LAB MID ASSIGNMENT

BY:

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FA23-BCS-004

Flight Tracking System (FlightAware Simulation)

1. Introduction

This project simulates the FlightAware system, designed to collect, store, and visualize real-time flight data. It mimics aircraft radio signal ingestion using a RESTful FastAPI backend, stores the data in MongoDB, and visualizes active flights on an interactive Folium map.

2. System Overview

Components of the system include:

• FastAPI Backend — Handles data ingestion and retrieval.

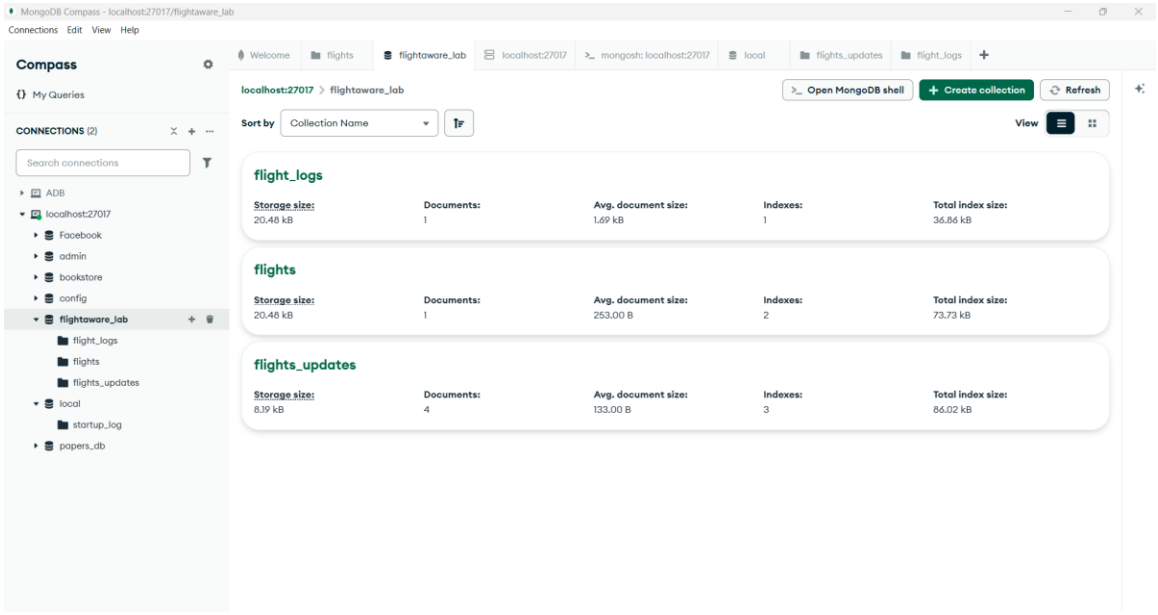
• MongoDB Database — Stores flight and update data.

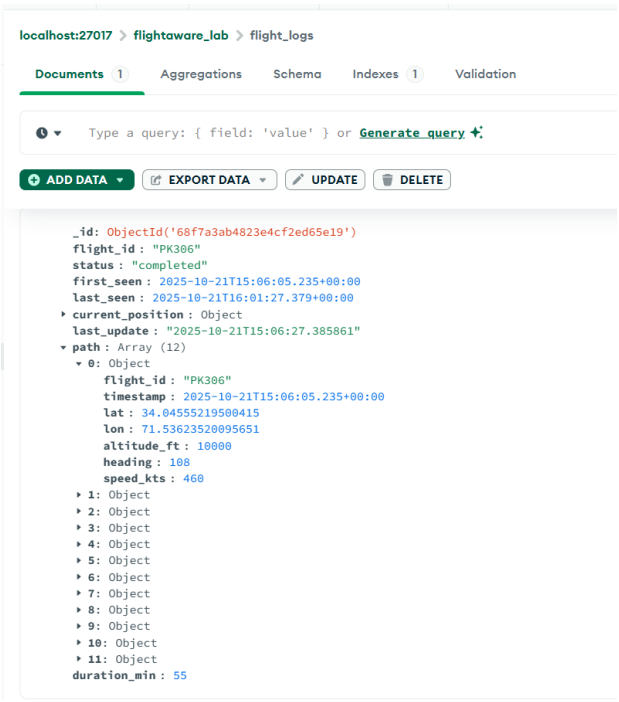
• Folium Visualization — Displays active flight paths and positions.

