WHAT IS INTENTION STRUCTURE?

Represent invisible information of spatial depicts

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Abstract. The significant problem of this paper is how we convey spatial information to represent concrete meaning of mental imagery. For replying the above problem, we are developing a spatial information structure called "Intention Structure". Intention structure is used to represent some spatial experience of a particular person and awareness of the aura into some spatial depicts at that physical place. The meaning of "intention" is implied into a sequential relation when a navigator moves and gazes something in a place. This sequential relation can be described into two ways of spatial representation: one is the action of human body including "*moving the body*" and "*moving the head*"; another is converting the visual information into spatial memories through the behavior of gaze, including "*the sight focus*" and "*the snapshot glance*". Otherwise, we also consider the limitation of topology at that physical place. Based on the above ideas, we use XML technologies in Java language to represent spatial data of intention structure for the describable usages of invisible information. we implemented this idea on a project of spatial analysis with Taiwanese traditional garden, the Lin family garden in Banciao, Taipei County, Taiwan.

1. Introduction

A place is an assemblage of unity that it is connected with different spaces. It proves a share principle of social experiences and human behaviors while human do some activities in, and it also connects the collective sense of these spaces between individual and environment (Kalay and Marx, 2001). The fundamental characteristics of these spaces briefly are possessed of gather and surround, they convey a concrete meaning which the internal subjectivity of a place exists among these spaces. Therefore, when human try

to represent the sense of space at a place, we can interpret the aura of this place based on metaphor and insinuation (Norberg-schulz, 1979). These ways can convey the perceptive capacity of comprehensive atmosphere at a place.

For constructing these spatial metaphor, Tversky (2001) proposes an information structure with three different levels that are, (1) nominal category, (2) order of sequential relationship, and (3) limitation of topological meaning. The main significance of this hierarchical structure is responded by Maller's (1991) opinion: the classification of components is also stood on spatial topics but not representable process. These spatial topics are described as concrete meaning of being into a place. In his opinion, specific purpose of spatial representation in architecture is to resurvey respondent reaction of spatial navigators, and then express some individual evaluations of their sentiments that get a superficial understanding through quick and casual observation in a place. Therefore, there are four represented aspects for the sense of place in architecture that are, (1) concrete context, (2) entities of architectural conveyance, (3) depicts of constructive components, and (4) representation of design concept. For example, an artistic work is located in a place; human can get a feeling about this work and then describe their criticism of this visualized representation; at the present, human can instantly realize why this artistic work must put in this place, and try to enjoy the atmosphere of situated environment that is composed of artistic work and place.

Based on the above reviews, spatial experience of a place is too abstract to realize as a conveyance of spatial topics. Through an empirical observation of spatial navigation, an observer can translate his or her feeling of imagery into a concrete meaning of spatial context as invisible information at a moment. However, it also produces some personal biases of spatial information while that different observational interpretation is given. Therefore, the significant problem of this paper is how we convey this spatial information while representing a concrete meaning of mental imagery? For replying the research issues described above, we are developing a spatial information structure called "**intention structure**". Within the scope of this paper, we then describe what the intention structure is and how it works for solving the problems.

2. What is Intention Structure?

Briefly speaking, intention structure is used to represent spatial experience of a particular person and awareness of the aura at that physical space. The word "**intention**" means by one kind of perceivable purpose when human navigates a place at the moment, i.e. a navigator. We then define "intention"

from invisible information such as spatial relationship or symbolic meaning of spatial depicts while a navigator walks around a place. This invisible information is produced by visible information of visual features.

This "intention" is implied into a sequential relation when a navigator moves and gazes something in a place. For example, this navigator gazes some spatial depicts of a place by his or her sight while he or she come into a physical place. Then this navigator also begins to progress directly or turn his or her direction after deciding an appropriate path. In other words, it leads an action of navigation into a cycle for searching spatial depicts and recalling spatial memory while this navigator walks on a navigating path at a place.

This sequential relation is described into two ways of spatial representation: one is the action of human body in which wants to capture spatial information of visual features, including "**moving the body**" and "**moving the head**".

