Project Requirements Document (Updated with DID + ZKP)

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1. Introduction

This document outlines the requirements for an AI-powered personal shopping assistant with an AR-based virtual try-on system. The goal is to deliver a seamless, personalized, secure, and engaging shopping journey for modern retail customers.

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2. Project Goals

- To provide personalized outfit suggestions using GenAI.
- To enable virtual try-on of garments using AR technology.
- To enhance customer engagement and satisfaction in retail.
- To reduce returns by improving sizing and visualization confidence.
- To increase average order value (AOV) and conversions.
- To provide privacy-first personalization through Decentralized Identity (DID).
- To ensure secure and private interaction feedback using Zero-Knowledge Proofs (ZKP).

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3. Core Features

3.1. Conversational GenAI Stylist

- Intent understanding from context, like occasion, season, mood, and weather
- Outfit recommendations from Walmart's catalog
- Learning from user feedback and conversation memory
- Voice and text interaction with TTS support

3.2. AI-Curated Outfit Suggestions

- Personalized looks using product embeddings and user profile
- Context-aware outfit generation

3.3. Augmented Reality (AR) Try-On Mirror

- Try clothes virtually via webcam/phone camera
- Realistic overlays, fitting algorithms, and lighting effects
- Support for full outfit visualization and sharing

3.4. Product Catalog Integration

- Integration with a mocked Walmart API
- Vector database (Pinecone) for semantic product search

3.5. User Experience (UX)

- Mobile + desktop responsive UI
- Chat, product view, AR, cart, and profile features

3.6. DID & ZKP Layer

3.6.1. Decentralized Identity (DID)

- User-owned fashion profiles stored via Ceramic/Polygon ID
- Contains style history, preferences, and feedback logs
- Consent-driven access for AI-based personalization
- Portable across devices and platforms

3.6.2. Zero-Knowledge Proofs (ZKP)

- Enables users to submit feedback/emotion signals without exposing raw data
- Used for emotion detection, try-on feedback, and style approval
- Based on SNARKs/Zokrates for compliance with data privacy laws

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4. Technical Requirements

4.1. Frontend

- React / React Native + Tailwind CSS
- Components: Chat, Product Display, Try-On, Profile, Cart
- Voice interface: Whisper integration
- DID consent management UI

4.2. Backend

- Node.js / FastAPI
- API endpoints for product, user, chat, outfit, DID, and ZKP
- Pinecone for vector-based search
- DID resolver and ZKP verifier modules
- Consent layer and secure session tracking

4.3. GenAI System

- GPT-4 via OpenAI + LangChain
- Contextual prompts integrating DID data
- Feedback loop enhanced by ZKP-verified feedback

4.4. AR System

- Snap AR SDK / 8th Wall / Three.js
- Camera access, clothing positioning, and lighting adjustment
- Multi-item support with realistic rendering

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5. Non-Functional Requirements

5.1. Performance

- Fast response for chat and AR modules
- Optimized for mobile and varied bandwidth

5.2. Security

- End-to-end encrypted sessions
- ZKP-based emotion/feedback without raw data storage
- User-controlled profile via DID

5.3. Scalability

- Modular microservices architecture
- Extensible to more verticals and brands

5.4. Maintainability

- Well-documented, clean codebase

5.5. Usability

- Accessible design with intuitive navigation
- Smooth transitions between chat, AR, and cart

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6. Key Milestones

- **June 22**: Week 1 Complete – Setup, mockups, DID/ZKP research
- **June 29**: Week 2 Complete – Core features + DID/ZKP basic integration
- **July 6**: Week 3 Complete – Full integration with DID consent + ZKP feedback
- **July 9**: Demo Ready – Showcasing privacy-first AI stylist
- **July 10**: Final Submission – Complete polished project

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7. Risk Mitigation

- **AR Complexity**: Fallback to simpler overlays
- **GenAI Limits**: Fallback prompt logic + caching
- **DID Complexity**: Use mock DIDs if full resolver fails
- **ZKP Overhead**: Simulate proofs if implementation lags
- **Demo Bugs**: Pre-recorded fallback demo

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8. Success Metrics

Week 1: Foundation

- Setup complete, mockups ready, DID/ZKP explored

Week 2: Core Functionality

- Chat, product catalog, and AR try-on functional in isolation
- DID integrated for preference personalization
- ZKP feedback prototypes working

Week 3: Integration

- All components integrated with secure consent & feedback
- Real-time AI responses using DID

Week 4: Demo Readiness

- Demo flow shows consent-driven personalization
- All modules polished with privacy safeguards
