Smart Attendance Management System Using Machine Learning and Facial Recognition

A PROJECT REPORT

Submitted by

Sharvesh R 210701244

Purushothaman M 210701199

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BONAFIDE CERTIFICATE

This is to certify that this project report titled “**Smart Attendance Management System Using Machine Learning and Facial Recognition**” is the bonafide work of “Sharvesh R 210701244,Purushothaman M 210701199” who carried out the project work under my supervision.

SIGNATURE

Dr. RAKESH KUMAR M, M.E., Ph.D.,
Assistant Professor
Department of Computer Science and Engineering
Rajalakshmi Engineering College

Chennai - 602 105

This project report is submitted via viva voce examination to be held on ……

.... at Rajalakshmi Engineering College, Thandalam.

EXTERNAL EXAMINER **INTERNAL EXAMINER**

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First and foremost, I acknowledge the amazing Grace of God Almighty, who blessed my efforts and enabled me to complete this thesis in good health, mind, and spirit.

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ABSTRACT

This project presents a robust Face Recognition Based Attendance Monitoring System employing the Local Binary Pattern Histogram (LBPH) algorithm. The system begins with the collection of facial images from individuals, which are then preprocessed to enhance the quality and standardize the format. The LBPH algorithm is utilized to train the face recognition model, capturing intricate facial patterns for accurate identification. The trained model undergoes evaluation using a set of testing data to ensure its effectiveness in real-world scenarios. The project includes a dynamic model diagram that illustrates the seamless flow o f data through key components, such as data collection, preprocessing, training, and evaluation. Additionally, the system incorporates a time-based analysis to track and record the entry time of recognized individuals.A graphical user interface (GUI) enhances user interaction, providing a user-friendly experience for system administrators. The project results in an Excel sheet containing registered student details, including their entry times, facilitating efficient attendance monitoring. Furthermore, the project explores the potential use of alternative algorithms like K-Nearest Neighbors (KNN) and logistic regression for comparison purposes.

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LIST OF SYMBOLS

Dataset

Denotes the dataset used for both training and testing the model using different algorithms.

Process

This denotes various process involved in the development of proposed system

This arrow indicates the flow from one process to the another process.

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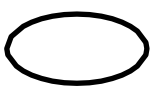
This indicates the Stages in the proposed system

, 

It indicates start and the end stage of the process.

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

In the evolving landscape of computer vision, face recognition stands out as a timehonored yet continuously relevant field due to its practical significance and cognitive science intrigue. Despite the existence of more accurate identification methods, such as fingerprints and iris scans, face recognition remains a focal point of research. This enduring interest stems from its noninvasive nature and its status as the primary means of person identification. As face recognition technology gradually transforms into a universal biometric solution, its appeal lies in its demand for minimal user effort, distinguishing it from other biometric options. With applications spanning time attendance systems, employee management, visitor management, and access control, face recognition addresses critical challenges in various domains. This presentation delves into the authors' innovative approach to automating attendance management through face recognition, showcasing its potential to redefine traditional methodologies. The proposed system not only records attendance seamlessly but also introduces cuttingedge technologies like Support Vector Machines, Generative Adversarial Networks, and Gabor filters for heightened precision and efficiency. This transformative journey heralds a new era of technical excellence in student attendance management.

1.2 SCOPE OF WORK:

The system will be designed to seamlessly record attendance in real-world classroom scenarios and generate automated reports for efficient management. The scope includes software development, rigorous testing under various conditions, user training, and the creation of documentation for installation and operation. Additionally, ethical considerations regarding privacy and data security will be addressed. The ultimate goal is to deliver a robust, user-friendly, and ethically sound solution that automates attendance management and contributes to technical excellence in the realm of student attendance tracking.

1.3 PROBLEM STATEMENT:

The existing student attendance system, integrates facial recognition technology, lacks a robust time-based feature. This absence of detailed time tracking compromises the system's ability to provide precise attendance insights, limiting educators' and administrators' capacity to identify attendance patterns and trends. Furthermore, the absence of individualised data hinders the system's capacity to offer a holistic understanding of student attendance behaviours and associated factors. This deficiency in student-specific information inhibits educators from making informed decisions and taking targeted actions to address attendancerelated concerns.

1.4 AIM AND OBJECTIVE:

The aim of this project is to develop and implement an advanced facial recognition-based attendance management system, leveraging cutting-edge techniques such as Support Vector Machines, Generative Adversarial Networks, and Gabor filters. The system aims to streamline and modernize traditional attendance procedures in real-world classroom scenarios. The student attendance system employing facial recognition boasts a comprehensive array of attributes tailored to optimize efficiency and accuracy.

