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FACULTY OF INFORMATICS

THESIS WORK

OE-NIK	Student's name:	**Péter Makó**
2023	Student's registration number:	**T010187/FI12904/N**

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THESIS WORK

DESCRIPTION

Student's name: **Péter Makó**

Registration number: T010187/FI12904/N

Title of thesis work:

Development of mobile shopping assistant application

Bevásárlást támogató mobilalkalmazás fejlesztése

Internal supervisor: Dániel Kiss

External superviosr:

Submission deadline: ……………..

Subjects of the final examination: ………………

                                    …………………….

The task:

Shopping assistant smartphone applications are very popular nowadays, as they can simplify the often exhausting and stressful procedure of purchasing goods, as well as they can help the user to save money by providently planning the shopping and offering personalized discounts.

The goal of this thesis is to design, implement, and test a smartphone application that is able to identify products by their barcodes or QR codes, then, provides the user with a personalized list of the availability and the prices of the products from online sources. By building a profile based on shopping preferences or frequently searched items, the application may suggest stores for the user that minimize costs or shopping times.

The study is required to include the following:

1. The brief outline of the motivation and the business background of the problem,
2. A comprehensive summary of software applications with similar or related purposes, as well as the theoretical background of their design,
3. The precise specification and the system design of the smartphone application to be developed,
4. The documentation of the implementation procedure,
5. The thorough summary of the testing scenario, and the test result of the application,
6. Discussion of the work and further development possibilities.

L.S.

……………………

Head of Institute

The specification is valid until:

(According to OE TVSz 55 §).

I consider the thesis suitable for submission:

………………………………….…   …………………………………….…

External supervisor   Internal supervisor

STUDENT'S DECLARATION

I the undersigned student hereby declare that this thesis is the result of my own work; I have disclosed the references and tools used in an identifiable manner. The results indicated in my thesis completed may be used by the university and the institution announcing the task for their own purposes free of charge.

Dated: Budapest, 05. 21. 2023

....
Student's signature

CONSULTATION LOG

Student's name: Neptun code: Specialty:

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Phone number: Mailing address (e.g. domicile):

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Thesis / Thesis work [1] title in Hungarian:

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Thesis / Thesis work [2] title in English:

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Internal supervisor: External supervisor:

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Please write the data in printed capital letters!

Occ.	Date	Content	Signature
1.			
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3.			
4.			

The Consultation log is required to be countersigned by either supervisor on a total of 4 occasions of consultation.

The student has complied with the requirements of the subject titled Thesis I / Thesis II (BSC) or Thesis work 1 / Thesis work II / Thesis work III / Thesis work IV [3] (MSc) and is allowed to proceed for reporting / defense [4].

Dated: Budapest, ...

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Internal supervisor

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CONTENTS

1   INTRODUCTION

The purpose of this thesis work is to explore the topic of creating a mobile application that would make people's lives easier when it comes to shopping. With the enormous growth of the competitiveness of the retail market, as well as e-commerce, customers are often left confused whether they would be better off just shopping in the nearest supermarket or rather travel to another one that is further away, but may offer better prices. Implementing a solution for this problem has the potential to become valuable in the eyes of confused customers, who would like to make informed decisions regarding their shopping habits.

Elaborating on the previously mentioned issue, the consumers often face multiple challenges when it comes to a seemingly easy task like shopping. Without information on prices, decision-making is only affected by factors like travel time and personal preference. For this reason, shopping can lead to overpaying for items or not finding the preferred brand or good in the selected store. The process can also become more time-consuming than expected, since there is no guarantee that the customer will only have to visit one shop. Big differences between retail prices can also raise trust issues and misconceptions among customers. Additionally, from the retailers perspective, coming up with the right pricing strategy can be hard, when the factors affecting the customers' decisions are unclear.

The development of such application can potentially result in numerous benefits for both the customer and retail side, such as clear comparisons between different retailers, a more transparent way of pricing the goods, efficient adaptation to the newest valuation trends, customer oriented marketing and the possibility to reduce the time spent with shopping. All of these would result in customers who are aware about the stocks and prices of these retail shops, leading to them making well-informed decisions when choosing shopping habits, as well as getting better prices than ever, because of the fiercer contest on providing the best prices.

