RETURN

DOCUMENTATION OF BRAZILIAN HISTORICAL TOWNS: HIGH TECH AT LOW COST
- Keynote Paper -

Hans-Peter Bähr[1], Luiz Ernesto Renuncio[1,2], Steffen Landes[1],
Carlos Loch[2], Lilian Simon[3], Isabel Cristina Braga[2]

[1] Universidade de Karlsruhe
Instituto de Fotogrametria e Sensoriamento Remoto - IPF
Englerstr. 7, D-76128, Karlsruhe - Alemanha
e-mail: renuncio@ipf.uni-karlsruhe.de
e-mail: baehr@ipf.uni-karlsruhe.de
e-mail: landes@ipf.uni-karlsruhe.de

[2] UFSC - Departamento de Engenharia Civil
Laboratório de Fotogr., Sensor. Remoto e Geopr.
Campus Universitário - 88040-900 - Florianópolis - SC
e-mail: ecv2icb@ecv.ufsc.br
e-mail: loch@ecv.ufsc.br

[3] FCC - Fundacao Catarinense de Cultura
11ª SR / IPHAN /SC - Instituto do Patrimonio Historico e Artistico Nacional
e-mail: lilian@iphan.sc.gov.br

KEY WORDS: historical urban ensembles, 3D urban models, cadaster, standardisation, CIPA

ABSTRACT

Documentation of cultural heritage is highly challenged by advanced digital technology. The dream of the experts involved might become true; i. e.: very fast data acquisition at acceptable precision and reasonable cost.

The realisation of these ideas requires straightforward use of standard digital components as digital cameras, advanced micro computers, standard software and standard data presentation models . As for the result, digital orthophotos seem to be more useful than the conventional line plans. This is particularly true for Historical Brazilian Towns, because colour plays an important role and, even more important, photorealistic facades open the link to multimedia applications.

A methodology based on these ideas was developed and tested in Laguna, a city of about 50.000 inhabitants of historical centre located at the coast of Santa Catarina (it marks the Meridian of Tordesillas). It has to be pointed out, that whole town ensembles deserve as much attention for preservation as single monuments, because they are generally much more endangered due to the very dynamic and often unsupervised change in urban environment.

The paper presents the data collection procedure in Laguna as well as the developed computer programs for orthophoto generation in colour. The system allows to „walk“ along the facades of Praca Garibaldi in Laguna and to investigate details selected by the user.

Another advanced tool which has already become a standard for global communication, is the Internet. Consequently, this technique is exhaustively used for data dissimination. The whole Laguna data set is available in the Internet:
(http://www-ipf.bau-verm.uni-karlsruhe.de/Personen/renuncio/laguna/modelo3d.htm).

It is an amazing fact, that all high-tech components mentioned lead to an economic, „low cost“ procedure. This is due to standard hard- and software and photorealistic results instead of special developments and line plans.

The big challenge now is the introduction of the technique into operational use by architects and town planners. It stimulates, after all, new applications, like for instance installation of spatial information systems. Examples are given for the University Campus Information Systems in Karlsruhe and Florianópolis. Opportunities for CIPA in this context are analised and systematically presented.

RESUMO

A documentação do patrimônio cultural vem sofrendo fortes evoluções em função de avanços na tecnologia digital. O sonho de especialistas envolvidos com a coleta, processamento e apresentação destes dados está próximo de tornar-se verdade: aquisição rápida de dados, com precisão adequada e a custos razoáveis.

A realização desta idéia requer aplicação intensiva de componentes baseados em tecnologia digital, como é o caso de câmaras digitais, micro computadores de última geração, softwares e padrões para apresentação de dados digitais. Como resultado, ortofotos digitais parecem ter mais aplicações do que planos convencionais lineares. Isto é particularmente verdade para conjuntos arquitetônicos históricos em cidades, onde a cor é um item de fundamental relevância, e mais importante ainda, fachadas foto-realísticas abrem espaço para aplicações em multimídia.

Uma metodologia calcada nestas idéias foi desenvolvida e testada em Laguna, uma cidade com aproximadamente 50.000 habitantes localizada na costa do estado de Santa Catarina (cidade que marca o ponto extremo Sul do Meridiano de Tordesilhas). Têm sido afirmado que conjuntos urbanos são merecedores de tanta atenção no que diz respeito à necessidade de sua preservação quanto monumentos isolados, pois normalmente encontram-se em situação de maior perigo em função de característica de mudanças dinâmicas em centros urbanos.

Este paper apresenta o procedimento para coleta de dados em Laguna, bem como os algoritmos computacionais desenvolvidos para a geração de ortofotos coloridas. O sistema permite “andar” ao longo das fachadas da Praça Anita Garibaldi em Laguna e investigar diferentes detalhes, selecionados pelo usuário.

Outra ferramenta avançada que tornar-se-á um padrão para comunicação global, é a Internet. Conseqüentemente, esta técnica está sendo extremamente explorada para disseminação de dados. Todo o conjunto urbano de Laguna está disponível na Internet para consulta:
(http://www-ipf.bau-verm.uni-karlsruhe.de/Personen/renuncio/laguna/modelo3d.htm).

É um fato impressionante, que todos os componentes tecnológicos apresentados anteriormente conduzem a um procedimento econômico, de baixo custo. Isto é resultado da utilização de elementos de hardware e software padrões e resultados foto-realísticos ao invés de aplicativos específicos e planos lineares.

O grande desafio agora é a introdução (transformação) destes procedimentos no dia-a-dia de arquitetos e planejadores urbanos. Isto estimula novas, como por exemplo a instalação de sistemas de informações espaciais. São dados exemplos para os Sistemas de Informações dos *Campi* Universitários em Karlsruhe e Florianópolis. Neste contexto, as oportunidades para a CIPA são analisadas e sistematicamente apresentadas.

