

Supporting Ambience Design with Visual References

Formulation of Intentions

Salma Chaabouni ¹, Jean-Claude Bignon ², Gilles Halin ³

CRAI (the research centre of architecture and engineering) _Architecture school of Nancy
http://www.crai.archi.fr/ninter-dev/detail_pers.php?pers=1, http://www.crai.archi.fr/ninter-dev/detail_pers.php?pers=4

¹ salmachaabouni@crai.archi.fr; ² bignon@crai.archi.fr; ³ gilles.halin@crai.archi.fr

Abstract. *This paper presents a study to assist the design of luminous ambiances by visual references from early design stage. Our method proposes, from an analysis of the reference work and the cognitive activities associated, a formulation of intentions built from navigation inside a collection of visual references. Different modes of navigation are discussed in adequacy with the forms of reasoning solicited in the referential activity.*

Keywords: *daylight ambience, image references, navigation, formulation of intentions.*

Introduction

Experience shows that, in the field of luminous ambience design, architects have to take into account the quality of interior spaces from early stages. They have to conceive and project luminous ambiances by satisfying the requirements related to the different uses of these spaces. In such approach, designers are looking very early to formalize intentions about luminous ambiances based largely on their experience and on those of other designers. In this case, they call for references and particularly for visual references that play the role of heuristic devices.

The term 'references' is used to mean 'objects of mediation' that help designers to express their problems and/or to imagine solutions. Several researchers, using experimental approaches (Verstijnen et al., 2001), have shown the importance of the use of visual reference in design situation.

Concretely, a visual reference allows, for example, to formulate or refine an ambience intention

without having need to describe it precisely. It can also contain some response elements useful for the definition of the project. We know for example the role played by the Villa Adriana in Tivoli for Le Corbusier in design of the light ambience at the chapel of Ronchamp (Pauly, 1980).

Thus, in the early stages, when the designer is searching for relevant ideas, collections of images can play a valuable role as means to support the creative activity. This article proposes to assist the ambience design activity by using a tool that manages with a set of visual references (photographic images). This tool proposes different modes of navigation in the referential space, allowing the user to find potential references for the formulation of his intentions.

The first part of this article study some approaches aiming to support ambience design from early design stage in order to put forward our proposition. The second part analyzes the activity of reference work in order to determine the different operations and cognitive reasoning employed which will

be interpreted as criteria-based to be integrated into the tool that we implement. These criteria are considered as reference points in the choice of the modes of navigation in order to determine those that are more adapted and useful to the formulation of intentions. The final part of this article exposes the validation protocol in order to investigate the use of visual references in ambience design activity, and the contribution of the tool we implement.

Supporting ambience design, approaches and tools

In the field of design assistance, several tools known as 'ambience design supports', are based on simulations of parameters defined beforehand (position and size of bays, identification of masks, orientation of walls,...). Some of these parameters are revealed by intentions. Thus, these tools may help the designer to verify and control the effects of his intentions (Sarawgi et al., 2002). Thus, we can consider these tools as supports to a design decision phase which are not really adapted to the first stage of design. Indeed, during this stage, the designer is searching for relevant ideas or solutions to implement in the formulation of his intentions. We have identified two possible approaches addressing the question of ambience design supports:

Approach- oriented pedagogy and knowledge acquisition

Tools, which are oriented to pedagogy and knowledge acquisition, enable users to enrich and enlarge their competence about luminous ambiances (<http://audience.cerma.archi.fr>), (Lassance, 1999). The gained knowledge is very useful at the time of the project, allowing the designer to take better, luminous ambiances, into account. In these approaches, projects are considered as references (case references). The user browses these projects to visualize opening types or specific luminous effects. He navigates, for example, from project to project, or from project to effect using hypertext links.

In project presentation, the textual information is as important as the visual references. The photographic image is used as a mean to complete and illustrate textual and theoretical information. In 'Daylight Design Variations Book', the photographic image is also used to represent and point up different positions of openings having a proof effect (<http://sts.bwk.tue.nl/daylight/>). Thus, these approaches can be useful at a learning stage by bringing important and necessary information to apprehend ambiances.

