Patterns in Nature: A different approach towards User Interface Design

Vikas Pandey
Department of MCA
Dayananda Sagar Colleg of Rngineering
Banglore, India

Asst. Professor Alamma B. H
Department of MCA
Dayananda Sagar Colleg of Rngineering
Banglore, India

Abstract— **Patterns in Nature have been used for a long time to improvise and better various fields of science arts and even commerce for that matter consciously or unconsciously. User Interface Design is field that started with Command Line Interfaces and evolved to modern User Interfaces that aims to present information in the most understandable and visually pleasing way as possible. The aim of this research paper is to discuss these patterns, where can we spot them around us and attempt to find ways that these patterns may be adopted into modern Visual and User Interface design. The information discussed in the paper is an attempt to understand and use the patterns that have been known to work in various fields including design and discuss ways to further these trends in User Interface Design**

Keywords— Nature, UI/UX Design, Fractals, Symmetry, Golden Ratio

I. INTRODUCTION

Nature and mathematics are two terms that don't seem to get along at first glance. However, Mathematics reveals hidden patterns in nature that help us get a deeper understanding of the same. Patterns we are discussing are regularities in nature that can sometimes be modelled mathematically. These are known to occur often in nature right from the structure of cells to the length of our arms and the shape of our face. Meanders, trees, spirals, foams, symmetries, cracks, tessellations, stripes and waves everything seems to follow these patterns[1]. It is the tendency of the human mind to find order in chaos something that we find more and more proof of in the Chaos Theory. Finding these patterns allow us to have different perspective of the things around us. Scientists and artists have long used these patterns to their advantage. It is only fitting to make use these patterns in the modern internet age.

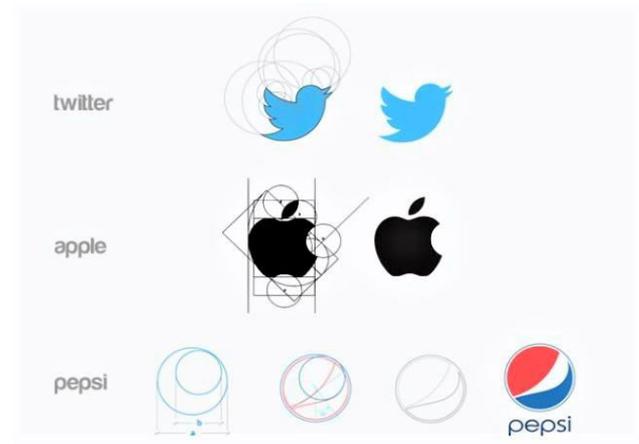Natural Patterns have already found their way into design by some of the major brands of the

Figure 1: Golden Ratio used in popular brand logos

world including but not limited to Apple Inc, Twitter and Pepsi Co. The usage of these patterns has known to improve the overall perception of design by the end users. To use these patterns we need to understand them first.

II. LITERATURE REVIEW

Natural patters are a means of finding order in the chaos of the natural world. Fractals form the basis for a lot of the patterns. Previous Research[2] point to a universal aesthetic appeal towards fractal patterns having low to mid-range fractal dimensions. The understanding and use of these patterns for UI Design constitute a range of fields from mathematics to perception psychology. Little large-scale research has been done on the specific subject. However, an understanding of the Gestalt Principles and The

Eight Golden Rules of Interface Design[3] provide a great starting place to understand how these patterns can help in UI Design specifically.

III. THE FORMATION OF PATTERNS

The formation of these patterns devolves into the field of reaction diffusion systems most popularly described by Alana Turing and James Murray. Alan Turing[4] suggested a feedback control system that controls the production of morphogens, signaling molecules that cause reactions in cell genes of young organisms[5]. The non-uniform distribution of morphogens, its interaction with specialized cells that come in contact with it and paired with an inhibitor chemical leads to the development of these patterns. A non-biological example of this kind of scheme is the Belousov–Zhabotinsky reaction. A similarity between each phenomenon is effect that under the influence of stimulus a development of patterns is seen.

IV. COMMON PATTERNS IN NATURE

A. Fractals

Fractals are complex patterns built from a simple pattern repeated recursively through infinite iterations. Each iteration uses the results of the previous iteration to get the new result. To put it simply a small part of a fractal when enlarged will result in the same shape. Ferns are examples of basic fractals. Fractals are among the less understood patterns. They form the basis for quite a few of the patterns mentioned here. The have been called the fingerprints of nature.
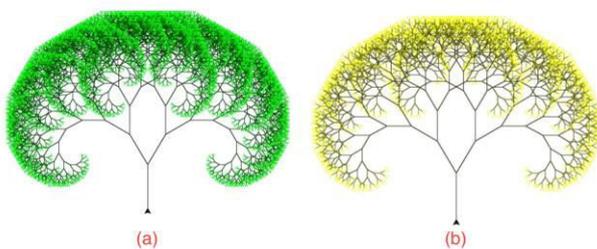

Figure 3: Y-Fractal Tree

A popular use of fractals is a coding challenge called the Y-Fractal tree where the Y pattern is used to generate a shape using a recursive algorithm. In User Experience design fractals can

be used as tool to target the end-users pattern recognition skills to get them familiarized to the placement of elements of an interface[6], thereby allowing the users to predict where they have to look based on a pattern, they have noticed in the interface subconsciously. If done right it could boost the user experience greatly. However, that approach falls under user experience, in terms of design the best example is the piece mesmerizing computer generated art called "Emergence" by Julius Horsthuis.

