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PRECONFERENCE

PROCEEDINGS

ADVANCES IN COOPERATIVE COMPUTER-ASSISTED ENVIRONMENTAL DESIGN SYSTEMS

(Focus Symposium, August 18th)

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Preface

It is often stated that the technological advances in computer hardware have greatly exceeded developments in computer software over the past two decades. For example, in respect to CAD software even the most sophisticated current (i.e., mid-1990s) commercial offerings incorporate primitive and inadequate representation facilities, and are incapable of integrating more than a single agent into their operational environment. This, despite the fact that approaches for solving the representational problem and methods for coordinating multiple agents have been developed and demonstrated in the research environment for at least a decade. While it is true that these CAD models have been tested only as prototype systems they were sufficiently mature, already a few years ago, to provide a solid basis for commercial development.

The software industry is driven primarily by consumer needs and, therefore, depends on users to vigorously and clearly articulate their requirements. In other words, major advances in applications software are more sensitive to economic and social forces, based on consumer understanding and expectations, than technical progress. However, human society tends to evolve relatively slowly. Opportunities generated by technical advances are not necessarily realized when they first occur, but often remain virtually dormant for years until conditions are conducive for promoting change. For example, while the underlying technology had been available for several decades, FAX transmission did not become established as a major communication medium until the late 1980s.

In the fields of engineering and architectural design, and similar complex problem areas in planning, management and economics, the need for more sophisticated decision-support facilities has begun to be recognized only recently. Diminishing resources and increasingly global involvements are strong catalysts in this regard. Decision makers, whether they are designers or managers, find themselves under increasing pressure to adapt to dynamic changes in the parameters that define their problem situations. At the same time, the quality of the product of the decision making process is coming under greater scrutiny. These factors are creating a demand for integrated software systems that facilitate timely access to distributed information sources, and extend the expertise and functional capabilities of the human decision maker. It is likely that multi-agent, knowledge-based systems will increasingly fill this demand.

It is therefore not surprising that since the inception of this series of focus symposia in 1990, under the umbrella of the annual InterSymp Conference, we have seen the emphasis shift decisively toward cooperative computing solutions. Again this year, in the 1995 Symposium Proceedings, by far the majority of papers address either fundamental issues related to cooperative computer-assisted design systems or describe the design and implementation of experimental prototypes.

Session 1 papers deal with design knowledge and its representation in computer-assisted design systems. Several authors draw attention to the dynamic nature of design knowledge and the importance of user-computer interaction in the computer-assisted design environment. High level object representation capabilities emerge as the critical requirement for meaningful computer-based design assistance.

Session 2 papers address a fairly wide range of issues dealing with some technical system implementation matters, such as inter-agent message-passing facilities and neural networks, but mostly present innovative proposals for cooperative design system implementations.

In Session 3 the focus is on computer-based design assistance tools in domains such as building lighting, environmental noise, energy conservation, and regional planning utilizing GIS facilities. The final paper in this Session describes a High Speed Train simulation system developed at the Delft University of Technology in the Netherlands.

Session 4 starts with collaboration and ends with educational opportunities and related issues. The former papers describe design collaboration involving integrated networks of human designers utilizing computer-based information systems for facilitating communication. In this context a distinction can be drawn between `cooperation' and `collaboration'. Collaboration assumes a high level of coherence among individuals as the group pursues a common goal. Each individual member of the group has some knowledge of the global solution objectives. Cooperation, on the other hand, has less stringent requirements for intellectual coherence and shared knowledge. The individual members of the group cooperate by carrying out their individual tasks without necessarily having knowledge of all contributions to the project.

It is perhaps important to keep this distinction between cooperation and collaboration in mind when comparing some of the systems with multiple computer-based agents presented in Sessions 2 and 3 with the collaborative design team proposals of Session 4.

Jens Pohl **June 16th, 1995**

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SPECIAL FOCUS SYMPOSIUM

Cooperative Computer-Assisted Environmental Design Systems

August 18th, 1995

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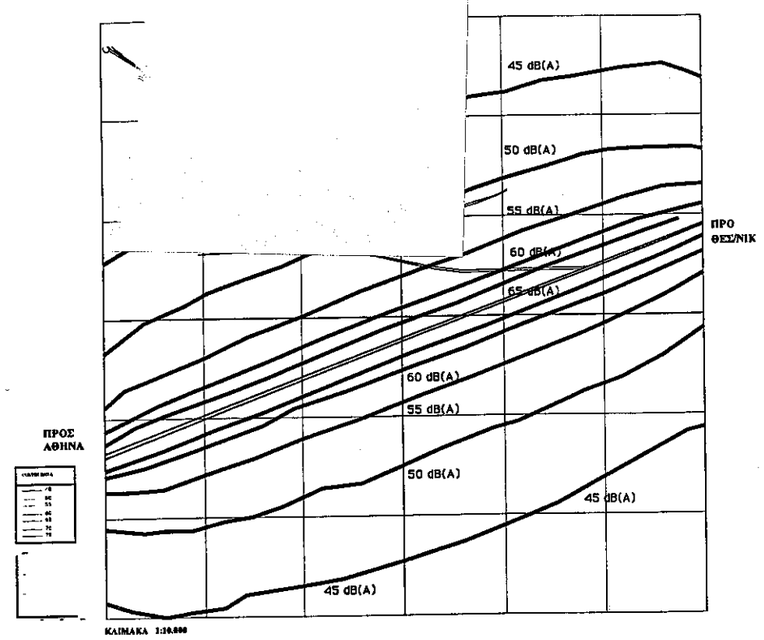
Design Knowledge and Representation



