Interactive Media on Demand: Generic Recording and Replay of Interactive Media Streams

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1. INTRODUCTION

In this demonstration we present a generic recording service for *distributed interactive media*, i.e., media which allow a distributed group of users to interact with the medium itself. Typical examples of this media class are shared whiteboard systems, distributed virtual environments and networked computer games. By defining an abstract model and an application level protocol we were able to develop the first *generic* recording service for *arbitrary* distributed interactive media. This service is called Interactive Media on Demand (IMoD), and it is able to record and replay all applications that are based on the RTP/I protocol. In particular it allows random access to the recorded media streams. *We demonstrate the IMoD system by recording and replaying a shared whiteboard, a networked computer game and a 3D telecooperation application.*

2. DISTRIBUTED INTERACTIVE MEDIA

In order to provide a generic recording service that is reusable for a whole class of media, we define a media model. A more detailed discussion of this model can be found in [2]. A distributed interactive medium has a state. For example, the state of a shared whiteboard is defined by the content of all pages currently present in the shared whiteboard. An application for distributed interactive media generally maintains a local copy of the medium's state. It is therefore said to have a replicated distribution architecture. The state of a distributed interactive medium can change for two reasons, either by passage of time or by events. Generally, a state change caused by the passage of time does not require the exchange of information between application instances since each user's instance can independently calculate the required state updates. Any state change that is not a fully deterministic function of time is caused by an event. Information about events must be transmitted to all remote instances of the application in order to keep the remote copies up to date.

3. RTP/I PROTOCOL

The *Real Time Protocol for Distributed Interactive Media (RTP/I)* [2] is a protocol framework for distributed interactive media. It consists of two parts: a data transfer protocol for the transport of events, states, and requests for state information, and a control protocol for meta-information about the medium and the participants of a session.

The data transfer protocol provides a standardized framing for so-called application data units (ADUs). This framing contains information that is common to the distributed interactive media class. Typical examples for the information contained in the RTP/I data framing include a timestamp which indicates the time at which an event happened or a state was calculated, the type of the data (e.g., event or state), and the unique ID of the ADU's sender. RTP/I can also be used to request the state of a sub-component in a standardized way.

RTP/I is closely related to the Real Time Transport Protocol (RTP) [3] which is mainly used for the transmission of audio and video. However, while RTP/I reuses many aspects of RTP, it has been thoroughly adapted to meet the needs of distributed interactive media.

4. IMoD SYSTEM

The *Interactive Media on Demand (IMoD)* [1] system is a generic recording and playback service for RTP/I-based interactive and RTP-based non-interactive media streams. The recording and playback of interactive media streams is based exclusively on the common aspects of distributed interactive media as they are exposed by RTP/I. For this reason, the IMoD system is capable of handling *any* interactive media stream using the RTP/I protocol, regardless of the specific media type or encoding. For example, a recording might contain a distributed dynamic 3D model combined with a shared whiteboard, as well as audio and video data.

The main idea of the generic recording is to record the ADUs (states and events) as they are transmitted during a live session. At a later time, the stream of ADUs can be replayed in the proper order and with the correct timing as provided by the RTP/I header information. The properties of the replayed ADUs are re-calculated to match the conditions at replay time. The stream produced in this way can be interpreted and presented to a user by an unmodified application.

One challenging problem with the development of a generic

recording service for distributed interactive media is the realization of random access to the recorded stream. The main problem here is that the listening applications must be initialized with the current state of the medium before they are able to follow the recorded stream. Since the recorder is generic, it will not be able to calculate this required state information. However, using the information contained in the common RTP/I protocol headers, it can determine a combination of recorded state and event ADUs which puts the receivers into the desired state at the access position. A detailed discussion of generic random access mechanisms for interactive media streams can be found in [1].

5. DEMO

Our demo shows the generic recording and replay of RTP/I-based applications provided by the IMoD-System. For this purpose, we show the recording and playback of the media streams produced by three different RTP/I-based applications (a 3D telecooperation application, a networked computer game and a shared whiteboard). We will demonstrate the generic random access to these recordings, in particular the initialization of these applications with the correct state followed by continuous playback of subsequent events.

The demo setup includes three computers: two will run the applications while on the third computer the IMoD system will record

and replay these sessions. The audience will be able to use the applications as well as to operate the IMoD System.

A demo video, showing the recording and replay of the 3D telecooperation application and of the simple networked game can be downloaded from: http://www.informatik.uni-mannheim.de/informatik/ pi4/projects/RTPI/demo.html.

6. ACKNOWLEDGEMENTS

7. REFERENCES

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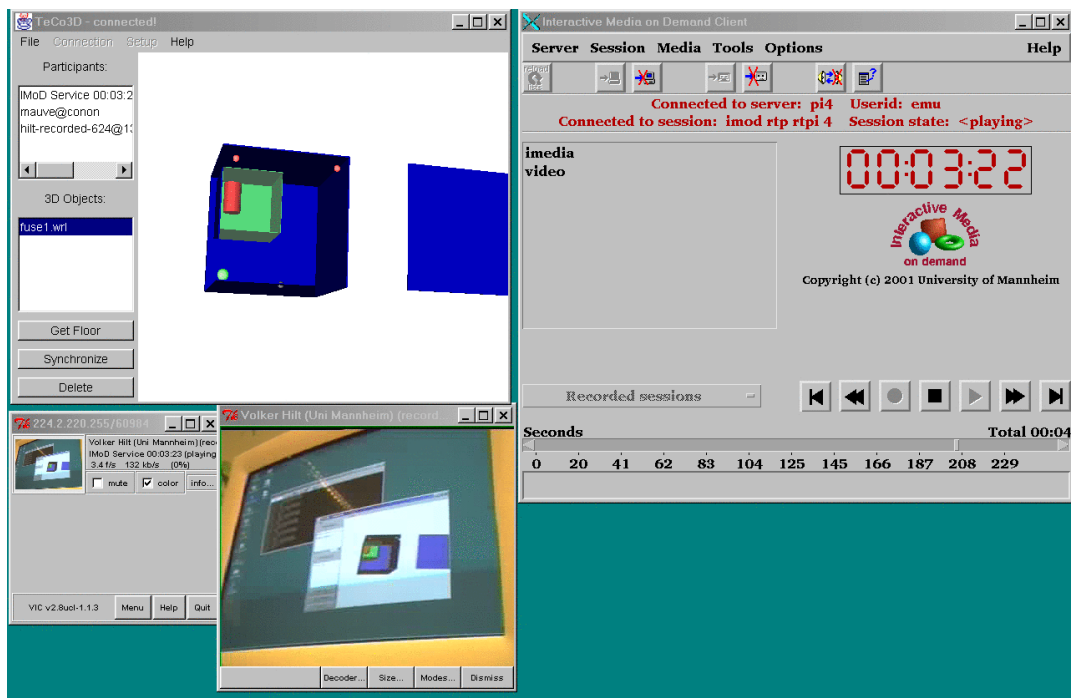
Figure 1: Example of a recorded session containing a video and an interactive media stream being played back by the IMoD system. The interactive media stream is decoded by the application in the upper left corner. The video stream is received by vic, depicted in the lower left corner. The video shows the display of the interactive media application captured during the recording. The IMoD client application is shown on the right.