Machine Learning Powered Automated Facial Attendanc Tracking System

Mid Term Status and Progress Evaluation

April 22, 2024

Content

Status Overview

Frontend

1. App Implementation is 50 % complete.
2. Integration with Backend is pending.

Backend

1. Backend Implementation of APIs is 80 % complete.
2. Core functions are working.
3. Integration with Frontend is pending.
4. Improvement in Face Recognition is pending.

Frontend Technologies

Libraries Used for Creating Cross Platform App

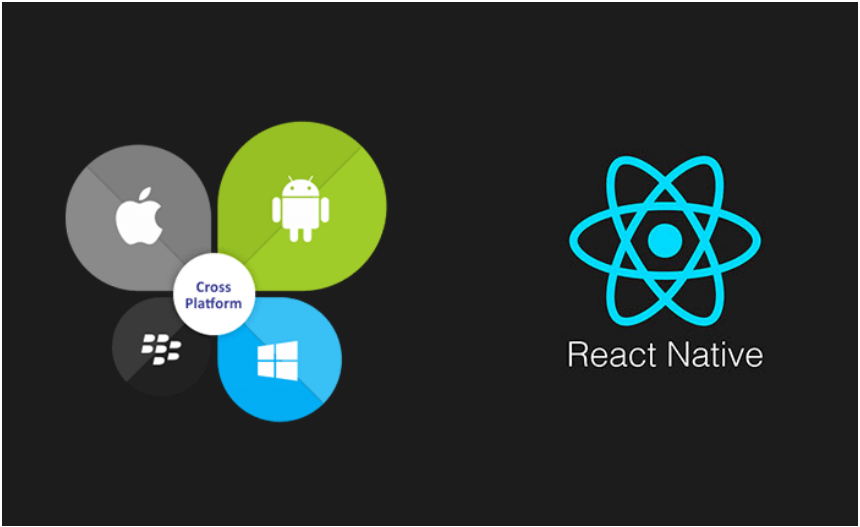
1. React Native
2. Axios
3. React Navigation

React Native

1. React Native is a JavaScript framework for writing real, natively rendering mobile applications for iOS and Android.
2. It's based on React, Facebook's JavaScript library for building user interfaces, but instead of targeting the browser, it targets mobile platforms.
3. Its Cross Platform, meaning it will work on both iOS and Android, *which are the primary Operating systems our teachers use.*

React Native

Cross Platform App Development



Frontend Drafts

These are the initial drafts of the app

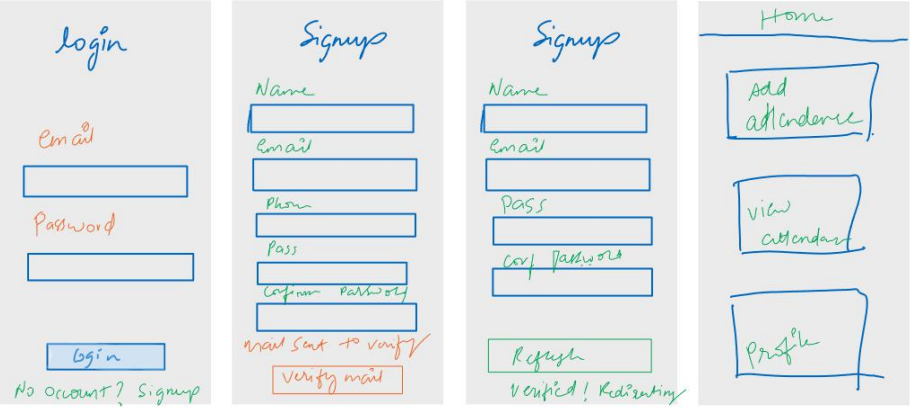
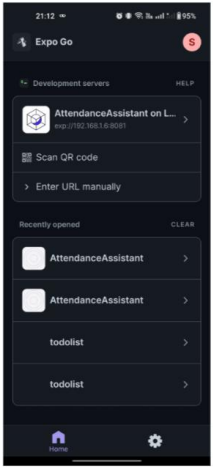


Figure: Drafts of the App

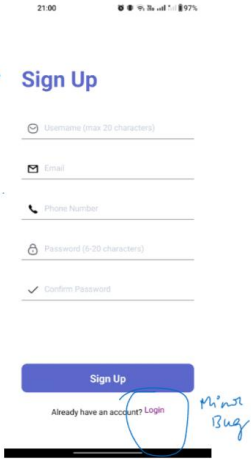
Frontend Progress

Current Progress in App Development (Mid Term Stage)

Current Development going on on Expo (React Native support framework for Application Development)



