Spatial Diagnosis as a Means to Design Mediated Spaces

Marianthi Liapi, Konstantinos Oungrinis
School of Architecture, Aristotle University of Thessaloniki, Greece

This paper addresses the concept of spatial diagnosis as a methodology for architects to analyze and evaluate the quality of existing spaces periodically and improve them with the use of digital media. Initially the methodology researches the physical characteristics of the examined space, which are investigated both historically and empirically, as well as people's mental imagery of it, which is examined through cognitive mapping techniques. The research findings are used as a mapping device for the application of the digital media 'treatment.' Selected intelligent systems form a digital, immaterial layer upon the existing spatial elements increasing the quality of space and consequently improving people's experience in it. The goal of this project, which focuses solely on public spaces for the extent of this research, is twofold. On a design level, it proposes a way to increase the quality of space as well as its potential to communicate with people through a synergic, adaptive approach. On a research level, it seeks to bring together three diverse but not distant disciplines, those of architecture, cognitive psychology and information technology.

***Keywords**: Spatial diagnosis; mental imagery; digital media; mediated spaces; user-space communication.*

Architecture and representation: ascribing meaning to space

Architecture has a discreet but powerful influence on the human mind. Geometric forms, decorative elements and spatial relations, regardless of their complexity, gradually unfold to become evident to the thinking eye. People on the other hand are the energy unit for the building. Their presence and their activities is the catalyst that turns a space into a 'place' (Lawson, 1999). The 'liveliness' of a building is a direct effect of people's actions in it. Without people a building is like a machine lacking the power to operate. It is a variation of the philosophical notion of what does really exist if people are not there to experience it. An empty building is considered inanimate. The paradox is that the feeling of inertia remains even when people occupy space because the actual building stays inanimate, unless an external factor (e.g. people) moves or causes the movement of some of its elements -like the puppeteer moves the inanimate puppets.

From the first steps of the conceptualization, in the mind of the architect, the building is also inert. It could be argued that after a stage of fluidity during a form-finding process the intent is to 'freeze' and produce something inert and passive –a background for people's actions rather than a "living cell." To continue the argument, the deliverable of the design process is the materialization of a mental image that was accepted in the mind of the architect as the most promising form to fit the given building program.

Within this frame, the produced form is intended to express the architect's metaphors and subsequently to impress people rather to be occupied by them. As with any fixed composition, the spatial characteristics of a building trigger a temporal interest in people's mind. The duration of the first impression is intimately linked with the elaboration of the form and the decoration, both comprising a building's communicative tools (Liapi, 2005). The more interesting form and decoration are the longer people's interest will last. But this is an ephemeral glory. After people realize that there is nothing else to see, nothing to engage them longer with space, they cease to 'pay attention' to the building itself. Subconsciously they place it at the background as a fixed, familiar stage for their activities, while they save memory and energy for computing other stimuli of everyday life (Milgram, 1970). Does this mean that people become oblivious to space after frequent use? Does this mean that architects design only for that first impression?

Going deeper into the domain of cognitive science, one discovers that the mental imagery of space that people create is different from the mathematical uniform model of architectural space (Tversky, 2003). People cognitively recompose space with subjective dimensions perceived through experience. In order for the mind to comprehend what the body is involved with, it extends (Bergson, 1988) a mental virtual projection from a central point, Husserl's nullpunkt (Jormakka, 2002) and reconstructs a 'caricature' of the actual space, an impression. Descartes in his Optics talks about the "sensory awareness of the soul" claiming that the feeling, the impression of an object, is more important for people than the actual image of it formed in their minds (Cottingham et al., 1991). The key elements of the reconstructed mental image are spatial 'landmarks' that are considered either important (because of their scale) or meaningful (because of their context) or both. These "cognitive reference points" (Tversky, 2000) constitute conceptual beacons that give stimuli to the human intellect and help people immerse themselves in 'their' world (Virilio, 1996).

