***Solution Approach***

**Face Recognition Attendance System with Supabase Integration - Solution Approach**

**1. Overview**

This Python-based face recognition system is designed to automate attendance and grant access tracking for students. It integrates with Supabase for backend data management and includes real-time face detection, recognition, and logging capabilities.

**2. Modules Used**

* **cv2 (OpenCV)**: For image and video processing.
* **face\_recognition**: To detect and compare face encodings.
* **cvzone**: For enhanced UI elements.
* **supabase-py**: To interact with Supabase database.
* **requests**: To fetch images via URL.
* **pickle, os, time, datetime, json**: For local file and time operations.

**3. Supabase Integration**

* **Initialization**: Supabase credentials are read from a local JSON file.
* **Updating Records**: The update\_attendance(student\_id) function updates total\_grants and logs the last\_granting\_time in the Supabase students table.

**4. Image Handling**

* Loads student images from a local folder.
* If unavailable locally, fetches from an image URL stored in the database.

**5. Webcam and UI Setup**

* Initializes webcam feed and overlays it on a predesigned background.
* UI displays modes such as scanning, access granted, access denied, etc.
* Draws bounding boxes around detected faces.

**6. Face Recognition Logic**

* Encodes and compares current webcam frames against known student encodings.
* If a match is found within a threshold, it logs attendance.
* Prevents re-entry within a defined cooldown (attendance\_delay).
* Displays student information and updates UI elements accordingly.

**7. Unauthorized Detection**

* If face distance is beyond threshold (unknown\_distance\_threshold), the system treats it as unauthorized.
* Confirms unauthorized status over multiple frames.
* Saves unauthorized images to a local folder (unauthorized).

**8. UI Feedback and Status**

* Displays real-time status messages like "Scanning", "Access Granted", or "Unauthorized".
* Controls cooldown and timing logic to manage system responsiveness.

**9. Edge Handling**

* Handles failed webcam capture.
* Handles network timeouts and image load failures.
* Gracefully exits on 'q' keypress.

**10. Future Enhancements**

* Add GUI for enrollment.
* Add blinking detection or anti-spoofing.
* Add support for multiple cameras.
* Log entry times and history into a separate Supabase table.