Marwadi University Marwadi Chandarana Group	**Marwadi University** **Faculty of Engineering and Technology** **Department of Information and Communication Technology**
Subject: Capstone Project	**Aim: System Design and Architecture - Intermediate Review**
Date: 24-9-2025	**Enrolment No: 92310133004**

Introduction

The proposed attendance system using AWS is made to offer a scalable, secure, and automatic way to manage attendance in schools and other organizations. It removes the problems of old ways of tracking attendance by using cloud computing, artificial intelligence, and computer vision.
This section explains the system's modular design, the technology it uses, and how it can grow.
The modular structure makes it easy to update and adapt, while the selected technologies ensure good performance and fit with standard practices. The scalability plan ensures the system can handle more users and data over time without slowing down or becoming too expensive.

Modular Design

The system is made up of separate parts, each responsible for a particular task. These parts work on their own, so changes in one part don't impact the others. This makes it easier to update, use again, and add new features later.

Modules:

1. **Frontend (React.js Dashboard)**
   - Provides a user-friendly interface for faculty and administrators.
   - Allows image uploads, viewing attendance reports, and download Excel sheets.
2. **Backend (Flask API in Python)**
   - Handles communication between frontend and AWS services.
   - Processes uploaded images, calls Rekognition APIs, and prepares attendance data.
3. **Database and Storage**
   - **Amazon DynamoDB**: Stores metadata (student IDs, face embeddings).
   - **Amazon S3**: Stores uploaded class images and generated Excel reports.
4. **AI/ML Module (AWS Rekognition)**
   - Performs face detection and recognition.
   - Matches detected faces against the registered dataset of students.
5. **Authentication and Security (AWS IAM)**
   - Manages user roles (admin).
   - Ensures secure access to data and prevents unauthorized use.
6. **Visualization and Reporting**
   - Attendance records converted into charts and analytics using Python libraries (Pandas, Matplotlib, Seaborn).
   - Exportable Excel reports for institutional use.

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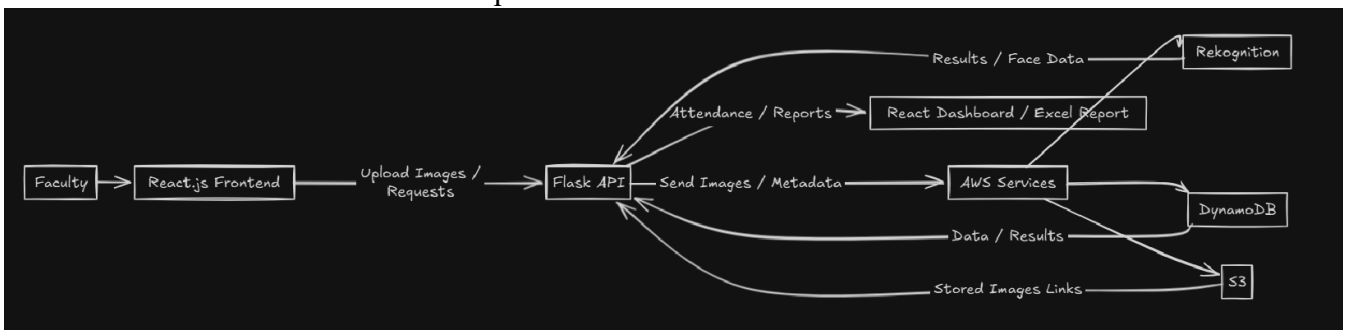
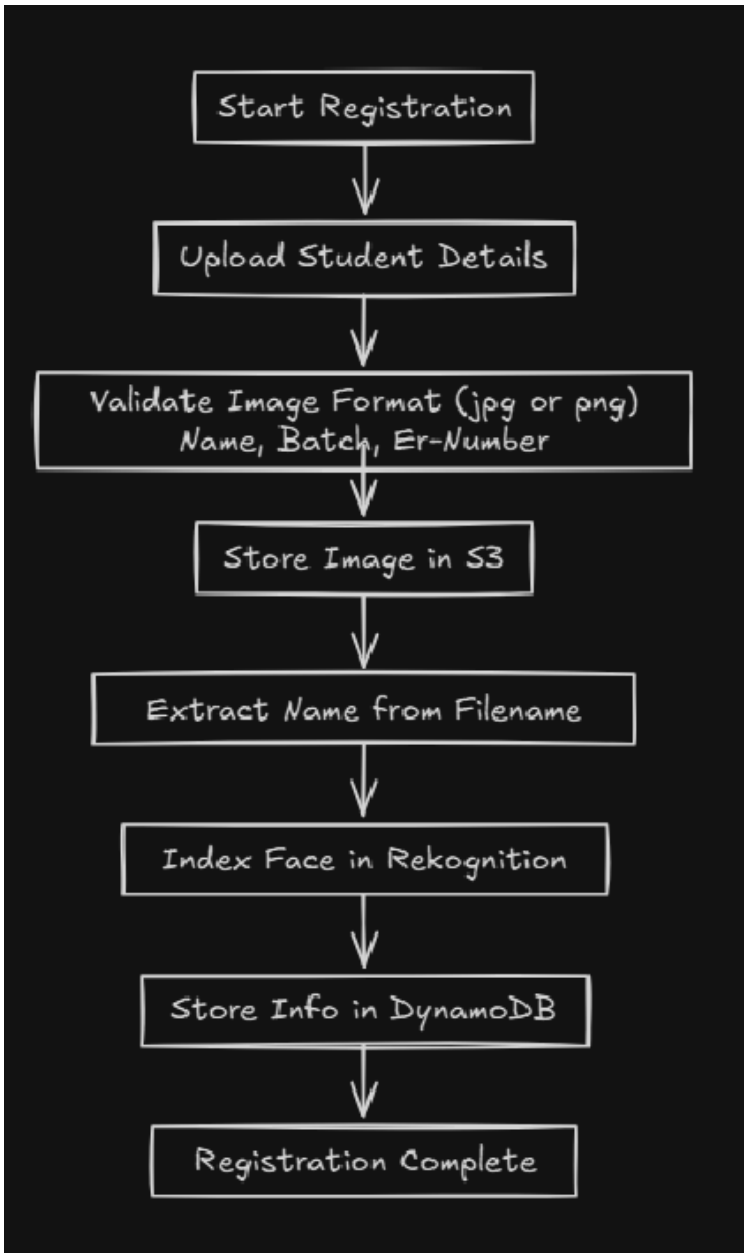
Communication Between Start to end process:



Add Student Process:



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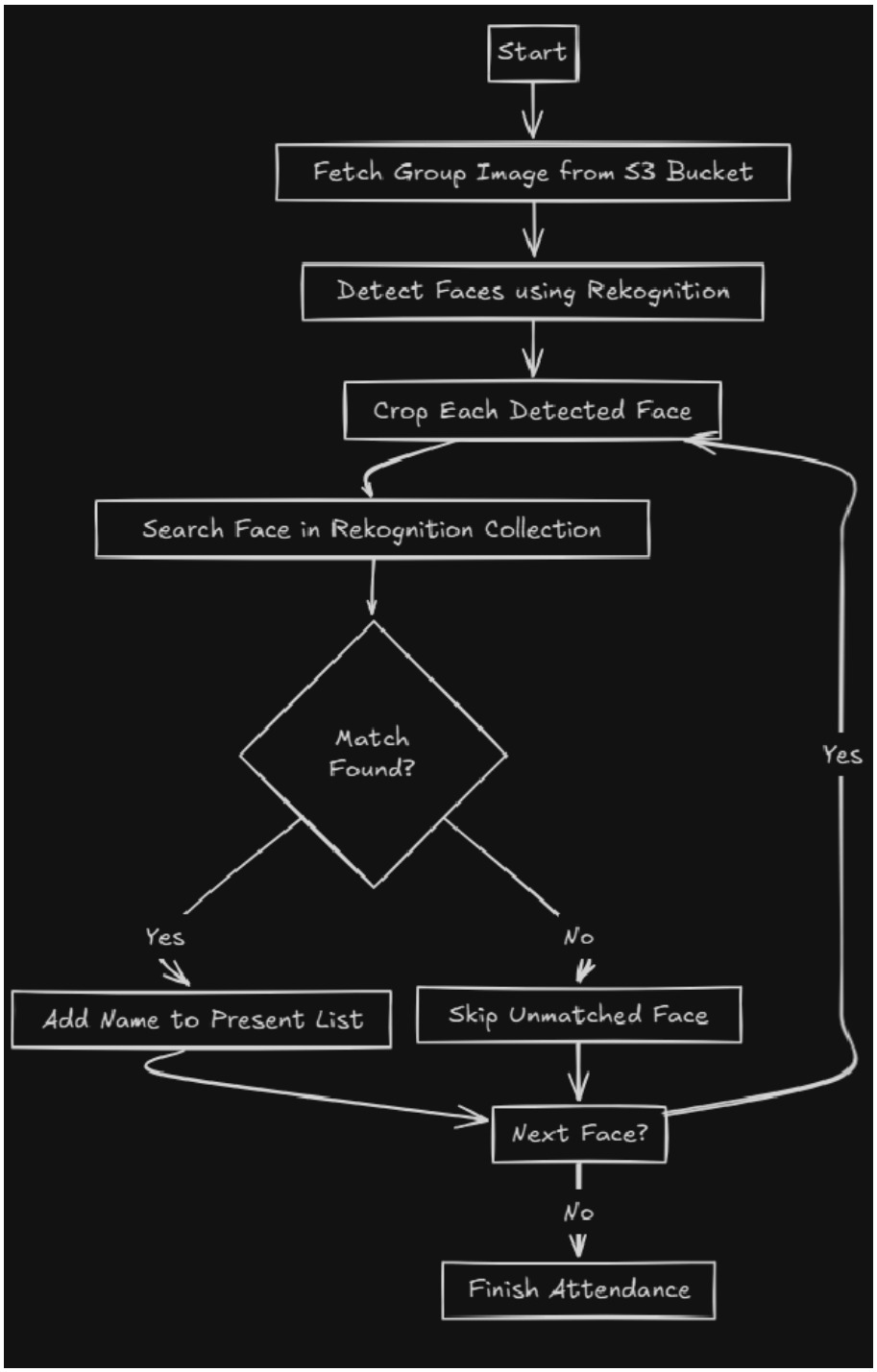
Tack Attendance Process:



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Technology Stack

Programming Languages

- **Python 3.13.6**: Backend development, data processing, and AWS integration.
- **JavaScript (React.js)**: Frontend dashboard for interactive UI.

Frameworks & Libraries

- **Flask**: Lightweight backend framework to build REST APIs.
- **Tailwind CSS**: Provides modern, responsive UI styling.
- **Pandas, Matplotlib, Seaborn**: Used for data analysis and visualization.

Cloud Infrastructure (AWS Services)

- **Amazon Rekognition**: AI-based face detection and recognition.
- **Amazon S3**: Scalable cloud storage for images and reports.
- **Amazon DynamoDB**: NoSQL database for fast, serverless data storage.
- **AWS IAM**: Identity and access management for secure authentication.
- **AWS EC2**: For deployment and execution of backend services.

Database and Storage

- **DynamoDB** for metadata (face IDs).
- **S3** for binary files (images, Excel reports).

Security Components

- **IAM roles and policies** for controlled access.

Justification of Technology Choices

- **AWS Rekognition** is chosen for its high accuracy and pre-trained deep learning models.
- **React.js + Flask** ensures fast development with a modular frontend-backend structure.
- **S3 and DynamoDB** provide serverless, cost-effective, and highly scalable storage.
- **IAM** provides enterprise-grade security.

Scalability Plan

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The system is designed to scale **horizontally** and **vertically** with growing data and users.

Horizontal and Vertical Scaling Strategies

- **Horizontal Scaling**: Use AWS Auto Scaling groups to add instances when user demand grows.
- **Vertical Scaling**: Increase EC2 instance types if backend processing becomes CPU/GPU intensive.

Database Scaling

- **Sharding in DynamoDB**: Distributes load across partitions for high throughput.
- **Replication**: Ensures high availability and disaster recovery.

Load Balancing

- Use **AWS Elastic Load Balancer (ELB)** to distribute requests across backend instances.
- Prevents bottlenecks at the Flask API layer.

Caching and Performance Optimization

- **Amazon CloudFront** for faster content delivery.
- **Local caching** of frequently accessed data to reduce Rekognition API calls.

Cost and Reliability Considerations

- **AWS Free Tier** used during prototyping.
- **Pay-as-you-go** pricing ensures cost-efficiency.
- **High availability** through multi-Availability Zone deployment.