The best way to use Fractals in UI Design with our current understanding of it is using them in generative art as website imagery to bring a feeling of depth to the interface.

B. Symmetry

Symmetry is quite common in living things. Animals usually display a bilateral symmetry as do some plants. Radial or rotational symmetry is more common among plants and many flowers and some groups of animals such as jelly fish. Crystals demonstrate a variety of symmetries; they can be cubic or octahedral. The human brain tends to look for symmetries. The American scientist Alan Lightman stated "The reason must be partly psychological. Symmetry represents
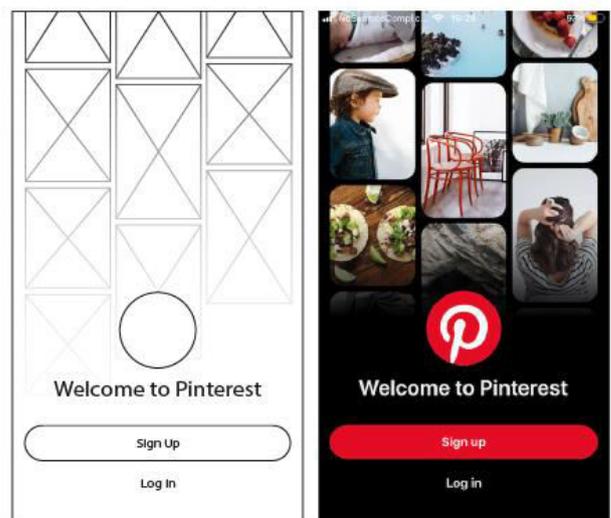

Figure 3: Symmetry in Pintrest UI

order, and we crave order in this strange universe we find ourselves in. It helps us make sense of the world around us"[7].

UI design can benefit from both symmetry and asymmetry. In the Pinterest app, organises the background into three columns but with different horizontal axes. A vertical symmetry that draws the eyes down to the bottom of the screen and a horizontal asymmetry that balances with the Call-to-Action button at the bottom of the layout. It is a great example of how both aspects can be used in a single layout.

C. Spirals

Spirals are among the most easily recognizable patterns in nature. Logarithmic spirals can be considered a special case of fractals given the modern understanding of the concept. The Fibonacci sequence a common pattern in itself tends towards the golden ration which in turn is related to the golden spiral. The Golden ratio is a widely used concept in design, however, its uses in UI design have been very limited. The golden ratio can be used in UI Design in the following ways:

- Grid Layout: The rise of responsive designs has standardised over all process. Screen dimensions in percentages allow the layout to be adjusted according to varying screen sizes. The Golden ratio can be applied to gird layouts by simply dividing by 1.618. As shown in the example below.
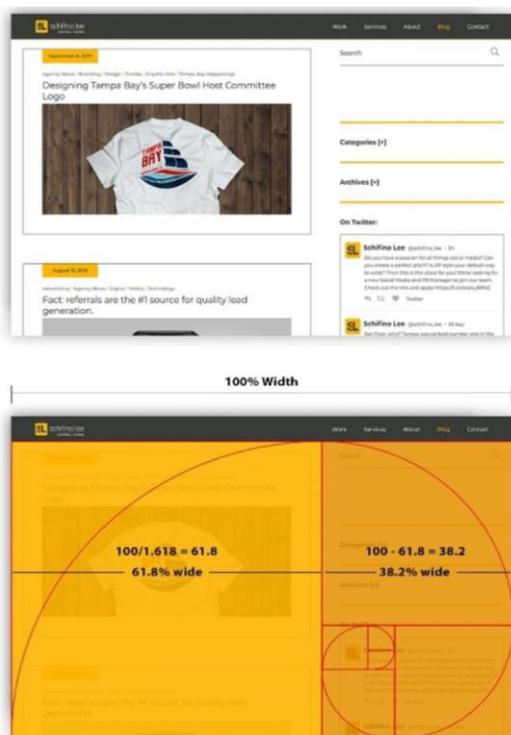

Figure 4: Using the golden ratio for grid layouts in web design

- Typography: It is often tough to get the heading and body of a section the right size without one overshadowing the other. Using the golden ration here almost always gives a great balance between the sizes. The heading when set as 1.618 times a legible body-size gives good readability to the title as well as the body of a text

- Including imagery that follows the golden ratio in the UI Design brings the balance captured in the picture to the design. Further, placing elements at key points in the imagery enhances the usability of the interface.

