this research, a unique method, combining heuristic user tests conducted on top three most visited e-commerce platforms in Turkey (Trendyol.com, Hepsiburada.com and N11.com) and evaluation criteria mostly based on distinguishability part of perceivability section of Web Content Accessibility Guidelines 2.1, is created in order to evaluate e-shopping platforms' visual accessibility performance. This method is used to understand the easiness of a task for the users whether they have a sight related health problem or not. The findings of this study indicate that users encounter numerous visual accessibility problems. The evaluation of Trendyol.com, Hepsiburada.com, and N11.com demonstrates that these platforms exhibit multiple failures, not only in terms of more complex visual accessibility criteria but also for basic criteria such as contrast ratio and text size. On a positive note, the study reveals that most of these visual accessibility problems can be easily resolved.

Keywords: Visual Accessibility, Web Content Accessibility Guidelines, Web Design, Graphic Design, Color Contrast, E-Commerce, Online Shopping

TÜRKİYE'DEKİ E-TİCARET PLATFORMLARININ GÖRSEL ERİŞİLEBİLİRLİK PERFORMANSI: TRENDYOL.COM, HEPSİBURADA.COM VE N11.COM ÜZERİNDE YAPILAN ÖRNEK İNCELEME

ÖZET

Birçok çevrimiçi satıcı, yalnızca klavye komutları veya ekran okuyucular gibi yardımcı teknolojiler kullanılarak gezinilebilen erişilebilir web siteleri sunar. Ancak, klavyeyle erişilebilen bir dijital ürün geliştirmek, evrensel olarak kabul edilen görsel erişilebilirlik standartlarını karşılayan bir dijital ürün üretmekten çok farklıdır. Bir web sayfasındaki kullanıcı arayüzü öğelerinin görsel nitelikleri, erişilebilirlik yaklaşımıyla e-ticaret platformları tasarlarken tasarımcılar ve geliştiriciler için bazen ikincil öncelik haline gelmektedir. Bu araştırmada, Türkiye'de en çok ziyaret edilen ilk üç e-ticaret platformu (Trendyol.com, Hepsiburada.com ve N11.com) üzerinde gerçekleştirilen sezgisel kullanıcı testleri ve çoğunlukla Web İçeriği Erişilebilirlik Yönergeleri'nin algılanılabilirlik kısmının ayırt edilebilirlik bölümüne dayanan değerlendirme kriterlerini birleştiren benzersiz bir yöntem kullanılmıştır. Bu yöntem çevrimiçi alışveriş platformlarının görsel erişilebilirlik performansını değerlendirmek için oluşturulmuş ve görme ile ilgili bir sağlık sorunu olsun ya da olmasın, kullanıcılar için bir görevi tamamlamanın ne kadar kolay olduğunu anlamak için kullanılmıştır. Bu çalışmanın bulguları, kullanıcıların çok sayıda görsel erişilebilirlik sorunuyla karşı karşıya kaldığını göstermektedir. Mevzubahis platformların değerlendirmesi, onların yalnızca karmaşık görsel erişilebilirlik kriterleri açısından değil, aynı zamanda kontrast oranı ve metin boyutu gibi temel kriterler açısından da başarısız olduğunu gösteriyor. Olumlu olarak, çalışma, bu görsel erişilebilirlik sorunlarının çoğunun kolayca çözülebileceğini ortaya koyuyor.

Anahtar Sözcükler: Görsel Erişilebilirlik, Web İçeriği Erişilebilirlik Yönergeleri, Web Tasarım, Grafik Tasarım, Renk Kontrastı, E-Ticaret, Online Alışveriş

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LIST OF SYMBOLS

+	Plus
-	Minus
÷	Division
=	Equal

LIST OF ACRONMYMS AND ABBREVIATIONS

ADA: The Americans with Disabilities Act

ADHD: Attention-Deficit / Hyperactivity Disorder

AI: Artificial Intelligence

AIGA: The National Association of Schools of Art and Design, and Graphic Artist Guild

AODA: The Accessibility for Ontarians with Disabilities Act

ASD: Autism Spectrum Disorder

ASSETS: International ACM SIGACCESS Conference on Computers and Accessibility

AT: Assistive Technologies

ATAG: Authoring Tool Accessibility Guidelines

CERN: European Council for Nuclear Research

CRPD: The Convention on the Rights of Persons with Disabilities

DDA: The Disability Discrimination Act

DOM: The Document Object Model

HCI: Human Computer Interaction

HTML: HyperText Markup Language

ICIDH: The International Classification of Impairments, Disabilities, and Handicaps

ICT: Information and Communication Technology

ISO: International Organization for Standardization

LGBTQIA+: Lesbian, Gay, Bisexual, Transgender, Queer, Intersex, Asexual, Plus

MS: Microsoft

OCR: Optical Character Recognition

OS: Operating System

PDF: Portable Document Format

POUR: Perceivable, Operable, Understandable, Robust

TfL: Transport for London

UAAG: The User Agent Accessibility Guidelines

UI: User Interface

UK: The United Kingdom

UN: United Nations

US: The United States

UX: User Experience

W3C: The World Wide Web Consortium

WAI: Web Accessibility Initiative

WCAG: Web Content Accessibility Guidelines

WHO: World Health Organization

1. INTRODUCTION

1.1 Brief Information About the Research

Many online retailers offer accessible websites, which can be navigated using keyboard-only commands or assistive technology, such as screen readers. Accessibility solutions make browsing and purchasing products online easier for people with disabilities. However, creating fully accessible digital products is very challenging for web developers and designers. For instance, a keyboard-accessible digital product is very different from a digital product which meets universally accepted contrast ratio standards for accessibility. It is because a keyboard accessible digital product is designed by considering reading order of HTML elements on a webpage and enable blind users or people who can't use a mouse to navigate through the page. As it can be assumed, it doesn't ensure accessibility in other aspects such as text size, audio control or simplified text. The reason of this difference is that everyone has their unique abilities and needs. A blind person's needs differ vastly from a low-sighted person's requirements when using a digital product such as a web page, a PowerPoint presentation, or a PDF file.

There are four main principles of accessibility. These are simply called as POUR: Perceivable, operable, understandable, and robust (The City University of New York, 2022)[1]. Since this research investigates the appropriateness of visual elements of a digital product, the main focus area of the study is the first principle of these principles which is perceivability. This choice leads the research to investigate the distinguishability of the user interface elements of a website in terms of their visual features. It can be stated that

[1] See Section 2.7.2

visual attributes of e-commerce platforms are evaluated regarding accessibility. The research also has an approach combining accessibility and graphic design.

In the research, disadvantageous people are identified as “people with disabilities” instead of “disabled people” to prevent any harm to the mentioned group of people. This term is chosen because it is known that many scholars have abandoned to use the term of “disabled people” due to its having a negative denotation. The term of “people with different abilities” is also eliminated since academia has not built a consensus on its usage because of its potential to hinder the awareness of the society towards disabilities. However, it must be noted that this research doesn’t only include people with disabilities, it includes all people in the society whether they live with a disability or not.

Using gender pronouns are also avoided in this thesis. Avoiding using gender pronouns can help to erase people's identities and make the setting uncomfortable for those who identify as LGBTQIA+. This is very important for the research because the field of study is highly related to concept of inclusion. That’s why “the one” is used to identify a person instead of the pronouns like her, his, she or he.

It must also be noted that the terms of “digital accessibility” and “web accessibility” are used interchangeably in this study. Even though digital accessibility encompasses web accessibility, the reason for this usage is that web accessibility is the most prominent aspect of digital accessibility by quite a margin. The terms of “e-commerce”, “internet shopping” and “online shopping” are also used interchangeably throughout this dissertation.

1.2 Purpose of the Research

The purpose of this research is to understand how online shopping platforms, which operate in Turkey; perform in terms of fundamental visual accessibility standards. The research aims to understand people's experience when they e-shop by revealing potential

problems related to visual accessibility whether the users are low-sighted or not. Contrast ratio and text size are the most important features of a user interface element to be considered in regard to visual accessibility because they directly affect the distinguishability of an element and their potential to create problems for all people in case of their inappropriate usage. Moreover, the contrast ratio for non-text user interface elements (such as icons and other non-decorative user interface elements), line height, letter spacing, line length, and text justification are evaluated to reach a more detailed and holistic result.

The data gathered during the research process is evaluated to understand e-shopping platforms' performance related to visual accessibility. This information is also segmented to each research criteria to better understand the problematic areas in general. Results for each category are visualized to make reader to comprehend them more easily. The final data is discussed to understand not only the aforementioned e-commerce platforms but also the accessibility issues that create problems for the users of all e-commerce platforms because most e-commerce platforms having similar design attributes.

1.3 Significance of the Research

Online shopping is not regarded as a fundamental right in today's society. Basic rights, such as the right to life, liberty, and the pursuit of happiness, are typically those that are acknowledged by the law as crucial to the protection of individual freedom, dignity, and autonomy. Szoszkiewicz (2018) claimed that many steps have been taken to consider access to the internet as a human right. United Nations (UN) declared many reports aiming to consider access to the internet as a human right, but there is still no consensus on the topic. That's why these developments remained merely as recommendations. Nonetheless, it is impossible to overlook the significance of online shopping in the lives of contemporary people. Some nations have declared internet access to be a fundamental human right, and access to the internet and the capacity to participate in online activities are becoming increasingly acknowledged as significant aspects of modern life.

It's important to note that even though online shopping is not considered a fundamental right, everyone has the right to access goods and services in a non-discriminatory manner. If someone with disabilities cannot access goods and services in a physical store, online shopping can be a significant option for them to exercise their right to access those goods and services. This situation makes online shopping particularly important for people with disabilities for several reasons. First, it is very convenient for those people. Online shopping allows people to shop from the comfort of their homes, without navigating physical stores or dealing with transportation barriers. Additionally, online shopping can offer a wider variety of products than physical stores, including items that may be difficult to find locally. Online shopping's being more cost-effective is another aspect making it more significant for modern people. Internet shopping can often offer lower prices than physical stores, which can be beneficial for people with disabilities who may face additional financial barriers due to their regular medical expenses and/or limited employment opportunities. This reason can be especially important for people with disabilities who require specialized products or equipment. Overall, online shopping can provide people with disabilities with greater independence, convenience, and access to a wider variety of products at lower prices. The reasons which make online shopping a great option for people with disabilities are also evident for people without disabilities.

E-commerce platforms have been rising, especially during the last decade, in terms of share in the industry, thanks to increasing number of customers who use these platforms more and more instead of conventional shopping platforms such as malls, local shops, or grocery stores. This shift in the commercial area has become more noticeable since the pandemic. Today, people don't only online shop for niche products, but they also e-shop for their basic needs such as groceries and clothing. Most of these platforms have taken huge steps to make themselves easily reachable by most of the population. In Turkey, it is known that e-commerce platforms such as Amazon Türkiye, Getir, Migros One and Teknosa have collaborated with BlindLook. BlindLook is a start-up company aiming to increase awareness towards to the blind people and helping its clients to create more accessible websites for those disadvantageous group of people to make their platforms more blind-friendly. (BlindLook, n.d.) Unfortunately, BlindLook only concerns

accessibility with regarding blind people. This brave and innovative company does not help its clients to create better visual attributes in terms of visual accessibility. Even if it is disregarded in some extent, it is obvious that graphical content is as important as the other elements in a digital product in regard of accessibility due to its taking huge part of "Perception" section under Web Accessibility Initiative's POUR (Perceivable, Operable, Understandable and Robust) principles. This partial connivance generates some issues for e-commerce platforms' visual accessibility performance with regarding low sighted people or people with no vision related problems who needs more accessible visuals on e-shopping websites.

As stated, the industry focuses mostly on the operability-related attributes of digital platforms by regarding accessibility. Also, the academia takes the issue into account with a wide perspective which results a lack of investigation purely assessing the visual accessibility performance. All the information provided in this section implies that this research can have a potential to fill the gap in the academia because it assesses the issue with a very specific approach merging accessibility and graphic design by evaluating the problems of very important and popular platforms which are used by modern humans.

1.4 Motivations

Accessibility is a very important concept because it ensures that everyone can access and fully participate in all aspects of society regardless of their abilities. This includes everything from physical spaces and transportation to digital content and technology. When accessibility is prioritized, it doesn't only benefit individuals with disabilities, but it also creates positive impacts for a wider community. The concept promotes inclusivity, equality, and diversity, and helps to create a more just and fair society. Additionally, making content and technology more accessible can improve user experience for everyone, not just those with disabilities. It's a win-win situation that benefits everyone involved. As a graphic designer believing that the good graphics are created with an approach that equally involves with science and art, the researcher has always interested

in graphical content which can sustain clear communication to almost every individual in the society. That's why, the researcher has been studying accessible graphic design in his academic life and using the information that he has acknowledged from the field to contribute the one's professional work.

Accessibility and graphic design go hand in hand because graphic design is crucial for producing accessible materials. People with disabilities, such as those who have visual impairments or cognitive difficulties such as ASD (Autism Spectrum Disorder), may find it easier to grasp and access information with the help of effective graphic design as Monaco et al. (2014) suggested. For instance, making text simpler to read for those with visual impairments and cognitive difficulties can be achieved by utilizing high contrast colors and legible typography. Poor graphic design, on the other hand, can obstruct accessibility. Those with visual impairments, for instance, may have trouble reading small print or text with poor contrast, while those with cognitive impairments may have difficulty comprehending and navigating complicated or cluttered layouts. Even a person without a disability can suffer from low visual accessibility of a digital product. Hence, graphic designers have to provide accessible materials and to take into account the demands of all users. By doing this, graphic designers can contribute to create more inclusive experiences to everybody regardless of their abilities. That's why the researcher wants to increase awareness towards the concept of visual accessibility.

The most important study that drove the researcher to go deep on the subject is the work of Phills, Deiglmeier, and Miller. It has contributed the researcher's awareness on the importance of the issue in a social aspect. Phills et al. (2008) asserted that many innovations can create social benefits for some parts of society, but only social innovations distribute the created value toward the whole society. Based on this assertion, it can be claimed that determining and solving accessibility problems is very important. It is so important that it can be considered as an action which can create social innovation. This work has not only highlighted the significance of the concept for the researcher, but it has also encouraged the one to conduct a study which is related to the accessibility.

Since then, the researcher has begun to look for a topic related to accessibility for the one's thesis.

1.5 Research Questions

The topic that is selected for the thesis also motivates the researcher more than other subjects because it is more related to the one's professional field. As a graphic designer, the researcher has always focused on graphics-related accessibility issues such as contrast ratio, text size, letter spacing, line height etc. Accessibility problems related to reading order, alternative text or assistive technologies have always had a secondary importance for the one due to their not being directly related to the graphic design. This situation has led the researcher to ask more specific questions about the one's goal. Eventually, the author has come up with several important questions at the end of the pre-thesis process.

Main research questions are listed below:

- What are the problems related to accessibility when people use online shopping platforms?

- Are popular e-shopping platforms adequate to meet universal web accessibility standards?

- What are the most prominent visual accessibility problems of user interface elements of online-shopping platforms?

- What can be done to improvise the visual attributes of an online-shopping platforms in terms of accessibility?

- Can people, regardless their abilities, easily complete a task on a popular e-shopping platform without encountering any major barrier related to visual accessibility?

- How do e-commerce platforms in Turkey perform in terms of visual accessibility standards?

2. LITERATURE REVIEW

2.1 Concept of Accessibility

The word “access” has its roots reaching the word “accessum” in Latin. This Latin word can be translated to “approach” or “reach” in English. This gives us a clue about the concept of accessibility. Accessibility is a concept/term/subject that describes a product, a service, or a physical environment’s being easily usable by people with the widest range of capabilities. It is the most common description of the concept. In a practical sense, it can be claimed that accessibility is the practice of creating products, services and/or environments which are accessible to everyone, regardless of their abilities.

Accessibility has also other definitions. With a city planning perspective, accessibility can be defined as the opportunity which an individual or type of person at given location possesses to take part in a particular activity or set of activities (Hansen, 1959). The International Organization for Standardization (ISO) defines the concept as usability of a product, service, environment, or facility by people with the widest range of capabilities (International Standards Organization, 2008). Web Accessibility Initiative (WAI) focuses on web design and disabilities when it defines the concept. According to WAI, web accessibility means that websites, tools, and technologies are designed and developed so that people with disabilities can use them (The World Wide Web Consortium, n.d.d).

The concept of accessibility is based on the principle suggesting that people should be able to use products, services, and environments with ease. It involves creating designs that are inclusive and considerate of the wide range of abilities and needs of people. The concept is not limited to physical spaces or environments, but it can also be applied to digital products. In the context of digital technology, it is evident that accessibility refers to design websites, software, and electronic documents that can be used by people with

disabilities, including those who are blind or visually impaired, deaf, or hard of hearing, and those with mobility or cognitive impairments. Additionally, accessibility interests almost everyone in the world because disabilities can also be temporal and situational.[2]

Accessibility has a wide spectrum of touchpoints. The different facets of a product or service which must be considered to ensure that people with disabilities can access and utilize them are referred to as the major touchpoints of accessibility. There is no consensus in the academia to classify the touchpoints of the concept since its being very extensive in that regard. However, it can be claimed that some of the primary touchpoints that are commonly acknowledged are those that are physical, digital, communicative, attitudinal, and policy accessible. The term of physical accessibility refers to the physical environment, such as structures, modes of transportation, and public areas, which must be planned and built with people with disabilities in mind. This explanation covers elements like ramps, elevators, parking places with access, and tactile warning strips. Digital accessibility refers to the accessibility of digital content that should be planned and produced to be accessible to people with disabilities, such as websites, software, and mobile apps. This statement covers functions like captioning, audio descriptions, and keyboard accessibility. The availability of communication is the other key touchpoint. This relates to accessibility of communication channels that should be created to be accessible to individuals with impairments, such as telephone systems, video conferencing, and in-person contact. This includes functions like closed captioning, sign language interpretation, and relay services. The attitudes and beliefs of people and society toward those with disabilities are a key component of attitudinal accessibility. It is crucial to promote a culture of inclusion and acceptance because attitudes can be some of the most prominent obstacles to accessibility. Accessibility of policies must be highlighted as the final touchpoint. This relates to laws and policies providing equal access to opportunities and services for people with disabilities. The Americans with Disabilities

[2] See Section 2.4.2

Act (ADA) in the United States and the Accessibility for Ontarians with Disabilities Act (AODA) in Ontario, Canada, are examples of such laws.

2.2 History of the Concept

Levine et al. (2019) stated that the concept of accessibility has been around since the early 20th century with the published articles in the academia. Hurd's (1903) analysis of "urban growth", Haig's (1926) "ease of contact", and Stewart's (1948) "demographic energy" are some of the earliest examples of these studies. However, the concept had not been established on a scientific basis until the late 1950s. Hansen (1959, pp. 73-74) explained and formulated the theory in the one's famous article called "How Accessibility Shapes Land Use". The author revealed the relation between places and people; and for a long time, accessibility has been considered a concept focusing on physical accessibility of places for people. The author created a model which is known as Hansen's Accessibility Model. Basically, this model was founded on the idea suggesting that an area's growth potential increases as it becomes more accessible to a range of activities and has more available land. Accessibility, in this context, refers to a measure of how closely an area is located in relation to all other activities in the surrounding region. Hansen has worked on numerous accessibility-related projects and initiatives, including assisting with the development of accessibility guidelines for websites and software. The scholar has also been an active participant in a number of groups that focused on accessibility, such as the World Wide Web Consortium's (W3C) Accessibility Guidelines Working Group. Hansen has significantly advanced accessibility and has been a crucial figure in highlighting the value of creating places, services, and products that are usable by individuals of all abilities.

For many years, academics have debated the ideas relating to the concept of accessibility from the perspectives of space and city planning. As it was already established, Hansen was credited with coining the term "accessibility" in the one's well-known work mentioned above. There are other studies that have been built on Hansen's studies. Morris

et al. (1979) stated that accessibility is the simplicity with which activities can be reached from a particular area using a particular transportation system. The study's authors underlined the opportunity for interaction that accessibility offers. They suggested that analyzing transportation systems by using accessibility is a helpful methodology in their work. They asserted that their method enables a thorough and inclusive study of how, where, and why people travel, by taking into consideration the interconnectedness of land use and transportation.

Geurs and Wee (2004) also focused on accessibility in terms of space and transportation. The authors identified four factors of accessibility based on existing definitions and applied measures. The first factor is referred as the land-use component implying the number and distribution of opportunities in each area. The second factor is the transport component considering the effort required to travel from one point to another. The third factor is the temporal component, which takes into consideration the availability of activities at different times of day. The fourth and final factor was the individual component, which considers the varying needs and opportunities of different socio-economic groups, such as those with different income levels.

The academics' claims about the emergence of the concept and its being evaluated by a physical space perspective is supported by a relatively recent study. Batty (2009) asserted that the roots of the concept are highly related to physical accessibility. The author suggested that this model, which relates land use and people's activities, is called as "generic concept of accessibility". The author evaluated the model and tried to understand its strong and weak points. The study is not directly related to this research. Therefore, there is no reason to give more details about it. On the other hand, it is important to mention about it because the scholar proved that the concept was mostly related to spatial attributes of physical spaces in the early stages of its conceptual evolution.

The concept of accessibility has always been evolved and will continue to transform itself in order to response the everchanging needs of the society. According to Ahuja and Tiwari (2021, pp. 5-6), the definition of accessibility in the late 1970s depended on elements like

location, distance, and timing. Access has become based on infrastructure and transportation systems in the late 1990s and the ability to engage in activities has been redefined as accessibility in the beginning of the twenty-first century. As a result, accessibility planning has begun to take an activity-oriented approach, putting more emphasis on making activities accessible than just the physical distance or expense. This strategy has stressed how people may access activities with ease and independence, independent of their location or other characteristics.

The studies focusing on the concept have also spread to cognitive studies. Linguist Mira Ariel has demonstrated that there is a direct correlation between the kind of referencing expressions employed and the ease with which entities may be mentally recalled. Informativity, rigidity, and phonological size, according to studies of Ariel, are the three basic concepts that underlie this relationship. The level of detail of a referring statement can be used to understand its informativeness. The easier it is for the listener to forget the entity, the more instructive the term. When the subject has a lower degree of accessibility in the listener's consciousness, for instance, "The lady with the dog" is more informational than "The lady," and it should be used. The degree to which the expression limits the possible entities that the listener might take into consideration is what defines rigidity. In Israel, for instance, the name "Bibi" can only be used to refer to a certain individual, whereas "Binyamin" is less restrictive because it can be used to refer to a variety of people. According to the phonological size principle, phrases that are longer and more complex have lower accessibility levels. Ariel gauged phonological size based on the expression's duration and degree of stress. For instance, "The US" denotes a higher level of accessibility than "The United States of America" because it is shorter. (Ariel, 1988, 1991) These studies have proven that the simplicity is the one of the key factors to increase accessibility and affected other areas related to the field such as web design, graphic design, and user experience design.

As it was mentioned above; mobility, architecture and city planning are the prominent elements for the concept of accessibility since the emergence of the concept. Nevertheless, digital accessibility has emerged as a notion with the introduction of World

Wide Web. While the topic of accessibility has been a subject of academic discussion for many years, it was during the latter part of the 20th century, following the emergence of the digital revolution over 40 years ago, that academic studies specifically focusing on accessibility in relation to digital products started gaining prominence.

British computer scientist Tim Berners-Lee developed World Wide Web in 1989 while the one was employed by CERN, the European Council for Nuclear Research. The web is a decentralized network of information, with links on each page making it simple for visitors to visit other web pages. After the one's incredible achievements, Sir Lee founded The World Wide Web Consortium's (W3C) in 1994. The organization develops open standards to ensure the long-term growth and evolution of the World Wide Web. The W3C provides technical specifications, guidelines, software, and tools to promote the development of the web as an open platform for innovation and collaboration. It can be asserted that web accessibility is the one of the most important concerns of the organization. W3C presented Web Content Accessibility Guidelines to the world in 1991. The organization constantly updates it to meet the ever-changing demands of the society. The organization has a mission to lead the web to its full potential by promoting a high degree of interoperability among different platforms and devices, and by ensuring that the web remains accessible to all users regardless of their abilities. To achieve this mission, the W3C collaborates with a wide range of stakeholders including industry, government, academia, and the general public. (The World Wide Web Consortium, 2022)

Towards the millennium, the concept of digital divide has also emerged as a term in the academia. The digital divide refers to the gap between those who have access to and can effectively use information and communication technologies (ICTs), such as computers, smartphones, and the internet, and those who do not. This disparity can exist on various levels, including individuals, households, communities, or even between different regions or countries. Janelle and Hodge (1999) discussed the issue in their study. They argued that although the internet has become more accessible to certain previously marginalized groups, there is a growing disparity in the utilization of personal computers and online services between European Americans and African Americans in the United States

between 1994 and 1997. This widening gap highlights the existence of a "digital divide," emphasizing the urgent requirement for approaches to represent and assess individual internet resource access. It can be claimed that this gap is still evident between developed and underdeveloped countries today.

As industry evolves itself to meet accessibility criteria with the help of non-profitable organizations, the scholars have begun to discuss the concept of digital accessibility by focusing on web accessibility during the early 2000s. Bjarnik (2004) suggested that web accessibility is a concept which aims to enable the users to perceive, operate, and understand the contents, regardless of their ability. Milne et al. (2005) also stated that web accessibility is the capacity of a wide variety of individuals to access and utilize online content. According to these suggestions, it can be asserted that web accessibility refers to the inclusive practice of designing and developing online content and applications in such a way that people with diverse abilities can access, use, and interact with them effectively. The concept aims to eliminate barriers which have a potential to prevent some individuals from accessing web content. This purpose of the concept creates an opportunity for equal access and opportunity for all individuals.

Digital accessibility has also been evolving over the decades considering the practices in the industry, with the development of technologies and tools to make digital content more accessible to people with disabilities. For example, Adobe has developed a range of accessibility features for its products, such as screen readers, text-to-speech, and closed captioning (Kirkpatrick, n.d.). Microsoft has additionally been actively working on making its merchandise and offerings extra accessible, with the improvement of its Accessibility Evolution (Microsoft, n.d.). Overall, with the developments in the academia and the industry, accessibility has come a lengthy way in the previous few decades, with greater interest being paid to making digital content material and offerings which are more useful for people with disabilities.

Today, digital accessibility is a significant part of the accessibility studies. People interact with digital products in almost every aspect of our daily lives. They use computers,

mobile phones, infotainment systems etc. They also interact with various digital products in public spaces. There are also guidelines which help the designers to produce accessible websites. These extensive guidelines, such as WCAG 2.1 and Section 508, are also applicable to many other digital products such as portable document formats, PowerPoint presentations and video file formats.

2.3 Related Terms

Accessibility is a notion which is related to many terms. One of the important aspects of accessibility is its being a part of the discipline of design. Accessibility is a concept which has close ties to other important fields of design such as inclusive design, human-centered design, and universal design (design for all). Above all, accessibility is a concept which is significantly related to the concept of usability, because both notions focus on improvement of user experience. Albeit almost all scholars agree that the existence of strong relation between two concepts is obvious, there is no consensus on the internationally accepted definition of accessibility concerning its relations to usability. Petrie and Bevan (2009, p. 3) suggested that the definition of accessibility varies depending on whether you look at the Web Accessibility Initiative (WAI) or the International Organization for Standardization (ISO). WAI suggests that accessibility is a part of usability, only applicable to older people and people with disabilities. In contrast, the ISO considers usability as a part of accessibility, focusing on a wider range of users including elderly and people with disabilities. This lack of agreement highlights the issue of accessibility's potential misperception by many people. However, in practical terms, usability is used when arguing the development of eSystems for the mainstream, people without disabilities, younger users, and their issues. Conversely, accessibility is used when talking about the development of eSystems for older individuals and users with disabilities and their issues.

Iwarsson and Ståhl (2003, pp. 64-65) give us more information for our perception of two concepts. According to them, it can be seen as an advantage if usability becomes more

prominent than accessibility because the term accessibility can be stigmatizing and associated only with people with disabilities. Additionally, planners may not be interested in solving problems for a small group of users. Using the term usability instead highlights a more positive and health-promoting perspective. Usability is increasingly used in Human Factors Research for any potential user group and is associated with functioning rather than disability. This approach, along with universal design, has more democratic values and human rights perspectives, which can hopefully lead to equal opportunities for people with disabilities.

Universal design is also a concept which shares similar targets with accessibility. Universal design is a concept aiming to create products, environments, and systems that can be used by people of all ages, abilities, and backgrounds, without the need for adaptation or specialized design. The goal of universal design is to make things as inclusive and accessible as possible, so that everyone can use them and get benefited from them. Story et al. (1998) defined the concept in the famous book called as "Universal Design File". According to the authors, universal design refers to the creation of products and surroundings that can be utilized by people of various ages and abilities. This approach acknowledges and values human differences and fosters the integration of all individuals in all aspects of life. Universal design also has significant relation with the concept of usability. That's why it can be asserted that these three concepts strongly interact with each other.

The relationship between aforementioned concepts still raises some concerns among the scholars. Persson et al. (2014) debated the relation between accessibility and some similar concepts such as barrier-free design, design for all, universal design, inclusive design, and cooperative design. According to them, there is no agreement on how to define accessibility across various fields, including among those involved in ISO standardization. The definition of accessibility can change depending on the design methodology employed during development, making it a subjective quality concept. This disagreement among experts may impede the widespread adoption of accessibility, which could limit the potential advantages at the individual, business, and societal levels.

Accessibility has evolved in many aspects and diffused to many other fields of studies. That's why, it can be asserted that it is a concept having a lot of in-common aspects with many other concepts. It is a notion which is related to design for all, inclusive design, universal design, human-centered design, and usability. The list can be prolonged with other similar concepts; however, one notion becomes prominent when the accessibility is discussed. This notion is disability.

2.4 Disabilities

Any physical, sensory, intellectual, or mental impairment restricting an individual's capability to engage in particular activities or areas of society is referred to as a disability. Disabilities can range in severity and effect on a person's life, and they can be either temporary or permanent.

Physical disabilities (such as paralysis or impaired mobility), sensory disabilities (such as blindness or deafness), intellectual disabilities (such as developmental delays or cognitive impairments), and mental health disabilities (such as depression or anxiety disorders) are some of the different types of disabilities that exist. Some disabilities may also be invisible, which means that others may not notice them right away.

It is vital to recognize that people with disabilities should not be defined solely by their disability. They have unique skills, talents, and experiences, and should be treated with respect and dignity, and given the same opportunities as everyone else to participate in society.

2.4.1 Concept of disability

Accessibility and disability are closely related concepts, but they are not the same thing. The degree to which a setting, object, or service is usable by people with disabilities is

referred to as accessibility. It covers everything, including how easily people can enter buildings, whether assistive technology is offered or not, and how websites and other digital contents are made. Contrarily, a disability is a physical or mental condition that limits a person's capacity to be a part of a particular activity or do certain duties. From minor to severe, disabilities can result from a variety of causes, such as heredity, disease, trauma, or aging. Therefore, accessibility is necessary for individuals with impairments to fully participate in society. Without accessibility, people with disabilities could encounter obstacles that keep them from gaining access to important services like healthcare, employment, and education. On the other hand, by making things simpler and more comfortable for everyone to use, developing goods, services, and surroundings that are accessible to persons with disabilities can be advantageous to everyone. As a result, providing accessibility is crucial to building an inclusive society that celebrates variety and encourages equal opportunities for everyone. It also has implications for social justice and equity.

According to the latest report of WHO (World Health Organization) concerning disabilities; over one billion people around the world live with a kind of disability (World Health Organization, 2021). This proves the significance of the concept. Its importance is not only due to the sheer number of people who are considered as individuals with permanent disabilities, but it is also because of disabilities' occurring temporarily and occasionally. Hence, it becomes obvious that the accessibility relates to more people than we might have initially thought.

Aging population is another factor which needs to be considered when disability is regarded. As people get older, they become more dependent on other people around them when they interact with digital or physical environments, services, and products. Accessibility is the practice to be used to eliminate this need. Therefore, accessibility becomes more vital because of its effects on billions of people worldwide. According to the latest report of WHO on aging world population, about one billion people is over 60 years old. Their share in the total world population is 12% at the moment, but WHO predicts that it will increase to 2.1 billion and make its share in total population 22% in

2050. (World Health Organization, 2022) The other study conducted by the organization (World Health Organization, 2018), which was mentioned in the previous paragraph, focuses solely on people with disabilities. According to that report, about one billion people worldwide live with at least one permanent disability. When these two reports are taken into account, it is hard to ignore the significance of accessibility because it is obvious that it is a must instead of a choice in the modern world. The concept has gained popularity and begin to get public attention after the millennia and it is clear that it will increase its significance for the future because the society is getting older and becoming more aware of the social concepts such as diversity, inclusion, and equity.

People's abilities are unique. That's why it is really hard to define disability. In their work, Clarkson and Keates (2002, p. 71) asserted that the prevalence of disability in any study is influenced by the study's objectives and methodologies. The lack of a clear and universally accepted definition of disability creates confusion around terminology, which is a significant issue. Nevertheless, the International Classification of Impairments, Disabilities, and Handicaps (ICIDH) offers a systematized approach. ICIDH identifies the disability by a model dividing the issue into four steps. According to this model diseases, aging or accidents result functional impairment depending on the affected areas of the body. While impairments trigger disability, disability results handicaps respectively (WHO, 1980, p. 11).

The interpretation of the concept of disability has changed throughout the years. Elaine Ostroff; who is one of the contributors of the book called as “Universal Design Handbook” and the founding director of US based organization, which is named as “The Institute for Human Centered Design”; stated that there has been a considerable change in how disability is defined and understood during the past 35 years. Previously restricted to the medical model alone, the classification scheme of the World Health Organization now includes the social model as well. The social model acknowledges that disability is a result of interactions between people and their environment rather than being purely a personal trait of the individual. (Preiser & Smith, 2011, p. 34) Based on this assumption,

accessibility can be recognized as the key notion to enhance the interactions occurring between people with disabilities and the environments, products, or services.

2.4.2 Types of disabilities

The article presented by Crow (2008) overviewed the difficulties and obstacles experienced by people with disabilities when they use online learning platforms. The author identified four main categories of disabilities: visual, auditory, motor, and cognitive impairments. WebAIM, which is a famous organization working to enhance digital accessibility, also categorizes the disabilities in a similar way. The organization recognizes several types of disabilities that can affect a person's ability to access and interact with digital content, with a user perspective. First one is visual disabilities. This category includes blindness, low vision, color blindness, and other conditions that affect a person's ability to see content on a screen. Hearing disabilities is the second category, and it includes deafness, hard-of-hearing, and other conditions impacting a person's ability to hear audio content. Third one is called motor disabilities. This includes conditions such as Parkinson's disease, cerebral palsy, and other conditions affecting a person's ability to use a mouse, keyboard, or other input devices. Cognitive disabilities create the fourth category, and this category includes conditions such as dyslexia, ADHD, and other conditions that impact a person's ability to read, understand, and process information. The last category is called as seizure and vestibular disorders. A class of neurological illnesses known as seizure disorders, commonly referred to as epilepsy, are characterized by recurrent seizures. When the brain experiences aberrant electrical activity, seizures happen. Seizures can cause a wide range of symptoms, depending on the person having the seizure and the type of seizure. They could involve unconsciousness, convulsions, rigidity of the muscles, and uncontrollable movements. A category of illnesses known as vestibular diseases is related to the vestibular system. This is an anatomic system which is in charge of balance and spatial orientation. Vestibular abnormalities can cause dizziness, vertigo, balance issues, nausea, and coordination issues, among other symptoms. (Institute for Disability Research, Policy, and Practice,

n.d.) All of these situations of an individual impact a person ability to use products, services, or environments in a negative way if these products, services, and environments aren't accessible enough.

There is another approach to classify disabilities. It is not a generally accepted classification method; however, it helps us to understand the fact that the concept is not only related to people with disabilities or elderly. This classification considers permanent, temporal, and situational disabilities (Types of Disabilities | Usability & Web Accessibility, n.d.). Disability that is anticipated to last a person's entire lifetime and may be brought on by a hereditary condition, an accident, or a disease is called as permanent disability. Spinal cord injury, Down syndrome, and cerebral palsy are a few examples of long-term impairments. Impairments that are anticipated to be temporary, such as a few weeks or months, are those that are typically brought on by accidents or illnesses are defined as temporary disabilities. A fractured bone, a concussion, or a condition brought on by pregnancy are examples of temporary disabilities. The last classification is called situational disabilities. There are disabilities occurring in specific situations or environments. These disabilities may be temporary or permanent. For example, a person who uses a wheelchair can only be considered as a person with disability in an environment without wheelchair ramps or an individual who is not deaf may have difficulty communicating in a loud, crowded environment which makes the one situationally impaired in terms of hearing abilities.

2.5 Types of Accessibility

In the academia, there is no clear classification for the types of accessibility. Each scholar evaluates accessibility in a different perspective. Some discusses the concept in regard to transportation systems, some take it into account in terms of linguistics, and some argues it in the aspect of visualization. Iwarsson and Ståhl (2003, p. 59) categorized accessibility by physical environment, information, or societal activities and services. On the other hand, this classification is not widely accepted in the academia.

