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Automated Airline Slot Allocation using Rationalized Block Time

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Abstract:
Presently, the slot allocation process allocates departure slots at an airport. The airlines then request an arrival slot after the due consideration of flying time, at the destination airport. If the arrival slot is not available, the next available arrival slot is allotted, thereby adding an artificial "balloon" to the total flight time. The Slot allocation is done with respect to Gate out Time and Gate in Time for the respective City pair. The varying factors are adjusted accordingly to meet the requirements of Gate out and Gate in Times ie.,Total Block Time. However, based on historic data the extra padding or buffer time are added for airlines, is and are not realistic. This results in uneven distribution of air traffic between congested airports. We have built an innovative solution to carry out the data analytics and to arrive at an innovative solution in the development of an algorithm for slot allocation between two/multiple congested city airports with rationalized block timings.
Keywords*: Slot. Time, Airport, Algorithm*

I. INTRODUCTION

The web application we built will get the slot requests from the airlines and will allocate the slots based on the Airlines OTP points. India has been experiencing exponential growth of air traffic. Domestic air traffic movements have seen a consistent growth rate of 15% or above since the last couple of years. All the domestic airlines have plans to augment the fleet substantially in the next five years. It is estimated that the air traffic will almost double in the next five years, propelling India as the third largest aviation market. The growth of aviation requires a continued-up gradation and improvement in the infrastructure. However, the creation of infrastructure has a long gestation period and therefore, airport capacity and air traffic demand needs to be optimally balanced to minimize operational inefficiencies such as serious congestion at Metro Airports/airspace, avoidable aviation fuel burning and carbon emission. One method of strategic planning of allocation of airport resources is airport departure and arrival slot allocation to various airlines. The process of slot allocation is carried out twice in a year, in the months of October [Winter Schedule] and March [Summer Schedule] each year. For each capacity constraint airport, also called a coordinated airport, based on the specific capacity bottlenecks, the annual and hourly declared capacity have been established in terms of available slots. Each airline needs a slot to operate an air service at the coordinated airport. The coordinator, who is appointed by the Government, allocates the

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slots each season to the airlines in an independent, neutral and non-discriminatory way. The detailed process of slot allocation is available in the "Guidelines for Slot Allocation (revised May 2013) "published by the Ministry of Civil Aviation, Government of India.

II. Objective

- To ensure safe operation of Aircrafts
- To ensure congestion and hassle free smooth operations in Level 3 Airports
- To save billion worth fuels, thus reducing carbon footprint
- To reduce the time taken in allocating slots
- Ensuring optimal allocation of Slots to Aircrafts

II. TECHNOLOGY

- Semantic UI React
- MongoDB
- Node.js
- Version Control System

III. DESIGN OF PROPOSED SYSTEM

A. Existing System

One method of strategic planning of allocation of airport resources is airport departure and arrival slot allocation to various airlines. The process of slot allocation is carried out twice in a year, in the months of October [Winter Schedule] and March [Summer Schedule] each year. For each capacity constraint airport, also called a coordinated airport, based on the specific capacity bottlenecks, the annual and hourly declared capacity have been established in terms of available slots. Each airline needs a slot to operate an air service at the coordinated airport. The coordinator, who is appointed by the Government, allocates the slots each season to the airlines in an independent, neutral and non-discriminatory way. The detailed process of slot allocation is available in the "Guidelines for Slot Allocation (revised May 2013) "published by the Ministry of Civil Aviation, Government of India.

B. Proposed System Design

The Airlines will login to request slots for the Aircrafts they are going to operate between the Ports and the details of those Aircrafts such as Aircraft Modal, Operating Period etc., and the Algorithm will allocate the rationalised slots of the airlines. This eases the most time consuming and labour intensive error and also reduces the chance of errors in the slot location.

IV. APPLICATION

The web application we built is built in an elegant and robust way using the state-of-the-art Technologies, such as Semantic-UI React for front end, Node.js for server configuration and MongoDB as the Database. The Airlines will login and request slots for the Aircrafts they are going to operate between the Ports in the specific season and the details of those Aircrafts such as Aircraft Modal, Operating Period etc., will also be provided by the airlines to the algorithm. Our web Application will act as an automated cognitive system powered with Stable two-sided matching Algorithms such as Trade Cycle (TC) Schummer algorithm to assist the ATC controllers in allocating and managing the slots in an efficient way. Our Algorithm takes the requests from the Airlines and the ATC Controllers regarding the Flight's ETA and ETD along with other necessary parameters to consider, such as Flight Size, Priority etc., and will suggest the ATC controllers for the best possible Slot. As our system is connected to both the Departure Airport and Arrival Airport, immediate decisions can be made by processing availability of slots in both the ports, this eliminates the Balloon to the total flight time. Heuristic approach will be used to find the optimum solution within a short time. The current system of coordinating aircrafts in the port is dependent on the experience of the ATC controllers and its really challenging for the controllers to handle multiple aircrafts at the same time. We have built the web application to tackle the problem of congestion in airports by building an automated slot allocation

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algorithm with rationalised block timings.

