1. Project Description

1.1 Project Idea

Traditionally, attendance marking has relied on manual processes like paper-based sign-in sheets or calling out names. These methods are not only time-consuming for instructors and administrators, but they are also prone to errors and inaccuracies.

The rise of facial recognition technology presents a compelling opportunity to revolutionize attendance management. Attendify, our proposed face recognition attendance system, aims to address the limitations of conventional methods by offering a more efficient, reliable, and secure solution.

Challenges with Traditional Attendance Systems

- **Time Consumption:** Manually calling out names or collecting signatures can eat into valuable class or meeting time.
- **Inaccuracy:** Traditional methods are susceptible to errors such as students signing for absent classmates (buddy punching) or forgetting to sign in altogether.
- **Inefficiency:** Data entry and record keeping from paper-based systems can be cumbersome and time-consuming.
- **Limited Functionality:** Traditional systems lack the ability to track tardiness, early departures, or generate real-time reports.

These challenges can have a significant impact on various stakeholders. Instructors lose valuable teaching time, administrators face difficulties with accurate data collection, and organizations may struggle to track employee engagement.

The Rise of Face Recognition Technology

Recent advancements in facial recognition technology have made it a viable and reliable solution for attendance management. These algorithms can accurately identify individuals based on their unique facial features.

Face recognition offers several advantages over traditional methods:

- **Efficiency:** Attendance is marked automatically upon identification, significantly reducing time spent on manual processes.
- **Accuracy:** Facial recognition eliminates the possibility of buddy punching or forgotten sign-ins.
- **Data Security:** Attendify can implement robust security measures to protect sensitive data, ensuring user privacy.
- **Advanced Features:** The system can track tardiness, early departures, and generate detailed reports on individual and group attendance.

- **Scalability:** Attendify can be easily scaled to accommodate institutions and organizations of all sizes.

1.2 Objective

Attendify, our face recognition attendance system, is designed to address the shortcomings of traditional attendance methods and leverage the potential of facial recognition technology. Our primary objectives are:

- **To improve efficiency:** Attendify aims to automate the attendance marking process, eliminating the need for manual sign-in sheets or roll calls. This will free up valuable time for instructors and administrators, allowing them to focus on more important tasks.
- **To enhance accuracy:** Facial recognition technology ensures that only authorized individuals are marked present, eliminating the possibility of buddy punching or attendance fraud. This will lead to more reliable and trustworthy attendance data.
- **To increase security:** Attendify will be designed with robust security measures to protect sensitive user data, such as facial recognition information. This will ensure user privacy and compliance with data security regulations.
- **To provide advanced functionalities:** Attendify will go beyond simply marking attendance. It will offer features like add client using face detection and after that Attendify can mark his/her attendance with the help of face recognition feature.
- **To offer scalability and ease of use:** Attendify will be designed to be scalable and user-friendly. It should be adaptable to the needs of institutions and organizations of all sizes, with a user interface that is intuitive and easy to navigate for both administrators and attendees.

By achieving these objectives, Attendify will establish itself as a reliable and efficient attendance management system that transforms the way attendance is tracked and monitored. This will benefit instructors, administrators, organizations, and ultimately, students and employees by promoting better time management, accurate data collection, and improved overall productivity.

2. Technologies Used

2.1 Backend Technologies

2.1.1 Java Networking (java.net)

Java Networking is used in the Attendify to create Server-Client architecture (TCP based) to process each request to provide clients better services that maintain integrity. Socket will handle each request with threads from thread-pool.

2.1.2 Java Database Connectivity (java.sql)

Java Database Connectivity or JDBC is used in the Attendify to connect, access, execute and manage Data stored in Database related to project through Java Database Driver (mysql Driver here).

2.1.3 HikariCP

HikariCP is a lightweight and high-performance connection pool library for Java Application. In Attendify HikariCP is essential for allowing multiple connections to database without repeatedly opening and closing them.

2.1.4 Java Computer Vision with OpenCV (JavaCV)

OpenCV or JavaCv is used in the Attendify to implement functions that provide Face Detection utilities also it is responsible for accessing webcam of system. It is done by converting facial feature into matrix that Java application can understand and saving extracted facial feature of detected faces.

2.1.5 AWS Rekognition SDK for Java

Amazon Rekognition can detect faces in images and stored videos. With Amazon Rekognition, you can get and information about the facial features. Amazon Rekognition can search for faces. Facial information is indexed into a container known as a collection. Face information in the collection can then be matched with faces detected in images, stored videos, and streaming video.

2.1.6 Java Mail

Java Mail is Java API that provides different mail utilities such as sending or receiving mail through Java Application with the object to authentication and verification. Here, It is used to verify client with one time passwords.

2.2 Frontend Technologies

2.2.1 JavaFx

JavaFX is a modern Java framework for building visually appealing and interactive user interfaces across various platforms. It offers seamless integration with Java, intuitive UI design tools, and support for multimedia and 3D graphics. Compared to alternatives like Swing, JavaFX provides a more modern approach to UI development with CSS styling, FXML for declarative design, and built-in animation features. Its cross-platform compatibility and vibrant community support make it a compelling choice for developers aiming to create engaging applications with ease.

Here, most of the frontend part of the Attendify is created with the help of JavaFx.

