Patterns for Analogous Representation

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Introduction

Analogous Representation patterns offer a way to express entities and their relationships in an analogous fashion. Redundant but useful information seems more natural and/or friendly for human beings to understand than that has been handled in conventional Information Technologies (hereafter, IT) systems, can be captured and represented in a consistent way.

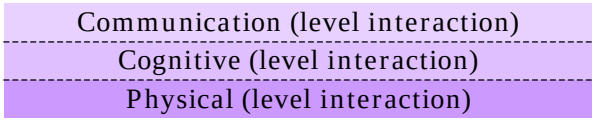
In this paper, several major patterns that allow us to represent analogous information for entities stored in IT systems are introduced, and their usefulness is explained as natural for human beings’ everyday intellectual behaviors.

The current Software Engineering as well as IT largely focuses on digital representation (and hence, digital thinking) of information, however, in the human brain it seems that information is usually represented and recognized in an analogous manner.
Information current technologies deal with is somewhat scattered in a sense, and thus relations amongst them must be carefully prepared and stored before hand for future use. Since human brain behavior seems to be based on categorization (see Lakoff), *Analogous Representation* is more natural, much friendlier, and more useful to ordinary users.

Overview and Background

The patterns presented here are basically based on both the experience that the author once went through certain application development almost ten years ago, and the long time incubation since that. The author’s expertise is software engineering neither interaction design nor industrial design, however, it would be worthy to mention the brief introduction to interaction deign in general as the background of the patterns, and also to illustrate the overall structure of a pattern language that the author has been, and also will be, intending to establish, where the patterns presented here are also included, on purpose to help readers easily grasp the structure of the patterns

Patterns for Analogous Representation could be classified into, somewhat so called interaction design, which is of course including GUIs or UIs but more broad concept or field. Basically concept of interaction design consists of three major parts, Physical, Cognitive, and Communication layers, as described below.



The bottom most layer is dedicated to provide interaction facilities between the user's five senses and the physical devices and/or environment that the user manipulates. Mice, keyboard, monitor designs, and headphone design of 'Walkman' are included in this layer.

Next layer is Cognitive level interaction design, which is the core of interaction design in general, enables both the user and the system *inter*-act together. This means that the user is able to make requests and change the system's behavior, however, at the same time the system is also able to change the user's behavior and/or expectations via the responses the system made. Conventional UIMS, graphical user interface design, and human interface design of software could be classified in this layer, but modern interaction design lays its emphasis on cognitive aspect, such as eliminating cognitive friction;

> … *the resistance encountered by a human intellect when it engages with a complex system of rules that change as the problem permutes* …
> … *like friction in the physical world --- not necessarily a bad thing in small quantities, but as it build up, its negative effects grow exponentially* … (Cooper, 1999[1])

Finally, the top layer is Communication level interaction design, enables the user communicates with other users via system. In this situation, a system works as a glue to connect users and at the same time to provide several types of cyber space, say, a cyber community, for birds-of-a-feather users.

According to the layered partitioning of the interaction design principle mentioned above, Patterns for Analogous Representation could be placed in the middle layer, the core of the interaction design. This implies that there would be the patterns correspond to the top most Communication layer, in which the patterns correspond to the middle layer could be used as the essential elements to realize the upper level patterns. Same manner, there would also be the sustaining patterns exist to sustain the patterns in the middle layer, patterns for Analogous Representations. (Fig. 1)

