

## INNOVATION APPROACHES CENTERED ON SENSORY DESIGN. A CASE STUDY.

**Abstract:** When discussing a new product, user-centered innovation plays an important role. By prioritizing the needs and preferences of the intended audience, companies can develop products that satisfy both functional and emotional requirements. The evolution of kitchen appliances highlights the influence of technological progress and changing lifestyles on product design, transitioning from basic constructions to smart devices connected to the internet. The purpose of this article is to present an innovative design for a multifunctional kitchen appliance, which combines two commonly used kitchen appliances, a bread toaster, and a sandwich maker. Our contribution lies in providing a multifunctional appliance that integrates sensory design, advanced technology, ergonomic design, and intuitive controls. Through strategic innovation management and a focus on user-centered design, this appliance represents a synthesis of utility, aesthetics, and sustainability. To achieve the objectives of this article, a detailed analysis of existing literature in the field was conducted.

**Key words:** Innovation, kitchen appliances, sustainability, multifunctional, sensory design.

## 1. INTRODUCTION

In the contemporary era of technology and innovation, user-centered product development and sensory design innovation have emerged as critical aspects for success in the industry. These strategic approaches prioritize the needs and preferences of users at the core of the product design and development process, resulting in products that not only fulfill functional requirements but also emotional ones [1 – 7].

Sensory design innovation involves crafting products to stimulate human senses - touch, sight, hearing, and smell - to establish a strong emotional connection between users and products. This approach extends beyond the functional aspects of products, aiming to create pleasant and memorable experiences for users. By engaging the senses, products become more appealing and captivating to consumers, leading to increased brand attraction and loyalty [8 – 13].

Close collaboration between design teams and users is necessary to ensure the creation of products that optimally meet market requirements. The product implementation team will consider the user's sensory experiences, product aesthetics, the use of environmentally friendly materials, and the potential for reuse after the product's lifecycle [1, 14 – 23].

By delivering products that create pleasant and memorable experiences for users, companies can attract customers, leading to a significant competitive advantage and long-term business success.

## 2. CONTEXT

The evolution of kitchen appliances is closely linked to technological progress and changes in human lifestyle over time. From early simple innovations to today's smart, internet-connected devices, kitchen appliances have evolved significantly, bringing a host of benefits and conveniences to households [24]. The first household appliances emerged in people's homes at the end of the

19th and the beginning of the 20th century. They were often constructed from basic materials such as wood and metal and had a functional yet rudimentary design. Examples include early refrigerators and cooking appliances.

During the interwar decades, a series of technological innovations led to the development of more advanced household appliances. Kitchen appliances such as fruit juicers, meat grinders, microwave ovens, and toasters became more common, and their designs began to improve to reflect both style and functionality.

Between the 1950s and 1980s, significant progress was made in household appliance technology. New features and characteristics emerged, and designs became more diversified. Pastel colors and retro patterns became popular, with appliances becoming a symbol of modern lifestyle [25 – 33].

In the 1990s and 2000s, digital innovations completely transformed the design of household appliances. Smart devices with advanced digital control functions and internet connectivity emerged. Their design became more minimalist, and new materials such as plastic and glass were introduced to provide a modern and elegant appearance.

Today, the design of household appliances continues to evolve rapidly. Current trends emphasize energy efficiency, recyclable materials, and smart technology. By utilizing high-quality materials and innovative designs, modern appliances are crafted to offer not only functionality but also style and elegance.

Within this project, we have developed the design of a kitchen utility appliance due to the benefits it brings to breakfast preparation or quick snacks. By integrating two essential functions into a single device, this appliance saves space in the kitchen and provides a wider range of culinary options without the need to purchase two separate appliances [34].

It is the ideal solution for those who value efficiency and practicality in food preparation. The bread toaster and sandwich maker are considered indispensable in

modern kitchens, offering a quick and efficient way to prepare breakfast [35 – 38].

The first bread toasters or sandwich makers appeared in the early 20th century and were often constructed from iron or metal, featuring a simple and functional design.

With technological progress, their design evolved to become more aesthetically pleasing and practical. In the 1950s and 1960s, they became more compact and user-friendly, with some models adorned with retro motifs and vibrant colors to match the style and aesthetics of the time.

