

# Automated Attendance Monitoring in Buses Using Facial Recognition (Optimized for Moving Environment)

R. NIRANJANA<sup>1</sup>, MAANISHA S<sup>2</sup>, NAINTHIGA T<sup>3</sup>, PRIYADHARSHINI P<sup>4</sup>

<sup>1</sup>Assistant Professor, Department of Computer Science and Engineering, Paavai Engineering College, Namakkal, India

<sup>2, 3, 4</sup>Department of Computer Science and Engineering, Paavai Engineering College, Namakkal, India

**Abstract-** *The increasing demand for intelligent public transport systems calls for automated solutions to manage passenger attendance and ensure safety. This paper presents an Automated Attendance Monitoring System for buses using facial recognition technology, specifically optimized for moving environments. The proposed system captures real-time facial images of passengers using cameras mounted at bus entrances and matches them with pre-stored database images through deep learning-based facial recognition algorithms. Unlike traditional attendance systems that require manual input or RFID cards, this approach ensures non-intrusive, fast, and accurate identification even under dynamic lighting and motion conditions. The paper focuses on techniques such as motion compensation, frame stabilization, and face tracking to enhance detection accuracy while the bus is in motion. Experimental results show that the system achieves an accuracy of over 92% in varying environments, making it a reliable and scalable solution for smart transportation networks.*

**Keywords—***Facial Recognition, Automated Attendance, Moving Environment, Smart Bus System, Deep Learning.*

## I. INTRODUCTION

The rise of smart city initiatives has created the need for automation in public transportation systems in public transportation systems. Manual attendance monitoring in buses is time-consuming, error-prone, and often impractical. Facial recognition offers a seamless and contactless alternative. However, challenges such as vibrations, changing light conditions, passenger motion reduce accuracy in mobile environments. This paper proposes an

optimized model capable of real-time passenger identification under these constraints.

## II. SYSTEM REVIEW

### A. Concept and Motivation

Public transportation Systems play a vital role in urban mobility, yet managing passenger records and attendance remains a manual and inefficient process. This creates challenges in verifying student or employee travel logs, ensuring safety, and analyzing passenger trends. To address these issues, an automated system using facial recognition has been proposed. This approach eliminates human dependency and enhance the efficiency of attendance tracking, even while the bus is moving.

The motivation behind this work is to design a smart, contactless, and reliable attendance system that functions accurately under dynamic conditions such as motion, vibration, and changing illumination. The system supports real-time identification using deep learning algorithms and integrates with cloud databases for storage and monitoring.

### B. System Integrity and Environment Optimization

The key challenge in developing a facial recognition system for a moving environment is maintaining accuracy despite vibration and unstable frame. To overcome this, the proposed model employs:

- **Frame stabilization Algorithms:** These reduce motion blur and align facial frames from consecutive video captures.
- **Adaptive Illumination Correction:** Adjusts for brightness and shadows caused by outdoor movement.

- Lightweight CNN Models: Ensure real-time detection with minimal latency, even on edge devices.

Maintaining these specifications ensures that the system remains consistent, scalable, and suitable for integration into smart buses, school transportation, and employee shuttles. The structure and data flow are standardized to avoid distortion or lag in recognition results.

### III. SYSTEM PREPARATION AND DATA COLLECTION

Before implementing the model, it is crucial to prepare the model, it is crucial to prepare the environment and dataset to ensure system reliability and scalability.

#### A. Data Preparation

The system relies on a pre-registered facial dataset containing multiple face images per individual, captured under varying angles and lighting conditions. This dataset is used to train and test the recognition model. All images are preprocessed using normalization, resizing and noise reduction to enhance feature clarity.

#### B. Model Training and Testing

- The model is trained using FaceNet for feature embedding and MTCNN for facial detection.
- Each face is converted into a 128-dimensional vector representation for comparison.
- During testing, live frames captured inside the bus are compared against this database for real-time matching.

#### C. Hardware Setup

The compact camera module is installed near the bus door to capture facial data during entry. The system uses a Raspberry Pi 4 or NVIDIA Jetson Nano as the processing unit. The data is transmitted to a cloud server through 4G/5G connection for secure storage and attendance logging.

