MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE GWALIOR

(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)

NAAC Accredited with A++ Grade

Project Report

on

AI Face Recognition Attendance System

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CENTRE FOR ARTIFICIAL INTELLIGENCE

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE

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Abstract

The Face Attendance System is a cutting-edge project aimed at revolutionizing traditional attendance tracking methods by implementing facial recognition technology. Designed to address the inefficiencies and inaccuracies associated with manual attendance systems, this innovative solution leverages the face_recognition library and Firebase cloud services. The project's feasibility is demonstrated through a robust database structure, real-time synchronization, and secure storage facilitated by Firebase.

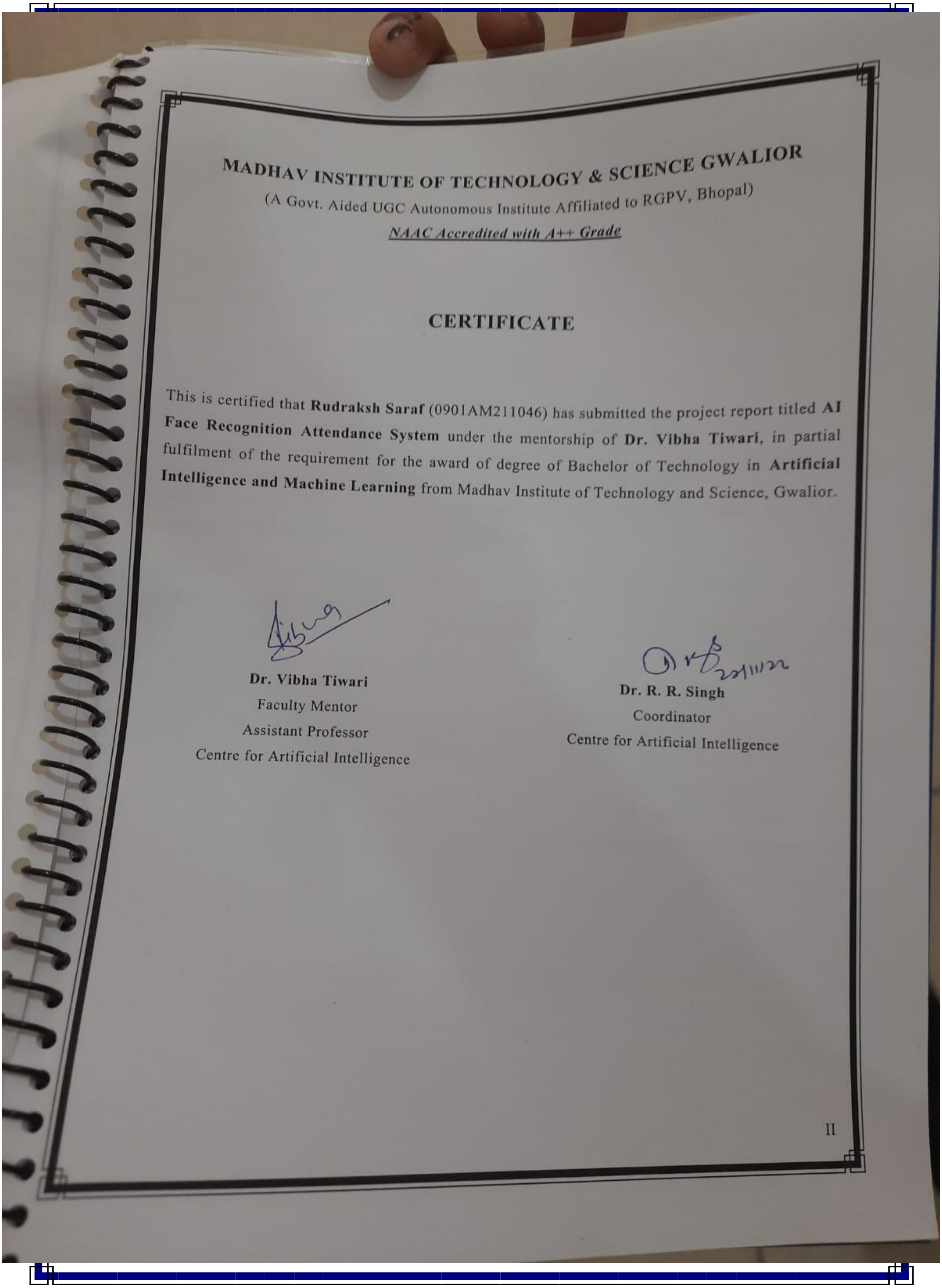
The face_recognition library, a key component of the project, employs deep learning techniques and pre-trained models to accurately recognize and verify individuals based on facial features. Its capabilities include facial encoding, comparison, and precise distance measurement, ensuring reliable identification even in dynamic environments.

The preliminary design involved the setup of Firebase, database structuring, and integration of the face recognition library. The final analysis encompasses result evaluation, application scenarios, encountered challenges, and a thorough conclusion. Results from the system's implementation showcase its efficiency in providing accurate attendance records through a user-friendly Tkinter GUI.

While the system demonstrates promise for applications in educational institutions and organizations, challenges such as privacy concerns and potential inaccuracies under specific conditions need consideration. The project's success highlights the transformative potential of advanced technologies in attendance management, emphasizing the ongoing need for refinement, user education, and adherence to ethical standards for sustained impact and widespread adoption. In conclusion, the Face Attendance System represents a significant advancement in attendance tracking, embodying the fusion of facial recognition and cloud-based solutions for enhanced efficiency, accuracy, and adaptability in diverse settings.

Keyword:

- Facial Recognition
- Attendance Management
- Tkinter GUI
- Firebase Integration
- Deep Learning
- Cloud-Based Systems
- Educational Technology



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CERTIFICATE

This is certified that **Rudraksh Saraf** (0901AM211046) has submitted the project report titled **AI Face Recognition Attendance System** under the mentorship of **Dr. Vibha Tiwari**, in partial fulfilment of the requirement for the award of degree of Bachelor of Technology in **Artificial Intelligence and Machine Learning** from Madhav Institute of Technology and Science, Gwalior.

