A System Model for Identifying Historic Buildings by Using Multiple Typologies

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Abstract: This paper discusses the problem of locating buildings of architectural heritage with respect to different typologies. The cross referencing process of such a task can often be tedious and difficult. Within this framework, this paper introduces a system model that enables users to pin-point the buildings with respect to different typologies. The model introduced here differs from similar efforts by displaying of the results of inquiries on a visual matrix. A limited sample domain of Classical Ottoman architectural heritage illustrates how the proposed model will operate. All the buildings entered in the system have textual and visual data entries along with static and dynamic attributes. In any inquiry, the attributes determine which buildings will be included, and the visual data fill in the cells of the matrix.

1 INTRODUCTION

One of the most important tasks of design research is the study of historical precedents. Usually research on architectural heritage proceeds by gathering information from various resources; this is a linear process (Miranda and Park 1998), but comparison and analysis of the gathered data is non-linear and this cross-referential process is a task for the researcher. When it is necessary to pin-point the position of one particular building with respect to different typologies, this task becomes especially difficult, complex and confusing. Often, different typologies exist for styles, buildings and architects of the architectural heritage.

This paper introduces a system model for pin-pointing the nature of a building with respect to different typologies. The introduced system not only aids in locating a building with respect to typologies, but it makes use primarily of visual data in displaying the results. This approach is based on the power of visual data in learning and analyzing architectural precedents (Purcell and Gero 1998), and the power of visual materials in conveying information more effectively than verbal or textual data (Herada and Miskiewicz-Bugajski 2001). For architectural education and research especially, visual information is indispensable and learning largely depends on visual recall.

In line with this argument, there are studies that concentrate on storing, displaying and organizing architectural data. Some examples are ADMIRE (Mishima and Szalapaj 1999), the Interactive Search and Access System (Montero et al. 2003), and retrieval tools in building case bases (Colajanni, Pellitteri and Concialdi 2000). In a similar study, a relational database and navigational software are integrated to teach a course on the history of architecture (Fitzsimons 1999). Other similar efforts range from electronic libraries of significant buildings representing selected architectural periods (Chan et.al. 1999) to the prototype attempt at comparing the works of two specific architects I.L. Kahn and F.L. Wright (Allegra et al. 1995). There are also projects, such as the CEREN project on an El Salvador archaeological site (Lewin and Gross 1996), that employ virtual reconstruction techniques to model existing or non-existing buildings, cities and/or sites.

However the model introduced in this paper is different from similar efforts on architectural heritage by being a 'visual reference system' based on inter-related visual matrices. The interface of the system was previously developed and discussed (Senyapili, 2003a-b); this paper focuses on the operational model of the system. The novelty of the proposed model does not lie in the underlying query process, but rather in the original display format. The framework for the utilisation of the visual format, and the benefits of such a format are the topics of this work.

2 SYSTEM STRUCTURE

The general structure of the proposed system model is formed by inter-related individual sections of each building entry. Each individual section contains textual information (about the historical, architectural and urban contexts), and related visual information, (such as drawings, photographs, a 3D model, and a movie), for one building (Figure 1).

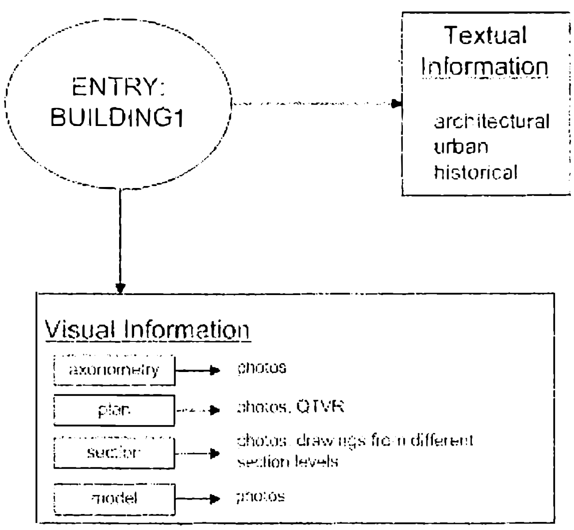


Figure 1 Contents of a typical section for a specific building

This format allows the structural, historical, and urban aspects and the drawings of the buildings to be studied and analysed one building at a time, or this can be done comparatively, analysing several buildings consecutively. In order to access information about one specific building, the user needs to access the individual section about that building. Individual sections of several buildings can be accessed consecutively for comparative purposes. For cross-analyses, the system also allows for specific inquiries to be made and to these inquiries it responds with a specific display format, called the 'visual matrix'.

