The Process of Pattern Recognition in the Natural Systems

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Abstract

Any natural system can build its own logical form/ skeleton /foundations, this logical form can be abstracted in a shape of patterns. Even the most complex systems, their patterns can be abstracted, that because they are built upon an inner Order, besides, their Good design avoids unnecessary complications. However, the ability to recognize patterns cannot be perfect, or pure, or simple that is because the inner order depends on the balance between its contradicting forces which could lead to, somehow, random forms. It cannot be perfect but can crystallize a certain idea that resonates in the conscious mind of the observer.

The ideas always are renewable and developing as long as there is a continuous emergence of scientific theories that examines the origin of forms and the cosmogenesis. Therefore, this paper is one of many that aim to discuss the concepts relating to the Pattern toward a new contemporary architectural methodology, which starts, in the first steps, with knowing how to discover the hidden patterns. This is a big challenge to architecture -as an artistic science or scientific art.

Introduction

Although the notion of Pattern recognition has been crystallized and discussed extensively in the field of artificial intelligence and machine learning -as an automatic method of discovering the regularities in any data (Bishop, 2006, p. 1), but earlier, in the 70s, it had been introduced in architectural by the pioneer Christopher Alexander while he was discussing the concepts "The pattern language" and "The centers" in his famous books "The pattern language","the timeless way of building", and "the phenomenon of order".

Alexander was fascinated by the architectures of ancient civilizations, he considered them as natural organisms connected somehow with Nature and filled with life and wholeness, and he considered them as examples showing the ability of ancient architects to mimic the hidden order in Nature. So, he aimed -in this researches- to

set up new design methodology based on the concept of the pattern which enables designers to create new designs full of wholeness and life.

1.1. Research major problem:

There is no systematic process the architects can follow to discover the patterns in a natural system that is proper to their visual skills.

1.1. Research sub-problems:

1.1.1. The concept of pattern recognition has been discussed extensively in the field of artificial intelligence, not in architecture.

1.1.2. The most known method for observing any phenomenon in any natural system is based on a materialistic concept, which is the building is an exotic machine has beenput in nature, this method is inappropriate to the new trend of architecture, which isarchitecture is an unseparated

part from nature. This method consequently ignored the intuitive skills of observing that the architects had.

1.1.3. There is a suitable proposal to discover patterns used by Alexander in his research but he mentioned it shallowly. This method is intuitive and visual, but it does not have the structure to be a systematic process.

1.1.4. There is a difficulty facing the architects to use the patterns inspired from natural systems because they always got lost because there is no scientific format to recordthem.

1.2. Research aim：

1.2.1. This paper aims to set up a logical method to discover patterns.

1.2.2. Find a way to put the discovered patterns in clear formulas and languages that makethem usable and sharable.

1.2.3. Helping in increasing the architectural language.

1.3. Research Methodology:

This paper is based on combined strategies: it uses the qualitative strategy to discuss what the pattern is, what the concept of pattern recognition is, and what the procedures to recognizethe pattern.

It uses the comparative analysis to show the differences between both "the empirical
/experimental method" of Rene Descartes and the "visual/ intuitive method" of Christopher Alexander.

also, it uses the historical strategy to examine the developing of pattern writing starting fromthe pattern language formula in Alexander book " the pattern language" in 1977, passing by thepatterns' formula in the software field in the book "Design Patterns: Elements of Reusable Object-Oriented Software" in 1994, to the new version of pattern writing in Alexander's book" the phenomenon of order" 2002, to

the new formulas which keep emerging with the digital architecture age where the parametric patterns.

2. THE DEFINITION OF "PATTERN":

Alexander totally changed the shallow/narrow notion of pattern that was known before, heclarified that the patterns are not merely elements of spatial configurations that artists and architects arrange to make beautiful designs, he expanded its definition gradually from a geometric configuration that expresses a social event, to be a general and essential rule that organizes the spatial configurations, to a *hierarchic structure* that contains different scales of patterns (Salingaros, 2000, p. 3) and interlocked at the same time with another hierarchic structure, to a generative "Space-Packing process" (Segal, 2011, p. 11) which is an "evolutionary" process of grouping peoples, events, spaces, units …etc. This extensions that exploded by Alexander turn the challenge from "how to make arrangements" to "how to

recognize a pattern"

2. THE DEFINITION OF "PATTERN RECOGNITION":

The concept of pattern recognition consists of two words, the first word is "the pattern" Alexander defined it as "the hidden subroutine" (Alexander C. , 1979, p. 247), Carpenter and Grossberg defined it as "the codes that can be categorized in a network model" (Carpenter & Grossberg, 1987, pp. 54-55), while Schuler defined it as "holistic principles" which cannot be invented, but it must be extracted" (Schuler, 2008). All of these definition means that there is a phenomenon that happens in a system and needs to be captured, documented, organized and disseminated.