Dr. Vibha Tiwari
Faculty Mentor
Assistant Professor
Centre for Artificial Intelligence

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Dr. R. R. Singh
Coordinator
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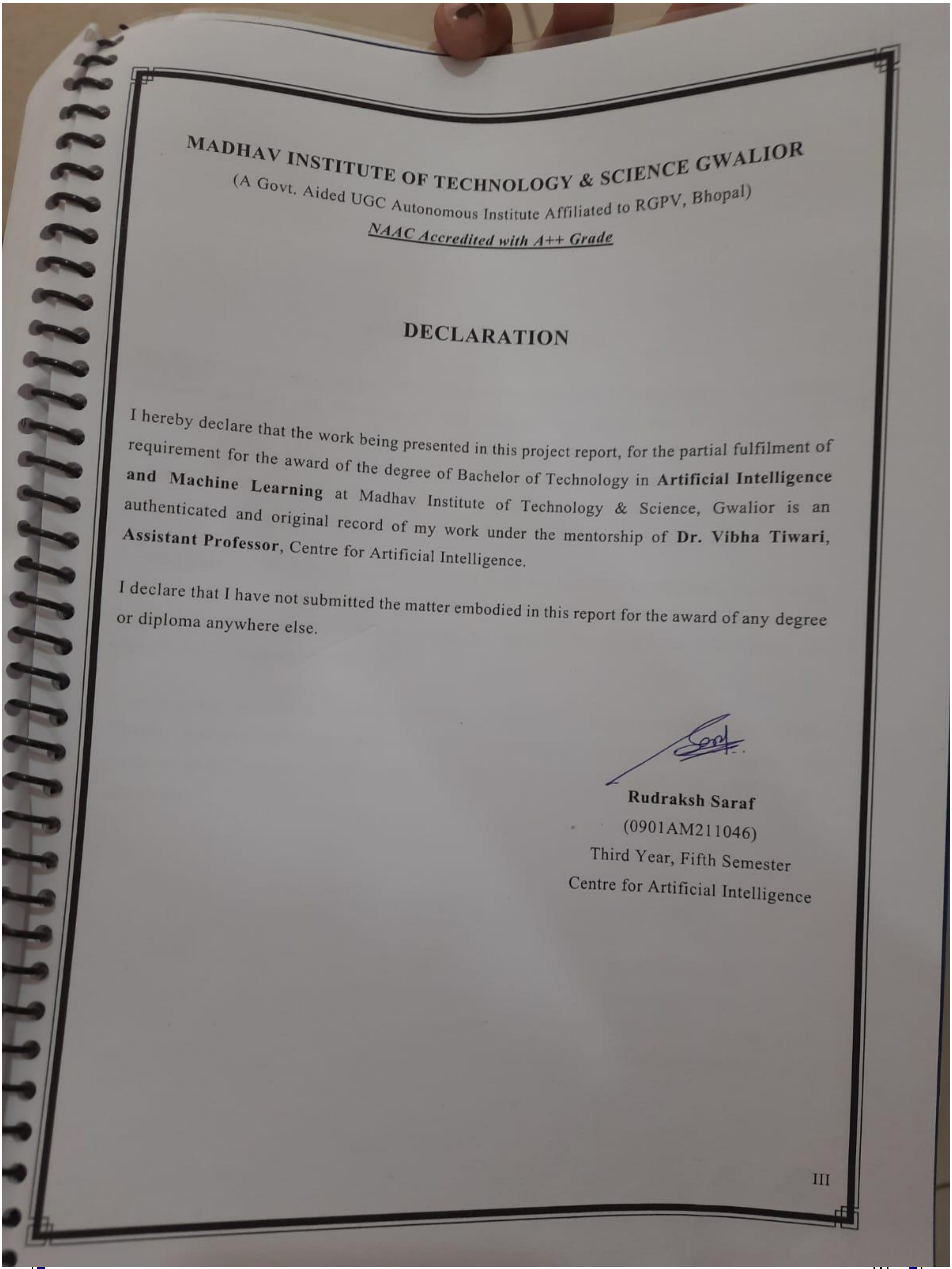

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DECLARATION

I hereby declare that the work being presented in this project report, for the partial fulfilment of requirement for the award of the degree of Bachelor of Technology in **Artificial Intelligence and Machine Learning** at Madhav Institute of Technology & Science, Gwalior is an authenticated and original record of my work under the mentorship of **Dr. Vibha Tiwari, Assistant Professor**, Centre for Artificial Intelligence.

I declare that I have not submitted the matter embodied in this report for the award of any degree or diploma anywhere else.

Rudraksh Saraf
(0901AM211046)
Third Year, Fifth Semester
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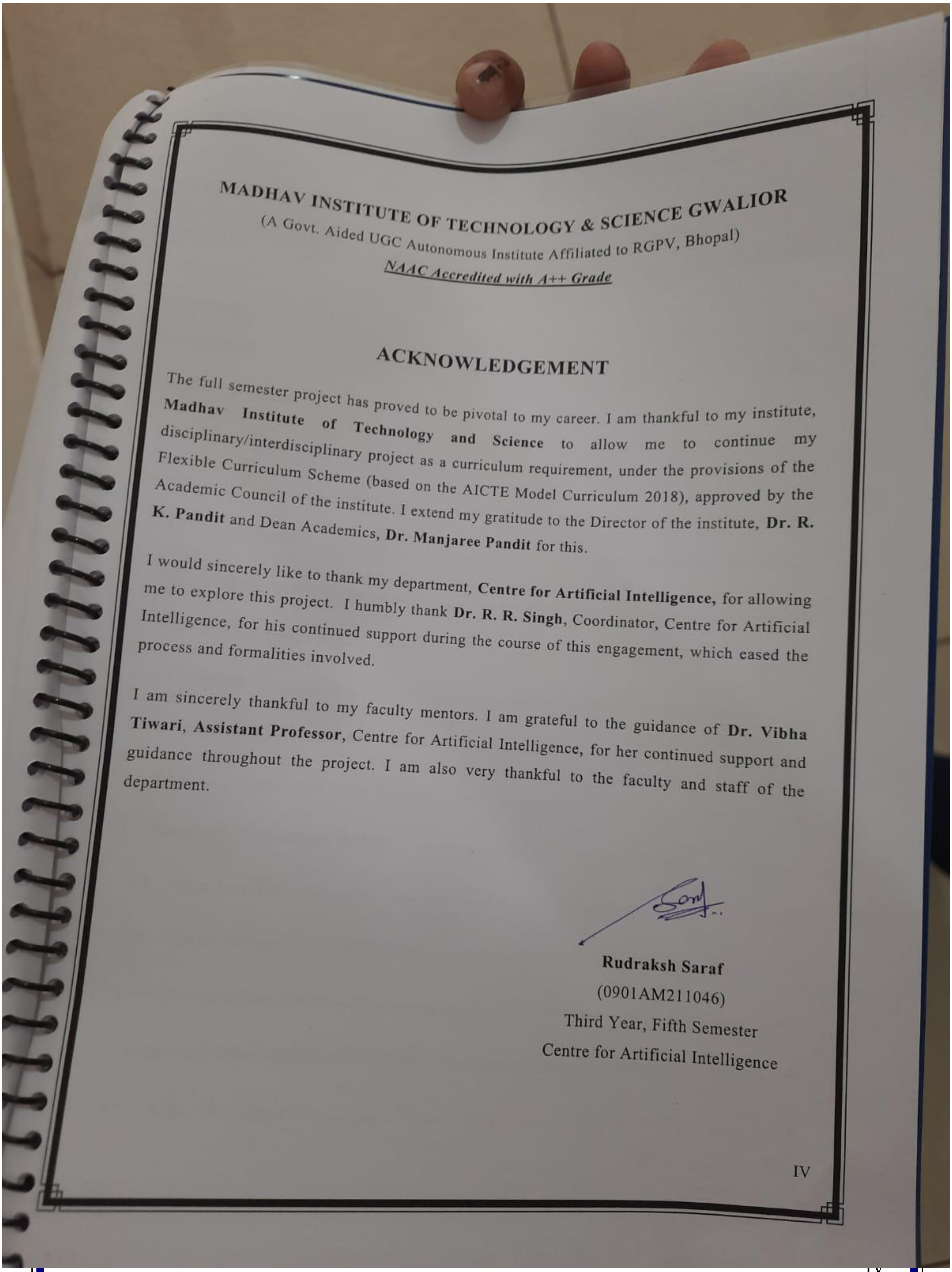