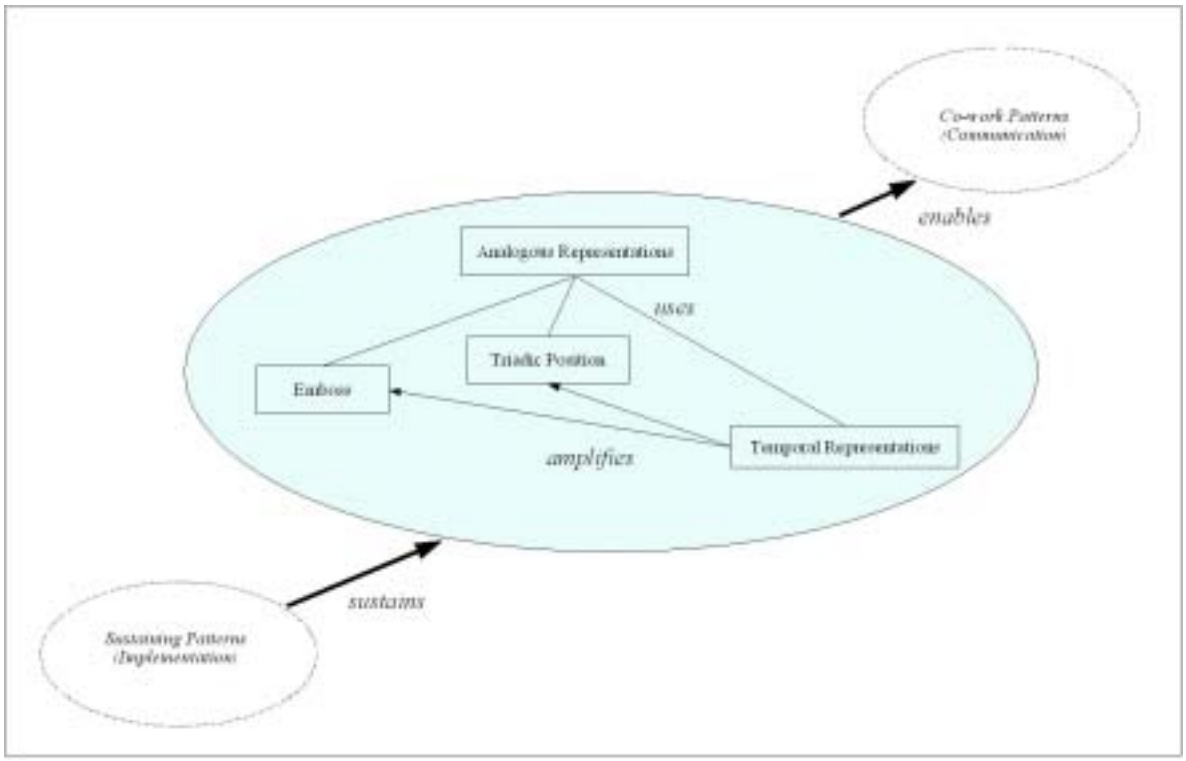


Fig. 1 Overall structure of the patterns

As shown in the figure, the *patterns for Analogous Representation* consists of four patterns, *Analogous Representations*, *Emboss*, *Triadic Position*, and *Temporal Representation.*

Analogous Representations

… the way we usually treat things in the real world, it would be more natural for ordinary people to manage things in the virtual world in the same manner ...

Context

Handling correctly the entities we are interested in is not an easy task, when they become voluminous and complex. However, our living world is changing continuously, so we must take care to keep those entities, once captured, meaningful for future use. The relationships amongst objects are also, by their nature, transient and volatile. Rigid and/or digitally expressions of those relationships might easily loose their meanings.

Problem

There is such a voluminous amount of information so that it is difficult to describe each chunk, and thus difficult for human beings to remember[1], where the intended entity exists.

Forces

The real world is changing continuously. So the entities we are interested in increase[2] day by day, and the relationships amongst them also increase and change continuously. Over time, information we face becomes voluminous and complex.

Information technology is so widely accepted in our everyday life, thus the chances for ordinary people to utilize such IT systems is becoming common. Information those IT systems handle and present must be easy to understand, and further operation on them must be friendly for those ordinary people.

When a user needs to cope with certain information, he/she has to designate it in someway. However, accurate designations, such as by specific location, by name (ID), or by whatever things we call designators, are sometimes hard to learn and remember, especially when certain characteristics of intended entities differ only very slightly from each other.

Solution

Provide some ways of designating things with their relationships/arrangements (i.e. spatial, temporal or both), instead of absolute designators.

To find the longest piece of spaghetti before boiling, the digital solution might be to measure the lengths of all of them. However, in the real world we do not usually do this; instead, we simply grab all the spaghetti and stand them on end. The longest one becomes obvious. No measurement is needed, no one-by-one comparison. Gathered things expose themselves, which is the longest one. This way of analogical representation is natural

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[1] As described in *Context* section, the focus here is how easily remember where the entity that you have once captured is, rather than querying an arbitrary entity by specifying certain descriptors. Of course querying is very much useful as long as you can provide the accurate keywords/descriptors that correctly designates the intended entity. However, in the real world, what we usually do is just place the thing somewhere on the shelf. If the thing seems to be valuable to us, we probably put it relatively close to us so that we can easily get it when we will need it.

[2] This ‘monotonic increase’ view is based on the observation that more the technology advance, the finer our resolution of the world, such as the Quantum theory introduces ‘parcel’ which is more finer than ‘atom.’

in the real world, but in the IT world everything is treated digitally, and sometimes it seems very unusual, or far from our natural thinking, like measuring spaghetti digitally.

Example

To provide an analogous presentation, we have to cope not only with the entities we are interested in but also their relationships with others, and sometimes more broadly with their surroundings that had been deemed less meaningful or redundant to handle in conventional user-interface design. One of the important characteristics of analogical representation is its ability to treat and visualize the spatial relationships that are very natural and easy to understand for ordinary users. For instance, in Information Visualizer[3], the typical spatial relationships are represented in an analogy (or metaphor) of a room (Fig. 2), or a wall (Fig. 3).