The other word is "recognize", it is the synonym of the words, 'detect', 'discover' and 'appreciate'. It is a process of perception which concerns fundamentally with how humans discover, learn and recognize the properties and characterization of the

environments they are exposed to, and how to recognize the codes spontaneously emerge through an individual's deepinteraction with this environment (Carpenter & Grossberg, 1987, pp. 54-55).

So the pattern recognition process means putting a phenomenon under examination, observing it, and identifying the invariant principles found in it. These principles abstracted intopatterns which need to be analyzed systemically, sorted and arranged, then recorded in a simpleprecise language to be used, over and over again easily. In all this process the designer not onlyvisually registers information but also constructs its meaning, value, and applications. This process is built on an inner believing at the observer mind that there is a hidden order in -the under studying- visual system, this order can be unraveled by decoding and analyzing its entanglements to the essential elements and relationships, and delaminating the layers of unimportant actors (Agostinho, 2005, p. 84).

In brief, and from an architectural perspective, the "Pattern recognition"

concept helped inliberating architecture from the constraints of the old and formal styles of design to the new diversities and possibilities based on the ideas of "pattern-making" and "biomimicry". It is "an intuitive, unintentional creative process" of the new age, as Bohm described (Bohm & Nichol,1998, p. xiii).

3. METHODS OF DISCOVERING PATTERNS:

For hundreds of years, even until now, scientists use the empirical/experimental method of Descartes for observing and discovering (Alexander, 2002, p. 368), this method has a logical consequential structure that allows finding a comprehensive agreement about any natural system's order. This method is not proper for artists and architecture because it deals with architecture as a machine, as a strange artificial object implanted in a natural medium, this is This is quite the opposite of Alexander spiritual proposal which deals with architecture as a living organism, as a part of the natural system. Consequently, his proposal respects the intuitive

tendencies and the emotional feelings that architects and artists have during pattern recognition process as well as designing process. In this part of the research, Descartes's method, and Alexander's proposal will be discussed as follows:

3.1. Descartes method "synthetic method":

The French philosopher Rene Descartes (1596-1650) called this method the "synthetic method" of doing geometry (Mahoney, 1979), he meant that it is an analytic method used to discover the geometric axioms in any system. Descartes argued that all things have an inner essence or form which explains the structure of things as they ordinarily appear. He tried to find the Reasons behind this essence and the reasons that there are these patterns and regularities in Nature. His method of observation consists of 4 main steps:

3.1.1. Doubt everything: means to avoid the prejudgments, and to accept nothing morethan what was presented.

3.1.2. Break the whole problem into smaller part.

3.1.3. Solve the simplest problems first then rise little by little to the most complex.

3.1.4. Be thorough/ detailed: to make the observation so complete and so general.

4. The idea of Descartes was materialistic, it is based on the hypothesis that everything eventhe world is a machine, which could be taken-apart into segments. This belief was largely .

accepted by scientists in the 20th century- it is believed that the only statements which can be true or false are statements about mechanisms. These are the so-called "facts" familiar to everyone in the 20th century (Alexander, 2002, pp. 16-17).

4.1. Alexander's proposal "the mirror of the self":

Alexander didn't accept this crucial results of Descartes because to be used architecturally,he believed that his method is isolating things, breaking them into fragments, and making machine-like pictures of how things work. And this is not how reality actually is, architecture should be unseparated part of nature that mast characterized by wholeness and life -he considered the buildings as living organisms. So, he indirectly introduced in his book "the phenomenon of life" a new proposal of recognizing patterns built on the visual skills and intuitive feelings of designers, and confirms his spiritual concepts such as the wholeness, the life, the centers, and the quality without a name "QWAN".

So, we can find in his book a general discussion for these notions, and a presentation for thepatterns that he discovered, and how he recorded them formally – he invented a way of writingto record the patterns- but there is no discussion for

the systematic procedures that he followedto discover patterns.