Human can decide their navigating way by four directions: (1) go forward, (2) turn right, (3) turn left, and (4) go back. These four directions are used to confirm body movement of a navigator. Besides "moving the body", a navigator can change his sight by turning his head while he want to see something of interesting in a place. This action of human being is limited at the angle of rotation, we can consider the direction of rotation into (1) clockwise, CW, (2) counterclockwise, CCW, (3) raise the head, and (4) lower the head.

Another is converting the visual information into spatial memories through the behavior of gaze, including "**the sight focus**" and "**the snapshot glance**". A focus of spatial depicts is set the weight of fitness to evaluate the importance of spatial information when a navigator is gazing it. However, these results of evaluation are generated by similar patterns of visual presentations that the navigator resurveys them continuously. In other words, the navigator matches constantly similar pattern of spatial depicts in one sight of view when he walks around a place and stops to gaze somewhere.

After catching visual information of a place, a navigator converts this image into his spatial memory to match a mental imagery of a place. This mental imagery usually has a symbolic meaning of cultural characteristics. It likes a snapshot of a place, when the navigator sees this focused depict, he associates with the mental imagery of spatial depict in thinking, and then recognizes it as a concrete information of this place, to decide his next step of navigating way or stand for appreciating that a wonderful atmosphere of this place he images, i.e. the aura.

Besides above two spatial representations, we also must consider the limitation of topology. The location and relative distance within objects in a place is one kind of physical conditions that is constructed by the human's

sense of a place. When a navigator walks into a place, it can be recorded a relative position of spatial coordination by metric method, we simply consider the planer coordination system of a place that it will be easy to convey spatial information of transformed representation on this issues.

3. How to Record Intention Structure?

For the usages of convey the information, how to record the intention structure is a key. Our approach is to apply computational principles and digital transformation to convey the components and operators of the intention structure from physical space to digital space. The digital space is used as a recorded platform and XML technologies in Java developmental environment is implemented by intention structure.

Many images of physical place as analytic samples of spatial data, we want to do is that using information technologies to represent the "intention" within these spatial images. First of all, we must (1) classify spatial information on an image sample; then (2) consider the sequential relationship of progression and visual focus from this sample; and then (3) decide the limitation of topological meaning in this sequential relationship.

3.1. WHY XML DOCUMENTATION?

We use two basic standards of XML document format, simple API for XML (SAX) and document object model (DOM), to convey spatial data of an intention structure. Why we choose the XML document? This is because that XML documents can be used in (1) metadata, to describe other documents or online information; (2) configuration files, to describe configured augments of software; (3) rich documents, to conclude the description of document and rich contents by themselves. The following sections we will explain what we do in using this rich document.

The structure of SAX is an interface of XML document on event-driven operation. SAX format is used to parse structural information by a registered handler such as a component with attribution and value. The handler is an interface with one set of call-back method. This format is suitable for the spatial information which is used in a part of space but not entirety. Therefore, SAX format can record the characteristic of spatial fragments which capture from the gaze of sight. It also can represent the human attention of spatial features. For example, we try to record "moving the body", all the moving progresses do not need any evaluations, so it is fit to describe in SAX format.

In addition, the structure of DOM is inherited from node interfaces of objects. DOM format represents the information into a tree. It is used to

record the spatial information conveyed from the body action. For example, a navigator walks around a place, his sight is constructed with a scene, the invisible information is implied from this scene that the navigator try to recall his spatial memory to recognize it. At this moment, we record this situation by DOM format as a tree structure.

3.2. THE XML DOCUMENTATION OF INTENTION STRUCTURE

Based on the above XML formats, we construct the spatial information of entire navigation into a XML node. The "Action" node is one intention of navigating action at a moment. It includes three main child nodes of XML Document in intention structure:

1. **<bodymovement>**, for recording "moving the body", with one child node <direction> for representing the direction of movement, and one attribute progress that be used in marking the relative distance of movement.
2. **<headrotation>**, for recording "moving the head", with one child node <turn> and one attribute angle that be used in marking the angle of head rotation.
3. **<gaze>**, for recording the behavior of gaze, i.e. "the sight focus" and "the snapshot glance", with two child nodes <depict> and <scene>, and one attribute viewcount that be used in marking the accounts of spatial depicts. The <depict> tag is formed by two child nodes <name> and <function>, and with one attribute no that be used in marking the sequential number of spatial depicts; the <scene> tag is formed by two child nodes <view> and <principle>, and with one attribute depict that be used in marking the focused depicts. Table 1 shows the examples of these tags.

