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Computer Graphics

Computer graphics is the **technology with which pictures, in the broadest sense of the word (synthetic graphics as well as grayscale and color images), are captured or generated, presented, manipulated, digitally processed in the appropriate form for the respective application and merged with other, nongraphical application data.** Computer graphics also includes the computer-supported integration and manipulation of these pictures with other kinds of data, such as audio, speech and video **(to create multimedia systems)** as well as corresponding advanced **dialogue and interactive technologies**. Concepts which characterize the important topics of computer graphics are, to name a few, visualizing information, visual data mining, visual computing, virtual reality (VR), augmented reality (AR), interactive Internet services and secure image transmission and communication.

EDITORIAL

Dr. Stefan Noll, Jorge Posada, Luís Almeida

Dear Reader, welcome to this COMPUTER GRAPHIK Topics issue. This co-edition by Centro de Computação Gráfica (CCG), VICOMTech and GraphiTech, presents some of the most recent R&D projects under development in these institutions. The articles presented in this issue cover a broad range of application areas, all of them very actual and of special interest in terms of the related research fields.

GraphiTech
The new Center for Advanced Computer Graphics Technologies,
Fondazione GraphiTech moved in March to its new offices in Rovereto and hold its opening ceremony on April 4th (see Events). GraphiTech has been established in order to conduct research and development activities in the broad technology area of advanced computer graphics and virtual reality. The aim of the joint venture is to enhance the competitiveness of Trentino's industries through the development and application of advanced computer graphics. The foundation will contribute towards the transfer of knowledge between the research sector and the industry through the promotion of research on advanced graphic, information processing and visual communication, including virtual reality and virtual engineering. GraphiTech started in January 2003 with a set of projects in the area of innovative product design and product development process, knowledge management systems, collaborative Virtual and Mixed Reality systems and distributed computing service platforms and applications, including GRID-Computing. Fondazione GraphiTech, Center for Advanced Computer Graphics Technologies has been founded as joint venture between the INI-GraphicsNet Stiftung, the Cultural Institute of Trento (Istituto Trentino di Cultura ITC-irst) and the University of Trento (Università degli Studi di Trento).

CCG
Reinforced focus on national industry
For CCG the reinforcement of cooperation with national industry is an objective to be pursued for several sectors. An example is the »TECNOMOLDE« project, which aims for the development of innovative work and solutions for thermoplastics mould making industry. Another article presents the »Mobile Added Services«, taking advantage on the most recent mobile technologies for location based services. A set of services enabling to access information, recently only throughout Internet using a PC, available in the context of a specific environment, are presented. The third contribution from CCG exemplifies another ongoing consortium work in the field of Polymer extrusion research, the E-xtruder.net Being one of the most important technologies used to produce plastic parts, the article presents the work to be performed for project, which aims at the implementation of software for modeling, optimization, monitoring and training of polymer extrusion process, implementing a powerful and efficient tool able to support this industrial sector, during the development and production of new products.

VICOMTech
A consolidated R&D Technology Centre
In its 3rd. year of operation in San Sebastian, VICOMTech has consolidated at the local, national and European levels. With several projects covering our 5 application areas (Digital TV, Medical Applications, Edutainment, Cultural Heritage, and Industrial Applications), and about 30 staff researchers and students, VICOMTech is now pursuing 3 strategic objectives: advanced laboratories infrastructure, to be active in the EU 6th. Framework Program, and to increase industrial contacts.

VICOMTech presents here a project of each area. TRAC introduces Augmented Reality techniques to aid surgeons in liver operations. SEITV focus on the R&D of leisure and educational applications in Digital TV. ASEDUC uses avatar technologies improve the E-Learning process. IGARTUBEITI is an advanced Cultural Heritage virtual walktrough of a old farm in the Basque Country. BIOSEK is an industrial application project that introduces a Biometrics Lab.

SIMI-Pro –

A Semantic-based Information Management system to support Innovative Product Design

Dr. Giuliana Ucelli, Dr. Raffaele De Amicis

German abstract

Im Mittelpunkt des Projektes steht die Phase innerhalb des Produktentwicklungsprozesses mit der geringsten technischen Unterstützung: die Konzeptions- und Designphase. Ziel des SIMI-Pro-Projektes ist es, eine Verbindung zwischen den beiden traditionell getrennten Bereichen »Virtuelle Realität (VR)« und »Wissensmanagement« zu schaffen, um zwischen den Teilnehmern am Design-Prozess einen direkten Informationsaustausch mit VR-Unterstützung zu ermöglichen. Die den Design-Prozess beschreibenden Informationen werden innerhalb der virtuellen Umgebung über einen zentralisierten Speicherort zugänglich sein. Die Daten werden gemäß dem Nutzerprofil personalisiert angezeigt.

International competition and the rapidly global economy offer to the consumers an enormous choice of goods and services. The result is that companies now require quality, value, time to market and innovation to be competition. In the automotive sector this is traduced in the need of optimization of the design and development process, that, in the view of the authors, can be achieved enhancing technological support during the creative design phase of the product, and through the maximization of reuse of data and internal knowledge of the company.

This research has specifically targeted one of the most naïvely technologically supported stages of the product development process, the conceptual design phase. Its main contribution is in proposing an integration of Virtual Reality technology and Knowledge Management systems, so far two distinctive research fields, within the early stages of the design process. The conceptual design phase is characterized by personal creative processes carried out using traditional drawing methodologies, such as freehand sketches, and by means of knowledge gained through personal experience. Previous authors' works have delivered Virtual Reality technology-based applications for conceptual design, both in the mechanical[1] and in the architectural domain[2]. In these applications Virtual Reality technology has been tailored for the exigencies of designers succeeding in preserving their traditional design approaches, such as in the eraser pen [3] and in the 3D-Tape drawing[4]. Concurrently research activities have been focusing on technology and methodology for Knowledge Management with the attempt to tackle issues related to the structuring of companies' knowledge[5].

In line with these efforts, the aim of this research activity is achieving a step further towards an integrated virtual design platform supporting product development. The objective is to integrate VR technology with an original and general-purpose knowledge management platform, which will allow peer-to-peer sharing of information among the participants during the design process[6, 7]. Information describing the creative design process will be accessible not only from a centralized repository, typical of server-client architectures, but also from single users' repositories. Further, retrieval of data will be handled independently from the taxonomy of the single users, meaning that the information will not be accessed according to the data structure of the internal repositories of the single users but they will be accessible, from a Virtual environment, in a open and personalized manner, according to the user profile.

The Virtual Design environment that will be used in SIMI-Pro is a customization for the automotive industry domain of the JCAD-VR platform [2], while the Knowledge Management system will be the contextualization of a general-purpose information handling and retrieval platform named KEEx (Knowledge Enabling and Exchange System)[5]. The main contribution of this research effort is in pursuing the vision of a platform that, through the integration of highly information-rich environments, such as Virtual Environments, with Knowledge Management systems, will support not only design creativity enhancing the natural capacities of the stylers but also will allow a better understanding of the creative process through its decomposition.

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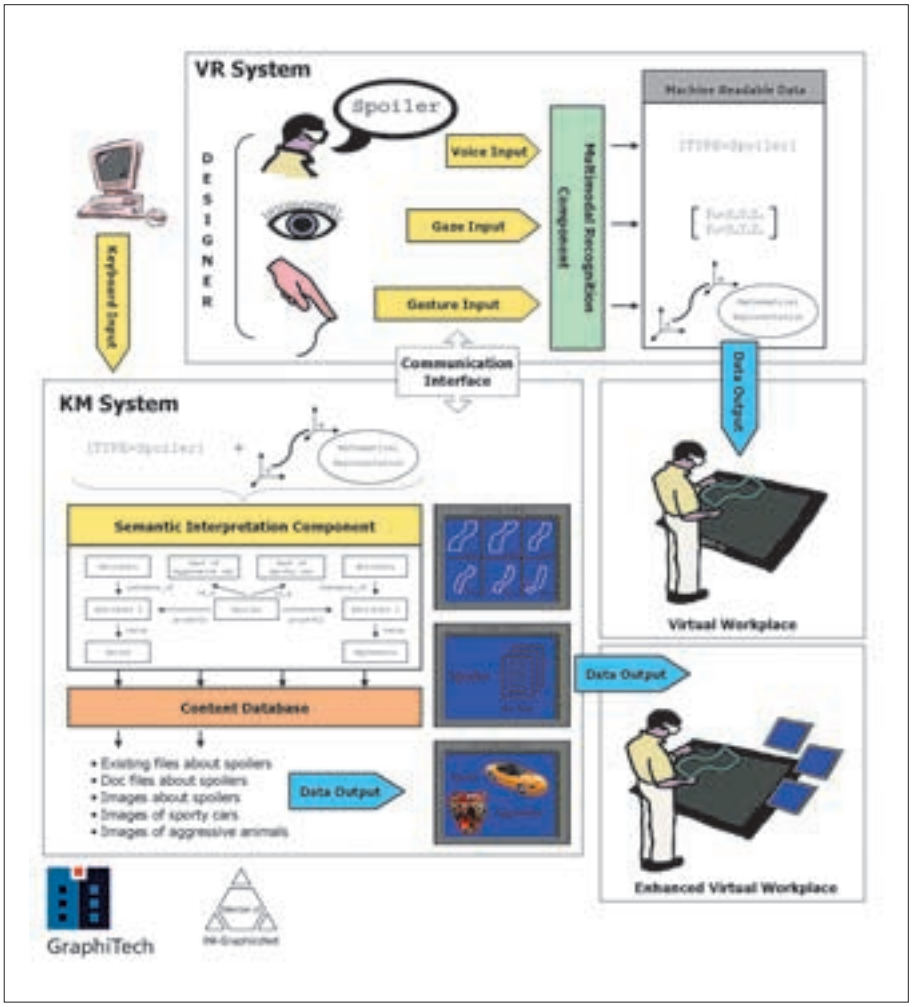

Figure 1: Integration of a Virtual Design Environment with a Knowledge Management system in SIMI-Pro

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JCAD-VR –

A Multi-user Virtual Reality Design System for Conceptual Design

Dr. Giuseppe Conti, Dr. Giuliana Ucelli, Dr. Raffaele De Amicis

VR for Architectural Design

In the last few years the profession of the architect is timidly experiencing a transition towards VR-based tools. Although VR is nowadays a quite mature technology, it is seldom used throughout the design stage, while its use could give the designer a quick and flexible tool to support the quest for design solutions.

JCAD-VR (Java™ based Collaborative Architectural Design tool in VR) has been developed to encourage the use of VR at the beginning of the architectural conceptual design process. It provides the architect with a user-friendly environment that supports collaborative design on a synchronous base. The entire system can be thought of as an investigation tool that allows the designer to create and manipulate simple 3D shapes within a shared architectural virtual context.

This paper reports the present state of the system, it highlights its future developments and it presents a usability study to test its capabilities.

System Architecture

The three ideas upon which JCAD-VR is being built are:

- The user has to be able to investigate design solutions while immersed in the appropriate spatial context
- All the users present in the virtual world have to be able to share the same virtual environment in a »transparent fashion«
- The User Interface (UI) has to be easy and it has part of the virtual world itself

German abstract

Für den architektonischen und konzeptionellen Design-Prozess ist ein benutzerfreundliches und Team-unterstützendes VR-Tool entwickelt worden: JCAD-VR (JavaTM-basiertes, Team-unterstützendes, architektonisches Design-Tool in VR – Virtueller Realität). Das System wurde komplett auf der Basis einer Client-Server-Architektur konzipiert und ermöglicht den Designern synchrone Zusammenarbeit. Jeder Benutzer kann gleichberechtigt auf die Umgebung zugreifen, das Design verändern und Funktionen gemeinsam mit anderen Benutzern verwenden. Ein umfassender Test hat das Potenzial des Systems nachgewiesen.

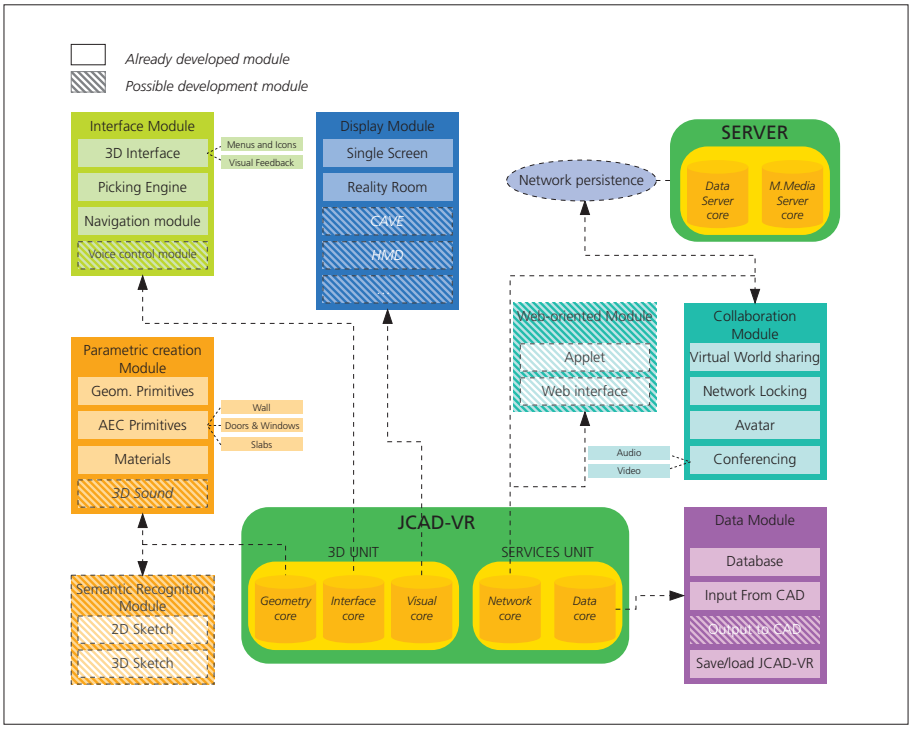

Figure 1: The JCAD-VR framework schema

The system has been entirely developed around a client-server architecture to allow constant synchronous collaboration between several users. Every user accesses the virtual world, interacts with the Virtual Environment (VE) and shares design tasks.

Virtual Design in a 3D Architectural Context

When JCAD-VR is initiated, the user is asked for a login name to be used within the virtual world. The system can be initiated in single or multiple screen mode. The latter has been developed to support devices such as multi-projector display systems. The user can also activate or de-activate video conferencing facilities. A stand-alone option is also provided in case collaboration is not required.

Once the system is initialised a set of 3D menus and icons gives the user access to a number of functions such as communication with other users, navigation and creation of objects. The user is then able to load the virtual context where to investigate its design solutions. A number of 3D shapes and AEC (Architecture-Engineering- Construction) objects such as walls, doors, windows, can be created and shared with other participants while immersed in the spatial architectural scenario. The system routinely checks for constrains and allows only the possible objects modifications – for example a door cannot be moved onto or too close to another door. Feedback about size, material or cost is provided through »3D rulers« and a 3D panel placed by the object.

JCAD-VR has been developed to ensure that every object created in the system is assigned with a unique ID-number result of a combination of a local and a user ID assigned by the server. This way each object is attributed a unique number consistent for all the users in the system. When a user selects an object, this becomes locked and an event is broadcast through the network to other users. Thus every time an object is about being modified its status is checked against the network lock mechanism to guarantee consistency throughout the system. This prevents concurrent editing of the same object by more than one participant.

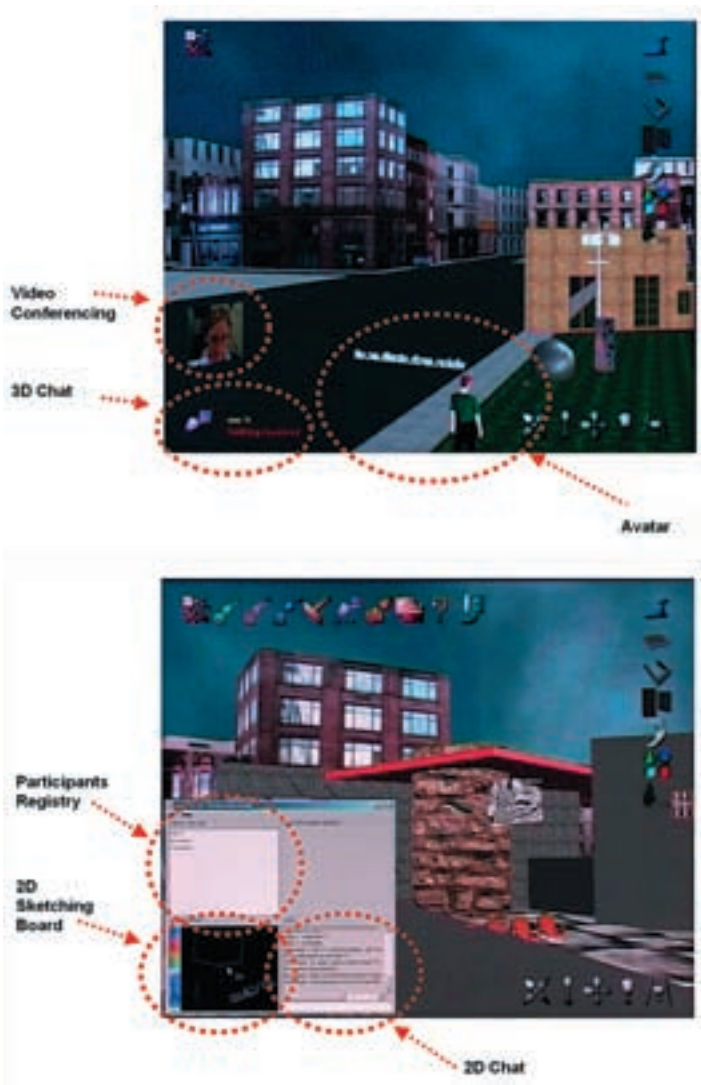

Figure 2: Graphical User Interface of the collaborative features

To ensure communication between users, represented in the 3D world by avatars, different means are provided, from basic chat to voice and video conferencing. Freehand 2D sketching is also possible through a shared electronic whiteboard.

Server Package

The server is made of two parts: a module that looks after the VE information to be broadcast, and another module which takes care of audio/video streams necessary to the video conference tool.

As an independent part of the framework the server has an autonomous and simpler interface that provides primarily information about the network status. The intrinsic multiplatform nature of JCAD-VR, inherited from the language used for coding, allows the server to transmit data to a broad range of platforms. This has given the research team the freedom to test the software with several operating systems.

System Implementation and Hardware Used

JCAD-VR was entirely implemented using Java™ (Sun Microsystems, 2003) for a number of features that made it the perfect choice for the development of such VR-based collaborative environment, such as its:

- Multi-platform nature
- Network-oriented architecture
- Effective database management
- Availability of existing APIs dealing with:
  - 3D Graphics through Java 3D™
  - Audio and video support and real-time network streaming through Java™ Media Framework (JMF™)

Although less efficient in terms of performance if compared with other languages, the adoption of Java™ offered great flexibility, true scalability and last but not least, complete multi-platform support. The system successfully demonstrated its platform's independence since PCs as well as Sgi workstations were concurrently used throughout the experiment reported in the next section.

