A Project report on

SkyLinker Aero Pathways

A Dissertation submitted to JNTU Hyderabad in partial fulfillment of the academic requirements for the award of the degree.

Bachelor of Technology
in
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CERTIFICATE

This is to certify that the Major Project Phase I report entitled **"SkyLinker Aero Pathways"** being submitted by **P Shreyansh Srikar Rao (20H51A05D2*),* P Nithin Varma Reddy (20H51A05F1), V Venkata Sai Charan Reddy (20H51A0578)** in partial fulfillment for the award of **Bachelor of Technology in Computer Science and Engineering** is a record of bonafide work carried out his/her under my guidance and supervision.

The results embodies in this project report have not been submitted to any other University or Institute for the award of any Degree.

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ABSTRACT

As an aviation enthusiast team, we have always been fascinated by aeroplanes and airports. During one of our regular plane-spotting visits to observe aircraft take-offs and landings, we started wondering how one could keep track of all the flights in real time. That sparked the idea of building an aircraft tracking application. After initial research, we discovered ADS-B (Automatic Dependent Surveillance-Broadcast) - a system where aircraft broadcast their position via radio signals. We realized these publicly available ADS-B feeds could provide the real-time flight data needed for our tracking app idea.

Flying is revolutionised by the SkyLinker Aero Pathways Application, which combines innovative technology with a solid foundation. Using a range of programming languages and advanced tools, it smoothly merges real-time flight monitoring, predictive analytics, and user-friendly interfaces.

Modern web technologies like JavaScript, HTML, and CSS are used to build the application's front-end interface, with the assistance of frameworks like React and Angular. This guarantees responsive and dynamic user interactions, making it simple for travellers and aviation enthusiasts to see flights on interactive maps.

The backend employs a microservices architecture (Python, Java, or Node.js) for tasks like notifications, predictive algorithms, and flight data retrieval, relying on RESTful APIs. Cloud platforms like AWS or Azure provide scalable hosting. Databases (MySQL, PostgreSQL, MongoDB) ensure efficient data management, preserving flight data and user preferences.

Leveraging WebSocket, SSE, front-end tools, databases, cloud, microservices, and RESTful APIs, the Flight Tracker provides instant flight updates, revolutionizing aviation data interaction. Accurate monitoring, predictive insights, and engaging interfaces transform travel, enhancing user experience.

CHAPTER 1

INTRODUCTION

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1.1:Problem Statement

Keeping track of real-time flight information is a challenging yet critical task for many travelers and aviation enthusiasts. However, existing flight tracking options lack key features and functionality that would enable smooth, engaging, and predictive flight monitoring experiences.

Most flight tracking apps and websites rely on outdated technologies that cannot deliver instantaneous flight updates. Their user interfaces often lack intuitiveness and interactivity, making it tedious to search, track, and analyze flight statuses. Additionally, very few platforms incorporate predictive analytics to forecast flight delays or other irregular operations.

There is a need for an innovative flight tracking solution that leverages modern web technologies, microservices architectures, cloud platforms, and predictive algorithms. By combining real-time data feeds, automated notifications, interactive maps, and intelligent predictions, such a platform could revolutionize how travelers and aviation geeks monitor and interact with airline flight information.

The proposed SkyLinker Aero Pathways application aims to fill this gap and transform flight tracking. By building a responsive frontend, scalable backend, and leveraging capabilities like WebSocket and predictive analytics, SkyLinker Aero Pathways can offer travelers and enthusiasts an engaging, smooth, and insightful flight monitoring experience. The development of this real-time, intelligent, and user-friendly flight tracking application will greatly enrich aviation data interaction.

1.2:Research Objective

To develop an innovative flight tracking application (SkyLinker Aero Pathways) that provides real-time flight status updates and predictive insights to travelers and aviation enthusiasts through modern web technologies, microservices architectures, and intelligent algorithms.

More specifically, the key research goals can be summarized as:

•Leveraging ADS-B and other real-time flight data feeds to enable live flight monitoring capabilities.

•Building responsive front-end interfaces with JavaScript, HTML, CSS to allow intuitive flight searching and tracking experiences.

•Implementing scalable back-end microservices in Python, Java, Node.js for tasks like notifications, predictions.

