DIGITAL PHOTOGRAMMETRY INTEGRATION POSSIBILITIES TO HERITAGE RECORD BY AN ARCHITECTURAL INFORMATION SYSTEM

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ABSTRACT

Architectural heritage preservation makes necessary to produce an initial technical documentation to be able to establish the necessary plans and studies which allow later to develop both suitable approaches and criteria for appropriate buildings interventions.

Every time becomes more necessary the application of the most modern methods to carry out some technical documents production. Those documents must be able not only to quantify the geometric and formal characters of these architectures, but also to detect and to end up evaluating possible pathologies and present damages at the monuments.

Nowadays, to solve with success the necessities mentioned, graphic and alphanumeric database is needed, on which all the implied professionals in this topic can lean on and make their performances. In addition to, the elaboration of some architectural surveying, the techniques based on the use of the Digital Photogrammetry and the Geographical Information Systems allow us not only to edit some plans with a high degree of graphic precision and metric accuracy, but also to detect all those defects or structural and constructive degenerations that cause the minimum deformations or alterations in the formal state of the building. Also, these technologies highlight on the conventional techniques in being an open system that allows the gradual incorporation of new applications or studies as these they leave applying.

The digital rectification of images, allows to correct the perspective effect introduced by the photographic objective, so that the resulting images constitute a graphic document on which can be carried out any type of measures, in precise and quick way without one has to make any correction type in the measures. This way, a document is got which joins the advantages of the conventional planes with the wealth of qualitative information that provides a picture, without having to incur in the high costs associated to any other alternative photogrammetric technique. This methodology allows us the creation of a historical graphic file that shows the evolution of the object along the time, allowing to study the state and the possible degradation of the same one, contributing to an improvement in the taking of decisions in this respect.

The digital processing of images makes possible: to translate digital pictures and graphics in analogical format (paper, film..), to obtain a series of improvements in the quality of its visualization and a great variety of by-products, of great utility in architecture.

Moreover, the Geographic Information Systems (GIS) are a relatively new technology that joins the computer science advantages with the modern systems of capture of data, so that it allows the integration and the treatment of all type of information of a computer team, in a simple way on the part of any user that requires to work with this information.

A GIS include software and hardware tools, and a group of procedures elaborated to facilitate capture, edition, administration, manipulation, analysis, modeling, representation and exit of spatial referenced and semantic data, to solve any type of planning, administration, storage, and so on information concerning problem.

As conclusion one can affirm that the digital photogrammetry and the GIS provide a group of advantages and benefits in the architectural tasks impossible to obtain with such an efficiency, velocity and economy by means of other procedures. These advantages and benefits are among others:

- To have a graphic database of quality, on which can work in a coordinated way, all the professionals involved in the cataloguing and preservation tasks.
- To provide a basic instruments for the coordination and pursuit of the works and carried out studies or to develop.
- To facilitate the access, manipulation and bring up to date of all the information.
- To reduce the costs, so much in the obtaining of the data, like in the later tasks to carry out during the documentation process, restoration and preservation.
- To facilitate the exchange of data between diverse organisms and companies whose performances can impact or to influence in the environment of the monument.

For that mentioned previously, it has been created in Las Palmas de Gran Canaria University an investigation team formed by two groups: photogrammetry and cartography researchers and architect researchers. The first ones apply the modern techniques of writing of graphic documents and they formalize an alphanumeric database to incorporate to the document. The seconds they indicate which is the formation of the final document completing all the necessary data for the creation of the architectural system of information.

In this report the Architectural Information System will be seen that are developing like team.

1. Introduction

Today's society is getting more and more concerned about the conservation of the architectural patrimony. This tendency is perceived by the series of strategies focused on the recuperation of this important cultural heritage wich is exposed at the effects of time and progressive degradation from the external agents or by the man's hand.

These actions towards conservation are supported by the new technological tools existing today. By using such tools the tasks about the architectural heritage conservation get to be developed in an easier and more efficient way, providing solutions that weren't possible till today. We are considering that only by the use of the most advanced technological media –that often come from disciplines aside from Architecture- and the cooperation among professionals from different disciplines, it will be possible to guarantee the transmission of the architectural legacy to the future generations.

To get the analysis, valoration and execute the restauration process, more and more often the experts use the new auscultation methods and the datation system for physic and chemical components, the new powerful programming languages, the databases, last generation microprocessors, algoryms for image analysis and manipulation, database software, digital photogrammetry and the CAD and GIS system… are some of the tools wich can be used. All of them provide information of great value and different nature; all of this info has to be processed, integrated and gestionated to produce the desired final products.

