What Am I Eating?

- Users, who want to pay attention to their diet for any reason, can use this application.
- After entering the application, users select the ingredients they want to eat or do not want eat.
- When users go to a restaurant; by taking a picture of the menu, they can see the meals in the menu match their preferences.

1-) Abstract

I've developed an android application that identifies food from restaurant menu with the help of phone camera, finds ingredients from the web service that I've implemented, and recommends food to users according to the user preferences.

The application allows the user to select food according to the materials he/she wants or does not want. In this way it is aimed to find the most suitable food for their health or diet.

2-) Introduction

In this project, I tried to find the most suitable meals according to the user preferences. It requires identifying meals' names from the restaurant menu and performing search over the recipes of the meals in order to give recommendation. Thus, I can say that the project consists of two main parts: Optical Character Recognition and Information Retrieval.

I've used Google's OCR engine for getting meals' names from the restaurant menu. I also used Lucene Library to create dataset and perform search over this dataset in order to give recommendation.

To create dataset, I've used some of the well-known meal websites that have recipes of the various types of meals. Then parsed the content of the web page to get information about the recipes by using Jsoup Library.

This report includes technical details about implementation of the used technologies and architectural design of the project. Also, the results of main scenarios and comments about development process are included.

3 -) Background

OCR(Optical Character Recognition): OCR is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document or a photo of a document. It is a common method of digitizing printed texts so that they can be electronically edited, searched, stored more compactly, displayed on-line and used in machine processes such as cognitive computing, machine translation, text-tospeech, key data and text mining. OCR is field of research in pattern recognition, artificial intelligence and computer vision.

I’ve used OCR to read meals in the restaurant menus in this project. As OCR engine, I’ve used Google Cloud Platform's Vision API. In order to use this API, I received an Application Key from Google and used it in this application. Sent menu image to Google servers using the REST API.

Lucene is an information retrieval library implemented with Java. It allows to perform complex queries and get results quickly over the big dataset. In this project I associated recipes with the meals.

A meal is modeled as an object which has ingredient fields mapped by its recipe. A meal and its ingredients constitute a document. Lucene uses inverted index structure to store these documents.

Each meal and ingredient has a list of documents that are related with them. By this way, by looking at the document list of a particular meal or ingredient, I can see all the occurrences of specific meal or ingredient. This structure allows to get results quickly from complex queries which include many “and”, “or”, “not” operations.

