Aviation Safety System

A Project Report Submitted

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Abstract

The Aviation Safety System is a disruptive innovation aiming to develop a user-friendly web application for managing aviation accident reports. It serves to streamline the process of incident reporting and provide valuable insights for improving aviation safety worldwide empowering passengers to make informed decisions about the flight options available to them. It provides an intuitive interface that makes it easy for anyone to access and contribute accident reports, regardless of their technical expertise. This allows maintenance and accuracy of the Aviation Database and ensures that accurate and legitimized information is received by the public.

A key feature is the integration of data visualization techniques, presenting accident statistics and trends in clear, graphical formats. These visualizations make complex safety data easily understandable, revealing patterns and risks briefly. Furthermore, the application leverages a simple machine learning model to assess flight safety based on historical accident data. A points-based system rewards users for accurate reporting, incentivizing active community participation. The application encourages users to engage with the system regularly and contribute high-quality data.

The design, maintenance and implementation. The backend is powered by SQL Plus, ensuring robust data management, while the frontend is built in C#, offering a modern, responsive user interface. The application is built around the usability, adaptability, and promptness, ensuring accessibility for users with varying levels of technical expertise.

The application has significant potential to improve aviation safety by providing valuable insights derived from accident data. By putting data directly into the hands of safety analysts and stakeholders, it empowers them to make informed decisions and develop effective interventions. By enabling users to analyze patterns and trends, it can help identify risk factors and inform the development of safety protocols. The intuitive filtering and visualization tools make it easy to pinpoint problem areas and spot emerging threats. The machine learning component offers a proactive approach to assessing flight safety, predicting potential issues based on historical accident patterns. This could prevent future accidents and save lives. By giving aviation professionals, the tools to anticipate risks and take proactive action, the application has the potential to revolutionize safety practices in the industry. The gamification element, awarding points for accurate reporting, encourages users to actively engage with the system and contribute valuable data. By making the reporting process fun and rewarding, it ensures a steady stream of high-quality incident reports. This collaborative approach leverages the collective wisdom of the flight safety community to enhance safety. By pooling knowledge and resources, users can improve aviation safety for everyone's benefit.

ACM Taxonomy

[D. Software]: Software Engineering; Software Design; Software Maintenance.

[H. Information Systems]: Database Management; Information Retrieval; Data Management.

[L. Computing Methodologies]: User Interface Design; Database Systems; Document Processing.

Sustainable Development Goals

SDG 3: Good Health and Well-being, as it aims to improve passenger safety and prevent accidents in air travel. By providing tools for proactive safety analysis and community-driven data collection, it seeks to reduce the occurrence of aviation accidents, ultimately promoting the health and well-being of passengers and aviation personnel.

SDG 9: Industry, Innovation, and Infrastructure: The project utilizes technology to innovate and improve existing processes in laboratory management. Digitizing the indent form process contributes to building resilient infrastructure, promoting sustainable industrialization, and fostering innovation.

SDG 17: Partnerships for the Goals, by fostering collaborative problem-solving and knowledge sharing in the aviation safety domain. By encouraging active community participation through a points-based system, it promotes collective action towards enhancing safety standards and reducing accident rates. Additionally, the integration of data-driven insights and machine learning techniques supports proactive safety analysis, contributing to the goal of building effective partnerships to achieve sustainable development.

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Abbreviations

SQL-Structured Query Language

ERD-Entity Relationship Diagram

NF-Normalization Form

BCNF-Boyce Codd Normalisation Form

DBMS-Database Management System

UI- User Interface

Chapter 1

Introduction

1.1 Scope

Accessing and analyzing aviation accident data has traditionally been a laborious and exclusive process, primarily accessible to regulatory bodies and aviation experts. This limited accessibility has posed challenges for leveraging data-driven insights and fostering collaborative efforts to enhance aviation safety.

