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RESEARCH OF THE CREATION OF A DISTRIBUTED SCHEME VIRTUAL REALITY VIDEO STREAM DELIVERY

ДОСЛІДЖЕННЯ СТВОРЕННЯ РОЗПОДІЛЕНОЇ СХЕМИ ДОСТАВЛЕННЯ ВІДЕО ПОТОКУ ВІРТУАЛЬНОЇ РЕАЛЬНОСТІ

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The concept of the Metaverse gained popularity during the recent pandemic, when people preferred to avoid personal interaction; companies implemented remote work policies and adopted digital methods of communication. As a result of the emergency people wanted to learn about the Metaverse and understand its usefulness. The Metaverse is a highly interactive three-dimensional virtual world. Just like in real world, users can trade land, buildings, and other digital assets, communicate, or develop and test, for example, cars, using their personalized avatars. An avatar is a real user reflection in the Metaverse and can do anything a human can do in the real world. In addition to the above actions, the opportunity to perform remote medical procedures and operations is especially important. While implementing this idea a few problems must be overcome. In this work, I

would like to clarify the guaranteed delivering a 3D virtual reality video stream from a computer game server through IP networks.

Ideally, using dedicated lines from the servers that generate a stream of 3D video frames of virtual reality and fiber optic cables, significant problems with a high-quality frame transfer and with a sufficient frame rate per second do not occur. However, when trying to use the Internet, a few problems arise. Obviously, it is impossible to lay an optical fiber to every computer.

A significant problem of non-guaranteed delivery networks (which includes Internet, which is based on IP) is that there is no guarantee which way another frame will go from the server to the user's computer. And this means that one cannot know in advance the time of delivery of one frame, which causes frames to rattle when playback of the video stream in real time. In addition, IP packets can be lost, or errors occur in them. It is clear that for a real-time application it is impossible to create buffer to accumulate frames or send a repeat-request to the server for them.

First, I will review the existing methods of eliminating packet loss in wireless networks [1]. The traditional ARQ (Automatic Repeat-ReQuest) scheme is unsuitable for real-time video applications because it creates a long delay and may not meet strict video streaming time requirements. As an alternative error-tolerant encoding (Forward Error Correction – FEC) can be adopted to protect video packets and use multiple multicast trees to provide redundant paths for transmitting the coded video bit stream. Such clear excess can add unnecessary network load and reduce data transfer speeds. However, if nodes generalize operations beyond simple replication and routing, it has been shown that improved throughput and implicit redundancy can be achieved when encoding is enabled at intermediate nodes. Known as network coding (NC), this approach has attracted a lot of attention since it was first introduced, but its application to video delivery remains mostly unexplored.

Research is being conducted on the use of error-tolerant coding [2] and of a distributed 3D virtual reality video stream delivery scheme. In [3] the authors suggest architecture for scalable delivery of 3D video streams over IP networks, where they highlight two aspects. First, they model 3D video as a multi-stream application where each stream (or layer) carries a single encoded video signal or encoded scene description data. Second, they offer an end-to-end delivery model for 3D video applications that uses distributed system architecture for reducing bandwidth and processing costs on the server and end nodes users. Although the work [3] is focused on solving the issue of 3D video delivery from multiple video cameras filming a real-world scene from different angles, combining this approach with the principles of error-tolerant coding is worth noting and can be a topic for further research.

In the case of broadcasting interactive content of 3D virtual reality video games increasing the reliability of the system is possible due to the development of a model, which involves the creation of several communication channels between the server and the computer user and protocol for creating and reading multi-layer (multi-channel) traffic, due to the use of several multicast trees for provision of redundant paths. At the same time, one channel (main layer) carries the main load and the entire video stream of the game, while others carry a duplicated (completely or partially) video stream while preserving the sequence of the video stream and are backup channels at the same time. Thus, one more task to the computer for 3D virtual reality video games is detecting lost, damaged frames or frames arriving late and switching to other channels to find suitable frames for rendering the integrity of the video stream with the appropriate quality for the user. Quality development of this model requires significant time resources and the involvement of a larger number of specialists, so my research continues.

Undoubtedly, the idea of creating the Metaverse is worth attention and needs further research, which is currently actively happening, for example, with support of Meta for the development of its Facebook social network product.

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