CAPSTONE PROJECT

5990 HCI Capstone Course

ABSTRACT

This capstone project presents Prism, an AI-powered augmented reality (AR) shopping assistant designed to enhance in-store experiences by reducing cognitive load and improving accessibility. Prism combines smart AR glasses and a mobile app to deliver real-time product insights such as price comparisons, nutrition facts, and personalized recommendations through hands-free interaction. Grounded in human-centered design, the project involved surveys, interviews, and usability testing with diverse participants to identify user needs and inform system features. Key findings revealed challenges around information overload, accessibility gaps, and the need for more intuitive, personalized decision-making tools. Prism addresses these issues through features like object recognition, voice-controlled interaction, and customizable overlays. The project demonstrates how integrating emerging technologies with inclusive UX design can create more seamless and empowering retail experiences for a wide range of users.

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The Problem

Shoppers today often experience information overload when making in-store purchases. Comparing prices, checking nutrition labels, and finding trustworthy product reviews frequently requires switching between multiple mobile apps while trying to physically navigate a crowded store. This creates friction, especially for users with accessibility needs. Visually impaired and neurodivergent individuals face even greater barriers, such as reading small text, identifying product variants, and filtering options quickly without support.

Although smartphones and online platforms provide information, they are not optimized for hands-free, real-time access during physical shopping. Moreover, most accessibility tools are either siloed or don't integrate seamlessly into the in-person shopping experience. There is currently no cohesive solution that unifies AI-powered product intelligence, social commerce insights, and inclusive design in a real-world setting.

Project Idea: Prism AR Shopping Assistant

Prism is a hands-free, AI-powered augmented reality (AR) assistant designed to help users make smarter, more informed purchasing decisions while shopping in physical stores. The system addresses the challenges of information overload and inaccessibility by using smart AR glasses to display only the most relevant information through intuitive visual and audio overlays.

Prism is designed with a diverse user base in mind — including:

- General shoppers looking to compare prices or find better alternatives
- Visually impaired and blind users seeking real-time, voice-based product descriptions
- Neurodivergent individuals who benefit from simplified decision-making tools
- Digital-native consumers who rely on social recommendations and reviews

User-Centered Research Approach

To ensure Prism is grounded in real user needs, I plan to recruit at least six participants from a variety of relevant groups. These will include university students and faculty with an interest in UX, AI, and AR technologies; everyday retail shoppers who reflect the target personas; online communities who can participate in remote surveys and interviews; and members of accessibility or tech-focused groups who can offer valuable inclusive feedback. Through a combination of qualitative methods, including interviews, contextual inquiry, and usability testing, I aim to uncover pain points, define accessibility requirements, and validate key design decisions as the system evolves.

System Overview

Prism consists of two primary components:

- AR Glasses with a transparent OLED display for heads-up overlays
- Companion Mobile App (Mobile-first) for setup and personalization

Core Features:

- AI-Powered Object Detection (via TensorFlow Lite) recognizes products as users look at them
- Live Price Comparisons from online and in-store APIs (e.g., Walmart, Amazon)
- Product Details like reviews, nutrition facts, and sustainability scores
- Voice-Controlled Interaction for fully hands-free usability
- Accessible Interface with adjustable text, high-contrast mode, and audio cues

Users customize their experience through the mobile app, setting preferences for what information is displayed (e.g., budget-friendly, sugar-conscious, brand-agnostic).

Why Prism?

Prism stands at the intersection of AI, AR, UX, and accessibility. No existing solution bridges the gap between real-time physical context and digital insights in a seamless, assistive, and inclusive way.

While AI and social commerce have transformed online shopping, the in-person experience remains outdated, especially for those who need it most. Prism reimagines how we interact with products in physical environments, not just by digitizing shopping, but by enhancing it intelligently and accessibly.

This project also reflects my passion for cognitive engineering and inclusive UX. By blending AI-driven design with real-world utility, Prism shows how human-centered technology can empower better, faster, and more confident decision-making for everyone.

Discover Phase: Understanding the Problem and User Needs

The problem identified for this project centers around the challenges shoppers face due to information overload during in-store purchases. Shoppers often spend considerable time and cognitive effort comparing product details, checking prices, and seeking reliable reviews while navigating retail environments that lack real-time decision-making support. Many rely on smartphones to gather this information, which disrupts their shopping flow and adds friction to the experience. Users with accessibility needs, including visually impaired individuals and neurodivergent shoppers, face even greater barriers in identifying products and making comparisons efficiently.

Cognitive load theory suggests that when individuals are presented with too much information at once, their ability to process and retain details becomes impaired (Sweller, 1988). In a fast-paced retail setting, this cognitive overload can lead to suboptimal purchasing decisions, frustration, and increased dependence on external tools like online reviews (Jacoby et al., 1974). This research explores these

assumptions through user-centered methods to better understand shopper needs and identify opportunities for technological support.

Current User Journey

To understand how users currently navigate in-store shopping, I developed a journey map (figure 1) based on insights from interviews and survey data.

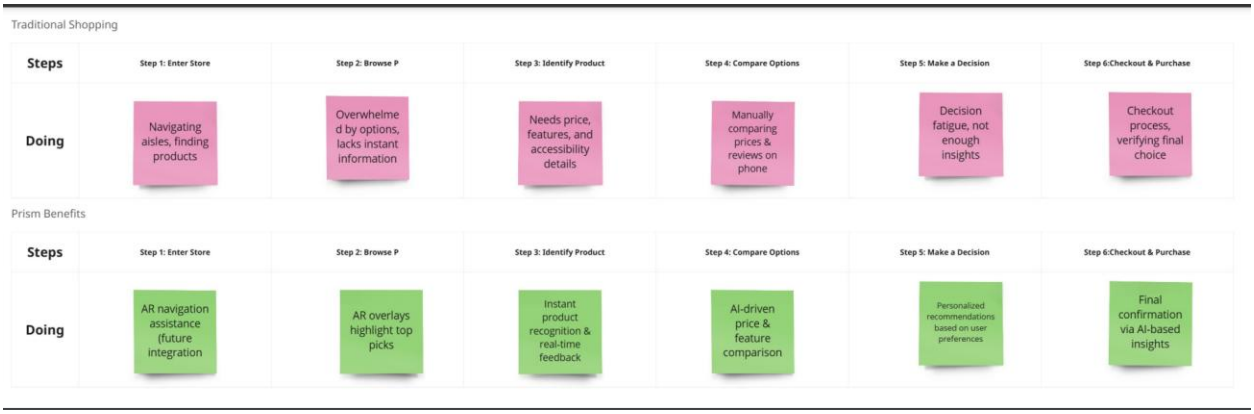


Figure 1 Current User Journey

This visual illustrates a typical shopping session, from entry to checkout, and highlights key frustrations:

- Frequent interruptions to look up reviews or price comparisons
- Struggles identifying preferred products quickly
- High cognitive load from multitasking

These task breakdowns reveal major opportunity areas where support tools like Prism could be impactful.

