AR Portion: Dynamic solution for visualizing food portions in nutritional tables

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Abstract. *This work proposes the concept of an Android application, based on augmented reality, to make the presentation of nutritional information tables on products interactive and accessible, given that label information is often displayed in reduced sizes, making it difficult to read and understand. The solution overcomes the limitations of physical labels by displaying interesting information based on the portion consumed. Developed with Unity 2022.3.20f1 and ARCore SDK, this application integrates image tracking and surface detection for an enhanced interactive experience.*

1. Introduction

It is common for consumers of industrialized food products to consult the packaging for information about the food being consumed, whether to verify the product's composition, especially in cases of food allergies, or for nutritional control in diets.

Traditionally, nutritional information tables have a column dedicated to presenting nutritional values based on a serving size suggested by the manufacturer. However, the suggested serving size often differs significantly from the actual serving size, compromising the accuracy of the information provided to the consumer and hindering dietary control, especially in contexts of restrictive diets or specific needs. Moreover, the small font size used on labels makes reading difficult, especially for people with visual impairments, which increases barriers to accessing information and limits consumer autonomy in decision-making.

From this problem, the proposal to consider all possible portion variations emerged. This approach would only be feasible if the packaging presented infinite variations of the serving size used as a base. To overcome this problem, a platform was designed that allows portion sizes to be calculated dynamically, going beyond the physical limits of the label. In this context, the use of Augmented Reality (AR) in a mobile application is proposed to enable this extrapolation.

2. Related Works

The use of AR for nutritional estimation has been explored in multiple contexts, with a focus on improving accuracy and facilitating health learning. A notable example is ServAR [Rollo et al. 2017], a tool that uses AR to project the desired food portion onto a plate as a visual template, assisting the user in meal assembly. This system has been shown to significantly reduce portion estimation errors in controlled environments, being one of the first to experimentally validate the use of AR in this domain.

The goal of the application developed by [Juan et al. 2019] was to provide a tool that would help users read and interpret nutritional information on real-world packaging labels. The system improved understanding of macronutrient composition, with a focus on carbohydrates, demonstrating a positive impact on learning and conscious dietary decision-making.

Other AR-based systems reinforce this trend. Applications such as BE_{AR} [Domhardt et al. 2015] and EatAR Tango [Dinic and Stütz 2017] have demonstrated reduced errors in portion and carbohydrate estimation compared to traditional visual methods. Similarly, VAPS (Virtual Atlas of Portion Sizes) [Lam et al. 2021] uses photogrammetry (a technique that extracts measurements and 3D models from multiple photos from different angles) to allow users to manipulate three-dimensional food models in AR, improving the perception of volume and quantity.

Augmented reality solutions make food selection more accessible and enjoyable than reading labels. Applications like the one proposed by [Moses 2023] have demonstrated greater usability and satisfaction. The XR-PortionControl tool [Ullas 2024], highlighted in the 2024 review in the Proceedings of the Nutrition Society, indicates that immersive technologies (XR) certainly impact portion control and food preferences, but longitudinal studies are needed.

Unlike previous works, our application combines AR-based packaging detection with dynamic portion updates and detailed allergen and ingredient views. This enhances interactivity and provides accurate, real-time personalized nutritional information, filling gaps in prior systems that were limited to static visualization or data estimation.

Furthermore, the use of AR in this project enables rapid product comparisons, for example by framing multiple packages simultaneously on a supermarket shelf. This functionality is grounded in the concept of situated visualization, which anchors digital information directly onto physical objects, reinforcing the spatial contextualization of data and preserving its perceptual linkage to the environment. As [ElSayed et al. 2016] argue, this approach improves users' performance in comparison and decision-making tasks by reducing association errors, accelerating interaction, and fostering more immediate, situated interpretations of nutritional information.

3. Implementation of the Experience

The development of the prototype required reconciling technical resources, both physical and virtual, with functional objectives, resulting in efficient and practical solutions to coherently integrate AR into the food context. Accordingly, the technical structure and usability for the end user are described.