Architecture has always been the catalyst in this process, as it constitutes the medium that provides artificial space with meaningful points of reference through representation. Representation is one of the dimensions of architecture. It is another layer in the design process that creates landmarks in space, which are meant to convey messages, passively, to the human user (Liapi, 2005). Representation is manifested through a building's form and through its decorative elements. The form of the structure transmits more abstract messages aiming toward an overall impression. Decoration on the other hand has a more personalized nature since it encompasses a multiplicity of details, closer to the human scale, that can 'tell' people a story.

Methodology

The concept of the diagnosis in general describes a process employed upon the emergence of a problem in order to identify it, understand it and confront it. It involves researching the history of the problematic situation, examining the present state for signs and symptoms around its occurrence and formulating a hypothesis on how to deal with it. It is a fluid process that adapts every time to the information revealed.

The concept of the spatial diagnosis seeks to examine and understand all the aspects around the problematic relationship between the space, the architect and the user that has direct consequences on their communication. The objective is to restore communication on the best level possible, affecting at the same time the nature of the relationship (Liapi, 2005).

The proposed methodology involves three stages of investigation:

Background Research

The first part of the methodology is about investigating the history of the examined space, from conceptualization, to implementation, and the stages of its (possible) mutation to its present state. It is a record of the building's 'profile' with reference to the architect's spatial vocabulary and the directives of the building program. Structural, formalistic, decorative and other 'frozen' architectural elements are numerically and objectively recorded, isolated from the animated parameters of people and time. The findings form the platform upon which the diagnosis will be built.

Empirical Observations

The information at hand from the first part of the methodology can be described as a canvas of an unfinished painting representing an objective reality of the examined space. From that point on, the architect/researcher works on-site in order to record how space changes in the passage of time. The forces that cause those changes to happen are generated by people who occupy the examined space as well as by physical elements (e.g. sun-light) within it. The focal point of the observation is people's behavior in space, their activities (social/single, mobile/stationary, engaged with space/indifferent) and their relationship with spatial elements. Any other changes caused by external factors (such as sun-light, shadows, sounds and smells) are also important and therefore noted. The recording media can be either physical or digital. They vary from notes and sketches (like story-boards of the actions taking place) to conceptual diagrams, photographs, video, counting sensors and so on. The findings from this part of the methodology reveal the active and inactive zones of the examined space as well as the interesting and the indifferent elements of space that affect people's actions. Furthermore, the temporal observations inform the space's timetable, marking 'prime-time' zones.

Cognitive mapping - Questionnaires

This part of the methodology directs the architect/researcher to explore through questionnaires how people read (conscious), experience (subconscious) and remember (memory) the examined space. Moreover it targets the development of cognitive maps (Downs & Stea, 1973), mainly through sketching (Lynch, 1960). The questionnaire is based on the potential of all the study participants to provide the inquiry with valuable information about the present state of space as well as with directions for design proposals or even solutions to an acknowledged problem.

The questionnaires involve seven thematic areas targeting information about both the physical and the cognitive relationship of the respondents with the examined space:

a. time-related knowledge of the examined space.
b. the language of the examined space.
c. using the examined space.
d. user-space experience.
e. user's imagery.
f. user-space communication.
g. user's imagination (Liapi, 2005).

The invaluable aspect about the questionnaire is that it reveals 'preferences' and 'impressions' relating people with the examined space that could not be approached or identified through any other kind of research. The questionnaire can be completed either in the form of live interviews or digitally, through dispersed terminals located close to the place of interest. The results from both sources are processed conjunctively since an automatic questionnaire is simpler but easier to fill-in while the 'live' one is more detailed but is time consuming and requires human resources.

