Facial Recognition-Based Attendance Tracking System Using AWS

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Abstract—*This paper offers a cutting-edge facial recognition-based attendance system that automates and streamlines the procedure by utilizing AWS cloud services. The system guarantees real-time updates and smooth data integration by combining Amazon Rekognition for facial recognition, DynamoDB for safe data storage, Amazon S3 for image management, and AWS Lambda for backend automation. Large-scale deployment is made possible by this method, which also improves accuracy and reduces manual involvement. The technology gives businesses real-time attendance information while increasing security, decreasing human error, and improving operational efficiency.*

Keywords—*Facial recognition, cloud based attendance system, AWS rekognition, Dynamo DB, lambda, S3 bucket, real-time tracking.*

I. INTRODUCTION

In many fields, such as education, business settings, and residential communities, precise and effective attendance tracking is crucial. Conventional techniques like biometric sensors and paper-based registers are frequently labor-intensive, error-prone, and inefficient. These antiquated methods raise administrative burdens, reduce productivity, and compromise security. A scalable, automated, and secure attendance monitoring system becomes more and more important as businesses expand. Cloud-based solutions in conjunction with facial recognition technology provide a contemporary method of managing attendance. Organizations can attain automatic, precise, and real-time attendance tracking by utilizing AWS services like AWS Lambda for backend automation, Amazon Rekognition for facial recognition, DynamoDB for safe data storage, and Amazon S3 for picture management. This guarantees smooth integration with current systems, improves security, and does away with the need for human record-keeping. By lowering errors, enhancing data accuracy, and permitting large-scale deployment, the suggested method improves operating efficiency. AI-powered facial recognition and real-time updates allow businesses to automate attendance management while preserving privacy and security. This creative solution offers a dependable and affordable substitute for conventional attendance tracking techniques, making it perfect for residential facilities, business offices, and educational institutions.

II. LITERATURE REVIEW

A. Face Recognition based Attendance Management System [1]

A contemporary attendance system that uses facial recognition to increase accuracy is covered in a research report. In order to preserve correct data, the system uses a webcam to identify faces and compare them with pre-existing photos. The study highlights the effectiveness of facial recognition in automated attendance management systems by contrasting the efficacy of the Histogram of Oriented Gradients (HOG) algorithm with Euclidean distance measures for face matching

B. Cloud-Based Attendance Management System Using AWS Services[3]

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C .Security and Privacy Concerns in Cloud-Based Facial Recognition Systems [4]

Even though facial recognition has numerous advantages, privacy and security issues still exist. A study examined the dangers of cloud-based attendance systems' data storage and access management. When putting facial recognition systems on AWS, the researchers recommended

utilizing access control settings and encryption approachesto guarantee data security.

D. Facial Recognition Attendance Systems[12]

The facial recognition attendance systems are examined in an article, with a focus on their features, benefits, and costs. These technologies revolutionize how companies monitor and control employee attendance because they provide unmatched accuracy, security, and ease. Using cutting-edge facial recognition technology improves overall operational efficiency, decreases time theft, and streamlines labor management.

E. Facial Recognition Market Trends and Growth Analysis[5]

He global facial recognition market is expected to grow at a compound annual growth rate (CAGR) of 16.3% from its 2023 valuation of USD 6.3 billion to USD 13.4 billion by 2028, according to a report by Markets. Because of its precision and effectiveness, the research emphasizes how facial recognition technology is increasingly being used in a variety of industries, including attendance tracking systems. The scalability and dependability of these systems are being enhanced by the integration of facial recognition technology with cloud services such as AWS.

III.METHODOLOGY

A. Design of System Architecture

Utilising AWS services, the system is built as a serverless cloud-based solution. The following are the main elements of the architecture:

• **Amazon S3:** Holds datasets and photos of faces. Face detection and identification is done by Amazon Rekognition.

• **AWS Lambda:** Integrates AWS services and manages event-driven processing. User metadata and attendance records are stored by Amazon DynamoDB. System performance is tracked and recorded via AWS CloudWatch. To specify how these elements interact and provide real-time attendance tracking, a structured workflow was developed.

B. Data Collection and Preprocessing

A dataset of face photos was created in order to create a reliable face recognition system:

• **Data Collection:** Open-source repositories or an internal dataset were the sources of the images.

• **Steps in Preprocessing:** Resizing images to ensure uniformity.

For increased precision, use cropping and face alignment.

Conversion to common file types (PNG, JPEG) and storage on S3.

