Blue Blueberries
Human Computer Interaction

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***Abstract*—In this paper we describe the whole process that has led to the making of the Blue Blueberries cookbook application following the good principles of Human Computer Interaction. During the course of this writing will be addressed the four main stages of the application development. These range from the needfinding and realization of the mock-up to software implementation and finally concluding with a phase of usability tests. From the beginning we wanted to deliver a user experience as comfortable as possible, for this we resorted to the introduction of a voice assistant that could handle the execution of a number of tasks, relieving the user from having to physically perform them.**

***Keywords*—cookbook, ionic, angular, speech recognition, human computer interaction.**

I. Introduction

There are many web and mobile applications on the market that offer standard cookbook features, such as a category-based division of recipes, basic search functionality by ingredient, category, difficulty or time of execution. A few sometimes also include the ability to fill out a shopping list. None of these, however, offer voice assistant integration that can accompany the user throughout the main stages of usage of the app. Our idea was to be able to assist the user in his process of discovering of a recipe and decision to save it for a later use in a private collection or shopping list.

However, the one aspect on which we placed particular attention and that represents the core of the whole application is undoubtedly the recipe visualization. We wanted the user to be able to decide within a handful of seconds of opening a recipe whether or not it was the right recipe for them. If after these brief moments the user remains on the page and decides to scroll through the recipe, then we once again wanted to make it as straight forward as possible to navigate the recipe. This is done through an easy division into steps, lots of illustrative photos, and help from the voice assistant.

In the following sections are listed all the steps characterizing the development of the application. Following the principles of human computer interaction, we started from the need-finding phase and formulation of the personas in Section II. This allowed us to clearly identify the most interesting features for users and outline the main functionalities that we wanted our application to have. Relying on the mock-ups from the previous phase, we proceeded to the software implementation of the application in Section III.

Finally we moved to the usability tests phase in Section IV in order to validate how intuitive and user-friendly the features introduced were.

II. Phase 1: Needfinding

Needfinding is one of the most important phases in the development of a new application. It allows to lay out the foundations for a good software design right from the start. The needfinding process can be broken down into several phases. A first phase consists of real interviews carried out involving a fair range of users and designed with the aim of uncovering interesting and useful characteristics for certain types of people. In a later stage, can be mapped out the personas, that is, typical characters representing a certain group of people with similar interests and needs. After that it is possible to move on to placing these personas inside scenarios. Casting the different personas within scenarios allows to derive a narrowed down list of requirements. Once the requirements are known, it is possible to move on to the final phase of mock-ups.

A. Interviews

Conducting good interviews is what makes the difference between actually being able to find out what the person's requirements and needs are and not being able to do so. In fact, asking people leading questions often results in binary and biased answers. What we tried to do in the course of the interviews was to ask questions as open as possible, making sure that the users themselves described the main features they would have wished.

To carry out these surveys was recruited a group of about eleven people among friends and relatives, users of different types of smartphones. They were asked generic questions regarding what were the main features for a cookbook like app that would make the difference between deciding to install the application or not. After an initial brainstorming session, more specific questions were asked about the use of a voice assistant, usefulness of more advanced filters based on main ingredients, available ingredients and so on, in order to find specific recipes.

From the feedback gathered during this phase it was then possible to develop the personas.

B. Personas formulation

From the analysis of the interviews, were identified three types of personas, which can be denoted as Jack in Fig. 1, good at cooking but not used to technology, Cindy in Fig. 2 would really like to improve her culinary skills but needs a guidance to be able to do it. Lastly Emily in Fig. 3 is already experienced and is ready for the next level.

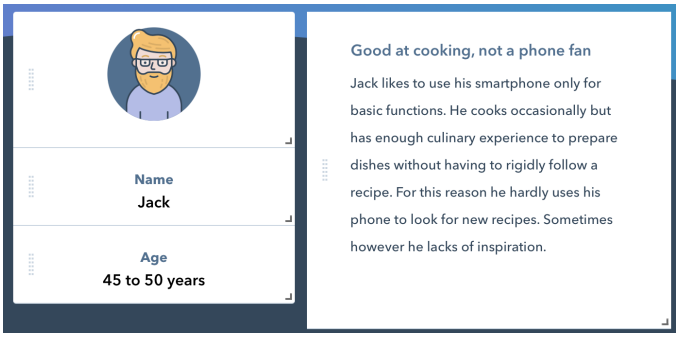

Figure 1: Jack, good at cooking but not a smartphone fan.