Research Methods

To validate the initial hypothesis and gain an in-depth understanding of user needs, qualitative user interviews and a survey were conducted. This phase used mixed methods: a qualitative survey and contextual interviews with six participants (P1–P6) representing a mix of frequent shoppers, accessibility users, and eco-conscious consumers.

The survey gathered both quantitative and qualitative insights on:

- Shopping habits
- Preferences for AR/AI features

- Accessibility needs
- Technology adoption

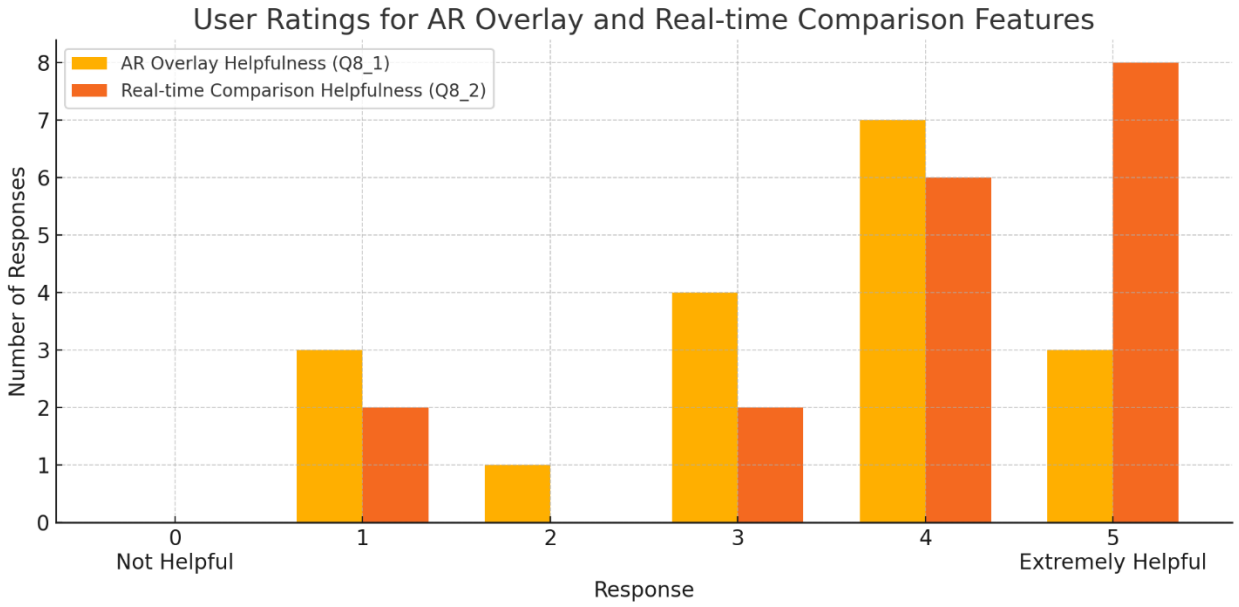


Figure 2: Survey

Survey & Qualitative Insights

Survey results and contextual interviews revealed consistent patterns in shopping behavior, feature preferences, and accessibility needs. Most users shop in physical stores on a regular basis, with trips typically lasting between 10 and 60 minutes. Price and feature comparisons were frequently cited as essential to their decision-making process, yet many reported frictions when trying to access that information in real time.

In terms of desired features, users expressed high interest in AR overlays that provide real-time product insights such as pricing, nutritional content, and customer reviews. Many also valued the idea of AI-driven recommendations that could help them make faster or more personalized decisions based on goals like saving money or selecting healthier alternatives. One user (P2) shared, “Shopping feels overwhelming when products look similar; quick access to clear, comparative info would be incredibly useful.”

Accessibility emerged as another key area of focus. Several participants expressed a need for adjustable text size, high-contrast visuals, and audio feedback to accommodate visual impairments or cognitive preferences. For example, P3 stated, “As someone with a visual impairment, current shopping solutions aren't adequate, identifying products independently is still a struggle.” Another respondent (P5) mentioned, “Choosing healthier or eco-friendly options quickly is difficult; I'd love technology that suggests these alternatives seamlessly.” Others noted difficulty reading small print on packaging or navigating crowded shelf layouts, reinforcing the importance of inclusive design.

Adoption was generally high, with most users open to trying AR glasses, especially if supported by a user-friendly companion app. Still, concerns were raised about usability, privacy, and learning curve, indicating a need for guided onboarding and customizable settings. P1 noted, “I frequently find it frustrating to stop and use my phone to compare prices while shopping; it interrupts my flow,” while P6 echoed this by saying, “My shopping trips take too long because I’m always juggling my phone and the products. I want something hands-free.” P4 emphasized the value of streamlining information access, stating, “I constantly rely on online reviews, even in-store. Having this information more easily accessible would make shopping much faster.”

In addition to user insights, I conducted an analysis of the broader ecosystem in which Prism would operate. Key stakeholders identified included retailers, e-commerce platforms (such as Amazon, Walmart, and Target), social media platforms and digital influencers, assistive technology organizations, and consumer advocacy groups. Each of these stakeholders contributes essential data, content, or services that can enhance the user experience and platform functionality.

- **Retailers and E-Commerce Platforms** provide real-time product data, pricing, and availability via APIs—critical for enabling Prism’s product comparison and recommendation features.

- **Social Media Companies and Content Creators** (e.g., TikTok, YouTube, Instagram) influence consumer behavior by sharing product reviews and trends, which can be integrated into Prism's recommendation system.
- **Assistive Technology Organizations**, such as the American Foundation for the Blind (AFB) and neurodiversity advocacy networks, offer guidelines and frameworks that shape inclusive design decisions.
- **Consumer Advocacy Groups**, including the Better Business Bureau (BBB), promote ethical shopping practices and help verify product claims, contributing to consumer trust.