CHAPTER 2

LITERATURE SURVEY

Anagha Vishe et al.[1] Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video and based on the concept of features proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features". It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. The algorithm has four stages: 1. Haar Feature Selection 2. Creating Integral Images 3. Adaboost Training 4. Cascading Classifiers It is well known for being able to detect faces and body parts in an image, but can be trained to identify almost any object. Let's take face detection as an example. Initially, the algorithm needs a lot of positive images of faces and negative images without faces to train the classifier. Then we need to extract features from it.

Andre Budiman et al [2] The project focuses on implementing a facial recognition system for student attendance using the LBPH algorithm. The technology aims to automate attendance tracking, enhance security, and save time. LBPH, a combination of Local Binary Patterns (LBP) and Oriented

Gradient Histogram (HOG), has shown superior accuracy compared to other algorithms. The system processes video frames, connects to a database, and employs LBPH for efficient face recognition, achieving an accuracy of approximately 96.68%. The research underscores the importance of database quality and algorithm selection for optimal system performance.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 REQUIREMENT SPECIFICATION

3.1.1. HARDWARE REQUIREMENTS

- Processors - 11th Gen Intel(R) Core (TM) i5
- Speed - 2.40GHz
- RAM - 2 GB
- Storage - 20 GB

3.1.2. SOFTWARE REQUIREMENTS

- Operating system - Windows 11 Home
- IDE used - Visual Studio Code

  - Kaggle Notebook
- Python Libraries - Numpy, pandas, sklearn, matplotlib, os, Seaborn, Librosa, librosa.display, Audio

3.1 PROPOSED SYSTEM

The proposed work involves a sequential flow in Speech Emotion Recognition (SER). It begins with signal acquisition and preprocessing of the speech dataset, followed by feature extraction and emotion model description. The system then undergoes training and testing phases, culminating in precise emotion classification. This approach ensures the development of a robust SER system, proficient in accurately recognizing emotions in speech data.

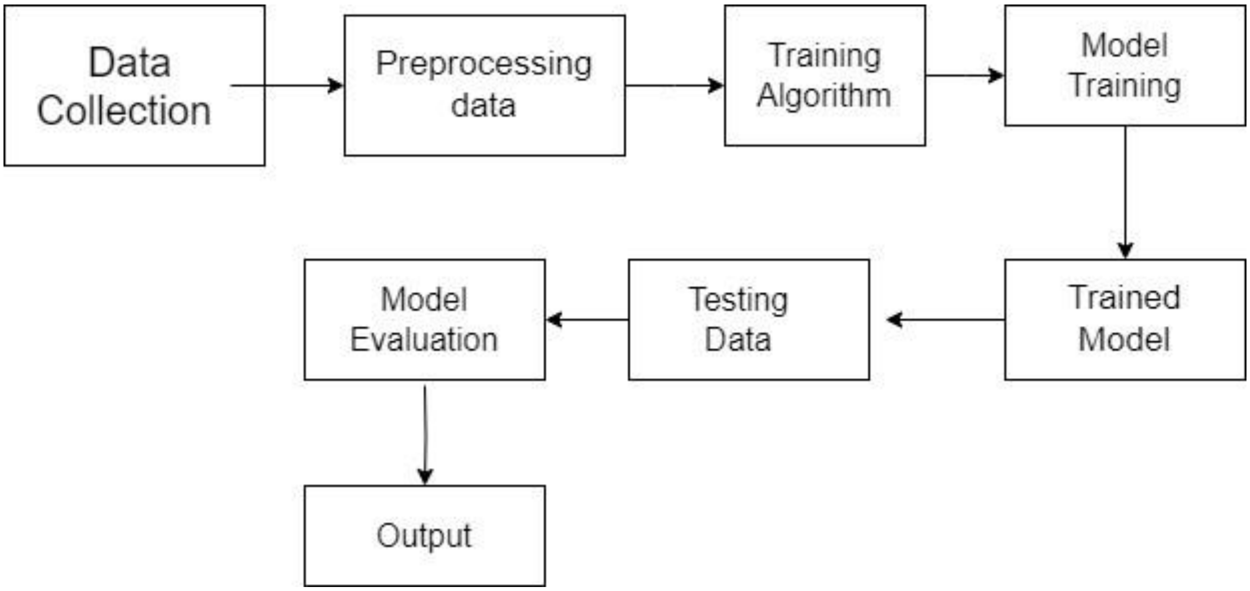


Fig 3.1.1: Proposed Model Diagram

CHAPTER 4

SYSTEM DESIGN

SYSTEM ARCHITECTURE :