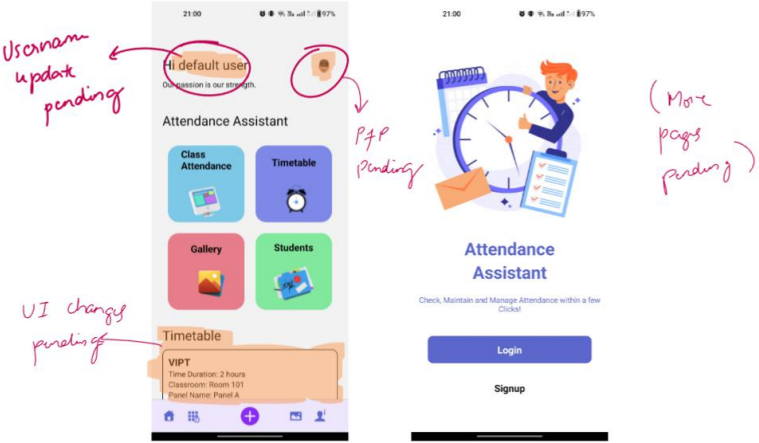
Connection to Backend Pending.



Frontend Progress

Current Progress in App Development (Mid Term Stage) Continued

Current Development going on on Expo (React Native support framework for Application Development)



Frontend Work Remaining

1. Integration with Backend.
2. Improving User Interface.
3. Adding Core Features of taking photos and uploading Attendance

Backend Technologies

1. FastAPI for creating APIs.
2. MongoDB for Database.
3. Multiple Face Recognition Libraries
4. Python for Backend Development
5. Docker for Containerization
6. Swagger for API Documentation

FastAPI

Overview

1. FastAPI is a modern, fast (high-performance), web framework for building APIs with Python 3.6+ based on standard Python type hints.
2. It is based on standard Python type hints, which makes it easy to use and understand.
3. It is one of the fastest Python frameworks available.

FastAPI

In Use

```python
app = FastAPI()

# Include routers here
from routers import client_uploads, test_route, face_rec, college, subjects, students, teachers, panels, lectures

app.include_router(client_uploads.router)
app.include_router(students.router)
app.include_router(face_rec.router)
app.include_router(panels.router)
app.include_router(college.router)
app.include_router(subjects.router)
app.include_router(teachers.router)
app.include_router(lectures.router)
app.include_router(test_route.router)
```

Swagger for API Documentation

Overview

1. Swagger is a set of open-source tools built around the OpenAPI Specification that can help you design, build, document and consume REST APIs.
2. It is used to document the APIs in a user friendly way.
3. It is used to test the APIs.
4. It is used to generate client libraries for the APIs.
5. It is used to generate server stubs for the APIs.
6. It is default with FastAPI.

MongoDB for Database

Overview

1. MongoDB is a general purpose, document-based, distributed database built for modern application developers and for the cloud era.
2. It is a NoSQL database, which means it stores data in JSON-like documents.
3. It is used to store the data of the students and their faces.

MongoDB for Database

In Use

Attendance

LOGICAL DATA SIZE: 24.28KB STORAGE SIZE: 432KB INDEX SIZE: 400KB TOTAL COLLECTIONS: 12

Collection Name	Documents	Logical Data Size	Avg Document Size
buildings	7	461B	66B
classes	25	14.88KB	610B
encodings	12	2.2KB	188B
lectureImages	12	2.45KB	210B
panels	2	676B	338B
rooms	3	114B	38B
schools	1	116B	116B
semesters	1	330B	330B
specializations	2	156B	78B
students	8	2.47KB	317B

Backend Drafts

the readme file from github etc

Backend Work Done

1. Core APIs are working.
2. Face Recognition is working.
3. Database is working.
4. Swagger Documentation is complete.
5. Docker Containerization is complete.

API

Uploading Images from App or Pi or Website

FastAPI 0.1.0 OAS 3.1

/openapi.json

Upload Images or Attendance Info from App/Website/Pi

POST	/upload/add_student_face_from_url	Add Student Face From Url Route
POST	/upload/add_student_face	Add Student Face Route
POST	/upload/add_class_photo_from_url	Add Class Photo From Url Route
POST	/upload/add_class_photo	Add Class Photo Route
POST	/upload/add_attendance	Add Attendance Route
POST	/upload/add_face_encoding	Add Face Encoding Route
POST	/upload/update_face_encoding	Update Face Encoding Route

Students

GET	/student/test	Test route
POST	/student/add_student	Add a student

API

The Model to add attendance (from Teachers App only)

```python
class AttendanceModel(BaseModel):
    room: str
    subject: str
    teacher: str
    panel: str
    start_time: str
    date: str
    end_time: str
```

API

Students API

Students

GET	/student/test	Test route
POST	/student/add_student	Add a student
POST	/student/get_student_from_panel_id	Get students from panel id
POST	/student/get_student_encoding	Get student encoding From student ID
GET	/student/get_all_students	Get all students

API

Students Models

```python
class StudentModel(BaseModel):
    name: str
    prn: str
    panel: str
    panel_roll_no: int
    face_encoding: Optional[str] = ""
    faces: Optional[List] = []
    # add validators to check if the panels and stuff are actually valid, cache databases if necessary to avoid multiple router calls

    def set_id(self, _id):
        self._id = _id
```

