

Emotion-Adaptive Shopping Assistant: Overview and Implementation Plan

The **Emotion-Adaptive Shopping Interface** is an AI-driven system that personalizes e-commerce browsing based on the user's current emotional state and behavior. By using webcam-based emotion detection (optionally) and implicit behavior signals (e.g. cursor movements, scrolling patterns), the interface dynamically adjusts the UI and recommendations. In practice, a **browser extension or web app** overlays on shopping sites (Amazon, eBay, Flipkart, etc.), scraping product details and user feedback. It then processes these inputs and the user's mood to alter the page theme (colors, layout), highlight deals or warnings, and surface tailored suggestions (e.g. alternative products, coupons). This **real-time personalization** promises a more engaging user experience: studies show emotion-aware UIs can significantly improve engagement and satisfaction ¹ ². For example, the meditation app Headspace adapts its content and color palette to user-stated stress or excitement levels ¹. In retail, experts predict that by 2030 around **40% of shopping interactions** will involve such emotion-adaptive interfaces ².

Emotion-aware AI builds on advanced techniques (computer vision, ML, NLP) to sense feelings via facial expressions, voice, text, or physiological signals ³ ⁴. In our context, the extension's key components are:

- **Emotion Detection (Webcam):** A lightweight CNN or hybrid model runs on live video (e.g. 7-class model for emotions like happy, sad, angry ⁵). Open-source tools (e.g. Mediapipe for face localization plus a trained emotion classifier) can achieve **60+ FPS** on modern hardware ⁵ ⁶. Using AMD's ROCm platform and GPU acceleration (MIOpen libraries) can further speed up inference for real-time responsiveness ⁷.
- **Behavioral Signals:** If webcam use is disabled, the extension infers mood from user behavior. Research shows that cursor movement patterns, scroll dynamics, and click timings correlate weakly with affect ⁸. For instance, erratic cursor paths or rapid scrolling might indicate frustration, while languid behavior suggests boredom. Simple statistical models on these features can supplement (or replace) vision-based emotion cues.
- **Page Content Analysis:** The extension uses **content scripts** to parse any e-commerce page generically. It identifies product information (titles, prices, images) and user reviews via the DOM or site APIs. For compatibility with platforms like Amazon, Walmart, eBay, etc., it either uses known element selectors or heuristics. This allows it to extract data for further processing (price history, review sentiment, etc.).
- **AI Modules:** Several AI/ML sub-systems run either in-browser or on a backend:
- **Review Filtering & Sentiment:** Using NLP/sentiment models, the system flags likely "real" vs. spam/fake reviews (e.g. by analyzing linguistic patterns) and summarizes pros/cons ⁹ ¹⁰. Browser extensions already exist that "filter out fake reviews" with AI ⁹.
- **Recommendation Engine:** A context-aware recommender uses the user's inferred mood and behavior. For example, if the user seems anxious, the system might suggest comfort products or display calming visuals. In VR/LLM research, combining emotional context with user history improves personalization ¹¹ ⁴. We would train or fine-tune models to embed product

descriptions and user queries, and then match them with items whose reviews and attributes align with the user's mood ¹¹ ¹² .

- **UI Adaptation Logic:** Based on detected emotion, the UI theme (colors, fonts, layout) changes subtly. For example, a frustrated user might see cooler tones and simplified interfaces, whereas an excited user sees vibrant colors and playful animations. This follows UX principles for emotional design ¹³ .

Technology Stack: The frontend (extension + web UI) will be built with HTML/CSS/JavaScript (using React/Vue or vanilla JS). Emotion models can run with WebAssembly or TensorFlow.js (for on-device inference) or via calls to a backend service. The backend (if used) could be Python/Node.js with ML frameworks (TensorFlow/PyTorch). Crucially, we leverage **AMD GPUs** on the server: AMD's ROCm allows high-performance training and inference of AI models, significantly boosting throughput ⁷ . For example, a CNN emotion model that runs at 60 FPS on CPU can exceed 120 FPS on a GPU ⁶ .