He discussed how he with the help of his colleagues put thousands of buildings' examples under a process of the intuitive comparison doing by a sample of people, this process is like a questionnaire which aimed to find out which buildings have a life and which are died, and the degrees of the life and death. Alexander called this process "the mirror-of-the-self" test because it reflects the inner feeling of the observer (Alexander, 2002, p. 353).

4.2. The Logical/intuitive method:

Both proposals of Descartes and Alexander are useful in observing patterns in different ways, while Descartes method allowed only the focusing on the outer reality and the forms of mechanisms in the world, Alexander proposal requires focusing on the inner reality of feeling.Based on both methods, a new logic and systematic method could be set up by combining bothmethods, this method follows

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these steps:

4.2.1. In the beginning, the observer, the observer must be saturated with a major idea he seeks to and searches for every clue to prove it during the recognition process - considering that the patterns recognition is a process of registering information andconstructing the meanings.

4.2.2. Then he collects a lot of photos for the domain under study, and studys the context of them by using the other scientific fields that interested in studying them, such asphysics, mathematics, biology etc.

4.2.3. During that, he records all the row terms and features used by scientist to deal withthis visual domain.

4.2.4. Then, he examines these terms, forms, and features to discover which ones of themcould be abstracted to a visual characteristic -that all the photos shared obviously, here we did not yet get a pattern, but we just obtained proper statements describe the situation.

4.2.5. Now, the observer starts the stage of pattern identification, the focus mostly is on inventing precise Names to describe these proper characteristics (which could be forms, rules, colors, geometric shapes), then he draws them in a simple and clear Diagram.

4.2.6. And of course, it is important to use one of the clear Formats which will be discussednext- to write this characteristic. At this point, this is the beginning of a useful pattern.

4.2.7. This pattern has to be followed by a stage of refining to achieve the clarity and simplicity, this stage could be repeated again after using and sharing the pattern, so,patterns must be easy to find and share widely as possible.

5. PATTERN RECOGNITION PROCESS:

The procedures of the pattern recognition process -the logical intuitive method- could be summarized in 4 major as following: "Observation", "Abstraction", "Writing", and "Sharing and refining".

5.1. The Observation stage:

To have an objective picture of a phenomenon of any kind in the world, we must find an analyses way that gives sharable and useful results about it. This happens, in the beginning, bythe observation stage.

The observation stage is deeper and takes longer time than merely seeing something, if thebehavior of 'seeing something' is the action visual cognition (Choi & Han-Jong, 2005, p. 41) which is an evidence of the ability to see (Agostinho, 2005, p. 85), "observing something" willbe the visual recognition, which is a higher level of perception. It is an intuitive active processf information–seeking, through which we could make sense of the world around us by using many mechanisms in

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the eye and the brain, some conscious and others unconscious, it is biological mechanisms made by the observer's organs of sensation, which easily handle the conscious processes such as analyzing, abstracting, sorting, and structuring (Lam, 1977, pp. 3,17).

Observation always combining with a specific **theoretical scheme**. It is the background which guides the way the observer looks to the under-study system, this scheme -to achieve successful detecting- must be accurate, complete, undistorted and based on deep scientific research. For example, an observer could observe the system saturated with a mathematical background.

After identifying the scheme, the observer simply starts with **looking** at thousands and thousands of samples and pictures for the demanded domain, this stage demands a mode of thought different from the flow of design mode, it needs the observer awareness and neutrality in answering the following questions (Woodbury, 2010, p. 189): Can we find any structural features which tend to be

present in the domain/visual field? Are these features happen again and again? Can these features be described in phrases? What are the shapes and relationships are easier to 'discover' when we look at a domain/visual field?

If the answer is "yes" to each of these questions, so the domain has a pattern which needsto be formulated in a language.