Collaborative Experiments

A major test of the potential of JCAD-VR successfully demonstrated the functionalities of the system. The test, carried out at the University of Strathclyde in Glasgow, involved a group of students of the faculty of architecture. The students, after a brief introduction to the system, were asked to use JCAD-VR to accomplish a given design task. None of the students had prior experience with VR neither they were given the chance to discuss possible design solutions before the beginning of the experiment.

The participants were placed in separate rooms within the department and were asked to use JCAD-VR's tools to agree upon a common design solution and eventually to deliver a final design within two hours. The experiment, fully monitored and recorded, showed how quickly the participants got accustomed to the user-friendly HCI of the system. Furthermore the intense flow of information during the two-hours long experiment allowed effective team working and the delivery of a common result thus successfully proving the effectiveness of JCAD-VR.

Conclusions and Further Developments

The JCAD-VR prototype makes some steps toward the use of VR as a powerful and effective architectural design tool. The main contribution of the system is that it provides a highly immersive and collaborative tool to support architects in the early stage of conceptual modelling without forcing the use of complex visualization set-ups. JCAD-VR will be also adapted to be used as conceptual modelling tool in the SIMI-Pro project, where the Virtual Environment will be enriched by a Knowledge Management system.

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A User-Friendly Tool for AMIRE Mixed Reality System

Dr. Giuseppe Conti, Dr. Raffaele De Amicis

German abstract

Das von GraphiTech entwickelte Tool ermöglicht den Einsatz der kommerziellen Modellierungseinheit »Maya« als Entwicklungsumgebung für Autorensoftware mit Mixed-Reality (MR) Inhalten. Der Einsatz wird durch eine Reihe von brandneuen Funktionen gewährleistet, die dem Standard-Maya-GUI hinzugefügt wurden. Das AMIRE-Maya Integrationstool verarbeitet die Meta-Informationen innerhalb der Komponenten, die die Elemente einer MR-Umgebung bestimmen, und es ermöglicht die dynamische Erzeugung und Manipulation ihrer Eigenschaften. XML gewährleistet die Persistenz des Informationsflusses von und zu AMIRE.

Introduction

Because of a lack of suitable tools, the authoring process of mixed reality -based environments is virtually relegated to the sole domain of experts who hardcode the application to suit the specific need of each context scenario. Unfortunately, the authoring phase of MR content is, despite the maturity reached by its technology, nowadays often a cumbersome and tedious process during which neither standardized authoring metaphors nor specific authoring tools are available.

The idea behind the AMIRE project was to design a framework for MR applications to support users in the process of authoring content in an effortless manner [1]. The approach followed by the whole AMIRE project was to deploy a modular structure based on Gems and Components within a general framework which permits easy reconfiguration of the authored environment by reusing and combining simple elements into more articulated and effective parts [2]. The specific issue addressed by GraphiTech was the development of a user-friendly visual tool which could enable non-experts to author MR content quickly and effectively within an environment the users are familiar with. The final goal was to create a system which could, in a simple manner, deliver a number of components required for the creation of an MR environment.

The Authoring Tool

The integration tool developed at GraphiTech has allowed for the adoption of a commercial modeling package to be used as the authoring environment for Mixed Reality content. The advantage of this approach is that the author can create the geometric content and frame it within an MR layout within the same application. This approach yields a number of manifest advantages in terms of usability and user-friendliness since the user interacts within a familiar framework, he/she does not need to use different applications for different phases of the authoring process, and, last but not least, he/she does not need to perform any programming.

The authoring tool has been deployed within Alias|Wavefront Maya 4.0 and, more specifically, it has been coded in MEL (Maya Embedded Language), which is the built-in scripting language providing the means to customize Maya for specific purposes.

Once installed, the AMIRE-Maya integration tool rearranges the layout of the GUI according to the needs of the authoring environment and, most importantly, it provides the user with a new set of instruments within the standard Maya GUI (cf. figure). In fact, a new shelf contains a number of new instruments which enable the user to easily create AMIRE components.

The system allows the user to generate and group Geometric Components, tocreate Marker Components, and to specify their logical relationships. When the user creates a new Component, he/she is asked to provide AMIRE with some required supplementary information. The authoring tool can then handle the meta -information stored within components to allow the dynamic creation and manipulation of their properties.

If we refer to elements of the MR environment in terms of Components, the user can, with the authoring tool, create geometries with the standard Maya functions and convert the result into a Geometry Component at the touch of a button. This is done by specifying a number of parameters and meta-data which are kept and manipulated by the system for the specific MR environment requirements.

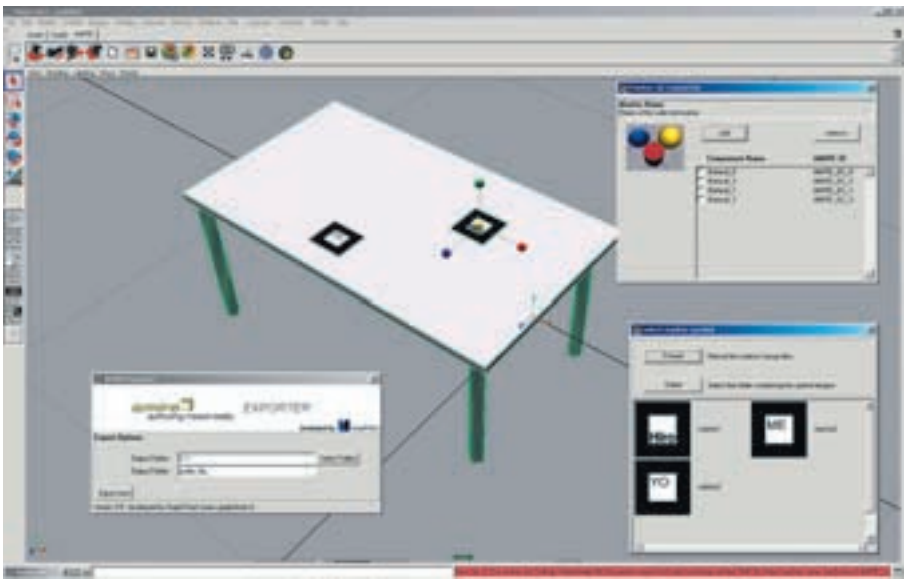

Figure 1: Integration of the AMIRE tools within Alias|Wavefront Maya environment

The system also allows for the definition of markers [3] which users can customize according to their requirements. The user can select dimension and pattern to be used for each specific marker. The AMIRE-Maya integration tool can then be used to arrange the layout of the environment and to specify the content and the logical hierarchy and interrelation among Components in a fast and simple manner.

In this way, the authoring process is divided into two steps. At a first stage, the user rapidly creates the content and defines the interrelation among elements within the AMIRE-Maya integration system. The user creates the required markers and geometries and links them appropriately. At a later stage, the user specifies the fine optimization of the environment itself when the AMIRE application is used within the real context scenario.

This way the author, as far as the AMIRE-Maya integration tool is concerned, only needs to focus his attention on the formal aspects of the environment, such as geometries and markers with their mutual relationships. The precise calibration of the final prototype is meanwhile easily done within the final (real) context where, with the help of its MR capabilities, the user can fine-tune the MR content in a very intuitive manner.

The persistence of information from and to the AMIRE-Maya integration tool is provided by XML files. The XML structure adopted provides the means for storing both properties and features of Components, their internal structure, as well as mutual interrelations, ensuring an effective yet quick way to transfer information within the two applications.

References:

[1] J. Zauner, M. Haller, A. Brandl. Authoring of a Mixed Reality Furniture Assembly Instructor. In ACM SIGGRAPH 2003 Conference Abstracts and Applications, to be published.

[2] The AMIRE project website: http://www.amire.net

[3] ARToolkit: http://www.cc.gatech.edu/ael/projects/ARToolkit.html

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ELIN –
The Electronic Newspaper Initiative

Martin Einhoff, Dr. Stefan Noll

German Abstract

Privathaushalte können heute Technologien nutzen, die noch vor wenigen Jahren Großunternehmen und Forschungseinrichtungen vorbehalten waren. So bedienen sich heute immer mehr Nutzer des Internets, um sich schnell über das aktuelle Tagesgeschehen zu informieren. Ziel des von der EU geförderten Projektes ist die Entwicklung eines Systems zum Erzeugen, Verbreiten und Visualisieren einer personalisierten, interaktiven, elektronischen Zeitung. Der Zeitungsleser soll die Inhalte des Mediums in einer dreidimensionalen virtuellen Welt intuitiv erleben können. Ferner haben Anzeigenkunden die Möglichkeit, ihre Produkte oder Dienstleistungen in dieser Umgebung auf neue Art zu präsentieren. Ein Redakteur kann beispielsweise den Beitrag über ein Motorsportrennen oder den Testbericht eines neuen Autos durch die dreidimensionale Darstellung des Fahrzeugs in der virtuellen Welt ergänzen. Kerntechnologien, die im Projekt eingesetzt werden, sind interaktives MPEG4-Video, intelligente Personalisierung von Nachrichten und Werbung, interaktive 3D-Animation und Visualisierung, integrierte Mehrbenutzerkommunikation und MPEG7 zur Klassifizierung der Nachrichten und Werbung.

»ELIN will focus on the personalization of 'Live Newspapers' by developing interoperable solutions and a platform for a flexible newspaper on demand.«

ELIN will solve the constrains with regard to ease of use of today's web-based newspapers by embedding smart agents into the vital process of newspaper creation and consummation. It also supports the day to day news update by, for example, IP and wireless communication services.

But the integration of structure and information in order to reflect »Live Newspaper« is not limited to this scenario. By the use of media, producers of newspapers will be able to make more interesting news articles and add interactivity to possible »Live Newspapers«. Scalable solutions for advertisements not only on electronic paper media, but also on different handheld computers and smart phones, will provide the means for the industrial partners to provide these devices more or less free of charge. 3D advertisements will provide new user-friendly approaches to advertising in combination with the interactivity possibilities of MPEG-4.

Virtual Newspapers Conquer Living Rooms

As increasingly powerful PCs and graphics hardware become available, even small and mid-sized companies as well as many private households are able to enjoy and take advantage of advanced technology, formerly reserved for large enterprises and research institutes.

The ELIN project consists of basic scenery the appearance of which can be tailored to the respective target audience by newspaper publishers. This basic scenery can be arranged into subject areas just as in actual newspapers, for instance by placing different buildings within the virtual world. News feeds can be projected on multimedia canvases inside and

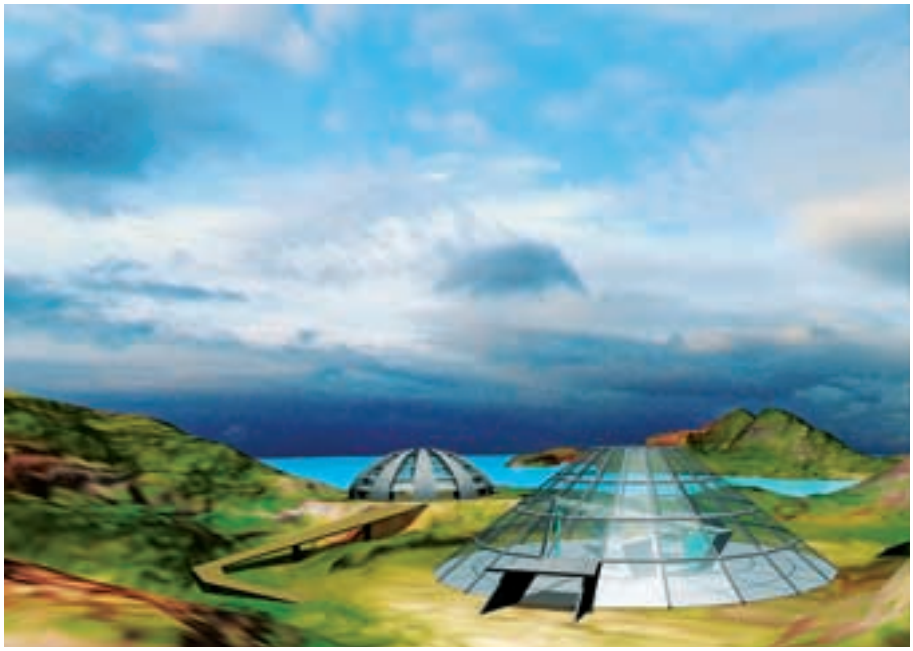

Figure 1: The virtual newspaper world with two thematic buildings

outside these buildings. The virtual newspaper world is modeled in a way that allows for an intuitive navigation and which enables the user to quickly and easily access those news feeds which are of particular interest to him. The graphical user interface allows for visualization and enrichment of news by means of three-dimensional objects.

The Reader Becomes an Avatar

Within the virtual environment, computer-animated characters called »avatars« represent the readers of an electronic newspaper. These avatars enable the user to navigate through and interact with the surrounding virtual world. When the reader moves his avatar, he can also see and communicate with other users' avatars. A group of readers can therefore jointly experience the multimedia information and three dimensional objects. ELIN pushes the boundaries of simple visualization: each user can interact with 3D objects and presentation screens in order to show and discuss specific news with other avatars while he is visible to all other users.

High quality audio/video communication enables the readers to talk to each other in an easy and intuitive manner, whereby individual communication streams are visualized directly at the communicating avatars. In order to allow the user a simple and intuitive spatial localization of diverse acoustic information sources, the virtual scenery employs spatial audio (3D sound) to render audio sources. Powered by these high-quality communication facilities, the three dimensional newspaper world becomes a community environment.

Figure 3: A newspaper reader informs himself about the weather

Figure 2: Virtual advertisment object with avatar and live video communication

Research Objective of ELIN With GraphiTech

GraphiTech works on the implementation of the publishing client and publishing manager component of ELIN.

The publishing client and manager will enable the newspaper publisher to create, edit, and publish visual, audio, and textual news, 3D objects and MPEG-7 descriptions of the news, in a comfortable way, within the ELIN system.

Research Objective of ELIN With Fraunhofer IGD, Department for Communication & Cooperation

The Department for Communication and Cooperation will develop a 3D client as a shared virtual community environment for the PC platform where the different types of multimedia data are represented as textures on virtual walls/panels or as 3D objects. The client will serve as an integration platform and 3D user interface for the underlying ELIN components.

ELIN Project Presentation

The aim of the project is the ELIN toolkit, an add-on for the publishing systems of media companies. The core technologies in the project are interactive video (MPEG 4 and 7), personalization, and interactive animation. These technologies will support the use and production of interactive news and advertising on demand.

The ELIN project is developing this ELIN toolkit for the electronic newspaper production of tomorrow. The toolkit will be used as a complement to the existing systems for media production at media companies. The toolkit will interface with the current production of news and advertisements for radio, television, printed editions, and current web productions.

The ELIN toolkit enables news publishers to develop new markets and customer groups. Even publications for customer-related content and internal enterprise magazines benefit from the virtual newspaper worlds.

The project, sponsored by the European Community, started in October 2001 and it will finish by end of the year 2004.

Other Project Partners

ALAMO On-Line S.A., Spain
Diari Segre S.L., Spain
Unversitat Politecnica de Catalunya, Spain
Linköpings University, Sweden
Oestgoeta Correspondenten AB, Sweden
Forschungszentrum Informatik, Germany
INRIA-LORIA, France

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Opal –
Online Partnership Lens: A social browser for the networked enterprise

G.Heinrich, U.Krafzig, Dr. Stefan Noll

Opal (Online Partnership Lens) addresses a significant knowledge management problem: human capital in small firms which need to find cooperation partners. Such cooperations significantly increase competitiveness of small companies by widening their scope of possible commercial activity.

The focus of Opal is to establish such cooperation, and in the project, the concept of human capital is extended beyond competence modeling: As social dimensions such as trust and compatibility are a major factor for partnership success, Opal strives to find ways to make such soft factors explicit and accessible for team creation. Specifically, the Opal consortium develops a methodology for modeling online partnerships with respect to expertise and soft skills. According to this methodology, soft attributes are elicited by intensive interaction between partner candidates. Candidates in Opal can be both individuals and teams or companies.

The methodology is implemented in a software toolkit, which allows validation with real-world user partners. The Opal toolkit forms a virtual partner network and is at the same time a communication platform. The approach is centrally based on storage, manipulation and retrieval of both user competence data acquired by enterprises themselves and data about compatibility and trust, which are measured by peer evaluation of online interaction between partnership candidates.

For profile storage and attribute sets, the system draws from semantic methods: entities such as competencies, roles, attributes, and job descriptions or social relations are modeled in an ontological class structure which can be queried and extended with moderate effort by external ontologies. It will therefore be possible to configure the system for specific domains.

German abstract

Das Ziel des Opal-Projekts ist die Kooperation in verteilten Arbeitsgruppen zu ermöglichen. Diese Teams werden zusammengestellt mit Hilfe einer Online-Datenbank mit Expertisedaten und darüber hinaus durch die Nutzung »weicher« Kriterien wie Vertrauens- und Kompatibilitäts-Beziehungen zwischen Menschen, da diese als einer der Hauptfaktoren für den Erfolg von Projektpartnerschaften gelten. Hierfür entwickelt das Opal-Konsortium eine Methodologie und implementiert diese in Form einer Software. Eingebunden sind Fraunhofer IGD und GraphiTech hierbei besonders in die Entwicklung von Komponenten für die Online-Kooperation, die Zusammenstellung von Projektpartnerschaften sowie in die Realisierung eines erweiterten Suchkonzeptes, mit dem Bewertungsdaten über Vertrauen in die Suchdatenbank zurückgeführt werden.

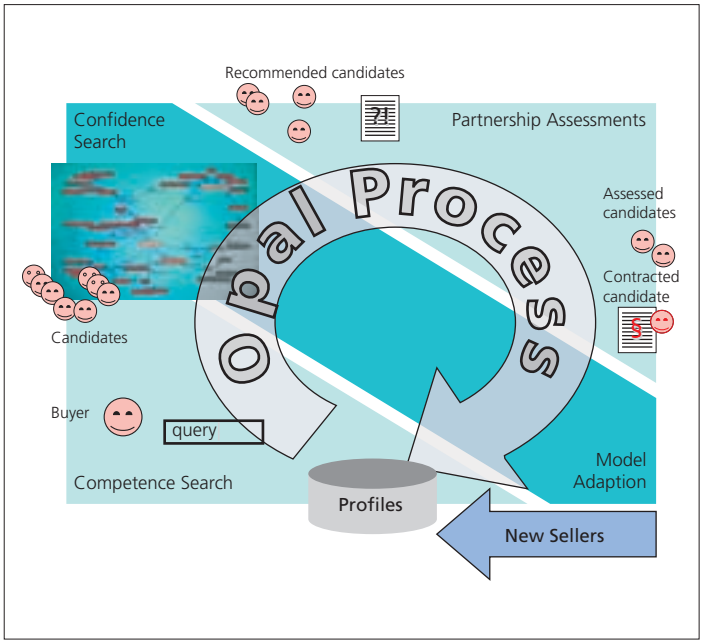

Figure 1:
Opal forms a closed-loop process between recommendation of appropriate partners, assessing them, and feeding these assessments back into the profile database

Figure 2:
Network-based interface for social relations. This development example shows the consortium itself.