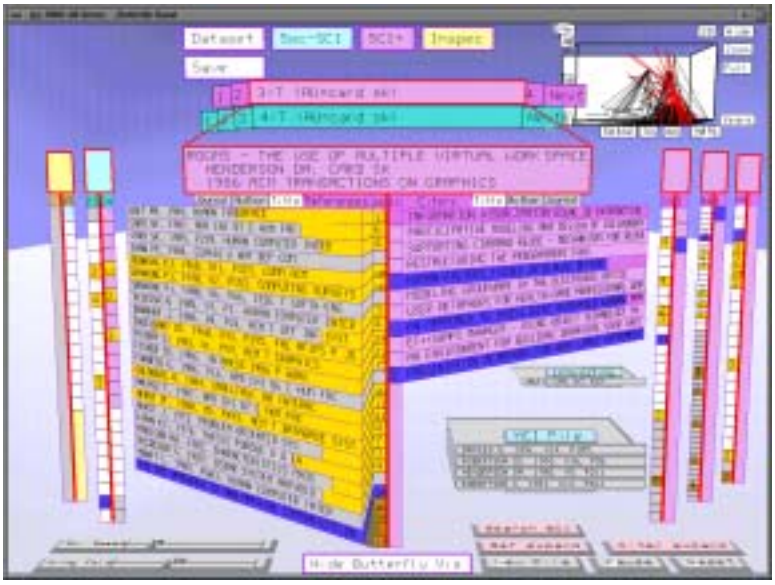

Fig. 2 Spatial relationships represented as 3D room metaphor [9]

In a room, a user can place arbitrary information (entity) in any position, such as, in front of other entities, on the top of an entity, or at the back of an entity, and so forth. Those spatial relationships will be used when the user designates a certain entity with large ambiguity, such as:

> "..probably a stack next to the right most wall, and almost at the top of the stack, a bar whose center is marked in blue…

Of course the user can issue a query to find the intended entity by specifying the appropriate designator of the entity, such as 'ID = SC199308', but for the user, the spacial relationships are very easy to remember, and almost all of his/her focus is on the right position when he/she gives a glance to this room.

In the same manner, we can introduce temporal relationships into this metaphor to extend the analogical representation. (Fig. 3)

[3] Marti Hearst, Gary Kopec, and Dan Brotsky , "Research in Support of Digital Libraries at Xerox PARC - Part II: Paper and Digital Documents," D-Lib Magazine, June 1996
http://www.dlib.org/dlib/june96/hearst/06hearst.html#Robertson

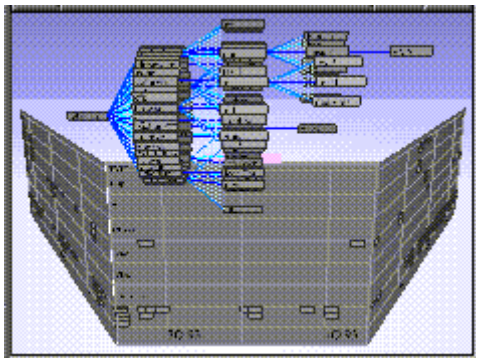

Fig. 3 Temporal relationships expressed on a wall [9]

With the wall, the user's focal point is always positioned at the center of the wall, where the time line the user is interested in is expressed. The left portion of the wall stands to represent the past time line along with entities stored and placed before. The right portion of the wall represents the future[4]. Thus, the user can easily confirm what has been done in the past and is planned for the future, while his/her focus can be retained on the focal point. To avoid superabundant presentation of information, which introduces cognitive overhead and spoils the users' attention, the more apart from the focal point, the smaller the size of entities. This allows the user to be aware that something exists (in the past or future) but at the same time he/she is free from being bothered by these aspects.

Known Use

VisualRecall[5], a Windows application provided by Xerox Corporation utilizes a wall metaphor (actually, a product version of Fig. 3) to represent spatial and/or temporal relationships/dependencies between entities.

* * *

Now you can see the power of analogical representation, and the importance of both spatial and temporal relationships. But spatial relationships and temporal relationships differ slightly from each other…

[4] Note that in this context, the terms *now*, *past* and *future* are only relative to a specified period on the time line.
[5] To date, the name 'VisualRecall' is no longer found in Xerox's site, but still available in Japan, supported by Fuji Xerox Information Systems, a subsidiary of Xerox Corporation. See, http://www.fxis.co.jp/DMS/vrecall/visualrecall_02.html

Emboss

… it's rather easy to remember the intended things with their surroundings, than precisely designate them alone, since relationships between things, especially the way they are spatially related, we can unconsciously memorize ...

Context

In the real world, things exist not solely alone, instead, they surround each other, such as a table is surrounded with several chairs, it stands on the floor, covered by a table-cloth, a flower vase placed on it. So that we can easily confirm or distinguish the intended thing – in this case, 'a table' – from the look-alikes, for instance, we can easily recognize the table from another (very similar) one, because its surroundings differ. We can unconsciously confirm that the table is the one we intend.

Problem

Sometimes the reason (or cause) why we are here (why the things are presented in front of your nose) is forgotten[6], and sometimes it is hard to confirm that the thing in front of you is what you are really interested in or not.

