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IT214 - Database Management Systems (DBMS)
Lab Report

Flight Tracking Database Management System

Lab Group - S1_T5

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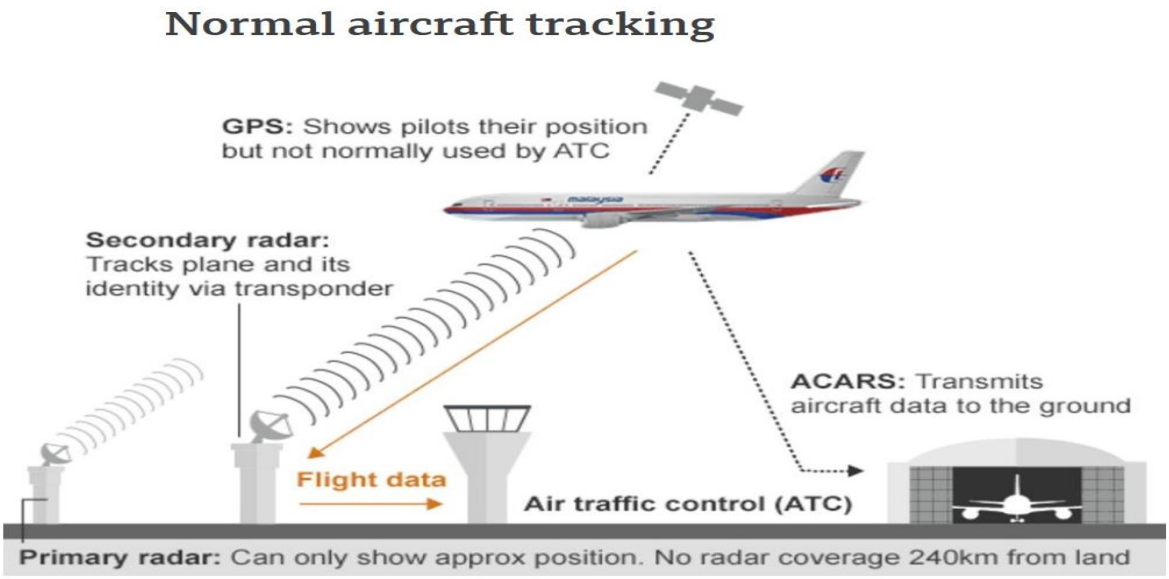
Section1: Final Version of SRS

Problem Description

The task is to create a database for a system that tracks flight's sky paths. The system would be keeping track of flight paths that a plane needs to follow for a given day, and it would provide paths & weather information to pilots and copilots of those specific flights. It would also keep track of live feeds of plane locations during an ongoing flight. It would be able to set alternative paths in case of weather or war emergencies. The database would be able to keep track of old trips and store alternate paths for flights operating above war areas during war emergencies. Along with assisting the pilots and copilots with crucial data, the system would also contain essential information about the pilots that fly their assigned flights. These details would include their unique pilot_id, name, flying hours, designation, etc.

So what presently governs the flight path data, is the data sent by the satellites and radars in the coverage area of which an aircraft is flying. As the flight proceeds on its path, it goes from the area covered by one radar to another and such a process goes on. The radars play an essential role in establishing connection between aircrafts and the air traffic control. Currently, both the planes and the ATC are equipped with sensors and sources which essentially feed data to their respective systems. Our flight path data management system would alter this process in a sense that it will become a unanimous intermediate platform which will provide customized services to all the different classes of users.



The need for making decisions about what flight path to take given the conditions at that time is the crux of this project. A boolean variable denoting whether the crew member is a doctor or not is also stored for each crew member which will be useful at the type of medical emergencies. In such a situation of emergency, these doctor crew members can come to the rescue. Moreover, if a crew member is a doctor, his/her specialization is also stored for making the work easier during emergencies. When considering emergency situations due to some natural calamity or man-made hazards like war, providing optimal flight path suggestions and/or effective re-routing inputs would be a major purpose of this database. Also, the database's information may be helpful for the air-traffic control department for planning to introduce or reduce new flights across varied routes within and outside the country so that people don't have to pay extra money due to high demand or airlines don't suffer heavy losses due to low demand.