API

Face Recognition and Panels

Face Recognition

GET	/face_rec/test	Test route

Panels, Schools and Specializations

GET	/panels/test	Test route
POST	/panels/add_panel	Add a panel
GET	/panels/get_all_panels	Get all panels
POST	/panels/add_school	Add a school
GET	/panels/get_all_schools	Get all schools

API

Panels Continued

POST	/panels/add_specialization	Add a specialization
GET	/panels/get_all_specializations	Get all specializations
POST	/panels/add_spec_to_school	Add a specialization to a school
POST	/panels/update_school_for_panel	Update school for a panel
POST	/panels/update_spec_for_panel	Update specialization for a panel
POST	/panels/set_current_sem_for_panel	Set current semester for a panel
POST	/panels/add_semester_to_panel	Add a semester to a panel
POST	/panels/add_student_to_panel	Add a student to a panel

API

Panel Models

```python
class PanelModel(BaseModel):
    panel_letter: str
    school: str
    specialization: Optional[str] = ""
    students: List[str]
    semesters: List[str]
    current_semester: str

    def set_id(self, _id):
        self._id = _id

```

API

Rooms and Buildings

Rooms and Buildings

GET	/college/test	Test route
GET	/college/get_all_rooms	Get all rooms
POST	/college/add_room	Add a room
POST	/college/add_building	Add a building
GET	/college/get_all_buildings	Get all buildings
POST	/college/get_rooms_from_building_id	Get rooms from building id
POST	/college/add_room_to_building	Add a room to a building

API

Models to Manage Rooms and Buildings

```python
class RoomModel(BaseModel):
    name: str

    def set_id(self, _id):
        self._id = _id

class RoomResponseModel(BaseModel):
    name: str
    room_id: str

class BuildingModel(BaseModel):
    name: str
```

API

Subjects and Semester

Subjects and Semesters

GET	/subjects/test	Test route
POST	/subjects/add_subject	Add a subject
GET	/subjects/get_all_subjects	Get all subjects
POST	/subjects/add_semester	Add a semester
GET	/subjects/get_all_semesters	Get all semesters

API

Semester Model to be added from Admin Page

```python
class SemesterModel(BaseModel):
    semester_number: int
    panel: str
    specialization: str
    school: str
    start_date: str
    end_date: str
    subjects: Optional[List[str]] = []
    teachers: Optional[List[str]] = []
    teacher_subjects: Optional[dict] = {}

    def set_id(self, _id):
```

API Documentation

Teachers API, used during Signup

Teachers

GET	/teachers/test	Test route
POST	/teachers/add_teacher	Add a teacher
GET	/teachers/get_all_teachers	Get all teachers
POST	/teachers/get_teacher_by_id	Get a teacher by id

API

Teacher Model

```python
class TeacherModel(BaseModel):
    name: str
    email: str
    subjects: List[str]
    panels: List[str]


class TeacherIDModel(BaseModel):
    teacher_id: str
```

API

Lecture API, used when adding Attendance

Lectures

POST	/lectures/add_lecture	Add a lecture
GET	/lectures/get_lecture	Get a lecture
GET	/lectures/get_all_lectures	Get all lectures
GET	/lectures/get_lecture_images_between_time	Get all lecture images between a start and end time

API

Lecture Models

```python
class lectureModel(BaseModel):
    date: str
    start_time: str
    end_time: str
    subject_id: str
    teacher_id: str
    panel_id: str
    semester: str
    room_id: str
    students_present: List[str]
    students_absent: List[str]
```

Face Recognition Libraries Used

These are the libraries on which all images will be trained and tested.

1. ***face_recognition***: A simple face recognition library for Python. It is used to recognize the faces in the images, and to compare the faces.
2. ***OpenCV***: Open Source Computer Vision Library. It is used to detect the faces in the images. [1]
3. ***dlib***: A toolkit for making real world machine learning and data analysis applications in C++. It is used to detect the faces in the images.
4. ***DeepFace***: A lightweight face recognition and facial attribute analysis

[1] Marked in blue have been used so far.

Face Recognition Libraries To Use

Continued

1. ***imutils***: A series of convenience functions to make basic image processing functions such as translation, rotation, resizing, skeletonization, and displaying Matplotlib images easier with OpenCV and Python.
2. ***MTCNN***: Multi-task Cascaded Convolutional Networks. It is used to detect the faces in the images.
3. ***FaceNet***: A face recognition library developed by Google. It is used to recognize the faces in the images.
4. ***InsightFace***: A face recognition library developed by the InsightFace team. It is used to recognize the faces in the images.

Training Data

images of people we uploaded. also class details and stuff.

Preliminary Results

the pics with faces identified. hopefully names on top.

Backend Work Remaining

list of todos. integration etc.