Novel Evaluation of Aircraft Data Structure Optimization Techniques And Opportunities

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Abstract- *Despite having an enviable safety record, the aviation industry is under constant pressure to drive down accident rates. Air accidents are headline news and inhibit the growth of the industry. As an integral part of an airline's safety management system, analysis of flight data allows safety managers to identify trends and fully investigate the circumstances behind minor incidents so that operational procedures and training can be improved, along with raising awareness of safety issues , Several different methods of data visualization are currently available ranging from manual analyzation to computer-based representation in the form of textual data, spreadsheets, and navigational charts. The above process requires highly skilled technical expertise and time consuming as it visualized in plain data form. Due to difference in the formats between aircraft, the process of analyzing the data even for a single sortie is also difficult process. Flight Data Visualization and Comprehensive Analysis Software (FDVCAS) is an interactive visualization tool, which collects, store, process, analyze and present the flight data with high fidelity graphical presentation in 2d and 3d formats. It synchronizes and present in both graphical and synthetic visual form to the extent of analyzing the impact of the data on the system in a three-dimensional graphic animations of the flight.*

Keywords- Flight data, simulation software, OWI, Feedback system, aircraft safety

I. INTRODUCTION

Analyzing the problem in a data form is very difficult since the decision is made based on behavior of data. In order to analyze the data effectively it is required to develop a system with graphical user interface to monitor the data, which is super imposed on the synthetic outside window imagery. The analysis of the data pictorially improves the efficiency and helps to study the impact of the data on the system. This shows the importance of FDVCAS

II. REVIEW OF LITERATURE

The data's from an aircraft is acquired using flight data recorder and analyzed to identify any exceedances of the data and failures of the sub systems. The taanalyzation presently used is namely "data display" to compare the selective data's and its range. The capability of comparison and analysis of data are limited to the options provided for analysis in the above tools.

The 3d visualization of the flight path is done separately through "synthetic terrain visualization software" developed by ADA. During the visualization, the abnormal behaviors in the phases of the flight are identified with the list of possible parameters and the respective data are analyzed using above said methods.

The above standard procedures followed shall be integrated and automated with minimum intelligence to built, in with the system. In order to analyze the flight data in a coherent way it is required to integrate both 2d and 3d form in a synchronized way.

III. OBSERVATIONS FROM THE REVIEW

Analyzing and comparison of the problem in a data form was very difficult since the decision is made based on behavior of data. The requirements were analyzed using standard tools called MS ACCESS and MSWord to read and to display the data in offline format, the 3D visualization is done using Synthetic Terrain Visualization Tool. The process involves capturing the data from different input sources and extracting the data from different data formats, analyzing the features of the data and monitoring are done manually in an unsynchronized fashion which is difficult and requires highly skilled technical expertise as it is visualized in plain data form. In order to analyze the data effectively it is required to develop a system with graphical user interface to monitor the data in offline.

To overcome the above difficulties a proper analyzing software is required so FDVCAS system is used.

IV. PROPOSED SYSTEM

It is proposed to develop a system with a single solution by providing data display, graphical charts and replay features with a sophisticated graphical user interface, which is super imposed on the outside window imagery. Several different methods of data visualization are currently available using different tools for monitoring data ranging from textual data, spreadsheets, and navigational charts. Synchronized video and detailed three - dimensional graphic animations of the flight with overlapping the data are proposed to provide a realistic and effective analysis.

FDVCAS consists of Bypass data acquisition system, Outside Window Imagery (OWI) system with graphical analyzer. Bypass data acquisition system receives data from aircraft recorder and transmits the data in engineering format to FDVCAS system. The OWI system has three main modules namely, 3D Visual module, GUI based Graphical analyzer and Warning display module. The warnings and the graphical plots are super imposed on the 3D Visual.

V. BENEFITS OF PROPOSED SYSTEM:

1. Graphical Data analysis Convert raw flight data into valuable information
2. Data analysis in a 3d window environment to study the impact of the parameters
3. Plotting of more than one data at a time to compare
4. Frame-wise visualization of 2d and 3d data with pause, forward, backward and play features
5. Selective data plotting

VI. LAYOUT OF THESIS

The thesis is organized as follows, Chapter 1 presents introduction of FDVCAS, motivation, review of literature, observation of existing work and benefits of present work. Chapter 2 gives problem formulation, Hardware and software specification, FDVCAS system flow and architecture. Chapter 3 discuss about experimental techniques ,different graph views , Input design , output design and also discuss about system implementation chapter 4 discuss with the results and screen shots .Chapter 5 gives the conclusion and future scope of the work. Chapter 6 consists of references and websites

VII. PROBLEM FORMULATION

Aerospace plays a significant role in analyzing flight data for each flight sortie. During takeoff and landing, sensors mounted on the aircraft continuously measure critical parameters such as acceleration, external pressure, internal engine performance, fuel tank pressure, fuel temperature, guidance and navigation performance etc are stored in a recorder. These parameters vary with phases of the flight time some of them quite rapidly. Acceleration, for example, can oscillate up to several thousand times each second.

Flight data, extracted directly from the aircraft's Flight Data Recorder (FDR) is routinely analyzed to identify the areas of risk and opportunities for improved efficiency. As the number of sortie increases the data becomes huge and difficult to analyze and takes more time. Analyzing the problem in a data form is also very difficult since the decision is made based on behavior of data.

