October 2019

VARIANT AND VARIATIONS ON FURNITURE FOR EMOTIONAL DESIGN IMPACT ON USERS

Chadi Khoury
Assistant Professor, Faculty of Architecture , Design & Built Environment, Beirut Arab University,
s.khoury@bau.edu.lb

VARIANT AND VARIATIONS ON FURNITURE FOR EMOTIONAL DESIGN IMPACT ON USERS

Abstract

The process of design is the subject of many studies in the field of psychology or social science or technologies. Its wealth is based on its complexity within the variant and variations that include during its progress. An investigation on computer-aided integrated design and production using advanced automated tools aims to provide integrated solutions for the design and production of geometrically complex forms merged with machines restrictions that could serve as potential design variations. These variations relies heavily on the use of parametric design modeling that are incompatible with a linear approach. Beyond functionality, comfort, and technology, the objective is to propose a conscious and creative dimension of living, offering an anti-stress formula for the design and daily management of the space. This paper investigates the emotional design impact on products specifically on furniture to evoke emotions in people, suggesting that emotions are at basic importance for the success of a product since they influence product evaluation, purchase decision and product experience of users significantly. To formalize this iterative process, we propose a dynamic model allowing multiple variations on furniture affecting the users emotionally from the very beginning of the interaction at the pre-possession stage to long-term use, giving emphasis on form, color and material. We propose a dynamic model allowing multiple variations on furniture within a conscious and creative dimension of living offering an anti-stress formula for the design and daily management of the space.

Keywords

Emotional design, Digital Design, Variations, Integral Manufacturing, Furniture

1. INTRODUCTION

The current renewal of the new language in the world of contemporary architecture shows a preference for curves and folds, for the torsion of surfaces, for superimposed grids, for models of unique variability. Over the last twenty years, the interest of architects for formal complexity has increased and is supported, as well as stimulated by the integration of information technology in the design phase. Furthermore, the development of CAM (Computer Aided Manufacturing) seems to satisfy an eminent desire of the architect, increasing control over the complete production chain, in which a specific design idea supported by the software is able to materialize, through numerical control machines (Wetzel, 2009). In the meantime, we are witnessing a gradual movement of the architectural project from a finished object of planning to a manufacturing process, which allows research towards a condition of infinite variability. By freeing the architects from the *a priori* typology and the order of the box, the attention on the processes diversifies the architectural research and allows exploring and making explicit the definition of the strategies.

The development and improvement of parametric modeling systems has allowed multiple variations of the project to be integrated into a single "representation of the real" model: geometric variations, the relationship between form and structure, energy exchanges, up to production output of structures and coating surfaces. The practices of digital technology as developed today in the field of architectural design and fabrication have instrumented the idea of an uninterrupted development of the shape. The chronological chain, from design to fabrication, is no longer a linear approach but becomes a series of simultaneous developments and possible variations. The emergence of new materials or new components and their relating technicalities makes possible this continuum of shape (de)formation and virtualization on a basis of potential variations of the production tools (Meyer, Duchanois, Bignon, 2015).

The aim is to create a customized and economic product that is the result of an integrated design between form and structure. In the design of a product, it will be noted how the constructive, structural and material choices are guided by analysis of the form, the structure, and the relative optimization. The potential of parametric design is exploited by developing a model whose characteristics of shape and structure evolve continuously to find the optimal solution based on the established parameters. Alongside these aspects, which can be considered more technical, strong design and aesthetic component have been maintained which has led to prefer some formal solutions compared to others.

Moreover, this study explores the mechanism of how products affect the users emotionally from the very beginning of the interaction at the pre-possession stage to long-term use. The study gives an emphasis on form, color and material. "Emotional design" term was selected to be used within this paper for two reasons: First, to reflect the current issues about 'emotion' in design sphere and second, to benefit from the familiarity of the term 'emotion' in daily language to represent the related 'affective phenomena' including the terms "emotion, sense, feeling and effect" with ease of understanding and coherence. Since these terms have similar meanings and are used interchangeably for each other in daily life the term emotion will be used throughout this paper to describe the responses and sensations evoked in people by products when it is needed.