•Using cloud platforms like AWS and Azure to host and scale the application.

•Incorporating predictive algorithms and models to forecast flight delays or irregular operations.

•Providing travelers and aviation geeks engaging, smooth, and insightful interfaces to interact with flight status data.

•Evaluating the usability, performance, accuracy, and impact of the SkyLinker Aero Pathways flight tracking application.

So in summary, the core research objective is to design, develop, and evaluate an innovative real-time flight tracking application called SkyLinker Aero Pathways using modern programming stacks and predictive analytics. The goal is to revolutionize how users monitor and interact with live aviation data.

1.3:Project Scope & Limitations

Scope:

•The flight tracking application will be named SkyLinker Aero Pathways and developed for web and mobile platforms.

•It will provide real-time flight status updates for commercial flights worldwide by leveraging data sources like ADS-B feeds.

•Users will be able to search, track, and save flights to get instant notifications on status changes.

•Interactive maps will display flight positions and details.

•Predictive algorithms will forecast delays and irregular operations.

•The frontend will be built using React, Angular, HTML, CSS, JavaScript.

•The backend will use a microservices architecture with languages like Python, Java, Node.js.

•Cloud platforms like AWS and Azure will be used for hosting and scalability.

•Data will be stored in SQL and NoSQL databases like MySQL, MongoDB.

•The focus will be on building a minimum viable product (MVP) with core functionalities.

Limitations:

•The app will only cover commercial flights and airports with available real-time data feeds.

•Military, cargo, or private flights will not be trackable initially.

•Predictive capabilities will be limited to delays and irregular ops to start.

•Advanced features like booking, seat selection, baggage tracking etc. are out of scope.

•Only web and mobile apps will be built. No desktop or tablet versions to start.

•Access will be limited to search and tracking functions. Account registration is optional.

•The MVP will target key user workflows and scenarios. Additional nice-to-have features may come later.

So in summary, the scope covers building a flight-tracking MVP focused on real-time status, notifications, predictions and clean interfaces, while limitations include flight types, features, platforms, users etc.

CHAPTER 2

BACKGROUND WORK

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BACKGROUND WORK

2.1 Flightradar24

2.1.1 Introduction:

In the modern world, flight tracking has become an essential component of air travel. Passengers, airports, and aviation enthusiasts require ways to track these aircraft in real-time as they frequently cross continents and seas. This is where Flightradar24 has intervened to transform the experience of flight tracking.

One of the most well-known flight tracking systems worldwide, Flightradar24 was established in 2006 by two aviation enthusiasts in Sweden. Through its website, mobile applications, and ADS-B receiver network, it offers real-time information on thousands of planes all over the world.Flightradar24 allows users to track flights in full from the moment engines are started at the gate until it lands at the destination, in contrast to flight status boards at airports that only display a limited amount of information.

An interactive map shows specific information like altitude, speed, aircraft type, and flight path. Users can quickly search for and follow flights using the flight number, airport, airline, or type of aircraft. The majority of contemporary aircraft are equipped with ADS-B transponders, which frequently transmit aircraft information and are the source of this data. These signals are picked up by the over 28,000 ADS-B receivers that Flightradar24 has placed across the world to provide real-time data. This network is enhanced by additional radar, airline, and MLAT data.

Flightradar24 has established itself as the go-to flight tracking alternative for tourists, aviation enthusiasts, and even airlines thanks to its appealing features, user-friendly interface, and global reach. It presently serves over 600 million flight tracking requests each month and has a community of over 2 million active users.Flightradar24 has transformed the public's access to real-time flight information from all over the world, benefiting everyone from anxious travelers to aviation enthusiasts. Its extensive database and user-friendly interface provide an unrivalled flight monitoring experience.

2.1.2 Merits, Demerits and Challenges.

Merits:

- Provides real-time flight tracking data for thousands of aircraft globally.
- User-friendly interface and mobile apps make flight monitoring very accessible.
- Detailed flight information like altitude, speed, aircraft type etc.
- Global network of ADS-B receivers enables wide flight data coverage.
- Options for advanced data analytics and exports through premium plans.
- Large flight and aircraft database accumulated over the years.
- Innovative use of technologies like ADS-B, MLAT, microservices, interactive maps.