Architecture and Data Flow

1. **User Sign-Up & Configuration:** The user registers on our website or via the extension, granting permission for webcam use (optional) and behavior tracking ¹⁴ ¹⁵ . Privacy is paramount: all emotion data is anonymized and stored securely (or processed locally without upload) ¹⁵ ¹⁴ . The user can review and revoke permissions at any time.
2. **Browser Extension Activation:** After installation, the extension injects a content script into supported e-commerce domains. It monitors page loads: upon detecting a product page, it scrapes product details and review sections.
3. **Emotion & Behavior Sensing:** Simultaneously, the user's webcam feed is analyzed frame-by-frame by the emotion detection model (running at ~50–60 ms latency per inference ⁶). If no camera is used, the extension logs mouse speed, scrolling depth, and time-on-page as implicit indicators.
4. **AI Processing:** The scraped product data is sent (if needed) to backend AI services, or processed client-side. The review filter identifies *verified and high-quality* reviews, generating a concise summary of pros/cons ⁹ ¹⁰ . The recommender module uses the current emotion, browsing history, and product context to score or retrieve relevant suggestions (e.g. alternate products, coupons). This may use embeddings and similarity measures as in advanced recommender architectures ¹² .
5. **UI Customization:** Based on the emotion analysis, the extension modifies the page's CSS and DOM:
6. **Color Theme:** It may overlay a semi-transparent color filter or switch site theme (light/dark tone) to match mood (e.g. soft blues when user is anxious ¹).
7. **Layout Adjustments:** If frustration is high, the UI could collapse non-essential widgets, enlarge fonts, or simplify navigation to reduce cognitive load. Subtle animations or "encouragement" messages might be inserted.
8. **Informational Overlays:** A sidebar or floating panel appears, showing tailored content: current detected mood (e.g. "We sense you're feeling a bit stressed"), personalized recommendations ("Calming teas popular right now"), and analytical tools. For instance, it can display a **price history chart** under the listed price so users see if the deal is good ¹⁶ . It can highlight "Top Verified Reviews" and hide suspect ones ⁹ .
9. **User Interaction & Feedback:** The user can interact with these overlays (e.g. toggle review filter, click recommended items). Feedback (like clicking a "Help me decide" button) can refine the AI in future sessions.
10. **Data Storage:** User preferences, session data, and (optionally) anonymized emotion logs are stored in a database (e.g. NoSQL or SQL with encryption). AMD's secure computing features ensure robust

protection. This data helps personalize future sessions (long-term preferences) without exposing raw personal metrics.

Throughout this pipeline, **real-time processing** is crucial: all steps from video capture to UI update should occur within a few hundred milliseconds. The cited real-time emotion tools demonstrate that CNNs and optimized models can indeed run at 30–60 FPS ⁵ ⁶ . If performance is limited on the client, heavy inference can offload to a local companion app or a cloud service with GPU acceleration. Using AMD GPUs via ROCm can slash inference time for both vision and NLP models ⁷ .

MVP Features (Key Capabilities)

Emotion Sensing (Core):

- **Real-time facial emotion recognition** (webcam) with at least 7 classes (happy, sad, angry, etc.) ⁵ .
- **Behavioral mood inference** if camera is off, using features like idle time, click rate, scroll speed. (Research shows cursor dynamics can explain ~10–20% of mood variance ⁸ .)
- **User-selectable mode:** Users can opt-in/out of camera use, ensuring behavior-based analysis is always available as fallback.

UI Adaptation:

- **Dynamic color theming:** The site's accent color or background tint shifts to match mood (e.g. calm blues or warm yellows for positive moods). [Emotionally adaptive UI examples exist in design research ¹ .]
- **Layout personalization:** Interface elements reflow for clarity. For example, reducing on-screen options when stress is high (subtle UX change recommended in adaptive design ¹⁷).
- **Mood-driven copy and animations:** UI text or tooltips change tone (more reassuring or upbeat), and small animations (like breathing lights) reinforce the mood theme.