1 INTRODUCTION

Historical urban ensembles require particular preservation same like monuments of cultural heritage. This is even more important as they are not yet fully recognised as outstanding exponents of socio-cultural development. Apart from this, being elements of everyday life, they are exposed to the natural dynamic and often destructive change of urban development.

This situation is particularly evident in Brazil. Here urban development is characterised by extremely dynamic changes (see Wehrhahn, 1998) involving the destruction of unique historical ensembles built during the last three centuries. Neither international awareness has awoken nor Brazilians themselves have fully recognised that the monuments are worth to be preserved. The problem becomes even more stringent because there are hundreds of historical nuclei distributed all over Brazil from the equator to the thirtieth latitude and it is materially impossible to preserve all of them as they stand now. This brings us to the urgency of documentation and the necessary discussion of future use in the context of urban environment.

The problem has a quantitative as well as a qualitative component. The international community has fully recognised that the documentation of this kind of urban elements would require hundreds of years of hard work if conventional techniques for documentation were to be applied due to the high cost and low speed of conventional procedures (Waldhäusl, P. 1992). Therefore, there are recommendations and resolutions demanding exhaustive application of novel digital techniques to this kind of problem. E. g., ISPRS recommends:

> *„... the formation of a Working Group to develop automatic close-range photogrammetric systems to extract models of objects and sites for applications in visualisation and virtual reality."* (Resolution ISPRS Comm.V, Vienna, 1996)

At this point we have to give our view of the terms "high-tech" and "low-cost". Both terms are relative, of course. As far as high-tech is concerned, we simply mean digital image acquisition, processing and distribution. As regards low-cost, digital photogrammetry has for many applications already shown to be considerably cheaper in many aspects than analytical or analog procedures (i.g. for orthophoto production). In connection with cost, the faster acquisition of data and the faster and easier processing should be mentioned.

2 AVAILABLE ADVANCED TECHNOLOGY

The above encountered problems have already existed for a couple of decades. It turned out that conventional analogue techniques cannot cope with the challenge since they are not able to significantly speed up the documentation process keeping costs low at the same time.

This situation, however, has dramatically changed with the application of digital technology which presents new options and sets new standards for every aspect of the above mentioned task, i.e., data acquisition, data processing and, fundamentally, data distribution.

We have to point out here that a change of tools as is the transfer from analogue to digital technology brought the problem into a new light and that, consequently, it must not to be expected that the products obtained through the latter should be similar to those traditionally obtained by application of the former.

To give an example: a new perspective that opens through digital processing is the extremely easy data distribution by Internet. This possibility has to be taken into account when digital documentation and processing of historical monuments is approached.

This fundamental feature cannot be stressed enough. It is important to become aware of the fact that new technologies not only will produce new products but that they open the way to unexpected further advantages as it is, in the case of digital technology the easiness of data transfer by Internet. For distribution of information about cultural heritage this is of particular practical and political importance.

In the following paragraphs the available advanced technology will be discussed in more detail.

2.1 Data acquisition

Fast and low-cost procedures for data acquisition of historical monuments have to be based on pictorial information. Besides the classical analogue photography, digital photography is becoming more and more operational. Finally laser scanning has proved to offer many unexpected advantages (Wehr, 1997) and may substitute camera-based image acquisition when multi-channel systems are available.

In this paragraph we shall concentrate, however, on the basic question whether digital cameras are the appropriate tool for data acquisition or if a hybrid system is to be preferred. By "hybrid" we mean a metric or a semi-metric camera with the resulting film being digitised.

The investigation which is the basis for this report started in 1995, and both alternatives have been thoroughly analysed. It turned out that generally speaking, there are obvious advantages and disadvantages on both sides (see Table 1).

FEATURE	HYBRID SYSTEM	DIGITAL CAMERA
Image format	+	--
Geometric Resolution	++	-
Geometric stability	+	-
Performance of colour	-	+
Digital archiving	--	++
Operability	-	++
Cost	-	+

Table 1: Comparison of the properties of a hybrid system (medium format photogrammetric camera: Pentax PAMS 645 together with a Microtek Film Scanner) and a digital camera (amateur: type: Polaroid, chip approx. 1 MB): ++ = very good, -- = very bad

Table 1 gives a summary of what has already been reported in a couple of publications (Bähr, 1998, Renuncio *et al*., 1998; Martins *et al*., 1998; Landes, 1996). Concluding, we may say that advantages and disadvantages of each of the systems have to be weighted in the light of the particular application. In the long run, however, there is no doubt that digital cameras of high performance will fully substitute hybrid systems. The main factor lies in the future availability of high-resolution chips starting from 16 megabytes.

2.2 Data processing

Like data acquisition, data processing was brought to new by digital technology. The overall impact of digital computers of all types is obvious and requires no comment. It should be mentioned, furthermore, that beside hardware, software components for image processing have inundated the market.

Photogrammetry of the analogue times used to be considered an "ultra-specialised tool" only accessible to the expert. This situation has radically changed due to the impact of 3-D virtual reality and the game market. No wonder, therefore, that photogrammetric applications have taken over what had been developed in other fields.

The following elements have been adopted in the course of a commom research project at the Universities of Karlsruhe and Florianópolis in order to set up a high-tech though low-cost system for mapping urban ensembles:

1. Personal computers *of the last generation*,
2. high-end graphic boards,
3. VRML language and
4. PhotoModeller image processing

The hardware and software design of the developed system is given in more detail by Landes (1999b) and Renuncio *et al.* (1998a).

It should be stressed that the tendency of photogrammetry is towards standard components which emerge from other applications, as mentioned. The use of standard systems opens the way to the design of standard procedures. Here we face one of the main bottlenecks in close range photogrammetry where due to the enormous scale of applications standardisation could not be pushed forward like in mapping. (see paragraphs 6.1 ... 6.3).

2.3 Data distribution

Data processing on the one hand and distribution of the documented data on the other must be considered as a single unseparable unit.

This is not generally accepted because in the "old analogue times" when data acquisition and data distribution were naturally separated because they were based on different techniques. Photogrammetrists considered this *separation* to be even a big advantage compared to conventional surveying. Today, digital data processing is the common tool for both data processing and data distribution.