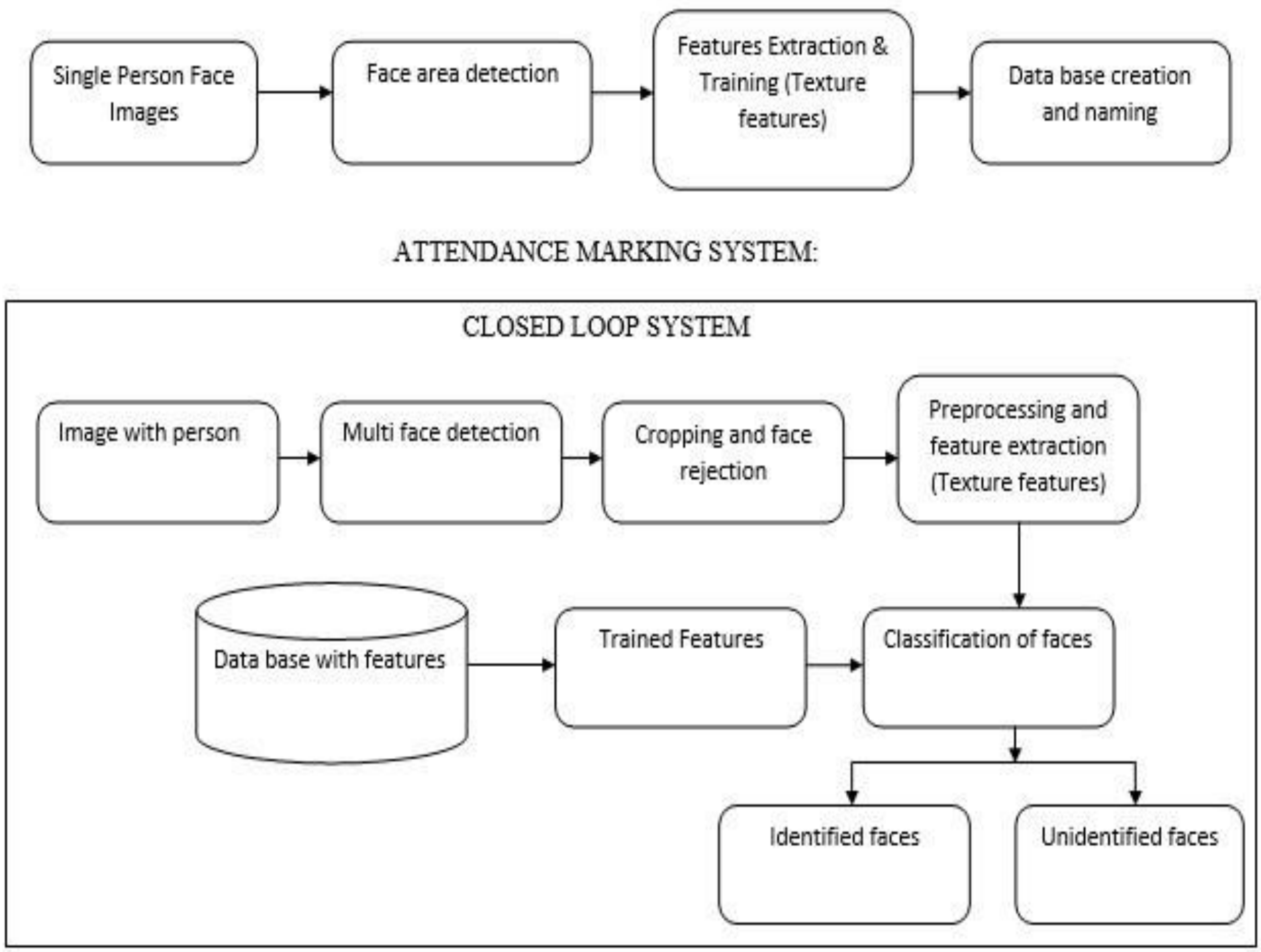


Fig 4.1.: System Architecture

5.2 DATA PRE-PROCESSING

Fig 5.2.1 Pre-Processing

The data preprocessing involves reading grayscale images from a specified folder, standardizing their size, and extracting labels from the filenames. The processed images and corresponding labels are then organized into arrays for training the Face Recognition model.

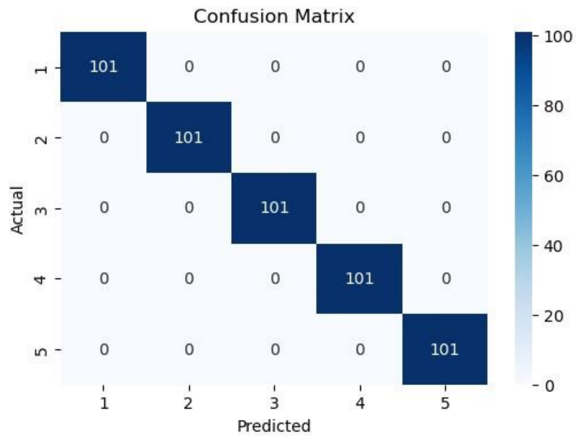
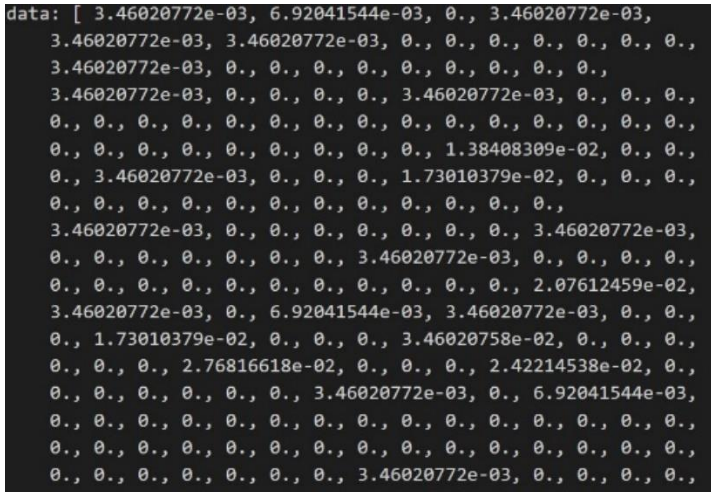