In the following decades, technological innovations brought significant improvements to the design of these household appliances [7]. Features such as digital temperature and toasting time control, a viewing window to monitor the toasting process in the toaster, the introduction of non-stick materials for plates in the case of the sandwich maker (Figure 1), as well as more efficient and uniform heating systems, were introduced.



**Figure 1** Sandwich maker / Bread toaster [2].

Presently, they are more ergonomic and easier to use. Cool-touch handles, tactile buttons, and bright displays make using these appliances more comfortable and intuitive. Additionally, their compact and aesthetic design allows these household appliances to seamlessly integrate into any type of modern kitchen.

Both bread toasters (Figure 1) and sandwich makers are available in a variety of styles and colors to meet the individual preferences and tastes of users. From retro models with chrome finishes to modern toasters, their design reflects current trends and preferences in kitchen product design. Redesign is an essential process in the development and continual improvement of existing products. While a product may be initially conceived and manufactured to meet the needs and requirements of the market at that time, changes in consumer preferences, new technologies, and other factors can render it outdated or non-competitive.

In the current context, where concerns for the environment and sustainability are increasingly significant, the creation of more eco-friendly and environmentally friendly products is paramount.

In addition to environmental considerations, the creation of new products also aims to enhance the sensory experience of the user. This may involve improving product ergonomics for easier and more comfortable handling, integrating pleasant tactile elements, or creating an intuitive and enjoyable user interface [35].

Therefore, we can bring multiple benefits to the product, both from the perspective of environmental

protection and user experience, contributing to the creation of more sustainable and attractive products for consumers. It is essential that this process be approached strategically, considering market trends and requirements, as well as the impact on the environment and user experience.

### 3. PRODUCT DESCRIPTION

The product we have chosen to design aims to meet people's needs for food preparation in a pleasant and effortless manner. The household appliance aims to bring numerous advantages, both directly impacting the user and the environment [1].

Based on a compact design, the "Bread Wonder" (Figure 2) is a multifunctional household appliance, representing a clever combination of a bread toaster and a sandwich maker. Its compact dimensions make it suitable for any type of kitchen, designed to be easy to use and store. The sliding crumb tray and easy-to-clean materials ensure quick and efficient cleaning of the appliance, reducing the time and effort required for maintenance. The new "Bread Wonder" eliminates issues with uneven toasting of bread and provides a more enjoyable and efficient breakfast experience.



**Figure 2** The multifunctional appliance "Bread Wonder"

The bread toaster (Figure 3) is equipped with two toasting slots, where slices of bread are inserted for toasting. These slots are sized to accommodate standard bread slice dimensions.



**Figure 3** "Bread Wonder" – bread toaster

With advanced technology, this bread toaster is capable of precisely and uniformly toasting bread, ensuring that each slice is perfectly toasted. This is possible thanks to its intelligent temperature and toasting time control system, which automatically adjusts settings based on the type and thickness of the bread.

The toaster is also equipped with a warming rack (Figure 4) that sits above the bread toasting slots. It can be used for heating muffins, croissants, or other food items, depending on preferences.



**Figure 4** Warming rack for muffins, croissants

The control panel screen (Figure 5) is equipped with a clock, intuitive smart touch controls, allowing you to navigate and customize the toasting experience with ease. Adjust settings with a simple touch for precise control over browning.



**Figure 5** "Bread Wonder" – Control Panel

The toasting technology has been enhanced to ensure even toasting and browning of bread slices in an even shorter time. New and improved functions have been added, such as the Quick Toast mode, to provide an even faster and more efficient toasting experience.

The sandwich maker is a clever appliance, equipped with two non-stick cooking plates, specifically designed to prevent food from sticking and to facilitate easy cleaning afterward. The plates are equipped with a secure locking system, ensuring that the appliance remains closed during cooking, thereby preventing leaks and accidents. The rapid heating technology allows the sandwich maker to reach the optimal temperature in a

short time, while the adjustable thermostat allows users to adjust the temperature according to their preferences or the type of food they are cooking. This feature is useful for achieving perfect results based on personal preferences.