Diagnosis Findings

All the data gathered from the aforementioned parts of the methodology are analyzed, cross-examined and cross-validated. The outcome is a detailed identification of the present condition of the examined space. The findings are grouped and collapsed to form general and specific conditions that need to be 'treated.' The treatment in particular is directed toward 'healing' the identified problems, boosting up the 'healthy' agents and 'waking-up' space to communicate with people. The directions for the design of the mediated space are collapsed to design goals and, depending on the design approach, the appropriate digital media systems are engaged in order to achieve results in the most flexible and effective way.

This process can be repeated in the future to evaluate the 'evaluation' especially if the treatment includes embedded computation solutions, which can easily facilitate such a process. Even after the application of the treatment is completed, it can still be easily (re)-adjusted. Continuous loops can 'fine-tune' space until the findings ideally reveal maximum qualities to all categories and, most importantly, minimum negative impressions. The ever-evolving progress of people makes this process necessary.

Media Treatment

This is the final part of the proposed methodology. It employs research found in the field of information technology, interactive art and the gaming industry. Although the domain of information technology is still overwhelming for the architectural practice, the proposed methodology can be used as a tool for a controlled application of digital media. Whatever the design approach is, it should target the impression of people, increasing the quality of the examined (experienced) space -the measures of which were established through the previous examination- without affecting its physical elements. In this process, the designer is not requested to find a particular form but to create a dynamic, real-time responding environment, able to take many forms according to the changing conditions, such as a "sensponding" environment (Oungrinis, 2006).

Furthermore, using only immaterial illusions, the design targets experience rather than accommodation, much like a work of art but with a different purpose. The discreet difference in the case of art pieces that distances them from architecture is that, on the one hand, they are like parasites within the building organism that crave to steal all the attention from the surrounding space rendering it a dull, unimportant background, and on the other, they hinder the actual usage of space by creating singularities and anomalies, like 'traffic.' The challenging objective would be to plan and design the mutation of those parasites into symbiotic organisms that would act in favor of the hosting spatial environment. Art and architecture could become intimately linked for on more time (Risebero, 1979) with the transition from art installations to architectural applications. Moreover, the creation of immersive environments with digital media is not impossible since it is well developed today through the expansive video game design. Besides, MMORPG (Massively Multiplayer Online Role-Playing Games) have already shown the way toward orchestrating people's events when they interact with a system in real-time. It is just a matter of moving away from the computer screen.

To handle these issues, the proposed methodology employs contemporary media systems, selected for their function and effect (operating system and mechanisms), as well as for their methods and patterns of application. The systems vary from informational systems (simple programmed projections), to interactive projection systems (systems that have the ability to 'respond' to human activity), to 'memory' systems (systems that keep a trace of activity and fade over time), to sensor-actuator systems (systems that can keep track of the overall activity and maintain efficiency combined with economy) as well as smart materials or smart assemblies with changeable properties (elements able to respond to exogenous conditions with or without computer control) (Addington & Schodek, 2005).

Case study

The proposed methodology was tested within an existing space at the Massachusetts Institute of Technology (MIT), the Lobby of Building 7 (Liapi, 2005).

The first three stages of the methodology produced a detailed identification of the present condition of the examined space and its relationship with the people who occupy it daily. Three categories were observed and classified as following:

- findings related to implicit values (e.g. people used 'impressions' and 'feelings' as their prime mechanism to describe and, subsequently, to perceive space),
- findings related to explicit conditions (e.g. metric and other objective descriptions pointing toward signage, site related information and so on) and
- specific design proposals.

Following is a recap of the most important conclusions deducted that point to design directions in the treatment part:

- Space and its elements created a nearly transparent mental image that needed to be enriched.
- Active and inactive zones were located.
- Interesting and indifferent spatial elements were identified.
- Temporal observations informed the space's timetable, marking 'prime-time' zones.
- Positive impressions, such as monumentality and reverence, were linked to specific spatial elements (ionic columns, dome) and characteristics (symmetry, clarity of form) whose charac-