In response to these challenges, the Aviation Safety System project emerges as a groundbreaking initiative aimed at revolutionizing the management of aviation safety data. By embracing a more democratized and efficient approach, the project seeks to digitize the collection and analysis of aviation accident reports, thereby making critical information readily available to stakeholders across the industry, researchers, policymakers, and the wider public. Through the strategic application of technology, the Aviation Safety System endeavors to streamline safety analysis, foster collaboration, and drive innovative solutions in the aviation sector. By seamlessly integrating digital tools and methodologies, the project envisions a future where aviation safety data is openly shared and actively utilized to proactively prevent accidents and ensure safer skies for all.

1.2Abstraction Layers

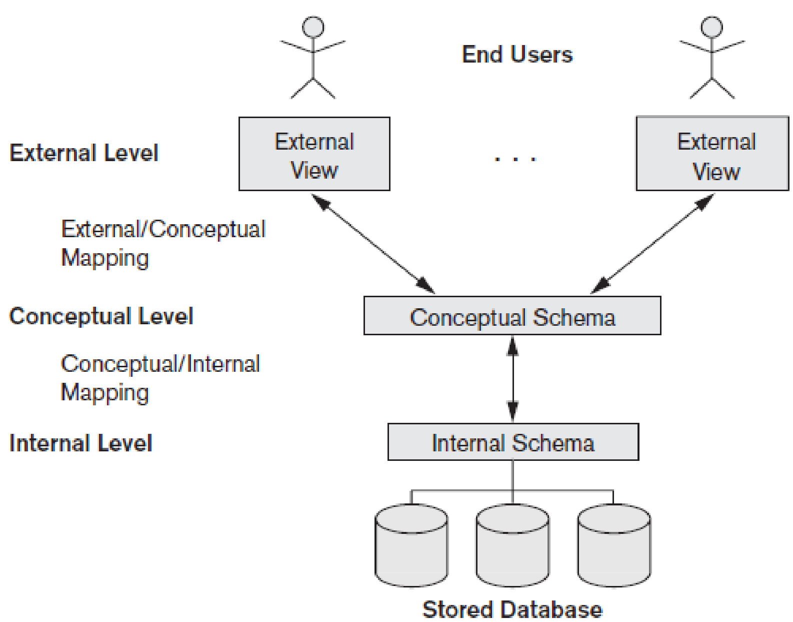


Figure 1.1: Three Tier Architecture

External level: This is the highest level of abstraction. Access is given only to the part of the database that is relevant to a particular user. It is used to refer to users in this context, however application programmers, database administrators, naïve users, sophisticated users all interact with the system at this level. The Naïve users interact with the system through the application interface Application programmers interact with the system through the application programs Sophisticated users interact with the system through query tools Database administrators interact with the system through administration tools Program data independence and Program Operation independence can be observed at the external level. The underlying implementation is not visible.

Conceptual level: Information that is collected in the external layer is processed. It contains the logical structure of the entire database as seen by the DBMS manager. It shields database users from the details of the physical level. It also describes what data is stored in the database and the relationships among the data.

Internal Level: This is where the information that is processed at the conceptual level is stored and managed.

Chapter 2

Background

2.1 Introduction

The aviation industry is one of the most critical sectors globally, facilitating transportation for millions of passengers and cargo every day. However, with the complexity and inherent risks involved in air travel, it is imperative to continuously monitor and analyze aviation safety data to enhance safety standards and prevent accidents.

2.2 Challenges faced in the current paradigm

Accessing and analysing the aviation accident data has been a complex and cumbersome process, often limited to regulatory bodies and aviation experts. This restricted accessibility hindered the broader utilization of data-driven insights and collaborative efforts to improve aviation safety.

Recognizing these challenges, our team embarked on developing a comprehensive system aimed at democratizing access to aviation accident data.

2.3 Key desired features

Beyond mere accessibility, the community needs a culture of innovation and collaboration within the aviation community. We need to leverage advanced technologies such as machine learning, users can proactively assess flight safety based on historical accident data, enabling airlines to

Overall, our system represents an accident. By making valuable data more accessible, we empower users to explore trends, identify patterns, and derive actionable insights from aviation safety data.

