Digital Culture & Heritage
Patrimoine & Culture Numérique

Haus der Kulturen der Welt, BERLIN
Aug. 31st - Sept. 2nd, 2004
31 Août - 2 septembre 2004

TNT: THE NEANDERTHAL TOOLS

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Published with the sponsorship of the French Ministry of Culture and Communication

Actes publiés avec le soutien de la Mission de la Recherche et de la Technologie du Ministère de la Culture et de la Communication, France

Interprétation simultanée du colloque et traduction des actes réalisées avec le soutien de l'Agence Intergouvernementale de la Francophonie

Abstract (EN)

TNT is a combined RTD- and demonstration project and will develop advanced services and applications to improve access to Europe's cultural heritage, namely to collections and artifacts of the Neanderthal species. Thereby, it will increase the commercial value of parts of Europe's cultural heritage. TNT will enhance user experience in cultural tourism, visualizing scientific objects and artifacts and developing a new repository for intelligent heritage and tourism. Thereby, new revenue streams for museums and digital content providers will be created. TNT will also provide high-bandwidth access to distributed and highly interactive repositories of European culture. Thereby, scientific collaboration among Europe's top notch researchers in the field of Neanderthal research is improved.

Technology-wise, TNT is to develop a Visual Simulation Engine, called VISICORE will enable researchers in different locations to collectively explore and modify digital models of artifacts, sensor scans and other scientific data. VISICORE will also enable media companies to apply such technologies in commercial digital media applications.

Service-wise, TNT will establish NESPOS - The Neanderthal Species Professional Exploration Service. NESPOS will streamline business processes in a range of European Natural History museums and will improve distributed collaborative working among European pre-historians.

Application-wise, TNT will create the ARCH Channel _, a cross media popular science channel for intelligent heritage and cultural tourism whose goal is to transform (pre)-historic and other archaeology related representational content into commercially viable and tourism related digital media applications accessible from a range of Internet and mobile portals.

Keywords: realtime visualization, digital archive, cultural heritage, intelligent heritage, cultural tourism, Visual Simulation Engine (VISICORE), TNT, Neanderthal Species

Zusammenfassung (DE)

TNT ist ein kombiniertes RTD- und Demonstrationsprojekt, im Rahmen dessen fortgeschrittene Services und Applikationen entwickelt werden um den Zugang zu europäischem Kulturerbe, speziell zu Sammlungen und Artefakten von Neandertalerfunden, zu verbessern. Dadurch wird der Wert von Teilen des europäischen Kulturerbes erhöht. TNT

wird die Nutzererfahrung im Bereich Kulturtourismus, in der Visualisierung wissenschaftlicher Objekte und Artefakte und in der Entwicklung einer neuen Quelle für wissenschaftlich aufbereitetes kulturelles Erbe entwickeln und bereichern. Für Museen und Anbieter von digitalem Content werden so neue Einnahmequellen geschaffen. TNT wird außerdem einen Breitbandzugang zu verteilten und interaktiven Quellen der europäischen Kultur bereitstellen, wodurch die wissenschaftliche Zusammenarbeit zwischen Europas erstklassigen Forschern auf dem Gebiet der Neandertalerforschung verbessert wird.
Technologieseitig entwickelt TNT eine Visual Simulation Engine, genannt VISICORE. VISICORE wird es ermöglichen, dass Forscher, die sich an unterschiedlichen Orten befinden, gemeinsam digitale Modelle und Artefakte, hochauflösende CT-Scans und andere wissenschaftliche Daten erforschen und modifizieren können. Darüber hinaus wird VISICORE Medienunternehmen ermöglichen derartige Technologien auf kommerzielle digitale Medienapplikationen anzuwenden.
Serviceseitig wird TNT NESPOS einführen, den Neanderthal Species Professional Exploration Service. NESPOS wird Unternehmensprozesse in einer Reihe von europäischen Naturhistorischen Museen und Instituten einführen und die dezentralisierte Zusammenarbeit zwischen europäischen Prähistorikern verbessern.
Applikationsseitig wird TNT den ArchChannel etablieren, ein populärer Cross-Media Wissenschaftskanal für wissenschaftlich aufbereitetes kulturelles Erbe und den Kulturtourismus. Ziel des ArchChannel ist es (prä-)historischen und anderen mit der Archäologie verwandten Inhalt in kommerziell brauchbare und Tourismusrelevante digitale Medienapplikationen zu überführen, die über eine Reihe von Internet- und mobilen Portalen zugänglich sein werden.

