Bilkent University

Department of Computer Engineering

Senior Design Project

InPackt

Project Specifications Report

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1. Introduction

After the industrial revolution, the number of packaged products has increased drastically. Nowadays markets are full of packaged products and comparing the products is a time consuming activity in our lives. Reading the table of contents for each product we bought, understanding chemicals in the product and deciding which one to put into the shopping cart became a growing problem as the chemicals and number of packaged products increased.

Health is without question the single-most important value in life. Without sound health, nothing else can be important. Therefore, great importance must be given to how we fuel our bodies. Many food items, especially packaged ones, contain additives that the average person is not even able to pronounce, let alone know the effects. People need to be educated about these ingredients in order to make informed choices about their most basic need.

Based on these issues, InPackt will offer a quick and healthy shopping experience and help to compare between products. Thanks to algorithms and developing technologies, we can compare and decide the best products for us without looking at their table of contents directly. The user only needs to point their phone camera at the product and InPackt will take care of everything from there. It will display to the user the ingredients, packaging information, dangerous content warnings as well as similar product recommendations based on user preferences.

1.1 Description

InPackt will be a mobile application developed for android and iOS users and will be available in Google Play Store as well as the App Store. InPackt will enable users to eliminate risky products specifically catered for them by scanning the product's package to see the harmful ingredients and further information about the contents. Aforementioned products can be of the types food, and if time and resources allow us, cosmetics, cleaning products or supplements.

The determination of the "risky" product or ingredient will be customized depending on the choice of the user. Customization can include specific unwanted ingredients, allergants as well as products that are gluten or lactose free, vegan, vegetarian or halal. The goal of our project is to provide an easy way to see the ingredients of the market products and shorten the decision process of choosing between products by individualized ingredient detector. A user will be able to look at alternative products to the one that they scanned depending on their customization criteria.

InPackt will also present the container type and information of any product with a package to further inform the user. If they want, the users will be able to factor in the sustainability and the recyclability of the packaging in their recommendations.

In the product information page, among the ingredients and container type, there will be calorie specifications as well if the product is a food, and the user will be able to choose to be recommended lower-calorie items.

InPackt will utilize real-time object recognition in order to identify the product. The user will point their camera toward the product and the recognized item will pop up

on the screen. If time and efficiency allow us, we want to implement an Augmented Reality feature so that the instant that the app recognizes a product, it is displayed on the user's screen on the product. The object recognition is the main focus, and if it fails, the writings of the package will be read to match with a product. If that fails as well, the options of voice command, barcode scanner or manual product entry will be displayed.

The project will definitely be available for users in Turkey, in Turkish and English, and if the time and technology is sufficient, be available for users worldwide in English. The products will need to be searched in their own language, however apart from that the app can be used in both languages.

1.2 Similar Applications

Similar applications to our project are discussed in this section, as well as what makes our project different and unique.

1.2.1 Open Food Facts

Open Food Facts is an open-source, worldwide, collaborative project that aims to store information about branded food such as its ingredients, nutrition facts, and packaging, organized and divided by country [1]. In fact, since it is the largest and most comprehensive database available to us for our country, we will use this project as a source for our database. The app of this project includes a barcode scanner for identifying a product, whereas our project will use real-time object recognition to

identify the product. Furthermore, it does not include personalized recommendations or specific needs. Also, as the name suggests, this project only focuses on food items, whereas ours has a larger scope.

1.3 Constraints

The following sections divided into implementation, economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability discuss the related constraints.

1.3.1 Implementation constraints

- Jira and GitHub will be used for project management, source control and code review.
- The frontend will be designed by Flutter because the application will be on both IOS and android.
- Object Recognition will be implemented based on TensorFlow Lite [2].
- The backend will be implemented by Python [3] because we will use libraries for python and google APIs
- The product data and object images which are used for object training are stored in PostgreSQL [4].
- The product data will be obtained from the source by parsing.

- To get a high percentage of correct recognition, the training object data will be compared by Google image search by Google Cloud [5] or Google's Custom Search JSON API [6] .

1.3.2 Economic Constraints

- Open Food Facts is an open-source and collaborative project which allows the use of its database for free.
- Publishing apps on Google Play Store requires a one-time payment of 27 US and publishing an application on App Store requires a subscription fee of 99 USD each year.

1.3.3 Environmental Constraints

- The project must work on both iOS and Android.
- The project must be developed on different computers, so it must be machine independent.

1.3.4 Social Constraints

- Understandable language must be used to describe the harmful ingredients in order to not misguide anyone.

1.3.5 Political Constraints

- Politics should not affect recommendations and users should not be able to select specific brand recommendations based on political reasons.

1.3.6 Ethical Constraints

- The application will have a minimized, optimally no, error rate for allergens in order to protect users from harmful, potentially deadly, products. The information and database used must be accurate, flawless and up to date.
- In order to not affect the market competition, a new product should be added to the database as soon as possible.

1.3.7 Health and Safety Constraints

- Because of the ongoing pandemic, ideally the users should be able to identify a product in front of them without touching the package.
- The application will be customizable according to the user, since understanding of a healthy product may differ for each user. So, the recommendation system must be unbiased.

1.3.8 Manufacturability Constraints

- For the implementation, APIs, libraries and data sets should be available for the project.

1.3.9 Sustainability Constraints

- The products must be updated and added regularly for long term use.
- Users should be able to give feedback or add non-existent products in the database.
- Any errors or bugs must be fixed as soon as possible.