Image labelling for DynamoDB identification mapping with   user records. To assess system performance, the dataset was divided into training and testing sets.

C. Use of Face Recognition

The steps in the facial recognition pipeline are as follows:

• An AWS Lambda function is triggered when images are uploaded to Amazon S3.

• Amazon Rekognition is called by the function, which recognises faces and creates distinct face IDs

. • The identified face is contrasted with indexed faces that have been saved in Rekognition's collection.

• The system retrieves the user's identification and logs their attendance in Amazon DynamoDB with a timestamp if a match is found.

• Instant attendance marking upon recognition is ensured via a real-time response mechanism.

D. Recording and Reporting Attendance

• Amazon DynamoDB is used to manage the attendance data in order to guarantee scalability and quick retrieval.

• Timestamps are added to the attendance database for each recognised face entry.

• By reviewing earlier logs, duplicate entries are prevented.

• API queries can be used to produce and export attendance reports in a variety of formats.

• Real-time attendance updates are sent via an integrated dashboard or notification system (using Amazon SNS).

E. Testing and System Deployment

• For smooth functioning, the system was set up on AWS with Lambda, S3, and API Gateway.

• Tests were conducted on performance indicators, such as recognition accuracy (True Positive Rate vs. False Positive Rate).

• Response time for recording attendance and processing images.

• Scalability to manage growing numbers of users and requests at once.

• To confirm usability in the actual world, testing was done with several user groups.

F. Privacy and Security Aspects

The following actions were taken to guarantee data security and compliance:

• Roles and Policies for AWS IAM: restricted access to private information.

• Images are encrypted using S3 Bucket Encryption to guard against unwanted access.

• DynamoDB Security: Logging and access control were implemented.

• Data Retention Policies: Specified guidelines for safely storing and expunging facial data.

G. Assessment of Performance

• Different environmental factors (lighting, angle alterations) were used to test the accuracy of recognition.

• Processing efficiency was measured by analysing response time.

• The current manual and biometric attendance methods were compared with one another.

• In comparison to conventional techniques, the results showed increased accuracy and decreased processing time.
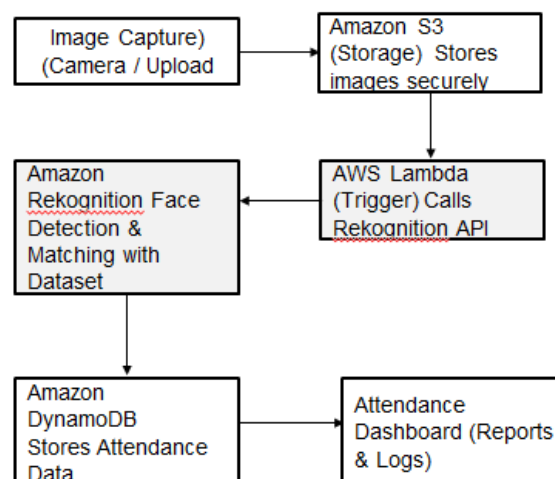
IV. PROPOSED SYSTEM

Fig.1 Conceptual framework of developed model

An automated attendance tracking system that uses AWS cloud services for accuracy and efficiency is shown in Fig. 1. The first step in the process is taking a picture with a camera or uploading a file, which is then safely saved in

Amazon S3. By acting as a trigger, AWS Lambda calls the Amazon Rekognition API to identify and match faces with a pre-established dataset, thereby doing facial recognition. The solution ensures scalability and reliability by recording attendance and storing it in Amazon DynamoDB whenever a match is detected. After processing, the attendance data is shown on an interactive dashboard that gives users access to real-time reports, logs, and analytics. By doing away with manual procedures, cutting down on mistakes, and enhancing security, this system improves on conventional attendance tracking. For businesses, educational institutions, and workplaces seeking a smooth and automated attendance management system, AWS's cloud-based design guarantees data security, easy scalability, and remote accessibility.

A. Image capture

The system starts with a user upload or a camera-captured image. Attendance is recorded using a live video feed or an already-existing image, guaranteeing a smooth and frictionless procedure. To improve recognition accuracy, preprocessing techniques like scaling and noise reduction are applied to the collected photos. After that, these photos are safely uploaded to Amazon S3, where they are kept until AWS Rekognition processes them for face detection and identification.