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The full semester project has proved to be pivotal to my career. I am thankful to my institute, **Madhav Institute of Technology and Science** to allow me to continue my disciplinary/interdisciplinary project as a curriculum requirement, under the provisions of the Flexible Curriculum Scheme (based on the AICTE Model Curriculum 2018), approved by the Academic Council of the institute. I extend my gratitude to the Director of the institute, **Dr. R. K. Pandit** and Dean Academics, **Dr. Manjaree Pandit** for this.

I would sincerely like to thank my department, **Centre for Artificial Intelligence,** for allowing me to explore this project. I humbly thank **Dr. R. R. Singh**, Coordinator, Centre for Artificial Intelligence, for his continued support during the course of this engagement, which eased the process and formalities involved.

I am sincerely thankful to my faculty mentors. I am grateful to the guidance of **Dr. Vibha Tiwari**, **Assistant Professor**, Centre for Artificial Intelligence, for her continued support and guidance throughout the project. I am also very thankful to the faculty and staff of the department.

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Chapter 1: Project Overview

1.1 Introduction:

The AI Face Attendance System is an innovative project designed to streamline and automate the process of attendance tracking in educational institutions or organizations. Traditional methods of manual attendance are time-consuming and prone to errors, leading to inefficiencies in managing large groups of individuals. The Face Attendance System leverages facial recognition technology to provide a reliable, accurate, and convenient solution to address these challenges.

Figure 1

The face-recognition library utilized in this project is a powerful Python module that provides comprehensive facial recognition capabilities. Leveraging the dlib and OpenCV libraries, it offers accurate face detection, facial landmark localization, and face encoding for recognition. The library excels in recognizing faces across images and video streams, making it ideal for applications like attendance systems. Notable features include the ability to compare and match faces, identify facial features, and seamlessly integrate with OpenCV. Its versatility and ease of use make it a popular choice for implementing facial recognition functionalities in diverse projects, ensuring robust and reliable performance.

1.2 Objectives and Scope:

The primary objective of the AI Face Attendance System is to automate the attendance tracking process by utilizing facial recognition techniques. This project aims to replace traditional methods, such as paper-based attendance sheets or card-based systems, with a more advanced and efficient system that offers real-time tracking capabilities. The system aims to:

- **Minimize Time and Effort:** By automating the attendance tracking process, the system reduces the time and effort traditionally associated with manual methods.
- **Enhance Accuracy:** Leveraging advanced facial recognition algorithms, the system ensures a high level of accuracy in attendance records, mitigating the risk of errors.
- **Improve Organizational Efficiency:** Through real-time monitoring and centralized data management, the system contributes to the overall efficiency of educational institutions and organizations.
- **Reduce Proxies:** This Attendance system ensures that there are no proxies and all the entries in the database are legit.

1.3 Project Features:

- **Facial Recognition:** The system employs state-of-the-art facial recognition algorithm to accurately identify and verify individuals.

- **Real-time Monitoring:** The system provides real-time monitoring of attendance, allowing administrators to track attendance instantly.

- **Data Management:** Student or employee data is securely stored in a Firebase Realtime Database, ensuring centralized and organized information.

- **User Authentication:** A secure login system ensures that only authorized personnel have access to attendance records and system functionalities.

- **Interactive UI:** The system features an interactive user interface created using Tkinter, providing a user-friendly experience.

1.4 Feasibility:

1.4.1 Technical Feasibility:

Hardware Requirements: The system requires standard hardware components, including a computer with a camera for facial recognition. These components are readily available and cost-effective.

Software Requirements: OpenCV, face_recognition library, Tkinter, and Firebase are widely used and well-supported libraries and platforms, ensuring technical feasibility.

Development Expertise: Skilled developers with proficiency in Python and relevant libraries are available, making the system technically feasible.

1.4.2 Economic Feasibility:

Development Costs: The cost of developing the Face Attendance System is reasonable, given the availability of open-source libraries and development tools.

Operational Costs: The ongoing operational costs are minimal, mainly associated with maintaining the server for the Firebase Realtime Database and annual cost of maintaining technical devices.

1.4.3 Operational Feasibility:

User Training: The system's user interface is designed with simplicity in mind, minimizing the need for extensive training. Users can quickly adapt to the touchless attendance system.

Integration with Existing Systems: The system is designed for seamless integration with existing databases and organizational workflows, ensuring smooth operations.

1.4.4 Legal Feasibility:

Compliance: The system complies with data protection and privacy regulations, as facial recognition data is securely stored and accessed through authenticated channels.

Ethical Considerations: Ethical concerns related to facial recognition technology are addressed by implementing secure and transparent practices.

1.4.5 Schedule Feasibility:

Development Timeframe: The system can be developed within a reasonable timeframe, leveraging the efficiency of Python libraries and Firebase for database management.

Implementation Time: The touchless nature of the system facilitates quick implementation, reducing disruptions in organizational processes.

1.4.6 Social Feasibility:

User Acceptance: The system promotes touchless and efficient attendance tracking, aligning with current health and safety concerns. User acceptance is likely to be high due to its modern and user-friendly design.

Adaptability: The system is adaptable to various educational and organizational settings, accommodating different user preferences and needs.

1.5 System Requirements:

1.5.1 Hardware Requirements:

Computer or Laptop: Any standard computer or laptop running Windows, macOS, or Linux.