Picture 6. Sound level curves displayed through polylines in layer "CUR".*

GIS AS THE URBAN ENVIRONMENTAL-DESIGN ASSISTANT

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Abstract

Recent IT (Information Technologies) applications to architecture and urban design show the possibility to enhance the designer work making all the necessary information available at the same time. It means that He/She is virtually working on real world simulation.
The paper suggests the conceptual representation and analysis of the town environment supported by GIS/CAD integrated tools.

Particularly the methodology for town-modelling using GIS technologies is demonstrated. Through the methodology the designer is able to select strategically relevant environmental problems to be solved by new projects and town management decisions.

System architecture and user interface definition are critical phase of a GIS project application to urban design. Data sources inventory, standards and technical facilities available on site as well as the operational procedures applied and the correct design of the user interface are the basis for a successful project. Also new possibilities are done by networking and telematics especially in work-group and cooperative design mode.
References related to up-date literature, magazines, Internet sources are also indicated.

Keywords
Geographical Information Systems, Application Conceptual Analysis, Urban Environment, Design, Management.

Introduction

IT technologies and procedures allow today the possibility to really bring into practice co-operative computer-assisted Environmental Design Systems (EDS).
What that really means in terms of environmental design procedures have been not well conceptualised and it is not really clear: fistly because each one of us probably refers todifferent scale of problems and also about different software application types.
The IT areas in which we are interested to this aim, as architecs and engineerings, are mainly CAD (Computer Aided Design) and GIS (Geographical Information Systems). The big difference between these SW environments approach is that in the first case one defines a model to be phisically created in the real world (carrying out a project) while in the second case one defines a model of representation (using an abstraction process) of what phisically already exits in the real world. We could simply say that GIS functionalities are more dedicated to the analysis of the urban environment as well as CAD functionalities supports the simulation of new entities.
Futhermore the interest of both CAD and GIS experts are focusing their interest on common architecture (client server, high-speed networking), common software tool areas (intelligents agents, object oriented data bases) and new data sources (GPSs, remote sensing images).
That probably means that these SW environments are going to be more and more integrated in the future because of several common new technologies will drive growth in the CAD/GIS market.
But the techological trends forecasting seems to be today too difficult because of several key market uncertainyties exists.

1-The Crisis Of The Project-Scale Concept

The necessity to correctly practise the abstraction process allows, for the GIS analyst, the importance of an accurate analysis of each applicative case aimed to structure the reference framework model (AGI, 1995). Practically during the analysis process should being selected the data classes and the level of accuracy of data sets requested by EDS.
Very often in this phase there is lack of model structuration and the result it is not sufficient to guarantee the effectiveness of the computer aided analysis process of the urban realty.
We observe that recent GIS applications to urban environment design/management show how to enhance the designer work possibility making all the necessary information available at the same time. It means that He/She is virtually working on a real world simulation aimed to the specific problem analysed.
From the GIS point of view is practically non-influent the scale one is working: only changes the type and quality (accuracy) of data one could access. The CAD archive, also no-scale generated, could be transparently integrated and being one of the information resources for details.
In fact the digital data representing the elements of a project in a CAD as well in a GIS are no-scale data because of the entities are measured in real scale and being only represented at a specific scale.
Furthermore the geographical entities forming the project's background are geo-referenced in GIS environment, not related to the map boundary, but to their position on the earth surface in term of geographical coordinates. Practically the traditional approach by dimensional scales is criticizable because it is a very limited model of the real world compared with the possibilities offered by these integrated tools. One of the consequences, in theoretical term, is also that the traditional break between architectural scale and urban design scale could be also be criticised.