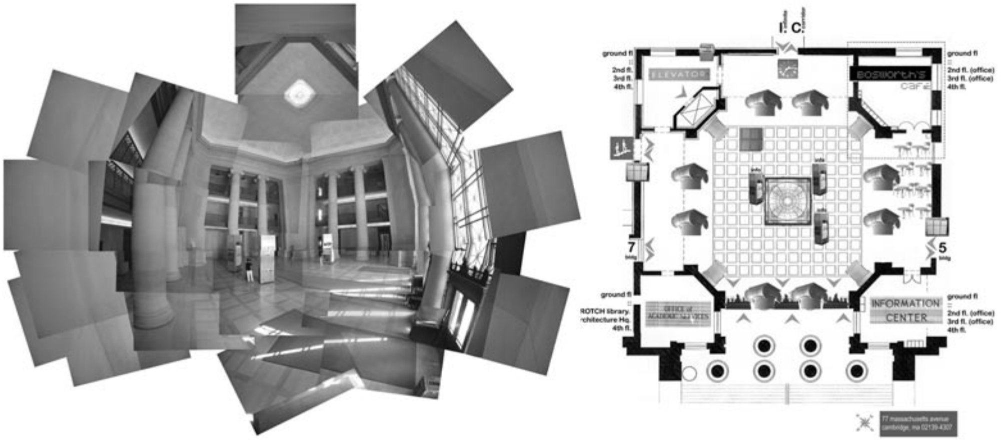

Figure 1
Collages showing the present state of MIT's Lobby 7.

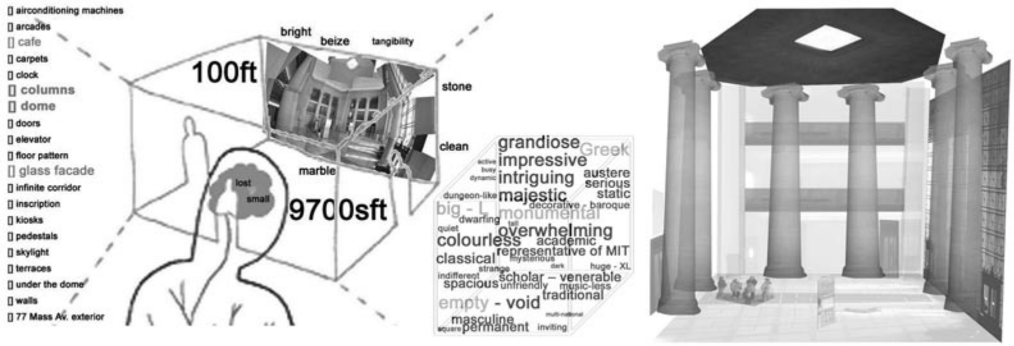

Figure 2
Cognitive maps of the same artificial space.

ter was not only to be maintained but also to be 'elevated.'

- Negative impressions, such as emptiness and inadequacy of signage, were not connected to specific spatial elements but when noted that came along with the desire for objects in an intermediate scale as well as for informative elements.
- Viewpoints on various levels were examined.
- The need for space accessories was noted. Suggestions though should bear a pedagogic meaning, permitting any kind of user interaction.
- Mobility axes and flows were observed in relation to the spatial elements that framed them.
- People had specific requests revolving around the MIT pride, unification, empowerment of identity and an engaging environment.
- The character of the institution required a codification to signify the differences between the MIT community and the community of people outside MIT.

The findings were initially analyzed, cross-examined and cross-validated and then grouped to form general and specific conditions that needed to be 'treated.' Two basic design directions for the architect/researcher emerged. The first dictated a more elaborate, in spatial elements, environment for people to create a more complete (and accurate) mental image of it. The second revolved around the dissemination of information. The media treatment was directed toward a 'sensponding' system (Oungrinis, 2006) which included:

- Large-scale projections with intelligible content, such as general information about MIT events, welcoming messages and so on, placed within the active areas while maintaining a discreet presence;
- Medium scale material interventions, such as property changing materials that can change automatically their appearance or form in response to conditions regarding weather, temperature, humidity, and so on;
- Small-scale digital interventions (light effects, audio-visual projections, holograms) carrying both intelligible and abstract content, placed within the inactive areas or upon the 'background' elements to elevate their importance in people's mental imagery;
- Embedded computing systems and transparent interfaces, which facilitate people-space communication without any mediums interfering in the process, since space itself becomes the interface.