2.1 Visual Matrix

The entries in the system and the results of user inquiries are displayed on a *visual matrix*. The visual matrix is a format for collection, storage, organization and display of information (Senyapili 2003a-b). Visual matrices constitute an operational platform for establishing a *visual reference system for architectural heritage*. The proposed system establishes a tool for easily accessing and processing information on world architectural heritage. Enquiries can be made and the results are displayed on visual matrices.

The main idea behind organizing the visual materials in matrix format is two-fold. First, the matrix structure gives the possibility of seeing all the visual data together for comparative purposes. For instance, all the plan views contained in the system can be displayed on a matrix side by side, allowing easy comparisons of size, plan scheme, forms, etc. (Figure 2).

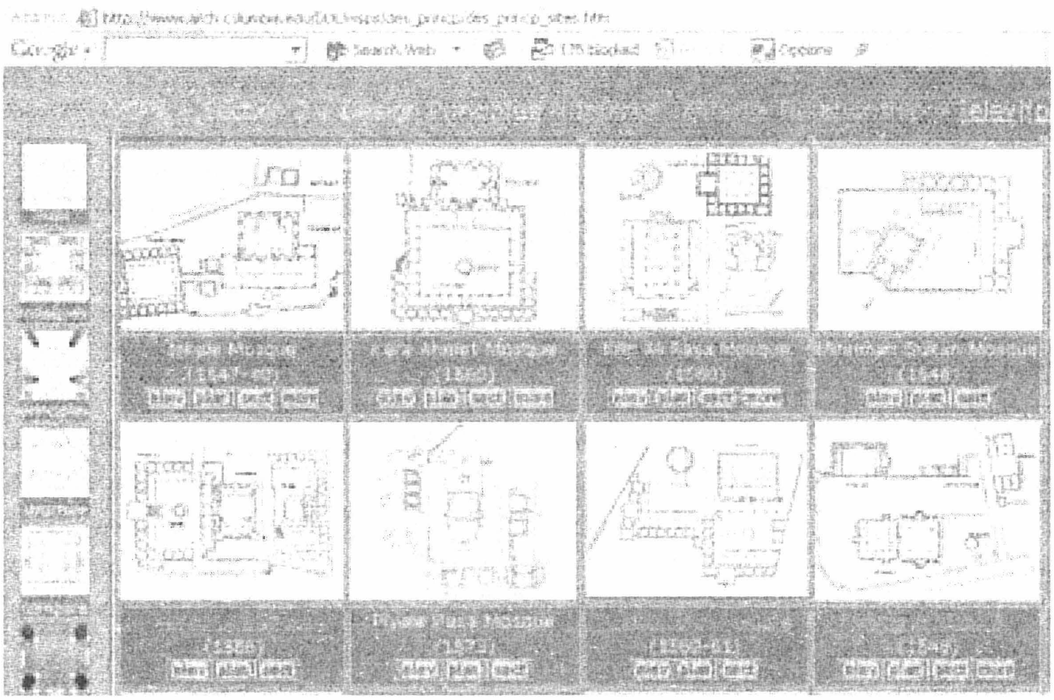


Figure 2 Visual matrix

Second, the organisational capacity of a matrix is powerful. When an inquiry is run, sorted buildings can be displayed on a matrix with respect to multiple typologies at the same time.

2.2 Data Attributes

Each building entry (B_N) in the system has one 'alphabetical' (A_A), one 'chronological' (A_C) and one 'geographical' (A_G) attribute. These attributes are static since they exist for each entry and do not change according to typologies. Then, each entry has typological attributes (A_{TN}). These are dynamic attributes, meaning that they are subjective and may be interpreted according to the respective typology. For instance, size is such an attribute. One typology may interpret a building as 'large', whereas another typology may break down the large buildings into sub-groups. Hence, the same building can be assigned to the 'medium' size group in the latter typology.