The idea of making the life of consumers easier has been around for a while now, but many times they are web-based, meaning that the user experience is not going to be as optimized and straightforward as a dedicated application's case. Furthermore, these applications are usually targeted for international customers, or for those of other nationalities, not to mention that websites usually lack the possibility of searching for bar codes, let alone scanning them for an easy and fast experience.

Implementing the idea for this application requires coming up with all the possible use cases, a well planned software architecture, a seamless development process, and the thorough testing of the end product.

Within the scope of this thesis work project, an application will be designed which will

provide the user with functions such as using the camera for scanning the bar code of an item, searching for these items with this code or product name, getting prices from various retailers. Moreover, the application will try to give personalized recommendations for the user on where to shop, depending on the goods availability, prices and distance of the shops.

While the primary aim of this project is to target Android devices, for future possibilities it might be more desirable to develop the application using a platform independent approach, like Xamarin. For achieving the desired functionality, there is a need for numerous APIs to provide relevant data on product information, prices as well as the distance between the user and surrounding shops. The testing of the product will be done through multiple approaches to ensure a seamless user experience.

In conclusion, this easy and accessible way of price comparison between shops, brands and goods can lead to an improved consumer culture, where both retailers and customers can make informed decisions. In the following chapters, a detailed examination will be provided on the topic of the importance of transparent price comparison, relevant fields and existing solutions, as well as outlining the concept of the project application, planning and executing the implementation, and finally testing the end product.

2   BACKGROUND

The development of barcode technology, as well as the upbringing of handheld software solutions already have noticeable effects on how we shop in our favorite stores. Many retail shops have already implemented self checkout services and handheld or stationary devices, which provide information on the scanned item. Taking this technology one step further will lead us to mobile applications. Out of many already existing programs, finding a Hungary-specific mobile application with such functionality is rather challenging.

2.1   History of Barcode Technology

The invention of barcode dates back to the 1940s, when Bernard Silver and Norman Woodland came up with the patent for a system that automatically read product information, using ultraviolet light and ink patterns [1]. However, only after the introduction of Universal Product Code (UPC) in 1974 did it become widespread in retail industry [2]. Since then, multiple new types of barcodes emerged, such as the Quick Response (QR) code, which is able to store substantially more information and is faster to read than the original version [3].

2.2   Evolution of Mobile Devices and Barcode Scanning Applications

Since the mobile devices come with high-end cameras and very high computational capabilities, they led to the possibility of developing applications, that are capable of scanning the barcodes on products and then providing them with useful information about them, like details, ratings and prices [4]. The first famous pioneers were RedLaser and Shop-Savvy, whose popularity has been mainly connected to the users ability to save time and money using them for comparing product details and prices [5].

2.3   Relevance of Price Comparison in The Retail Industry

A highly competitive market results in price comparison becoming an essential aspect of modern shopping experience, since an increasing majority of consumers strive to become more informed about the products and their details before making a decision on where and what to shop for [6]. This trend is fueled by e-commerce, widespread mobile internet access and an increasingly high competitiveness in retail market [7]. Using these applications led to retailers being forced to use different pricing strategies, as well as investing in digital technology to provide the customers with the required transparency and comfort [8].

3   ANALYSIS OF PURPOSE-RELATED SOFTWARE

The technology of scanning barcodes has evolved since inventing it. Nowadays, these codes have multiple types, such as the one-dimensional, linear barcodes, the two dimensional barcodes, like QR code and Data Matrix. These codes are scannable with either a special scanning device, a mobile phone or some other imaging devices, which have a software capable of deciphering these codes installed.

While websites with capabilities to track product details do it so using a code from user input, the advent of smart phones with built-in cameras has led to designing applications which are capable of fast scanning of barcodes and then fetching details about the given item. Throughout the years many libraries and APIs have been developed to make integrating such functions into mobile applications easier.

No matter whether the web or the mobile approach is used, these applications could provide crucial functionalities when it comes to the rising trend of barcode scanning and real time price comparison. Soon after realizing this, many companies decided to provide users with solutions with such functionalities. However, to come up with something innovative, we have to understand the background and functionality of already existing software. This chapter will give a comprehensive analysis on multiple similar or functionally related solutions, such as PriceGrabber.com, Google Shopping, RedLaser, PriceRunner, ShopSavvy, and Hungarian ones like Arukereso.hu and Cashmap.hu. Considering these implementations, my goal is to develop an application that will stand out in the competitive market.

