**Face Recognition Attendance System**

A Synopsis Submitted

in Partial Fulfilment of the Requirements

for the Degree of

**BACHELOR OF TECHNOLOGY**

in

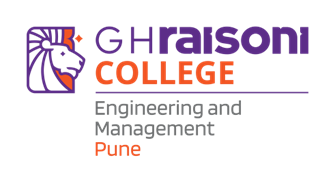
# Department of Artificial Intelligence & Machine Learning

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**Introduction**

This project is a web-based facial recognition attendance system aimed at automating the process of marking attendance using machine learning. **Presence** identifies students in real-time through facial recognition, eliminating the need for manual attendance tracking. The system ensures a smooth and efficient attendance process, streamlining an otherwise tedious task for institutions.

Making use of advanced machine learning models, **Presence** offers fast and accurate facial recognition, ensuring high reliability. This system provides an effective way for institutions to manage attendance efficiently, reducing human error and allowing for better tracking and record-keeping in real-time.

**Objectives**

The major objectives of this project are:

i. Camera-based facial recognition

ii. Subject and class selection

iii. Attendance recording and monitoring

iv. Attendance history tracking

**Literature Review**

Various facial recognition-based attendance systems have been developed using models like VGG16, ResNet50, and Inception V3, often focusing on high accuracy and large datasets such as the Labelled Faces in the Wild (LFW). These systems are typically designed for applications in security, surveillance, or commercial use, where accuracy is prioritized. However, there is a gap in systems tailored specifically for educational settings that require real-time performance, ease of use, and seamless integration with classroom infrastructure.

Most existing systems fail to address the unique needs of schools, such as fast processing for attendance tracking and simple interfaces for educators. **Presence** aims to fill that gap by developing a user-friendly facial recognition system optimized for real-time performance in educational institutions. Unlike advanced models focused solely on accuracy. **Presence** emphasizes usability and scalability, ensuring it fits easily into classrooms and integrates with learning management systems. The goal is to streamline attendance tracking while enhancing the user experience for both teachers and students.

**Methodology**

The Presence project developed a facial recognition-based attendance system by evaluating four deep learning models: VGG16, ResNet50, SENet50, and Inception V3. Using the Labelled Faces in the Wild (LFW) dataset, containing 13,233 images of 5,749 individuals, the models were trained with data augmentation techniques like cropping and flipping to improve accuracy.

The models were compared based on training loss, validation loss, accuracy, and training time. VGG16, with its 16-layer architecture, ResNet50’s residual blocks, SENet50’s Squeeze-and-Excitation blocks, and Inception V3’s multi-filter architecture were analysed. ResNet50 performed the best, achieving a validation accuracy of 88.55% after 100 epochs, and was later fine-tuned to 88.57%

**Presence**’s machine learning methodology involved careful model selection, dynamic learning rate adjustments, and performance monitoring. The system was built using Flask for the backend, handling machine learning model integration and user interactions. The frontend, developed with HTML, CSS, and JavaScript, provides an intuitive interface where users can manage classes, process attendance in real-time, and view records.

Ultimately, ResNet50 was chosen for its superior balance of accuracy and efficiency, becoming the core model for the attendance system. The Presence system was designed for easy deployment on web servers, offering scalability, real-time attendance processing, and enhanced user experience for both students and faculty. This provides a robust solution for automating attendance in educational settings.

**Tools and Technologies**

- **Frontend:** HTML, CSS and Javascript for the graphical user interface.

- **Backend:** Python with Flask for handling logic and state management.

- **Machine Learning:** Python, PyTorch, Pandas, Tensorflow.

- **Attendance Calculator:** Fine Tuned custom instance of DeepFace, ResNet50 model,

- **Data Storage:** CSV for all Biodata which is updated dynamically.

**Project Plan and Timeline**

The project was completed over a six-month period, divided into the following phases:

**1. Phase 1 - Requirement Analysis and Design (0.5 month)**

* Activities:
  + System requirements for the facial recognition model and web application were gathered.
  + The architecture was finalized, including model selection (ResNet50) and database design.
  + Wireframes for the web interface were designed, and data flow between components was defined.

**2. Phase 2 - Frontend Development (0.5 months)**

* Activities:
  + The frontend was built using HTML/CSS/JavaScript for user interaction.
  + Pages were developed for class selection, attendance records, and real-time webcam integration.
  + A responsive design was ensured to provide a seamless experience across devices.

**3. Phase 3 - Backend Development (0.5 month)**

* Activities:
  + The Flask server was set up to handle HTTP requests and process attendance data.
  + The trained ResNet50 model was integrated for facial recognition and attendance tracking.
  + The functionality for dynamically updating the listed\_100\_biodata.csv file was implemented.

**4. Phase 4 - Model Training and Fine-Tuning (1 month)**

* Activities:
  + The ResNet50 model was trained on the LFW dataset, and data augmentation techniques were used to improve accuracy.
  + The model was fine-tuned, achieving a validation accuracy of 88.57%.
  + Testing under real-world conditions ensured the model’s reliability in classroom environments.

**5. Phase 5 - Integration and Testing (1 month)**

* Activities:
  + The frontend and backend were integrated for real-time attendance tracking.
  + The system's performance, including face detection accuracy and responsiveness of data updates, was rigorously tested.
  + Unit and integration tests were conducted to validate all system components.

**6. Phase 6 - Final Adjustments and Deployment (0.5 month)**

* Activities:
  + Final user feedback was gathered, and adjustments were made as necessary.
  + The system was prepared and deployed on a web server, ensuring accessibility from any device.
  + Project documentation and user manuals for educators were completed.

**Expected Outcomes**

The Presence facial recognition attendance system is expected to deliver highly accurate real-time student identification using the ResNet50 model. ResNet50 was chosen for its balance of speed, accuracy, and computational efficiency. During testing, it outperformed other models, achieving a validation accuracy of 88.55% after 100 epochs and 88.57% after further fine-tuning over 500 epochs. The model's 50-layer architecture with residual connections ensures effective feature extraction, making it well-suited for real-time facial recognition. Steady decreases in training and validation loss throughout the process confirm the model’s ability to generalize well to unseen data.

The expected impacts include:

1. **Improved Efficiency**: Streamlines attendance-taking, saving time.
2. **Enhanced Accuracy**: Reduces errors in student identification.
3. **Real-time Tracking**: Provides immediate updates on attendance.
4. **Increased Accountability**: Ensures accurate and tamper-proof records.
5. **Scalability**: Easily adaptable to larger classes or institutions.
6. **Integration Potential**: Can integrate with existing LMS and admin tools.
7. **Data-Driven Insights**: Offers insights into student participation trends.

**References**

* **ResNet50 Architecture**:
* Based on "Deep Residual Learning for Image Recognition" by He et al.
* Introduces residual connections to train deep networks and is central to the facial recognition model.
* **Global Average Pooling & Batch Normalization**:
* GAP reduces feature map dimensions to prevent overfitting.
* Batch Normalization speeds up convergence and stabilizes the model.
* **Inception V3**:
* From "Rethinking the Inception Architecture for Computer Vision."
* Uses parallel convolutions to capture various features in images for better recognition.
* **Data Augmentation**:
* Techniques like cropping, flipping, and jittering increase dataset diversity, improving model robustness.
* **Face Recognition using ResNet50**:
* Discusses ResNet50’s use in real-time attendance systems, achieving high accuracy (up to 99%).
* **Automated Attendance System**:
* An IEEE paper covers the implementation of facial recognition systems in educational settings for attendance tracking.

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