Each building can be analyzed through its own specific features (structural, historical, architectural attributes), and each building can be analyzed through its position within the context of various typologies. The system can point out the location of a building within the context of multiple typologies with one inquiry. This action cannot be carried out with one step in regular linear research. Moreover, each building can be compared to its precedents, its contemporaries, and to later works. This comparative approach distinguishes the system from other similar systems, which give visual and textual heritage information without the possibility of cross-referencing and sorting by selection.

3 THE PROBLEM OF TYPOLOGIES IN ARCHITECTURE

Generally more than one typology exists for the same style/period/domain of architectural heritage. This variety arises as a result of the differing viewpoints in constructing the typologies. Each typology leads to the formation of groups and sub-groups with respect to its defined criteria. Often it is a difficult task to grasp the outlines of a typology and it is even harder to compare various typologies.

Especially during design education, students are confronted with the hard and confusing task of understanding the position of a building with respect to more than one typology. One of the domains of architectural heritage where this situation is apparent is Islamic architecture. Because of their wide distribution chronologically and geographically, the buildings of Islamic architecture are subject to many categorisations. This is particularly the case for Classical Ottoman architecture where Islamic tradition is influenced by the innovations of a particular architect. Thus in Classical Ottoman architecture, the general typologies of Islamic architecture interact with the typologies of that particular period.

3.1 Classical Ottoman Architecture: A Case Study in Architectural Typologies

Classical Ottoman architectural heritage is almost synonymous with the works of the architect Sinan (Mimar Sinan). He developed an innovative style of his own based upon the heritage of the Early Islamic style. His style is unique and original. He is known to have built almost 500 edifices during his mastership as the head architect of the 'Saray' (Palace). Therefore his style is worth studying not only within the Ottoman domain, but in the Islamic architectural heritage as well. Both the typologies for Islamic architecture and the typologies that categorize Classical Ottoman architecture can be applied to Sinan's works. Locating the position of any of his buildings becomes a difficult task since so many typologies exist.

Different typologies refer to different aspects of the same building. Thus, for the full analysis of a building, each typology is important. Yet, when the number of typologies increases, it becomes difficult to locate the building within each typology, and to remember each location within each typology. Moreover, typologies may conflict with each other, creating further confusion.

In order to illustrate the above-mentioned problem and to aid in demonstrating how the proposed system will operate, three sample typologies that categorize Classical Ottoman mosques according to different criteria are selected. The first typology by Günay (1987) refers to the number of piers in a mosque as the main criterion (Figure 3). According to Günay's typology, the plans of the mosques are analysed and grouped as having 4, 6, 8, or multi piers. Within the 4 pier group there are two more sub-groups defining the roof structure as having one dome or being composed of half domes.

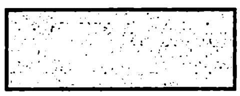
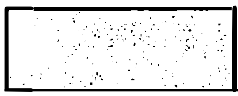
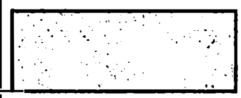
GÜNAY	4 piers	6 piers	8 piers	Multiple piers
One dome	●			
Half dome	●			

Figure 3 Günay's typology

Kuran (1987), on the other hand, establishes a typology based on the units of the interior space (Figure 4). His first criterion is having either single or multiple domes, and he further groups the spaces with single domes according to the number of revaqs. For the spaces with multiple domes, Kuran analyses the spaces with respect to the overall geometry of the plan.

KURAN	Single Dome	Multiple Domes	
3 piece revaq	●	□	
5 piece revaq	●	□	
Square mass	□	●	
Longitudinal rectangular	□	●	
Transversal rectangular	□	Transversal single space	●
		Double flanked	●
		Triple flanked	●
		Cross flanked	●

Figure 4 Kuran's typology

Gabriel and Mamboury (1992) refer primarily to the total floor area to construct their typology and classify the mosques as small, medium and grand, and then refer to the structural elements for further grouping (Figure 5).

