FoodAR - An Augmented Reality Application used in Gastronomy

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ABSTRACT
Augmented reality is used today in many different domains with important benefits for the end users. They are helped to understand the concepts better or to do simple things guided by augmented information presented like texts, images, audios or videos. In this paper we present an augmented reality application created to help the user identify fast the existing ingredients in a fridge and then choose a recipe which can be prepared with these ingredients. The application also provides the necessary steps to prepare this recipe and suggestive images which can help the user during the preparation process.

Author Keywords
Augmented reality; Gastronomy; Usability testing.

ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces. H.3.2. Information Storage and Retrieval: Information Storage.

General Terms
Human Factors; Design.

INTRODUCTION

Augmented reality has started to be used more and more these last few years. A first study with the most important fields that use this concept a lot was made in 1997 [1] and another one more recently in 2014 [8].

The areas where augmented reality is currently used are becoming increasingly diverse:

(1) in the medical field, doctors could use application such as Liver Explorer [14] which provides real-time AR guides and medical assistance,

(2) in production and reparations the people working at Volkswagen have developed the MARTA (Mobile Augmented Reality Technical Assistance) system [16], which comes to the rescue when a car is not functioning properly,

(3) in 3D collaborative modelling, Canon's MREAL (Mixed Reality System) [19] is supporting the design process, allowing the joint between 3D models and real-life objects,

(4) in annotation and visualization, Wikitude [29] and Metaio Junaio [18] are two examples of AR browsers which provide context sensitive information, capable of identifying locations and real-life objects which can be connected to digital information,

(5) in the military field, the Q-Warrior helmet [22] has AR elements, that gives the soldiers the ability to identify the situation, identify friends or foes, have night vision and an increased efficiency to coordinate unit soldiers with similar equipment,

(6) Recon Jet [23] is an AR system available for entertaining activities, with a display situated at head level, such as glasses or lenses, that connects to third party sensors, like Bluetooth and WiFi, and offers real time information about the route, the weather, user's performance and also allows social media access,

(7) Word Lens [30] can run on almost any smartphone and provides immediate translation of text from a language into another,

(8) for facial recognition, Infinity AR [12] scans a face and compares it to profile images from social media, attaching the information about the resulted person for the user to see,

(9) in the auto industry, BMW models [3] display on the car's windscreen information which can help the driver, such as speed, direction based on surrounding objects recognition, parking assistant, sensor information, traffic and collision warnings etc.,

(10) for interior design, the most recent Ikea brochure [11] uses AR and allows the user to place digital versions of Ikea furniture in their living rooms with their mobile devices, making it possible to test the size, style and color of the piece of furniture in a chosen position,

(11) in the Internet of Things area, the Revolv system [24] combined with Google Glass can give control to the user of all the digital devices from his/her household (for example, lighting and security system),

(12) a hacker from Japan has used an existing 3D model and motion sensors to have an "AR meeting" with a famous anime character (Hatsune Miku [9]).

USING AUGMENTED REALITY IN GASTRONOMY

A new field where augmented reality has started to grow is the gastronomy and healthy eating one. In the application presented in [2] the authors provide through an Android application information about the calorie count of a scanned product using a mobile phone's camera.

For example, by scanning an apple, the nutritional information and the 3D object associated to the apple can be viewed on the Android device screen, so the users can easily understand the displayed text. The authors' tests have shown that the generated nutritional data can provide useful information about calories, such as carbohydrates, proteins and fats. Since the '70s, food and beverage sizes have increased year by year, both in the USA [6], [21] as well as in Australia [5] and Ireland [20].

Among the factors identified to have contributed to the bigger servings consumption, we include the perception of the "money value", the size of pre-packed products like food, beverages, pots and cutlery, the continuous exposure to larger portions because of the food environment we live in and the lack of awareness or understanding of the recommended serving sizes [15], [20] and [28].

Providing larger sizes of food servings is associated with an increase in the level of energy we receive. Many laboratory studies have shown that providing larger portions of food to consumers leads to increased food amount and energy consumption for them [26].

Although there is no clear link between large portions and obesity [15], a recent meta-analysis of 58 studies has shown a small to medium effect of association between large servings or food packages and the increased received energy [10]. The experiments conducted with the ServAR application [25] have shown that it has improved the accuracy and consistency of serving among users, proving that ServAR has helped the accurate serving of food portions. Such applications are very useful for people who are on diet or those who have health problems and must comply with certain dietary restrictions.

PROPOSED SOLUTION

In this section we will provide details about implemented applications and about resources used by it.

