Academic Journal of Science and Technology
ISSN: 2771-3032 | Vol. 5, No. 2, 2023

Application Research of Virtual Reality Technology in Intelligent Civil Aviation Airport Visual Management

Peizhi Zhuo

Civil Aviation Chengdu Electronic Technology Co., Ltd, Chengdu 611435, China

Abstract: With the increasing development of science and technology, the increasing popularity of the Internet, and the increasingly widespread application of high-tech technology in various industries, profound changes have taken place in the operation mode of airports in China's civil aviation industry. Research on the development of smart civil aviation airports is also increasingly enriched. Airports are beginning to use information and intelligent technology to change their operating modes. From the current situation of China's civil aviation airport control, it is an unprecedented opportunity to apply VRT (Virtual Reality Technology) to the visual management of smart civil aviation airports. Utilize VRT to establish a real immersive visual management system that integrates operational dynamic display, virtual simulation, and simulation training that can be used for control and efficiency improvement based on the current situation of smart civil aviation airports. The system is mainly built through three-dimensional models that are highly close to the scene, thereby verifying and optimizing the operation mode of smart civil aviation airports, and obtaining the best scheme. Realized the application of VRT in the visual management of smart civil aviation airports.

Keywords: Virtual reality technology, Smart civil aviation airport, Visual management.

1. Introduction

With the development of computer technology and people's higher and higher requirements for simulated environment operation, virtual reality, as a new technology in the computer field, has been widely developed and applied in all industries around the world, and has also been popularized and applied in the development of civil aviation industry. With the development of science and technology, the Internet has become more and more popular, and high-tech technology has been widely used in all walks of life. The operation mode of airports in China's civil aviation industry has undergone profound changes [1]. The research on the development of smart civil aviation airport is also increasingly rich. The airport began to use information technology and intelligent technology to change its operation mode.

Judging from the current situation of civil aviation airport control in China, it is an unprecedented opportunity to put VRT into the visual management of smart civil aviation airports. VRT is a new technology which is different from the traditional simple information acquisition technology of text, sound and terminal video. It can simulate the real environment with the help of modeling technology and combine with related sensing equipment to realize the user's immersive feeling, and allow various functions of real information input, including actions and voices, to realize the controllability of users in the virtual environment and achieve the effect of virtual reality [2]. The most important thing in the control work is that the controller can be familiar with and see the whole apron scene, establish the corresponding situational awareness in his mind, and judge the aircraft dynamics in the apron area and the relative situation of related surrounding objects.

The traditional airport operation management mode has become a bottleneck factor for the further development of large airports. Aiming at how to improve the management level and operate and manage the airport terminal more conveniently. Using VRT combined with the current situation of smart civil aviation airport, a real immersive visual management system integrating dynamic display, virtual simulation and simulation training is established. The system is mainly established through a three-dimensional model that is highly close to the scene, and real-time data is connected through the operation service system of each airport operation unit, which is logically processed by computer programming technology, and finally displayed in a virtual three-dimensional form [3-4]. The application of VRT in the visual management of smart civil aviation airport is realized.

2. Design and Implementation of a Visual Management System

2.1. System model establishment

Establishing a basic 3D model for the intelligent civil aviation airport area is the foundation for the realization of the entire airport VR display. Due to the particularity of the intelligent civil aviation airport, when modeling the entire airport apron area and even the buildings, aircraft, vehicles, etc., it is necessary to conduct corresponding demand analysis and resource design to improve the accuracy of the model. Therefore, this article attempts to study the visual management of smart civil aviation airports using VRT. VRT is not only the technology of these tools, displays, and sensing gloves, but also all related technologies and methods with natural simulation and realistic experience. The three basic features of VRT: interactivity, immersion, and imagination enable users to immerse in a virtual environment while controlling system motion, transcending existing scene motion, and having sufficient imagination space, emphasizing the dominant role of people. It aims to create a harmonious human-computer environment that resembles an objective environment but transcends objective space-time, can immerse in it and control it, that is, a controllable space composed of multidimensional information Its ultimate goal is to have a real experience and facilitate natural human-computer interaction[5]. Systems that can achieve or partially

achieve such goals are collectively referred to as virtual reality systems.