Chapter 3

Problem Statements

In the aviation industry, the management and analysis of aviation accident data present significant hurdles that impede safety enhancement efforts. Traditionally, accessing and processing such data has been arduous and limited, mainly confined to regulatory bodies and aviation experts. This restricted accessibility stifles the broader utilization of data-driven insights and hampers collaborative endeavors aimed at improving aviation safety.

The challenges associated with the current approach to managing aviation accident data are multifaceted:

Accessibility: Limited accessibility to aviation accident data inhibits stakeholders across the industry, researchers, policymakers, and the public from accessing valuable insights and contributing to safety enhancement efforts.

Efficiency: Manual processes for collecting, analyzing, and disseminating aviation accident reports result in inefficiencies and delays, hindering timely safety interventions and preventive measures.

Collaboration: The lack of a centralized platform for sharing and analyzing aviation accident data undermines collaboration among stakeholders, preventing the collective pooling of knowledge and resources to address safety challenges effectively.

Innovation: The absence of a standardized and accessible database for aviation accident data stifles innovation in safety analysis techniques and preventive measures, limiting the industry's ability to adapt and evolve.

There is a pressing need for a comprehensive solution that modernizes the management and analysis of aviation accident data.

The Aviation Safety System project endeavors to confront these challenges head-on by developing a transformative platform that digitizes the collection, analysis, and dissemination of aviation accident data. By providing stakeholders with a user-friendly interface and powerful data visualization tools, the project aims to democratize access to critical safety insights, promote collaboration, and drive innovation in the aviation safety domain. Through the integration of advanced technologies and collaborative partnerships, the project seeks to usher in a new era of proactive safety management and contribute to the continuous improvement of aviation safety standards worldwide.