Nowadays people are much busy with work than before and in their free time they just want to relax. So, when they come home, they don't want to spend a lot of time searching for recipes to cook and then go to the store to buy the missing ingredients. They want something that can be cooked with the ingredients that are already present in their fridge. With this idea in our mind, we decided to make an application that can help people with this problem.

FoodAR is a mobile application which consists of a set of features: possibility to choose recipes, to recognize ingredients with the device's camera and to check them in the list, to see how you can make a culinary product with your own hands using a video. The main schema of the application is represented in Figure 1.

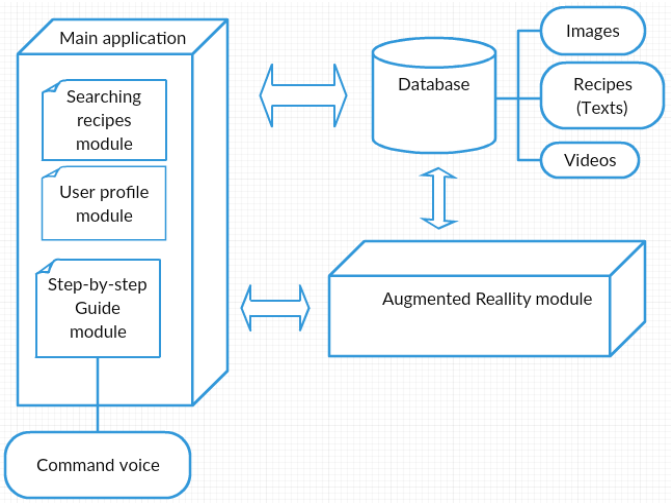

Figure 1. Main Schema of the application FoodAR.

The application is still in developing process, but up to this point, it has the next functionalities: a list of recipes from you can choose, showing the details of recipes like ingredients and steps, taking a picture with the ingredients and sending it to the Clarifai API to predict what items are in the image and then searching for recipes using the identified ingredients.

The Recipes

The main feature of the application is to help the user decide what he should eat. We have decided to offer two ways to do this: (1) one which is more limited in order to make the choice an easier one, and (2) one perfect for the hard-to-decide type of user which shows multiple different options to inspire him/her.

The first one uses the AR Component and the Edamam Recipe API [7], which makes an efficient search throughout over 1.5 million of English recipes stored in a semantically organized database and can be filtered by a list of ingredients and by calories, diet and allergy preferences. The REST API call returns a list of recipes, identified by a title, a summary, the total number of calories and a picture, because we all know that one can speak a thousand words.

This screen appears after items are checked in the prediction component and the Next button is pressed. The search for the API is done only using those ingredients. We can further improve this by adding a user profile page where they can choose their dietary preferences. The list is paginated, in order to be more efficient when the user

scrolls through them and to only load a number of items which fit on the screen (see Figure 2).

