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GIS is/and Knowledge: Documenting and Managing Catania's Historic Urban Heritage

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Abstract: The present study shows the results of a research aimed at the knowledge of the significant features of Catania's urban environment. The complexity of the different features of the city, the several scales of representation, the multi-dimensional objects and the historical, anthropic, formal relations have produced different kinds of information requiring a flexible instrument that is able to transcribe images, charts, texts and symbols in a single model of representation. In the perspective of creating a fundamental cognitive framework, the research team paid attention at drawing up a GIS (Geographic Information System) for documenting and managing historic urban heritage. The idea is to have a structure able to collect data like a logic archival system or an open database, which can immediately be consulted and constantly implemented. Indeed, the aim of this GIS is to organize, manage, query and visualise the peculiar aspects which characterize Catania's architectures. Thanks to multi-directional "access-windows" it is possible to navigate through its contents (texts, drawings, 3D rendering, pictures, historical documents). The system will also allow the integration of several documents in a common geo-database up to visualise the most meaningful details. Its use could assure suitable proposals of urban transformations and coherent plans in using and/or managing heritage goods for a sustainable city development.

Key words: Urban and architectural heritage, GIS, safeguard, knowledge.

1. Introduction

The historical centres of our cities represent the collective memory of the several civilizations which have left a trace of their presence. As a matter of fact, the sense of belonging and respect to our own territory develops from the identity elements of places, which make up a territory's cultural link.

Knowledge and information are the main steps for the preservation and the valorization of the whole cultural heritage. This means that to provide the respect for identity and singularity during years it is necessary a more active historical-scientific document research.

The present study deals with results of a research, still in progress, aimed at the knowledge of the significant features of Catania's urban environment. The complexity of the different features of the city, the several scales of representation, the multi-dimensional objects and the historical, anthropic, formal relations have produced different types of information. Thus, a flexible instrument [1] able to transcribe images, charts, texts and symbols into a single model of representation is required.

For this purpose geomatics has been used. This discipline explains phenomena observed from a territorial scale point of view, starting from knowledge and instruments that are able to acquire, integrate, archive, handle, analyse, manage and distribute geo-referenced spatial data.

By means of GIS (Geographic Information System) the urban environment becomes like a "hypertext" that memorizes structured information concerning different objects. These last are placed in their spatial position and defined by their reciprocal topological relations. Thanks to the conceived structure it is possible to manage, organize, investigate and visualize the most interesting features of Catania's historical architectures. The GIS is open to further integrations and updates. Each user can carry out his own process of knowledge by reviewing and printing data.

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It is a multi-scale system that allows integrating many kinds of documents on a common geographical database: starting from a cartographic overview up to visualize the most meaningful details (constructive, formal, morphological, figurative, stylistic ones, etc.). As a matter of fact, surfing through "access windows" it is possible to get contents (texts, drawings, 3D views and renderings, historical documents, etc.).

The main goal is to reveal the transformation potentialities of historical urban areas by giving "answers" to each question, arranging programs on management, improving the utilization of cultural assets and carrying out interventions for the protection and development of the city [2].

2. Case Study: the Urban Environment of Catania

Catania's historical center is rich in events that have changed the city both from an architectonic point of view and from a chorographic one (earthquakes, volcanic eruptions). In order to manage and communicate the complexity and the heterogeneity of information concerning the city, a single "platform" has been structured and arranged.

As field of investigation we have chosen the urban area related to via Umberto I and viale XX Settembre which were the main expansion axis of 19th century city [3–6]. As a matter of fact, these new roads mark the expansion of the city from the north-east towards the sea. Furthermore they cross Via Etnea, the main axis of the city in north-south direction from Piazza Duomo up to Mount Etna's sides (Fig. 1).

Thus, in the city a new center has born. This could be considered a propulsor for the new urban expansion through a system of orthogonal meshes that connects the eastern coast to the new area where trading was supposed to take place. The new project, linked to a chessboard model system, was supposed to create homogeneous city blocks. In reality, the final result is that in the same block there were different typologies of buildings. Indeed, these new city blocks overlap the pre-existing urban fabric (extra-moenia) born without a criterion of salubrity and hygiene (Rinazzo, Carmine, Redentore).

These pre-existing areas used to be low-lying and underdeveloped compared to the road level of via Etnea with its elevated curtains that made up a sort of scenography. Thus hiding poverty and unsatisfactory hygienic conditions. The heterogeneous condition of blocks overlooking the new roads network has led to the study of the morphologic-figurative features not only according to an architectural scale but rather at an urban scale in order to study the relations with the past [7, 8].

