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# LILY: DEVELOPING A CONTEXTUAL IDEA LINKING TOOL FOR DESIGNING ON SITE

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**Abstract.** This research develops a supporting tool (Lily) to inspire designer generates relevant ideas while he or she is on site visiting. This mobile application has been developed via scenario-based design paradigm and testing experiment. Based on the analysis of the interaction process from experiment observation, the visualization is comprised of both the physical information (site) and virtual information (linking form idea pieces) that is implemented based on the Location-Based technology with iOS application platform. An implementation called *Lily*.

**Keywords.** Mobile; idea linking; on site; design tool.

## 1. Introduction

Architecture has strong relation with its context (the site). Therefore, visiting or experiencing the site is often an important exercise in learning design. During the exercise, ideas are formed and inspired while designers are in the context themselves. Mostly linking, the association between the glance of context (site) and the images in the designers' minds is a proved operation for collecting and visualizing the inspiration of context. Designers often take sketches, photo or notes for catching these associations while they are visiting the site, and then interpret them in the design studio. However, some important pieces of information are lost or faded away during the in-studio interpretation process. How to catch and preserve the instant reflection on site? Our instinct is if the reflection occurred on site, why can we start the design process right away? The motivation of this research is to bring the possible

design tools back to the scene—the context, and transfer whatever information designers have in mind during site visit digitally for later examination during design process.

### 1.1. THE PROBLEM

The problem is two-folds—what kind of activities should and could be identified during site visit? And what are their representations that can be stored digitally? A pilot study of observing a group of third grade architectural students during site visit process has conducted for exploring these problems. The information available during the designing-on-site process and their composition are further unleashed. Linking ideas, or more precisely the contextual ideas linking activities, are the key activity among those activities identified. One observation is that participants usually draw some partial sketches to record or represent the site information during the linking ideas process. Sometimes, participants will draw many delegations right away before they move to next target. The reflection on the visual feedbacks and linking ideas are the most common activities identified.

Briefly, the activity identified can be classified as a visual-linking-reflection process. Visual information is translated into a permutation that can allow linking to diverse sources or fragment of ideas. The designers then combine these fragments of ideas as concepts into several workable design forms following design strategies of issues in the reflection session. These are similar to the ICF (Issue-Concept-Form) structure of Oxman (2004) that is adapted as the basis of design representation.

In this research, we are developing a contextual idea-linking tool for realizing certain inspirations into visualization for designing on site. Four research steps are conducted: 1) user studies for analysis of behaviours that frames the representation; 2) observation studies for retrieving the interaction procedures as the system mechanism; 3) mobile application developing for the testing platform as the prototyping; 4) scenario and testing case that utilizes the system developed for exploring the obscures in the process.

## 2. User Studies and Observation: Finding the representation

### 2.1. OBSERVATION OF DESIGNING ON-SITE ACTIVITIES

An activity observation over a group of users while they are designing on-site is conducted for exploring a useful computational representation for our implementation. First, the selection of novice designers and the observation method over selected group are based on the exploration process researches by (Goldschmidt, 1991; Cross, 2003; Abdelmosen and Do, 2009). From

these researches, due to the inexperience on finding relevant relationship between ideas and the clue of context, novice designers tend to spend more time on exploring and collecting relevant contextual information. This will allow this research to identify the possible exploration and collection activities of designing on-site.

Along with the activities, the cognitive sequences for these activities are the modified reflection-action model proposed by Oxman (2002). While based on Schön and Wiggins's seeing-moving-seeing model (1992), Oxman further classified the moving into cognitive (reflection) and physical (action). These sequences are suitable for describing the on-site design activity because of its immediate reflection and identifying the physical actions over the process. With the cognitive sequences and the users, the observation is conducted during third-grade design studio students. While site visit take places, picture taking and hand drawing are the frequent activities for collecting contextual information. However, from the follow-up interviews, since lacking of cognitive reflection and action on site directly, participants might miss some connections with the site easily in the later reflection in studio as predicated.