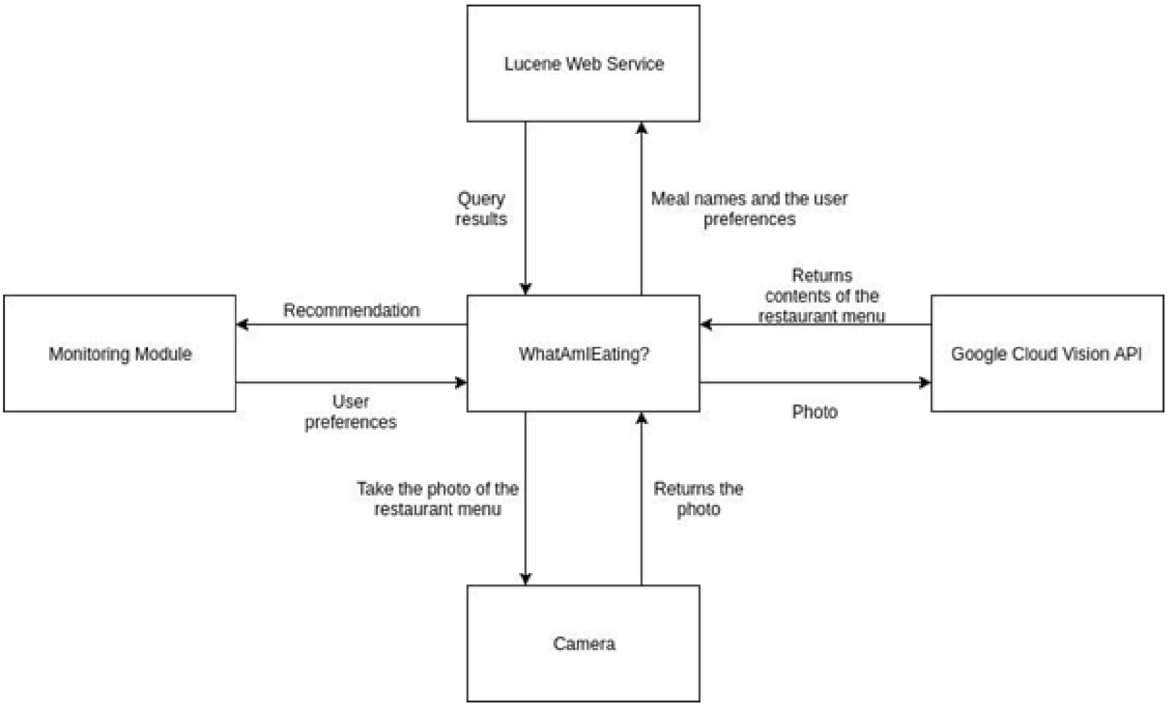
4 -) Method

First, I needed a dataset that includes meals and recipes to perform search for ingredients and meals. So, I’ve searched the recipes of the meals from the Internet. Parsed ingredients from the recipes and sent them to Lucene Library. I created documents and indexed them by using Lucene Library. By this way, constructed a dataset which is ready to perform search to get various information from it.

After that, analyzed images of the restaurant menu to get meals’ names. I’ve used Google Cloud Vision API for this process. After getting contents of the restaurant menu, I sent the contents along with user preferences to Lucene web service implemented by me. Lucene web service creates queries according to incoming data and sends results back to the user.

Since there are many different meals in restaurant menus, I expanded the dataset periodically and started index process over and over again. The dataset still needs to be expanded.

5 -) Technical Design

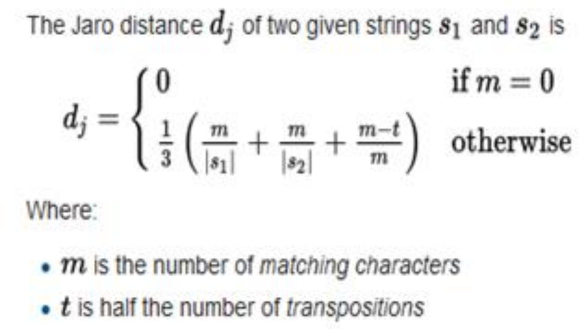


There are two main components of this application. The first component of the application; converts image of the restaurant menu to text in order to get meal names. The second component of the application creates dataset which consists of the meals and their recipes and performs search over this dataset to give recommendation to the user.

The application communicates with two servers throughout the recommendation process. The first server is responsible for converting image to text. The application sends the text information to the second server in order to get recommendation. The second server is responsible for creating queries according to restaurant menu and user preferences. After that the server sends results to the application. This application will run on mobile android devices.

User takes the photograph of the restaurant menu. The application sends this photo to Google Cloud Vision API and requests contents of the menu. After getting contents of the restaurant menu, the application performs validation over incoming text information to eliminate the price and extra information about meals. The application sends meal names and the user preferences to Lucene server and requests recommendation. Lucene server creates queries according to incoming data and returns the results to the application. The application renders incoming data and constructs user interface to show the results to the users.

Some important points about the application; since the OCR Engine cannot read the texts on the photo with 100% accuracy, I need an algorithm to simulate the text I have obtained from the dataset. For this purpose I’ve used the *Jaro-Winkler String Similarity Algorithm*.



