Automated Attendance System

1. Executive Summary

The Automated Attendance System is a comprehensive, role-based platform designed to modernize academic attendance tracking. Utilizing advanced Face Recognition technology, the system enables touch-free, automated attendance marking for students, while providing powerful dashboards for Faculty and Administrators to manage courses, view real-time logs, and generate detailed reports.

2. System Architecture

The system follows a modern Client-Server architecture, separating the User Interface (Frontend) from the Business Logic and Data Management (Backend).

Frontend (Client Side)

- Framework: React.js (v19) with Vite (v7)
- Styling: Tailwind CSS (v4)
- State Management: React Context API
- HTTP Client: Axios
- Features: SAP (Single Page Application), Split-screen Kiosk Mode, Responsive Dashboards

Backend (Server Side)

- Framework: FastAPI (Python)
- Server: Uvicorn (ASGI)
- AI Engine: face_recognition (Dlib/OpenCV based)
- Authentication: OAuth2 with JWT (JSON Web Tokens)

Database

- Type: Relational Database
- ORM: SQLAlchemy
- Engine: SQLite (Development/MVP), Compatible with MySQL/PostgreSQL

3. Detailed Technology Stack

Core Libraries & Versions

- Python: 3.x
- FastAPI: Latest
- React: v19.2.0
- OpenCV-Python: Computer Vision operations
- NumPy: Matrix operations for face encodings
- Lucide-React: Modern Iconography

4. Database Schema

The database is normalized to support role-based access and course-specific tracking.

Users Table

Stores all actors (Admin, Teacher, Student). Key columns: role, email, password_hash, face_encoding, department.

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Subjects Table

Stores course details. Key columns: name, code, start_time, end_time, teacher_id.

Attendance Table

Transactional table for logs. Key columns: user_id, subject_id, date, status (present/absent/late).

StudentCourse Table

Many-to-Many link between Students and Subjects (Enrollments).

5. Key Modules

A. Smart Kiosk (Public Interface)

A split-screen interface located at classroom entrances.
- Left Panel: Continuously scans for faces. If a registered student is recognized, it checks their schedule and marks attendance automatically.
- Right Panel: Secure login portal for Staff and Admins.

B. Faculty Portal

- Live Classroom: Real-time monitoring of class attendance via webcam.
- Roster Management: View student lists, Bulk Mark attendance, Edit status.
- Analytics: Attendance percentages and exportable CSV reports.

C. Administrative Dashboard

- User Management: CRUD operations for Students and Teachers.
- Face Enrollment: Upload and process reference images for users.
- System Stats: Global overview of attendance and user base.

6. Security Implementation

- Password Hashing: Bcrypt
- Token Authorization: Bearer JWT with expiration
- Role-Based Access Control (RBAC): Middleware checks for 'admin' or 'teacher' scopes before executing sensitiv
- CORS Policy: Configured for secure frontend-backend communication.