Stakeholder Ecosystem & Personas

Together, this research into both users and the surrounding ecosystem forms the foundation for the Prism system's direction, ensuring it is both user-centered and context-aware. To represent the diversity of Prism's target users, I created three key personas grounded in survey data and interview insights. These personas reflect the primary user types the system is designed to support and guide the feature prioritization process.

Emma is a busy working professional who prioritizes speed and convenience while shopping. She often shops on tight schedules and dislikes interruptions that slow her down. Emma wants quick, reliable product insights without needing to pull out her phone or use her hands, making hands-free, real-time feedback a top priority for her.

Samantha represents the eco-conscious consumer. She values ethical and sustainable products, such as vegan, cruelty-free, or low-waste items. Samantha prefers tools that surface this information clearly and transparently, enabling her to make decisions that align with her values without requiring extensive research during her shopping trips.

Jake is a visually impaired shopper who relies on audio cues, adjustable contrast, and structured guidance to navigate stores and make confident purchase decisions. He often finds current tools lacking in

accessibility and depends on systems that offer real-time support and adaptive feedback tailored to his needs.

These personas highlight the range of motivations, barriers, and expectations that Prism must address deliver a truly inclusive and effective user experience.

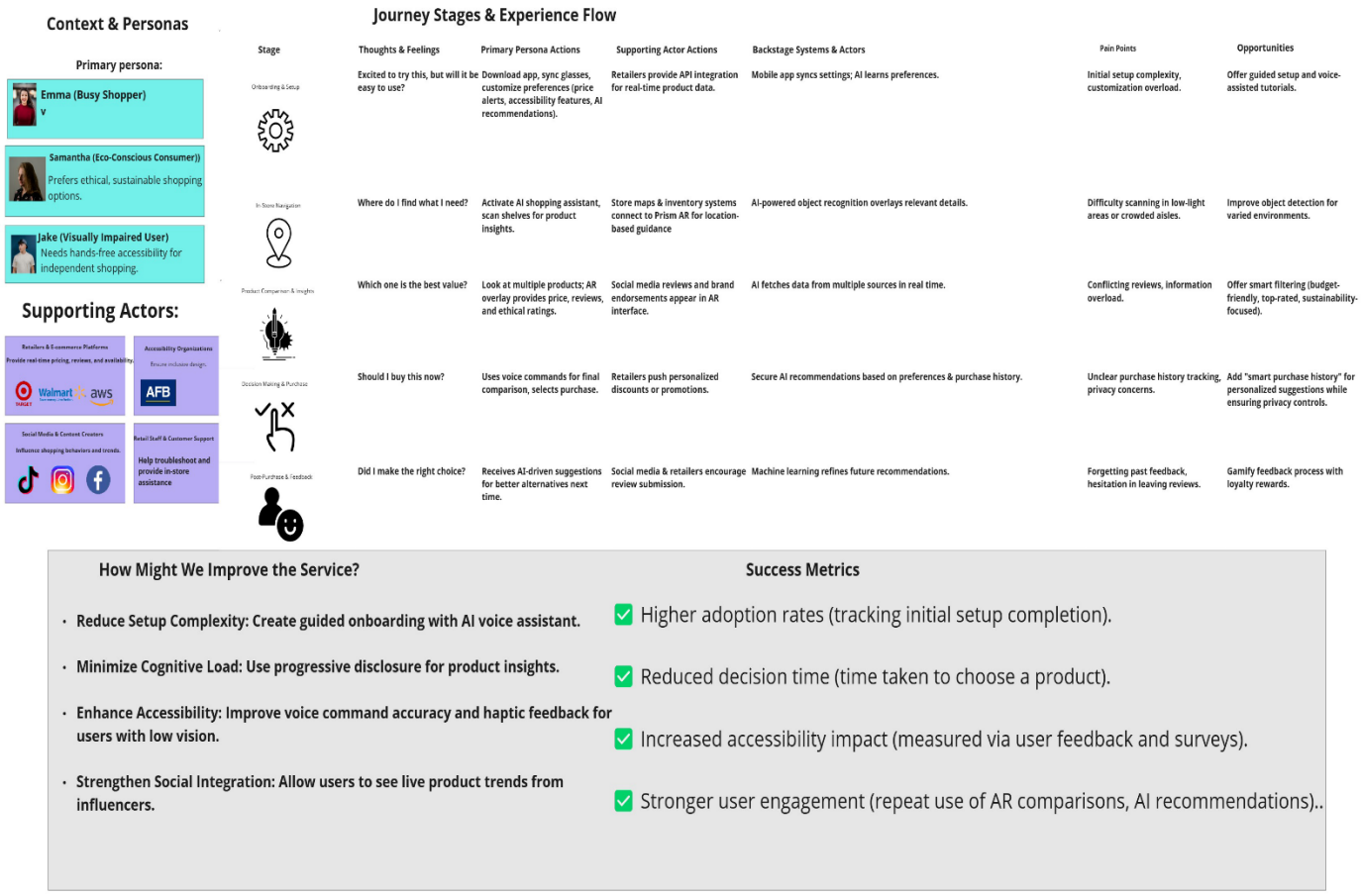


Figure 3: Journey Stages & Experience

Competitive Analysis

The table below compares Prism's features across both its AR glasses and mobile app to other well-known shopping technologies. Prism uniquely offers a fully integrated, real-time shopping assistant experience that includes hands-free interaction, AI-powered object detection, and accessibility

customization across platforms. While some competitors provide partial functionalitysuch as price comparison or basic object recognition—none match Prism's seamless blend of accessibility, intelligence, and cross-platform usability.

Feature	Prism AR Glasses	Prism Mobile App	Amazon Shopping App	Google Lens	Vuzix AR Glasses
AI-Powered Object Detection	Yes	Yes	No	Yes	Yes
Live Price Comparison	Yes	Yes	Yes	No	No
Real-Time Product Overlays	Yes	Yes	No	Limited	Limited
Voice-Controlled Interaction	Yes	Limited	No	No	Yes
Personalized Recommendations	Yes	Yes	Limited	No	No
Adjustable Text Size	Yes	Yes	No	No	Limited
High Contrast Mode	Yes	Yes	No	No	Limited
Audio Feedback	Yes	Yes	No	No	No
Hands-Free Interaction	Yes	Limited	No	No	Yes
Mobile App Access	No	Yes	Yes	Yes	No

Use Cases

Based on user interviews and survey results, three primary tasks were identified that users expect to accomplish seamlessly with the Prism system. These tasks emphasize the need for seamless, real-time interactions that support smarter decision-making without increasing cognitive load.