GABRIEL& MAMBOURY	Small	Medium	Grand
1-2 dome	●	□	□
6 dome	●	□	□
Central dome	□	●	□
Hexagonal	□	●	□
Octagonal	□	●	□
East-west half domes	□	□	●
4 half domes	□	□	●

Figure 5 Gabriel and Mamboury's typology

According to the proposed system structure, for each mosque there is one alphabetical, one chronological and one geographical attribute. Then, each mosque holds an attribute related to each one of the three selected typologies. For instance, "Sehzade Mosque" has three static entries, A_A = Sehzade, A_G = Istanbul and A_C = 1573. If the typologies are numbered in the sequence of their introduction above, Sehzade Mosque has the following typological entries: T1G1G1 (4 piers with half domes), T2G2G1 (Multi dome with square mass), and T3G3G2 (Grand size with 4 half domes).

Within this framework, it is possible to make three different kinds of inquiries. The first one is an inquiry involving static attributes, for instance, geographical (A_G) and chronological (A_C) (Figure 6). The results may be given in the selected visual format, such as drawings, photographs, or 3D models.

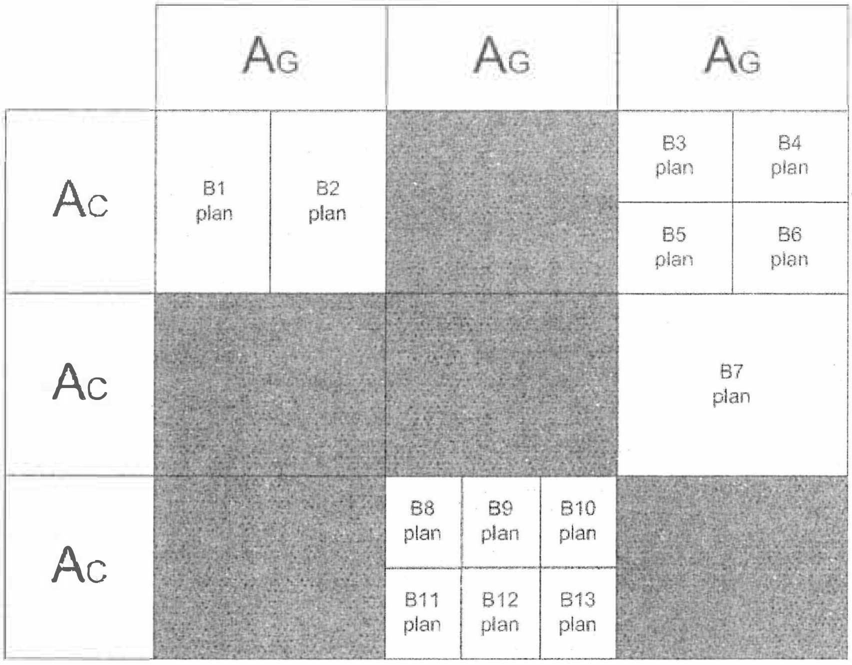


Figure 6 Sample inquiry result for static attributes using building plans

Second is an inquiry involving one static and one typological attribute (A_{TN}). For instance, an inquiry can be made involving chronological data (A_C) and typological position in relation to number of domes A_{T1}. In such a case the sub groups of the typology (G1, G2 and G3) will be involved as well (Figure 7).