Webcam: A webcam is required for capturing live video feed for facial recognition.

Internet Connection: An active internet connection is necessary for certain functionalities, such as accessing Firebase for data storage and retrieval.

1.5.2 Software Requirements:

Python: Ensure that Python is installed on your system. You can download Python from the official Python website.

Python Libraries: The required Python libraries can be installed using the following commands:

```
pip install opencv-python
pip install Pillow
pip install numpy
pip install tk
pip install cvzone
pip install cmake
pip install dlib
pip install face_recognition
pip install firebase-admin
pip install pandas
pip install openpyxl
```

Firebase Account: A Firebase account is needed to set up the Realtime Database for storing student information.

Service Account Key: Obtain the serviceAccountKey.json file from Firebase, which is required for authentication.

Storage Bucket: To store images in Firebase Storage, a storage bucket needs to be set up and configure the necessary permissions.

Mode Images and Background Image: Ensure that the required images for modes and the background image are available in the specified directories.

Chapter 2: Literature Review

The literature surrounding face recognition systems underscores their significant contributions to various domains, particularly in security, surveillance, and human-computer interaction. Over the years, researchers have explored diverse methodologies, ranging from traditional eigenface-based approaches to more sophisticated techniques such as Local Binary Pattern Histograms (LBPH) and Convolutional Neural Networks (CNNs).

Eigenface-based methods, introduced by Turk and Pentland, laid the foundation for face recognition. LBPH algorithms, known for their robustness to variations in lighting and facial expressions, emerged as a viable alternative. The advent of deep learning revolutionized face recognition, with CNNs demonstrating exceptional performance by automatically learning hierarchical features.

Real-time processing, multi-face detection, and adaptability to varying environmental conditions are notable features of contemporary face recognition systems. These advancements have fueled their integration into diverse applications, including attendance management systems, access control, and law enforcement.

Noteworthy features of facial recognition include real-time processing, multi-face detection, and tolerance to variations in lighting and facial expressions. Researchers have explored the integration of face recognition into attendance management systems, underscoring its potential to enhance accuracy and automate record-keeping processes.

While acknowledging the technological strides, ethical concerns surrounding privacy, bias, and misuse of facial recognition technology are prevalent in the literature. Researchers emphasize the importance of responsible deployment, legal frameworks, and transparency to mitigate potential risks.

The synthesis of literature informs the development of the AI Face Attendance System, integrating the latest advancements while addressing ethical considerations for a comprehensive and effective solution.

Chapter 3: Preliminary design:

The preliminary design of the Face Attendance System involves a systematic blueprint for its architecture and functionality. The system comprises three main components: the user interface, the facial recognition engine, and the database integration.

3.1 User Interface:

The Graphical User Interface (GUI) is designed using Tkinter in Python, offering an intuitive login form for users.

A login button triggers the authentication process, connecting to Firebase for username and password verification.

Successful login transitions to the main application window, featuring a live video feed and dynamic displays for attendance information.

3.2 Facial Recognition Engine:

Utilizes the face-recognition library for real-time face detection and recognition.

The system captures video frames from the webcam, processes them through the facial recognition algorithm, and overlays bounding boxes on detected faces.

Facial encodings are compared with pre-existing encodings of known individuals stored in Firebase.

3.3 Database Integration:

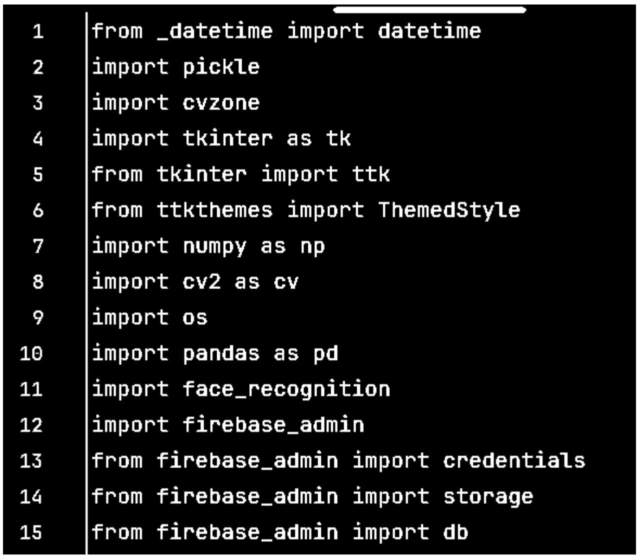
Firebase Realtime Database manages student information, including names, majors, attendance records, and last attendance timestamps.

Firebase Cloud Storage stores student images for recognition.

The system fetches data from Firebase to dynamically update student details and maintain accurate attendance records.

Chapter 4: Final Analysis and Design

4.1 Importing Libraries:



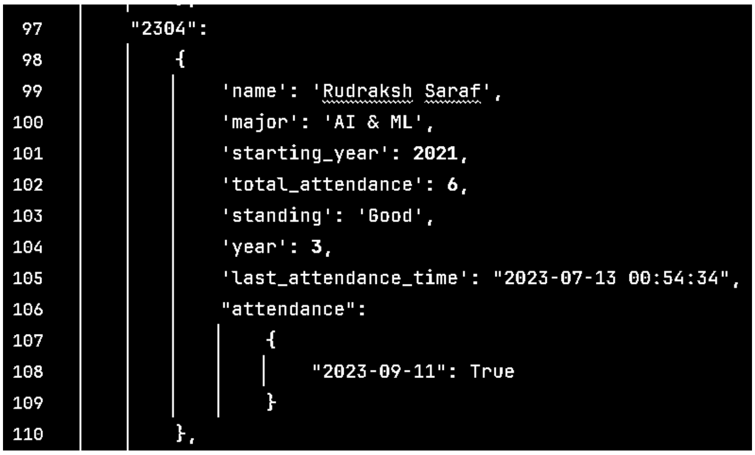
```
from _datetime import datetime
import pickle
import cvzone
import tkinter as tk
from tkinter import ttk
from ttkthemes import ThemedStyle
import numpy as np
import cv2 as cv
import os
import pandas as pd
import face_recognition
import firebase_admin
from firebase_admin import credentials
from firebase_admin import storage
from firebase_admin import db
```

Figure 2

The following libraries are imported and used throughout the application’s interface.

4.2 Collecting Required Data

The student’s past data is collected and used in building the AI based Attendance system. The data includes their academic details, personal details, past records of attendance and their digital photos for face recognition.