- **Instant product identification:** Users want Prism to automatically detect and identify products, providing immediate visual and/or auditory feedback detailing price, features, and other essential information. They also desire the option to enable or disable the feature based on their preferences and the information they wish to share.

Example Use Case**:** A user with dietary restrictions enters a grocery store. By glancing at a food product, Prism overlays the item's nutrition label, allergen warnings, and ingredient breakdown, preventing them from having to manually read the fine print.

- **Comparative Insights**: Users frequently need immediate comparative insights between similar products. Prism must display price differences, reviews, nutritional information, or sustainability data to facilitate quicker decision-making. They also mentioned that they want to obtain insights based on their preferences.
- **Example Use Case:** A customer is choosing between two laundry detergents. Prism detects the products and displays a comparison overlay highlighting price differences, customer ratings, and whether they are eco-friendly or free of harsh chemicals.
- **Personalized Recommendations**: Users expressed the desire for personalized recommendations, such as eco-friendly or healthier product alternatives, accessible through tailored visual interfaces or audio feedback, catering especially to visually impaired and neurodivergent shoppers.
- **Example Use Case:** A user shopping for skincare products wants vegan and cruelty-free alternatives. Prism filters recommendations and highlights suitable brands while excluding products that do not meet their criteria.

These tasks are typically performed in dynamic retail environments, where users are standing, walking, or multitasking, thus emphasizing the importance of hands-free, intuitive interaction and rapid information delivery.

Participants describe various frustrations with existing tools, including smartphone apps (Amazon Shopping, AI) and voice assistants. Common breakdowns included high cognitive load due to manual interaction requirements, limited real-time product context, inadequate accessibility support, and lack of seamless integration with physical shopping experiences.

Current market alternatives generally fail to deliver a hands-free, contextually aware, and integrated shopping experience. Prism's differentiating factors, driven by user feedback, should include automatic AI-based product recognition (via TensorFlow Lite), intuitive AR overlays for immediate visual and audio feedback, and integration of social media-driven insights. Crucial design implications emerging from this analysis include intuitive voice and gesture controls, minimal cognitive load via concise displays, robust accessibility features (adjustable text, high contrast, voice commands), and personalization engines driven by real-time analytics.

To evaluate Prism's effectiveness once implemented, measurable success criteria identified through research include:

- **User Adoption Metrics:** Tracking the number of initial and returning users.
- **Interaction and Engagement Metrics:** Frequency and type of interactions, such as average products scanned per shopping trip and frequency of use for comparative shopping features.
- **User Satisfaction and Usability Scores:** Measured through surveys and structured user feedback sessions evaluating ease of use, confidence in decision-making, and accessibility effectiveness.
- **Conversion Metrics:** Analyzing whether recommendations lead to actual purchasing decisions and how effectively Prism influences consumer behavior.

From a business perspective, Prism includes both a wearable AR glasses system and a mobile companion application, offering users flexible access to the same core features: real-time product identification, price comparison, and AI-powered recommendations. This dual-platform model broadens market reach by supporting users who may be hesitant to adopt smart glasses or who prefer to interact via smartphone.

Prism's monetization strategies include a subscription-based tier offering enhanced AI recommendations, exclusive social commerce insights, and an ad-free experience across both the glasses and app. Additionally, affiliate partnerships with major retailers and e-commerce platforms allow Prism to generate revenue through referral commissions, sponsored product placements, and personalized brand integrations.

Ensuring feasibility involves securing partnerships with:

- **Retailers and e-commerce platforms** for access to product data and pricing APIs
- **Social media platforms and influencers** to surface trend-based recommendations and reviews
- **Accessibility organizations** to co-develop inclusive features and validation criteria

Both the glasses and the app collect anonymized user data (with consent) to improve personalization, provide value to partners through behavioral insights, and enhance user engagement. This ecosystem encourages stakeholders to participate in product integration, targeted marketing, and accessibility outreach. The insights gathered from user research including surveys, interviews, and journey mapping, validated that shoppers face cognitive overload and accessibility friction during in-store purchases. By triangulating this data, three recurring design themes emerged: the need for instant product recognition, real-time comparisons, and personalized, hands-free support.

These insights shaped the design direction of both the glasses and the companion app, ensuring Prism remains grounded in real user needs. Next steps include refining feature flows across platforms, developing mid-fidelity prototypes, and testing both solutions with a diverse set of users. This approach not only validates usability but ensures flexibility in how Prism supports smarter shopping decisions, regardless of device.

Design

Prism is an AI-powered AR shopping assistant that enhances in-store shopping experiences by providing real-time product insights, AI-driven recommendations, and accessibility features through

augmented reality glasses and audio feedback. This system aims to reduce cognitive load, improve decision-making efficiency, and make shopping more inclusive. Users, including those with accessibility needs, can scan products using the AR interface to receive relevant information without manual interaction. Prism integrates real-time object detection, live price comparisons, and voice-controlled interactions, allowing users to interact seamlessly with the environment while shopping hands-free. The system is particularly valuable in dynamic retail settings, where quick decisions are necessary, and traditional smartphone-based research disrupts the shopping flow. User research from surveys and interviews suggests that most shoppers value real-time price and feature comparisons, and AI-driven product suggestions. Additionally, high contrast text and adjustable font sizes were highlighted as key accessibility needs. While the majority are open to trying AR glasses, usability concerns such as learning how to use the technology and bifocal vision issues were noted.

Functional Requirements

Prism must support a dual-platform experience across AR glasses and a mobile application. The system should provide consistent access to its core features, regardless of whether users interact via wearable technology or the smartphone app. This ensures inclusivity for users who prefer not to use smart glasses or want a backup option for convenience.

Core Functional Requirements

1. Pair the AR glasses with a smartphone via Bluetooth or Wi-Fi.
2. Offer a fully functional mobile app alternative for users without AR glasses or during non-glasses usage.
3. Recognize products in real time using AI-powered object detection across both platforms.
4. Display key product information (price, reviews, sustainability, and nutrition facts) using AR overlays (glasses) or app-based visual cards (mobile).