Furthermore, extensive search and visualization features allow accessing and analyzing the parameters of a partner or a group.

The methodology for the Opal system is based on the following working steps to establish ad hoc partnerships:

– Self-Assessment of the individual's or the group's own attributes and storage as a profile in a central profile database. This is done by a potential »seller« party – but the network is designed to require self -assessment from every participant.
– Setup of a Partnership Project. All interaction and storage is done within a Partnership Project which thus forms a knowledge base of a particular project domain accessible for the candidate partners with a domain-based security system.
– Identification of potential partners by searching in the profile database. This is done by the »buyer« party.
– Interaction with the candidates as a basis for information exchange, and to elicit cues for compatibility and confidence between the partners. Depending on the requirements of a particular situation, this interaction can either be unstructured, i.e. users exchange information about the work to be done in collaboration and about their technical backgrounds, or structured, i.e. the users are lead through an interaction like a collaborative scenario-based game to allow for specific attributes to be assessed.
– Assessment of each potential partner according to questionnaires especially designed for different assessment types (games, audio/ video conference, email, question form). The questionnaire results are transformed into attributes which are fed back into the profile database and globally influence searches. Design of the questionnaires, interaction structure, and attribute sets are part of the active research in Opal.
– Finally the decision on the collaboration is made and the work on a specific project or task can be started.

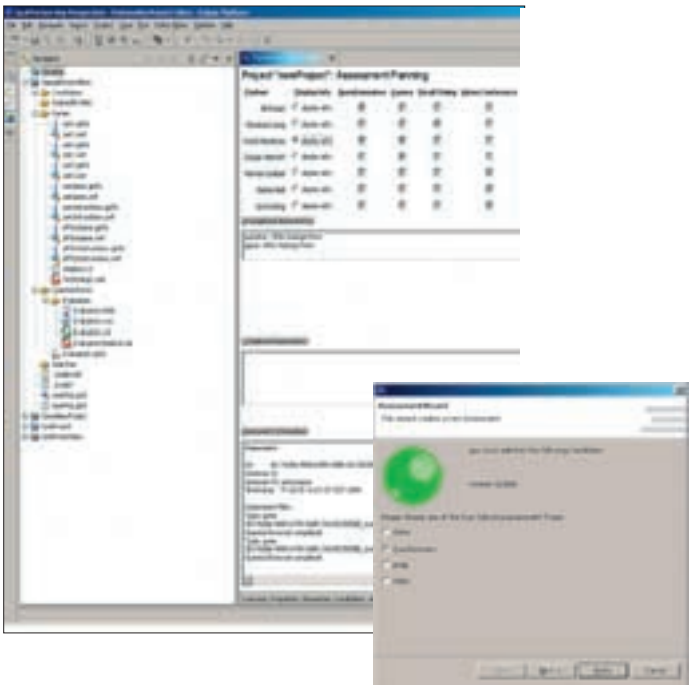

Figure 3:
The Assessment Manager builds the front-end for assessments which have been started and allows planning, controlling, and modifying assessment processes for candidates. Summaries of results

Partners beside the Fraunhofer IGD are Software AG, Madrid, Spain; Napier University, Edinburgh, Scotland; Univentures GmbH, Frankfurt, Germany; DCA data Collie Associates, Edinburgh, as well as Scotland, AET (Asociacion Española de Teletrabajo). Within the consortium, IGD and GraphiTech are subcontractor involved in the development of collaboration components, partnership management tools, as well as an advanced search concept which feeds back soft attributes assessments into the profile database.

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Visual Grid Job Authoring for Grid Computing

Christoph Jung, Dr. Stefan Noll

German abstract

Das Ausführen von komplexen und zeitintensiven Berechnungen stellt hohe Anforderungen an die IT-Infrastuktur im wissenschaftlichen und wirtschaftlichen Bereich. Während durch den technologischen Fortschritt und dem Einsatz des – vor allem in Nordamerika populären – Grid Computing die Effizienz der IT-Infrastruktur durch z. B. verbesserte Ressourcenauslastung erhöht werden konnte, ist die Beschreibung der zu berechnenden so genannten Grid Jobs weitgehend auf selbst geschriebenen Scripts aufgebaut, welche Detailkenntnisse des zugrundeliegenden Grids und seiner Ressourcen erfordern und entsprechend nur von Spezialisten effektiv eingesetzt werden können. Einem breiteren Einsatz und Durchbruch in Bereiche außerhalb der Forschung wird dem Grid Computing bislang u. a. durch diesen Umstand verwehrt. Zur Erleichterung der Erstellung von Grid Jobs wurde daher für das Fraunhofer Resource Grid (FhRG) ein Editor entwickelt, mit welchem sich die Beschreibung des komplexen Arbeitsablaufes mit Hilfe einer graphischen Oberfläche und der Modellierung in Form eines Petri-Netzes für den Benutzer wesentlich einfacher gestalten lässt.

Introduction

The execution of complex and time-consuming calculations makes great demands on the underlying distributed computing infrastructure. While the efficiency of the IT-infrastructure has been improved through enhanced load balancing caused by the technological development and the increased usage of grid computing, which is particularly popular in North, the description and definition of the so-called grid jobs is still inconvenient and dissatisfying. While several toolkits such as Globus (www.globus.org) provide the basic grid functionality for heterogeneous operating systems and hardware combinations using open internet standards, especially for end-users who are not familiar with grid computing, it is nearly impossible to launch or even define a so-called grid job without the help of experts. Grid jobs based upon scripts are still widespread in the computing grid community although efforts have been made to solve this problem. These scripts require detailed knowledge of the underlying grid architecture and resources; therefore they have to be coded by grid experts.

Grid Computing

Grid Computing itself stands for a more sophisticated distributed computing infrastructure for advanced science and engineering. Its focus on large-scale resource sharing, new concepts, as well as improved coordinated problem solving, distinguishes it from conventional distributed computing.

Grids are typically used for research and development processes, i.e. scientists and engineers use this specific and powerful infrastructure for analysis, computation, or visualization of large and complex amounts of data. While computing grids are powerful and efficient tools for solving complex problems, there is no convenient way to use them. Several more or less sufficient attempts to solve this problem have therefore been made in the grid computing community, to increase the usage of grid technology outside the fields of scientific or commercial research.

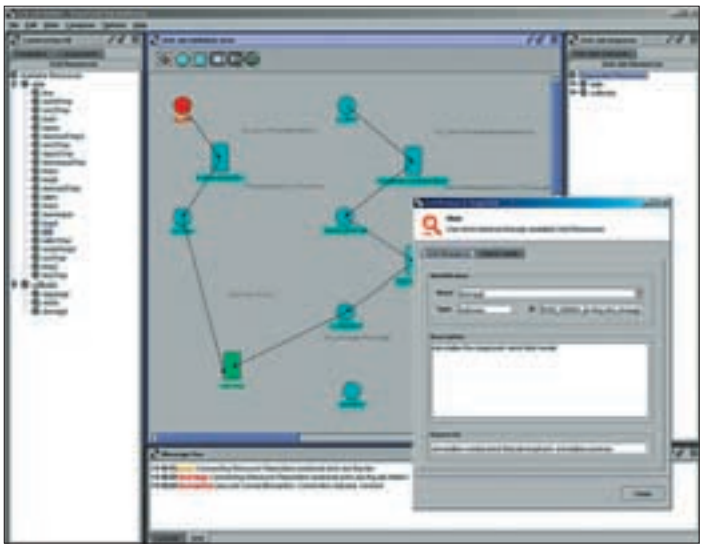

Figure 1: 2D Grid Job Authoring

Grid Service Applications

Several Fraunhofer Institutes – including the Fraunhofer IGD – have founded the so-called Fraunhofer Resource Grid making use of a bundle of software components which have been developed on top of the globus grid toolkit. These software components serve as grid service applications which provide a new way of simplifying the process of defining, scheduling, and running complex grid jobs, as well as describing and mapping the grid resources involved. The applications use an XML-based family of description languages to analyze input (grid resources) as well as to generate output (grid jobs). While a special repository for content storage and delivery of resources, and a specific handler for the analysis of grid jobs and the execution of grid jobs, have been developed for storing, retrieving, and handling the large amounts of different sources like data, software, or hardware, an additional tool is used to combine the resources selected by the system or the user to solve specific problems.

Graphical User Interface

The Grid Job Builder (GJB) is an end user-oriented tool which supports the import of resource descriptions as well as the definition and submission of generated grid jobs. The jobs are modeled as a workflow of involved resources with their dependencies. Using visual elements, the generated job will later be executed using a Petri Net logic when it has been submitted to the grid. The imported physical existing grid resources are shown in a special tree and can be dragged and dropped into the drawing area. Unnecessary information will be hidden from the users while, for example, important properties or a description of a software resource can be displayed in several ways, as shown in figure 1 (using the Grid Resource Inspector, for example). Besides the pre-selected grid resource, user-defined resources can be created, i.e. resources which do currently not exist in the grid. A typical example of such a resource is a temporary data file resulting from one of the calculations inside the workflow.

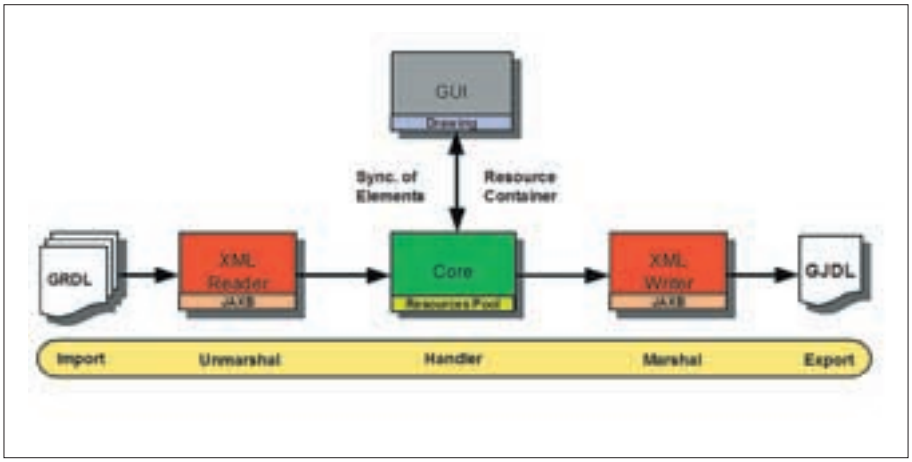

Figure 2: Workflow of Grid Job Authoring (simplified)

Visualization of Dependencies and Sequences

The drawing area of the Grid Job Builder visualizes the logical dependencies of the elements which are needed to determine the execution sequence within the grid. Although the resulting workflow might be hard to read once the grid job has become more complex, most of the underlying technical information is hidden and the user does not have to take care of it. All the essential information for the resulting grid job execution will be automatically supplied by the editor in the final grid job description – the job workflow design remains simple in contrast to the complexity of the underlying computing grid's processes.

The workflow as shown in figure 1 describes a diffusion simulation of pollutants in the atmosphere (environmental pollution). Other grid jobs may consist of calculations in the following common areas:

- parameter optimization (materials research)
- flow simulation (aircraft industry)
- molecular simulation, data analysis and visualization (pharmaceutical industry)
- financial calculations (electronic commerce)

Conclusion

Although a lot of technical problems still have to be solved in this research area until grid computing will be applicable and widely accepted outside the research community, visual modeling using Petri Nets has proved to be a promising procedure. While the amount of time needed to describe a grid job to an expert could be shortened, beginners and intermediates will benefit from the reduced complexity of the information overload evoked by the grid resources and their highly nested dependencies which are involved in the workflow of a grid job.

Based upon the experience gathered in the project, the participating institutes will continue the development of their grid software and introduce the results to the established Fraunhofer Resource Grid as a reference implementation of a user-friendly grid. The intention of I-Lab is to establish a new standard for the development of distributed applications and the usage of the Internet as a pool for distributed computing power.

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I³VPDP –
An Interactive, Immersive, Integrative Platform

Dr. Raffaele De Amicis, Dr. Giuseppe Conti, Dr. Giuliana Ucelli

German abstract

Der Einsatz von technischen Prototypen ist eine weit verbreitete Methode, um das Design und die Funktionen von komplexen Produkten zu testen. Während des Entwicklungsprozesses dieser Produkte wird eine enorme Menge verschiedener Prototypen produziert. 3D-CAD-Systeme bieten problemorientierte Modellierungsabläufe kombiniert mit Kinematik, NC-Simulationen oder FEM-Analyse. Die Umstrukturierung des Design- und Entwicklungsprozesses nach den Richtlinien des »Concurrent-Engineering«-Konzeptes (»Simultane Technik«) bedeutet, dass man sich fortschrittlicher Informationstechnologien bedienen muss. Im Rahmen des I³VPDP-Projektes wird eine interaktive, immersive und einheitliche Plattform entwickelt, die die Phasen des konzeptionellen Designs, des technischen Designs, der Simulation und der Analyse des industriellen Produktentwicklungsprozesses unterstützt, eingebettet in ein Wissensmanagement-System.

Supporting the Virtual Product Development Process

This paper describes the vision that drives the ongoing research activity of GraphiTech in the augmented engineering domain. The I³VPDP defines an Interactive, Immersive, Integrative Platform supporting the stages of conceptual design, engineering design, simulation and analysis of the industrial product development process wrapped by a knowledge management system.

The integration of the know-how of the research centers already present in the Trentino area also partners of this project: CRF, GraphiTech, IRST, will enable the development of such an innovative platform, which will benefit by the integration of industrial inputs and by the research capabilities of the single partners. Within the aims of the project will be also the creation of new expertise in the Trentino area and nationwide.

Currently various technological tools support the initial phases of the product development (CAS, CAD, CAE) and various expertise is involved during these stages. The main objective of this project is to solve the intrinsic difficulty of integrating these tools and to provide a common platform thus enhancing communication among the actors, sharing of knowledge, and control over these initial phases. The integration difficulty is also worsening by the aspiration of using tools that support both designers' creativity and the dissemination and exploitation of their knowledge. These are issues that will be investigated during the research activity thus providing designers and engineers with easy access to the knowledge of the company in order to maximize the benefits of internal expertise and to enhance re-use of design solutions.

In recent years the development of innovative tools has fostered the adoption of various interaction paradigms, such as collaborative design, concurrent engineering, etc. in the development process. These means of interaction, although effective in specific sub phases, are currently far from being used during the whole product development process.

Virtual Reality technologies offer the possibility to integrate all the aforementioned phases of the product development process in one virtual environment. Therefore the aim of the project is the development of a platform that, with the help of VR technology, will integrate the existing tools in a unique environment while allowing circulation and sharing of various knowledge models among the participants to the process.

Innovation

The mayor innovation of this project is to pursue the vision of an integrated and fully comprehensive platform for product design and engineering. The collaborative design paradigm is here enriched through the development of integrated tools supporting cooperation and sharing among various expertises.

In particular, the project will focus on the following phases of the product development process:

- Concept/Support for stylers
  - Use of tools that emphasise the natural capabilities of the designers
  - Access to technical data
  - Possibility to attach and retrial semantic meanings to shapes
  - Meet of the requirements product/process
  - Integration of knowledge management tools

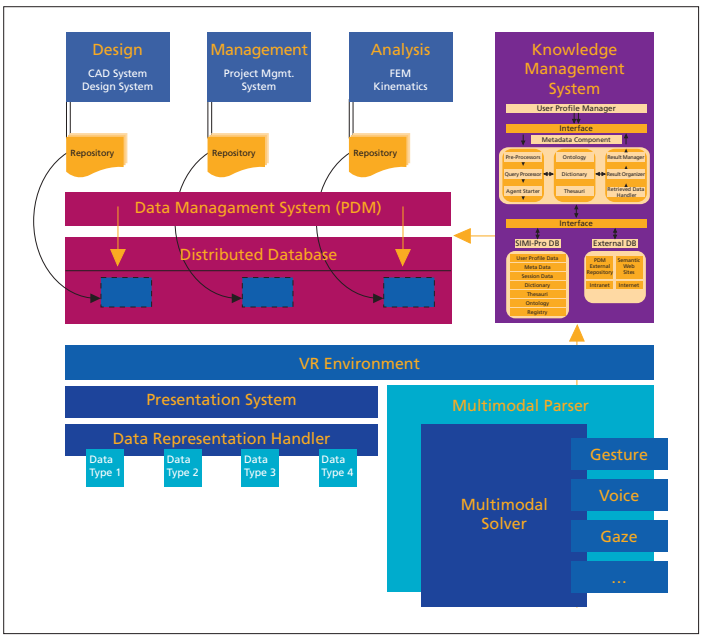

Figure 1:
I³VPDP General
Architecture

- Engineering phase
  - Modification of parametric data within a virtual design environment
  - Exchange of information and data with knowledge management systems
  - Re-use of design solutions and know-how
- Simulation
  - Interactive modification of parametric data for:
    - Structural Analysis
    - Analysis of the process
    - Ergonomics
  - Real Time analysis of the results of the simulation

Therefore the main topics addressed by the project are the following:

- 3D interaction and modeling in Virtual and Augmented Reality
- CAx/Virtual Reality integration
- Engineering visualisation
- Collaborative Engineering
- Product data technology
- Knowledge Management

The research activity will define three-dimensional innovative techniques in Virtual Reality, and Mixed Reality environments, in order to model and generate shapes meeting creative, engineering and industrial requirements.

The project will require:

1. The development of robust exchange procedures between the CAx environment and the advanced visualization system.
2. The interactive analysis of the simulation phases of the product/process, participating at the development and implementation of the data exchange formats (i.e. STEP,…).
3. The integration with a knowledge management platform that will allow sharing of information among the participants during the development process. Information describing the creative design process will be handled independently from the taxonomy of the single users, this means that the information will not be accessed according to the data structure of the internal repositories of the single users but they will be accessible in a open form.
4. Within the collaborative environment, the development of tools and procedures, of type stage & gate, which permit control and validation of the progress of work during the various phases of the product development process.

For a wider dissemination and beneficial impact of the project, the various partners will encourage the creation of an industrial board with external expertise that will guide and then validate the quality and feasibility of applying the results of the project in the real development context.

The I³VPDP project is also included in the research initiative of the Centro Ricerche Fiat called »Laboratorio Strumenti Abilitanti per lo Sviluppo Prodotto« (Laboratory of Tools Aiding the Product Development) and it is in line with the research activity of the »Laboratorio di grafica tridimensionale interattiva per visualizzazione e la modellazione« (Interactive three-dimensional Graphics Laboratory for Visualization and Modeling) of the Fondazione GraphiTech.

Impact on the territory

Explicit objectives of the I³VPDP project are a strong impact on the territory and to promote innovation in local companies. The expertise excellence and the research complementarities of the various partners of the project will foster the creation of a research center specialized in the development of tools supporting the product development process. This will be also possible activating strong collaboration among the partners and through the synergic use of each partner's infrastructure (CRF, GraphiTech, IRST). This research center will be accessible for both large companies, which could directly acquire the software deliverables of the project, and for SMEs, which could benefit from the facilities and services provided by the center without being forced to plan unaffordable investments.