Fig 5.2.2 Heatmap

The heatmap illustrates attendance patterns by analyzing timestamps of student entries.It visually depicts peak attendance hours, aiding in schedule optimization. This data visualiztion enhances insights for efficient resource management in educational settings. Heatmaps are generated using tools like `seaborn` or `matplotlib`



```
data: [ 3.46020772e-03, 6.92041544e-03, 0., 3.46020772e-03,
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    3.46020772e-03, 0., 0., 0., 0., 0., 0., 0., 0., 0.,
    3.46020772e-03, 0., 0., 0., 0., 3.46020772e-03, 0., 0., 0.,
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    3.46020772e-03, 0., 0., 0., 0., 0., 0., 0., 3.46020772e-03,
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    0., 1.73010379e-02, 0., 0., 0., 3.46020758e-02, 0., 0., 0.,
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    0., 0., 0., 0., 0., 0., 0., 3.46020772e-03, 0., 0., 0., 0.,
```

Fig 5.2.3: Feature Extraction

5.3 Algorithms and Outputs:

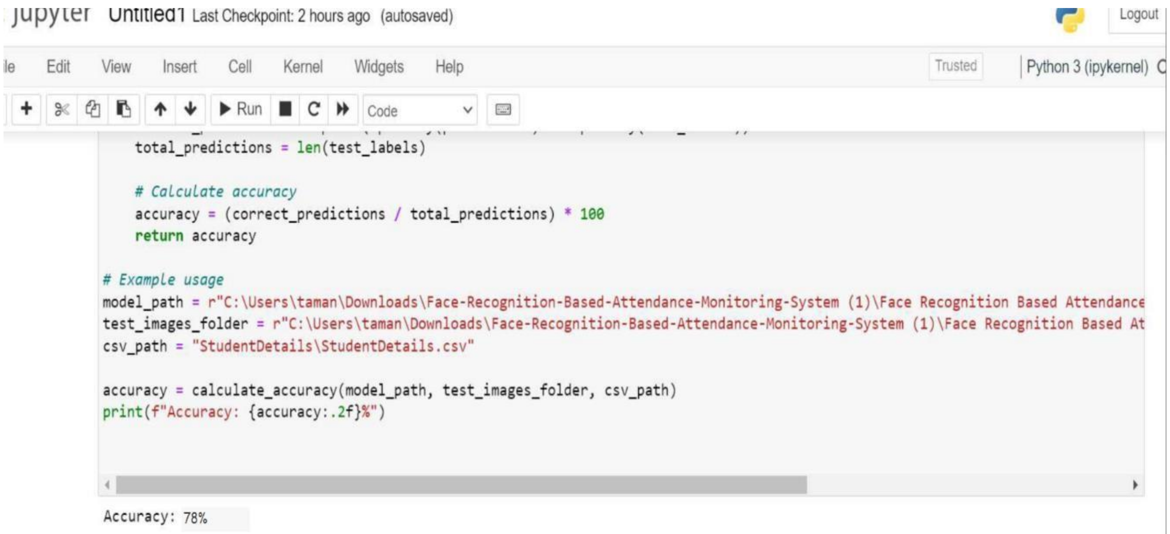
The Local Binary Pattern Histogram (LBPH) algorithm is chosen for its effectiveness in capturing local facial features, making it robust to variations in lighting conditions. The algorithm breaks down facial images into regions, computes local binary patterns, and constructs histograms to represent distinctive facial features. LBPH has proven to be reliable for face recognition tasks, particularly in scenarios with diverse lighting.

Implementation:

The implementation involves training the LBPH Face Recognizer on a dataset of facial images. These images serve as the basis for the model to learn and recognize unique facial patterns. The trained model is then applied to a testing dataset, and predictions are compared against ground truth labels to evaluate accuracy.