3.1. Physical and Virtual Resources

The project was developed using Unity Engine version 2022.3 in conjunction with the ARCore SDK (Software Development Kit). Initially conceived as a practical demonstration for a local lecture, it aimed to quickly illustrate AR possibilities, showing how it could aid innovation in the food sector and facilitate rapid access to information for users who often struggle to find or read it.

ARCore was used to align the project with current standards, provide a good experience for Android users [Brata et al. 2023], and improve overall performance and robustness, such as enhanced plane tracking, environmental lighting, and computational efficiency. Currently, the mobile application is only available for Android.

Image identification and tracking in AR are internally managed by ARCore, based on the extraction of features (unique points or patterns) present in the camera-captured frame. For accurate recognition, the target (each image in the database to be identified) must have high contrast and avoid patterns, as these hinder feature identification. Due to this limitation, the use of product barcodes as targets was discarded because their patterns proved highly ineffective in tests. Thus, it is proposed to create a small icon that exclusively identifies each food product, integrated into the packaging layout. These icons are then used as targets for image identification. This ad-hoc approach is acknowledged as a limitation, and future work may explore more robust solutions.

3.2. Application

The user must select a product to consult its information. Then, they should point the smartphone camera at the packaging target image (the proposed icon to identify the item). Upon detecting this target, the application automatically identifies the product and associates it with the corresponding information, displaying an AR overlay. Figure 1 illustrates this step through items A' and A'' of the AR mode.

Beyond simple visualization, the user can click to expand the AR table and perform actions. Selecting a visible overlay expands it to fullscreen mode, exiting AR mode and showing additional table options. To calculate a customized portion, the user inputs the desired value, and the application updates the displayed data, as demonstrated in Figure 1 through the items B' and B'' of the fullscreen mode, after entering a new value and clicking calculate. Although simple, the calculation applies simultaneously to all rows of the nutritional table. Once the portion is edited, the user can exit fullscreen mode, and the updated information will be reflected in AR mode to facilitate subsequent table consultations.

As shown in Figure 2, the AR Portion application will also feature two complementary screens detailing nutritional information, focused on displaying allergens and ingredients. The allergens screen presents a list with names and icons of allergens present in the product, facilitating quick identification, especially for users with specific dietary restrictions. The ingredients screen provides the product's composition. Both screens are accessed in fullscreen mode via side navigation, ensuring smooth transitions and clear, dedicated viewing. These features enhance the app's utility, offering essential information for more informed dietary choices and providing more accessible reading experience, with clear information conveyed to the user.