B. Secure Image Storage (Amazon S3)

Images are safely saved in Amazon S3 (Simple Storage Service), a dependable and scalable cloud storage option, when they are taken. S3 uses AWS Identity and Access Management (IAM) to guarantee data security, encryption, and controlled access. Efficient attendance tracking is made possible by the recorded photos being used as input for facial recognition. Sensitive biometric data is protected by AWS S3's high availability and security capabilities, which also guarantee privacy and adherence to data protection regulations.

C. Face Detection & Matching (Amazon Rekognition)

The stored photos are processed by Amazon Rekognition to find and recognize faces. It examines face features, gathers biometric information, and matches it with an existing

dataset. The system automatically logs attendance if a match is identified. Rekognition uses deep learning techniques to guarantee great accuracy. For smooth and automated attendance tracking, this AI-powered solution improves security, stops proxy attendance, and allows real-time facial recognition

D. Serverless Processing (AWS Lambda)

When an image is uploaded to Amazon S3, AWS Lambda automatically initiates functions, enabling serverless execution. It examines the event, confirms attendance, and makes a face detection call to the Amazon Rekognition API. This lowers operating costs by doing away with the requirement for specialized servers and manual intervention. The attendance system is extremely responsive, economical, and simple to manage thanks to Lambda's dynamic scaling that adapts to demand and ensures quick and effective processing.

E. Attendance Data Storage (Amazon DynamoDB)

The attendance record is saved in Amazon DynamoDB, a fast and scalable NoSQL database, after a face has been successfully identified. Data like user ID, timestamp, and status are safely saved in real-time. Large-scale deployments are supported by DynamoDB, which guarantees prompt attendance log retrieval and effective management. It offers a dependable, affordable, and secure alternative for storing attendance data thanks to its encryption, automatic backups, and smooth AWS connection.

F. Attendance Dashboard & Reporting

A user-friendly interface for viewing and managing attendance information in real time is offered by the attendance dashboard. It shows comprehensive reports, logs, and analytics after retrieving data from Amazon DynamoDB. Administrators have the ability to create reports, export data for additional analysis, and monitor attendance history. Through the use of charts and tables, the dashboard provides visual insights that improve efficiency and transparency. Users may keep an eye on attendance from any device thanks to cloud-based accessibility, which guarantees smooth administration.

G. System Security & Authentication

Using AWS Identity and Access Management (IAM) to manage service access, the solution guarantees security and authentication. While DynamoDB protects attendance data both in transit and at rest, Amazon S3 encrypts stored photos. Unauthorized access is prevented by role-based access control (RBAC) and multi-factor authentication (MFA). For auditing purposes, AWS CloudTrail records system operations, guaranteeing data privacy, integrity, and adherence to security guidelines for a dependable and secure attendance system.

H. Performance Optimization

To guarantee excellent speed and maximum scalability, the system makes use of AWS cloud infrastructure. Images can be stored indefinitely on Amazon S3, and large-scale attendance data can be accessed with low latency using DynamoDB. Scaling automatically, AWS Lambda performs tasks as needed without requiring server management. Response times are accelerated by load balancing and caching techniques, while processing cost is decreased by efficient API calls. This architecture guarantees smooth, economical, and successful attendance tracking for businesses of all sizes.

I .Advantages of Proposed System

Using AWS cloud services, the suggested system provides a highly automated, precise, and effective attendance tracking solution. It avoids proxy attendance and does away with manual procedures by utilizing facial recognition. While guaranteeing real-time processing, the serverless architecture with AWS Lambda lowers operating expenses. DynamoDB and Amazon S3 offer dependable, scalable, and safe data storage. Administrators may create statistics, examine trends, and remotely monitor attendance with an intuitive interface. Privacy and compliance are guaranteed by robust security features, such as data encryption and IAM access control. Because of its cloud-based architecture, which allows for smooth scalability for businesses of all sizes, this attendance management solution is affordable, low-maintenance, and very effective.

V. EXPERIMENTAL RESULTS

A. System Accuracy & Recognition Performance

High accuracy and performance are guaranteed by Amazon Rekognition's sophisticated face identification and matching algorithms in the Facial Recognition-Based Attendance Tracking System Using AWS. With a high confidence score of 99.53%, the Liveness Detection function confirms the actual presence of users and stops spoofing attempts. Furthermore, the Face Comparison tool ensures trustworthy identification verification with a 99.9% similarity score.