It can be suggested that some facets of the concepts become prominent in the academia and industry. These are physical, visual, auditory, cognitive and, emotional accessibilities. Physical accessibility refers to making physical spaces, products, and services accessible to individuals with physical disabilities. This can include things like wheelchair ramps, accessible parking, and accessible restrooms. Visual accessibility involves making content and information accessible to individuals with visual impairments. This can include things like using alternative text for images, ensuring good color contrast, and providing screen reader compatibility. Auditory accessibility refers to making content and information accessible to individuals with hearing impairments. This can refer things like providing transcripts or closed captions for videos and ensuring sound quality for audio recordings. Cognitive accessibility focuses on making content and information accessible to individuals with cognitive impairments or learning disabilities. This may include things like using clear and simple language, avoiding complex sentence structures, and using consistent formatting. The last type is called emotional accessibility. This refers to creating an environment that is emotionally accessible to individuals with mental health disabilities or conditions such as autism spectrum disorder. This can include things like minimizing sensory overload, providing a calm and predictable environment, and avoiding triggers that may cause distress.

This research involves with the visual accessibility because it focuses on visual perceivability of user interface elements used in the e-commerce platforms. To ensure perceivability, website designers and developers should present text alternatives for non-textual content such as images, videos, or audio files, so that people with visual or auditory disabilities can understand the content. For example, an image should include a text description of the image for those who cannot see it. Website designers should also ensure that the contrast between text and background is high enough so that people with visual impairments can distinguish the text from the background. They should also avoid using color as the only way to convey information, as some people may be colorblind or have difficulty distinguishing between certain colors. Furthermore, designers should provide alternative ways to access information, such as transcripts or captions for videos or audio content. This can benefit not only people with visual or auditory disabilities, but

also those who may have slow internet connections or limited bandwidth. By ensuring perceivability, website designers can create a more inclusive online environment, allowing all users to access and interact with web content. However, it must be emphasized that visual accessibility is not directly related to all the sub-principles of perceivability such as text-alternatives and adaptability.

As it was claimed, visual accessibility relates most to distinguishability. Distinguishability focuses on both visual and audio representation of the content such as audio control, separation of background sound, color contrast, text resizing, text size and text spacing (The World Wide Web Consortium, n.d.e). When the works of scholars mentioned in "Graphic Design and Accessibility" section are considered, it can be argued that the legibility of the text and visibility of non-decorative web content are the most important features of digital accessibility. Based on this assumption, it can be suggested that the contrast ratio between text/non-decorative graphic content and the background, text size, line length, line space, paragraph space and letter spacing must be sufficient for all users to be easily distinguished.

2.6 Graphic Design and Accessibility

Graphic design can play a significant role in making contents accessible to all individuals, including those with disabilities. By using appropriate design principles and techniques, designers can ensure that information is presented in a clear and easy-to-understand manner, regardless of a person's ability. For example, in terms of visual accessibility, graphic designers can use high-contrast colors and clear typography to make text legible, especially for individuals with visual impairments. They can also use alternative text descriptions for images, so that individuals using screen readers can comprehend the content. In addition, designers can ensure that layouts are easy to navigate and that interactive elements are large enough to be easily clicked or tapped. Overall, graphic design can help bridge the gap between individuals with disabilities and ensure that everyone has equal access to information and content.

It is known that some browsers, desktop operations systems or mobile operation systems offer some solutions to increase the accessibility of digital products. Google Chrome offers several accessibility features to elevate the browsing experience for people with disabilities. Some of the accessibility features available in Google Chrome are high contrast mode, zoom and magnifier. These features increase the visual accessibility of the webpages. iOS (mobile operating system used on iPhones and iPads) and Windows OS (the most popular operation system for desktops) also offer a range of accessibility features to make their devices more usable for people with disabilities. Nevertheless, these companies' offers don't solve the problems which are caused by poorly accessible graphic design. In their study, Moreno et al. (2008) indicated that there is a huge potential for users for not being able to use these kinds of tools. The users aren't aware of these features, either. That's why proper graphic design in the aspect of accessibility is very important to ease the lives of the users.

Legibility may be one of the most important facets for graphic design and accessibility. The notion can be defined as the degree to which text is easy to read and understand. It directly affects how easily and quickly information can be communicated to the reader. In graphic design, legibility is achieved by using appropriate typefaces, font sizes, line height, and contrast. The choice of typeface can have a significant impact on legibility, as some fonts are designed specifically for use at small sizes or for use on screens (especially sans-serif fonts), while others may be more suitable for use in print. The colors of the text and the background also play an important role in legibility. Contrast is key, as text that does not stand out from its background can be difficult to read. Additionally, the spacing between letters, lines, and paragraphs can also impact legibility. Overall, a graphic designer's goal is to ensure that text is legible and easy to read, so that the intended message can be communicated clearly and effectively to the audience. In the light of this information, it can be claimed that designers can remarkably improve the accessibility of textual content by using appropriate graphical attributes. Thompson et al. (2004) highlighted the importance of legibility in their work. The scholars claimed that visual elements make it difficult for a person to focus on or comprehend the fundamental ideas if they don't have proper visual attributes. Such visual components may include a variety

of aspects, including contrast, font size, alignment, line heigh, length of lines, white space, charts, tables, photographs, and presentation methods for responses. Petrie et al. (2004, p. 15-16) claimed that confusing page layouts, complex navigation mechanisms, inadequate contrast, incompatibility with assistive technologies and small text and graphics are the prominent accessibility problems which are encountered by the users.

Accessible graphic design is not only important for the web, but it is also important for the physical materials used in physical spaces. Some organizations, which don't have a direct relationship with graphic design, understand the importance of the issue in terms of accessibility. TfL (Transport for London); which is a government organization responsible for the public transport in London, UK; has sections setting rules for graphical contents' accessible usage on digital and physical products in public transport network of the city in its guidelines. Nevertheless, it is witnessed that the graphic design is overlooked by the developers when it comes to accessibility.[3]

Research focusing primarily on physical accessibility also directly or indirectly contribute to digital accessibility studies from a visual design perspective. The study concerning smart showers for people with disabilities presented by Ferati et al. (2018) advocates this study's researcher's suggestion about the significance of accessible graphic design. The authors asserted that individuals who have visual disabilities suggest that digital healthcare solutions featuring buttons need to be created in a way that ensures the buttons have unique shapes, colors, and sizes in order to make them accessible and practical to use. Story et al. (1998) also underlined the importance of the graphic design's significance to create accessible content. This study focused on visual accessibility of physical assets such as books and road signs with a universal design perspective and the authors asserted that contrasts in color and brightness, separation of objects from a background and clarity of the content are vital for visual perception of these elements. These ideas and practices are also applicable for digital products in many aspects.

[3] See Section 2.9.4

2.7 Digital/Web Accessibility

Digital products are the essentials of 21st century's humans lives. Products or services that may be translated into binary format are considered as digital products. These products are different from one another in terms of their attributes and possible trade terms (Hui & Chau, 2002). The variety of these products are immersive. Books we read on our Kindles, songs we play on Spotify, digital maps we use when we navigate around the cities or presentation files we prepare for our projects are several examples of these products. Moreover, the platforms presenting these products are also digital products. Spotify, Google Maps or Microsoft PowerPoint are also considered as digital products. World Wide Web is one of the most prominent digital products because of its usage by billions and being a base platform for other digital products. That's why the main organization (The World Wide Web Consortium); which sets rules for digital products; aims to regulate the web in terms of accessibility.

E-commerce or online shopping is a phenomenon that exists in the digital world and e-commerce platforms are considered as digital products. Electronic commerce, or "e-commerce," is referred to as the online purchase and sale of goods and services. To put it simply, it entails making business transactions online. Online marketplaces (like Amazon and eBay), online stores (like Shopify and Magento), and social media platforms (like Facebook and Instagram) are just a few examples of e-commerce platforms, which enables these companies to offer their goods and services to customers directly. People may now more easily shop whenever and wherever thanks to the transformed way of business operations. Additionally, e-commerce has created new opportunities for entrepreneurs and small enterprises to compete globally and reach a larger audience.

In their work, Bevan et al. (2007) stated that a sizable barrier prevents a significant percentage of the population from efficiently utilizing e-services from both public access systems and commercial and government websites. Improvements in usability and accessibility are required to make sure that e-services are inclusive of people with disabilities, the elderly, and other developing populations like immigrants. This study

didn’t mention e-commerce platforms directly, but it discussed these platforms indirectly with regarding commercial websites. This perspective also makes these statements to be applicable for e-commerce platforms.

According to Lazar et al. (2015), accessibility refers to the degree of availability and ease of use of a particular product, service, device, or environment for individuals with disabilities or those with unique requirements or limitations. Based on their study, the authors suggested that current roundtable discussion focuses on digital accessibility, which pertains to access to technology products, resources, and services, encompassing both hardware and software. However, when accessibility is discussed; it is generally forgotten that the concept does not only concern physical spaces and services, but it is also significantly related to digital environment or services. In their works, Iwarsson and Ståhl (2003, p. 59) asserted that the term "accessibility" can be divided into different dimensions. One way to categorize it is by the type of accessibility, such as physical environment, information, or societal activities and services. Usually, people focus on physical environment accessibility when discussing disability issues, but the other two categories are also important and gaining more attention. Another way to describe accessibility is by different levels, like micro, meso, and macro levels, which refer to our immediate environment, our neighborhood, and society as a whole, respectively. These levels can be applied to all types of accessibility, including physical environment, information, and societal activities and services. Their work emphasizes the change in the world. Digital accessibility is important as physical accessibility for the modern humans. The importance of graphic design for the accessibility can’t be disregarded since the practice’s being a significant aspect of digital products.

Nimalaratne (2013) also signified the importance of accessibility for digital products. The author suggested that the utilization of technology can improve the quality of life for individuals who have different physical abilities. A significant proportion of the population are visually impaired or completely blind, which makes accessing information on the Internet challenging for them. Initiatives in developed nations, including Western

countries, have attempted to address this issue by creating screen readers that can read out text selections.

Peter Olaf Looms (2012, pp. 6-7) is one of the scholars who discussed digital accessibility. Looms created a model called as “the inclusion pyramid for digital media”. In this model, the author described four different concepts interacting with each other when a person uses a digital product. The base of the inclusion pyramid is formed by availability, which pertains to the necessary conditions for obtaining media, such as economic and technological requirements. The following step is accessibility, which is also considered a vital aspect of inclusion by the author. This stage involves the provision of access services and assistive technologies to assist viewers with disabilities in benefiting from the media content. Finally, usability constitutes the third stage, and all three stages collectively facilitate users in reaching the pinnacle of the pyramid, which is digital literacy. According to this model, accessibility is crucial for digital products as it is presented as the second step for the usage of a digital product.

Assistive technologies are crucial parts of accessibility. Assistive technologies (AT) are devices, tools, software, or equipment that are designed to help people with disabilities or impairments perform tasks that may be difficult or impossible for them to do otherwise. AT improves the quality of life and independence of people with disabilities, allowing them to participate more fully in their communities, education, and work. For physical accessibility, mobility aids such as wheelchairs, crutches, and walkers and hearing aids can be given as examples. Software which enables people with disabilities to use the digital products easily are fundamental part of digital accessibility. According to Brophy and Craven (2007, pp. 954-955), these technological tools and equipment can offer solutions to individuals who are blind or have partial sight, allowing them to overcome obstacles like reading print, using a computer, taking notes, and communicating in written or electronic form. These aids include video magnifiers, electronic readers, Optical Character Recognition (OCR) software, speech output systems, and electronic Braille devices. All these tools are commonly referred to as "assistive," "adaptive," "access," or "enabling" technology. Typically, people use a combination of these technologies to read

electronic text, such as relying on speech output while using Braille output for unusual spellings or language. Additionally, magnification may be used to explore a page, while speech output is used to read more text-heavy portions of the page.

2.7.1 Universal standards of web accessibility

Web accessibility refers to the design and development of websites, tools, and technologies in a manner that enables individuals with disabilities to effectively utilize them. This includes being able to perceive, understand, navigate, and interact with the web, as well as contribute to it. Web accessibility encompasses all disabilities affecting access to the web, including auditory, visual, physical, speech, cognitive, language, and learning disabilities.

The World Wide Web Consortium (W3C) is a community to set accessibility standards for web-based products. The organization was founded by world-wide web's inventor Sir Tim Berners-Lee; approximately 5 years later its phenomenal invention (The World Wide Web) in 1989 (Berners-Lee, n.d.). The community's standards are considered as golden rules for web accessibility. That's why many nations' governmental organizations around the world follow the organization's latest guidelines which is called Web Content Accessibility Guidelines 2.1 to improve their governmental web platforms' accessibility features (The World Wide Web Consortium, 2023). The first version of these guidelines was called Web Content Accessibility Guidelines 1.0 (WCAG 1.0). It was an early version of the web accessibility guidelines developed by the World Wide Web Consortium (W3C). It was first published in 1999 and aimed to provide a universal set of guidelines for web content accessibility. WCAG 1.0 consisted of 14 guidelines, each of which was associated with one or more checkpoints that described specific requirements for web content accessibility. These checkpoints were divided into three priority levels (Level A, Level AA, and Level AAA) to help developers prioritize accessibility efforts. These levels are stepwise. Therefore, complying all requirements of Level AA criteria

doesn’t ensure that the digital product has a Level AA accessibility in that regard if it doesn’t conform a Level A criterion.

The guidelines covered a wide range of issues related to web accessibility, such as providing text equivalents for non-text content, designing pages that can be navigated without a mouse, and ensuring that content does not cause seizures or other physical reactions. While WCAG 1.0 was an important milestone in the development of web accessibility guidelines, it has since been superseded by WCAG 2.0 and, more recently, WCAG 2.1. These later versions have provided more comprehensive and up-to-date guidelines for ensuring that web content is accessible for people with disabilities. These manuals set accessibility-related rules for many criteria such as reading order, closed captions, buttons, hover interactions, sound volumes, text-heights, font usage and contrast ratio. The list goes on and on. The members of the community are working for the version (WVAG 2.2) of these sets of rules at the moment. The World Wide Web Consortium also has a guide called Authoring Tool Accessibility Guidelines (ATAG). These guidelines enable people with disabilities to produce web-based products. Additionally, User Agent Accessibility Guidelines are among the guidelines presented by W3C. The User Agent Accessibility Guidelines (UAAG) provide instructions on how to ensure that user agents, such as browsers, browser extensions, media players, readers, and other applications that display web content, are accessible to individuals with disabilities. These guidelines aim to make these user agents inclusive and usable for everyone, regardless of their disabilities. Unfortunately, these sources lose their ability to impact if most of the designers and developers don’t get adequately benefited from them. (Henry, 2019)

The other standards concerning digital accessibility is Section 508 Guidelines. These guidelines are not universal, but they are based on the similar universal design principles as WCAG. Section 508 of the Rehabilitation Act is a federal law in the United States, which requires federal agencies to ensure that their electronic and information technology is accessible to people with disabilities. The law was enacted in 1998 and updated in 2017. The Section 508 guidelines are similar to WCAG developed by the World Wide Web Consortium (W3C), but they are specific to US federal agencies. The Section 508

guidelines provide a legal framework for ensuring accessibility of electronic and information technology for people with disabilities in the US federal government while WCAG provides universal standards for web accessibility. The Section 508 guidelines provide specific technical standards for ensuring accessibility of electronic and information technology, including websites, software applications, and other digital content. The standards are organized into various categories, such as software applications and operating systems, web-based information and applications, telecommunications products, video and multimedia products, self-contained products, desktop and portable computers, and functional performance criteria. (The United States Government, n.d.) Compliance with the Section 508 guidelines is mandatory for all US federal agencies and contractors that provide technology services to the federal government. On the other hand, its lacking universality gives an advantage to it over WCAG guidelines because it is easier regulate the industry with these guidelines because it is created by a single government, and it regulates a single market.

2.7.2 Principles of web accessibility

The World Wide Web Consortium suggests that there are four main principles to create accessible web contents. These principles are called as POUR. POUR is an acronym for "Perceivable, Operable, Understandable, and Robust", as outlined by the Web Content Accessibility Guidelines (WCAG) 2.1. These principles provide a framework for web developers and designers to ensure that their websites are accessible to people with disabilities.

First principle of the guidelines is perceivability. It asserts that information and user interface components must be displayed in a way that can be perceived by all users, including those with visual, auditory, or other sensory disabilities. This means providing text alternatives for non-textual content, such as images or videos, and making sure that content can be distinguished from the background. Second principle is operability. It argues that user interface components and navigation must be operable by all users,

including those who use assistive technologies, such as screen readers or voice recognition software. This means making sure that all functionalities can be accessed using a keyboard, providing clear and consistent navigation, and avoiding content that causes seizures or other physical reactions. Third principle is called understandable. It refers that information, and the operation of user interface must be understandable by all users, including those with cognitive or learning disabilities. This suggests using clear and simple language, organizing content in a logical way, and providing instructions and feedback in a way that is easy to understand. The last principle, which is called robust, argues that web content must be robust enough to be interpreted reliably by a wide variety of user agents, including assistive technologies. This means using standard coding practices and following best practices for web development, such as using proper HTML markup and avoiding proprietary technologies that may not be accessible to all users.

By following the POUR principles, web developers and designers can create websites that are more accessible to all users, regardless of their abilities or disabilities. (The World Wide Web Consortium, n.d.d)

2.8 Awareness of Legal and Industrial Entities Towards Accessibility

The researchers have been studying the concept of accessibility since the beginning of the 20th century; however, the world hasn't properly reacted to the problems caused by insufficient accessibility features for a long time. The most important unified action was taken by the United Nations on 3 December 2006. The Convention on the Rights of Persons with Disabilities (CRPD) was adopted and opened for signature on 30 March 2007. The treaty strives to advance, safeguard, and ensure that all people with disabilities are able to enjoy all human rights and basic freedoms fully and equally. According to the CRPD, people with disabilities have the same rights as everyone else and should be given the opportunity to participate completely and equitably in society. (UN General Assembly, 2006) This proves that the world is somehow aware of the situation, but it is difficult to suggest that the governments and organizations are doing their bests to create

equal opportunities for everyone because the convention doesn't enforce certain rules or doesn't imply any kind of methodology to deal with accessibility problems that people with disabilities encounter. It is because many governments around the world doesn't have regulations to enforce many organizations to take the convention directly into account when they produce products, services, and environments. Nevertheless, the treaty lays out a thorough framework of rights and responsibilities, encompassing civil and political rights, economic, social, and cultural rights, as well as particular rights pertaining to disabilities. The following are some of the CRPD's major provisions:

- **Non-discrimination:** People with disabilities have a right to receive equal treatment and are free from prejudice in all facets of life.

- **Accessibility:** It is the responsibility of the state to guarantee that people with disabilities have equal access to the built environment, transportation, information, and communication.

- **Participation:** People with disabilities have the right to take part in politics, culture, and other facets of daily life.

- **Independent living:** People with disabilities are entitled to the freedom to live their own lives and to participate in society.

- **Education:** People with disabilities have the same access to inclusive education as everyone else.

- **Employment:** Individuals with disabilities are entitled to employment, equal opportunities, and reasonable accommodations at work.

- **Health:** People with disabilities have the right to unequal access to healthcare services.

Even though many of the countries which has ratified the convention has not taken significant steps to increase the accessibility of products, services, and environment because they are not forced to take actions in that regard, the number of these countries reveals the increasing awareness towards the concept. As of September 2021, 182 nations had accepted the CRPD, making it one of the human rights treaties which has been ratified the fastest in history. The agreement is a significant step in recognizing and protecting the rights of people with disabilities, and it can give assist to foster more inclusive and equitable communities when it is put into practice appropriately. (United Nations, n.d.)

There are also legislations which are created separately before and after the Convention on the Rights of People with Disabilities. Australian lawmakers created the Disability Discrimination Act (DDA) long before CRPD, in 1992, with the goal of advancing equal rights and opportunities for those with impairments. Discrimination against people with disabilities is prohibited by the law in areas like employment, education, public access, and the provision of products and services. The DDA mandates that service providers, employers, and companies all make reasonable modifications to ensure that individuals with disabilities are not placed at a disadvantage. Later, in 2009, the law was strengthened and brought into compliance with global norms. (The Australian Human Rights Commission, n.d.) The United Kingdom's Disability Discrimination Act (DDA), which was passed in 1995, prohibits discrimination against those who have impairments. The Equality Act 2010, which expanded on the rights offered by the DDA to include age, gender, ethnicity, and religion, later replaced the previous law. (House of Lords Library, 2020) The US also created a legislation called Section 508 in 1998. It is a provision of the Rehabilitation Act of 1973. The set of legal rules sets standards for accessibility and covers a wide range of technologies, such as websites, software applications, electronic documents, videos, and telecommunications equipment. The aim of Section 508 is to make sure that people with disabilities are enabled to access to the same information and services as everyone else, regardless of the technology used to provide that information or service. The guidelines presented by this act is very similar to WCAG and it is the second most popular accessibility guidelines used by designers and digital product developers worldwide. This convention helps to promote inclusion and equal access to

information for all individuals, regardless of their abilities. (Federal Communications Commission, n.d.) In the continental Europe, German, Italian, and French governments have brought similar legal requirements into force in 2002, 2004, and 2005 respectively. These individual acts are unified by The European accessibility act in 2019 (EUR-Lex | Access to European Union law, n.d.).

When considering disabilities, our common perception often revolves around permanent conditions like blindness or deafness. However, as mentioned before, certain disabilities can be temporary or situational in nature. For example, a person, who has had a hand surgery, lives with a disability for a while. This condition obviously makes that person disable for a period. Also, an individual watching a video in a noisy environment has a situational disability, because surrounding environment disables that person to hear the content properly. In the light of these suggestions, it can be safely predicted that the concept of accessibility concerns much more people than people with permanent disabilities because it is not only about people with permanent disabilities, but it is also about the people without permanent, temporary, or situational disabilities. (Including Temporary and Situational Disabilities in the Accessibility Conversation, 2020) When we deal with the issue with considering these perspectives, we can be sure that accessibility certainly relates to more than 1/7th of the world population. That's why we experience that a lot of companies present some features such as closed captions, high contrast modes and big text usage not just for people with permanent disabilities but for people without permanent disabilities thanks to the legal requirements and increased awareness among the public.

The growing proportion of elderly individuals in the global population contributes to the heightened awareness surrounding the concept. This trend is particularly notable in both developed and developing countries, thanks to advancements in healthcare. According to Newell and Gregor's (2002, p. 3) research, the population is aging, and older individuals are living longer while experiencing the negative effects of aging. As a result, societal demands are shifting accordingly. Consequently, the significance of accessible design is progressively increasing each year. The number of individuals requiring more accessible

physical and digital products, services, and environments is becoming more prominent as the elderly population becomes more integrated into the digital realm.

People who are elderly may use the internet for a variety of reasons. First, it gives them access to an extensive range of data, services, and resources that they might not otherwise have. Being able to participate in society and interact with others while being at home can be very beneficial for persons who are housebound or have restricted mobility. Second, the internet can support the freedom and autonomy of the aged people. For instance, they can manage their finances by using online banking services or use online shopping platforms to buy food or household goods without having to leave their homes. The other reason of the importance of the digital world for older people is that these people might be lonely or alone can find enjoyment and social interaction online. Through social media platforms and online discussion boards, they may stay in touch with friends and family. They can also take advantage of online games, videos, and other digital contents. This situation also makes tech giants, popular social media platforms and game studios to adapt themselves to the needs of this group of audience since these companies want to get financial benefits from them.

A recent study conducted in the UK also supports the established claims by focusing on the frequency and way of older people's using internet. Subramanian (2022) stated that when older people start using the internet, they usually incorporate digital technology into their daily routines. 71% of older adults using the internet go online almost every day, while another 11% go online several times per week. The other finding of the study also proved that the e-commerce platforms' importance for elderly people because they shop online especially for pharmaceutical products and food. Since the elderly people share some difficulties with people with different abilities when using internet, we might assume that not only they, but significant proportion of the society also needs accessible digital products such as e-commerce websites or online shopping mobile applications. The author also states that high contrast ratio, color usage and adequate text size is crucial for elderly people when they use digital products because significant part of the elderly population suffer from the problems related to the vision.

Industrial applications generally follow the academic studies. It is understood that numerous designers and developers in the field have been involved with the concept for over a decade. However, despite this extensive experience, many simple and fundamental issues related to digital accessibility persist due to the intricate nature of the subject. Fortunately, there is a constant increase in the number of companies that include accessibility in their company statements and goals. Moreover, digital accessibility relates the huge part of these targets. Increasing their services and products' digital accessibility attributes does not only contribute their public images, but it also contributes their SEO rankings on the search engines on the internet since almost all the search engines prioritize more accessible web pages. Especially the companies having millions of target audience have led the way in the aspect of accessibility. Tech giants having huge target audience such as Alphabet (parent company of Google), Amazon, Apple, Meta (previously known as Facebook Company), and Microsoft have led the way in the aspect of accessibility. They are sure concerned about their public images, but they are obviously more concerned about their revenues. They reach millions of people and people with permanent disabilities are highly populated group in their audience. Whatever the reason is, the world witnesses the emergence of more democratic web. It seems that this trend will continue because lots of companies become more aware of the issue and many governments around the world gradually force the organizations and companies to create more accessible digital products by increasing the legal requirements concerning digital accessibility for the industry.

The world has taken lots of steps towards to a more egalitarian digital environment. It seems that there is no turning back from here; however, it is obvious that this trend occurs with two different approaches. When developers and designers create web-based product, they either build them with an all-in-one approach or they create websites sporting two different modes: Normal mode and a mode with increased accessibility features. First approach is the one that Web Accessibility Initiative clearly supports. This kind of digital products present one solution to its users. Both groups of users (people with disabilities and without disabilities) use these products in equal way because they are built in a mindset to conform worldwide accessibility standards. The official web services of the

governments are mostly designed with this perspective. Most governments, which have ratified the “The Convention on the Rights of Persons with Disabilities of United Nations”, have fully accessible websites for their services. Especially Nordic countries has led the way in that regard, but there are also many other countries which prioritize the accessibility concerns. For instance, “gov.uk” is a United Kingdom public sector information website. It is created by the Government Digital Service and provides the UK citizens a single point of access. The website has a one-for-all approach. Each user, whether the one has a kind of disability or not, equally accesses the services presented by the platform. “turkiye.gov.tr”; which is also known as “E-devlet” in Turkish society; is another example which takes the same approach. It is a digital platform presenting various services to Turkish citizens. Even if it is not successful as “gov.uk” in terms of contrast ratio or text-sizing, it has taken a lot of steps in recent years. It is also stated that the developers will continue to increase the accessibility of this platform. On the contrary, the second approach is a bit problematic. This issue may be a result of lack of awareness towards the concept. These types of products present an additional mode beside the default version. If the user chooses the additional approach, they became enabled to enjoy a more accessible digital product. By doing it so, the developers enable the users to create their mode which fits them best. At first, it seems that this is a better way, but it comes with a potential harm. This is problematic because it highlights the disability of the user and makes the one feel different in a negative way. This approach is popular especially among design-oriented companies’ digital products. The website of global fashion brand Zara is an example for this type of digital product. Although, its default website conforms many accessibility standards, it presents an increased accessibility mode to its users. It is obvious that the intention of the company is rightminded, but this presentation divides its users according to their different abilities as a result. Some may claim that a fashion brand has no burden on its shoulders to be sensitive in that aspect and these companies having a design-first approach is understandable to some extent. Also, many legislations don’t bound private companies to make their digital products accessible. However, this mindset results that many private companies put the aesthetics first when designing digital products and ignore the fact that accessible graphics design and mainstream aesthetics can go hand in hand.

The other aspect that is ignored occasionally is that many people don't think about elderly when it comes to accessibility. Abilities changes when a human gets older. In their study, Hanson et al. (2005) claimed that age-related deficits ought to be regarded as disabilities as well. This approach is widely accepted now, and it definitely increases the significance of the concept of accessibility because when the elderly is considered as people with disabilities, the total number of individuals who really need accessible products, services or environments remarkably increases. Newell and Gregor's (2002) research sheds light on the changing dynamics of society, particularly the growing proportion of elderly individuals due to improved healthcare. They emphasized the presence of various barriers that hinder meeting the needs of this demographic. Additionally, The World Health Organization (WHO) published a report in December 2020 that further emphasizes the importance of understanding the significant population of individuals with disabilities worldwide. According to WHO, there are over one billion people living with some form of disability, which poses obstacles for them when accessing products and services (World Health Organization, 2018). This issue extends to digital products as well. Therefore, adopting an inclusive design approach that considers accessibility becomes crucial in addressing these challenges and fostering a more equitable society. When we consider the insights from the WHO report, the study by Hansen et al., and the research of Newell and Gregor, it becomes evident that design problems related to accessibility have become more critical than ever before.

Developing and underdeveloped countries are home to hundreds of millions of individuals with specific needs. Unfortunately, many of these countries lack the capacity to provide accessible digital interactions to their citizens due to limited resources and lower priority given to accessibility on their political agendas. Consequently, the awareness surrounding accessibility in these countries is insufficient compared to developed nations. Abascal et al. (2015, pp. 179-181) argued in their work that the concept of universal accessibility overlooks socioeconomic contexts. The scholars proposed that there is a digital exclusion experienced by individuals who lack access to advanced technology or educational infrastructure. Therefore, economic factors play a

crucial role in designing accessible digital products that cater to marginalized segments of the global population.

The process of understanding of disabilities also is still ongoing in the academia. Understanding disabilities are very important to understand the concept of accessibility because disability studies can contribute to accessibility research. In their study, Hofmann et al. (2020) underlined this relation. According to them, accessibility research and disability studies are interconnected areas that have a common goal of creating a more inclusive world for individuals with disabilities and acknowledging and enhancing the real-life experiences of individuals with disabilities. The former concentrates on developing technology that caters to various impairments, while the latter emphasizes recognizing and advocating against discriminatory systems that marginalize people with disabilities. They highlighted three major notions which may impact the accessibility studies in a negative way. These notions are ableism, connection, and oversimplification.

They argued that discrimination and disregard for people with disabilities' viewpoints, commonly disguised as well-intentioned measures, are pervasive in accessibility research and reflect entrenched ableism. The scholars shared their concerns about these studies' focusing primarily on disabilities. According to the authors, accessibility research tends to overlook the importance of support systems, which include professional and personal relationships among individuals with disabilities and their allies. These relationships are crucial for identifying and addressing access issues. It is also remarkable for exploring how technology impacts human and environmental interactions, especially concerning disability and ally identity formation, instead of solely focusing on impairments. The third notion that these academics concern for is oversimplification. Abilities are typically presented in accessibility research as unique and independent diagnostics, symptoms, or impairment units. These categorizations, however, are not thoroughly examined and are taken out of context. Findings of another study also support their claims in the aspect of oversimplification. Hamraie (2013) discussed that research concerning accessible technologies primarily focuses on a small number of disabilities. These focus areas include blindness, deafness, mobility problems, and cognitive impairments. The author

suggested that in the 1500 papers presented at the ASSETS conference, 42% of them are about blindness, 40% are about cognitive impairments, 27% are about motor impairments, and only 14% are about deafness. Furthermore, just 10% of the papers presented at the conference make use of phrases like "chronic," "illness," or "invisible." In the light of this information, it can be claimed that there are lots of problems of understanding of the people's abilities and this makes the situation is harder to fully understand for the researchers, designers or people who are not directly involved with the field.

2.9 Main Sources of Digital Accessibility Issues

The diversity of disabilities results in a wide range of accessibility challenges, as each disability possesses its distinct characteristics. Individuals with disabilities face numerous obstacles when utilizing digital products, including mobile phone applications, websites, and infotainment systems in passenger vehicles. These barriers can be occurred because of inaccessible design which do not answers the users' unique needs cause by speech-related, auditory, cognitive, neural, physical, or visual disabilities (Types of Disabilities | Usability & Web Accessibility, n.d.).

Accessibility considerations for digital materials include HTML, MS Word, PDF, MS PowerPoint, multimedia, captioning, and complex images. In addition to understanding the fundamentals of accessibility, it is important to be respectful and inclusive of people of all abilities. Digital products aren't also immune against accessibility related problems. For visual accessibility, it is vital to understand the reasons of digital accessibility problems in terms of their visual attributes. There is a belief arguing that many companies still do not prioritize accessibility and many graphic designers are not educated well enough to create digitally accessible products. In this section, potential sources of visual accessibility problems are briefly analyzed with a perspective focusing on graphic design.

2.9.1 Resistance from the businesses

The significance of the concept for society is often not fully recognized by the majority of people, particularly in developing and underdeveloped countries. This observation is supported by a study conducted by Freire et al. (2008, pp. 87- 94) in Brazil, which highlights this perception. In their research, the scholars surveyed over 600 professionals involved in web development processes. The findings revealed that only 19.9% of the participants considered accessibility in their web development practices. According to the researchers, this lack of awareness can be attributed to factors such as the absence of legal requirements, limited consumer demands, and insufficient training. Although this study is relatively dated, there is no academic research suggesting that the situation has significantly improved in recent times.

The situation is better in the developed countries. The report published by the Disability Rights Commission, which is one of the three commissions promoting equality in the UK, states that big organizations' awareness towards the concept is encouraging. The results indicate that larger organizations are more aware of accessibility as an important issue, with 97% claiming awareness. Additionally, 76% of them have accessibility policies, 68% take accessibility into account when developing a website, 71% have conducted testing, and 88% have plans for improvements. On the contrary, smaller organizations with less than 250 employees showed lower levels of awareness, with only 69% claiming awareness of accessibility. Only 34% have accessibility policies, 29% take accessibility into account when developing a website, 17% have conducted testing, and 58% have plans for improvements. The interview responses also showed that some website commissioners, especially from small organizations, were completely unaware of accessibility as an issue. Although larger organizations seem to be aware of accessibility, testing of 1,000 websites showed that 81% of them failed to satisfy even the most basic Web Content Accessibility Guidelines standards. Although 68% of website commissioners from large organizations claim to take accessibility into account, only 31% of clients showed a positive attitude towards it. These findings suggest that even though large organizations may be concerned about meeting the needs of people with

disabilities, their practices may not reflect their concern. The perceived cost of accessibility, a lack of knowledge and expertise, technical limitations, conflicts with general aesthetics and creative considerations, and a general lack of awareness were cited as the main barriers to accessibility by respondents from both large and small organizations. (Stationery Office, 2004, p. 36-37) The study was conducted two decades ago; however, there is no study asserting that the reasons behind these discouraging results are completely extinct in the industry today.

Over time, there has been an improvement in awareness regarding the needs of society in terms of accessibility. Recognizing the benefits of accessibility for both society and the private sector is crucial in striving for a more equitable world. Henry et al. (2014) emphasized the integration of accessibility into research and development processes as a means to promote awareness and understanding of accessibility issues. The authors argued that accessibility not only benefits individuals with disabilities or the elderly but also enhances the experiences of those without disabilities. Consequently, stakeholders of digital products are more likely to invest in improving accessibility when they are aware of these advantages.

Considering the concerns of time and cost within businesses is another important aspect in this context, as many accessibility problems stem from organizations' reluctance to incorporate an accessibility-focused approach during product development processes. Cornish et al. (2015, pp. 184-189) highlighted this issue in their study. They found that 25% of graphic designers who participated in their research indicated that they would prefer not to use accessibility tools due to time and budget constraints imposed by clients. The authors also noted a negative correlation between clients' experience and the importance assigned to accessibility in graphic design projects. Another study by Horton and Sloan (2015, pp. 2-3) addressed a similar concern, pointing out that large companies such as Apple and Bank of America emphasize accessible design in their statements. These companies are sufficiently large to prioritize accessibility despite potential return on investment considerations. However, many smaller companies claim that they cannot afford such investments. The scholars argued that investing in accessibility can ultimately

contribute to the financial success of these smaller companies in the long run. Thus, dispelling these misconceptions within the industry can lead to the creation of better products in terms of accessibility.

Fortunately, the business has begun to realize the potential of accessible products. According to Brown (2008), design has been regarded as a later stage in the development process where designers would simply add a visually appealing touch to an already innovative idea without contributing to its creation. Although this approach has been effective in some cases, as it has made new products and technologies more attractive to consumers, or improved brand image through creative advertising and communication strategies. However, the author claimed that there is a shift in the industry which favors accessibility since the user's expectations have become more important for design processes. Instead of requesting designers to enhance the appeal of an already established idea to consumers, companies are now requiring them to come up with ideas that cater more effectively to consumers' needs and wants.

2.9.2 Lack of legislation

The first steps concerning the legal regulations which are related to accessibility have been taken by Nordic countries. These considerably small and disintegrated advancements have triggered other countries such as the United Kingdom, the Netherlands and France to take legal actions almost half a century ago.[4] Some dreary instances in the history have also triggered some advancement in the field. Kwan (2005) argued that the situation in the US after the Indo-China conflict have a positive impact on the regulations about people with disabilities. War with Vietnam resulted many people to lose some abilities. President George Bush (Sen.) presided over the Signing Ceremony of the Americans with Disabilities Act (ADA) in the late 1980s. Later on, in October 1992,

[4] See Section 2.8

the U.S. Equal Employment Opportunity Commission and the U.S. Department of Justice published the ADA Handbook. European countries have also produced similar kind of handbooks. These handbooks were created with an approach which aims to eliminate the physical barriers for people with disabilities. Although it is safe to assert that the crucial turning point in the development of barrier-free design was the publication of the ADA Handbook and Guidelines and the idea it introduced was adopted by other texts throughout the world; these manuals' setting just minimum standards resulted to the designers and architectures' taking initiatives. This imbalance between standards and people's needing to take additional actions to create a more accessible spatial designs created a lack of unification.