Demerits:

- Requires internet connectivity and good data speeds for real-time tracking.
- Not all regions have comprehensive ADS-B coverage currently.
- Basic service is free but advanced features require paid plans.
- Potential errors or gaps in flight data from sources like ADS-B feeds.
- Does not cover certain flight types like military, cargo or private planes.
- Faces competition from other flight tracking services and apps.

Challenges:

- Expanding ADS-B receiver network to maintain global flight data coverage.
- Handling and processing exponentially increasing flight data volumes.
- Redundancies to address any data source outages or coverage gaps.
- Delivering low-latency experiences for real-time tracking as usage grows.
- Rolling out new features while maintaining system stability and uptime.
- Protecting flight data security and user privacy with cybersecurity measures.
- Evolving data analytics capabilities to provide more insights over time.

2.1.3 Implementation of Flightradar24

Data Collection

- Deploy a global network of ADS-B receivers to pick up aircraft broadcasts
- Establish data sharing agreements with aviation authorities for radar data
- Partner with airlines to receive direct data feeds and flight details
- Backend Infrastructure
- Build a scalable microservices architecture on cloud platforms like AWS
- Ingestion services to take in and validate various data feeds
- Enrichment services to add metadata like flight numbers, aircraft info etc.
- Calculation services to derive flight parameters like altitude, speed
- Databases like PostgreSQL, Elasticsearch to store processed flight data
- Frontend Applications
- Develop interactive map visualizations using JavaScript, WebGL, D3.js
- Enable searching and tracking flights via routes, numbers, airports etc.
- Create flight cards showing details like position, altitude, heading
- Build mobile apps for iOS and Android for on-the-go tracking
- Allow saving searches, getting notifications, sharing flight links
- Analysis and Operations
- Implement machine learning pipelines for predictive flight delay models
- Develop dashboards and analytics to derive operational insights
- Monitor performance metrics and logs for issue detection
- Conduct load testing and failover drills to ensure high availability
- Create administration portals for managing data sources and receivers
- With these key components, Flightradar24 leverages innovative data collection, scalable architectures, compelling visualizations and operational excellence to deliver an end-to-end real-time flight tracking experience.

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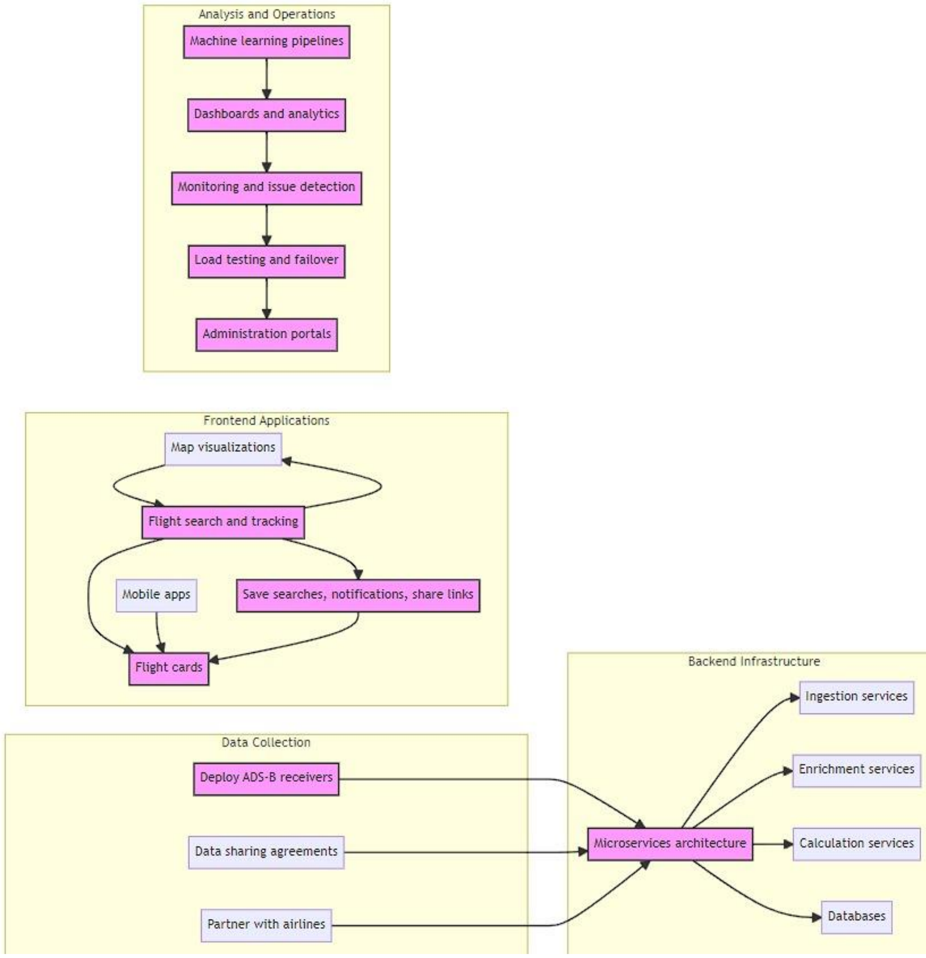