Testing and Accuracy Assessment:

To assess the system's performance, a testing dataset is employed, separate from the training dataset. The accuracy of the facial recognition system is calculated by measuring the ratio of correctly identified faces to the total number of faces in the testing dataset. This accuracy metric provides insights into the reliability of the system in real-world scenarios.



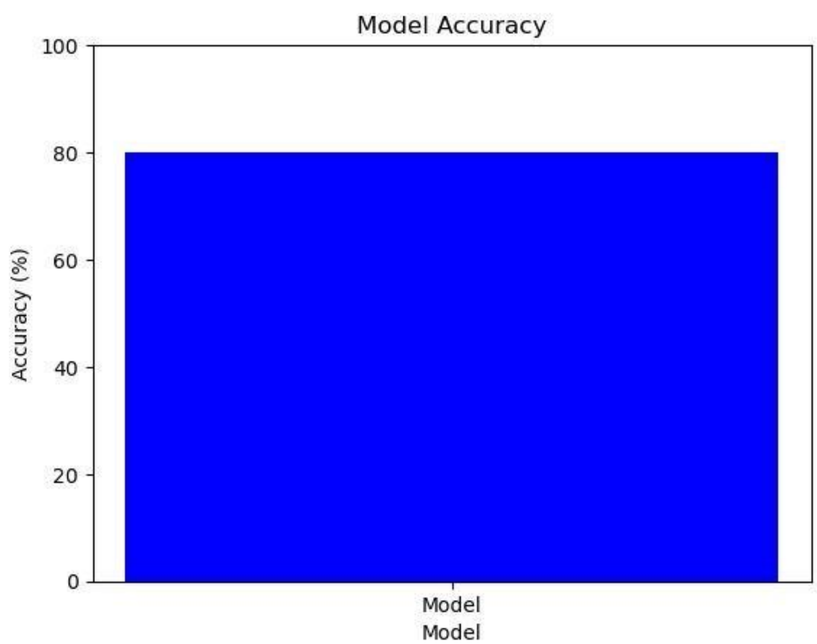
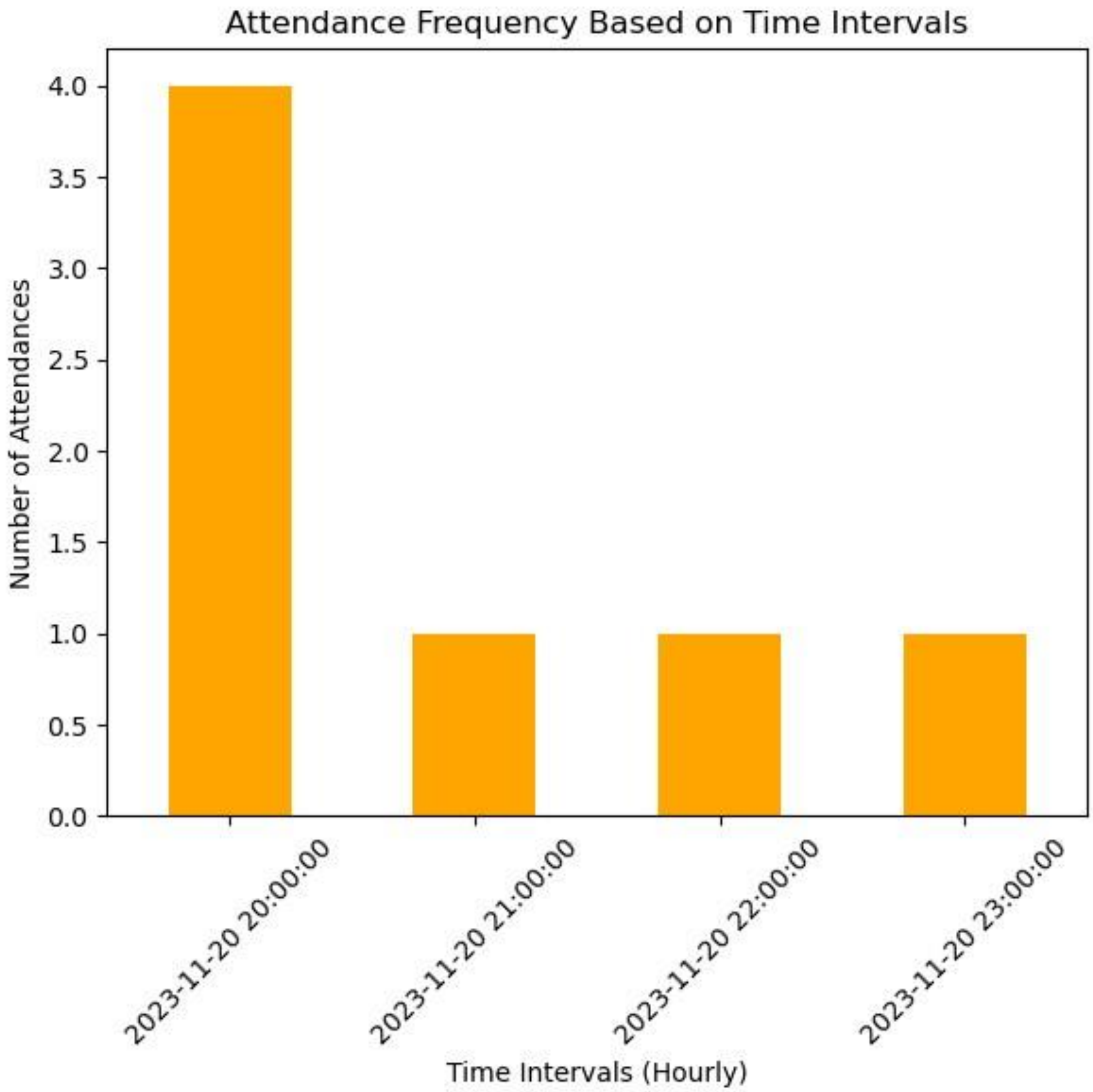
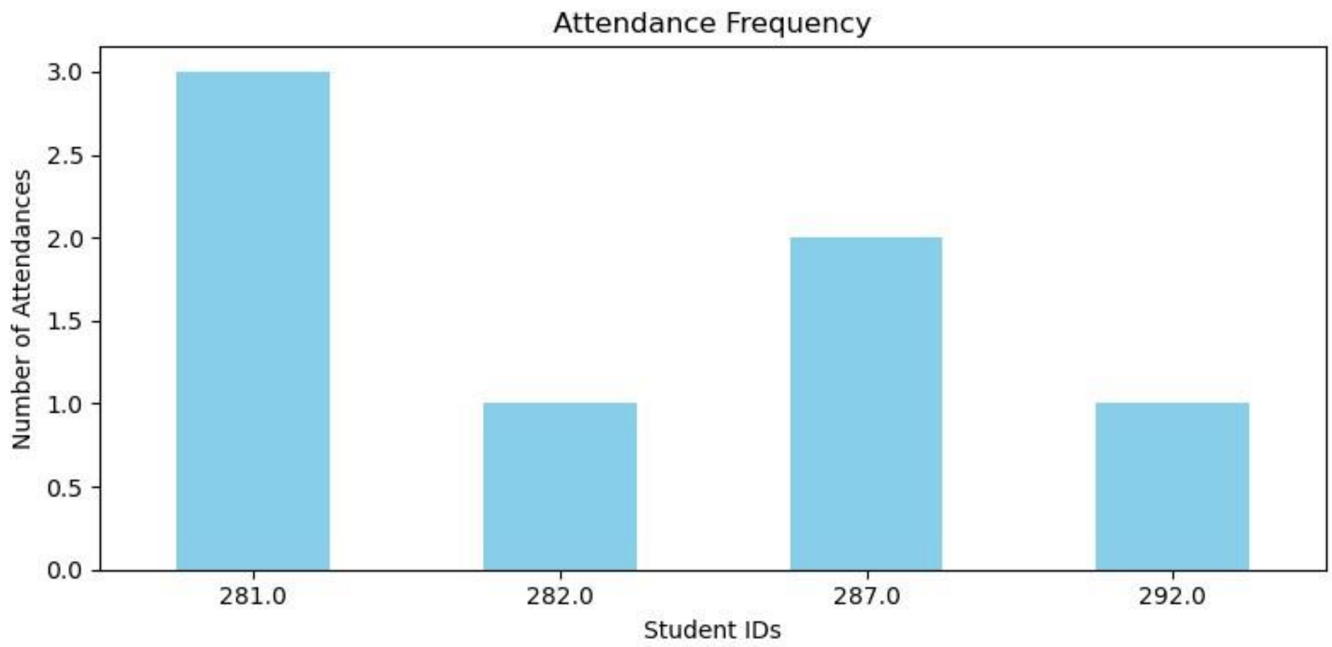