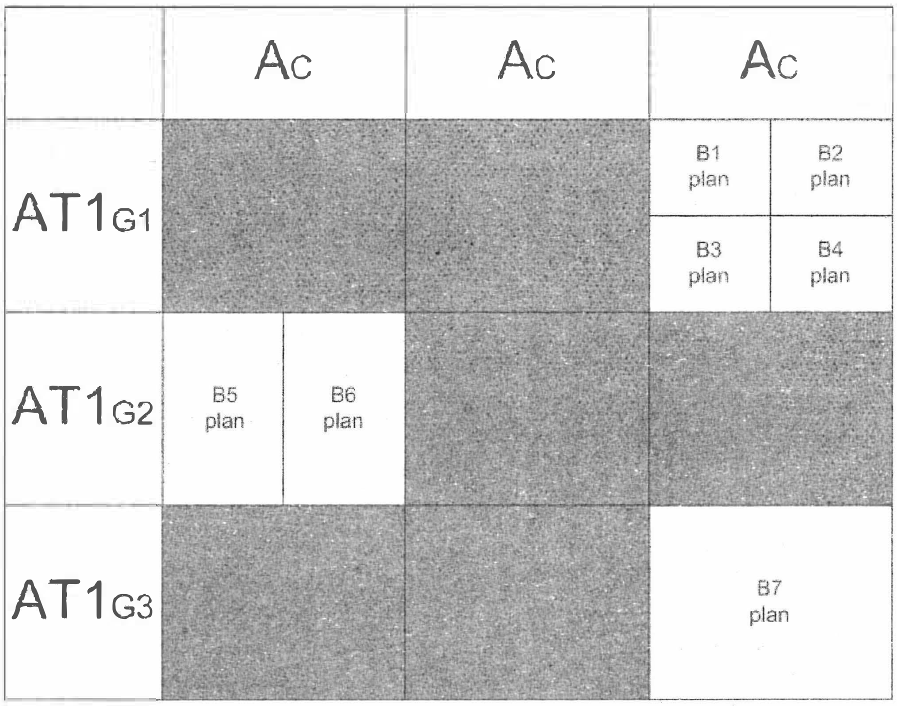


Figure 7 Sample inquiry result for one static and one typological attribute using building plans

For each new sub-group, the attribute will be extended, each group definition being the prerequisite for the one that follows it, like G1G1, meaning the first sub-sub-group of the first sub-group. Finally, the third inquiry may consist of two typological attributes, such as A_{T1} and A_{T2} (for instance number of piers and size) (Figure 8).

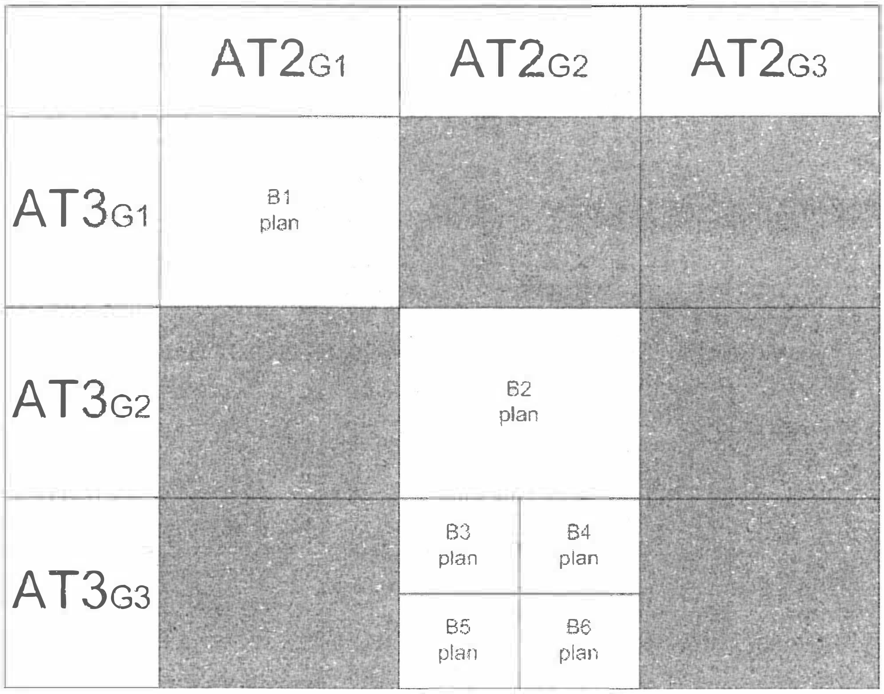


Figure 8 Sample inquiry result for two typological attributes using building plans

The result of one particular inquiry will look like Figure 9. Here the inquiry involved the typological criterion that the mosque should have 4 piers; all the mosques with 4 piers were brought up by the system and displayed in alphabetical order.