5.2. The abstraction stage:

There is a link between thoughts and perception. Good perception means that we can read the structural features of the object perceived, this means being able to build abstractions. Actually, every scientific theory is a kind of limited map of the universe, it is a limited abstraction and not entirely accurate nor holistic (Bohm & Beat, 2011, p. xvii). Also, every kind of thought in the human's mind is an abstraction, it is limited in its own way, it does not and cannot cover the whole of reality, but combining different kinds of thoughts and different kindsof abstractions

may give a better reflection of reality

Architecture mostly represents itself through visual languages such as drawings, images, and models. So most architects and students consider themselves as 'visual thinkers' (Austin & Qattan, 2016, p. 831). Thus, the more close method to the architects' minds to study and mimicany field's structure is by making some visual abstraction which is a process of focusing on themain features of this structure and isolating them from all the infinite, fluctuating complexity of the background.

the abstraction is a general concept that means discriminating the forms that are relatively constant and neglecting the inessential detail, it is associated with vagueness; it may be hard toobtain much from an abstract idea, but in design, abstract ideas are often used as a base from which many alternatives can be generated (Woodbury, 2010, p. 30). The pattern is a sufficientlyabstract idea that is repeating again and again. So, designers must know and practice how to make and use abstraction.

Patterns abstracting also is an intuitive process takes place in the field of consciousness, where the thoughts and feelings explicate and extract the order of system" the visual field" in simple forms which continuously repeat themselves in similar ways and have well-defined locations in space. In other words, the order in any system is associated with relatively simple

orders of similarities and differences, which the sense of perception tends to abstract them inrelatively simple formulas (Bohm & Beat, 2011, p. 184).

5.2.1. Abstraction according to categorization:

Bohm and Beat in their book "science, order, and creativity" clarified that the first notion of order depends on the ability of the human consciousness to abstract the similarities and differences in the visual field of a system. This means that perception begins through gatheringthe similarities and differences as primary data

of vision, then use them to build up the Categorizations, which are groups of similar forms abstracted from a different background. In other words, abstraction visually happens by making categorization for certain things – namely similarities and differences- that are selected from the general background, that guarantee reducing and eliminating most of the unimportant details from the fully structured field and distinguish those important ones. This categorizing involves two actions of abstraction (Bohm& Beat, 2011, p. 106): A selection which means "to gather apart": separate similar things fromdifferent background. A collection which means "to gather together": put these things togetherin one category.

For example: In the process of observing a flock of birds in a tree the category of birds is formed by putting things together that are simultaneously distinguished from those that do not belong to this category such as squirrels. In this way sets of categories are formed, and these, in turn, influence the ways in which things

are selected and collected. Selection and collection, therefore, become the two, inseparable sides of the one process of categorization.

This determination of similarities and differences can go on indefinitely, it can go gradually complex to represent the level of order, the first level of complexity -as Bohm and Beat defines in their book (Bohm & Beat, 2011, pp. 110- 113)- starts with the categorizing according to similarities and differences, then the categorizing according to the similar differences or different similarities which is

chaos.

| similarities and differences | similar differences or different similarities | The Order of Orders | The Order of disorder (the chaos) |

Also, the accurate abstract of any complex and wide-ranging body of a phenomenon is very difficult and various because some distortion and tolerance could happen. So, if we must sacrifice total representational accuracy, we have to decide to what range this distortion and simplification could happen? And what is the case that the accuracy is absolutely essential? (Singer, 1961), these decisions are very difficult because they are dependent on the ability of the observer to go to the heart of the system to get its really deep ideas, this ability depends on only the observer's skill and intuition because no one can tell how to do this in science, and also no one can tell how to do this in design, and so that Alexander said "Making abstractions is an art." (Alexander C. , 1979, p. 262).
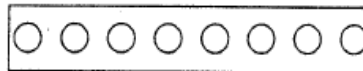
5.2.2. Abstraction according to the gestalt theory.

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The gestalt principles are rules for organizing the visual field, they are efficient tools for abstraction, they aim to formulate the regularities rules for the unitary forms, and put them in asub-wholes or groups, thus, they are efficient in perceiving the groups of elementary components/units as abstraction and segregating them from other groups (Todorovic, 2008).

Any visual system is divided up into regions of common texture, shape, and color. Every region is a long chain of features, so the same features connected to form continuous contours and boundaries. In other words, if any group of objects/elements of a system have a particular feature, so these objects/elements will be visually bonded, thus this feature acts as a boundary between this region and other regions of other features, the result is that the visual field is segmented into patterns. So we can say that pattern finding according to Gestalt theory is a hierarchy process, start with the meaningless low-level features which are formed into patterns in the second stage, then meaningful objects in the third stage (Colin, 2008, p. 10). The Gestalt principles, figure no (2):

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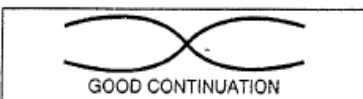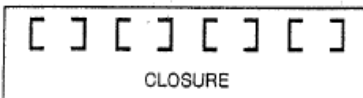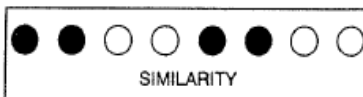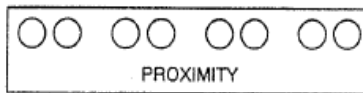
5.2.2.1. Abstracting the patterns according to the Proximity principle; this principle aims to abstract the pattern which consists of units perceived as one group because they are near toeach other.