Towards such a goal, this paper has been constructed on two bases:

a. Scientific evidence based on the study of Donald Norman showing that emotions have an important role in human life such as decision-making and well-being. In addition, furniture design can enrich life; achieve higher user satisfaction, product longevity, and better use through emotions.

b. To consider how variations on the same design idea can be applied to abroad range of architectural design, interior design and furniture allowing the transition from the prototyping to the fabrication phase.

2. EMOTIONAL DESIGN CONCEPT

The word "emotion" is often applied to a wide range of phenomena, such as passions, feelings, temperament, and moods. Although these words are regularly used as synonyms, they refer to specific and different experiential phenomena, called affective states. Pietre Desmet in his book Designing Emotion describe also four different emotional states: emotions, moods, emotional traits and feelings.

The first category of affective states is represented by emotions. Emotions are intentional because they involve a relationship between the person who lives them and a particular event or a surrounding object: we are afraid of something, we are proud of something; we are in love with

something and so on (Frijda, 1994). Moreover, people are usually able to identify the object of their emotion (Eckman, and Davidson, 1994): we know whom we love and know with whom we are angry. Besides having a known object, emotions are acute and exist for a relatively short period of time, normally, the duration of emotion is limited to seconds or minutes at most (Eckman, 1994). The cause that arouses an emotion (the stimulus) can be an external event in the environment (for example someone who calls our name or see a building), or a change within us (such as thoughts or memories) (Eckman 1994).
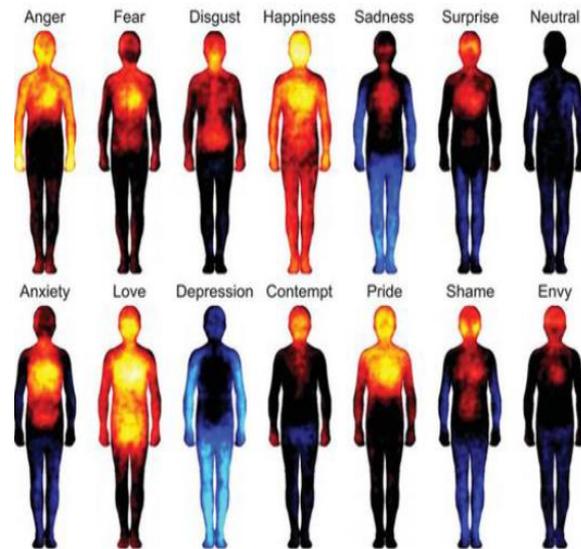

Fig.1: The map of emotions to understand how our body reacts to emotions

Certain architectural atmospheres evoke certain emotions, mostly unconsciously, that influence our emotional state (emotional state). These feelings can be a mixture of different emotions or even conflicting emotions.

An emotion is an intense affective reaction, pleasant or unpleasant, accompanied by physical and psychic reactions. According to the definition of Robert Plutchik, the primary emotions are eight and divided into four groups (Fig. 1): 1- Anger and fear, 2- Sadness and joy, 3- Surprise and waiting, 4- Disgust and acceptance.

Donald Norman (Norman, 2004) argues that the emotions aroused by a given artifact can sometimes be more important than its actual functional characteristics since the objects that surround us represent to us something more than the mere possession of material goods. This happens because we attribute to them a narrative component and sometimes the expression of ourselves. The perception of the functionality of an artifact is combined with the emotions it arouses, to evidence that cognition and emotion are actually two indispensable parts of a system. Norman admits that in one of his previous books Norman, 1988 his attention was mainly focused on usability, voluntarily not considering aesthetics as a subject related to it. He also welcomes the critics of the designers, who had observed that, following his prescriptions, they would certainly have created usable, but ugly products that nobody would have liked to possess. Ultimately, Norman 2004 concludes that although a functional product does not necessarily have to be fun to use, just as an attractive design product does not have to be efficient, beauty and function, aesthetics and usability must somehow be part of an artifact. This change of perspective certainly reflects recent greater attention to the emotions of the user in the design of artifacts and the consideration that they are indispensable elements in determining the affective, behavioral and even cognitive dimension of an individual in an interaction situation. In the activity of decision making and expression of judgment, for example, emotions are necessary first of all to make us aware of what is good and what is not, an activity that is only later interpreted by the cognitive system, and secondly to make us able to assign a value to the various choice options.