Chapter 4
Data Design

4.1. ER Diagram

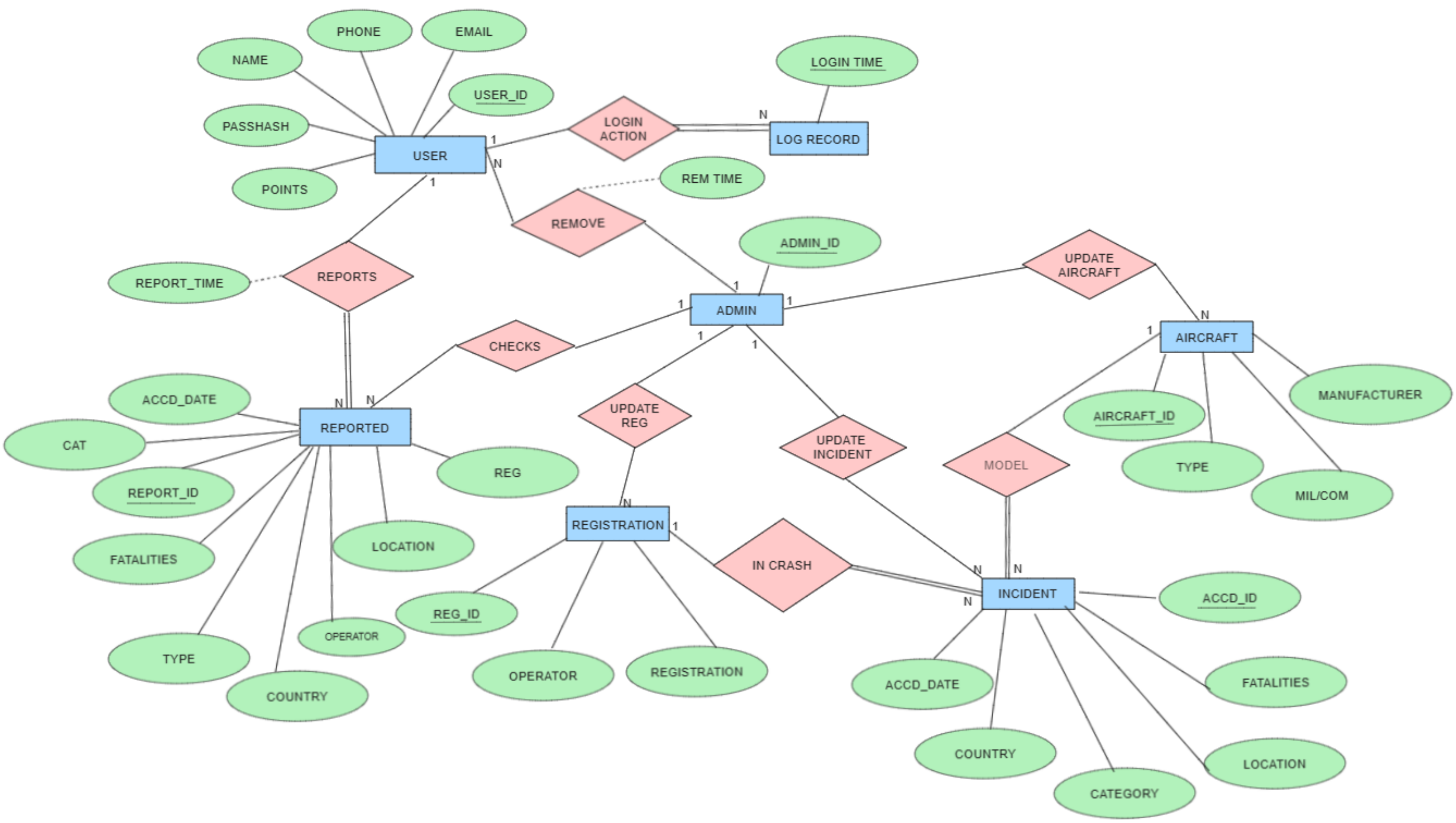


Figure 4.1: ER Diagram of Aviation Safety System

4.2. Schema Diagram

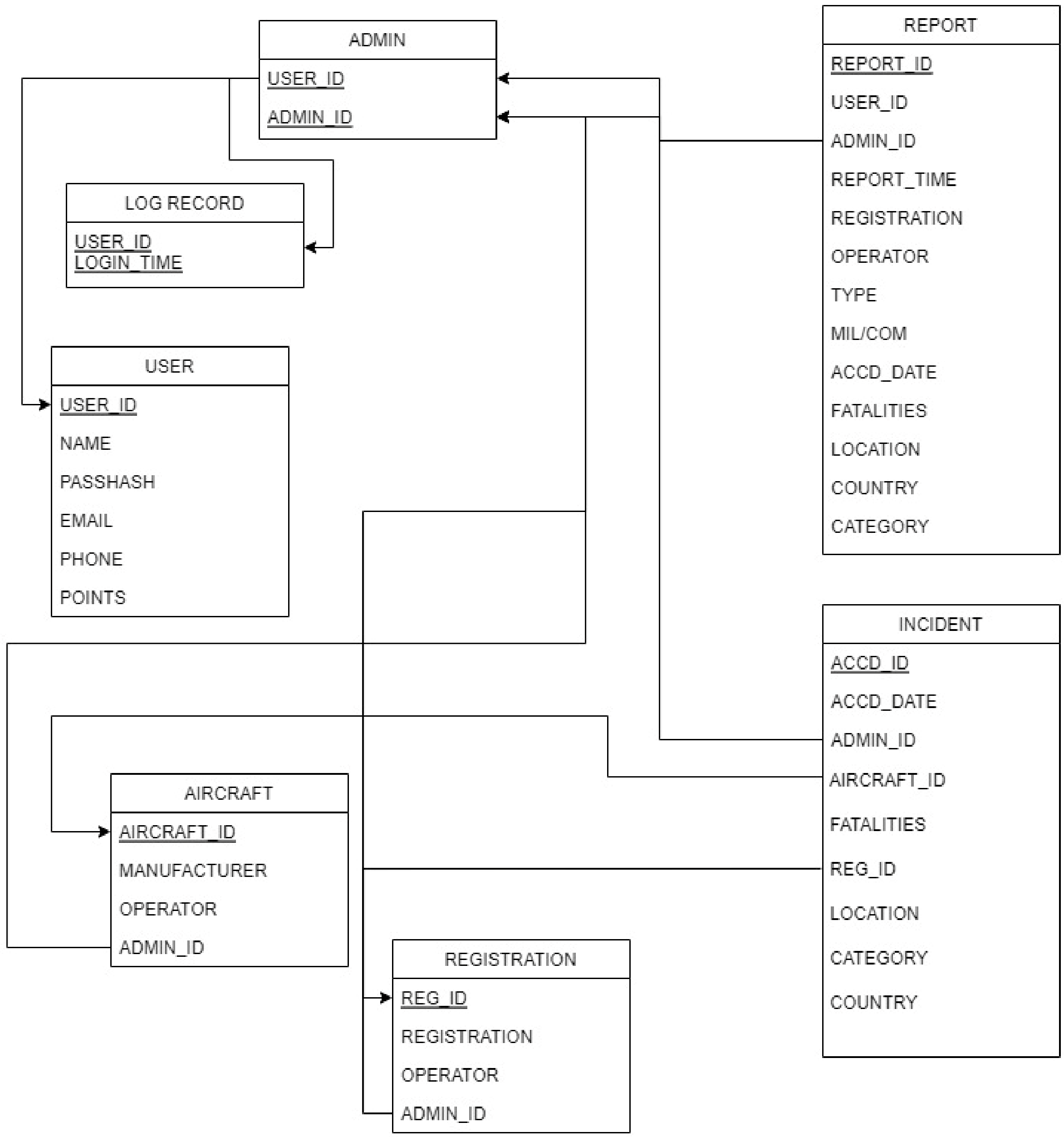


Figure 4.1: Schema Diagram of Aviation Safety System

4.3. Normalization

Universal Table:
R { User_id, Password, Username, Phone, Points, E-mail, admin_id, report_id, report-datetime, manufacturer, registration, type, mil_com, accident_date, operator, fatalities, location, country, cat, accepted, aircraft_id, registration_id, incident_id }

Functional dependencies:
User-id→ {username, pass hash, email, phone, points, login}
Email→ {user_id, username, password, phone, phone, points, login}
Admin→ (admin_id}
Reg_id→ manufacturer, registration,admin_id,aircraft_id}
Accd_id→ {accd_id, operator, fatalities, location,reg_id,category,country,admin_id,aircraft_id}
aircraft_id → {type, manufacturer, mil/com,admin_id}
{user_id,report_id} →{report_date, manufacturer, registration, operator,accd_date, country, category, mil/comm, fatalities, location}

1NF:
Keeping only atomic relations
Login is multivalued, so we make it a new relation
R1 → {user_id,login}

2NF:
Removing partial dependencies
Incident_id → {accident_date, location, fatalities, cat, country, type, manufacturer, mil_com, registration, operator, aircraft, registration, aircraft_id}
Report → {report_id, user_id, Username, Password, Phone, Points, E-mail, {report-datetime, manufacturer, registration, type, mil_com, operator, fatalities, location, country, cat, accepted, accident_date}

