Bilkent University

Department of Computer Engineering

Senior Design Project

Final Report

Project short-name: GoodBuy

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1. Introduction

With the decrease in agricultural production and the increase in industrial production, people started to meet their nutritional needs by consuming more packaged products. Users find it difficult to read because the contents of the products are written very small. In addition, they may not understand because it contains foreign words. Reading the ingredients section can be a waste of time. This difficulty causes users to be hesitant when consuming products. One of the reasons for this is that the allergenic substances in the contents of packaged foods can negatively affect people. The prevalence rates of food allergies with people vary between 6–10.5%, however current data suggest that the prevalence of this rate is increasing worldwide [1]. Considering this condition all over the world, the number of people allergic to certain substances is quite high. People who have adopted vegan and vegetarian lifestyles are also hesitant when purchasing packaged products. In order to understand whether the product complies with that life requirement, it is necessary to examine the ingredients in detail, and at this stage, users have difficulties. In addition, some users do not want to waste time by examining the product and trying to read small texts to learn the calorie of the product, the national stamps, the place of production and the price. In addition to that, the increase in the consumption of packaged products encouraged people to use the market. It is seen that the same product is sold at different prices in different markets [2]. Users have to visit all the markets one by one and keep in mind the prices of the products in order to be able to shop more economically, and this causes both physical and mental fatigue. The GoodBuy application which we will create allows people to protect their health, save time and make shopping more economical.

This report includes requirement details, final architecture and design details, development and implementation details, testing details, maintenance plan and details and other project elements while implementing the GoodBuy application.

2. Requirements Details

In this section pseudo, non-functional and functional requirements of GoodBuy are provided. Functional requirements are description of service that our GoodBuy application must offer. Whereas, non-functional requirements are specifications that describe our GoodBuy applications' operation capabilities and constraints. On the other hand, pseudo requirements are description of project management & system version control, testing, target platform & user experience, external tools and technologies.

2.1 Functional Requirements

The system should perform following tasks:

- Displaying the menu
- Listing user-specialized suggestions if any
- Listing products to be selected
- Receiving finalized basket
- Receiving camera input
- Communicating with the cloud & receiving related data
- Informing the user for the best options of markets
- Redirecting to a map application to show closest market
- Displaying AR models and outputs on the live camera
- Showing advertisements

The user can/should perform following tasks:

- Scanning the product via device camera
- Choosing the products s/he wants among the product list & adding to the basket
- Learning the ingredients of the products
- Entering the ingredients which s/he does not want and s/he allergic to
- Getting suggestion feedbacks according to her/his past selections
- Being informed about the best and closest market
- Observe any advertisements that are showed

2.2 Nonfunctional Requirements

2.2.1 Scalability

Scalability is an essential component of enterprise software. Prioritizing it from the start leads to lower maintenance costs, better user experience, and higher agility[5]. Since our software is used in markets (somewhere people are in there in their daily life) it is crucial for our project to be scalable as much as possible. In other words, our application has to have the ability to respond to a large number of consumers' requests in the minimum amount of time in order to encourage people to use our app in their daily life. To achieve this, we will be using cloud services that can handle possible large scales of data in the future.

2.2.2 Reliability

Application reliability is the probability of a piece of software operating without failure while in a specified environment over a set duration of time. In a perfect world, a reliable piece of software is completely defect free, does not create downtime, and performs correctly in every scenario[6]. Since our project's goal is to be used in one of the most important activities in people's daily life, it is urgent for our project that all functionality and features run smoothly and accurately. Unity and cloud servers give us enough opportunities for achieving a high reliability in our project.

2.2.3 Availability

Application availability is a measure used to evaluate whether an application is functioning properly and usable to meet the requirements of an individual or business[7]. We are not designing or developing this project for a company or business. However, Bilkent University is asking about a requirement report in which we should specify all functionalities.. Therefore, we are doing our best to design and develop all functionality with high accuracy and lowest fault.

2.2.4 Maintainability

Understanding software maintainability allows organizations to identify improvement areas as well as determine the value supplied by current applications or during development changes[8]. Since we want to be nominated for at least one of the prizes in the CS Fair, we have to design and implement our project as maintainable as possible. Therefore, high maintainability of the project helps us to make changes and add features easily in order to make our app more and more powerful. We can achieve high maintainability by having a

perfect software architecture. Hence, we are planning to have meetings with software architecture experts for deciding our software architecture in different parts of the project.

2.2.5 Security

Since we are storing images, users' information and their medical information, security is one of the most important non-functional requirements for our project. Therefore, we decided to use Firebase which is reliable and highly secure for storing this information. Furthermore, for storing images we are using Vuforia's cloud servers hence, our data will be highly secured there by Vuforia.

2.2.6 Usability

The interface of the application will provide necessary and sufficient features to give the best user-friendly experience to the users. It will consist of accurate images of the products, different language options and simplistic design.

2.3 Pseudo Requirements

2.3.1 Project Management & System Version Control

- For reports of application we are using Google doc which helps all members of the group working on the same documents and they are able to read and check the information which is provided throughout the report. Therefore, by getting help from Google doc we can easily manage our information which is provided in the report.
- For managing the different versions of the system and updating the application we are using GitHub.

2.3.2 Testing

- Each member has to create a couple of test cases in order to test and make sure of the accuracy of the assigned part to them.
- Alpha and Beta environments are considered for testing and controlling the accuracy of the whole application. For this reason different groups of people with different backgrounds are chosen for testing the application.

2.3.2 Target Platform & User Experience (UX)

- For the administrator part in order to control some information through the application we are planning to run it on the web.
- Clients can run our application on IOS and Android.

2.3.2 External Tools and Technologies

- For chatting and sharing the information among the members Whatsapp is used.
- For online meetings, the Zoom application is used.
- For designing the UML diagrams, Lucidchart and Visual Paradigm are used.
- For designing the user interface, UIzard website[6] is used.

3. Final Architecture and Design Details

GoodBuy's architecture and design consists of 2 different databases, 1 main application that is built in Unity and 1 another application that is managing one of the databases and searching markets and prices of the products.

3.1 Unity Application

GoodBuy's unity application is the main application that users interact with. In this side of the project 2 different design patterns are used. One of them is singleton design patterns that are used for UserManager, ProductManager, AudioManagers, ShoppinglistManagers. The other design pattern is the MVC. In this application we seperated model, view and controller from each other. We used Unity's ready to use dropbox and some of the UI elements to show allergies, shopping lists and products. This application connects with two of the databases. It uses Vuforia AR Engine to find items that are uploaded as images in Vuforia Cloud Databases. On the other hand, for getting prices and details of the products this application connects with a database that is controlled by the other application that manages prices, products and their details. For the user information storage, we used Google Firebase Realtime Database. This database includes both user information and product details. Detailed information about it will be provided below.

