New 3D Visualization Technologies as a Part of Scientific Gateway and Portal

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Abstract: - Our paper describes the use and also the great importance of new modern tools of 3D visualization technologies as one of the main components of the Science Gateway (SG), and portals. As new technologies of 3D visualization are improved and developed, so are new scientific portals and gateways, which are also created by using new 3D technologies such as Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), etc. Our paper aims to point out and explain with several examples where we supported the use of new modern technologies of 3D visualization as part of the science gateway in the portal. Our research focuses on the creation of visualization tools in the fields of natural disasters, astronomy and astrophysics, education, water management, and many other sectors.

Key-Words: - Scientific gateway, portal, 3D visualization, Virtual Reality, Augmented Reality

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1 Introduction

A gateway or portal is a site with clear, numerous links to many other pages, through which you can access personalized data, applications, and services. A science gateway is usually created and perfected by a single community, which accumulates in it a set of tools, applications, data, and various other necessary information. It can be said that access to all scientific results in a given community area is integrated through a portal or science gateway, usually in a graphical user interface that is further adapted to the needs of a particular community. A great benefit is that science gateways allow users associated with a common discipline to exploit national resources through a common interface that is designed and configured for their optimal use. Such a structure saves research teams a lot of time and they can focus on their scientific goals because they already have the necessary cyberinfrastructure in place. Gateways containing clear links to other community sites thus encourage collaboration and exchange of ideas and scientific results of the particular community.

We adapted our development to the Tera Grid tool, [1]. TeraGrid Science Gateways provides community access to TeraGrid resources. The advantage of Tera Grid is mainly that TeraGrid allows gateways to request resources on behalf of the entire community, which brings several benefits such as targeting a larger number of users. This gateway provides community members with the customized interface needed to sign up, submit jobs, and access data collection through the transparent use of TeraGrid resources, by opening access to new communities of users who have not registered directly with TeraGrid. TeraGrid resource providers need the ability to collect user statistics as inputs for future planning and success metrics, both for internal use and scientific gateway with several advantages

Our approach has enriched the scientific gateway with several advantages, [2], such as:

- *transparent data access*
- *access to meta-data*
- *access to visualizations*
- *access to analysis*

Transparent Data Access

For scientists provides access to data repositories that are typically scattered. These are scattered across multiple domains and institutions.

Access to meta-data

Access to meta-data and meta-data sources to perform search and discovery activities.

Access to visualizations

Access to visualizations is an essential component of the scientific gateway, as scientists can easily and

quickly understand the results of research in a given area in a simple, sophisticated visualization way. For this reason, we are using new visualization methods through scientific gateways.

Access to analysis

After all, access to analyses is very important for evaluating scientific results in a given area.

2 New Modern Scientific Gateway

We start with Virtual Reality Scientific Gateway, and later in parallel with the development of 3D imaging, we changed our approach and created the Augmented Reality Scientific Gateway.

Now it is becoming increasingly apparent that along with the development of these technologies, it is necessary to simultaneously develop modern 3D visualization tools as well as their integration into the structure of a concrete SG. Modern SG contributes to the education of scientists, students, and anyone interested in the field. As part of our scientific research, SGs are an important article for the presentation of our research results.

The choice of a new imaging techno purpose depends on what purpose it is used for. For example, Microsoft has taken the approach of a new modern visualization technology such as Mixed Reality (MR) for use with HoloLens. I.e. overlapping interactive holograms with the real world as well as with their background. Applications using MR have proven themselves in the professional field, especially in various healthcare sectors. It greatly assists surgeons with non-invasive surgeries, or in the business sector, where it helps with machine maintenance on site. Such a method also provides hands-free assistance in real-time.

However, for the scientific gateway, which is an education technologies table choice of new modern 3D visualization technologies' differences and advantages virtual reality and augmented reality? Virtual reality (VR) was invented in the 60s and developed in the 70s. Virtual reality was developed along with flight simulators developed by military aviation. Progress in research into CoR educational applications has been uneven, with empirical studies being scarce (Jacobson, 2008, pp. 62-75). MR is very effective in learning, which requires a sequence of steps, that is, procedural tasks, and also for tasks that required movement in a 3-dimensional space. In the early 2000s, multi-user virtual environments (MUVE) use modern visualization technology such as Augmented Reality (AR). The affordability of these new technologies was also a great advantage. It took almost 25 years when the need arose for these new technologies to be fully introduced into the educational process and scientific gateways as essential educational tools.