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DENTROTRENTO –

Real and Virtual experiences of the Trentino culture

Mariapaola Riggio, Dr. Raffaele De Amicis, Dr. Giuliana Ucelli, Dr. Giuseppe Conti

Enhancing Cultural Heritage

The final goal of this project is the promotion of historic, artistic, naturalistic, and cultural heritage in the Trentino region in Italy through the use of multimedia, virtual reality technology, and computer graphics applications. These technologies will be employed so that a broad public, tourists, and local citizens can better comprehend and enjoy cultural heritage.

The initial scenario of the project has the objective of enhancing the didactic and entertaining potential of the Roman archaeological site underneath the Theatre and the square C. Battisti in Trento.

Recent Roman Discoveries

At the base of this project is the recent discovery of archaeological finds belonging to the Roman civilization, found at the foundation level of the theatre in Trento.

The main objective of the project is to try filling the perception gap between the archaeological finds and their reconstruction through the use of immersive VR technologies. This goal will be achieved through a 3D graphical reconstruction of historical buildings and monuments the traces of which are still visible on the archaeological site of Palazzo Festi, and by offering the chance to superimpose the virtual representation onto the real objects.

German abstract

Das Ziel des DENTROTRENTO-Projektes ist die Verbesserung des didaktischen Potenzials und des Unterhaltungswertes der römischen Ausgrabungsstätte, die sich unterhalb des C.Battisti-Platzes und -Theaters in Trento befindet. Eine Ausgrabungsstätte zu besuchen und gleichzeitig ihren Wiederaufbau mittels VR-Technologien zu erleben, erlaubt es, Kontakt mit antiken Kulturen aufzunehmen und deren Lebensweise besser zu verstehen. Das Szenario basiert auf dem virtuellen Wiederaufbau der römischen Straße, die den Hauptteil der Ausgrabungsstätte von SASS bildet. Der virtuelle Wiederaufbau des römischen Tridentum (römisch für Trento) wird es ermöglichen, Besuchern eine verständliche und globale Darstellung der Stätte zu bieten. So können sie die historische Stadt genau betrachten und damit ihr kulturelles Erlebnis steigern.

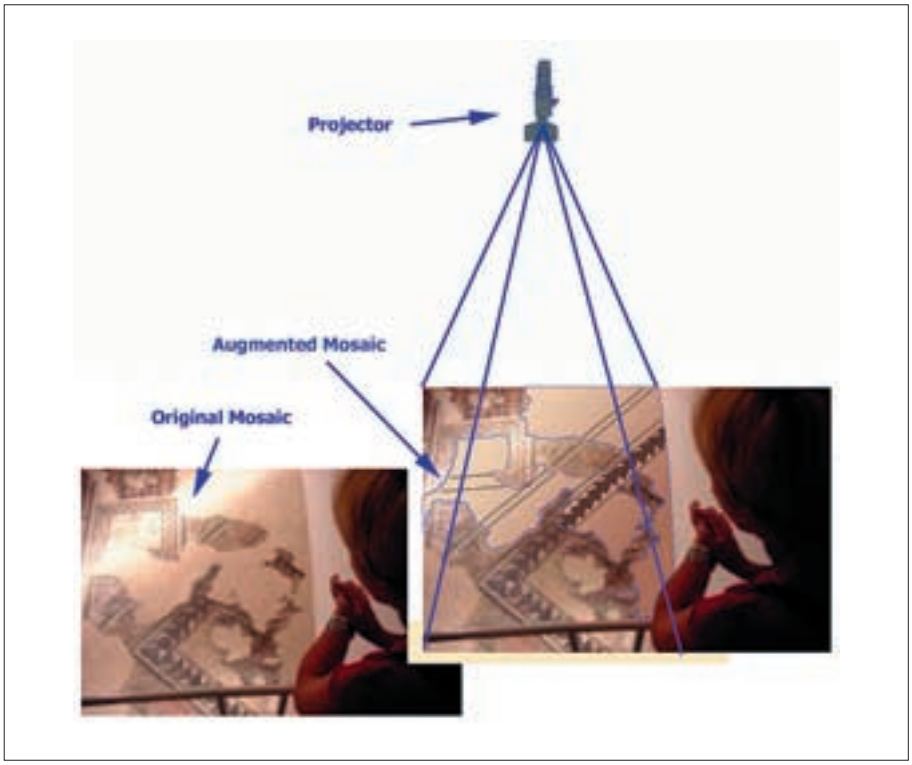

Figure 1: Augmented Virtual Mosaic

Figure 2: The interior of the museum

Figure 3: Historical reconstruction of the plan of the Roman city of Trento

The installation which will be produced as a result of the project will offer the visitors the chance to virtually walk past the most significant spots of the reconstructed ancient city of Trento, and to experience its evolution from the Roman period to the most recent years.

Visiting an archaeological site and experiencing its reconstruction through the use of VR technology at the same time are powerful end effective means to get in contact with ancient civilizations and to better comprehend their habits and cultures. Laypeople often experience the frustration of not fully comprehending fragmented finds, and the difficulty of not being able to interpret their meaning within the ancient cultural context.

This project sees its main beneficiaries in tourists and citizens willing to gain deep knowledge of the ancient history of the Trento area, but also in scientists and archaeologists interested in opening their investigation tools to new technologies.

Virtual Reconstruction of the Roman City of Trento

This scenario is based on the virtual reconstruction of the Roman Street which is the main part of the archaeological site of the SASS. The visit of the site is rather disturbed by the narrow space available for the exposition due to the fact that the site was discovered at the foundation level of the theatre thanks to the recent renovation works of the building. The peculiarity of the site does not offer the visitor a coherent and global view of the finds, and it repeatedly disturbs the experience of the site with structural elements such as the ceiling, which occludes the vision of the real height of the ancient buildings, walls, which limit the global perception of the ancient street, and foundation pillars of the theatre, which contribute to the spatial disorder of the place.

Through the virtual reconstruction of the Roman Tridentum, which is the Latin name of Trento, it will be possible to offer the visitors a coherent and global view of the site to enhance their comprehension and therefore to enrich their cultural experience. All the disturbing elements present in the real place will then be removed in the virtual representation in order to allow the visitor to virtually walk around the Roman street and to experience the spatial organization of the ancient city.

Virtual Restoration of Mosaics Using AR

The restoration of ancient mosaics and paintings is one of the most debated issues in cultural heritage, because it raises the diatribe about the necessity to preserve the authenticity of the works of art while assuring a pleasant fruition for a wide public of not-experts. Ancient mosaic floorings have been discovered in the archaeological site of the SASS. There are wide areas where the decoration has been lost or severely damaged. It is therefore very difficult to imagine the pattern of the original decorations. Traditional techniques for restoring and filling the lacunas of the decorations are all based on insertion of materials which, even if done paying particular attention towards reversibility, will eventually modify the perception of the original work of art. Virtual Reality technology, and especially Augmented Reality, can solve this diatribe allowing the superimposition over the real mosaics of images showing lost or damaged parts. AR technology opens up the possibility of a virtual and truly reversible restoration of the works of art allowing the user to switch interactively from the augmented to the real mosaic.

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TECNOMOLDE –

Implementing a Decision Support System in a Mould Making CAD System.

Luís Almeida, Sofia Gameiro, Mónica Oliveira, Rui Curado

Introduction

Injection moulding operations have been increasing rapidly in response to the demands for higher productivity of plastic products. It can guarantee the production of a large amount of complex parts, but it is also often characterized by technologically demanding requisites. CAD (Computer Aided Design) and CAM (Computer Aided Manufacturing) are examples of systems that have been introduced in the mould design process as an effort to raise efficiency. CAE (Computer Assisted Engineering) has also been introduced for early process modeling, but it is only used during the design stage and in problematic cases, because it is time consuming and requires a great deal of expertise. Regarding the multi-variable nature of injection moulding, with various process transients and interrelated flow and heat transfer as well as phase changes, deterministic solutions are unlikely.

TECNOMOLDE emerged from the need to integrate the knowledge currently available (CAD and CAE) into an integrated platform during the mould design stage. TECNOMOLDE will allocate a technological decision support system to that stage, seeking: increased mould time operability, better part quality, and reduced operation cycle times with substantial energy savings during the overall process.

TECNOMOLDE is a project in consortium where R&D Institutions join their efforts with the industrial sector in order to investigate, develop and test technological functions and parameters for injection mould production optimization. Such functions are to be integrated in an existing workbench where they are to be tested prior to its final industrial implementation.

The TECNOMOLDE Project

TECNOMOLDE's main objective is the implementation of true technological capabilities in an ordinary CAD system, allowing the designer to take informed decisions based on scientifically tested algorithms and advanced visualization techniques. Nowadays,

German abstract

TECNOMOLDE ist ein Konsortialprojekt, das die Bemühungen von Forschungsinstituten und der Spritzformindustrie vereint, die Integration eines Entscheidungsunterstützungssystems (EUS) mit bestehenden CAD-Werkzeugen für Formdesign und -produktion zu entwickeln. Das EUS ist ein auf Regeln basiertes System, das der Phase des Formdesigns spezifische technologische Funktionen zur Verfügung stellt und dadurch den Formdesigner im Entscheidungprozess unterstützt.

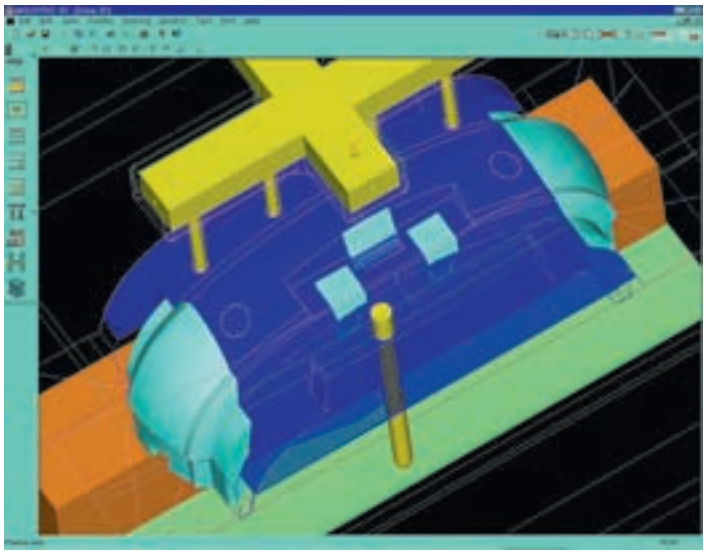

Figure 1:
The »MoldPro« platform

this is done on the basis of personal experience and non-scientific experimentation, having obvious negative consequences in terms of time consumption, material costs, errors and costumer dissatisfaction.

This project intends to be an important contribution to overcome such constraints, transferring to the Mould Making Industry a complete, integrated and innovative CAD/CAE solution.

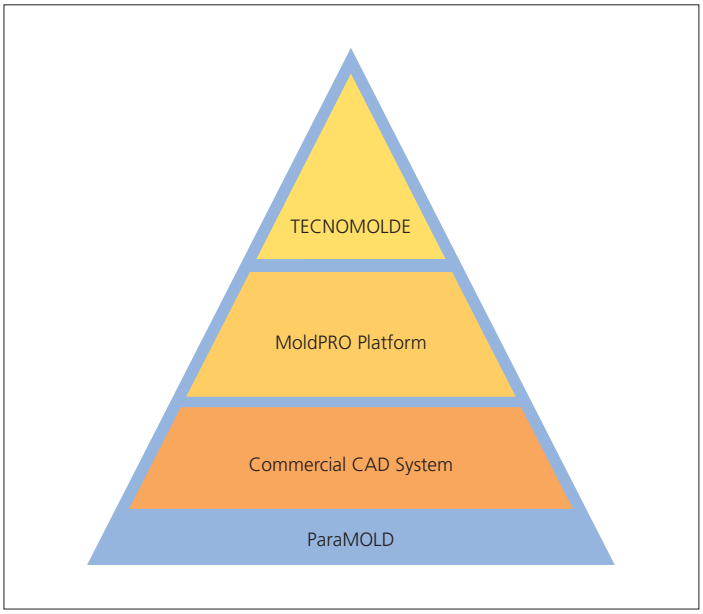

Figure 2:
The »ParaMold« schema

Technological Goals

TECNOMOLDE's main technological goals are:

- Definition of the technological matrix associated with the mould design and project stages, which implies the definition of a technological model to serve as the starting point for all mathematical and computational development;
- Development and implementation of computational algorithms and their integration into the workbench (CAD/CAE solutions);
- Implementation of the associated graphical component, guaranteeing both the visualization of technological functions and user interaction with the system;
- Integration of the resulting CAD system with commercially available analysis tools;
- Contribution to the state of the art of commercially available CAD systems, providing advanced features and functionalities fully integrated with others of general usage.

Implementation Strategy

Those having knowledge about the mould making industry can easily understand the high complexity of the process and its difficult systematization into a technological matrix. Every mold can be considered a prototype, and a lot of creativity goes into each project.

That was indeed the major difficulty faced by the TECNOMOLDE consortium. In order to overcome some of the above mentioned constraints, the consortium asked for the opinion of industry mould making experts, establishing priorities for the several technological functions to be implemented, their applicability and visualization.

Further research on the resources available highlighted the importance of implementing – on an already existing framework for mould design, the »MOLDPro« platform (cf. Figure 1) – computational algorithms resulting from the technological definitions of systems such as: injection, refrigeration, and extraction. This platform, being satisfactory in terms of construction of mechanical elements, is still totally absent of analysis functionality.

Considering the computational implementation for each technological function besides the study and development of corresponding algorithmic definition, interaction with the »MoldPro« platform – which, as referred, is the base for all implementation – has been studied.

The final goal is to achieve an integrated platform, the so-called »ParaMold«, over a commercial CAD product, yet to be announced, as a plug-in (cf. Figure 2).

Visualization and model manipulation, assembly and constraints management functionalities, and complex geometries support or »draft analysis« for real time analysis of different mould parts movement are all fundamental reasons to integrate the »ParaMold« platform into a commercial CAD solution, reusing characteristics of the host CAD system. Nevertheless, the solution implies restrictions in terms of programming language and graphic kernel. Our development is currently based on C++ and OpenGL.

The project intends to use real mould prototypes, currently being constructed by the industrial consortium partners, which are to be used for the overall application benchmarking. They provide a consistent view over the overall mould design process while revealing many of the »design uncertainties« that every mould designer deals with every day.

The »ParaMold« solution aims to achieve a high degree of decision support during mould design stage, which often depends on analysis and visual representation of alphanumeric information. In order to achieve this objective, functionalities for graphical visualization and analysis of results are being developed (cf. Figure 3), using, as support, the CAE tools MoldFlow® and CadMold®, two of the best-known and complete finite element analysis software for the mould making industry, which are commercially available.

This external support, reflected on graphical visualization of technological variables in the »ParaMold« platform work area, is essential for decision support, mainly concerning the mould injection process and cooling analysis.

Initially, the state of the art in terms of visualization techniques, available for the representation of dynamicly quantifiable processes and fluxes (physically and mathematically), was studied for the graphical visualization of technological variables.

The visualization by color gradient was preferred by the majority of the industry's future users which had been inquired, therefore this was the primordial method selected for implementation. It is based on a surface triangulation (triangular mesh), calculating vertex colors and interpolating for each triangle color computation. It implies the attribution of a scale of colors for the representation of the various possible values for a certain variable. Such values are the result of analysis process performed with specific software, as referred before. In the final »ParaMOLD« application, the 3D CAD model and the graphical representation will for better analysis be visualized together.

Several algorithms are currently being implemented and studied in order to achieve a fully satisfactory graphical representation for the results of the analysis, trying to maximize the ratio image quality/processing time.

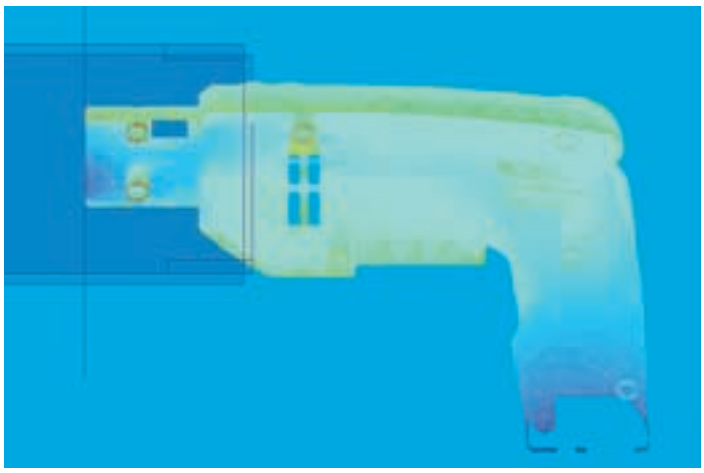

Figure 3: Graphical representation of temperatures using a colour gradient

Conclusions and Future Work

The rise of tools like the ones proposed by TECNOMOLDE will give mould designers a global perspective of the process with less dependence on heuristic knowledge, and it will most certainly lead to gains in time and quality production and reduction of production costs, resulting in a overall increase in performance.

The user's reaction has been an important source of encouragement to fully achieve project objectives.

Indeed, TECNOMOLDE intends to be a strong contribution to the state of the art, transferring a complete and integrated CAD/CAE solution for the Portuguese Mould Plastic Industry, as stated before. Nevertheless, its integration into commercially available applications will, for sure, guarantee that the results are going to be available worldwide.

The overall benchmark of the final application will guarantee full accomplishment of project objectives and goals.

Future work concerning the TECNOMOLDE platform integration with other decision supporting tools as well as the development and implementation of other technological functions besides those already being considered, will be taken into account, aiming for innovative and intuitive solutions.

The »ParaMOLD« application, resulting from TECNOMOLDE, is expected to be commercially available after the end of the project, turning into a complete product with continuous development and support.

Consortium Partners

A multi-disciplinary consortium has been established for TECNOMOLDE development, implementation, and test. The participants are:
CCG – Centro de Computação Gráfica
University of Aveiro (Department of Mechanical Engineering – TEMA)
Distrim2, Lda (CAD/CAM solutions for mould making industry)
3DTech (Mould making production company)
Moliporex (Mould making production company)

Acknowledgements

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A second reference for the other members of the development and coordination team who made TECNOMOLDE possible: Martin Bernhard (Distrim2); António Diogo (CCG); Antonio Sousa, Victor Neto and Renata Castro (University of Aveiro) and Pedro Gago (3DTech).

Further Information

In order to achieve the objectives of the project proposal in terms of dissemination, a project web-page was prepared and implemented. Additional information about the project as well as its intermediary results publication is available from this URL: http://tecnomolde.ccg.pt (for now only in Portuguese).

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E-xtruder.net –

Optimization, monitoring and training system of polymer extrusion process

Cristina Escaleira, António Gaspar-Cunha

German abstract

Das e-xtruder.net Projekt besteht aus der Konzeption und Entwicklung eines Systems für die automatische Überwachung, Modellierung und Optimierung des Extrusionsprozesses. Ziel ist, eine Anwendungssoftware zur Unterstützung industrieller Aktivität im Bereich der Kunststoffextrusion zu entwickeln. Mit diesem Projekt soll die Optimierung des Prozesses durch spezifische Rechnerdienste erreicht werden. Ein Schulungsmodul für die gezielte und kontinuierliche Fortbildung der Mitarbeiter; ein Modelierungsmodul um das Verhalten des Extrusionssystems – Kopf und Material – in spezifischen Situationen besser zu verstehen; und ein Expertensystem, um in unterschiedlichen Verhältnissen die am besten angepassten operationellen Zeitfenster zu ermitteln und die am besten geeigneten Extrudertypen zu finden.