A. Figures

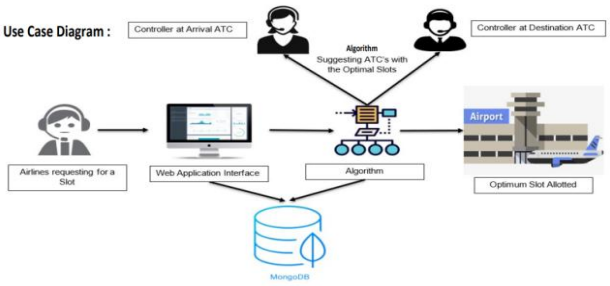


Fig. 1.**Use case diagram**

Fig. 2.**Login page**

Fig. 3.**Login page with dropdown selected**

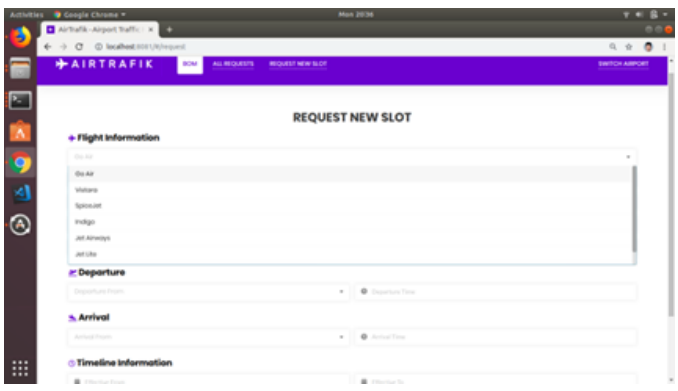


Fig. 4.**Slot request form 1**

Fig. 5.**Slot request form 2**

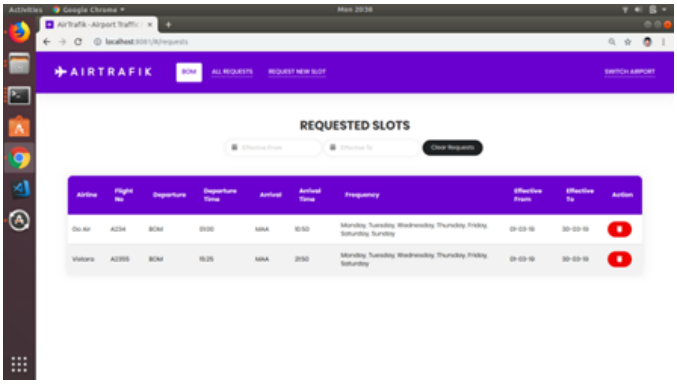


Fig. 6.**Request list**

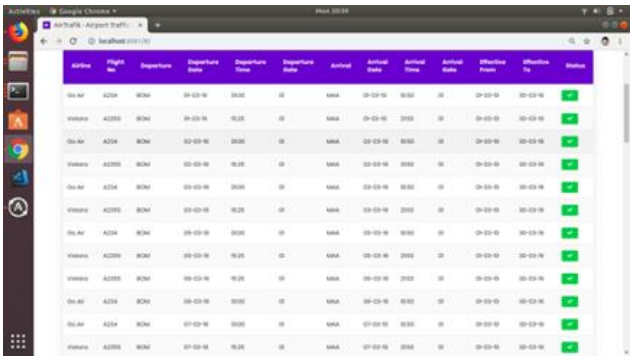
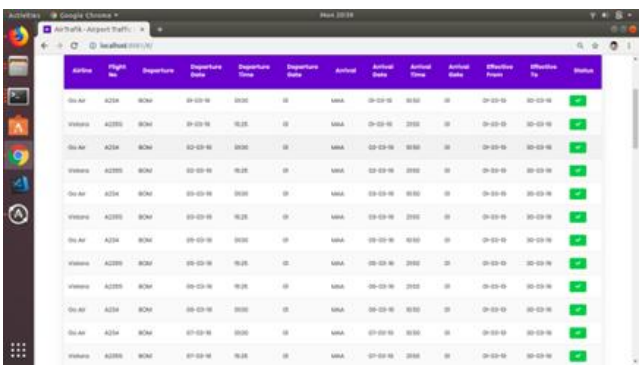


Fig. 7.**Allocated slot list**



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V. IMPLEMENTATION OF PROPOSED SYSTEM

A. Our Approach

- Heuristic Approach
- Batching Flights based on Size
- Allocation of Take Off order with the consideration of direction of destination, to maximize the distance between flights.
- Giving reputation points to aircrafts based on their timely operation.
- This reputation points will help in taking penal action against the airlines.

VI. RESULT AND DISCUSSION

1) Increased capacity to handle multiple aircrafts
2) Simplifies the process of Handling Aircrafts
3) Ensuring safe and smooth operations
4) Instantaneous allocation of Departure and Arrival Slots.
5) Minimises runway holding time.
6) Reduced Carbon Footprint

VII. CONCLUSION

This system will considerably reduce the time taken in allocating slots to the airlines, and also has the potential to increase the capacity of the aircrafts using its heuristic approach in solving the problem.

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