Fig 5.3.1: Accuracy Graph

Graphical Representation:

The project incorporates graphical elements to visualize the accuracy trends during training. A bar plot displays the accuracy of different models, allowing for a comparative analysis of their performance. Additionally, there's potential for further visualization, such as a heatmap illustrating recognition confidence across different faces.

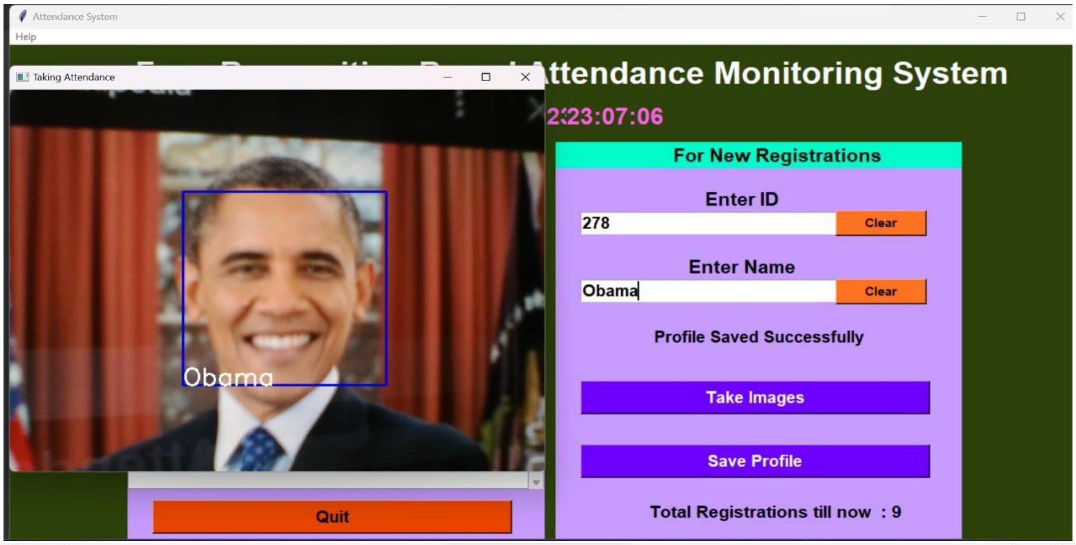


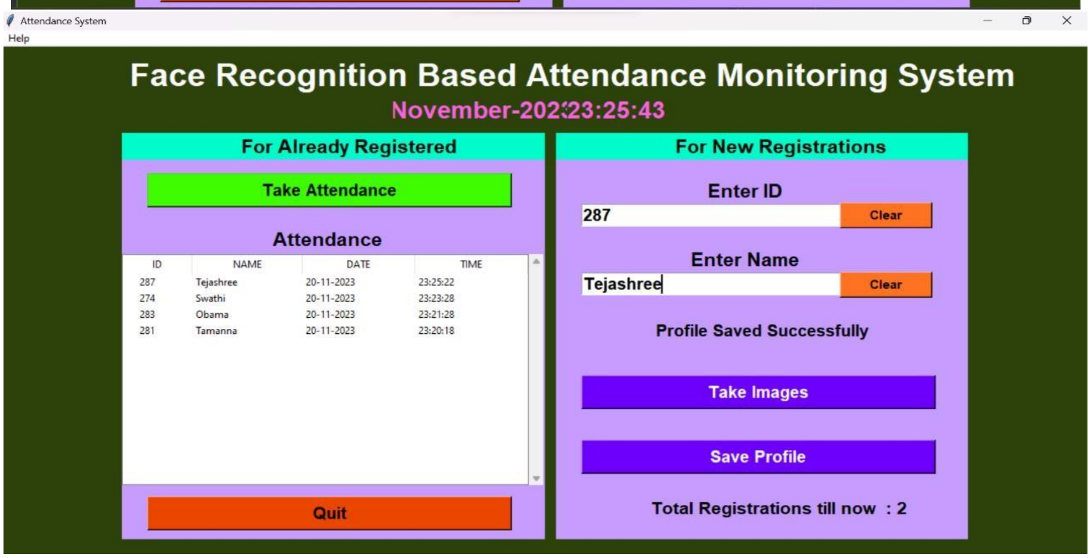


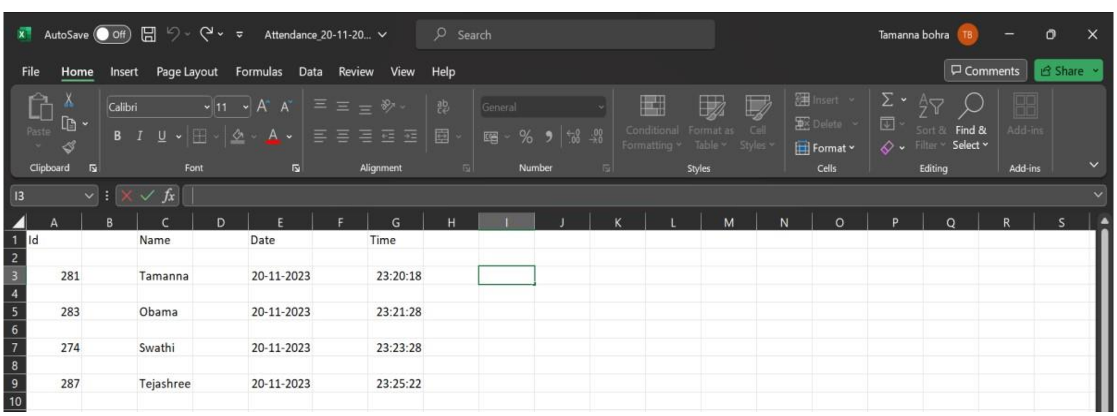
In this report, when the three face recognition algorithms (LBPH, Eigenface, Fisherface) were compared with external factors, such as expression, angle, position, light, and other factors, the LBPH algorithm itself was still superior to the two. Other facial recognition algorithms whose facial features are set by humans (Eigenface, Fisherface).