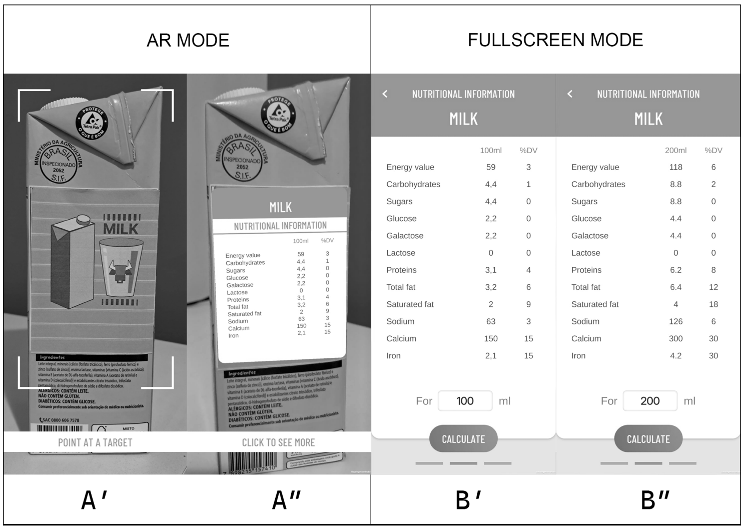

Figure 1. AR and fullscreen modes of the AR Portion application

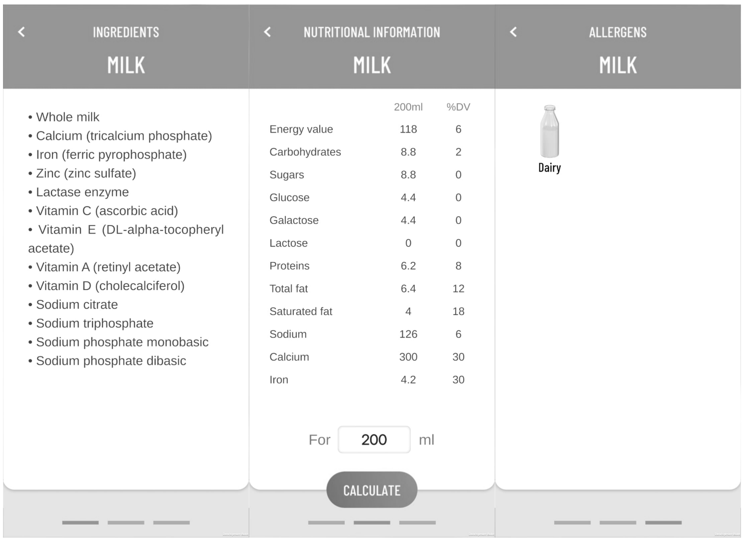

Figure 2. Complementary screens for ingredients and allergens.

The application uses a JavaScript Object Notation (JSON) file to store and retrieve product data. The database is an array of objects, each containing fields such as name, serving size, total quantity, allergens, ingredients, and an object with an array of nutritional information. Each nutritional item includes name, value per serving, and percent daily value. The data is hosted online on Google's Firebase. Therefore, the data is loaded via web request, and if the data retrieval fails or the network connection fails, the application uses a local backup of the file.

Using online JSON allows the application to display information dynamically, facilitating future changes and data maintenance, as well as allowing new products to be added or modified without changing the application's source code. Changes are immediately reflected for any user upon reloading the app. This ensures greater flexibility and scalability, especially in contexts where the item catalog may be expanded or changed frequently.

3.3. Challenges

The main development challenge was to build a user interface that is simplified, and offers a user experience (UX) comparable to native Android applications developed using established platforms like Android Studio.

Considering that users may be consuming the product, preparing a recipe, or have one hand occupied for other reasons, navigation was designed to be fully functional with a single hand when necessary. The challenge was to balance usability and ergonomics, ensuring a practical and comfortable experience in any context.

4. User Tests and Results

The initial testing phase of the AR Portion application focused on evaluating usability, navigability, and collecting user feedback. Tests were conducted with ten individuals aged 22 to 27, familiar with technology but without prior training on the application.

During the tests, participants were introduced to the application and invited to interact with it, locate targets, view nutritional information, and access complementary screens. Afterwards, they answered questionnaires with questions such as: "Does the product achieve its goal of scanning and displaying food data?" and "Would you be able to use it autonomously in your daily routine?". The objective was to evaluate usability, ease of use, and gather improvement suggestions. The results showed that 78% of participants believe the product meets its goal and could use it autonomously, in addition to providing suggestions such as adding instructions to guide first-time users, including a product history, and enabling reading a target from the device's gallery, indicating that the results obtained in this phase will serve as a basis for future adjustments and refinement.

5. Conclusion

This work presents an Android application based on AR for dynamic visualization of nutritional tables. Developed with modern technologies, it offers a flexible and scalable system with potential for future features, positioning AR Portion as an innovative tool in the food sector.

The prototype demonstrated technical feasibility for dynamic recognition and tracking of targets via AR, displaying nutritional information based on user-defined portions. Integration with Unity and ARCore provided a satisfactory interactive experience with room for optimization. Initial tests indicate good acceptance, making information consultation more practical and accessible via AR, notably real-time nutritional adaptation and easier allergen reading.

To enhance functionality and usability, new sections and features are planned, including a scanned products history and a favorites list, facilitating quick access to previously consulted information.

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