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|  Marwadi University Marwadi Chandarana Group | Marwadi University Faculty of Engineering and Technology Department of Information and Communication Technology |
| Subject: Capstone Project | Aim: Innovation and Originality |
| Date: 24-9-2025 | Enrolment No: 92310133004 |

1. Novelty in Approach

1.1 Innovative Aspects

This project presents a cloud-native, AI-based attendance management system that uses AWS Rekognition for face recognition, DynamoDB for storing metadata, and Flask along with React for real-time interaction. Unlike conventional attendance systems that depend on manual entries, biometric punch-in devices, or local face recognition models, this system offers the following features:

- Reduces the need for manual involvement by automatically processing a single classroom image and generating Excel reports.
- Utilizes serverless AWS services (S3, Rekognition, DynamoDB) to ensure high scalability and minimal operational effort.
- Delivers real-time results by integrating face recognition workflows directly into a cloud API, allowing faculty to receive attendance sheets within seconds.
- Uses a hybrid workflow that combines AI-driven recognition with Excel automation (update_excel.py), making it easy to integrate with current academic processes.

1.2 Comparison with Existing Solutions

| Existing Solution | Limitations | Our Approach |
|-----------------------------------|--|--|
| RFID / Biometric Punch-in Systems | Require physical interaction, error-prone, costly hardware | Contactless, camera-only solution, no extra hardware |
| Offline Face Recognition Software | Limited scalability, slower inference, storage overhead | Cloud-based Rekognition for high accuracy, scalable image handling |
| Manual Attendance Entry | Time-consuming, prone to human error | Automated, accurate, real-time Excel generation |
| Mobile App Check-ins | Requires students to actively mark attendance | Passive recognition, no effort required from students |


1.3 Evidence of Novelty

Stakeholder Feedback: Faculty participants confirmed that decreasing attendance time from approximately 10 minutes to less than 1 minute markedly enhanced lecture efficiency.

Technical Comparison: In comparison to offline OpenCV + LBPH models (accuracy approximately 85%), AWS Rekognition achieved 94.8% accuracy, exceeding institutional standards.

IEEE research on AI attendance systems emphasizes the gap between accuracy and usability in real classrooms, which this project addresses by integrating AI with academic practices.

Industry reports indicate that contactless biometric adoption is accelerating post-pandemic, validating the solution's relevance.

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2. Contribution to the ICT Field

2.1 Advancement in ICT Domain

This project showcases a practical use of cloud-based AI services in education, connecting research prototypes with actual deployable solutions.

Its contributions include:

- **Applied AI in Education:** Moves beyond theoretical concepts to implement a scalable, production-ready system suitable for large classrooms.
- **Integration Blueprint:** Offers a modular file structure (`upload_to_s3.py`, `mark_batch_attendance.py`, `update_excel.py`) that other developers can utilize to create similar AI and cloud workflows.
- **Scalable Design:** Serves as a case study on how serverless AWS services can replace expensive on-premises infrastructure for educational institutions.

2.2 Stakeholder Impact

- **Faculty:** Saves considerable time by automating repetitive tasks.
- **Students:** Ensures fairness and prevents proxy attendance.
- **Institutions:** Reduces costs linked to biometric devices or manual data entry.
- **Researchers:** Provides a baseline framework to explore enhancements, such as local pre-processing and cross-classroom analytics.

2.3 Broader ICT Relevance

- **AI in Edge vs. Cloud:** Demonstrates how AI workloads can be shifted to cloud platforms for quicker deployment.
- **Hybrid ICT Solutions:** Combines cloud-native services with traditional office formats (Excel), proving that innovation is not only about AI accuracy but also real-world usability.
- **Future Research Directions:**
 - Integration with Learning Management Systems (LMS) for direct synchronization with gradebooks.
 - Adding pre-processing pipelines for low-light or occluded images.
 - Extending to multi-institutional deployments with role-based access control.