Schlüsselwörter : Echtzeit-Visualisierung, digitales Archiv, Kulturerbe.

Résumé (FR)

TNT est un projet combiné de validation grandeur réelle (RTD) et de démonstration. Il développera des services avancés et des applications pour améliorer l’accès à l’héritage culturel européen, notamment l'accès aux collections d'objets fabriqués par l’espèce néandertalienne. TNT augmentera ainsi l'appréciation commerciale de certains pans de l’héritage culturel européen. TNT offrira à ses utilisateurs une expérience enrichie en matière de tourisme culturel, par la visualisation d'objets d’intérêt scientifique et d'objets fabriqués,

créant une nouvelle ressource pour le patrimoine et le tourisme intelligent. Un effet indirect escompté est d'augmenter les revenus perçus par les musées et de favoriser l'émergence de fournisseurs de contenus numériques.

Pratiquement TNT offrira un accès à bande passante élevée à des ressources interactives distribuées. Ceci devrait contribuer à renforcer la coopération entre les scientifiques européens de haut niveau dans le domaine de la recherche sur les Néandertaliens.

Sur le plan technologique TNT est basé sur le développement d'un appareil de simulation visuelle appelé VISICORE. VISICORE permettra à des chercheurs situés à des endroits différents d'explorer ensemble et de modifier des modèles digitaux d'objets fabriqués, d'explorations électroniques par balayage, et d'autres données scientifiques. VISICORE permettra aussi aux éditeurs et aux médias d'utiliser ces technologies dans des applications à caractère commercial.

TNT mettra en place le service NESPOS - Neanderthal Species Professional Exploration Service (Service professionnel d'exploration de l'espèce néandertalienne). NESPOS permettra de rationaliser les procédures dans de nombreux musées d'histoire naturelle européens, et d'améliorer la coopération entre les préhistoriens européens.

TNT créera l'application ARCH – une chaîne scientifique multimédia pour le patrimoine culturel et le tourisme intelligent dont le but est de transformer les représentations concernant la (pré)histoire et l'archéologie en applications destinées aux médias, rentables commercialement et accessibles sur de nombreux portails Internet et mobiles.

Mots clés : visualisation en temps réel, archives numérique, patrimoine culturel, tourisme culturel, préhistoire, Néanderthal.

I. TNT - Project objective(s)

Europe possesses the majority of museums and scientific collections, worldwide. This makes it necessary to record and store a large variety and quantity of objects and artifacts, to protect them and to present them to the public.

A museum's collection usually consists of a range of differently structured objects. Some of these objects are displayed permanently. However, many of them are stored in archives, while others cannot be exhibited at all due to their condition (fragile, too large, number of objects, missing exhibition space, destroyed, on loan, etc.). As a consequence, a lot of highly valuable objects and a great amount of Europe's cultural heritage is only known and accessible to a very limited number of people. This is an impediment to the scientific collaboration of European researchers. This is also an impediment to the promotion of intelligent tourism and to the intelligent access to Europe's cultural heritage by the public.

Visual Simulation has become an ubiquitous technique used in research, engineering, manufacturing and entertainment. It was in broad use a long time before the advent of the Internet, but was restricted to those areas of application that could afford very expensive graphics workstations and supercomputers. Today, with the computer game industry as main driving force pushing the limits of visual computing hardware, a low cost graphics display processor delivers an unprecedented amount of special purpose computing power that exceeds those of five years old supercomputers. At the same time, every company, every research facility and the majority of households in the European Community are connected to the Internet.