Our research aims to create new scientific gates and especially to grayscale already existing scientific gates with new technologies such as augmented reality AR, and mixed reality MR. With new trends starting a lot of researchers are interested in SG and portals, [3], [4]. We try to enrich this creation with the possibility of call sing with modern new modern 3D visualization technologies and tools. The results of research in the field of astronomy, the field of science, natural disasters, and also in the field of education have been incorporated into the relevant scientific gates. Widely known as the Water HUB is a scientific gateway for research and education in the field of water, it is a global communication and research platform for research, education, knowledge sharing, and global outreach.

The Water HUB, which is based on hub zero's cyberinfrastructure for scientific collaboration, develops and makes available data modeling and sharing tools used in water-related research and education activities, [5]. Its tools also include the online SWAT Share application, which allows users to run and calibrate their SWAT models and supports model sharing and visualization of output data through web browsers. In addition, the Water HUB will also benefit from other national efforts, such as the web services of the Hydrological Information System (HIS) of the Consortium of Universities for the Development of Hydrological Sciences.

3 Some Examples

New modern 3D visualization technologies are composed of the digital world with our real world, making it the best educational platform for research and education. The required audiovisual elements, overlaid in the real world, make up the perfect development tool. With the correct implementation of physical activities, new modern 3D visualization technologies can become an entry platform for scientific gateway and portals, [5].

The entry platform for science and education brings several benefits. Mobile application to enable researchers and students to account for all the new modern 3D visualization technologies and research results. New modern 3D visualization technologies are virtually speaking head and text-to-speech and speech-to-text services. Web-based authoring tools and mobile applications for Android and IOS affect

collaborative interfaces, education modules and bring new modern technologies and lessons, and books.

3.1 Some examples from water management

Our research focused on simulations in the field of water flow, water pressure in high-rise buildings as well as in the field of water quality. For calculations and the display of scientific results, we designed and created several modern tools, [6]. For example, we created the new modern 3D visualization technologies tool to display the scientific results of these simulations.

These tools were subsequently incorporated into the scientific gateways of water research, [7]. We start with the terrain of Bratislava town covered with water pipes and Orto-photomaps. See Figure 1 and Figure 2. The water pleasure in high-rise buildings is shown in Figure 3 and Figure 4, as the flow of water.

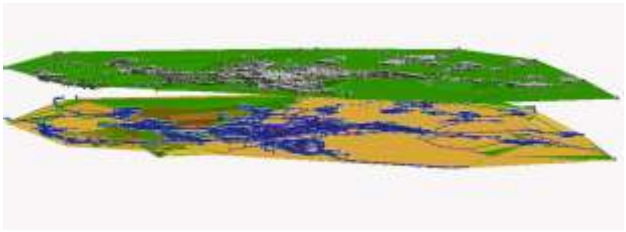

Fig. 1: The terrain of Bratislava town is covered with water pipes

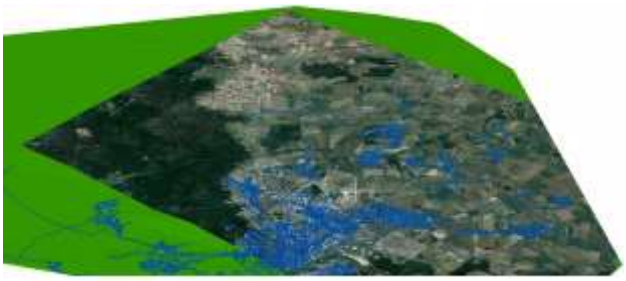

Fig. 2: Terrain covered with water pipes and with ortho-photo-maps

Our research focused on simulations in the field of water flow, water pressure in high-rise buildings as well as in the field of water quality. For calculations and the display of scientific results, we designed and created several modern tools. For example, we created the new modern 3D visualization technologies tool to display the scientific results of these simulations. These tools were subsequently incorporated into the scientific gateways of water research. The water pleasure in high-rise buildings is shown in Figure 3 and 4 and the flow of water. See Figure 5.