TABLE 1. The example of representing intention structure

Tag	Attributes and values	Contents
<Action>	index = "1"	
<bodymovement>	progress = "30"	
<direction>	(forward, left, right, backward)	forward
<headrotation>	angle = "10"	
<trun>	(CW, CCW, raise, low)	CCW
<gaze>	view ="2"	
<depict>	no = "1"	
<name>		bedroom
<function>		room for sleeping
<depict>	no = "2"	
<name>		tablet
<function>		for writing and working
<scene>	depict ="2"	
<view>		divide scene
<principle>		at the corner of room

3.3. JAXB TECHNOLOGY

In general, we must transform the DOM tree or SAX event into data type of a class in java before logic processing of this class is executed. For solving this problem, we used the Java Architecture for XML binding (JAXB) technology to construct a binding scheme. This binding scheme is implemented as a specific parser between java classes and XML documents. It also includes the marshalling function which can transform the data type of a java class into a XML document. On the contrary, the unmarshalling function can transform the XML document into a data type of a java class. It also needs a validation function to verify the schema of XML documents with the content tree of java class is legal. Figure 1 is the working flow of JAXB mechanism.

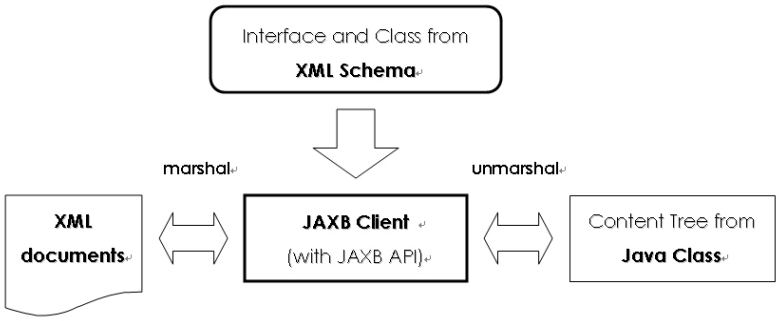


Figure 1. Working flow of JAXB technology

The main significance of using JAXB mechanism is to more easily bind the data structure and java class into a run-time process of system platform. It is a useful solution while we want to consider designing a computer-aided system with java developmental platform.

4. Implementation: The Traditional Garden in Taiwan

The implementation of the intention structure is tested on a project of spatial analysis with Taiwanese traditional garden, the Lin family garden in Banciao, Taipei County, Taiwan. First at all, we analyze compositional types of traditional garden as samples of spatial information. In this example, how to connect and integrate spatial information of intention structure with architectural entireties and visual features in a cultural heritage is our main task.

4.1. INVISIBLE INFORMATION OF SPATIAL DEPICTS

For representing the characteristics of traditional gardens, the following spatial features are usually applied in design thinking: firstly, suitable selections of free variations is obtained all materials from nature environments; secondly, smaller spatial components can be included in the bigger one, in other side the void place and the real one are interdependent; thirdly, spatial flows and the comparison of a place are hidden in spatial layers of scenes, these scenes is briefly converted from the imagery of literature works and landscape paintings.

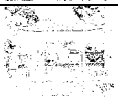
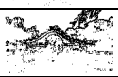
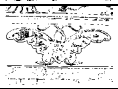
In order to represent these invisible information of spatial depicts, visual feature of navigating behavior is the most crucial originalities of transformation. Table 2 is a list of gaze samples.