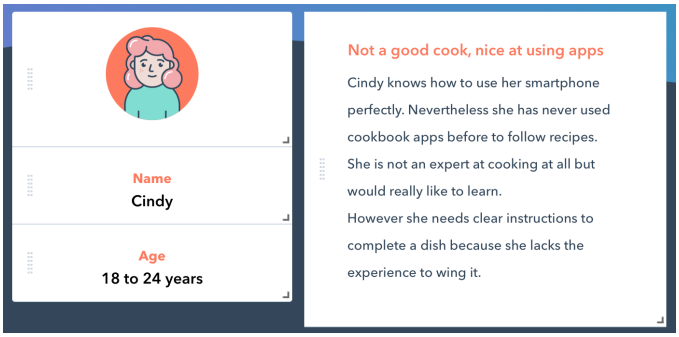

Figure 2: Cindy, the Guru of technology but not at all of cooking.

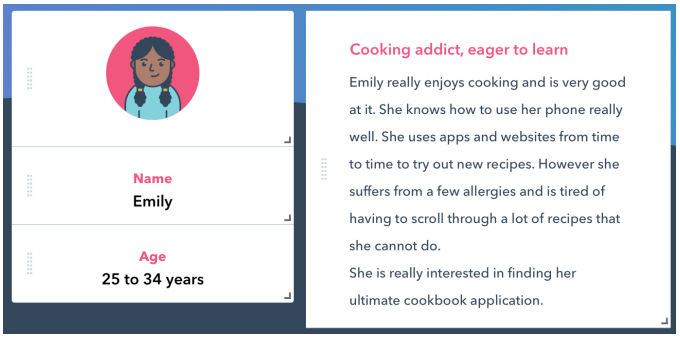

Figure 3: Emily, loves to cook and is always ready for the next culinary challenge.

C. Scenarios

The personas developed at the previous step were then placed within plausible scenarios to derive the key features that the application should meet. The scenarios we have isolated are the following:

- **Jack** finds it very difficult to use a smartphone and when he has to, he tries to touch as little things as possible so as not to break anything. He still believes in the power of cookbooks and good pen and paper for his shopping lists. However tonight Jack is alone at home, nothing is ready, he opens the fridge and sees a handful of ingredients. Unfortunately, he has never used those ingredients before and at that moment he thinks how nice it would be to be able to ask someone for advice by just listing what he has. He is just looking for inspiration.
- **Cindy** is not a good cook at all, she lacks experience, but not the willingness to learn. Sometimes she is forced to follow recipes she finds online. Unfortunately, these recipes are often poorly detailed for beginners and even more often lack the necessary pictures. Not to mention her clumsiness when she cooks and is constantly trying to turn on her smartphone to follow the recipe, risking getting it dirty. It's in those moments that she wishes she had an app that would show her a recipe with step-by-step pictures. An app that keeps the screen switched on all the time while she follows the recipe and gives her the ability to move between steps with very few touches or even her voice alone.
- **Emily** is always looking for new recipes to try. Having tried many apps she can say that she loves when they provide thematic categories to choose from. However, she has special needs for her diet having several allergies. Therefore she is always forced to go through a lot of recipes before finding the one that meets her dietary requirements. Each time she thinks about how great it would be to have an app where she could set her food preferences, diets and allergies. She would feel so free to then explore the recipes knowing that she is only seeing the results that are tailored to her needs.
- **Cindy** likes to premeditate the recipes she wants to cook. That's why when she goes grocery shopping she always