Referring to Donald Norman's definition of expressive behavior in emotional design (which is the external sign for an experienced emotion); Norman mentioned three design related aspects which

are visceral, behavioral, and reflective design (Fig. 2). They are linked to each other and associated with three levels of perception as well (Norman, 2004). The ways in which the three levels interact are complex. It is, however, possible, purely for application purposes, to make some very useful simplifications.

The three levels correspond to the characteristics of a product in the following way:
- Visceral Design > Appearance
- Behavioral design > Pleasure and effectiveness of the use
- Reflective design > Self-image, personal satisfaction, memories

Even these simplifications are difficult to apply. How do visceral pleasures translate into products? Do the same things that excite a group of people frighten others? Similarly, as regards of the reflective level, is it not true that a deep reflective component is attractive to some and boring or unfriendly to others? Moreover, we can all agree on the importance of behavioral design - no one ever takes sides against usability - but to what extent, in the overall scheme of things? How to compare the importance of each of the three levels with each other?.
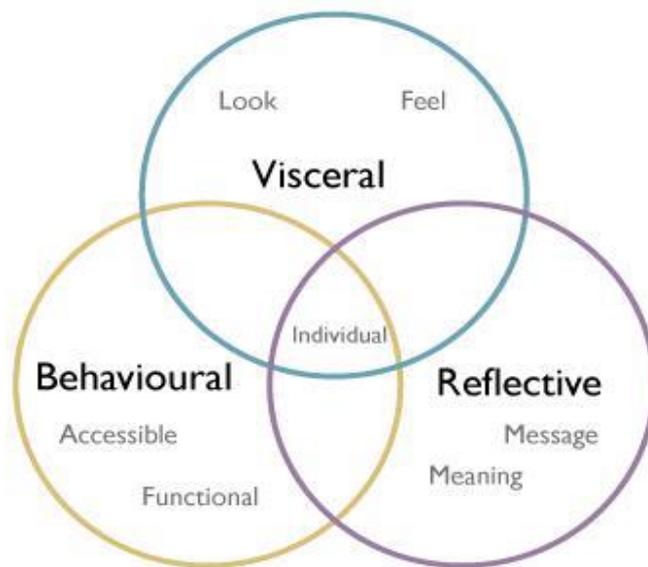

Fig.2: Norman's "Visceral, behavioral, and reflective" diagram

The answer, of course, is that no single product can hope to satisfy everyone. The designer must know the audience to whom the product is directed. Despite having illustrated the three levels separately, each concrete experience includes all three: in practice, it is rare to meet a single level, and if it were to exist, it is very likely that it derives from the reflective level rather than behavioral or visceral.

These three phases of user experience with products can be used as a sequential guideline and tool for orienting users' decision making processes toward repurchase specific products. Designing for visceral and reflective design relates directly to the entire purchase process. As the first aspect, the visceral design focuses on introducing products to users, whereas reflective design represents previous experience, including users' evaluation. These two aspects, visceral and reflective, control the entire purchase process in a continuous thinking loop. Furthermore, the reflective design provides logical thinking and reasons upon which users' base their decision to repurchase or purchase a new product.

Immanuel Kant who, in 1781, had sustained the decomposability of reality in two simultaneous aspects, similar to two "worlds" contained one inside the other: the phenomenon and the noumenon. Both represent a projection of the "thing in itself" (understood as an external reality to the thought of the subject by its nature unknowable and indescribable) on the conscience. The first concerns the external appearance of the thing, constituted by the union of form and matter; the second one concerns the perception that the subject has of the thing in itself, which is obtained by overcoming the superficial cognitive stage.

In cybernetic terms, we can say that the world we experience as external to ourselves is not really the world such as, but its virtual replica generated by the perceptive and imaginative processes of our consciousness.

The distinction between the two dashes of realism, direct and indirect, is schematically illustrated by the following figure (fig. 3, Left and right). In the direct realist view, the environment that surrounds us is identified as objectively given beyond ourselves, identified in its physical dimension perceptible through the senses (fig. 3 left).

