Demo: ARMart – AR-Based Shopping Assistant to Choose and Find Store Items

Tobias Röddiger
Karlsruhe Institute of Technology
Karlsruhe, Germany
roeddiger@teco.edu

Dominik Doerner
Karlsruhe Institute of Technology
Karlsruhe, Germany
dominik.doerner@student.kit.edu

Michael Beigl
Karlsruhe Institute of Technology
Karlsruhe, Germany
michael@teco.edu

Abstract
Supermarkets offer a wide range of products which makes it challenging for consumers to choose between the different options and find the items they are looking for. Augmented Reality (AR) applications, however, have a high potential to enrich real-world objects with information which can be leveraged to improve this process. We developed an application that runs on a regular smartphone and helps users to choose between packaged groceries based on factors such as calories or sugar, rated on a scale from red (bad) to green (good). Compared to previous work, there is no need for a priori knowledge about product locations making the system suitable for many use cases. Moreover, information maps precisely onto the outline of the product's and not on the approximate shelf. To do so, no modifications of the objects, such as specialized tags, are necessary. Additionally, users can find items just by entering the name. Highlighting the packaging virtually helps to find the desired product. It is also possible to make a binary distinction between groceries that contain specific ingredients.

Author Keywords
augmented reality; shopping; assistant; smartphone

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

	2015	2030
Obesity	36%	51%
Severe O.	6%	9%

Table 1: Future linear projection of the percentage of the population affected by (severe) obesity [2].

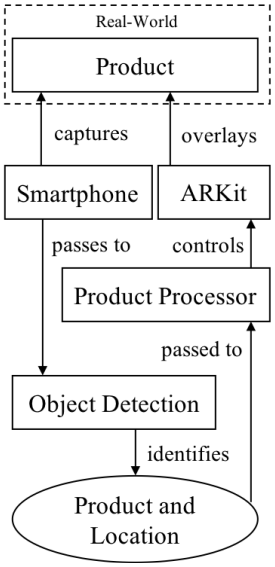

Figure 1: Flow of the system that we developed.

Introduction

Obesity projections in the US (see table 1) suggest that there will be a growing number of the population struggling with diseases related to being overweight [2]. This also results in an economic burden due to growing healthcare costs. Therefore, we should investigate solutions that can counteract this problem.

A key step towards preventing obesity is a healthy and balanced eating lifestyle. However, it is challenging for consumers to understand which products contain which ingredients and even more complex to compare these ingredients across several grocery items. An experiment over two years in a cafeteria showcased that a traffic-light-like labeling of products results in healthier choices, therefore, suggesting that such a system can promote long-term changes in a population's eating behavior [5]. Nevertheless, this approach only works if either the producers are forced to label their items or the stores do so themselves which requires a lot of time and money. As a result, we would like to investigate the potential of using AR to achieve the same effect and more with precise virtual labeling.

Related Work

Previous work has already explored the potential of using AR to label grocery items with color which reduces search time to find healthy food items and helps to improve the user's ability to quickly and easily identify products to avoid [1]. However, the system requires accurate determination of the user's indoor location as well as exact knowledge about which shelf holds which item. Additionally, the information does not map directly onto the outline of the product's packaging but only on the shelf.

From a design point-of-view, mobile augmented reality experiences in the context of shopping scenarios should aim for efficiency, relevance, and empowering users with useful context information [4]. Not fulfilling these expectations will negatively reflect on the perceived goodness of the system. Therefore, we should keep those factors in mind while designing our solution.

Working Principle

The system that we developed is independent of the user's location and no previous knowledge about where groceries are located is necessary. It could even be used in e.g. the user's kitchen as only the appearance of the packaging is used to identify specific grocery items.

Figure 1 illustrates the working principle of our system. First, the smartphone captures the products using the built-in camera. This data is then passed to the object detection. Our demo's object recognition is based on the packaging's front-side and uses Apple's proprietary algorithms [3] which make it possible to detect images in 3D-space without extensive training. With a single input image for each grocery item the front-sides are detected reliably at a distance of about one meter. Additionally, the system works best in well-lit settings. The product processor then determines the overlay for each identified product depending on which product classification principle is selected. The information is mapped onto the products using ARKit [3] which overlays the groceries with a colored rectangular shape. All relevant data about products is locally stored on the device and includes name, brand, package measurements, price, calories, fat, sugar, salt and if nuts or lactose might be contained. To run the application an iOS device with an A9 or newer chip is required. The groceries can be spread on a table, stored on a shelf or even be picked up by the user.