Introduction

Polymer extrusion is one of the most important technologies used to produce plastic parts. Due to the complexity of the process, which involves the coexistence of solids and highly viscous fluids, the equipment is very often not used under the best operating conditions. During the last decades several computer programs have been made available. However, they are only able to take an instant picture of the process, i.e., they are only able to calculate the process performance for a given combination of polymer properties, extruder geometry and operating conditions. If the aim is to optimize the process, i.e., to define the best operating conditions and/or geometry, a procedure of trial-and-error must be carried out. The present Project aims to overcome these difficulties by implementing an automatic optimization scheme together with a modelling routine and a polymer extrusion tutorial integrated. The differentiation of this system among other is the simultaneous availability of these three modules.

The E-xtruder.net project

The project aim is the implementation of software for modeling, optimization, monitoring and training of polymer extrusion process, by building a powerful and efficient tool to support enterprises in this sector, on the development of new product and production of other ones.

Technological Goals

The technological objectives of the project are:

- Development of a extrusion modeling software able to predict in real time a precise answer to a set of inputs;
- Implement an optimization algorithm, that considering either the operation condition or the system geometry, able to produce an automatic answers to a set of process requirements predefined by the user;
- Make available a monitoring system of the process and it's component with capability for statistical treatment of results;

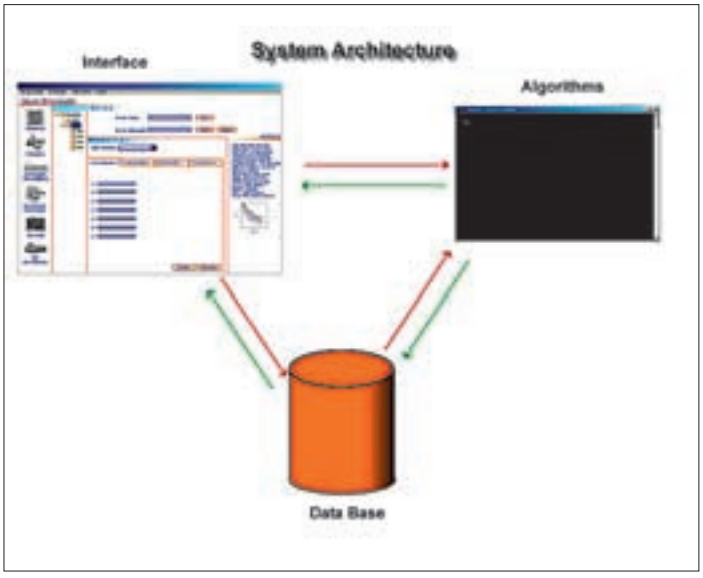

Figure 1: Software architecture

Figure 2:
Design of User interface

- Construction of a tutorial for polymer extrusion process addressed to several levels of specialization. It should have an introduction, physical fundaments and special topics supported with virtual reality;
- Online software access in order to maximize its potential also for less specialized users;
- Online support and consulting service;
- Evaluate the program structure and as well the interfaces and the results within the potential user enterprises.

The project is now in the specification and design phase where information flow diagrams modeling and database design is being accomplished.

Implementation Methodology

One advantage in this project is the multidisciplinary team that involves different knowledge from Plastic Industries, researchers in Polymer extrusion to informatics and computer graphic experts. Right now, the specification and design phase is being done where the different teams have to find a common language to perform product specification from the different process to be implemented. These processes result from years of investigation on mathematical modeling of the plasticating extrusion process and optimisation algorithms. The modeling package considers the existence of solids conveying in the initial turns of the screw, melt conveying in the final part of the screw and in the die and the coexistence of solids and melt. The momentum and energy equations are solved using numerical methods considering the non-isothermal flow of a non-Newtonian fluid.

The optimisation is performed though the use of Multi-Objective Evolutionary Algorithms, which avoids the need of a trial-and-error procedure. The decision-maker only needs to define the parameters to optimise, the criteria of optimization and the relative importance between them. Then, the software is able to define a set of possible solutions, permitting to the decision-maker the final choice.

One challenge in this software is to make use of the 3D models to represent the different components and elements of the extrusion process. The interfaces of the software will create dynamically different graphical elements defined by the user and draw results on real time that help the user understand the whole process. The usability and interaction components in the interfaces have to be careful design in order to simplify each step from the Polymer extrusion.

Future work

One main focus is this project is to reuse the industrial partners experience with Polymer extrusion by involving them already in the specification and later on in the development phase of the product.

Several user tests on different implementation versions of the software are planned, in order to validate usability of the user interfaces, graphical representation of the several machines and components.

Consortium Partners

CCG – Centro de Computação Gráfica
CASO (IT Consulting)
Piep (Inovation Center for Polymer Eng.)
Soprefa (Industrial Partner)
Periplast (Industrial Partner)

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Mobile Added Services – Practical Cases

Alexandre Oliveira, Octávio Malgueiro, Pedro Figueiredo

German abstract

Heutzutage ermöglicht die mobile Telekommunikationstechnik überall und zu jeder Zeit den Zugang zu Informationen. Die Entwicklung des Mobile Added Services-Konzeptes erlaubt es, mehrere nützliche und wertvolle Dienste für den Benutzer zur Verfügung zu stellen, die abhängig von seinem momentanen Standpunkt sind. Dieser Artikel erläutert die Arbeit, die das CCG in Kooperation mit der Abteilung Informations-Systeme der Universität von Minho im Projekt VADE (Value ADded Environment) zur Zeit entwickelt. VADE hat das Ziel, das Bereitstellen von ortsabhängigen Diensten im Bereich Telekommunikation zu erforschen. Das bedeutet nicht nur, dass jeder Dienst ortspezifische Informationen verarbeitet, sondern auch, dass die Suche und Auswahl eines bestimmten ortsabhängigen Dienstes vom Standort des Benutzers abhängt. Um dies zu ermöglichen kombiniert das VADE Projekt die mobilen Telekommunikationstechniken mit den Einrichtungen und Möglichkeiten von WiFi, IrDA und Bluetooth. Dies erlaubt es eine Plattform zu schaffen, die es ermöglicht Dienste durch die Mobilfunkgesellschaften zur Verfügung zu stellen und zu managen. Gleichzeitig können auch Drittanbieter Services verwalten. Das CCG entwickelt verschiedene Dienste, um diese neue Möglichkeit des Zugangs zu Informationen zu testen.

Introduction

Mobile technologies enable the access to information anywhere and at any time nowadays. The Mobile Added Services concept makes it possible to provide the user with a set of useful services which depend on his or her current location.

This article will present the work that CCG is currently carrying out in cooperation with the University of Minho´s Information Systems Department. Our joint VADE (Value Added Environment) project aims to explore a services model based on the services that will test this new information access paradigm. This means that localization is supported by each service not only internally, but also at the service's search level, enabling the selection of the ones that have specific meanings with respect to the user. To make this possible, the VADE project will combine the mobile phone network technology with WiFi, IrDA and Bluetooth facilities. This will enable to create a platform the provides simultaneously mobile services through the mobile network operator, and mobile local services managed by a third party.

Mobile Services

The services presented above will be provided within the context of the Virtual Campus project, which is currently being implemented on the University of Minho's campus grounds. The idea is to provide contextualized information to a user

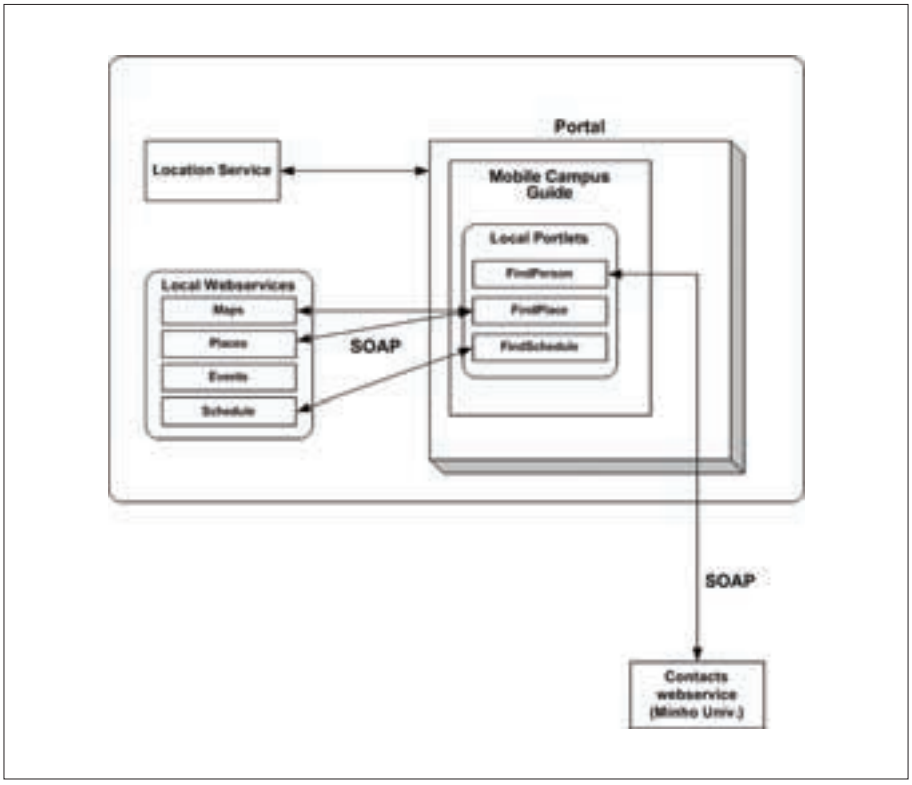

Figure 1: Conceptual Model

who is in the campus area. But, exploring the VADE concept, these services will also be accessible outside the campus boundaries through a mobile phone operator portal.

At this stage, the following functionalities already meet a test phase: contacts, schedules, and webwall. The first two are part of a generic application, the Mobile Campus Guide.

Figure 2:
Search for contact

Mobile Campus Guide

The Mobile Campus Guide's main purpose is to support the visitors of the Azurém Campus with mobile devices that support technologies such as Wap, Bluetooth, WiFi, or IrDa. Once located in the VADE environment, the visitors will be able to access the functionalities presented below.

Contacts service is based on two different approaches: global, where the results obtained refer to the surrounding environment as a whole (not depending on the user's location); restricted, where the results obtained depend strictly and directly on the instantaneous location.

In the first approach, the user inserts only the name of the person for whom he or she is looking.

As a result, a set of names is obtained which match the name that was previously inserted. The search will be refined as many more names are introduced. In order to visualize the information associated with one given person, it will only be necessary to select the name from the resulting names list.

The second approach, more specific than the previous one, is about requesting contact information with respect to the place where the user is found, for example a building, a specific department, a services office, and so on.

The fundamental difference between this approach and the previous one resides in the filtering of the results obtained. The user is only provided with information relating to the location where he/she is currently found.

Regarding the Schedules service, this provides two search options: daily schedule of a course, and weekly schedule of a specific discipline.

By selecting the year, semester, and day of a given course by using a drop down list, it is possible to obtain its relative schedule. This form of interaction becomes sufficiently efficient, and besides being intuitive for its similarities to a web page search, it completely reduces the possibility of not obtaining any results, or obtaining incorrect results.

Searching for the schedule of a specific discipline is similar to the search described previously. It is, however, a distinct form of interaction. The user will have to select the course, year, and semester from a list in order to obtain the respective list of disciplines. By selecting a specific discipline from this list, the user will be provided with its schedule.

Webwall

The purpose of this application is to present multimedia contents, with the possibility of multi-user interaction through mobile devices.

The architecture of this service resides in a set of small applications, each one of them responsible for managing various sources of information content such as images, videos, web pages, text, and web games, which are intended to be visualized. There could be several different kinds of data sources, previously defined or created on the fly by users, sending information from mobile devices to the webwall.

The interaction of the users is made possible by a wap portal, where the access can be carried out by means of GSM, WiFi, Bluetooth, or IrDA. This portal provides the necessary interaction functionalities such as the submission of text or short messages, images, small videos, and URLs referring to websites.

One of the webwall's main functions is to present distinct profiles. Each one of these profiles is a set of predefined applications which are responsible for the presentation of the various information sources in different templates.

Application scenarios could be workshops, conferences, trade fairs, hotspots, and so on, where the users can interact with the webwall appli-

Figure 3:
Search results of daily schedule of a course service

cation by submitting SMSs, images, electronic voting, etc. The webwall can be a projection in the public environment where everyone sees the results of the user's interaction, enabling to assist in real-time, from a distance, to an event, for example. This concept implements a public multimedia log book just making use of mobile networks and devices, and also a projection in public spaces.

Thus webwall supplies a flexible architecture that allows instantaneous access and interaction with various sources of information.

Technologies

The technology which is used as a base for the development of the services presented above is Jetspeed from Apache.

Jetspeed is an open source implementation of corporative portals which uses Java and XML technology as a basis. The users can access a specific portal through a web browser, WAP devices, or any other mobile device.

Jetspeed is particularly interesting since it implements the portlet concept, though it still does not totality satisfy the JSR 168 specification standard. Portlets can be seen as components, each one of them being responsible for accessing and providing information either from a site, database, or e-mail server, etc.

From the user's point of view, a portlet is a portal window that provides a service or specific information.

From the application development perspective, portlets are modules that are designed to run in a portlet container. The portlet container provides a runtime environment in which portlets are instanced, used, and destroyed.

The choice for these technologies is directly related to the remaining components of the VADE project. However, this is considered to be a very flexible technology that can easily be adapted to the kinds of scenarios presented here.

Conclusion

It will be possible to explore the diverse opportunities provided through the VADE platform by using the technologies and concepts presented above. The development of new services such as Find Place will contribute to the mobile added services offered in the context of the Virtual Campus, where the installation of a wireless network is foreseen on the whole university campus. The combination of the access to the information through a WiFi network, for example, and a portal provided by one of the mobile operators, extends the possibilities of mobile access, thus giving more potential to the implementation of these services and their use.

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Virtual Igartubeiti –

New Technologies for the Dissemination of a Basque Cultural Heritage Asset

Igor Leanizbarrutia, Dr. Maria Teresa Linaza

German abstract

Igartubeiti ist ein Musterbeispiel für die Holzarchitektur aus dem 16. und 17. Jahrhundert und zudem ein getreuer Repräsentant des goldenen Zeitalters baskischer Bauernhäuser, der so genannten »baserriak«. Die Hauptmotivationen für die Entwicklung des Projektes sind eine vier Jahrhunderte alte Geschichte, das Restaurations- und Sanierungsprojekt und die kulturelle Reichhaltigkeit des Bauernhauses. Eines der größten Mängel dieses Kulturgutes besteht darin, dass der normale Bürger so wenig weiß über seinen Standort und den kulturellen Wert, der sich innerhalb seiner Mauern befindet. Das Ziel des Projektes ist die Implementierung eines Virtual-Reality-Systems für verschiedene Darstellungen (Web, Stereo-Projektionsleinwand), um durch Digital Storytelling ein anschauliches Erlebnis des Erscheinungsbildes von Kulturgütern und deren Geschichte und Kontext zu vermitteln. Zudem soll der Besucher ermutigt werden, den wirklichen Ort zu besuchen, und nicht nur den virtuellen, in dem er sich gerade befindet. Das Storytelling-Erlebnis wird mit Mixed Reality-Technologien und Digital Storytelling-Techniken implementiert, um eine Geschichte mit narrativen und emotionalen Merkmalen »zu erzählen«. Die Storytelling-Technologien sind gut dazu geeignet, um das Interesse des Besuchers zu wecken und um das Verständnis textabhängiger Informationen dieses Kulturgutes zu fördern.

Introduction

For European cultural institutions, »being digital« is not an option anymore, but a need and increasingly reality. Today, cultural institutions are confronted with a virtually endless amount of digital cultural information of all types and formats, including digital images, audio and video recording, electronic text, interactive and multimedia applications, as well as geographic information, which complement more traditional cultural information.

Simply providing information on where to find cultural heritage objects or giving access to digitized objects themselves may be of interest to academic users or highly specialized communities, but it may not be sufficient to also attract new user groups and broader audiences. This is what can currently be observed, with services, which are particularly targeted at certain communities and not necessarily meaningful to other audiences.

In order to reach broader audiences, cultural institutions need to build knowledge-rich multimedia information resources which provide explanation and guidance as well as additional context. New tools and systems are therefore required to support this effort to truly disseminate the value of the cultural heritage resources they are taking care of.

Objective

The project's main objective is the implementation of a Virtual Reality system for different displays (web, stereoscopic projection screen) in order to convey a vivid experience of the appearance, history and context of Cultural Heritage assets through Digital Storytelling, and to encourage the visitor to visit the real place he is virtually immersed in.

Figure 1: Front view of the Igartubeiti farmhouse

The storytelling experience is implemented using Mixed Reality technologies and Digital Storytelling techniques in order to »tell a story« with narrative and emotional characteristics. The storytelling technology is a good means to arouse the visitor´s interest, and to facilitate the understanding of the cultural asset's contextual information.

Application of New Technologies to the Diffusion of the Cultural Heritage of Gipuzkoa: the Igartubeiti Farmhouse

Igartubeiti is a fine example of 16th and 17th century wooden architecture and a faithful representative of the golden age of Basque farmhouses or »baserriak« (cf. Figure 1).

The main motivations to develop the current project are four centuries of history, the restoration and reconstruction project, and the cultural richness of the farmhouse. One of the main weaknesses of this cultural treasure is the normal citizen's lack of knowledge about its location and the cultural value which can be found inside its walls.

The current project therefore aims to reproduce the farmhouse, its life, and traditions with high realism using innovative IT technologies in

Figure 2:
Kattalin of
Kortabarria.

order to encourage the visitor to be conscious of the richness of this Cultural Heritage asset and to visit the real site afterwards.

Implementation
The virtual model of the farmhouse, including the structure of the building and all its content, has been implemented in Maya. The AVALON platform, developed by the ZGDV centre in Germany, has been used in order to make this model interactive. This platform allows the integration of interactive 3D models with different types of interaction interfaces, the addition of conversational Avatars into the scene, and real-time rendering of the complex virtual environment.

In order to implement a human-like character or avatar which serves as a guide throughout the site, its geometric model had to be designed, implemented, and animated (cf. Figure 2).

The synchronization of the voice and the face movements is crucial, because the visitor could easily detect any time delay and lose the impression of immersion and naturalness.

Digital storytelling tools have been used to achieve the best possible realism, including a script developed by experts within the culture and communication areas. Moreover, the possibility of enhancing the experience by a parallel exhibition of real artifacts will be taken into account so that the user could get a clearer idea of the farmhouse' content.

Interactive experience
The interactive exhibition begins with the visitor's approach to the projection display. A joystick has been chosen as the interaction interface. After selecting the language for the story, the immersion of the visitor into 16th century everyday life begins.

