AI-Based Air Traffic Control System Using Opensky API

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Abstract- Air traffic management is an essential component of the current aviation system. With the rise of the number of aircraft flying across the globe, the conventional method of air traffic control is facing difficulties in handling large quantities of data. This paper focuses on an AI-based system for monitoring air traffic using the OpenSky Network API to access the required data. The system receives aircraft information such as altitude, velocity, etc., using the API. The received data is then analyzed using intelligent algorithms for the purpose of monitoring. The proposed system will be useful for the visualization of the movement of aircraft in the airspace, thus helping to identify possible congestion. The proposed AI-based system for monitoring air traffic will be beneficial for the efficient management of air traffic.

I.   INTRODUCTION

Air traffic control is an essential factor for ensuring the smooth movement of flights in the air. With the ever-increasing air traffic around the world, it has become increasingly challenging to process large amounts of flight data. Existing air traffic control systems mainly rely on humans for monitoring flights and maintaining proper distance between flights and are heavily radar dependent Today, advancements in artificial intelligence have opened doors for improving air traffic control monitoring systems by leveraging the capabilities of intelligent data processing systems. This project aims to design an air traffic control monitoring system based on artificial intelligence, which will fetch flight data from the OpenSky Network API for better monitoring of air traffic control.

NEED OF THE STUDY

In the last few years, there has been a tremendous growth in air transportation. As a result, the number of aircraft in the air at any given time has increased significantly. It is quite challenging to control the increased number of air traffic by using traditional air traffic control systems, as it is mainly based on manual control and radar technology. As the number of aircraft is increasing, it is important to have better tools that can help in the efficient control of air traffic.

Due to the advancement in Artificial Intelligence and real-time data technologies, it is possible to create a smart system for the efficient control of air traffic. It is possible to obtain real-time flight data using the OpenSky Network. By using the flight data, it is possible to create a smart system based on Artificial Intelligence technology. This will help in efficient air traffic control.

This study is based on developing an AI-based air traffic control system by using the OpenSky Network API. This will help in observing the aircraft in the air.

3.1 POPULATION AND SAMPLE

In this study, the population is defined as all aircraft whose flight information is available through the OpenSky Network database. The OpenSky Network is a database that collects real-time flight data from aircraft transponders worldwide. The data collected includes flight information such as aircraft position, altitude, speed, and identification.

From the defined population, a sample of real-time flight data is collected using the OpenSky Network API. The system retrieves flight data within a specific geographic region and time period. This data is used to monitor the flight patterns and movements. The sample data collected includes aircraft parameters such as latitude, longitude, altitude, and velocity. This data is used to illustrate the working of the proposed AI-based air traffic control monitoring system.

3.2 Data and Sources of Data

For the purposes of this study, secondary data will be employed to create and test the developed AI-based Air Traffic Control system. The main source of data for this study will be obtained from the OpenSky Network, which offers real-time and historical flight data from various parts of the world. This data is obtained from various aircraft transponders. OpenSky Network offers access to various pieces of aviation-related data through its Application Programming Interface, known as API.

Data obtained from OpenSky Network API includes various parameters, such as identification of aircraft, latitudes, longitudes, altitude, velocity, and direction, which are constantly updated. These pieces of data are utilized by the system to monitor various aircraft movements in real time. These pieces of data are further analyzed with the aid of Python programming tools. By employing accurate data from OpenSky Network, this study aims to provide precise monitoring of various aircraft movements, thus proving the practicality of the developed AI-based Air Traffic Control system.

3.3 Theoretical framework

The theoretical framework of this study is based on the concept of using Artificial Intelligence to analyze the flight data in real-time for the purpose of monitoring the air traffic. The system uses the API of the OpenSky Network to collect the data related to the aircraft, which is then used to analyze the movement of the aircraft in the airspace. The system uses various parameters to analyze the aircraft movement.

II. RESEARCH METHODOLOGY

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

3.1 Population and Sample

In the present research, the population indicates the set of aircraft for which the flight data is accessible via the OpenSky Network database. However, as the data does not require the assessment of all the aircraft across the globe, a smaller set of real- time flight data is considered for the purpose of the research. The data is collected from a particular region and time using the OpenSky Network API. The data is utilized to monitor the movement of the aircraft for the purpose of the proposed AI-based air traffic monitoring system.

3.2 Data and Sources of Data

The data used in this study is collected from the OpenSky Network platform. This platform offers open access to aviation data through the API. It collects flight information in real time, including aircraft identification, latitude, longitude, altitude, and velocity. It uses tools based on the Python programming language for flight monitoring and visualization. It is a reliable source for collecting accurate information on aviation.

3.3 Theoretical framework

This study's theoretical framework will consist of utilizing Artificial Intelligence with real-time data from aviation to provide a mechanism for improved efficiency of air traffic monitoring and management. Global airspace is presently experiencing an increase in the number of aircraft flying in it, therefore traditional monitoring systems face many challenges when processing large quantities of flight data in a timely and accurate manner. By utilizing AI Technology, large sets of data can be analyzed for patterns and will improve decision-making in dynamic environments like that of air traffic control.

The OpenSky Network is the primary source used for data collection in this study. The OpenSky Network collects flight data from aircraft transponders and provides that data to the public as real-time/or historical aviation data through their API. This data consists of many valuable pieces of information such as: aircraft ID number; geographic location (i.e., latitude and longitude); altitude; speed; and direction. These pieces of information will be used for the purpose of monitoring the movements of aircraft inside of controlled airspace.

The proposed system will retrieve the above-mentioned real-time aircraft data from the OpenSky Network API and process utilizing tools that are Python based. The written code will parse, store, and analyze this data to identify trends, movement patterns, and traffic density. Artificial Intelligence techniques will be employed during the data processing stage to assist in identifying trends and anomalies in aircraft movement.