## 2.2. REPRESENTING THE INFORMATION: DIM

In general, designers link ideas through their individual memory as well as other participants' knowledge that are often linked graphically or in a graph like structure. Linking ideas do not necessarily be represented graphically; texts or metaphors are also used for linking the ideas, for example. However graphical representation, often in graph-like representation, is still the most used organizational mechanism for collecting the information of design from the observation. Consequently a graph-like knowledge is naturally the representation for representing the individual memories with the nodes and arcs that are the ideas and the association between ideas respectively.

For developing the design tools that are useful during site visit, we need some automatic mechanism, in this case, linking mechanism that can find the association on the fly. Several mechanisms are examined, and a simple idea association framework–Dynamic Idea Map, *a.l.a.* DIM (Lai and Chang, 2006) is selected as the linking representation. DIM is comprised of idea entities and three types (similarity, contrast, contiguity) of linking relationships. The form-association (of ICF) in DIM to link ICF database is adapted for the purpose of immediate reflection-action and better association on site according to its visual presentation.

DIM, dynamic idea map, as described before is designed for representing the graph-like knowledge that are suitable for linking the clue of site and the

ideas from designers needed in this research. In DIM, an idea map is comprised of idea entities (ie) and three types of linking relationships among idea entities. Based on the issue-concept-form (ICF) schemata proposed by Oxman (1994), each idea entity includes three attributes. They are issue (I), concept (C) and form (F) that are represented and visualized by keywords, texts and image photos respectively.

### 2.3. THE REFINEMENT: DESIGN JIGSAW FRAMEWORK

Based on the observation of design activities on-site, the modification on original DIM, dividing Concept into three arguments: form(Cf), function(Cfu), and structure(Cs), is following three objectives: 1) be able to show the visual information of a piece of design and clue of the site; 2) be able to link and generate another hint for inspiration; 3) can generate convergent outcomes within a limited and reasonable scope to reflect the design concept. Such modified framework is called *Design Jigsaw* that will focus on the assembling the piece of design together along with the linkage among these pieces of design that are called *Idea Pieces* (IP)s.

Every IP records three attributes of the design knowledge which is comprised of Issue (I), Concept (C) and Form (F) as same as idea entity along with linking relationship among I/C/F. Also, IP further divided C into three properties as Cf(form), Cfu(function) , and Cs(structure) base on to depict architectural idea related to contextual information that are mostly described by keywords in implementation. The C and F are the main linking hints of IPs in the seeing-moving-seeing process; the key design knowledge will be constructed until designer solved the design problem.

The visualization (for the purpose of seeing) is comprised of both the physical information (site) and virtual information (linking Form attributes) that is implemented based on the Location-Based technology on iOS platform. A prototype system called *Lily*, a contextual linking idea tool, is then developed based on the design jigsaw representation described above. This tool is carried out in the investigation process of on-site scenario described below.

## 3. Scenario

For observing how users can find more ideas by linking relationships among three types of concepts (Cf, Cfu, and Cs). A scenario is set up for exploring the possible idea linking operation on site. Lily is used as a supporting tool assisted participants to go through the design process.

### 3.1. THE SETTING

A scenario of collecting and linking ideas during site visit is planned. Four steps are recognised during the scenario and verified by the test followed. The scenario operation is shown as Figure 1:

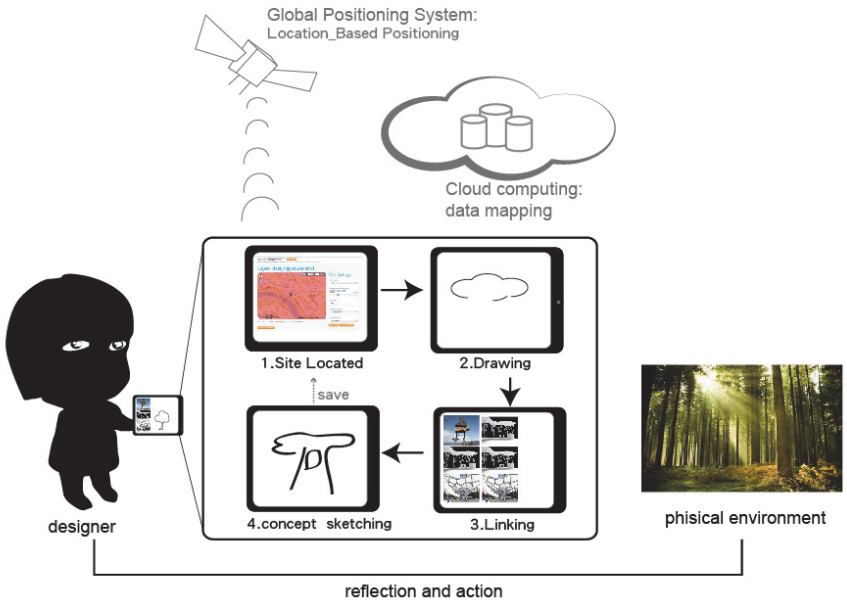



*Figure 1. The scenario operation*

Four main sequential phases are described below:

- Phase 1 Site located: site investigation is a crucial training for every designer. In this step1, designer has to log in and locate on site to record the precise position via Google Map API to the Lily.
- Phase 2 Drawing: When designer has been visited on site; he or she usually searches for visual information from the feature of site as linking hint in the beginning. This step is to transform visual information collected on site into a set of symbols that can be recognised by the Lily. As a proof-of-concept, geometric features are used as the features of these visual information that can be further classified into nine types. They are line, curve, surface, polygon, line and curve, line and surface, line and polygon, curve and surface, curve and polygon.

- Phase 3 Idea linking: After drawing is recognized as a set of geometric features, a cluster of IPs will be selected based on the types of geometric features recognised. In this step, designer accords the IP concept properties (Cf, Cfu, Cs) to select more linked IPs that are reachable by the Lily. This step can be repeated until designer makes final decision.
- Phase 4 Design sketches: designer will sketch a concept representing the design inspiration after consulting the IPs from last step. The design sketches will then be saved on database as one inspiration.

## 3.2. TESTING EXPERIMENT

Six third-year architecture undergraduate students participated in the experiment. These six participants who are equipped with basic architecture training and familiar with the Lily, and they are also acquainted with the concept of finding design inspiration during site visit. The Design Task assigned is a design project of an information station for tourists located on Dadouchan Harbour in Taipei.

Participants are required to document every piece of information collected during the site visit and will be interviewed afterwards for unleashing the transition of thinking on the interaction with the Lily. As a limitation, the site and river is close-by that participants can visit frequently and the initial linking concept: water is chosen for the purpose of limiting the search for participants and the related images are preloaded onto the Lily before the experiment to avoid the internet connection problems.

The duration of each session is about 75 minutes. The participant carried out warm-up and operation for 15 minutes prior to the experiment. During the last 30 minutes, participants are required to draft their conceptual sketches as design outcomes.

Each participant is assigned one iPad with Lily preloaded. There are 60 IPs preloaded in the built-in database for linking and searched by the hint sketched by the participants (Figure 2).

*Figure2：The testing experiment of designing on-site.*

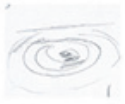
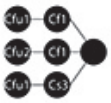
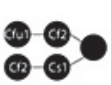
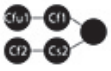
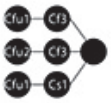
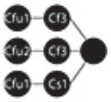
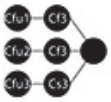
## 4. Analysis and Observations

During the experiment, the participants generated 6 design sketches (ideas) within a 30-minute period. From these 60 ideas, each participant then found some hints that could link away to proceed to another stage. Some phenomenon and lessons was observed and analysed as below.

### 4.1. ANALYSIS

During the process, we discover not only the outcome of idea linking is important, but the sequence of selection is also reflecting the strategy thinking of participants. The outcomes besides the interaction process are recorded as followed: (1) concept keywords had been used frequently in the idea linking process, (2) the sequence of idea linking process is also recorded for further investigation, (3) the concept sketches of final design solution are done in another piece of paper but scanned into the program. The result is shown in Table 1. The order of selecting Cf, Cfu IPs reflects on the solution itself. From the table 1, the order of selecting Cf, Cfu IPs reflects on the solution itself. We can see the linking sequences are not only selecting but also combing IPs by participants. The sequence will be (selecting-combining)→ (selecting-combining).