Understanding the sources of accessibility problems relies heavily on legislation. In the research "Legal and Policy Factors in Developing a Web Accessibility Business Case for Your Organization" by WAI (n.d.b), the authors have analyzed policies and legislations pertaining to accessibility. They have argued that adhering to even the minimum standards can be challenging during the development of digital products due to the existence of different guidelines and standards. The researchers have also suggested that organizations may choose to meet additional guidelines to ensure sufficient accessibility if the needs of certain individuals with disabilities are not adequately addressed by the required accessibility standards. Additionally, the authors have pointed out that legal requirements are not always clear, which can create potential issues for developers when producing digital products.

Many industries lack regulations specifically addressing accessibility, with governments sometimes slow to respond and regulate emerging sectors. The automotive industry serves as an example in this regard. A study conducted by Reuters, reported by McBride and Lienert (2015), revealed the lack of comprehensive regulations in the industry, with most companies voluntarily following self-created guidelines. This results in various interface design approaches, and there are contradictions between government guidelines and industry guidelines, particularly in areas related to public safety. Resolving this lack of consensus is a key challenge in creating more accessible graphics. It is important to

note that this lack of consensus is prevalent in many other technology-related industries, as technological advancements outpace the ability of governments and legal institutions to enact regulatory measures.

Another study that sheds light on the legislative landscape worldwide is a report published by the Web Accessibility Initiative, conducted by Mueller et al. (2018). The report outlined the current policies of over 20 independent countries and the European Union. Upon examination, it became evident that there is a lack of universal policies and insufficient legal enforcement. While it is encouraging to see that many countries have implemented accessibility regulations for the web, most of them only regulate specific sectors. For example, some countries focus on regulating the public sector or governmental websites exclusively. This report provides valuable insight into the legislative situation worldwide concerning the topic of this research. Brophy and Braven (2007, p. 953) also highlighted the absence of a unified universal policy. The authors noted the lack of pan-European legislation and the independent regulatory efforts of the United States. Although the authors did not explicitly describe this situation as problematic, it can be argued that having multiple regulations with diverse approaches is not as desirable as a unified policy implemented globally. On the other hand, Persson et al. (2014, pp. 515-516) suggested that most governments worldwide have ratified the Convention on the Rights of Persons with Disabilities and have enacted some form of non-discrimination legislation. However, it is evident that these implementations have occurred at the national level. All three studies express concerns about the lack of a unified global policy.

Government websites are fairly sufficient in terms of accessibility. The extent to which individuals can access information and communicate with their government through web-based applications is influenced by both accessibility and usability. Poor design of websites, web technologies, or web tools can create obstacles that prevent people from using them effectively, ultimately leading to exclusion. Research into the accessibility and usability of government websites suggests that it's still a challenge to comply with legal and professional standards. Monaco et al. (2012) argued that some state and federal

websites have not managed to achieve success. It is obvious that even the governments experience trouble when enforcing regulations to their own electronic platforms. This situation suggests that it is hard to be convinced that e-shopping platforms easily comply with the standards because even most strictly regulated websites such as governmental websites are not immune to fail in the aspect of digital accessibility.

Accessible graphic design is not only vital for people with different abilities, but it is also important for all people because we temporally or situationally lose some of our abilities. For instance, driving is an activity creating high amount of cognitive load which leads a situational disability. Drivers must not take their eyes from the road ahead more than several seconds. Otherwise, it can lead problems which relate safety. There is another study raising awareness towards accessible graphic design's importance for the public safety. In their research, Kouchak and Gaffar (2017, p. 553) discussed safety concerns related to accessibility. They argued that poorly designed infotainment interfaces in cars can cause visual, manual, auditory, and cognitive distractions for drivers. This leads to drivers focusing more on using the infotainment system as a secondary task rather than paying attention to the road while driving. Driving is a demanding activity that places a significant cognitive load on individuals. Also, Tashev et al. (2009, p. 1) referenced a study conducted by the Bureau of Transportation Statistics in the United States in 2001, which revealed that 77% of adults use their personal vehicles for commuting to work. These individuals wanted to be informed and entertained during their trips to make them more enjoyable. This is where the infotainment systems in their cars came into play. However, this situation has a high potential for creating safety issues since the report stated that a significant number of car accidents in the United States are the result of distractions. There is no reason not to think that it is also a common reason behind these accidents at the rest of the world today. Hence, accessible graphic design is crucial to protect people. That's why some kinds of strict regulations are needed for graphic design in the aspect of accessibility.

Some may claim that graphic design is not important to be regulated since it does not create considerable value for the business and society. On the contrary, the usage of

graphic design is crucial in many industries, including user interface design, marketing, branding, and advertising. How consumers view products, services, and concepts can be significantly influenced by the design of visual components. In order to prevent audience misdirection or deception and to ensure that the design components employed in these domains comply with ethical and legal norms, graphic design must be regulated. Consumers can be tricked or duped via graphic design. For instance, deceptive advertising may cause consumers to suffer harm or financial loss. Such events can be avoided with the help of graphic design regulation. Graphic design can have a big impact on how people see things. As a result, it's important to confirm that graphic design abides by moral principles, such as not endorsing prejudice, hate speech, or other damaging material. Above all, better graphic design can help to create safer society for all, and implementation of accessible graphic design is very important for that.

2.9.3 Insufficient awareness of graphic designers and web developers towards accessibility

There are many concerns claiming that the industry does not really care about the concept of accessibility. There is a study which underlines these concerns. According to the report of the Disability Rights Commission, website designers lack information about creating accessible websites and have a limited understanding of the needs of users with disabilities (Stationery Office, 2004, p. 10). Even though the study is outdated, the fact revealed by it can be still evident. Web designers are more aware of the accessibility issues than the graphic designers since the existence of some kind of legal requirements in the aspect of web accessibility for many years. This report proves that most of the graphic designers are not aware of the concept, or they simply don’t know how to create accessible graphics because of insufficient education. Although there are very comprehensive guidelines for designers and developers enabling them to create accessible graphical content, the ignorance towards accessible graphic design is alarming. It is known that the developers and designers focus more on non-visual HTML elements concerning elements such as reading order, radio buttons and reactivity when coding a

webpage. The graphical elements' ensuring current accessibility standards is second priority for most digital developers and designers. There is indeed no visible reason behind this since the concept of accessibility does not exclude graphic design at all. Most prominent guidelines such as Web Accessibility Initiative's Web Content Accessibility Guidelines have a very detailed explanations to improve the accessibility of graphical design elements for webpages.

In their study, Sharples et al. (2015, p. 75) outlined the common misconceptions held by designers and clients regarding accessibility. They argued that many designers mistakenly believe that following accessibility guidelines alone is sufficient to create accessible digital products. However, disabilities are diverse, and guidelines may not cover all specific needs. Therefore, designers must come up with new solutions when they encounter issues not addressed by existing accessibility guidelines. Another misconception highlighted in the research is the belief that providing an alternative interaction model is enough for inclusive design. This perspective contradicts the essence of accessibility, as it ultimately segregates people into two categories based on their disabilities and offers them separate options for navigating the digital product, rather than providing a unified solution that accommodates all individuals.[5] The study also mentioned the misconception held by many designers that visually accessible design is only relevant to visually impaired individuals. However, this belief is inaccurate since accessibility can benefit a much larger population in society, as many individuals also experience temporary or situational disabilities.[6]

Lack of education in the higher education is one of the most prominent areas creating the lack of awareness towards the concept. Lots of graphic designers are not educated well in regard to the concept of accessibility. McCollam (2014, pp. 320-322) stated that it is vital to force students to think about more complex problems and challenge them to find more human-centric solution when designing. However, that is not sufficient because the

[5] See Section 2.8

[6] See Section 2.4.2

lecturer can choose to ignore this approach because there is no regulation to force the educators to act in this way. In the United States, there are several institutions, such as The National Association of Schools of Art and Design, and Graphic Artist Guild (AIGA), which concern ethics in graphic design education. However, they have failed to regulate the education sector. According to the author, they are figureheads rather than governing organizations because graphic design is not considered as a notion which have potential to harm people. This kind of lack of regulation in design education is another problem for the accessibility because the more familiar designers get with human-centric notions, the more they will emphasize the importance of the accessibility.

There are other studies indicating the problems in the aspect of lack of awareness for accessibility among designers who create digital products. Bevan et al. (2007) claimed that a lot of web designers acknowledge the significance of web accessibility, but they lack the comprehension of the complex details of the Web Content Accessibility Guidelines, which were formulated by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium. Scholars also argued that they also don't know how to put them into practice. Cremers et al. (2013, p. 324) also discussed the issue by considering awareness towards inclusive design. Inclusive design is a concept highly related to accessibility. Scholars indicated that inclusive design theory and methods are not commonly known among developers of digital products and services. Moreover, these theories and methods are often developed and studied in research contexts, which makes their practical application challenging. As a result, there is a disconnection between theory and practice in inclusive design. Therefore, a practical tool is needed to increase awareness of inclusive design among ICT developers and provide easy-to-use information and tools to implement the methods effectively for diverse target groups.

A study conducted by Vaughan et al. (2017), which was published by EDUCAUSE, signified the importance of accessibility in the higher education. EDUCAUSE is a non-profit organization aiming to promote higher education through the utilization of information technology. The organization provides to the community with the necessary resources, knowledge, and opportunities in order to assist in shaping strategic decisions

concerning IT at every level of higher education. According to the authors of the study, the industry has been swept by concerns and interests regarding accessibility, flexibility, user-friendliness, and diversity. It is only a matter of time before these expectations start to appear in higher education. The UX movement, specifically, is creating an unprecedented awareness of user diversity in the digital world, motivated by both legal requirements and a fresh understanding of inclusive design. Higher education was not prepared for these new learner expectations, leading to an ongoing clash of cultures that is stressful for some, but productive for many. The process of radically rethinking how to make learning welcoming and accessible to all students, with their diverse profiles and needs, is now taking root globally in most campuses. Even thought, there have not been a significant improvement in the higher education in terms of the integration accessibility education into the curriculum, these steps have the potential to increase awareness towards the concept. This kind of initiatives may trigger the integration of accessibility-related content in the design programs at the universities for the near future.

Even if the awareness towards accessibility in the higher education increases, most of design students' not getting an accessibility related education creates problems for web design. According to Regan (2004), even while accessibility and design techniques are increasingly overlapping on a technological level, the number of websites performing well in both accessibility and design viewpoints are low. The author claimed that it's crucial to recognize that web design is essentially the work of individuals rather than principles or regulations to comprehend the reason behind the scarcity of websites that showcase both exceptional design and accessibility. Websites are constructed by human beings, not by following set standards. To put it simply, designers prioritize the visual aspect of a website, whereas accessibility advocates emphasize conformity to standards. Designers replicate websites that they find amazing or inspiring rather than creating designs only because they are simple to reach. The only way accessibility can be widely adopted is if designers who make websites are encouraged to apply their imagination to solve the special problems of accessibility. The design community should be aware of accessible design's potential, and accessible design should encourage originality and creativity. The mismatch between designers and accessibility has been the biggest

roadblock to development, but it also offers the most room for improvement. Considering the statements of the author, it can be claim that changing the mindset of designers is one of the most crucial actions to be taken in order to create a more egalitarian digital world and best way to achieve this is to educate them. The study may seem outdated, but the reasons of this mismatch between designers vision and accessibility needs for web design haven't been drastically changed in the last two decades and they are still probably relevant.

2.9.4 Aesthetics, design and technology related issues

While developing a website, accessibility and aesthetics are both crucial factors. While accessibility relates to the website's suitability for use by those with disabilities or restrictions, aesthetics refers to the website's visual appeal and design. In web design, it's critical to achieve a balance between aesthetics and usability. A website that looks good but is unavailable to some visitors is not really effective because it excludes a sizable percentage of potential users. Similar to this, a visually ugly website that is nonetheless accessible may not be enticing to users, which can have an impact on engagement and retention. When creating a website, designers should combine many user-centered design components to accomplish both aesthetics and accessibility. The major aspects which must be considered during the process of web design are color contrast, font size, navigation, reading order/DOM (The Document Object Model), images/media, consistency, and layout. This new way of thinking also brings a new aesthetic approach.

Zdenek (2015) suggested that accessibility elements are being included into the internet's more general visual aesthetics. So, it becomes more and more important for designers to make sure that their websites are both aesthetically pleasing and usable by people with disabilities. By doing this, the developers can make the internet a more welcoming place for all people and enhance everyone's user experience. The importance of including accessibility and aesthetics in web design is emphasized in the study. This new approach

to design thinking and aesthetics, according to the author, cannot be disregarded any longer.

Even if the importance of accessible design can't be denied, there is a resistance among designers towards design languages which promote accessibility. In their work, Petrie et al. (2004) claimed that many designers believe that websites made accessible for users with disabilities must be plain and uninteresting, lacking visual appeal. This is because creating such sites does not present a challenge for designers. According to the authors, this belief is incorrect as visually appealing and complex sites can still be accessible to all users. While a plain and simple site may be accessible, it is not always the case that an interesting and visually appealing site is inaccessible. After analyzing 100 websites with 51 users who have different disabilities, the researchers proved that visual design is not limited by accessibility requirements. They proposed that effective visual designs should be able to fulfill the accessibility objectives. Consequently, accessibility should be perceived as another challenge for designers and implementers instead of a limitation.

The study conducted by Newell and Gregor (2002) also addressed the issue of the conflict arising from the growing design-for-all guidelines and designers' tendency to adhere to mainstream aesthetics. While many designers believe that creating visually appealing and accessible products is an impossible task, scholars argued that accessibility and good design can be seamlessly integrated. Mbipom and Harper (2011) also investigated this issue by conducting a study involving 30 sighted individuals who assessed the aesthetics of 50 website homepages. These homepages were also evaluated by accessibility experts. The study demonstrated that minimalist webpage designs tend to be more accessible, but webpages with expressive or aesthetically pleasing designs can also be accessible to individuals with low vision if designed appropriately with accessibility in mind. Another study by Petrie et al. (2004), pioneers in the field, supported these claims. They evaluated 100 websites with 51 users with disabilities and found that some of the most accessible websites had complex visual attributes. They advised designers to consider accessibility as a challenge during the product development process rather than disregarding it completely. Therefore, it can be argued that the belief among designers that accessibility

and visual design are incompatible is not well-founded, and visual designers should not overlook accessibility.

Another issue in web design concerning accessibility lies in the evaluation process. Petrie (2009, p. 17) highlighted the problems associated with accessibility evaluation methods. The author suggested that automated accessibility checking tools can only assess a limited number of checkpoints defined in the Web Content Accessibility Guidelines. These tools can also misguide designers by approving certain attributes of a product even if they do not conform to accessibility standards. Therefore, designers should always manually check websites or digital products. Unfortunately, many designers tend to avoid this process due to its time-consuming nature.

With the advancement of technology, more tools are being integrated into digital products. However, most newly developed tools are not implemented in accordance with accessibility standards. In their study, Hackett et al. (2004) evaluated random websites and discovered that they became less accessible over time due to the increased complexity of the tools used in their interfaces. On the other hand, they also found that government websites managed to maintain accessibility despite becoming more complex. This indicates that complex tools only create accessibility barriers if they are not properly implemented. However, it should be noted that even if these tools are implemented correctly, the use of complex tools can pose problems for individuals without advanced technological infrastructure, as they may require high-speed network connections.

2.10 Evaluation of Accessibility for Digital Products

In many cases, Web Content Accessibility Guidelines (WCAG) are used to evaluate the accessibility of a web product. These guidelines are also used as a reference to evaluate other digital products in terms of accessibility. However, there are some opinions in the academia claiming using only WCAG's guidelines is not enough to create adequately accessible digital products. Cheoh et al. (2020) advised utilizing the WCAG criteria as a

starting point for developing an accessible web interface, however some people might prefer different approaches. The authors suggested combining user experience studies with WCAG criteria is a better approach because everyone has personal preferences when it comes to web design. These preferences can be useful in developing accessible interfaces. This is because each website has different requirements, and it's preferable to combine user experience studies with accessibility criteria to produce a more complete user experience. The scholars advised user testing in addition to WCAG standards for web engineers because the input from people with disabilities can be very helpful in developing a web interface that is accessible to all. On the other hand, it is also very problematic in my opinion. People's abilities being so unique makes it almost impossible to find a universal solution for the users. There will always be a person who may need different solutions tailored for the one's abilities. The study conducted by Elavsky et al. (2022, p. 59) also supports this study's researcher's claim in that regard. The researchers used a method combining WCAG 2.1 and heuristic evaluation in their study. They claimed that the evaluation models that rely on heuristics have been used in Human Computer Interaction (HCI) studies for a considerable period of time, and they are relatively inexpensive to employ, requiring minimal expertise. Their research has demonstrated that these models are effective approaches for practitioners, particularly when compared to evaluative methods such as user testing, focus groups, or other techniques that necessitate the involvement of experts or recruitment, moderation, and payment of participants. Most importantly, their method takes the accessibility problems into account with a wide perspective disregarding specific abilities. Adebesin et al. (2012, p. 307) also asserted that the heuristic evaluation method is one of the best ways to evaluate accessibility due do its flexibility and easiness.

In their research, Kelly et al. (2005) pointed out the weak points of the accessibility guidelines. The authors listed lots of reasons. They claimed that Web Content Accessibility Guidelines' being very theoretical, ambiguous, and complex are the most prominent weak points of these guidelines. According to the authors, the guidelines are too focused on theory and are based on the perspective of The World Wide Web Consortium (W3C) rather than actual experiences in the real world. They argued that the

WCAG documentation also doesn't talk about popular digital products like PDF and Flash, but instead, emphasizes on W3C technologies such as RDF, PNG, and SVG which are not widely used and have limited practical experiences available. In their work, it is also stated that the guidelines are not clear, and they contain ambiguous phrases like "until user agents" and "if appropriate," which are difficult to interpret. They also argue that the WCAG guidelines are not only difficult to understand but they are also quite complex. As a result, there have been many documents created to clarify and interpret the guidelines. However, this has created more confusion as these explanatory documents may reinforce misunderstandings. Petrie et al. (2004, p. 15) also argued that simply following the WCAG guidelines and checkpoints is not enough to ensure practical accessibility of websites.

2.10.1 Visual accessibility standards for digital products

It is obvious that Web Content Accessibility Guidelines (WCAG) lacks effectiveness in terms of evaluation of web accessibility when they are solely used, as stated in the previous section. On the contrary, it is hard to oppose that they create a very effective base for the evaluation of the visual attributes. The visual elements must be evaluated by considering 3 attributes: contrast ratio of the text/non-decorative visual elements, visual presentation of text blocks and text spacing (The World Wide Web Consortium, n.d.e).

According to the guidelines, the visual products ensuring web accessibility in regard to the minimum color contrast ratio are classified as Level AA. The visual presentation of text and images of text must have a contrast ratio of at least 4.5:1. For large text, which is at least 18 point (if not bold) or 14 point (if bold), contrast ratio must be at least 3:1. In order to meet the standards of Level AAA, the visual presentation of text and images of text must have a contrast ratio of at least 7:1. For large text, which is at least 18 point (if not bold) or 14 point (if bold) contrast ratio must be at least 4.5:1. Text that is part of a logo or brand name has no contrast requirement.

WCAG suggests that a mechanism must be available for the visual presentation of blocks of text. Foreground and background colors must be selectable by the user, width of the lines mustn't be more than 80[7] characters or glyphs, text must not be justified to both sides and users must be able to resize the text without assistive tech up to 200% in a way that doesn't require the user to scroll horizontally to read a line of text on a full-screen window. The elements sufficiently comply with these criteria meet Level AAA standards.

Text spacing is the last feature which must be considered for visual accessibility. In order to meet Level AA standards of WCAG 2.1 in this aspect; line height must be at least 1.5 times the font size, spacing between paragraphs must be at least 2 times the font size, letter spacing (tracking) to at least 1.12 (0.12em[8]) times the font size and word spacing to at least 1.16 (0.16em) times the font size.

Minimum text size is not specified in WCAG because the guidelines offers that the size of the text must be editable with the help of assistive technologies such as screen magnifiers. However, most designer and developers don't use a text which has a size below 9 points. This size is the minimum text size which is widely offered to ensure legibility (Penn State, 2020). On the other hand, WAVE Accessibility Tool offers a size bigger than 9 points. This reference is more important because the tool developed by Web Accessibility Initiative. Therefore, it can be suggested hidden rule for minimum text size for accessibility is 10 points.

[7] 40 for CJK (Chinese/Japanese/Korean)
[8] An em (from English em quadrat) is a unit in the field of typography, equal to the currently specified point size

2.10.2 Tools for web accessibility evaluation

To manually evaluate a website according to the mentioned criteria can be painful for a designer or a developer because it takes immense amount of time and can result unreliable results. That's why there are software products which help designers in that regard.

"Accessibility Insights for Web" is an extension for Google Chrome and Microsoft Edge that helps developers find and fix accessibility issues in web apps and sites. The assessment conducted by the software allows anyone with HTML skills to verify that a web app or web site is compliant with Web Content Accessibility Guidelines (WCAG) 2.1 Level AA. It also includes automated checks in compliance with approximately 50 accessibility requirements. This tool is widely used by the developers. However, it does not give very detailed information about the problems and evaluate the issues with an approach having a perspective of a developer instead of a designer since the report based on the evaluation is not properly visually presented.

The other popular tool used for accessibility evaluation of the websites is called Lighthouse. It is an open-source, automated tool for improving the quality of web pages. It has audits for performance, accessibility, progressive web apps, SEO, and more. It is very useful for evaluating a website's general performance. Unfortunately, it gives a very general report considering the accessibility and mostly focus on HTML attributes of the pages and vastly ignores the visual accessibility evaluation.

WAVE can be the best tool for accessibility evaluation for the websites. It is developed by WebAIM. The software is a collection of evaluation tools that assists content creators in making their web pages more accessible to people with disabilities. WAVE is capable of detecting a variety of accessibility and Web Content Accessibility Guideline (WCAG) errors, but it also enables manual review of web content. It gives very detailed reports to the developers and designers including visual accessibility problems' total number and their positions on a specific page.

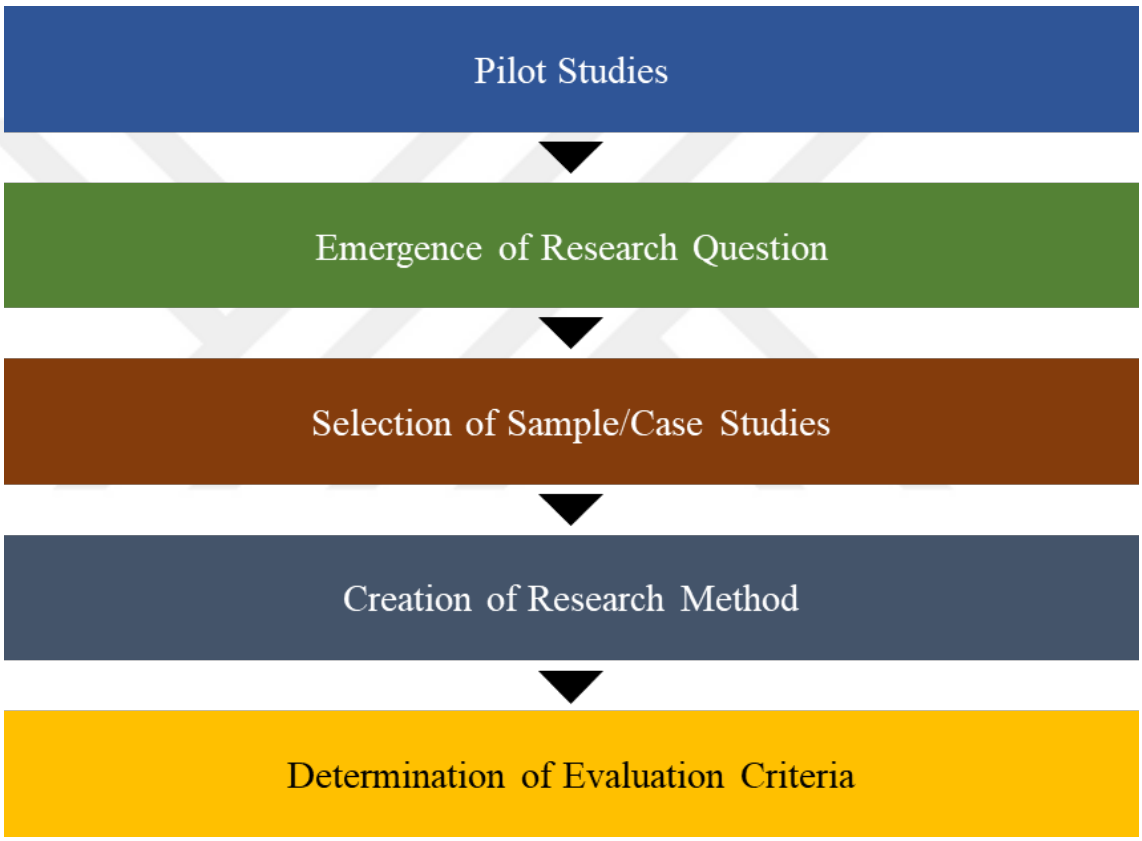
3. RESEARCH

3.1 Research Introduction

Research process is shown below.

Figure 3.1

Research Process



Many people are suffering because of the designs which are not created with an approach encompassing accessibility. Websites are not exceptions in that regard. Since the e-shopping's increasing existence in modern people's daily life, the accessibility performances of these platforms are investigated with a visual accessibility perspective

in this research. In this section, research processes are overviewed. More details about each process are given in the following sections.

Three platforms are selected as samples/case studies, to take part in this study. Their visual attributes such as text to contrast ratio, non-decorative elements' contrast ratio against the background, text size, line height, line length, letter spacing, and text justification are evaluated with a methodology combining Web Content Accessibility Guidelines 2.1's visual accessibility criteria and a heuristic user test which includes a customer journey with a specified task.

At the end of the research, a set of data is obtained. This data shows the accessibility performances of each page that the user encounters when using the selected platforms during the customer journey part of the research. Results are evaluated to get a wider understanding of the current situation of e-commerce platforms concerning visual accessibility. Nevertheless, it is better to mention the earlier processes of the research to better understand it.

Three pilot studies have been conducted before this research. These studies have contributed to the research topic and methodology[9]. After the pilot studies, many research questions have emerged such as "What are the problems related to accessibility when people use online shopping platforms?", "Are popular e-shopping platforms adequate to meet universal web accessibility standards?", "What are the significant accessibility?? problems of UI design elements of online-shopping platforms?", "What can be done to improvise the visual attributes of an online-shopping platforms in terms of accessibility?" and "Can people, regardless their abilities, easily complete a task on a e-shopping platform without encountering any major barrier related to visual accessibility?". Eventually, "How do e-commerce platforms in Turkey perform in terms of visual accessibility standards?" has been selected as the research question.

[9] See Section 3.2

To correctly answer the research question, a detailed literature review is conducted. The literature review hasn't been only beneficial to comprehend the subject with a wide perspective, but it has also been helpful to shape the research methodology because the researcher found some studies that uses similar methods which has been inspirational for this research's methodology.

Most visited e-commerce platforms in Turkey have been selected as samples/case studies. These platforms' visual accessibility performances have been analyzed for the research. A modified heuristic user testing technique has been used with a scenario resulting in a user journey. Each web page the user encounters has divided into three main interaction areas depending on their importance for the task included in the customer journey's scenario.

Five different software have been used for the evaluation process, and a set of criteria has been created based on Web Content Accessibility Guidelines. These criteria don't focus on problems related to a specific user group. Instead, it is created with an approach to understanding all problems, which can create barriers to all users without regarding their abilities. Usage of these tools and criteria reveals the performance of the evaluated websites and the visual accessibility problems of the users. The process of research is visualized below.

3.2 Pilot Studies

While searching for the research topic of the thesis, three pilot studies have been conducted. These studies have been beneficial in understanding/exploring the concept of accessibility and finding the appropriate methodology.

The initial pilot study took place in late 2020 and aimed to assess the existing accessibility issues of car infotainment systems. The findings of the study revealed that automotive companies still have a considerable amount of work to do in order to enhance the safety

of these systems for drivers, passengers, and pedestrians. To conduct the study, an online survey was administered to 42 drivers, ranging in age from 20 to 62. Out of the participants, 25 were male, 15 were female, and two did not specify their gender. The survey results indicated that 42% of the participants encountered vision-related problems, 16% experienced hearing difficulties, and two individuals faced challenges with manual dexterity. Interestingly, 91% of the respondents suggested the use of a touchscreen system, while only 26% mentioned that their vehicles were equipped with physical control buttons for operating the interface. The data gathered from this study revealed that these systems rely mostly on graphical interface, and it showed the importance of the need of properly design user interface elements in regard to visual accessibility. 86% of the participants suggested that their vehicles' audio, communication, entertainment, and navigation systems give visual feedback, and 36% of the attendees claimed they spent more than 2 seconds understanding the visual feedback. According to US-based organization NHTSA (National Highway Traffic Safety Administration), the 2-seconds threshold is important because it is the maximum amount time that must be spent for a single glance when using in-car infotainment systems (National Highway Traffic Safety Administration, 2010). In addition, only 21% of the participants asserted that they could adjust the text sizes. In the questionnaire, the participants were requested to assess the menu layout and language accessibility of the infotainment systems installed in their vehicles. The evaluation was conducted using a 5-point scale, with higher scores indicating better performance. The average score for ease of navigating through menus was 3.6, while the average score for the comprehensibility of the system's language was 3.5. Additionally, the participants were also asked to evaluate various visual attributes of their car's systems, including screen size, position, text sizes, contrast, and brightness. Even though the subject has vast potential, it has been cancelled due to its not directly encompassing all individuals in society. Its evaluation of the accessibility problems concerning several different areas that aren't directly related to visual accessibility, such as the existence of physical controls and positioning of the medium (infotainment systems' screens), has been another reason for the cancellation of the research. However, the study has showed that graphic design's importance for public safety on the contrary of suggestions claiming that the graphic design isn't an important notion for the society

in terms public of safety[10]. Moreover, the study promoted the idea suggesting that accessibility is not only related to people with disabilities because of its potential to have an impact on every individual. The other contribution of this pilot research to this thesis is that it made clear that everyone has their unique abilities and using universal standards instead of evaluation criteria focusing on personal abilities is better when researching on accessibility.

The second pilot study, which is conducted in early 2021, focused on usability performance of Amazon Türkiye's website in order to understand problems with a usability perspective. Remote conducted usability tests were realized with 3 participants to identify problems of the platform. This study contributed to this thesis in the aspect of understanding of usability and the user experience, related to e-commerce platforms. Even though the methodology of this pilot study wasn't involved with heuristic evaluation, it signified the importance of understanding the basics of a usability test methodology which is used as an additional element for this research's methodology.

The third pilot research was conducted in late 2022. This study was about the information screens used in public transport busses in İstanbul. The graphics used in these screens have also low contrast ratio. The aim of the study was to understand the exact reasons behind these problems and come up with a solution. In this pilot study, semi-structured interviews, roleplaying, and observation were the primary research methods, mainly focusing on exploring visual accessibility problems. The semi-structured interviews, which took part at the initial research process, were conducted with three participants. Two of them were visually impaired (one astigmatic and one short-sighted) people; one attendee was a person without any significant visual impairment. The study results implied that even a couple of people may have a very different experience when using a digital product. The attendees' encountering various problems underlines the people's abilities being unique. As the first pilot study, it revealed that developing of a set of

[10] See Section 2.9.3

criteria based on universal accessibility standards is more efficient. Additionally, the study highlighted the importance of the legibility for graphic-design related accessibility issues and suggested that insufficient graphic design can also harm the experience people without disabilities.

All these experiences have contributed this research in terms of its topic and methodology. They result a study focusing on the accessibility performance of most used online shopping platforms in Turkey by evaluating their visual attributes with a unique methodology. With the help of these pilot research, this thesis has become a study which concerns millions of people due to e-shopping's being in modern people's daily life and uses a valid research method.

3.3 Research Methodology

3.3.1 Sample / case studies

It is known that the accessibly has evolved from a concept that solely focuses on people with disabilities into a more inclusive concept by aiming to eliminate potential barriers for every individual. That's why this research targets to understand visual accessibility problems caused by poor graphic design practices for the top three most visited e-commerce platforms in Turkey. Visual accessibility refers sufficient contrast ratio between the background and the text, text size, contrast ratio for non-text user interface elements, line height, letter spacing, line length and text justification attributes used in evaluated e-shopping platforms in the study.

E-commerce is important for users as it provides them with convenience, a wide range of products, competitive pricing, personalized experiences, easy price comparison, seamless delivery, hassle-free returns, and access to exclusive deals. It empowers users to make informed purchasing decisions, save time and money, and enjoy a more personalized and

convenient shopping experience. Most importantly, e-commerce offers users unparalleled accessibility. With just an internet connection, users can browse and purchase products or services from the comfort of their homes or on the go regardless of their abilities. This eliminates the need to physically visit stores, saving time and effort. E-commerce platforms are available 24/7, allowing users to shop whenever it is convenient for them.

According to one of the latest studies conducted on the field (T24, 2021); Trendyol.com, Hepsiburada.com, and N11.com are Turkey's most popular e-shopping platforms in terms of total visitor number. They have a market share of 27%, 17%, and 9% respectively. Combined, they possess more than half of the online shopping traffic in the country. That's why these three e-shopping platforms are chosen to be evaluated for this research to have a larger sample to analyze the issue.

3.3.2 Research design

The research targets to understand how e-commerce platforms perform in terms of visual accessibility by evaluating their user interface elements. A user interface (UI) element, also known as a UI control or widget, is a visual or interactive component that allows users to interact with a software application or system. Buttons, text fields, dropdown menus, and icons are some examples for user interface elements.

The study uses mixed method research which combines qualitative and quantitative methods. The methodology is designed with an approach inspired by usability tests since many scholars have claimed that using solely criteria, which are presented by Web Content Accessibility Guidelines (WCAG), is not enough to create valid research[11]. That's why a usability test is integrated to the methodology. A usability test is widely known as a technique used to assess a product's efficacy, efficiency, and satisfaction from the user's point of view, such as a website, app, or device. User interaction with the

[11] See Section 2.10

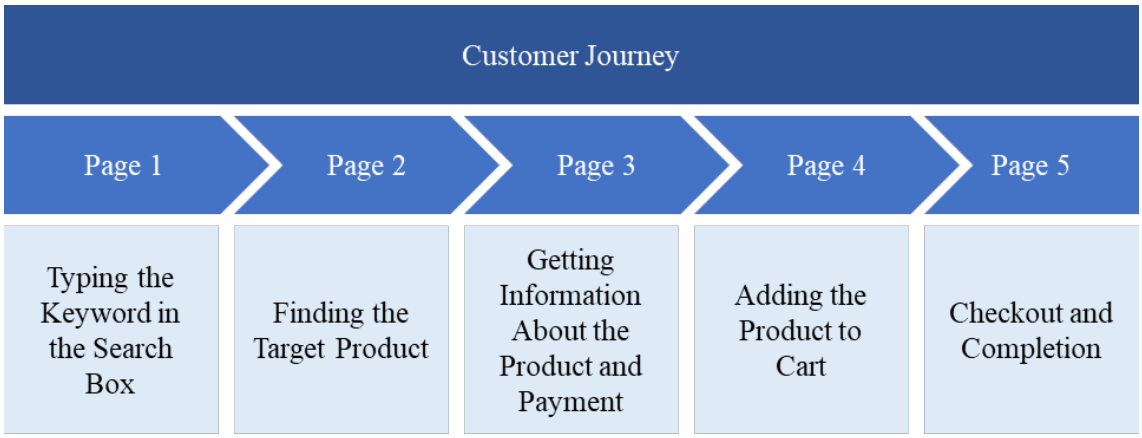
product is observed during usability testing, and user input is gathered. There are many different methods for conducting usability tests, including in-person sessions, remote sessions, and automated tests. In a usability test, the user is given straightforward tasks to complete while using the product, and the researcher observes their actions and behaviors to collect data. There is a customer journey that the user is expected to follow to complete the assigned task. The data gathered during a usability test can pinpoint usability problems and enhance the user experience. On the other hand, this research disregards the qualitative assessment methods of a regular usability test since it is based on set of tangible criteria which are mostly based on WCAG standards.

The research uses a heuristic usability test to evaluate the accessibility problems. Heuristic evaluation methodology is used to identify usability issues. The method is very effective in terms of time and cost. It can help to improve a product's overall usability and user experience. It is a usability inspection technique that is used to evaluate user interfaces by examining them against a set of predefined heuristics, or guidelines, for good design. These heuristics are typically based on established human-computer interaction (HCI) and usability principles. They are intended to identify potential usability issues to improve the design of the interfaces by focusing on attributes such as efficiency, aesthetics, error prevention, user control etc. In this research, heuristics are mostly related to visual attributes of textual content. The evaluation is usually carried out by a small team of experts or an individual expert who independently examines the interface and apply the heuristics to identify potential usability problems. In the research, this process is conducted by the researcher with the usage of a set of software to assess the accessibility performance of a webpage.