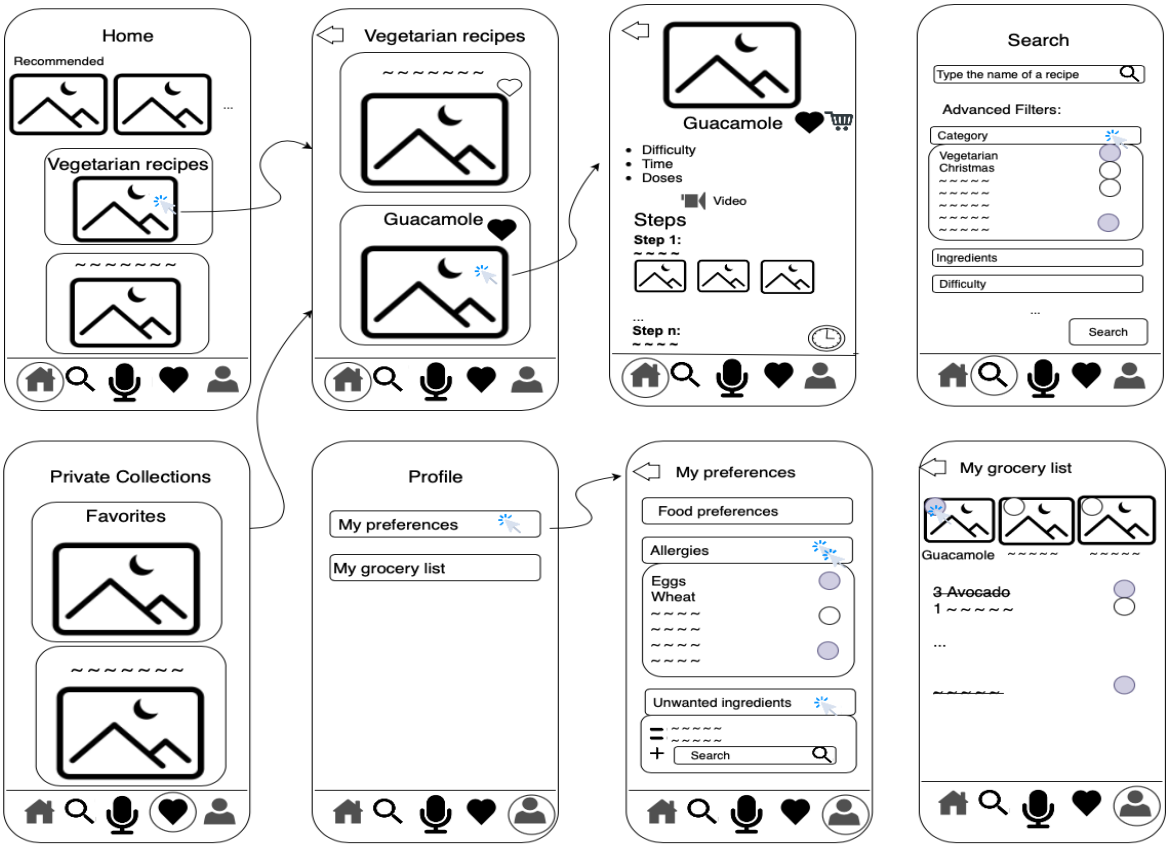

Figure 4: Mock-up of the application that outlines its main features.

prepares a list that is often very messy. She also finds it very inconvenient to have to carry around a pen to cross off the things she has already taken. She would also like to know which ingredients belong to which recipe so if she reconsiders, she knows what to exclude.

D. Main requirements

Having framed and clearly identified the personas now allows us to outline the main requirements of the application, which can be summarized with the following list:

- Users want to be able to **easily view recipes**. They want these to be displayed clearly with all the most important information prominently displayed, such as preparation time, difficulty, presence of allergens.
- The recipes then need to be divided into clear and **detailed steps with lots of pictures**.
- The **screen must not go off** when the user reads the recipe.
- It must be possible to **discover** new recipes easily.
- There must be **categories** that group together different recipes so that it is easier to discover new ones according to thematic areas.
- A filter search section where it can be possible to do **advanced searches** by combining different options.
- Is required the possibility of **excluding certain foods** or food groups from the application so that they are never suggested.
- A **shopping list** that is intuitive, clear and quick to use.
- The **voice assistant should be an additional feature** rather than the main one. It must be able to support the different tasks within the app and not replace them entirely. For this reason, it must be possible to set a search filter both manually and through the assistant.
- The **assistant** can also be used **to execute simple tasks** such as navigate within a recipe while reading the different steps or allow users to set a timer with simple commands.

E. Mock-up

Once established the main objectives and features required by our application we started to elaborate the mock-ups that constitute the last step of design. They identify the foundation and the basic structure on which to rely during the software realization phase. In Fig. 4 we show one of the mock-ups produced.

III. Phase 2: Application development

Having defined all the objectives and features, following the mock-up made at the previous stage, we moved on to the realization of a working prototype of the application, equipped with all the functionalities.