Based on the difference of spatial relations, we sort spatial depicts of traditional garden by three categories:

1. **Building**: there are five groups of spatial depicts that are (1) Tang, Ti'ng, Guan, the front side of major scene in a garden by ordinary; (2) Lou, Ge, Xuan, the important contract view near the water or on a rockery by ordinary; (3) Ting', Xie, Fang, The solely for embellishment is the secondary component on the navigated path, it usually has a smaller form and structure; (4) Lang, the major connective component in a garden. It attaches a wall side or near water by ordinary; (5) Ciao, the connection with different scenes and the view of water.
2. **Decoration**: there are three major groups of spatial depicts that are (1) Wai-yan, the outside adornments of a building such as windows, doors, and railings; (2) Nei-yan, the inside adornments of a building such as grid doors, ground covers, and painting screens; (3) Bian-lian, it usually locates on doors and internal hall, or the columns of pavilions.
3. **Opening**: we divide this categories into two main groups that are (1) Ciang, such as cloud-liked wall, ladder-shaped wall, level wall; (2) Lou-chuang, such as square windows and rectangle windows with vivid patterns.

After classifying main categories of spatial depicts, we need to recognize another originalities of spatial depicts are "the sight focus" and "the snapshot glance". We assume that there are many images of navigating process are captured by the sight of a navigator. These images are extracted by the algorithm of computer vision "Canny edge detection", to simplify the complex value of image pixels by matrix of Laplacian operation with a fitness value of tolerance.

TABLE 2. The sample of invisible information

Categories	Names	Depicts	Functional Information
Building	Tang		Hall for a specific public use
	Ti'ng		Large communal room
	Guan		Accommodation for guests or for travelers
	Lou		Multi-story building
	Ge		Two-story pavilion
	Xuan		Room or hall with high eaves
	Ting'		Pavilion
	Xie		Pavilion or house on a terrace or pool
	Lang		Veranda
	Ciao		Bridge
Decoration	Wai-yan		Outside eaves
	Nei-yan		Inside eaves
	Bian-lian		Horizontal inscribed board and a couplet written or posted on gate posts
Opening	Ciang		Wall
	Lou-chuang		Leaked window

4.2. COMPOSED VIEW OF SCENES

A precious ancient book of landscape design in Ming dynasty, Cheng Ji's *Yuan-ye* (how to design a garden), is described an important principle of scene compositions: *Ciao-yu-yin-jie*, *Jing-zai-ti-yi*. It means that the view is taken advantage of the following landscape and its environment, and then composed each designing element well for suitable nature. The garden can be divided view areas into the inside part and the outside one, but there is no limitation of distance for selecting the view of scenes.

The selection of scenes is sorted spatial principles by three main types, that are (1) Fen-jing, use spatial elements to be isolated the sight or the path; (2) Jie-jing, it must form an artistic conception of view with the mind of a navigator; (3) Dui-jing, it is visually connected the sight of a navigator with two different scenes. Table 3 is a list of details in our selections of garden scenes.

TABLE 3. The selections of garden scenes

Types	Scenes	Spatial Principles
Fen-jing	Zang-jing	There are barrier of rockery and rocks, courtyard barrier, tree barrier or forests.
	Ge-jing	To use in divide the space up or divide the spatial depicts of scenes, it can be formed by real partition, void partition, and to be at an interval of void and real scenes.
Jie-jing	Yuan-jie	Lend a long-ranged view into the garden as a scene.
	Lin-jie	Lend a close-range view into the garden as a scene.
	Fu-jie	To ascend a height to see the far scene, and to look down at the scene in the garden or outside it.
	Yang-jie	To view upward the high place outside the garden or the view on a upper storey of pavilion.
	Yin-jie	To employ the change of seasons or one day into the scenes of garden.
Dui-jing	Dui-jing	To set off by contrast among scenes.
	Yi-jing	To represent the scenes by priorities such as the hidden scene first and after the appearance one.

