<論文>

A Study on the Animation System Development Using the Flight Data

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비행데이터를 이용한 3차원 영상구현 시스템개발에 관한 연구

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목 차

Abstract

본 논문은 비행 정보 등 각종 운항 자료를 보다 다양하게 분석하고, 좀더 쉽게 이해하기 위하여 시각적으로 구현할 수 있는 비행정보 분석시스템 개발에 대한 개념 설계서이다. 비행이 완료된 후, 항공기에 탑재된 비행 데이터 저장 장치(QAR, Quick Access Recorder)로부터 비행 및 관련 시스템 데이터를 추출한 후, 이 데이터를 변환한다. 또한 변환된 데이터를 이용하여 각종 비행 및 시스템 정보 분석과 운항 궤적 및 ND, PFD 등 조종실 내 운항 시스템들의 상황을 운항 시와 동일하게 3차원 그래픽으로 재현하는 시스템을 구축하였다. 이는 시스템 분석 및 안전, 표준 운항 체계 구축에 도움을 줄 수 있으며 유사 관련 분야로의 확대도 가능하다.

Key Words : FDAS, Flight Animation, QAR, system data

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I. Introduction

To understand and analyze the flight status, we can extract the flight data from QAR(Quick Access Recorder) which records a lot of aircraft parameters during the flight and converting program like the GRAF(Ground Replay and Analysis Facility) or FLIDRAS(Flight Data Replay Analysis System) converts the QAR raw data into ASCII or general form. But the converted data from GRAF or FLIDRAS is text-typed data, so only special engineer or analyst who is in charge of FOQA(Flight Operational Quality Assurance) can understand the meaning(1),(2).

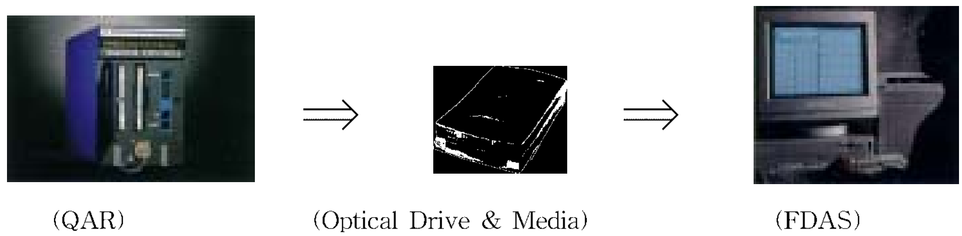
As we want more precise understand the flight situations, it is necessary to visualize as the 3D animation based on the converted flight data. Using the system, furthermore pilots may take an objective view of flight situation and evaluate bad flight habits for himself. Besides, it may be used for investigation of accidents and aircraft system analysis(2).

II. The FDAS Concept

FDAS(Flight Data Analysis & Animation System) is PC-based solution that has 3D animation programs and flight data converting programs. It is consist of 3 PCs that each serve for the data processing, animation and analysis tool. As we consider the unified aspects of FDAS, the function of each computer(data processing, animation and analysis) is separated independently as well as only one computer has all functions.

The software for the FDAS is designed to operate under the Microsoft Windows NT operation system and the communication among the computers make use of the DirectX program via IPX/SPX, TCP/IP.