Approach- oriented design by intentions

In (Tourre et al., 2006), they propose a method which concretizes lightening ambience intentions by producing geometrical properties of openings. In this case, the designer materializes his ambience intentions in 3d scene by means of sketches. The proposed tool interprets these sketches and proposes several solutions concerning the opening forms in correspondence with those intentions.

Intentions are considered as guidelines for the project, and during the expression of intentions, significant decisions and choices are made. Therefore, supporting the formulation of intentions favours design creativity.

We develop an intermediate approach to apprehend ambiances and concretize intentions. Our method proposes, from a study of the reference work and the cognitive activities associated, a formulation of intentions built from navigation inside a collection of visual references.

Analysis of the reference work operations

By placing the design of ambiances at the centre of our investigation, the aim is to determine the way to use visual images in order to identify the different cognitive operations implemented in a reference work.

In a research concerning Le Corbusier, M. Besset (Pauly, 1980) attempts to identify, in particular, the report that this architect maintains between his

previous observations and his creative work. He distinguishes, especially, between three singular cognitive activities: “to look and to see, by distinguishing carefully to look that is simply to note, to collect, to gather in, and to see what is already to understand, to generate reports, or as he also said to classify; just to invent and create”¹. In incubation phase there is, therefore, a clear distinction between the ‘look-gather’, ‘see-classify’ and ‘invent-create’ operations, which are numerous potential operations in using references to fund the project.

In a pedagogic experiment conducted with students of the architectural School of Toulouse, Estevez and Tiné (Estevez et al., 2007) distinguished four operations by describing the activity of perception-design:

- To make: making by selection, by choice and by assembling precedents.
- To see: activate looking; apprehend objects, search for meaning (take pictures, choose the frame).
- To name: reinterpret objects with ‘new’ words; considered perception.
- Re-start: the moment of research; produce models: reasoned devices that relate to the elaboration of the new.

If ‘to make’, ‘to see’ and ‘re-start’ cover operations which are similar to the operations described by Beset, ‘to name’ seems to be as a complementary operation which is simultaneous to the other operations of production and representation. It is a specific activity leading to the appropriation and integration of perceived elements into the project.

If we translate these cognitive operations in activities of a reference work using images, four operations can be identified (Chaabouni et al., 2008):

- selection of an image, potential reference;
- projection of the reference in the project: formal analogy and/or functional and procedural analogy;
- integration of the reference into the project: interpretative activity;
- formulation of intentions.

Integrating reference work’s operations in a tool supporting ambience design

Pasma (Pasma, 2003) suggested that the development of a computer supporting system in the field of a ‘creative’ tasks should be criteria-based, instead of task-based. Criteria involved in the design of such computer system should be considered in terms of how they carry on the design process of the user rather than in terms of a method that can guarantee the generation of a ‘good’ solution.

Therefore, a set of important criteria and considerations for the development of the interface were derived from the analysis of the identified operations of a reference work. These will be discussed with regards to their implications for the interface functionalities and navigation method to be adopted:

To enable an easy search and browsing an image collection: the navigation method should enable an effective exploration through rapid and pertinent browsing, searching for relevant images. Also, the presentation of the results of a retrieving activity (query) should not possess a rigid and static character; the user must be able to interact with the system in order to set up a relevant dialogue.

To support capturing of analogies and offering the possibility to interpret images: the designer should be able to assess the similarities, differences and relationships between presented images, in order to extract and use embedded knowledge in the formulation of his intention. In this case, a semantic indexation of images can play a valuable role as a means to express the correspondences between images. Furthermore, the interface should provide its user with enough interactive and flexible dialogue with the content of the database to enable interpretation of the relevance and meaning of displayed images.

To allow the confrontation of ideas and solutions: a system, which should support the formulation of intentions, should have as its goal the possibility of letting the designer sketch and also inform his sketches by images or text.

To offer flexibility: throughout the activity of

formulation of intentions, the operation process is not a linear path but usually iterative. The environment of the interface should therefore afford a degree of flexibility of changing between functionalities, for example shifting from browsing to sketching.