3D modeling can provide users with a comprehensive static display of the 360 degree perspective of the operating object, and is also a basic element for building a virtual scene of the entire aircraft apron area. The establishment of high-precision three-dimensional models is the first step in providing situational awareness for controllers. This system uses VRT to combine model making and database management methods, providing the design and implementation process of airport terminal structure and management information from the data layer to the presentation layer and then to the actual application layer. Figure 1 is a structural diagram of the system.

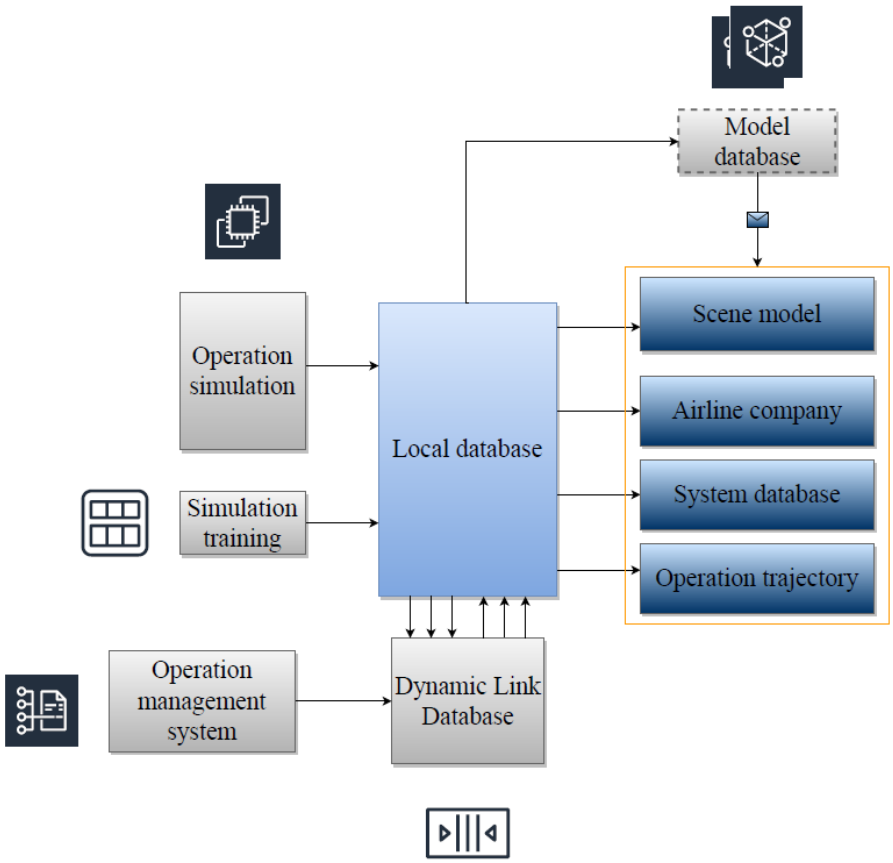


Figure 1. System Structure

Information sources such as aircraft stand information integrate airport data information into the system, conduct data processing through the underlying data processing system, organize information through the logical layer, and finally visually display the current situation of the apron in real-time through three-dimensional models on the interactive layer [6]. After importing data, you can make a series of function selections regarding time periods, nodes, slices, and thresholds as needed. The time slicing function allows users to analyze different times or sub periods of the same time as needed, enabling comprehensive causal analysis of research issues. Directly import the drawn drawings through VRT to fill and model the scene of the airport apron area, making the scale of the three-dimensional model established more realistic.

2.2. System scene planning and construction

The model established and rendered by VRT is just the capital for the whole system to build a scene. In the process of building the clearance model, all the different parameters are parameterized, so that the corresponding clearance model can be calculated by giving different parameter values according to different flight zones [7]. And if we want the scene of the whole apron area to move according to the demand and give it life, we need to realize it through VRT engine. Draw a closed line along the inner wall lines of restaurants, counters, ticket gates, etc. that need to be rendered on the top plan, stretch the closed line just created into a solid, enter the required height, and then right-click it to convert it into an editable polygon [8].