Aviation authorities of countries across the world can use this system and keep track of flights flying round the day across the globe. The system can be used to suggest a modified path should it need to change its path. The data can be

used for economic surveys worldwide for cost comparison over years and across countries. It can also be used for estimating worldwide travelling trends that will help the tourism industry to prepare for the forthcoming years. It can be used by research scholars to study and derive insights on air traffic. As previously described, the pilots and copilots will have all the system data on their dashboards with the help of which they can make in-air real-time decisions about path-change, ascend, descend, speeding, slowing, etc. Furthermore, the passengers of a flight would also have access to a certain amount of abstracted data from the system, which would provide them the facility of real-time location tracking. Their experience can be further enhanced by an interactive mode of presentation like a mobile application.

This management has the potential of being practically applied for convenient real time traffic management and route-picking in cases of emergent situations or unfavourable weather. Also provide intercommunication options for on-board crew and the control room on land where data can be shared, updated and managed with ease. The database also has the potential of adding new features and updating existing features which increases scalability of the system. Since this problem statement deals majorly with air-traffic and arial routes, the customer details and related information would be a fruitful extension to the scope of our product. The system would also contain the details of the serving on-board crew-members - details like employee_id, availability, name, designation, working shift, etc. The project is designed in such a way that customer details can be easily linked with the existing database. This data features names of the passengers, their ticket number (which would be unique for every traveller), their flying class, contact details like email id, seat number, and dates of departure and arrival are what would make the system more diverse.
The project revolves around obtaining, maintaining, updating and retrieving data regarding air-traffic. Several authorities can update the data within the project like government authorities, ATC, Satellite and radar system scientists, Pilot and crew and all the experienced authorities for that matter. The system would contain the essential data pertaining to the ATCs like its region, airport, airport_id, and the range of its installed radar(s). Moreover, the system would also have the contact number of the ATC station which might be used for on-land communications. The constantly-updating dynamic information of on-air flights such as location, (based on coordinates), the aircraft deployed for that flight, speed, altitude, previous stop, path, flight type etc. are the factors which need to be updated. The general details like flight_id, take-off and landing times, source, destinations, the id of the deployed aircraft, number of passengers, refuelling status, requirement of emergency landing, the name of the airline, id of the path taken, etc. of every flight Another important feature of the system is that it keeps the data regarding every flight that gets executed. The details here include rerouting specifics like whether the flight was rerouted, what was the reason which made the pilots decide to take a different path, the location at which the plane changed its course, the date and time of occurrence, the information about the old path as well as the new path (path ids), the flight_id and the aircraft_id, etc. These would be tracked by the system.

It would also have the details of aircraft assigned to a specific flight like aircraft_id, its make, model, passenger capacity, fuel capacity and the no. of flights it has done in the past. Some of these can vary with real time such as weather while stop and destinations are generally fixed beforehand so these would make up relevant data about every individual flight . Other factors like weather information, ground status of airports and natural physical parameters like temperature, pressure, etc. will also be the deciding factors because the satellite data is not 100% reliable so we pilot and crew will feed in real time data time to time that what are conditions because nowadays with advanced technologies we detect natural calamities such as cyclones or high speed winds but it isn't true in all the cases sometimes there might be a case in which natural calamity occurs all of a sudden. So , what needs to be done here ?

Our project deals with that too. As mentioned before we have given database access to pilots, copilots and crew so they will also be able to feed in the real time air data in case of emergent situations , with the help of which ATC will reroute the flight so these factors would be among what the database would take care of. The database would be fruitful for making decisions about what flight path to take given the conditions at that time. For facilitating the details of

take-off and landings, the system would have airport details like name, region, number of terminals, no. of accessible runways and a unique identification parameter assigned to it. Each flight will be tagged with the path_id of the path which it is designated to follow. Subsequently, all paths would have a path name for pilots to easily understand the route. As mentioned in the 'privileges' section, all this database would be under control of the system admin who has control over all and every aspect of the database.