Intelligent Shopping Tools:

- **Personalized Recommendations:** Suggest products or deals based on mood (e.g. "You seem tired; how about a soothing tea?"). This uses context-aware recommendation influenced by emotion ⁴ ¹² .
- **Review Analysis:** Filter reviews to show only real, relevant ones. Summarize main pros/cons via NLP (pros/cons lists from reviews) ⁹ ¹⁰ .
- **Sentiment Summary:** Aggregate real user sentiments (positive vs negative) and label the product accordingly. (Existing AI assistants summarize reviews neutrally ¹⁰ .)
- **Price and Deal Insights:** Display price history charts and highlight if the current price is unusually low/high ¹⁶ . Indicate "Good Deal" or "Overpriced" statuses using algorithmic thresholds ¹⁸ .
- **Product Comparison:** Provide a side-by-side quick comparison with similar items (via AI-curated lists) to help decision-making.
- **Seller/Credibility Signals:** Show trustworthiness indicators (seller ratings, fraud alerts) to reduce risk (as in the Safe Deal extension) ¹⁹ .
- **Cross-Site Sync:** Store a shopping list or wishlist that works across sites. If user viewed a product on one site, suggest the equivalent best deal on another.

Engagement and Accessibility:

- **Optional Gamification:** Offer badges or incentives for emotionally healthy shopping (e.g. "You've been browsing patiently – here's a discount!").
- **Accessibility Modes:** If frustration or fatigue is detected, automatically enlarge fonts, increase spacing, or

switch to high-contrast theme.

- **Multi-language Support:** For international users (like existing AI assistants support many languages ¹⁰).

These MVP features align with what market-leading extensions are doing: for instance, the “Safe Deal” Shopping Assistant overlays price graphs and flags deals as “Good/Bad” with AI ¹⁶ ¹⁸ , and an Amazon review assistant summarizing pros/cons is already available ¹⁰ . Our unique addition is *emotion awareness* driving these adaptations.

Application Flow and Pages

The solution comprises two parts: a **Web Dashboard** and a **Browser Extension**. Below are the main pages/sections and user flows:

- **Landing/Home Page:** Introduces the tool (“AI-Powered Emotion-Adaptive Shopping”) and highlights features (emotion-based UI, smart recommendations, review analysis). Includes links to install the extension (Chrome/Firefox) and a signup button.
- **Signup/Login Page:** Users create accounts or log in (via email or OAuth). Privacy and consent information is clearly shown (what data is collected and why) ¹⁴ ¹⁵ .
- **User Dashboard:** Once logged in, the dashboard shows an **emotional shopping summary**: e.g. a chart of the user’s recent moods while shopping, top recommended products from past sessions, and current deals. Settings allow toggling webcam/emotion tracking or customizing UI themes. Users can view and delete their stored data. A button/link to install or update the browser extension is prominently displayed.
- **Settings/Preferences:** Here the user can enable/disable features: “Use webcam for mood detection” (on/off), “Allow behavior tracking” (yes, required), choose default color themes for certain moods, and privacy options. Clear explanations accompany each setting (e.g. what “behavior tracking” means).
- **On-Page Extension Overlay:** When the user visits a supported e-commerce site and activates the extension (either automatically or via the extension icon), the interface injects UI elements into the current page:
- **Top/Side Panel:** A floating panel or sidebar appears, showing the **detected emotion** (icon/emoji and word like “Content” or “Frustrated”) and brief AI insights. It might say, “You seem a bit stressed; here are some calming options.”
- **Color Overlay:** The page’s background or accent hues adjust subtly. For instance, if the user is tired, the site might shift to softer pastels (simulating Headspace’s calm theme ¹).
- **Product Info Cards:** Below or beside the original product info, cards appear with **related products** (found via the recommender) and **price history graphs** under the price tag ¹⁶ .
- **Review Enhancements:** Next to the review section, buttons allow “Show only verified reviews” or “Summarize reviews”. When toggled, it filters or highlights, e.g. marking AI-detected fake reviews to ignore ⁹ . A generated pros/cons summary (in user’s language) may appear at top of reviews.
- **Notifications/Tooltips:** As the user scrolls or hesitates, context-specific tips pop up (e.g. “Notice: Most customers who felt like you rated this item 4.5★” or “Limited-time coupon available!”).
- **Extension Popup (Icon Click):** Clicking the extension icon opens a small window listing options: “Analyze this page”, “Change mood settings”, “View recent stats”. It may show the last detected emotion and allow quick toggles (pause emotion tracking, etc.).