Fig. 1 Urban fabric of Catania interested by the development of via Umberto I and viale XX Settembre.

From the noble architectures, that hide miserable blocks, we then pass on humble buildings, with one or at least two levels, memories of a still existing past along the narrow alleys and courtyards (Fig. 2).

The carried out structure is a "cognitive representation" which takes example from the direct experience and in situ survey, from drafts and models built, from researches and stories reported. The material has been integrated with historic-archive sources in order to understand if there are any relations between social-economic and physics history. It is also a support for the creation of thematic maps, views, charts that tell the story about the urban environment, its natural inclinations and suffered amputations.

The use of these instruments applied to the urban and architecture scale allow the simultaneous development of the cognitive system. The GIS guarantees the circulation of information and the involvement of actors together with a periodic updating of data.

The redaction in the GIS environment of the informative database dealing with the urban area of Catania allows to have forecasts, Datum changes, transformations related to coordinate systems.

The GIS allows to associate to the information collected at end of the survey the qualities of the objects (archival projects, technical reports and photos; metric data, typological, historical information, current photos, 2D and 3D survey elaborations) and of the relations which characterize a certain context. Thus it is possible to monitor the urban environment at different scales through simulation systems. As a matter of facts, the superposition (overlapping) of thematic layers also allows to understand the complexity of the key variables and the reciprocal interactions.

In a few words, the conceived structure is a data base which tells the story of Catania's urban fabric history by means of different kinds of documents (texts, pictures, drawings); which preserves the sites' identity, its origin and changes through the memory of the past and the knowledge of present.

Finally, it is a way to pass down to future generations the history of the city and its changes.

3. Database Structure and Contents

In the perspective to create a fundamental cognitive framework of the surveyed urban area, the research team has elaborated a structure that is able to collect data into a defined and interrelated logic archive system. It is built like an open and flexible database, which can be immediately accessible and implemented (Fig. 3).

In fact, today the logic of the informative system can be considered as the best system to represent the city's complexity since it can link lots of non-homogeneous

(a) (b)

Fig. 2 (a) The noble architecture which hides poor buildings; (b) The humble building from one to two elevations memories of the pre-existent Rinazzo quarter.

information and it can manage and visualise them according to several parameters and different interpretative keys [9–14]. In this way, during the consultation each user can get directly information without following sequential predefined steps.

Starting from these methodological presuppositions, ArcGis Software by ESRI has been used since it satisfied all the needs and requirements of the conceived structure [15–18].

Two connected data banks have been created: the "geographic data bank" and the "informative and descriptive data bank" (Fig. 4). The "geographic data bank" concerns the surveyed area and the buildings involved along via Umberto I and along viale XX Settembre. It has been created by supplying georeference to the Gauss-Boaga national system. They have been geo-referenced both the drawings concerning surveyed buildings (trilaterations, ground floors, first floors and roofs) and the cadastral historical maps of Catania. These last ones are very important because through their overlapping it is possible to understand the evolution of the urban fabric of the city.

Moreover, it has been created a data bank, which can be systematically implemented, concerning a cataloguing chart of the buildings. It links at the same time the informative content and the description of each catalogued building.

The correlation between the two data banks has been realized according to some flexible and interrelated ways by allowing different reading itineraries. Thus, it is possible to visualize in a very simple way, even from a cartographic point of view, all the interested data (i.e., through the creation of adequate thematic maps).

The final goal is to have interconnected information thanks to the creation of an informative system that going from the general to the particular allows more and more a closer approach to the single building. It is also possible to have a double reading key: an "horizontal" one for the different thematic characters of the surveyed area and a "vertical" one for single buildings. Therefore, starting from general information

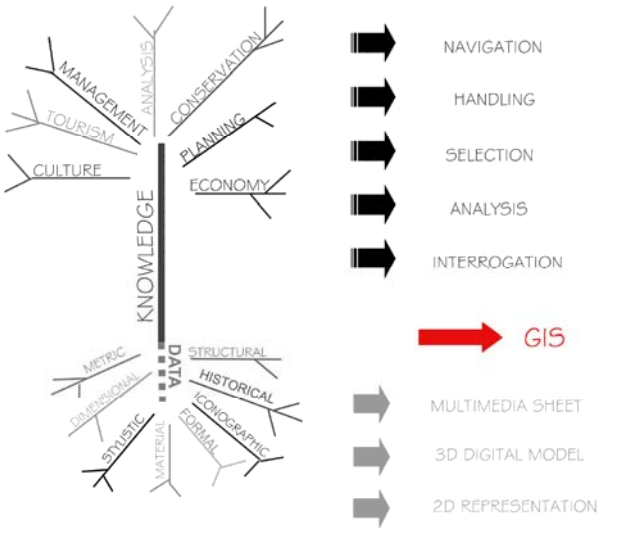

Fig. 3 Organisation of the process of knowledge through a tree structure.

