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Distributed Framework for Managing Aircraft Traffic Using Aircraft Vehicular Adhoc Networks and Hadoop Map Reduction

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Abstract: Now a day's technology growth is keep on growing which changes the transport of human from roadways, waterways and airways. Due to heavy traffic on roadways, people encourage to utilize the airway transport. This interest of human in future airways also becomes traffic due to take off and land time delay. In order to avoid the time delay between the takeoff and land time, it is the need of an Intelligent technique which monitoring the activity of aircraft positioning and decides the land and take off without any disturbances. In this article proposed a technique to manage the air traffic by providing the shortest route from source to destination, monitoring the aircraft location, calculating arrival time to the destination based on the speed of aircraft, advance reservation of landing, emergency help, etc. This research work was carried out by using the hadoop distributed file system and map reduction function is used to create the feasible path in distributed framework. Hadoop framework is designed to operate on GPS and aircraft vehicular adhoc network. This new designed device was simulated in hadoop map reduction and results shown the better resource allocator for aircraft traffic control.

Key words: AVANET, MANET, VANET, FANET, hadoop distributed file system, GPS, map reduction

INTRODUCTION

Adhoc Network is a wireless technology which was designed initially for communication between devices with specific range called Mobile Ad-hoc Network (MANET). Later this communication was improved to send signal among Vehicle to know the status of traffic also called Vehicular Ad-hoc Network (VANET). Unmanned Aerial Network (Brown *et al*., 2007; Chao *et al*., 2007; Elston *et al*., 2009; Frew and Brown, 2009; Han *et al*., 2009; Lopez *et al*., 2007) designed for a specific operation like military, fire service and police was using a Flying Adhoc Network (Bekmezci *et al*., 2013).

Due to time constraint and traffic on Road ways, people are migrating to usage of airway transport which leads to increasing density of aircraft introduction by the government and private sectors. Consequences, needs well planned monitoring of the Aircraft take off and landing time, this leads foreword the Aircraft Vehicle Adhoc Network (AVANET).

Protocols were specially defined for aeronautical communication like ACARS3 are implemented over satellite communication VHS/HF3 link. The existing infrastructure of Aircraft devices is interconnected with GPS (Hu *et al*., 2012) and Wi-Fi transmitter which are used for extending the desired features in AVANET. World health organization and national crime records bureau reports are saying that the number of human death as far as minimized. In this issue, Aircraft crashes may not be identified in advanced, Air jacking is another issue never gets solution still. Hadoop Distributed file system architecture will help to provide the shortest path (Prakash and Manickavasagam, 2014) from source to destination using a Dijkstra's shortest path algorithm along with map reduction function.

Global Positioning System GPS Abboud and Geographic Information System (GIS) are used to locate the Aircraft correctly. These above two information's are received from Aircraft every periodic duration. The position and speed of the Aircraft also used to determine the time to reach destination. This Research study, we proposed an intelligent monitoring (Kamijo *et al*., 2000) device about aircraft based on Hadoop Map Reduction Framework Gillick which will capture, store, process and analysis the status of Aircraft. This proposed system will track individual Aircraft in the Video frames and find out the total number of Aircraft travel over the same path. Identify the Aircraft which are crass in advance.

Additionally, this intelligent system will identify the air jacking by adding additional security frame like periodic pilot secret code the control station. Finally, this

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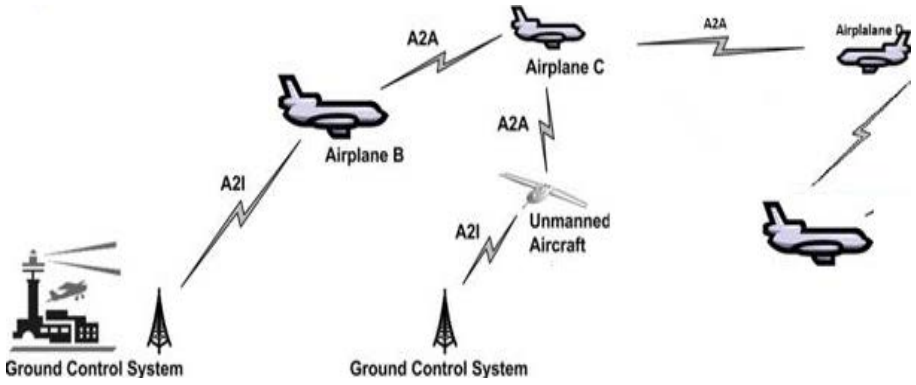

Fig. 1: Aircraft adhoc network

GPS Abboud is connected to the AVANET to provide the landing path.