Breaking incident into aircraft and registration due to partial dependency
Aircraft_id → {type, manufacturer, mil_com}
registration_id → { registration, operator, aircraft,aircraft_id}
Incident_id → {accident_date, location, fatalities, cat, country, registration_id, aircraft_id}
report_id -> {user_id, report-datetime, manufacturer, registration, type, mil_com, operator, fatalities, location, country, cat, accepted, accident_date}
User_id → {Username, Password, Phone, Points, E-mail}

3NF
User_id → {username, password, email, phone, points, login}
All attributes are directly dependent on the candidate key user_id.
No transitive dependencies.

Aircraft_id → {type, manufacturer, mil_com, admin_id,mil/comm}
All attributes are directly dependent on the candidate key aircraft_id.
No transitive dependencies.

Registration_id → {registration, operator,admin_id}
All attributes are directly dependent on the candidate key registration_id.
No transitive dependencies.

Incident_id → {accident_date, location, fatalities, cat, country, registration_id, aircraft_id }
All attributes are directly dependent on the candidate keys (registration_id, aircraft_id).
No transitive dependencies.

{report_id, user_id} → {report-datetime, manufacturer, registration, type, mil_com, operator, fatalities, location, country, cat, accepted, accident_date }
All attributes are directly dependent on the candidate key (report_id, user_id).
No transitive dependencies.