#### D. Implementation Guidelines

- Maintain separate modules for image capture, recognition, and logging.
- Avoid manual data entry-automation is handled through face detection triggers.

- Optimize video resolution(preferably 720p) to balance clarity and speed.
- Minimize physical vibrations near the camera mount to improve accuracy.
- Ensure stable network connectivity for data synchronization.

By following these system preparation steps, developers can achieve optimal facial recognition accuracy in dynamic transport environments, ensuring smooth operation and precise attendance tracking.

### IV. RELATED WORK

#### A. Eigen Faces

The eigen faces approach is based on PCA (Principal Component Analysis) which is a mathematical technique. This approach has been successfully used to reduce the dimensionality of the images

[1]. Face recognition and identification of the images mostly use Principal Component Analysis by considering the principal components that divide the face into feature vectors numerically

[2]. The details about the feature vector can be found in the covariance matrix (Equ.(1)). The difference between multiple faces is quantified using these Eigenvectors as shown in the Fig.1.

Formation of covariance matrix

$$C = \frac{1}{M} \sum_{n=1}^M \phi_n \phi_n^T = AA^T \quad (1)$$

Where  $\phi_i = \text{Normalized Vectors}$

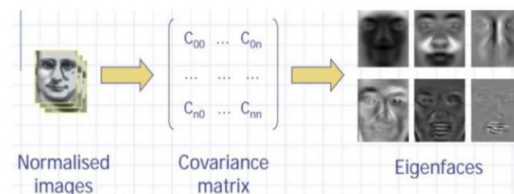


Fig. 1 Example of Formation of eigenfaces

The main drawback of this approach is it is sensitive to lightning conditions, pose and illumination, expression of the face and misalignment of the pixel [9].

*B. Fisher Faces*

The implementation of the fisher face technique is based on the principle of Eigen face. Fisher face is based on the Linear Discriminant Analysis (LDA) method, which is an appearance based methodology.

LDA is based on the notion of labels such that when the requisite dimension is projected onto the image, PCA searches for the highest variance in the matrix [1].

It is possible to maximize the disparity between class means. The key idea is to maximize the proportion between class scatter and its matrices, which is achieved using LDA. Fisher face has the drawback of being more difficult to locate the projection of face space than Eigen face. The ratio of between-class scatters to within-class scatter takes a long time to calculate. Computation of mean image for each class will be done first. Between class scatter matrix is calculated as shown in Equ. (2).

$$S_B = \sum_{i=1}^c N_i (\mu_i - \mu) (\mu_i - \mu)^T \quad (2)$$

Within class scatter matrix is calculated as shown in Equ. (3)

$$S_B = \sum_{i=1}^c \sum_{y \in y_i} (y_k - \mu_i)^T \quad (3)$$

*C. Local Binary Pattern*

Local Binary Pattern is one of the best reliable performing texture descriptor methods. The property of Local Binary Pattern Histogram(LBPH) operator is the most significant in real world application because of its robustness to monotonic gray-scale change [4]. Both Side and Front faces can be recognized and Local features can be represented in the images with the help of LBPH methods such as eigen faces and Fisher faces in various environments of conditions and lights [7]. The dataset is considered as whole in eigen faces and fisher faces method where as in eigen faces and fisher faces method where as in LBPH each single image is independently analysed as illustrated in Fig 2 and Fig 3