3.1   PriceGrabber.com

Established in 1999, PriceGrabber is one of the oldest price comparison services out there. Naturally, back then it started off as a website, but later a mobile application was developed as well. The service lets customers get free price information on millions of products, while getting its profit from countless merchants paying for each lead. In 2005 it was acquired for 485 million USD by Experian and was expected to grow substantially in the next five years [9], then later another acquisition was made by Connexity in 2015 and it has been owned by them ever since [10].

The success of PriceGrabber originates from its ability to adapt through the evolution of the technology industry. Eventually a smart phone application was released, first for iPhones, later for android devices, which enabled the user to access the same functions as from the website. It was designed to host an increasing number of users and allowed them to read product reviews, create a favorite list and compare prices. Laura Conrad, the president of PriceGrabber, stated that this application was developed to remove the

boundaries between online and offline shopping, targeting the growing number of people of mobile shoppers [11].

3.2   Google Shopping

Possibly the best known e-commerce platform, Google Shopping took off in 2002. It has been a major part of the search engine and google ads ever since. Whenever a user searches for something retail related, google gives them the best matches and options alongside with sponsored ads.

On the business side, the target audience is made up mainly from advertisers and sellers, providing them with different methods to promote their goods and services. The service is based on a Cost-Per-Click model, which means that Google gets paid for every click that users make on a company's ad. Ranking is affected by multiple factors, such as relevance to search keywords, how well does it fit into the user search history and last, but not least on how much does a company pay for their product to be ranked higher, in which case google differentiates it with a "Sponsored" flag from the other ads.

From the consumer's point of view, the service provides personalized ads based on factors like demography, search history and interactions with Google services. This kind of personalization ensures relevance and user engagement leading to a competitive, yet rewarding environment.

On the technical note, the service is backed up by Google's robust systems. It is strict with forcing the retailers adhere to Google's policies before letting them post their ads. It uses machine learning models to maximize the relevance for users. Google Shopping also gives a lot of personalization possibilities for the consumers, such as filtering the products, depending on the category, brand and more importantly price. The service also incorporates reviews from multiple sources to assist a better understanding on the benefits and drawbacks of choosing certain products. The process ends with clicking an ad, where Google's business model steps into action and the seller pays them for the successful redirection to their product's page. [12]

3.3   RedLaser

Although it has been discontinued since and taken down from both App Store and Google Play Store, RedLaser, acquired by eBay in 2010 was one of the most popular barcode scanner and price comparison application using various services of its acquirer.

In 2011 RedLaser 3.0 rolled out, with integration of various eBay mobile services, creating a great user experience for shopping based on price comparison. The application

utilized Milo's local inventory data to enable price comparison among online and offline stores and PayPal's mobile express checkout for a secure payments.

Although the earlier versions were well known too, the application's popularity rapidly grew thanks to the new, unique features introduced by this update. These included the ones mentioned in the previous paragraph, along with a refined user interface, which made scanning and creating lists and QR codes much easier. It also enabled users to share categorized shopping carts through Facebook, SMS and e-mail.

In RedLaser's prime it was downloaded tens of millions of times, however, after many years, it could not keep up with the competition and was discontinued.

3.4   PriceRunner

PriceRunner, founded in 1999, is an independent price comparison service offering a platform to help consumers make informed decisions about their purchases in the United Kingdom. Using the service is free of charge and it provides daily updates on millions of products regarding their price and details. Even though the in 2022 PriceRunner was merged into Klarna, PriceRunner managed to keep its core values, which are independence, credibility and unbiasedness, therefore highly contributing to smarter e-commerce decisions. [13]

Much like Google Shopping, PriceRunner uses the model of affiliate marketing [14]. This is commonly known as the Cost-Per-Click model mentioned earlier in Google's case. The service gets paid by affiliated customers after each successful referral. It boasts a unique feature, buyer protection, beneficial for the users in case where the retailer does not meet their statutory obligations. Buyer protection is a free service for all users, providing financial coverage up to five thousand pounds, in case of a purchase from any of PriceRunner's associated retailers. [15]