Forces

When a thing is almost solely presented alone, we have to consciously pay attention to confirm that the presented thing is the one we are really interested in or not.

Though, in the real world, things exist without any rigid identifiers/designators, we can still distinguish intended thing(s) from others and also designate it clearly by the expression of relationships to neighbors.

The validity (meanings) of the focal point has to be evaluated in the context where it belongs, so that we can easily distinguish the intended thing from others even though it is surrounded with the look-alikes.

As the real world is changing continuously, we are also continuously evaluating (confirming) the meanings of the things we are interested in, along with the context we live in.

While recognizing a thing presented, making a confirmation of the validity of whether the thing is really required or not, introduces cognitive overhead[7].

Solution

Present the intended things every time with their surroundings[8] (neighbors), so that its focal point is apparent

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[6] Since our short term memory is so volatile, and its capacity is limited – it is said only seven, plus/minus one or two, at a time – our current/ongoing intention and/or context can be easily interrupted by a small noise. 'Even a sneeze brings back the philosopher from his/hers deep thought.' (Paul Valery)

[7] Suppose we are using Google and key words has been entered. Then Google lists the candidate URLs that all satisfies the query we gave. However, there probably 'noises' are included in the list, so we have to have some criteria to distinguish the intended one from those noises, by evaluating contents with the criteria. It looks cumbersome.

[8] One of the easiest way to do this is to present the spatial layout of intended thing and its neighbors to the user, then allow the user to identify or distinguish the intended thing with the special layout in which it belongs.

so as an embossment[9] is. And let the surroundings generate the affordance[10] that calls a user's attention to the focal point.

Example

In the wall and the room (Fig. 2, Fig. 3), things are placed with their neighbors and some of them are structured to define yet other chunks. Each chunk exhibits its own characteristics, such as its spatial position (on the floor, its neighbor on the right, hanging on a wall, etc.), its appearance (forming a relatively tall stack, flattened on the floor, etc.), and as a whole this information let the user distinguish each chunk without any cognitive overhead. Consequently this distinction allows the user to *re*-cognize (realize again) the intended things and to remember what the intended things are.

More importantly, when the user is working on a certain entity (in Fig. 2, we can see the tag labeled '*3/7 (AU=card sk)*' on its surface, hanging near the top of the front wall, and its contents have been spawned and shown on another tag) in a chunk, the spatial relationships between the entity and the chunk, and the other surroundings, are still maintained and are obvious. In the figure, the rigid red line drawn from the entity tag to the spawned tag navigates[11] a '*spawned from*' relationship – to the user.

From the cognitive science perspective, without the surroundings some of the information won't be seen or recognized by the human brain. But once such surroundings are provided, the overall vision becomes apparent.

[9] It can be said that at least we can designate intended thing in two ways. One is to directly designate it in some way, and another is to designate its surroundings instead of itself, or in addition to it, like inverted openwork of craft. When an interruption occurs, restoration of the former case is very hard, since there is almost no other clue to help this restoration process. In contrast, the latter case we can easily recover, since the surroundings seem to work as a memento and help the restoration of our short term memory.

[10] The term 'affordance' is defined by Gibson[5], as a kind of cognitive attractor that ecologically lies between the user and the surroundings, and affords the user to make some action upon the focal point in the surroundings. For instance, a button affords user to push it, a chair affords user to sit. Moreover, some of the thin chairs afford some of the users (I mean, looks heavy) that they 'cannot sit.' Thus 'affordance' is neither buried in an object nor environment, rather it lies 'ecologically' between a user and environment.

[11] The author believes that this style of navigation is somewhat conventional rather than the analogical way of expression we are regarding in the patterns, however, in the real world, once spawning has happened, no physical relationships can be seen between the source entity and the spawned one. This implies that the relationship '*spawned from*' is truly an imaginary entity, and our lack of experience with imaginary things makes it difficult for us to establish a good literacy upon them. In a virtual (IT) world, we have to cope with imaginary things some way, and the challenges are to establish the literacy of the artificial expression – it should be natural so that ordinary people can easily and analogically understand what the expression means – of those truly imaginary things.