Data Storage: All user data (profiles, preferences, anonymized emotion logs) reside in a backend database. Product and session data may be cached locally (IndexedDB) to avoid repeated fetches. Secure login tokens (OAuth/JWT) maintain sessions. AMD's secure enclave features and encryption libraries protect this data. For performance, the system uses REST or WebSocket APIs to communicate extension↔server.

User Interaction Flow (Step-by-Step)

1. **Sign Up / Onboarding:** The user visits the homepage, reads about the emotion-adaptive assistant, and creates an account ¹⁴. They are asked to grant permission for webcam access (optional) and to accept privacy terms (detailing that emotion/behavioral data will be used only to personalize their UX).
2. **Extension Installation:** The user installs our browser extension. A tutorial page or built-in guide explains how to navigate (e.g. enabling the extension on shopping sites).
3. **Initial Calibration (Optional):** On first use, the extension may run a quick calibration (e.g. asking the user to smile or frown) to tune the emotion model. This data stays local.
4. **Browsing and Sensing:** The user browses to an e-commerce product page (say Amazon). The extension auto-activates. It starts capturing (if allowed) video frames and logging cursor/scroll events.
5. **Content Analysis:** Simultaneously, the extension reads the product title, price, image URL, and the first few reviews from the page. It may send this info to the server to fetch additional data (price history, similar items, aggregated ratings).
6. **AI Inference:** The emotion model classifies the current mood (e.g. "Neutral"), while an NLP module filters the reviews and picks top-verified comments. A recommender scores other products by relevance to the mood and context.
7. **UI Update:** The extension injects new UI: a soft overlay color appears (say light green for calm), the recommendation panel slides in showing "Popular choices for your mood". Price history sparkline appears beneath the price ¹⁶. The least reliable reviews are greyed out or hidden ⁹.
8. **User Takes Action:** The user can interact: they might click a recommended item, use the review filter toggle, or simply continue shopping. Each action is logged (and can fine-tune future suggestions). If the user manually changes a setting (e.g. disables webcam), that preference is saved to their profile.
9. **Continuous Adaptation:** If the user's mood changes (detected after some time or after reading content), the UI subtly shifts again. For example, if the user starts smiling, the panel might recommend more "positive" deals (like an upsell with a free gift).
10. **Session Summary:** After shopping, the extension might notify the user with a brief summary (e.g. "You spent 15 minutes, mood was 80% calm, you saved \$5 with deals!") on their dashboard.

Throughout this flow, **all components interact seamlessly**: front-end scripts handle UI and basic logic, while heavy tasks (emotion classification, NLP summarization) leverage optimized AI libraries (potentially on the server). AMD's GPU acceleration (via ROCm) ensures these deep learning tasks stay within the real-time budget ⁷ ⁶.

Privacy and Ethical Considerations

Emotion analysis raises privacy concerns. We strictly follow best practices: **Transparency and Consent** are built in ¹⁴ ¹⁵. Users explicitly opt into emotion tracking and are informed exactly how data is used. They can opt out at any time, reverting to a non-emotion-adaptive mode. Sensitive data (face images, emotion logs) is encrypted or kept only in volatile memory; any long-term storage is anonymized and used only in

aggregate analytics or for improving personalization models. We also guard against “manipulative” use: the UI changes are designed to be **subtle and empathetic** (not aggressive upselling). The user always controls the final decision, in line with ethical design guidelines ¹⁴ .