At the Las Palmas de Gran Canaria University we have a multidisciplinary workteam, with architect, historiators, photogrammeters and cartographers. All of these persons are designing an informatic system wich will allow them the gestion of edifications on the old part of the city of Las Palmas de Gran Canaria, individually and in a global way. This system has to be open enought to extend it to other city areas considered of interest.

The general objective consists on the definition of a system wich, taking as basis the metric and semantic description of the architectural object wich is obtained from the digital photogrammetric system and with the alphanumeric info relative to the same object, allows the team to deal with all the information in an integrated way, so the data gets melted into an unique object about the building in wich the conservation works are taking place. Such system has to cover the professional's needs and has to be formed by existing hardware and software tools. With a previous research of the best and more economic tool

This system is called Architectural Information System (AIS), and is composed by a serie of already existing tools and already used in other workfrields: a photogrammetric system – film cameras, CCD and a digital resampler- and an informatic system –with a DB gestor and GIS software-.

In our proyect, one of our first objectives is to develop the solution for two specific needs: building catalogation and their 3D models. This general info will be linked to the alphanumeric info associated to the buildings, always keeping an eye on developing a system wich will allow all kind of professionals to get the products and answers they need in each of their duties related to the object's restauration; giving them fast and accurated access in real time to all the geometric information about the object and also to the following information derivated from all the works wich are taking place.

In this article we present the general scheme we are proposing for the AIS, and the works wich are taking place to get the tridimensional definition of the architectural object.

2. AIS's Schema

Our system has the following configuration:
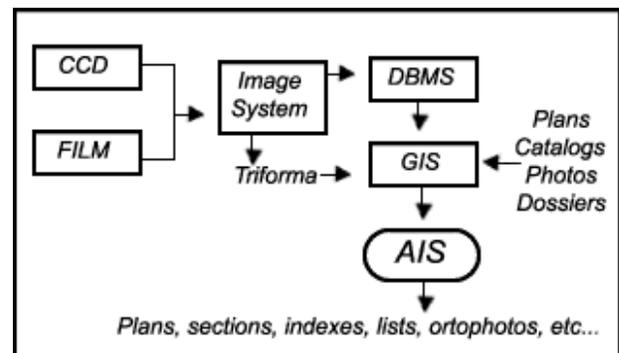
AIS system has two main cores: a digital photogrammetric system and the second core wich deal with the database management (the graphical one and the alphanummeric ones). This last core consists on a relational database gestor, a DBMS and a GIS software. The plattform chosen is Microsoft Windows NT.

The digital photogrammetric system was chosen because it allows us to:

- Work with digital images gotten after an scanning process or CCD sensors.
- Atomatization of the procedures of data measurement and the following processing, building an accurate description of the object's 3D geommetry.
- Structurate the data in the way they are structurated in the usual CAD models used in architecture.
- Get different graphic results such plans, views, sections, 3D models, etc…
- Integrate the data with different visualization techniques as animations, thematic materials classifications, pathologies…

- Link the definited graphic elements with a DBMS and finally with a building's information system.

The second core, the one wich will gestionate the graphic and alphanummeric database includes software and hardawre tools along with procedures created to make easier the capture, edition, administration, manipulation, analisis, modelization, representation and flow of the data from spatial objects. This core is built to solve any kind of planification, administration and data storage about the architectural patrimony in wich the works will take place. That's why the graphic and alphanummeric informatin is classified in three different levels:

- Catalogation and literal description of the building: the dossier and the building's database.
- The graphic building's description: 3D model, general plans, detail plans, sections, raster images, elevation and profile.
- The grapic description of the building's physical environment: situation plans and placement plans, detailed suburb's cartography and city's cartography..

3. The photogrammetric system

The photogrammetric system is composed by a photogrammetric software: Imagestation, from Intergraph, running on a PC with a P-III processor. An UNIX system may provide a stabler plattform, but to make the system more accesible to all kind of users the choice was made on a pc.

The stereoscopical images acquirement is made with semi-metric cameras, operating with conventional film as the Pentax 645 and Fuji STX-2 as a CCD sensor cameras as Sony DCS-D700. The film cameras have been calibrated and are used depending of the precision requirements for each building.

With the CCD Sony, the images obtained wil lhave 1.5 pixel millions; this allows us to get high resolution quality images (1344x1024 pixels). This camera produces TFF and JPEG images, manual and automatic exposition, 5x zoom and black-white contrast control. The camera has been calibrated, so it's principal distance, the radial and tangencial distorsion and the centering error is already know.