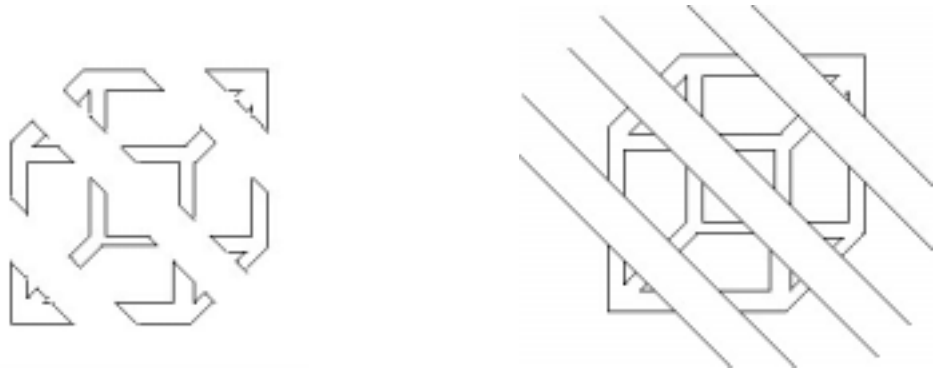

Fig. 4 *3D* box, before and after

For example, it is almost impossible for the human brain to visualize a 3D box from the information provided by the figure presented on the left side of Fig. 4. However, once six slanted lines are added to the same figure, it is obvious and everybody can capture a 3D box in the figure with no difficulty. (The right side of Fig. 4)

The same phenomena can be seen in Fig. 5. This time, three packmen are added to the left side figure but what our brain recognizes in the right side figure is actually very complex! We can see two triangles in the right side figure, one has a black rigid line for a boarder, and another has a transparent border (because we can see it).

Fig. 5 Surroundings help our cognition (cont.)

According to the examples and figures presented above, we have to be aware of how deeply the human perception depends on the context. Kanizsa[12] said that 'seeing is quite different from thinking.' When the three packmen are discarded, we can still think — more precisely, reason — about the transparent triangle, but we can no longer see the outline[13] of it.

Known Use

VisualRecall, a Windows application provided by Xerox Corporation utilizes a wall metaphor (Fig. 3) with

[12] The figures presented here are the original work of Kanizsa, and are frequently referred to as typical examples of Gestalt. See, *Kanizsa, G., Organization in vision, New York: Praeger, 1979.*

[13] It is called 'subjective contour' or 'illusory contour'. See, *Grossberg, S. & Mingolla, E., Perception of an illusory triangle with masked inducing figure, Perception, 9, 599-602, 1985.*

fish-eye view. A user can concentrate on the things appear on the center wall but at the same time the user is aware of the existence of surroundings (in this case, appear on both the left-side and right-side wall) that give priority to the focal point.

Focus plus context screen[14] (hereafter *f+c*), a prototype system that has been explored by Baudisch et al., seems to utilize same principle as *Emboss* pattern. In *f+c*, 'surroundings' are treated as context, where 'the scaling of the image is preserved.' Thus one can easily recognize where one's focus is all about, without having any cognitive overhead.

The Design Amanuensis[15], an instrument for multimodal design capture and playback, developed by DMG of University of Washington, can handle multimodal, mixture of text, sketch, and speech, interactions of designers working together on a graphical document. One of the interesting feature that *the Design Amanuensis* provides is *PlayBack*, with which the designers working on a graphical document can re-play certain scene (or conversation) once they have passed. Since actual drawing and speech events are not synchronized, thus during playback, the amanuensis highlights to indicate current graphic mark and spoken word (see, http://depts.washington.edu/dmgmedia/0.Amanuensis/6.playback.html). In this regard, the highlights could be seen to play a same role as surroundings in *Emboss* pattern.

* * *

Now we are able to express things with their surroundings in an analogous manner, primarily based on the power of spatial relationships. However, spatial relationships have a tendency to introduce overly complicated relationships. To avoid this, the following patterns could be applied …

[14] http://www.darmstadt.gmd.de/~baudisch/projects/focuspluscontextscreens/
[15] http://depts.washington.edu/dmgmedia/0.Amanuensis/0.default.html

Triadic Position (Primal Three Position)

… some of the spatial relationships are indeed natural and basic to us, thus utilizing those basic spatial relationships we can allow the user to enjoy the large degree of freedom where a limited number of relationships provides...

Context

Utilizing the spatial relationships, a user can easily manipulate things expressed in an analogical world, such as the room and the wall. However, some of the complicated spatial relationships, such as 'a thing covers A and B', can be accidentally introduced into the existing relationships and in time the complexity of the relationships increases and eventually disrupts the user's activity. So, some guidelines are needed to maintain, retain and lower the complexity of the relationships.

Problem

Introduction of overly complicated relationships might easily interrupt our primary focus. Providing attention to a secondary concern, or trying to follow the right way — when there are so many relationships to choose — sometimes causes us to lose our primary focus (cognitive overhead is easily introduced).

Forces

Cognitive overhead is easily introduced when two different contexts conflict. Suppose that you have stored more than fifty bookmarks in your favorite browser, such as IE or Navigator, and while your are writing a pattern paper, you have come to refer to a specific site whose URL has already been bookmarked. However, finding an intended one from the long list of bookmarks heavily draw your attention from your primal task.

Introduction of overlapping contexts may increase the complexity. Consider following joke, 'at the first bus stop, two passengers got on, and the second bus stop, three passengers got off, and …, so, how many stops did the bus make?' Even a question itself is trivial, it is not easy for us to give a correct answer, since our attention is easily violated by this type of mixture of contexts, in this case, the number of passengers and bus stops.