In order to analyze the data effectively it is required to develop a system with graphical user interface to monitor the data, which is super imposed on the synthetic outside window imagery. The analyzation of the data pictorially improves the efficiency and helps to study the impact of the data on the system.

The extracted data from the recorder is stored in a data file in the form of comma separator variable format and the same is given as input to FDVCAS. The list of variables to be monitored are selected through GUI and displayed in the user selected graphics format.

VIII. HARDWARE SPECIFICATION

The system consists of processor with high-speed memory, graphics card with more than 256 MB texture memory, which supports higher resolution with aliasing features and more than 100 MB size of memory.

The “synthetic terrain visualization” module developed by ADA consists of south Asian terrain data with five-meter resolution with the exact height information. The main process involved during display of every frame is culling the area depends on the present aircraft position and its orientation and rendering the image on the screen, which requires high computing power and graphics capability. Every frame of the image also required to be updated at minimum 60 Hz.

The hardware configuration selected to realize the same based on the above requirements are

1. Intel Xeon (R) CPUX5660@2.8GHz*12
2. NVIDIA Quadra4000 Graphics Card with 2048 MBRAM
3. 32GB RAM
4. 399.8GB Hard Disc

IX. SOFTWARE SPECIFICATION

The "Flight Data Visualization and Comprehensive Analysis Software" is an object oriented based software, which is integrated with existing "synthetic terrain visualization" software. The main objective of integrating the same is to carry out data analysis in on line, which is super imposed on the outside imagery generated using ADA software.

The "synthetic terrain visualization" software is developed from open source graphical library, which is compiled using "GNU" compiler (GNU C++compiler, GNU C Compiler, GNU Fortran95 Compiler). It has a database of terrain imagery in "flight (FLT)" format, which has the details of the triangles and the polygons.

The above software's are being developed using C++ language under Windows platform. A make file is used to integrate and compile using GNU compiler.

The details of the software specification is

Language : C++
Library :PLIB, OpenGL
Compiler : GNU compiler
Software Tool : Synthetic Terrain Visualization (STV) tool

GNU Compiler

The GNU Compiler (GNU C++compiler, GNU Compiler, GNU Fortran95 Compiler).is a compiler system produced by the GNU Project supporting various programming languages. GCC is a key component of the GNU tool chain.Originally named the GNU C Compiler, because it only handled the C programming language.

GNU Fortran is a part of GCC, the *GNU Compiler Collection*. GCC consists of a collection of front ends for various languages, which translate the source code into a language-independent form called *GENERIC*. This is then processed by a common middle end whichprovides optimization, and then passed to one of a collection of back ends which generate code for different computer architectures and operating systems.

OpenGL

OpenGL has a very large and continually expanding developer and end-user community that is very active and vested in the continued growth of OpenGL. There are discussion boards, news groups and a variety of other venues for learning how to code using OpenGL, getting feedback on your projects, job opportunities, and support for the consumer trying to play a 3D game

- OpenGL is a Most Widely Adopted Graphics Standard

OpenGL is the premier environment for developing portable, interactive 2D and 3D graphics applications. OpenGL has become the industry's most widely used and supported 2D and 3D graphics application programming interface (API), bringing thousands of applications to a wide variety of computer platforms. OpenGL fosters innovation and speeds application development by incorporating a broad set of rendering, texture mapping, special effects, and other powerful visualization functions. Developers can leverage the power of OpenGL across all popular desktop and workstation platforms, ensuring wide application deployment.

- High Visual Quality and Performance

Any visual computing application requiring maximum performance-from 3D animation to CAD to visual simulation-can exploit high-quality, high-performance OpenGL capabilities. These capabilities allow developers in diverse markets such as broadcasting, CAD/CAM/CAE, entertainment, medical imaging, and virtual reality to produce and display incredibly compelling 2D and 3D graphics.

C++ Language

- C++ has certain characteristics over other programming languages. The most remarkable ones are:
- Object-oriented programming

The possibility to orientate programming to objects allows the programmer to design applications from a point of view more like a communication between objects rather than on a structured sequence of code. In addition it allows a greater reusability of code in a more logical and productive way**.**

- Portability

You can practically compile the same C++ code in almost any type of computer and operating system without

making any changes. C++ is the most used and ported programming languages in the world.

- Brevity

Code written in C++ is very short in comparison with other languages, since the use of special characters is preferred to key words, saving some effort to the programmer (and prolonging the life of our keyboards!).

- Modular programming

An application's body in C++ can be made up of several source code files that are compiled separately and then linked together. Saving time since it is not necessary to recompile the complete application when making a single change but only the file that contains it. C++ is backwards compatible with the C language. Any code written in C can easily be included in a C++ program without making any change.

- Speed

The resulting code from a C++ compilation is very efficient, due indeed to its duality as high-level and low-level language and to the reduced size of the language itself.

X. CONCLUSION

FDVCAS consists of data acquisition module, GUI module, FDVCAS engine, Graphical analyzer and STV modules. The received data is converted into an engineering format and it is send to the FDVCAS engine. Data acquisition modules acquires data from the data file namely, Pressure, Temp, Alt, Pitch, Roll, Theta, Lat, Long etc and samples the data for every 6o Hz. The sampled data set is given to graphical analyzer and the STV to display the parameter information.

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