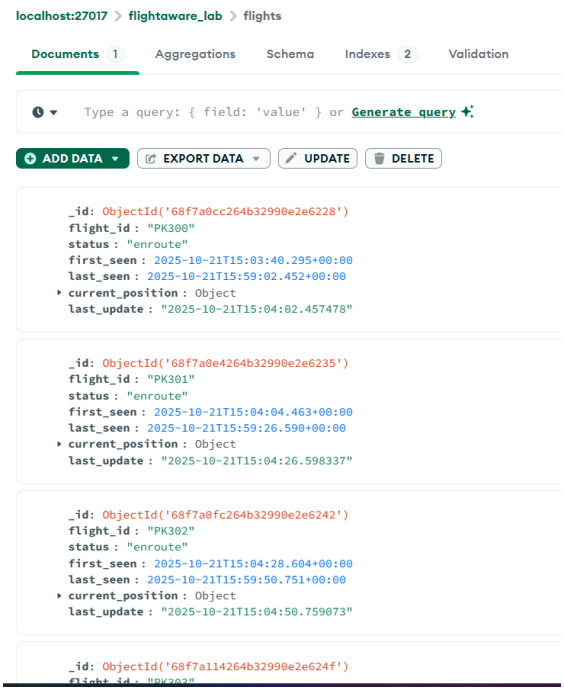
3. Database Design

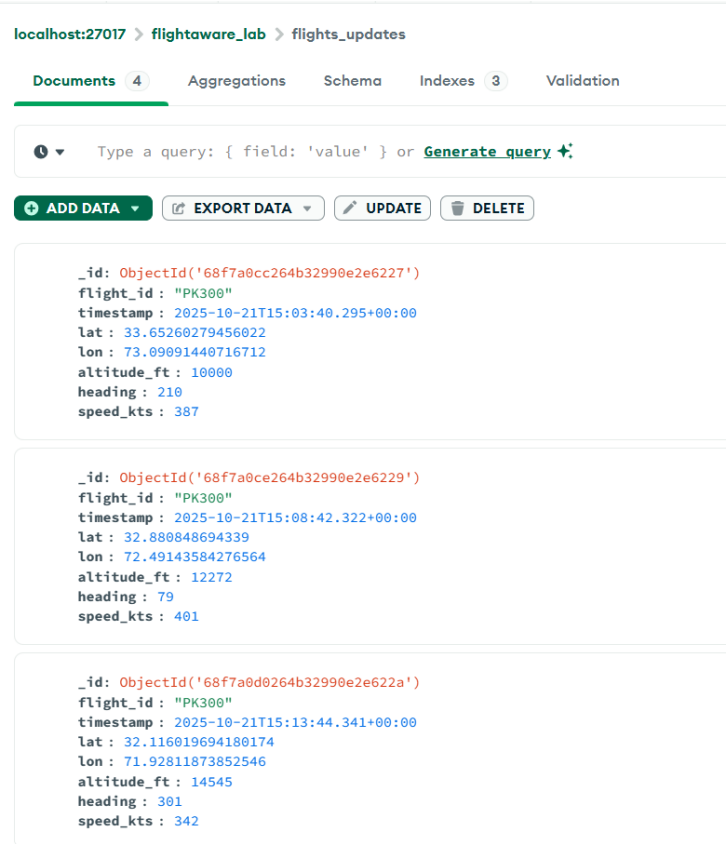
MongoDB is used as the backend database. It contains three main collections:

1. flights — Stores master flight details such as flight_id, origin, destination, and status.
2. flights_updates — Contains real-time position updates for each flight.
3. flight_logs — Keeps logs and historical data for auditing and analytics.




localhost:27017 > flightaware_lab > flight_logs
Documents 1
Aggregations
Schema
Indexes 1
Validation
Type a query: { field: 'value' } or Generate query
ADD DATA
EXPORT DATA
UPDATE
DELETE
_id: ObjectId('68f7a3ab4823e4cf2ed65e19')
flight_id : "PK306"
status : "completed"
first_seen : 2025-10-21T15:06:05.235+00:00
last_seen : 2025-10-21T16:01:27.379+00:00
current_position : Object
last_update : "2025-10-21T15:06:27.385861"
path : Array (12)
0: Object
flight_id : "PK306"
timestamp : 2025-10-21T15:06:05.235+00:00
lat : 34.04555219500415
lon : 71.53623520095651
altitude_ft : 10000
heading : 108
speed_kts : 460
1: Object
2: Object
3: Object
4: Object
5: Object
6: Object
7: Object
8: Object
9: Object
10: Object
11: Object
duration_min : 55


localhost:27017 > flightaware_lab > flights
Documents 1
Aggregations
Schema
Indexes 2
Validation
Type a query: { field: 'value' } or Generate query
ADD DATA
EXPORT DATA
UPDATE
DELETE
_id: ObjectId('68f7a0cc264b32990e2e6228')
flight_id : "PK300"
status : "enroute"
first_seen : 2025-10-21T15:03:40.295+00:00
last_seen : 2025-10-21T15:59:02.452+00:00
current_position : Object
last_update : "2025-10-21T15:04:02.457478"
_id: ObjectId('68f7a0e4264b32990e2e6235')
flight_id : "PK301"
status : "enroute"
first_seen : 2025-10-21T15:04:04.463+00:00
last_seen : 2025-10-21T15:59:26.590+00:00
current_position : Object
last_update : "2025-10-21T15:04:26.598337"
_id: ObjectId('68f7a0fc264b32990e2e6242')
flight_id : "PK302"
status : "enroute"
first_seen : 2025-10-21T15:04:28.604+00:00
last_seen : 2025-10-21T15:59:50.751+00:00
current_position : Object
last_update : "2025-10-21T15:04:50.759073"
_id: ObjectId('68f7a114264b32990e2e624f')


localhost:27017 > flightaware_lab > flights_updates
Documents 4
Aggregations
Schema
Indexes 3
Validation
Type a query: { field: 'value' } or Generate query
ADD DATA
EXPORT DATA
UPDATE
DELETE
_id: ObjectId('68f7a0cc264b32990e2e6227')
flight_id : "PK300"
timestamp : 2025-10-21T15:03:40.295+00:00
lat : 33.65260279456022
lon : 73.09091440716712
altitude_ft : 10000
heading : 210
speed_kts : 387
_id: ObjectId('68f7a0ce264b32990e2e6229')
flight_id : "PK300"
timestamp : 2025-10-21T15:08:42.322+00:00
lat : 32.880848694339
lon : 72.49143584276564
altitude_ft : 12272
heading : 79
speed_kts : 401
_id: ObjectId('68f7a0d0264b32990e2e622a')
flight_id : "PK300"
timestamp : 2025-10-21T15:13:44.341+00:00
lat : 32.116019694180174
lon : 71.92811873852546
altitude_ft : 14545
heading : 301
speed_kts : 342