Another aspect of the framework is the emphasis on the visualization of the system. This is where the positions of the aircraft are shown using a graphical user interface. This allows the user to be able to see the activity of the aircraft. This, in turn, helps the user to be able to understand the distribution of the aircraft in a given region of the airspace.

From the above, the theoretical framework shows the potential of the integration of Artificial Intelligence, the data obtained from the aviation sector, and the visualization of the data. The system shows the potential of the integration of intelligent technologies in the management of the air traffic.

3.4 Statistical tools and econometric models
This section elaborates the proper statistical/econometric/financial models which are being used to forward the study from data towards inferences. The detail of methodology is given as follows.

3.4.1 Descriptive Statistics
In the current study, descriptive statistics are used in summarizing and understanding the real-time flight data collected using the OpenSky Network API. The data collected in this study includes information such as the aircraft's position, altitude, velocity, and direction. Descriptive statistical methods are used in organizing and presenting the data in a simple and meaningful way, which makes the patterns in the aircraft's movements easily observable. Averages and ranges are used in understanding the general behavior of the air traffic in the specific region, which makes the monitoring process easier in the proposed AI-based air traffic control system

3.4.2 Correlation Analysis
On the one hand, correlation analysis is applied in this study to evaluate the relationship between various parameters of flight obtained from the OpenSky Network API. In addition, the obtained dataset includes essential parameters like altitude, velocity, latitude, longitude, and direction of movement of an aircraft. By analyzing these parameters, one can understand how various parameters of flight are correlated with each other during real-time movement of an aircraft.

It becomes evident from this analysis that one can understand how changes in one parameter can affect changes in another parameter. For instance, one can understand the relationship between the speed of an aircraft and its altitude, as well as changes in geographical position over a specific period of time. By understanding these relationships, one can easily identify various movements of an aircraft within a specific airspace.

This analysis helps in developing an AI-based air traffic monitoring system by gaining a better understanding of various traffic patterns. One can easily identify various trends like traffic density, movement consistency, and changes in various parameters of an aircraft.

Overall, the role of the correlation analysis in the organization and interpretation of the flight data is significant, which contributes to the improvement of the effectiveness of the proposed AI-based air traffic control monitoring system. Besides, the use of the correlation analysis contributes to the simplification of the large amount of flight data by emphasizing the significant relationships that exist between the various variables. Considering the fact that the real-time aviation data is subject to constant updates and has several parameters, the identification of the relationships makes the monitoring process efficient. By understanding the relationships that exist between the various factors, such as the speed, altitude, and geographical position, the system can better interpret the movement of the aircraft within the monitored region, which makes a significant contribution to the objective of the study.

3.4.2.1 Trend Analysis
In this study, the concept of trend analysis will be utilized to analyze the patterns of the movement of aircraft over a given period of time using the data

collected from the OpenSky Network API. The collected data, which include the aircraft's position, altitude, and velocity, will be analyzed to identify the changes in the air traffic over the chosen region. The analysis of the trends will enable the system to recognize the changes in the patterns of the movement of aircraft.

This analysis will be useful in understanding the patterns of the behavior of aircraft over a given period of time. It will be useful in the proposed AI-based system for monitoring air traffic since it will be able to identify the patterns of the movement of aircraft. This analysis will be useful in understanding the importance of the analysis of the data in the improvement of the air traffic control system.

3.4.2.2 Traffic Density Analysis
The use of traffic density analysis is applicable in this study, which helps in understanding the concentration of aircraft in a specific airspace at a given time. The number of aircraft present in the selected region is observed and analyzed based on the real-time data obtained from the OpenSky Network API.

The traffic density analysis helps the system identify the regions where the movement of aircraft is higher compared to other regions. This helps in understanding the air traffic and the movement of aircraft in the selected region. It also helps in demonstrating the capabilities of the AI-based system, which helps in managing the air traffic by providing clear insights into the movement of aircraft in the selected region.

The traffic density analysis also helps in demonstrating the visualization aspect of the proposed system. It helps in understanding the distribution of aircraft in the selected region, which makes the system easier to comprehend and interpret. It helps in demonstrating the capabilities of the system, which makes the air traffic monitoring easier and demonstrates the capabilities of the system.

3.4.3 Comparison of the Models
In the current study, various techniques such as descriptive statistics, correlation analysis, trend analysis, and traffic density analysis are used in the analysis of flight data retrieved using the OpenSky Network API. These techniques give a different view of flight movements and air traffic. Descriptive statistics are used to describe the data, correlation analysis is used to find relationships in the data, while trend and traffic density analyses are used to understand the movements and the aircraft in the monitored area.

III. RESULTS AND DISCUSSION

4.1 Results of Descriptive Staticstics of Study Variables Analysis of real-time flight data obtained from the OpenSky Network API proved to provide valuable insights into the movement of aircraft within the observed airspace. By analyzing various parameters such as altitude, velocity, and geographical coordinates, the study was able to understand various aspects of aircraft movement. As indicated by the study, aircraft movement is constantly changing as aircraft undergo various stages of movement, including climbing, cruising, and descending.

Further observations from the study indicate that various regions are more active in terms of aircraft movement compared to others.

These observations are an indication of commonly used routes by aircraft. By analyzing various parameters, the study was able to understand their interaction during aircraft movement. As indicated by the study, this shows that real-time data can be effectively utilized in monitoring and analyzing air traffic conditions. Therefore, based on the results obtained, the study proves that the proposed AI-based air traffic monitoring system can be effective in air traffic management. By combining real-time data analysis with various visualization techniques, better understanding of the distribution of aircraft can be achieved. This shows that AI can be utilized in modern air traffic management.

IV. ACKNOWLEDGMENT

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