TRAVO – Transfer and visualization of mobile graphical 3D objects

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German Abstract

TRAVO (Transfer und Visualisierung mobiler graphischer 3D Objekte) ist ein von der Heinz Nixdorf Stiftung gefördertes Forschungsprojekt, dessen Schwerpunkt die Übertragung von dynamischen 3D Daten auf unterschiedlichste Endgeräte wie z.B. Smartphones, PDAs, PCs oder Notebooks darstellt. Dabei wird der Ansatz, der bereits im WAP Projekt entwickelt wurde, weiterverfolgt und erweitert. Der Focus von TRAVO liegt vor allem auf der Visualisierung von 3D Daten auf mobilen Endgeräten wie Smartphones oder Pocket PCs. Ein weiterer Schwerpunkt der Forschung soll in Optimierungen für GIS Daten bzw. Anwendungen liegen, Hier soll der effiziente Transfer von Terraindaten und Stadtmodellen ermöglicht werden.

Introduction

The TRAVO project - Transfer and Visualization of mobile graphical 3D objects - aims at enabling real-time 3D communication for multiple end user devices using dynamic 3D datasets. The range of devices includes smartphones and pocket devices as well as desktop computers and notebooks. A special focus lies on the optimization for GIS (geographical information systems) data sets. The project is funded by the Heinz-Nixdorf-Stiftung. Basis of the research are the results of the WAP project - a recently finished project also funded by the Nixdorf-Stiftung. The extension of the WAP system in the TRAVO context will enable the communication of mobile devices in 3D content connected in a real-time graphics environment to multiple other users. Sharing the dynamic 3D data sets constitutes a large step towards a mobile online society where everyone is connected online.

Fields of application

In the Geographical Information Systems sector the TRAVO solution can have a high impact on the usage of navigation systems and city information networks. City maps can consist of 3D models that allow a much more flexible and ergonomic view to the cityscape than the 2D top view does nowadays. Looking at the game industry sector this application scenario can become a very important part of the future development. Nowadays predefined datasets are controlled by servers. Transmitting data and reaching dynamics in 3D applica-