In addition to these four criteria, the way to visualize images also has an influence on making images more accessible and meaningful. An experiment conducted by Paolucci (Paolucci, 1998) in the field of Hypermedia concluded that, in fact, a relationship exists between the structuring of the knowledge domain, as reflected by the hypermedia software, and positive learning performance.

A prospective study on systems that propose dynamic and non-sequential navigation methods in databases of images (Halin et al., 2005; Veltkamp et al., 2002) was conducted, allowing us to examine several modes of navigation using the identified criteria as reference points. Attention was concentrated on the manner in which each navigation mode proposed retrieving and visualizing database images in order to choose those are potentially applicable and useful to a reference work.

Tool's functionalities and modes of navigation

Several navigation modes were studied (Chaabouni et al., 2007). Each one proposes a specific method of visualization and navigation supporting different criteria and stimulating different activities and operations. We have chosen two relevant modes of navigation: the mosaic and the relational graph. In addition we proposed a new one, the navigational compass, which can facilitate a better localization in the referential space (image database).

To build up the image database, a large corpus of photographic images representing interior spaces was constituted. Each photo was then indexed from a thesaurus which was established around the scope of luminous ambiances. The thesaurus is divided in five categories, which are considered to be relevant in the description of represented ambiances

according to the definition of luminous ambiance (effect, quantity, space, use, and openings).

Mosaic

In a mosaic navigation mode, images are visualized according to a mosaic form: the images, all having the same importance, are juxtaposed according to a regular frame -and sometimes imposed.

The system displays a first mosaic of images randomly selected. The user can choose, reject or not give an opinion on each image presented. The interactivity of this navigation, associated with a process of relevance feedback (Halin, et al, 1990) allows refining the research from the analysis of positive images (selected) and negative images (rejected), and then proposing a new mosaic. This mosaic navigation can help efficiently in the easy searching and browsing of the image collection.

Images, selected by a user as positive ones, are considered as potential references. The system stores them in a group, and they can be browsed later and used, for example, to start a graph or to provide the user's sketches, thus emphasizing the flexibility criterion of the system.

Relational graph

A relational graph visualizes information using node-link representation, revealing relationships between objects (nodes). Examples of such tools are Vizster and TouchGraph Amazon Browser.

Vister (<http://jheer.org/vizster/>) is an online social network for exploring connectivity between members in a large graph structure, where nodes represent members of the system and links represent the articulated friendship links between them. Members are presented using both their self-provided name and a representative photograph. The networks are presented as 'ecocentric' networks (Figure 1-a) consisting of a member (in the centre) and his immediate friends.

TG Amazon Browser (www.touchgraph.com/TGAmazonBrowser.html)¹ is an application for exploring the connections between books, music or

Figure 1
 (a) Ecocentric network view;
 (b) Community analysis

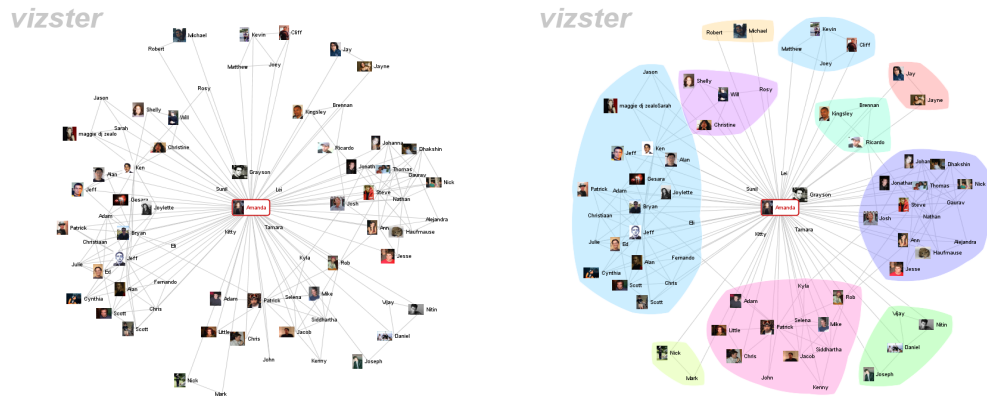
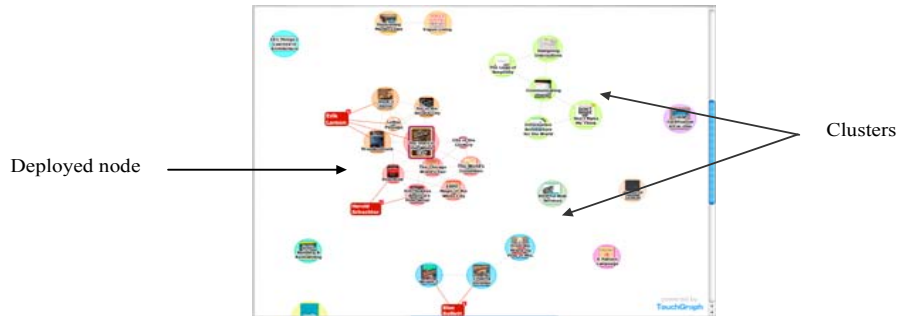