It is has to be strongly stressed that it would be deadly for photogrammetry as a scientific discipline to restrict itself to the mere acquisition and processing of data while neglecting archiving and data distribution. In the course of the research project mentioned in 2.2 which forms the basis for this publication it became clear that the worth of documentation of urban ensembles is directly correlated with the capacity of data distribution.

Fortunately there is a common standard tool which allows global data exchange: the World-Wide Web technology. This goes together with new programming standards like JAVA and 3-D visualisation. The Virtual Reality Modelling Language (VRML) has been adopted as an Internet standard for 3-D visualisation by the International Standard Organisation (ISO) (see ISO, 1997). A future-oriented system for mapping urban ensembles has to take into consideration the advanced WWW-tools in order to integrate them into the system from the very beginning.

In paragraph five the consequences of these ideas are given in more detail.

3 LAGUNA, THE PILOT AREA

It was not by mere coincidence that Santo Antônio dos Anjos de Laguna settled in this place in 1767 (or 1784 according to some authors). The selection of the site had to be in accordance with the Portuguese tradition, which uses to consider diverse factors: the existence of a natural port sheltered against the strong winds and turbulent waters; its surrounding flat land band; a firm ground that allowed the construction of a village; easy and abundant water supply of good quality. A decisive factor was its strategical geographic position, on the imaginary Meridian of the Tordesillas Treat, in order to guarantee the limits to the Portuguese territory.

Since the beginning of the foundation of Santo Antônio dos Anjos de Laguna, the city has had diverse economic cycles and alternating periods of ups and downs. These moments are reflected in its architecture and in the urban space as well, characterizing it as one of the most significant historical ensembles of the Santa Catarina State, together with the city of São Francisco do Sul.

At a first moment, Laguna served as a base for the military operations for preserving the Portuguese domain in South America.

The Paraguay War (1865), caused the development of telegraphic communications and railroads. Next, with the discovery of the coal in the South and its exploitation, Laguna had a period of wealth and development, once the whole mineral production was exported through its port. This was the end of the 19th and beginning of the 20th century.

In this century the port of Laguna lost the condition of coal exporting port for the port of Imbituba, that has better equipment and presents better conditions of use. It is beeing gradatively transformed into a fishing port, and is systematically losing its economic role.

By its historical and landscape attributes the Historical Site of Laguna was acknowledged in 1985 as part of Brazilian National, Historical and Artistic Patrimony.

As a cultural environment of tourism, the Historical Site presents a great potential for the economic development of the city. The whole ensemble accomodates about 600 constructions that form a singular set, with features from 18th century, as the old Paço Municipal, the Santo Antônio dos Anjos Church, one and two floors residences of the colonial period, eclectic constructions, art nouveau, art deco, and modern buildings. The ensemble is distributed throughout an area of 2 km^2 (see Fig.1).

The preservation of historical ensembles and sites in Brazil began in the 30's and became definitive with the promulgation of the Decree nº 25(1) of November 1937. The Serviço de Patrimônio Histórico e Artístico Nacional (SPHAN), created at this same time, was the responsible agency for the protection of national historical and artistic heritage. It is the oldest official entity of preservation in Latin America.

The concept of urban patrimony was extended from an idea of *built ensembles* to the concept of urban environment. This encompasses a more dynamic idea that is based in a urban representation.

The historical cities deserve careful and extremely criterious actions. Therefore it is recommended that every

Figure 1- Aerial photo, showing the historical site.

Figure 2 – A zoom into the surveyed area (see A in Fig.1).

urban ensemble should be documented as realistic and complete as possible. The landscape interventions must be planned throughout the use of simulations using scenarios in virtual reality (see pilot area in Fig. 2).

This way, the interventions in the historical areas, extremely sensible under the point of view of the authenticity and cultural value, are harmonic with less probability of identity change in the urban environment.

4 DATA ACQUISITION FOR THE TOWN OF LAGUNA

The accelerated process of development in Brazilian cities demands the expansion of infrastructure and the occupation of extensive areas by industrial, commercial and residential buildings. This process unfortunately does not go along with the necessary official policies for protection of monumental heritage in terms of public interest and economic benefit. There is a lack of guidelines for interventions, as well as of suited methodologies to evaluate and to solve the problem.

On the other hand, and concerning Laguna's natural touristical potential, local authorities look for alternatives to solve, in the short term, the most urgent problems of restoration. In the long term there are programs to improve the resident's understanding of the city by seminars and meetings, as well as by visual despollution of the commercial zone, by putting underground electricity cables and by tax reduction for those who keep their house in a good state of conservation.

Regarding the construction of the database for this heritage documentation, three main sources of data were brought together:

a) Specific data about preservation: The IPHAN's (National Institute for the Preservation of Historical and Artistic Heiritage) database comprises extensive description including architectural characteristics, current state of conservation and photographic record for every of the almost 600 monuments located in the historical site. The whole database includes more than 50 attributes for every object (monument);
b) Municipality Cadaster: The municipality of Laguna maintains the cadaster infomations about each building (owner, physical characteristics of the parcel etc), and street section (whether it is provided with public services or not and what kind of services) (Fig.3);
c) Representation of the facades, obtained by digital low cost photogrammetric means, developed within this project (Fig. 4).