2.1.1:Flightradar

2.2.1:Flightaware

Real-time flight tracking has become an integral part of modern aviation and air travel. FlightAware is one of the leading innovators in this space, providing insightful flight monitoring capabilities to passengers, operators and aviation members.

Founded in 2005, FlightAware was one of the first companies to realize the potential of fusing data from multiple sources like FAA surveillance systems, airline databases and positioning technologies to create a comprehensive real-time flight tracking and status platform.

Powered by a global network of terrestrial and satellite ADS-B receivers, FlightAware collects and processes over 100,000 flights per day amounting to over 150 million flight positions daily. This enables tracking flights worldwide across airline, private, cargo and more.

With an easy to use interface, travelers can search and track flights, set up alerts and access predictive data like delay probabilities. Airlines and operators use FlightAware for operational analytics, flight planning, crew management and more.

Features like 3D flight replay and route animations appeal to aviation geeks. FlightAware also provides a robust API allowing partners to integrate its flight data into custom solutions.

Through its early innovative efforts in harnessing novel data sources and technologies for flight tracking, FlightAware has ensured continuous access to global flight information for the modern aviation industry. Its comprehensive real-time data and intuitive interfaces deliver flight monitoring experiences unmatched in accuracy and ease of use.

2.2.2:Merits, Demerits & Challenges

Merits:

- Real-time flight tracking using extensive ADS-B receiver network and satellites.
- Combines multiple data sources like ADS-B, airline feeds, FAA systems.
- Scalable cloud-based infrastructure handles large volumes of flight data.
- Intuitive apps and interfaces for consumers to track flights.
- Powerful analytics and tools for aviation operators and crew.
- 3D visualizations and animations appeal to aviation enthusiasts.
- APIs allow the development of custom solutions using flight data.

Demerits:

- Requires paid premium subscriptions for some advanced features.
- Limited coverage in regions still lacking ADS-B infrastructure.
- Potential data gaps or lags if an outage occurs.
- Not all airlines share direct data feeds.
- Less emphasis on predictive analytics compared to some competitors.

Challenges:

- Expanding ADS-B and satellite coverage to maintain real-time global tracking.
- Handling exponentially increasing flight data volumes smoothly.
- Updating infrastructure to leverage new technologies like AI/ML.
- Delivering low-latency experiences as user base increases.
- Developing more advanced predictive flight delay/status models.
- Enhancing cybersecurity and protection of user data.
- Evolving pricing model as flight tracking becomes more common.

2.2.3 Implementation of FlightAware

FlightAware, one of the largest flight tracking services in the world, is implemented in a similar way to Flightradar24, with a few key differences.

Data Collection:

- FlightAware operates its own network of ADS-B receivers, but also accepts data from third-party receivers, including those operated by Flightradar24.
- FlightAware has data sharing agreements with air traffic control authorities in over 45 countries, giving it access to radar data.
- FlightAware also partners with airlines and other aviation organizations to receive direct data feeds and flight details.

Backend Infrastructure:

- FlightAware uses a cloud-based infrastructure to process and store its data.
- FlightAware's backend infrastructure is designed to be scalable and reliable, able to handle millions of data points per second.
- FlightAware uses a variety of databases to store its data, including PostgreSQL, Elasticsearch, and Redis.