4.3. SYSTEM IMPLEMENTATION

After considering previous selections about spatial analysis of traditional garden, the spatial information of the intention structure can be converted the classified results into an integrated XML document developed in the java language. Figure 2 shows the final state of this XML document in the IE browser.

```
- <Garden>
  - <action index="1">
    + <bodymovement progress="30">
    + <headrotation angle="30">
    + <gaze view="2">
    </action>
  - <action index="2">
    - <bodymovement progress="10">
        <direction>right</direction>
      </bodymovement>
    - <headrotation angle="15">
        <turn>UP</turn>
      </headrotation>
    - <gaze view="2">
      - <depict no="1">
          <name>guan</name>
          <function>Accommodation for guests or for travelers</function>
        </depict>
      - <depict no="2">
          <name>ting</name>
          <function>Pavilion</function>
        </depict>
      - <depict no="3">
          <name>bian-lian</name>
          <function>Horizontal inscribed board and a couplet written or posted on gate posts</function>
        </depict>
      - <scene depicts="3">
          <view>jie-jing</view>
          <principle>Connect with different spatial elements</principle>
        </scene>
      </gaze>
    </action>
  </Garden>
```

Figure 2. The sample of XML document

For verifying significant usages of intention structure, we try to apply this spatial information of intention structure into a computer aided spatial analysis system for traditional garden, *Tau-tei system*. Our analytic samples of spatial depicts are captured from the Lin family garden in Banciao, Taipei County, Taiwan. The operative functions of this *Tau-tei system*, see Figure 3, are described as follow:

1. **Pre-processing mechanism for gaze images of a navigator**: we used this pre-processing mechanism to deal with 375 view images from 25 places of scenes in the Lin family garden. In each image of using “Canny edge detection” algorithm in computer vision, we try to classify any possible glance of a navigator gaze to map the concrete meaning of spatial depicts.
2. **Data structure of spatial information for the intention structure**: we constructed a specific XML parser of JAXB client to be easily used to edit the XML document that it is represented the spatial information of the intention structure. it can edit each node and child node in the data structure of XML document and then can save the varied data after you have changed the attribute and value or have moved the hierarchic position of node in a DOM tree.
3. **Editable functions of spatial analysis**: a spatial analyzer can load an original image of spatial depicts and then to add the analytic results by manual operation to supply the insufficiency of automatic processing by

default variables. Based on the classification in invisible information of spatial depicts, we provided seven composed elements of traditional garden to imply this idea, the analyzer can use them to easily add the spatial depicts that those do not be found in pre-processing mechanism.

Figure 3. Screen shots of Tau-Tei system

5. Discussion

The main significance of intention structure is useful to represent invisible information of spatial depicts, i.e. the *aura* of a place. We can use it to extract these invisible information from the visible information which that is based on the navigating action and the gaze behavior of a navigator. This intention structure is constructed with expectancy that it has a simple and exquisite framework to imply in many different situations of representing spatial aura at a place.

However, it still has some limitations for using:

1. It must be setup a mode of spatial evaluation in advance before processing a spatial analysis. Just like our example, we setup an analytic mode of traditional garden to classify the spatial depicts by anticipation. It maybe would have some research biases of classification. To reducing this misgiving, we suggest that when you want to establish the intention structure of spatial depicts, to choose the concrete objects of architectural elements, do not setup too much the abstract meaning of spatial evaluation such as the symbolic meaning of cultural issues or items.
2. Using the fitness value of tolerance in the “Canny edge detection” algorithm must be more carefully. This is because that the recognized result of spatial depicts in gaze behavior will so different if you use an unsuitable value. We try to reconsider about this problem for using different evaluated methods in computer vision in the further studies.
3. To think deeper over the cultural issues in the intention structure, each spatial depict maybe be referred a symbolic meaning of aura at a place, how we explain these cultural or social issues in the intention structure? this problem is produced from a situation in our example that when a

navigator walks into a traditional architecture, he saw the architectural elements of structure such as Dou-gong, a kind of structured system of wood brackets on the top of a column supporting the crossbeam, was he felt the form and decorations on this Dou-gong or the cultural meaning of auspicious symbol which was connoted in it at the moment? In our definition of this paper, we prefer recognizing the previous one cause of that the latter is too complex to realize in a computational approach. But it is an interesting issue of spatial information; we will vitally try to implement it in a suitable way in the further researches.

6. Conclusion

In this paper, we described intention structure that it is used to represent invisible information of spatial depicts from visual features at a place. It can be useful in converting different spatial information among different architectural types. In addition, we want to use this intention structure to develop a real-time capture system with spatial learning mechanism in the further researches.

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