3.2 Product Analyser Application

Product Analyser application is the application that searches 8 different markets that are specified by us and finds prices of the products, made in locations and ingredients of the products. After this application gets these specified information by analyzing 8 different markets' websites, the application updates Google Firebase Realtime Database. Because this information should be accessible from the Unity application. We have chosen Google Firebase Realtime Database because it is a NOSQL database that provides an easy to use and quick way of storing data. This application uses Selenium standalone to go into markets and analyze prices. Selenium standalone is controlled by a program that is coded in Python language and this python program connects this information with Google Firebase Realtime Database.

3.3 Vuforia AR Engine & Cloud

Vuforia AR Engine is used for searching products from their images. We used Vuforia Cloud Database to upload our products' images. Vuforia AR Engine is compatible with Unity and its API is easy to use. Therefore we used Vuforia AR for Image recognition. Vuforia's Engine was firstly analyzing the images of products that we have uploaded. After opening the camera of the Vuforia AR Scan Camera, Vuforia Engine searched for objects with similar details of photos that are uploaded on Vuforia Cloud.

3.4 Google Firebase Realtime Database

We used Google Firebase Realtime Database to store product name, ingredients, market prices and made in the country. On the other hand, we used the same database to store user information and allergy, prohibited preferences. In this database there are two main nodes. One of them is the user node that is responsible for storing user information and the other one is the product node that is responsible for storing product information. We used Google Firebase because easy to implement on both Unity (C#) and Python. Its user node is managed by Unity application. The Unity application both reads and writes user information and just reads the product node that includes product information. The product analyzer application both reads and writes the product node of the database. The other reason for why we have chosen this database to use is that it was free to use and a very quick database. The information that is sent to it is written in a very short amount of time.

4. Development/Implementation Details

In this part, GoodBuy mobile application, product price analyzer program details will be explained separately. Vuforia and Google Firebase implementation and development details will be explained inside of these parts.

4.1 GoodBuy Mobile Application

GoodBuy mobile application is developed using Unity's 2021.3 version. Pages of the application are built by using Unity scenes. For each new page, new scenes are added to the system. Users are interacting with these scenes and use functionalities. In order to implement functionalities we needed UI elements therefore we used Unity's dropdown and button systems. We coded new scripts for controlling buttons and dropdowns. We developed 16 different scenes for users and for each of them multiple number of UI interaction elements are developed. For unity, these scripts are coded by C# language that we were already familiar with. We faced different problems while using Unity and developing our application. One of them was, after each scene change objects were destroyed by Unity. Therefore we needed some managers to be staying until the application closes. In order to solve this situation, we used Singleton design patterns. Thanks to that, we could reach all of our managers from any scene that we want. While developing the application we used GitHub for the version control system. We tracked bugs and the todo list from Github too. For the tests, we applied manual testing for our mobile application.

4.2 Product Price Analyzer Program

For this application we have chosen to use Selenium. In order to use Selenium we needed to choose one of the software languages that Selenium supports. Therefore, we have chosen Python that is easy to code for us. We have chosen Python 3 to code because we were familiar with this version of it. In order to run Selenium on Python, we needed to use Google Chrome Webdriver. In our servers we had Chrome version 101.04, therefore Webdriver of Chrome downloaded with the same version. After that, we implemented our Selenium by using our downloaded Chrome Webdriver on Python 3.0. In this part, each markets' website was analyzed by us and where they located their price and description of the products are specified. After that links of products that our application supports are found one by one and they are added to the list of our product list. For each of these links Selenium opens the our webdriver and goes to links. After that, it gets prices from links and

adds the information into our Google Firebase Realtime Database in order to use in GoodBuy Mobile Application.

5. Testing Details

In order for our project to work smoothly in its implementation, we had to test every new feature added. So, we used GitHub to provide version control. We have done bug and performance tests in every version of the application.

There are two servers in our project. One of these servers is for user information and the other is the Vuforia cloud server where the photo information of the products is. In order to make sure that our servers are working correctly, we scanned the products we bought from the market and tested whether they matched correctly on the server. In addition, we performed password, authentication and verification tests for the server containing user information.

6. Maintenance Plan and Details

After the application is launched on the market, we plan to receive feedback from users about the changes that may occur in the package designs of the products. These feedbacks will consist of photographs with certain standards and text boxes containing possible information changes of the product.

We would also like to receive feedback for upcoming versions of the app. For this reason, we expect to receive requests for new features, themes or debugging from users. We would like to plan new releases based on these future suggestions and criticisms.

In the scenario where the application expands considerably, our database will reach a level that can be used to find the scanned product. In order to overcome this situation, we are considering creating user-specific filters that will run in the background. These filters will speed up the search by prioritizing products with the same keywords as the products the user has previously scanned.

7. Other Project Elements

7.1 Consideration of Various Factors in Engineering Design

Following topics are the factors that can possibly be affected by our project.

7.1.1 Security Concerns

Since we collect personal information from our users, the security of these data will be crucial. We will be following most accepted regulations such as GDPR so that users can trust the product. In addition, we use the GPS data of the user and the supermarkets in the application. Thus, there will not be any sharing of location data of the users to the servers for the sake of best security. We will be setting the boundary of security tight so that there cannot be any leakage.

7.1.2 Public Health and Sustainability

We are basically developing an application where you can see the ingredients of a packaged product so this means we make it easier for users to detect the best option for them. This best option could be in terms of price and health. Presenting a better option is an example of sustainability since there will be less consumption of unwanted products. According to our estimates, in the long term, extensive use of this application will cause a positive effect on public health.

7.1.3 Communication and Sustainability

In our application, we will be implementing a feedback loop for the renewal and addition of products that come from the users. This will provide a sustainable environment for our continuing system. In addition, we will be adding an extra language option for the menu and context since all the tourists are our possible customers. This feature will bring a variety to the communication inside the application.

7.1.4 Social Factors

GoodBuy has no apparent factor on gender, age, weight, height or race. Our application can be used by any individual of society.

7.2 Ethics and Professional Responsibilities

GoodBuy is an application that can guide people's shopping. Therefore, information about the products should be gathered from reliable sources. Because of the fact that, ingredients of the products are gathered from Migros which is a large company that has been serving in Turkey since 1954. On the other hand, information about consumers should not be in a reliable database. Google is one of the most reliable companies that cares about security vulnerabilities. Therefore, we have chosen Google Firebase Realtime Database to store people's prohibited ingredients and allergens.

People create shopping lists and search for products on our mobile application. This information should not be gathered to risk it. Therefore our application does not track users who searched which product and their shopping lists. The data is kept in users' local storages that we found the safest place to store.

