Ground Information Virtual Reality System (GIVRS)

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1. Introduction

The Ground Information Virtual Reality System (GIVRS) is an application designed to give airport supervisors real-time, three-dimensional visual display of actual and simulated aircraft ground movements. GIVRS can be used to enhance any textual flight information application with graphical models representing real world objects like buildings, aircraft, vehicles, trees and other structures. The system can provide an up-to-date visual presentation of the airport operational dynamics, using actual data from the Airport Operational Data Base (AODB).

The PC-based GIVRS draws on the computer graphics, database and network communications branches of computer science to provide users with a more comprehensive and realistic appraisal of airport operating situations than has been hitherto possible. For its great application value, GIVRS has been adopted for use for assisting terminal operation management in the Beijing Capital International Airport. Some key features of the GIVRS are as follows:

> **Effective Communication in the Dynamic Airport Environment**

Real-time information from the AODB is combined with text, graphic models of the airport environment and animation of aircraft ground movements to present situations to the operational supervisors in a clearer and more comprehensive way than has been previously possible.

- ➢ **3D Animation**

  Animation is used to display interactions between objects. Its main function is to illustrate landing and taxiing progress of inbound aircraft. Animation is automatically initiated and maintained from the moment the GIVRS receives the actual arrival time of the aircraft until the aircraft approaches its stand.
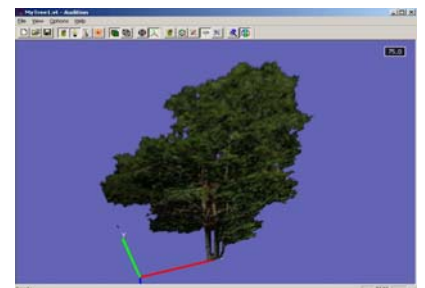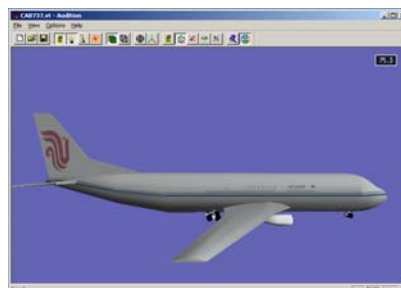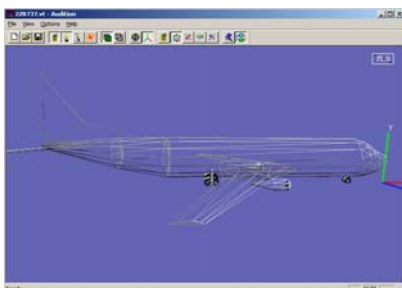

- ➢ **Interaction**

  Using friendly graphical user interface (GUI), operators can readily simulate variations in a setup scene such as changing the lighting and alteration of eyepoint.

2. Overview of our developments

To make the GIVRS an interactive, user-friendly and informative supporting system for airport operation management, our VR research group spent about 4 months to produce a prototype system and experimented with several techniques for improving the rendering performance of this system, such as level of details and occlusion culling. With the aid of several speedup techniques, the average interactive frame rate (>18fps) of rendering the whole airport data has been attained. After another 4 months we produced the final version of the GIVRS collaborating with researchers from the Beijing University of Aeronautics and Astronautics (BUAA). The major work we have done in this project covers the following aspects:

- ➢ **Modeling of the airport environment**

We used the 3DMax and MultiGen Creator (MultiGen-Paradigm) as modeling tools. Meanwhile, the MultiGen Creator was used to transform 3D graphical models to the OpenFlight standard format (*.flt) files that are then transformed to Vt standard format (*.vt) files via OpenFlightToVTree file translator.

For Harnessing and extending the powerful but complex OpenGL industry standard graphics API, we chose Vtree (CG2), which is a library of C++ classes and functions based on OpenGL, to import Vt files into the interactive VR application and control them in real time to create the interactive virtual airport.

➢ Developing server and client programs

The GIVRS is based on a client-server model. So we developed programs in C++ for the server and the client separately. The server, which we call the Central Processor, has real-time communication to the AODB with the support of ODBC and sends dynamic airport operational data to its clients over a TCP/IP socket.

The interactive VR application developed with Vtree library runs on the client. The client, which is called the Display Processor, is responsible for initiating the network (TCP/IP) connection to the Central Processor and rendering 3D scenes to present airport real-time information received from the Central Processor. That is, the Display Processor acts as the GIVRS's visual interface with airport supervisors.

机场地面信息系统主机
Server of Capital Airport Terminal System

Switch
交换机

GIVR 系统服务器
Server of GIVR System

集线器
Hub

图像处理器
Display Processor

图像处理器
Display Processor