5.2.2.2. Abstracting the patterns according to the similarity principle: this principle aims for abstracting different patterns which each consist of units tend to be integrated into groups because they are similar to each other.

5.2.2.3. Abstracting the patterns according

to the continuity principle: this principle aims for abstracting different patterns, each consists of units tend to be integrated into one whole because they are aligned with each other.

6. Throughout the ages, People needed tools to refer to the things which exhibiting importantspatial features to them, so they used drawings to represent how things were arranged or shaped,besides that, there were the words which were one of the easy and accurate ways to describe any spatial configuration, language is a very effective tool that provides descriptions to any visual entity, that implies, any visual pattern can be easily stored in memory by both visual andverbal codes, in other words, any shape easier to be found and memorize if it was expressed bydrawings and vocabularies (Liu, 1995, p. 372).

On this basis, some linguistic templates were the chief and the most reliable methods for representing the characteristic of the patterns (Resnik, 1997, p. 227), this in spite of being associated with very developing and complicated linguistic systems such as syntactic and semantics. Almost, all the current systems have what so-called scripting language (Woodbury, 2010, p. 35), which is a constant and clear format of writing that marks the pattern as somethingdifferent from the average piece of technical writing.

According to these templates and formats, which are the most distinctive features of the pattern, patterns become easier to be abstracted, shaped, arranged, and designed. Also, by using them one can learn how to design things before manufacturing. But the main importance of these templates and formats comes from their precision and their regulation which push to reduce possibilities, whereas without introducing abstract template, one will be facing a lot of chaotic probabilities about how things might be arranged or designed or shaped.

So, and because of being a good tool for grouping, Patterns always are contributing in building up a big sharable library of low-level and simple languages and ideas (Woodbury, 2010, p. 189), this library needs every pattern be written in a precise format. Patterns writing can enrich the vocabulary of design by coining new terms, forms, and concepts. Hence, just bysaying terms such as "echoes" or "self-similarity" we can communicate our design ideas very effectively (Fowler, 1997, p. 7).

There are many common constant formats many people used to follow (Fowler, 1997, p. 8):

- "Pattern language" format: A form of language.
- "Gang of four" format: A formal structure.
- "Timeless way" format: A set of flexible ideas.
- Woodbury format: another version of "gang of four".

6.1.1. <u>Pattern language format:</u>

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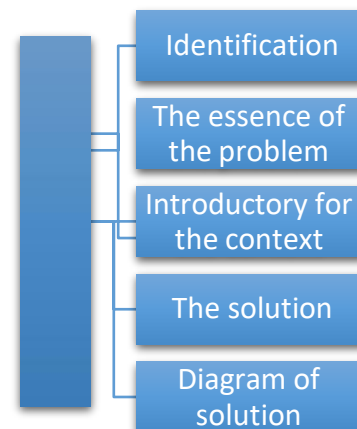
This method is the first try to write patterns, it is inventedby Alexander at 1977 to write his 253 functional patterns in his famous book" pattern language". He defined the pattern as a three-part construct: context, problem, and solution (Alexander, 1977, p. x). This format consists of:

6.1.1.1. Identification: including name, number, confidence rating, and a photograph of a typical example.

6.1.1.2. A headline: the essence of the problem. 5.3.1.3.An introductory paragraph: to set the context.

5.3.1.4.A paragraph explaining the solution.

5.3.1.5.A diagram of the solution.

Table no 1: show the component the pattern language format. Example (Alexander, 1977, pp. 10-14)	
Identification(number, name, and photo)	**1.** INDEPENDENT REGIONS *Figure 3 Alexander gave this pattern language the number 1, he called it INDEPENDENT REGIONS, and he put this photo of a swan to express it, photo from Nature (Alexander, 1977, pp. 10-14).*
A headline: the essence of the problem	Metropolitan regions will not come to balance until each one is small and autonomous enough to be an independent sphere of culture.

