Knowledge Cube

Architectural Heritage as a Source of Inspiration for Generative Design

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***Abstract*—Architectural identity, as an evolutionary chain of creative tradition, can only be sustained and revived from within, starting with a strengthening of these very internal processes and not by imposing external forms. Usually talking about architectural heritage it is just about the one preserved for touristic events. To overcome this shortage we are going to deal with depends on knowledge or expertise and also on effective application of requisite processing operations to relevant knowledge. The prototyping, testing, evaluation and evolution all use the formidable power of the computer, but the initial spark come from human creativity. The aim of this paper is to resolve the missing integrative vision of culture as a phenomena concept within the existing ontologies. One common criticism of visualization research is that it presents techniques that are technically interesting but that do not provide solutions to real problems. This is a classic problem in research tool and system designs, where technologists have a vision, based on what is computationally possible, but lack an understanding of what is really needed to solve the problems of their generative systems to become a source of inspiration for architectural design process. The new relations between digital form and digital processes are contributing today to the emergence of new conceptual vocabulary, and domain knowledge. Ontologies are known as artifacts designed to model domains of knowledge in a machine understandable manner. In order to exploit machine power in historical data processing it would be necessary to achieve machine interpretable knowledge which is tied with knowledge representation and ontologies. Creative thought potential users. The solution to this problems are the imaginative use which means using the computer like the genii in the bottle to compress evolutionary space and time so that complexity and emergent architectural forms are also a source of inspiration.**

***Index Terms*— Architectural identity, knowledge, ontology, generative design, metadata.**

I. Introduction

For the sake cultural continuity, how is it possible to explore the role of digital media in relation to the way our knowledge and concepts considering architectural heritage are transformed to design models, digital processes and methodologies. The combination of interactivity, transformability and parametrically controlled perturbations that generate discrete structural variations within design formation processes is an emerging characteristic phenomenon of digital design. If digital design knowledge constitutes among other things a new set of conceptualizations, including ideas related to the meaning of form, the nature of functional and formal knowledge, and the models of generative processes, there is a need for an encompassing theory of digital design pedagogy that accommodates this modified knowledge base. The involvement of multiple knowledge structures in creative thought, however, poses a host of questions [5]. For example, do some forms of knowledge provide a particularly useful basis for the generation of ideas and the formation of creative problem solutions? Is creative problem-solving more likely to occur if multiple knowledge structures are applied? "Fig. 1" identifies the types of knowledge structures that act both alone, and in combination, to influence idea generation and creative problem-solving. Regardless of what might be the particular formal vocabulary, syntactical and formal knowledge is strongly accepted as a foundation of design pedagogy in architecture.

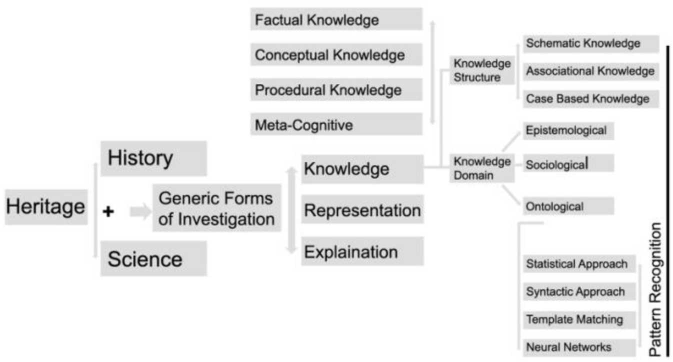

Fig. 1. Heritage and knowledge.

II. Data In Historical Knowledge

Due to the quality and quantity of data in historical knowledge and the way it is acquired, the main complexities in the design of conceptual models lies in epistemological arguments rather than engineering models. Therefore, it is necessary to investigate and clarify our epistemological assumptions (what usually taken for granted), before designing an ontology for history and archaeology. Ontologies and vocabularies play an important rule to provide different conceptual definitions and to draw the relations between them. So, cultural domain can be better integrated to the semantic web having domain ontology. In particular, ontology allows for constraining, expressing and analyzing the intended meaning of the shared vocabulary of concepts and relations in a domain of knowledge. Hierarchical classification systems and structured vocabularies do not lend themselves easily to rich inter-linking of conceptual „trees‟. A major step further in this direction is the object-oriented conceptual "Knowledge Cube". The metadata are represented through an ontology features that will be grouped into meaningful entities, attributes and relations "Fig. 2". Both *plain* and *ontology-driven* metadata might have attributes in order to represent the properties of an information resource [4]. The attribute values can range in different domains. They can be numerical, textual, and categorical or even represent spatial and time extensions. If the attributes are numerical, textual, spatial or temporal there are explicit encoding of relations among the attribute values.