Through the storage of information in the database, the running trajectories of airport aircraft and vehicles in the past period can be played back, which is convenient for the evaluation and learning of airport operating efficiency and the investigation and handling of subsequent events. Highlight innovation within the whole business chain, and realize efficient integration of ecological operations, comprehensive and controllable safety management, personalized air travel services, efficient linkage of transportation hubs, and precise interaction of business ecology. At the same time, based on the language support of VRT, the algorithm encapsulated in the development environment may not be enough to meet the development of our visualization system. We can write our own algorithms to optimize the environment construction, such as the design of the optimal path algorithm for aircraft taxiing and launching.

2.3. Virtual Reality Interactive Environment

The prominent advantage of VRT is that it can establish an immersive three-dimensional environment, allowing people to transmit environmental information to the brain through sensory organs like the real world, presenting a situational awareness that is close to the real environment. To achieve such an effect, not only the support of the aforementioned 3D model and virtual environment construction, but also the support of hardware is required. The height of the obstacle restriction surface is determined by the airport flight zone level, and the clearance area range and restriction surface height corresponding to different flight zone levels are different. The taxiing mode and sequence of aircraft are the key to improving the operational efficiency of smart civil aviation airports, so as to verify and optimize the operation mode of smart civil aviation airports and obtain the best scheme.

The object processed by the smart civil aviation airport is information and data related to products and manufacturing systems. The processing result is a fully digital product, not a real physical product, but it is a digital model of a real physical product, that is, a virtual product, a mapping of a real product in a virtual environment, and has the characteristics and performance that a real product must have [10]. It is extremely important to correctly connect the device lines and access the port module, that is, to access the VRT engine that we have set up in advance for the ramp area scenario setup. The implementation of this function also requires a corresponding configuration environment, that is, to use virtual reality plug-ins in VRT.

3. System Operation and Achievements

3.1. The system is beneficial to terminal operation management.

For the terminal building, there are more smooth curves than regular cubes, so it is necessary to use advanced modeling methods to build models. NURBS modeling is used most in this system. NURBS modeling can be used to generate smooth curves and surfaces with arbitrary shapes, and it can be easily adjusted. In this paper, four groups of main clusters are selected according to the frequency, intermediate centrality and contour value to measure the internal homogeneity of clusters, as shown in Table 1.

Table 1. Main clustering of smart airport keywords

Serial number	Cluster name	Frequency	Centrad
1	Smart airport	162	0.51
2	Civil aviation airport	28	0.12
3	Artificial intelligence	14	0.09
4	Wisdom	20	0.07

These clusters appear frequently, but their centrality is not high, which shows that the connection function of the corresponding nodes in the whole network is weak. This system interacts with air traffic control ADS-B system, AODB flight dynamic information system, scene guidance activity system and so on through the interface, exchanges data in real time, displays apron dynamics and aircraft information, and stores relevant data through the database. According to the different modes of presentation and operation, the system can be roughly divided into four categories, namely: desktop virtual reality system, enhanced virtual reality system, immersive virtual reality system and network distributed virtual reality system.

The terminal operation management system dynamically manages the terminal building, counts the number of people in various positions of the terminal building, and can give an alarm in time when there is a potential danger, and the staff can take effective measures in time to avoid the danger. In addition, based on the multi-agent characteristics of smart civil aviation industry and high safety requirements, it is suggested that efforts should be made to promote the research on data sharing and the construction of artificial intelligence application standard system, form effective policy system and mechanism support, and give play to the leading role of policies in the construction of smart airports.

3.2. The system is conducive to passenger travel

The efficient transmission of information and the use of scientific and technological means to enhance the accuracy and timeliness of information have become the main characteristics of smart airports, which has greatly improved the operational efficiency of smart airports. The system is connected to air traffic control, airport, and airline operation related systems through interfaces to conduct real-time monitoring and operational analysis of airport core operational resources, greatly improving ground safety operational efficiency.