Table 1. The result of experiment with sequences and outcomes.

| Participant | drawing (inspiard by site) | feature | linking keywords | linking sequences | selecting numbers | combing numbers | sketch |
|---|---|---|---|---|---|---|---|
| a |  | curve + surface | expansion, float, separate,antigravity |  | 6 | 4 |  |
| b |  | curve + surface | continuity, float, flow,penetrate,drop |  | 4 | 3 |  |
| c |  | curve + surface | forming, float,flow unit,surface |  | 4 | 3 |  |
| d |  | curve + surface | separate, float, layer |  | 6 | 4 |  |
| e |  | curve + surface | flow, float, layer,wave |  | 6 | 4 |  |
| f |  | curve + surface | flow, separate, layer, surface |  | 6 | 4 |  |

## 4.2. THE PHENOMENON OF DESIGNING ON SITE

Four observations of experiment results are shown as below:

1. The actions can be further divided into three consequential steps: drawing-linking-sketching. These three steps represent—initiating a site information, finding associated images or metaphors based on that piece of information, and refining these association into a design concept or re-initiating another round of moving process. The data will be the partial initial diagrams, the linking/ideas mechanism and the grouping mechanism.
2. The first IP selected by the visual relationship with the hint which users consider it as the feature of site by hand drawing. Through the geometrical

features grouping, more Cf, Cfu IPs are linked in the beginning. The users will select and combine them into next round of selection.

3. The participants select and combine four to six linking IPs in a sequence

## 5. Conclusion

Based on the Steps of ideas linking and experiment, this research discovers that participants can engage in design production on site forthwith. Such mobile implementation can support novice designers to reveal the constructive meaning within the graph-like knowledge structure of design thinking. As well as it can provide a just-in time design environment for ideas linking with the local context. Five insights learned for future research are described as below:

1. Although the main steps are identified, there are still more steps at the phase of idea linking. Designer are also generating design concept by combining several IPs.
2. It is advisable for transforming designer's abstract drawing into some types of geometrical features. It connects designer's thinking and visual impact as information recognized by Lily. Related IPs can be grouped together to link more ideas.
3. The physical actions in the design process can be further elaborated as a sequence of drawing – linking – sketching.
4. Through feature grouping, selecting, and combing IPs, designers construct their graphic-like knowledge. The six concept sketches reveal similar linking process, however it turns different outcome by the keyword and image of Cf, Cfu, Cs.
5. Mobile interface in this research is a link between designer's thinking and the visual information of physical environment. As a instant dialogue tool to induce designers feel more reflection form the site, the assisted mechanism such as Augmented Reality will be discuss more in the future.

This research starts with a simple concept and develops a supporting tool via scenario-based design paradigm—user studies, observation, prototyping and presentation. A mobile application has implemented and used in the user-studies experiment. Although the initial requirement finding relevant information according to the contextual experiment has been fulfilled, the research turns out to unleash more information and requirement than expected. Further user evaluation will be carried on to investigate more design behav-

iours with contextual environment and refine the interaction for the Lily developed.

## References

Abdelmohsen, S. M., & Do, E. Y. L.: 2009, Analyzing the significance of problem solving expertise and computational tool profiviency in design ideation, Cultures and Visions: CAADFutures.

Cross, N.: 2003, The Expertise of Exceptional Designers, in N. Cross and E. Edmonds (eds), Expertise in Design, Creativity and Cognition Press, University of Technology, Sydney, Australia

Goldschmidt, G.:1991, The dialectics of sketching, Creativity Research Journal, 4(2), pp.123-143.

Lai, I.C. & Chang, T.W.: 2006, A Distributed Linking System for Supporting Idea Association in the Conceptual Design Stage. Design Studies, 27(6), pp.685-710.

Oxman, R.E.: 1994, Precedents in Design: a computational model for the organization of precedent knowledge, Design Studies, 15(2),pp.117-134

Oxman, R.E.: 2002, The Thinking Eye: visual re-cognition in design emergence, Design Studies, 23(2), pp. 135-164.

Oxman, R.E.: 2004, Think-maps: teaching design thinking in design education, Design Studies, 25(1), pp.63-91.

Schön, D.A. and Wiggins, G.: 1992, Kinds of seeing and their function in designing, Design Studies, 13(2), pp. 135-156.