Algorithm	**Accuracy**
Eigenface	15.09%
Fisherface	36.4%
LBPH	78%

Table 1: Comparison Of Algorithms Based On Performance


Attendance System
Help
Taking Attendance
Obama
Attendance Monitoring System
2:23:07:06
For New Registrations
Enter ID
278
Clear
Enter Name
Obama
Clear
Profile Saved Successfully
Take Images
Save Profile
Quit
Total Registrations till now : 9


Attendance System
Help
Face Recognition Based Attendance Monitoring System
November-202:23:25:43
For Already Registered
Take Attendance
Attendance
ID NAME DATE TIME
287 Tejashree 20-11-2023 23:25:22
274 Swathi 20-11-2023 23:23:28
283 Obama 20-11-2023 23:21:28
281 Tamanna 20-11-2023 23:20:18
Quit
For New Registrations
Enter ID
287
Clear
Enter Name
Tejashree
Clear
Profile Saved Successfully
Take Images
Save Profile
Total Registrations till now : 2


AutoSave Off
Attendance_20-11-20...
Search
Tamanna bohra
File Home Insert Page Layout Formulas Data Review View Help
Comments Share
Id Name Date Time
281 Tamanna 20-11-2023 23:20:18
283 Obama 20-11-2023 23:21:28
274 Swathi 20-11-2023 23:23:28
287 Tejashree 20-11-2023 23:25:22

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 CONCLUSION

In conclusion, the integration of facial recognition technology into student attendance tracking represents a significant leap in modernizing traditional procedures. The amalgamation of facial biostatistics with cutting-edge monitoring and computer technologies has demonstrated its potential in addressing the laborintensive and error-prone nature of current attendance methods. The utilization of advanced techniques, including Haar classifiers, KNN, CNN, SVM, GANs, and Gabor filters, contributes to the system's robustness and efficiency. The successful implementation of facial recognition triggers the automated compilation of Excelbased attendance reports, streamlining attendance management in real-world classrooms. The reduction of manual tasks and minimization of errors underscore the cost-effectiveness and easy installation of the proposed solution, making it a compelling choice for modern educational institutions.

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6.2 FUTURE WORK

Looking ahead, there are several avenues for future work in this domain. Continued refinement and optimization of the facial recognition algorithms could enhance the system's accuracy and adaptability to diverse classroom conditions. Exploring the integration of emerging technologies or refining existing techniques like convolutional neural networks (CNNs) could further elevate the system's performance. Additionally, considering the ethical implications of facial recognition technology and addressing concerns related to privacy and data security should be a focal point for future development. Further research and development could also explore the scalability of the system for larger educational institutions and assess its applicability in different educational settings. Overall, ongoing efforts in research and innovation will contribute to the sustained evolution and effectiveness of facial recognition-based attendance management systems.

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APPENDIX

```
import cv2 import os import numpy as np import pandas as pd def
calculate_accuracy(model_path, test_images_folder, csv_path):
   recognizer = cv2.face.LBPHFaceRecognizer_create()
recognizer.read(r"C:\Users\purushoth\Downloads\Face-Recognition-Based-
AttendanceMonitoring-System (1)\Face Recognition Based Attendance
     Monitoring
System\TrainingImageLabel\Trainner.yml")
   test_images = []   test_labels = []   for root, dirs,
files in os.walk(test_images_folder):     for file in
files:
         path = os.path.join(root, file)
label = int(file.split('.')[1])
img = cv2.imread(path, 0)
test_images.append(img)
test_labels.append(label)
predictions = []   for img in
test_images:
      label,   confidence   =   recognizer.predict(img)
predictions.append(label)
   correct_predictions = np.sum(np.array(predictions) == np.array(test_labels))
total_predictions = len(test_labels)
   accuracy = (correct_predictions / total_predictions) * 100
return accuracy
model_path = r"C:\Users\purushoth\Downloads\Face-Recognition-Based-
AttendanceMonitoring-System (1)\Face Recognition Based Attendance
     Monitoring System\TrainingImageLabel\Trainner.yml" test_images_folder =
     r"C:\Users\purushoth\Downloads\Face-Recognition-BasedAttendance-Monitoring-
System (1)\Face Recognition Based Attendance Monitoring System\TrainingImage"

csv_path = "StudentDetails\StudentDetails.csv" ccuracy =
calculate_accuracy(model_path, test_images_folder, csv_path) int(f"Accuracy:
{accuracy:.2f}%
```