PriceRunner offers their services both on their website and on their mobile application. Being UK's largest product and price comparison service, it lines up more than 2.6 million products. The app provides the users with smart features enhancing their shopping experience. These functions include but are not limited to using its built-in barcode scanner to find certain items, compare their prices and upcoming deals on the product. It also equips the customer with price alert settings, so that they will be notified about the drops in price. The great user experience is maintained by continuously updating pricing data from thousands of retailers ensuring that the price comparisons are up-to-date. Additionally, users can create lists of certain products they like and monitor their prices and deals on them. [16]

3.5   ShopSavvy

Possibly the best application out there in this topic would be ShopSavvy, developed by Monolith Technologies Inc., which has been around since 2008. It was one of the first applications developed for both iOS and Android. It is available for all popular browsers, such as Microsoft Edge, Google Chrome and Safari as an extension plus as a mobile application for iPhones, iPads and all sorts of Android devices. The service's goal is to provide the user with the best possible prices on all kinds of items, with promoting fairness, being customer oriented and independent. [17]

ShopSavvy evolved from a barcode scanner app to a service that rounds up tens of thousands of retailer partners and covers all aspects of price comparison such as sales, markdowns and coupons to provide the best possible price for the user. It monetizes the platform in two major ways. Firstly, they target users with personalized offers through the service and if this offer catches the eye of the consumer enough for them to make a purchase, the company will earn commission from that sale. Secondly, it generates revenue from advertisers using the platform to reach even more costumers, therefore serving as a mediator platform between retailers and customers. ShopSavvy considers itself as a product search company, with an aim to match the consumers with their desired products for the best possible price. CEO John Boyd explains that the best strategy for competing with giants like Google, Facebook and Amazon is to constantly innovate and come up with unique value propositions. [18]

The company rounds up multiple software solutions for using their service. Meanwhile the browser add-ons are for online shopping, usually for non-essential items, the application shines when it comes to grocery shopping with barcode scanning possibilities. The service itself gathers information from over 30 thousand retailers, both online and physical stores through two methods. Firstly, it partners up with retailers, so they would provide information about prices and sales, secondly it uses web crawling and scraping to find information on products from non-partner stores. The data about items and prices are collected real time, meaning that the user is provided with the most up-to-date information. The search and scraping work using both barcodes and keywords to find accurate results. The hardships of the recent lockdowns forced ShopSavvy to adapt and come up with an in-stock inventory tracking, which lets customers locate hard-to-find items in stock. It offers an easy to navigate platform for users to discover, shop and save. It aggregates product information from a wide-variety of network sources to provide the customer with unbiased data on deals, ratings and reviews. The platform also provides a place for the users to form a mobile shopping community that extends beyond the general concept of such applications. [19]

3.6 Arukereso.hu

Arukereso.hu is a market-leading price comparison website in Hungary with operating in two additional countries, namely Romania and Bulgaria. It started off as a small service maintained by two individuals in 2004, listing and comparing a few items from a few webshops around the dawn of internet shopping. In 2009 it was acquired by Allegro Group, but the current state was established in 2016 when another acquisition was made by Rockaway group. [20]

Arukereso.hu is similar to previous price comparison websites. It uses the same Cost-Per-Click affiliate business model to get revenue from partner retailers or sometimes extra for actual purchases through them. What makes them unique on the market is the fact that it is the best-known website with such functionality in Hungary, where many other companies do not operate yet, coupled with providing an all-around unbiased review system, where users can rate both the product and the seller. This system solves the asymmetry when it comes to cheap prices and questionable sellers and also ensures a more trustworthy line-up of stores. [21]

The previously mentioned review system comes into play after a user makes a purchase. They get asked to provide feedback on the product they purchased along with the seller they bought it from. The ratings are designed to allow replies, that way the stores or other users can clarify reviews in certain cases. The site also provides an option to ask questions about certain products, which paired with the review system provides a platform for a community of mindful customers. An additional layer of trust is provided by a "Trustworthy Shop" badge, which is only achievable with a high number of positive reviews left by actual users [22].