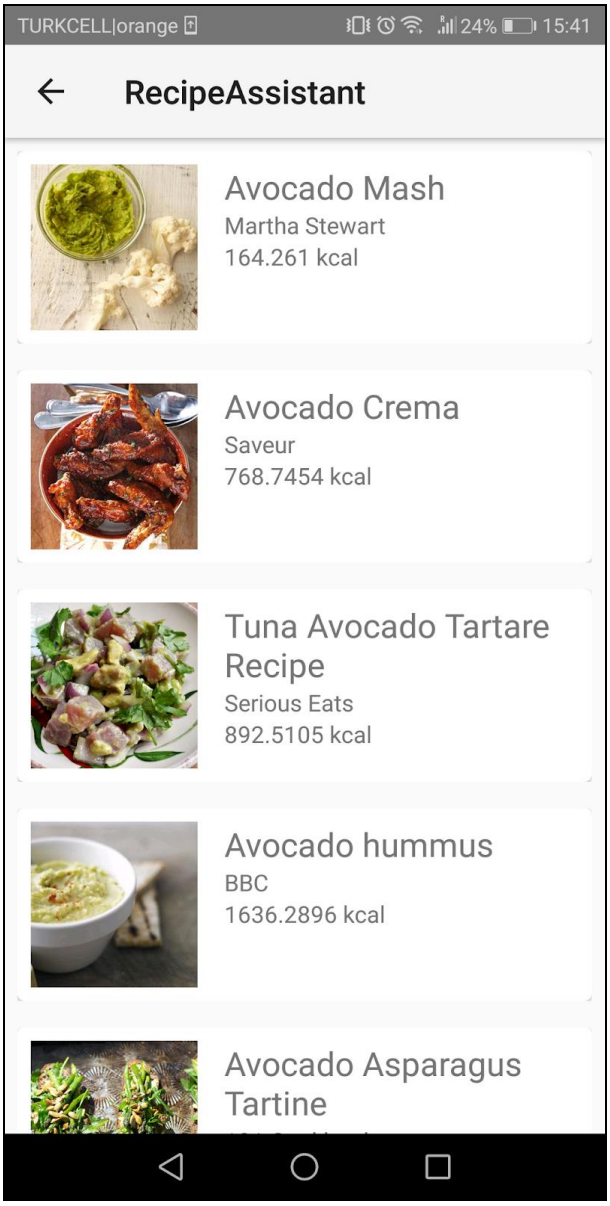

Figure 2. Available recipes in application.

After tapping on an item, a browser is opened with the corresponding URL and it shows the ingredients (see Figure 3) and steps to cook the chosen recipe (see Figure 4). The URLs are usually from popular websites, some even made by famous cooks such as Martha Stewart [17], Jamie Oliver [13].

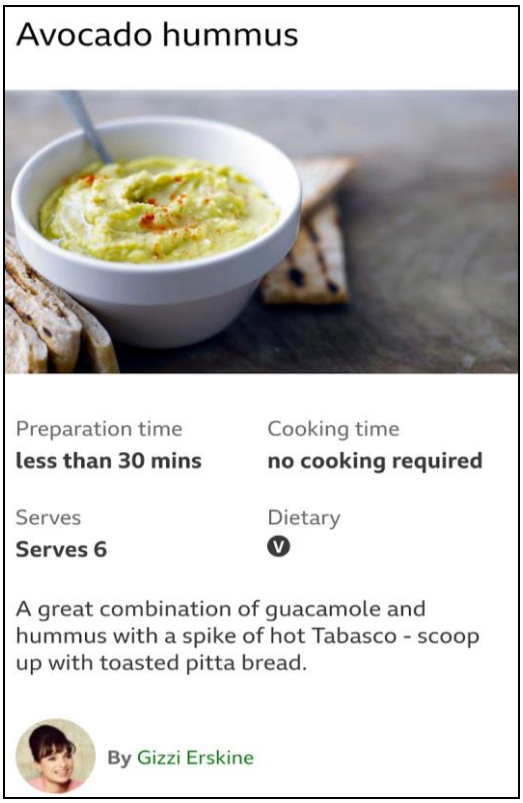

Figure 3. Details about a recipe from the Internet.

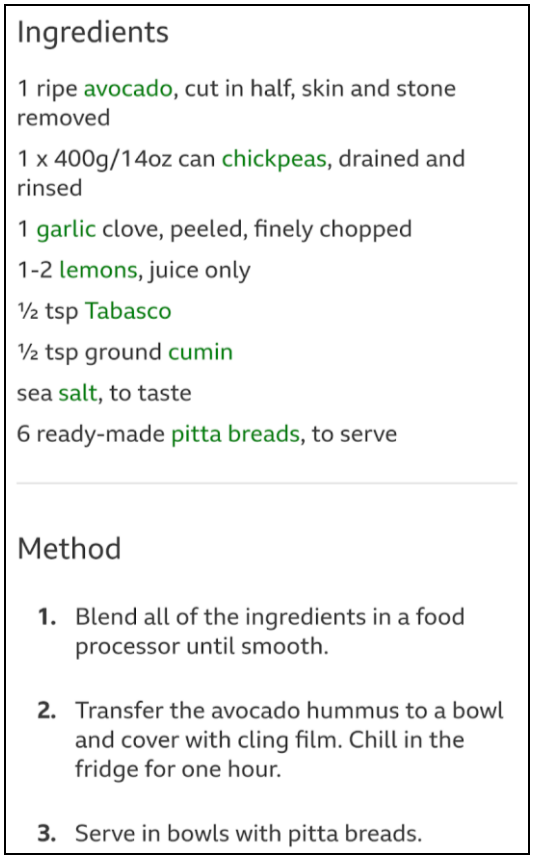

Figure 4. The steps necessary to prepare a recipe.

The second one has the recipes stored in a local database of SQLite type through Android and the user can browse through them without Internet. It contains ingredients, pictures and steps to prepare it (see Figure 5). We also want to include videos in the future which can help much more than text in the process of preparing a recipe.