In the indirect realist view, the external environment is represented as a miniature perceptive copy obtained through brain processing (fig. 3 right).

Fig.3: The left side represents a direct realist vision. The right side represents indirect realist vision.

3. VARIANT AND VARIATIONS IN DESIGN

"The figure of Eurytus, a Pythagorean of the 5th century, often associated with Filolao, is interesting in this regard. Eurytus was famous among his contemporaries because assigned to any real object a certain number (we do not know how he obtained it). He showed in a characteristic way the natural necessity of the relationship between one and the other: there was provided an equal number of pebbles, traced the figure of the object in question and interlocked along its perimeter such pebbles (the number apt to define the figure of the man was for example 250). By varying the size of the object, the number of pebbles, which expressed its essential relationships, did not change. In this way, Eurytus wanted to visually establish the relationship, typical also of Filolao's thought, between number and form limiting the real entities: the number, translated in form, was, therefore, the principle of individuation and also of intelligibility of nature." (Vegetti, 1970)

This historical annotation by Mario Vegetti illustrates effectively how, already in Greece in the age of Pericles, the philosophy of nature had clearly identified a relationship of correspondence between number and form. This correlative device could be assumed as an archetype of the parametric contemporary procedure: to create a link between figure, geometry, and number - between the physical-formal and the mathematical aspect of reality - establishing a relationship able to manage dimensional variations.

The parametric design process focuses on defining a set of parameters that influence the shape: the final shape is not in the middle of research, but it is induced. Changing parameter values generates not only an object but also a set of variations: the process is not simply based on metric values, but on the set of relations among the objects that make up the form. A modification of an element causes one transformation of the system in its entirety. The parametric model can automatically update all links and associations, a possibility to enter the geometric model in a series of variations based on the digital concept of associativity. Thus, the design consists of a set of geometric rules and logical relations between the first elements of the model: these initial components, points, lines or surfaces, constitute in their assembly and in their related relationships the hypotheses of the project. Changing one of the parameters will change the whole system, so the parametric design allows the manipulation of the object at all scales.

Michael Hensel and Achim Menges (Hensel and Menges 2006) give an example of parametric component defined by an analog manipulation of a paper tape (Fig. 4). The component integrates the constraints of the material, its opportunities for modeling and deformation and methods of assembly: it is a unitary element that if multiplied includes a larger system. The system is in itself potentially transformable for the differentiation of each parametric component.
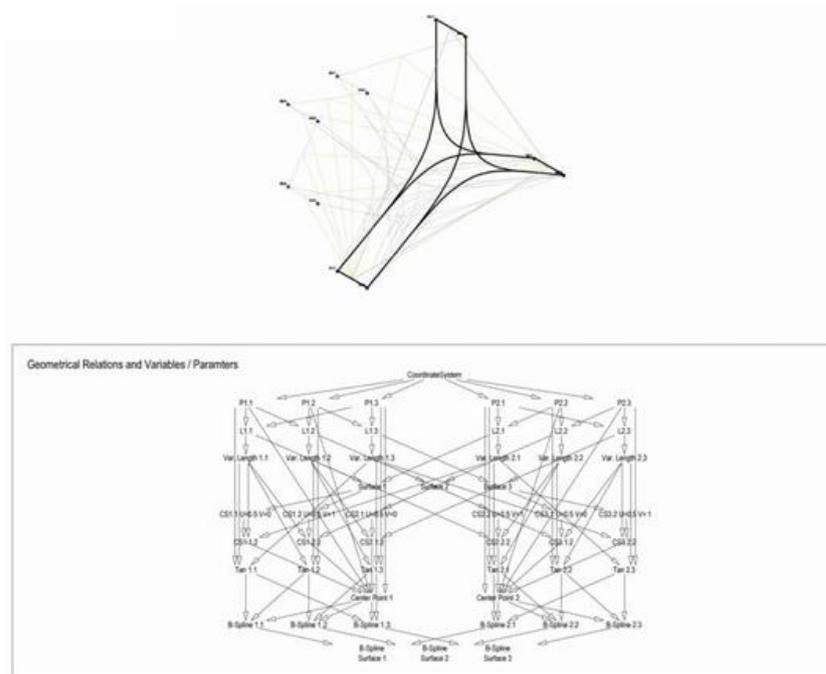
Fig.4: Example of a parametric component
Hensel and Menges 2006

Here the problem is the geometry of a device in an operational implementation perspective. There are opportunities in changing values of the parameters that allow the exploration of multiple variations. The experiments conducted in this direction could be integrated by incorporating dimensions, not only constructive, but also economic and social.