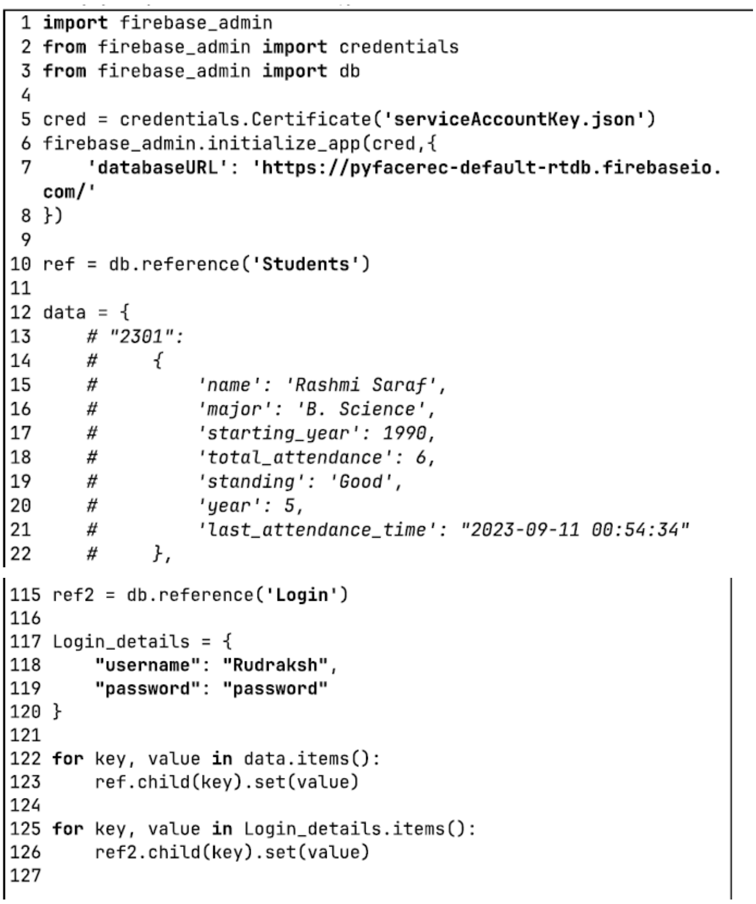


```
    "2304":
        {
            'name': 'Rudraksh Saraf',
            'major': 'AI & ML',
            'starting_year': 2021,
            'total_attendance': 6,
            'standing': 'Good',
            'year': 3,
            'last_attendance_time': "2023-07-13 00:54:34",
            "attendance":
                {
                    "2023-09-11": True
                }
        },
```

Figure 3

4.3 Adding Data to Database:

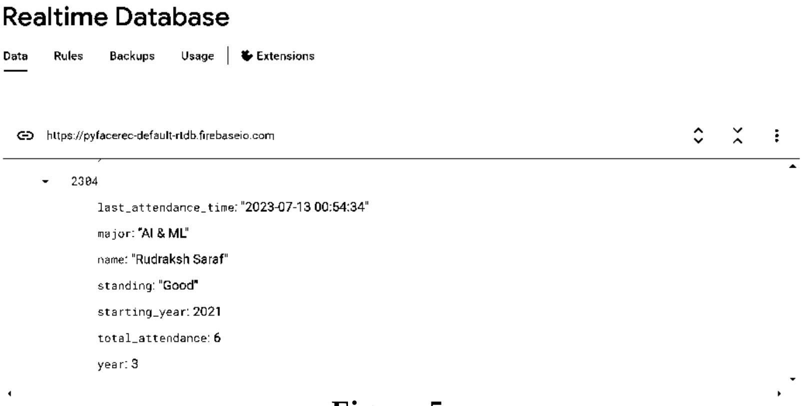
A separate python script is used to add the students data to the firebase realtime datsbase by sending the data in the form of json objects.



```python
import firebase_admin
from firebase_admin import credentials
from firebase_admin import db

cred = credentials.Certificate('serviceAccountKey.json')
firebase_admin.initialize_app(cred,{
    'databaseURL': 'https://pyfacerec-default-rtdb.firebaseio.com/'
})

ref = db.reference('Students')

data = {
    # "2301":
    #     {
    #         'name': 'Rashmi Saraf',
    #         'major': 'B. Science',
    #         'starting_year': 1990,
    #         'total_attendance': 6,
    #         'standing': 'Good',
    #         'year': 5,
    #         'last_attendance_time': "2023-09-11 00:54:34"
    #     },

ref2 = db.reference('Login')

Login_details = {
    "username": "Rudraksh",
    "password": "password"
}

for key, value in data.items():
    ref.child(key).set(value)

for key, value in Login_details.items():
    ref2.child(key).set(value)

```

Figure 4

Now this script is run and the database updates accordingly

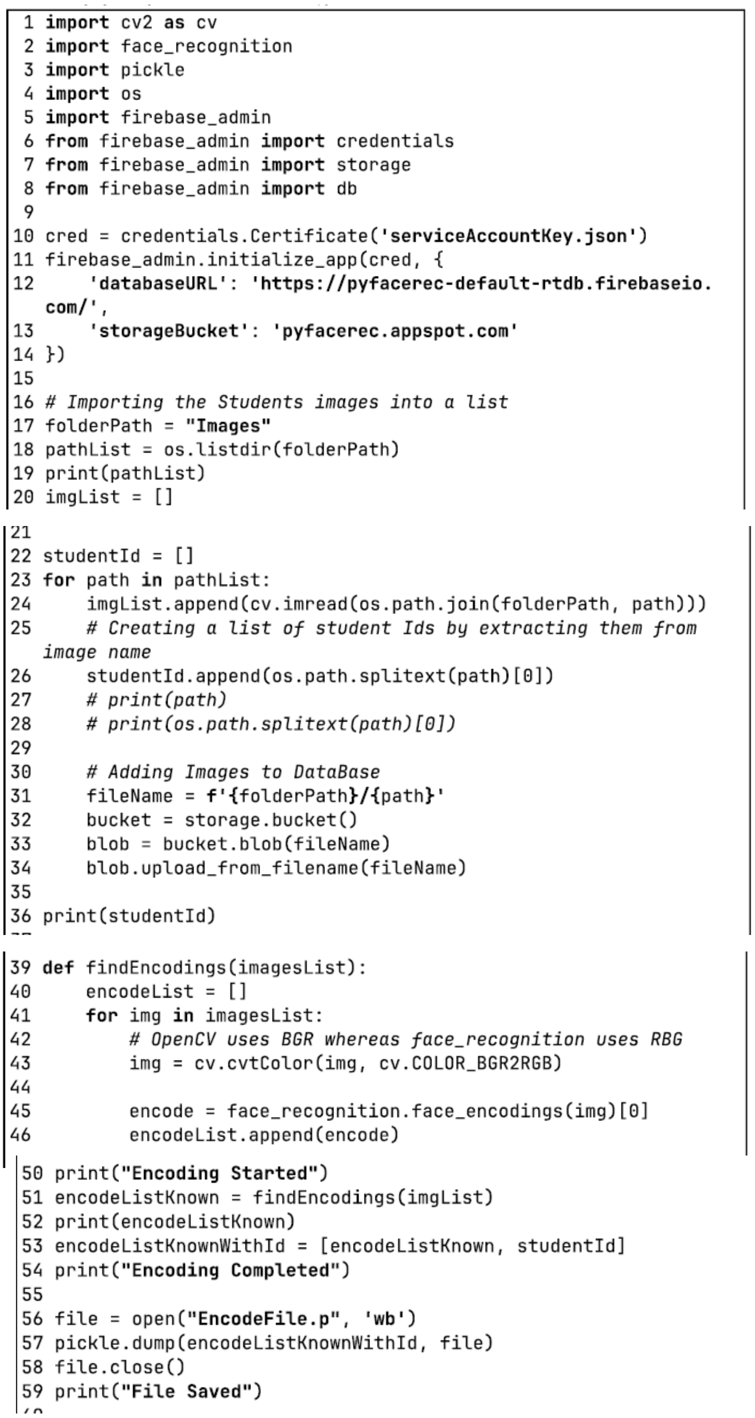


```
2304
    last_attendance_time: "2023-07-13 00:54:34"
    major: "AI & ML"
    name: "Rudraksh Saraf"
    standing: "Good"
    starting_year: 2021
    total_attendance: 6
    year: 3
```