A heuristic usability test includes a task that results a customer journey. For the usability test, a scenario and a persona were created. According to this scenario, the user wants to buy a specific product online. Friends of the user advise to the one that the one should check the new product of Dyson. The product is called “Dyson V12 Detect Slim Absolute” which has a laser light on its head which helps users to see the dust on the floor more easily because the user sometimes cannot see the dust on the floor properly even

though the one has no health problem related to the one's vision. The aim of the user in this scenario is to buy this product online. With this scenario, customer journey is developed. The journey consists of five steps in total. The user does not sign up since the one already has an account with the credit card and address info. The one automatically is logged with the help of the cookies. The user types "dyson süpürge"; which means "dyson vacuum cleaner" in English inside the search box located on the homepage of the website, at the first page. At the second page, the user needs to find the product and the product must be chosen among the search results. In the third page, the user reads the product description and checks for installment options for credit cards. Then the user adds the product to the cart at the fourth page. In the fifth ant last page, the user goes to the cart and completes the purchase. The customer journey is designed to have different kind of pages which helps the researcher have a more complete results concerning the performance of aforementioned platforms. A demonstration of the process is shown below.

Figure 3.2



Henry (2007) stated that accessibility can be evaluated as part of usability research. This statement implies that people with impairments are eligible to participate in user testing, and that the heuristics employed in a heuristic evaluation can be widened to include those

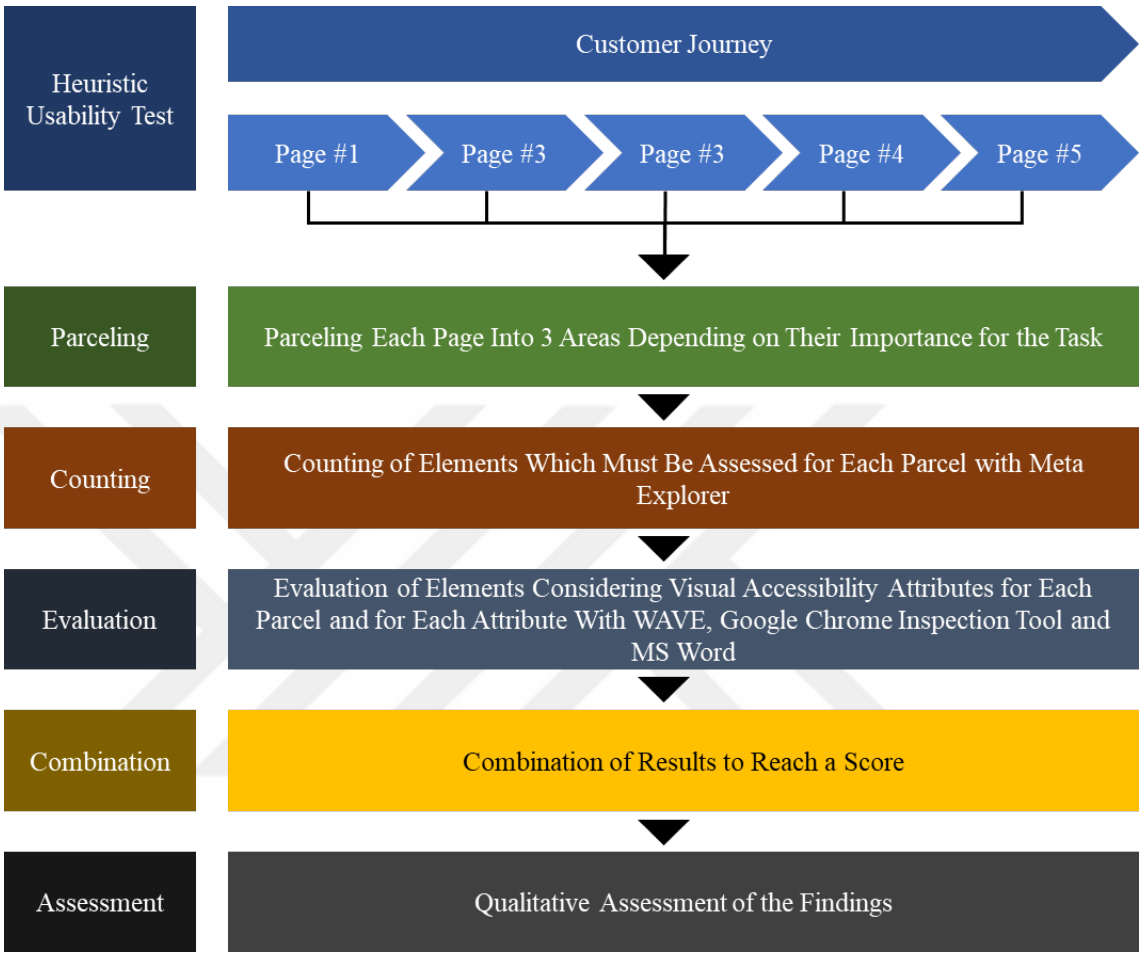
that particularly address accessibility difficulties. On the other hand, in this research the users' abilities are disregarded since people's abilities are unique to them. Also, it is better to handle accessibility with an approach that encompasses all people without regarding their abilities because the concept has evolved itself to consider all the people in the society, as it is mentioned in the previous sections. It means that tests are conducted without users in this research as it is evident that there is no way to create a methodology tailored for each individual concerning their abilities. Instead, a set of criteria has been created to evaluate the attributes of the websites.

These suggestions above make it clear that a method combining different aspects is a good practice for this study. That's why heuristic usability methodology is modified with several software tools[12] to properly evaluate visual attributes of interactive elements' appropriateness of accessibility. Briefly, the usage of these software helps to count the number of user interface elements which must be assessed and evaluate these elements' visual attributes such as text size, contrast against the background, line height, letter spacing, line length and text justification. The software used for the study is explained in a more detailed way in the "Evaluation Process and Criteria" section since their usage is related to the evaluation part. The research methodology is visualized below.

[12] See Table 3.1

Figure 3.3

Visualization of Methodology



3.3.3 Evaluation process and criteria

When it comes to accessibility, the focus is on methods based on expert knowledge rather than those that involve the user. According to a recent study (Sauer, et al, 2020), checklists are frequently utilized to provide targeted guidance for designers. These checklists help the designers assisting users with disabilities. Cognitive walkthrough methodology assesses the severity of barriers and evaluate performance attributes that may be affected. Another approach involves automatic checking, which employs algorithms and software to quantify parameters like text-background contrast, text size, text justification, line

length, line height etc. However, unlike usability and user experience assessments, accessibility does not incorporate self-report questionnaires as an evaluation tool because accessibility standards mostly rely on tangible criteria instead of direct user experience. That's why the research method of this study is related to mostly technical inspection based on the scientific evaluation criteria, which are imported mostly from WCAG 2.1, by using software tools.

Each webpage making a scene during the customer journey is divided into three main sections to be separately evaluated. These areas are separated based on their importance for the task in each page. The area which is vital for the task is considered as primary interaction area while the areas can be supportive for the user is considered as secondary interaction area. The area which is unrelated to the task is labelled as all interaction area. It must be noted that all interaction area includes the elements placed on primary and secondary interaction areas. This separation is made to determine if the visual accessibility performances of differently essential areas for the user to accomplish the targeted task are similar or not.

Five tools are used in the evaluation process for primary, secondary, and all areas separately. The number of visible elements for each area, which must be assessed, was calculated with the Meta Explorer tool. Meta Explorer is an extension presented in the browser called Google Chrome. It is an extension that helps developers explore and analyze a web page's metadata. Metadata includes information about the page, such as its title, description, keywords, author, and other attributes. It helps the researcher to count all the visual elements that a user may interact such as headers, dropdown menus, internal and external links on a specific webpage. On the other hand, it must be noted that all dropdown menus must be expanded to enable the tool to make a proper calculation. That's important because without doing it the software inaccurately presents the total number of elements which must be assessed. Total number of header elements are added up to total number of links on the page to reach the total numbers of interaction areas which must be evaluated. The number of images on the web page are ignored because technical assessment tools cannot evaluate the contrast ratio of images and the text attributes of

embedded texts. Also, images are not directly related to the research targets. Additionally, it must also be noted that some user interface elements include one or more additional sections which cannot be detected by Meta Explorer. That's why these additional elements are calculated manually and added to the total score to reach a more valid data. These manual calculations are operated for each web page which the user encounters during the heuristic usability test process. As a whole, this process gives the total number of the elements which must be evaluated in a web page.

The other tool which is integrated to the methodology is called WAVE. The software is a Google Chrome extension that is used to assess the accessibility of websites. Through the identification of potential accessibility problems and the provision of improvement recommendations, the tool aids developers and designers in evaluating the accessibility of their web content. The tool draws attention to any accessibility issues and alerts on the page and offers explanations and pointers on how to correct them. WAVE can identify a variety of accessibility problems, such as empty links, inaccessible form components, missing alt text for photos, and poor color contrast. It also offers a thorough report that describes every accessibility issue identified on the page along with its level of severity. These attributes of the tool make it a clear choice for accessibility evaluation among other accessibility evaluation tools [13]. As stated, WAVE tool presents all the problems relating to web accessibility; however, my research focus is on graphical contents' accessibility. That's why accessibility problems such as missing alternative texts, wrong dome/reading order or empty buttons were disregarded. With the help of the tool, the contrast ratios of the user interface elements against the backgrounds are assessed with regarding Level AA accessibility standards and text size is assessed based on the reference minimum text size presented by the tool. Total numbers of the elements which does not meet accessibility standards are calculated in this way. WAVE is also used for the detection of text justification problems.

[13] See Section 2.10.2

The third tool is the developer tool of the used browser (Google Chrome) for HTML elements. CSS styles for the user interface elements are checked by inspecting their line and letter spacing.

The fourth tool used in the research is Microsoft Word. Line length is inspected with software. This is done manually by copying the lines in the web page; which have a potential to exceed line length limits; and calculating the total number of the characters (including spaces) with the help of the software.

The last tool is a basic tool to check the contrast ratios separately to give additional information. There are lots of websites on the web to serve the same purpose, however WebAIM's contrast checker tool is chosen for this research. It gives the exact value of ratio between two colors.

Table 3.1

Software Used for Evaluation

Software	Type	Short Description	Used to Evaluate…
Meta Explorer	Browser Extension	An extension that helps developers explore and analyze a web page's metadata.	Number of Elements Which Must Be Assessed
WAVE	Browser Extension	A suite of evaluation tools identifying many accessibility and Web Content Accessibility Guideline (WCAG) errors	Text Size, Contrast Ratio for Regular Text, Contrast Ratio for Large Text (at least 18 point (if not bold) and at least 14 point (if bold)), Contrast Ratio for Non-text User Interface Elements, Text Justification

Google Chrome Developer Tools	Browser Add-in	A set of web developer tools built directly into the Google Chrome browser enabling web designers to inspect the rendered HTML (DOM) and network activity of web pages	Line Height, Letter Spacing
Microsoft Word	Separate Software	A word processing program allowing users for to create and edit simple or complex documents	Line Length
WebAIM: Contrast Checker	Website	A website helping developers to check contrast ratio between foreground and background colors	Contrast Ratio

The total number of the elements which does not meet accessibility standards is deducted from the total number of elements which must be evaluated. The problems which occur on the same element simultaneously has been counted as "1" in order to prevent any duplication. Then this result is divided to the total number of elements which must be evaluated. The result gives us the percentage of elements which conforms accessibility standards (mostly based on WCAG 2.1) of this research in terms of contrast ratio between text and the background, text size, contrast ratio for non-text user interface elements, line space, letter space and line length. This process is separately applied for the three main interaction areas (primary interaction area, secondary interaction area, and all interaction area) of all web pages which the user encounter during the automated usability test. An example of the process is presented in Example of Method Section.

It is well-known that contrast ratio between text and background and text size are the most important two attributes for visual accessibility when considering the digital products or webpages. In their study, Petrie et al. (2004, p. 15-16) found out that that poor contrast, and small text are two of the most significant visual attributes of website elements which results accessibility related problems for the users. The latest version of Web Content Accessibility Guidelines takes a similar approach. According to WCAG 2.1, the visual products ensuring web accessibility in regard to the color contrast are classified as Level AA accessible. The visual presentation of text and images of text must have a contrast ratio of at least 4.5:1 for regular text. On the other hand, Level AAA standards for visual representation of user interface elements aim to solve more niche accessibility problems. [14]Since this research intends to analyze e-commerce platforms' visual accessibility performance without considering the abilities of users in a detailed way, some parts of attributes of Level AAA standard are included.

Overall, the methodology of this study uses the latest version of Web Content Accessibility Guidelines' (WCAG 2.1) Level AA evaluation criteria for the contrast ratio of textual elements and non-textual graphical content which don't have decorative-only purposes and Level AAA criteria for the attributes of text justification, line height, line length, letter spacing (tracking). Attributes such as paragraph spacing, and word tracking are disregarded since there is no available tool directly evaluating them for the web-based products. Criteria for selection of background and foreground colors and resizing of the text are also disregarded since their needing assistive technologies. As stated previously, not everyone knows how to use assistive technologies. That's why all the graphical content must be presented in a way that the users don't need an additional tool to interact with them properly. Typeface design is also ignored since there is no objective criteria to evaluate them. Fortunately, almost all modern e-shopping platforms, including Trendyol.com, Hepsiburada.com and N11.com, use very simple and easy-to-read sans serif fonts in their platforms.

[14] See Section 2.10.1

WCAG doesn't mention for a minimum text size because it suggests a mechanism enabling users to edit the size of the text. However, a standard must be set for this attribute. In the evaluation criterion for the text size, minimum text size is set to 8 points because WAI indirectly sets it to 10 pixels via WAVE accessibility tool (10 pixels height is equal to 7.5 points). Evaluation criterion for each attribute is presented below.

Table 3.2

Accessibility Evaluation Criteria for the Visual Attributes of User Interface Elements

Attribute	Accessible; If…
Text Size	…8 points or above
Contrast Ratio for Regular Text	…the ratio is above 4.5:1
Contrast Ratio for Large Text (at least 18 point (if not bold) and at least 14 point (if bold))	…the ratio is above 3:1
Contrast Ratio for Non-text User Interface Elements	…the ratio is above 3:1
Line Height	…1.5 time the font size or above
Letter Spacing	…0.12em or above
Line Length	…80 character or below
Text Justification	…not justified

The process of qualitative and quantitative assessments begins after the completion of technical assessment for each web page that the user encounters during the customer journey. These assessments are based on the results of visual accessibility scores of each page. The end results for accessibility performance for each interaction area are also separated into two parts. One of them is for Level AA accessibility performance ratings of the pages. This is called "Basic Visual Accessibility Performance" which only concerns text size and contrast ratio. The other is "Overall Visual Accessibility Performance" which includes text size and Level AA contrast ratio evaluation and Level AAA line height, letter spacing, line length and text justification. This is made to

understand how these platforms performs against less demanding and more demanding accessibility criteria.

3.3.4 Example of method

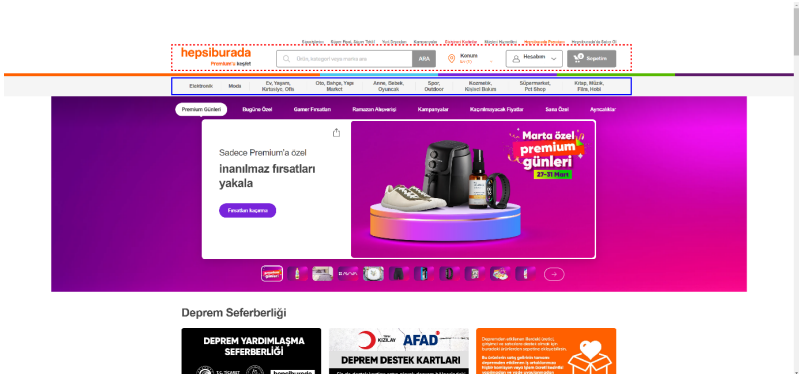
This section explains the methodology from the beginning of the parceling phase with a more detailed way by focusing on a webpage which is encountered during customer journey.

Parceling of the Web Page:

As stated previously, the interaction areas are categorized according to their significance for the task on each page. The primary interaction area is the crucial section for completing the task, while the secondary interaction area serves as supportive for the user. The remaining area, unrelated to the task, is referred to as the "all interaction area." This division allows for assessing whether the visual accessibility performances of variously important areas, necessary for the user to achieve the desired task, are comparable or not.

Figure 3.4

Parceling a Page to the Interaction Areas[15]



Counting of Elements Which Must Be Assessed a Page:

Table 3.3

Example of Counting of Elements to Be Evaluated on an Interaction Area of a Page of Selected E-Commerce Platform

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Elements to be Evaluated
Primary Interaction Area	X	X	X	**X**
Secondary Interaction Area	X	X	X	**X**

[15] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

All Interaction Area	X	X	X	**X**

Evaluation of Visual Accessibility for Each Attribute for Each Interaction Area on a Page:

Table 3.4

Example of Visual Accessibility Evaluation on an Interaction Area of a Page of Selected E-Commerce Platform

Total Number of Elements Not Conforming Text Size Standards	X
+	
Total Number of Elements Not Conforming Contrast Standards	X
+	
Total Number of Elements Not Conforming Line Height Standards	X
+	
Total Number of Elements Not Conforming Letter Spacing Standards	X
Total Number of Elements Not Conforming Line Length Size Standards	X
+	
Total Number of Elements Not Conforming Text Justification Standards	X
-	
Duplicated Problems	X
=	
Total Number of Elements Not Conforming the Standards	X

Calculation of Basic Visual Accessibility Performance for Each Interaction Area on a Page:

Table 3.5

Example of Calculation of Basic Visual Accessibility Score for Each Interaction Area on a Page of Selected E-Commerce Platform

Basic Visual Accessibility Performance of Primary Interaction Area	**XX%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**XX%**
Basic Visual Accessibility Performance of All Interaction Area	**XX%**

Basic Visual Accessibility Performance = (Total Number of Elements to Be Evaluated in Related Interaction Area - Total Number of Problems Related to Text Size and Contrast Ratio in Related Interaction Area) ÷ Total Number of Elements to Be Evaluated in Related Interaction Area

Calculation of Overall Visual Accessibility Performance for Each Interaction Area on a Page:

Table 3.6

Example of Calculation of Overall Visual Accessibility Score for Each Interaction Area on a Page of Selected E-Commerce Platform

Overall Visual Accessibility Performance of Primary Interaction Area	**XX%**
Overall Accessibility Performance of Secondary Interaction Area	**XX%**
Overall Accessibility Performance of All Interaction Area	**XX%**

Overall Visual Accessibility Performance = (Total Number of Elements to Be Evaluated in Related Interaction Area - Total Number of Elements Not Conforming the Standards in Related Interaction Area) ÷ Total Number of Elements to Be Evaluated in Related Interaction Area

Visualization of Basic and Overall Visual Accessibility Performance for Each Attribute for Each Interaction Area:

Figure 3.5

Example of Basic Visual Accessibility Performance for Each Interaction Area of the Encountered Pages of Selected E-commerce Platform

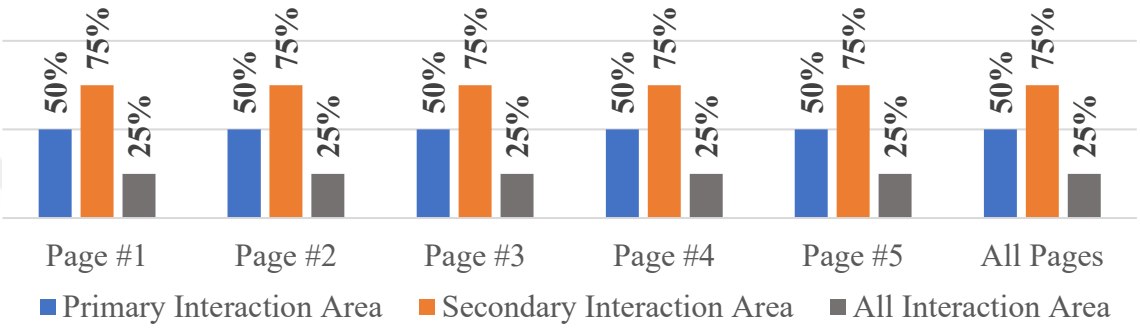
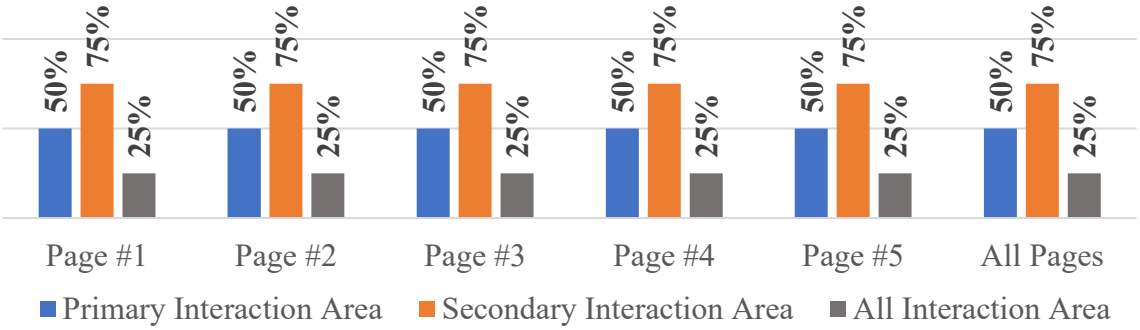


Figure 3.6

Example of Overall Visual Accessibility Performance for Each Interaction Area of the Encountered Pages of Selected E-commerce Platform



3.4 Findings

In this section, results of the research are shared for each step of the customer journey for each e-commerce platform. There are 15 steps in total, 5 for each platform. Detailed tables and edited screenshots of the evaluated pages are presented to make it easier for the reader to understand the findings.

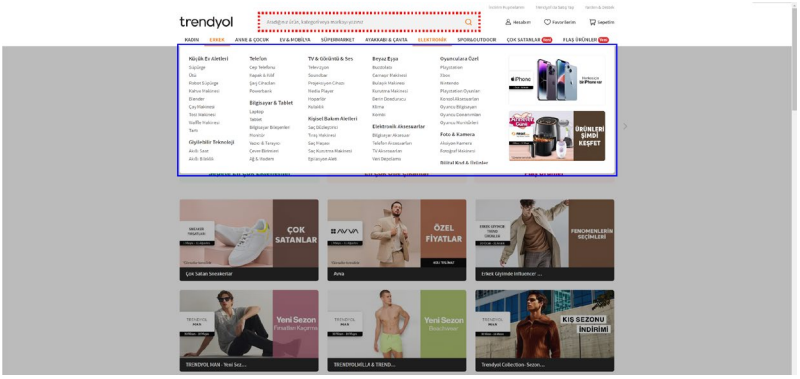
3.4.1 Findings for Trendyol.com

Page #1 (Homepage):

The task for the consumer on this phase is to type the product name on the search bar. That's why the area sporting the search bar is parceled as the primary interaction area on this phase. Secondary interaction area is the dropdown menu which is located on the navigation bar since it helps to the user to find the product. Parceling process of the page is demonstrated below.

Figure 3.7

Parceling the Page #1 of Trendyol.com to the Interaction Areas[16]



At the first stage of the customer journey, the user encounters the homepage of the website. There are 815 user interface elements which must be assessed on the page. 2 of them are in the primary interaction area and 75 of them are in the secondary interaction area. Please see the table below for more detailed information.

Table 3.7

Total Number Evaluated Elements on Page #1 of Trendyol.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	2	0	**2**

[16] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

Secondary Interaction Area	0	75	0	**75**
All Interaction Area	10	805	0	**815**

There are 61 elements which don't conform text size standards. None of them is visible on primary or secondary interaction areas. There are 70 elements which fail minimum contrast ratio standards. One of them is on primary interaction area and one of them is on secondary interaction area. These elements contrast ratio is below 3:1. Many user interface elements are filled with brand color. However, this situation results problems. The contrast ratio between brand color and white is 2.77:1. The other issue that must be mentioned is about hover interactions. When a user hovers the mouse over an interactive element the background color turns from black to white and text color turns from white to brand color (a light hue of orange) in most parts. The reason of this problem is that the developers are using the company color for the hover interactions and this color cannot present an adequate contrast ratio with white background. Since problems only occurring on the hover state are disregarded, it is excluded when calculating the accessibility score. On the other hand, it is important to mention about.

For the attributes relating to Level AAA accessibility, the performance of the page is generally very satisfying. Line height is 2.43 times bigger than the text size for the most parts of the page. The maximum detected line height is 3 and the minimum detected line height is 1.85 times bigger the text size. Letter spacing is 0.18em and above throughout the page. 6 elements don't conform both line length standards. These elements are not placed in the primary or secondary interaction. Most of them exceeds 200 characters. There is no issue detected concerning text justification standards. Please see the tables below for more detailed information.

Table 3.8

Visual Accessibility Evaluation of Primary Interaction Area of Page #1 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	1
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**1**

Table 3.9

Visual Accessibility Evaluation of Secondary Interaction Area of Page #1 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	1
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**1**

Table 3.10

Visual Accessibility Evaluation of All Interaction Area of Page #1 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	61
Total Number of Elements Not Conforming Contrast Standards	70

Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	6
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**137**

When only contrast ratio and text size problems are considered, primary interaction area's basic visual accessibility score is 50% and secondary interaction area's score is 99%. All interaction area gets a score of 84%. When all elements in the page are considered, its overall visual accessibility score is 83%. For the secondary interaction area, it scores 99%. On the other hand, the page fails at the primary interaction area. This area is the most important interaction area, and it consists of 2 user interface elements: A search box and an icon. The text size and color used in the search box is adequate but the contrast ratio between search icon and the background does not meet contrast ratio standards of WCAG. Therefore, this area's accessibility score is 50%. Please see the tables below for more detailed information.

Table 3.11

Basic Visual Accessibility Performance of Page #1 of Trendyol.com

Basic Visual Accessibility Performance of Primary Interaction Area	**50%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**99%**
Basic Visual Accessibility Performance of All Interaction Area	**84%**

Table 3.12

Overall Visual Accessibility Performance of Page #1 of Trendyol.com

Overall Visual Accessibility Performance of Primary Interaction Area	**50%**
Overall Accessibility Performance of Secondary Interaction Area	**99%**

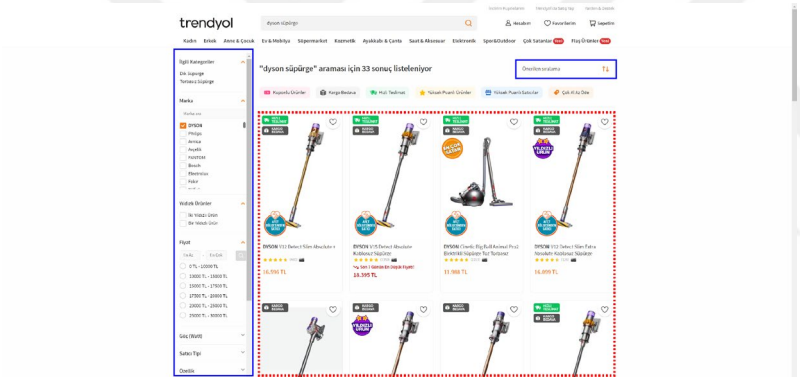
Overall Accessibility Performance of All Interaction Area	**83%**

Page #2 (Search Page):

The user needs to select the targeted product on the page. The area that consists of listed products is considered as primary interaction area. The areas helping the user to sort and filter the search results form the secondary interaction area. Parceling process of the page is demonstrated below.

Figure 3.8

Parceling the Page #2 of Trendyol.com to the Interaction Areas[17]



At the next step during customer journey, the user encounters a page which consists of products relating to the one's search. There are 1350 user interface elements which must be assessed on the page. 230 of them are in the primary interaction area and 104 of them are in the secondary interaction area. Please see the table below for more detailed information.

[17] Red dotted line is for primary interaction area and the blue continuous lines are for secondary interaction area.

Table 3.13

Total Number Evaluated Elements on Page #2 of Trendyol.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	33	197	**230**
Secondary Interaction Area	0	80	24	**104**
All Interaction Area	6	995	339	**1340**

There are 87 elements which fail in terms of text size standards. Unfortunately, all of them are visible on primary interaction area. There are 89 elements which don't conform minimum contrast ratio standards. 86 of them are on primary interaction area and 2 of them are on secondary interaction area. 3 user interface elements which are not located on primary interaction area are filled with brand color. That's why their contrast ratios are slightly below 3:1. The problem related hover interactions occurred in the first page are also evident here. However, they are ignored as in the first page.

For the attributes relating to Level AAA accessibility, the performance of the page is remarkable. Line height is the same as homepage. It is 2.43 times bigger than the text size for the most parts of the page. There is no maximum or minimum detected line height for this page because most of the textual content has only one line and the textual content having two lines have 2.43 times bigger line height than the font size. Letter spacing is also the same as the homepage. It is 0.18em at minimum. There is no element failing to conform text justification and text length standards. Please see the tables below for more detailed information.

Table 3.14

Visual Accessibility Evaluation of Primary Interaction Area of Page #2 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	87
Total Number of Elements Not Conforming Contrast Standards	86
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	26
Total Number of Elements Not Conforming the Standards	**147**

Table 3.15

Visual Accessibility Evaluation of Secondary Interaction Area of Page #2 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	2
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**2**

Table 3.16

Visual Accessibility Evaluation of All Interaction Area of Page #2 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	87
Total Number of Elements Not Conforming Contrast Standards	89
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	26
Total Number of Elements Not Conforming the Standards	**150**

The page performs well in terms of visual accessibility when Level AAA standards are considered. This results identical scores for basic and overall visual accessibility performances. On the other hand, the visual accessibility performance of the page is low when Level AA standards are considered. It is disappointing because Level AA standards are the basic standards for visual accessibility. When all elements in the page are considered, its visual accessibility score is 89%. For the secondary interaction area, it scores 98%. Especially filtering bar designed with an approach considering accessibility. Only problem occurring in that area is a search icon's having very insufficient contrast when it is not activated. On the other hand, the page fails again at the primary interaction area. Primary interaction area's visual accessibility score is 36%. This area is the most significant interaction area when the task assigned to the user is considered because it consists of products that the user is looking for. There are lots of text which does not meet both text size and contrast ratio standards. These problems cause is not related to the elements which are always on the page. Some user interface elements giving additional information about the related product are the main causes of these problems. For example, the text boxes claiming "Hızlı Teslimat" (means "Fast Shipping" in English) or "Kargo Bedava" (means "Free Shipping" in English) always results visual accessibility problems in terms of text size and contrast ratio. This situation results an idea suggesting that the website has been designed with an accessibility approach, but user interface elements

have been added to the pages in later stages have not been designed with the same perspective. Please see the tables below for more detailed information.

Table 3.17

Basic Visual Accessibility Performance of Page #2 of Trendyol.com

Basic Visual Accessibility Performance of Primary Interaction Area	**36%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**98%**
Basic Visual Accessibility Performance of All Interaction Area	**89%**

Table 3.18

Overall Visual Accessibility Performance of Page #2 of Trendyol.com

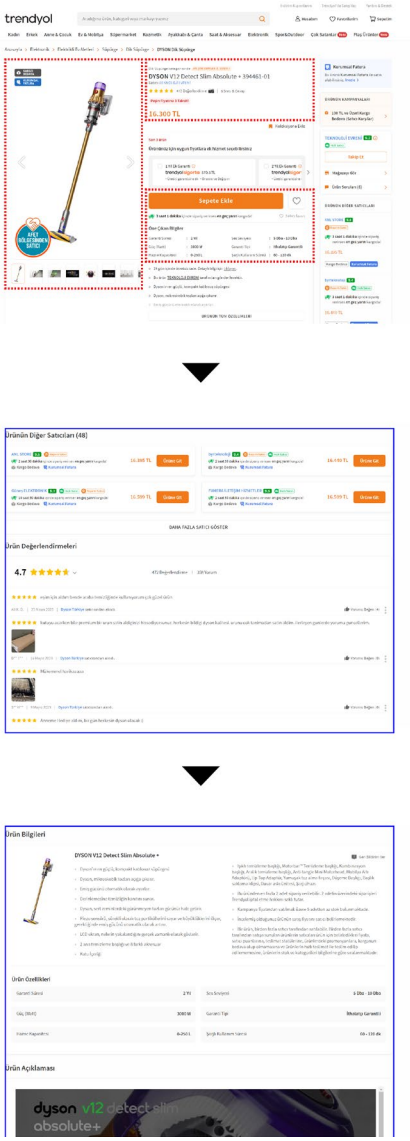
Overall Visual Accessibility Performance of Primary Interaction Area	**36%**
Overall Accessibility Performance of Secondary Interaction Area	**98%**
Overall Accessibility Performance of All Interaction Area	**89%**

Page #3 (Product Page):

The researcher parcels the page based on the following information. In this page, the main task of the user is to look at the product images, check the name of the product, get a quick information about the seller, learn about the rating of the product, and review the highlighted features of the product before adding the item to cart. The area providing this information to the user is considered as primary interaction area. Secondary interaction area consists of user comments, questions and answers and the detailed product information sections. Parceling process of the page is demonstrated below.

Figure 3.9

Parceling the Page #3 of Trendyol.com to the Interaction Areas[18]



[18] Red dotted lines are for primary interaction area and the blue continuous lines are for secondary interaction area.

At the third stage of the customer journey, the user encounters the product page. There are 1833 user interface elements which must be assessed on the page. 22 of them are in the primary interaction area and 80 of them are in the secondary interaction area. Please see the table below for more detailed information.

Table 3.19

Total Number Evaluated Elements on Page #3 of Trendyol.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	1	6	15	**22**
Secondary Interaction Area	5	8	67	**80**
All Interaction Area	18	966	849	**1833**

There are 5 elements which fails in terms of text size standards. None of them is visible on secondary interaction areas, however 2 of them occur in the primary interaction area. There are 206 elements which don't conform minimum contrast ratio standards. 3 of them are on primary interaction area and 48 of them are on secondary interaction area.

On the product page, the performance of the page is lower for the attributes relating to Level AAA accessibility standards, on the contrary to first and second pages. There are 32 problems regarding line height. 24 of them occur in secondary interaction area. Some of the lines have a line height as low as the text height. As already established, it must be at least one and half time bigger than the text height. 6 line length problems are detected on the page. 3 of them occur on the secondary interaction area. The page performs well in regard to text justification standards and letter spacing criteria since there was no issue

detected concerning these attributes. Please see the tables below for more detailed information.

Table 3.20

Visual Accessibility Evaluation of Primary Interaction Area of Page #3 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	2
Total Number of Elements Not Conforming Contrast Standards	3
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**5**

Table 3.21

Visual Accessibility Evaluation of Secondary Interaction Area of Page #3 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	48
Total Number of Elements Not Conforming Line Height Standards	24
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	3
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	2
Total Number of Elements Not Conforming the Standards	**73**

Table 3.22

Visual Accessibility Evaluation of All Interaction Area of Page #3 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	3
Total Number of Elements Not Conforming Contrast Standards	155
Total Number of Elements Not Conforming Line Height Standards	32
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	6
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	2
Total Number of Elements Not Conforming the Standards	**194**

The page's visual accessibility performance significantly varies among interaction areas. Its overall visual accessibility score is 89% for all interaction area. The value increases to 91% when basic visual accessibility performance is considered. The performance of the page can be considered adequate (77%) for the primary interaction area. This score is same for basic and overall visual accessibility performance. Nevertheless, the page fails on secondary interaction are by scoring only 9% when overall visual accessibility performance is taken into account. However, this area's basic visual accessibility performance is significantly higher with a score of 40%.

It must be mentioned that the product information section which supplied by the producer of the product (Dyson) failed mostly because of line height. On the other hand, this section performed well when Level AA accessibility standards are considered and performed poorly when Level AAA standards such as line length and line height criteria are considered. This type of section does not use the mother platform's design style. They directly use the style of related brand's design language. They are also part of the page, but e-commerce platforms don't standardize these sections and their accessibility score are affected positive or negatively depending on the producer of the product's accessibility performance.

The other issue that must be mentioned that there is no character limit for line length for “user review” and “question and answers” areas. The page only shows 5 reviews and one question and answer as preview. Not showing all comments and questions helps the page to get a more sufficient accessibility score because these areas generally fail when line length and contrast ratio standards are considered. Please see the tables below for more detailed information.