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An introductory paragraph to set the context	There are four separate arguments which have led us to this conclusion: 1. The nature and limits of human government. 2. Equity among regions in a world community. 3. Regional planning considerations. 4. Support for the intensity and diversity of human culture.……..
A paragraph of solution	Wherever possible, work toward the evolution of Independent regions in the world; each with a population between 2 and 10 million; each with its own natural and geographic boundaries; each with its own economy; each one autonomous and self-governing; each with a seat in a world government, without the intervening power of larger states or countries.

A diagram of the solution	*Figure 4 alexander drewthis sketch for this pattern(Alexander, 1977, pp. 10-14)*

1.1.1. <u>Gang of four" format:</u>

"Gang of four" is a famous title which indicates to the four writers of the important book" Design Patterns: Elements of Reusable Object-Oriented Software". The writers succeeded in developing the pattern language format to another format proper to write software patterns. This format used in the "Object-Oriented Software" (Gamma, et al., 1994, p. 19). It contains a lot of terms and conditions that exist in this discipline only. It is far from architectural patterns, butit helps in

discussing how fixed formula can be used to write a pattern. This method consists of:

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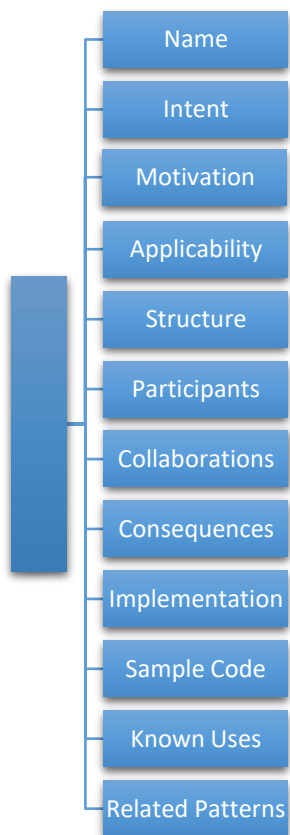
5.3.2.1. Pattern Name and Classification: The pattern's name conveys the essence of the pattern succinctly.

5.3.2.2. Intent: A short statement that answers the following questions: What does the design pattern do? What is its rationale and intent?

5.3.2.3. Motivation: A scenario that discusses the design problem and how the pattern solves the problem. The scenario helps in understanding the more abstract description of the pattern that follows.

5.3.2.4. Applicability: What are the situations in which the design pattern can be applied?

5.3.2.5. Structure: A graphical representation of the pattern using interaction diagrams to illustrate the sequences

5.3.2.6. Participants: The objects participating in the design pattern and their responsibilities.

5.3.2.7. Collaborations: How patterns collaborate to carry out their responsibilities.

5.3.2.8. Consequences: How does the pattern support its goals?

5.3.2.9. Implementation: What pitfalls, hints, or techniques should you be aware of when implementing the pattern?

5.3.2.10.   Sample Code: Code fragments that illustrate how you might implement the pattern

5.3.2.11.   Known Uses: Examples of the pattern found in real systems

5.3.2.12.   Related Patterns: What design patterns are closely related?

Table no 2: show the method that Gemma and his colleagues used to write the patterns (Gamma, et al., 1994, p. 79)	
The Name	Abstract factory
Motivation	Provide an interface for creating families of related or dependent objects without specifying their concrete classes.
Applicability	Consider a user interface toolkit that supports multiple look-and-feel standards, such as Motif and Presentation Manager.
Structure	Figure 5 structure of the pattern of " abstract factory (Gamma, et al., 1994, p. 79)
Participants	• Abstract Factory (Widget Factory) • Concrete Factory (Motif Widget Factory, PM Widget Factory) • Abstract Product (Window, Scroll Bar) • Concrete Product (Motif Window, Motif Scroll Bar)

Collaborations	• creates product objects having a particular implementation • creation of product objects to its Concrete Factory subclass
Consequences	1. It isolates concrete classes 2. It makes exchanging product families easy 3. It promotes consistency among products 4. Supporting new kinds of products is difficult
Implementation	1. Factories as singletons 2. Creating the products 3. Defining extensible factories
Sample Code	class MazeFactory { public: MazeFactory(); virtual Maze* MakeMaze() const { return new Maze; }
Known Uses	ET++ [WGM88] uses the Abstract Factory pattern to achieve portability across different window systems.