7.3 Judgements and Impacts to Various Contexts

Judgement Description	Application should be free and available for both iOS and Android	
	Impact Level	**Impact Description**
Impact in Global Context	4/5	More people use the application, the more people make smart purchases.
Impact in Economic Context	5/5	More people use the application, the more people spend their money smarter.
Impact in Environmental Context	5/5	More people use the application, the more people avoid buying products that will harm the environment and themselves.
Impact in Social Context	0/5	This judgement of GodBuy doesn't have any social impact.

Judgement Description	Application should recognize images of products instead of QR codes.	
	Impact Level	**Impact Description**
Impact in Global Context	2/5	In local markets QR codes may not

		be available or finding QR codes can be hard.
Impact in Economic Context	2/5	This judgement may help to remove QR codes from products and shelves and to use these areas more effectively.
Impact in Environmental Context	0/5	This judgement does not have any environmental impact.
Impact in Social Context	4/5	Finding QR codes could be needed touching products instead of just showing the front face of the product, which can increase the risk of increasing epidemic diseases like corona.

7.4 Teamwork Details

In this part we are going to inform teamwork details in separate parts. We are going to describe contributing and functioning effectively on a team, helping create a collaborative and inclusive environment, taking the lead role and sharing leadership on the team, meeting objectives, new knowledge acquired and applied.

7.4.1 Contributing and functioning effectively on the team

In the beginning of the project we divided team roles and prepared a table for each of the responsibilities. All of the team member's responsibilities were assigned before starting the implementation of the project. All of our roles and responsibilities and concerns can be found below.

Role	Project Manager
Participant(s)	Turan Mert Duran
Responsibilities	- Analyzing business requirements and determining the source of the project. - Planning the work schedule, assigning tasks to team members.
Concern(s)	Working to increase the efficiency of

	the software process and reduce its cost. ● Providing continuous information about software activities to upper units.

Role	Software Architect
Participant(s)	Radman Lotfiazar, Turan Mert Duran, Asım Güneş Üstünalp
Responsibilities	● Selecting the technologies to be used in the project. ● Advising on project methodology and processes. ● Creating and maintaining the overall design structure of applications
Concern(s)	● Evaluating the appropriate ones in project parameters such as quality, technique, time and scope. ● Checking whether the project is at a sufficient level. ● Testing and approving coding practices and standards.

Role	Software Designer
Participant(s)	Radman Lotfiazar, Pelin Çeliksöz
Responsibilities	● Designing the system before the implementation by following the requirements. ● Participating in troubleshooting and planning for a software solution to a problem.
Concern(s)	● Evaluates the software in terms of usability, reliability, maintainability, and compatibility.

Role	Software Developer of Unity Mobile App
Participant(s)	Turan Mert Duran, Asım Güneş Üstünalp
Responsibilities	● Talking and working with users to

	- understand user needs for the software. - Following the current processes closely. - Understanding the system needs related to the software.
Concern(s)	Ensures the design and maintenance of the software system is followed within the framework of engineering principles.

Role	User Interface Designer
Participant(s)	Pelin Çeliksöz, Ömer Faruk Kayar
Responsibilities	- Identifying the target audience by finding user lifestyles and characteristics - Creating an Interface Design scheme, which is a schematic representation of the application.
Concern(s)	Adaptation of user interface design based on development results and feedback.

Role	Front-end Developer
Participant(s)	Pelin Çeliksöz, Ömer Faruk Kayar, Asım Güneş Üstünalp
Responsibilities	- Implementing user-friendly interfaces. - Designing mobile-based features. - Creating solutions by receiving feedback from users and customers.
Concern(s)	- Writing reusable content modules and ensuring the maintainability of the code. - Optimizing mobile applications to achieve maximum speed. - Following best practices and standards to ensure cross-browser compatibility and accessibility

Role	Back-end Developer
Participant(s)	Turan Mert Duran, Radman Lotfiazar, Asım Güneş Üstünalp, Pelin Çeliksöz
Responsibilities	● Programming the actions of the mobile application performed by the server. ● Implementing the back-end part of the application.
Concern(s)	● Adding required databases and every other field interconnected, without interruption and without confusion.

Role	System Integrator
Participant(s)	Turan Mert Duran, Radman Lotfiazar, Ömer Faruk Kayar
Responsibilities	● Working around software solutions that are prebuilt and can be integrated into the enterprise with minimal customization.
Concern(s)	● Integrating the software application into business processes and determining whether the required efficiency is achieved from the implemented solution.

Role	Quality Control Engineer
Participant(s)	Radman Lotfiazar, Asım Güneş Üstünalp
Responsibilities	● Controlling the development process.
Concern(s)	● Identifying and correcting the overlooked stages during the development.

Role	Research & Development Engineer
Participant(s)	Pelin Çeliksöz, Ömer Faruk Kayar
Responsibilities	● Taking actions on cost improvement

	or prolonging the life cycle of existing products.
Concern(s)	● Managing new design and product processes.