3.7 Cashmap.hu

With unfortunately less public information available comes another Hungary specific shopping assistant, Cashmap.hu. It is a newly launched startup designed to transform the way Hungarians shop. It encourages their users two make well informed and rational decisions about where they shop and what they buy. It provides information on prices and discounts for up-to 9 popular supermarket chains. The service is completely independent, it is not by any means in business relationship with the stores they provide information about. [23]

Their service is a web-based application with features like searching for the desired product and compare prices among multiple stores. The user can also put a personalized shopping cart together and calculate which store offers the best final sum. If the shopping cart contains items the user does not need right away, there is a possibility to move

them into a "Later Cart" to wait for future discounts. The service uses web crawling and scraping, using multiple sources, including in-store surveys, online sale fliers, online store interfaces and internet searches to ensure that the information provided is accurate and up-to-date. [23]

3.8 Conclusion

After a thorough examination of already existing software solutions for this specific problem, it is clear, that the market is somewhat saturated and that there are multiple notably great features implemented in the analyzed applications. However, it is important to mention, that while some have great functions, there are those that do not exist anymore and others, which do not necessarily target the same demographics.

Since the idea for creating this application came from the current situation in Hungary, specifically with grocery shopping in mind, while the international and other region specific implementations are important from a technical point of view, they do not affect the market and target audience in question yet. On the other hand, both of the Hungarian websites mentioned provide features that are on par with some of the ones I am planning to implement. This also encourages a solution for this problem that places the application in a unique spot on the market. A key difference will be accessibility, since the software will be a dedicated smart phone application instead of a generic website solution.

Finally, the following conclusion can be drawn from this analysis. For the upcoming application to be successful among the target audience and in the target market segment, it needs to combine the best of all worlds, meaning that it should line-up a number of features not yet available in our region, build on the existing and well-established model, pay close attention to the reactions and requests of the user-base and adapt if needed. In the upcoming chapter I will carefully develop the vision for this application and its aspects.

4 VISION

4.1 Introduction

4.1.1 Purpose

This chapter serves as an outline for the vision for "BargainScan", an innovative mobile application to help customers save on everyday shopping tasks and to spend on what really matters. This vision will guide the reader through all key aspects of the development of the upcoming application such as opportunities, challenges, target audience, benefits and features of the software. It will act as a reference for all stakeholders involved in the project.

4.1.2 Scope

"BargainScan" is an upcoming mobile application aimed to make grocery shopping a conscious and informed act for Hungarians by providing a platform for scanning and searching for products, comparing the prices across supermarket chains and retail shops, providing calculations on shopping lists in different stores, listing shops sorted by travel distance and affordability and building an aware shopping community in Hungary.

4.2 Positioning

4.2.1 Business Opportunity

The global and local e-commerce and retail market has shown significant growth in the past decade. With the increasing adoption of smart phones into people's everyday life, especially concerning their shopping habits, it is clear that there is an opportunity for developing applications to assist them with these daily tasks. "BargainScan" is aimed to fulfill this mission by offering a comprehensive and versatile solution, equipped with a user-friendly and straightforward interface.

4.2.2 Problem Statement

As stated in the previous chapter (3), while the global market has many solutions for shopping assistants, many lack important features or are implemented as websites which are less accessible than a mobile application. Additionally, even if there are adequate solutions on the global market, they simply are not meant to be used in Hungary, since

they only list products and retailers that are commonly not available in Hungary with many times not even supporting this region.

Currently there are no mobile applications with such purpose on the Hungarian market. On the other hand, there is a series of established that more or less offer useful features for the users, which share the problem of not being accessible enough, especially for older folks, who need a very straightforward way of accessing the software. Moreover, neither of the existing applications seem to offer a solution that covers the whole process of finding the best products and prices and planning the next shopping spree carefully including various factors, for example travel distance or how crowded the place is.

Customer Perspective: They need a comprehensive and intuitive application that helps them find not only the best prices, but also the best way of shopping by filtering out stores that do not fit into their desired characteristics. Additionally, they need a platform where they can build a community to rate and share insights on certain products and sellers.

Seller Perspective: Businesses need a platform to provide their up-to-date information on, therefore reaching potential customers, increasing the likeliness of being chosen by the users and making their prices competitive against other companies.

4.2.3 Product Position Statement

"BargainScan" will be an application designed for money-conscious individuals who seek a comprehensive, clean and user-friendly solution for the stated problem. Unlike existing applications, its primary aim is to cover not only a few, but most aspects of the shopping process, from searching for products through their name or barcode, finding the best prices, filtering shops and products on certain terms, getting personalized recommendations and reading unbiased ratings and opinions on products and businesses.

