The Multi-Dimension Navigating System Based on VRML-Java and its Integrity Checking

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Abstract: With the development of wireless communication and computer, Navigation has entered into a newer era especially for navigating. Now, the system used for navigation in DaLian is only the two-dimension (2D), dull and stand-alone electronic navigation chart. In order to display own vessel and its surrounding sea, to query some related information in the way of three-dimension (3D), we implement a navigating system, which combines the 2D chart and 3D scene, based on VRML and Java. The user can surveillance vessel dynamic and real-time earmark on the 2D chart. What's more, the user can observer the 3D neighbor environment and query kinds of dynamic information in the 3D scene with a more intuitionistic vision. The security of sea traffic depends on the navigating system primarily, and any data tampering in the system will give sailor fatal error judgment. So, it is important to protect the system from tamper. It is a very effective method to solve this problem. And we will give the network frame to fulfill the communication.

Key words: navigation, VRML-Java, Watermark, Tamper

1 Introduction

In the past, the user interface is only made up of dull, short-detail description and non-intuitionistic 2D chart in navigating system. The 2D chart can only display the action of sea data of special navigation domain while steering. There is no remarkable predominance to paper chart except displaying, stepless scaling and data storage. It has received some progress in the research of 3D visual harbor and vessel simulating, but it doesn’t implement navigating with meaning. We implement a multi-dimension navigating system that is combined 2D chart and 3D scene based on VRML-Java (Virtual Reality Modeling Language). The 2D chart is implemented by using Java and the 3D virtual scene is by VRML, while the EAI is used to accomplish the synchronous communication between them.

The navigation system protects data being tampered by allowing sailors a vivid, integrity and real-time 3D scene. It is a valid method to solve this problem by using digital watermark. And we will propose a communicating frame in the end.

We will introduce this system and related technology in the second part. Next, an example will be given to strengthen description. Then, we will give the communication frame to protect evil tamper.

2 Multi-Dimension Navigating System

VRML is a kind of virtual modeling language that is used to construct the model of real world or virtual 3D world on Internet. The dynamic action in VRML is implemented by an interface that is combined with the outer. The interface includes SAI (Script Authoring Interface) and EAI (External Authoring Interface). EAI can expand the function of VRML, and is used to achieve the communication between VRML and Java. So, EAI can overcome the interactive disadvantage in VRML. 3D virtual reality will be more reality, lively and convenience by uniting VRML and Java. The communication between 2D chart and 3D scene is come true by using EAI in the system. 

It is illustrated in the Fig 1.

![Fig. 1 Communication between 2D chart and 3D scene implemented by EAI](image)
3 An Application Example

In order to understand this system well, we will give an example of a harbor named DaLian in China. It is illustrated in figure 2. This example will display the virtual scene of DaLian Harbor, and its function is mainly to navigate for in or out this port.

1. Constructing 3D models of vessels and scene respectively
2. Translating the information of the vessel in the 3D scene to the 2D chart through EAI
3. Locating the vessel on the 2D chart with a marker and changing with the movement of the vessel in the 3D scene. Seeing the right-bottom in the Fig 2.
4. In the meantime, displaying the dynamic information of vessels that users designate on the right-top in the Fig 2.
5. 3D scene is displayed in the left in the Fig 2

The 3D scene based on VRML and the 2D charts based on Java are embedded into the same HTML as showed in the Fig 2. The 2D chart can access the 3D scene through EAI interface by using the functions that are encapsulated in the pack of vrml.external.Browser, vrml.external.Node and vrml.external.filed.*. And these functions can make Applet to access the 3D scene by using the events of getEventOut and getEventIn to obtain the event instance, by using getNode (…) to get the node in the scene. Thus, the 2D chart will get the data about vessel such as location and orientation, and to synchronously display the chart in the same time.

4 Integrity and Communication Frame

It will display chart after Applet receives the data about the chart came from servers through Internet and parses the data. In the meantime, it will offer the mutual operation between the system and the user. The user only need designate the URL in the browser, and the Applet will download to the end-user automatically to run it.

Triangle mesh is the most usual expression of three-dimension geometrical model in VRML. Progressive meshes (PM) [2] define a lossless, continuous-resolution representation of arbitrary meshes, and support scalable rendering, progressive transmission. PM offers a compact storage mode to real-time dynamic Level of Detail (LOD) of multi-solution model. It is possible to produce any multi-solution LOD model in succession from PM by edge-collapse and vertex-split. The method of simple geometric transfiguration can make lubricous transition between these consecutive dynamic LOD. In addition, PM is also an expression to be used to gradual transmit directly. The base mesh of PM can be set to the end user first, as to interactive with end user’s fleet. Then, the collapsed record will be
transmitted ceaselessly until the base mesh reversed the original mesh. The end-user can gain a simple version even when network is interrupted. When the remainder vertices are not less than the $N$ (determinate in advance) as doing edge collapse in PM, we will embed frangible digital watermark by modifying attribute of the vertices to make it more sensitivity to tamper of data in 3D scene. After the 3D scene and models are translated, the end-user will have the watermarked scene and models. The frame of translating 3D scene and integrity checking will be illustrated in the Fig 3.

**Summary**

The multi-dimension navigating system based on VRML-Java offers users a more intuitionistic interface to help decision-making by combining the 2D chart and 3D scene. The user can survey vessel dynamic and real-time earmark on the 2D chart. What’s more, the user can observe the 3D neighbor environment and query kinds of dynamic information in the 3D scene with a more intuitionistic vision. In order to ensure to do correct decision and assure the sail security, we use frangible digital watermark to enhance the sensitive to data tamper. With the maturity of the technology of virtual reality and communication, the multi-dimension navigating system will become an important application in sailing in the near feature.

**Reference**


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