Figure 2
 TouchGraph Amazon Browser



movies. Figure 2 shows a first result of a query for books on an architecture search. This first result shows clusters of related books as determined by a purchase-recommendation function. The user can expand the display by selecting nodes to make visible books related to the selected node. In this case, links are determined according to the books' subjects.

In the Vizster application, the user also explores the graph by expanding nodes of his or her immediate friends. This kind of exploration supports visual and animated graphs and analysis. Vizster also supports explicit visualisation of community structures by placing each node (member) in its own community (Figure 1-b) allowing an analysis of the community structures. This visualisation combines two types of information: related members

and the community they belong to.

In our case, the nodes are the images and an arc connecting two images materializes the semantic similarity between them. Indeed, each image of our corpus is indexed textually from a thesaurus constructed on the basis of luminous ambiances (Chaabouni, et al, 2007). The semantic similarity between two images is calculated on the basis of this indexation.

The first graph visualizes an ecocentric view with the chosen image in the centre, related to its immediate similar images. The user can interact with the graph by selectively expanding the nodes to explore associations. In this way, the user moves from association to association, thus navigating through the database.

In addition, selecting a node can cause it to

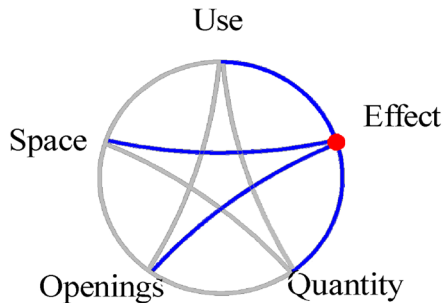
either expand or contract, depending on its current state. This mechanism allows the user to grow up or reduce the quantity of displayed images depending in the interpretative capacity of the user to assimilate visualized information.

What is important in this mode of navigation in comparison with the mosaic mode, is that semantic relations between the similar images are visible. In this case, the user can assess the similarities and relationships between images. From this base, he has a better understanding of the content of the images, and can more easily make interpretations of a 'cause and effect' type or of form 'A is to B as C is to D', thus facilitating analogies.

The navigational compass

The previous analyzed graphs, TG Amazon Browser and Vizster, show objects in an ever-changing context. In other words, a unique relationship can exist between two nodes. In our case, the navigational compass is a functionality to be combined with the relational graph and the mosaic navigation modes. This functionality allows, by orienting the context of the similarities between images, a different localization and visualisation of images from the referential space.

The navigational compass consists of five vertices connected with ten arcs. Each of these vertices represents a semantic domain of the thesaurus from which images were indexed (Figure 3).



Navigation with this navigational compass is done using a cursor. Several positions are possible, each one of which can be used to increase the weight given to its relative domain (or domains):

- Vertices: while placing the cursor on one of the five vertices, the system searches for similar images by changing the emphasis to the domain related to the selected vertices.
- Arcs: while placing the cursor on one of the arcs, the search for similar images is guided according to the two domains represented by the vertices of the arcs.