Table 3.23

Basic Visual Accessibility Performance of Page #3 of Trendyol.com

Basic Visual Accessibility Performance of Primary Interaction Area	**77%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**40%**
Basic Visual Accessibility Performance of All Interaction Area	**91%**

Table 3.24

Overall Visual Accessibility Performance of Page #3 of Trendyol.com

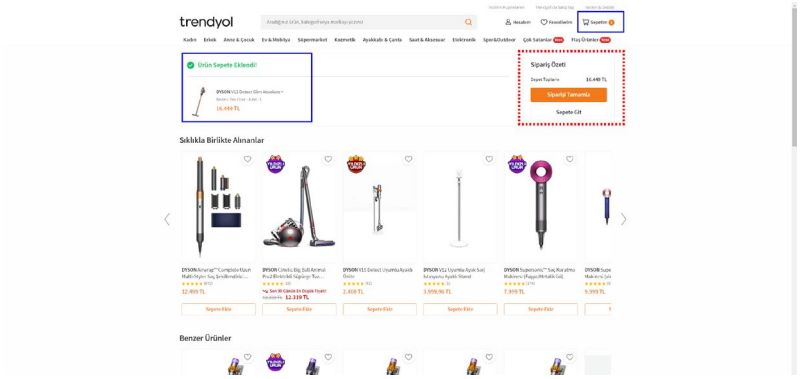
Overall Visual Accessibility Performance of Primary Interaction Area	**77%**
Overall Accessibility Performance of Secondary Interaction Area	**9%**
Overall Accessibility Performance of All Interaction Area	**89%**

Page #4 (Cart Page):

The task for the consumer on this phase is to proceed to purchasing page. The page is parceled based on this information. The area having the button which enables to user to proceed to next step is considered as primary interaction area. Secondary interaction area is the area providing main information about the item such as its name and price. Parceling process of the page is demonstrated below.

Figure 3.10

Parceling the Page #4 of Trendyol.com to the Interaction Areas[19]



The user is directed to a page which previews the order at the next step in customer journey. There are 1302 user interface elements which must be assessed on the page. 7 of them are header elements, 974 are links. There are 321 additional elements which are detected manually. 5 of these user interface elements are in the primary interaction area and 8 of them are in the secondary interaction area. Please see the table below for more detailed information.

Table 3.25

Total Number Evaluated Elements on Page #4 of Trendyol.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	1	4	**5**

[19] Red dotted line is for primary interaction area and the blue continuous lines are for secondary interaction area.

Secondary Interaction Area	0	2	6	**8**
All Interaction Area	7	974	321	**1302**

There isn't any element which fails in terms of text size standards. On the other hand, the number of elements which don't conform Level AA accessibility standards in terms of contrast is high. There are 157 elements which don't conform minimum contrast ratio standards. One of them is on primary interaction area and this problem occurs because of the usage of company color on the background of the textual content. 6 of them are on secondary interaction area. The green, orange (brand color) and gray text on white background result a contrast ratio below 3:1 (2.42:1, 2.77:1 and 2.75:1 respectively).

Line height performance of the page is very variable. It is 2.57 in most lines. However, there are 51 lines which have 1.27 line height. As previously stated, it must be at least 1.5 to conform Level AAA accessibility standards regarding this attribute. Fortunately, none of them occurs in primary and secondary interaction areas. There are also lines which have 1.22 line height, however they all have single lines. That's why these problems are ignored since they aren't perceivable by the user. Letter spacing is 0.18em at maximum and 0.17em at minimum. This implies that the webpage performs well in that regard. There is no element failing to conform text justification and text length standards. Please see the tables below for more detailed information.

Table 3.26

Visual Accessibility Evaluation of Primary Interaction Area of Page #4 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	1
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0

Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**1**

Table 3.27

Visual Accessibility Evaluation of Secondary Interaction Area of Page #4 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	6
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**6**

Table 3.28

Visual Accessibility Evaluation of All Interaction Area of Page #4 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	157
Total Number of Elements Not Conforming Line Height Standards	51
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**208**

When all elements in the page are considered, its overall visual accessibility score is 84%. For the secondary interaction area, the page scores very low. Overall visual accessibility score of the secondary area is 25%. Primary interaction area's overall visual accessibility score is 80%. All problems occurring in primary and secondary interaction areas are related to low contrast. That's why there is no difference between these areas basic and overall visual accessibility scores. On the contrary, all interaction area's basic visual accessibility performance is higher (88%) than its overall visual accessibility performance. Please see the tables below for more detailed information.

Table 3.29

Basic Visual Accessibility Performance of Page #4 of Trendyol.com

Basic Visual Accessibility Performance of Primary Interaction Area	**80%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**25%**
Basic Visual Accessibility Performance of All Interaction Area	**88%**

Table 3.30

Overall Visual Accessibility Performance of Page #4 of Trendyol.com

Overall Visual Accessibility Performance of Primary Interaction Area	**80%**
Overall Accessibility Performance of Secondary Interaction Area	**25%**
Overall Accessibility Performance of All Interaction Area	**84%**

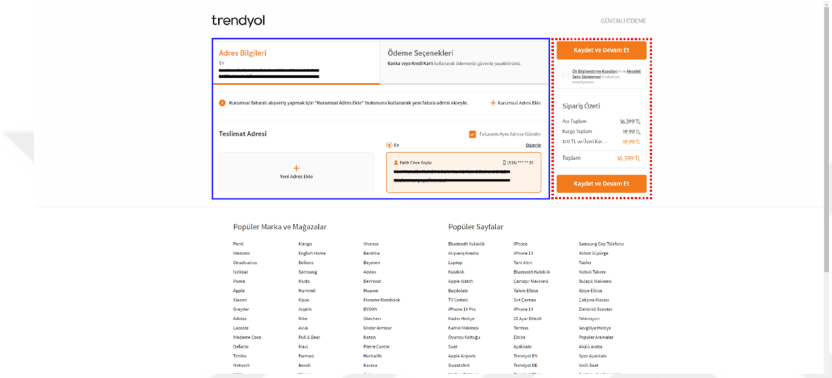
Page #5 (Address and Payment Information Page):

This page split into two sections. One of these sections is for address and billing information and the other one is for payment information. In both sections, user doesn't need to input new information about the one's address, billing, or payment information since they are already saved in the one's account. The task of the user is to review this information and complete the purchase. The page is parceled based on this information.

That’s why the area having buttons which enable the user to complete the purchase is considered as primary interaction area and the area providing shipping, billing and payment information forms the secondary interaction area. Parceling process of the page is demonstrated below.

Figure 3.11

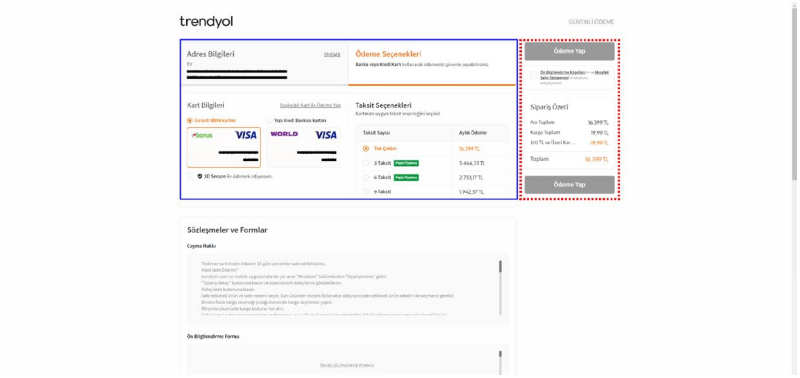
Parceling the Page #5.1 of Trendyol.com to the Interaction Areas[20]



[20] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

Figure 3.12

Parceling the Page #5.2 of Trendyol.com to the Interaction Areas[21]



At the last stage of the customer journey, a page asking for address and payment information welcomes the user. There is a section having two tabs. One tab is for address information and the other is for payment information. As already stated, the user uses an existed account in this customer journey. That's why the one doesn't need to input new information to complete this stage. The tabs in the page reviewed separately but the evaluation results are shared after combining two different results.

In total, there are 201 user interface elements which must be assessed on the page. 41 of them are header elements, 130 are links. There are 30 additional elements which are detected with manual inspection. 15 of total elements are located in the primary interaction area and 29 of them are in the secondary interaction area. Please see the table below for more detailed information.

[21] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

Table 3.31

Total Number Evaluated Elements on Page #5 of Trendyol.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	4	11	**15**
Secondary Interaction Area	2	14	13	**29**
All Interaction Area	41	130	30	**201**

There are two elements which doesn't conform text size standards. Both are located in the secondary interaction area. These are important failings because these problems occur on the tags showing an information about the installments. These tags also have low contrast. There are 41 elements which don't conform minimum contrast ratio standards. Most of them are not visible on primary or secondary interaction areas. Primary and secondary interaction areas have 12 problematic user interface elements in regard to the contrast ratio, 5 of them are present on the primary interaction area. Two of them occur on the buttons which are essential to complete the task. These buttons' background color change from gray to orange when the necessary action to activate this mechanism has been made by the user. Text color aren't changed during this process. That's why it has a 2:77:1 contrast ratio for orange background-white text combination and 2.84:1 contrast ratio for grey background-white text combination. The rest of the failures related to the contrast occur in the section about the agreements and forms. This section consists very important information about the legal rights of the customer; however, it is well-known that many users don't give adequate attention on this information. That's why the section is excluded from primary and secondary interaction areas.

Line height couldn't be detected by the Google Chrome Developer Tools to check HTML and CSS attributes of the page. That's why a manual inspection is conducted. This inspection shows that the line height is between 1 and 1.5 in most text which are not single lined. 41 of these problems occur on the agreements and forms area. One of them is visible on primary interaction area and one of them is evident on secondary interaction area. The section related to legal agreements and forms brings other visual accessibility problems such as contrast and line length problems. 41 contrast and 41 line length failures are visible on the section. Letter spacing is 0.18em on the page. Therefore, there is no issue related to letter spacing on the page. Also, there is no problem detected concerning text justification. Please see the tables below for more detailed information.

Table 3.32

Visual Accessibility Evaluation of Primary Interaction Area of Page #5 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	5
Total Number of Elements Not Conforming Line Height Standards	1
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**6**

Table 3.33

Visual Accessibility Evaluation of Secondary Interaction Area of Page #5 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	2
Total Number of Elements Not Conforming Contrast Standards	7
Total Number of Elements Not Conforming Line Height Standards	1

Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	2
Total Number of Elements Not Conforming the Standards	**8**

Table 3.34

Visual Accessibility Evaluation of All Interaction Area of Page #5 of Trendyol.com

Total Number of Elements Not Conforming Text Size Standards	2
Total Number of Elements Not Conforming Contrast Standards	41
Total Number of Elements Not Conforming Line Height Standards	41
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	41
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	70
Total Number of Elements Not Conforming the Standards	**55**

The webpage's basic visual accessibility performance is 80%. Basic visual accessibility performance of secondary area is 79%. Primary interaction area's performance in this regard is 67%. Overall visual accessibility performance of the page is lower for all three interaction areas. Primary interaction area gets a score of 60% while secondary interaction area achieves a score of 72%. All interaction area's overall visual accessibility score is 73%. Please see the tables below for more detailed information.

Table 3.35

Basic Visual Accessibility Performance of Page #5 of Trendyol.com

Basic Visual Accessibility Performance of Primary Interaction Area	**67%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**79%**

Basic Visual Accessibility Performance of All Interaction Area	**80%**

Table 3.36

Overall Visual Accessibility Performance of Page #5 of Trendyol.com

Overall Visual Accessibility Performance of Primary Interaction Area	**60%**
Overall Accessibility Performance of Secondary Interaction Area	**72%**
Overall Accessibility Performance of All Interaction Area	**73%**

All Pages:

The total number of user elements which is evaluated is 5491 for Trendyol.com. 274 of them belong to primary interaction areas and 296 of them are located on secondary interaction areas across the pages. There are 635 contrast and text size related visual accessibility issues in total. 159 of them occurs on primary interaction areas and 64 of them are detected on secondary interaction areas. Please see the tables below for more detailed information.

Table 3.37

Basic Visual Accessibility Evaluation on Interaction Areas of All Pages of Trendyol.com

Total Number of Elements Not Conforming Text Size and Contrast Standards for Primary Interaction Area	**159**
Total Number of Elements Not Conforming Text Size and Contrast Standards for Secondary Interaction Area	**64**
Total Number of Elements Not Conforming Text Size and Contrast Standards for All Interaction Area	**635**
Total Number of Evaluated Elements on Primary Interaction Area	**274**

Total Number of Evaluated Elements on Secondary Interaction Area	**296**
Total Number of Evaluated Elements on All Interaction Area	**5491**

Table 3.38

Basic Visual Accessibility Performance of All Pages of Trendyol.com

Basic Visual Accessibility Performance of Primary Interaction Area	**42%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**78%**
Basic Visual Accessibility Performance of All Interaction Area	**88%**

For Trendyol.com, a comprehensive evaluation is conducted on a total of 5491 user elements. Out of these, 274 are found in primary interaction areas, while 296 are located in secondary interaction areas throughout the pages. In terms of visual accessibility, there are a total of 744 issues. Among these, 160 occur in primary interaction areas, and 90 are detected in secondary interaction areas. Please see the tables below for more detailed information.

Table 3.39

Overall Visual Accessibility Evaluation on Interaction Areas of All Pages of Trendyol.com

Total Number of Elements Not Conforming the Standards for Primary Interaction Area	**160**
Total Number of Elements Not Conforming the Standards for Secondary Interaction Area	**90**
Total Number of Elements Not Conforming the Standards for All Interaction Area	**744**

Total Number of Evaluated Elements on Primary Interaction Area	**274**
Total Number of Evaluated Elements on Secondary Interaction Area	**296**
Total Number of Evaluated Elements on All Interaction Area	**5491**

Table 3.40

Overall Visual Accessibility Performance for Each Interaction Area on All Pages of Trendyol.com

Overall Visual Accessibility Performance of Primary Interaction Area	**42%**
Overall Accessibility Performance of Secondary Interaction Area	**70%**
Overall Accessibility Performance of All Interaction Area	**86%**

Visual Accessibility Performance of Each Interaction Area of All Pages Which Are Encountered During Customer Journey for Trendyol.com:

Figure 3.13

Basic Visual Accessibility Performance for Each Interaction Area of the Encountered Pages of Trendyol.com

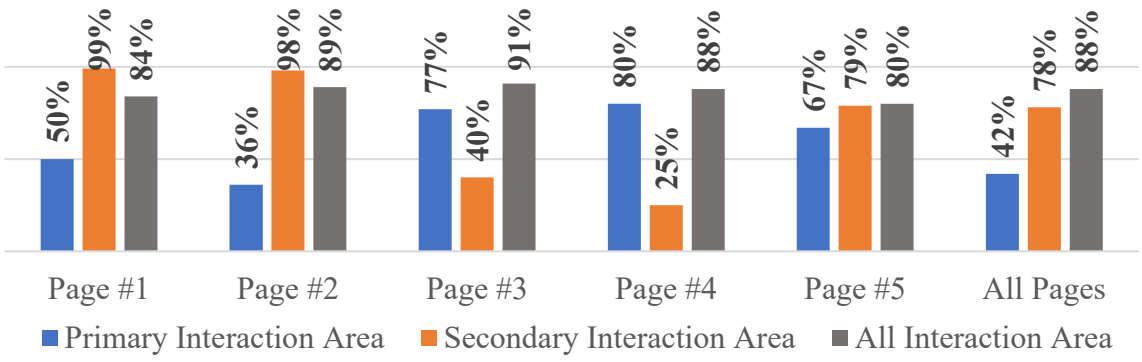
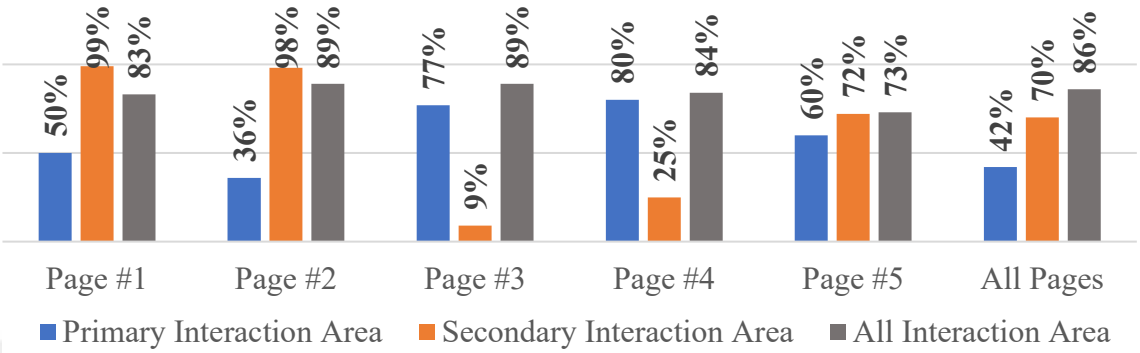


Figure 3.14

Overall Visual Accessibility Performance for Each Interaction Area of the Encountered Pages of Trendyol.com



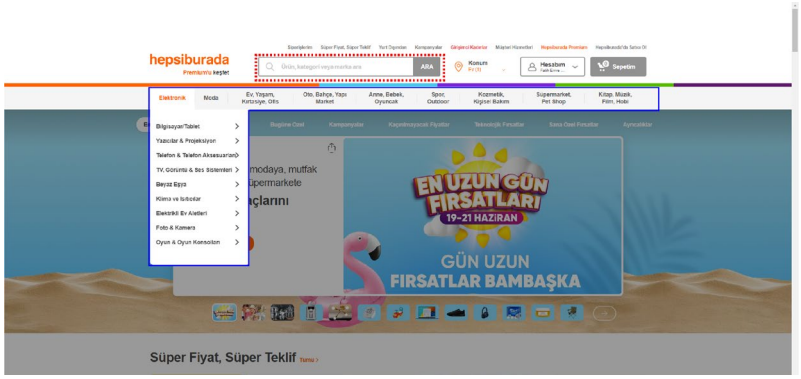
3.4.2 Findings for Hepsiburada.com

Page #1 (Homepage):

The task for the consumer on this phase is to type the product name on the search bar. That's why the area sporting the search bar is parceled as the primary interaction area on this phase. Secondary interaction area is the dropdown menu located on the navigation bar since it helps to the user to find the product. Parceling process of the page is demonstrated below.

Figure 3.15

Parceling the Page #1 of Hepsiburada.com to the Interaction Areas[22]



At the first stage of the customer journey, the user encounters the homepage of the website. There are 4188 user interface elements which must be assessed on the page. 2 of them are in the primary interaction area and 1644 of them are in the secondary interaction area. Please see the table below for more detailed information.

Table 3.41

Total Number Evaluated Elements on Page #1 of Hepsiburada.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	2	0	**2**
Secondary Interaction Area	1	366	0	**377**

[22] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

All Interaction Area	273	2271	1644	**4188**

There are only 1 element which doesn't conform text size standards. None of them is visible on primary or secondary interaction areas. There are 2171 elements which fail minimum contrast ratio standards. One of them is on primary interaction area and the others occur on all interaction area. These elements' contrast ratio is below 3:1. Many user interface elements are filled with brand color, similar to Trendyol.com. When the exact color (orange) of the brand is used it results 3.03:1 contrast ratio which is adequate for Level AA accessibility standards if the text is classified as big text (18 points or bigger for regular, or 14 points or bigger for bold); however, a lighter hue of brand color is used for many textual or background content. This color results 2.55:1 contrast ratio. There is another element type for contrast ratio related problems. When the rating of a product is visualized, the developers use orange-colored stars. This orange color's contrast ratio is 2.11. Since they are non-decorative visual elements, they affect the visual accessibility of the page negatively.

For the attributes relating to Level AAA accessibility, the performance of the page varies. As default, line height is set to 1.15 times bigger than the text. For some user interface elements, the line height is detected as 1.33. Both line heights are not sufficient comply with lates WCAG guidelines. Fortunately, most of the textual content have a single line. That's why the total number of detected line height problems is 257. None of them occurs either primary or secondary interaction areas. Letter spacing is 0.17em and above throughout the page. There is no element which doesn't conform line length standards or text justification problems occurring in all interaction area. These elements also fail at conforming line height criteria. These issues are reduced from the end result to avoid duplication. Please see the tables below for more detailed information.

Table 3.42

Visual Accessibility Evaluation of Primary Interaction Area of Page #1 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	1
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**1**

Table 3.43

Visual Accessibility Evaluation of Secondary Interaction Area of Page #1 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	0
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**0**

Table 3.44

Visual Accessibility Evaluation of All Interaction Area of Page #1 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	1

Total Number of Elements Not Conforming Contrast Standards	2171
Total Number of Elements Not Conforming Line Height Standards	257
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	4
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**2433**

When all elements in the page are considered, the page's basic visual accessibility score is 42%. On the other hand, the page scores 100% for the secondary interaction area in terms of basic visual accessibility performance. The page's basic visual accessibility performance for the primary interaction area is not adequate. This area consists of two user interface elements. One of them is a search box and ant the other is an icon. The text size and color used in the search box is sufficient but the contrast ratio between search icon and the background does not meet contrast ratio standards of WCAG. Hence, this area's accessibility score is 50%. Only difference between basic and overall visual accessibility performance is realized for all interaction area. This area's basic visual accessibility performance is slightly higher. It is 48%. Please see the tables below for more detailed information.

Table 3.45

Basic Visual Accessibility Performance of Page #1 of Hepsiburada.com

Basic Visual Accessibility Performance of Primary Interaction Area	**50%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**100%**
Basic Visual Accessibility Performance of All Interaction Area	**48%**

Table 3.46

Overall Visual Accessibility Performance of Page #1 of Hepsiburada.com

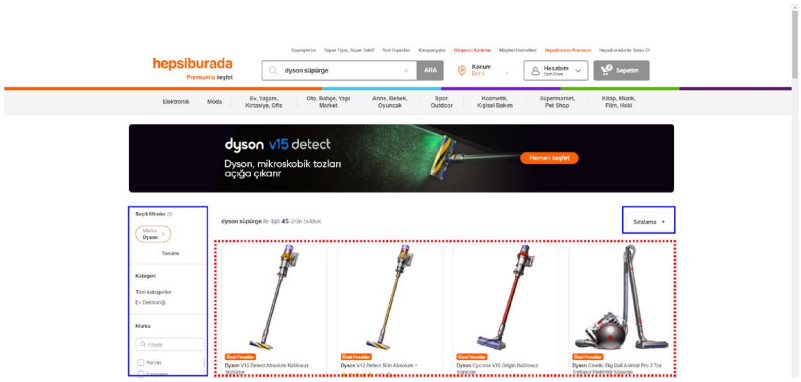
Overall Visual Accessibility Performance of Primary Interaction Area	**50%**
Overall Accessibility Performance of Secondary Interaction Area	**100%**
Overall Accessibility Performance of All Interaction Area	**42%**

Page #2 (Search Page):

The user needs to select the targeted product on the page. The area that consists of listed products is considered as primary interaction area. The areas, which helps the user to sort and filter the search results, form the secondary interaction area. Parceling process of the page is demonstrated below.

Figure 3.16

Parceling the Page #2 of Hepsiburada.com to the Interaction Areas[23]



[23] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

At the next page, the user is welcomed by a page which consists of products relating to the one's search. There are 2789 user interface elements which must be assessed on the page. 186 of them are in the primary interaction area and 1539 of them are in the secondary interaction area. Please see the table below for more detailed information.

Table 3.47

Total Number Evaluated Elements on Page #2 of Hepsiburada.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	45	45	96	**186**
Secondary Interaction Area	0	32	1507	**1539**
All Interaction Area	58	466	2265	**2789**

There is only 1 element failing in terms of text size standards. This problem occurs in all interaction area. There are 159 elements which don't conform minimum contrast ratio standards. 132 of them are on primary interaction area and 9 of them are on secondary interaction area. Similar to the problems occurring at the homepage, these contrast-related issues are mostly based on brand color usage on light background.

Line height varies between 1.15 and 1.33 across the page. Since not all the textual content have more than one line, there are only 21 issues related to this topic. 18 of them are evident on primary interaction area and none of them is visible on secondary interaction area. Nevertheless, it must be stated that insufficient line height used at the page can affect the accessibility score of the page if the number of the text boxes, which have more than one-line, increases. Letter spacing is the same as the homepage. It is 0.17em. Therefore, there is no detected problem considering the letter spacing across the page. There are 4

elements failing to conform line height criteria. No issue is detected in regard to text justification. All of them are evident on all interaction area. Please see the tables below for more detailed information.

Table 3.48

Visual Accessibility Evaluation of Primary Interaction Area of Page #2 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	132
Total Number of Elements Not Conforming Line Height Standards	18
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**150**

Table 3.49

Visual Accessibility Evaluation of Secondary Interaction Area of Page #2 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	9
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**9**

Table 3.50

Visual Accessibility Evaluation of All Interaction Area of Page #2 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	1
Total Number of Elements Not Conforming Contrast Standards	159
Total Number of Elements Not Conforming Line Height Standards	21
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**181**

When all elements in the page are considered, its overall visual accessibility performance is 94% whereas its basic accessibility score is slightly higher (0.7%). Since the data is presented as whole number in this section, this tenuous change is not visible on the tables. For the secondary interaction area, basic and overall visual accessibility score is same. It is 99%. This score is remarkably high. Especially filtering bar is designed with an approach considering accessibility. On the other hand, the page performs poorly at the primary interaction area because most accessibility problems occur on this area. Primary interaction area's overall visual accessibility score is 19% and its basic visual accessibility score is 29. This area is the most significant interaction area because it consists of products that the user is looking for. There are lots of text which does not meet both contrast ratio and line height standards on all interaction area. Please see the tables below for more detailed information.

Table 3.51

Basic Visual Accessibility Performance of Page #2 of Hepsiburada.com

Basic Visual Accessibility Performance of Primary Interaction Area	**29%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**99%**

Basic Visual Accessibility Performance of All Interaction Area	**94%**

Table 3.52

Overall Visual Accessibility Performance of Page #2 of Hepsiburada.com

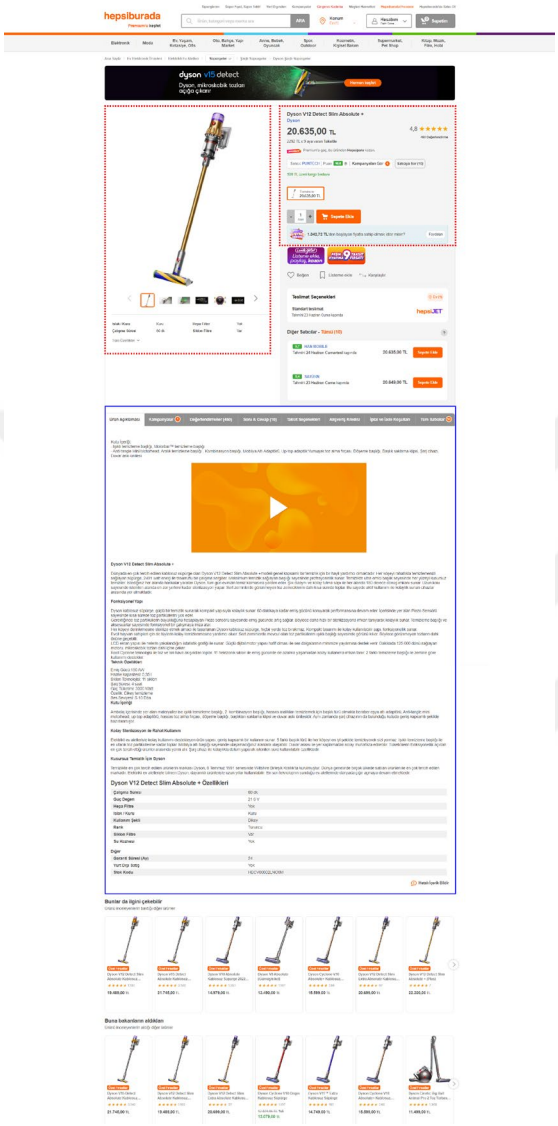
Overall Visual Accessibility Performance of Primary Interaction Area	**19%**
Overall Accessibility Performance of Secondary Interaction Area	**99%**
Overall Accessibility Performance of All Interaction Area	**94%**

Page #3 (Product Page):

The page is parceled based on the following information. At this stage, the task of the user is to look at the product images, check the name of the product, get a quick information about the seller, learn about the rating of the product, and review the highlighted features of the product before adding the item to cart. The area providing this information to the user is considered as primary interaction area. Secondary interaction area consists of user comments, questions and answers and the detailed product information sections. Parceling process of the page is demonstrated below.

Figure 3.17

Parceling the Page #3 of Hepsiburada.com to the Interaction Areas[24]



[24] Red dotted lines are for primary interaction areas and the blue continuous line is for secondary interaction area.

At the third stage of the customer journey, the user encounters the product page. There are 3008 user interface elements which must be assessed on the product page. 46 of them are in the primary interaction area and 1378 of them are in the secondary interaction area. Please see the table below for more detailed information.

Table 3.53

Total Number Evaluated Elements on Page #3 of Hepsiburada.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	1	29	16	**46**
Secondary Interaction Area	27	122	1229	**1378**
All Interaction Area	113	624	2187	**3008**

There are 2 elements which fail in terms of text size standards. Both are located on all interaction area. There are 1012 elements which don't conform minimum contrast ratio standards. 15 of them are on primary interaction area and 822 of them are on secondary interaction area.

When Level AAA accessibility standards are considered, the page's performance is not sufficient. Line height ranges from 1.2 to 1.5 throughout the page. There are 75 problems regarding line height. 6 of them occurs in secondary interaction area. There are lots of textual content which have more than one line on the secondary interaction area, but they conform the standards since the line height is 1.5 times bigger than the font size. Nevertheless, paragraphs which are on "product description" section have 1.2 line height which is not sufficient to comply with the latest WCAG standards in terms of

perceivability. It must also be noted that textual content which only have one line are not considered as problematic. It shows that the number of problems is prone to increase when longer text is used. 17 line length problems are detected on the page. All of them occur on the secondary interaction area. There is no problem concerning text justification. These issues are visible on all areas. They also have accessibility problems related to line height. This situation is considered, and the number of these problems are deducted from the end result to avoid any duplication in order to reach a more reliable result. Please see the tables below for more detailed information.

Table 3.54

Visual Accessibility Evaluation of Primary Interaction Area of Page #3 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	15
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**15**

Table 3.55

Visual Accessibility Evaluation of Secondary Interaction Area of Page #3 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	822
Total Number of Elements Not Conforming Line Height Standards	6
Total Number of Elements Not Conforming Letter Spacing Standards	0

Total Number of Elements Not Conforming Line Length Size Standards	17
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**845**

Table 3.56

Visual Accessibility Evaluation of All Interaction Area of Page #3 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	2
Total Number of Elements Not Conforming Contrast Standards	1012
Total Number of Elements Not Conforming Line Height Standards	75
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	17
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	6
Total Number of Elements Not Conforming the Standards	**1100**

When all interaction area is considered, basic visual accessibility score of the page is 67%. For overall visual accessibility performance, this area's score drops from 67% to 67%. The page's performance for the primary interaction area is disappointing. It gets a score of 67% for both basic and overall visual accessibility performance. The situation is much worse for the secondary interaction area because overall visual accessibility score of this area is 39%. Its basic visual accessibility score is slightly higher: 40%.

Unlike Trendyol.com, Hepsiburada.com doesn't provide a product information section which uses producer's style. Instead, a simple text is provided to the user. However, it impacts the page's accessibility performance negatively since the usage of insufficient line height and very long line length.

Some sections have the potential to decrease the accessibility performance of the page because of wrong usage of WCAG standards. These are “product information”, “shopping credit”, “user review” and “question and answers” sections. “User review” section previews only 10 reviews, and “question and answers” section has 10 user interface elements as preview. Not showing all comments and questions helps the page to get a better visual accessibility score because these areas generally fail when line length standards are considered. Please see the tables below for more detailed information.

Table 3.57

Basic Visual Accessibility Performance of Page #3 of Hepsiburada.com

Basic Visual Accessibility Performance of Primary Interaction Area	**67%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**40%**
Basic Visual Accessibility Performance of All Interaction Area	**66%**

Table 3.58

Overall Visual Accessibility Performance of Page #3 of Hepsiburada.com

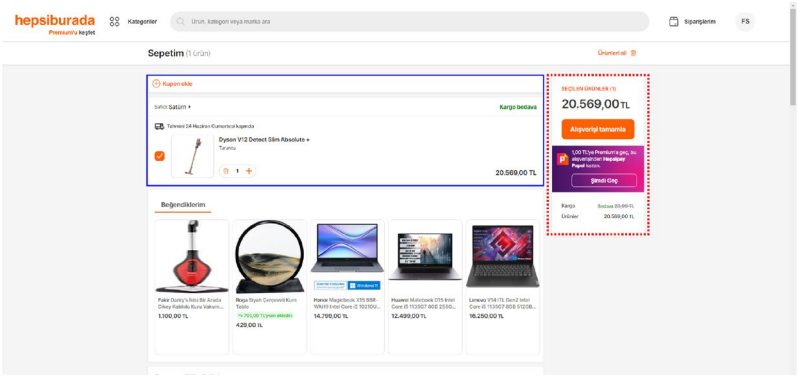
Overall Visual Accessibility Performance of Primary Interaction Area	**67%**
Overall Accessibility Performance of Secondary Interaction Area	**39%**
Overall Accessibility Performance of All Interaction Area	**63%**

Page #4 (Cart Page):

In this phase, the consumer's objective is to navigate to the purchasing page. The page is divided into sections according to this information. The primary interaction area is where the button allowing the user to move on to the next step is located. The secondary interaction area contains the essential details about the item, including its name and price. Parceling process of the page is demonstrated below.

Figure 3.18

Parceling the Page #4 of Hepsiburada.com to the Interaction Areas[25]



The user is guided to a page that displays a preview of the order in the subsequent step of the customer journey. On this page, there are a total of 541 user interface elements that need to be evaluated. Out of these, 54 are header elements, 305 are links. Additionally, there are 182 extra elements that are identified manually. Among these user interface elements, 8 are located in the primary interaction area, while 12 can be found in the secondary interaction area. Please see the table below for more detailed information.

Table 3.59

Total Number Evaluated Elements on Page #4 of Hepsiburada.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	1	7	**8**

[25] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

Secondary Interaction Area	2	1	9	**12**
All Interaction Area	54	305	182	**541**

There is an element which fails in terms of text size standards. The number of elements which don't conform Level AA accessibility standards in terms of contrast is very high. There are 440 elements which don't conform minimum contrast ratio standards. 5 of them are on primary interaction. None of them is visible on secondary interaction area.

Line height is set to 1.15 across the page. That's why all lines having more than one line fail according to Level AAA standards of WCAG 2.1 in this regard. In total, 37 line height problems are detected and one of them is evident on the primary interaction area. There is no issue on the secondary interaction area in terms of line height. Letter spacing is 0.17em throughout the page. This highlights that the webpage performs well in that regard. There is no element failing in terms of line length standards. There is no issue detected related to text justification criterion. Please see the tables below for more detailed information.

Table 3.60

Visual Accessibility Evaluation of Primary Interaction Area of Page #4 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	5
Total Number of Elements Not Conforming Line Height Standards	1
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0

Total Number of Elements Not Conforming the Standards	**6**

Table 3.61

Visual Accessibility Evaluation of Secondary Interaction Area of Page #4 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	0
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**0**

Table 3.62

Visual Accessibility Evaluation of All Interaction Area of Page #4 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	1
Total Number of Elements Not Conforming Contrast Standards	440
Total Number of Elements Not Conforming Line Height Standards	37
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**478**

When taking into account all the elements presented on the page, its basic visual accessibility score is 19%. This score drops to 12% when overall visual accessibility criteria is considered. On the other hand, the secondary interaction area's score is great.

There isn’t any problem on this area which results a score of 100%. The primary interaction area performs poorly as all interaction area. Its score is 38% for basic visual accessibility performance and 25% for overall visual accessibility performance. Please see the tables below for more detailed information.

Table 3.63

Basic Visual Accessibility Performance of Page #4 of Hepsiburada.com

Basic Visual Accessibility Performance of Primary Interaction Area	**38%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**100%**
Basic Visual Accessibility Performance of All Interaction Area	**19%**

Table 3.64

Overall Visual Accessibility Performance of Page #4 of Hepsiburada.com

Overall Visual Accessibility Performance of Primary Interaction Area	**25%**
Overall Accessibility Performance of Secondary Interaction Area	**100%**
Overall Accessibility Performance of All Interaction Area	**12%**

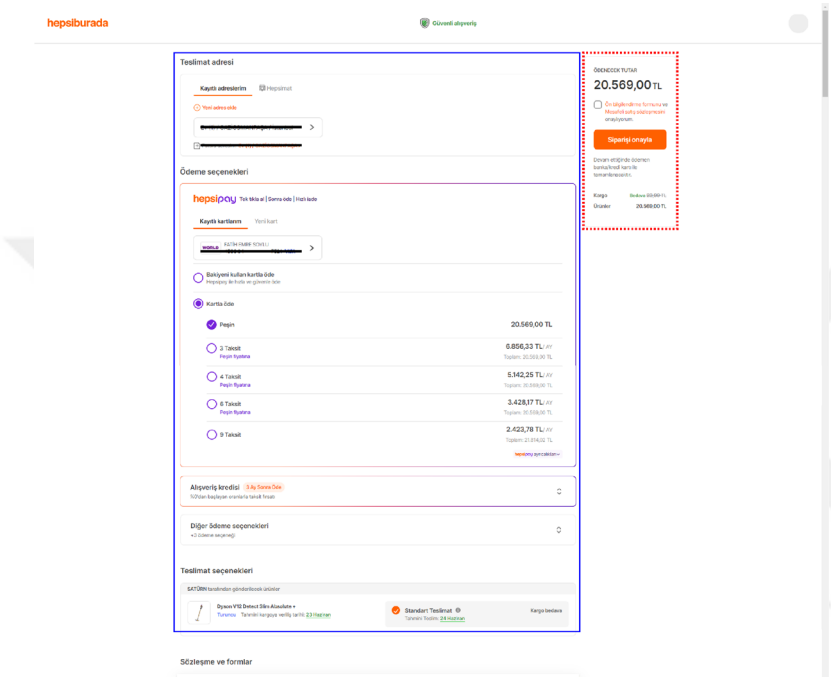
Page #5 (Address and Payment Information Page):

This page is parceled based on the following information. The page consists of address, billing information, and payment information. The task of the user is to review the one’s address, billing, and payment information and complete the purchase. The page is parceled based on this information. That’s why the area having buttons which enable the user to complete the purchase is considered as primary interaction area and the area providing shipping, billing and payment information forms the secondary interaction area. There are other sections which consist of very important information about the legal rights of the customer; however, it is well-known that many users don’t give adequate attention on this information since they are very long to read. That’s why the section is

excluded from primary and secondary interaction areas. Parceling process of the page is demonstrated below.