7.4.2 Helping creating a collaborative and inclusive environment

As we mentioned before, we have prepared a detailed table about who will be doing what and their responsibilities. It helped us to divide tasks and work in a collaborative environment. After that we divided tasks into weeks and prepared a chart that can be seen below. We tried to stick to these plans and this helped us not to delay our work.
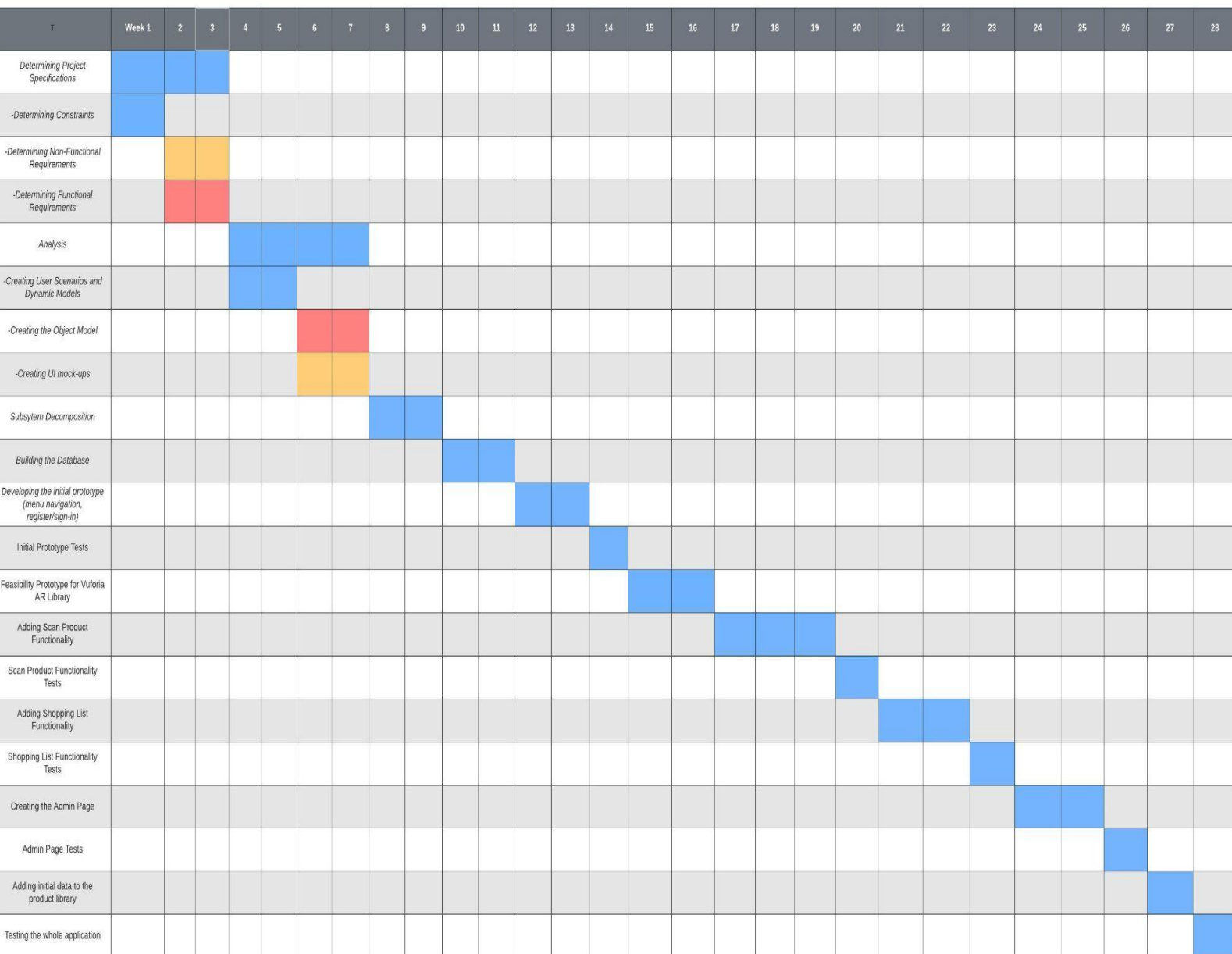
T	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Determining Project Specifications	█	█	█																									
-Determining Constraints	█																											
-Determining Non-Functional Requirements		█	█																									
-Determining Functional Requirements		█	█																									
Analysis				█	█	█	█																					
-Creating User Scenarios and Dynamic Models				█	█																							
-Creating the Object Model						█	█																					
-Creating UI mock-ups						█	█																					
Subsytem Decomposition								█	█																			
Building the Database										█	█																	
Developing the initial prototype (menu navigation, register/sign-in)												█	█															
Initial Prototype Tests														█														
Feasibility Prototype for Vuforia AR Library															█	█												
Adding Scan Product Functionality																	█	█	█									
Scan Product Functionality Tests																				█								
Adding Shopping List Functionality																					█	█						
Shopping List Functionality Tests																							█					
Creating the Admin Page																								█	█			
Admin Page Tests																										█		
Adding initial data to the product library																											█	
Testing the whole application																												█

Figure 1: Weekly Tasks To Do Table

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7.4.3 Taking lead role and sharing leadership on the team

In the beginning of the project, we assigned Turan Mert Duran as the project manager. He was the person who brings other people of the group together. After that, as we specified in contributing and functioning effectively on the team part we shared leadership on different tasks and different responsibilities were assigned to different group members. All of us stuck to our responsibilities and tasks. Dividing tasks into pieces and dividing leadership for each thing helped us to maintain development of the project. Thanks to that, everyone put in almost equal effort on the project.

7.4.4 Meeting objectives

Because we have already defined weekly tasks and things to do, we knew the meeting objectives before the meetings. Meeting objectives can be seen from the "Weekly Tasks To Do Table" figure 1. In each meeting, we were starting with talking about what we have done so far and what we need to do until the upcoming meeting. We were talking about who is responsible for what and what should be done until the next meeting. Thanks to that, we did not lose so much time wasting with specifying meeting objectives.

7.5 New Knowledge Acquired and Applied

We did not know how to implement our idea before starting the project. We started with our idea and thought about how we would implement it. We started by doing research about Augmented Reality and how we can implement it. We found different AR libraries and engines. However we needed to implement AR into mobile applications, no one of us had experience with developing mobile applications except Unity. We found Vuforia AR supports Unity and because some of us have learned before Unity, we decided to move to developing the project on Unity. All of us learned how AR works and how to implement Vuforia AR. After that, we needed to learn a technology & library to search market prices on the internet. After taking the Verification & Validation course in Bilkent University, we have learned a new technology that can help us to automatically get market prices from the internet called Selenium and we understood that Selenium could be used for getting market prices on the internet. Therefore, we used Selenium which can be counted as new technology for us.

# 8. Conclusion and Future Work

8.1 Conclusion

GoodBuy is a mobile application that helps the people who want to buy packaged products, take care of their health, save time and money while shopping. GoodBuy application identifies the objects by using AR (artificial intelligence) and cloud-based, real-time object recognition engine. When the camera of the App is pointed towards the packaged product, information about the product is displayed along with user-specific alerts. It can be seen how much the price of the shopping list created through the GoodBuy application will be in all markets in the selected location. By looking at the price of products on different markets, the user can choose the most suitable market. As a team, we have learned lots of new things, terminologies and technologies while doing this project.

8.2 Future Work

Until now, we have introduced a small number of products to our system. We are planning to add all packaged products to our system in the future. On the other hand, we want to show nearby markets from our application and we want to send customers directly from our application to markets' locations by using Google Map. Another thing that we are planning to do is user participation by adding new products. We want to develop a new server and database for getting new product requests from users. It may help us to maintain the application with new products. Another thing that should be considered is better UI elements. We are planning to hire one graphic designer to improve our applications' UI elements.