Figure 5

4.4 Encoding Face Images:

The Face Images are encoded using EncodeGenerator.py script where features from face are extracted from the individual faces and then the encoding are compiled in a dictionary with student id as keys. These Encodings are then saved in Encoding.p file which can be further used for recognition of faces. Encodings are to be done once only throughout the software’s life. With regular updates only when the database is modified.



```python
import cv2 as cv
import face_recognition
import pickle
import os
import firebase_admin
from firebase_admin import credentials
from firebase_admin import storage
from firebase_admin import db

cred = credentials.Certificate('serviceAccountKey.json')
firebase_admin.initialize_app(cred, {
    'databaseURL': 'https://pyfacerec-default-rtdb.firebaseio.com/',
    'storageBucket': 'pyfacerec.appspot.com'
})

# Importing the Students images into a list
folderPath = "Images"
pathList = os.listdir(folderPath)
print(pathList)
imgList = []

studentId = []
for path in pathList:
    imgList.append(cv.imread(os.path.join(folderPath, path)))
    # Creating a list of student Ids by extracting them from image name
    studentId.append(os.path.splitext(path)[0])
    # print(path)
    # print(os.path.splitext(path)[0])

    # Adding Images to DataBase
    fileName = f'{folderPath}/{path}'
    bucket = storage.bucket()
    blob = bucket.blob(fileName)
    blob.upload_from_filename(fileName)

print(studentId)
```

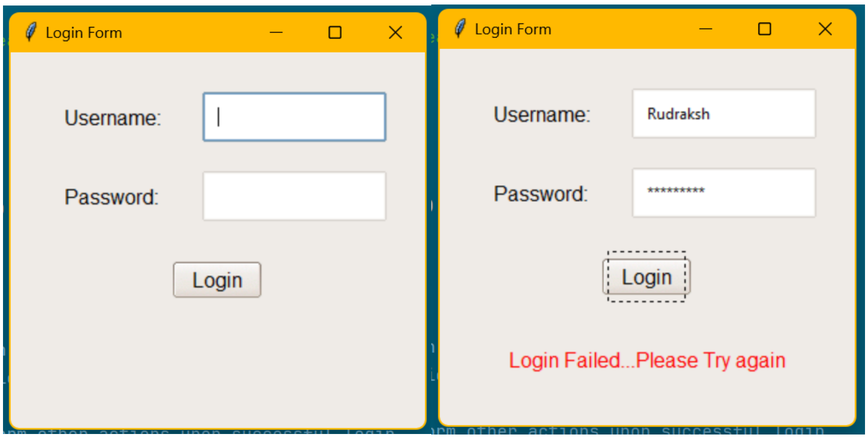
```python
def findEncodings(imagesList):
    encodeList = []
    for img in imagesList:
        # OpenCV uses BGR whereas face_recognition uses RBG
        img = cv.cvtColor(img, cv.COLOR_BGR2RGB)

        encode = face_recognition.face_encodings(img)[0]
        encodeList.append(encode)
```

```python
print("Encoding Started")
encodeListKnown = findEncodings(imgList)
print(encodeListKnown)
encodeListKnownWithId = [encodeListKnown, studentId]
print("Encoding Completed")

file = open("EncodeFile.p", 'wb')
pickle.dump(encodeListKnownWithId, file)
file.close()
print("File Saved")
```

Figure 6

4.5 User Authentication via Login Window:

Every user of the application must be containing authentication credentials which are stored in the firebase database for security. This authentication is provided by username and password.



Username:

Password:

Username: Rudraksh

Password: *********

Login Failed...Please Try again

Figure 7

Only users with correct credentials can login and initiate the attendance procedure.

4.6 Attendance Procedure:

Once the Login has completed, a new window opens which is the main attendance window. This window has the interface for displaying the webcam window and the student details.

4.6.1 Active Mode: This is the first display mode in which the webcam is active and ready for recognition.

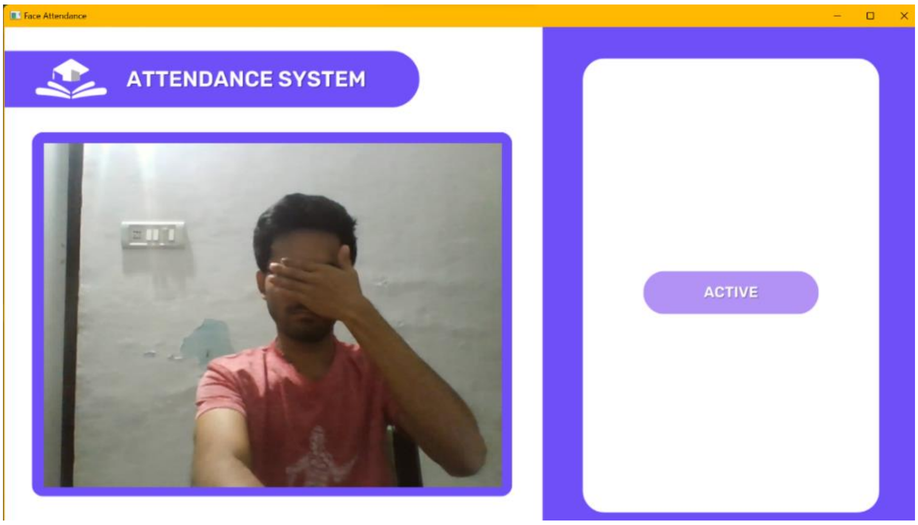


Figure 8

4.6.2 **Display Mode:** This is the second display mode in which the webcam detects the face on screen, compares it with the existing encodings and recognizes the face. Then the details of the recognized face are displayed on the screen for verification.