Figure 3:
Scenes of the
virtual walkthrough

The visitor is no longer a passive subject; he is able to choose a way to visit the farmhouse and to control the path with a joystick. At some points of the walkthrough, the woman of the farmhouse, dressed as a farmer from the 16th century, explains the use of some of the tools around her such as the washing machine, the cheese-making procedure, and even the place where the treasures are hidden (cf. Figure 3.)

Internet
A website including interactive 3D content is currently being implemented. The Internet visitor is able to access the Igartubeiti website before his visit to the real environment, book his visit on-line and retrieve information about the environment. This website is an example of the Internet use as a complement to the 3D interactive experience. Another advantage is the use of Internet to provide access to a wider audience.

The virtual reconstruction has been implemented using VRML, a standard language to describe 3D models, which allows user interaction over the Internet. The result has been a multi-platform system for the visualization of the model on websites. The VRML image allows a 3D immersive interactive experience, adapted to the respective limitations of bandwidth and processing power. The user controls the navigation through the model as in the physical set-up.

Acknowledgement
This project has been developed in collaboration with the Culture Department of the Local Government (Diputación Foral) of Gipuzkoa. Their help in the content and script preparation, as well as in the financing, has been crucial in order to implement the project.

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Laboratory and Evaluation Methodology for Biometric Devices in Security

Nora Mendoza, Alberto Larzabal, Jorge Posada, Dr. Christoph Busch

German abstract

In unserer globalen Informationsgesellschaft gibt es einen stets wachsenden Bedarf an Personenauthentifizierung. Es gibt verschiedene Möglichkeiten zur Benutzerauthentifizierung: durch Merkmale, die Wissen oder Eigentum betreffen, oder durch biometrische Merkmale. Bei der auf Wissen basierten Identifikation wird eine geheime Information, wie zum Beispiel ein Passwort oder eine PIN, verwendet. Die auf Eigentum basierte Authentifizierung beruht auf der Vorlage eines spezifischen Gegenstandes, beispielsweise eines Schlüssels oder einer Karte. Die biometrische Erkennung unterscheidet sich von diesen Methoden, da sie auf einer engeren Bindung an die Person basiert. Ein biometrisches Merkmal, wie beispielsweise ein Fingerabdruck oder das Abbild der Iris, kann nicht vergessen, verlegt oder weitergegeben werden. Die Ziele dieses Projektes von VICOMTech, mit der Beratung von Fraunhofer IGD, sind das Design und der Aufbau eines Labors, das biometrische Systeme zur Authentifizierung beinhaltet, und die Entwicklung einer Methode zur Bewertung und zum Vergleich dieser Systeme. Das Labor wird es ermöglichen Probleme zu erkennen, die Performanz von Systemen zu bewerten, neue Forschungsrichtungen zu erkunden und Institutionen und Firmen bei der Anschaffung von biometrischen Systemen zu beraten.

Introduction

In these uncertain times, where knowledge of and ease of access to special places or information is critical, the use of biometrics for personal authentication is becoming convenient and considerably more accurate than current methods (such as the utilization of physical devices, passwords or PINs). This is because biometrics links the identification or authentication to a particular individual (a password or token may be used by someone other than the authorized user), because it is convenient (nothing to carry or remember), accurate (it provides for positive authentication), can provide an audit trail, and because it is becoming socially acceptable and inexpensive.

To recognize a person, Biometric devices use automated methods based on physical or behavioral characteristics. Common physical biometrics includes fingerprints, hand or palm geometry, and retina, iris, or facial characteristics. Behavioral characters include signature, voice (which also has a physical component), keystroke pattern, and gait.

The need for biometrics can be found in a range of sectors: government administrations, enterprise-wide network security infrastructures, secure electronic banking, investments and other financial transactions, retail sales, law enforcement, health and social services, etc. All these sectors can benefit from biometrics technologies for authentication and security. After years of research and development, vendors now have several products to offer. Some are relatively immature, having only recently become commercially available, but even these can substantially improve the traditional methods for strict authentication in the companies. However, there is no such thing as a »best biometric technology«, and different applications and contexts require different biometrics. Also, the lack of knowledge and trust in how to measure or compare these new devices impairs a broader use of biometrics in traditional applications.

Objectives

The aim of this project is to design and set-up a laboratory which includes biometrics systems for authentication, and to develop a methodology to evaluate and compare them in order to give interested institutions and companies the possibility of high quality consultancy in the area, as well as to promote the medium and long-term research on these technologies.

In this laboratory, different biometrics systems will be analyzed, evaluated, and compared following a methodology which will allow evaluating them with a high level of trust given a concrete application and context. The outcomes obtained will serve as a reliable base to advise the companies when acquiring biometrics systems, or to evaluate the real security level of the systems that are already in use.

In addition, the research will be expanded in biometrics areas of clear interest for the companies and society.

Exhibition Setup

There are two fundamental tasks in this project: to create a specialized laboratory, and to develop an evaluation methodology.

Therefore, biometric devices, both commercial and prototypes, will be included in an advanced laboratory which will be located in VICOMTech (35 m^2). This lab will be used by VICOMTech for applied R+D in biometrics, and by the contracting company, S21sec, for security audit and consulting. In the future, this lab will be open to other institutions, companies, and universities.

Figure 1: Some biometric characteristics used for authentication

Outcomes of the Project

- Establish clear criteria to evaluate and compare the biometrics systems (existing and prototypes).
- Create a systematic methodology for evaluation and audit as an extension of areas in digital security, which have already been developed.
- Investigate the lacks of these systems from the point of view of Computer Graphics advanced knowledge and interaction technologies in order to determine the possible risks of their use.
- Analyze the social effects of the daily use of biometric authentication systems.
- Define a stable cooperation frame with the companies which will allow improving the evaluation and comparison method in the medium and long term, promoting the combination between the research advances and the real needs of the industry.

Consortium

Due to the nature of the project, a core workgroup consisting of S21sec and VICOMTech has been established.

S21sec is a renowned Spanish company which works as a consultant in several aspects related to digital security. S21sec evaluates the security risk of the companies, proposing solutions to improve their current status. S21sec uses its own evaluation methodology based on international standards for it, and will extend this methodology to also include biometrics aspects, in cooperation with VICOMTech.

From the INI-GraphicsNet, VICOMTech is the main technological partner in the consortium, with the responsibility for the setup of the laboratory as well as for establishing R&D parameters for the evaluation of the biometric devices. For this purpose, it collaborates tightly with the Fraunhofer Institute for Computer Graphics (Security Technology Department – Dr. Christoph Busch), European reference in evaluation and comparison of biometric systems. Frauhofer IGD has a very good experience in similar projects in Germany and will advice VICOMTech in the project for the Spanish context.

Public Event

At the end of the year 2003, a public workshop will be organized to present the laboratory and the methodology to companies and institutions, with the presence of international experts and representatives of the Ministry.

Acknowledgement

This work is sponsored and partially financed by the Spanish Ministry of Science and Technology through the PROFIT Program.

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TRAC – Augmented Reality Project in Liver Surgery

Eduardo Carrasco, Iván Macía, Rubén Gómez, Dr. Georgios Sakas

German abstract

Das Ziel des Projektes ist die Entwicklung eines Prototypen, der auf Augmented-Reality-Methoden (Methoden zur Schaffung Erweiterter Realität) basiert, und in Operationssälen effektiv Hilfe bei der Planung von Leberoperationen, wie zum Beispiel Leberresektionen oder -transplantationen, leisten soll. Die Hauptaufgabe dieses Tools besteht darin, dem Chirurgen ein 3D-Abbild der Leber zur Verfügung zu stellen, das auf Live-3D-Videobilder des Patienten übertragen wird. Die Leberabbildungen sind individuell auf die Patienten zugeschnitten, denn sie werden von magnetischen Resonanzbildern (MRI, magnetic resonance images) des Patienten bezogen. Der Abgleich zwischen den MRI-Bildern und dem Live-Video des Patienten wird durch ein optisches Ortungsgerät (Tracking-System) erreicht. Zudem wird die gemeinsame Visualisierung der Leber und der Live-3D-Videobilder des Patienten mit Hilfe eines PCs und eines autostereoskopischen Bildschirms durchgeführt. Im letzten Projektabschnitt wird dieser Prototyp in einem Operationssaal der national anerkannten Abteilung für Hepatische Chirurgie und Transplantation im Cruces Krankenhaus in Bilbao (Spanien) installiert.

Introduction

Present surgery is a field that can substantially be enhanced by tools based on Augmented Reality technologies. With these tools, physicians will be able to overcome several difficulties which they have nowadays. They will be able to see through the patient's skin, watch desired internal anatomy and functions, and they will operate using minimally invasive tools. These are just a few examples of what we are going to see in the future.

With these tools, surgeons will be able to work in a more efficient way, save time and money, make operations safer for the patients, and allow a quicker recovery.

In this project, an approach to these near future tools is intended, and, using ultimate technologies, a first generation Augmented Reality tool is going to be developed.

A well-defined scenery is also outlined. The exact fields of application for this case are liver operations, mainly for hepatic cancerous tissue resections. For these operations, an accurate augmented live visualization of the patient and his liver will be a valuable tool in the operating theatre, and it will substantially help planning the operation.

Objectives

The current project aims to create an augmented reality prototype which can help the surgeon in liver surgery by visualizing an augmented reality view of the patient with a virtual reconstruction of his liver in the correct position. The system is designed so that it involves minimal annoyance for both the surgeon and the patient during the operation. The virtual liver is a 3D model obtained from a stack of MRI images taken from the patient prior to the operation.

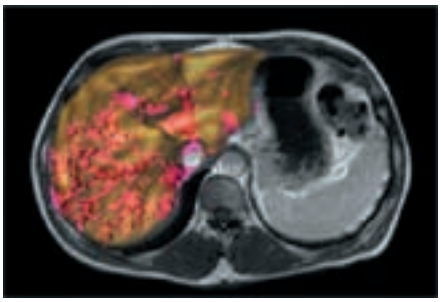

Figure 1: 3D reconstructed liver over 2D MRI image

Working methodology

Segmentation and 3D reconstruction

The first step is to produce a 3D model of the patient's liver. First, the stack of MRI images obtained from the scanner must be pre-processed using different filters. These are used to remove noise and to adequately enhance characteristics of the image without removing relevant detail (for instance using edge enhancement filters). The choice of filters depends greatly on the approach used for segmentation. The chosen segmentation algorithms are then applied to the filtered MRI images in order to obtain the contours of the liver. There are several options for segmentation which include region growing, thresholding, edge-based segmentation, or deformable models. Once these contours have been obtained, a 3D reconstruction algorithm is applied resulting in a 3D surface which accurately represents the patient's liver. If the resulting surface consists of too many polygons, further algorithms can be applied in order to reduce their number, thus avoiding expensive calculations in further steps.

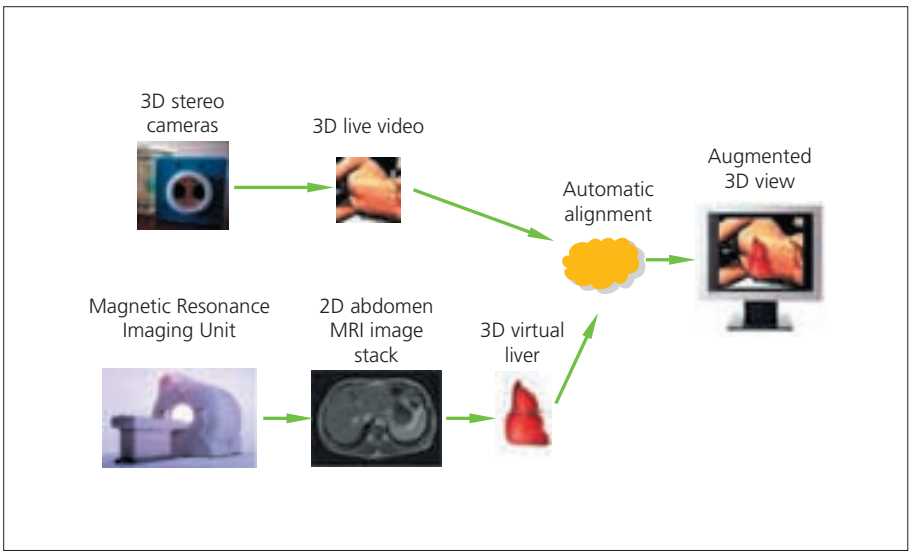

Figure 2: process diagram

During the process, a 3D surface representing the abdomen is also obtained. This surface will be used as a reference to position the virtual liver in the real scene when creating the augmented view. Both the surface and the liver share a common reference system which will be referred to in the operating theatre.

Alignment

In order to create the augmented reality view it is necesary to position the liver graphic object in the correct position relative to the patient. A tracking system keeps track of some optical markers placed in the patient's abdomen. An approximate 3D surface of the patient's abdomen in the operating theatre is reconstructed from these markers in real time. This surface is aligned with the surface obtained from the MRI images by first orienting both surfaces and then using distance minimization algorithms. The result is a rotation matrix which adequately positions the virtual liver in the real scene, given the position of the latter.

Visualization

In order to create the augmented reality view it is neccesary to establish a common reference system which allows merging real and virtual images in a realistic way. The optical tracking system registers the patient's position and the movement of a pair of stereo video cameras which produce live color TV-quality images in the operating theatre. These cameras are compact and light-weight, which makes it possible to attach them to a mobile arm which can easily be positioned by the surgeon during the operation. This way, the surgeon can obtain the best view of the augmented scene without interfering with his own field of view. As the cameras are being moved by the surgeon, the optical tracking system tracks their positions and sends them to the system. This information, combined with the relative position of the virtual liver in relation to the real scene, will allow generating the corresponding augmented reality view.

Finally, the result is visualized by the surgeon on an autostereoscopic monitor which has been chosen among other stereo visualization devices due to its simplicity and the fact that it does not invade the surgeon's work area during the operation. Other devices such as HMDs are complicated and cumbersome, and they can obstruct the view of the surgeon or distract him during the complicated phases of the operation.

Consortium

Due to the interdisciplinary nature of the project, a core workgroup consisting of partners in research, industry, and health has been established. VICOMTech manages the project and contributes knowledge of Augmented Reality technologies, STT contributes expertise in the development of optical tracking systems, BILBOMATICA is an expert in handling medical data, and Cruces Hospital is the final assessor of the prototype.

Collaboration with Fraunhofer IGD

The Department of Cognitive Computing & Medical Imaging (Dr. Georgios Sakas) collaborates with VICOMTech in this project, giving advice and direct help in the development of the project, based on the valuable experience in similar previous projects in Germany and Europe.

Acknowledgement

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ASEDUC –

E-Learning Course Delivery Using 3D Conversational Avatars

Amalia Ortiz, Iker Aizpurua, D. Oyarzun, I. Arizkuren, Jorge Posada

German abstract

Das in diesem Artikel vorgestellte Projekt hat die Entwicklung von Kommunikations- und Interaktionstools im E-Learning-Umfeld zum Ziel. Die Tools haben eine dialogorientierte Benutzeroberfläche und ermöglichen die Darstellung von Bildungsinhalten im Internet. Die Interaktion zwischen Schüler und Lehrer wird in E-Learning-Systemen oft vergessen. Der Einsatz einer virtuellen Figur (Avatar) hilft dabei, in diesen Systemen eine intuitive Interaktion zwischen Schüler und Lehrer herzustellen. Aus diesem Grund ist eines der Hauptziele des Projektes die Entwicklung von Tools, die die Bearbeitung der verschiedenen eingesetzten Multimedia-Aspekte ermöglichen, um sie zu einem späteren Zeitpunkt, wenn auch die entsprechenden 3D-Avatare eingebunden sind, visuell und automatisch in die Kurse zu integrieren. Mit diesen Tools kann man zudem das Verhalten des Avatars für jeden Kurs und jedes Benutzerprofil individuell festlegen.

Introduction

As most people have access to a PC and the Internet nowadays, the development of more flexible and open educational models using the E-learning advantages has become possible. The interaction between teacher and student is different in this type of education, because the student learns more actively and autonomously.

A successful approach in the distance courses is to use a methodology based on the feedback between teacher and student. In this way, the student's motivation depends on the communication language, the kind of interfaces, and the proposed services during the tele-formation. In the past, CCC (the leading Distance Formation Centre in Spain, founded in 1939) has taken special care of these aspects, working traditionally with mail and video, and using the figure of the tutor as a key aspect in the communication language used. They have recently initiated their Internet activities with the aim to develop new on-line courses as a better way to reach their clients. They realize that the presence of the tutor is essential for a better student understanding and motivation. In order to achieve a better introduction of the virtual tutor figure in the online courses, CCC and another company (Menke Informatics) have a joint project with the R&D Center VICOMTech, called ASEDUC. In particular, it was identified that Social User Interfaces, especially avatars, can be a good means to achieve better audio-visual communication with the virtual tutor. An avatar is an intelligent agent with graphical representation, often humanoid and with speech capabilities. The virtual character helps the E-learning purpose by attracting the student's attention by imitating the speech and

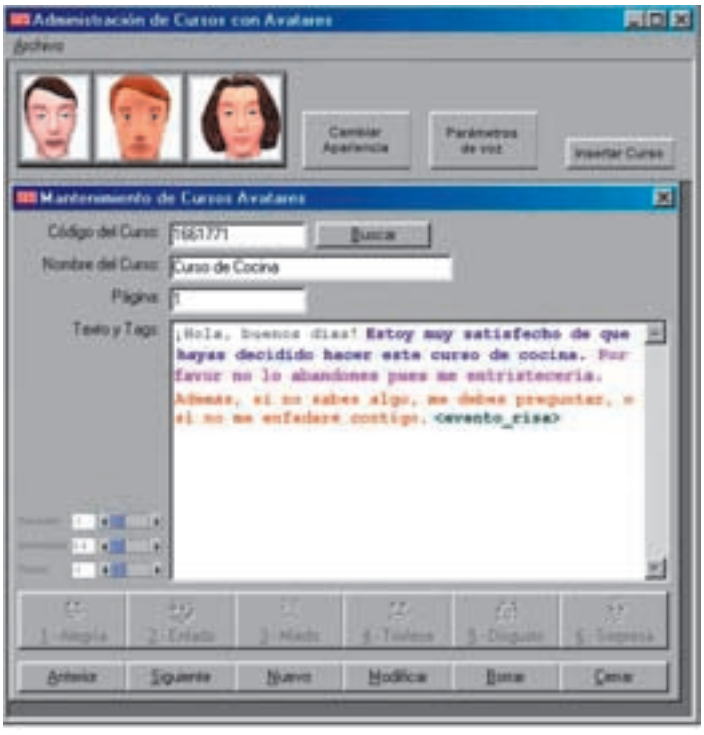

Figure 1: Avatar Mark Up Editor

behavior of human communication, especially on behalf of the tutor. The integration of a real time speaking 3D avatar offers a new intuitive and more autonomous way of learning concepts thorough a new communication language. Having an avatar in an E-learning context helps to achieve intuitive interaction and natural expressions in the learning process.