1.4 Professional and Ethical Issues

Professional and ethical issues related to both the development and the use of InPackt are discussed below.

1.4.1 Professional Issues

- The project will be implemented with clean coding discipline which is easy to read and easy to modify.
- Personal data will not be used and shared for any other purposes.
- To give correct product recognition, training data and Chrome search API will be compared.

- For accurate suggestions and information, the real data will be used. By this approach, the product owner's right will not be violated.
- Democratical environment will be applied for making decisions .
- The project will be divided into separate areas and these will be shared equally.

1.4.2 Ethical Issues

- The user's ethical concerns will determine the best products for them individually, not the paid sponsorships or advertisements.
- Since our program compares the products and recommends one to another, the industry owners may be involved if their sales are highly affected negatively. However, the application detects the best product for each user individually, so the application only helps users to see ingredients and comparison with similar products without affecting their individual choices.
- Since InPackt ease the process of learning the harmful ingredients, industries might be enforced to rearrange the ingredients to make the products more healthy. So, the information must be correct and up to date for best practise.

2. Requirements

The requirements of the project are explained below in functional and non-functional subheaders.

2.1 Functional Requirements

The functional requirements are discussed below, separated into system and user requirements.

2.1.1 System Requirements

The system should:

- Ask permission to access the camera, microphone, local storage, and internet connection of the user's mobile device.
- Provide an option to create an account to save the user's preferences and personalized choices to the cloud.
- Provide an option to continue without creating an account and save user’s preferences and personalized choices in their local storage.
- Display the focused object apart from surrounding objects on the screen.
- Provide an option to scan the product's barcode.
- Provide an option to search the product manually.
- Provide an option to search the product via voice.
- Send the recognized object picture or scanned barcode to the backend server for processing.
- Find the product from the database and receive its contents.
- Compare the contents of the product with the user's disallowed list.
- Display ingredients of the product and warnings if there are any unhealthy ingredients, ingredients from the user's disallowed list and package material .

- Suggest similar products without the ingredients from the disallowed list according to the user's personal choices.
- Provide options that the users can personalize their preferences such as vegetarian, vegan, alcohol-free, halal, lactose intolerance and gluten intolerance.
- Provide options to the users to customize default lists of vegetarian, vegan, alcohol-free, halal, package material, lactose intolerance and gluten intolerance.
- Provide an option to see the general ingredients list to choose and add to the disallowed list.
- Provide an option to remove ingredients from the disallowed list.
- Provide an option to suggest a product to add with ingredients information and send the suggestion to approval.

If time allows, the system should:

- Display warnings and ingredients on focused objects in the camera view above the product.

2.1.2 User Requirements

The user can:

- Allow or deny permissions to access camera, microphone, local storage, and internet connection of the mobile device.
- Create an account to save their preferences and personalized choices to the cloud.
- Continue without creating an account and save their preferences and personalized choices to the cloud.

- Select a product to focus on the camera view.
- Scan the barcode of the product.
- Search the product manually.
- Search the product via voice.
- View its ingredients as a list.
- View warnings next to the risky ingredient.
- View similar products if the product has an ingredient from a disallowed list.
- View general ingredient list.
- Personalize their preferences such as vegetarian, vegan, alcohol-free, halal, lactose intolerance, package material and gluten intolerance.
- Customize default lists of vegetarian, vegan, alcohol-free, halal, lactose intolerance and gluten intolerance.
- Choose ingredients to add to the disallowed list.
- Remove ingredients from the disallowed list.
- Suggest a product with ingredients information.

If time allows, the user can:

- View warnings and ingredients on focused objects in the camera view above the product.

2.2 Non-Functional Requirements

The non-functional requirements are explained below in seperate headers.

2.2.1 Availability

- InPackt application should be available 24 hours a day, 7 days a week for all users who have devices with iOS or Android operating systems.
- InPackt application should be available mainly for users who live in Turkey, and ideally worldwide.

2.2.2 Accuracy

- InPackt application should be able to display the ingredients of the product scanned by user with at least %90 accuracy.
- InPackt application should be %90 accurate when recommending products according to the personal characteristic specified by the user while creating a profile for the product scanned by the user

2.2.3 Response Time

- InPackt application should display the ingredient of the product in less than 3 seconds after the user scans.
- InPackt application should display the alternative products in less than 3 seconds.

2.2.4 Extendibility

- The design of the InPackt application should be extensible for future updates covering additional features according to the needs of the users.

- The user data of the InPackt application should be stored to be extensible for a Web application or other platforms.

2.2.5 Scalability

- InPackt application database should be scalable according to the increased number of users.Initially, at least 100 different devices can access simultaneously.

2.2.6 Privacy

- User information should not be stored and used outside the user's device.
- User information should be encrypted to store their own devices.
- The InPackt application should ask the user's permission for the alternative product recommendation system according to the private user information that has been created by the user.

2.2.7 License

- All used databases, libraries and the like must be licenced.

2.2.8 Maintainability

- The InPackt application should have a design that will allow the maintainability of the system without any problems with future updates and ensuring that some changed parts are not affected to others functionality.

2.2.9 Usability

- The application aims to present to the user what is in the content of the product that the user wants to buy, whether it is suitable for the profile created by the user, and if it is not suitable, what other alternative products are available to the user in a fast, easy and reliable manner.
- Tutorial and guideline for how to use the InPackt app is available within the app.

2.2.10 Reliability

- The information displayed on the application must be accurate.
- There must be a brief information page about most used and unknown harmful ingredients to be displayed when there is no internet connection for informing users when they need to be informed.

3. References

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