4. FURNITURE EXPERIENCE DESIGN

Most of the authors and researchers who have written about products designed for emotions and the way to test and measure a consumer's emotional responses to them, have focused on a variety of products such as electronics or hi-tech products and household appliances. These products can affect consumers with their appearance and artificial intelligence interactions, while furniture is a non-electronic product, which required an attempt to apply designing an emotional one with possibility to interact. Designing interactive furniture is new to the field of furniture design, especially with manually controlled interaction rather than complicated electronic and technological controls. Furthermore, authors and researchers have concentrated on many types of products and ignored furniture items (e.g., chairs, tables, beds) because the pleasure evoked from furniture sometimes relies more on physical ergonomic satisfaction (Chang & Wu, 2007), whereas in this study it will rely on emotional fulfillment after isolating functionality and usability features. Nevertheless, furniture as a product can also be chosen depending on emotional contact with regardless of functionality and usability, which are widely offered. Italian furniture style, for example, is preferred by some people, whereas others prefer the Scandinavian style, such emotional responses related to attitudes are elicited by the appearance of the 'object as such' and not by an (anticipated) consequence of usage or by (expected) behavior or functioning" (Desmet, Porcelijn & van Dijk, 2007). Moreover, furniture, which have a long-term usage lifetime, should have the priority to be emotionally designed to evoke users' positive emotions, to inhibit their negative one, and to provide them with a positive experience on the long run. In addition, this wide range of furniture usage in general - tables for example - emphasizes the direct physical and emotional relation to users; accordingly, it is necessary to shape this relation positively. Ultimately, choosing a furniture product is merely a case study to examine how successful the design process development is in the product design field, and to benefit from the area of specialization, previous experience, and expertise of the author of this research.

4.1 Variant of the Project

An outdoor bench is the design concept that has been selected for applying and then validating the developed design strategy. This strategy includes some tools such as co-design and mass-customization, used for addressing user's specific emotions. We implemented the same formal

strategy on adherence to mathematical and proportional relationships and on the centrality of the compositional process of the design strategy. Not a-priority form, but a design determined by a consequence of spatial transformations.

Fig.5: Variant for the bench
Designed by the author March 2019

4.2   Variations by form

Form is a three-dimensional geometrical, it refers to the way the design elements have been united (Lidwell & Kritina Holden, 2010) and how they have been visually and perceptually combined. Form is defined here to dispel the confusion between forms and shapes and to recognize how to perceive both form and shape. It is also defined to control the role forms play in design success as one of the main visual and aesthetic components of design. Furthermore, forms have the ability to carry emotional content and messages from the designer to the user, accordingly a new approach have been introduced to the field of design and emotion. Whereas "Form follows function" is a famous principle associated with designing objects in the 20th century and links object form to purpose/function (Zen, 2006), "Form follows Emotion" is a new approach that focuses on an advanced level of the importance of product form, and is concerned with emotionality instead of functionality. "…Even if a design is elegant and functional, it will not have a place in our lives unless it can appeal at deeper level, to our emotions" (Demir, 2008). There is a link between form and emotion that has been clarified according to Wallach (Wallach, 1953) who assumes that there is an impact of our past experience that plays an important role in perceiving form, and set out to demonstrate such an effect in a rigorous way. At the same time, our previous experience has been shaped by our emotions and memories, which in turn refers to the link between emotion and form. The more our experience is associated with positive emotions related to a design component like form, the more this will establish for the positivity of the next experience, depending on positively perceived forms in the past. Likewise, the "Form follows Emotion" approach emphasizes the importance of form in product design, as form plays an essential role in provoking users emotions.