Figure 3.19

Parceling the Page #5 of Hepsiburada.com to the Interaction Areas[26]



In the final phase of the customer journey, the user is greeted by a page where they are prompted to provide their address and payment information. This page includes a section with two tabs, one for entering address details and the other for entering payment information. As mentioned earlier, since the user is utilizing an existing account in this customer journey, there is no need for them to input new information to complete this stage.

[26] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

In total, there are 421 user interface elements which must be assessed on the page. 19 of them are header elements, 225 are links. There are 177 additional elements which are detected with manual inspection. 10 of total elements are located in the primary interaction area and 53 of them are in the secondary interaction area. Please see the table below for more detailed information.

Table 3.65

Total Number Evaluated Elements on Page #5 of Hepsiburada.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	2	8	**10**
Secondary Interaction Area	6	20	27	**53**
All Interaction Area	19	225	177	**421**

All elements conform text size standards. There are 25 elements which don't conform minimum contrast ratio standards. All of them but 2 are visible on primary or secondary interaction areas. 6 contrast problems occur on primary interaction area and 17 problems occur on secondary interaction area. 1 of them occur on the buttons which is essential to complete the task. This button's background color is the company color and the text color is white. This combination results 3.03:1 contrast ratio. Since the font size is below 14 points, contrast ratio which is below 4.5:1 is insufficient to comply with the standards.

Line height is set to 1.5. That's why the page performs well in that aspect. The section related to legal agreements and forms brings line length problems. There are 84 line length failures which are visible on the section. Letter spacing varies from 0.17em to 0.32em on

the page. This usage is enough to comply with the standards of WCAG 2.1. Please see the tables below for more detailed information.

Table 3.66

Visual Accessibility Evaluation of Primary Interaction Area of Page #5 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	6
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**6**

Table 3.67

Visual Accessibility Evaluation of Secondary Interaction Area of Page #5 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	17
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**17**

Table 3.68

Visual Accessibility Evaluation of All Interaction Area of Page #5 of Hepsiburada.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	2
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	0
Total Number of Elements Not Conforming Line Length Size Standards	84
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**86**

Primary interaction area's score for visual accessibility is 40%. The visual accessibility score of the secondary area is 68%. These values are same for both basic and overall visual accessibility evaluation since all problems visible on these interactions areas are contrast related issues. The page's basic visual accessibility score is 99% while it gets a score of 80% for overall visual accessibility performance when all interaction area is considered. The reason of this difference is that there are lots of textual content which don't comply with WCAG 2.1's line length standards. Please see the tables below for more detailed information.

Table 3.69

Basic Visual Accessibility Performance of Page #5 of Hepsiburada.com

Basic Visual Accessibility Performance of Primary Interaction Area	**40%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**68%**
Basic Visual Accessibility Performance of All Interaction Area	**99%**

Table 3.70

Overall Visual Accessibility Performance of Page #5 of Hepsiburada.com

Overall Visual Accessibility Performance of Primary Interaction Area	**40%**
Overall Accessibility Performance of Secondary Interaction Area	**68%**
Overall Accessibility Performance of All Interaction Area	**80%**

All Pages

Hepsiburada.com is assessed with a comprehensive evaluation of a total of 10947 user elements. Among these, 252 are found in primary interaction areas, while 3359 are located in secondary interaction areas across the pages. The evaluation also identifies a total of 3785 visual accessibility issues related to contrast and text size. Of these, 159 occurs in primary interaction areas, while 848 are detected in secondary interaction areas. Please see the tables below for more detailed information.

Table 3.71

Basic Visual Accessibility Evaluation on Interaction Areas of All Pages of Hepsiburada.com

Total Number of Elements Not Conforming Text Size and Contrast Standards for Primary Interaction Area	**159**
Total Number of Elements Not Conforming Text Size and Contrast Standards for Secondary Interaction Area	**848**
Total Number of Elements Not Conforming Text Size and Contrast Standards for All Interaction Area	**3785**
Total Number of Evaluated Elements on Primary Interaction Area	**252**
Total Number of Evaluated Elements on Secondary Interaction Area	**3359**

Total Number of Evaluated Elements on All Interaction Area	**10947**

Table 3.72

Basic Visual Accessibility Performance of All Pages of Hepsiburada.com

Basic Visual Accessibility Performance of Primary Interaction Area	**37%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**75%**
Basic Visual Accessibility Performance of All Interaction Area	**65%**

The total number of user elements which is evaluated is 10947 for Trendyol.com. 252 of them belong to primary interaction areas and 3359 of them are located on secondary interaction areas across the pages. There are 4275 visual accessibility issues in total. 178 of them occurs on primary interaction areas and 871 of them are detected on secondary interaction areas. Please see the tables below for more detailed information.

Table 3.73

Overall Visual Accessibility Evaluation on Interaction Areas of All Pages of Hepsiburada.com

Total Number of Elements Not Conforming the Standards for Primary Interaction Area	**178**
Total Number of Elements Not Conforming the Standards for Secondary Interaction Area	**871**
Total Number of Elements Not Conforming the Standards for All Interaction Area	**4278**
Total Number of Evaluated Elements on Primary Interaction Area	**252**
Total Number of Evaluated Elements on Secondary Interaction Area	**3359**

Total Number of Evaluated Elements on All Interaction Area	**10947**

Table 3.74

Overall Visual Accessibility Performance for Each Interaction Area on All Pages of Hepsiburada.com

Overall Visual Accessibility Performance of Primary Interaction Area	**29%**
Overall Accessibility Performance of Secondary Interaction Area	**74%**
Overall Accessibility Performance of All Interaction Area	**61%**

Visual Accessibility Performance of Each Interaction Area of All Pages Which Are Encountered During Customer Journey for Hepsiburada.com:

Figure 3.20

Basic Visual Accessibility Performance for Each Interaction Area of Encountered Pages of Hepsiburada.com

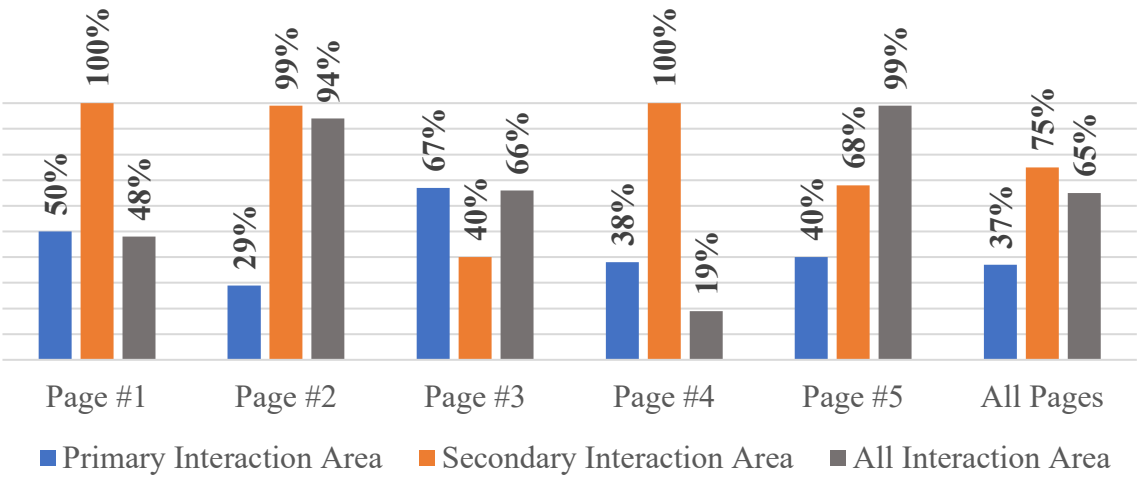
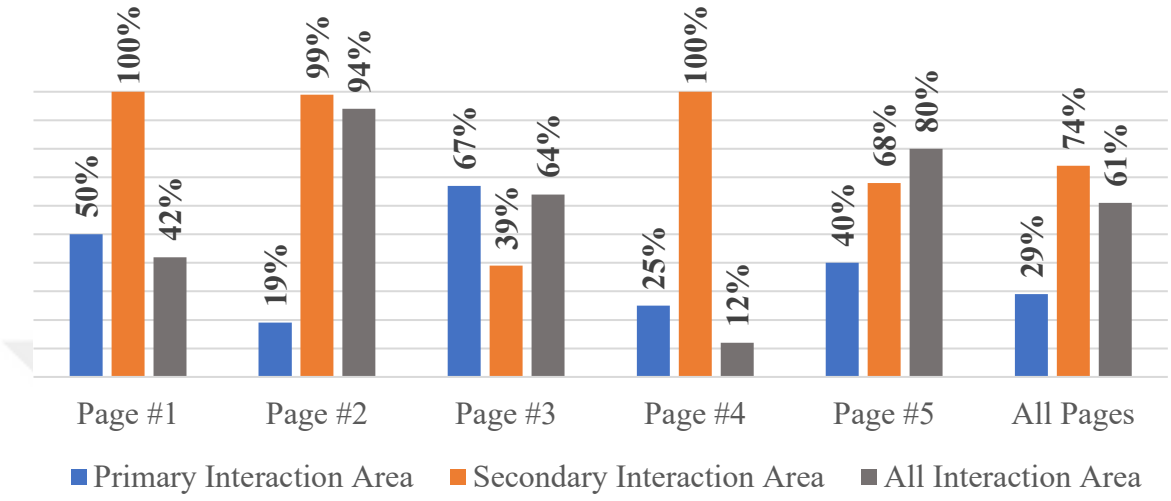


Figure 3.21

Overall Visual Accessibility Performance for Each Interaction Area of Encountered Pages of Hepsiburada.com



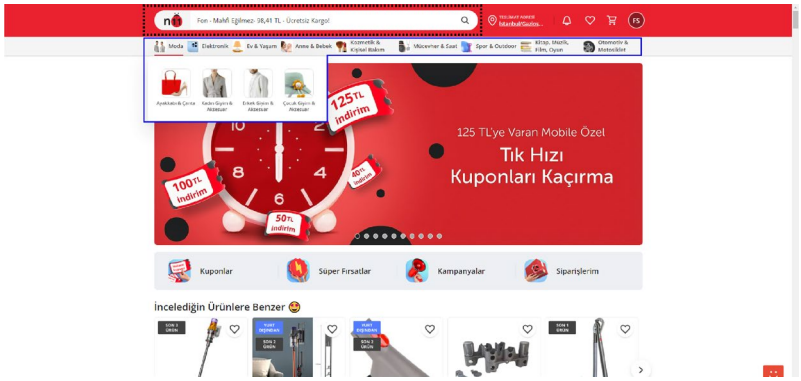
3.4.3 Findings for N11.com

Page #1 (Homepage):

In this phase, the user's objective is to enter the product name in the search bar. This is why the area containing the search bar is designated as the primary interaction area in this phase. The secondary interaction area is represented by the dropdown menu located on the navigation bar, as it assists the user in locating the desired product. Parceling process of the page is demonstrated below.

Figure 3.22

Parceling the Page #1 of N11.com to the Interaction Areas[27]



During this stage of the customer journey, the user arrives at the website's homepage. The page consists of a grand total of 2527 user interface elements that require assessment. Out of these, 2 elements are positioned within the primary interaction area, while 90 elements can be found in the secondary interaction area. see the table below for more detailed information.

Table 3.75

Total Number Evaluated Elements on Page #1 of N11.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	2	0	**2**
Secondary Interaction Area	0	90	0	**90**

[27] Black dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

All Interaction Area	82	543	1902	**2527**

There isn't any element which doesn't conform text size standards. There are 864 elements which fail minimum contrast ratio standards. None of them is visible on primary or secondary interaction areas. 119 of them are actually images. In this research, images are disregarded because their contrast ratio can't be evaluated properly. However, these images are used as tags containing color filled backgrounds and textual content on these backgrounds. These are also evaluated because of their having non-decorative purposes. These tags inform the user that the product that they are attached are products with coupons. These elements' contrast ratio is 4.4:1. This ratio is just below the threshold which is 4.5:1 for small text. These problems occur because of the usage of company color (it is red in this case) as background color behind white-colored text. Also, user interface elements showing the ratings of products are filled with yellow and grey colors which results very insufficient contrast ratio with white background, 1.61:1 and 1.32:1 respectively. There are other element types for contrast ratio related problems. These are also tags saying "free shipping" and "on the cart…". Their contrast ratios with white-colored backgrounds are 2.52:1 and 3.8:1 respectively.

For the attributes relating to Level AAA accessibility, the performance of the page is very poor because of the letter spacing. Text is condensed to a degree which is between 0.07px to 0.2px. The exact value in terms of "em" values caries depending on the text size, however it is not important since it is "em" value is negative. As default, line height is set to 1.5 times bigger than the text. That's adequate to comply with WCAG 2.1. There is no element which doesn't conform text justification standards and there is an element failing to conform line length standards. Please see the tables below for more detailed information.

Table 3.76

Visual Accessibility Evaluation of Primary Interaction Area of Page #1 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	0
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	1
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**1**

Table 3.77

Visual Accessibility Evaluation of Secondary Interaction Area of Page #1 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	0
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	90
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	0
Total Number of Elements Not Conforming the Standards	**90**

Table 3.78

Visual Accessibility Evaluation of All Interaction Area of Page #1 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	864
Total Number of Elements Not Conforming Line Height Standards	257

Total Number of Elements Not Conforming Letter Spacing Standards	1714
Total Number of Elements Not Conforming Line Length Size Standards	1
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	526
Total Number of Elements Not Conforming the Standards	**2310**

When all elements in the page are considered, the page's overall visual accessibility score is 9%. The page scores 0% for the secondary interaction area in terms of overall visual accessibility criteria. The page's performance for the primary interaction area is better in that regard. This area consists of two user interface elements. One of them is a search box and ant the other is an icon. Icon's contrast ratio is not adequate to meet the criteria. That's why this area's overall visual accessibility score is 50%. On the contrary, the page's visual accessibility performance regarding basic visual accessibility criteria is significantly higher. Primary interaction area gets a score of 100% by doubling its performance for overall visual accessibility. Secondary interaction area's performance increases to 100% from 0% when only contrast ratio and text size criteria are taken into account. All interaction area's performance also increases significantly for basic visual accessibility performance. The area gets a score of 66%. Please see the tables below for more detailed information.

Table 3.79

Basic Visual Accessibility Performance of Page #1 of N11.com

Basic Visual Accessibility Performance of Primary Interaction Area	**100%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**100%**
Basic Visual Accessibility Performance of All Interaction Area	**66%**

Table 3.80

Overall Visual Accessibility Performance of Page #1 of N11.com

Overall Visual Accessibility Performance of Primary Interaction Area	**50%**

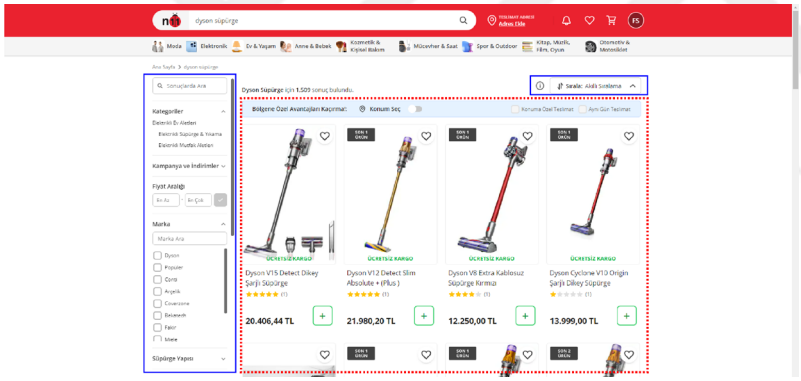
Overall Accessibility Performance of Secondary Interaction Area	**0%**
Overall Accessibility Performance of All Interaction Area	**9%**

Page #2 (Search Page):

The user is required to choose the desired product from the webpage. The main section containing the listed products is referred to as the primary interaction area. The sections that assist the user in organizing and refining the search results make up the secondary interaction area. Parceling process of the page is demonstrated below.

Figure 3.23

Parceling the Page #2 of N11.com to the Interaction Areas[28]



At the next step during customer journey, the user encounters a page which consists of products relating to the one's search. There are 755 user interface elements which must be assessed on the page. 182 of them are in the primary interaction area and 161 of them are in the secondary interaction area. Please see the table below for more detailed information.

[28] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

Table 3.81

Total Number Evaluated Elements on Page #2 of N11.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	24	24	134	**182**
Secondary Interaction Area	15	6	140	**161**
All Interaction Area	52	360	343	**755**

4 elements don't comply with text size criteria. Their sizes are 7.5 points. All of them on the primary interaction area. These problems occur alongside contrast ratio issues on the same elements. These elements are the tags saying "reklam" which means "advertising" in English. There 75 are elements which fail in terms of contrast ratio standards. 52 of them are visible on primary interaction area. These problems are mostly related to the elements showing the ratings of the products and the additional information tags. 16 low contrast issues occur on secondary interaction area. On the other hand, not all tags are problematic. The ones implying "Son 1 Ürün", which means "Last 1 Product" in English, are filled with a dark gray color. The usage of this color with white text results a 10.04:1 contrast ratio.

For the attributes relating to Level AAA accessibility, the performance of the page is very insufficient. Text is condensed across the page. That's why all elements which consists of textual content fails for latest WCAG's Level AAA standards in regard to letter spacing. There are 405 letter spacing problems across the page. 139 of them are visible on primary interaction area and 114 of them are evident on secondary interaction area. Some of these elements fails at contrast ratio criteria. That's why the results are achieved

by considering this situation to avoid any duplication related mistakes. As default, line height is set to 1.5 times bigger than the text. This usage is sufficient to comply with WCAG 2.1. There is no element which doesn't conform text justification and line length standards. Please see the tables below for more detailed information.

Table 3.82

Visual Accessibility Evaluation of Primary Interaction Area of Page #2 of N11.com

Total Number of Elements Not Conforming Text Size Standards	4
Total Number of Elements Not Conforming Contrast Standards	52
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	139
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	110
Total Number of Elements Not Conforming the Standards	**85**

Table 3.83

Visual Accessibility Evaluation of Secondary Interaction Area of Page #2 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	16
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	114
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	4
Total Number of Elements Not Conforming the Standards	**126**

Table 3.84

Visual Accessibility Evaluation of All Interaction Area of Page #2 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	75
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	405
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	120
Total Number of Elements Not Conforming the Standards	**330**

Taking into account all the interaction areas, the page has a basic visual accessibility score of 90%. However, when considering the overall visual accessibility performance, the score drops to 56% due to the excessive amount of user interface elements failing to meet letter spacing criteria. The primary interaction area of the page receives a score of 71% for basic visual accessibility performance. This area's overall visual accessibility score is 53%. The performance of secondary interaction area is even lower as it has an overall visual accessibility score of 22%. Although its basic visual accessibility score is significantly higher at 90%. Please see the tables below for more detailed information.

Table 3.85

Basic Visual Accessibility Performance of Page #2 of N11.com

Basic Visual Accessibility Performance of Primary Interaction Area	**71%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**90%**
Basic Visual Accessibility Performance of All Interaction Area	**90%**

Table 3.86

Overall Visual Accessibility Performance of Page #2 of N11.com

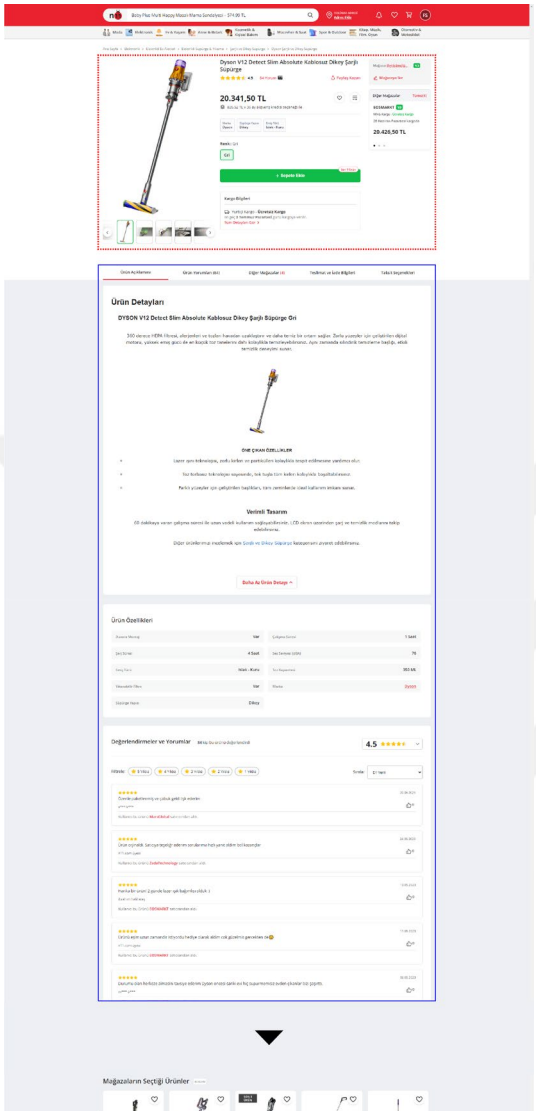
Overall Visual Accessibility Performance of Primary Interaction Area	**53%**
Overall Accessibility Performance of Secondary Interaction Area	**22%**
Overall Accessibility Performance of All Interaction Area	**56%**

Page #3 (Product Page):

The researcher parcels the page based on the following information. In this page, the main task of the user is to look at the product images, check the name of the product, get a quick information about the seller, learn about the rating of the product, and review the highlighted features of the product before adding the item to cart. The area providing this information to the user is considered as primary interaction area. Secondary interaction area consists of user comments, questions and answers and the detailed product information sections. Parceling process of the page is demonstrated below.

Figure 3.24

Parceling the Page #3 of N11.com to the Interaction Areas[29]



At the third stage of the customer journey, the user encounters the product page. There are 1524 user interface elements which must be assessed on the page. 43 of them are in the primary interaction area and 609 of them are in the secondary interaction area. Please see the table below for more detailed information.

[29] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

Table 3.87

Total Number Evaluated Elements on Page #3 of N11.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	1	20	22	**43**
Secondary Interaction Area	16	40	553	**609**
All Interaction Area	117	612	795	**1524**

There are 92 elements which fails in terms of text size standards. 32 of them is visible on secondary interaction area, one of them occur in the primary interaction area and the other one is located on all interaction area. There are 222 elements which don't comply with minimum contrast ratio standards across the page. 12 of them are on primary interaction area and 170 of them are on secondary interaction area. Low contrast ratio problems occur because of the similar reasons on the previous pages. It means that brand color usage, star icons' colors and light green text usage on the white background are the main reasons behind these issues.

It is found that the line height is set to 1.5 times higher than the font size when CSS attributes of the page are investigated. At the product description section, the value of it increases to 1.6. It means that there isn't any issue in regard to line height. On the other hand, the main problem is the letter spacing, similar to previous pages. Throughout the page, 606 problems detected in that regard. Some of the lines have a line height as low as the text height. 37 of them occurs on primary interaction area and 219 letter spacing problems are detected on secondary interaction area. There are 13 user interface elements which don't conform line height standards. All of them occur on secondary interaction

area. No text justification problems are detected on the page. Please see the tables below for more detailed information.

Table 3.88

Visual Accessibility Evaluation of Primary Interaction Area of Page #3 of N11.com

Total Number of Elements Not Conforming Text Size Standards	1
Total Number of Elements Not Conforming Contrast Standards	12
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	37
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	13
Total Number of Elements Not Conforming the Standards	**37**

Table 3.89

Visual Accessibility Evaluation of Secondary Interaction Area of Page #3 of N11.com

Total Number of Elements Not Conforming Text Size Standards	32
Total Number of Elements Not Conforming Contrast Standards	170
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	219
Total Number of Elements Not Conforming Line Length Size Standards	13
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	93
Total Number of Elements Not Conforming the Standards	**351**

Table 3.90

Visual Accessibility Evaluation of All Interaction Area of Page #3 of N11.com

Total Number of Elements Not Conforming Text Size Standards	34
Total Number of Elements Not Conforming Contrast Standards	222
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	606
Total Number of Elements Not Conforming Line Length Size Standards	13
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	97
Total Number of Elements Not Conforming the Standards	**778**

The page's basic visual accessibility performance overall visual accessibility score is 49% for all interaction area. The value increases to 85% when basic visual accessibility performance is considered. The overall visual accessibility performance of the page for primary interaction area is 14%. This score raises to 72% when only contrast ratio and text size issues are considered. Secondary interaction area gets a score of 42% when overall visual accessibility performance is taken into account. However, this area's basic visual accessibility performance is also significantly higher, similar to primary interaction area, with a score of 72%. Please see the tables below for more detailed information.

Table 3.91

Basic Visual Accessibility Performance of Page #3 of N11.com

Basic Visual Accessibility Performance of Primary Interaction Area	**72%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**72%**
Basic Visual Accessibility Performance of All Interaction Area	**85%**

Table 3.92

Overall Visual Accessibility Performance of Page #3 of N11.com

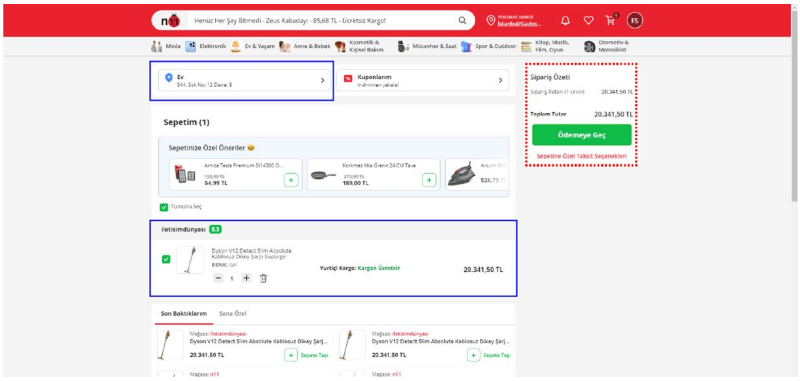
Overall Visual Accessibility Performance of Primary Interaction Area	**14%**
Overall Accessibility Performance of Secondary Interaction Area	**42%**
Overall Accessibility Performance of All Interaction Area	**49%**

Page #4 (Cart Page):

In this phase, the user's objective is to check address information and total amount of the order before heading to payment page. The page is divided into sections according to this information. The primary interaction area is where the button allowing the user to move on to the next step and information about order summary content are located. The secondary interaction area contains the essential details about the item, including its name and price. It also contains the preview of shipping address information. Parceling process of the page is demonstrated below.

Figure 3.25

Parceling the Page #4 of N11.com to the Interaction Areas[30]



On this page, there are a total of 541 user interface elements that need to be evaluated. Out of these, 54 are header elements, 305 are links. Additionally, there are 182 extra elements that are identified manually. Among these user interface elements, 8 are located in the primary interaction area, while 12 can be found in the secondary interaction area. Please see the table below for more detailed information.

Table 3.93

Total Number Evaluated Elements on Page #4 of N11.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	1	2	4	**7**
Secondary Interaction Area	0	1	12	**13**

[30] Red dotted line is for primary interaction area and the blue continuous lines are for secondary interaction area.

All Interaction Area	48	345	42	**415**

There are 1 element which fails in terms of text size standards. It is on all interaction area. The number of elements which don't conform Level AA accessibility standards in terms of contrast is 28. 2 of them is located on primary interaction area and 2 of them are visible on secondary interaction area.

Line height is set to 1.5 across the page. That's why no accessibility issue is detected in this regard. Letter spacing is similar as previous pages. This reveals that the webpage performs well in that regard. There is no element failing in terms of text length standards. 4 elements don't comply with the standards in regard to text justification. Fortunately, none of them is located on primary or secondary interaction areas. Please see the tables below for more detailed information.

Table 3.94

Visual Accessibility Evaluation of Primary Interaction Area of Page #4 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	2
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	7
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	2
Total Number of Elements Not Conforming the Standards	**7**

Table 3.95

Visual Accessibility Evaluation of Secondary Interaction Area of Page #4 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	2
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	7
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	3
Total Number of Elements Not Conforming the Standards	**6**

Table 3.96

Visual Accessibility Evaluation of All Interaction Area of Page #4 of N11.com

Total Number of Elements Not Conforming Text Size Standards	1
Total Number of Elements Not Conforming Contrast Standards	22
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	184
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	22
Total Number of Elements Not Conforming the Standards	**185**

Considering all the elements on the page, visual accessibility score amounts to 55% according to overall visual accessibility standards. When contrast ratio and text size criteria are solely considered the score increases to 95%. Overall visual accessibility score of secondary interaction area is 54% whereas it gets a score of 85% in terms of basic visual accessibility criteria. All elements on the primary interaction area fail at either at contrast ratio or letter spacing criteria. This results a score of 0% for overall visual

accessibility performance and 71% for basic visual accessibility performance. Please see the tables below for more detailed information.

Table 3.97

Basic Visual Accessibility Performance of Page #4 of N11.com

Basic Visual Accessibility Performance of Primary Interaction Area	**71%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**85%**
Basic Visual Accessibility Performance of All Interaction Area	**95%**

Table 3.98

Overall Visual Accessibility Performance of Page #4 of N11.com

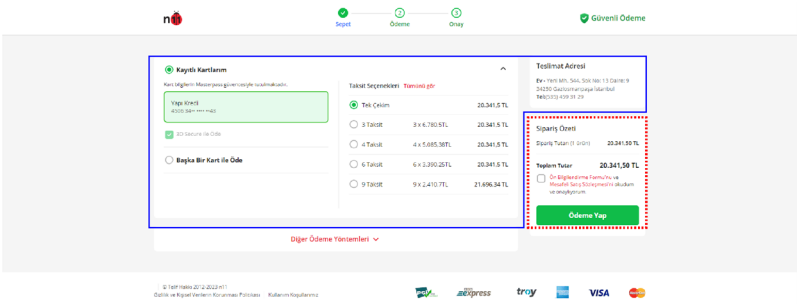
Overall Visual Accessibility Performance of Primary Interaction Area	**0%**
Overall Accessibility Performance of Secondary Interaction Area	**54%**
Overall Accessibility Performance of All Interaction Area	**55%**

Page #5 (Payment Information Page):

This page is divided into different sections based on the provided information. The sections include the address, billing information, and payment information. The user's task is to review the delivery address, payment information and order summary in order to complete the purchase. Alongside the order summary, primary interaction area of the page contains a button that allows the user to finalize the purchase. Secondary interaction area provides payment information. Important forms and contracts are presented with two additional links. Hence, they are not directly located on the page. As mentioned previously, these aren’t considered within primary and secondary interaction areas. This situation results a lack of interaction between them and the user. Based on those reasons, they are not evaluated separately. Parceling process of the page is demonstrated below.

Figure 3.26

Parceling the Page #5 of N11.com to the Interaction Areas[31]



At the last stage of the customer journey, a page asking for payment choices welcomes the user. The user uses an existed account in this part of customer journey. That's why the one doesn't need to input new information to complete this stage. The one needs to choose among the installment options and click the big green button to complete the entire journey.

There is a total of 89 user interface elements that need to be evaluated on the page. Out of these, 8 are header elements and 49 are links. Additionally, 32 elements are identified with manual inspection. Among the total elements, 31 are situated in the primary interaction area, while 9 of them are found in the secondary interaction area. Please see the table below for more detailed information.

[31] Red dotted line is for primary interaction area and the blue continuous line is for secondary interaction area.

Table 3.99

Total Number Evaluated Elements on Page #5 of N11.com

	Total Number of Header Elements	Total Number of Links	Total Number of Additional Elements	Total Number of Evaluated Elements
Primary Interaction Area	0	3	6	**9**
Secondary Interaction Area	1	9	21	**31**
All Interaction Area	8	49	32	**89**

All elements conform text size standards. There are 12 contrast ratio problems on the page. Most of them are not visible on primary or secondary interaction areas. One of them is present on the secondary interaction area and 3 of them are on primary interaction area. One of the problems occur on the most important element on the page. The button enabling user to complete the text has a contrast ratio of 2.5:1 between its textual content and background.

It is revealed that the line height is set to 1.5 the page after the inspecting the CSS attributes of the page with the Google Chrome Developer Tool. Therefore, the page performs well in this regard. On the other hand, the letter spacing couldn't be detected, however, there is no proof that implies that the page uses a different type of letter spacing usage. That's why, all text is considered as problematic n that aspect. There are 36 letter spacing issues on the page. 7 of these problems occur on primary interaction area and 26 of them are located on secondary interaction area. There is no problem related to text justification or line length criteria on the page. Please see the tables below for more detailed information.

Table 3.100

Visual Accessibility Evaluation of Primary Interaction Area of Page #5 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	3
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	7
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	3
Total Number of Elements Not Conforming the Standards	**7**

Table 3.101

Visual Accessibility Evaluation of Secondary Interaction Area of Page #5 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	2
Total Number of Elements Not Conforming Line Height Standards	0
Total Number of Elements Not Conforming Letter Spacing Standards	26
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	3
Total Number of Elements Not Conforming the Standards	**25**

Table 3.102

Visual Accessibility Evaluation of All Interaction Area of Page #5 of N11.com

Total Number of Elements Not Conforming Text Size Standards	0
Total Number of Elements Not Conforming Contrast Standards	12
Total Number of Elements Not Conforming Line Height Standards	0

Total Number of Elements Not Conforming Letter Spacing Standards	36
Total Number of Elements Not Conforming Line Length Size Standards	0
Total Number of Elements Not Conforming Text Justification Standards	0
Duplicated Problems	8
Total Number of Elements Not Conforming the Standards	**40**

Taking into account all the elements present on the page, the visual accessibility score stands at 55% according to the criteria for overall visual accessibility. However, when considering only the criteria of contrast ratio and text size, the score remarkably improves to 87%. In terms of overall visual accessibility, the secondary interaction area of the page achieves a score of 19%, while it obtains a score of 94% for basic visual accessibility criteria. Primary interaction area gets a score of 22% for overall visual accessibility performance and 67% for basic visual accessibility performance. Please see the tables below for more detailed information.

Table 3.103

Basic Visual Accessibility Performance of Page #4 of N11.com

Basic Visual Accessibility Performance of Primary Interaction Area	**67%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**94%**
Basic Visual Accessibility Performance of All Interaction Area	**87%**

Table 3.104

Overall Visual Accessibility Performance of Page #4 of N11.com

Overall Visual Accessibility Performance of Primary Interaction Area	**22%**
Overall Accessibility Performance of Secondary Interaction Area	**19%**
Overall Accessibility Performance of All Interaction Area	**55%**

All Pages

The total number of user elements which is evaluated is 5310 for N11.com. 243 of them belong to primary interaction areas and 904 of them are located on secondary interaction areas across the pages. There are 1162 contrast and text size related visual accessibility issues in total. 65 of them occurs on primary interaction areas and 158 of them are detected on secondary interaction areas. Please see the tables below for more detailed information.

Table 3.105

Basic Visual Accessibility Evaluation on Interaction Areas of All Pages of N11.com

Total Number of Elements Not Conforming Text Size and Contrast Standards for Primary Interaction Area	**65**
Total Number of Elements Not Conforming Text Size and Contrast Standards for Secondary Interaction Area	**158**
Total Number of Elements Not Conforming Text Size and Contrast Standards for All Interaction Area	**1162**
Total Number of Evaluated Elements on Primary Interaction Area	**243**
Total Number of Evaluated Elements on Secondary Interaction Area	**904**
Total Number of Evaluated Elements on All Interaction Area	**5310**

Table 3.106

Basic Visual Accessibility Performance of All Pages of N11.com

Basic Visual Accessibility Performance of Primary Interaction Area	**76%**
Basic Visual Accessibility Performance of Secondary Interaction Area	**83%**

Basic Visual Accessibility Performance of All Interaction Area	**78%**

The total number of user elements which is evaluated is 5310 for Trendyol.com. 243 of them belong to primary interaction areas and 904 of them are located on secondary interaction areas across the pages. There are 3659 visual accessibility issues in total. 243 of them occurs on primary interaction areas and 600 of them are detected on secondary interaction areas. Please see the tables below for more detailed information.