Introduction of complexity could violate the user friendliness of the system. Some people, especially techie, loves to specify certain things in detail, or gimmick, but ordinary people do not. Retain things as simple as possible.

Complex expression of information is not welcome. In general, the more the complexities increase, the more likely the chances of the misunderstanding occur.

Solution

Use the essential *triadic* relationships[16] that are naturally embodied in ourselves and in everyday things, such as upward–current–downward (top–current–bottom), forward–current–backward (front–current–back[17]),

[16] Since there are two poles, and between the poles a neutral position exits, the three positions are essential and the term triadic is used to express those relationships.

[17] Interestingly, the word *oriental* stands for the direction *east*, where the sun rises, thus the ward *orient* stands for *forward* direction, where light comes, and at the same time the word *occidental* stands for counter direction, and hence both words represent an essential spatial relationship. This relationship can be observed in almost all languages, from an

leftward–current–rightward (left–center–right), so that the user can unconsciously track the right relationship without disturbing the primary intention. Utilization of these kind of deeply embodied sensitivenesses, such as an exhaust noise of straw sucking represents, metaphorically, a warning of low fuel to the pilot without any mental pressure, so that unnecessary interruptions to the cognition could be avoided.

Example

Essential triadic positions are deeply embodied in life. We are almost unconsciously aware of those triadic relationships no matter how we are concentrating on a certain context. Moreover, triadic positions are easy to remember, and can be treated as powerful cardinal points to express the spatial relationships in the surroundings. For convenience' sake, we are going to introduce three analogical types of entity: book, shelf, and locker. Each type corresponds to several levels of information chunking. Suppose each small size chunk is represented as a book, and books are stored on shelves. A shelf can be treated as a medium size chunk of information. Shelves are stored in lockers. We have three lockers in a room, and each locker is placed along the wall of the room. (Fig. 6)

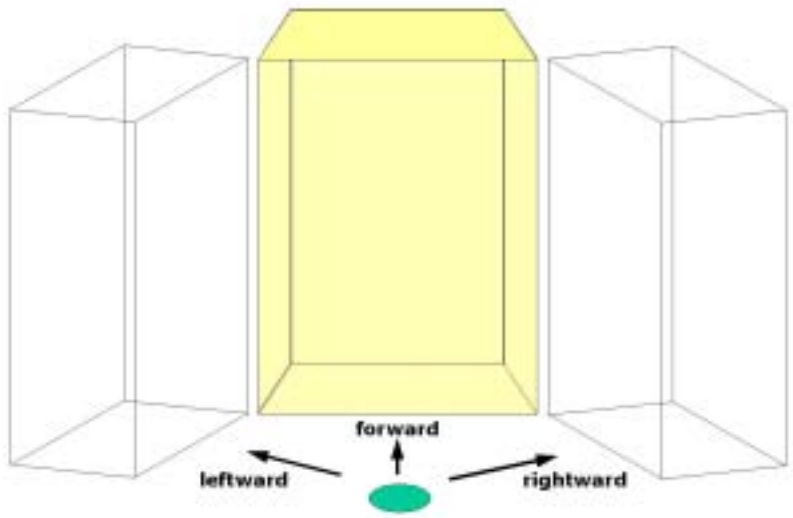

Fig. 6 Three lockers placed in a room

According to the figure, you can easily designate each locker by its spatial position, such as:

- *center* locker
- *right* (side) locker
- *left* (side) locker

In the same manner, we can distinguish and designate each shelf in a locker (Fig. 7) as:

- *center* (middle) shelf
- *top* (upper most) shelf
- *bottom* (lower most) shelf

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ethno linguistic aspect. Similarly, *right* and *left* represent a spatial relationship, for instance, in ancient Japanese, the words south and north come from the same root, which represent *right*, since south is just *right* of east, an orient, where one's face is pointing. And visa versa, the word north stands for *left*.

Further, we can designate a certain book on a shelf by utilizing its spatial relationships but in a somewhat ambiguous way (Fig. 7):

- *around the center* of the shelf
- *rightmost* side of the shelf
- *leftmost* side of the shelf

As a result, one can roughly designate the location of a certain book with the combination of those spatial relationship expressions. Can you figure out where the intended book exists, when the designator expresses the location of the book in the manner stated below?

