2025 CSUSM Software Engineering Capstone Design Conference

CartOptics

Qualcomm

CartOptics

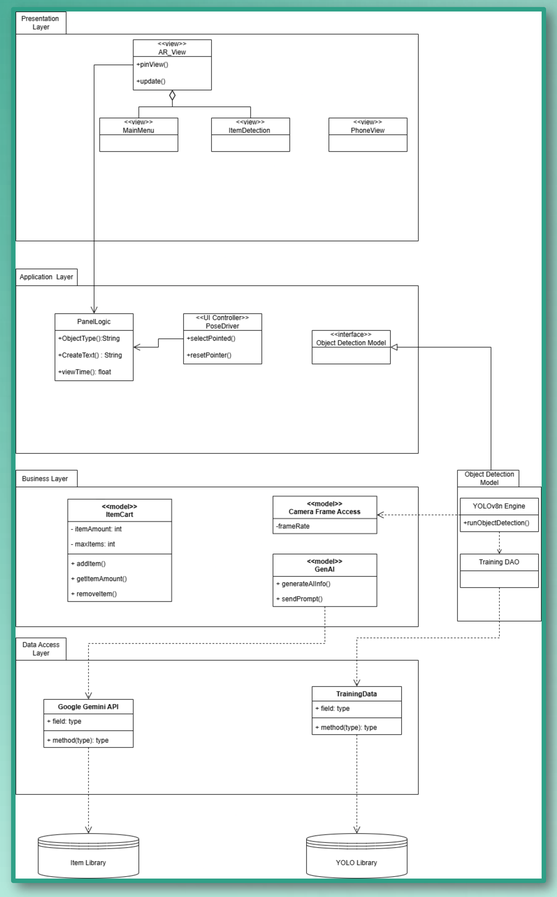
California State University SAN MARCOS

Introduction

CartOptics leverages SnapDragon Spaces with an AR Head-Mounted Display (HMD) that enhances the grocery shopping experience through real time object detection. We utilized user gaze to recognize grocery items in the user's virtual environment and leverages the Google Gemini to generate relevant product information such as taste, nutritional details, and potential allergens – helping users make more informed and healthier shopping choices.

Architecture

For the design of our system , we decided to use a Model View Controller (MVC) pattern, while incorporating principles of Clean Architecture to maintain separation of concerns and scalability. The presentation layer shows the different views and how they relate with each other. The application layer has the classes relating to the functionality of UI elements as well as the controls to navigate between them. The business layer has the core functionalities of the project, and the data access layer has the classes that are responsible for accessing the data during runtime.



Authors & Abstract

Student Team: Elijah Munoz , Kyle Beck ,Mason Vick, Aaron Hamilton

Faculty Advisor: Yongjie Zheng

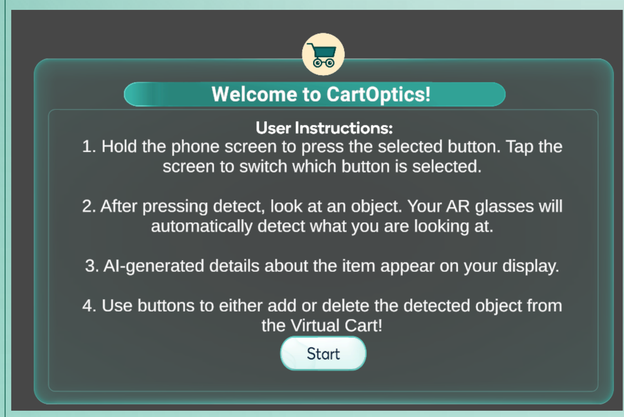
Industry Mentor: Karen Weeks

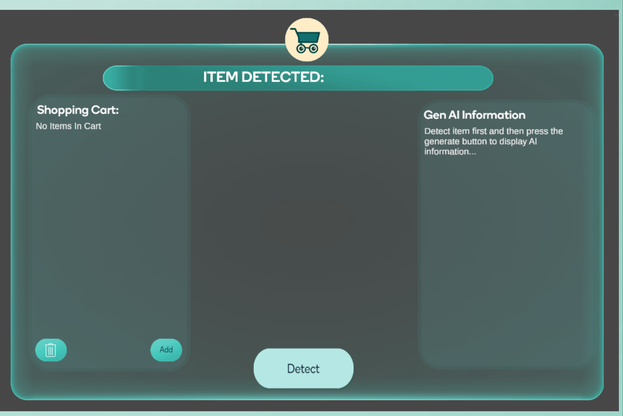
Sponsored By: Qualcomm

Abstract

CartOptics is an innovative software solution developed for the Snapdragon AR HMD, designed to enhance and streamline the in-store grocery shopping experience. This application enables real time detection and recognition of grocery items using advanced object detection technology , paired with the Google Gemini API to provide a dynamic product of information directly within the users filed of view. The key features of CarOptics include image-based item recognition , user interaction tracking and interactive visual feedback. As users scan shelves , grocery items are highlighted with overlays displaying essential product details such as product names, nutritional information and allergen warnings Which illustrates consumers to make healthier , more informed purchasing decisions. Built using Snapdragon Spaces for AR integration and Unity as the primary development engine, CartOptics delivers a seamless and intuitive AR experience. It's real time responsiveness and user focused interface aim to redefined everyday retail interactions , making grocery shopping more efficient , informative and engaging for the user. By fusing an on-device AR capabilities with cloud powered intelligence, CartOptics bridges the physical and digital retail worlds, paving the way for the future of augmented shopping.

Results



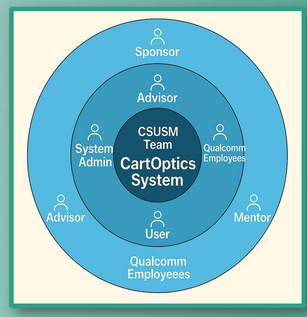


Main Menu Page (Left): This screen introduces users to CartOptics and explains the core functionality of the application. Step by Step instructions on how the AR enable system works . This page also includes a Start Button , which users can tap the Start button to begin their Shopping Experience . The overall design ensures that the first-time users can quickly understand how to interact with the system and navigate the menu with ease.

Main Interface (Right): This screen appears after an item is detected. It shows the user's cart , a live camera view and section to generate product information. Users can interact with the item by selecting buttons like "Add to Cart " , "Detect" or "Generate" to display more details about the object. The trash can icon can also delete items from your cart , if the user decides to remove an item.

Broader Impacts

CartOptics enhances more than just the user experience. It promotes privacy conscious AI by using Yolo for secure object detection , addressing growing concerns about data protection in AR systems.



The integration of Snapdragon Spaces AR and Generative AI provides real time product insights , improving the accessibility and decision making for users in retail environments.

Third Party Software

Unity

Qualcomm snapdragon

Google colab

Google Cloud Platform

ONNX

References

- Qualcomm : XR Bootcamp Snapdragon Spaces https://xrbootcamp.com/snapdragon-spaces/
- Qualcomm Technologies : Setup Guide for Unity https://docs.spaces.qualcomm.com/unity/setup/setup-guide#import-the-package
- ONNX : Integration with Ultralytics https://docs.ultralytics.com/integrations/onnx/
- Unity Technologies : Barracuda Neural Networks for Unity https://docs.unity3d.com/Packages/com.unity.barracuda%401.0/manual/index.html.
- Deep Learning AI : Introduction to On-Device AI https://www.deeplearning.ai/short-courses/introduction-to-on-device-ai/