Some initial considerations about the current databases are necessary:

a) Two different governmental agencies separately run information databases, in order to manage historical and urban planning issues. This lead to redundancy, inconsistency and an inefficient utilisation of public resources (each building is surveyed twice, by different teams, applying different criteria);
b) Municipality of Laguna: its database comprises alphanumeric and geometric data that are still displayed and managed in analog format;

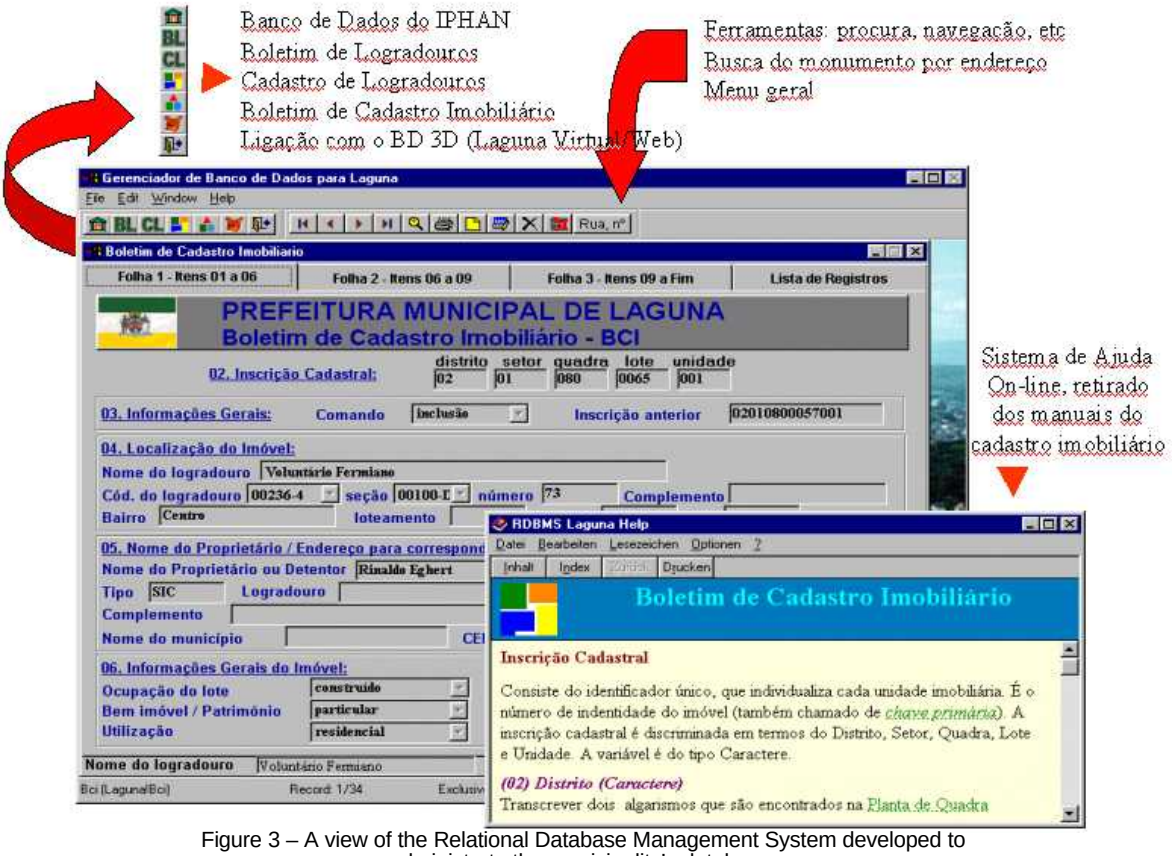

Figure 3 – A view of the Relational Database Management System developed to administrate the municipality's database.

c) IPHAN: its database is currently being converted to digital media. The information is beeing held in a low cost/low performance relational database management system, ACCESS;

d) There is no systematic record from the facades geometry. An effort to document the monuments has been carried out by IPHAN, but the lack of financial, technical and human resources is still a problem.

Figure 4 – Digital rectification of a facade from 6 sub-sets (original in colour)

We have had no problem for getting existing basic attibute data. Both Municipality and IPHAN have particular interest in the generation of new tools that could support the heritage management and urban planning. Cadastral basemaps and bulletins and the digital IPHAN database helps us to work with real data. The municipality database was brougth to digital format and is administrated with the help of a Visual FoxPro 5 interface, developed specially for the goals of this project.

Image acquisition is carried out in an A/D hybrid system, integrating the Pentax PAMS 645 camera (analog) to a Microtek 45t film scanner. The system is calibrated as a whole, and not each component individually. The images are digitized by a spatial resolution of 25.4 µm (diapositive) and stored as jpeg files. The tiff -> jpeg conversion was executed avoiding, as much as possible, radiometric and geometric loss of information. Diapositives of the facades were interpreted, processed and stereoplotted with the use of Photomodeler. One of its characteristics advantages are yielding line models together with foto-realistic texture attached to them (Fig. 4).

5 RESULTS

The final product is a virtual 3D environment and information system, connected to a standard geographic information system and distribuited database management systems through a self-developed interface. To the capabilities of storage, manipulation, analysis and modelling of geographical data, common to 2D-GIS, simulations and scenario predictions are added. The interactive visualisation (walk through) allows the analysis of landscape, proportionality between different heights, the composition of different architectural styles, and the analysis of the Urban Plan. By this, an urban planner can "feel" the real impact of a project in its local environment.