Possible reasons for change path of flight abruptly mid-air:

1. Security reasons (radar and altitude)
2. Technical Failures (Engine failures, pressure disturbance, etc.)
3. Passenger Problems (Medical emergencies)
4. Administrative reasons (Permissions to use air-space)
5. Weather conditions (poor visibility, snow, strong winds, etc.)

Possible reasons for cancellation/delay of flight before take-off

1. Unavailability of pilot/crew members at the time of take-off
2. Heavy and unexpected air-traffic at that time of take-off and landing.

Workflow with respect to Travellers:

1. Board a flight.
2. Access the mobile app / website that would act as the front end of this system, if they want to see the live location of their plane.
3. Ponder around the neighborhood of the flight's location.
4. Get an idea of the time required for the flight to reach its destination.

Workflow with respect to Pilots and CoPilots:

1. Begin the flight.
2. Consume the output of the system to judge whether the path assigned to the flight has no potential obstructions on the way.
3. Take inputs from the ATC as well as this system to fix the altitude and speed of the plane.
4. If they find the system data contradicting the actual weather conditions, they may overrule the system data with their own observations and feed the updated data back into the system.

Workflow with respect to ATC:

1. Schedule flights and decide their courses of travel.
2. Derive insights with the help of the data provided by the system to assign path to an aircraft.
3. In case of emergency such as adverse weather, medical emergency, aircraft breakdown, war situation, etc., the ATC would rely on the data in the system to reroute a flight by suggesting the best possible route.
4. The ATC makes sure that the data in the system is consistent with the present rules and regulations of national governments.

Workflow with respect to Governments:

1. Audit the air flight path details from the system whenever required.

Workflow with respect to Security Agencies:

Keep a constant watch on the data and the nature of changes in the data through the system.

[C]. Create Fact-Finding Chart

Objective	Technique	Subject	Time Commitment
To get a proper understanding about flight tracking system	Background Reading	Blogs Research Papers Videos Help of TA's, Kaggle dataset	1 day
Find out core system business	Interviews	Interview of CEO(role play)	40 minute
Find out core system process	Interviews	Interview of ATC (role play)	40 minute
Find out core system application	Interviews	Interview of Captain And airport authority(role play)	40 minute
To know requirements specifically from User perspective	Interviews	A batchmate (potential user)	40 minute
Get User Specification	Questionnaire	Batchmates Friends Relatives	3 days
Observation	Chart analysis	Form answers	2 days

[D]. List Requirements

Under this section we are listing the important features and other relevant points that we can tell by the data we collected using the google forms survey.

1. One has to have different rights for access so should be encapsulated accordingly.

2. We should provide a live tracking system for on ground users because according to surveys they are highly interested.

3. There should be a facility using which a pilot can contact ATC in case of calamities.

4. There should be a facility such that ATC can contact pilots uniquely in case of congestion so pilot details are needed in this case along with that we should maintain crew details too.

5. There should be a functional query such that pilots can act on the advent of databases, exact positional information. This enables direct routes, reduced flight times and reduced fuel consumption.

6. Authorities should have access to the real time data about weather conditions without discrepancy.

7. Efficient rerouting on the basis of information available in times of calamities should be conducted via querying the nearest shortest path.

8. We should have proper passenger travelling details so that in case of medical emergency we can query on the table to find a doctor.

9. We need to have proper aircraft details about weight, fuel capacity, requires refueling, needs repair etc so that while rerouting we reroute it to perfect altitudes because speed of winds and altitudes have effect upon planes flying.

10. We need to take care of where the plane is at regular intervals, so incase of communication problems or flight gets lost midway, it is easy to track at what possible locations the plane might have crashed or currently might be.