Motivation: The motivation for this research has inspired from traffic control in vehicular adhoc network. Peoples attention in airways convention increases the threats like Air Jacking, Traffic delay in the Landing and Take off, Aircraft Vehicle Breakdown etc. Parallelly distributed file system vast development their networking connection in world wide web. Especially Hadoop Distributed File System (HDFS) (Kim *et al*., 2013), a Map Reduction Function which is encouraging to invent an Intelligent technique to overcome the difficulties in Aircraft. This research study focuses on the following:

- Providing shortest path using disjistra shortest path algorithm
- Tracking aircraft movement for identifying crass or jacking etc
- GPS connect to the AVANET to provide landing in run way

Literature review: In order to propose an Intelligent Technique, The following relevant work was carried out:

- Vehicular Adhoc network
- Aircraft vehicular adhoc network
- Global positioning system
- Dijkstra shortest path algorithm
- Hadoop distributed file system
- Map resuction function

These relevant works are collectively working together to achieve the improvement in aircraft performance.

Vehicular Adhoc network: The vehicle adhoc network is designed to provide an intelligent transport system in road transport (Coifman *et al*., 1998). VANET is a kind of MANET where vehicles act as a node. There is no predefined vechiles in VANET based on the speed of the vehicle VANET size may be differ.

Aircraft vehicular Adhoc network: The aircraft vehicular Adhoc network is designed to provide traffic safety and dynamic route (Garcia and Ortega, 2009) changing and long range wireless communication with cost effectively. Which is an extension of VANET-AVANET. In this type communication between aircraft on the ground, aircraft to Aircraft and ground to Aircraft as shown below in Fig. 1. There are different Aircraft Vechiles are connected to the ground control system. There exists a connection between aircraft. This scenario will help to communicate with Groung control system, when an Aircraft loss its connection to the ground due to climatic conditions like raining, weather conditions etc.

To extend the coverage, aircraft uses craft to infrastructure data link instead of aircraft to aircraft communication shown in below Fig. 2. Multi craft communication can be made between Aircraft to make reliable communication when aircraft may be disconnected due to weather conditions. This scenario explained in The Fig. 3. In critical situations any of the aircraft can be actuated to coordinate other aircraft which are not connected to the control station due to climatic conditions, raining, weather changes . This scenario is shown in Fig. 4 . These different aircraft infrastructure and communications motivates to provide the solutions for AVANET using intelligent techniques with Hadoop distributed file system and map reduction function.

Global Positioning System (GPS): GPS is designed by US Department of Defense for positioning the device on the earth using satellite based system. Satellite, control