- *a book is placed at the rightmost side of the shelf, which is in the middle of the left side locker*

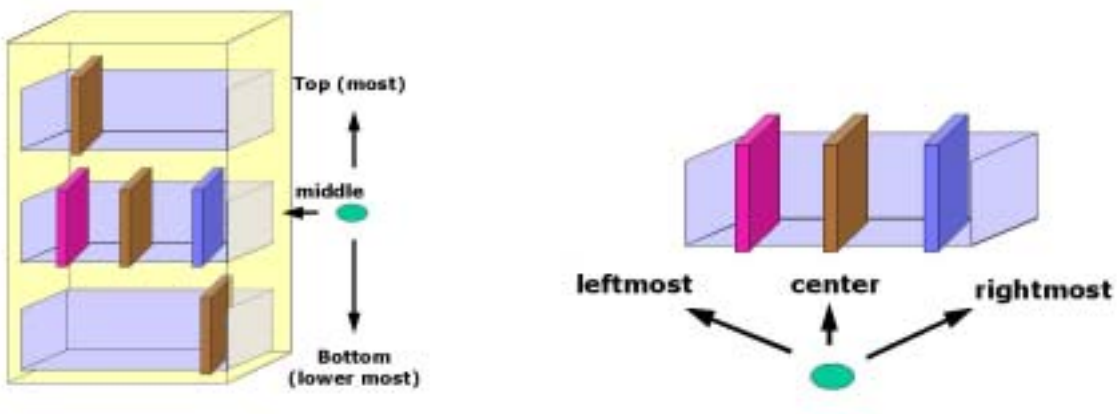

Fig. 7 Spatial relationships in the locker/shelf metaphor

In this way, even when a limited number of triadic positions are introduced, the user can designate the intended thing(s) using its spatial relationships. Note that the traversal (or interpretation) of those spatial expressions is almost automatic in the human brain, since the triadic positions are essential and embedded in our brain. As a result, the user's primary intentions (e.g. looking for a certain book) are retained throughout the execution of those spatial traversals. Additionally, triadic positions are also very easy for human beings to remember[18], thus the burdens we face when we use a conventional inventory system, which usually requires us to specify rigid designators, could be reduced by the introduction of those spatial expressions as another designator.

Known Use

An application system named VEIL[19], a kind of information sharing system for the earth resources searching expertise, utilized these room, cabinet, shelf and book/folder/brochure metaphors based on the triadic position. The triadic position and the familiar metaphors VEIL provides enabled the users to deal with their own specialty without paying much attention to the reconciliation of the information they had once captured.
The idea of triadic position was inspired from the success of the application of the limited ontology, such as

[18] It seems no additional effort is needed, since in the real world, we unconsciously utilize the triadic special relationship.
[19] The name stands for an abbreviation of **V**irtual **E**lectric **I**nformation **L**ibrary, which developed and used circa 1992, by the predecessor of InArcadia.

SHRDLU[20] and the headrest of Volvo car. SHRDLU's world and its ontology is limited to a blocks world, so that the limited/constrained natural language expressions could be interpreted by the software and thus the software manipulates the blocks correctly in accordance with the user's request. Introducing the appropriate constraints simplifies the world.

In Volvo's case, their non-adjustable headrests provide more safety to the passengers than adjustable headrests that other car manufacturers provide. This is because to adjust an adjustable headrest in a correct position is almost impossible to ordinary passengers, who usually have no enough knowledge about the correct position of the headrest. It is said that Volvo's non-adjustable headrest can cover almost all the varieties of passenger's head in a safe zone, though other adjustable headrests reportedly can cover only 20% or so in average due to the maladjustment done by the ordinary passengers. Here again, the appropriate constraints simplifies and makes the world better.

* * *

Now you are ready to extend your understanding of the spatial relationships to the temporal relationships, with the help of the following patterns ...

[20] SHRDLU is a program for understanding natural language, written by Terry Winograd at the M.I.T. Artificial Intelligence Laboratory in 1968-70. The spelling SHRDLU come from a frequency order of the English characters, "ETAION SHRDLU." See, http://hci.stanford.edu/cs147/examples/shrdlu/

Temporal Representation

… over time, things are changing not only their own profiles but also the relationships amongst them ...

Context

While real world is changing continuously, we can still recognize a thing is the same, no matter how the look of it has changed.

Problem

Over time, things we once recognized gradually change their profiles and/or properties, especially their appearances, so that it is sometimes not an easy task for us to *re*-cognize (realize again) them when we meet them again.

Forces

The real world is changing continuously. Objects themselves and the relationships amongst them, by nature, gradually change or, in other words, loose their original characteristics.

To *re*-cognize the things, which have been realized once before, is required so frequently. No matter how we are familiar with, or no matter how prefer, everyday we have to unconsciously[21] *re*-cognize the surroundings around us.

Over time, some are gone and some are stay, however, the more recently we have touched it, the more likely it is that we need to remember[22] it[23].

Sometimes we are at a loss to find out, or to remember where the appropriate thing is stored, even though we were working on it, and set it somewhere just a short time ago.

Time flows only in one direction[24] [25] (replay is impossible.)