[E]. User Classes and Characteristics

Flight Passengers:
The passengers travelling in a particular flight would be the end-users of the flight path data management system, if provided as a software or mobile application service. This is because of the natural human tendency to know what is going around them. Curiosity would drive the users to make use of this flight path data management system to know about the path they are travelling on. The system may provide notifications to the users about specific geographical locations over which their plane is flying. For example, getting to know that their plane is flying alongside the Himalayan mountain range, or the Caribbean islands for instance, would be something the users might be interested in. Other notifications from the system like 'You have just crossed the equator' or 'Enjoy the sunrise at your east' would surely rescue the passengers from the boredom of a 12-hour long flight. The system can also be handy for people whose relatives/friends are travelling by air, as they get a live flight-tracking facility.

Pilots and other onboard crew members:
In the present times, a pilot flying a jet mainly relies on two inputs for A-Z proceedings of their flight. These are - the data of numerous physical parameters like visibility, humidity, turbulence, temperature, etc. provided by the plane's computers and instructions related to maintaining altitude, maintaining speed, ascend, descend, etc. The proposed flight path data management system would, in a way, merge both these aspects by taking into consideration a UNION of both the sets of factors. It would give reliable insights with which the pilot can alter the path of the flight if needed. Inversely, there would also be an option wherein the pilot who has the best knowledge of the weather situation at a specific location, can add relevant data to the system and correct some data if it is found unupdated.

Air Traffic Control:

The Air Traffic Control, generally abbreviated as ATC, manages every aspect of air traffic. It is with the help of ATC that the pilots can undoubtedly proceed on a prescribed air path. This is because the ATC allocates flight paths such that no two flights have a chance of colliding. The ATC would be the final authority that would assign a new path to a pilot in case of an emergency. So, the ATC would be a major stakeholder of the system as it would rely on the data provided by the system to figure out the best new path for an ongoing flight. It is necessary to note that the system would have a constant inflow of accurate data about weather conditions, natural parameters, ground situations of airports, permission of air-space usage in different countries, etc. at regular time intervals.

Governments of nations:
Although the governments of different countries cannot be termed as the 'users' of the flight path data management system, their policies, decisions, way of functioning and relations with other nations heavily impact the data that the system would hold. For example, if the international relations of a country with other nations are not commendable, it might lead to them putting restrictions on the usage of their air-spaces for the flights of the concerned country. The government of a particular nation may consider restricting its planes from flying over some war-affected region and this could be a great situation where this system can prove its worth by providing efficient re-routing. Moreover, the aviation department of a country may use this system to audit flight path data to make analytical and statistical deductions.

Security Agencies:
Securities are of utmost importance for any nation. This is the reason why governments pump billions of dollars every year for ensuring security. After the unfortunate 9/11 incident, the world has well understood the level of destruction that can be caused if air security is compromised. Coming back to the point, data is the fuel for security agencies that analyse the same and make crucial deductions about a country's security and potential steps the country should take to avoid an air-attack. The defence forces of nations too, bear a weary eye over air traffic. All these surveliances can be accurately and efficiently handled if there is a reliable source of well-maintained data. This can be well furnished by this flight path data management system.

[F]. Operating Environment

There is a huge scope of implementing this flight data path management system. The choice of the implementation platform would be decided on the basis of user requirement.

If we consider a version of this system for end-users, i.e. the air travellers, offering the system in the form of a mobile application would make much more sense than offering them a website.

Talking about the pilot and the air crew, there would be a need to integrate this system in the electronic frame of the airliners so that the pilots can access the system without any added accessibility difficulties.

The Air Traffic Control can be provided with a dedicated portal where the system would be executing and the ATC would be able to insert, edit, modify or delete data.

On the other hand, the security agencies or the defence departments of a nation generally have their own top-notch infrastructure. In this case, just providing raw data without any user interface would be the best option. This data can later be processed and used as per the customization needed by the agency.