BCNF:
user_id → {username, password, email, phone, points}
Here, user_id is a superkey, so it satisfies BCNF.

aircraft_id→ {type, manufacturer, mil_com, admin_id}
Here, aircraft_id is a superkey, so it satisfies BCNF.

registration_id → {registration, operator}
Here, registration_id is a superkey, so it satisfies BCNF.

{registration_id, aircraft_id} → {accident_date, location, fatalities, cat, country}
Both (registration_id, aircraft_id) together form a composite superkey.
This table has a superkey on the left side of each non-trivial functional dependency.
Therefore, it satisfies BCNF.

{report_id, user_id} → {report-datetime, manufacturer, registration, type, mil_com, operator, fatalities, location, country, cat, accepted, accident_date}
Both (report_id, user_id) together form a composite superkey.
This table has a superkey on the left side of each non-trivial functional dependency.
Therefore, it satisfies BCNF

Final tables:
User(user_id, passhash, name,email, phone, points,login_time)
Admin(user_id, admin_id)
Registration (reg_id,admin_id,registration, operator)
Aircraft (aircraft_id, admin_id,type, manufacturer, mil/com)
Incident (accd_id,admin_id, reg_id,aircraft_id,accd_date,Fatalities, location, category, country)
Reported (report_id, user_id,admin_id,report_time,registration,operator,type, military/commercial, accd_date, operator, Fatalities, location, country, category)
Logrecord (user_id ,last_login)

Chapter 5

Methodology

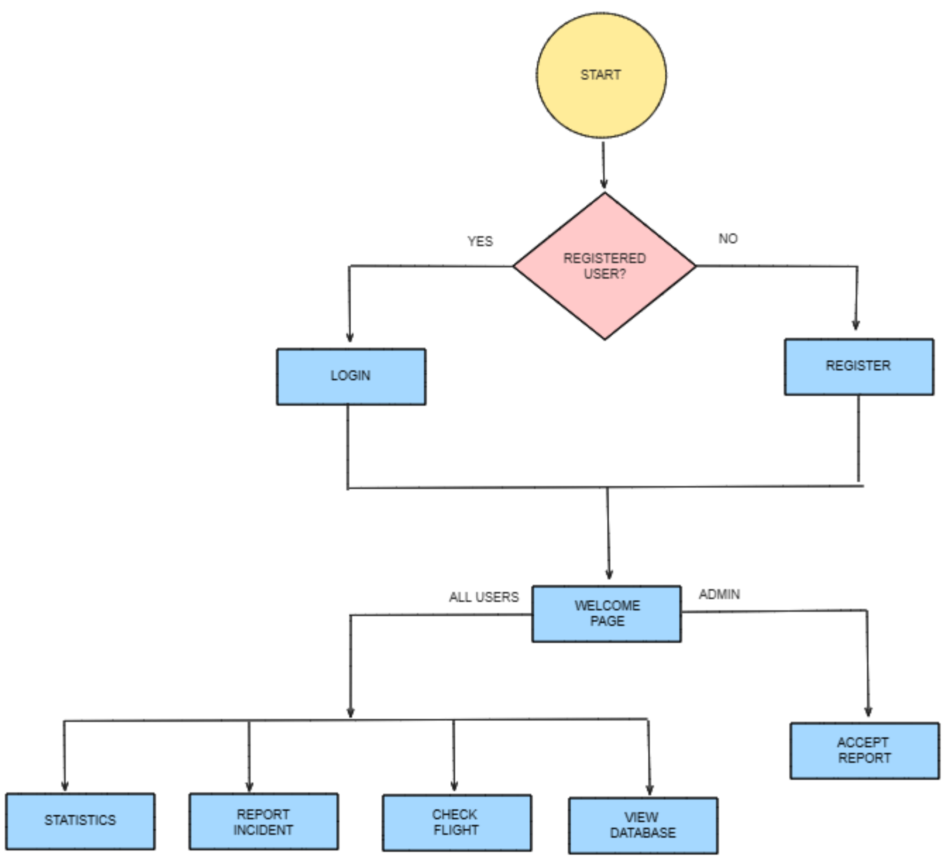
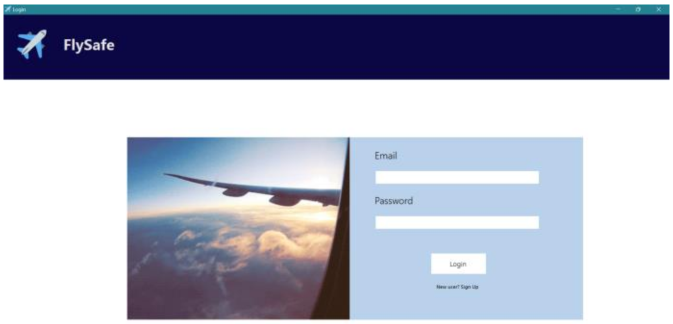