Frontend Applications:

- FlightAware offers a variety of frontend applications, including a website, mobile apps, and APIs.
- FlightAware's website and mobile apps allow users to track flights in real time, view flight schedules, and get flight status alerts.
- FlightAware's APIs allow developers to integrate FlightAware data into their own applications.

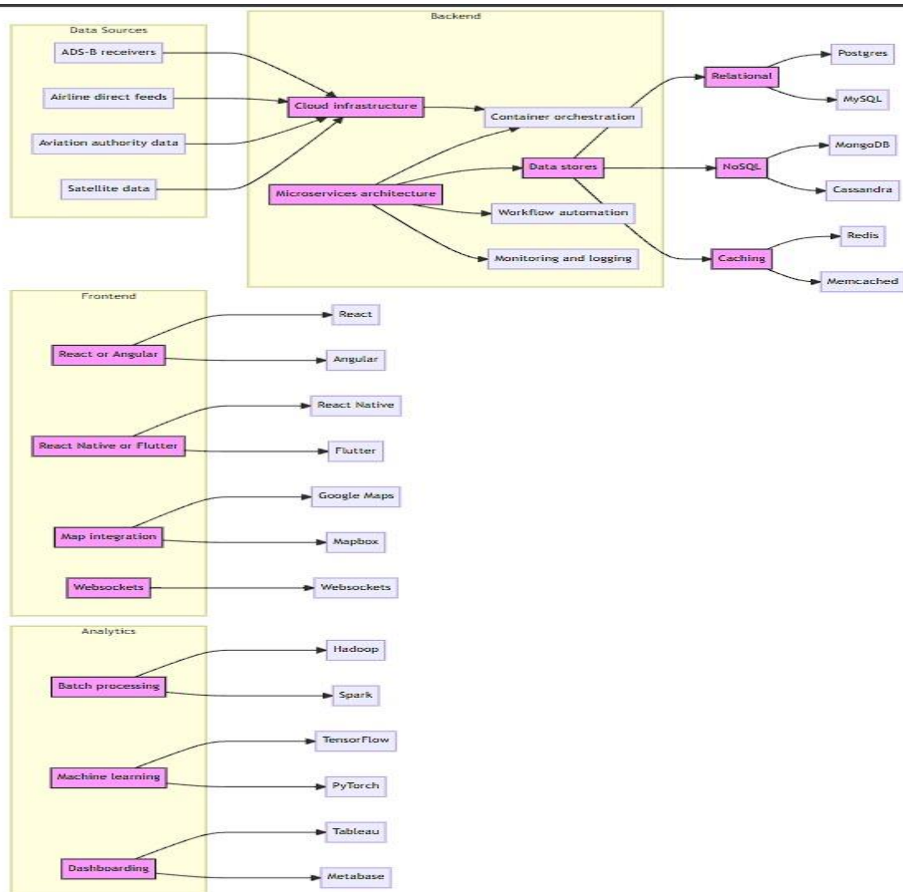
Analysis and Operations:

- FlightAware uses machine learning to analyze its data and provide insights, such as predictive flight delay models and estimated arrival times.
- FlightAware also uses its data to develop dashboards and analytics for aviation professionals.

•FlightAware monitors its performance metrics and logs to identify and resolve issues quickly.

•FlightAware conducts load testing and failover drills to ensure that its service is always available.

•FlightAware also offers a variety of administration portals for managing data sources and receivers.



2.2.1:Flightaware

2.3.1 FlightStats

In today's aviation industry, access to real-time flight information is critical for operators and passengers alike. FlightStats has been a leader in providing insightful flight status data since its founding in 2005. Powered by a global network of terrestrial and satellite ADS-B receivers, FlightStats provides accurate real-time flight tracking for thousands of commercial flights worldwide. Its flight status data covers departures, arrivals, gate assignments, taxi details and more. For passengers, FlightStats allows tracking flights in real-time as well as accessing historical on-time performance data. Its mobile apps and flight alerts ensure travelers are notified promptly about delays or gate changes. For aviation operators, FlightStats offers a suite of flight planning, dispatch and operational tools leveraging real-time data fusion and predictive analytics. Airlines use these capabilities for crew management, fuel optimization and irregular operations. With its combination of real-time flight monitoring, predictive capabilities and data-driven operational analytics products, FlightStats delivers actionable intelligence. Its flexible APIs also allow partners to build custom solutions using FlightStats data. By providing insights from pre-departure to landing backed by technical innovation, FlightStats continues to power the evolving needs of 21st century aviation. Its platforms ensure passengers, airlines, airports and other stakeholders have access to accurate real-time flight information

2.3.2:Merits, Demerits & Challenges.