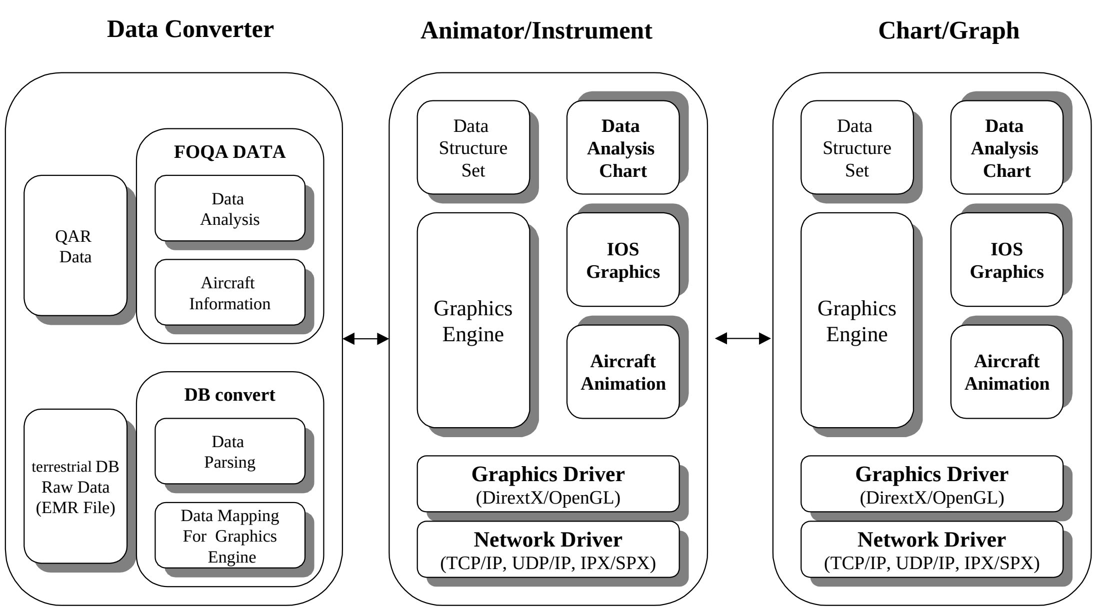
<Figure 1> Appearance of the FDAS



<Figure 2> Flight Data Processing of the FDAS

III. The Structure of FDAS

The FDAS software has three major components: Flight Animation/Instrument, Data Processing/Converter, Chart/Graph. Each of these components can execute on only one PC(standalone mode) or expand them into several PCs with networked solution, so it is able to offer the detailed flight information, instrument status and charts during replaying the flight data.



<Figure 3> FDAS Structure Diagram

3.1 Flight Animation/Instrument

The flight animation programs consist of Graphic Modeler, Image Generator, Image Database and 3D Modeler. Image generator module allows zoom in and out, and rotation of view points while replaying the converted flight data from Data Converter by communication that is six degree of freedom data. Geographical graphic modeler provides 3D model library for user that is an easy solution to make new something like airport facilities and runways. It also reads a 3D model file of commercial software and has a function of texture mapping.

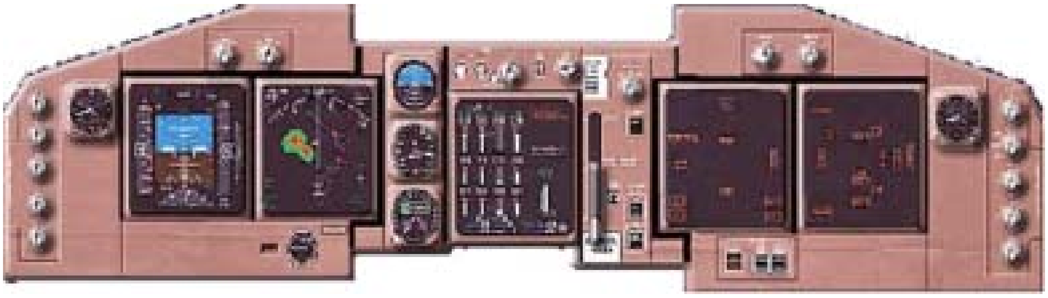
The flight animation programs have a basic feature that can be real-time display, photo realistic cockpit instruments and 3D terrain modeler & path reconstruction tool. It would be developed under the development environment which used windows 98/2000 as a Operating System, visual C++ 6.0 as a compiler and a graphics library is used OpenGL[3].

In the flight animation there are some important scenes as follows.

Figure 4 is so called outside view which is the 3D animation of airplane observed from the outside. And figure 5, 6 that is so called instrument panel view are able to lie on the plane view and change the location and the size of it. Cockpit view shows the situation of instrument panel in cockpit as a pilot's viewpoint.

The major instruments like the PFD, ND and EICAS are made by special drawing tool for simulation. As it depends on the specific types of aircraft, if possible, it would be designed as similar to real instruments[4],[5].