The design goal was twofold. Firstly it had to increase people's interest in space and its elements, and as a result to inform a more complete (and accurate) mental image. This way, the indifference and the emptiness diagnosed initially were reduced while the sense of monumentality was further nurtured and increased. Secondly, it had to increase the informative dimension of space and by that to create a friendlier sensation that supported the MIT character. These goals were achieved through multiple mediums, comprised of embedded digital systems with overlapping areas of effect in order to maximize their efficiency, while maintaining a discreet character and presence in space.

For the achievement of the first goal, the proposed interventions were:

- 'Animated' lights on spatial landmarks (such as the ionic columns).
- Projections of colors and patterns from the top, at random areas, accompanied by music every now and then in order to create specific sensations.
- Media-surfaces on the walls of all the levels of the examined space that visualize weather, traffic or other external conditions.
- Memory-tracing materials and installations on the floor as well as on mobile elements of space to visualize human presence and flows.

Comments – All these projections should be ambient in character, with increased intensity programmed at times where a highly impressive surrounding is required.

For the achievement of the second goal, the proposed interventions were:

- Digital projections or even holograms with welcoming messages as well as information on MIT events, floating in the middle height of the Lobby area.
- Holograms of MIT 'gadgets' placed within specific areas.
- Small-scale information projections regarding the MIT topography, the MIT history, dining options at MIT and so on.
- Projections of various views of the lobby taken from cameras installed on various levels of space in order to create a feeling of accessibility and possibly to reduce the magnitude of the scale.
- Personalized information given through info-booths or smart surfaces preferably placed within the inactive areas of the lobby. There should be efficient signage though to announce their presence.
- Game-like projections on various screens scattered in space to intrigue and entertain visitors.

Comments – All the MIT information should be "coded" in order to align with the policy of mind exercising and distinct identity.

The use of MIT technology for the realization of those goals was a popular demand. Research indicated the possible applied media found suitable to satisfy the design goals. Most of them were projects researched by MIT Media Lab and by MIT CSAIL groups (to name but a few):

- The *Gesture-Sensing Radar*, the *Window Tap Technology* and the *LaserWall* projects by the Responsive Environments Group (www.media.mit.edu/resenv: May 2005).
- The *Collective Memory/Collective Intelligence* and the *Playful* projects by the Ambient Intelligence Group (ambient.media.mit.edu: May 2005).
- The *Teleaction* and the *Sociokinetics* Projects by the Sociable Media Group (smg.media.mit.edu: May 2005).
- The Pervasive Human-Centered Computing Project *OXYGEN* conducted at MIT's CSAIL[1].

[1] oxygen.csail.mit.edu/Overview.html#today: May 2005

The application of MIT technologies would simultaneously cover for the explicit needs of the users, such as the dissemination of information and the ability to create 'games' in order to explore MIT, while increasing feelings of MIT pride. The game design industry has already employed the 'knowledge' of design from various fields such as "architecture, software engineering, evolutionary biology, mathematics, and interaction design" and of interaction environments from the fields of "sociology, social psychology, psychology, and cognitive science" (Björk & Holopainen, 2005).