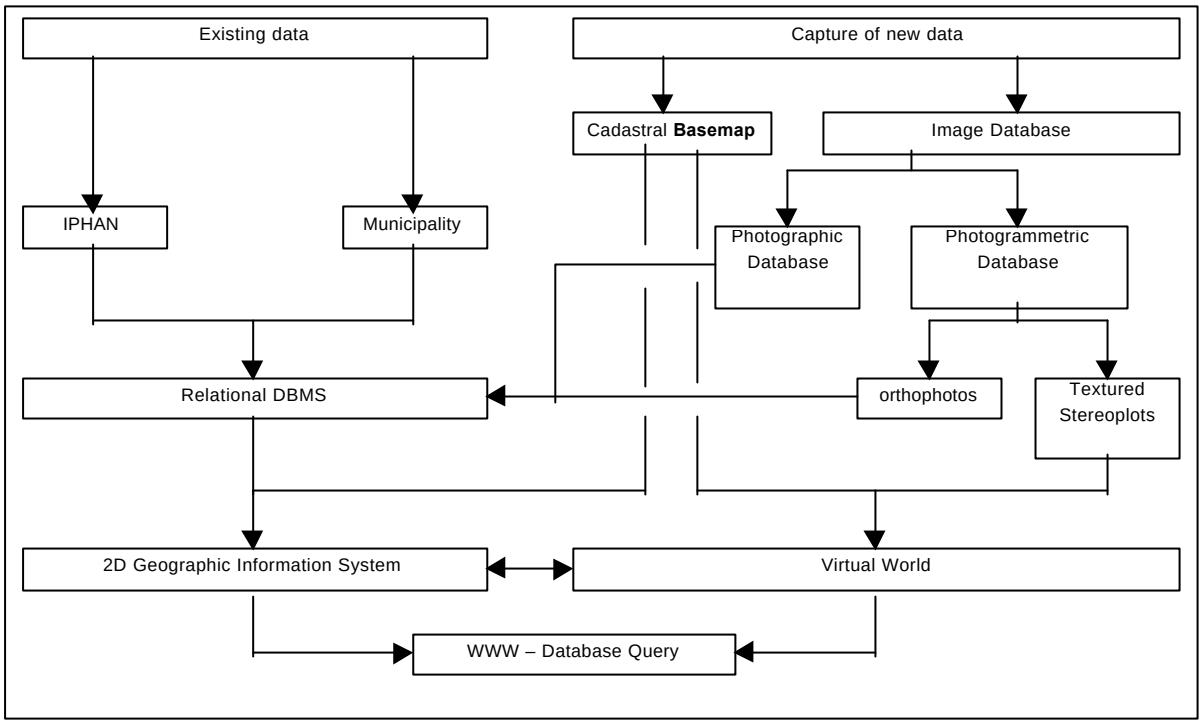

Figure 5 – Workflow for the development of a solution that integrates bi- and tridimensional information systems.

The 2D-GIS component was developed under ArcView GIS (ESRI Inc.) and comprises the 2D cadastral map (blocks, parcels, street map), cartographic basemap and the information stored in different RDBMS (Relational Database Management System) as Visual Foxpro and Microsoft Access. The software provides the integration of geometric and non-geometric attributes through an ODBC interface. A current project at the IPF in Karlsruhe, the GISTERM, will make it possible to share the data accross a machine-independent platform. The GISTERM is fully developed in JAVA and enables the query and visualization of data through a conventional web browser.

The 3D-GIS is an Internet-based information system, also developed using of a cross-platform programming language (JAVA). This component makes use of new networking, database access, remote class invocation, security and virtual reality visualisation models. It brings to the user a “low-cost” (almost no-cost) interface so that it is now possible to query distributed databases, obtaining the buildings’ attributes and a reference to a 3D model of the building, which can be selected to display a virtual reality environment of Laguna.

Furthermore, with the selection of Postgres, a free and powerful Object-Oriented/Relational database management system, the whole system will have the advantage of using exclusively free software licenced products. Postgres joins the habilities of beeing a complete SQL-compliant Relational DBMS (managing transactions, remote connections, queries, file management module, ...) with the use of a object-based data structuration concept. The last one has prooved to be a very powerful tool for modeling the real world in terms of objects and the relations they carry with each other.

The environment, which has been constantly updated, is available at the addresses: http://150.162.76.176/lfsg/renuncio/laguna/vrml/modelo3D.htm or user (http://www-ipf.bau-verm.uni-karlsruhe.de/Personen/renuncio/laguna/modelo3d.htm (Fig. 6).

6 OPORTUNITIES FOR CIPA

6.1 Procedures must be standardised in order to turn them operational

The secret behind any technical success lies in standardisation. This is a general law. Examples may be shown galore for all technical fields. In architectural photogrammetry it is true for the product itself, for hard- and software as well as for functionality of data storage

