Colors of Life - Tech Stack Document

Core Technologies

Frontend

- **Framework**: Next.js 14 with React Server Components
- **State Management**: React Context API & Zustand
- **Styling**: TailwindCSS with custom design system
- **Animation**: Framer Motion
- **Component Library**: Custom UI components with Headless UI integration
- **Forms**: React Hook Form with Zod validation
- **API Client**: Apollo GraphQL Client

Backend

- **API Layer**: GraphQL with Apollo Server
- **Core Services**: Rust for performance-critical components
- **Microservices**: Go for supporting services
- **Authentication**: NextAuth.js with JWT
- **Database**:
  - PostgreSQL for relational data
  - Pinecone for vector embeddings and similarity search
- **File Storage**: Amazon S3 with CloudFront CDN

Mobile

- **Framework**: React Native (primary)
- **Alternative**: Flutter (for specific performance-intensive features)
- **State Management**: Redux Toolkit
- **Navigation**: React Navigation

DevOps & Infrastructure

- **Cloud Provider**: NVIDIA AI Cloud (formerly NVIDIA GPU Cloud)
- **Container Orchestration**: Kubernetes with Istio service mesh
- **CI/CD**: GitHub Actions

- **Infrastructure as Code**: Terraform
- **Monitoring**: Datadog, Sentry
- **Logging**: ELK Stack (Elasticsearch, Logstash, Kibana)

AI & Machine Learning Stack

Computer Vision

- **Body Measurement**: Custom models built on NVIDIA's CV models
- **Pose Estimation**: MediaPipe or OpenPose integration
- **Segmentation**: Meta's Segment Anything Model 2.0

Generative AI

- **Virtual Try-On**: Kling AI API Integration
- **3D Avatar Creation**: NVIDIA Picasso
- **Content Generation**: Fine-tuned Claude 3.7 Sonnet or GPT-5

Natural Language Processing

- **AI Stylist**: Fine-tuned Claude 3.7 Sonnet or GPT-5
- **Search Enhancement**: Embeddings with sentence-transformers

Recommendation Systems

- **Product Recommendations**: Hybrid collaborative and content-based filtering
- **Style Matching**: Vector similarity search with Pinecone
- **Trending Detection**: Time-weighted engagement analysis

Kling AI Integration

API Integration

- **Authentication Method**: JWT-based authentication with Kling AI services
- **Request Processing**:
  - RESTful API integration
  - Base64 image encoding/handling
  - Image preprocessing to meet Kling requirements

Endpoints

- **Create Task**: `POST /v1/images/kolors-virtual-try-on`
- **Query Task (Single)**: `GET /v1/images/kolors-virtual-try-on/{id}`
- **Query Task (List)**: `GET /v1/images/kolors-virtual-try-on`

Middleware Services

- **Image Processing Service**: Handles preparation of images for Kling API
  - Image format conversion
  - Resolution adjustments
  - Background removal when needed
  - Image compression
- **Task Management Service**: Manages try-on task lifecycle
  - Request creation and submission
  - Task status polling and updates
  - Result processing and delivery
  - Error handling and retries

Caching Strategy

- **Redis Cache**: Store recent try-on results
- **CDN Integration**: Cache generated images for performance
- **Warm Cache**: Pre-generate popular item try-ons

Development Tools

Code Quality

- **Linting**: ESLint with custom rulesets
- **Formatting**: Prettier
- **Testing**:
  - Jest for unit tests
  - Playwright for E2E testing
  - Cypress for component testing

Design Tools

- **UI Design**: Figma
- **Prototyping**: Framer

- **Design System**: Storybook
- **Asset Management**: Cloudinary

Project Management

- **Issue Tracking**: Linear
- **Documentation**: Notion
- **API Documentation**: GraphQL Playground with Schema Documentation
- **Knowledge Base**: Confluence

Third-Party Integrations

Payment Processing

- **Provider**: Stripe
- **Alternative**: PayPal
- **Fraud Prevention**: Sift

Analytics

- **User Analytics**: Amplitude
- **Performance**: Datadog APM
- **Marketing**: Segment

Content Delivery

- **Video Streaming**: AWS MediaLive + AWS Elemental
- **Content Distribution**: CloudFront CDN

Communication

- **Email**: SendGrid
- **Push Notifications**: Firebase Cloud Messaging
- **In-app Chat**: Stream Chat

Performance & Scaling Considerations

Real-time Processing

- **WebSockets**: Socket.io for real-time updates
- **Server-Sent Events**: For one-way notifications

- **Task Queues**: Redis-based queue for Kling API task processing

Caching Strategy

- **API Caching**: Apollo Cache
- **Edge Caching**: Vercel Edge or CloudFront
- **Database Caching**: Redis
- **Image Caching**:
  - Short-term: CDN for try-on results (30-day expiry to match Kling policy)
  - Long-term: S3 for permanent storage of user's favorite try-ons

Security Implementation

- **Authentication**: OAuth 2.0 with PKCE
- **Authorization**: RBAC (Role-Based Access Control)
- **Data Protection**: Field-level encryption for sensitive data
- **API Security**: Rate limiting, JWT validation, CORS policies
- **Image Security**: Secure handling of user photos with proper consent management

Development Environment Setup

Local Development

- **Containerization**: Docker & Docker Compose
- **Environment Variables**: dotenv with different environments
- **Hot Reloading**: Next.js built-in + custom watchers for services
- **API Mocking**: Mock Service Worker for Kling API simulation

Quality Assurance

- **Automated Testing**: GitHub Actions workflows
- **Visual Regression**: Percy
- **Accessibility Testing**: axe-core
- **Performance Testing**: Lighthouse CI
- **Load Testing**: k6 for simulating high volume try-on requests

Version Control Strategy

- **Branching Model**: GitHub Flow

- **Release Management**: Semantic versioning
- **Code Review**: Pull request templates and required approvals

Recommended Service Providers

- **Cloud Infrastructure**: AWS or GCP with NVIDIA GPU instances
- **CI/CD Platforms**: GitHub Actions or CircleCI
- **Domain & DNS**: Cloudflare
- **SSL Certificates**: Let's Encrypt with automatic renewal
- **Error Tracking**: Sentry

Technology Evaluation Criteria

When evaluating additional technologies or replacements, consider:

1. Performance impact on key user journeys
2. Developer experience and team familiarity
3. Community support and documentation quality
4. Long-term maintenance outlook
5. Licensing and cost implications
6. Security considerations
7. Integration complexity with existing stack
8. Scalability for future growth