5. Support hands-free interaction using voice commands (on both platforms) and hand gestures (on glasses).
6. Deliver AI-driven recommendations for healthier, cheaper, or more sustainable alternatives.
7. Allow users to customize preferences such as price filters, dietary tags, or accessibility options.
8. Provide accessibility enhancements, including:
    - Adjustable text size and contrast
    - Text-to-speech functionality
    - Audio cues and voice navigation
    - Haptic feedback (on compatible devices)

System Requirements

1. Provide real-time product recognition and context-aware information overlays.
2. Display only essential information first (progressive disclosure) to reduce cognitive load.
3. Enable offline access to recently viewed or saved product data.
4. Offer error handling and alternative search options when object detection fails.
5. Synchronize preferences and shopping history between the glasses and the mobile app.

Design Space

Considered Trade-offs:

1. **High quality vs. Complexity:** The AR overlays must be detailed enough to convey necessary product information while maintaining a clean and intuitive interface.
2. **Battery life vs. Performance:** Running object detection and real-time product scanning consumes significant power, requiring optimization techniques to balance processing efficiency.

3. **Hands-free experience vs. User Control:** While automation enhances usability, it must allow user intervention to avoid errors or incorrect recommendations.

Hardest Requirements:

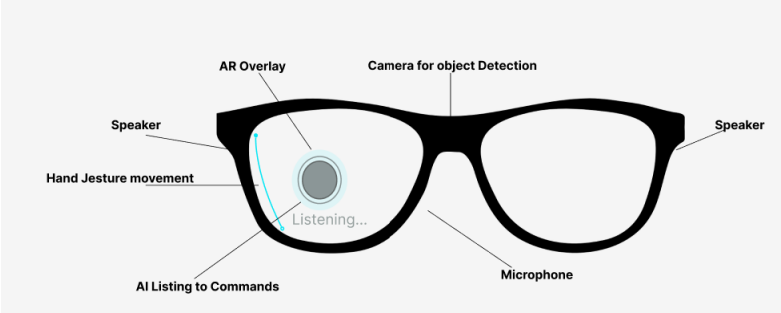
- Real-time Object Detection: Prism must accurately recognize products under various lighting conditions and angles, which requires robust AI training and machine learning models.
- Accessibility for Visually Impaired Users: The AR overlays must provide effective auditory feedback for users who rely on voice-based interactions while maintaining usability for sighted users.
- Ensuring accurate product recognition in varying lighting conditions.
- Reducing cybersickness effects from AR overlays.
- Maintaining seamless synchronization between AR glasses and the mobile app.

The Design

The Prism AR system prioritizes minimal cognitive load while delivering comprehensive shopping insights. User feedback from surveys and interviews confirms that real-time price comparisons, product reviews, and alternative recommendations are among the most valued features by potential users. A large number of participants found AR overlays could be helpful, with real-time comparisons ranking as a high-priority feature. Additionally, adjustable text size and high-contrast modes were highlighted as key accessibility needs, reinforcing the importance of customization.

Further, the survey data reveals that many users are open to AI-driven shopping suggestions, suggesting that automated recommendations can enhance decision-making efficiency. However, usability concerns were noted, particularly regarding learning how to use the technology and adjusting to bifocal vision challenges. These insights validate the need for a simple, intuitive interface that gradually introduces advanced features through progressive disclosure.

To achieve this balance, the design leverages Cognitive Load Theory (Sweller, 1988) to simplify overlays, integrating progressive disclosure techniques, where users can request additional details as needed. By allowing users to choose between summarized and detailed information, Prism ensures that only the most relevant data is displayed, reducing visual clutter and cognitive fatigue.



Sarah, a first-time user of Prism AR, downloads the Prism mobile app to set up her AR glasses for seamless shopping assistance.

Mobile App Set Flow:

1. **Welcome Screen (Sign Up/Login):** When Sarah opens the app, she is greeted with a welcome screen introducing Prism's features, such as real-time price comparisons, product insights, and accessibility options. She selects "Sign Up", enters her details, and creates an account.

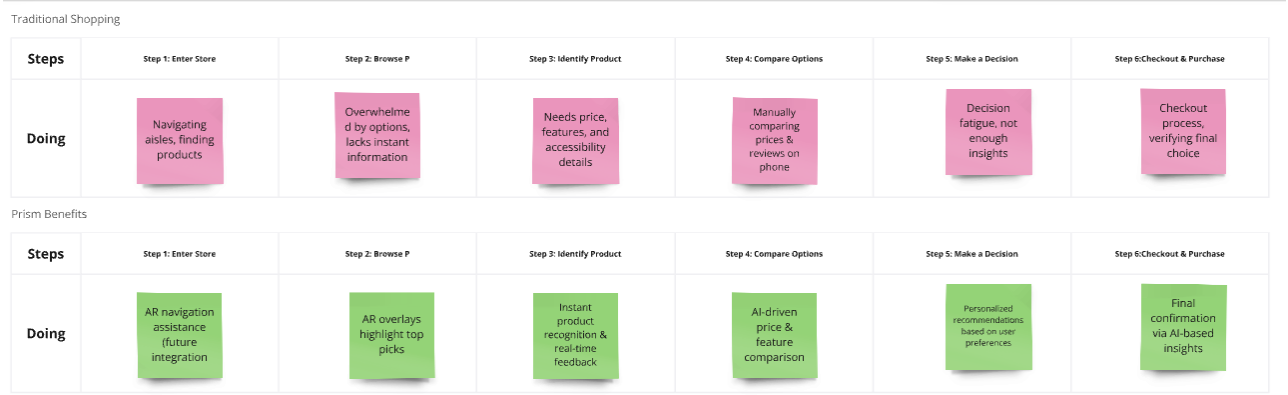
2. **Preference Selection (Price Comparison, Nutritional Facts, etc.):** After signing in, Sarah is prompted to customize her shopping experience. She chooses to prioritize price comparisons and nutritional facts, enabling features that highlight low-sugar, high-protein, and sustainable products. Additionally, she enables audio feedback to assist with hands-free interactions.

