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| Marwadi University<br>Marwadi Chandarana Group | **Marwadi University**<br>**Faculty of Engineering and Technology**<br>**Department of Information and Communication Technology** |
| **Subject: Capstone Project** | **Aim: Testing and Validation** |
| **Date: 24-9-2025** | **Enrolment No: 92310133004** |

# 1. Introduction

This section outlines the testing and validation process for the Attendance System on AWS. The aim is to confirm that the system works as intended, functions consistently under normal conditions, and supports the project's goals. The testing includes unit tests, integration tests, performance checks, and validation against the set objectives. The results, test records, and system logs are provided as evidence.

# 2. Testing Methodology

## Tools and Frameworks:

- Python (Flask Backend): We use pytest for running unit tests, unittest.mock to mimic AWS services, and moto to simulate S3, DynamoDB, and Rekognition.
- API Testing: We validate endpoints using Postman and curl scripts.
- Frontend (React): We test components with React Testing Library and Jest.
- Load Testing: Apache JMeter is used to simulate multiple users making API requests at the same time.
- Excel Validation: openpyxl is used to read and check the generated Excel files in automated tests.

## Test Categories:

1. **Unit tests:** Verify correctness of individual modules (e.g., S3 upload, Rekognition wrapper, Excel generator).
2. **Integration tests:** Validate interactions between backend, AWS services, and frontend.
3. **Performance testing:** Measure API response times, face recognition latency, and Excel generation times under normal and stress load.

# 3. Unit Tests

| Test ID | Module | Description | Input | Expected Output | Actual Result |
|---|---|---|---|---|---|
| UT-01 | upload_to_s3.py | Test image upload to S3 | Dummy image file | File stored in mock S3, URL returned | ✅ Passed |
| UT-02 | mark_batch_attendance.py (Rekognition wrapper) | Test search_faces_by_image | Sample student face image | Matching FaceId returned | ✅ Passed |

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| Test ID | Module | Description | Input | Expected Output | Actual Result |
|---|---|---|---|---|---|
| UT-03 | reports_service.py (DynamoDB) | Test student registration | {roll_no, name, face_id} JSON | Record inserted in DynamoDB (mock) | ✅ Passed |
| UT-04 | update_excel.py | Test Excel generation | Lists: [Present], [Absent] | Excel file created with correct sheets | ✅ Passed |
| UT-05 | main.py (Flask API) | Test invalid file upload | Non-image file request | HTTP 400 Bad Request error | ✅ Passed |

# 4. Integration Tests

## Summary of Test Cases

| Test ID | Components | Description | Input | Expected Output | Actual Result |
|---|---|---|---|---|---|
| IT-01 | Frontend → Flask API | Upload class image | Image + class metadata | Success response with Excel download link | ✅ Passed |
| IT-02 | Flask API → AWS Rekognition | Attendance marking workflow | Group image + class | Present/Absent lists returned | ✅ Passed |
| IT-03 | Flask API → DynamoDB → Excel | Verify end-to-end workflow | Image + registered students | Correct Excel sheet with all students marked | ✅ Passed |

# 5. Performance Metrics

## Defined Metrics

Response Time (RT): The time required to process the /api/upload request (faculty upload → Excel response).

Face Recognition Accuracy (FRA): The percentage of students correctly identified compared to the actual data.

Throughput (TP): The number of requests handled per second under a load

| Metric | Normal Load (10 users) | Stress Load (50 users) | Target | Achieved |
|---|---|---|---|---|
| RT (avg) | 2.1s | 3.5s | ≤ 4s | ✅ Met |
| FRA | 94.8% | 92.3% | ≥ 90% | ✅ Met |
| TP | 12 req/s | 9 req/s | ≥ 8 req/s | ✅ Met |

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# 6. Validation Against Objectives

Project

Objective: Allow faculty to upload class images and automatically generate precise attendance Excel sh eets.

| Objective | Validation Evidence | Status |
|---|---|---|
| Automated attendance from class image | Upload test image (30 students). Excel correctly marked 28 present, 2 absent | ✅ Achieved |
| Integration of AWS services | Verified through integration tests with S3, Rekognition, DynamoDB | ✅ Achieved |
| User-friendly workflow | React frontend tested with 5 faculty users. Feedback: intuitive and easy to use | ✅ Achieved |
| Accuracy ≥ 90% | FRA achieved 94.8% in controlled test set | ✅ Achieved |

Deviations & Limitations

Limitation: Images taken in low-light or blurry conditions lower recognition accuracy (~85%).

Mitigation: Faculty are recommended to take well-lit classroom images.

Future iterations may incorporate local pre-processing techniques (e.g., histogram equalization).