9. User Manual

9.1 Welcoming Page
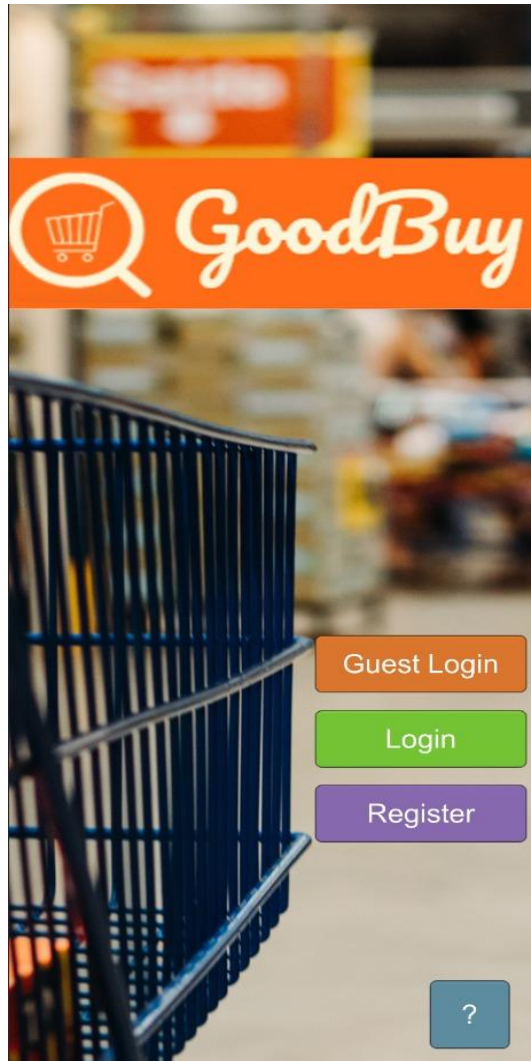
This is the page which welcomes users when they just run the application. There are 4 different actions that can be applied.

1) Guest Login: If the user presses the guest login, the user can use the functionalities of our application without registering the application.

2) Login: If the user presses the login button, the user can go into the login page.

3) Register: If the user presses the register button, the user can go into the register page.

4) About Us: If the user presses the question mark button, the user can go into the about us page.

9.2 About GoodBuy Page
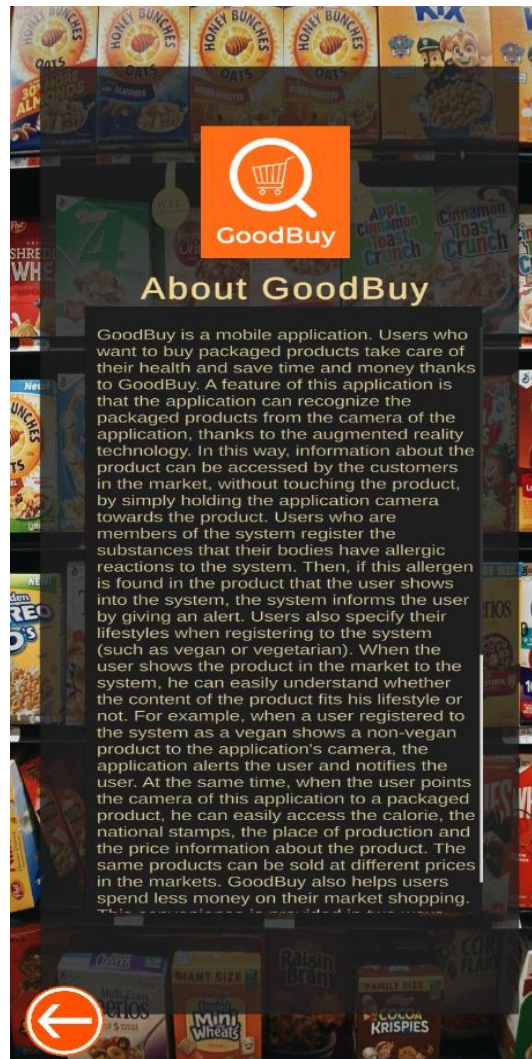
This is the page which gives information about the application.

9.3 Register Page
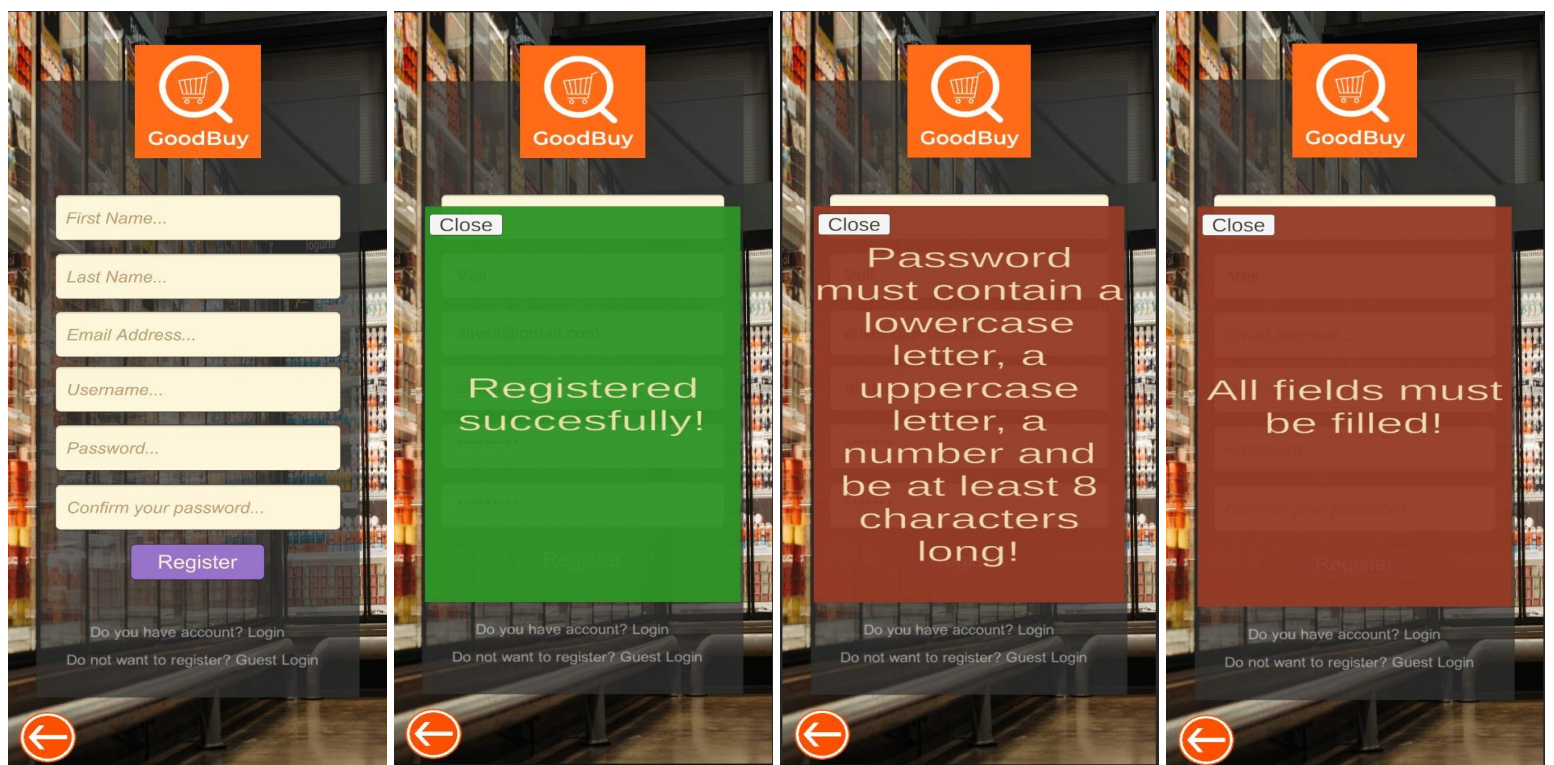
This is the page which provides registration to users after filling blank areas and pressing the register button.

