Tutorial Notes

Tutorial T8
Adaptive Graphics Generation in the User Interface

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Abstract

Advances and breakthroughs in the area of computer graphics have made visual media a major ingredient of the modern interface, and it is for sure that graphics will significantly influence the way people communicate and interact with computers in the future. On the other hand, powerful graphical user interfaces cannot be implemented without considering knowledge of the domain, user, task and the peculiarities of human communication. Within the AI community there is the vision of so-called intelligent interfaces with advanced communication skills. Thereby, the attribute "intelligent" refers to the ability to flexibly adapt the way how information is presented to the user as well as the way how the user can interact with an application through the interface. Such adaptive interfaces are advantageous since they can accommodate for a broad variety of different users with varying needs and preferences. To take advantage of both - adaptivity and the power of visual expressiveness – we have to go beyond the standard graphic pipelines since higher-level design tasks must be addressed as well.

The tutorial aims at providing a comprehensive overview of state-of-the-art approaches in the field of automated graphics generation for various types of applications. The tutorial is structured as follows:

Part 1 addresses the role that graphics may play in the next generation of user interfaces. Here we will take a closer look on some of the most popular visions for a post-GUI era. Part 1 concludes with the observation that there is a strong need for mechanisms which are able to generate graphical presentations on the fly in order to customize them for individual users in a broad variety of tasks and modes of interaction. Finally, Part 1 introduces the concept of an automated graphics generator and provides a short overview of potential application areas, the different roles that an automated graphics generator may play, and some general characterization criteria for such systems.

Part 2 elaborates on basic issues that must be addressed when dealing with the graphical presentation of information. When using graphics as a means of communicating information, it is quite useful to borrow concepts from the area of linguistics and rely on the classical distinction between syntax, semantic and pragmatics - but adapt it to the case of graphics. On the syntactical level, graphical presentations can be conceptualized as compositions of (possibly modified) graphical objects whereby the visual appearance of the objects as well as the compositions are governed by certain (syntactical) rules. However, what should be considered a graphical object, and what are eligible modifications and compositions is always a matter of granularity and also depends very much on the particular graphical genre. For instance, in the world of abstract presentation graphics, the graphical objects may be bars, axes, circle segments, markers, etc., whereas icons or projections of 3D objects may become the constituents of graphics that illustrate the maintenance of physical devices. The semantic dimension addresses the question of what information graphical objects and their compositions encode, and how such encodings can be represented. The communicative role that a graphics (and its parts) can play in a communication is addressed at the pragmatic level. By introducing some communication-theoretic structuring principles, it is shown how this dimension of graphics can be approached as well. For the sake of generality, Part 2 presents a variety of different approaches in order to compare them with regard to syntactic, semantic and pragmatic aspects.

Part 3 deals with the notion of "design as a product" In this view, design is regarded as the outcome of a construction process. In order to evaluate designs according to some quality measurements, expressiveness and effectiveness criteria are introduced. By means of examples, several methodological approaches are presented and discussed.

Part 4 focuses on "design as a process". In fact, there is a variety of different approaches that may be used for the automated design of graphics. This part of the tutorial provides an overview on approaches that have been developed for automated graphics generators, and discusses their particular strengths and weaknesses. For example, a rule-based composition seems to be a good choice for the design of abstract presentation graphics since this task is driven by the underlying structure of the data. On the other hand, a hierarchical planning approach seems to be more adequate in case of an abstract presentation goal that needs to be decomposed and refined into more elementary tasks to determine a concrete graphical design. Part 4 also addresses the issue of how to represent design knowledge in a computer system.

Part 5 presents a number of selected showcases and systems representing different graphical genres and application fields. The first examples illustrate the notion of interactive graphics. The use of graphical representation in a tele-cooperation environment is also addressed. Furthermore, Part 5 presents examples of multimedia generation systems. The motivation for the development of such systems is based on the observation that graphics is often used best in concert with other presentation media. A special instantiation of such multimedia generation systems are systems that rely on life-like presentation characters. Here, graphics generation comes into play for two different purposes: the generation of the graphical presentation material as well as for the design of believable character animation.

Acknowledgement

Working in the field of automated graphics design for almost ten years, the author of this tutorial has profited much from various personal conversations with experts in the field as well as from a lively exchange of documents with them. Some of the illustrations used in the tutorial are taken from these documents (see indicated sources). The author owes thanks to all of them.

Bibliography of the instructor

Dr. Thomas Rist is a Senior Scientist at the department Intelligent User Interfaces of the German Research Center for Artificial Intelligence (DFKI). He studied computer science and mathematics at the University of the Saarland. In his doctoral thesis he developed a knowledge-based approach for the automatic generation of 3D-graphics common in instruction manuals for technical devices. Since 1989, he has been a member of the Intelligent User Interfaces group at DFKI GmbH. His areas of experience include knowledge-based graphics, intelligent multimedia systems, life-like interface agents, and AI techniques. He was involved in various projects funded by the German Ministry for Education and Research, the European Union, and industries. One of these projects, WIP, was a winner of a 1995 Information Technology Award (ITEA). As a Senior Scientist he was also in charge of management tasks in a number of industrial projects. He is currently manager and project leader of the European Long Term Basic Research Project "Magic Lounge" within the so-called i3 initiative on Intelligent Information Interfaces. He is also actively involved in the European project Puppets (virtual puppet theatres as an environment for early learning), Fluids (multimedia interfaces for decision support in telematic applications), the TMR network TACIT (theory and application of continuous interaction), and the nationally funded project AiA (animated interface agents for personalized infobahn access).

Together with members of the ERCIM Computer Graphics Network Task II Group, he launched an initiative towards the development of a Standard Reference Model for Intelligent Presentation Systems. He was the organizer of various workshops in the field of intelligent multimedia, graphics and user interfaces (among others at ECAI'96, JJCAI'97, ACL'97, ECAI'98, i3 Spring Days'99). Dr. Rist has served as a program committee member for national and international conferences and workshops (among others, Advanced Visual Interfaces'96, Tagung für Simulation und Animation'97, 98, 99). He was chair of the i3-Spring Days'99 conference, and is currently a member of the i3 Coordination Group.

Dr. Rist has authored and co-authored over 80 technical papers for journals, conference proceedings and workshops in the area of intelligent user interfaces, knowledge-based graphics, adaptive presentation generation, and life-like interface agents. He has taught courses at the University of Saarbruecken on knowledge-based graphics, intelligent interface agents, and multimedia systems. He also delivered presentations and invited talks on the subject of this tutorial at several conferences, e.g. at ECAI, AAAI, HCI, MMM, Simulation and Graphics.