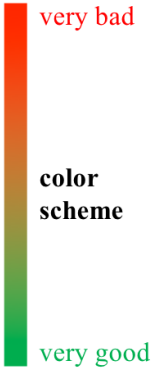

Figure 2: Color scheme of the rating system that we developed.

Functionalities

Our application has three core functionalities. Filtering items depending on a specific parameter, searching an item based on the name of the product or brand and exclusion of products that contain certain ingredients.

Filtering

Users can select different filtering options from a drop-down menu in the bottom left corner. The color that is assigned is calculated based on the recommended daily intake for adults. Red means that a product is likely to have a very bad impact on the lifestyle e.g., exceeding recommended intakes, whereas green is very good to stay within these limits. Labeling with colors in between those two edge cases enables a fine-grained differentiation. Figure 3 showcases an example with the filtering option calories selected.

Figure 3: Filter items by different factors (e.g. calories).

Search

Sometimes users know which item they are looking for but just can not find it in the shelf. By entering the name in a free-text field, the database of groceries is queried to identify the item that a user is most likely looking for. This can be based on the name or brand whereas it must contain the search string as a substring. The product is then highlighted with a green rectangle making it very obvious where an item is placed. To do so, the color green is used and no distinction is made based on the confidence that a match is correct. Figure 4 shows this functionality.

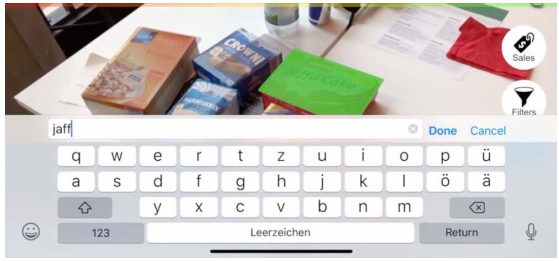

Figure 4: Search for items based on name or brand.

Exclusion

Many groceries possibly contain ingredients that affect users with different types of allergies. Therefore, it is possible to distinguish items that contain specific ingredients such as nuts. Items to avoid are shown in red and groceries that are fine in green. Figure 5 shows this distinction.

Figure 5: Warnings for items that contain nuts.

Conclusion

The system that we developed offers a wide variety of interactions with grocery items. It precisely maps the information onto the packagings. An intuitive coloring scheme of grocery items supports to pick and find the right items for a healthier lifestyle. By empowering the users with our system they can get access to useful context information.

Limitations

The number of products is limited by the product information stored locally on the user's device. Additionally, only products with a rectangular shape are supported.

Future Work

We aim to evaluate our system to gain additional usability insights and understand how users interact with the groceries using our high-fidelity prototype. Additionally, an architecture that enables a more flexible system and can identify a large number of products at scale is desirable for the future. Integrating existing product databases will likely be an integral part of this approach, which will help to gain access to a large pool of already collected product data. A key challenge will also be to find suitable image data of various product packagings to detect them reliably in the user's environment.

REFERENCES

1. Junho Ahn, James Williamson, Mike Gartrell, Richard Han, Qin Lv, and Shivakant Mishra. 2015. Supporting Healthy Grocery Shopping via Mobile Augmented Reality. *ACM Trans. Multimedia Comput. Commun. Appl.* 12, 1s, Article 16 (Oct. 2015), 24 pages. DOI: http://dx.doi.org/10.1145/2808207
2. Eric A Finkelstein, Olga A Khavjou, Hope Thompson, Justin G Trogdon, Liping Pan, Bettylou Sherry, and William Dietz. 2012. Obesity and severe obesity forecasts through 2030. *American journal of preventive medicine* 42, 6 (2012), 563–570.
3. Apple Inc. 2018. ARKit - Integrate iOS device camera and motion features to produce augmented reality experiences in your app or game. (July 2018). https://developer.apple.com/documentation/arkit.
4. Thomas Olsson, Else Lagerstam, Tuula Kärkkäinen, and Kaisa Väänänen-Vainio-Mattila. 2013. Expected user experience of mobile augmented reality services: a user study in the context of shopping centres. *Personal and ubiquitous computing* 17, 2 (2013), 287–304.
5. Anne N. Thorndike, Jason Riis, Lillian M. Sonnenberg, and Douglas E. Levy. 2014. Traffic-Light Labels and Choice Architecture: Promoting Healthy Food Choices. *American Journal of Preventive Medicine* 46, 2 (2014), 143 – 149. DOI: http://dx.doi.org/10.1016/j.amepre.2013.10.002