Here are some potential merits, demerits and challenges for FlightStats in providing flight tracking services:

Merits:

•Real-time flight status tracking using global ADS-B receiver network

•Combination of multiple data sources including airline feeds

•Advanced predictive analytics capabilities using AI/ML

•Robust flight operations tools for airlines and operators

•Flexible APIs enable development of custom solutions

•Passenger-friendly interfaces and mobile apps

•Backed by technical expertise of Cirium company

Demerits:

•Limited free tracking capabilities, premium paid plans required

•Potential for data gaps in areas with poor ADS-B coverage

•Data accuracy depends on airline partnerships

•Competition from other flight trackers like FlightAware

•Additional value-adds beyond just tracking limited

Challenges:

•Scaling infrastructure to handle rapidly increasing data volumes

•Recruiting talent for cutting-edge predictive analytics

•Forging partnerships with more airlines to augment data

•Expanding ADS-B network to maintain real-time global coverage

•Redundancies required for high uptime despite outages

•Monetization difficult as flight tracking becomes commoditized

•Privacy regulations around use of passenger data

2.3.3:Implementation of Flights stats:

Here is an overview of how FlightStats could implement their flight-tracking platform:

Data Sources

•Deploy ADS-B receivers globally to collect real-time aircraft position data

•Partner with aviation authorities for radar and other air traffic data

•Establish direct feeds with major airlines to augment flight details

Infrastructure

•Leverage cloud platforms like AWS for scalable hosting

•Build ingestion pipelines to take in diverse data feeds

•Microservices architecture using Node.js, Python, Java for modular components

•Relational databases like PostgreSQL for structured flight data

•Fast NoSQL caches like Redis for frequent queries

•Kubernetes for container orchestration and deployment

Frontend

•Develop web apps using React/Angular for interactive Uis

•Enable searching, tracking and alerts for flights

•Integrate Google Maps for mapping flight positions

•Build mobile apps for iOS and Android devices

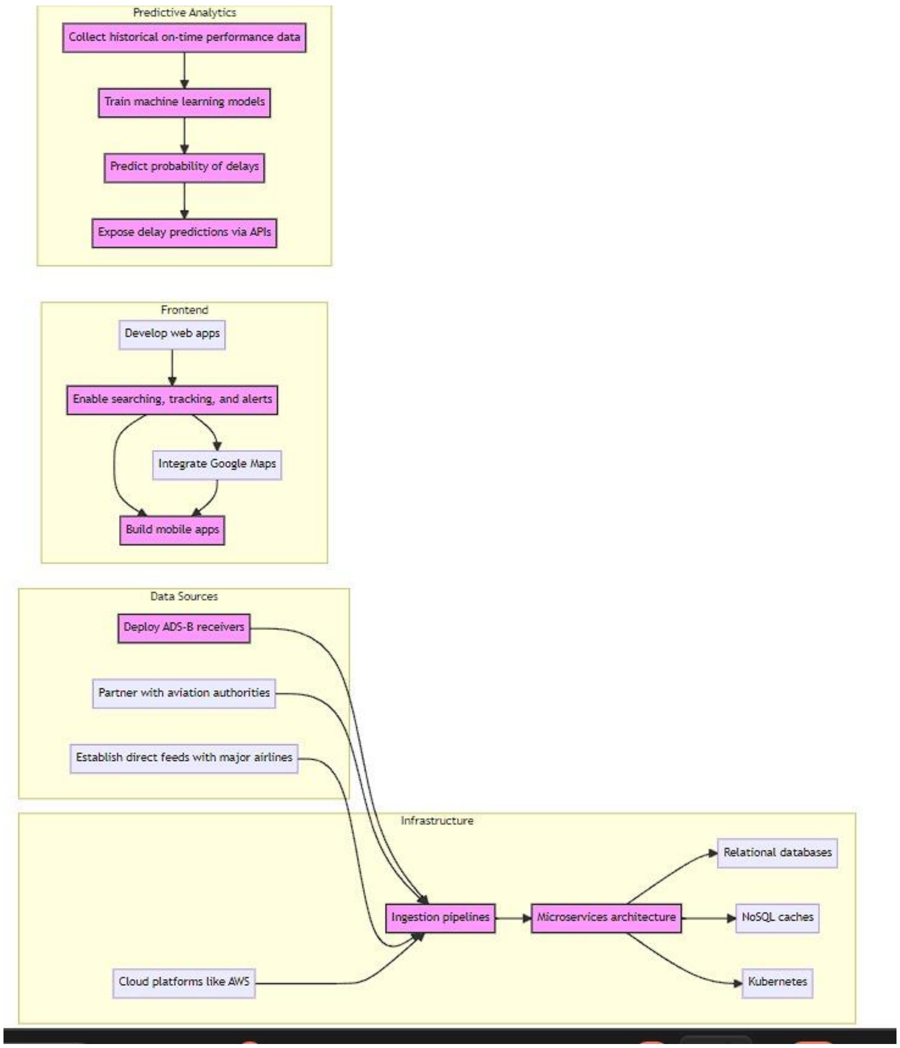
•Collect historical on-time performance data