9.4 Login Page
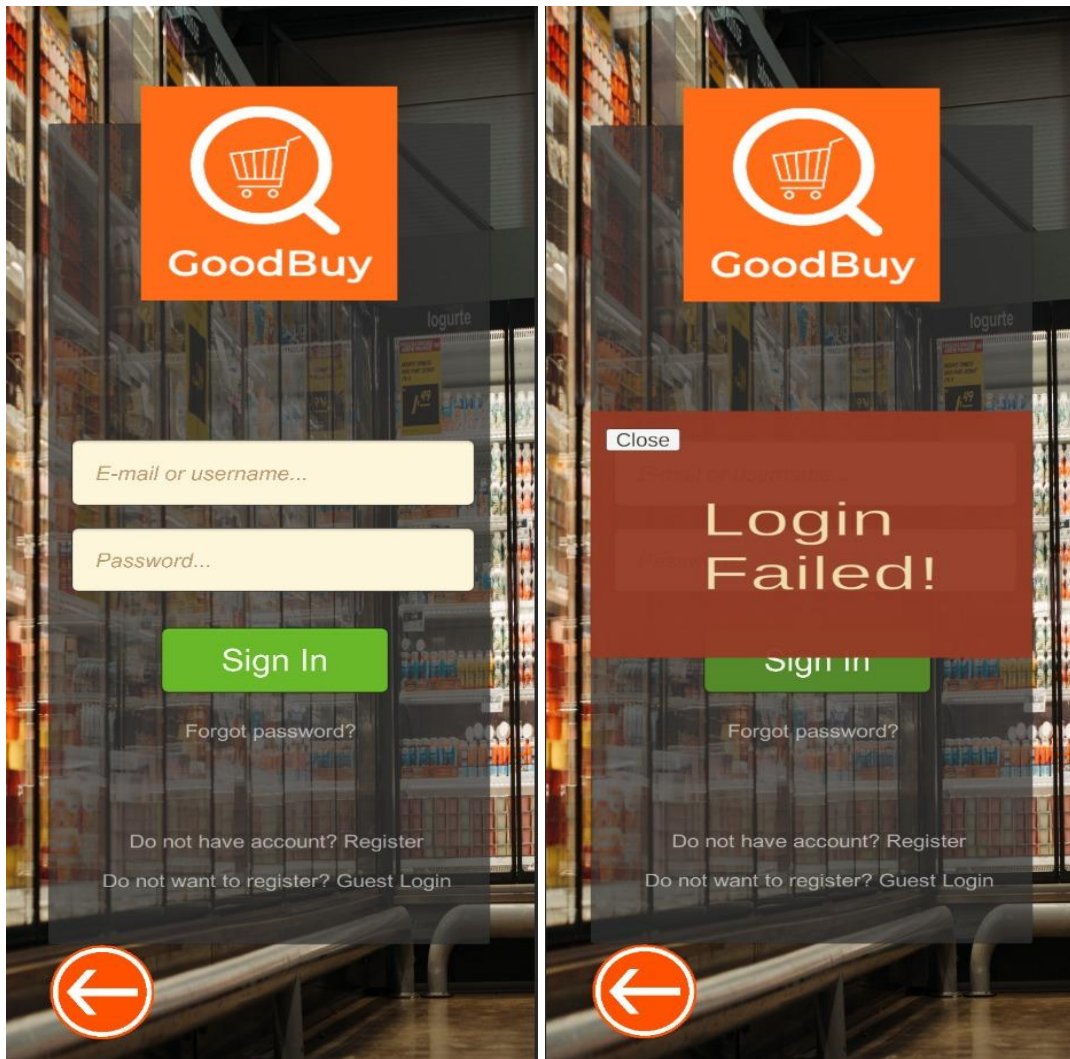
This is the page which enables users by entering their account. Email or username and password should be entered before pressing the sign in button.
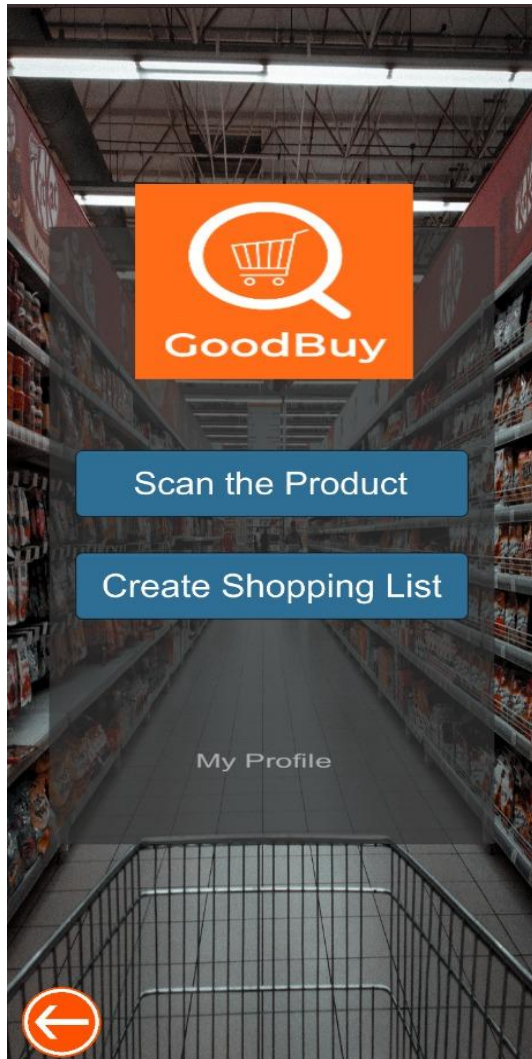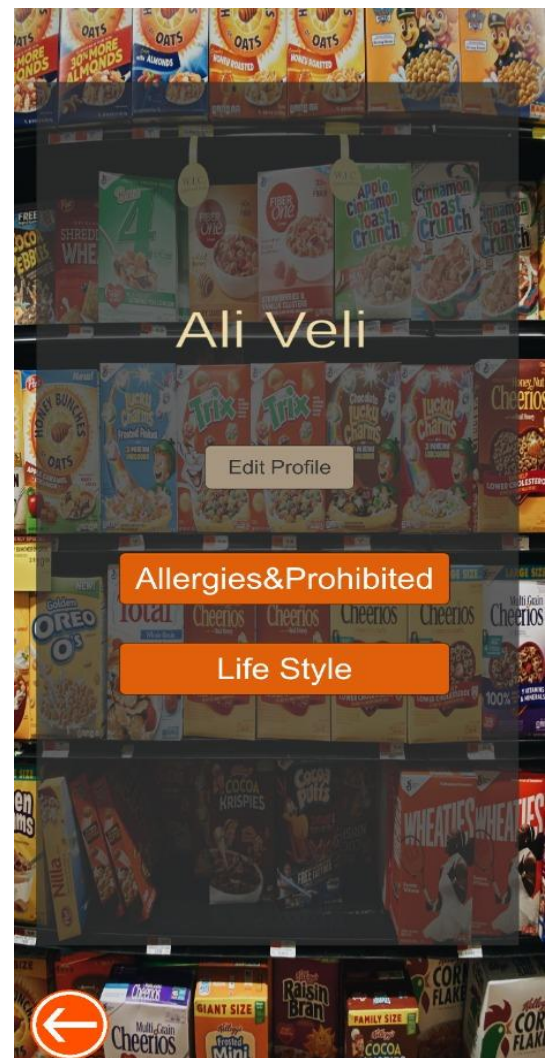
9.5 Home Page