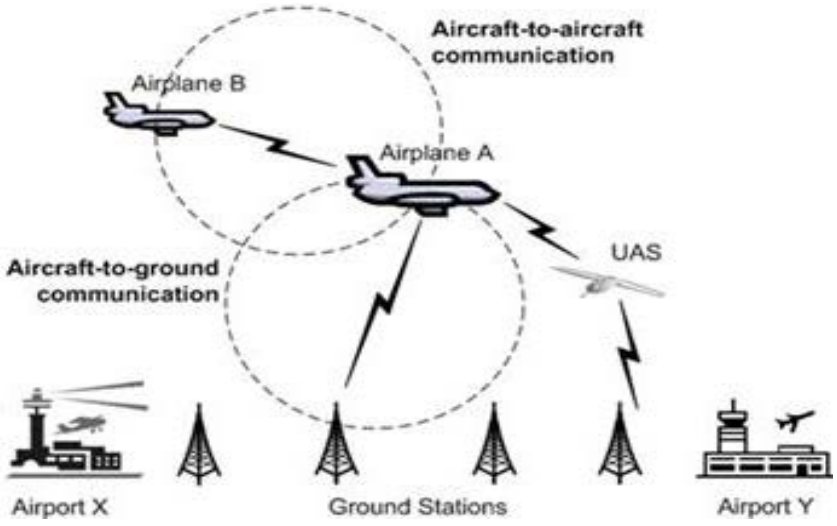

Fig. 2: Aircraft to infrastructure communication

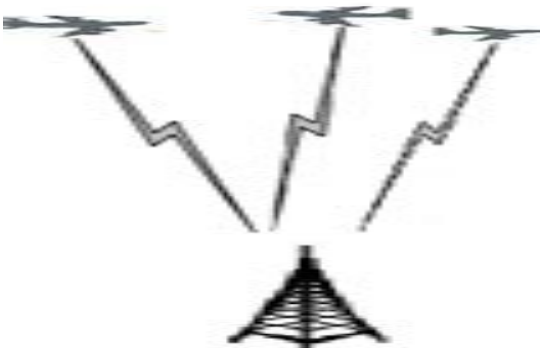

Fig. 3: Multi craft communication with infrastructure

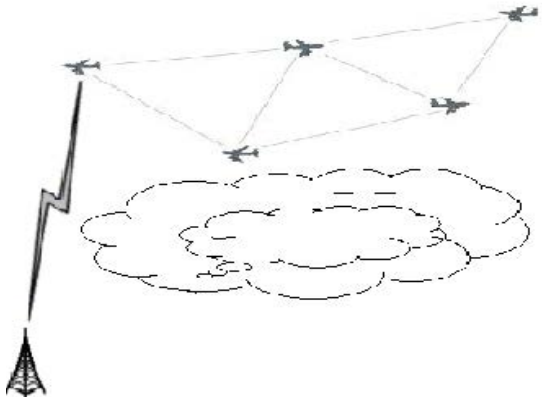

Fig. 4: Aircraft disconnected due to climatic conditions

and monitor stations and GPS Abboud receiver is the three major components of GPS Abboud. The applications of GPS are resolving the distance between locations, find the way of one location to another location, establish the location of the place and create digitized maps and so on. These are the reasons to take GPS as a research relevant research. Satellite is continuous around the earth which transmit information to control station. Control stations send back information after correcting radio s8ignal to the antenna.

To cover the earth 3 satellites are sufficient but efficient 3D position needs one more satellite. Normally GPS (Singhal and Shukla, 2012) uses three segments, like space segment used for satellite orbit around the earth, control segment used for controlling and monitoring stations and user segments GPS Abboud receiver for application development are shown below in Fig. 5. Dijkstras algorithm used for finding out the current location in GPS Abboud. Given (x1, y1, z1) and (x2, y2, z2) coordinated position, then the distance will be calculated using the formula of: Distance = $[(x2-x1)+(y2-y1)+(z2-z1)]^{1/2}$.

Dijkstra shortest path algorithm: A Dijkstra shortest path algorithm is a kind of data structure algorithm used for finding out the shortest distance between two locations. The same principle is designed to finding of the shortest path between the location of the source and destination. Additionally uses a multipath generation for dynamic change of topological change due to weather, Aircraft crashes etc., Specially designed an algorithm called multipath generation Dijkstra shortest path algorithm shown below in Fig. 6. Any aircraft wants to know the destination shortest location, Turn on the GPS