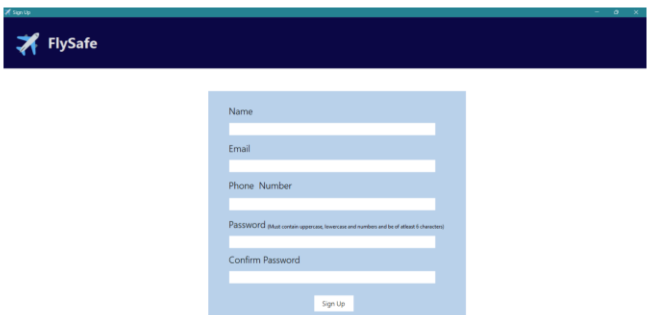
Figure 6.1. Block Diagram

Chapter 6

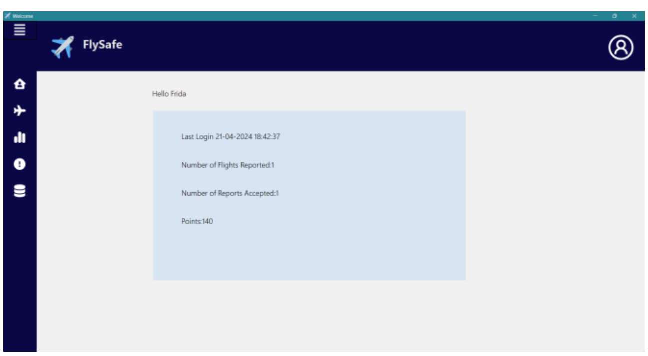
Results



Login: Based on the user_id the access privileges are provided.

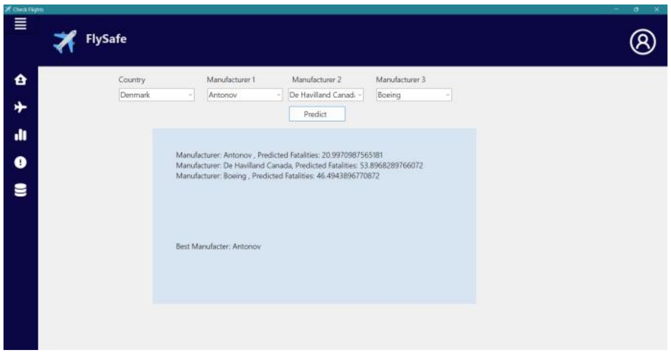


Registration: For new user people to enter their details to sign up securely.

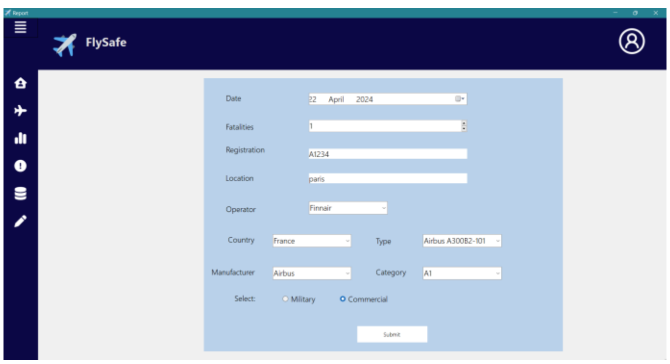


Home Screen: Containing the user’s points and number of reports submitted and accepted.