Applying visual simulation to the distributed collaboration of researchers and to building commercial digital media applications as well as combining the knowledge base of scientific research with the expertise of digital media builders may support access to Europe's cultural heritage, may foster intelligent tourism, may increase the commercial value of Europe's cultural heritage and may help in overcoming parts of the obstacles mentioned above. This is what TNT is to achieve.

The following organizations are joining forces to organize the system that aims to cluster all the dispersed knowledge regarding the Neanderthals: ART+COM, a company for interactive media technology in Berlin; PXP, an internet agency in Austria; the Hasso-Plattner Institute in

Potsdam, Germany; the Royal Belgian Institute of Natural Sciences in Brussels; the University of Poitiers in France; the Natural History Museum of Croatia; the Neanderthal Museum in Mettmann, Germany. NATIONAL GEOGRAPHIC DEUTSCHLAND is reporting exclusively on the new scientific findings and bears editorial responsibility for the ArchChannel.

II. Visual simulations and the TNT Visual Simulation Engine - VISICORE

Despite the recent advances in the computing industries distributed collaboration using visual simulation techniques via the Internet are not in broad use today.

The reasons for this are manifold, among them the inherent complexity of the necessary software, the high costs of 3D-content production, and a lack of acceptance by inexperienced or casual users due to usability problems. The high demand of computing power and network bandwidth necessary for collaborative visual simulation tasks cannot be satisfied very often, yet. But commoditisation should change this in the near future.

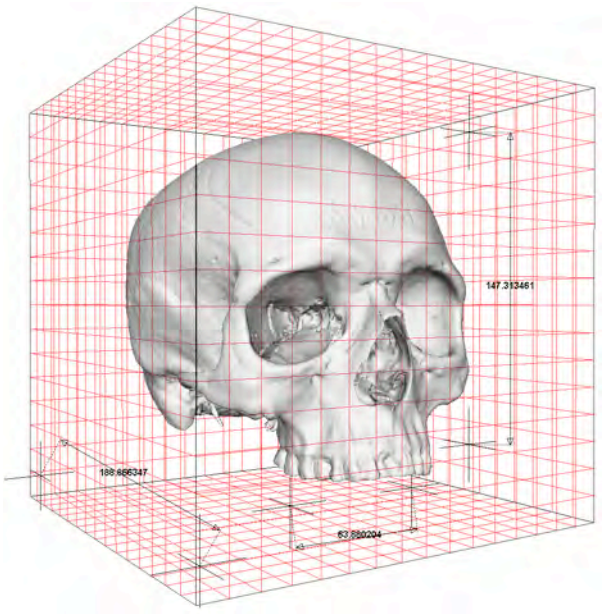

Fig. 1: Modern human scull - 3D based measurements

During the last two decades many visual simulation systems have been developed both in the

research- and in the commercial communities.
Looking at global research today, there is a noticeable decline of efforts, with many "Virtual Reality" companies having disappeared during the last years. On the other hand there is more graphics processing power being installed every day today than existed world-wide ten years ago. The computer game industry has become bigger in size than the film industry. And powerful professional 3D-Content creation tools are affordable today and such as the likes of Desktop Publishing, Digital Image Manipulation, Web Page Creation, Digital Film and Audio Editing are used as day-to-day tools not only by professionals, but by consumers by researchers and by small businesses.

The described state of the art makes it obvious that it is not sufficient to throw existing tools and technology together to create a collaboration and media application platform that will gain acceptance in a broad community of researchers and Internet application builders, let alone the interested public in form of a web user at home. It is necessary to push the limits by exploring the capabilities of the new and next generation technology thus overcoming the following main obstacles:

- the costs of content creation is too high
- the usability of visual simulation systems and navigation in three-dimensional scenes is too demanding for new or casual users
- the quality of the visual results often can not compete with other cheaper media or is simply not up to the given task
- The learning curve for users that desire to contribute content is either too steep or they do not get the expressiveness they need
- users of complex systems often get distracted and demotivated by technical problems, so they simply refrain from further use

A successful platform needs to address all the issues, as leaving any of these issues unresolved might lead to the technological failure of the TNT project in the long term.