3. **AR Glasses Pairing Instructions:** Next, Sarah is guided through pairing her Prism AR glasses with the app. The screen instructs her to turn on the glasses and enable Bluetooth/WiFi. Within seconds, the app detects the glasses and confirms a successful connection. Sarah also updates her device settings to sync shopping preferences between the app and glasses.

4. **Tutorial & Calibration for optimal user experience:** To ensure a smooth AR experience, Sarah is taken through a short tutorial and calibration process. She learns how to scan products using glasses, navigate through AR overlays with gestures, and use voice commands for hands-free control. The calibration ensures that text size and contrast are adjusted based on her visual preferences. With everything set up, Sarah is ready to use Prism AR for her next shopping trip, confident that it will provide personalized insights and enhanced accessibility as she shops.

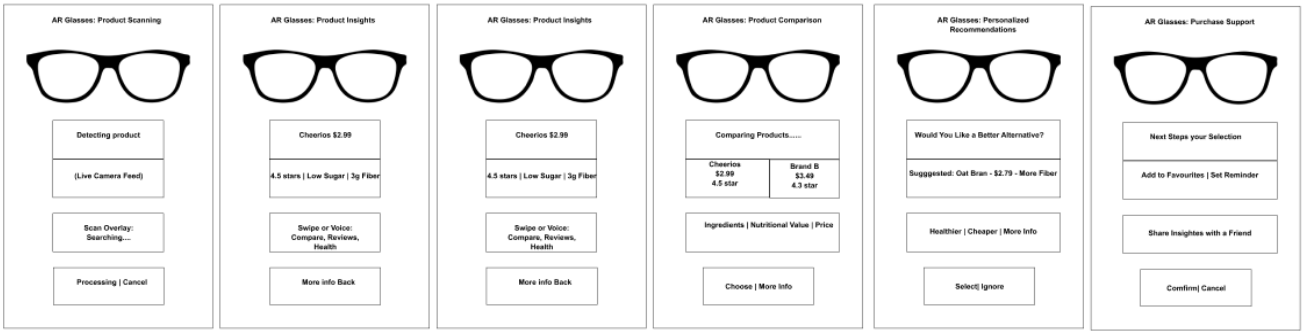
Mobile App Setup Flow

In-Store Usage Flow (AR Glasses Interface):



Scenario: Jane, a health conscious shopper, enters a store wearing Prism AR Glasses. She picks up a cereal box, and the AR overlay displays price, sugar content, and customer ratings. A voice prompt asks, “Would you like a healthier option?” Jane responds, “Yes,” and the glasses highlight a lower-sugar alternative. She adds it to her favorites for future reference.

1. Product Scanning Mode: Displays “Detecting Product...” while processing.
2. Product Insights Display: Provides basic product details with options for further details.
3. Product Comparison View: Side-by-side overlay of similar products.
4. Personalized Recommendations: Suggests alternatives based on user preferences.
5. Purchase Decision Support: Enables favoriting, sharing, or setting reminders for products.



Store Usage Flow (AR Glasses Interface):

Emerging Technologies influence

AI-driven Shopping Assistants:

The integration of AI-powered shopping assistants in Prism AR enhances recommendation accuracy by leveraging machine learning algorithms. These AI models analyze purchase history, real-time preferences, and external factors like pricing trends to provide highly personalized product suggestions. According to Sweller’s (1988) Cognitive Load Theory, reducing extraneous cognitive load enhances decision-making efficiency, making AI-driven recommendations particularly useful in reducing mental

strain during shopping. Moreover, AI systems optimize information processing, ensuring that only the most relevant insights are presented at a given time.

Eye-tracking AR Displays

The implementation of eye-tracking technology in AR glasses can significantly minimize cognitive load by adjusting interface elements based on user gaze. Lee (2021) emphasizes that high cognitive workload contributes to decision fatigue and stress, making adaptive interfaces a key improvement in reducing mental strain. Studies in HCI cognition models suggest that dynamic eye-tracking can increase efficiency by presenting essential data only when the user needs it, eliminating unnecessary distractions.

Haptic Feedback Integration

Prism AR leverages haptic feedback technology to provide tactile responses during interactions, ensuring that users receive confirmation cues without relying solely on visual or auditory inputs. Payne (2003) discusses users' mental models, noting that multisensory feedback improves cognitive mapping and interaction efficiency, making AR-based shopping more intuitive. By incorporating haptic alerts, users, especially those with visual impairments, can receive enhanced feedback without overloading their sensory perception.

Ethical and Social Implications

Privacy Concerns

One of the most pressing concerns with AI-driven AR shopping assistants is user data privacy. Since Prism collects shopping behavior, product interactions, and preferences, it is essential to implement opt-in data policies and transparent data governance. Lee (2021) highlights workload stress factors, including user anxiety related to data tracking and information overload, making it critical that Prism

adopts strong privacy safeguards. Ensuring that users have full control over what data is collected and how it is used fosters trust and encourages adoption.

Accessibility

While Prism AR significantly enhances usability for visually impaired and neurodivergent users, it must also address cost and accessibility challenges. Stanney (2020) discusses cybersickness and accessibility concerns in AR, emphasizing the need for adjustable text sizes, voice navigation, and high-contrast overlays to improve inclusivity. To promote adoption, Prism could explore subsidized pricing models, partnerships with accessibility organizations, or insurance-backed AR devices.

Retail Disruptions

The widespread adoption of AR shopping assistants like Prism may reshape consumer behavior, leading to disruptions in traditional retail markets. Payne (2003) discusses mental models in HCI, explaining that shifts in decision-making paradigms impact how consumers interact with technology. Retailers may face adaptation challenges; especially as real-time price comparisons empower consumers to make cost-conscious purchasing decisions. To counteract this, Prism could form strategic partnerships with retailers to integrate AR-compatible promotions and dynamic pricing models.

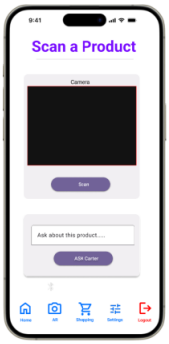
Prototype

My prototype centers around Prism, a dual-platform augmented reality system designed to enhance how people engage with product information in real-world environments. The foundation of the project began with the design and construction of custom AR glasses, which use real-time object detection, AR overlays, and voice feedback to assist users in tasks like scanning products, accessing nutritional facts, and comparing prices. These glasses represent the first physical realization of the concept, providing a hands-free, heads-up display for users navigating physical spaces like grocery stores.