There would be a firm/company who would administer this database system. This class of user will be the 'superuser class' as they'll have all the authorities pertaining to the roles in the system, It will look after the maintenance of the entire system.

[G]. Product Functions

- Login/Sign In :- As per the type of user whether it's customer, airport authority, pilot or administrator the he/she should be able use the software.
- Track :- Using this function we will provide a live tracking system for on ground users.
- Delay Details :- Using the details function a user can check if a connecting flight is delayed or not.
- Route Details :- Using the Route Details function a user can check the route of the current flight.
- Is Safe :- Using this pilot can ask ATC if the route is safe so results in Enhanced safety of flight throughout the region.
- Reroute :- Using this function pilot can act on the advent of databases, exact positional information. This enables direct routes, reduced flight times and reduced fuel consumption.
- Weather_Details :- Using this function authorities can access the real time data about weather conditions.
- Emergency landing :- Using this function the pilot can ask ATC to reroute in case of calamity. Efficient rerouting on the basis of information available in times of calamities.
- Medical Facility Available :- Using this function we can have a flight check for medical facilities also.
- Acress_db :- Scholars can use this database for research and educational purposes using this function.
- Overruling :- The real-time data provided by the pilot will be able to overrule the previously present data in the system.
- Get the number of available runways :- In case of emergency landing or terminal landing using this function pilot checks where to land.
- Change_Role :- This function will provide a functionality to change a role for a specific user and will be controlled by a firm which will purchase this database system.
- Back_up :- This function will generate backup.

[H]. Privileges

Different users of this system can be divided into different types of roles according to the privilege given to them. i.e. according to the system access given to them. 3 major classes which we thought of are as follows:

i) Pilot role

This role will have the access to send weather information or any information about emergent situations in the flight. It also has the privilege to update the weather details in the main database, in case the system forecast contradicts the results felt by the pilot. It will also have the privilege to see its current location and path, and receive information about changed routes in case of rerouting.

ii) User role

This role will have the access to see tracks and current position of all the flights in action at the moment. It will not have any other privilege except this.

iii) Air Traffic Control (ATC) role

This will have the access to see information about all possible paths for all the flights to take. It will have the access to request the pilot of any flight to change its current path to any of the available possible paths for that flight according to the weather and security conditions.

iv) System Admin role

This is the topmost role in the hierarchy which will have access to functionalities of all the above 3 roles. In addition to it, it will have the privilege to assign or revoke the role of any individual. Thus, all in all, the company providing this software will have this topmost admin role.

[I]. Assumptions

We have made the following assumptions for making this report :

1. The pilot has accurate information about the weather at that particular time and place.
2. The technological advances are sound enough that all the features that we want to introduce are feasible to implement on ground.
3. The air traffic controller has complete information and autonomy to change the path of flight as per requirements.
4. The system shows accurate data to the users in a real time scenario without any delay for updating.
5. The connection between crew members and air traffic controllers is always maintained and is never broken.
6. All the data collected is highly reliable and available in real time.

[J]. Business Constraints

The following would impact a lot of business constraints:

1. Price of fuel used : All the aircrafts require highly refined fuels in high amounts, so price of fuel will be a determining factor.
2. Government rules and regulations : Each country has to pay a certain amount of money to another country for using its airspace for some time. Also, which countries' aircrafts will be allowed to fly and which won't is also decided by the government.
3. Salaries of professionals like pilots, air-hostess, crew members etc will also impact the business constraint to a certain extent because this domain requires highly specialized persons and small mistakes can be fatal to the passengers in the aircraft.
4. The number of people travelling at a certain location and proximity of other airports: If a lot of people want to fly from a particular place , it is likely that an airport will be built in a nearby area , provided there isn't another airport nearby.
5. Safety concerns : Airplanes generally take routes that are safer even if it means taking longer routes. For example, flights are currently not flying in the Afghanistan region due to safety concerns and planes don't fly near the bermuda triangle.