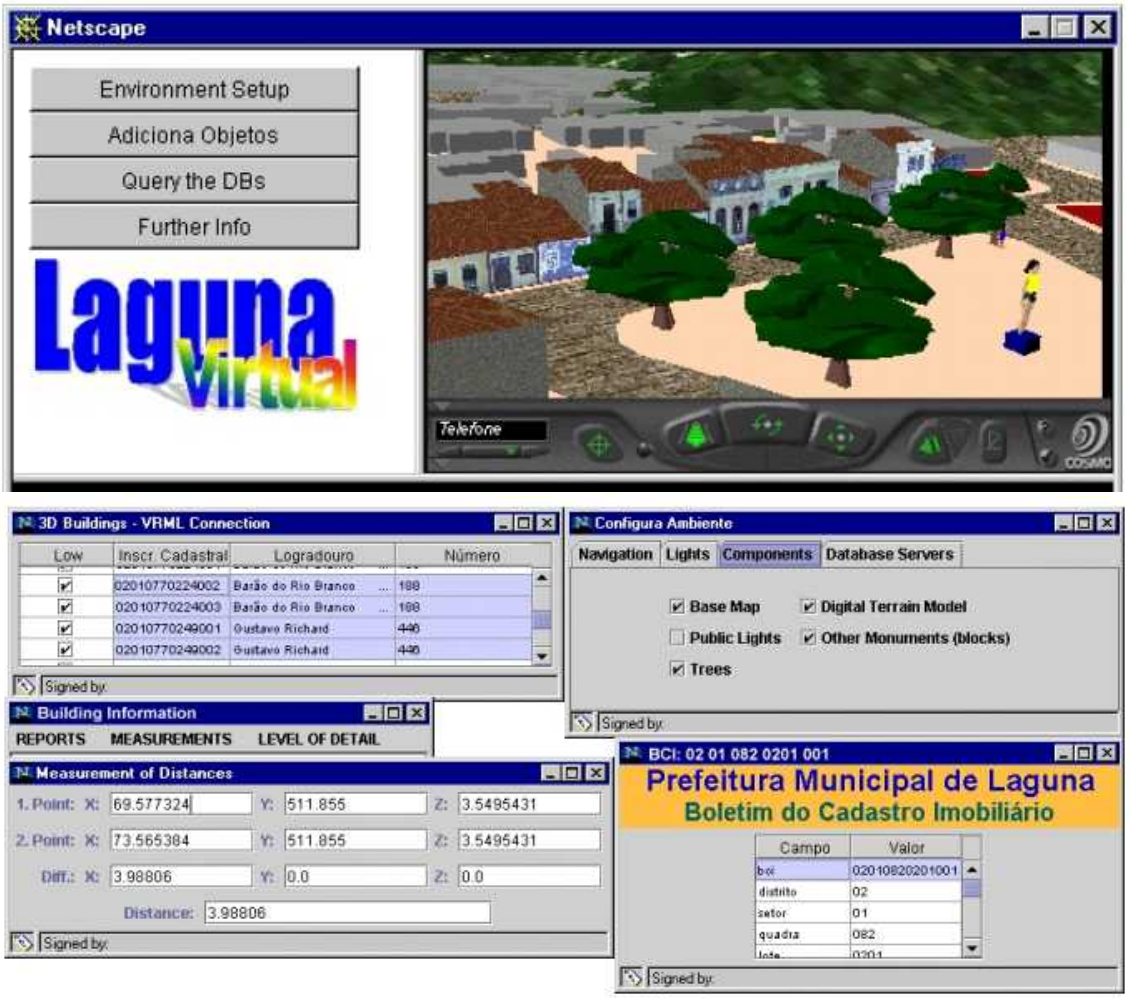

Figure 6 – Snap-shots of the current graphic user interface, that enables the control of the 3D environment.

and distribution. As a prerequisite for the worldwide acceptance *of aerial photogrammetry as the principal tool for mapping*, cameras, films, flight procedures, restitution instruments etc. were standardised. This was done with respect to the desired product, a topographic map of its particular scale.

In the domain of architectural photogrammetry applied to the documentation of historical monuments this seemed not to be possible due to the large variety of types at the one hand and lacking documentation standards on the other. This is, after all, a reason for the relatively insufficient use of this technique up to now.

6.2 Digital technique is favourable to standardisation

As an example, we may take the Internet. In its context, a lot of standards have been developed and internationally recognised. Without them, the global use would not have happened. Standardisation is controlled by the International Organisation of Standards (ISO). Most of the Internet-tools are available as open ISO standards or ISO drafts, like the Transmission Control Protocol (TCP; ISO/IEC 14766:1997), Hypertext Markup Language (HTML; ISO/IEC DIS 15445), Virtual Reality Modelling Language (VRML: ISO/IEC 14772: 1997) or the Structured Query Language (SQL; ISO/IEC 9075: 1992) to mention but a few ones. In the complex world of digital information transmission, compatibility of structures and codes has to be guaranteed. This includes pictorial information.

The frame for digital architectural photogrammetry together with storing, access and distribution of the data is pre-defined by the Internet world.

6.3 Concrete definition of a standard product

The procedures trigger the product and vice-versa. It had been shown, that standardisation is essential for technical progress. There is urgent need for product standardisation as a first step.

In the light of the immense number of possible products in architectural photogrammetry applied to the culture heritage, one should not hesitate to define particular tasks.

As an example (between many others possibles), we suggest city ensembles. The main reason for pushing this idea is the broad interest from many disciplines in this area. "3D city models" are presently developed for telecommunication, for town planning, for navigation, for tourism etc.. It is highly advisable that "cultural heritage" joins these groups in the context of documentation of historical town ensembles. This coalition would result in a much stronger position of CIPA, speed up and reduce cost of the documentation process.

Particular requirements of CIPA have to be defined a priori, but in close connection with the other disciplines involved.

6.4 Cost reduction: Hardware, software and manpower must avoid any special solutions and requirements but have to take generally available systems and people

This is not only a matter of economy, but also a matter acceptance by people. Both components are correlated, since availability in general goes along with low cost and experienced operators. In this context analogue photogrammetry is a negative example, since the operation of a stereorestitution instrument required a specialist. Though map-making by analogue procedures was rigorously standardised, very special tools and necessary specially trained operators kept map-making expensive.

This situation has to be avoided for 3D- documentation of city ensembles. As it was shown for Laguna (paragraphs 4 and 5), PC based procedures in connection with Internet are available. As for the manpower, the necessary know-how might be limited

to digital image processing and Internet operations. By the way, automation is more and more refined and may play a more important role in the future.

6.5 The term "documentation of buildings" has to be defined by a broader concept

From the conservative point of view, documentation ends by archiving the objects. Today however, documentation generates a digital data base. This must allow to see the archive as a part of a number of distributed data-bases of different kind, like ownership cadastre, general plan, tax lists etc.. When taking the opportunities offered by advanced technology, value-added products may be retrieved. Documentation of cultural heritage never was an isolated domain, but always in touch with many other disciplines. However, in the light of global networks, distributed databases and distributed clients, operating by generally accepted standards, this turns out to be even more important, because data fusion and multimedia techniques may generate completely new products. This seems in particular feasible for 3D city models of cultural value, as many users from very different disciplines are highly involved in this matter.

- The - traditionally - miserable financial situation for documentation of cultural heritage may improve from contributions by the industry (town planning, telecommunication, navigation systems, facility management .....), as a side effect (Bähr, 1999, Centeno *et al*., 1998, Westphal *et al.* 1998).

The next paragraph will give another example for application of the proposed technology.

7 CAMPUS INFORMATION SYSTEMS OF THE UNIVERSITIES IN KARLSRUHE AND IN FLORIANÓPOLIS

In the previous paragraphs a proposal was made and an example was given for a high-tech low-cost system for documenting historical town ensembles. The message was given that "documentation" has to be put into a broader context than in just the relatively narrow use for "cultural heritage". This insight follows from the fact, that digital data acquisition, storage, processing and retrieval must lead to new opportunities compared to the conventional analogue options. As a consequence, new relations to other disciplines and applications emerge, given by the following example, the Campus Information Systems.