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[21] David Bohm gave interesting observations concern to not only this matter but also why our recognition itself is seemed so 'consistent' over time despite the volatility of particle, from the quantum mechanics' aspect. See, "Wholeness and the Implicate Order," David Bohm, Routledge & Kegan Paul, London, Boston, 1980,

[22] The author once saw the research paper issued by Xero/PARC in late 80's, concerned to some empirical design study, the paper said that 90% of information stocked on the desk of typical researcher in a year was just only 'once' scanned, while only 10% were the originally written, modified, or frequently referred. Since the author hardly recollect the detail of the paper and thus not quite sure but the proportion expressed in the paper was somewhat very much hit the author's intuition.

[23] In Japan, several years ago, a book titled 'Cho-Seiri-Ho (Super Classify Mehtod, written in Japanese)' was one of the best sellers. According to the book, the proposed classification method is very simple. Put any chunk of information (mainly a paper) into a brochure (or a clear folder) and then locate it on certain side (for instance, leftmost) of certain shelf. So every time the newest brochure comes the most left side of the shelf (similar to a Last-in-First-out queue). When you pick up and refer certain brochure in the line of the shelf, then you have to return it at the leftmost position. After all, you can see relatively important information (brochures) is gathered almost at the left side of the shelf. The book also mentioned that only 10% or so is the information periodically used, the rest are candidate to disposal.

[24] Under some conditions, a chemical solution expresses an interesting behavior (chemical reaction). For instance, continuously heating the solution and certain temperature *t1* there two different acts (such as higher/lower the rate of the reaction) are potentially possible, and once a certain act (such as higher the reaction rate) is chosen (this is totally

Solution

Give temporal change (elapse) an epistemological sense, and express it in an analogical way, such as reference count as the width of a book[26], or give more vivid color[27] to the books recently referenced, while the color of others gradually fade as time goes by.

Related Patterns

Some of the existing patterns and/or pattern languages, such as *Time Patterns*[2], *Time Travel: A Pattern Language For Values That Change*[3] and *Time Cursor*[4], have also mentioned the temporal aspects of system development, and provided some useful and general approach to express the temporal aspects of the features needed in expressing such functionalities in a system.. These temporal aspects related patterns/pattern languages would be the great help to implement the features that needed to realize this pattern. Especially, the approach that the *Time Travel* has proposed, that to isolate the event happened in the real world from the ideal world where the phenomena caused by the event can be observed and thus introduce the two different but associated types of time as an essential modeling factor to organize temporal aspect sensitive system development, could be a novel contribution to the modern software development discipline.

* * *

The other patterns that sustain the patterns mentioned earlier are now under consideration. The work is in progress.

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unpredictable). Then once cool down the solution and again start heating, at the temperature *t1*the solution takes same action as before, as if it remembers which acts it has once taken. As the reaction proceeds, patterns can be observed. Same kind of reactions can be seen and well known such as famous Zhabotinsky-Belousov reaction. See, "The End of Certainty: Time, Chaos, and the New Laws of Nature," Isabelle Stengers, Ilya Prigogine, Free Press, 1997.

[25] It seems that Bohm also considered that time has a direction, and moreover, time and space, means the universe, should be regarded as one thing, as the flux.

[26] Suppose each piece of information is represented as a book and they are stored on a shelf, thus the user can manipulate - such as move, pick up, read its contents and so on - those books via a browser (see *http://www.patternlanguage.com*, you can find a similar look.) When a manipulation is made, the reference count of the book is increased and the book becomes wider to reflect the actual value of the reference count. Thus, important, or well-used books are obvious.

[27] Interestingly, the term 'evergreen' actually coincidences with this meaning.

Epilogue

Gibson[5], so far, might be the first person who is aware of the importance of *surroundings*.

Lakoff[6], and more extensively, Edelman[7], mention the way we human beings recognize and organize knowledge (recognition) by means of categorization.

Some of the research[8] done by the USAF offers an interesting result that a conventional beep sound had been used to notify the pilot that the refueling is needed, but it introduces an unnecessary mental pressure to the pilot, especially when the pilot is aiming a hostile plane the beep sound disturbs the concentration of the pilot, and the statistics tells almost all the pilot fail to catch a hostile plane in such conditions. Later, instead of a beep sound, the noise of sucking the last of a beverage through a straw was used and then, the pilot easily understood what the sound meant without any unnecessary stress. This kind of natural representation must be explored in the software field.

A more comprehensive approach to this field has been done by Card et al.[9], circa 1995 in Xerox PARC, in their Information Visualizer project.

Recently, researchers in CHI field pay much attention to the pattern approach tossed by Alexander. Some of the ‘pattern language’ approaches have been explored[10][11]. And also some interaction design researchers argue that the recent ‘agile’ movement in the software engineering field could be applicable even in interaction design[12]. This kind of ‘crossover’ and parallels could be interpreted as good signs that the more people will be soon aware of the impotence of so-called interaction design, including the patterns presented in this paper.

The author sees the future of the patterns and has been also strongly impressed by the approach that the TangibleBit[13] group is taking. Same kind of ‘tangible’ interface is also explored in DMG Uni. Of Washington as their ‘Navigation Blocks[14].’

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