While realizing all of the features which will make this software a unique solution, it is important to provide an application with a straightforward and easy-to-use interface for the target audience, because accessibility plays a key aspect in the adaption process, hence in the general success.

4.3 Market Analysis

4.3.1 Market Demographics

The growth in the competitiveness of retail and e-commerce led to a situation where customers are overwhelmed by choices, but they are unable to make informed ones due to lack of information about stores and products. The application is aimed to target the individuals with the desire to make conscious decision about their shopping habits. In the table (4.1) below, I will list the key aspects of the target market demographic.

Aspect	Description
Age Group	The target age group is between 12 and 99, comprising Generation Z, millennials, Generation X and even baby boomers, meaning that the application is for everyone that seeks help with making informed decisions. Additionally, the intuitive design of the application makes it suitable and accessible for all age groups.
Income Level	The application can prove to be useful for customers across various income levels, offering features for comparing prices and finding the best deals, which is particularly appealing to middle-income earners.
Geographic Location	The shopping assistant app is primarily targeted towards all areas of Hungary with internet connection and grocery stores available.
Shopping Habits	The primary user base is expected to be mostly made up from millenials and Gen X members, since they are shopping for groceries on a daily basis, are the most comfortable using technological solutions in their everyday routines and value convenience and time saved.
Technological Proficiency	The application will be developed for smartphone users with different levels of technological proficiency. The user-friendly interface is set out to ensure that every individual will be able to wrap their head around the concepts of the application.

Table 4.1: Market Demographics

4.3.2 Porter's Five Forces Analysis

To better understand the competitive dynamics and attractiveness of the proposed "BargainScan" application on the market, Porter's Five Forces analysis will be utilized in the table(4.2) below, encompassing the threat of new entrants, bargaining power of suppliers, bargaining power of buyers, threat of substitute products or services and rivalry among existing competitors.

Force	Impact
Threat of New Entrants	The threat of new entrants is high due to low entry barriers in the app development industry. In case of a successful counterpart for the application could mean serious competition.
Bargaining Power of Suppliers	In the context of a barcode scanner, price comparison and shopping assistant application, suppliers could be businesses whose products are listed. They have low bargaining power as there are numerous online and offline retailers and not being present could lead to missing out on potential customers.
Bargaining Power of Buyers	Buyers have moderate bargaining power. As of now, there are only websites available in Hungary for this specific purpose, with more or less relevant features.
Threat of Substitute Products or Services	The threat is moderate as there are other ways consumers can seek shopping assistance, such as through the mentioned websites, direct e-commerce platforms, but currently there are no Hungary specific applications on the market.
Rivalry Among Existing Competitors	The competition is fierce in the digital marketplace industry, the application needs to provide unique value proposal to be potentially considered instead of other existing solutions.

Table 4.2: Porter's Five Forces Analysis

4.3.3 PEST Analysis

The external macro-environment in which "BargainScan" is set out to operate in can be explored by using the PEST analysis, cosidering political, economic, sociocultural and technological factors. The evaluation of these factors are visible in the table (4.3) below.

Factor	Impact
Political	In Hungary various legal regulations affect data privacy, e-commerce, and internet advertising. Any changes in these policies may impact the operation and strategies of the application.
Economic	Economic factors such as income, unemployment rates, consumer confidence influence the way and frequency people utilize this application, the willingness of businesses to advertise their products through this platform will determine the success of the application.
Sociocultural	The growth of digitalization in every field of everyday life definitely helps the success of the application, since there is a wider spectrum of people who are ready to use their smart devices to make their lives easier. Additionally more and more people aspire to be more conscious about their shopping habits.
Technological	Rapid advancements in technology, such as artificial intelligence, machine learning, and the increasing size of mobile network coverage, can lead to more innovative and valuable features in the application. Cybersecurity on the other hand poses a significant challenge for designing such applications.

Table 4.3: PEST Analysis

4.3.4 Ansoff Matrix Analysis

A great tool for further clarification of the potential success of the application is the Ansoff matrix. The table (4.4) on the next page will study the strategies such as market penetration, market development, product development and diversification.