D. Concentric Circles

Concentric circles tend to bring a feeling of separation of elements while at the same time keeping them connected. Growth rings in trees, ripples on a surface are great examples. When combined with the Fibonacci series it adds an element of balance to the circles.

Figure 5: A Radial Menu by Dribble User Jared Katamani

Concentric circles have been commonly used in circular navigation interfaces. They allow the user to go through various parts of the interface from a single point. It has the potential to be a faster system of navigation with each menu item loading the items of the sub-menu belonging to it. Another more common way of using it is in imagery to draw the viewer to the area of focus.

E. Color Harmonies

Colour harmony is what makes certain sets of colours so pleasing to look at. Nature is one of the best places to look at for colours. The combination of these colours creates contrasts and consonances that are pleasing to the eye and are said to be harmonious. Any designer who takes

the users point of view will try to understand the effect the colour palette will have on the user and how the elements will be perceived because of that. Colours are known to stimulate certain emotions depending on the colour and the person. A good design will make use of these stimulations. It is the reason why the Hulk wears purple pants[8]. Colour Harmonies can be divided into 5 types:

- Monochromatic: This type of harmony uses various shades of a colour. The relation of the shades allows for the interface to have a uniformity making it pleasing to the eye. The contrast between them lets the designer target important elements for the viewer

- Analogous: This is harmony is based on related colours. The colours from the left and right of the select colour are used to make a serene and comfortable design.

- Complementary: Is when the colour is paired with the one opposite it on the colour wheel. It results in a vibrant look but must be used sparingly. All other colour harmonies are various of this in some way.

Figure 5: Commonly used color harmonies

- Triadic: This harmony is created by taking the two colours on the left and right of the complementary colour. This technique is stretches connect of colour harmonies and works well only when one of the colour dominates the other in the design.

- Tetradic: This harmony is close to using two complementary harmonies and ought to be used only when more than a few elements require attention.

V. PRINCIPALS OF USER INTERFACE DESIGN

User Interface Design is one of those fields where breaking of rules can often produce surprising results. The Eight Golden Rules of Interface Design and the Gestalts Principles[9] are often treated as guidelines rather than rules. UI designers often break one rule in order to emphasize on another as long as it does not compromise the over all user experience. It is good practice to try and incorporate all the guidelines if possible.

VI. FUTURE SCOPE

This paper covers the very basics of the concept of using these patterns in UI design and mainly relies on research conducted by other professionals of which there weren't as many. To further this paper more time and first-hand research needs to be conducted in the form of surveys especially in the field of universal aesthetics. A more in-depth analysis of the concepts discussed here would reveal better ways to use them in modern UI design.

VII. CONCLUSION

User Interface and User Experience Design is a vast multi-disciplinary field that is constantly evolving as the technologies associated with them evolve. We have come a long way from the days of Command Line Interfaces. Radial menus discussed under concentric circles seem to be the future of navigation interface for touch-based devices. Most of these patterns may differ in perception depending on the viewer's culture and background. The most affected by this factor is the concept of color harmonies. A deeper look into these concepts is necessary however this paper does point to that fact that it is a very probable field and something a designer needs to consider when designing an interface.

VIII. REFERENCES

[1] Christensen, E. (2020, November 3). Natural Patterns. ECstep. https://ecstep.com/natural-patterns/

[2] Taylor, R., Spehar, B., Hagerhall, C., & Van Donkelaar, P. (2011). Perceptual and physiological responses to Jackson Pollock's fractals. Frontiers in human neuroscience, 5, 60.

[3] Shneiderman, B. (1986). Eight golden rules of interface design. Disponible en, 172.

[4] Turing, A. M. (1990). The chemical basis of morphogenesis. Bulletin of mathematical biology, 52(1), 153-197.

[5] Rogers, K. W., & Schier, A. F. (2011). Morphogen gradients: from generation to interpretation. Annual review of cell and developmental biology, 27, 377-407.

[6] Mushock, T. (2018, July 30). User Experience Design Process: A Fractal Model. Medium. https://uxplanet.org/user-experience-design-process-a-fractal-model-7422a3b01f7d.

[7] BBC. (2017, February 19). Why we find symmetry so soothing. BBC Three. https://www.bbc.co.uk/bbcthree/article/6adaed45-2f21-4a7b-942a-5c40a7181dd6.

[8] Rodin, R. (2015, January 25). Color Harmony: Why Hulk Wears Purple Pants. Zeven Design. https://zevendesign.com/color-harmony-hulk-wears-purple-pants/.

[9] Todorovic, D. (2008). Gestalt principles. Scholarpedia, 3(12), 5345.