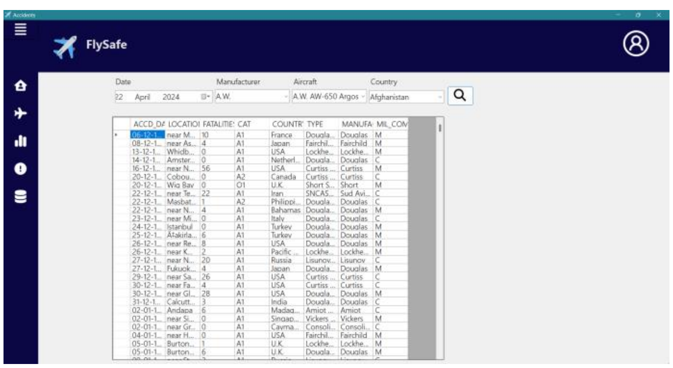
View Charts: Enables user to see the graphed-up data from the database.



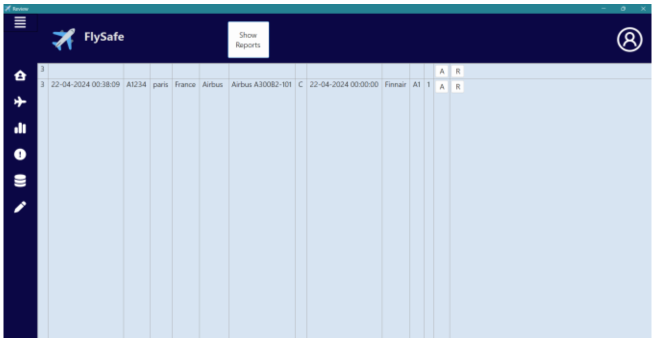
ML: Uses a simple ML linear regression model to find the best manufacturer for a given country.



Report new incident: Allows users to report new incidents.



View Database: Allows users to filter through data with the help of the drop-down option and look accordingly.



Accept Report: Allows admin to view the submitted reports and accept or reject them. Accepted reports immediately get added to the database.

Chapter 7

Conclusion

6.1 Conclusion

In conclusion, the Aviation Safety System marks a significant milestone in revolutionizing the management and analysis of aviation accident data. By digitizing the collection, analysis, and dissemination of aviation accident reports, the project addresses longstanding challenges related to accessibility, efficiency, collaboration, and innovation in the aviation safety domain. Through its alignment with Sustainable Development Goals and innovative use of technology, the project exemplifies the transformative potential of computing in addressing critical real-world challenges and promoting a safer and more sustainable future for air travel.

7.2 Future Work

The Aviation Safety System project lays the foundation for several exciting avenues of future exploration and advancement in aviation safety:

Enhanced Data Visualization Tools: Developing advanced data visualization tools and techniques could further enhance the project's capabilities in uncovering insights and trends within aviation accident data. Interactive dashboards, predictive analytics, and geospatial visualization could provide stakeholders with deeper insights into safety risks and trends.

Integration of Real-time Data Sources: Incorporating real-time data sources, such as aircraft telemetry data and weather information, into the platform could enable proactive safety interventions and enhance predictive modeling capabilities. By leveraging live data feeds, the project can provide stakeholders with up-to-date insights into potential safety hazards.

Collaboration with Industry Partners: Collaborating with airlines, regulatory bodies, and industry partners could facilitate the integration of additional datasets and expertise into the platform. By forging partnerships with key stakeholders, the project can ensure that it remains at the forefront of aviation safety innovation and addresses the evolving needs of the industry.

Implementation of Advanced Machine Learning Algorithms: Exploring advanced machine learning algorithms, such as deep learning and natural language processing, could enhance the project's capabilities in analyzing unstructured data sources, such as accident reports and safety investigations. By leveraging cutting-edge algorithms, the project can uncover hidden patterns and insights within aviation safety data, leading to more effective safety interventions.

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