Sponsored by the German Academic Exchange Service (DAAD), the Brazilian CAPES and both Universities, Campus Information Systems were developed simultaneously in Karlsruhe and in Florianópolis (Renuncio *et al*., 1998). Fig. 7 a gives the system architecture for the Campus Information System of the University of Karlsruhe (CISKA). It makes use of standard components like VRML, Java, RDBMS, HTTP among others as requested in the previous paragraphs. In principle, the architecture shown corresponds completely to the possible design of a system for acquisition and documentation of 3D City Models.

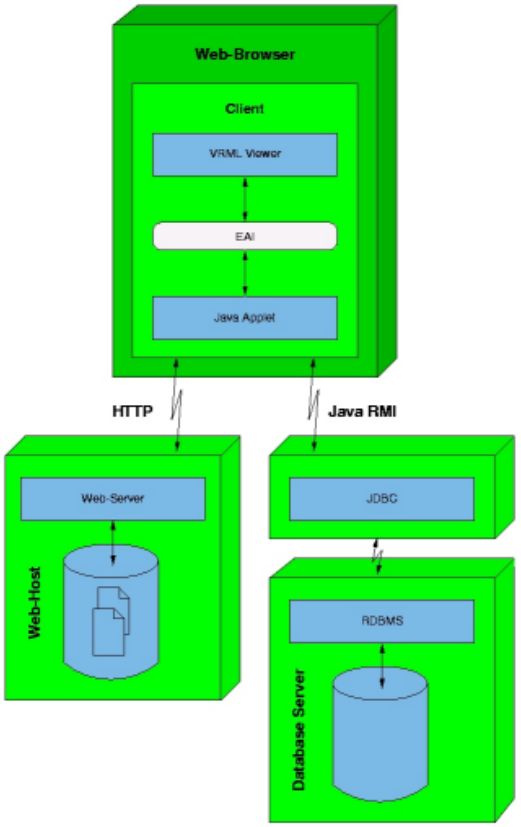

Fig. 7: System architecture for the Campus Information System of the University of Karlsruhe (CISKA), from LANDES (1999b), where:
VRML: Virtual Reality Modeling Language
EAI : External Authoring Interface
HTTP: Hypertext Transfer Protocol
JDBC: Java Database Connectivity
RDBMS: Relational Database Management System
JAVARMI: Remote Method Invocation

CISKA was published in the national press (see PRESS 1999) and is located on the homepage of Karlsruhe University (http://www.uni-karlsruhe.de/). It includes many animated multimedia options , like a temporal bar in order to demonstrate the development of the Campus from 1780 to now (in 2D), navigation in 3D under user control as well as guided "walk-throughs" and selection of viewpoints. Fig. 8 shows the starting position of the Web- Browser for CISKA together with some of its functionalities like the navigation bar.

One of the most important convictions for CISKA as well as for its Brazilian "counterpart" in Florianópolis is the necessity to have the facades covered by "true", i.e. photographic texture in colour. That way a orientation and navigation in the Campus environment is much easier and realistic than if the buildings were given by simple blocks only. The photographic texture was acquired by taking photos from digital cameras, which were mapped onto the wire-frame models generated from a large scale map together with photogrammetric heights.

This procedure may be taken in exactly the same manner for documentation of historical city ensembles. In this respect we strongly support the pictorial documentation (raster mode) rather than the graphical one (vector mode).

8 CONCLUSIONS AND FURTHER DEVELOPMENT

Overlooking the recent developments in digital sensors and computational hard and software we may say with full conviction that the systems have reached operational use. Although there are still obvious gaps in the development of digital sensor technology the project carried out in Laguna shows that even with low resolution non-metric digital cameras an outstanding contribution to low-cost data acquisition by fast new methods has

been found. As a consequence, more and more low-cost software for the processing of this kind of data is coming onto the market like the PhotoModeler system used in the Laguna project. Amazing dynamics have recently given a fully new challenging impact on the distribution of the processed data by Internet (Landes, 1999a). This aspect had not been recognised at the beginning of the project in 1995.

The results given in this paper are nevertheless referring to a *research* project. The step from a general scientific finding to operational application requires a new point of view. The system developed and proved in the context of the Laguna project is very well suited to become a standard procedure to meet CIPA´s vision of install fast low-cost systems to map historical urban ensembles.

The secret behind successful transition from science to practice lies in standardisation. As an example we may take photogrammetric mapping from aircraft: here all components of the mapping system had been internationally standardised (cameras, restitution procedures and – very important – *the final product*: orthophotos and maps).

New tools, like digital sensors, digital image processing and the Internet must provide new products when applied adequately. With respect to the documentation of monuments of cultural heritage, CIPA should observe the following rules:

- Define standard tasks (e.g. documentation of urban ensembles)