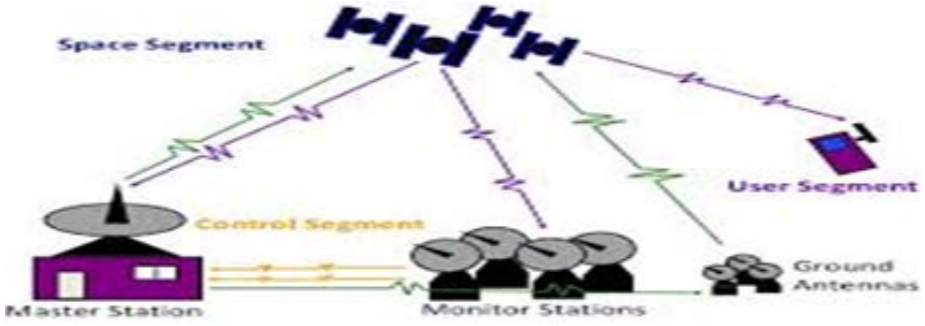

Fig. 5: Three segments of the GPS

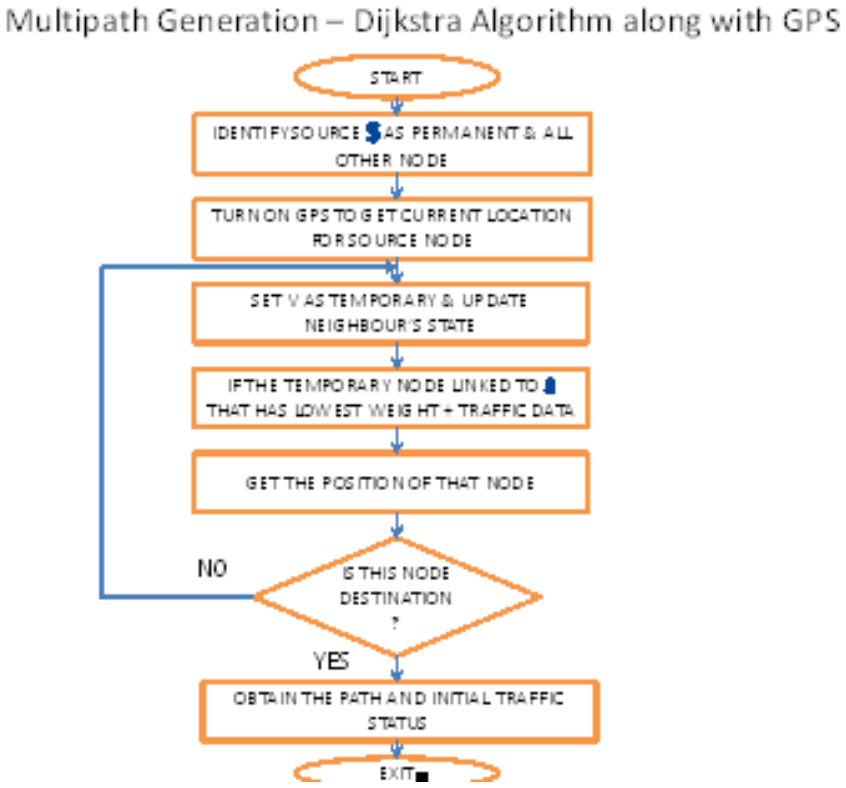

Fig. 6: Multipath generation dijkstra algorithm along with GPS

Abboud and call this algorithm. The algorithm set source node as a permanent node and find out the shortest neighbor with the lowest weight like distance, add that neighbor as a path, the process will repeat until find the destination location. This multipath generation algorithm will generate all the possible paths based on the distance. The pilot can select the desired route to the destination based on the climatic conditions.

Hadoop distributed file system: Open source software for reliable, scalable and distributed operation. Hadoop was invented the concepts of google map reduce and google file system. HDFS is a distributed file system which is suitable for storing large data. It relays like master and slave architecture. HDFS store data across thousands of servers. Map reduction function uses to differentiate the required data from the Bigdata. The general architecture of Hadoop shown in Fig. 7. In Hadoop framework arhitecture, Li and ZhongZhi (2010) the major functional elements are distributed file system and task manager. The distributed file system has data stored in different storage areas. The Task manager is to identify the client program task is called map function and submit to the reduced function of providing exact client required program.