This is the page which welcomes registered users. There are 3 different actions that can be applied.

1) Scan the Product: If the user presses the scan the product button, the user can go into the scanning page.

2) Create Shopping List: If the user presses the login button, the user can go into the create shopping list page.

3) My Profile Button: If the user presses the my profile button, the user can go into the profile details page.

9.6 Profile Details Page

This is the page which provides editing profile functionalities. There are 3 different actions that can be applied.

1) Edit Profile: If the user presses the edit profile button, the user can go into the edit profile page.

2) Allergies&Prohibited: If the user presses the allergies&prohibited button, the user can go into the specified user allergies and prohibitions page.

3) Life Style: If the user presses the life style button, the user can go into the life style specification page.

9.7 Edit Profile Page

This is the page which allows the user to change his/her information like name, last name, password etc. after pressing the save button.

9.8 Edit Allergies & Prohibited Items Page

This is the page which allows the user to add their allergies and prohibitions into the system. The dropbox above is used for adding new prohibitions to the system. Users' allergies and prohibitions can be found on the middle table. The dropbox below the page is used for removing items.
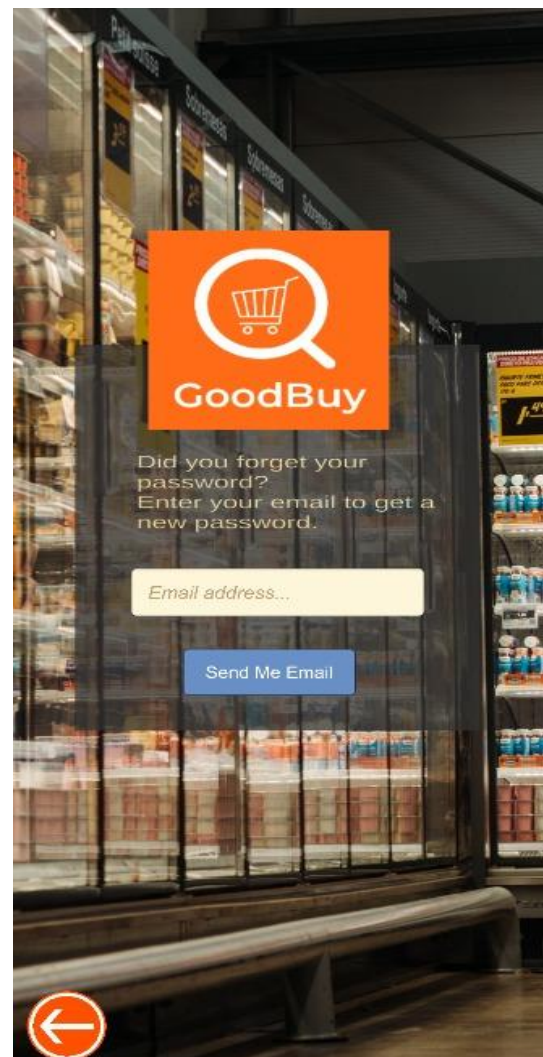
9.9 Edit Lifestyle Page

This is the page which allows the user to add vegan or vegetarian preferences by just clicking buttons.

9.10 Forgot Password Page

This is the page which allows users who forgot their password to send them an email to reach their accounts again.

9.11 Scan Product Page

This page opens user camera and searches for items that are scanned by users. After founding item, if the item does not include any of user prohibited and allergens it gives response like photo on the left. If the item includes any of user prohibited and allergens it gives response like photo on the right. After pressing go to product page, users can go to product details page.