Actually the CCD camera is being tested. Testing the metric accuracy prestations about objects and also about the possibilities of the digital manipulation of the images obtained in order to provide a better way to get the material and patologies classification done.

The software, once it has the digital images, proceeds with the interior orientation. This is the process of measuring the fiducial marks on the digital imagery. This measurement process will relate the pixel coordinates of the digital image to the photo coordinate system. Once the fiducials on the first photo have been measured, all the fiducial on subsequent photos will be automatically measured using image correlation techniques. Image footprints can be automaticaly generated into a design file allowing the operator the option to select an stereo model by graphically pointing to wich images he wants to process.

For the relative orientation all pass points, tie points, and control points can also be measured during the relative orientation step. After all necesary adjustements have been made, the results are read back into the Image Station environment where the exterior orientation parameters will be used to epipolar resample each stereo model.

Absolute orientation will come next if it's necessary. After this the software is ready for the digitising and features collection or ortho photo production.

4. The graphic and alphanummeric database

The graphic description of the building is extracted of the data generatein the photogrametric system, and always will be automatically vinculated to the BDE, so it gets acutalized with an interface that has been designed for this effect with a Microstation module. And those allows edit a DB with BDF format, at the same time we work with the drawing file meanwhile the elements are being obtained at the photogrammetric station. This application allows the operator to assign codes to each rebuilt element in the restitutor, so the assigned code is automatically registered in the DB table, allowing to fill and acualize the alphanumeric information.

The different desired graphic products for each building ara taken with Microstation and the module triforma. With this applications we get in an easy way sections, plans, 3d modelizations, etc.

The graphic description of the building environment is build integrating the digital plans of situation and placement of the surrounding building, and with the detail cartography and the suburbs configuration.

The alphanumeric database is made by the buildings catalogue and the buildings database. The catalogue is made by the index card wich has the building's technical specification, the specific database fields make the administration easier. The catalog card has a graphic description with the culding's characteristics and the works made on it. The catalog index are made from the more detailed information from the BDE. All of this information is gathered with the DBMS microsoft access and is linked with an identifier to the building's graphic database.

## 5. The graphical and alphanumeric dabatases Integration

We have two different kind of databases: the one who has the graphical and geometrical data and the one who has the alphanumeric data related to the graphical data. The first one will be generated from the photogrametric digital system or from other graphical external files (like digitized plans) and will be handled with the Microstation CAD. The second one will be handled with the DBMS ACCESS. Both databases will be linked and managed toguether by the GIS software Arc Vew 3.0, creating the AIS.

The access to all the info will be done simultaneously trought an user friendly interface using the arc/View 3.0 from Esri, wich allows to create projects who melt information in different formats like DGN, DHP, DBF, TIFF, etc… Consultations to the graphic and alphanumeric database can be made easily and also

allow to code other software applications to be integrated on the system, personalizing it.

An example will be the selection of all the buldings with posible troubles if there are some excavation works taking place in the surrounding area.

This other example illustrates how the databases are linked toguether:
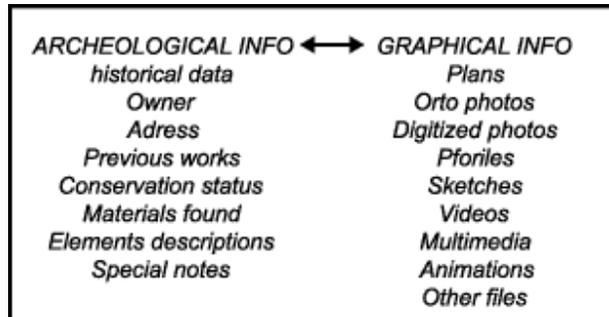
6. Future lines

Right now we are studyng the possibilities of the use of CCD images in the system and we are also designing the master lines of the databases, taking in consideration the needs of the different professionals who will work in the restauration works. Once we get the AIS designed, the following step will be to get the maximum automatization of all the procedures, specially with the photogrammetrics works.

Summing-up

Once we have the AIS operative, it will allow us to::
- Have a graphical database with metrics accuracy, in wich we can work with all the professionals involved in the preservation and catalogation works
- Have basical elements to survey the coordination and culmination of all the works and studies involving the restauration and conservation works
- Make easier the access, manipulation and actualization of all the info relative to the buildings and it's environment
- Reduce the costs of the data accquirement process, during the documentation, restauration and preservation works.
- Facilitate the information exchange among different organizations and company, wich actions can alter or influence the restaurated building's enviroment.

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