<Figure 4> Observed airplane view from the outside



<Figure 5> Cockpit Instrument View

<Figure 6> Instrument Views - ND, PFD, EICAS

3.2 Data Processing / Converter

```
HEADER, 17, 1, 256, 256, 0, #1107, #2670, #5107, #6670
"B747-400 QAR 4X frame format (KAL)";
PARAM, SYNC, "SYNCH WORD", 4, 0, 1;
TYPE6, 0, >FFF, "hex"; LOCN, 0, 0, b1111, 1, >FFF;
PANDG, 4608, 2, 1, 1;
{ DFDAC          LBL/SDI 340/XX  Input bit 28-17 }
PARAM, VRTG, "VERT ACCEL", 5, 0, 8;
TYPE2, 2, 2, 0, -3.375, 2.289E-3, 0, 0, 0, 0, 0, +3, "g";
LOCN, 0, 0, b1111,   2, >FFF; LOCN, 0, 0, b1111
LOCN, 0, 0, b1111,  26, >FFF;LOCN, 0, 0, b1111;
LOCN, 0, 0, b1111,  50, >FFF;LOCN, 0, 0, b1111;
{ ADC            LBL/SDI 203/XX  Input bit 29,28-13 }
PARAM, PALT, "PRESS ALT", 6, 0, 2;
TYPE1002, 0, 0, 1, 0, 64, 0, 2, 0, 0, -2000, +45000, "ft";
LOCN, 0, 0, b0001,  3, >FFF;
LOCN, 0, 0, b1111,  5, >7FF;
{ FMCG           LBL/SDI 075/00  Input bits 28-17 }
PARAM, GWT, "GROSS WEIGHT", 8, 0, 1;
TYPE2, 2, 0, 0, 0, 320, 0, 0, 0, 0, 400000, 870000, "LBS";
LOCN, 0, 0, b0010,  3, >FFF;
{ ADC            LBL/SDI 204/XX  Input bit 29,28-13 }
PARAM, BALT, "BARO ALT", 6, 0, 2;
```

<Figure 7> Text-typed converted data

Except B777 aircraft, each flight parameters that is converted data from QAR is different with recording period[1]. In order to animate it is necessary for the same period and we applied the interpolation, data recovery, filtering and estimation methods to get the same period[6],[7].

<Table 1> B747-400 Flight Parameter Periods (Take-off)

OPERATIONAL EVENT CATEGORIES BY FLIGHT MODE	PARAMETERS	SAMPLE RATE/SEC
HORIZONTAL STABILIZER SETTING	STABILIZER POS	1
EPR SETTING (AT 80 KTS)	EPR SET	1
	EPR TARGET	1
	COMP AIRSPEED	2
LONGITUDINAL ACCELERATION LOW	LONGITUDINAL ACC	4
	COMP AIRSPEED	2
	MAX LONG ACC	-
	SQUAT SWITCH	4
HEADING DEVIATIONS	MAG HEADING	1
	SQUAT SWITCH	4
ROTATION SPEED	ROTATE SPEED	4
VERTICAL ACCELERATION	VERTICAL ACC	16
PITCH RATE (T/O)	PITCH ATT, TIME	-
PITCH ATTITUDE ON GROUND (T/O)	PITCH ATTITUDE	4
	SQUAT SWITCH	4
LIFTOFF BANK ANGLES	ROLL ATTITUDE	2
	SQUAT SWITCH	4

Data Processing / Converter in FDAS has some important functions like the Texture Mapping Module, Terrain Data generate Module and Real time Rendering Module, etc. and the role of functions are as follows.

- Texture Mapping Module

Reading the ASE(ASCII Scene Export) file, it is generated to polygon consisted of many wire frames. FDAS provides a similar function of commercial 3D modeler like a texture mapping to cover with texture into polygon.

- Terrain Data generate Module

This module reads the geographical data around the airport and loads in computer memory.