•Train machine learning models to identify delay indicators

•Predict probability of delays using Gradient Boosting, Random Forests

•Expose delay predictions via APIs for apps

With these core pieces - scalable infrastructure, real-time + predictive data, and engaging frontends - FlightStats can deliver an end-to-end flight tracking platform that caters to passengers, airlines, operators and developers alike



2.3.1:Flightstats

CHAPTER 3

RESULT & DISCUSSIONS

CHAPTER 3
RESULT&DISCUSSION

3.1.1:Result

Several existing flight tracking systems and platforms were explored, including:

•Flightradar24 - Relies on ADS-B receivers and aircraft broadcasts for real-time tracking. Provides flight status via website and mobile apps.

•FlightAware - Combines ADS-B, airline, and FAA data for global flight tracking. Offers robust aviation operations tools.

•FlightStats - Leverages ADS-B network and airline partnerships for tracking and predictive analytics.

These systems demonstrate the viability of flight tracking using data sources like ADS-B and direct airline feeds. Most provide consumer-facing applications with map visualizations. Some also incorporate predictive analytics.

3.1.2:Discussion

Analyzing current flight tracking systems provided useful insights. ADS-B has emerged as a key enabler through increased equipage and deployment of receivers globally. Fusion of multiple data sources is necessary for comprehensive coverage and redundancy. Cloud infrastructure and microservices enable scalability. However, gaps exist around real-time capabilities, predictive features, and intuitive interfaces.

Opportunities remain to build an innovative flight tracking platform combining scalable ingestion of real-time data, predictive algorithms for delays/irregular ops, and engaging consumer apps. An open architecture allowing integration with other emerging aviation data systems is also advised. Overall, this landscape analysis highlights avenues for transforming flight tracking experiences through next-generation solutions.

CHAPTER 4

CONCLUSION

CHAPTER 4
CONCLUSION

4.1:Conclusion

The exploration of current flight tracking platforms like Flightradar24, FlightAware, and FlightStats provided useful insights into the flight monitoring landscape. While these systems have adopted technologies like ADS-B and direct airline feeds, gaps still remain when it comes to real-time data coverage, predictive analytics, and consumer experience.

Our proposed platform SkyLinker Aero Pathways aims to transform flight tracking by addressing these gaps. By ingesting real-time ADS-B, airline, and radar data into a scalable cloud-based architecture, SkyLinker Aero Pathways will facilitate live flight monitoring. Its web and mobile apps focused on end-user needs will provide intuitive flight search and tracking. Incorporating historical data will enable development of predictive models for delays and irregular operations.

Overall, this competitive analysis reinforced SkyLinker Aero Pathways strategic approach and opportunity to disrupt flight tracking experiences. Combining real-time data pipelines, predictive algorithms, and consumer-friendly design, SkyLinker Aero Pathways is positioned to enrich aviation data interaction. The lessons learned from assessing current systems will help guide SkyLinker Aero Pathways efforts to deliver next-generation flight monitoring capabilities catering specifically to travelers and enthusiasts.

CHAPTER 5

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