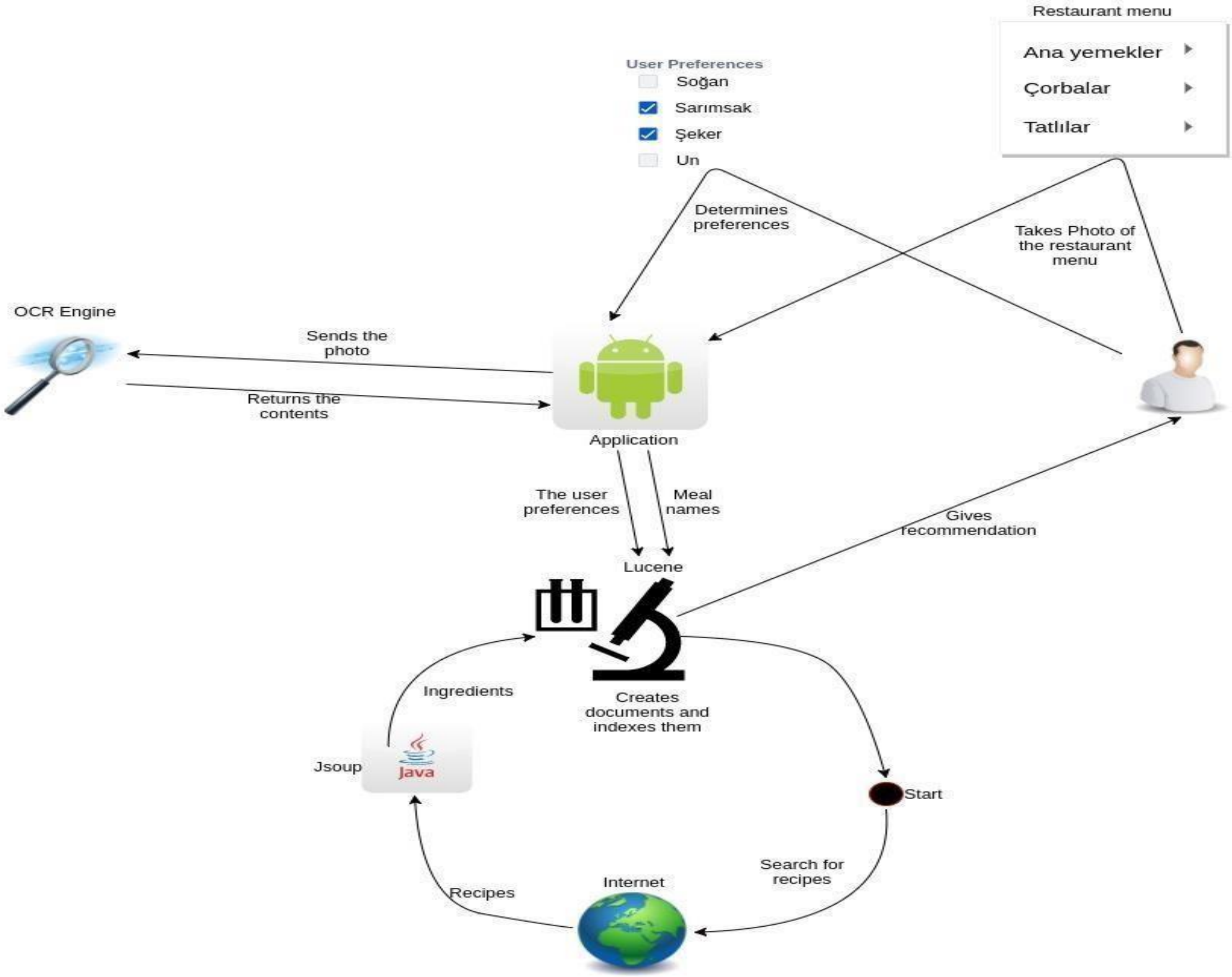
The Jaro distance d_j of two given strings s_1 and s_2 is

$$d_j = \begin{cases} 0 & \text{if } m = 0 \\ \frac{1}{3}\left(\frac{m}{|s_1|} + \frac{m}{|s_2|} + \frac{m-t}{m}\right) & \text{otherwise} \end{cases}$$

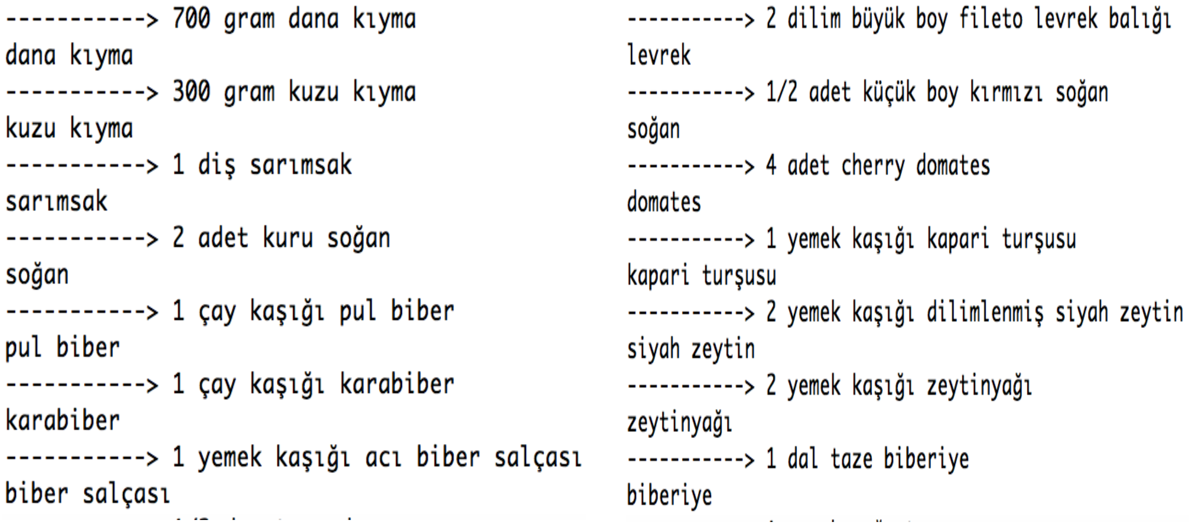
Where:

- m is the number of *matching characters*
- t is half the number of *transpositions*

Overview of the project;