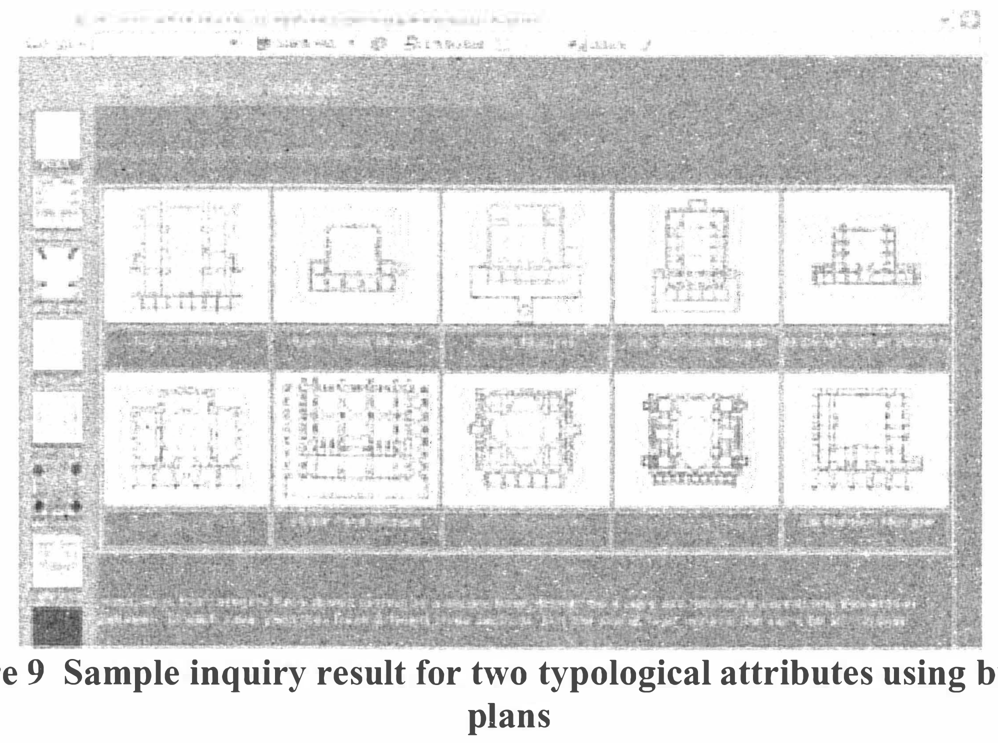


Figure 9 Sample inquiry result for two typological attributes using building plans

If no typological criteria were indicated, the system would bring up all relevant data, displaying a good summary of the works done. For instance, in the case of an inquiry like the second one above, the user may request a chronological sorting of all the works that fit the second typology (T2). What the visual matrix discloses is a subtle display of the architects' performance. In this case, it is easy to tell whether the architect built a building that conformed to the typological constraints of T2 within a specific year (Figure 7).

4 CONCLUSION

Retrieving architectural information from a pre-determined database is not a new idea. However, the proposed system introduces an original reference system for information retrieval based on interrelated multi-layered visual matrices. Moreover, this study points to the difficulty of pin-pointing buildings with respect to different typologies and suggests that the introduced system may be utilised to overcome the difficulties and confusions related to that problem. Regular research and education techniques convey data in a linear sequence. Recollection of this data for later use and comparative analyses relies upon one's memory and ability. For instance, the characteristics of Classical Ottoman architecture, (such as the play of the masses, transformation from human to monumental scale, centrality, and symbolism of form), can be better studied with cross-references between plans and elevations, site plans and sections. Such cross-referential tasks are tedious, and may not always lead to satisfactory results if handled through linear research.

Locating the position of the buildings with respect to various typologies is a non-linear process. The proposed system makes use of matrices of visual data in order to display the cross referential analyses. Visual materials to constitute the matrix can be selected by the user, as well as the inquiry, whose results will be displayed on the same matrix. The system does not exclude textual data; it introduces textual data on a requirement basis. The proposed system enables cross referencing for comparative analyses, thus aiding in research and education relating to the architectural precedents while studying architectural heritage.

The number of typologies that can be handled in the system is not fixed; therefore, a new typology may be added at any time, expanding the system further. With each new building entry, all attribute classes will be assigned and will be filled in for that particular building, and with each new typological entry, all buildings will be assigned with the corresponding typological attributes.

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