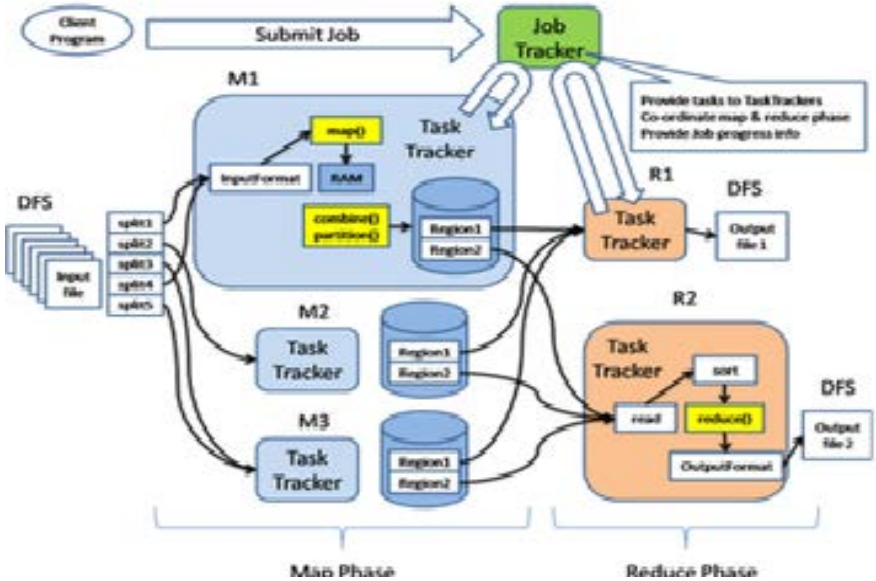

Fig. 7: Hadoop framework architecture

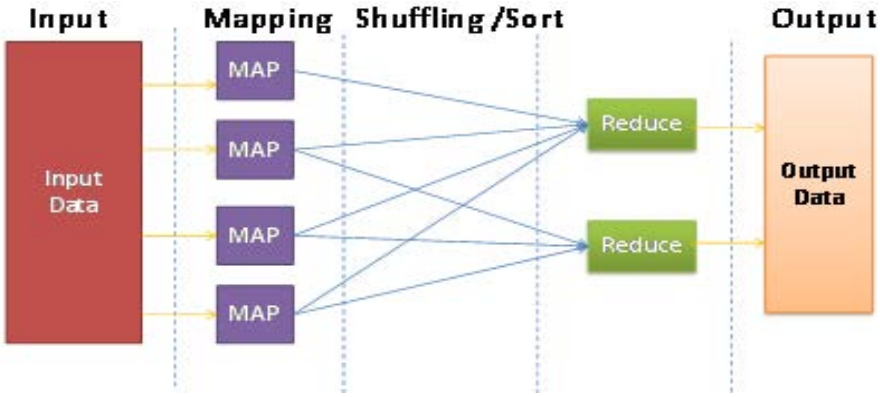

Fig. 8: General structure of map reduction function

This hadoop architecture is used to this research activity for storing the aircraft GPS Abboud information on big data via distributed file system. The proposed methods have a table called planner Table. To get the needed aircraft details on the planer Table, distributed file system is used to collect the details of the aircraft in the GPS Abboud.

Several servers involve in maintaining the aircraft information, the Hadoop map reduction function is used to retrieve the needed Aircraft information from distributed servers.

Map reduction function: Map reduction function is introduced by Google in 2004 to support large data set in distributed computing (Verma and Bhatia, 2013). The Map reduce function has two stages are map stage and reduce stage. In the map stage the key of input data is mapped with large data store the output of large data store has reduced as many level possible to provide as an output to user level shown in Fig. 8.

This map reduction function (Schmidt and Rella, 2011) is supported in Hadoop distributed file system for retrieving essential details from the server. This chapter discusses the relevant work for research work implementation and the next chapter will elaborate research methodology.

MATERIALS AND METHODS

In the previous chapter, the relevant research was discussed to carry out the research. The research