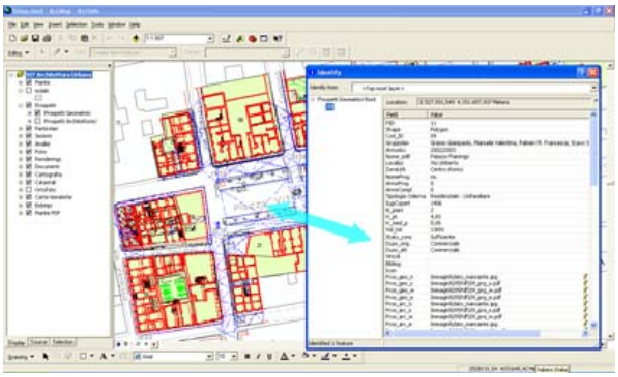

Fig. 4 The "informative and descriptive data bank" related to the "geographical" one.

we are able to reach very specific information on each single building even its architectural quality.

3.1 Geographic Data Bank

The geographic data bank represents the core of this informative system. It represents not only a meaningful cartographic reference for all buildings in the urban area of Catania, but also the data structure in which all the necessary information of the descriptive and informative data bank are linked to. Moreover, to geo-reference the buildings related to the two road trails simplifies: the future integrations for other areas of the city; the overlapping and/or the comparison with any other geo-referenced spatial reference into a single work area; the possibility to carry on spatial evolved

analysis (like geo-processing) typical of the GIS environment.

The Geographic data bank is based of the following components:

- vector numeric cartography of Catania in Dwg format at a 1:2000 scale, natively geo-referenced in the Gauss-Boaga system;
- Digital colored orthophoto of the Region of Sicily in ECW format at a 1:10000 scale, natively geo-referenced in the Gauss-Boaga system;
- Historical cadastral maps (1876, 1884, 1897, 1925) in Bmp format, specially geo-referenced;
- Plan drawings regarding trilateration, ground floors, typical floors, roofs, cartographic codified representations according to the UNI (Italian Organization for Standardization) Normative 7310/74 in DWG format, specially geo-referenced and put in different layers in order to carry out typological investigations on the urban fabric (Fig. 5);
- The different buildings have been identified through an ID code and recorded into a single layer in shapefile format, based on polygonal geometry, related to all buildings interested. This format has a database embedded thanks to which it is possible to have an easy access (just a mouse click) to one of the data linked to the polygons which represent the buildings.

Thus, the shapefile corresponding to the building represents the heart of this GIS structure since the "descriptive and informative data bank" are linked to it thanks to ID codes.

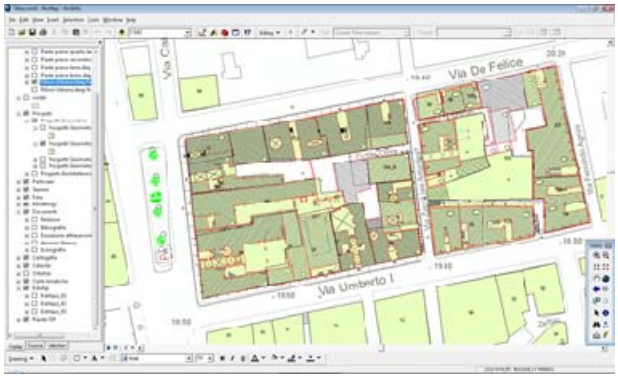

Fig. 5 Codified representations according to the UNI Normative 7310/74.

3.2 Informative and Descriptive Data Bank

Informative and descriptive data concerning the single buildings has been uploaded into the database connected to shapefile by providing a cataloguing chart. This is composed by many fields coherent to the complexity of the elements which constitute it. This chart has been conceived in order to guarantee an exhaustive data management, full of any detail, user friendly for consultation, visualisation and printing, with a good performance.