The object state is defined by its *attribute values*. The *object behavior* is defined by services (*operations*) that an object can perform when requested by other objects. The object *identity* is a unique property of an object by means of which any two objects in the system are considered different even if the share the same attribute values and operations [3].

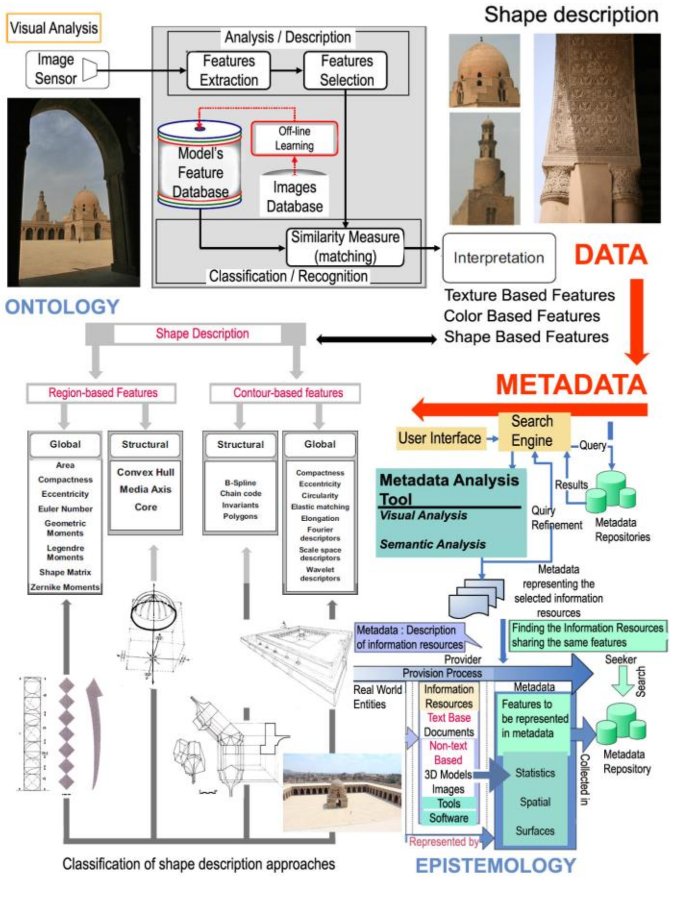

Fig. 2. Data, Meta data, and style analysis.

Feature selections for these objects and the patterns to be recognized and classified, are represented by measurements referred to as features. In order to classify objects, an appropriate set of features has to be selected.

Architectural buildings are composed of not only functional objects, but also visual form objects that are represented with points, lines, planes, or, volumes. Relationships are the way objects are organized. Knowledge of an object can be represented with relationships in hierarchical structures. With Shapes, the schema is a hierarchy structure that is composed of spatial relationship between sub shapes or semantics of shapes in pattern to identity relationships, and sets of congruent relationships that specify higher relationships.

III. Round-Trip Knowledge Cube

Software engineering is concerned with providing an architectural solution for the system, while designing and integrating architectural components into an operational system, which could benefit from round-trip visualization "Fig. 3, 4". This kind of visualization provides a useful support in the query refinement. In other terms, the similarity exploitation in the metadata analysis makes machine understandable the fact that when the user is searching for data having "courts" as theme and he gets unsatisfying results, the system suggests him to refine his query. It can be adopted to ease the *vocabulary problem* presented in that section. Let us suppose to have the following scenario: the seeker has to acquire architectural data dealing with a type of space in a building type. He formulates his query, but it fails since he adopts different terms from those exploited by data providers to indicate the same type [2]. The ontology visualization allows identifying the relationships among them. For instance the selection of a rectangular type internal court by a simple click on the ontology graph, allows understanding that spatial configuration of the Alhambra in Spain is more similar to that of Karaouine Masjid in Fez, Morocco. Research operations such as associations, analytic characteristics (*Environmental-Formal-Ideological-Technical*), comparisons, and history/description can be performed for various architectural building types, building components and building elements of Islamic Architecture in its different styles, regions and dynasties "Fig. 6".

The graph visualization helps the seeker to analyze and better understand this style of architecture. This visualization is able to provide an explicit representation of the schematic relations: it shows the structure of the ontology where each object is a theme and each element is an "is-a" or "part-of" relation [1]. This knowledge cube provides characterized-driven modeled classification for elements of design in Islamic Architecture.

Schematic knowledge, however, not only entails principles for organizing, or establishing relationships, within a category or concept, it also involves the construction of relationships linking different categories or concepts. Schematic knowledge provides a basis of analogical problem-solving with the application of feature search and mapping mechanisms.