4. API Endpoints

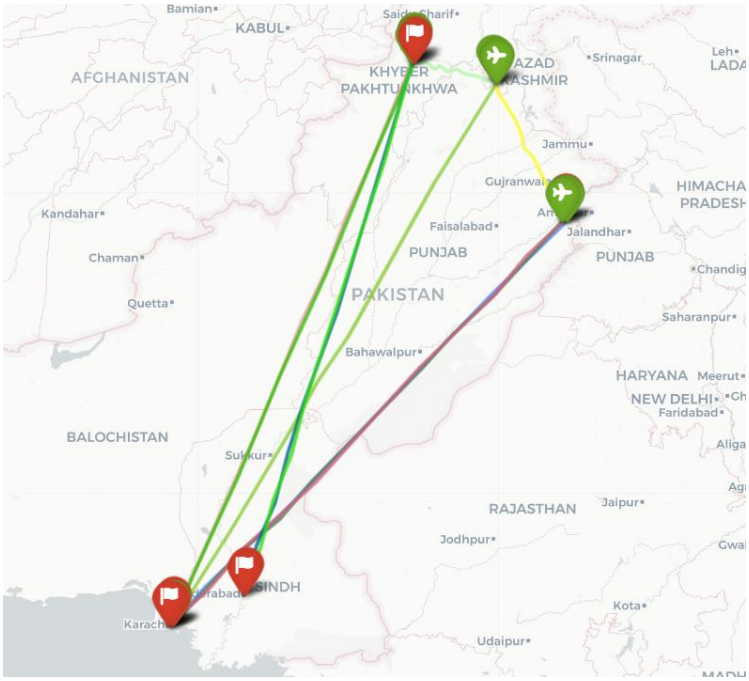
Endpoint	Method	Description
/api/ingest	POST	Ingests new flight telemetry data.
/api/active	GET	Returns all currently active flights.
/api/track/{flight_id}	GET	Retrieves the flight path and updates.
/api/complete/{flight_id}	GET	Marks flight as completed and archives it.

5. Data Flow

1. Flight data is received via POST /api/ingest.
2. Data is validated and stored in MongoDB.
3. Active flights can be queried using GET /api/active.
4. Folium uses these endpoints to visualize positions on a live map.

6. Visualization

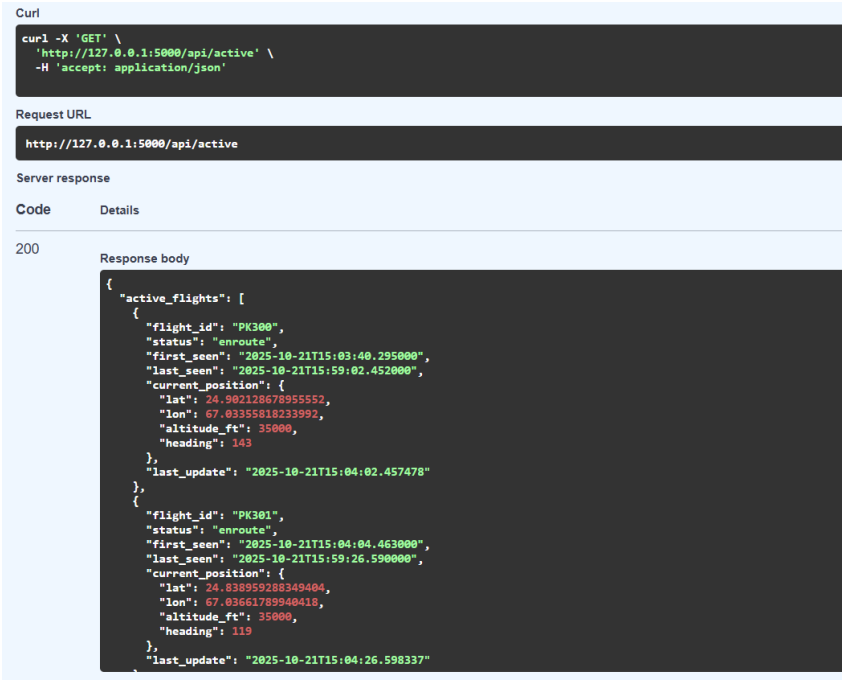
Folium is used to create interactive maps showing flight paths. Each active flight is represented as a polyline, and its latest position is shown with a red marker. The start position is green. Multiple flights are plotted simultaneously.