Strategy	Description
Market Penetration	The application will focus primarily on the demographic of daily grocery shoppers, so it will seek to deepen its influence in this existing market. In order to achieve this, the solution will offer unique features, ensure the best deals and unbiased product reviews.
Market Development	The app will be designed to be appealing to not only daily shoppers but also those who seek to spend their money consciously, by making informed decisions. Moreover, upon a successful adaptation in Hungary, an expansion to other geographic regions is considered part of the long-term plan.
Product Development	The fast paced advancement of technology draws a path for continuous technological developments, such as implementing artificial intelligence, machine learning, etc.
Diversification	Looking towards the future, the application's idea holds possibilities for expanding into other, new markets. Possibly the biggest potential of these opportunities is held by evolving into an application, that much like Wolt or Foodora, would offer delivering the products from an own warehouse or from existing stores.

Table 4.4: Ansoff Matrix Analysis

4.4 Stakeholder and User Descriptions

4.4.1 Stakeholder Summary

The table (4.5) below provides a summary for outlining the key stakeholders involved, highlighting their representation and roles in this mobile application project.

Name	Represents	Role
Users	Individuals seeking a comprehensive shopping assistant	Provide feedback, requirements, test application
Retailers	Businesses offering product information for customers	Provide feedback, requirements, test application, contribute to product and store data collection
Developer	Sole technical expert	Design, develop, test, maintain software solution

Table 4.5: Stakeholder Summary

4.4.2 User Summary

The table (4.6) below provides a summary for defining the potential users involved, detailing the way they might interact with the application and their representative stakeholders.

Name	Description	Stakeholder
General Users	Use the application to scan barcodes, search for products, create shopping lists, provide reviews on items and stores, filter stores based on personal criteria	Users
Researchers	Use the features of the software for market research purposes	Users
Admins	Manage the application data regarding stores, products and users	Users
Retailers	Provide data on their business and goods	Retailers

Table 4.6: User Summary

4.4.3 User Environment

Users are primarily individuals seeking an assistant that helps them make informed decisions about the products they buy and about the businesses they shop at. As mentioned in the user summary (4.4.2), the other types of users are researchers doing market research and retailers, who provide information on their business and products. The goal is to provide a user-friendly mobile application, that implements versatile functionality to fulfill all the important use-cases. The general users are expected to use the application both on the go and at home, while other users will probably use it from an office background.

4.5   Product Overview

4.5.1   Product Perspective

"BargainScan" is a comprehensive shopping assistant application, developed to help making informed decisions for customers across various demographics. Its positioned within the e-commerce market, targeting users with smartphone devices aged between 12-99 years. The application represents a solution for the overload of redundant information in the retail market, leading to customers being able to make conscious shopping decisions, based on their personal preferences and other consumers experience.

4.5.2   Summary of Capabilities

The summary of what functionalities the upcoming application will be able to provide is listed in the table (4.7) below.

Capability	Description
Barcode Scanning	Through its barcode scanning abilities, it can effectively look up details on the scanned products.
Price Comparison	The app ensures users get the most value for their money, comparing prices from multiple retailers and stores in real-time.
Deal Alerts	Users are notified about price drops for items in their shopping list.
Reviews	The app offers access to reviews and ratings on products and shops from purchasers, assisting users in making informed decisions.
Shopping List Management	Users can effortlessly create and manage multiple shopping lists, making planning and buying easier.
Filter Stores	The app is designed to let users filter the recommended shops by factors such as rating, distance, etc.
Upload Store and Product Information	The verified retailers are able to upload information about themselves and their products.

Table 4.7: Summary of Capabilities

4.5.3 Assumptions and Dependencies

This subsection will discuss a few assumptions and dependencies, which were in mind when coming up with the outline for this application.

Assumptions:

– There is an increasing number of money conscious consumers.
– Users can understand and utilize user-friendly applications.
– Retailers are interested in using the platform for sharing their prices and deals.

Dependencies:

– The app is dependent on internet access to provide real-time information.
– The functionality could be affected by changes in the operating system of the device.
– The effectiveness of the price comparison heavily relies on having information provided by both partner retailers and web scraping.

4.5.4 SWOT Analysis

To summarize the information disclosed in the product overview (4.5) section, a SWOT analysis will be utilized to evaluate the strengths, weaknesses, opportunities and threats. This evaluation can be seen in the table (4.8) below.