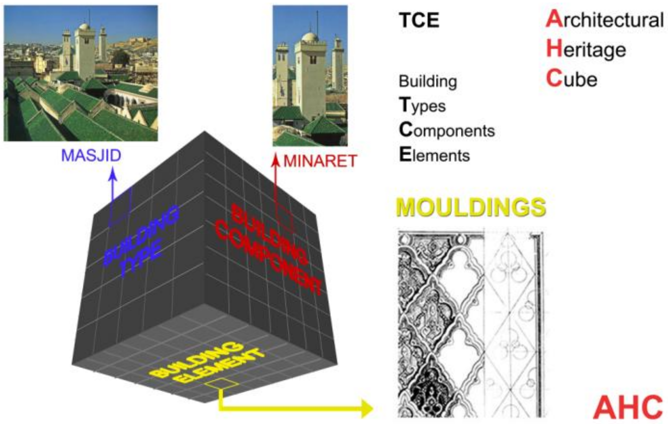

Fig. 3. Multi-dimensional representation of architectural data concerning building objects.

Interaction diagrams show how objects communicate with each other via their features. In particular, sequence diagrams show the temporal ordering of messages between objects and features. In particular, the collaboration diagrams can show exactly how the objects, features and associations in the class diagram *collaborate* to achieve the tasks and processing steps specified in the use cases.

Fig. 4. Multi-dimensional representation of architectural data concerning time, place and dynasties.

In the UML, visual modeling is an arrangement of so-called classifiers. A classifier is a model element that describes the system‟s behavior or structure and that normally has a visual representation. In our case, we have three main classifiers that are: urbanization classifiers, building classifiers, and articulation classifiers.

Through the identification and description of the principles and processes of designing, the nature of design knowledge, and the cognitive frameworks of design, one can approach to the foregrounding of present and future implications of digital technology that can be formulated in relation to the conceptual categories of design research methodology "Fig. 5". In this regard, we can propose that the design methodological research can constitute a conceptual framework for the formulation of a theoretical approach to digital design. The navigation system is based upon three-dimensional aperiodic spatial tiling "Fig. 3, 4" and this could be an important contribution in the direction towards more topological and less compositional grammars.