This fact indicates the close relationship that game design has with the conducted research and the proposed methodology. The reason why the architect/researcher should employ the use of specific game-design patterns is because they facilitate open-ended design (Liapi, 2005). Their success in grasping human attention and affecting the player's impression is considered *de facto* for the extent of this paper based on their wide-spread and popular-belief. Based on the work of Björk & Holopainen (2005) in the domain of game design, the pattern examples that can be employed in the treatment process and the elements that comprise them are: game world, strategic locations, patterns for information presentation, illusion of influence, immersion (spatial, emotional, cognitive, and sensory-motoric immersion), anticipation, freedom of choice, creative control, narrative structures, characters, identification, cooperation, constructive play, social interaction. These patterns are designed through the programming of the controlling system and should be evaluated on a regular basis. With constant evaluation, space will eventually be 'fine-tuned,' as it will always try to reach the maximum desired potential.

Conclusions

By bringing together the three diverse, but not entirely distant, disciplines of architecture, cognitive science and information technology in an iterative, adaptive design process and by establishing the presence of the human user in the mind of the architect, this methodology provides the plateau for the development of a vocabulary with which space will be in a position to communicate actively with people.

Escaping the traditional notion of designing a physical space, the notion of actually designing events rather than the 'limits' within which they will occur engenders exciting new directions (Liapi, 2005). People do not understand the mathematical space (Tversky, 2003). They understand a fictional one by constructing its mental image and by keeping it updated through experience.

Now architecture can aim directly to affect that image. The evolving 'place' can be rendered 'alive.' People can increase their connection with their spatial surroundings. The 'cold' quality of the 'absolute' produced by mathematics can acquire 'warmth' with the projection of illusions attending to various needs and desires that, perhaps most importantly, follow their fluctuations.

The proposed methodology is a tool for a participatory, synergic design process. In this process, people's mental imagery becomes a very potent medium for architects to see through the eyes of the actual users of space and use the imagery as a mapping device for the application of information technologies. Their design repertoire is expanded as they become able to control media applications in space. The methodology's end product is a fine-tuned, mediated environment produced by 'immaterial' low-cost interventions, able to cover aesthetic needs and to boost functional issues and also able to reinforce mental links that people create with space.

References

Addington, M., and Schodek, D.: 2005, Smart Materials and Technologies for the Architecture and Design Professions, Architectural Press, Oxford, UK.

Bergson, H.: 1988, Matter and Memory, Zone Books, New York.

Björk, S., and Holopainen, J.: 2005, Patterns in Game Design, Charles River Media, Hingham, MA.

Cottingham, J., et al. (eds): 1991, The Philosophical Writings of Descartes: Volume 3. The Correspondence, Cambridge University Press, Cambridge, UK.

Downs, R.M., and Stea, D.: 1973, Cognitive maps and spatial behaviour. Process and products, in R. M. Downs and D. Stea (eds), Image and Environment: Cognitive Mapping and Spatial Behaviour, Aldine, Chicago, IL, pp. 8-26.

Jormakka, K.: 2002, Flying Dutchmen. Motion in Architecture, Birkhäuser, Basel.

Lawson, B.: 1999, The Language of Space, Architectural Press, Oxford, UK.

Liapi, M.: 2005, Spatial Diagnosis and Media Treatments, SMArchS Thesis submitted to the Dept. of Architecture, MIT, Cambridge, MA.

Lynch, K.: 1960, The Image of the City, M.I.T. Press, Cambridge, MA.

Milgram, S.: 1970, The experience of living in the cities, Science, 167, pp. 1461-1468.

Oungrinis, K. A.: 2006, Transformations. Paradigms for Designing Transformable Spaces, Harvard University Graduate School of Design, Cambridge, MA.

Risebero, Bill.: 1979, The Story of Western Architecture, MIT Press, Cambridge, MA.

Tversky, B.: 2003, Structures of mental spaces: How people think about space. Environment and Behavior, 35, pp. 66-80.

Tversky, B.: 2000, Levels and structure of spatial knowledge, in S. M. Freundschuh, and R. Kitchin (eds), Cognitive Mapping: Past, Present and Future, Routledge, London, pp.24-43.

Virilio, P.: 1996, The Art of the Motor, (J. Rose, Trans.), University of Minnesota Press, Minneapolis, MN.