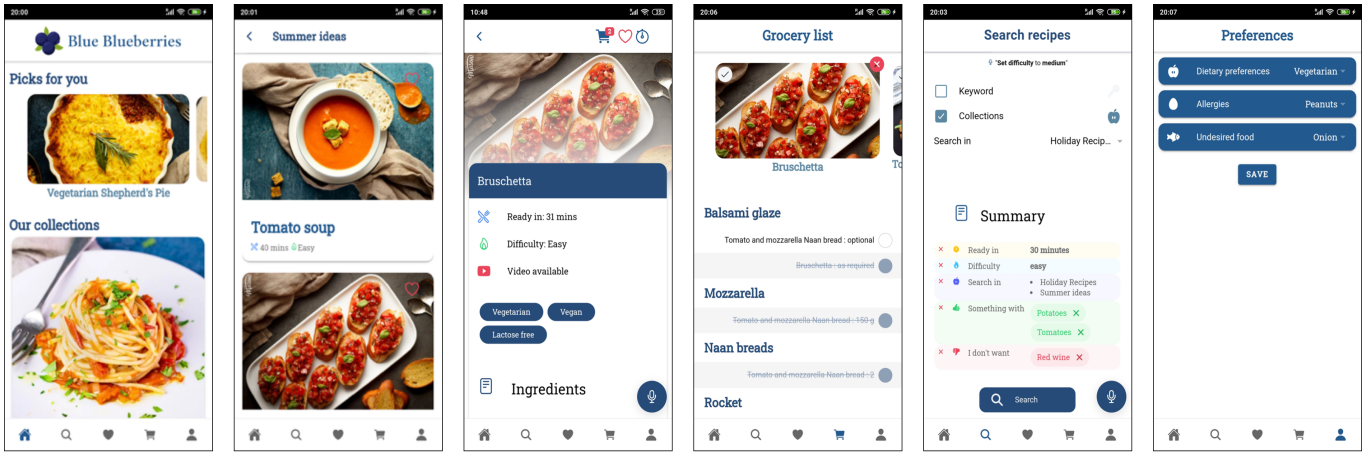

Figure 5: Some screens of the final result of the application [5].

A. *Tools and techniques adopted*

Since our aim was to build an application that could be used by a wide variety of users, we decided to rely on the Ionic toolkit [8]. This allowed us to build an application that was natively executable on the leading mobile platforms but with the advantages of a single code base. More specifically, we made use of Ionic Angular, which combines Ionic's core functionality with Angular's APIs [1]. All this with the aid of another framework, called Apache Cordova [2]. Cordova is an open source mobile application development framework that transforms standard HTML, CSS, JS into full-fledged native apps by providing JavaScript APIs for accessing native device functionality.

Since that the main goal of the Blue Blueberries application is to make recipes available, it quickly became clear that it was required a database that could store them. To solve this task we needed a database that could preserve all the data regarding the recipes on the cloud so as not to burden the user's device. For this reason we made use of the Firebase database [7]. On the other hand, however, we decided to store the users' own data, such as food preferences, allergies, private collections and recipes in grocery list on their very same device. To do so, we used an additional database, called Ionic Storage supplied by Ionic itself [9].

Since Firebase offers a free plan with limited storage and bandwidth, although we would have preferred to populate the application with a large and varied amount of recipes [10], we eventually settled for a dozen. Even though this is only a prototype, this little amount of recipes still already gives a fair idea of the general look and feel of the application.

Finally, for the implementation of the voice assistant we used a plugin provided by Cordova that could perform text to speech recognition [3]. As for the functionality of speech to text we used the library Annyang [12]. This is especially useful since it listens, performs the required action and starts listening again without the user having to do any further interaction.

Since that we relied on the frameworks mentioned above, and in particular Ionic integrated with Angular, it was easily possible to identify a good separation between model, view and controller following the well-known paradigm [4]. The Model component is responsible for adding or retrieving data to and from the two databases. In the case of our application the Model can be identified in four files, that is, the four ionic service components that manage the database data of recipes, private collections, grocery list and preferences. This way the controller is never forced to communicate directly with the database, ensuring a clean separation. Likewise, the Model does not speaks directly with the View either, but rather it is always the Controller that acts as an intermediary. The Controllers can be identified with all the remaining typescript files that manage the loading of data into the respective Views of the application pages. The Controllers also provide methods that can be invoked by the user from the View. Finally, the View is recognizable in the HTML and CSS files that make up the application. Views are created by the data which is collected by the Model component and that is sent to the View through the Controller.

In Fig. 5 are shown a few screens of the final result of the application.