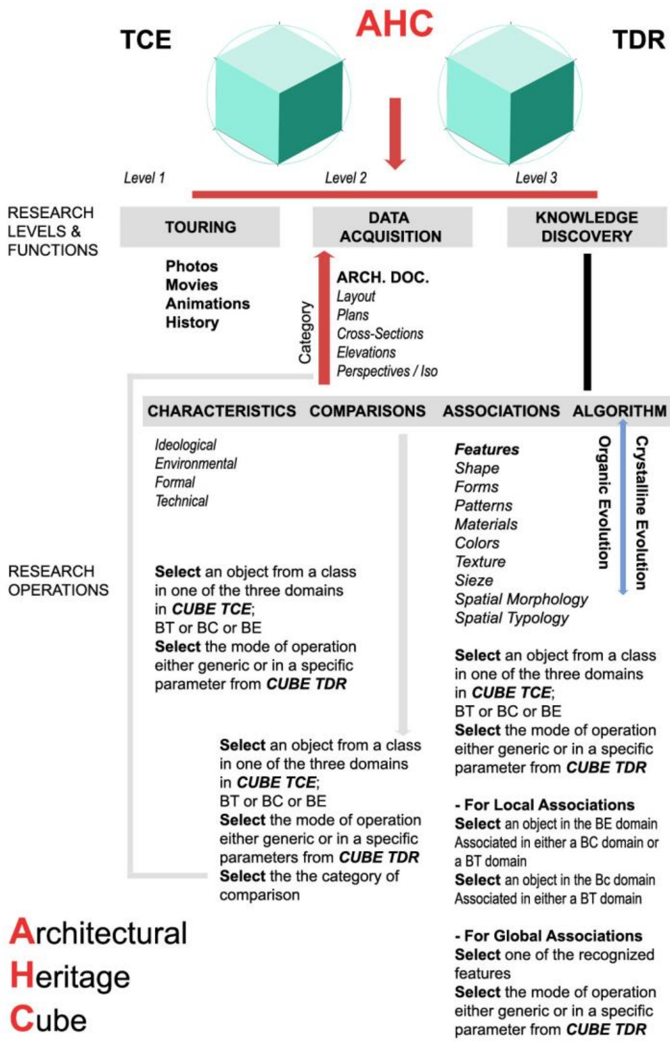

Fig. 5. The conceptual categories of design research methodology

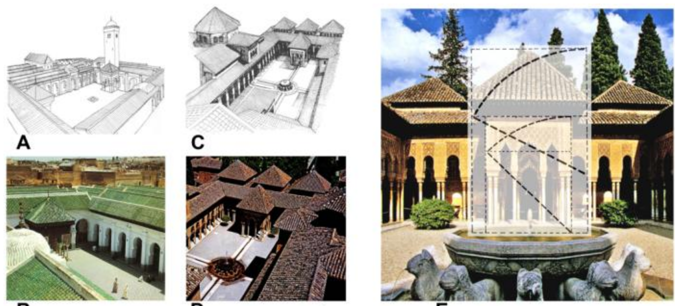

Fig. 6. Architectural *Associations*, *comparisons*, and *characteristics* as it should exist through research operations: – A, B: The al-Karaouine Masjid in Fez, Morocco built 859, C, D: Alhambra Palace in Granada, Spain, built 1314-1417. E: Proportions in the internal court of the lions at Alhambra.

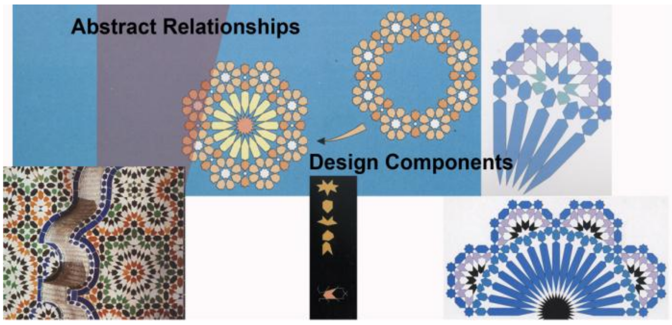

Fig. 7. Algorithms as it should exist through research operations (crystalline evolution). The processes of variation, recombination and selection on the basis of fitness underlying most processes of evolution and adaptation.

IV. Future Work

The knowledge cube could be implemented to be in the form of a software application which could be developed to include an additional cube dealing with elements of cultural heritage, that have a close and an integrated relation with the formation with that style of architecture in the first cube. That could enhance the way we understand the architectural heritage of a specific civilization.

This second cube will give the chance to an easy link between any architectural object and most of the surrounding environment which was acting and reacting with that architectural heritage in its spaces and details.

The knowledge cube could also be useful in e-learning, especially with the addition of the cultural heritage cube that would enable a comprehensive way of learning besides giving a deeper analysis and understanding to the various aspects "Fig. 8" that forms and reforms any civilization.

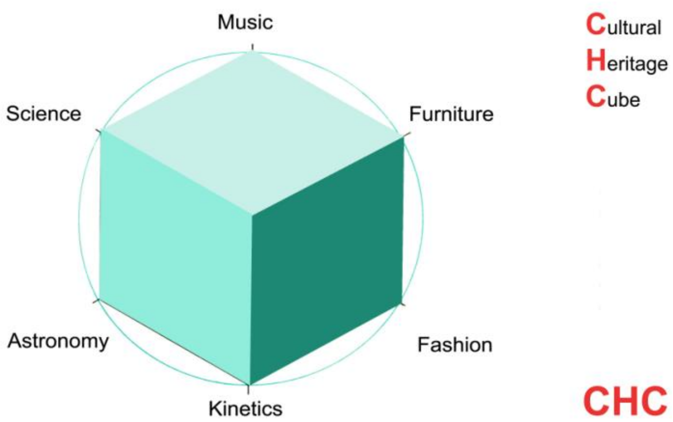

Fig. 8. Second cube dealing with elements of cultural heritage.

V. Conclusion

The use of three-dimensional displays and interaction devices to explore real-time computer-generated environments" that provides a structure through which new technical, aesthetic, and scientific standards can be defined and implemented, and whereas to represent the long-termed socio-cultural and environmental developments.

Ontologies together with epistemology will play an important role in the Semantic Web which is an extension of the well-known World Wide Web. In the semantic web, ontologies provide a shared understanding of a the multi-disciplinary extended enterprise including style, form design, historical background and a much more real definition of detailed characteristics of this interactive knowledge. The knowledge cube could re-address key theoretical issues (e.g. „formal knowledge‟, „models‟, „representation‟, etc.) that preoccupied the design community of that generation, and also re-address the process of „the trans- valuation of values‟. This could also resolve the missing integrative vision of culture as a phenomena concept within the existing ontologies. In this case, trans-valuation will take the form of a characteristic reinterpretation of root concepts that have been central to that previous theoretical discourse. Histories are also a rich source of material for learning. Previous stored cases can be used as a basis for abstraction or analogy, while cases with common similarities may help synthesize generalized knowledge.

Regardless of what might be the particular formal vocabulary, syntactical and formal knowledge is strongly accepted as a foundation of design pedagogy in architecture. Beyond the exploitation of digital media as tools, the relation between digital design and digital design models as a form of architectural knowledge has begun to emerge as a significant ideational resource for design and design education.

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