However, during interviews and user surveys, I uncovered a critical insight: not all users are comfortable wearing AR glasses, either due to personal preference, discomfort, or social perception. This led to the discovery and development of the Prism companion application, which replicates the core

experience of the glasses but on a mobile device. The app ensures inclusivity by offering a full-featured alternative for those who prefer not to wear smart glasses—without sacrificing functionality or task coverage.

Both the glasses and the companion app are connected through Carter, a conversational AI model embedded within the system. Carter helps users compare prices across stores, retrieve personalized insights, and access nutritional data through integrated APIs and object detection. Whether using the glasses or just the app, users can interact with Carter by voice or text. This structure ensures functional redundancy and device flexibility, allowing users to choose the experience that works best for them while maintaining a consistent interaction model and user interface. The user-centered approach I adopted was grounded in Don Norman's The Design of Everyday Things, which heavily influenced my focus on affordances, discoverability, and feedback throughout the UI. Users should immediately understand how to engage with the system, whether they're tapping on a phone or speaking aloud while wearing glasses. I placed particular emphasis on cognitive simplicity and error prevention, inspired by Norman's framework for intuitive design.



I began the design process with user interviews, followed by storyboarding, which helped map out key interaction flows across both platforms. These included the end-to-end task of identifying a product, reviewing price and nutrition data, making a purchasing decision, and saving items to a personal shopping list. The storyboards were then translated into a Figma prototype, which I used for early usability testing. From there, I developed a medium-fidelity Python prototype to simulate scanning, data overlays, and Carter's AI feedback. Meanwhile, the AR glasses handled real-time object detection and audio output through a Raspberry Pi-based system.

From both a technical and cognitive standpoint, I leaned heavily on the work of Lee and Wickens, particularly their chapters on cognition and workload/stress. Their research helped inform how I managed attention, task complexity, and user interaction timing, especially in fast-paced environments like grocery stores, where decisions are often made quickly and distractions are frequent. I also applied design methods from Emrah Yayici's Design Thinking Methodology Book, which helped guide my process of defining problems, generating ideas, prototyping, and testing without prematurely locking in a final solution.

In terms of fidelity, I chose a medium-fidelity prototype approach, simple enough to encourage open-ended feedback but realistic enough to demonstrate core functionality. This balanced fidelity allowed me to evaluate both visual and interaction design elements with users. The current prototype supports the complete, end-to-end task of product scanning, insight delivery, and shopping lists, tracking across both the AR and mobile platforms. While certain advanced features, such as gesture control and persistent nutrition tracking and other customer insights, are planned for future development, the current system effectively demonstrates the core value proposition and is ready for user testing with the original participants from earlier interviews.

The most challenging part of this milestone was designing a system that works equally well with or without AR hardware and making sure the transition between these modes feels natural and intuitive for

the user. Balancing two interfaces (glasses and mobile) required thoughtful UX alignment and deep consideration of different user contexts.

If I were to prototype this system again, I would start with the application first, then follow with AR hardware after conducting more interviews and evaluations. That approach would have given me stronger foundational insights. From this process, I learned just how important flexibility is in real-world system design. Listening to users pushed me to build something more inclusive, adaptable, and user-centered than I originally envisioned. I also deepened my understanding of how voice, visual, and touch interactions intersect in multitasking environments—and how to support those modalities with empathy and intention.

Link to Figma:
https://www.figma.com/proto/XFwqtYL66bEljylbhJ2JUm/prism?pageid=47%3A67&node-id=50-19087&viewport=-160%2C-297%2C0.5&t=VxRVroMBAPCz60lx1&scaling=scale-down&content-scaling=fixed&starting-point-node-id=50%3A19087

Link to Applications: Prism - Login

Evaluation

Prism is an AI-powered AR glasses and mobile companion application designed to enhance in-store shopping experiences. It allows users to scan physical products and receive instant information such as price comparisons, nutrition facts, product reviews, and alternative suggestions. The primary users are in-store shoppers who are tech-comfortable and prefer quick decision-making tools while browsing. Prism supports common in-store tasks such as identifying healthy or cost-effective products, comparing prices across retailers, viewing product reviews in real time, and saving products to a digital shopping list for future reference. The vision is to help users make faster, more informed decisions while reducing the cognitive load of in-store comparison shopping.

Users

Five users were tested Prism across multiple demographic and behavioral backgrounds to reflect diverse shopping experiences. All users shop frequently and have prior experience using mobile-based shopping tools.

P1: A 31-year-old frequent female shopper who is health-conscious and pays close attention to nutrition facts and product reviews. She is comfortable using mobile apps and relies on them during shopping trips.

P2: A 45-year-old value-driven male shopper who uses mobile apps such as Walmart and Target for budgeting, grocery planning, and comparing prices. He shops with cost-efficiency in mind.

P3: A 29-year-old user with mild cognitive accessibility needs. She shops with some support and frequently uses apps to help with reminders, organization, and list-making.

P4: A 36-year-old tech-savvy user who regularly utilizes tools like Google Lens, barcode scanners, and loyalty programs to enhance his shopping experience. He is familiar with AR and AI technologies.

P5: A 27-year-old early adopter of shopping and product discovery technologies. She frequently explores platforms like Amazon and is especially interested in personalized product recommendations.

Task Scenarios

1. Scan a product and view its information. Users were instructed to scan an item and read price, review, and nutrition info.
2. Compare prices of similar products. Users used the 'Compare' button to view side-by-side prices across stores.
3. Simulate purchasing a product using the 'Buy' feature. To test how users interpreted the save/purchase

flow.

4. Attempt to change the settings of a feature. Involved accessing and modifying display preferences (if functional).

5. View the shopping list. To confirm whether saved products were accessible after browsing.

Interview Questions

- How easy or hard was it to use Prism overall?
- What feature felt most useful to you?
- What (if anything) was confusing to you?
- How likely are you to use something like this in real life?
- If you could change one thing about Prism, what would it be?
- Did anything surprise you during your experience?
- Was there anything you expected that didn't happen?
- How would you explain this app to a friend?

Testing Environment

Testing was conducted in familiar, real-world environments where users typically shop or plan purchases, including a local grocery store and their homes. Participants interacted with the live Prism mobile application on their personal smartphones, connected via their cell phone service.

