TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering
Vol. 68, Issue III, September, 2025

ERGONOMICS AND SENSORY DESIGN

Nicoleta-Elisabeta PASCU, Nicoleta Luminita CARUTASU, Victor ADIR, George CARUTASU, Ionut Cristian PEREDERIC

Abstract: *In this paper we have tried to make a connection between these two important concepts in design. Both ergonomics and sensory design are tied by the human senses and for us it was a challenge to define together this important direction of design. In our research study we have found a lot of examples which are relevant for defining the rules for each one and, of course, the usual rules. The Human factor is very important not only in ergonomics, but we have noticed in sensory design, at the same time. For us it was an interesting field of study because we have had three main factors to deal with: the human senses, the equipment and the environment understand this connection we have learned about a lot of knowledge from anatomy and physiology, social psychology, environment, statistics and even philosophy. This paper is only the beginning; we may say our first step in this wonderful field of interaction between humans and objects.*
Key words: *ergonomics, sensory design, human senses, environment, connection.*

1. INTRODUCTION

Ergonomics is *a science* with a clear principle adapting an object to a user in the context of three elements: humans, equipment and environment (the workplace and surroundings). Sensory design is *a science* (we may affirm) which puts in accordance an object with one or more senses of people (that means smelling, seeing, hearing, touching and testing). Each of these two directions (ergonomics and sensory design) have their rules but there are also general rules for both. Because they have the same goal: to design something useful, good and safety for people.

As we have already maintained ergonomics, as science, must create a safety and comfortable place for people, lower injuries rates and reduced fatigue for workers. In [1] is very good represented the triangle of participants: the designer, the maker and the user (Fig. 1).

An important designer which was involved in ergonomic design was Niels Diffrient. He was considered by Forbes magazine as the "granddaddy of the ergonomic revolution" [2]. He designed a few interesting and innovative office chairs having a strong ergonomic design.

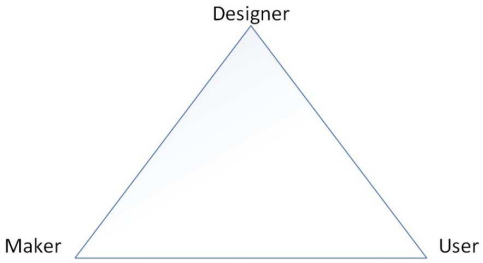

Fig. 1. Triangle of participants.

From the beginning there was a question: what are the origins of ergonomics? And the answer was found studying the workers` activities in factories which were considered as machines, at the end of the 19th century and in the first decades of the 20th. But in the middle of the 20th century, using the progress in various fields of activities, has appeared the ergonomics centered on health and safety of workers, and human-centered design.

It was a big step in ergonomic design which was applied from the optimal sitting position at desks to some heavy activities to avoid muscular and skeletal problems.

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Received: 29.07.25; **Similarities**: 01.09.25: **Reviewed**: 29.07./29.07.25: **Accepted**:10.09.25.

was a big step in ergonomic design which was applied from the optimal sitting position at desks to some heavy activities to avoid muscular and skeletal problems.

Of course, the furniture industry has created a lot of chairs for sitting with a wonderful design and as a creative masterpiece of ergonomics. There are many examples to support this affirmation.

2. ABOUT SENSORY DESIGN

Sensory design is a multifaceted challenge because the object must be created in accordance with human senses. It is crucial to have a deep understanding of how each human sense operates and to anticipate the reactions of people when they encounter a design that engages one or more of these senses.

Sensory design often emphasizes visual and tactile elements. For instance, when considering visual influence, it is essential for a designer to comprehend how colors work. Colors have a significant impact on affective reactions and behaviors related to the object. Our study has identified several principles that contribute to effective sensory design.

We have noticed a few steps that serve as principles to achieve good sensory design (Fig. 2). It is important to ensure that the general principles of dimensional design are adequately applied.

These principles include symmetry and asymmetry, proportion, balance, scale, rhythm, and harmony. In our research, we meticulously followed these five steps and provided thorough content for each one.

This process resulted in the development of an extensive library of papers related to our study theme, offering a clear understanding of human senses and their interconnections.

To elaborate, the first step in our process involves understanding the fundamental characteristics of each sense. This includes how they perceive stimuli and the typical responses they elicit.

The second step focuses on integrating these sensory insights into the design process. This means selecting appropriate colors, textures, sounds, or scents that align with the intended emotional and behavioral responses. The third step is testing and iteration, where prototypes are evaluated for their sensory impact and refined based on feedback.