ASEDUC: The project

This project focuses on the development of a communication and interaction tools for E-learning environments on the Internet which allow the delivery of educational contents on the web through a Graphical and Conversational User Interface.

For this purpose, VICOMTech's avatar technologies are integrated into the Internet platform of CCC, one of the most important companies for distance education (traditionally by mail and video) in the Spanish environment. Moreover, Menke Informatics also participates in the project as a specialist in web solutions. The main goals of the project are:

- To increment the pedagogic capacity of the actual courses the industry offers on the Internet, by means of a virtual tutor who supports and guides the learning process.
- To provide a solution which is technologically feasible, for the transmission of the virtual tutor in low speed Internet environments, by selecting an architecture and technologies which are suitable for these conditions (cf. Figure 1).
- The project will focus on creating a general infrastructure to introduce virtual teachers in distance formation courses. This infrastructure will allow the edition and later integration of the courses, with its corresponding 3D avatars integrated, in a visual and automatic way.

This project is co-financed by the INTEK program (CN02CX01) of the Basque Government.

Definition of the AVATAR'S behavior

One of the project's main targets is the development of tools which allow the edition of the different multimedia aspects to be used, for later integration in the courses (also with its corresponding 3D avatars integrated) in a visual and automatic way. These tools will make a customized definition of the avatar's behavior possible, for each course and user profile.

One of the main advantages of having an avatar integrated in an E-Learning system is to create the illusion in the student to be interacting with the system as if communicating with a real tutor. This is obtained through the imitation of dialogs and behaviors of the communication between the tutor and the student. This is why the synchronization of graphical animation and speech production and the simulation of facial expressiveness are highly relevant areas of research.

The human facial expressiveness is composed of mood emotions such as normality, severity, happiness, sadness, or anger, and a set of emotional events such as laugh, cry, and sigh, and so on. For instance, the emotional events are used often nowadays in Internet chats as gesture icons.

The way to synchronize and associate the avatar's behavior with the contents of the course is through a mark-up text which works as follows: the input marked text contains, besides the text for its reproduction, special labels that indicate (i) mood emotions, (ii) emotional events, (iii) some gestures which have to be produced in certain parts of the narration, and (iv) user profile dependent interactions. As mark-up language we are following VHML (Virtual Human MarkUp Language), mixed with some marks of EML (Emotional MarkUp Language) and GML (Gesture Mark Up Language).

An editor is currently being developed (cf. Figure 2) for marking the avatar's text in an easy and visual way. This editor is part of the infrastructure to introduce virtual tutors in distance formation courses.

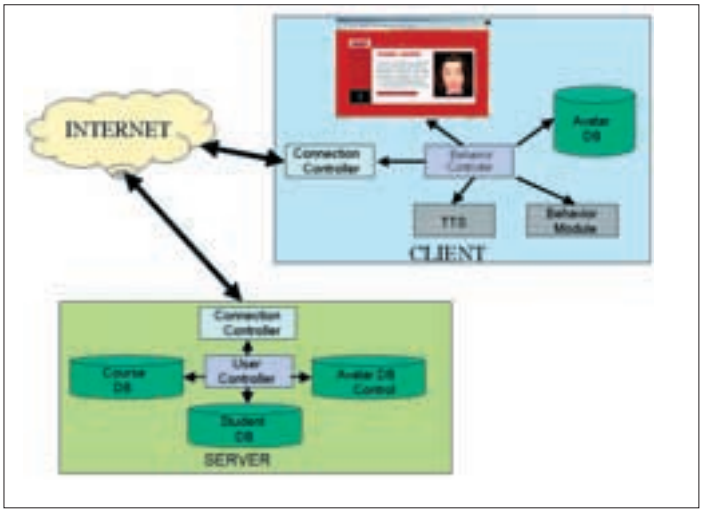

Figure 2:
Internet Architecture

Conclusion

The project implies an important technological innovation in two principal ways. On the one hand, the main contribution is the integration of 3D avatars with real time animation and Spanish speech in an E-Learning environment, with low memory and speed connection requirements. On the other hand, the speech production is formants-based, in contrast to the usual approach (concatenation-based). This technology allows having different kinds of voices for the different kinds of avatar appearances, in a low-weight application without the need for powerful servers for multiple access.

For this project, we also maintain close contact with the Department Digital Storytelling for the Center for Computer Graphics (ZGDV) in Darmstadt (Germany) within the scope of the common activities in the avatars area.

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SEITV –

Interactive Multimedia Leisure/Educational Services for Digital TV

Igor García, Iker Aizpurua, Nuria Lopez de Guereñu, Julián Flórez

German abstract

Die Möglichkeit über digitales Fernsehen Anwendungsdaten zusammen mit Audio- und Videoinhalten versenden zu können, eröffnet neue Möglichkeiten, interaktive Dienstleistungen über das Fernsehen zur Verfügung zu stellen. Somit werden den Anbietern von Multimediainhalten neue Horizonte eröffnet, denn digitale Fernsehausstrahlung ermöglicht die gleichzeitige Datenübertragung an Millionen von Digitalempfängern (Set-Top Boxes, STBs), ein Umfang, der über das Internet nur schwer zu erreichen wäre. Anwendungen, die für den Computergebrauch bestimmt sind, können jedoch nicht direkt auf einen Fernseher portiert werden, da es Unterschiede zwischen den Funktionen und den Benutzeroberflächen von Fernsehern und PCs, und dem Verhalten von Fernseh- und PC-Nutzern gibt. Des Weiteren reichen die Hardware-Funktionen der momentan erhältlichen Digitalempfänger nicht aus, um PC-orientierte Anwendungen zu unterstützen. Die Firma Redox Multimedia und der baskische Fernsehsender EiTB kooperieren mit VICOMTech, um für dieses Gebiet Forschung und Entwicklung zu betreiben. Sie haben sich zum Ziel gesetzt, eine Methodik zur Entwicklung von interaktiven Multimedia-Dienstleistungen in den Bereichen Freizeit und Bildung zu schaffen.

Introduction

As digital television allows the delivery of application data together with audio and video contents, it is possible to provide interactive services using television.

The applications designed to be displayed on TV cannot directly be ported from PC-oriented designs because of the differences between the TV and PC screen features like resolution, interlacing, color mode, distance between the human eye and the display, etc., not to mention the differences in the human-machine interfaces and between the attitudes of PC users and TV users.

Furthermore, the hardware features of the current Set-Top Boxes (STB) are not enough to support PC-oriented applications. However, digital TV broadcast allows to transmit data to millions of STBs simultaneously, something that would be very difficult over the Internet. This opens new horizons for the multimedia content providers.

In the SEITV project, the Redox Multimedia company (specialized in the development of multimedia content, mainly in CD support) and the Basque TV company EiTB are collaborating with VICOMTech in order to do R&D for the development of a methodology for multimedia leisure and educational interactive services.

Objectives

The present project aims to research into the new possibilities which digital TV technology is offering now, in order to develop multimedia interactive services for leisure and education. In this sense, an interactive service is being developed as a prototype. Additionally, the possibility of interactive applications, which can receive information from the Internet, will be studied. The Digital TV transmission system is a unidirectional broadcast and therefore needs a return channel to provide complete interactivity with a server. The return channel possibilities are also studied in this project.

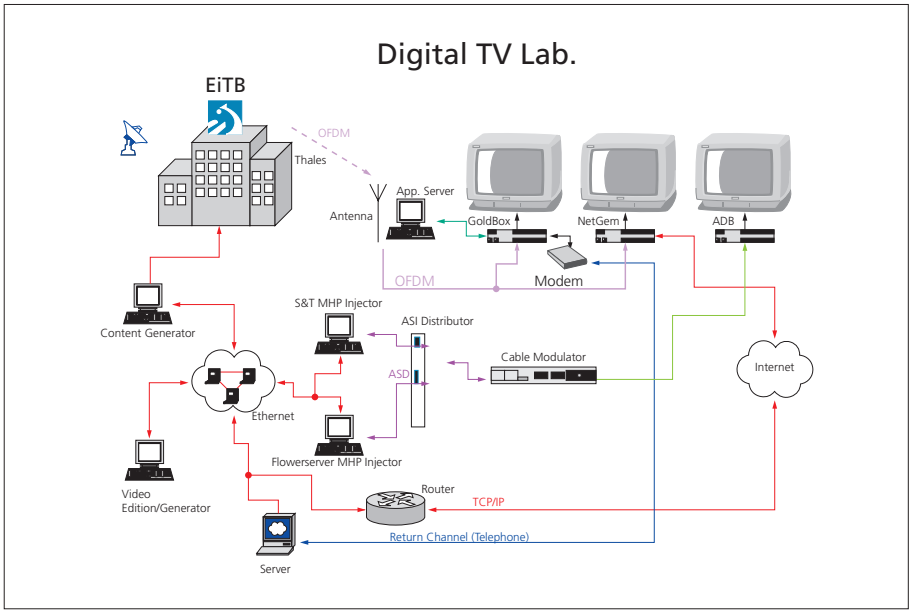

Figure 1: VICOMTech's Digital TV laboratory

Figure 2:
Prototype of the interactive educational leisure application

Another goal of SEITV is to analyze the MHP European standard for Digital Interactive Television to ensure that the applications developed are compliant to this standard, and that the current STBs are able to support the interactive services which have been developed.

The interactive service currently being developed will focus on an entertaining/educational prototype which will offer users the possibility of interacting with it. It will be a game the content of which will be enriched by a set of »tests« the user will have to pass in order to proceed, tests that may be general knowledge questions, or questions on specific areas. Through this model based on questions, presentations of interesting information, etc., that the company already uses in other supports, for example CD/Internet, the project will deepen into the educational/leisure potential of this new medium. Other objectives the project aims to fulfill are:

- Interactive service operation: Generation of an interactive educational service prototype, presented as a game, the correct operation of which can be initially verified in VICOMTech's digital TV lab and later in EiTB infrastructure.
- Definition of a technological matrix: investigating the advantages and limitations of current technology by studying DVB-MHP standard, evaluating the technological issues resulting from the functional specifications of the users' set-top boxes, available bandwidth, degree of interactivity, and analyzing available development tools and systems, considering the following elements:
  - Complexity of the possible graphical designs. Level of detail, mobility of elements composing the picture, textures, colors and, (very important) superimposing of images for which the handling of transparency is necessary.
  - Memory capability and CPU performance of STBs.
  - Embedding of music and other sound effects.
  - The design of the interactive service itself, including random elements, mechanisms to allow several participants, etc.
  - Promptness of the interactive service.
  - Level of the user's involvement throughout the interactive service.
  - Possibilities offered by the TV's remote control due to the limited number of buttons.
  - Internet access. Usable protocols.

Digital TV Lab

The development of this project takes place in the Digital TV laboratory of VICOMTech, where it is possible to create applications and test them with commercial STBs (cf. Figure 1). To do this, the Digital TV lab has a digital TV head-end to generate the DVB-MHP signals with the contents developed. When all the tests have been passed, the application can be integrated into a real TV broadcast head-end. The applications have been tested with very positive results during a prototype stage (cf. Figure 2) by EiTB (Euskal Irrati Telebista), which is the leading media group in the Basque Country with four television channels and five radio stations). The next stage will include tests of the service with some test users under real conditions.

Conclusion

Digital TV environments are a new form to use interactive services, which means that there is little experience on how the users' behavior will be, and the design of an adequate interface is one of the key questions in these first services for the MHP standard. In this regard, the users' response will be analyzed to obtain design rules and know-how about this kind of application.

Acknowledgement

This work is sponsored and partially financed by the Basque Government through the INTEK Program.

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Biosig Workshop 2003
From the »bio« finger to personality protection

CAST

Competence Center for
Applied Security Technology
Forum des ZGDV e.V.

Biometric recognition and the electronic signature were the key issues of this year's BIOSIG workshop *(http://www.cast-forum.de/events/ cast/2003/ Biometrie)* which took place on 24th July 2003 at the Fraunhofer IGD *(http://www.igd.fhg.de).* The mutual organisers were the specialist group »Biometric and electronic Signatures« (FG BIOSIG, *http://www.biosig.de*) of the Gesellschaft für Informatik (GI, *http://www.gi-ev.de*) (Society for Informatics) and the CAST Forum (Competence Centre for Applied Security Technology, *http://www.cast-forum.de*).

At the beginning, Klaus Keus, head of the department Key Technologies at the Federal Office for Security in Information Technology (BSI), held the keynote lecture. He sketched out the current national and international activities and explained their significance in detail. Due to the great interest and the variety of possible topics, the conference was divided into predominantly two tracks.

The track on the topic »Testing & Standardization« was moderated by Christoph Busch, director of the department, Security Technology at the Fraunhofer IGD. The evaluations BioFace and BioFinger were presented here, something which is carried out by the IGD on behalf of the BSI.

In addition to this, national and international standardization activities and evaluation methods were the subject of the lectures. Arslan Brömme, speaker of the specialist group BIOSIG, directed the track »Authentication«. The topics extended here via the combination of biometry and smart cards, PDA-based signing to the »Virtual Pin based on Biometrics«.

After the coffee break, the two tracks were combined again. In a lecture, Vuk Krivec, Josef Alois Birchbauer, Wolfgang Marius and Horst Bischof from Siemens AG presented a hybrid solution for finger touch recognition which can take into consideration, alongside minute details, also the direction of field. Dr. Astrid Albrecht from the BSI concluded the workshop with her lecture on »Authenticity in electronic Law Transactions and Personality Protection for the Use of biometrical Processes«.

On the whole, the organisers can look back on a very successful workshop. Just under 100 participants showed clearly that the interest in biometry is uninterrupted. »Such examples as biometric recognition features in identification papers promoted in the U.S.A will provide for sufficient discussion and research requirement in the future«, said Dr. Busch confidently.

Opening Ceremony
Fondazione GraphiTech
the New Center for Advanced Computer Graphics Technologies in Rovereto – Trento, Italy

On April 4th, 2003, Fondazione GraphiTech held an opening ceremony at its new office space in the Business Innovation Center in Rovereto. GraphiTech's first results and collaborations in the field of Virtual Reality and advanced computer graphics were presented with the help of a set of live and interactive demonstrations. Greetings were given from the Provincia di Trento by Assesore Mauro Leveghi, from the University of Trento by President Massimo Egedi and Assesore Donata Loss, from ITC-irst by President Gianni Bonvicini, and from INI-GraphicsNet Stiftung by President Prof. Dr.-Ing. José L. Encarnacao.

GraphiTech, Center for Advanced Computer Graphics Technologies, located in Rovereto – Trento, was founded as a joint venture between the INI-GraphicsNet Stiftung, Istituto Trentino di Cultura, and the Università degli Studi di Trento.

GraphiTech was established in order to conduct research and development activities in the broad technology area of advanced computer graphics and virtual reality. The aim of the joint venture is to enhance the competitiveness of Trentino's industries by developing and applying advanced computer graphics. The foundation will contribute to the knowledge transfer between the research sector and the industry by promoting research on advanced graphics, information processing, and visual communication, including virtual reality and virtual engineering.

An integrated application of a music concert in Virtual Reality was presented to the auditorium with Virtual Music Reproduction. A spatial audio installation combined with a visualization system allows interactive placement of music sources in the virtual concert hall.

GraphiTech staff in April 2003

Lab-Presentations in the new office space in Rovereto

During the opening ceremony, Prof. Dr.-Ing. José L. Encarnação, President of the INI-GraphicsNet Stiftung and Vice-President of Fondazione GraphiTech, presented INI-GraphicsNet Foundation and its Spin-off Support Program; Prof. Fausto Giunchiglia, Vicerettore of the University of Trento and President of Fondazione GraphiTech, presented Trentino development in research and business development, wide perspective of GraphiTech; Stefan Noll and Raffaele de Amicis, Managing Directors of Fondazione GraphiTech, presented an overview of GraphiTech and the actual project activities.

GraphiTech's research areas, with strong emphasis on interdisciplinary research and focus on the development of prototype applications, are:

- Interactive Graphics Systems
- Digital Technologies for Media & Streaming
- Digital Media Content Engineering
- Augmented Reality
- Collaborative Architectural Design
- Mixed Reality and Networked Audio – Visual Applications
- Technologies for the confidentiality of visual information
- New Generation Internet for visual communication
- Virtual Engineering

GraphiTech will utilize any form of technology particularly in the area of INI-GraphicsNet Stiftung, Istituto Trentino di Cultura, and Università degli Studi di Trento, as well as with other research centers or institutes, in furtherance with GraphiTech's objectives. The joint venture will benefit from the three partner's ideal combination of competences and resources which complement one another, and it will secure an optimum of synergy effects.

GraphiTech will gradually build up competence and capacity with the aim of making its technical possibilities available to commercial and private users in collaboration with the industry. According to the expansion plan, the staff number will be increased within a four-year period in line with the medium-term trend. The purpose of this collaboration is that GraphiTech will eventually dispose of sufficient competence and capacity to allow joint independent partnerships with national organizations and institutions from the industry, business, and science. Under these circumstances, GraphiTech will raise its profile through national and international research projects and industrial commitments in co-operation with INI-GraphicsNet, Università di Trento, and Istituto Trentino di Cultura.

A set of demonstrations was presented in GraphiTech's new labs, including Virtual Reality with two stereo projections, Mixed Reality with Camera Tracking of live objects, collaborative architectural design, live video conferencing to Germany, and visual programming of distributed service platforms.

The people of GraphiTech would like to thank all supporting sites for this event, including Provincia Autonoma Di Trento, ITC-irst, University of Trento, INI-GraphicsNet Stiftung, Fraunhofer IGD A2+A4+A9, Cybernarium GmbH, Comlogic GmbH, Advanced realtime tracking GmbH, Fraunhofer CRCG, AGENZIA per lo SVILUPPO S.p.A., CENTRO TECNOFIN SERVIZI S.p.A., and all other supporting people from the Business Innovation Center, Rovereto and Trentino.

Prof. Fausto Giunchiglia, President of Fondazione GraphiTech

Prof. Dr. -Ing. José L. Encarnacao, Vice-President of Fondazione GraphiTech

Stefan Noll, Managing Director of Fondazione GraphiTech

Raffaele de Amicis, Managing Director of Fondazione GraphiTech

Knowledge Media Design
The Computer Graphics Center establishes the Forum for Knowledge Media Design, thus strengthening the scientific basis for the development of innovative knowledge media.

In a modern information society, knowledge is the decisive factor for production. If you allow a gap to form, you risk losing your connection. Individuals, organizations and companies must therefore always remain up to date. But this process is becoming more and more difficult with the existing tools, because the quantity of information and the speed of distribution have increased considerably. The key question, therefore, is: how can data and information be transformed efficiently into knowledge?

Media play a key role in the knowledge design of the future. For example, innovative technologies enable human-machine interfaces which adapt themselves to the user, the user's tasks, the situation and the medium used. But technological developments alone are not enough. Visualization and the ability to engage in dialogue also demand creative and social competency. In order to develop ideal media for the generation, transmission, presentation and storage of knowledge, a large number of specialist fields are needed. These fields are being bundled together for the first time in the newly established Forum for Knowledge Media Design (KMD Forum).