Concretely, when the user/designer is searching for potential references, he wants -for example- to find images that represent different daylight effects in order to design an ambience with a particular or creative effect. In this case, starting mosaic navigation with the navigational compass (by moving the cursor to the effect vertices) enables him to go more quickly towards the references which could be relevant.

Or, when the user/designer has already located a potential reference, he can continue his navigation by graph mode. When the graph is visualized, the user/designer can navigate with the navigational compass and choose different positions. Changing the position allows the system to change the displayed images, similar to the central one, by orienting the retrieval to one (cursor placed in a vertex) or two domains (cursor placed in an arc) of the thesaurus. In this way, the user can centre his attention on a specific criterion of a luminous ambience (Figure 4).

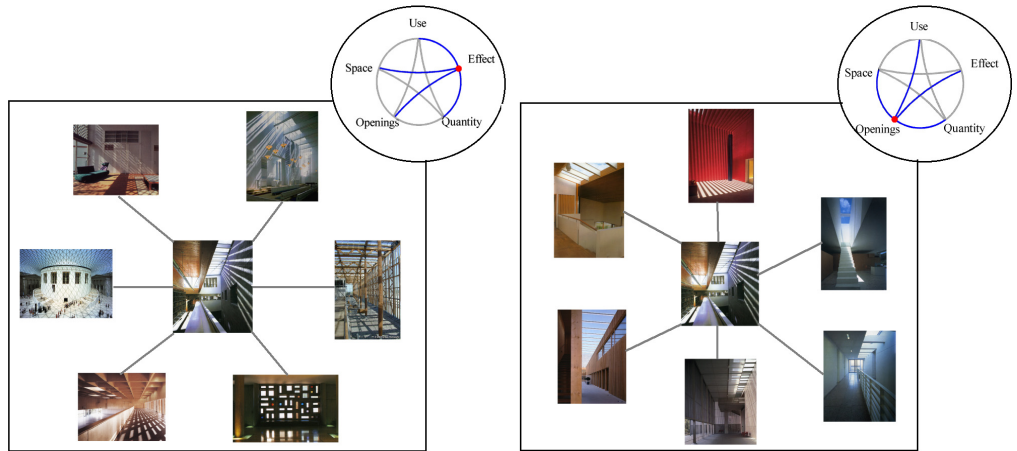
The objective of all these modes of navigation by searching and interpreting references is obviously the formalisation of intentions.

Freehand means of expression for the formulation of intentions

Drawing is largely a part of the process of reference exploitation in design activity for the formulation of intentions. So it is necessary to give the user the possibility to draw and integrate his references into his drawings allowing him to explore and

Figure 3.
The navigational compass

Figure 4
Navigation with navigational compass and relational graph: changing the position of the cursor from 'effect' to 'openings' changes the displayed images



evaluate his intentions by visual means. Therefore, a zone for freehand expressions is incorporated into the tool we project. In this zone, the user/designer can:

- draw one or several sketches,
- import images selected during the navigation process to complete the information contained in his drawn sketch; resize the imported image; choose all or a part of this image,
- annotate his sketch; add comments and text.

This zone can be accessible throughout the navigation activity.

For every project, the user/designer can produce several sheets of drawings. He can therefore constitute his own sketchbook which can be consulted at any time during the process.

Validation protocol

The validation of the hypotheses studied in this article requires the development of a prototype of the interface in order to conduct experiment.

The first step, the semantic indexation of reference images has been accomplished. The preoccupation now is to develop the modes of navigation and to integrate them into the interface.

The aim of the experiments is to investigate, on

the one hand the use of references in ambiances design, and on the other hand the contribution of the tool.

The experiments will be conducted with architectural students. These students, will be assigned an ambiance design problem, and asked to use the prototype to formulate their intentions.

The subjects will be asked to identify relevant visual references, and to use them to solve the assigned design problem. A number of dependent variables will be analyzed from the process followed by the subjects during design activity. These are consisted of: retrieval of visual references, selecting potential references, use of analogical principles, formulating hypothesis, and sketching intentions. The aim here is to verify if they adopt the four operations of reference work identified in this article. In addition, the analysis of the obtained results will allow us to test the impact of visual references in the design of luminous ambiances.