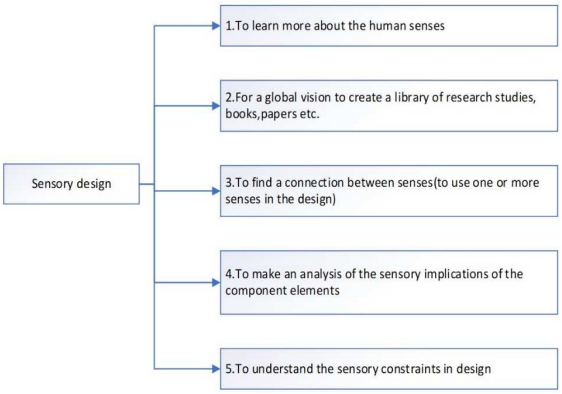

Fig. 2. Main steps to assure a sensory design.

The fourth step involves ensuring that the design elements harmonize well together. This means that visual, tactile, auditory, olfactory, and gustatory elements (if applicable) should create a cohesive and pleasing experience. The final step is validation, where the design is tested in real-world scenarios to confirm that it meets the desired sensory and functional objectives.

Through our study, we have also gained insights into how different senses can complement each other to enhance the overall experience.

For example, combining visual stimuli with tactile feedback can create a more immersive and engaging interaction. Additionally, we have explored how sensory design can be tailored to different contexts, such as creating calming environments in healthcare settings or stimulating environments in educational spaces.

Overall, our research underscores the importance of a holistic approach to sensory design. By meticulously applying principles of dimensional design and thoroughly understanding the interplay between human senses, designers can create objects and environments that are not only functional but also emotionally and behaviorally resonant. This comprehensive approach ensures that sensory design is not just about aesthetics but also about creating meaningful and impactful experiences for users.

3. A FEW CONSIDERATIONS RELATED TO THE DESIGN CONCEPTS

In our research study we have found interesting concepts about design which were used as a mark for a lot of objects created during the 20th century. They have contributed to the development of many objects which have been considered as icons. Briefly, these main concepts are *form follows function; form follows expression; form follows fashion; form follows material; form follows emotion; form follows fluid; color follows function; less is more.* In this paper we have presented a few considerations for each of them [3],[4].

Form follows function it was formulated by the American architect Louis H. Sullivan who considered that a connection between shape and function is important to define an object which must be pleasant and harmonious, with an aesthetic aspect. A handle for a tool must be functional and aesthetic, at the same time. What is the purpose of a chair? It is easy to answer: to sit on it, to act for sitting.

Form follows emotion relates to human senses; it is about the two sides of a human: rational and sensory. The German designer Hartmut Esslinger has pointed this concept. For him, aesthetic feedback is important for people to understand their lives.

The form follows fashion was a style which has embraced as reasons the art and the fashion of respective epoch (Art Nouveau, Art Deco, Bauhaus etc.).

Form follows material is the principle to choose materials for objects to perform.

Color follows function means the decision of the designer to choose the adequate color/colors because it is known that colors may "modify" form and proportion to understand details.

Less is more was explained and used by German architect Ludwig Mies van der Rohe who was interested to create objects using simple components, integrated and connected in the whole product. He was against the abundance of elements, only what was necessary to design something.

Donald Norman has explained three directions for design: simplicity; versatility and pleasurably. All these assure the design for a purpose. But we have added sensibility and ergonomics to make a useful and good design. It is about Fitness for Purpose.

4. THE CONNECTION BETWEEN ERGONOMICS AND SENSORY DESIGN

The shape is important for both directions of study because a good one may assure a comfortable place for working or for other activities. In our research about the theme of this paper we have focused on visual and tactile communication.

And we have found many examples where ergonomics and sensory design have created wonderful objects.

In [5] we have seen the connection between these two sciences to realize a lot of handles for umbrellas. A young architect from New Zealand has created a lot of handles for umbrella with an ergonomic design fitted to the hand. And, of course, this shape is a creation of sensory design (Fig. 3). And for the interior of a house, we have noticed this collaboration to create a pleasant and friendly space of living. Most of our study was focused on furniture, especially chairs.

Fig. 3. Example of handle for umbrella

But, why chairs? Because there is the necessity to sit on something, like chairs all over the world.

A lot of books [2], [6], [7], [8], [12] have been used as a lighthouse in our research. In this field we have understood the importance of design, having as foundation ergonomics and sensory design.

We have seen a lot of organic shapes for chairs which respect the intelligent combination between these two sciences.

Further, we have realized a library of data about ergonomic and design elements, the structure, material and texture, the name of the designer. In Fig. 4 there are a few examples of chairs related to our study.

1.[7]

2. [7]

3[12].

4.[8]

5[7].

6.[7]

7. [7] 8.[8]

9.[7] 10.[7]

11.[2] 12. [2]

13. [2] 14.[8]

15.[2]

Fig. 4. Ergonomics and sensory design in the universe of chairs [2], [7], [8], [12].

5. CONCLUSION

This paper was a significant challenge for us. From the outset, we established clear directions for our study: defining the implications of ergonomic and sensory sciences in the field of chair design; identifying the essential elements necessary for creating a good design; developing a typology of chairs based on their utilization; and determining the main characteristics required to achieve an ergonomic structure.