»We want to achieve close cooperation between designers, computer scientists and all associated fields, such as the cognitive sciences,« explained managing director Dr. Stefan Göbel from the Computer Graphics Center in Darmstadt. In addition to innovative technologies and various sciences, the Forum wants to integrate design fields above all. With the opportunities offered by interactive storytelling, for example, users can influence the sequence control of a learning environment and, by doing so, can acquire knowledge in a hands-on way.

Knowledge Media Design is not restricted to special areas of application. On the contrary: the transfer and preservation of knowledge are central topics in many industries. The Forum initiators therefore place great value in working in both a theoretically sophisticated and an application-oriented way. This gives rise to an innovation cycle which continuously integrates the latest findings. The scientific goals and practical requirements are gathered together in a competence pool, which should evolve in the course of establishing the forum. »The KMD Forum aims to be the point of contact for all issues surrounding Knowledge Media Design as regards technology, design and theory,« Göbel said.

In order to make scientific discoveries and experiences useful in practice, the Forum regularly holds workshops, seminars and conferences. The goal of these and other activities in the area of training and further education is to establish Knowledge Media Design as an occupational field. The gap should also be bridged between science and industry. »We view the Forum as a link between research and application. This allows the relevant research results to be geared towards market requirements,« Göbel said confidently. A demonstration center, which is in the planning, should also support this.

The corporate charter of the Knowledge Media Design Forum was signed in the spring of this year by a high-caliber founding team: Prof. Dr. Udo Bleimann from the Institute for Applied Computer Science at Darmstadt University of Applied Sciences, Dr. Maximilian Eibl from the Social Science Information Center of the German Social Science Infrastructure Services, Sebastian Sauer from ion2s – buero fuer interaktion, Prof. Ulrike Spierling from Erfurt University of Applied Sciences, Prof. Peter Friedrich Stephan from the Academy of Media Arts in Cologne, Prof. Dr. Harald Reiterer from the University of Constance and Prof. Dr.-Ing. José L. Encarnação, Dr. Stefan Göbel and Herbert Kuhlmann from the Computer Graphics Center.

These experts in the area of knowledge media are also available as contacts within the Forum. Additional information on the Forum can be requested from the KMD office:

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URL: http://www.kmd-forum.de

Researchers and Students at INI-GraphicsNet

Due to its international nature, the INI-GraphicsNet is obliged to a long tradition of exchanging researchers and students. Visitors in research and academia from all over the world have been hosted in INI-GraphicsNet institutes, which are adjoined to local universities and participate in university research, teaching and life. The Portuguese Centro de Computação Gráfica (CCG) is related to the University of Minho, CAMTech in Singapore to the Nanyang Technological University (NTU) and CRCG in the US to RISD and Brown University. The German institutes are adjoined to the University of Rostock, the Technische Universität Darmstadt and the Johann Wolfgang Goethe-University in Frankfurt (Main). Recently several new institutes joined the INI-GraphicsNet. VICOMTech in San Sebastian/Spain, NEMETech in Seoul/Korea and GraphiTech in Trento/Italy. And of course not to forget the new partnerships with the affiliated universities. These are the Universidad del País Vasco Euskal Herriko Unibertsitatea (University of the Basque Country), the Ewha Womans University in Korea and Università degli Studi di Trento in Italy. Student exchange programs between IGD and CRCG in Providence or CAMTech in Singapore directly support the exchange of students between these institutes. This way it's very easy and much less bureaucratic for students to get financial support. But of course there are other possibilities to get funding for exchanges where non of these internal exchange programs apply. Several hints on how to find these scholarships can be found on the studINI Web Site *(http://www.inigraphics.net/students/studini/index.html).*

Of course the student exchange appointee will assist you too, if you have further questions. Another good starting point for a search for scholarships is *http://www.daad.de.*

Marie Curie Fellowships for example provide European placements for pre and post-doctoral researchers, usually up to the age of 35, and for experienced researchers. Last December the first calls for proposals under the 6th framework have been published. Individuals may have a look at *http://europa.eu.int/comm/research/fp6/mariecurie-actions/action/fellow_en.html* to find the actual proposals and the deadlines for applications. The time for the application for some of the programs ends at the 12th or 18th of February in 2004.

While Marie Curie Fellowships are targeting experienced researchers, there are other funding opportunities for internships. The Leonardo Da Vinci program for example supports exchanges for internships within Europe. Due to the increased number of INI-GraphicsNet institutions within the European community, this program seams to be very promising. In corporation with the Fraunhofer IIS we are able to offer several of these Leonardo Da Vinci Fellowships, which makes the process of applying for it easier and faster for the applicant. Stay tuned for more information on that subject on the studINI website mentioned above. And of course, contact studini@igd.fhg.de for information on availability and for assistance with the application.

Additionally there are some new calls for application for PPP projects, programs for the exchange of persons in predefined projects. These programs are offered by the DAAD and are available for a special exchange country and typically a German project partner. More information on that subject you can find at *(http://www-zv.upb.de/~eb/neu%20eu%20web/ppp.htm)* (in German)

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ALUMNI

Addressing former staff members of INI-GraphicsNet:

The INI-Graphics-Alumni Forum

is a meeting-place and pool for former staff members of the INI-GraphicsNet. If you wish to become a fellow member please contact:

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Andrzej Trembilski
»Naturalistic methods for the visualization of meteorological data in augmented video«
June 10th, 2003
Supervisors:
Prof. Dr.-Ing. José L. Encarnação,
Prof. Dr. Müller (Uni Koblenz)

Numerical weather simulation models, like these of the German Weather Service (DWD), produce twice a day large quantities of simulation data, which must be visualized for the presentation on television. Special weather phenomena, which occur only locally, would disturb and are not desired or implemented in such a general view in today TV shows.

The requirements change as soon as one tries to make a local weather presentation. They result from the combination of the techniques of Augmented Video and Scientific Visualisation. If weather visualisation should be integrated into a video film, the schematic, global representation of the clouds is not longer acceptable. On the one hand the spectator can compare the artificial clouds with the genuine world presented in the video. Any break in the representation diverts from the actual information and irritates the spectator. On the other hand only a realistic cloud representation yields understandable weather forecasts. The actuality of the data in the presentation is an important restriction for the selection of the visualisation methods.

This work presents efficient methods to generate Augmented Video visualisations from weather forecast data. Several presented algorithms include the naturalistic generation of clouds and sky for the automatic insertion into the video sequence. Another part of the work deals with manipulation of the video sequences themselves for a better integration of the computer generated parts of the image and the mapping of the sky colours at the video sequence. The introduction of a general model for the visualization in augmented video closes the work.

Andrzej Trembilski celebrates his graduation

Sven Gürke
»A new approach for model-based restoration of teeth«
April 28th, 2003
Supervisors:
Prof. Dr.-Ing. José L. Encarnação,
Prof. Dr. Sakas

Modeling of the occlusal surface of teeth is an important problem in computer-aided design of dental restorations. The designed shape must fit the existing individual anatomy of the patient. Also, the design process must be fast to be practical in clinical applications. To fulfil these requirements a new technique for automatic adaptation of the occlusal surface for the restoration of teeth has been developed. By introducing free function assignment in the control points and an dimensional independency the basic concept of geometrically deformable models has been generalized. The presented approach handles also the problem of model generation und interactive model modifications. Further tests on synthetically produces images and real medical records proved its accuracy and many-sidedness.

Sven Gürke celebrates his graduation

STUDY & DIPLOMA THESES

»System architectures for interactive storytelling«
Diploma thesis by: Schmidt Andrea
Supervisor: Iurgel Ido

This thesis offers a detailed overview of systems for interactive stories and evaluates their approaches. Possibilities for taking over successful solutions from these systems and using them for the Art-E-Fact project of the EU were also explored. It was shown that at least two approaches could be used at a profit for this project in order to create adaptive, coherent and exciting stories algorithmically.

»Sketched-Based Interfaces in the Context of Geographic Information Systems«
Diploma thesis by: Tam Huynh
Supervisor: Thorsten Schulz

Interaction with today's database systems is largely text-based. While this kind of interaction is suitable for retrieving textual data, it poses problems when trying to describe spatial data. In a geographical context, for instance, people usually have a clear picture of the scene or location they are interested in. Translating this »mental image« into a text-based language like SQL seems unnatural and is likely to cause loss of information.

This work investigates a new kind of interaction with geographical information systems (GIS) in which the user formulates a query by sketching a scene of interest. Sketch-based interaction is intended to complement traditional forms of interaction. The focus of this work was on the design of the interaction with a sketch-based system, as well as the low-level analysis and structuring of the input. To this end, a prototype was designed and implemented. Strokes of the user are grouped into objects according to measures of spatial and temporal proximity. Features such as position, orientation and speed profiles are determined for each object. They serve as the basis for the identificaton of meta-data such as handwriting and direction indicators. In addition to that, topological and directional relations between objects are computed and visually similar objects are grouped into composite objects. The result of the analysis is a hierarchical model of the user's sketch that can be viewed, navigated and edited. The extracted data can be exported to an XML format for easy reuse in subsequent processing steps.

»Conception of an organization to support the inter-organizational knowledge transfer«
Diploma thesis by: Elisabeth Merlau
Supervisor: Anja Hoffmann

The thesis contains the conception of an organization to support the knowledge transfer between different companies. The conception has been made exemplary for the KMD-Forum (Forum for Knowledge Media Design). By offering possibilities for information, communication and cooperation, the Forum enables members of different organizations to acquire external knowledge. As the knowledge is stored in a central pool, every member can get many times more knowledge than he has put into the pool himself; therefore every member may profit by the mutual knowledge transfer. Moreover, new knowledge will be created by cooperations and joint activities.

The conception is based on the results of an online-survey of potential members. Moreover, it considers the different motives of members in organizations and the creation of corresponding incentives.

The KMD-Forum will be realized as a hybrid organization; the activities will take place on a physical basis in the form of events as well as on a virtual basis via an internet-platform. Both forms of presence offer specific advantages, whose combination enables the creation of a wide range of services. Within the scope of events, also the informal knowledge transfer will be supported particularly by the establishment of Talk Rooms.

Besides the knowledge transfer, the KMD-Forum aims at the establishment of the new discipline Knowledge Media Design as well as at the development of new methods concerning interdisciplinary teamwork.

The successful operation of the Forum depends on the active contribution of its members which will be supported by giving them the right to influence decisions concerning topics and activities. Moreover, the active contribution will be encouraged by implementing a bonus system which enables the members to collect bonus points for their busy participation. The compensation will take place in form of special offers and appreciating arrangements.

Finally, a guide containing the necessary activities to realize the Forum is presented.

»Hybrid Texture Synthesis«
Diploma thesis by: Nealen, Andrew
Supervisor: Alexa, Marc (DGM)

Patch-based texture synthesis algorithms produce reasonable results for a wide variety of texture classes. They preserve global structure, but often introduce unwanted visual artifacts along patch boundaries. Pixel-based synthesis algorithms, on the other hand, tend to blur out small objects while maintaining a consistent texture impression, which in return doesn't necessarily resemble the input texture. In this thesis, we propose an adaptive and hybrid algorithm. Our algorithm adaptively splits patches so as to use as large as possible patches while staying within a user-defined error tolerance for the mismatch in the overlap region. Using large patches improves the reproduction of global structure. The remaining errors in the overlap regions are eliminated using pixel-based re-synthesis. We introduce an optimized ordering for the re-synthesis of these erroneous pixels using morphological operators, which ensures that every pixel has enough valid (i.e., error-free) neighboring pixels. Examples and comparisons with existing techniques demonstrate that our approach improves over previous texture synthesis algorithms, especially for textures with well-visible, possibly anisotropic structure, such as natural stone wall or scales. Additionally, we extend the basic algorithm by an augmented patch-overlap error-metric based on frequency and feature distance. And finally, we enhance the speed of the pixel synthesis stage with hardly any visual drawback and intuitive user-controllable trade-off parameters.

International Certificate Program for New Media

Introduction
The International Certificate Program for New Media is offered by *imedia* (*The ICPNM Academy*) in collaboration with the INI-GraphicsNet Foundation, the Rhode Island School of Design, the Technische Universität Darmstadt, and a consortium of reputable universities world-wide. It is targeted towards post-associate-level university students and early to mid-career professionals.

- Participants benefit from a rigorous and comprehensive five-month course of study in the technological, visual arts, and business aspects of new media, with an additional four-month practicum period spent working on real-world projects.
- The program offers a sequence of learning experiences that encompasses a broad spectrum of knowledge and theory regarding the design, use, and applications of new media.
- Participants choose practicum projects based on their special interests and desired location; working on ongoing research projects at *imedia*, with Providence-area industry, or at their home institution or company.

Program Outcomes
Core competencies, which are developed through successful completion of the program, include both content and process outcomes.

Content competencies include:
- 3D Modeling
- 2D and 3D Animation
- Multimedia Design and Production
- User Interface Design and Development
- Web Page Design: Tools and Techniques
- Electronic Commerce
- Fundamentals of Interactivity
- Fundamentals of Video for Multimedia Production
- Introduction to Audio for Multimedia and the Web
- Cross-Media Publishing
- Creative Marketing

Process competencies include:
- Multicultural and Multidisciplinary Team Building/Learning
- Design As Process: Problem Identifying/Solution Seeking
- Communications: Processes and Products
- Technology Evaluation and Integration
- Project Management in the Media and Communication Industry

Program Details and Cost
- The program runs twice a year for nine months, with a Fall session (September-June) and a Spring session (April-December).
- Instructional modules are: Foundations in Design and Technology; Structured Multimedia; Live Websites; 3D Worlds and Virtual Reality.
- The four-month practicum can be completed at *imedia*, INI-GraphicsNet Foundation member institutions, through internship with local Providence industry, or at the home institution or company.
- The tuition for full registration amounts to approximately U.S. $21,000, covering the whole nine-month program, and including the purchase of a high-end, fully-loaded laptop.
- If desired, participants may enroll for the five-month instructional period only, but will not receive a certificate.
- Participants are responsible for all tuition and miscellaneous costs in full. However, *imedia* (The ICPNM Academy) and the collaborating universities will provide any documentation necessary to support the participants' search for external funding.
- Registrations are accepted as early as six months before the start of each program cycle, and space is limited.

Prerequisites: Two years of successful university study and fluency in the English language (documented by corresponding TOEFL scores) are required. Beyond these, no special skills are needed, but experience with computer-based applications is assumed, as is a basic understanding of the Internet, HTML, programming constructs and math terminology.

For more information and to request registration forms, please refer to URL http://www.icpnm.org

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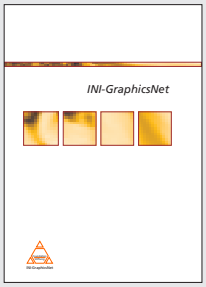

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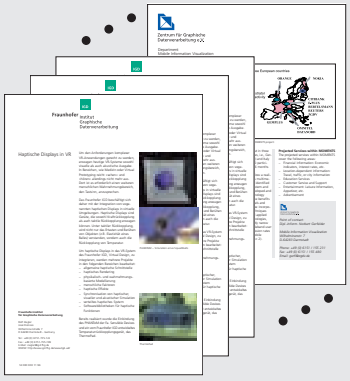

Datasheets (Prototypes)

Periodicals and brochures

- ❒ Annual Report of the Technische Universität Darmstadt TUD, Interactive Graphics Systems Group, TUD-GRIS (annually in German)
- ❒ Annual Report of the Computer Graphics Center, ZGDV (annually in German)
- ❒ Annual Report of the Fraunhofer Institute for Computer Graphics IGD (annually in English/German)
- ❒ Selected Readings in Computer Graphics (annually)
- ❒ Seminar Program (twice a year in German)
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- ❒ Thematic Brochures (as of April 2003)
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Computers & Graphics

The oldest international journal specialised in systems and applications of computer graphics

Computers & Graphics provides a medium for the communication of information concerning graphical man/machine interaction and the applications of computer graphics. The emphasis of the journal is on interactive computer graphics using CRT-type consoles and manual input devices such as light-pens, tablets, and function keyboards, and, within this scope, on graphical models, data structures, attention-handling languages, picture manipulation algorithms and related software.

The Editor welcomes papers dealing with applications of current interest, including, but not limited to:

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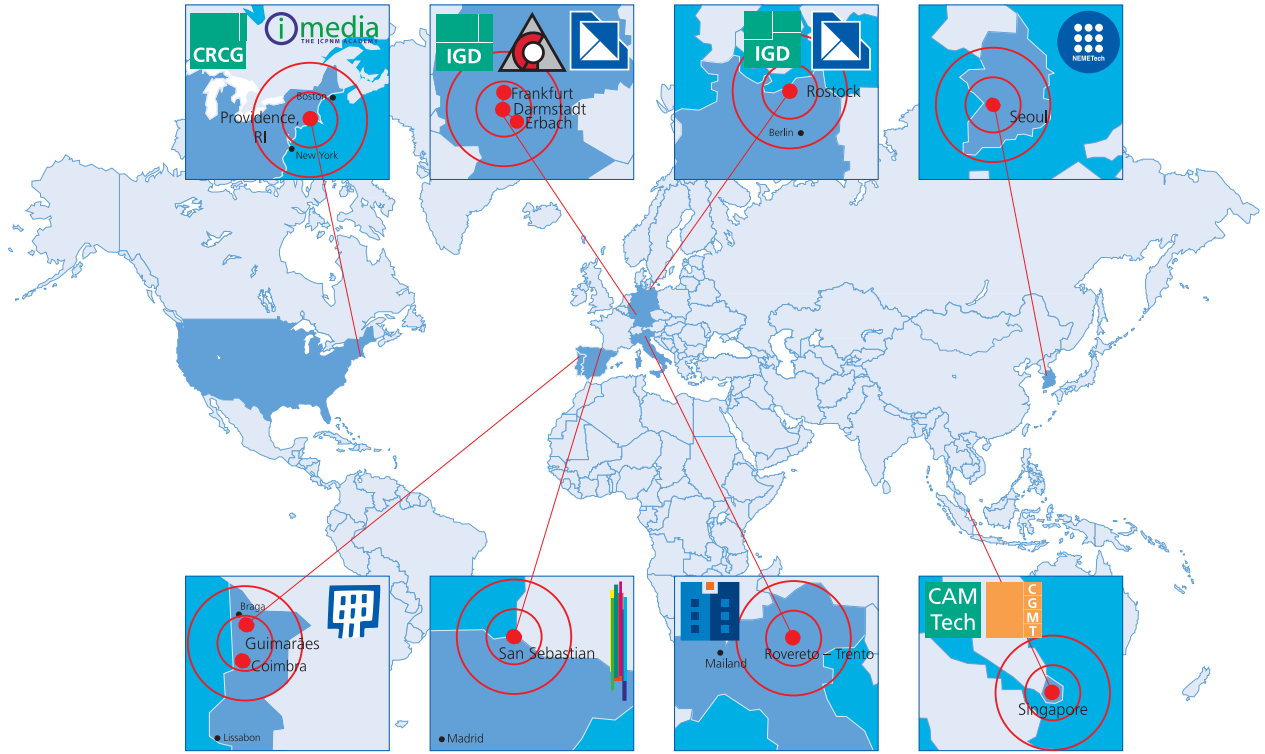

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