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ABSTRACT

Autism Spectrum Disorder (ASD) affects millions worldwide, yet early and accessible diagnostic tools remain limited. Although several AI-driven research models exist for ASD assessment, there is no readily available, cost-free, and effective tool for real-time behavioral analysis. This project proposes the Autism Spectrum Analyzer, a cloud-based application that enables real-time ASD screening through multiple assessment methods, including live behavioral analysis, eye-tracking tests, and AQ-based questionnaire evaluation. The system employs AI-powered models hosted on a cloud server, allowing users to stream live camera feeds for real-time behavioral assessment or engage in eye-tracking tasks using standard images employed in ASD diagnosis. Additionally, users can complete standardized autism spectrum questionnaires, analyzed using NLP-based models. The application enables continuous video streaming, advanced deep learning models for behavior and gaze tracking, and scalable AI inference through cloud computing, ensuring efficient and real-time analysis. The system ensures seamless accessibility across web platforms with an intuitive and responsive user interface, backed by a high-performance server that efficiently handles requests and data processing. By providing a free, AI-integrated, real-time ASD assessment tool, this project aims to bridge the accessibility gap in autism screening and promote early detection, ultimately aiding individuals and caregivers in seeking timely intervention.

Overview of Architecture

The system follows a **client-server** model, where:

- **Frontend (Client Side)** is a web and mobile app allowing users to select different ASD assessment modes.
- **Backend (Server Side)** is hosted on the cloud, where AI models process incoming real-time video feeds and questionnaire responses.
- **Cloud Storage & AI Computing** handle data storage, processing, and security, ensuring seamless, low-latency interaction.

System Flow & Components

(A) User Interaction via Web
- Users access the system through a React.js/Next.js web app, which provides options:
    1. Real-Time Behavioral Analysis (Live Camera Feed)
    2. Eye-Tracking Test (Gaze Analysis)
    3. Autism Spectrum Questionnaire (AQ Test & NLP-Based Analysis)

(B) Data Streaming to Cloud Server
- WebRTC / WebSockets facilitate continuous real-time video streaming from the user's device to the cloud server.
- API endpoints handle requests from questionnaire responses and eye-tracking data.

(C) AI Model Processing on Cloud
- The backend server (FastAPI/Django) processes requests, applies the relevant AI model, and returns real-time results.
- Models are hosted using Google Cloud AI / AWS to leverage cloud computing for fast inference.

(D) Continuous Output Streaming Back to Client
- Results (e.g., behavioral patterns, gaze tracking insights, AQ test analysis) are sent back in real-time.
- Users can view live analytics from the server.

Technology Stack Selection

- **Frontend (Client Side)**
  Web App: React.js / Next.js
  Live Camera Streaming: WebRTC / MediaPipe

- **Backend (Server Side & AI Processing)**
  API Framework: FastAPI (Python) or Django
  AI Model Hosting: Google Cloud AI / AWS SageMaker
  Real-Time Data Handling: WebSockets / Firebase Firestore

- **Cloud Infrastructure & Deployment**
  Server: Google Cloud / AWS Lambda / Firebase
  Database: PostgreSQL / Firebase Firestore
  Storage: Google Cloud Storage (for video uploads)

- **AI & ML Models**
  Facial Expression & Behavior: OpenCV + TensorFlow
  Eye-Tracking: MediaPipe + Gaze Estimation models
  Autism Questionnaire Analysis: NLP (BERT, GPT-based sentiment analysis)