2-The Urban Environment Model Definition Using Gis

Recent European Community documents (CEC,1990) points out some strategic areas, we could call them layers, of the urban model to be developed into specific reference models:

I-Air quality
II-Water quality
III-Built and town nature environment quality
IV-Transportation quality
V-Waste management
VI-Noise environment quality

This scheme have been followend in some urban specific GIS applications (Boehner & Esposito, 1995) and trough a European Concerted Action [1] trying to exactly define layers' data sets and procedures of different source data integration and utilisation. The definition of a reference model for specific applications is also the principal topic of research of the ET (Environmental Team) recently founded by a group of University researchers in Firenze. [2]
The urban environment framework could be built through GIS on this basis, starting from two very simplyfied parts:

[1] CEC-Environment Program, Space Techniques for Environmental Monitoring, S.I.S.T.E.R.S Project, Leader Nuova Telespazio/Università degli Studi di Firenze-DPMPE/LIS et Alii, 1995.
[2] Founded in 1995 the group is leaded by prof.P.A. Cetica and it's mission is to support the Public Administration to improve and manage the urban environment quality.

A-the geo-model based on three classes of main elements: impervious elements (i.e.built environment), soil elements (i.e.bare soil, idle land, etc.) vegetation (i.e.parks, green surfaces, forests, etc. (Ridd & Dudley-Murphy, 1992)
B-the urban-systems model based on an open list of layers (CEC, 1990) containing various classes of data and attribute as described above.
The data belonging the element A and the element B could be related in many ways through GIS query and analysis functionalities: such kind of selection and overlay procedures defines the representation (reference model) of one specific urban problem for example related to built and natural environment in the town (Esposito, 1995/2; Boehner 1995/2).
This studies are based on 4 main targets:

i)-DATA: to detect and understand the types of data used, both Eo (Earth Observation as well as ground data associated), instruments suited for urban information extraction, manipulation and integration of data in GIS structures;
ii)-USERS: to detect the possibility of an improvement of co-operation between users belonging to different community (e.g.climate research, agriculture, coastal ad marine studies, etc.) for environmental purposes, with the goal of achieving a greater use of EO data in Urban Environment applications;
iii)-TOOLS: to describe the state of the art of generic tools and techniques actually adopted for pre-processing and interpretation of data EO as well as ground data . Furthermore both visible/non visible data integration in GIS with particular attention to the possibility of suggest multiresolution and multitemporal merging capacity shuold be marked in actual application analysis. Also AI (Artificial Intelligence) techniques where applied will be underlined in his potentiality for the enhancement of urban information;
iv)-TECHNOLOGIES and QUALITY: to detect world-wide technologies risen from base research and interesting for better planning of field measurements and ground gathering campaigns and show procedures actually used for calibration and validation of data. Studies are going to be referred to three different data acquisition levels and accuracy: EO; Aeroplane and Ground data.

Particularly the methodology for town-modelling using GIS with traditional and EO data has been demonstrated applied to the city of Firenze (Italy) where an application model has been studied with the objective to detect, evaluate and visualize the natural elements such as trees and green surfaces in the town environment. (Esposito & Boehner, 1995)
Through the methodology the designer is able to select and overlay relevant data to create the composite visualization of the analysis with traditional 2D as well as animated 3D flys. This procedure could be used to simulate the actual consistency and effects of the green system compared with other visible data (geographical data) and non-visible data (citiziens attributes, services, etc.).
Such kind of procedure allows one to define what-if scenarios of the environmental problems to be solved by new projects and town management decisions.

3-How To Define The System Architecture And Interface

System architecture and user interface definition are critical phase of a GIS project application. Data sources inventory, standards and technical facilities available on site as well as the operational procedures applied and the correct design of the user interface are the basis for a successful GIS project.
Following this methodology an application has been developed at DPMPE/LIS [3] in a degree thesis [4] on the the green elements of the city of Firenze using real data belonging to the DB of

[3] with the support of CEC (Commission of European Communities)-JRC/ISEI (Joint research Centre/ Insitute of Software Engineering and Informatics).
[4] student Christiane Boehner, tutors Pier Angiolo Cetica and Maria Antonietta Esposito

the Assessorato all'Ambiente/sezione Verde Pubblico and Assessorato all'Urbanistica of the Comune di Firenze. The application objectives were to define procedures related to:
-different sources data import
-alphanumerical and geographical data integration
-remote sensing data integration
-software development/customisation for import, queries, overlay and plot
-GUI (Graphical User Interface) development
-user form-menu definition
-on-line help creation
Future developments of the methodology will also study the new possibilities done by networking and telematics especially in work-group and cooperative design mode, as allow recent studies (Pohl &Myers, 1994), and the integration of suited DSS (decision Support Systems) environment integration (Cetica, 1991a; 1991b; 1992) .
Then a question rises: are the traditional data bases adequate to spatial data handling by many contemporary users? these aren't ? The anwswer is not, because commercial database developers have just a low interest in develops DBMS suited for complex data models and large volumes of data as the matter in GISs (Gartzen, 1995). On the other hand GIS users ask for customised solutions every time different, effective, simple to use. The solution looks being in object oriented languages. This means again to be very carefull in the reference data model definition in each case: from that will depends the quality in terms of effectiveness of the application results by users audits.

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http://www.museum.state.il.us/1/research/GISLab
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