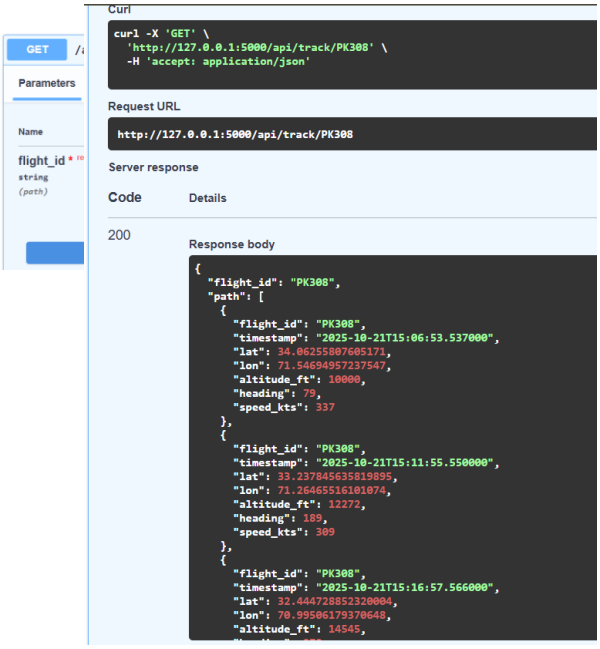
8. Implementation Details

• Framework: FastAPI
• Database: MongoDB
• Visualization: Folium (Python)
• Deployment: Localhost with Uvicorn server
• Tools: MongoDB Compass, cURL/Postman for API testing

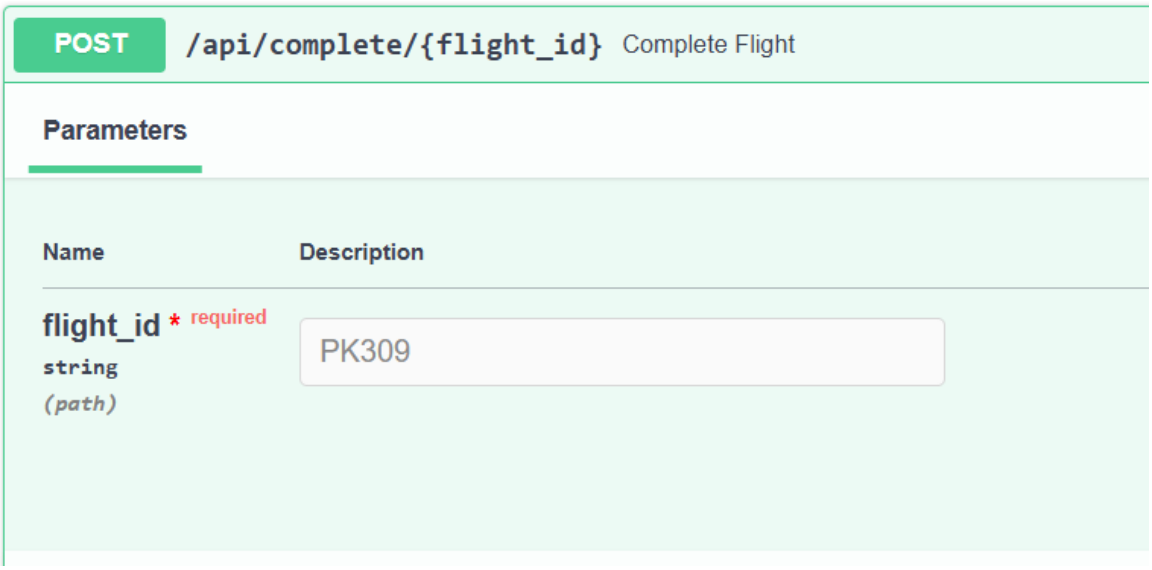
Active:



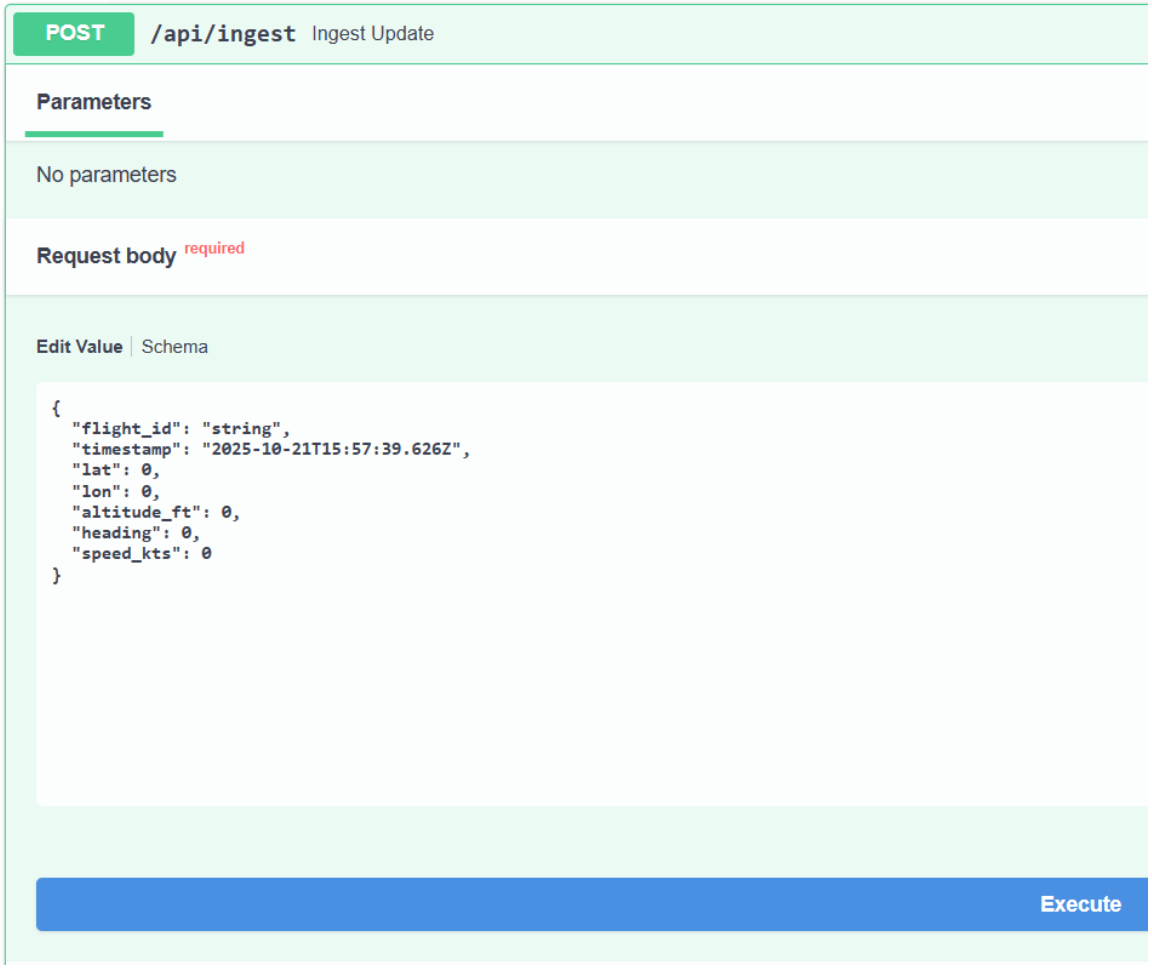
Track:



Complete:



Ingest:



9. Conclusion

The Flight Tracking System demonstrates real-time data ingestion, storage, and visualization using modern Python frameworks. It provides a strong foundation for building scalable, production-grade aviation analytics or tracking systems.