The TNT-VISICORE Platform will be built employing the following principles and technologies:

- a component-based software architecture that allows
    - late binding and scripting control of all scene objects
    - close-to-the-silicon special purpose rendering subsystems

- special purpose data management modules for the handling of large datasets

- a programmable hardware based graphics pipeline with custom vertex- and pixel shading programs
- Internet communication protocols and Internet server architectures (http and others)
- XML-based data encoding, special purpose data and media compression methods
- incremental agile software engineering processes
- W3C-DOM Events oriented approach to inter-system messaging
- use of latest computer graphics algorithms
- combination of novel and proven user interface techniques
- application of latest results from human perception theories
- sophisticated defect management and avoidance, rigid user acceptance tests

System Architecture

The next paragraph illustrates the architecture of the technical infrastructure that can be built using the VISICORE System

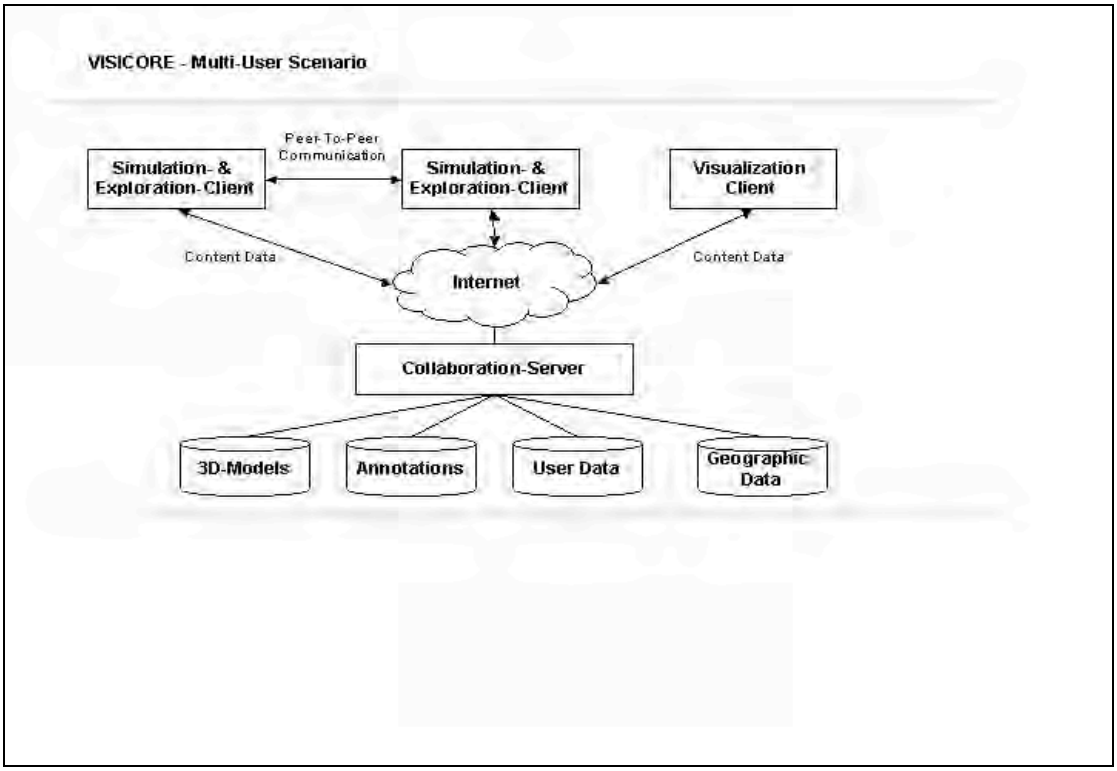

Fig. 2: VISICORE – Multi-User Scenario

The figure above shows the VISICORE System in a multi-user scenario. All clients are connected to a central collaboration server via the Internet. The system will support different types of clients:

- *Simulation & Exploration Clients* will allow full manipulation and simulation of the 3d-scene. They will typically run on performant PCs, equipped with top-of-the-line graphics hardware. Also a fast Internet connection will be required for access to large scenes.
- *Visualization Clients* will only support a subset of the functionality. They have read-only access to the data and are specifically designed for easy viewing and browsing in the 3d scene. Those clients will run on less powerful systems and could be used for educational purposes.