Our objectives included a thorough exploration of how these two sciences (ergonomics and sensory design) interact and inform the design process. We sought to understand how chairs could be designed to optimize comfort, functionality, and sensory appeal.

The result of our study has provided a solid foundation for future research in the field, particularly regarding the implications of ergonomic and sensory design within the industrial domain.

Throughout our research, we noted the significant advancements in technology during the 20th century that facilitated the creation of various objects, including furniture, machines, ceramics, jewelry, and textiles.

These technological developments were driven by the dual purpose of utility and aesthetics, objects needed to be not only functional and useful but also beautiful and pleasing to the senses (similar as presented in [13, 14]).

In our study, we delved into the specific elements necessary for good chair design, such as material selection, structural integrity, and aesthetic appeal. We examined how different materials can affect the tactile experience and how structural design impacts both comfort and durability. Additionally, we explored the typology of chairs, categorizing them based on their intended use (be it for office, dining, lounging, or other purposes) and how these uses influence their design requirements.

We also focused on the principles of ergonomic design (including sustainability aspects [15]), identifying key characteristics that contribute to the creation of chairs that support healthy posture and reduce the risk of musculoskeletal issues. These characteristics include adjustable features, lumbar support, appropriate seat depth and height, and the use of cushioning materials that distribute weight evenly.

Our findings underscore the importance of integrating sensory design principles with ergonomic considerations to create chairs that not only meet functional needs but also enhance the user experience through sensory engagement. By incorporating colors, textures, and forms that appeal to the senses, designers can create chairs that are not only practical but also delightful to use. This research has broader implications for the industrial domain, suggesting that a holistic approach to design (one that considers both ergonomic and sensory aspects) can lead to the creation of superior products. As we move forward, the insights gained from this study will inform future projects, aiming to develop objects that harmonize utility with sensory pleasure, ultimately enhancing the quality of life for users.

In conclusion, the integration of ergonomic and sensory design is crucial in the development of industrial products. Our study highlights the potential for innovation in this area, encouraging designers to consider both the physical and sensory needs of users.

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Ergonomia și designul senzorial

În această lucrare am încercat să facem o legătură între aceste două concepte importante în design. Atât ergonomia, cât și designul senzorial sunt legate de simțurile umane și pentru noi a fost o provocare să definim împreună această direcție importantă a designului. În studiul nostru de cercetare am găsit multe exemple relevante pentru a defini regulile pentru fiecare în parte și, desigur, regulile uzuale. Factorul uman este foarte important nu doar în ergonomie, dar am observat că și în designul senzorial, în același timp. Pentru noi a fost un domeniu interesant de studiu deoarece am avut de a face cu trei factori principali: simțurile umane, echipamentul și mediul. Pentru a înțelege această legătură, am învățat multe cunoștințe din anatomie și fiziologie, psihologie socială, mediu, statistică și chiar filozofie. Această lucrare este doar începutul, putem spune primul nostru pas în acest domeniu minunat al interacțiunii dintre oameni și obiecte.

Nicoleta Elisabeta PASCU, PhD., Assoc. Professor, National University of Science and Technology Politehnica Bucharest, Engineering Robots and Production Systems, 313 Splaiul Independentei, Sector 6, 060042 Bucharest, Romania, nicoleta.pascu@upb.ro, Office Phone: +40214029759
Nicoleta Luminita CARUTASU, PhD., Assoc. Professor, University Politehnica of Bucharest, Engineering Robots and Production Systems, 313 Splaiul Independentei, Sector 6, 060042 Buchareast, Romania, nicoleta.carutasu@upb.ro, Office Phone: +40214029759
Victor ADIR, PhD., Assoc. Professor, National University of Science and Technology Politehnica Bucharest, Engineering Graphics and Industrial Design, 313 Splaiul Independentei, Sector 6, 060042 Buchareast, Romania, victor.adir@upb.ro, Office Phone: +40214023812
George CARUTASU, PhD., Professor, Romanian-American University, Informatics, Statistics, Mathematics Department, 1B Bulevard Expozitiei, 012101 Bucharest, Romania, carutasu.george@profesor.rau.ro, Office Phone: +403721201139, PhD Supervisor, National University of Science and Technology Politehnica Bucharest, Doctoral School of Industrial Engineering and Robotics, 313 Splaiul Independentei, Sector 6, 060042 Buchareast, Romania, george.carutasu@rau.ro, Office Phone: Office Phone: +40256403180
Ionuț Cristian PEREDERIC, PhD. student, Asist. Professor, National University of Science and Technology Politehnica Bucharest, Engineering Robots and Production Systems, 313 Splaiul Independentei, Sector 6, 060042 Buchareast, Romania, ionut.prederic@upb.ro, Office Phone: +40214029759