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ABSTRACT

Design and Implementation of Virtual St.Paul Church

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Virtual Reality (VR) is a breakthrough technology of human-computer interaction. It could allow people to immerse in a realistic 3D and highly interactive environment. VR application is not just only a 3D application, it would involve specific hardware devices and diverging software technologies. Nowadays, VR has become a hot research topic and is playing a very important role in computer science, especially in the area of entertainment, training, industry and commerce etc. This thesis will present the key issues and the fundamentals in VR, through a particular application of VR, the design and implementation of virtual St. Paul church.

The tourist industry is very important to Macau. In addition to traditional promotion medium, it is necessary to initiate certain IT projects to promote the image of Macau. As the façade of the St. Paul Church is the landmark of Macau and the ruins of the church is the most important attraction place in Macau, virtual survey of the original St. Paul Church would be very interesting to the visitors. By using the technology of VR and Internet, we may provide an attractive and effective means to promote the image of Macau. Therefore, the research project of "Virtual St. Paul Church" was initiated.

This thesis presents the development architecture, development cycle, the methodologies and techniques involved in the development of the research project. The development architecture of VR systems mainly consists of two parts, Modeling and Rendering. Modeling is the creation of the whole virtual environment as a database, while Rendering is the real-time generation of the scenes of the virtual environment. Most of the work in Modeling focuses on

the façade since it is the main part of the application. Modeling for a complex environment such as St. Paul church would generate a large amount of graphics primitives and as a result gives rise to a heavy burden of computation on graphics rendering. Therefore, polygon optimization is applied to reduce the number of polygons. To create the texture image for a large object like the façade is not an easy task. In order to maintain the color consistence, neighboring photos are necessary to be color-matched before their stitching together. A Color Matching Algorithm and a Stitching Algorithm are then proposed, and a tool of "Color Matching and Stitching" is developed to speed up and enhance the result. To allow the users to have more interaction with the environment, objects like swinging bells are added. In sum, a geometry-based VR prototype of "Virtual St. Paul Church" has been built by application of contemporary VR technologies.

Deployment of VR applications to Internet has become an emerging trend. In addition to traditional VR application development, this thesis presents the issues, methodologies and techniques for deploying VR application to Internet. To reduce the storage size and thus the load time of the application, the methods of Binary File Storage, Vertex Optimization, Object Instantiation and Application Compression are introduced. To compensate the unwillingness of lengthy waiting for loading the whole application, the method of Redirect Loading is proposed. Finally, an Internet version of the prototype of "Virtual St. Paul Church" is built and the experimental results are given.