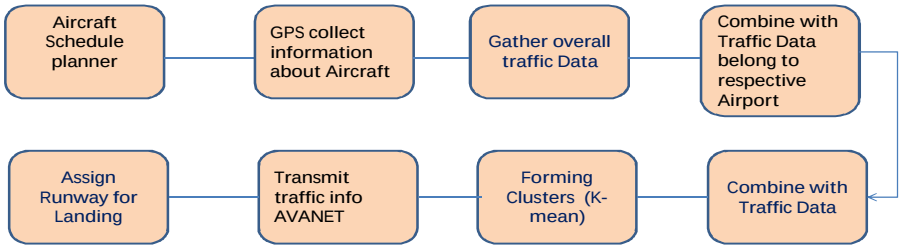

Fig. 9: Architecture

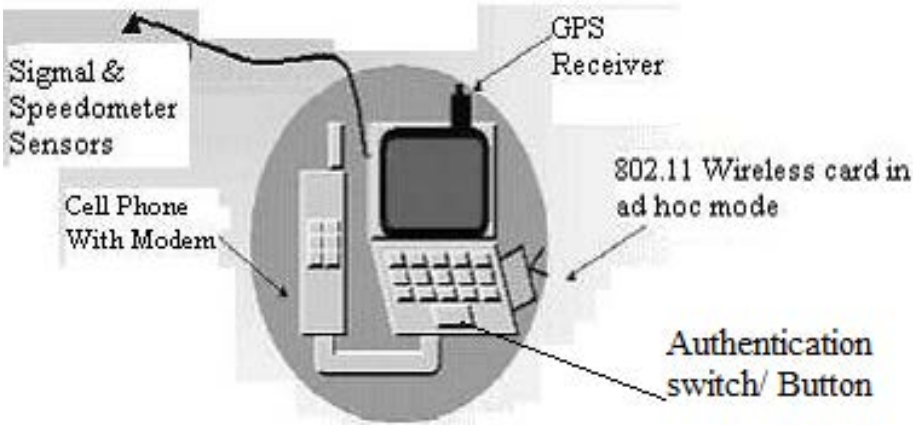

Fig. 10: Device fixed in aircraft for authentication

Table 1:Sample entery in the aircraft schedule planner

Date	Aircraft name	Departure time	Arrival time
21.03.2016	Air India	18.00 p.m	10.00 a.m
21.03.2016	Malysian aircraft	15.00 p.m	14. 00 p.m
21.03.2016	American	18.00 p.m	16.00 p.m

methodologies were used for aircraft vehicle adhoc network shown in the architecture diagram in Fig. 9. The design stages are:

- Aircraft schedule planner
- GPS collect information about aircraft
- Gather overall traffic data
- Combine with traffic data belong to respective airport
- Forming clusters (K-mean)
- Transmit traffic info AVANET

These stages are major stages and every stage has own responsibility are defoned as follows:

Aircraft schedule planner: At this stage the dynamic table is defined to maintain the schedule of daily aircraft at the airport. This Table is called aircraft schedule planner Table is common for all aircraft. Sample entry in the aircraft schedule planner shown in Table 1. This aircraft schedule planner is more useful for identification of aircraft.

GPS collect information about aircraft: According to the schedule given in the aircraft, global positioning system will identify the location of the Aircraft with a periodic time. This periodic time identification is useful for monitoring the aircraft movement to avoid air jacking and Aircraft crashes.

Avoiding air jacking will be identified by attaching a special device in to the Aircraft where the pilot authenticates the safe journey to the satellite in a specified periodic time. This authentication is a kind of wireless transmission of operating a switching device. If the aircraft is flying under air jacking, immediately pilot can transmit the message through the switch to the control unit via satellite communication. Fig. 10.

The global positioning system will identify the position of the aircraft periodically. In case any of two

Fig. 11: Assigning aircraft location

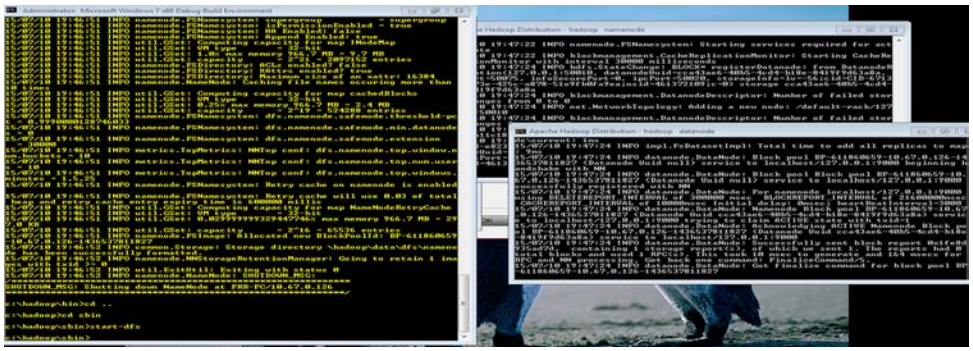

Fig. 12:HDFS data retrieval

aircraft are flying in the same GPS and aircraft going to be crashing with in a moment of time can also identified by this intelligent devices.

Gather overall traffic data: From the previous chapter GPS sends the position of the aircraft, comparing with the aircraft schedule planner, collect the overall traffic of the aircraft. This collected information is stored in big data using hadoop architecture.

Combine with traffic data belong to respective airport: This stage combines traffic data of the individual airport will be isolated. This isolated of respective Aircraft will be designed using map reduction functions

Forming clusters (K-mean): Individual aircraft information is grouped based on the time of landing to the airport runway. This is transmitted to the AVANET.