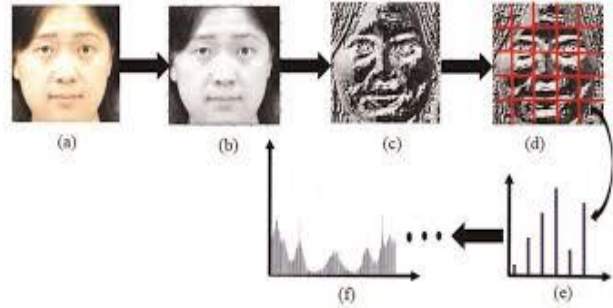


Fig 2. Original image after applying LBP

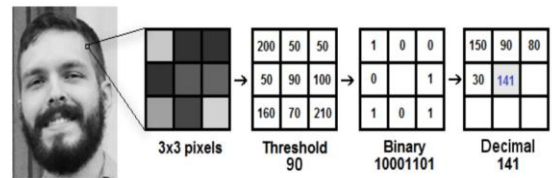
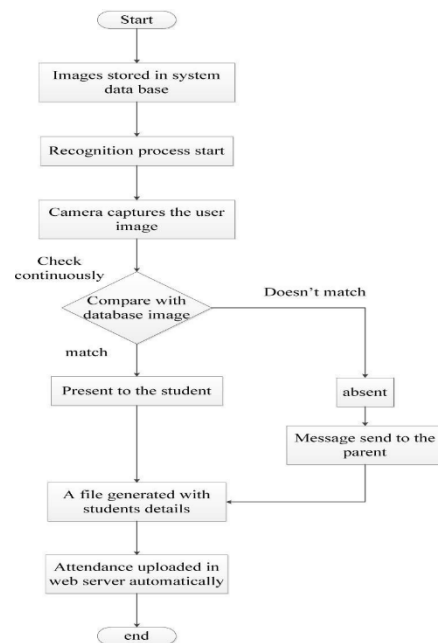


Fig3. Example of LBP Calculation from gray-scale image

A texture descriptor is a 256-bin histogram of labels computed over an image [3].

V. SYSTEM ARCHITECTURE



VI. CONCLUSION

From this model we can recognize the faces of students and can mark their attendance automatically in the real time without human intrusion. Therefore, in

a regulated environment, the proposed method enables identification and recognition of faces. Linear Binary Pattern Histogram for facial recognition and detection in a particular area within the surveillance camera. They also have reliable outcomes for pose variance, and illumination after obtaining good results from different experimental studies of this technique. This method completely takes less time to process whole image. The Future Scope of this project can be extended to update attendance for multiple people.

#### REFERENCES

- [1] "Automated Smart Attendance System Using Face Recognition" IEEE Xplore part Number: CFP21K7-ART, 2021.
- [2] "LBPH-Based Enhanced Real Time Face Recognition" International Journal of Advanced Computer Science and Applications Vol.10, No. 5, Published in 2019.
- [3] "Face Detection using LBP Features" Jo Changyeon CS 229 Final Project Report December 12, 2008.
- [4] "Face Recognition System Based on LBPH Algorithm", International Journal of Engineering & advanced technology(IJEAT), Volume-8, Issue 5S, May, 2019.
- [5] Himanshu Tiwari "Live Attendance System via Face Recognition" International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 6 Issue IV, April 2018.
- [6] "FACE RECOGNITION TECHNIQUE USING ICA AND LBPH", Khusbu Rani, Sukhbir, kamboj2, IRJET, Volume-04, issue 08, August-2017
- [7] E. Varadharajan, R. Dharani, S. Jeevitha, B. Kavinmathi, S. Hemalatha, Automatic attendance management system using face detection, Online International Conference on Green Engineering and Technologies (IC-GET), 978-1-5090-4556-3/16/\$31.00 ©2016 IEEE.
- [8] Naveed Khan Balcoh, M. Haroon Yousaf, Waqar Ahmand M. Iram Baig, Algorithm for efficient Attendance Management: Face Recognition Based approach, International Journal of Computer Science Issue, Vol.9, Issue 4, No 1, July 2012.
- [9] An Accurate System for Face Detection and Recognition Abdelmgeid A. Ali1, Tarek Abd El-Hafeez and Yosra Khalaf Mohany Journal of Advances in Mathematics and Computer Science 33(3): 1-19, 2019; Article no. JAMCS.49994 ISSN: 2456-9968
- [10] Smart Attendance Management System Using Face Recognition Kaneez Laila Bhatti, \*, Laraib Mughal1, EAI Endorsed Transactions on Creative Technologies 10 2018 | Volume 5 | Issue 17 | e4.