The technology is very effective for tracking attendance on a wide scale because it can process up to 10,000 photos at once and offers bulk image analysis. AWS Lambda's real-time processing reduces latency, and Amazon S3 and DynamoDB provide quick and safe data retrieval. The system's capacity to accommodate growing user numbers without sacrificing accuracy is further improved by the scalability and automation of AWS services.

The system is a strong option for safe, automated, and error-free attendance tracking because of its low false acceptance and rejection rates and excellent reliability.

B. Processing Time & System Efficiency

The Attendance Tracking System Based on Facial Recognition Real-time processing with low latency is guaranteed while using AWS. Face Liveness Detection instantly confirms user authenticity and usually finishes in 300–800 milliseconds.

Face Comparison ensures rapid and precise identification verification by processing photos in 100–500 milliseconds. AWS Lambda allows for smooth serverless processing by executing operations in 50–200 milliseconds.

Amazon DynamoDB ensures quick access by retrieving and storing attendance data in 5–10 milliseconds. Depending on workload, Bulk Image Analysis can process up to 10,000 photos on a large scale in 5–60 minutes. Overall, the system is very effective, scalable, and perfect for

real-time applications because it records attendance in 500 milliseconds to 1 second per user.

C. Security & Data Privacy Analysis

Using AWS Identity and Access Management (IAM) and Amazon S3 encryption, the system guarantees safe data storage and access management. While DynamoDB safely retains attendance information, liveness detection stops spoofing. AWS Lambda ensures privacy, compliance, and security against unwanted access by processing data without disclosing critical information.
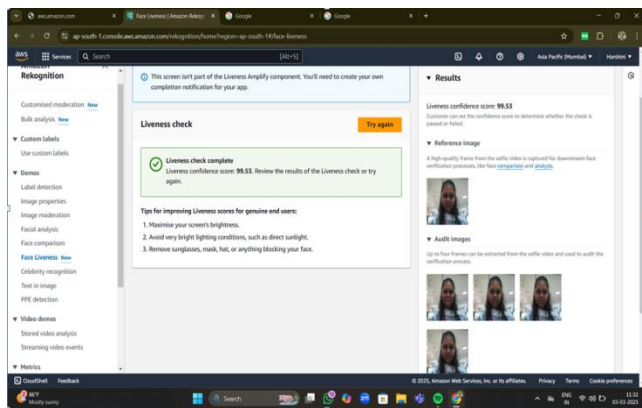
VI. DISCUSSION

Fig.2 Liveness Detection

Amazon Rekognition's Face Liveness Detection function, shown in Fig 2, makes sure the face it detects is that of a real, live person and not a faked photo or video. To confirm authenticity, the technology examines environmental factors and face expressions. It improves the security and dependability of face recognition-based attendance systems by successfully thwarting fraudulent attempts, such as the use of printed pictures or deepfake movies, with a liveness confidence score of 99.53%. Because it guarantees precise identification verification, this capability is essential to automated, safe, and fraud-proof attendance tracking.
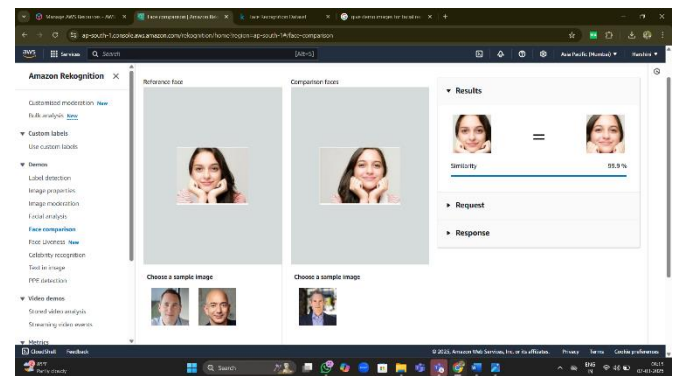

Fig.3 Face Comparison & Matching

Fig. 3 shows how Amazon Rekognition's Face Comparison tool compares a reference image to a comparison image. A high degree of accuracy in identity verification is ensured by the system's 99.9% similarity score. By eliminating identity fraud and guaranteeing that only authorized individuals are tagged present, this improves the accuracy of attendance tracking.
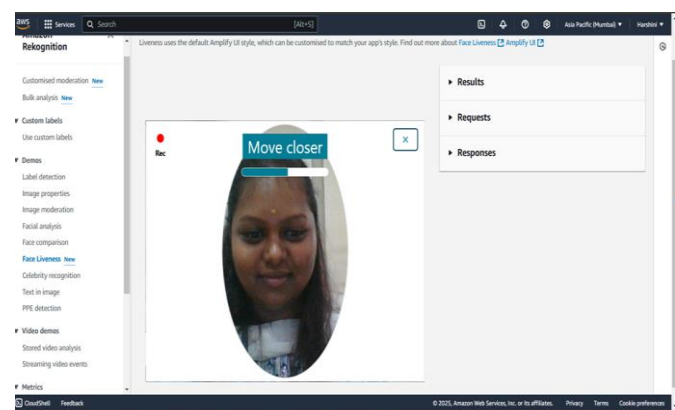