The server provides two types of services: Content-Provision and Collaboration-Coordination Services.

Content-Provision Services are similar to those of a standard web server. They provide content data of various formats to the end user clients. Data includes scanned images, 3D-models, geographic data, and annotations to the 3D-Scene, such as PDF documents or Excel spreadsheets. The Content-Server will apply a modular architecture that allows easy integration of new data-formats in the future (i.e terrain or voxel data)

Collaboration-Coordination Service cover services such as

- Coordination of concurrent scene-editing from different clients
- Coordination of concurrent simulation and visualization at different clients
- Directory services for peer-to-peer communication
- User authentification

III. Collaborative Research on the Neanderthal species – The NESPOS Service

Most of the museums and scientific collections in the world are in Europe. There is a necessity to record a large variety and quantity of objects, protect them and also present them to the public and to professional researchers world-wide.

The collection of a museum consists of many differently structured objects. Some of these objects are permanently on display. However, many of these objects are stored in archives, while others cannot be exhibited due to their condition (fragile, too large, number of objects, missing exhibition space, destroyed, on loan, etc.). As a result a vast amount of artifacts and objects are only known to and accessible by a very limited number of people. This is a severe

impediment to collaborative research and to intelligent access to Europe's cultural heritage.

The Neanderthal species - its rise and its decline - is one of the most important per-historic scientific topics, at all. And it is a truly European topic, as the Neanderthal men settled all over in what today is known as Europe. The Neanderthal men as being one of the most important ancestors of mankind, are also one of the important collaborative European research topics. Findings in one European country need to be compared with findings from other archaeological sites to shed light on questions such as how the Neanderthal men lived, how they differed to the Cro-Magnon men and what caused their final extinction.

Given that Neanderthal history is mainly representational - a history of viewing and exploring objects and artefacts, of assessing, comparing and interpreting them, improved visual simulation, 3D graphical representation and distributed collaborative access to it may well speed up research, streamline business (research) processes and increase output.

Hitherto, collaborative research on the Neanderthal species is to a large extend dependent on exchange visits, on sending around images via the Internet, on textual descriptions, etc. Collaborative exploration schemes are rare and especially with researchers in the applicant nations and with findings from their places virtually not to be found.

Museums cannot display permanently a large amount of objects and artifacts – neither to the public nor to professional researchers. This is mainly due to the condition of the artefacts, due to their age, their suffering from humidity, from being touched, from being exposed to human excrements, etc. Being able to display such objects and artifacts in 3-D or being able to exchange content from one museum to the other would also increase the attractiveness of existing scientific collections and would result in a more intelligent access to an important part of Europe's cultural heritage.

Applying VISICORE to research topics on the Neanderthal man and to the needs of museums in Europe, the limits on how cultural heritage is displayed and how collaborative research in Europe is currently undertaken can be pushed widely. With the VISICORE visual simulation engine researchers will have the chance:

- to easily exchange content in 3D format via the Internet and mobile devices,
- to compare results and artifacts with each other,
- to proof theories and
- to combine results world wide.

The result of the TNT project in service terms will be the NESPOS service - The Neanderthal Species Professional Exploration Service. NESPOS will initially be composed of four European Natural History Museums, who are leaders in researching the history of human beings and who have specialized in research about the Neanderthal species.

Each museum will make available a large amount of objects and artifacts in its possession. Objects will be made available for research purposes, i.e. to compare results obtained so far, to proof or disproof theories, etc., but objects will also be made available to include them in digitally displayed scientific collections and exhibitions. Each museum will provide different content which in total will give a never before accessible view on the important ancestor of mankind. With the help of VISICORE access to scanned and archived 3D data will also be possible as well as distribution, collaborative exploration and interactive presentation.