Results

During the usability sessions, users repeatedly expressed appreciation for the simplicity and responsiveness of Prism's scanning feature. Most participants noted how quickly the system returned useful information like price, nutrition facts, and reviews after scanning a product. The price comparison tool was another highlight, with several users stating it helped them make faster decisions.

However, breakdowns emerged around certain interaction points. The "Buy" button was a source of confusion for multiple users, as they expected a full checkout process rather than a simple save-to-list action. Additionally, some participants found it difficult to locate core features like the "Compare" button

or "Shopping List," especially without any onboarding or instructional guidance. One user mentioned they were unsure what the AR icon did after logging in, reinforcing the need for tooltips or a first-time tutorial. Across all users, there was clear interest in personalization, integrations with loyalty programs, and more actionable feedback from the AI.

Qualitative Themes:

• Most users found scanning intuitive and quick.

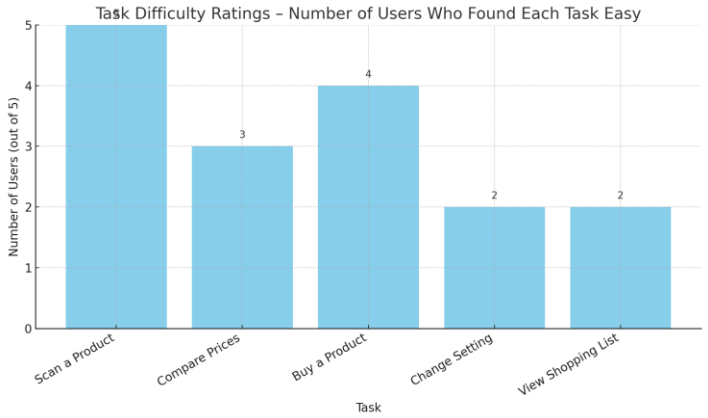
• The price comparison feature was consistently valued.

• Several users misinterpreted the 'Buy' button as a checkout flow.

• Some users struggled to find key icons like 'Compare' or 'Shopping List'.

• One user mentioned confusion about AR icon placement after login.

• Suggestions included integration with store loyalty programs and ability to delete from cart.



These direct user quotes provide deeper insight into participant reactions and frustrations:

Participants	Quotes
P1	“It was super easy to scan, I liked that.” Reflecting the overall positive experience with the scanning interface.
P2	“I wish it showed me how far away the cheapest store is.” Indicating a desire for geographic context in price comparisons.
P3	“I couldn’t find a delete option to take things out of the cart.” Highlighting a critical missing interaction for managing saved items.
P4	“Would be cool if it tied into your grocery store deals.” Suggesting future value through loyalty card integration.
P5	App feels intuitive – easy to navigate with a clear hierarchy.” Showing the visual structure of the app was appreciated, even if some features were hidden.

Categorized Usability Issues

Category	Description
Severe (Must Fix)	A consistent complaint was about the lack of a delete or remove option in the shopping list/cart, which caused frustration and created the impression that choices were final. This disrupted the user flow and created an unnecessary barrier to correcting mistakes. Some users also struggled to begin scanning due to a lack of onboarding or initial guidance.
Major Problems	The “Buy” button’s label misled users into thinking they were initiating a purchase, but it only saved the product. This was not clearly communicated. Additionally, some price comparison data was inaccurate, reducing trust in the feature among cost-sensitive users.
Minor Problems	Users had difficulty finding the Shopping List and Compare button after scanning, due to a lack of visual emphasis or placement cues. This slowed task completion and created uncertainty.
Cosmetic Issues	There was no visible loading feedback when using CarterAI, making the app feel unresponsive. Users also noticed inconsistent formatting in product cards and AI responses, reducing visual polish.
Feature Requests	Users suggested several enhancements including: - Delete/remove button for the cart or list - Loyalty card integration - Store distance display for price comparisons - AI filters (e.g., cheapest healthy snack) - First-time onboarding tooltips or intro tutorial

Discussion

Users liked the quick response time and clean design during scanning and product lookup. However, expectations shaped by tools like Amazon, Target, or Google Lens created friction points when certain features were either missing or not immediately obvious. For example, participants anticipated a true

shopping cart experience after tapping 'Buy', expecting checkout options rather than product-saving.

Feedback reinforced the need for better onboarding or an interactive walkthrough for first-time users. We learned that core features like comparison, accessibility, and list management must be visually emphasized. Users also valued personalization and requested features like integration with grocery rewards programs, proximity-based sorting, and shopping history reminders. A key takeaway was how users mentally aligned Prism with existing product discovery platforms but wanted more guided AI functionality and personalized utility. Future testing should include comparative evaluations versus competitor flows and focus on accessibility performance.

The hardest part of this milestone was maintaining natural flow in testing while collecting enough detailed feedback. In future evaluations, I would build more automation into response tracking and aim to include a wider range of cognitive and physical accessibility users.

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Appendix: User Testing Visual Summary

The following visual summarizes participant task, key findings, and design recommendations from the evaluation sessions.

Scanning is Smooth & Fast

"It was super easy to scan, I liked that." – P1

nick menough

"It was super easy to scan, I liked that." – P1

nick menough

"Very likely [to use this in real life]." – P3

nick menough

"The AR camera function that scans a product." – P2

nick menough

Confusion & Friction

"I couldn't find a delete option to take things out of the cart." – P1

nick menough

"At the start, I thought I had to download an app." – P2

nick menough

"There was no indication that [CarterAI] was loading." – P2

nick menough

"Some scanned items were incorrectly recognized." P3

nick menough

"When I first logged in, I was expecting to be able to click 'scan.'" – P4

nick menough

Feature Requests & Expectations

"If Google Lens doesn't pick up an image, I'd want to scan the actual code." – P1

nick menough

""Can use more functions outside of scanning..." – P2

nick menough

"Iterate on item recognition accuracy..." – P3

nick menough

"Would be cool if it tied into your grocery store deals." – P4

nick menough

"I'd like to be able to sort by healthy options or cheapest per ounce." – P5

nick menough

Visual Design & Flow

"App feels intuitive – easy to navigate..." – P1

nick menough

"I am confused about the settings for the AR glasses." – P2

nick menough

"I ended up adding more than I meant to." – P1

nick menough

"The formatting of the response could also have been better."– P2

nick menough