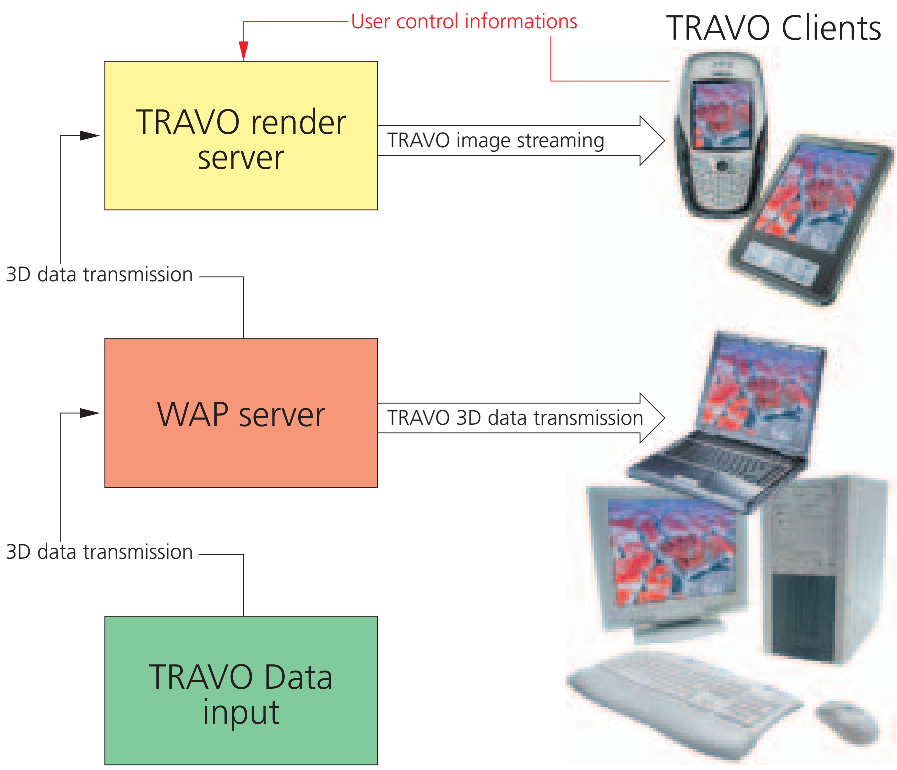

Figure 1: TRAVO system layout

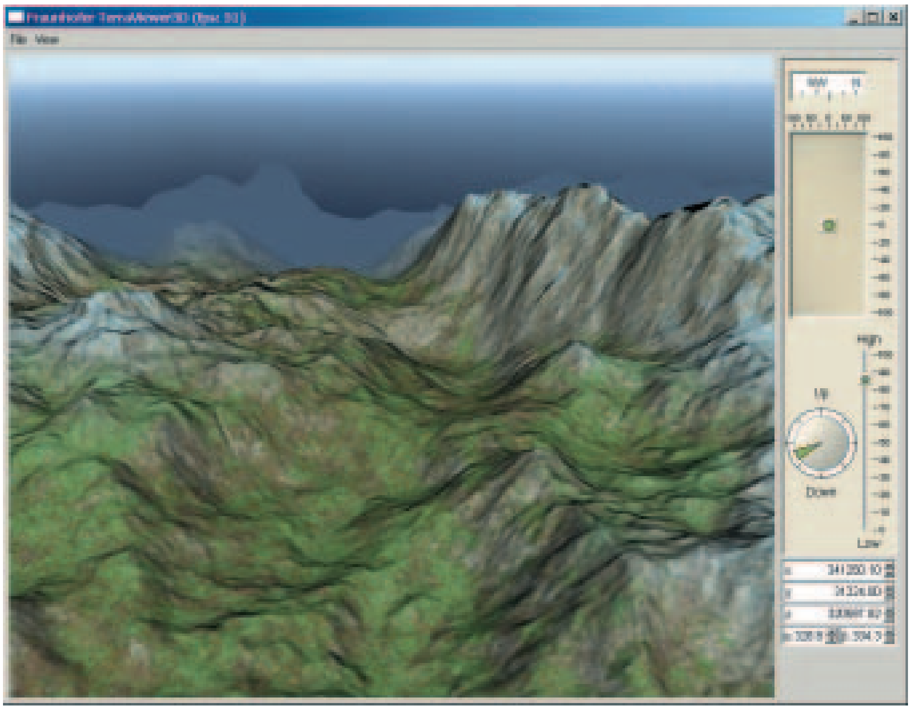

Figure 2: Optimized terrain renderer for large scenes

tions is a big step forward to a highly interactive online world.

Integrating limited interactivity into the 3D data visualization on the mobile clients enables the device to control larger devices connected to the same network and datasets. Using the control information of the mobile client connected to the current 3D scene can be used to control hardware that has knowledge of that 3D dataset.

Technical Solution

The main goal of TRAVO is to enable a visualization of 3D content on mobile devices. Here, the challenge is to handle the very restricted resources of such devices. For example a usual smartphone presently runs with a 220Mhz processor and 10Mbytes of available memory. Obviously this restriction is the biggest handicap for the transmission and visualization of graphical content. TRAVO will aim at the visualization of large 3D datasets like city models or 3D content creation data. The slim device itself cannot handle such amounts of data. Therefore our approach that outsources the calculation for rendering and dynamic representation of the scene to a render server that will precalculate all rendering data. This server gets its data directly from the data server. The results of the render server – the completely rendered images – are then transmitted to the mobile devices. The transmission can be done using either an image sequence or a coded video stream. Mostly all smartphones available today are able to process video streams in real-time. This fact enables the slim devices to show rendered scenes of a scalable quality and complex 3D scenes that are larger than the technical properties of the device itself would allow to handle. The limitation of the size and quality is now attached to the abilities and resources of the render server and no longer to the capabilities of the device itself.

Realizing the described approach will only allow the user to passively participate in the 3D scene. To enable interactivity, the control commands of the pocket device will be back-loaded to the render server enabling a basic interactivity. For example the user can now pick objects and get information on them or navigate through the scene. The render server reacts to the command input from the mobile client and concurrently adapts the rendering scene. The new information is immediately rendered and transmitted to the client using the described image stream.

When connecting a large number of clients to such a render server, the server reaches its computational limits very fast. To avoid this result, more than only one render server can be established. Handling only a limited number of clients by each server will allow a constant and stabile performance for bigger numbers of clients. This modularity will make the system very flexible to use and easy to port.

The second main TRAVO topic is the research for new algorithms allowing the fast and optimized visualization of GIS data sets. Especially for terrain models the implementation of a 2,5D system instead of the usage of real 3D data for the calculations can enable a very efficient and fast visualization of large data sets. Figure 2 shows the first results of this research. The algorithms of this render engine are optimized to speed up especially large scenes consisting of terrain data. The 3D data is constructed of height field images. The converter creates a tile-based scene structure that can be parsed very efficiently. This fast access allows a real-time clipping in the scene. Therefore, the size of the data set can extend the actual memory size of the device it is rendered on. The scene manager automatically adjusts the viewable parts of the scene to the hardware resources available. The future research within the TRAVO project in this area is mainly focused on the integration of dynamic 3D objects like building models. On the other side the visualization must be connected to the image streaming component of the render server. This will enable users to view large and complex 3D data sets, for example from emerging new GIS applications, on mobile devices.

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