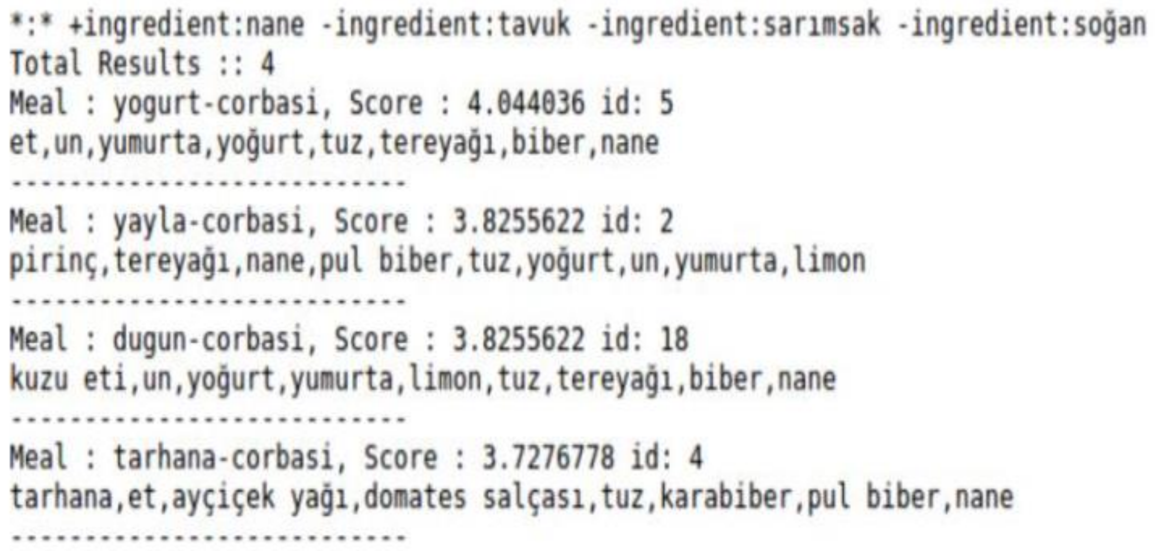
I've taken recipes with software scripts from various websites. However, these recipes contained rather unnecessary words. They had to be cleaned. For this purpose stopwords were created and used.



```
-----------> 700 gram dana kıyma
dana kıyma
-----------> 300 gram kuzu kıyma
kuzu kıyma
-----------> 1 diş sarımsak
sarımsak
-----------> 2 adet kuru soğan
soğan
-----------> 1 çay kaşığı pul biber
pul biber
-----------> 1 çay kaşığı karabiber
karabiber
-----------> 1 yemek kaşığı acı biber salçası
biber salçası
```

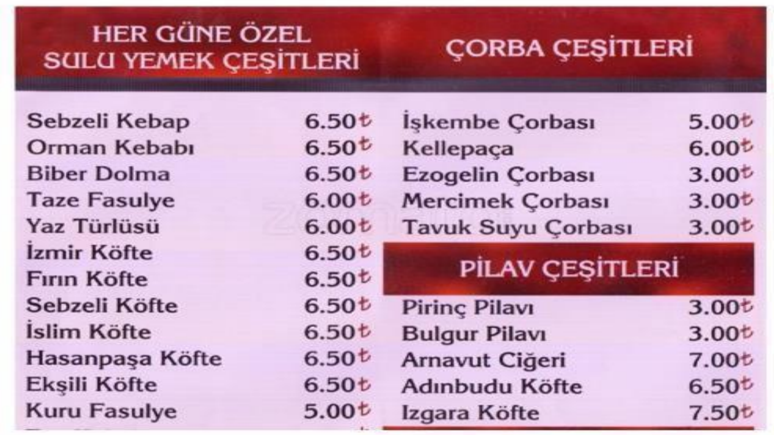
```
-----------> 2 dilim büyük boy fileto levrek balığı
levrek
-----------> 1/2 adet küçük boy kırmızı soğan
soğan
-----------> 4 adet cherry domates
domates
-----------> 1 yemek kaşığı kapari turşusu
kapari turşusu
-----------> 2 yemek kaşığı dilimlenmiş siyah zeytin
siyah zeytin
-----------> 2 yemek kaşığı zeytinyağı
zeytinyağı
-----------> 1 dal taze biberiye
biberiye
```

An example of finding meals according to ingredient preferences.
"Nane" is wanted by user; "Tavuk", "Sarımsak" and "Soğan are not wanted by user.