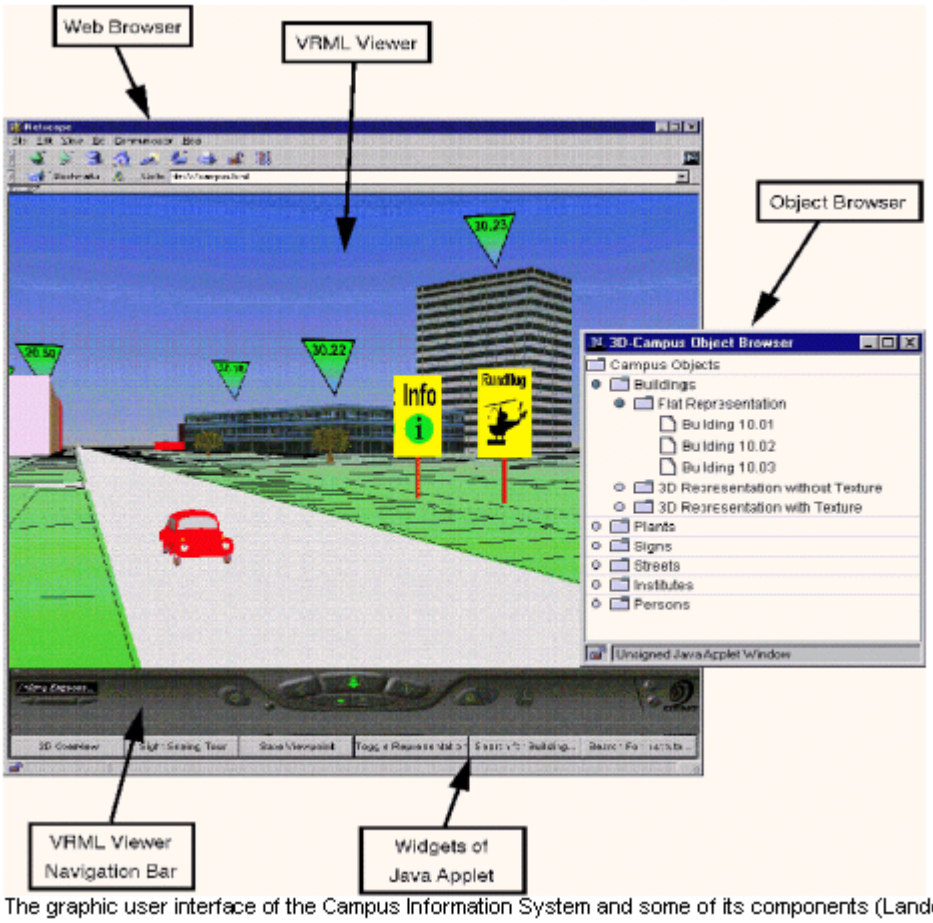

Figure 8 – The graphic user interface of the Campus Information System and some of its components (Landes, 1998).

- Use standard hardware and software components like digital cameras, PCs, and Internet technology to keep specialised know-how off
- Create databases in conjunction with other disciplines in order to take advantage from synergetic effects

9 REFERENCES

BÄHR, H.-P. (1998). Von der realen Welt zum digitalen Bild. In: Bähr/Vögtle (Hrsg). Digitale Bildverarbeitung. Anwendung in Photogrammetrie und Fernerkundung. 3. Auflage, Wichmann Verlag Heidelberg.

BÄHR, H.-P. (1999). Remote Sensing and Urban Analisys. In: Geographic Information Research: Transatlantic Perspectives. Taylor & Francis.

CENTENO, J. S.; BÄHR, H.-P.; KISHI, T. T. (1998). Uso Integrado de Mapas e Dados de Laser Scanner para o Reconhecimento Automático de Áreas Construídas. 3. Congresso de Cadastro Técnico Multifinalitário (COBRAC), UFSC, Florianópolis.

ISO (1997). Information Technology – computer graphics and image processing – the virtual modeling language, International Organization nof Standardization, ISO/IEC 14772:1997.

LANDES, S. (1999a). Access to Virtual Worlds via Internet. Geomatics Info Magazine, Vol. 13, No. 1, pp. 76-79, January 1999.

LANDES, S (1999b). Funktionalität des internetbasierten 3D-Campus-Informationsystems der Universität Karlsruhe (CISKA). Diss. Universität Karlsruhe, 1999, im print.

LANDES, S. (1996). Architectural photogrammetry and picture processing for acquisition and documentation of a brazilian town ensemble. In: International Archives of Photogrammetry and Remote Sensing, Bd. XXXI, pp. 309-312. Venna, ISPRS.

LANDES, S. (1998). Design and Implementation of a Web-Based 3D Campus Information System for the University of Karlsruhe. In Proceedings of the 3° Congresso Brasileiro de Cadastro Técnico Multifinalitário (1° Encontro de Cadastro Técnico Multifinalitário para os Países do Mercosul),

MARTINS, J. M.; RENUNCIO, L. E.; LOCH, C. (1998). Restituição digital da Igreja de São João Batista; In: COBRAC

98 · Congresso Brasileiro de Cadastro Técnico Multifinalitário · UFSC Florianópolis · 18 a 22 de Outubro 1998.

PRESS (1999): Vogelgleich über den Campus schweben ... In: UNIKATH – Universität Karlsruhe (TH). 30. Jahrgang, Nr. 2, Mai/99, pp. 4-5.

RENUNCIO, L. E.; LANDES, S.; BÄHR, H. P.; LOCH, C. (1998). Low cost record of a historical brazilian city ensemble by digital procedures. In: REAL-TIME IMAGING AND DYNAMIC ANALYSIS, Hakodate. Anais. Hakodate: ISPRS,1998. Comission V, volume 29, Tomo B5. p. 643-647

RENUNCIO, L. E.; LOCH, C.; BÄHR, H.-P. (1998). Parceria Universidade de Karlsruhe - UFSC em Fotogrametria eGeoprocessamento. In: INTERTECH 98 - V Conferência Interamericana de Educação em Engª e Tecnologia.

WALDHÄUSL, P. (1992). Defining the future of architectural photogrammetry. In: : International Archives of Photogrammetry and Remote Sensing. Washington, D.C.: ISPRS, 1992. Comission V., Bd. 29, B5, pp. 767-770.

WEHR, A. (1997). Abbildende Laserscanner – Anwendungen in Bauaufnahme und Denkmalpflege. In: Architekturphotogrammetrie gestern – heute – morgen. Hrsg.: J. Albertz, A. Wiedemann. Technische Universität Berlin, 1997, S. 114-127.

WEHRHAHN, R. : Urbanisierung und Stadtentwicklung in Brasilien – Geographische Rundschau. 11.1998, pp 656-663

WESTPHAL, F. S.; RENUNCIO, L. E.; LOCH, C. (1998). A Fotogrametria Digital como Ferramenta ao Planejamento Urbano; In: COBRAC 98 · Congresso Brasileiro de Cadastro Técnico Multifinalitário · UFSC Florianópolis · 18 a 22 de Outubro 1998.