Transmit traffic info AVANET: The AVAET receives the signal from the Hadoop server about the Aircraft is expecting the runway for landing. The AVANET uses allocating the runway to land of Aircraft is based on first in first out algorithm. The arrival and departure time of the Aircraft will be estimated from the Aircraft schedule planner. According to the departure time the runway path is assigned to landing shown in Fig. 11. This chapter elaborates the design stages of aircraft monitoring and next chapter will discuss the result comparison

RESULTS AND DISCUSSION

The Proposed intelligent techniques were designed using hadoop map reduction environment for counting the number of Aircraft about to land. Huge experiment was performed by making different Aircraft GPS information. Figure 12 shows that the screenshot of needed aircraft information. Two parameters have to be passed are data node and name node to the HDFS file system. Based on the name node (specified by the Aircraft name) HDFS check with the distributed file system data store. Retrieved information is transferred to the requested aircraft name.

Resource manager checks the available data in the distributed file system and displayed on the screen shown

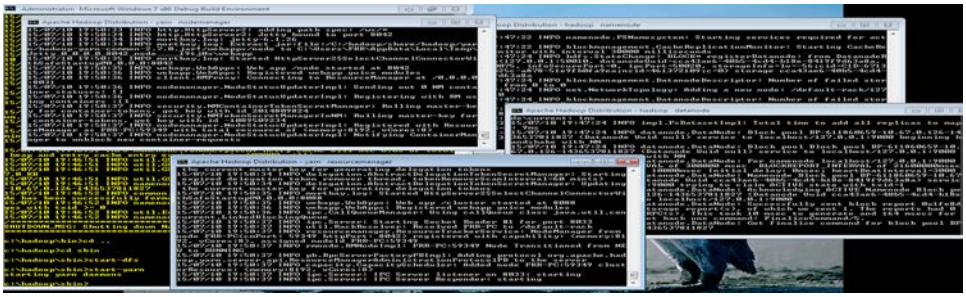

Fig. 13: Resource manager

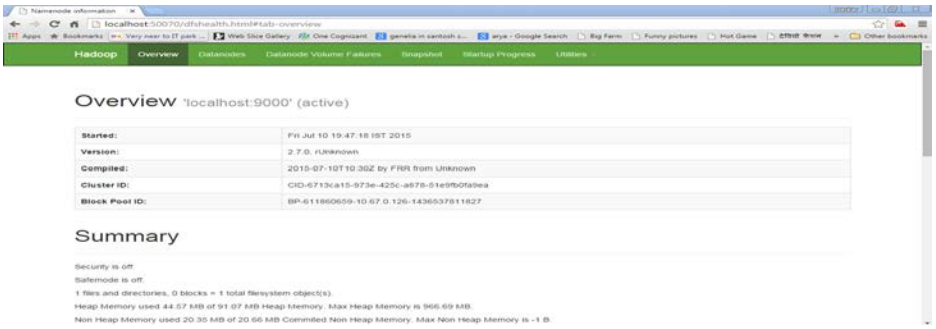

Fig. 14: HDFS name node

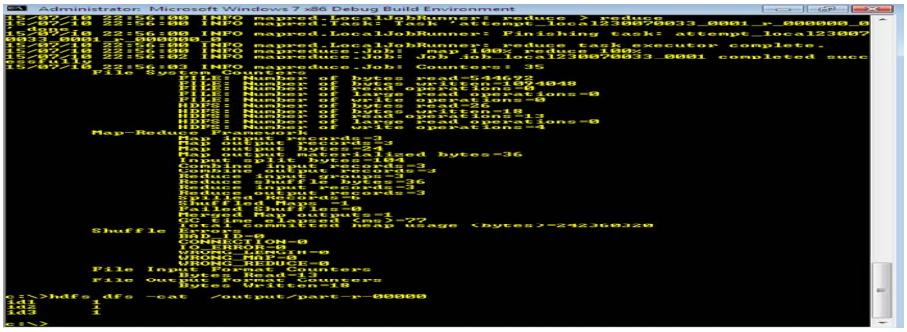

Fig. 15: Results

in the Fig. 13. The name node overview and summary is selected by the map reduction function is shown in Fig. 14. The cumulative result of the map reduction function is shown in Fig. 15.

CONCLUSION

This research study proposed an intelligent Architecture for monitoring the activity of Aircraft to advanced reservation of aircraft, landing and take off planning without delay, identification of air jacking, aircraft crashes and so on. This design was implemented in hadoop map reduction and results shown better utilization of the airport.

RECOMMENDATIONS

In future this Intelligent architecture will be enhanced for automatic or unmanned control unit in the Airport.

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