NESPOS is not planned to be a closed shop. Rather it will be open to other museums focusing on the Neanderthal species. To foster participation a user group composed of other pre-historic museums is planned to be formed. NESPOS will have its own Internet appearance as will the digitized and visualized material be included and displayed on the web pages of the different museums.

With the help of PXP, National Geographic TNT also plans to embed the visualized and digitized content within respective channels of Internet and mobile portals. Thus, the content will be made available to an even bigger number of users ranging from scientists to “average” Internet users, (prospective) museum or exhibition visitors and tourists prospectively interested in visiting an archaeological site or a museum related to the Neanderthal man while on or preparing for holidays.

Streamlining of workflow will focus on reducing research costs, reducing information costs, shorten development time and improving customer orientation. It will allow for increased re-usability of assets. Further, it will target the electronic transmission and the exchange of objects and collections as well as the retrieval of individual items and sequences.

IV. Intelligent Heritage and Intelligent Tourism media applications – The ArchChannel

Most of the museums and scientific collections in the world are in Europe. There is a necessity to record a large variety and quantity of objects, protect them and also present them to the public and to professional researchers world-wide.

With DSL technology shipped and installed in large numbers in the office and in the home web users are continually increasing their expectations of how visual content is to be displayed on the web. The well-known limiting factors of the (mobile and stationary) Internet make the development of new technologies necessary to increase the performance of visualizations, to simplify procedures and to create new interfaces to access content which as of today cannot be viewed in acceptable quality.

The well-known limiting factors of refinancing Internet sites and portals through advertising and e-commerce make the development of compelling content applications necessary for which the user is willing to pay while accessing it.

The Internet has become the most powerful media for gathering information and for communication purposes. Extracting scientific data and receiving information of all kinds is one of the strongholds of the Internet and a major source for interested consumers to satisfy their information needs. The availability of video on the mobile and stationary Internet through GPRS, UMTS and the deployment of cable modem, DSL connections etc. will soon make video and 3D on the net common media. Powerful 3D and video applications will also boost the use of the Internet and will attract still wider audiences.

Scientific content be it in the form of popular scientific content or targeting an academic audience is one of the key premium content areas, for which people are willing to pay (provided the quality is good enough). The same is true for tourism related content providing local or regional information on entertainment, cultural events, archaeological sites, etc. So far, most of the representational content residing with Pre-historic Natural History is not available in digital forms via media such as the Internet.

Displaying such content on the web pages of the four TNT-museums, and enhancing it with other content and embedding it in mobile and Internet applications of tourism and

archaeology related information and popular science sites means to widely push the limits of dealing with representational pre-historic content and its display to a world-wide audience.

Enhancing such content with background information (texts, images, history, museum guides), with interactive services (email, etc.), and with e-commerce (ticketing, travel, reservations, etc.) means to widely push the limits in supporting intelligent tourism, fostering access to Europe's cultural heritage and opening up new revenue streams.

And finally, deriving a role model for other content areas out of transforming representational scientific Neanderthal content into commercially viable media applications for which consumers are willing to pay may help to undertake similar projects in other areas. This in turn should further promote intelligent heritage and cultural tourism even further.

The result of TNT in application terms will be the ArchChannel – the archaeology channel – a cross media popular science channel (Internet and mobile) for intelligent heritage and tourism which will have transformed (pre)-historic and other archaeology related representational content into commercially viable and tourism related digital media applications accessible from a range of b-2-c portals.

The ArchChannel will not reside on one web page, instead it will feed various web pages. Category one will be the homepages of the four museums involved in TNT. Category two will be the websites/portals of National Geographic. Category three will be the development of white label content which will be sold/ given to websites informing about the regions where the four Neanderthal museums are located (city portals, etc.). Category four will be sites of tourist boards and other tourist information sites informing on the archaeological sites related to the Neanderthal species. Category five will be websites of travel agencies, travel companies and companies providing information about certain regions for tourists. Category six will be the travel and tourism channels of large general interest portals such as Lycos, Yahoo, etc.

Where already available the same syndication structure applies for the mobile Internet. Whether information shall also made available for other media such as radio, audio guides of museums, interactive TV and print will be decided during the course of the project.

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