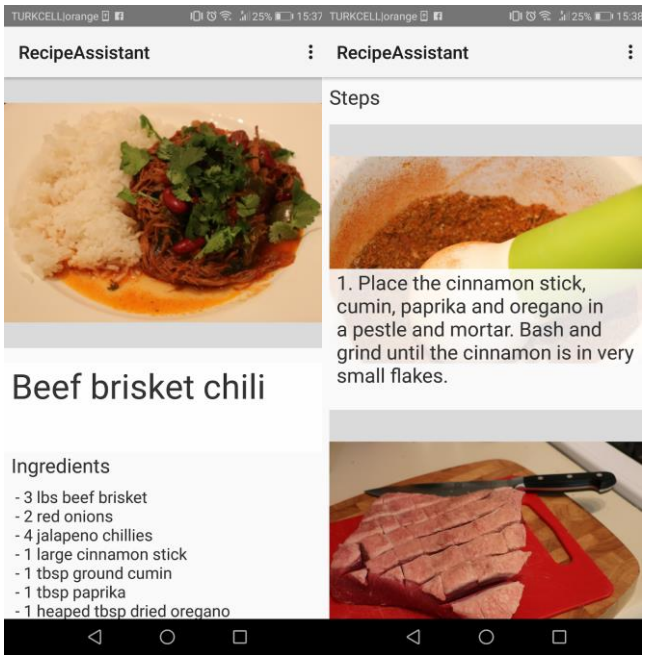

Figure 5. Details about a recipe from local database (left side) and the steps necessary to prepare it (right side).

Augmented Reality Component

While searching for tools that can help with ingredient recognition, we found Clarifai API [4]. The food model recognizes more than 1,000 food items in images down to the ingredient level. This feature was adapted in our application. The use case is pretty simple: the user takes a photo with the ingredients. In background that image is sent and analyzed in the Clarifai API [4]. After that, a simple report is generated. The report contains the ingredients found with a certainty percentage and the user can confirm the existence of a specific ingredient in the fridge and the desire to use this ingredient in the dish which will be prepared. These details are showed to the user on the camera preview, like in Figure 6.

The prediction of ingredients from the photo is good enough to use it in the application but still some items cannot be recognized from the image. Also, the API does not recognize the quantity of the ingredients.

We thought about using augmented reality for the ingredients themselves, but we decided to show them in a static way in order to have a still image which can make the user choose the right items much easier. They are not pinned in some place of the real life, so when we move the camera they will still be on the telephone display even though we are not looking at the ingredients anymore.

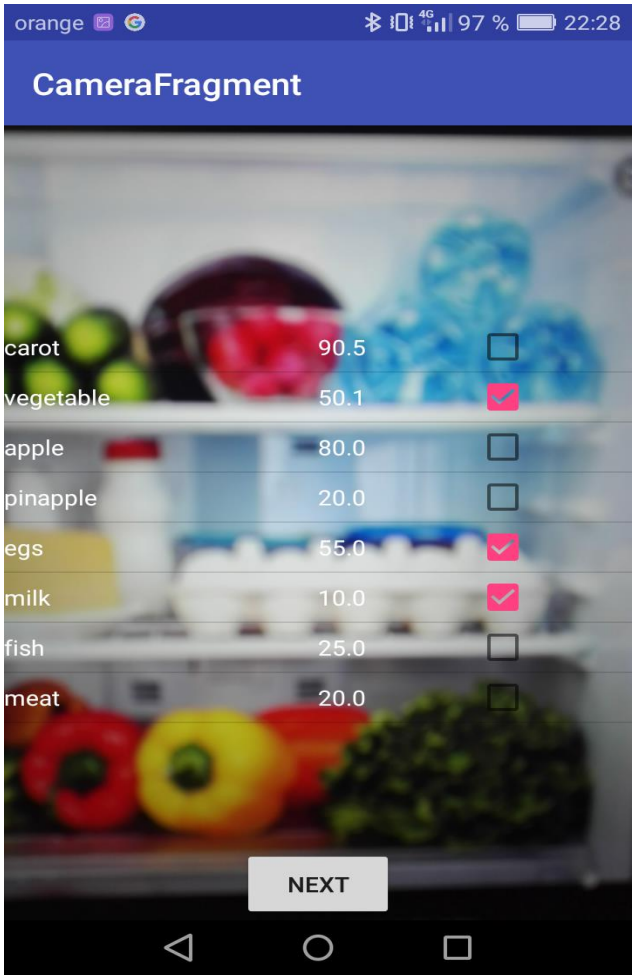

Figure 6. Augmented reality component in FoodAR application.

USABILITY TESTING

The steps for testing usability of the application are described in the Figure 7.