Key References and Supporting Evidence

- **Emotion Detection Performance:** Open-source systems can achieve **60+ FPS** emotion classification on commodity hardware ⁵ . With GPU (e.g. NVIDIA or AMD), this doubles (120+ FPS) with <50 ms latency ⁶ . Thus, real-time facial emotion inference is feasible for a browser extension.
- **AI Extensions Exist:** Several existing browser extensions already provide *contextual shopping assistance* using AI. For example, the “AI Shopping Assistant” extension summarizes pros/cons from reviews and works on Amazon, BestBuy, etc. ¹⁰ ²⁰ . Another “Safe Deal” assistant overlays price history charts and flags fake reviews on Amazon/AliExpress/eBay ¹⁶ ⁹ . These show that overlaying analytics on shopping pages is practical and valued. We will build on similar techniques, adding the emotion-driven personalization layer.
- **E-Commerce Personalization Trends:** Industry analysis stresses the growing role of emotional data in commerce. Emotional AI in retail (analyzing tones, facial cues) can boost satisfaction and loyalty predictions by 35–45% ²¹ ²² . Gartner predicts that by 2030, ~40% of retail interactions will adapt to user emotions ² . Furthermore, companies that capture real-time behavioral and emotional signals (“the predictive commerce flywheel”) see ~40% higher revenues and double retention ²³ . These trends underline the potential ROI of our approach.

Conclusion

By integrating advanced emotion detection and behavior analytics with smart shopping tools, the proposed system creates a **next-generation shopping UX**. The user journey – from login and extension setup to on-site adaptive interface – is designed for immediacy and privacy. Each page (landing, dashboard, settings) and overlay (product recommendations, review filters, theme changes) works together to make online shopping more intuitive and personally tailored. This solution leverages the latest AI research and hardware (AMD GPUs) to operate in real-time, enhancing both user satisfaction and purchase outcomes. With a carefully phased MVP (10–25 features listed above) and attention to ethical design, the Emotion-Adaptive Shopping Assistant can deliver a seamless, emotionally intelligent e-commerce experience ³ ⁹ .

Sources: Scholarly and industry sources on emotion-aware UI and AI shopping assistants informed this design ³ ¹⁰ ⁹ ¹³ ² ⁵ . These citations illustrate proven techniques (real-time emotion models, browser AI extensions) and the projected impact of emotion-driven personalization in retail.

¹ ¹³ ¹⁴ ¹⁷ Emotionally Adaptive Interfaces: How UX Changes With User Mood | by Blessing Okpala, PhD | Bootcamp | Medium

<https://medium.com/design-bootcamp/emotionally-adaptive-interfaces-how-ux-changes-with-user-mood-430b174871c1>

² ⁴ ²¹ ²² ²³ Top 15 AI-Driven Ecommerce Strategies for Predictive, Personalized Shopping | IT IDOL Technologies

<https://itidoltechnologies.com/blog/top-15-ai-driven-ecommerce-strategies-for-predictive-personalized-shopping/>

³ ¹⁵ Emotion-Aware AI In User Interfaces

https://www.meegle.com/en_us/topics/affective-computing/emotion-aware-ai-in-user-interfaces

5 6 GitHub - Shayanthn/Real-Time-Emotion-Detection-with-OpenCV-DeepFace: This project is a real-time facial emotion recognition system using OpenCV, Mediapipe, and DeepFace. It captures video from a webcam, detects facial landmarks, and analyzes emotions in real-time using deep learning models.

<https://github.com/Shayanthn/Real-Time-Emotion-Detection-with-OpenCV-DeepFace>

7 Use ROCm for AI — ROCm Documentation

<https://rocm.docs.amd.com/en/latest/how-to/rocm-for-ai/index.html>

8 Reading Emotion From Mouse Cursor Motions: Affective Computing Approach - PubMed

<https://pubmed.ncbi.nlm.nih.gov/29131372/>

9 16 18 19 Shopping Assistant: AliExpress, Amazon, eBay - Chrome Web Store

<https://chromewebstore.google.com/detail/shopping-assistant-aliexp/ejjhlpepcaaaehcemmjgnaekfggehdan>

10 20 AI Shopping - Review Analyzer & Compare - Chrome Web Store

<https://chromewebstore.google.com/detail/ai-shopping-review-analyz/kbfpiicecmeaelfochkjcdnlllhapedp>

11 12 CORES: Context-Aware Emotion-Driven Recommendation System-Based LLM to Improve Virtual Shopping Experiences

<https://www.mdpi.com/1999-5903/17/2/94>