Form is the first emotional contact of the product visual feature such as shape and color, with the users, and therefore the first impression. The form of a product communicates a personal and emotional meaning.

This is the concept we choose for the final object (Fig. 6). This design concept is expected to help users to overcome boredom arisen due to the long-term usage by means of an upgradeable appearance during the product usage lifetime. The form is simple with slight curvatures, yet engaging as this philosophy repeats throughout the design. The bench "Harmony" is suited in isolation as it fills a space with its visual impact. Robotic fabrication was used to fulfill our vision, as precision is needed to execute profiles based on mathematic equations, which are beyond human capabilities.
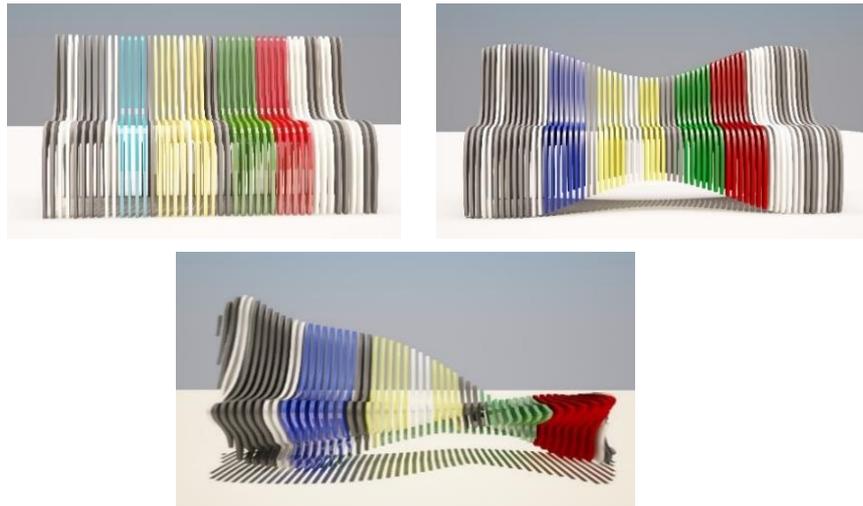
Fig.6: Variations by form
Designed by the author March 2019

4.3   Variations by Colors

The first and most important element where the first impression and attraction take place in the course of a user's visual linking with a product is color. As colors play a major role in how the design is perceived, and they are perhaps the most important element of design. They can be chosen by designers to be assigned to an object, and then be totally or partially accepted or rejected according to a user's point of view and/or taste (Morton, 1997). Colors can be chosen by the users themselves by investigating users' desired colors indirectly such as market surveys.

Furthermore, users may perceive colors positively or negatively, so color perception is an indicator of whether the emotional content sent from the designer has been delivered to the users or not. The way colors can be used in providing users positive relationships with products and ensuring their satisfaction should be studied as one of the main concerns for designers.

The focus in this section will be on the emotional impact and positive symbolic meanings of colors. This research looks to reveal and emphasize the positive effects of colors (Peacocke, 1997), as well as avoiding any negative impact on users' emotions and the way they perceive the product. Using color to stimulate and influence users' perception positively is the base of exploring the emotional effect of colors. Color is a key design element that delivers powerful message through the visual contact. Color affects users' moods, influences their psyches, and represents the most expressive of all design elements. As such, it is important here to note that choosing colors depends not only on a designer's choices or color's psychological and emotional effect, but also on the user's emotional and aesthetic preferences.

Colors may have meanings aside from their emotional arousal (Demir, 2008), which means that every user has his own personal and individual meaning in choosing colors. The designer's choice of colors and their combination could be powerfully effective in influencing design perception and acceptance or rejection.

This research is primarily concerned with providing users with customizable multicolored designs to enable them to change their product's visual appearance using changeable designs and color schemes. This will help users to accommodate many of their emotional changes that may occur during their experience with these products, as well as keeping users connected, visually, at the very least, to their products. There are three primary colors (red, blue, and yellow) in addition to the two achromatic colors black and white, from which all colors are derived. It is important to clarify these colors and their positive psychological properties, since the main goals of this research are associated with positive color perception.