The first part of the record — "informative data bank" — holds alphanumeric information on the surveyed building and it has been created according to the following fields: building identification code, work group, academic year, name of the building, location, urban area, designer, plan year, year of accomplishment, typology (civil, military, religious, social, funerary), cadastral references, covered surface estimate, number of floors, height of ground floor, average height of the other floors, total volumetric estimate, preservation state (awful, mediocre, sufficient, good, excellent), current and initial purpose of use regarding the ground floors, presence and typology of the constraints. Each one of this information can be quickly fetch from the map by clicking on the shapefile of the building concerned.

The second part of the chart — "descriptive data bank" — collects descriptive data on the involved building, describing the current state thanks to: photographic images and surveys (drafts, trilateration, plans at different levels, geometrical elevations, architectural elevations, details, sections, renderings and animations), graphical documentation that can be found in the historical archives, illustrative reports, iconographies, bibliography related to the building.

In order to guarantee a full availability of the contents and at the same time to protect them from any possible manipulations, PDF format has been used where possible (Figs. 6–8).

It is possible to access to these last data through the hyperlink function: by activating the object of interest

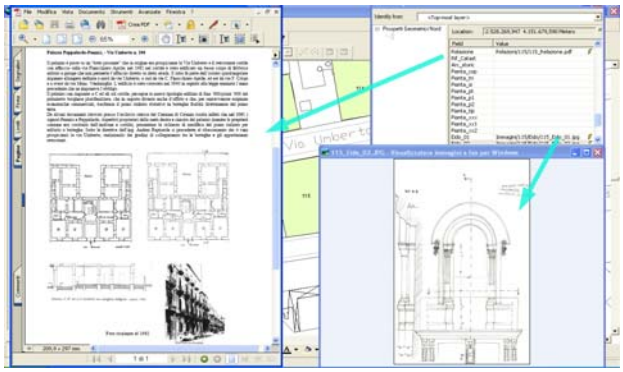

Fig. 6 The historic report and the sketches concerning a building.

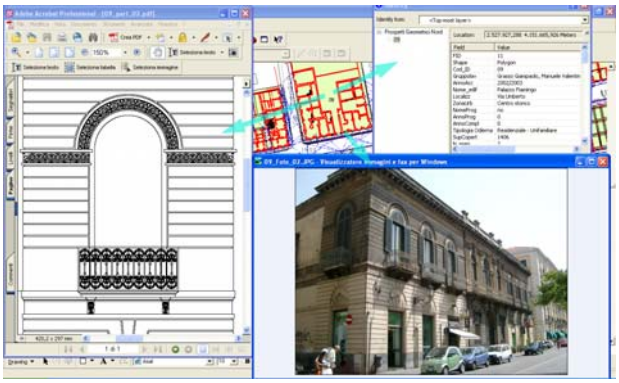

Fig. 7 Picture and architectural detail of an historic building.

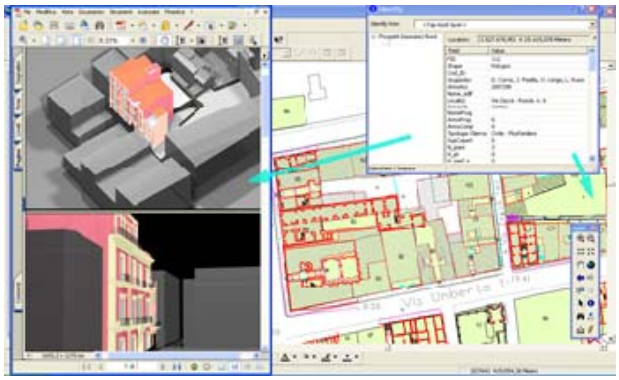

Fig. 8 3D views concerning a city block.

of the "descriptive data bank" from the legend and clicking directly on the map, on the correspondent building.

4. Conclusions

It has been developed a multidisciplinary, flexible and changeable reading model. A model through which it is possible to read the complexity of the natural and social evolution; a cognitive model based on the cultural structure of places, which describes transformative and modifying process of places.

The amounts of documentation, information collected during the survey and the following graphical processing, have decisively influenced the total size of the informative system. The database is now composed by 130 charts and 4,000 enclosed files.

The developed structure is a connective environment open to further integration. It allows an active cooperation between subjects who can get in touch thanks to it, in order to exchange, compare and discuss about themes and experiences related to auto-sustainable [19] local development and its way of representation.

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