## 9.12 Product Details Page

This page shows product information that is scanned by users. If the product includes any ingredients that are prohibited to user, the user sees the left page. If the product does not include any ingredients that are prohibited to user, the user sees the right page. Ingredients, market prices of the item and made in location can be found on this page.
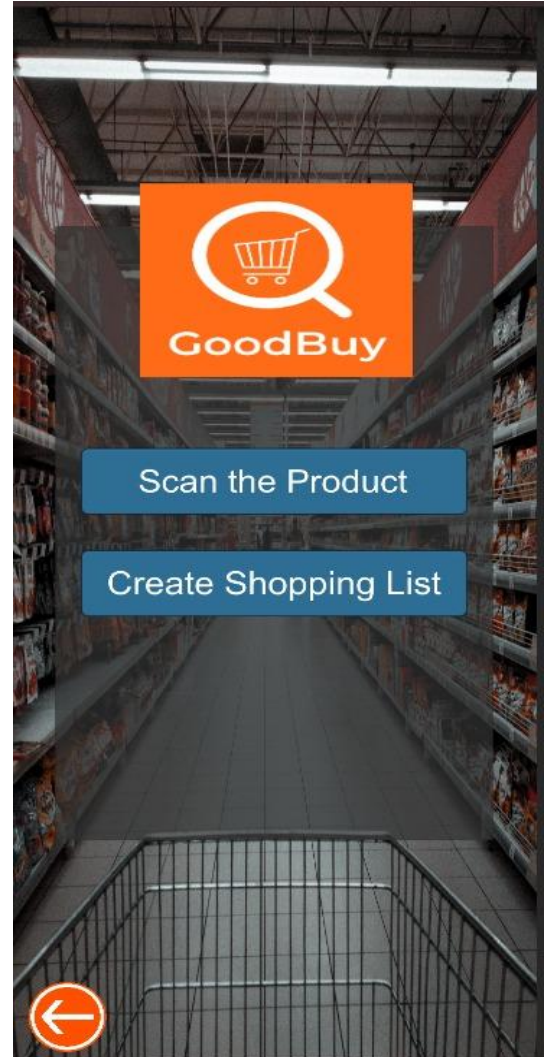
9.13 Shopping List Page
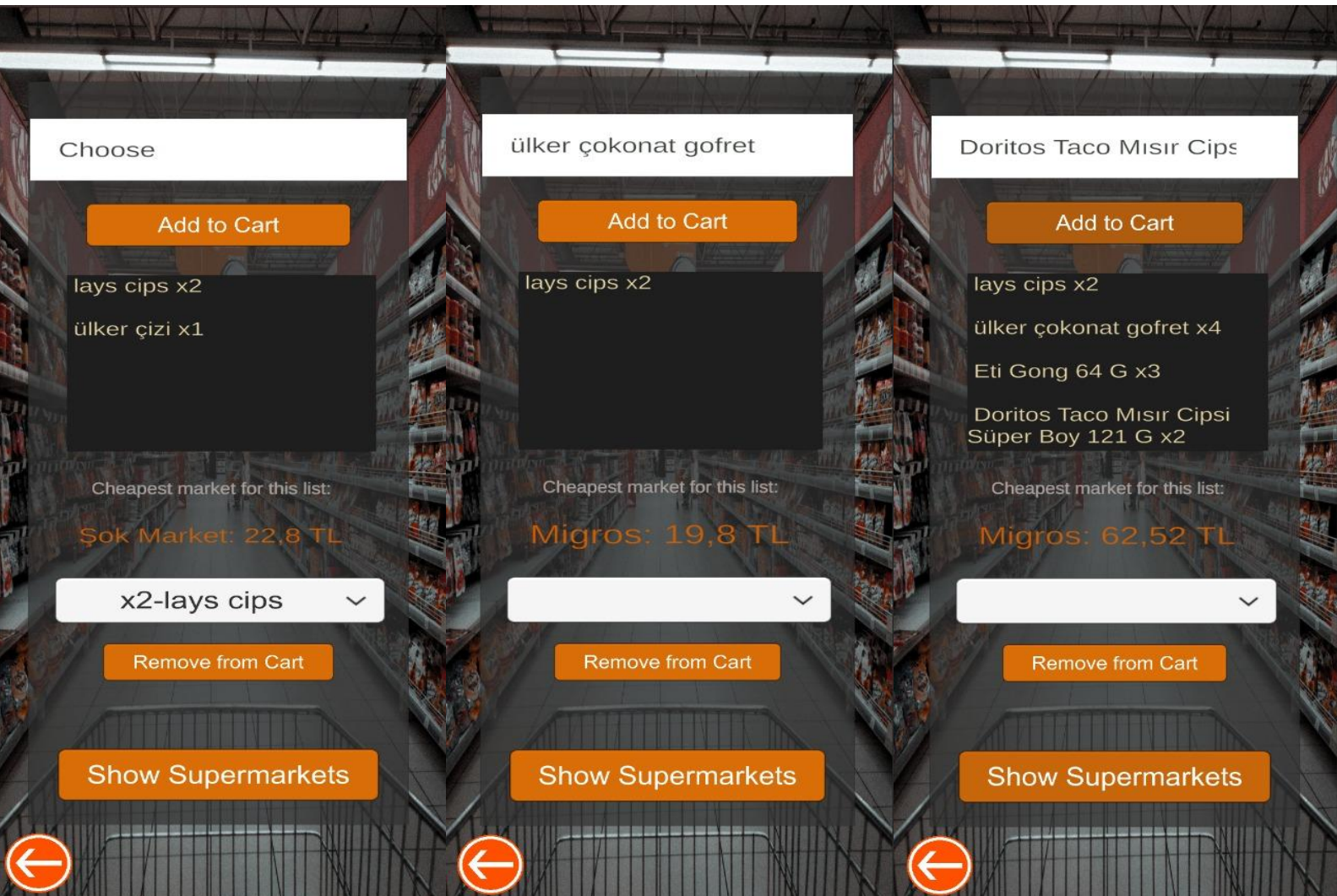
This page allows users to create shopping lists for the user. Items can be added by using searchable dropdown above and pressing add to cart button. Cart can be seen in the middle of the page with a list. Cheapest market for the list and price can be seen below that table. The dropdown below can be used for removing items from the list by pressing remove from cart button. Below that show supermarkets button allows users to go into show supermarkets page.
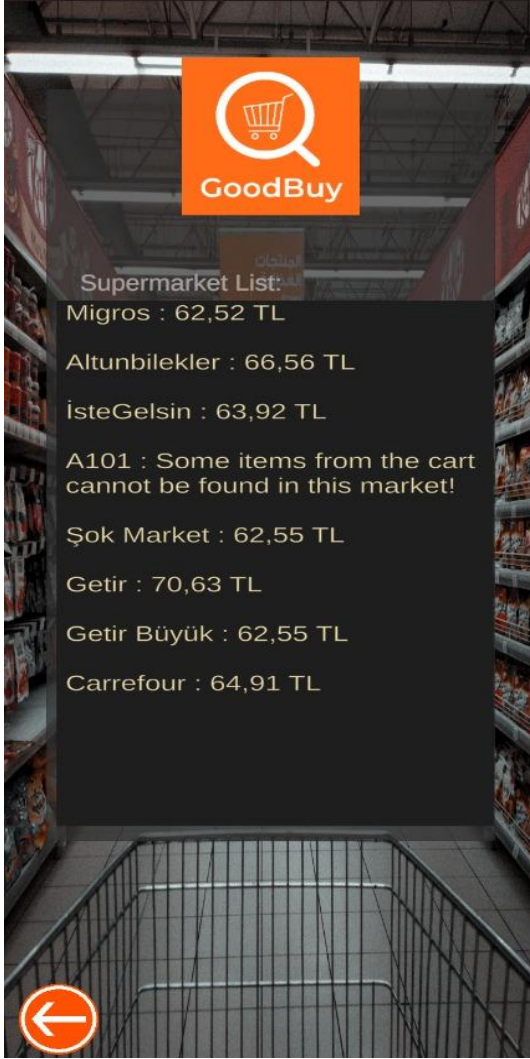
9.14 Supermarkets Page

This page shows supermarket prices of the shopping list that is created by the user.

9.15 Guest Welcoming Page

This page allows guest users who did not register the system to use some functionalities of the application like scan product by pressing scan product button and create shopping list by pressing the button create shopping list.

10. Glossary

AR: Augmented Reality

App: Application

GDPR: General Data Protection Regulation

GPS: Global Positioning System

11. References

1. J. Jiang, C. M. Warren, and R. S. Gupta, "Epidemiology and racial/ethnic differences in food allergy," *Pediatric Food Allergy*, pp. 3–16, 2020.

2. H. Görg, L. Halpern, and B. Muraközy, "Why do within-firm-product export prices differ across markets? evidence from Hungary," *The World Economy*, vol. 40, no. 6, pp. 1233–1246, 2016.