This experiment also aims to investigate the functions of navigation modes implemented and the adequacy of the use of the interface with the forms of reasoning solicited in the referential activity.

Conclusion

This article discusses the use of visual references as means to support ambience design. By an analysis of the process of exploitation of these references, four operations were identified which were interpreted as criteria-based. These criteria are taken as reference points to analyse and chose the adequate navigation modes for the formulation of intentions. Three forms of navigation have been analysed: the mosaic, the relational graph and the navigational compass. A 'freehand zone', where the user/designer can express his hypotheses by visual means and formulate his intentions, supplements these navigation modes.

The tool, currently in design stage, will allow us to conduct an experiment the protocol of which is presented in the final part of this article. The main objective of this experiment is to validate the hypotheses formulated about the adequacy of the modes of navigation with the forms of reasoning solicited in the reference activity.

Notes

¹ In its original context : « Regarder et voir, en distinguant soigneusement entre regarder qui est simplement noter, recueillir, engranger, et voir qui est déjà comprendre, dégager des rapports, ou comme il disait encore classer ; ensuite seulement inventer et créer ».

² TouchGraph Amazon Browser is an application of TouchGraph

References

- Chaabouni, S., Bignon, J.-C. and Halin, G.: 2008, Luminous ambience design, Navigation and reasoning by photographic images for formulation of intentions, Paper presented at the 9th International Conference on Design Decision Support Systems, 7-10 July, The Netherlands.
- Chaabouni, S., Halin, G. and Bignon, J.-C.: 2007, Première étape vers une navigation référentielle par l'image pour l'assistance à la conception des ambiances lumineuses, paper presented at the H2PTM'07 (Hypertextes, Hypermédiat), Hammamet, Tunisie.
- Estevez, D., and Tiné, G.: 2007, Le lièvre et la tortue, une autre course de la conception en architecture, in *Contemporanéité et temporalités, Cahiers thématiques*, (7), Conception/territoire/histoire, Jean-Michel Place, Paris, pp. 104-115).
- Halin, G., Créhange, M. and Kerekes, P.: 1990, Machine learning and vectorial matching for an image retrieval model., SIGIR '90, 13th International Conference on research and development in Information Retrieval, Bruxelles.
- Halin, G., Bignon, J.-C., Humbert, P. and Kacher, S.: 2005, A method for Constructing a Reference Image Database to Assist with Design Process. application to the Wooden Architecture Domain, *International Journal of Architectural Computing*, pp. 227-243.
- Lassance, G.: 1999, A Pre-Design Aid Support for Architectural Daylighting, paper presented at the Sharing Knowledge on Sustainable Buildings, 16-17 December, Bari.
- Paolucci, R.: 1998, The effects of cognitive style and knowledge structure on performance using a hypermedia learning system, *Journal of Educational Multimedia and Hypermedia*, pp. 123-150.
- Pasma, G.-J.: 2003, Designing with precedents, Delft University of Technology, Delft.
- Pauly, D.: 1980, Ronchamp, lecture d'une architecture, Ophrys ed., Paris.
- Sarawgi, T. and Paranandi, M.: 2002, Daylight Simulation: Examining its place during Conceptual Stages in a CAAD Studio, paper presented at the Conference of the Association for Computer Aided Design In Architecture, 24-27 October, Pomona (California).
- Tourre, V., Martin, J.-Y. and Hégron, G.: 2006, Expression of luminous ambience intention in CAAD, paper presented at the 24th eCAADe Conference Proceedings, 6-9 septembre, Volos (Greece).
- Veltkamp, R. C. and Tanase, M.: 2002, Content-Based Image Retrieval Systems: A Survey, Utrecht University.
- Verstijnen, I., Heylighen, A., Wagemans, J. and Neuckermans, H.: 2001, Sketching, Analogies, and Creativity - on the Shared Research Interests of Psychologists and Designers, paper presented at the II Key Centre of Design Computing and Cognition, University of Sydney, Australia.