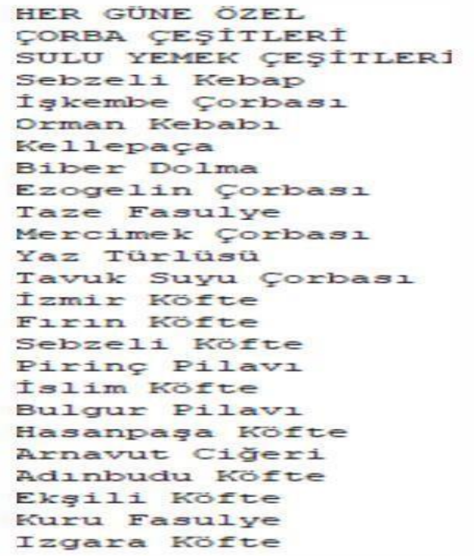


```
*:* +ingredient:nane -ingredient:tavuk -ingredient:sarımsak -ingredient:soğan
Total Results :: 4
Meal : yogurt-corbasi, Score : 4.044036 id: 5
et,un,yumurta,yoğurt,tuz,tereyağı,biber,nane
--------------------------
Meal : yayla-corbasi, Score : 3.8255622 id: 2
pirinç,tereyağı,nane,pul biber,tuz,yoğurt,un,yumurta,limon
--------------------------
Meal : dugun-corbasi, Score : 3.8255622 id: 18
kuzu eti,un,yoğurt,yumurta,limon,tuz,tereyağı,biber,nane
--------------------------
Meal : tarhana-corbasi, Score : 3.7276778 id: 4
tarhana,et,ayçiçek yağı,domates salçası,tuz,karabiber,pul biber,nane
--------------------------
```

Various image processing techniques (noise removing, grayscaling, resizing, deskewing and border removal) were applied to the photos in order to recognize Turkish characters.



HER GÜNE ÖZEL SULU YEMEK ÇEŞİTLERİ		ÇORBA ÇEŞİTLERİ	
Sebzeli Kebap	6.50₺	İşkembe Çorbası	5.00₺
Orman Kebabı	6.50₺	Kellepaça	6.00₺
Biber Dolma	6.50₺	Ezogelin Çorbası	3.00₺
Taze Fasulye	6.00₺	Mercimek Çorbası	3.00₺
Yaz Türlüsü	6.00₺	Tavuk Suyu Çorbası	3.00₺
İzmir Köfte	6.50₺	PİLAV ÇEŞİTLERİ	
Fırın Köfte	6.50₺		
Sebzeli Köfte	6.50₺	Pirinç Pilavı	3.00₺
İslim Köfte	6.50₺	Bulgur Pilavı	3.00₺
Hasanpaşa Köfte	6.50₺	Arnavut Ciğeri	7.00₺
Ekşili Köfte	6.50₺	Adınbudu Köfte	6.50₺
Kuru Fasulye	5.00₺	Izgara Köfte	7.50₺



```
HER GÜNE ÖZEL
ÇORBA ÇEŞİTLERİ
SULU YEMEK ÇEŞİTLERİ
Sebzeli Kebap
İşkembe Çorbası
Orman Kebabı
Kellepaça
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Ezogelin Çorbası
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Tavuk Suyu Çorbası
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İslim Köfte
Bulgur Pilavı
Hasanpaşa Köfte
Arnavut Ciğeri
Adınbudu Köfte
Ekşili Köfte
Kuru Fasulye
Izgara Köfte
```
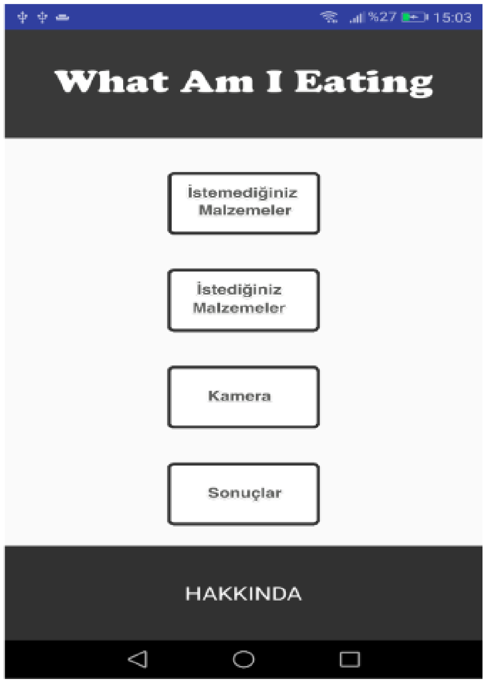
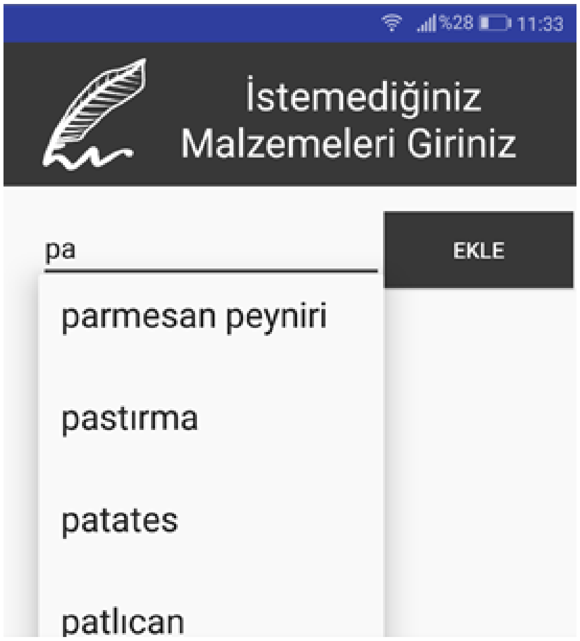