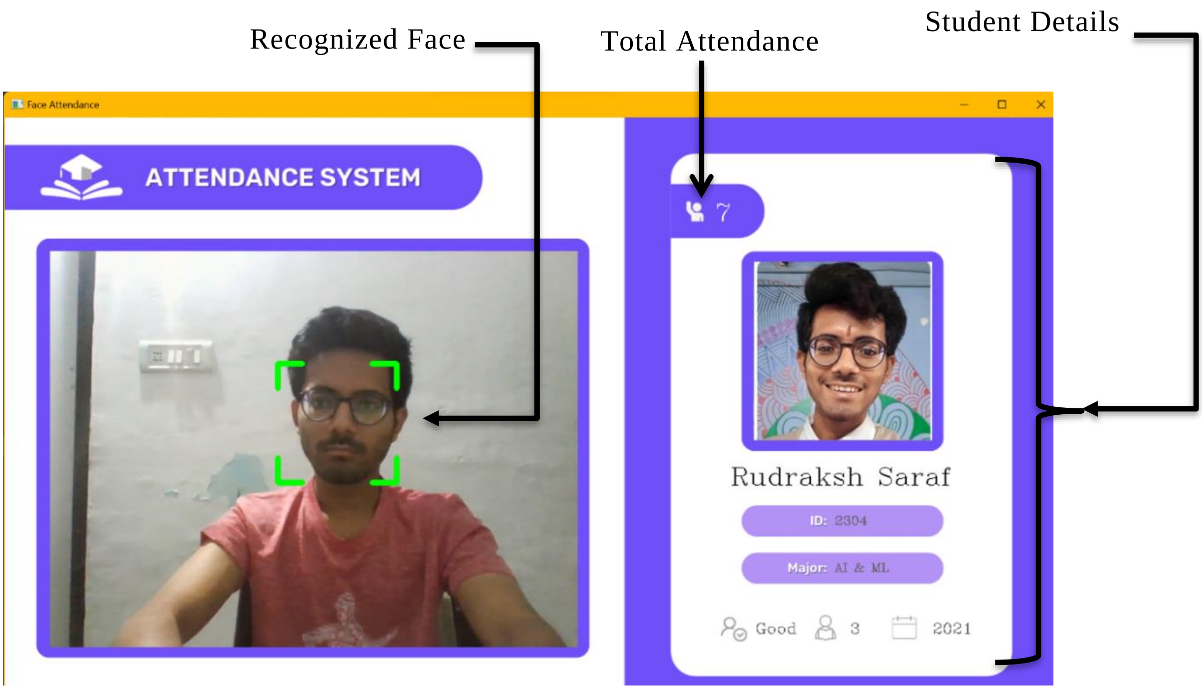


Figure 9

After a few seconds, The Mode is changes to “Marked”. In the backend of the application, the attendance date and time is noted and updated in the database for generating records.

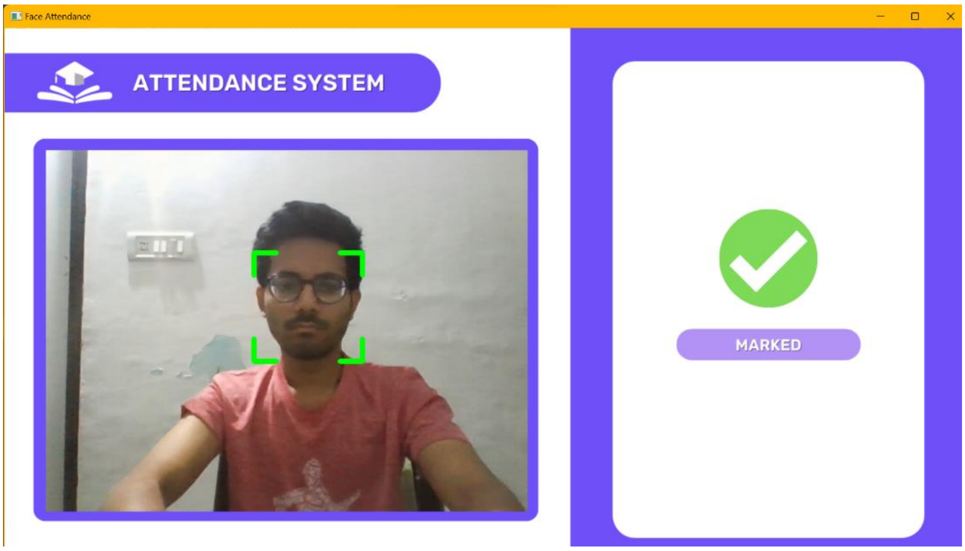


Figure 10

4.6.3 **Already Marked Attendance:** When recognizing a face, if the system detects that the record of the given student is already present between the given interval of time, the system displays an already marked status.