Category	Factors
Strengths	User-friendly design, covers the whole process of searching, choosing, comparing, filtering products and stores, offers unique features like filtering shops, utilizing web scraping and partnerships with retailers for searching purposes.
Weaknesses	Reliance on web scraping for product and pricing data and competition from either other solutions or integrated shopping assistants in established e-commerce platforms.
Opportunities	Expanding smartphone usage, willingness to let smart devices help our daily life and fast-paced technological advancements in AI and Machine Learning for future development possibilities.
Threats	Fierce competition in the market, rapid technological changes demanding constant product updates, and potential cybersecurity threats.

Table 4.8: SWOT Analysis

4.6 Product Features

The application will come with a broad range of features to ensure the best possible experience when it comes to convenience and clarity. The features walk the user through the process of choosing a store that is the most applicable to the users needs, prioritizing price to value. Each feature will be designed with the main goal being ease of use.

As the development progresses and the use case models will be clear, these descriptions will be updated and discussed in further details. The following table (4.9) lists the key features of the upcoming application, detailed on a level that is generally graspable.

Capability	Description
User Management	Distincts user types and based on the current level provides certain functionality.
Barcode Scanner	Turns the image of the barcode into a code sequence.
Product Search	Searches for the product either by name or by code.
Price Comparison	Creates a sortable list of the shops that are selling the product with price information.
Deal Notifications	Notifies users if items from their shopping cart are on sale.
Reviews and Ratings	Lets users write and read ratings for different products and stores.
Shopping List Management	Lets users create and manage multiple shopping lists.
Store Filtering	Lets users sort stores based on factors like distance from current position
Upload Store and Product Information	Lets the retailers provide documents with their pricing data.

Table 4.9: Product Features

4.7 Constraints

In the context of a shopping assistant mobile application, various constraints could impact the design, development, and implementation.

- **Technological Constraints:** Mobile applications need to be constantly updated to ensure compatibility with the latest versions of smartphone operating systems. Ensuring backwards compatibility might prove to be challenging and resource-intensive.
- **Resource Constraints:** Since it is a thesis work project, limited human resources can slow development down and the number of features that can be implemented will be reduced within the given timeframe.
- **Security and Privacy Constraints:** Since the application will provide possibility for creating different user profiles, sensitive data will have to be stored, therefore the application will need to comply with strict data privacy laws such as GDPR.
- **Regulatory Constraints:** Depending on the country, the application might need to adhere to various e-commerce and data collection regulations.
- **Time Constraints:** Deadlines for project milestones, such as testing phases and project hand in deadlines, might affect the state of the development and the number of features developed, leading to a change of scope.
- **Market Constraints:** The competitiveness of the market can lead to other applications emerging from nothing, or existing ones expanding with important and attractive features.
- **Integration Constraints:** Since the app relies on third-party services (APIs and web scraping), any changes or issues with these can result in unreliable or broken service.

4.8 Quality Ranges

This section will describe the target ranges for various quality aspects crucial to the success of "BargainScan". The characteristics include performance, robustness, fault tolerance and usability.

- **Performance:** The application should open, close and react to user interactions swiftly, handle high traffic, otherwise it will lead to a negative experience.
- **Robustness:** The software should be capable of operating smoothly regardless of the conditions. These can be network disruptions or lower system resources.
- **Fault Tolerance:** The app should be able to tolerate exceptions and errors occurring during operation. These problems could arise from external services, the host device or the software itself.

– **Usability:** The program should be easy-to-use for all individuals, providing a clear and straightforward interface.
– **Security:** Even though sensitive payment and financial details are not being utilized in the application, a safe way of authentication and data storing is of key importance.
– **Compatibility:** The application should work on a series of devices from the newest flagships, to at least 5 years old devices, to ensure availability for a wide target audience.

4.9 Documentation Requirements

This section will describe what documents will be developed along the software development to support a successful application deployment.

– **Release notes:** Release notes will be provided for all versions and updates of the software, describing what is new and what has changed.
– **Integrated help:** There will be an integrated, up-to-date help page in the application, covering the important use cases of the program.
– **Online help:** There will be a dedicated description area discussing the main functionality of the application on the product page of the respective smartphone application store.

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