6 -) Application

Home screen**;**



While the user reporting nutrition preferences; in terms of convenience to the user and to see the materials in the system, application has the autocomplete feature.



İstemediğiniz Malzemeleri Giriniz

pa

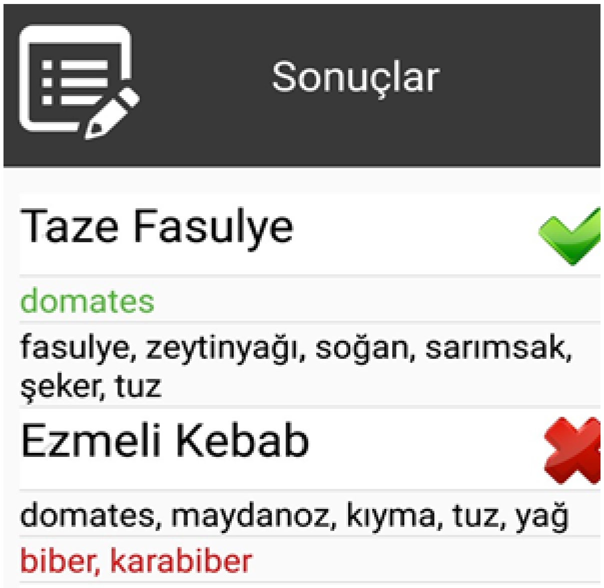
parmesan peyniri

pastırma

patates

patlıcan

While the user seeing the results, the color of materials ,that user wants to use, is green; the color of materials, which user is not interested in, is black; and the color of materials, which user does not want to use, is red.



Sonuçlar

Taze Fasulye ✓

domates

fasulye, zeytinyağı, soğan, sarımsak, şeker, tuz

Ezmeli Kebab ✗

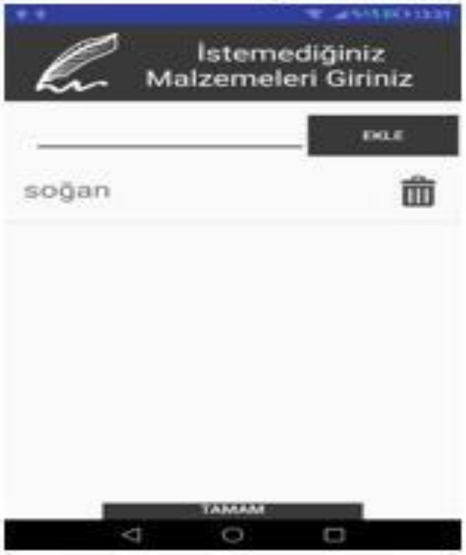
domates, maydanoz, kıyma, tuz, yağ

biber, karabiber

Results;

Case 1:

Unwanted Ingredients;