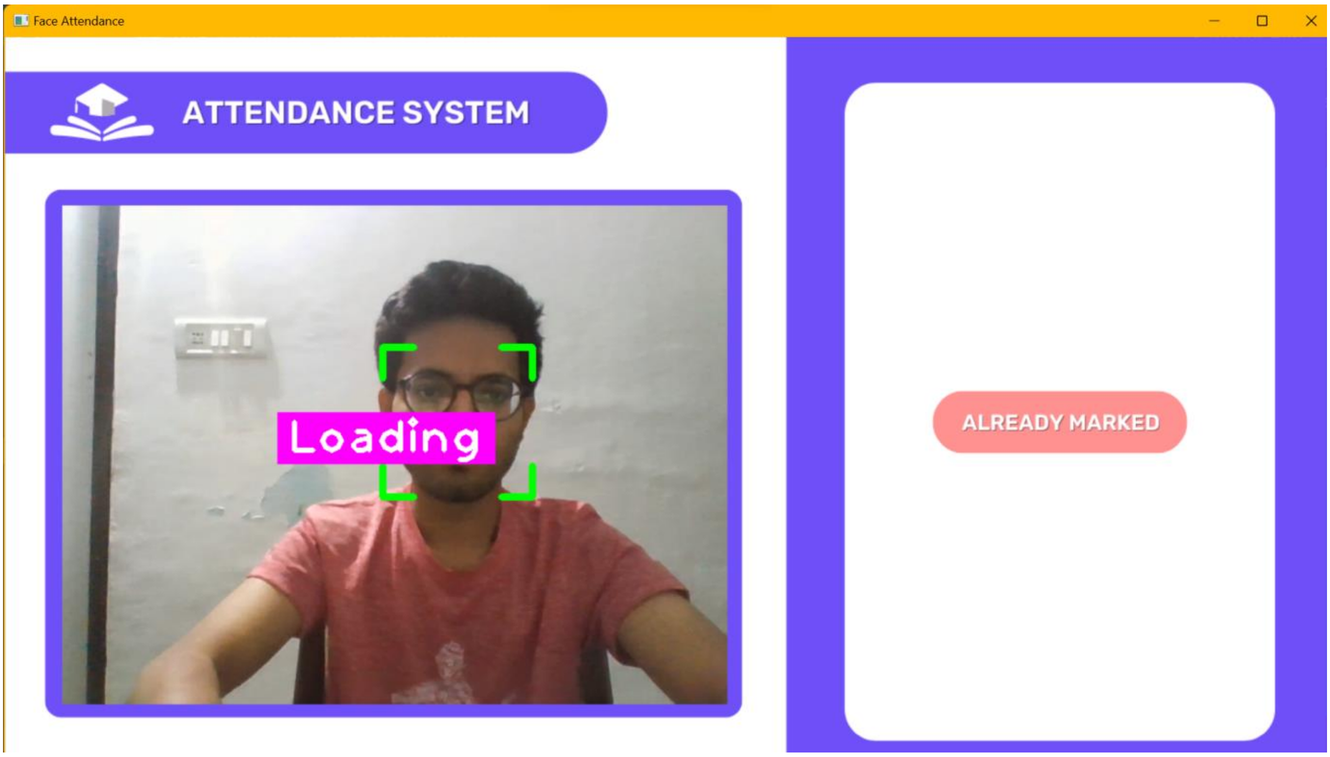
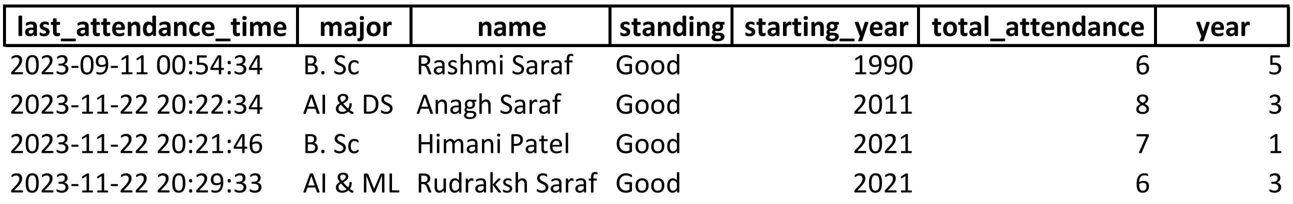


Figure 11

4.7 Display of Records:

The Attendance Records are stored in the firebare database and are retrived in the local system as soon as the program terminates. The records can be viewed as an excel sheet table.



last_attendance_time	major	name	standing	starting_year	total_attendance	year
2023-09-11 00:54:34	B. Sc	Rashmi Saraf	Good	1990	6	5
2023-11-22 20:22:34	AI & DS	Anagh Saraf	Good	2011	8	3
2023-11-22 20:21:46	B. Sc	Himani Patel	Good	2021	7	1
2023-11-22 20:29:33	AI & ML	Rudraksh Saraf	Good	2021	6	3

Table 1

4.8 Limitations:

The Face Attendance System, like any technology, has its limitations. Here are some potential limitations of the app:

Accuracy Concerns: Face recognition systems may face challenges in accurately identifying individuals under certain conditions, such as poor lighting, extreme facial expressions, or occlusions (covering part of the face).

Security and Privacy: Facial recognition technology raises privacy concerns as it involves capturing and processing sensitive biometric data. Users might have concerns about the security of their facial data.

Dependency on Camera Quality: The accuracy of face recognition is influenced by the quality of the camera used. Low-resolution or poor-quality cameras may result in less accurate recognition.

Processing Power: Face recognition algorithms can be computationally intensive. The app's performance may be affected on devices with limited processing power, leading to slower recognition times.

User Acceptance: Some users may be uncomfortable with the idea of facial recognition for attendance tracking due to privacy or cultural reasons. Resistance or reluctance to adopt the technology might be a limitation.

Network Dependency: If the app relies on cloud-based services for recognition or data storage, it may be dependent on a stable internet connection. Issues with connectivity could impact the system's performance.

Cost of Implementation: Implementing a robust facial recognition system can involve significant costs, including hardware, software, and infrastructure. This may be a limitation for smaller institutions or organizations with budget constraints.

4.9 Conclusion:

The Face Attendance System represents a significant leap forward in automating and enhancing the accuracy of attendance tracking processes. By leveraging facial recognition technology, this system offers a reliable and efficient alternative to traditional manual methods, addressing the inherent challenges associated with human error, time consumption, and scalability. This project was driven by the need to streamline attendance management in educational institutions and organizations, fostering a more seamless and technologically advanced approach.

The feasibility of the Face Attendance System is evident in its successful implementation and integration of various technologies. The system's architecture incorporates a robust database powered by Firebase, ensuring real-time data synchronization and secure storage. Firebase's cloud-based services, including the Realtime Database, storage, and authentication, contribute to the system's scalability and accessibility.

The chosen face recognition library, face_recognition, plays a pivotal role in the system's functionality. This library harnesses the power of deep learning and pre-trained models to accurately identify and verify individuals based on facial features. Its features include facial encoding, comparison, and distance measurement, enabling precise recognition even in dynamic environments.

The system's preliminary design involved setting up Firebase, creating a secure database structure, and integrating the face recognition library. The final analysis and design encompassed result analysis, application scenarios, encountered problems, limitations, and a comprehensive conclusion.

Results from the system's implementation demonstrated reliable face recognition capabilities, providing accurate attendance records. The system's user-friendly login interface, powered by a Tkinter GUI, ensures accessibility for both administrators and end-users. However, challenges were encountered, such as concerns related to privacy, security, and potential inaccuracies under challenging conditions.

The Face Attendance System has promising applications in educational institutions, corporate settings, and organizations requiring efficient attendance management. Despite its success, it is crucial to address limitations, including accuracy concerns, privacy issues, and dependency on external factors.

Chapter 5: References

Face Recognition Attendance System Using Python

Face Recognition with Real Time Database - Murtuza's Workshop

Python GUI: Tkinter Tutorial In Hindi 2019

Python tkinter tutorial

Modern GUI using Tkinter