The way we perceive colors and their association with color is closely linked to cultural factors, and the way we associate emotions with one color rather than another is greatly influenced by our personal experiences. According to the thought of W. Kandinsky color is a means to stimulate the soul in a direct way. He maintained that the harmony of colors is based on one principle:

Effective contact with our soul. The peculiarity of color, according to Kandinsky, is to have its own expressive and spiritual value and through it, it is possible to represent spiritual reality regardless of objective allusion.

All light is life, when we talk about color we talk about everything that is inextricably linked to nature, energy, sensations, emotions, life.

The man lives immersed in color in every moment of his existence. Color is not just a physical phenomenon, but a complex set of different factors for this reason, the encounter with color involves us on different levels: Physiological, Affective, Ideational, Psychological, and Spiritual.
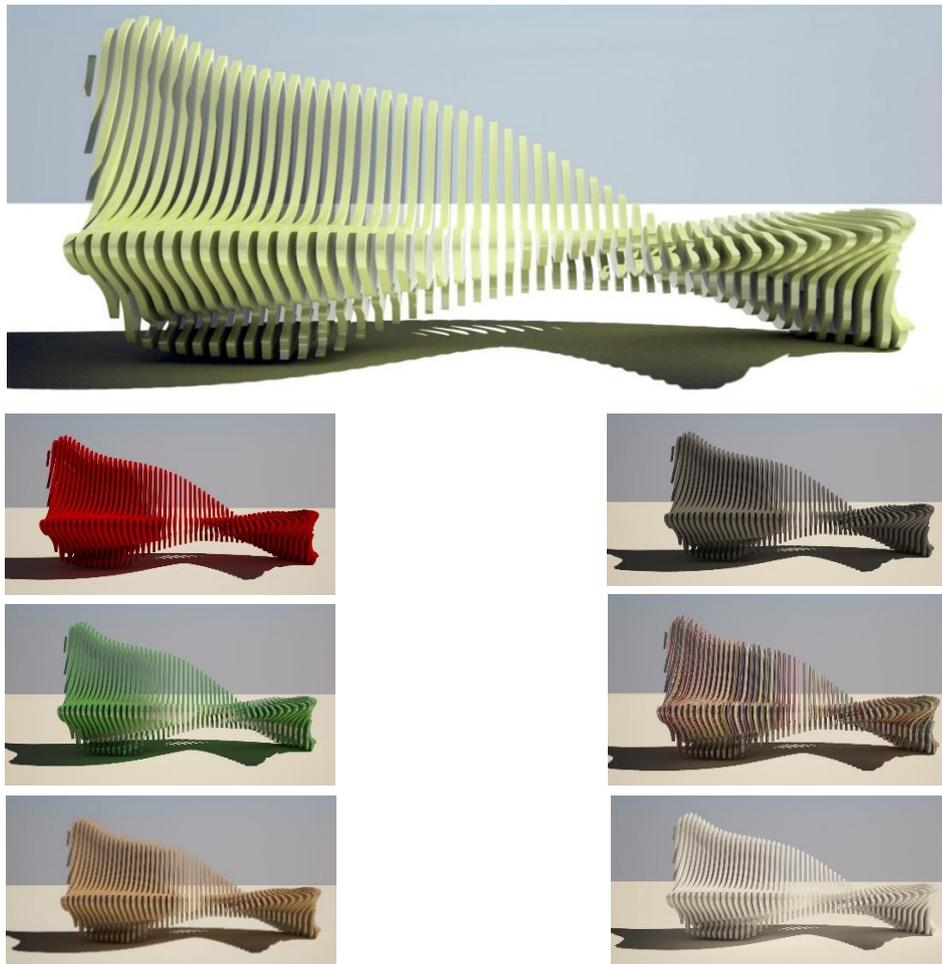

Fig.8: Variations by colors of the bench
Designed by the author March 2019

4.4   Variations by Texture

There are two different spectrums in design texture; smooth to rough and soft to hard. Textures are what determined our tactile experience of the product (Wong, 1993). The definition of texture is the surface characteristics of a material that can be experienced through the sense of touch, whether real or illusory (Paschke, 2000), there are two types of texture:

- **Tactile texture**: The actual 3D feeling of a texture that can be touched and perceived. This type of texture is applicable to all 3D textures (Nakayama, 1992).