Table 3.107

Overall Visual Accessibility Evaluation on Interaction Areas of All Pages of N11.com

Total Number of Elements Not Conforming the Standards for Primary Interaction Area	**137**
Total Number of Elements Not Conforming the Standards for Secondary Interaction Area	**600**
Total Number of Elements Not Conforming the Standards for All Interaction Area	**3643**
Total Number of Evaluated Elements on Primary Interaction Area	**243**
Total Number of Evaluated Elements on Secondary Interaction Area	**904**
Total Number of Evaluated Elements on All Interaction Area	**5310**

Table 3.108

Overall Visual Accessibility Performance for Each Interaction Area on All Pages of N11.com

Overall Visual Accessibility Performance of Primary Interaction Area	**44%**
Overall Accessibility Performance of Secondary Interaction Area	**34%**

Overall Accessibility Performance of All Interaction Area	**31%**

Visual Accessibility Performance of Each Interaction Area of All Pages Which Are Encountered During Customer Journey for N11.com:

Figure 3.27

Basic Visual Accessibility Performance for Each Interaction Area of Encountered Pages of N11.com

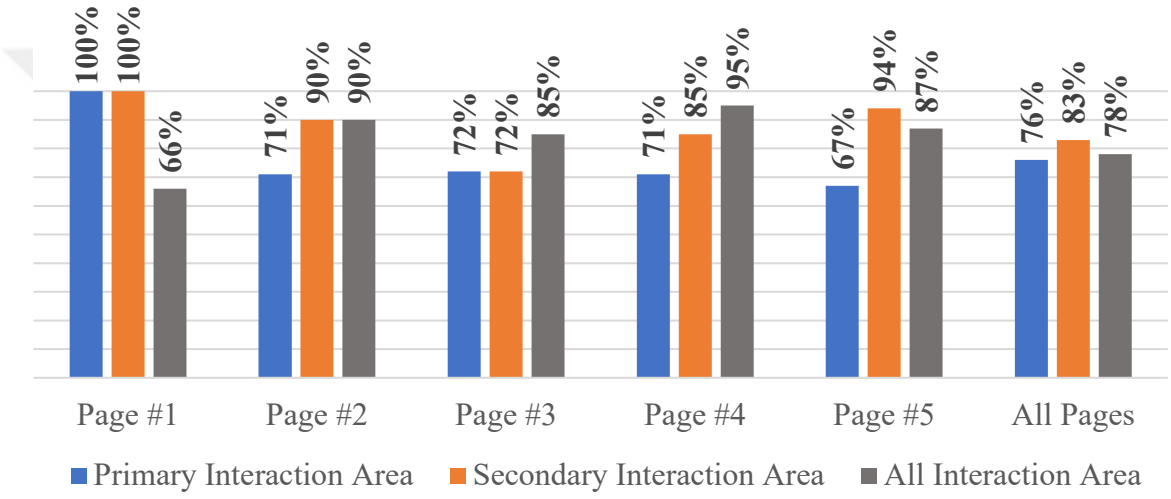
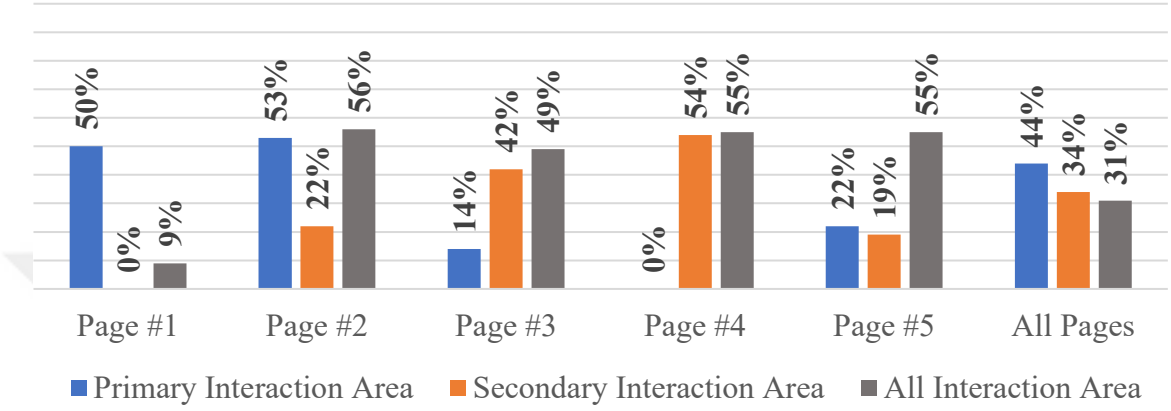


Figure 3.28

Overall Visual Accessibility Performance for Each Interaction Area of Encountered Pages of N11.com



3.5 Evaluation of Findings

In this section data presented at the "Findings" section are first evaluated with a perspective focusing on the prominent failures. The researcher gives information about the visual accessibility problems related to each criterion. Then, pages which are encountered by the user during the customer journey phase are assessed and compared with considering all three interaction areas of evaluated e-commerce platforms. Finally, platforms performances for each interaction area are evaluated and compared. These assessments are made by considering both basic and overall visual accessibility performances.

3.5.1 Evaluation of findings in terms of research criteria

All three websites present many challenges for the users in terms of visual accessibility. There are some important similarities behind visual accessibility issues among these e-commerce platforms. Obtained data from the research is evaluated for each criterion.

Text Size:

According to this research text size criteria, text size must be at least 10 points. The textual contents which have smaller text size than this value is considered as problematic.

All platforms perform very well in that aspect. Hepsiburada.com and N11.com performs exactly the same. Performance of Trendyol.com is slightly lower than its competitors. The reason behind this relatively low performance is that Trendyol.com uses lots of tags which says “Kargo Bedava”. It means “Free Shipping” in English. These user interface elements have very small texts. The website needs to increase the text sizes used for these tags in order to have similar score with other platforms evaluated for this research. This usage impacts Trendyol.com’s overall visual accessibility performance negatively especially on Page #2. This page consists lots of product and these tags are located on these products. The other problematic user interface elements related to this criterion are located mostly on all interaction area. This means that they don’t directly affect the user experience in visual accessibility perspective since the user is less likely to interact with these elements.

Contrast Ratio:

According to this research contrast ratio criteria, contrast ratio must be above 3:1 for big text (bigger than 18 points, or 14 points if bold) and non-decorative visual user interface elements such as icons. For small text (smaller than 18 points, or 14 points if bold),

contrast ratio must be at least 4.5:1[32]. The textual contents which have smaller text size than these values are considered as problematic according to Web Content Accessibility Guidelines 2.1, which is the latest version of the guidelines to this date. This criterion is the most challenging one for all three platforms evaluated in this research. Contrast related problems are mostly involved with traffic lights color or brand color usage. Among all three e-commerce platforms which are investigated, Trendyol.com is the most successful one, followed by N11.com and Hepsiburada.com.

Traffic light color usage refers the usage of green, yellow, and red in order to create a feeling of positivity or negativity for the users. They are also used to grab the attention of the user. However, hues of these color aren't proper to create a sufficient contrast behind the white colored text, especially when the text is smaller than 18 points if regular or 14 points if bold. The situation is not different when the texts are filled with these colors and the background is white.

Brand color usage are also very problematic in terms of contrast ratio with white background in the case of evaluated e-commerce platforms in this research. Trendyol.com's brand color is a hue of orange. This color creates a contrast ratio of 2.77:1 with the background. Hepsiburada.com has also a similar color as primary company color. Its contrast ratio is just above the threshold: 3.03:1. It is sufficient to comply with the standards for non-decorative visual element and big text usage. However, most of the text are considered as small text. This contrast ratio results many visual accessibility problems. N11.com's brand color is red. This color creates a higher contrast. It results a 4.4:1 contrast ratio against white color. However, as in the case of Hepsiburada.com, it only complies with contrast ratio standards of small text and non-decorative visual element usage due to its being lower that 4.5:1. Hepsibuarada.com uses excessive number of tags which uses brand color as background color behind white tags. This results to a lower performance in the aspect of contrast ratio standards of WCAG 2.1 when it is

[32] See Section 3.3.3

compared toother platforms in this research because Trendyol.com and N11.com avoid using company colors for these kinds of tags. These website's using a dark gray color for the most tags used on their pages helps them to achieve a better visual accessibility score in regard to contrast ratio.

The other problems that must be mentioned is related to the search icon located on the search bar. Trendyol.com and Hepsiburada.com use a text or icon for search button resulting an insufficient contrast. This is the reason behind these platforms' having a low visual accessibility score for primary area for the Page #1 (homepage).

Line Height:

Line height must be at least 1.5 times bigger than the text size according to the line height criterion of the research. All three platforms achieve similar scores when line height performance is considered. The differences among these platform's performances are marginal, but Trendyol.com is slightly better than Hepsiburada.com and Hepsiburada.com is slightly better than N11.com.

Even though most of the textual are enough to comply with this research's criteria in regard to text size, there are still considerable number of textual elements failing to comply with WCAG 2.1 criteria in terms of line height. Detailed inspection of CSS attributes of the platforms reveals that there is no standardization for line height. Minimum detected line height is 1 and the maximum detected line height is 2.43 across the evaluated e-commerce platforms. The data presented at "Findings" section may be misleading in that aspect because most of the textual content have single line and these elements are able to conform the criteria just because they have only one line. This situation implies that the websites are prone to perform worse if textual content are used in a format which has at least 2 lines.

Letter Spacing:

Letter spacing must be at least 0.12em according to the letter spacing criterion of this research. It means that the letter spacing must be increased from 100% to 115% for the typeface which is used to conform the standards of this research and WCAG 2.1 in that regard.

Some of the platforms perform perfectly in terms of letter spacing. There is no issue detected in that regard for Trendyol.com and Hepsiburada.com. They use 0.18em and 0.17em letter spacing respectively. These usages are set as default on these e-commerce platforms. This helps these platforms to get a better score for overall visual accessibility performance. On the other hand, when CSS attributes of N11.com's pages are investigated, it becomes obvious that the letter spacing is set below 0em. It means that text is condensed. That's why all textual content fails when this criterion is considered and N11.com gets a score of 45%.

Letter Length:

Line length must not exceed 80 characters (or 40 characters for CJK[33]) according to WCAG 2.1 and the line length criterion of the research.

All platforms perform well and similarly in the aspect of line length criterion. Even if the difference is marginal. N11.com is the most successful e-commerce platform among the others. It is followed by Hepsiburada.com. Trendyol.com is the least successful one among the evaluated platforms when line length standard is considered. Long texts are used mostly for "product description", "legal agreements", "forms" and "contracts" sections. These sections are prone to fail at line length criterion alongside "user review" and "question and answers" sections because none of the platforms use a limit for line length. The lack of a limit results considerable amount of line length related accessibility issues, especially at aforementioned sections.

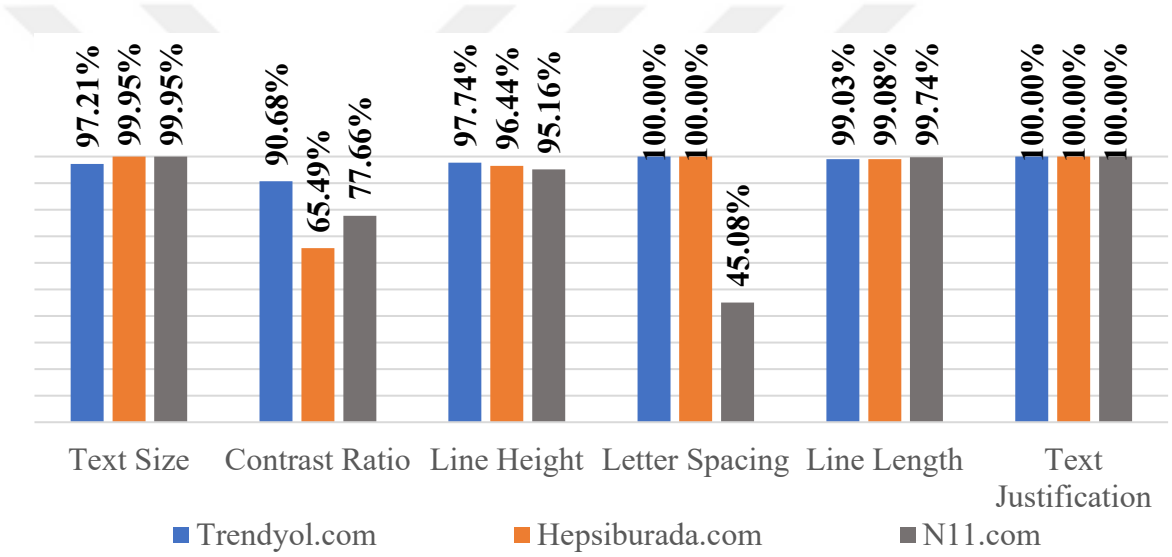
[33] Chinese, Japanese, Korean

Text Justification:

The text must not be justified to comply with this research's standards and WCAG 2.1. All platforms perform perfectly in that regard because no text justification related issue is detected across the pages on all platforms. A chart, which visualizes the performances of each evaluated platform for each research criterion, is presented below.

Figure 3.29

Overall Visual Accessibility Performance of Evaluated E-Commerce Platforms for Each Research Criteria



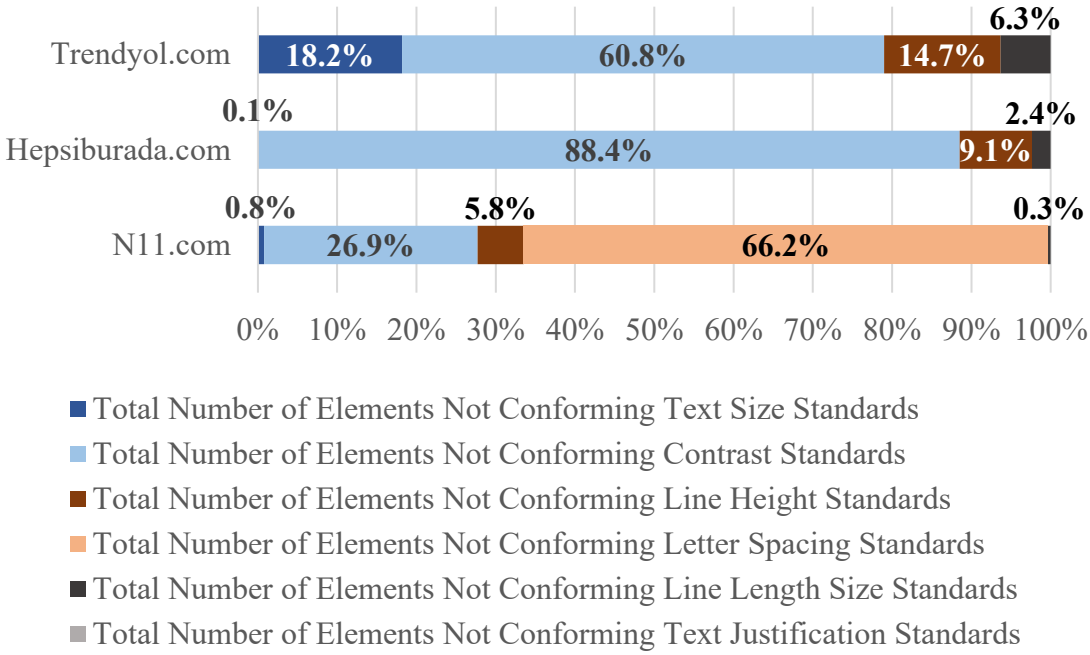
All Criteria:

When overall accessibility performance is considered the performance of the pages are very high if we ignore the letter spacing performance of N11.com. When all criteria are considered, it becomes obvious that most of the problems are related to contrast ratio. This criterion is the most problematic one for Hepsiburada.com and Trendyol.com. On the other hand, N11's accessibility problems mostly based on letter spacing since the platform use condensed text while other two platforms perform perfectly in regard to that criteria due to usage of default settings enabling them to comply with the standards. It is

disappointing because N11.com's performance remarkable for text size, line height, line length and text justification criteria. N11.com also performs better than Hepsiburada.com for contrast ratio criteria. The developers' dismissing this attribute's proper usage in terms of WCAG 2.1 impact its overall score negatively and results platforms falling behind the other evaluated e-commerce platforms in regard to overall visual accessibility performance. Text size criteria don't create any major problems for Hepsiburada.com and N11.com. On the contrary, 18% of accessibility issues detected on Trendyol.com's pages' all interaction areas are due to insufficient text size. Considerable amount of the visual accessibility issues is related to line height as it can be seen at the figure below. N11.com is the most successful website for line length criterion, followed by Hepsiburada.com and Trendyol.com. Most successful platform in terms of line length criterion is N11 whereas Trendyol.com is the least successful one in that aspect. A chart, which visualizes the sources of problems for each evaluated platform, is presented below.

Figure 3.30

Distribution of Accessibility Issues by Attribute for All Interaction Areas of All Pages of Evaluated E-Commerce Platforms



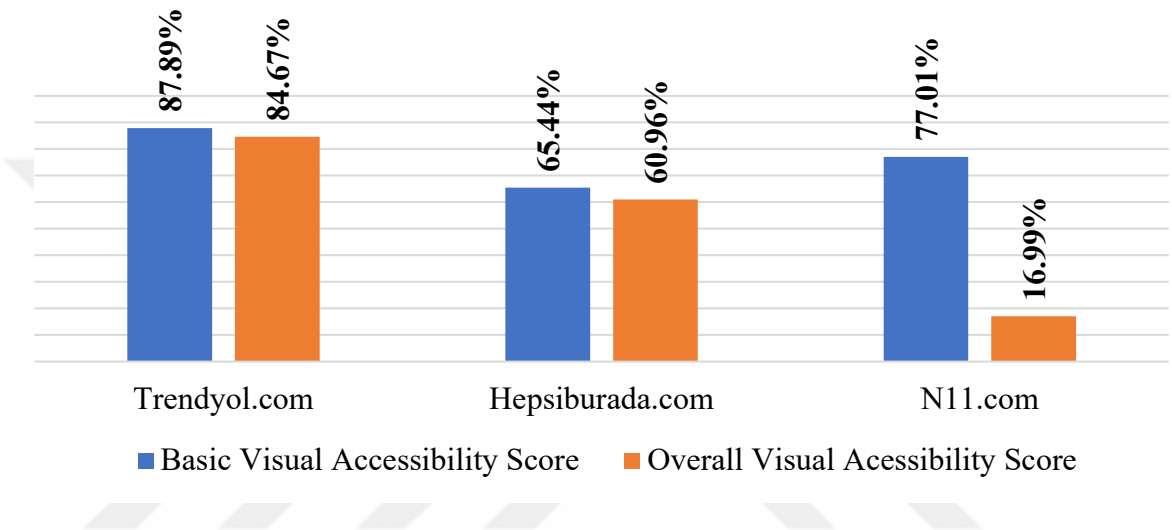
Basic visual accessibility scores of the platforms accessibility only concern text size and contrast ratio standards of research criteria whereas overall visual accessibility evaluation considers all criteria. In order to not fail, each element that is evaluated must conform all criteria. A failure considering one criterion results that the element doesn't comply with the standards. The platforms' successes are ordered according to their performances concerning overall visual accessibility.

When basic and overall visual accessibility performances of evaluated e-commerce platforms are considered, it is revealed that Trendyol.com is the most successful platform in general with a score of %88 for basic visual accessibility and 85% for overall visual accessibility. Trendyol.com is followed by Hepsiburada.com. Hepsiburada.com achieves a score of 65% for basic visual accessibility and 61% for overall visual accessibility. The least successful platform of this research is N11.com. Actually, the platform performs better than when basic visual accessibility performance is taken into account. It scores

77% in that regard. However, the platform's overall visual accessibility score is very low. It gets a score of 17%. A figure demonstrating the scores of the platforms for both basic and overall visual accessibility performances is presented below.

Figure 3.31

Visual Accessibility Performance of Evaluated E-Commerce Platforms



3.5.2 Evaluation of findings for customer journey pages

All customer journey pages' performance in terms of visual accessibility are evaluated and compared in this section. The data obtained from the research are assessed by considering the platforms' basic and overall visual accessibility performances for all interaction areas.

Page #1 (Homepage):

Basic visual accessibility performance of home pages of evaluated e-commerce platforms in this research are very similar for primary and secondary interaction areas. On the other hand, the difference among their performances for all interaction area is significant.

N11.com achieves a score of 100% and other two platforms get a score of 50% for primary interaction area. It is disappointing because this area is the most important area for the task. It consists of a search bar enabling the user to type and a button sporting an icon or a text saying “search” in Turkish. All platforms but N11.com fail to meet the contrast ratio criterion for the button located on this area.

Secondary area consists of a navigation bar. The bar contains all product categories such as electronics, clothing, and appliances. It offers a user an alternative way to find the target product. For this interaction area, Hepsiburada.com and N11.com perform almost perfectly. Trendyol.com’s performance on this area for the home page is also very good because it achieves a score of 99%. The reason behind the difference among the evaluated e-commerce platforms is that Trendyol.com’s highlighting some text with its brand color. This usage results an insufficient contrast. This usage is also evident when a hover interaction occurs.

The difference among pages for all interaction area is significant. Trendyol.com is the top performer for all interaction area when basic visual accessibility is concerned. It achieves a score of 84%. N11.com follows Trendyol.com with a score of 66%. Hepsiburada.com is the least successful performer among the platforms. The issues relating to visual accessibility for all interaction area are mostly related to contrast ratio of tags and star icons showing the ratings of the products. When the number of the products which are displayed on the page is increased, the performance of the page decreases. That’s why Hepsiburada.com’s presenting lots of product on the page makes it the least accomplished platform when all interaction area of Page #1 is considered. Hepsiburada.com achieves a score of 48% because of the aforementioned reasons.

Overall visual accessibility performance of home pages for primary interaction area of evaluated e-commerce platforms in this research are exactly the same as basic visual accessibility performance for secondary interaction area.

There is no difference between the scores of the homepages for secondary interaction area of Trendyol.com and Hepsiburada.com when basic and overall visual accessibility performances of are considered. This is because these homepages of these platforms' all issues' relating to either text size or contrast ratio for this interaction area. On the other hand, N11.com experiences a remarkable decrease for overall visual accessibility performance for its homepage for secondary interaction area. It gets a score of %0 because all elements evaluated have textual contents and their letter spacing is below the standards.

All platforms experience a decrease when overall visual accessibility performances of the homepages for all interaction area are taken into account. Trendyol.com's performance in that aspect is slightly lower with a score of 83% because visual accessibility issues of the home page are mostly related to text size and contrast ratio. The difference between Hepsiburada.com's scores between basic and overall visual accessibility performance is higher. Its score in that regard drops from 48% to 42% because of many textual user interface elements' having line height problems. On the contrary, N11.com' score in that aspect is significantly lower. When all criteria are considered, the platform's score is 9%. The reason behind this extreme difference is condensed text usage which result inconformity with this research criteria.

Evaluated e-commerce platforms basic and overall visual accessibility performances for interaction areas for Page #1 are separately presented below.

Figure 3.32

Basic Visual Accessibility Performance of Page #1 for Each Interaction Area of All Platforms

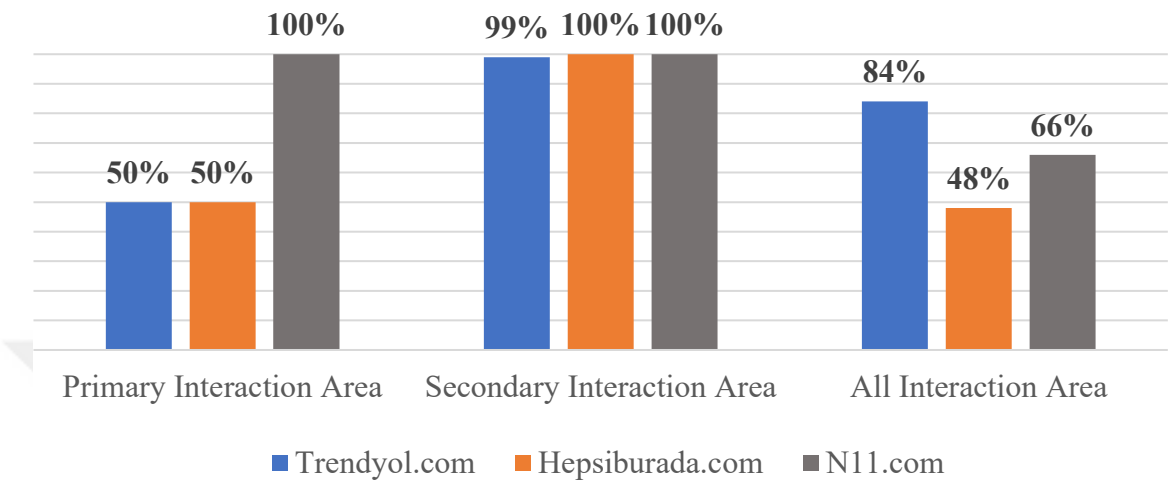
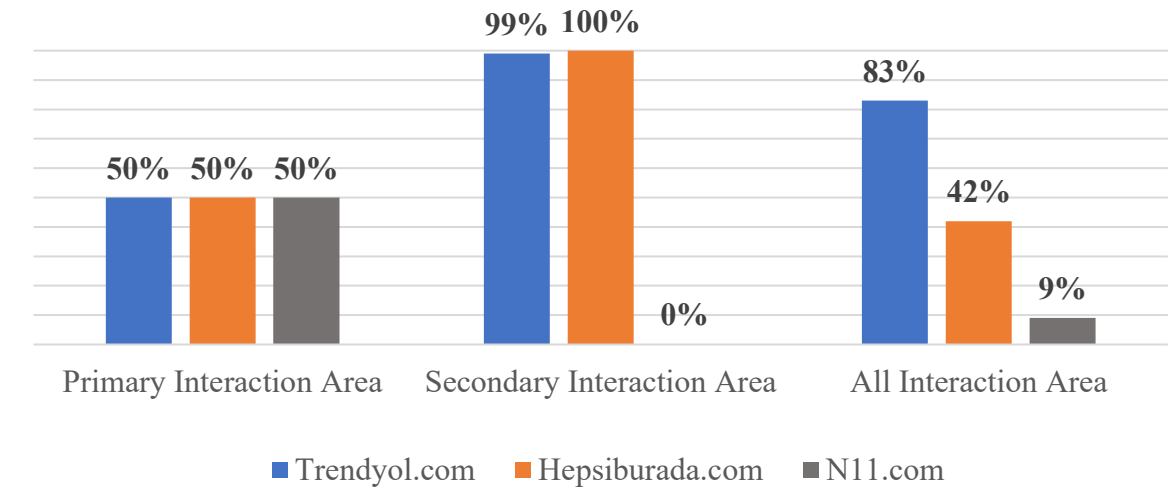


Figure 3.33

Overall Visual Accessibility Performance of Page #1 for Each Interaction Area of All Platforms



Page #2 (Search Page):

The platforms' scores for basic visual accessibility are not very distinct for all interaction area and secondary interaction area. On the contrary, the difference among their performances for primary interaction area in regard of basic visual accessibility criteria is more obvious.

The most successful platform is N11.com when basic visual accessibility performance of primary interaction area of search page is considered. It achieves a score of 71%. Most of the issues are related to star icons which visualize the user ratings of the products. These icons are filled with a yellow color resulting a contrast ratio of 1.61:1 with white background. The platforms getting a better score than its rivals its proper usage of tags in terms of text size and contrast ratio. Trendyol.com and Hepsiburada.com's performances fall behind N11.com's performance in this category with scores of 36% and 29% respectively.

All three platforms get high scores for the secondary interaction area. Hepsiburada.com is the top performer in this category with a score of 99% followed by Trendyol.com which gets a score of 98%. N11.com also performs well in this category. The evaluation of the page reveals that it doesn't create significantly more problems than the other problems. However, its having much less user interface elements on filtering bar impacts its result negatively. Eventually, N11.com's basic visual accessibility score for secondary interaction area of Page #2 is 90%.

The performances of evaluated e-commerce platforms considering overall accessibility criteria for all interaction area don't vary significantly. Hepsiburada.com takes the lead in this category with a score of 94%. It is followed by N11.com with a score of 90% and Trendyol.com with a score of 89%.

Trendyol.com is the most consistent platform when its overall visual accessibility performance is compared with its basic visual accessibility performance. For all interaction areas, the platform gets the same scores in that regard. It means that the

platforms issues are related to contrast ratio and text size. Hepsiburada.com's performance in this category stays similar for secondary and all interaction areas. However, its overall visual accessibility score drops to 19% from its score of 29% which it achieves for its basic visual accessibility performance. The biggest difference between basic and overall visual accessibility performances are observed for N11.com. It is not surprising because the platform's inappropriate letter spacing usage for textual content in regard to the research standards and WCAG 2.1 criteria results that it always performs significantly worse in regard to overall visual accessibility criteria.

Evaluated e-commerce platforms' basic and overall visual accessibility performances for interaction areas for Page #2 are separately presented below.

Figure 3.34

Basic Visual Accessibility Performance of Page #2 for Each Interaction Area of All Platforms

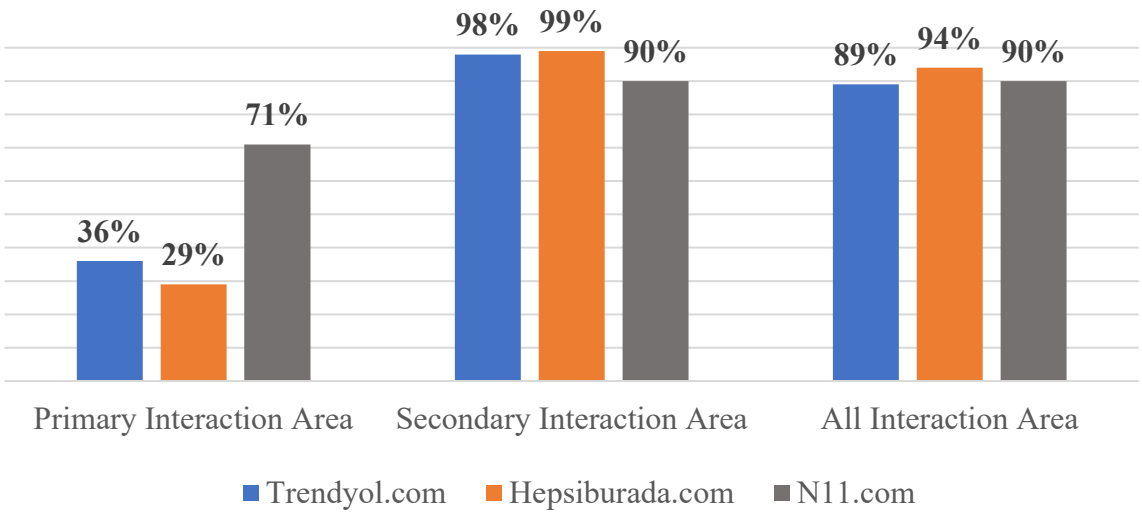
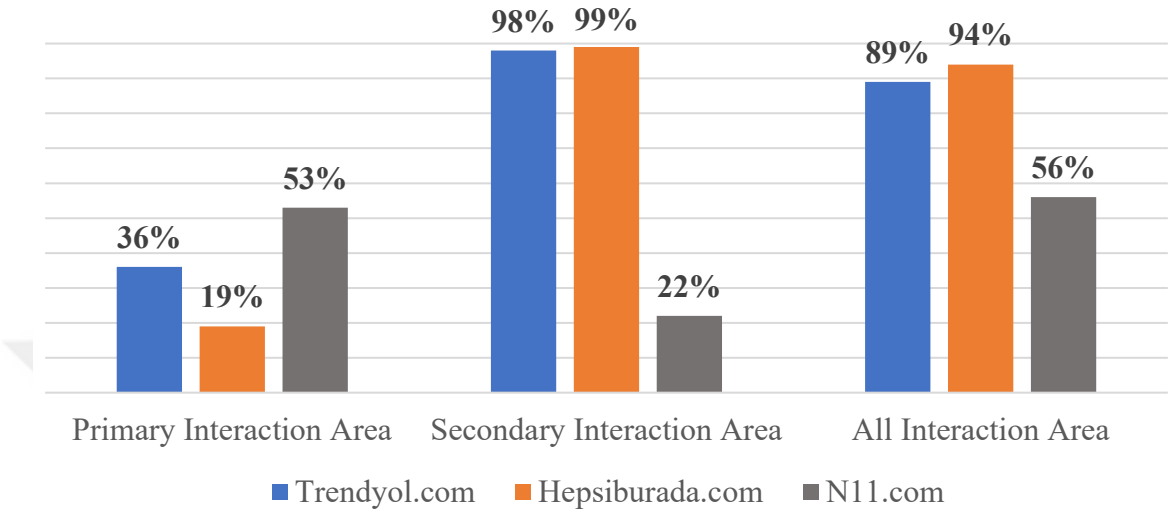


Figure 3.35

Overall Visual Accessibility Performance of Page #2 for Each Interaction Area of All Platforms



Page #3 (Product Page):

The platforms' scores for basic visual accessibility doesn't vary significantly for primary interaction areas of product pages. The difference between the top performer and the least successful platform is 10%. Trendyol.com achieves a score of 77% takes the lead according to basic visual accessibility performance criteria for primary interaction area of Page #3. It is followed by N11.com which scores 72%. The least successful performance in this category is Hepsiburada.com. It gets a score of 67%. Most of the problems occurring on primary interaction of the product pages are related to contrast ratio.

N11.com gets a score of 72% for its product page's basic visual accessibility performance for secondary interaction area. In this category, Trendyol.com and Hepsiburada.com performs significantly worse than N11.com. They both score 40%. Trendyol.com and Hepsiburada.com's visual accessibility problems occurring on secondary interaction areas of product pages are all related to contrast ratio whereas small amount of visual

accessibility problems in terms of text size share the responsibility for N11.com's failures alongside contrast-related problems.

When all area of a product page is considered, the inspection reveals that Trendyol.com is the most successful platform because it achieves a score of 91%. It is followed by N11.com which gets a score of 85%. Hepsiburada.com's performance is the lowest among its competitors. It scores 66% for overall visual accessibility performance at this category.

For page #3, Hepsiburada.com is the most consistent platform when its overall visual accessibility performance is compared with its basic visual accessibility performance. For all interaction areas, the platform gets the similar scores in that regard. It gets exactly the same score (67%) for primary interaction area. Secondary and primary interaction areas perform slightly less. The platform's score drops from 40% to 39% for secondary interaction area and its score for all interaction area decreases from 66% to 64% at this category. This situation revealed that the platforms issues are mostly related to contrast ratio and text size rather than other criteria which exclude the basic visual accessibility standards. Trendyol.com's score for primary interaction area of Page #3 is same for basic and overall visual accessibility performance. Its overall visual accessibility performance for the page's all interaction area is slightly lower (89%) than its basic visual accessibility performance in that regard. However, for the secondary interaction area, the performance of the page significantly decreases. It gets a score of 9%. It means a 31-point decrease when it is compared to the platform's basic visual accessibility score for secondary interaction area. The main reason behind this difference is that there are a lot of line which fails considering line height standards. As usual, N11.com significantly is affected by its inappropriate letterspacing usage. Its score drops from 72% to 14% for primary interaction area, from 72% to 42% to secondary interaction area and 85% to 49% for all interaction area when overall visual accessibility criteria are concerned.

One criterion must be high lightened for Page #3. It is line length. Product pages have lots of long textual content since they need to present lots of information to the user. Even

though the amount of problems related to this criterion is relatively low, their potential to damage these pages' overall visual accessibility performance in a more significant way cannot be denied because none of these websites uses a limiter for the line length.

Below, separate presentations of the evaluations conducted on the basic and overall visual accessibility performances of e-commerce platforms' product pages are displayed with regarding their interaction areas.