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Related Patterns	Builder Creational Patterns

1.1.1. <u>Timeless way format:</u>

Later, in his book "the phenomenon of order", Alexander simplified the pattern writing method to another formal one (Alexander C. , 1979, pp. 265-268). He used this style to write his 15 properties theory of centers. This method guarantee that pattern writing process can be easy and flexible to fit any scientific and artistic disciplines. This method needs only three conditions, without one of these conditions this writing will not be a pattern. This method consists of:

1.1.1.1. Formula: The pattern, as Alexander said, is a feeling in the *mind's eye* appears as a geometrical image (Alexander C. , 1979, pp. 265-268), it is like a certain kind of morphological feeling, which is hard to be precise stated, but can be crudely hintedat by flexible formulation for its idea.

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Once you obtain this formula, you will be ableto use it and tell others about it, in this stage, you will be so close to inventing a pattern.

1.1.1.2. Name: This formula must be given an expressing name. 5.3.3.3.Diagram: this formula must be combined with a simple diagram.

The name	Level of centers

Table no 3: show an example of the new way that Alexander used to write the patterns which he recalled centers in his book the "the phenomenon of life" (Alexander, 2002, p. 239):

The diagram	*Figure 6 diagram made by Alexander to the pattern of "level of centers" (Alexander, 2002, p. 239)*
The formula	This language discusses how the way that a strong center is made stronger partly by smaller strong centers contained in it, and partly by its larger strong centers which contain it.

5.3.4.   Woodbury format:

Woodbury in his book "Elements of parametric design" had put a clear and strong structure to describe the parametric patterns -which is an artificial pattern generated by a computational program- as follows (Woodbury, 2010, p. 187):

- Name
- Diagram
- What (goal)
- When (context)
- Why (reason)
- How (solution)
- Samples (examples)

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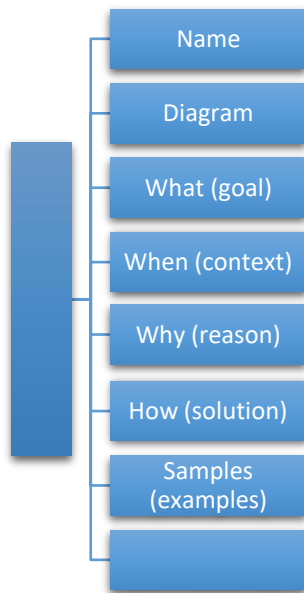
5.3.4.   Woodbury format:

Woodbury in his book "Elements of parametric design" had put a clear and strong structure to describe the parametric patterns -which is an artificial pattern generated by a computational program- as follows (Woodbury, 2010, p. 187):

5.3.4.1. The name; is a noun phrase describing the pattern briefly and vividly.

5.3.4.2. Diagram: is a graphic representation of the pattern. 5.3.4.3.What: states a one-sentence description of the goal
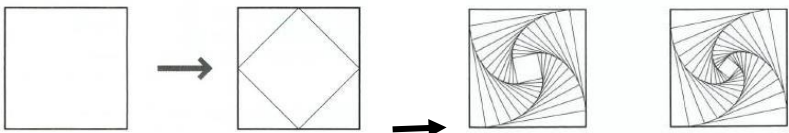
behind the pattern (goal).

5.3.4.4. When: describes a scenario comprising a problem and a context (context).

5.3.4.5. Why: states the reasons to use this pattern (reason). 5.3.4.6.How: explains how to adapt the pattern to solve the

given problem (solution).

5.3.4.7. Samples: illustrate the patterns with working code (examples).

5.3.4.8. Related Patterns: show the connections between different patterns (connections).

Table no 4: show an Example of the way that Woodbury used to write the parametric patterns (Woodbury, 2010, p. 261)	
The name	Rotating square
diagram	
What (goal)	Create a pattern by recursively replicating a motif.
When (context)	Nest a sequence of squares inside an initial square in a recursive way

Why (reason)	Space-filling
How (solution)	Start with a square "or any polygon". This is the initial motif "the input" to the recursion
Samples (examples)	Figure 7 The main gate of Le Méridien Seoul in South by Yang Minh, it is a Tunnel of Light Patterns a (JOBSON, 2017)
Related patterns (conn	Samples of related patterns such as Octagon and Square Patterns in Islamic architecture (Bonner, 2000, p. 255)

ections).	