2.2.2 Java Swing

Java Swing is a Java framework for building desktop applications with a rich set of GUI components. It's widely used for its simplicity and platform independence, offering developers tools to create responsive and functional interfaces. While Swing lacks some modern features like native look and feel and CSS styling found in JavaFX, its lightweight nature and extensive documentation make it a popular choice for straightforward desktop applications.

Here, Java Swing is used to capture and buffer image detected by OpenCV to provide seamless webcam simulation.

2.3 Database

MySQL is a popular open-source relational database management system that integrates seamlessly with Java applications. Its robust performance, scalability, and reliability make it a preferred choice for developers building Java applications requiring data storage and management. MySQL's JDBC (Java Database Connectivity) driver allows Java applications to interact with MySQL databases efficiently, enabling operations such as querying, updating, and managing data. With its wide adoption and extensive community support, MySQL offers developers a stable and feature-rich solution for integrating databases into Java applications, facilitating smooth and reliable data operations.

3. Implementation Details

3.1 Database Management:

The server leverages HikariCP for efficient connection pooling, significantly reducing the overhead associated with database connections, especially under heavy load. This choice boosts the system's performance and reliability, ensuring quick and consistent access to the database even with multiple concurrent client requests.

3.2 Thread Management:

To efficiently handle multiple client requests without straining server resources, **Attendify** utilizes Java's **ExecutorService** for thread pooling. This approach allows the system to manage a fixed set of threads to execute database operations, optimizing resource utilization.

3.3 User Roles and Access Control:

Attendify supports two primary user roles:

- **Admin**: Admin users have the capability to view and manage attendance records for all employees.

- **Client**: Clients (or employees) can access and view only their personal attendance records. This restricted access ensures data privacy and security, adhering to the principle of least privilege.

3.4 Face Detection and Capturing

The face detection and capture feature implemented in the project combines advanced computer vision capabilities with user-friendly interaction, facilitated by seamless integration of the OpenCV library within a Java environment. Leveraging the Haar Cascade classifier, the system accurately identifies human faces in real-time video streams captured by the webcam.

A user-friendly graphical interface provides intuitive interaction, allowing users to trigger the capture process with a simple click.

Upon capture initiation, users are prompted to input their email addresses for identification purposes. Subsequently, the system extracts the detected face region from the video frame, resizes it for consistency, and stores it locally. Integration with a database system facilitates efficient management of captured face data,

with each image associated with the respective user's email. Robust error handling mechanisms ensure stability and reliability throughout the capture and processing stages.

Overall, the implementation offers a practical and reliable solution for real-time face detection and capture, suitable for various applications requiring facial recognition functionality.

3.5 Face Recognition and Prediction

The project incorporates Amazon Rekognition to facilitate face addition and recognition tasks seamlessly.

- **Face Addition**: Through Rekognition's IndexFacesRequest, the system adds new faces to a designated collection. Upon receiving the source image, Rekognition indexes the faces within it, providing unique face IDs and bounding box coordinates for each detected face. This process ensures efficient organization and management of face data within the collection.

- **Face Recognition**: Leveraging Rekognition's SearchFacesByImageRequest, the system conducts face recognition tasks by comparing a given source image with the faces stored in the collection. By setting appropriate parameters such as the face match threshold and maximum faces to return, the system identifies potential matches and retrieves their corresponding face IDs. This capability enables the system to accurately recognize known faces within the collection, facilitating various applications such as identity verification and attendance tracking.

By harnessing Amazon Rekognition's advanced capabilities, the project enhances its facial recognition functionalities, offering a robust and scalable solution for face addition and recognition tasks.

3.5 Use of JavaFX and Additional Libraries:

The client interface is built using JavaFX, which provides a rich and responsive user interface, allowing for a seamless user experience. JavaFX's capabilities are extended with additional libraries for enhanced functionality, such as interactive tables and forms for data display and manipulation.

4. User Manual

4.1 Admin

- Do the sign in with your email and Password. (Sign In button)
- If you have forgotten your password, click on "Forgot Password?" to change it.
- If you don't have an account then click to "Sign Up" to create your account.
  - A one-time password will be sent to your entered email, verification will be done by that one-time password.
- You will direct to the Admin Dashboard.
- Click on "Update Profile" in sidebar to change your profile picture.
- In Sidebar there are three different menus:
  - **Home:** Click on "Home" to redirect you to dashboard.
  - **Community:** Click on "Community" to display the attendance records for that community.
  - **Help and Support:** Click on "Help and Support" to give a remark or feedback on Attendify.
- On right side pane there will be two buttons:
  - **Add Member:** Click on "Add Member" to add his face details in collection.
  - **Take Attendance:** Click on "Take Attendance" to Take attendance of clients with webcam.
- Click on "Sign Out" button at the end of sidebar to log out from the application.

4.2 User

- Do the sign in with your email and Password. (Sign In button)
- If you have forgotten your password, click on "Forgot Password?" to change it.
- If you don't have an account then click to "Sign Up" to create your account.
  - A one-time password will be sent to your entered email, verification will be done by that one-time password.
- You will direct to the User Dashboard.
- Click on "Update Profile" in sidebar to change your profile picture.
- In Sidebar there are three different menus:
  - **Home:** Click on "Home" to redirect you to dashboard.
  - **Community:** Click on "Community" to display the attendance records of user, who is currently signed in.

- **Help and Support:** Click on "Help and Support" to give a remark or feedback on Attendify.
- Click on "Sign Out" button at the end of sidebar to log out from the application.