IV. Phase 3: Usability tests

Finally, we move on to the last phase of application development: the usability tests. The purpose of these tests is to verify how easy it is to perform a series of representative tasks. Performing these types of tests allows to quickly identify the critical elements of the application and solve them more efficiently. The tests were conducted by distributing the app to the same participants interviewed during the needfinding phase. In particular, the ratios of the age groups were distributed as in Tab. I.

18-24	25-34	45-50
5	4	2

Table I: Age group composition of participants

The tests began by asking participants to install the app and share the screen during a video call. In a first phase, the users were allowed to freely explore the app. Then, they were asked to complete a series of **goals** here listed:

- Open a recipe.
- Search for a recipe with a specific ingredient.
- Add/remove a recipe to/from a personal collection.
- Delete a personal collection from the recipe page.
- Delete a personal collection from the collection page.
- Add/Remove recipes to/from the grocery list.
- Set their dietary preferences.
- Set a timer through the voice assistant
- Add a recipe to the grocery list through the assistant.
- Let the voice assistant read a recipe for you.
- Search for a recipe with eggs, milk and with the difficulty set to medium, all with the aid of the voice assistant.

A. The tests execution

After the execution of every goal, each participant was asked to answer a few Single Ease Question [11] so as to obtain a good estimate of the degree of difficulty encountered in the execution of the different tasks. Therefore here after are presented the results of the findings per goal.

1) Open a recipe: Opening a recipe was generally scored as an easy task by the entire sample of participants.

Single Ease Questions	1-2	3-5	6-7	Avg
Finding the recipe was easy	0%	0%	100%	6.8
I'm satisfied with the recipe visualization	0%	0%	100%	6.8

2) Search for a recipe with a specific ingredient: The search functionality was found to be fairly easy to locate. However, the particular search by ingredient was not evaluated positively by all users. In general, respondents were satisfied with the wide variety of filters available.

Single Ease Questions	1-2	3-5	6-7	Avg
The search was hard to find	68.6%	31.4%	0%	1.45
The food filter was easy to find	2.6%	17%	80.4%	5.1
I appreciated the variety of filters	1.7%	4.8%	93.5%	5.64

3) Add/remove a recipe to/from a personal collection: Completing this task was fairly easy for most respondents who immediately recognized the heart icon as an indicator of personal collections.

Single Ease Questions	1-2	3-5	6-7	Avg
Performing this task was easy	0%	0%	100%	6.6
The heart shaped icon is well suited	0%	0%	100%	7
It wasn't clear if I had succeeded	100%	0%	0%	1.1
Removing the recipe was easy	0%	6.8%	93.2%	6.6
I'm satisfied with this feature	0%	0%	100%	6.5

4) Delete a personal collection from the recipe page: Most people had serious issues in completing this goal, having to make several attempts. On the other hand, a small group of people didn't encounter any, as they immediately understood that they had to swipe on the collection in order to discover the hidden trash icon to delete.

Single Ease Questions	1-2	3-5	6-7	Avg
It was easy to do	16.2%	0%	83.8%	3.4
It wasn't clear if I had succeeded	100%	0%	0%	1
I had to try several times	13.5%	5.8%	80.7%	4.7

5) Delete a personal collection from the collections page: The amount of people in difficulty in this case increased. Most of them failed to complete the task and eventually the moderator had to intervene giving suggestions.

Single Ease Questions	1-2	3-5	6-7	Avg
It was easy to do	13.5%	37.8%	48.7%	3.4
It wasn't clear if I had succeeded	100%	0%	0%	1
I had to try several times	7.1%	17.9%	75%	5.1

6) Add/Remove recipes to/from the grocery list: Adding and removing recipes was generally considered a pretty simple task and a good addition to the application.

Single Ease Questions	1-2	3-5	6-7	Avg
I quickly found the button to press	0%	0%	100%	6.66
It wasn't clear if I had succeeded	78.6%	21.4%	0%	1.3
It is clear if a recipe is in list	0%	6.8%	93.2%	6.6
I'm happy with this feature	0%	11.9%	88.1%	6.1

7) Set their dietary preferences: The food preferences were considered easy to set up and a very useful idea.

Single Ease Questions	1-2	3-5	6-7	Avg
Where to set them was easy to find	0%	0%	100%	6.5
I preferred different preferences	100%	0%	0%	1.5
I don't find this feature useful	47.6%	52.4%	0%	1.9

8) Set a timer through the voice assistant: The assistant icon was easy to identify, however several people had issues making themselves understood.