User Survey

Because we are planning to make this app useful for people of different ages and environments, we are interested in their opinion about our first-phase application. We asked the following questions to different subjects:

1. *How easy is the app to use*?
2. *Would you use this app in the future*?
3. *Would you recommend it to a friend*?
4. *What can it be improved*?
5. *Other suggestions*?

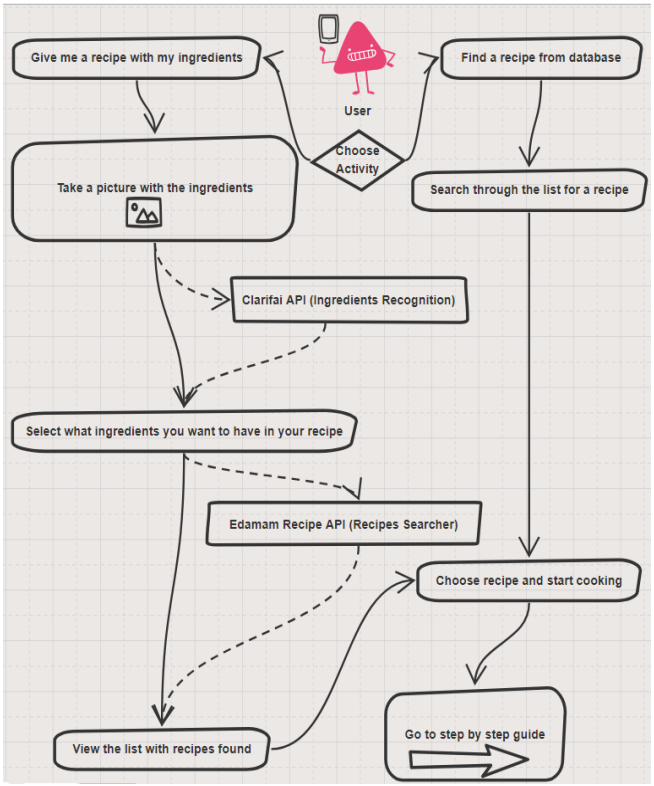

Figure 7. Application steps (diagram made with Sketchboard [27])

We asked 10 people to use the app for the first time and we analyzed their reactions, opinions and suggestions. We can group the answers we have received on two types of users:

(1) **Middle-aged mother**, who cook daily, agreed that: FoodAR is easy to use and it works pretty fast, but would be easier if it would also have the option to change languages to Romanian. Also, it would be extremely useful because often find themselves left without new recipe ideas to try. They were fascinated with the fact that they would not have to write the ingredients down by themselves, because for them typing usually takes more time. There was also a good response to the fact that offline recipes exist as well, because some didn't have mobile data, only internet at home and were thinking of using it when shopping as well. As suggestions, they think it would be great if for each recipe there would be a mention of what kind of drink goes with it (such as what kind of wine), but also what other food can it be combined with (this works great with salad, or with a tomato sauce). Others thought that an option which can showcase the most important features using some animations might also help with the initiation of the user in the process and will save time when they would be trying it out for themselves.

(2) **Colleagues from Faculty of Computer Science**, agreed that the application is easy to use, had suggestive buttons and instructions to guide you which actions to take. Some said that it offers the chance to experiment something new in the kitchen because being at the beginning of the cooking road, they are not very skilled in this area. Others thought that they might mostly use it when they are on a budget and can't go to a store to buy more products. The majority agreed on the fact that the mobile application can promote home cooking as opposed to ordering food or eating out, which is very common nowadays, but more expensive. As suggestions, they think that the searching part and the design of FoodAR can be improved and might attract more users. They remark also the fact that when the user checks a lot of ingredients from the list, the application doesn't show too many recipes.

CONCLUSION

The applicability areas of augmented reality are increasingly diversified. From the classical fields, such as medicine, engineering, military, collaborative 3D modeling, robotics, to newer areas adapted to our days: entertainment, social media, interior and exterior design, translation, security, car assistance during driving and so on.

In this paper, we presented our FoodAR application which can help users (1) to find a recipe accordingly with existing ingredients in the fridge and (2) to prepare a recipe offering the necessary steps and details about the quantities and mixing procedures.

In the future, we want to offer movies with the steps needed to prepare a recipe, and we want to control the film (start, pause, back and forth) through the voice or the iris.

ACKNOWLEDGMENTS

This work is partially supported by project The Digitization of the Cultural Food Heritage, The Region of Bacău – eCULTFOOD (PN-III-P2-2.1-BG-2016-0390).

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