Sharing and refining:

According to Alexander, The fundamental criterion of a successful pattern is to be usableand shareable, because, this will guarantee that it will be under continuous improvement (Alexander C. , 1979, p. 229).

Patterns are intended to be available codes able to be copied and modified at will, especiallyafter the digital copies became available freely (Woodbury, 2010, p. 189). So, Putting patterns in formal formats is useful because they enhance the communication in the architectural community, rather than having to explain a complex idea from the primitive scratch, the designers just can mention a pattern by its name, and everyone will know what this means. So,establishing a library of patterns is a keystone for professional practice, it helps users to choosethe suitable

alternatives and avoid the unsuitable ones. Thus, patterns have become a popular way to collect refining practices and semi-formal ideas.
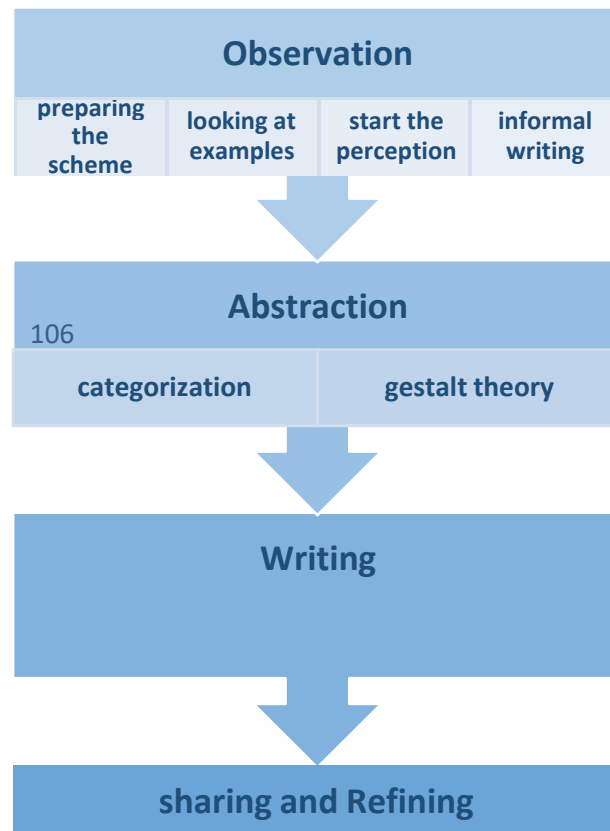
7. CONCLUSION:

This paper yielded the following:

- The Definition of "pattern recognition" concept architecturally, it is a logical and systematic "process" which used for exploring any visual phenomenon by taking a lot of pictures to this phenomenon , then putting these pictures under examination, then analysing its form's entanglements to the essential elements and relationships, and delaminating the unimportant layers. This process guarantee giving birth to ideas, concepts, and values that have never been thought of before, by mimicking the natural forms. This process has to be spread in architectural communities because it helps

the architects to satisfy their desire of exploring, it liberates them from the constraints of the traditional design and take them to a wider world of ideas. In this paper, the systematic procedures of this process had been concluded logically. It starts with the observation stage, then the abstraction stage, then the writing stage, and in the last, the sharing and refining stage.

- This paper clarified that the mostimportant stage in this process is the stage of writing because: It proves that there is a detecting process had been done to discover the patterns ina certain

Observation			
preparing the scheme	looking at examples	start the perception	informal writing

Abstraction 106	
categorization	gestalt theory

Writing

sharing and Refining

system. It helps in preserving the observers' efforts of exploring in a formal and decent way that facilitates using, sharing, refining the patterns. It increases the architectural languages by introducing new terms and vocabulary. And it assists to set up a comprehensive pattern's library that

makes the patterns shareable and usable.

- Every method of writing- as shown- has its own way to record patterns according to the system circumstances –of course, recording pattern in a biological system is different than it in a physical system,in a social system and etc. Although

pattern langage	The gang of four	timelessway format	Woodbury format

these ways are different, they show that the main principles in any visual

system, to be a pattern, is its ability to be written. That means, the pattern – to be a pattern - must has 3 important factors: a name, a sketch, and a definition. These three factors can be increased according to the research needs as shown in "the Ganges of four" method and "the parametric method", but they must not be lesser than these 3 factors.

- This paper recommends recording and using the patterns heavily, this Leeds to refine them. If the pattern is useful, it could be refined again and again. So, they must be shared widely as possible as can especially within the work groups. It should be easy to find, especially online.

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