Single Ease Questions	1-2	3-5	6-7	Avg
Activating the assistant was easy	16.6%	16.6%	66.8%	5.5
I had a hard time giving the order	0%	66.6%	33.4%	5.1
The timer was clearly visible	0%	0%	100%	6
Overall it is a useful feature	0%	0%	100%	6.8

9) Add a recipe to the grocery list through the voice assistant: Again, someone experienced some difficulties getting the voice assistant understand them.

Single Ease Questions	1-2	3-5	6-7	Avg
I had a hard time giving the order	66.6%	33.4%	0%	2.5
It wasn't clear if it got the order	100%	0%	0%	1
Overall it is a useful feature	0%	66.6%	33.4%	5.3

10) Let the voice assistant read a recipe for you: Having a voice assistant that could read a recipe for you was generally considered to be a great feature. This time in general people had no difficulties interacting with the assistant.

Single Ease Questions	1-2	3-5	6-7	Avg
It was easy to ask this command	0%	0%	100%	6.8
The outcome wasn't the expected	100%	0%	0%	1
I didn't knew how to stop it	100%	0%	0%	1.1
I find this feature useful	0%	16.6%	83.4%	6.3

11) Search for a recipe with eggs, milk and with the difficulty set to medium, all with the aid of the voice assistant: In this case, people generally succeeded, however the process of asking things to the assistant was a bit long and someone said they preferred to set the filters by hand.

Single Ease Questions	1-2	3-5	6-7	Avg
The voice assistant understood me	0%	16.6%	83.4%	6.3
I had to try several times	83.4%	16.6%	0%	2
I prefer setting the filters by hand	16.6%	0%	83.4%	5.6
What filters are selected is clear	0%	0%	100%	6.83

B. The findings

Finally, basing on the feedback received at the end of the execution of the different goals, users were asked to provide further feedback regarding the intuitiveness and functionality of the various components of the application. In particular, further questions were asked on the outcomes of the Single Ease Questions soliciting suggestions for particularly negative feedback that the execution of some goals had received. As well as it was asked why something was liked particularly.

In general, what emerged is that the application appears very fluid and has a nice and consistent look across screens. The major suggestions raised where regarding:

- Small graphical adjustments such as making the layout of minutes and hours clearer when setting the timer.
- The repositioning and changing of color of some icons.
- A different way of deletion of the personal collections.
- The voice assistant that sometimes failed to reconize commands. Also it was noted that some voice commands were not intuitive at first glance.
- The search filters a little bit confusing.

We first, therefore tried to analyze the reason for the issues related to the removal of the collections and, above all, how it was possible that there were formed two distinct groups of people that had serious issues, opposed to others that instead had succeeded immediately to carry out the goal.

The removal of a personal collection was possible through the action of sliding the card or the name associated to the collection. This action allowed to reveal the icon of a trash can that was normally hidden. Many users instead were attempting to let a popup appear, pressing and holding the collection. Those who managed to accomplish the goal without any problem were only iPhone users who perhaps have more ingrained the idiom of sliding an object to make hidden options appear. In any case, to meet the needs of Android users, it was decided to modify the method of deleting a collection, at least within the page dedicated to personal collections. This has been done by placing a special icon for deletion above the card.

With regard to the voice assistant, it was clear that the language gap of some of the participants negatively impacted their overall experience with the voice assistant. Finally the search filters and timer were arranged a little bit differently, following the suggestions of the participants. As a final note, it has been observed that in general the users skipped the initial tutorial, that maybe was too long, very quickly. Despite this, there were no later noticeable issues in navigating through the app.

People were thrilled to try out the recipes and expressed satisfaction with the final look of the application: they said they would definitely be willing to download it.

V. Conclusion and future developments

In this project it has been developed and tested the Blue Blueberries cookbook app, following all the phases of the Human Computer Interaction: needfinding, implementation and usability testing. The usability tests showed that the application is intuitive and pleasant to use. The only major issues are those regarding the voice assistant which is not very intuitive if the commands are not known. Also it is a bit uncomfortable if the user does not have a correct English pronunciation. As a future development, to solve this problematic the application could offer different languages to choose from. It would also be interesting to improve the robustness of the voice assistant by integrating it with services such as Google DialogFlow [6] or being able to call up the assistant exclusively with the voice without having to press on its button.

Another idea could be to integrate an authentication system to which users can sign up to and contribute by writing comments or even recipes. Also the timer could be improved letting it ring an alarm when time runs out. We also would have liked to add a further page for weekly meal plans.

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