- **Visual texture**: This is can be an illusion that creates an appearance of texture. Visual texture is applicable to all 2D textures (Bai, 2008).

These two types of textures help users to perceive any surface physical properties by the use of the sense of touch and according to their previous experience and knowledge. Texture is a tool the designer can use to communicate with users by using either appearance (visual) or real material (tactile) in order to enrich visual and aesthetic properties of surfaces (Manning, 2012).

5. CONCLUSIONS

In conclusion, it seems to be possible to affirm that, on the one hand, parametric design now imposes itself on the attention of the scientific community and the media as a new philosophy with a specific potential for the generation of original formal processes. On the other hand, designers and researchers are increasingly able to understand and embrace the opportunities inherent in these systems, integrating and managing a complex series of variations in the design process, not just a geometric nature. It is a new speculative and creative-productive horizon permeated with organic thought, which finds in the exploration and generation of formal systems "open" its strengths and in the control of complexity its greatest appeal.

Within this paper, an experiment related to digital design and production of urban furniture has been presented. Undertaken investigations range from the research of new geometric design methods to optimizations of integrated manufacturing techniques. The spectrum of the research has been spread in order to provide a global approach to the problem of design and production of architectural free-form objects for human well-being. It is highly important to situate the links of the digital chain within the global context of the design process engaged. Moreover, some basic considerations could be reiterate: emotions are fundamental elements for the construction of human experiences. This means that, in a world where everything is connected, interactive experiences can influence everyone's emotions. Allowing people to cultivate positive emotions, including greater satisfaction, optimism, good social relationships, a sense of fulfilment and self-esteem, creativity, becomes a challenge for design to transform its methods and processes to include this aspect as well.

REFERENCES

− Byrne, A., & Hilbert, D. R. (Eds.). (1997). *Readings on Color: The philosophy of color* (Vol. 1), MIT Press.
− Chang, W. C., & Wu, T. Y. (2007). Exploring types and characteristics of product forms. *International Journal of Design*, 1(1), 3-14.
− Demir, E. (2008). The field of design and emotion: Concepts, arguments, tools, and current issues. *Metu Journal of The Faculty of Arquitecture, Marmaris*, *25*(1), 135-152.
− Desmet, P. M. A. (2002). Designing emotions (Doctoral dissertation). *Technical University of Delft, Industrial Design Engineering, Delft*.
− Ekman, P. (1994). Moods, emotions, and traits. *The nature of emotion: Fundamental questions*, 56-58.
− Ekman, P. E., & Davidson, R. J. (1994). *The nature of emotion: Fundamental questions*. Oxford University Press.
− Hensel, M., & Menges, A. (Eds.). (2006). *Morpho-ecologies*. Architectural Association.
− Frijda, N. H. (1994). Varieties of affect: Emotions and episodes, moods, and sentiments.
− Marquize, K. (2010, October 6). Color Psychology: The Meaning behind the Hues.
− Meyer, J., Duchanois, G., Bignon, J. C., & Bouali, A. (2015). Computer Design and Digital Manufacturing of Folded Architectural Structures Composed of Wood Panels.
− Morton, J. (1997). *A Guide to Color Symbolism*. New York: Colorcom.
− Norman, D. A. (2005). *Emotional Design: Why We Love (or Hate) Everyday Things*. New York: Basic Books.
− Paschke, C. (2000). *The Essence of Design: Texture*. Retrieved February 20, 2019, from www.designsinkart.com
− Peacocke, C. (1984). Colour concepts and colour experience. *Synthese*, *58*(3), 365-381.
− Wallach, H., O'connell, D. N., & Neisser, U. (1953). The memory effect of visual perception of three-dimensional form. *Journal of Experimental Psychology*, *45*(5), 360-368.
− Wetzel, J. P. (2009). *Proposition d'un modèle et d'un outil dédiés à la conception morphologique architecturale en phase esquisse* (Doctoral dissertation).
− Zen, B. (2006, September 6). *Form Follows Emotion*. Retrieved from www.designtaxi.com: www.google.com