Figure 3.36

Basic Visual Accessibility Performance of Page #3 for Each Interaction Area of All Platforms

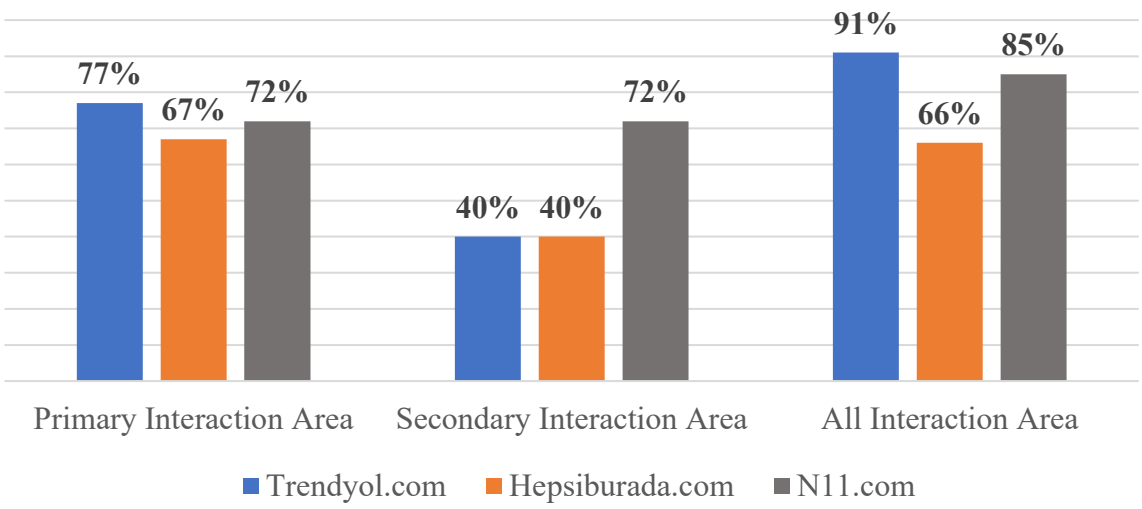
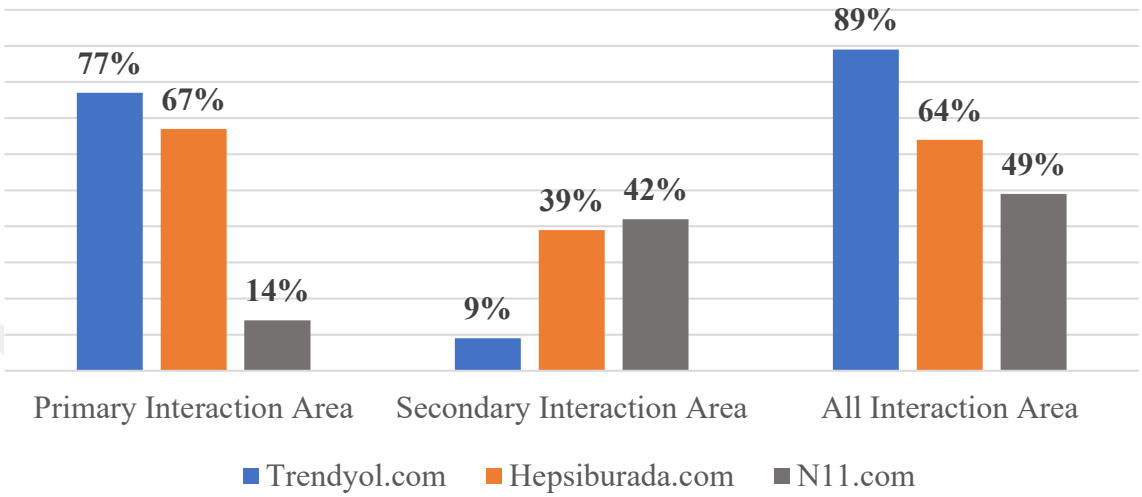


Figure 3.37

Overall Visual Accessibility Performance of Page #3 for Each Interaction Area of All Platforms



Page #4 (Cart Page):

At Page #4, the platforms' scores for basic visual accessibility strongly fluctuate for each interaction area. Trendyol.com achieves best results for overall visual accessibility performance with a score or 80% for this page when primary interaction area is considered. It is followed by N11.com which scores 77% and Hepsibuarada.com which gets a score of 38%. All the problems occurring on primary interaction area for these pages are related to insufficient contrast because the platforms insist on either their brand colors or tones of traffic light colors which results inadequate contrast for the buttons located on this interaction area.

The picture is reversed for secondary interaction area. This time the top performer is Hepsiburada.com which performs perfectly since no visual accessibility issue is detected concerning text size or contrast ratio. N11.com is the second-best platform in terms of overall visual accessibility performance with a score of 85% for this page. Trendyol.com achieves a very low score. It only gets a score of 25% at this category. All problems

occurring on secondary interaction area of cart pages of all three platforms are related to insufficient contrast.

When all elements are taken into account on cart pages, the research process reveals that N11.com is the best performing platform with a score of 95%. It is followed by Hepsiburada.com which scores 85%. Trendyol.com is the worst performer with a score of 71% at this category. The reason behind these differences is the number of tags which is used on offered products. The pages offer several elements which may grab the attention of the user before the completion of the purchase. When the number of these listed items increases the performance of the page decreases in the aspect of visual accessibility because most of these tags have insufficient contrast ratio.

For page #4, Trendyol.com is the most consistent platform when its overall visual accessibility performance is compared with its basic visual accessibility performance. The only score changing is related to all interaction area. It gets a score of 84% for overall visual accessibility performance whereas it achieves a score of 88% for basic visual accessibility performance for all interaction area of cart page. Hepsiburada.com achieves the exact same score for secondary interaction area's performance in regard to overall visual accessibility criteria as it gets a score of 100% for secondary interaction area's performance in regard to basic visual accessibility criteria. The platform's score drops from 38% to 25% for primary interaction area and its score for all interaction area decreases from 19% to 12% at this category. On the contrary, remarkable differences is realized between N11.com's basic and visual accessibility performances. It achieves a score of 0% for primary, 54% for secondary and 55% for all interaction area at this category due to the condensed text usage.

The platforms' cart pages' basic and overall visual accessibility performances for interaction areas are separately presented below.

Figure 3.38

Basic Visual Accessibility Performance of Page #4 for Each Interaction Area of All Platforms

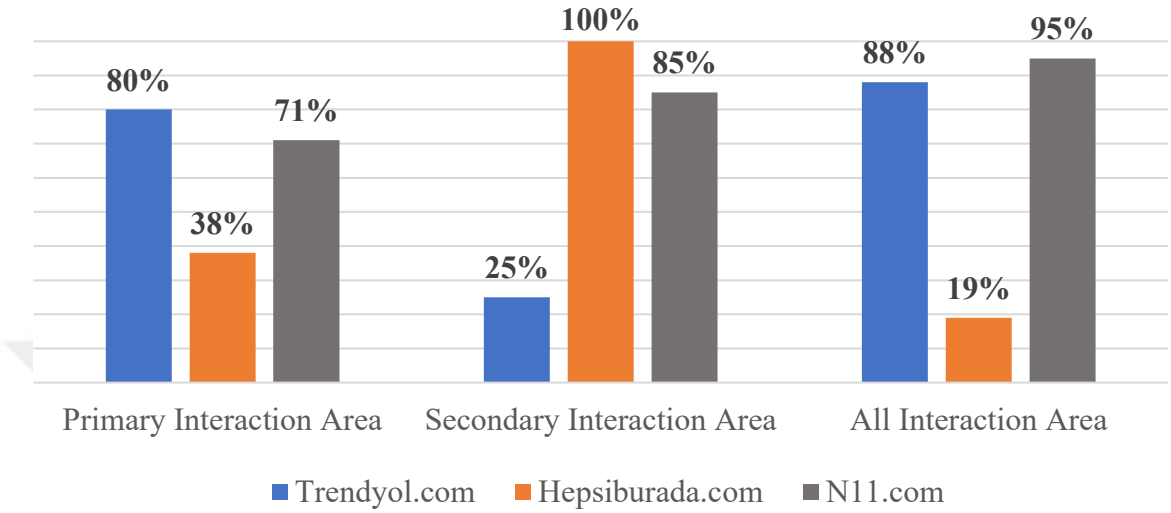
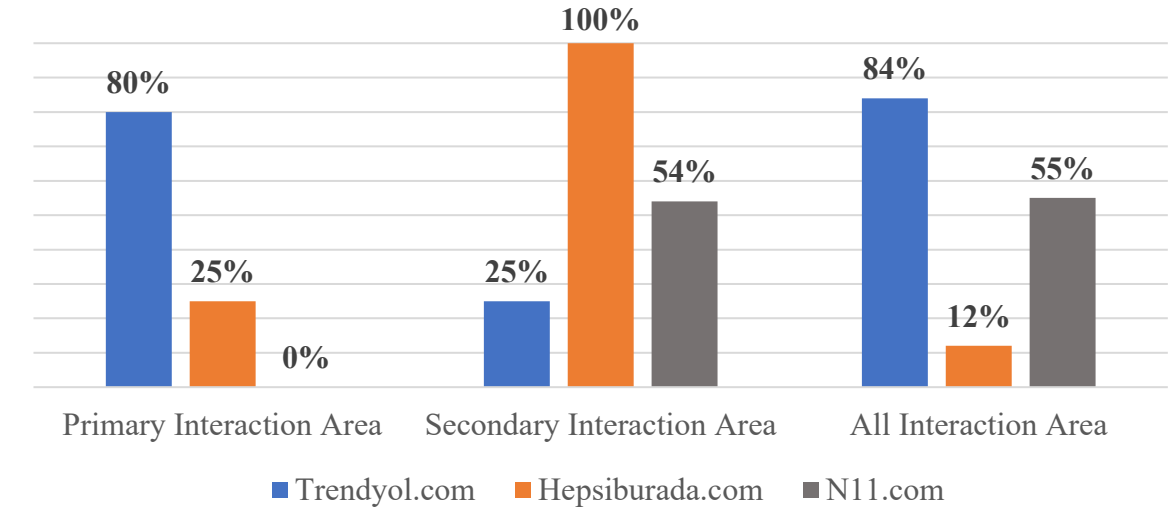


Figure 3.39

Overall Visual Accessibility Performance of Page #4 for Each Interaction Area of All Platforms



Page #5 (Address and Payment Information Page)[34]:

Trendyol.com and N11.com achieve best results for basic visual accessibility performance with a score or 67% for this page when primary interaction area is considered. Hepsiburada.com's score is significantly lower for this category. It gets a score of 40%. All the problems occurring on primary interaction area for these pages are related to insufficient contrast due to the platforms' using either their brand colors or tones of traffic light colors which results insufficient contrast for the buttons on this interaction area.

On secondary interaction area, N11.com reaches a score of 94% and becomes the top performer when basic visual accessibility standards are considered. Trendyol.com achieves a of 79% while Hepsiburada.com gets a score of 68% at this category. All problems occurring on secondary interaction area of address and payment information pages of all platforms evaluated in this study are related to insufficient contrast.

When all elements are considered on address and payment information pages, it becomes obvious that Hepsiburada.com is the best performing platform with a score of 99%. This website is followed by N11.com which scores 87%. Trendyol.com is the worst performer with a score of 80% at this category. Hepsiburada.com and N11.com's all failures are related to insufficient contrast. Trendyol.com also poses text size issues alongside the contrast ratio problems on Page #5.

For page #5, Hepsiburada.com is the most consistent platform when its overall visual accessibility performance is compared with its basic visual accessibility performance. The only score which decreases is related to all interaction area. The page gets a score of 80% for overall visual accessibility performance whereas it achieves a score of 99% for basic visual accessibility performance for all interaction area of address and payment

[34] Payment Page for N11.com

information page. Trendyol.com experience a decrease on all interaction areas when overall visual accessibility criteria are considered. The platform's score drops from 67% to 60% for primary interaction area, from 79% to 72% for secondary interaction area and from 80% to 73% for all interaction area. Line height and line length issues are behind this performance decrease. The performance differences between basic and overall visual accessibility performances of N11.com are more significant. The platform's primary interaction area performance decreases to 22% from 67%. For secondary interaction area, the platform experiences a remarkable downfall. Its score decreases from 94% to 19%. The research also reveals that N11.com gets a 55%. It means that the difference between basic and overall visual accessibility performance of this page's all interaction area is 32 points. The main reason behind this significant distinction is same: Condensed text usage.

The platforms' address and payment information pages' basic and overall visual accessibility performances for interaction areas are separately presented below.

Figure 3.40

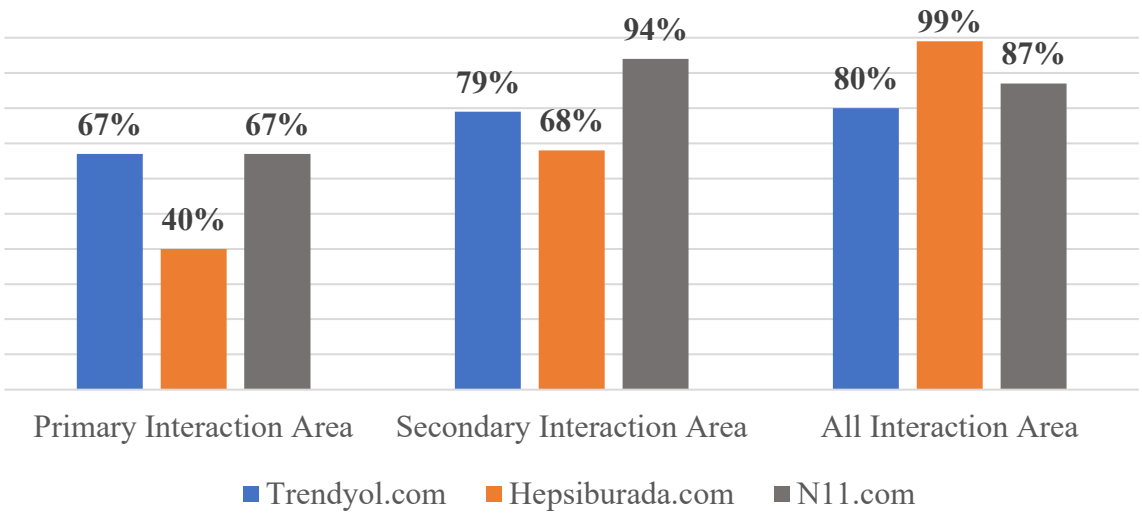
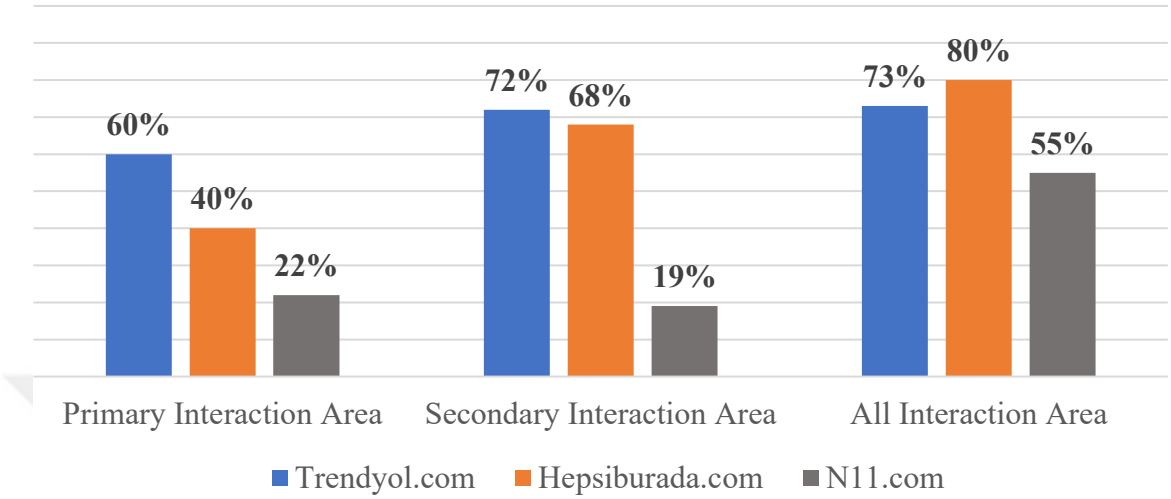


Figure 3.41



All Pages:

When only primary interaction areas considered, the variation which is observed in platforms' performance for basic visual accessibility is significant. Trendyol.com and Hepsiburada.com performs similarly by scoring 42% and 37% respectively. Nevertheless, these platforms fall far behind N11.com. N11.com achieves a score of %76 at this category. When the researcher applies overall visual accessibility performance criteria, the variation of the results become less distinctive. Trendyol.com keeps its score when these criteria are taken into account. Hepsiburada.com's primary interaction area performance decreases to 29% from 37%. On the other hand, N11.com experience a significant decrease for its primary interaction area performance. It achieves a score of 44%. However, N11.com claims to be the top performer of this category even with this drastic drop.

When only secondary interaction areas considered, platforms' performance for basic visual accessibility is similar. N11.com takes the lead again with a score of 83%. It is followed by Trendyol.com which gets a score of 78%. Hepsiburada.com scores 75% and

becomes the least successful platform in this aspect. The situation is reversed when overall visual accessibility performances of the platforms are evaluated. Hepsiburada.com becomes the most successful platform. It achieves a score 74%. It is a very slight difference between its secondary interaction areas' basic and overall visual accessibility performances. Trendyol.com's performance drops from 78% to 70%. N11.com experience a huge downfall again due to the condensed text usage on the platform. It scores 34% and becomes the least successful platform at this category.

When all areas of all pages are evaluated with the consideration of basic visual accessibility performance criteria, is revealed that Trendyol.com's score is 88%. This makes the platform most successful website at this category. Trendyol.com is followed by N11.com which scores 78%. The least accomplished platform at this category is Hepsiburada.com because it gets a score of 65%. When the researcher applies overall visual accessibility performance criteria, Trendyol.com becomes the top performer with a score of 78%, followed by N.11.com (78%) and Hepsiburada.com (65%).

Below, separate presentations of the evaluations conducted on the basic and overall visual accessibility performances of e-commerce platforms' all pages are displayed with regarding their interaction areas.

Figure 3.42

Basic Visual Accessibility Performance of All Pages for Each Interaction Area of All Platforms

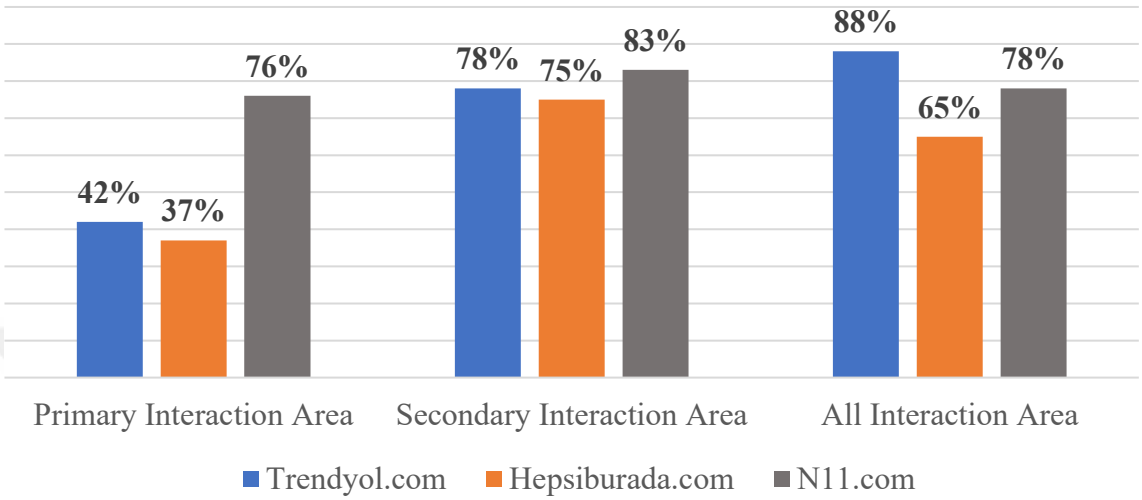
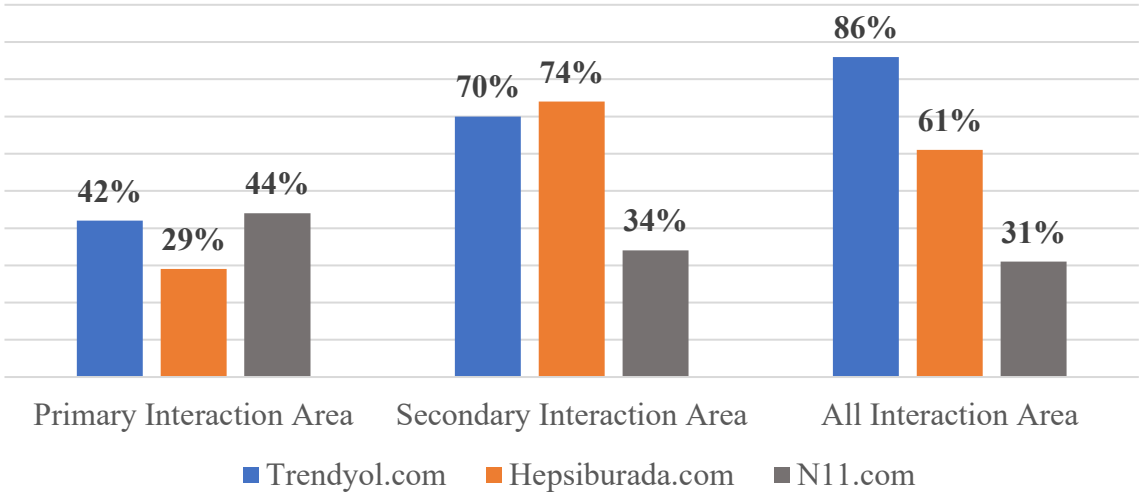


Figure 3.43

Overall Visual Accessibility Performance of Page All Pages for Each Interaction Area of All Platforms



3.5.3 Evaluation of findings in general

The researcher uses Level AA accessibility criterion of Web Content Accessibility Guidelines' latest version for contrast ratio instead of Level AAA criterion which is more challenging. Nevertheless, with the evaluation of the results, it becomes clear that most of the visual accessibility issues are related to contrast ratio. The main reason behind it is the usage of brand color and traffic light colors for a lot of buttons' background, texts, and non-decorative visual elements. The brand colors of all these platforms are insufficient to meet WCAG 2.1 criterion in that regard. Also, hues of traffic light colors are chosen in a way that result inadequate contrast ratio with light-colored backgrounds.

Text size problems are mostly dismissible for Hepsiburada.com and N11.com, but it is second most important reason behind the accessibility issues of Trendyol.com. Line height problems also create a potential to impact the users experience in terms of visual accessibility.

When all the scores are considered with regarding both basic and overall visual accessibility performance criteria, N11.com is the most successful platform for task-based evaluation because it is the top performer for primary interaction area, which is the most important area for the user to complete its task. It is the gets the second-best score when all interaction area is considered and evaluated in a way that only concerns most basic criteria (text size and contrast ratio). When all criteria are considered for the all-user interface elements which a user may interact with, N11.com is the least successful platform. On the other hand, Trendyol.com performs the best when all elements that is evaluated during customer journey are taken into account. Trendyol.com is also second-best platform when basic visual accessibility performances on primary interaction areas and overall visual accessibility performances on secondary interaction areas are considered. Hepsiburada.com only takes the lead for overall visual accessibility performances on secondary interaction areas of all pages.

If a user uses these platforms with a specific product in mind, the one would probably follow similar steps as this research's customer journey phase suggests. In this case, N11.com is the best platform in terms of visual accessibility. Nevertheless, there is another side of this statement. If the user has significant sight problems, N11.com is not ideal due to its low performance when all criteria of this research are taken into account. In that case, Trendyol.com would be more ideal for the user since it gets better scores when overall accessibility performance criteria, which are more challenging, are taken into account. If the user does not follow the task and choose to wander around the websites, Trendyol.com is better for the user. It is because the e-commerce platforms is the best performer among its rivals when both basic and overall visual accessibility performances for all interaction areas of all pages are considered.

3.6 Limitations

There are two limitations of the study. First, the samples of the research do not represent the entire e-commerce population in Turkey. Trendyol.com, Hepsiburada.com and N11.com are responsible for 53% of online shopping traffic in Turkey. This can create some reliability concerns. However, it is known that most of e-commerce platforms use similar layouts and design in order to not fall behind the global trends in the industry. That's why a generalized assumption based on the data gathered from the samples can be made. That's why the first limitation must be considered as a potential limitation.

The other limitation is that the results of this research are dependent on the time of evaluation process. Content on the e-commerce platforms constantly changes. This results a slight difference for the results each time a page undergoes an evaluation process.[35]

[35] See Table A.1 to see the dates of the conducted evaluations of the webpages

4. DISCUSSION

4.1 Reasons Behind Visual Accessibility Problems of E-Commerce Platforms

The research reveals that the users encounter many visual accessibility problems when they online shop. Most of these issues are contrast related. When they design their website, these e-commerce giants ignore the fact that their brand colors' not providing a sufficient contrast in terms of Level AA standards of WCAG 2.1. Albeit to this fact, they insist to use their brand color on many user interface elements. This situation affected these platforms visual accessibility performance negatively. The researcher believes that these companies prioritize their brand presence and aesthetics instead of accessibility. This is a very common issue in the industry. However, that's not the right way to go. As stated before, Newell and Gregor (2002) explored the topic of designers' adherence to mainstream aesthetics despite the growing emphasis on design-for-all principles. They highlighted the contradiction arising from this trend. While some designers may view the combination of visually appealing and accessible products as an unattainable goal, numerous scholars argue that accessibility and good design can be integrated harmoniously. Therefore, it can be claimed that the designers can prioritize accessibility during the design process without impacting overall aesthetics of them in a negative way.

There are other problems relating to contrast. These are not involved with brand usage. On the platforms, lots of buttons and non-decorative icons, which have insufficient contrast ratio to meet the related criterion of this research, are detected. These platforms use red color to create a negative or urgency feeling and green color to create a positive or opportunity feeling for the users. There is nothing wrong with that if they provide sufficient contrast ratio with the background. Unfortunately, hues of these colors that is used for the user interface elements on these platforms are mostly inadequate in terms of contrast ratio standards. They have very light tones of these colors. It seems that the designers want to keep the look of the platforms vibrant and more coherent with their brand. This attitude implies that the designers tend to follow mainstream aesthetics instead of promoting visual accessibility. The reason behind this attitude may be the

disbelief suggesting that visual accessibility and aesthetics can't go hand in hand. In their study Petrie et al. (2004) also highlighted this misbelief. They asserted that designers often think that websites designed with an accessibility approach should be plain and uninteresting, lacking visual attractiveness. However, the authors argued that this belief is incorrect, as visually appealing, and complex websites can still be made accessible to all users. While a basic and straightforward website may be accessible, it is not necessarily true that an engaging and visually appealing website is inaccessible. There is another research promoting the researcher statement in that regard. Newell and Gregor (2002) examined the issue by addressing the conflict arising from the growing emphasis on design-for-all principles and designers' inclination to adhere to mainstream aesthetics. While many designers may perceive the creation of visually appealing and accessible products as an unattainable goal, numerous scholars believe that accessibility and good design can be seamlessly integrated.

Evaluated e-commerce platforms in this research generally perform well for text size criteria. However, the evaluation conducted on these platforms reveals that especially Trendyol.com uses some tags which are problematic in the aspect of text size because these tags consist textual elements having a font size less than 10 points. Some pages of these platforms have a lot of content, and it seems that the designers try to show as much as content possible on a page. This results small text usage on several user interface elements. However, the researcher believes that these problems could have been prevented because N11.com and Hepsiburada.com also uses tags on the products but their usage does not generate visual accessibility related failures. Filling a page with lots of user interface elements also increases the complexity of that page. Some may claim that complex websites can cause many accessibility-related challenges for the developers and the designers. However, this claim cannot be accepted as an excuse for low visual accessibility performance of a webpage. In their study, Petrie et al. (2004) examined 100 websites with the participation of 51 users with disabilities. The findings of their research indicated that certain highly accessible websites possessed intricate visual elements. Based on this, the authors recommended that designers view accessibility as an additional challenge to consider during the product development process, rather than disregarding it

entirely. Therefore, it can be argued that this belief held by designers lacks proper justification, and visual designers should not overlook accessibility.

Another way to solve the problems of webpages which have complex visual structures is to have a minimalist approach. As mentioned in Section 2.9.4, Mbipom and Harper (2011) examined the matter through a study involving 30 individuals without visual impairments. These participants assessed the aesthetics of 50 website homepages. The accessibility of these homepages was also evaluated by experts in the field. The research demonstrated that webpages with minimalist designs were more accessible. However, it also showed that webpages with expressive or visually appealing designs did not present barriers to users with low vision, provided they were appropriately designed with consideration for accessibility.

A lot of accessibility issues stem from organizations' and companies' reluctance to incorporate accessibility measures during product development processes due to time and cost concerns. This point was emphasized in a study conducted by Cornish et al. (2015, pp. 184-189). According to the authors, 25% of the graphic designers who participated in their study expressed a disinclination to use accessibility tools due to time and budget constraints imposed by clients. The authors further argued that there exists a negative correlation between clients' experience and the importance attributed to accessibility in graphic design projects. However, the researcher believes that this is not the case for the visual accessibility problems of Trendyol.com, Hepsiburada.com and N11.com. These platforms target millions of people. That's why their time and money investment for visual accessibility can refund itself. A study supports the researcher's claim in that regard. Horton and Sloan (2015, pp. 2-3) mentioned that prominent companies such as Apple and Bank of America have taken a stance on accessible design, recognizing that their size and influence do not allow them to disregard the return on investment for accessibility. The authors also asserted that investing in accessibility can ultimately provide financial benefits for even smaller companies in the long run.

As already claimed in the previous paragraph, the researcher doesn't believe that the time and cost constraints are the main reasons of visual accessibility problems of the evaluated e-commerce platforms. The one thinks that insufficient awareness towards accessibility may be the one of the reasons behind these issues. Despite the existence of extensive guidelines that empower designers and developers to create accessible graphical content, there is a concerning lack of attention given to accessible graphic design. It is evident that developers and designers tend to prioritize non-visual HTML elements such as reading order, radio buttons, and interactivity when coding webpages. Ensuring current accessibility standards for visual elements takes a backseat for the majority of digital developers and designers. In this research, only visual accessibility is concerned, that's why the researcher doesn't have any assumption in other aspects of digital accessibility such as reading order, alternative text usage or integration of assistive technologies, however, the results of the evaluations conducted on Trendyol.com, Hepsiburada.com and N11.com make the researcher to share a similar idea.

Scarcity of professionals who have expertise on visual accessibility may be another factor related to visual accessibility performances of the evaluated platforms. According to Bevan et al. (2007), many web designers recognize the importance of web accessibility. However, they lack a comprehensive understanding of the intricate details of the Web Content Accessibility Guidelines, established by the World Wide Web Consortium's Web Accessibility Initiative (WAI). Additionally, scholars argued that designers also struggle with implementing these guidelines in practice. In a similar vein, Cremers et al. (2013, p. 324) addressed the issue of awareness regarding inclusive design, which is closely linked to accessibility. The researchers indicated that developers of digital products and services commonly lack familiarity with inclusive design theory and methods. However, results of this research also reveals that the designers of evaluated online shopping platforms aware of some of the standards. Trendyol.com and Hepsiburada.com performs perfectly in terms of letter spacing criterion. Only N11.com has issues related to this criterion. Also, no issue is detected regarding to text justification standards on all three platforms. That's why it is hard to assume that the designers don't know how to implement Web Content

Accessibility Guidelines (WCAG) to their digital product. However, it is also difficult to state that the designers are aware of all WCAG standards of visual accessibility.

Lack of legislation of the visual attributes of e-commerce problems may be the other reason behind these problems. As stated in Section 1.3, even access the internet is not considered as a human right. With the light of this information, it can be suggested that expecting the governments to regulate the e-commerce platforms in the aspect of visual accessibility is very unrealistic. This situation creates freedom for the developers, designers, and managers when they make design decisions during the development process of the websites. Even if they aim to create a visually accessible website, a challenge along the way can enforce them to make compromises regarding to visual accessibility since there is no legal boundary on them in that aspect.

4.2 Researcher's Overall Comments

The researcher believes that evaluated websites aren't designed with an accessibility first approach. Each platform, which takes stage in the study, generates many visual accessibility problems for the user. Some problems are very easy to solve by creating default settings, but it seems that the developers and designers of these websites aren't aware of that several visual attributes of their website don't comply with universally accepted visually accessibility standards.

N11.com always generates letter spacing related visual accessibility issues. Even though this problem is very easy to solve by setting the minimum letter spacing at 0.12em, the designers seems that they are unaware of this problem, or they simply prioritize squeezing content in an area more than accessibility. All of these platforms don't have a line length limit for the textual contents either. Line heigh is also not standardized in these platforms. These problems may not seem very important at the first glance, but WCAG present standards for these attributes for a reason. When the textual contents aren't properly displayed to the user, it makes it hard to read for the user. This situation doesn't only

impact visual accessibility performances of these websites, but it also affects the user experience negatively since the accessibility and usability affect each other in many aspects.

In the previous sections, contrast and text size related problems are frequently mentioned. These problems are more prominent to result a negative experience for many users because they can be realized more easily. That's why researcher believes that solving those problems can be beneficial for both visual accessibility performance of evaluated web platforms and their user experience.

It is also suspected that the managers of the evaluated platforms want that the pages must present a lot of products in order to increase the revenue of the platforms. However, the researcher believes that this approach does not directly result an increase in revenue because these elements can't properly present the related information because of the small real estate which they have on the pages. This approach of the managers can put the designers in a situation to decide between accessibility and aesthetics. Therefore, the website managers must not force the designers to put lots of product on a page because it results smaller text size, shorter line height and condensed text usage.

To sum up, there are lots of visual accessibility problems to be solved for Trendyol.com, Hepsiburada.com and N11.com. It can also be suggested that these issues can be found in any e-commerce platform in Turkey, or in the world. However, most of them are very easy-to-solve problems. If the awareness towards accessibility increases in the society, designers and developers can be encouraged to learn more about the concept and create more visually accessible digital products. In this way, they can make the online shopping easier and more satisfying experience for the users.

5. CONCLUSION

5.1 Fulfilling the Gap in the Academia

The digital industry primarily emphasizes the operability aspects when considering accessibility in relation to digital platforms. On the other hand, academia takes a broader perspective on the subject, which often leads to a lack of specific investigations solely focused on assessing the performance of visual accessibility. This research bridges this gap in academia by adopting a specific approach that combines accessibility and graphic design. It reveals the challenges faced by highly significant and widely used platforms, which are an integral part of modern human life.

5.2 Final Words

The research aims to gain insights into users' experiences while engaging in online shopping and uncover potential issues related to visual accessibility, regardless of whether the users have low vision or not. Eventually, this study reveals that the users are challenged by many visual accessibility problems. Evaluation conducted on Trendyol.com, Hepsiburada.com and N11.com reveals that these platforms generate many failures which are not only related to more challenging visual accessibility criteria but also related to basic visual accessibility criteria such as contrast-ratio and text size. On the other hand, the study unveils that most of visual accessibility related problems are easy to solve. Creating default settings for non-color related attributes of the textual content and avoiding colors, which are insufficient in terms of contrast ratio, can increase the visual accessibility performance of these platforms. By doing it so, these platforms can present a more enjoyable and error free user experience in terms of visual accessibility for the users, whether the users live with a kind of sight related disability or not.

It must also be noted that this study does not aim to hinder the brand images of the evaluated e-commerce platforms. The evaluation method of the study doesn't adopt another methodology directly. This results an absence of reference. Thus, it cannot be suggested that these platforms are better or worse than the others competing in the industry in Turkey or in the world. It can only be claimed that the one is better than the other one regarding a research criterion used in this study.

5.3 Further Studies

This study concerns only visual accessibility performances of three most visited e-commerce platforms in Turkey. It only gives a general overview for these websites in visual accessibility perspective. That's why there is a need to conduct research for other e-commerce platforms in Turkey in order to precisely understand how easy the online shopping is for the users in regard to visual accessibility.

Conducting interviews with the managers and developers/designers of these e-commerce platforms can be beneficial to precisely understand the reasons behind the visual accessibility issues.

In this research, many different tools are used to evaluate different criteria. This study can also help developers to create a software which uses this research's evaluation criteria. A single software combining all the tools used in this research can help developers to create a visually accessible website more efficiently in terms of time. In addition, integration of AI (Artificial Intelligence) can be very important because, a software without AI capabilities cannot parcel the interaction areas according to their importance for the user-test related tasks.

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APPENDIX A

Table A.1

Dates of Evaluation Process for the Web Pages

Page Name	Date of Evaluation
Page #1 of Trendyol.com	22/05/2023
Page #2 of Trendyol.com	22/05/2023
Page #3 of Trendyol.com	23/05/2023
Page #4 of Trendyol.com	28/05/2023
Page #5.1 of Trendyol.com	28/05/2023
Page #5.2 of Trendyol.com	29/05/2023
Page #1 of Hepsiburada.com	20/06/2023
Page #2 of Hepsiburada.com	20/06/2023
Page #3 of Hepsiburada.com	21/06/2023
Page #4 of Hepsiburada.com	22/06/2023
Page #5 of Hepsiburada.com	22/06/2023
Page #1 of N11.com	22/06/2023
Page #2 of N11.com	23/06/2023
Page #3 of N11.com	23/06/2023
Page #4 of N11.com	23/06/2023
Page #5 of N11.com	23/06/2023

CURRICULUM VITAE

Academic Background

Koç University Media and Visual Arts (GPA: 3.20) (2010-2015)

Foreign Languages: English (Advanced), French (Intermediate)

Work Experience

Simon-Kucher: Client Creative (Full-time) (November 2021-Now)

Magnetic London: Graphic Designer (Full-time) (August 2020-October 2021)

Neko Otomotiv: Graphic Designer (Full-time) (April 2017-July 2020)

Koç University Store: Graphic Designer (Part-time) (January 2013-June 2013)

TRT: Assistant Director (Part-time) (September 2011-June 2012)

Achievements and Scholarships

TÜBİTAK: Scholarship for Master Studies (2020-2022)

Kadir Has University: Scholarship for Master Studies (%100) (2020-2023)

ALES: 82.6 Points (Verbal) (2018), 80.2 Points (Equally-weighted) (2016)

YDS: 90 Points (A) (2016)

Koç University: Scholarship for Undergraduate Studies (%100), Suna-İnan Kıraç Scholarship (2015-2020), Vehbi Koç Scholar Award (2014)

TOEFL PBT: 567 Points (Advanced) (2011)

LYS: 96th at TS-2 Category (2010), 115th at TS-1 Category (2010)