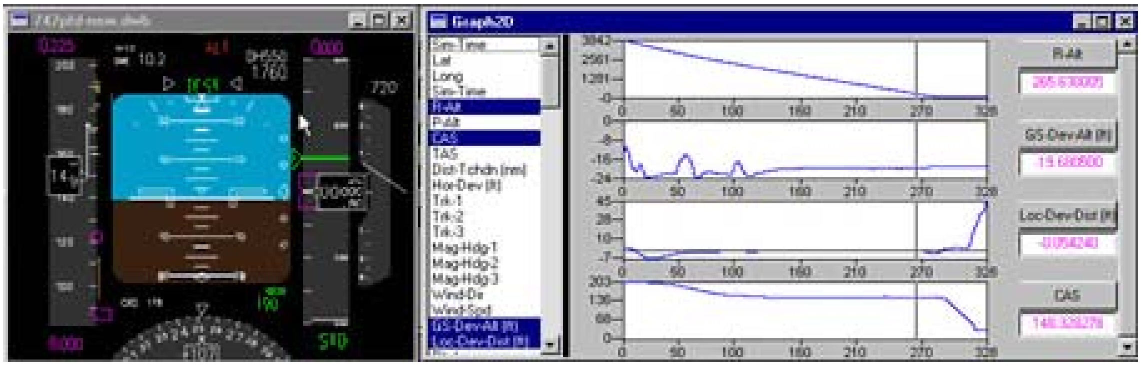
For this, we implement matrix conversion in the tree node and this data is converted to world coordinates for supporting display list array. And also modified terrain data is saved into disk for continuous upgrading.

- Real time Rendering Module

For the display, geographical elements made by terrain data generate module are animated in due consideration of time, weather condition, light effect and specially H/W, S/W processing speed. To improve the processing speed, the data structures for the polygon output are designed continuously to minimize the data missing when system-cache called the memory reference point. And the address of array is set like that of 'Cache line width', so make it possible to maintain at maximum transmission rate.

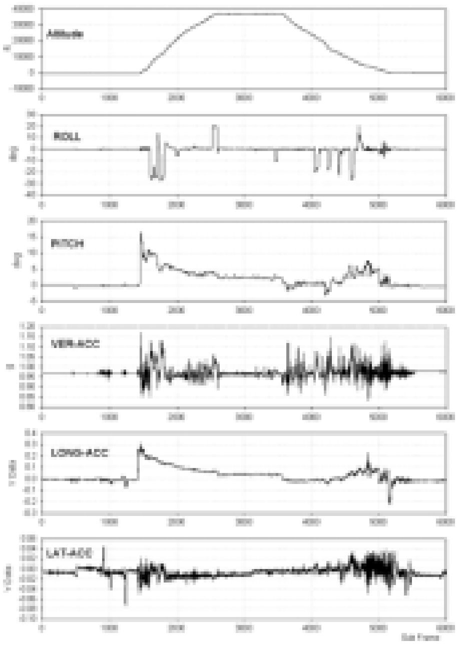
3.3 Chart / Graph and Others

The converted flight data in text-type demonstrates as belows. If user selects arbitrary point of graph, you can see the position in the 2D Map and the value of flight data at this point too. Also user can easily replay the animation from the selected point.



<Figure 8> Analysis Chart

Using the DirectPlay of Microsoft, we designed the system may have the extensibility and reliability. The first booted PC operates as Lobby-Server and exchanges informations like the booted S/W module and parameters with Lobby-Clients.



<Figure 9> Graph Example

<Figure 10> 2D Example

IV. Conclusions

In the improvement of flight safety, the FDAS is expected to offer several significant benefits as follows.

- Conversion of flight data into visualization makes enhancement of safety and standard flight operation.
- Cause the PC-type, this system is able to meet various user's requirements, many copies and low cost with great. And the clients have the ability to solve the adjustment and modification.
- It is very useful in investigation of critical situations.
- As a self-training and a protection of pilot's privacy, it will have many useful safeguard functions like a standard VHS output, network checking, password, etc.
- We expect to be extended intangible property and far-reaching effects by its the required technologies and a patent application.

In this study, the results of FDAS will be used to modify the current design concept and to make a more complete product.

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