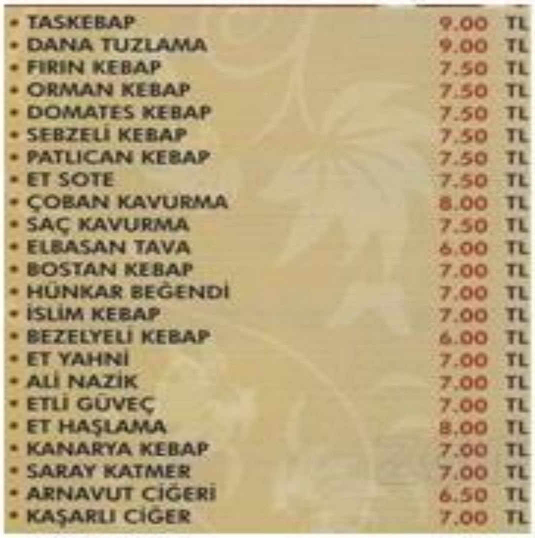

İstemediğiniz Malzemeleri Giriniz

EKLE

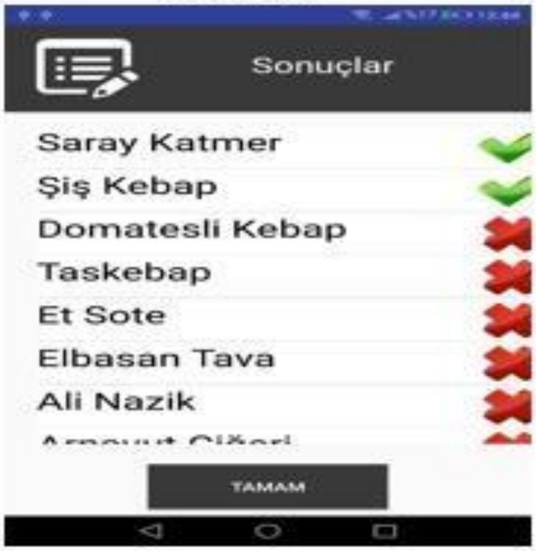
soğan

TAMAM

Restaurant menu;


• TASKEBAP	9.00	TL
• DANA TUZLAMA	9.00	TL
• FIRIN KEBAP	7.50	TL
• ORMAN KEBAP	7.50	TL
• DOMATES KEBAP	7.50	TL
• SEBZELİ KEBAP	7.50	TL
• PATLICAN KEBAP	7.50	TL
• ET SOTE	7.50	TL
• ÇOBAN KAVURMA	8.00	TL
• SAÇ KAVURMA	7.50	TL
• ELBASAN TAVA	6.00	TL
• BOSTAN KEBAP	7.00	TL
• HÜNKAR BEĞENDİ	7.00	TL
• İSLİM KEBAP	7.00	TL
• BEZELYELİ KEBAP	6.00	TL
• ET YAHNİ	7.00	TL
• ALİ NAZİK	7.00	TL
• ETLİ GÜVEÇ	7.00	TL
• ET HAŞLAMA	8.00	TL
• KANARYA KEBAP	7.00	TL
• SARAY KATMER	7.00	TL
• ARNAVUT CİĞERİ	6.50	TL
• KAŞARLI CİĞER	7.00	TL

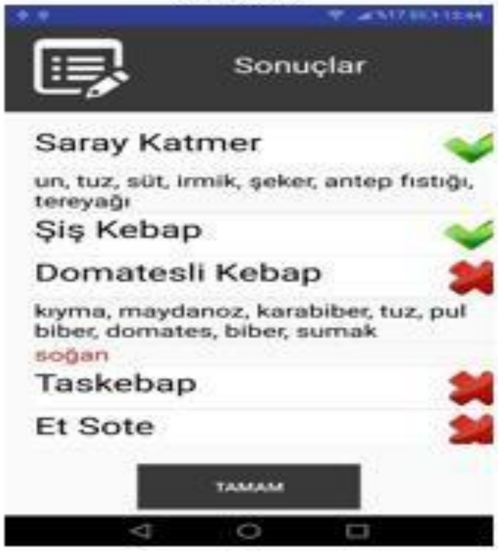
Results;


Sonuçlar

Saray Katmer	✓
Şiş Kebap	✓
Domatesli Kebap	✗
Taskebap	✗
Et Sote	✗
Elbasan Tava	✗
Ali Nazik	✗
Arnavut Ciğeri	✗

TAMAM

Details;


Sonuçlar

Saray Katmer ✓

un, tuz, süt, irmik, şeker, antep fıstığı, tereyağı

Şiş Kebap ✓

Domatesli Kebap ✗

kıyma, maydanoz, karabiber, tuz, pul biber, domates, biber, sumak

soğan

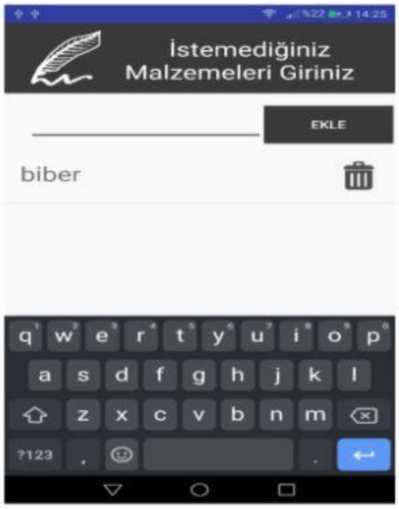
Taskebap ✗

Et Sote ✗

TAMAM

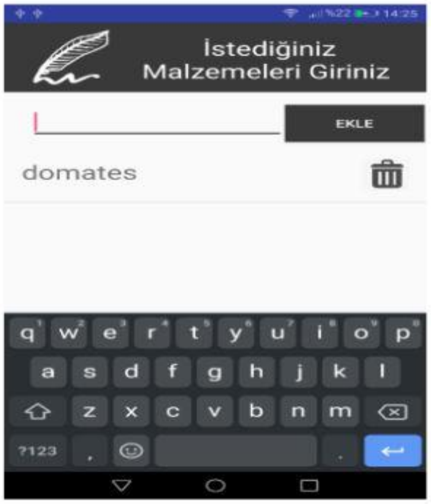
Case 2:

Unwanted Ingredients:



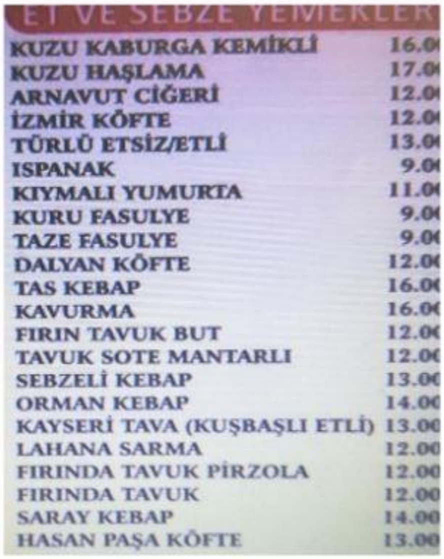
biber

Wanted Ingredients:



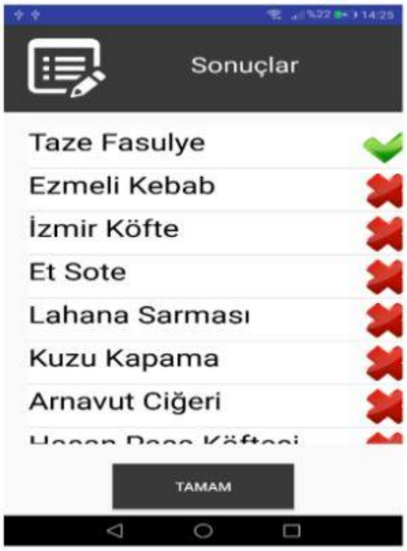
domates

Restaurant Menu Photograph:



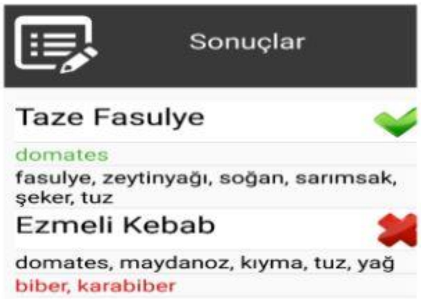
ET VE SEBZE YEMEKLER	
KUZU KABURGA KEMİKLİ	16.0
KUZU HAŞLAMA	17.0
ARNAVUT CİĞERİ	12.0
İZMİR KÖFTE	12.0
TÜRLÜ ETSİZ/ETLİ	13.0
ISPANAK	9.0
KIYMALI YUMURTA	11.0
KURU FASULYE	9.0
TAZE FASULYE	9.0
DALYAN KÖFTE	12.0
TAS KEBAP	16.0
KAVURMA	16.0
FIRIN TAVUK BUT	12.0
TAVUK SOTE MANTARLI	12.0
SEBZELİ KEBAP	13.0
ORMAN KEBAP	14.0
KAYSERİ TAVA (KUŞBAŞLI ETLİ)	13.0
LAHANA SARMA	12.00
FIRINDA TAVUK PİRZOLA	12.00
FIRINDA TAVUK	12.00
SARAY KEBAP	14.00
HASAN PAŞA KÖFTE	13.00

Results Screen:



Taze Fasulye ✓
Ezmeli Kebab ✗
İzmir Köfte ✗
Et Sote ✗
Lahana Sarması ✗
Kuzu Kapama ✗
Arnavut Ciğeri ✗
Hasan Paşa Köftesi ✗

Details:



Taze Fasulye ✓
domates
fasulye, zeytinyağı, soğan, sarımsak, şeker, tuz

Ezmeli Kebab ✗
domates, maydanoz, kıyma, tuz, yağ
biber, karabiber

7 -) Evaluation

When I review the results, I can evaluate the application as successful. In the taken menu photos; we can see that users can get suggestions with a good accuracy rate.

The most fundamental problem of the program may have trouble with is that the OCR results come with a low accuracy. In this case either no results will be found, or the Jora-Winkler string similarity algorithm will resemble the incoming text to another meal. In this case, a meal that is not actually included in the photographed menu will be displayed as a recommendation to the user. For this reason, the program is more successful at the photographs taken on clear text menus.

On the other hand, the food dataset that I created is not enough. When we think about the variety of food and the naming of foods in different forms, application needs a very large dataset.

8 -) References

https://cloud.google.com/vision/

https://lucene.apache.org/core/7_0_1/core/overview-summary.html

https://jsoup.org/apidocs/overview-summary.html/

https://en.wikipedia.org/wiki/Optical_character_recognition

https://en.wikipedia.org/wiki/Jaro–Winkler_distance