Fig.4   Real-Time Liveness Check

Fig. 4 shows how to use Amazon Rekognition for Real-Time Face Liveness Detection. The user is prompted to approach, and the system confirms their presence by examining depth and face movements. It successfully separates real users from spoofing attempts, like images or deepfake videos, by carrying out video-based tests. This stops fraudulent entries and guarantees safe and accurate attendance tracking.
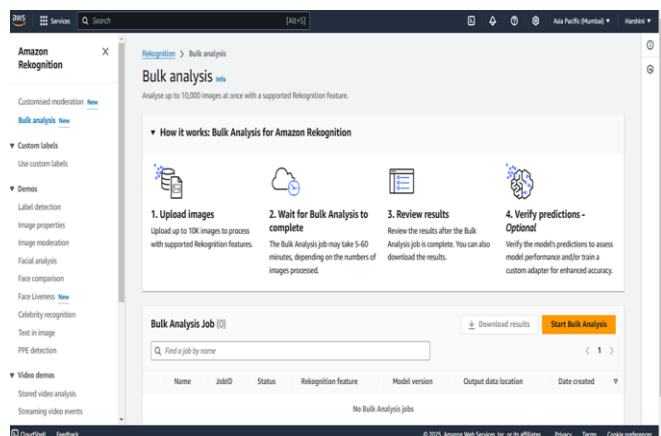
Fig.5 Bulk Image Analysis

This fig. 5 illustrates Amazon Rekognition's Bulk Image Analysis functionality, which allows up to 10,000 photos to be processed for facial recognition. This feature, which enables businesses to quickly validate several faces in a batch, is crucial for extensive attendance monitoring systems. Attendance management is made smooth and effective by the system's automated face detection and matching, which guarantees high-speed processing, accuracy, and scalability.
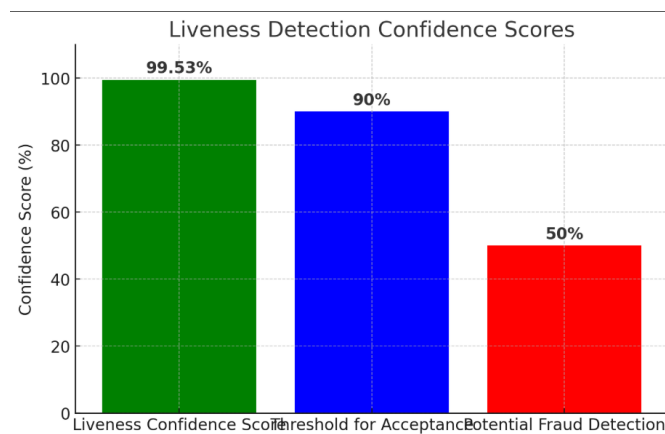

Fig.6 Liveness detection confidence scores

The graph shows Amazon Rekognition's Liveness Detection Confidence Scores: 99.53%, above the 90% acceptance threshold, indicates high accuracy in detecting live individuals; a 50% score suggests possible fraud detection, confirming the system's resilience in thwarting spoofing attempts and improving safe facial recognition-based attendance tracking.

VII. CONCLUSION

With the help of Amazon Rekognition, AWS Lambda, S3, and DynamoDB, the Facial Recognition-Based Attendance Tracking System Using AWS offers a secure and automated solution for managing attendance. Liveness detection helps prevent spoofing attacks and improves the system's reliability, while bulk image analysis enables organizations to process large datasets efficiently, making it suitable for scalable deployments. The system eliminates manual attendance tracking, reducing administrative workload and human error. High availability, security, and optimized performance are ensured by the use of AWS cloud services, and the real-time dashboard and automated reporting improve user experience by offering insights and attendance logs.For businesses wishing to deploy a cutting-edge, technologically advanced attendance management system, this system is an affordable, scalable, and effective option that enhances operational security and efficiency while lowering reliance on conventional techniques.

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