Mobile Augmented Reality Shopping System

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***Abstract*—This document serves as an extended abstract to detail the architecture for an augmented reality shopping application under current development for a thesis. The system consists of a progressive web app client that presents the augmented view to the user and performs object tracking, and a cloud server that performs object detection, localization, and the necessary product information retrieval and analysis.**

***Index Terms*—augmented reality, webAR, object recognition, mobile computing, mobile augmented reality, progressive web app**

I. Introduction

Product labels are fundamental for communicating relevant nutritional or drug facts, product warnings, allergy information, dosage, and a wide range of other information consumers need to make informed purchase decisions. This proposal details the design process and architecture of a markerless, web-based augmented reality (webAR) application for improving accessibility in retail by highlighting needed items on shelves and providing relevant data on nutrition or other product facts for selected items. The application will function as a two part system, the server-side back-end to identify objects and fetch the needed information, and the client-side progressive web application that will handle object tracking and rendering the augmentations. This expands upon previous work on a shopping AR framework by Souza-Herod [1]. Unlike that framework, this proposed system eliminates the need for unique markers and is designed for use with smartphones and tablets instead of the Microsoft HoloLens.

The system outlined by this proposal has several parts, each with their own associated design goals. The two major parts of the system are the client and the server. The server will receive images from the client and perform image recognition on the product label, item localization to identify the object's location in the view, any necessary pre-rendering of the augmentation, and the nutrition and product information retrieval. The client will be a platform-agnostic progressive web app (PWA) with support for ARCore and ARkit that will track the position of the detected objects and the device itself, render the augmentations, and provide the user interface and necessary interactions. The overall AR user experience will need to present the user with the most relevant information in a highly readable way, and the interactive portions of the interface will need to be usable on a variety of screen sizes. A secondary goal is to limit the amount of personal data users will be required to share as part of the app's functionality, opting for local user preference storage over a cloud-based user account system.

II. Proposed Methodology

The following subsections give an overview of the development and testing process for the AR system.

A. Hypothesis

The study, development and use of this mobile augmented reality application for shopping will lead to an improvement in the user's retail experience by decreasing the time spent finding items and identifying their contents or assessing their nutritional value.

B. Method

The AR shopping system has several parts, each requiring design and implementation. First, a proper literature review will be conducted, with a strong focus on AR user experience design and previous AR based shopping systems. Next, there will be a multiphase prototyping and testing period for the PWA clients on both iOS and Android devices to identify the strengths and weaknesses of both the app UI and the AR user experience, followed by a user study to assess whether the system provides a noticeable improvement in the shopping experience, especially when deciding whether to buy a specific product. The sections below expand on the proposed design in more detail.

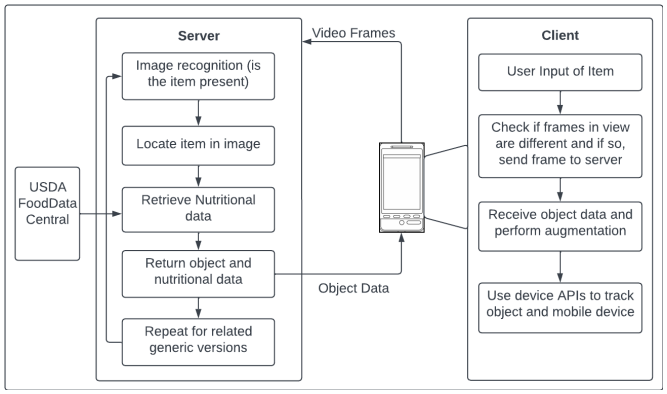

Fig. 1. Application Architecture

1) Object Recognition and Localization: One of the main goals of using a client/server architecture for AR with this system is to greatly increase the range of products detectable without placing heavy resource requirements on the user device. In a shopping setting, the user will direct their device towards shelves filled with many shapes and sizes of items. The system will need to identify whether the searched for item exists in the view, where that item is, and also identify and locate similar items or generics in case the user requests to view other options. We plan to develop and deploy a custom model through Amazon Sagemaker [2].

2) Nutrition and Product Information Retrieval: Nutritional and product information, ingredient lists and other relevant data for food and drug products will be gathered from the United States Department of Agriculture (USDA) FoodData Central product information database [3]. Information on generic options for products will also be retrieved if the product searched for/selected by the user is a pharmaceutical product such as ibuprofen. This information will be gathered first if a specific item is searched by the user to aid the object recognition in finding related items.

3) Augmented Visuals and User Experience: There are three main goals for the augmentations:

1) Locate the product on a shelf containing many items.
2) Present nutritional and other product information in a clear way.
3) Allow users to compare similar items.

Mobile devices like smartphones are far more prevalent than smart glasses or other head mounted displays for consumer use, but only offer a limited amount of screen space for user interaction. The application will need to have a very minimal user interface that maximizes the amount of open screen area for the camera viewport. Augmentations will be applied to the product itself when possible, rather than anchored to points in the room space like a billboard.

4) PWA Client Implementation: Developing multi-platform applications traditionally requires separate development workflows and platform specific API implementation. Users are also required to install an application, which may lack features depending on the platform, or may be incompatible with the user's device. This AR system aims to avoid those problems by serving the application on the web, providing a unified experience across both major mobile platforms. User preferences will be stored in the user's local browser cache to lessen the need for user accounts, and the required information and model data for the user's most frequently searched items will also be stored locally to allow for offline recognition.

C. Expected Contributions

The main contributions of this thesis will be:

- An efficient client/server hybrid system for recognizing and presenting information on household and pharmaceutical products
- A progressive web app client compatible with Apple and Android, capable of tracking objects, rendering augmentations, and capable of offline recognition of commonly searched items
- A platform-agnostic product recognition server capable of identifying item brand and type from images provided
- A thoroughly studied and documented mobile AR user interface
- An AR shopping user experience capable of finding and highlighting specific items on a shelf, presenting product information about held or focused items, and making comparisons of items in real time, among other features.
- A fully implemented, functional system.

III. Outcomes and Deliverables

Deliverables for this thesis currently include:

- A literature review covering AR user experience design and the different parts of the proposed system
- A report on the design and implementation of the object recognition server
- A research paper on what the most important product information to users is and what is the most effective presentation of that data
- Design documents for the user interface and AR augmentations
- A user study and report covering the PWA prototype and final application
- A final thesis report for the entire project

IV. Challenges

The main challenges will be overcoming latency issues when sending frames to the server for detection, creating effective overlays regardless of package shape, and providing users with a robust method for interaction when they need to hold their device.

V. Conclusion

This abstract proposes the research, design, development, testing and assessment of a mobile augmented reality application for shopping, with the goal of improving the user's shopping experience, especially when reading product labels and searching for items. This application will be capable of presenting product information in a way more readable than the product label without requiring any external markers, find and compare items physically in the space together, and provide the user with additional information through the use of virtual augmentations. In addition to the working implementation of the system, research reports and studies related to the design and implementation of the various parts will be produced.

References

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