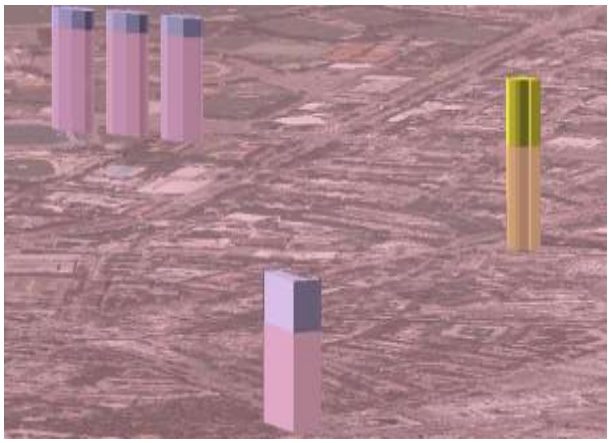

Fig. 3: Water pleasures in big buildings

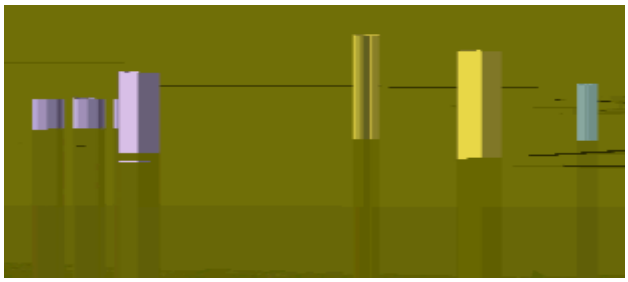

Fig. 4: The water pleasure in big buildings which are too high and water pleasure is not the norm

3.2 Some Examples from Astrophysics and Astronomy Scientific Gateway and Portals

Our research focused primarily on astrophysics and astronomy. We have created a very sophisticated mixed-reality tool for astronomy scientific gateway. VR, AR, MR, and all new visualization technologies have the main position as a way to control the execution process. The visualization tool is designed as a plug-in module, [8]. The client asking for visualization is a “visualization client”. Output data on the storage element are the input data for visualization jobs.

Visualization workers are to modify data to the visualizable formats and prepare the typical visualization scenes. The development of science portals and scientific gateways is to cover the requirements of large-scale sciences such as earth sciences, astronomy, and all sciences that use grid, cloud, or cluster computing and high-performance computing infrastructure. The article also shows the main position of new technologies of 3D visualization in the Science Gateway and as an example, we describe describes the architecture of the visualization tool for astrophysics simulations The 3D visualization tool is integrated into the web portal, as well as the e-science gateway for astronomy and astrophysics.

3D visualization tool for astronomical applications provides pictures from simulation of the evolution of proto-planetary discs from 1Myr to 1000 Myr. We can see that during the 1000 Myr time that the particles were replaced from the inside to the outside of the spheres. Figure 5 shows the result of the dynamical evolution of the Oort cloud as a part of a proto-planetary disk after its evolutionary stage which was the first Giga year.

Fig. 5: Dynamical evolution of the Oort-cloud as a part of a proto-planetary disk after its evolutionary stage which was the first Giga year

4 Conclusion

The great benefit of portals and scientific gateways is access to high-performance computing resources via the web. Portals and scientific gateways can be considered as technologies that provide scientific disciplines with the building blocks to create newer more modern approaches to scientific information, and also allow people to access computing and data resources. Since portals and scientific gates are supposed to serve everyone, it must be admitted that the solution and their creation using modern visualization tools are more and more understandable for students, scientists, and even for physically and mentally disabled people. Therefore, we currently want to focus our research on improving the communication of disabled students using a virtual speaking head in their given language. With this virtual head, we want to enrich all the scientific gateways we have worked on so.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

-Eva Pajorova, programming, software development; designing computer programs; implementation of the computer code and supporting algorithms; testing of existing code components and preparation, creation, and presentation of the published work, specifically writing the initial draft (including substantive translation).

-Ladislav Hluchy, verification, whether as a part of the activity or separate, of the overall replication/reproducibility of results/experiments and other research outputs.

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Conflict of Interest

The authors have no conflict of interest to declare.