Through the system, passengers can fully understand the structure of the terminal, view the current situation of the terminal, and reasonably arrange their travel time. However, it is still based on two-dimensional plane display data, lacking immersive interaction and stereo vision. The system uses the same interface and is based on VRT and three-dimensional modeling technology for reference, taking its essence and improving its imperfection. The establishment of situational awareness for civil aviation airport environments, as well as simulation training under heavy traffic and special circumstances, can be completed through virtual reality systems, which can both save costs and understand every detail of the scene without being limited by on-site environmental conditions through the joystick alone, completing simulation training. Finally, airports use information technology to instantaneously transfer information among multiple entities, greatly improving airport operational efficiency.

4. Conclusions

VRT is an advanced technology to realize virtual scene construction and human-computer interaction by using many technologies. Because of its immersion, interactivity and imaginative features and powerful functions, VRT has been widely used in many fields and achieved certain results. Based on VRT, this paper develops the above functions into a visual system, which is more vivid than the traditional intelligent civil aviation airport management system without dead ends. For terminal managers, this system can find people crowded in time, remind managers to evacuate people in time and avoid congestion accidents. For passengers, you can observe the flow of people in the terminal at home and provide reference for passengers to make reasonable travel

plans. At the same time, it provides a better visualization technology than the traditional two-dimensional abstract research for the simulation research of efficiency, safety and capacity of many airport areas. At different stages of the development of smart civil aviation airport, its present situation and development plan are different, which largely determines the hot spot evolution and frontier dynamics of smart civil aviation airport. The function of the system will be more and more perfect, and the visualization technology based on VRT can also be used in all aspects of civil aviation, which is a good technical support for the learning, real-time visual observation, simulation and optimal decision-making of the whole civil aviation system.

References

[1] Cha M H, Min G K, Ji C K, et al. Virtual-Reality Technology and its Applications to Smart Machineries[J]. Journal of Drive and Control, 2022, 15(7):36-57.

[2] Li N A. Visual information enhancement method of multimedia human-computer interaction interface based on virtual reality technology[J]. International Journal of Information and Communication Technology, 2021, 19 (2): 127-142.

[3] Luo W T, Deng W. Application of Virtual Reality Technology in Civil Aviation Simulated Flight Training[J]. Software Guide, 2022, 63(28):51-67.

[4] Wang K, Wang X, Cheng S, et al. Past and future trends of civil airport emissions in China, from 2010 to 2030[J]. 2021, 42(18):31-56.

[5] He Y, Li X, Xiong S H, et al. A multi-objective programming model of civil airport fire station site selection based on RRCD and RADPD[J]. Computer Integrated Manufacturing Systems, 2020, 56(14):21-29.

[6] Zhao B, Wang N, Fu Q, et al. Searching a site for a civil airport based on bird ecological conservation: An expert-based selection (Dalian, China)[J]. Global Ecology and Conservation, 2019, 20(11):e00729-e00738.

[7] Lan Z. Construction of Cement Concrete Pavement for Civil Aviation Airport Road Project in Winter[J]. Database of Foreign Science and Technology Journals (Abstract Edition) Engineering Technology, 2021, 35(1):4-17.

[8] AMR Pasandín, IP Pérez. Developing theory from practice: A case study in civil engineering airport design problem-based learning[J]. Computer Applications in Engineering Education, 2020, 45(11):31-56.

[9] Reid R L. New Runway Impacts Entire Isolated Alaska Airport[J]. Civil Engineering, 2022, 88(9):30-32.

[10] Yoo S G, Lee J K. Rehabilitation of the Samjiyon Airport and Establishment of Air Transportation System Between North and South Korea for Mt. Baekdu Tourism[J]. JOURAN OF THE KOREAN SOCIETY OF CIVIL ENGINEERS, 2019, 67(11):15-26.