**Figure 6** "Bread Wonder" – Sandwich Maker

The choice of colors for the "Bread Wonder" (Figure 7) was influenced by personal preferences, although the product may be available in a wide range of colors that can be customized according to customer preferences.



**Figure 7** "Bread Wonder" – Color Options

From a sensory perspective, the "Bread Wonder" focuses on stimulating all human senses to create a more pleasant and memorable experience during product usage. The aesthetic aspect of the toaster captures users' attention. A modern and elegant design gives the product a premium and attractive appearance.

User interaction with the appliance has been enhanced through the use of high-quality materials and pleasant tactile surfaces. The ergonomically designed handle and buttons, the bright and intuitive screen with clear information about settings and toasting status,

provide a comfortable sensation and facilitate product usage.

The introduction of a scent diffusion system adds an additional element of pleasure during toasting. As the food is being toasted, users are greeted by pleasant and comforting sounds, indicating the progress of toasting and breakfast preparation. These subtle and well-placed sounds contribute to creating a relaxing atmosphere in the kitchen and add an extra dimension to the toaster's user experience.

By integrating an ergonomic, aesthetic, and auditory approach into its design, the "Bread Wonder" toaster manages to provide a superior breakfast experience to its users. With a focus on comfort, elegance, and efficiency, this bread toaster promises to completely change the way people enjoy the first meal of the day and bring innovation to kitchens around the world.

#### 4. MATERIALS

International Journal of Manufacturing Economics and Management to reducing environmental impact and promotes the responsible use of natural resources.

The cooking plates (Figure 8) are coated with a non-stick Teflon layer, which facilitates cleaning and prevents food from sticking [15]. This reduces the consumption of water and detergents needed for cleaning the appliance, thus contributing to resource conservation, and reducing environmental pollution.



**Figure 8** Cooking plates

The finishes used are non-toxic and eco-friendly. They do not contain harmful chemicals and are safe for both users' health and the environment.

Recyclable components, such as cables and connectors, are used inside, which can be reused or recycled entirely. The choice of these materials contributes to waste reduction and conservation of natural resources [15].

To ensure optimal thermal efficiency and reduce energy consumption, environmentally friendly thermal insulation is used. This insulation is made from recyclable materials and has a high heat retention capacity, allowing for even toasting of bread without consuming excessive energy.

The commitment to environmental protection and responsible use of natural resources makes it an eco-friendly option for consumers concerned about their impact on the planet [15].

#### 5. CONCLUSIONS

The utility of this bread toaster and sandwich maker is to fulfill the human need for preparing quick and delicious snacks in a convenient and efficient manner. In addition to this primary function, this appliance also serves other purposes, such as saving space in the kitchen, saving time during food preparation, and providing a wide range of food preparation options, from toasting bread to making favorite sandwiches.

The purpose of this project is to highlight the challenges of managing innovation in the manufacturing industry, with a focus on user-driven innovation. The product presented is innovative and functional, resulting from a creative and technological process that combines utility and aesthetics.

The reliability of this product is ensured by the high-quality materials used in its construction, such as stainless steel for the cooking plates and durable internal components. Ergonomics are considered through the compact and user-friendly design, which allows for easy handling and cleaning of the appliance.

The aesthetics of the appliance are designed to complement a variety of kitchen styles, with modern lines and elegant finishes. Additionally, its functionality is enhanced by features such as digital temperature control and customizable toasting and sandwich preparation options. The design of this appliance covered the entire development cycle, from market research and identifying user needs to testing and optimizing the final product. Innovative technical solutions, such as the uniform heating system and advanced control functions, contribute to the quality and superior performance of this appliance.

The aim of this project was to create an innovative and functional product that meets the needs and expectations of modern users. By integrating all design and technological elements, this appliance represents a complete solution for quick and easy snack preparation in the home or office.

The creation of the "Bread Wonder" appliance has demonstrated the power of innovation in developing products that meet the needs and preferences of users, providing them with an enhanced and more enjoyable breakfast preparation experience. It combines both user-centric design innovation and sensory design to deliver a superior user experience.

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#### REFERENCES

- [1] Sossou, G., Demoly, F., Gomes, S., Montavon, G. (2022). *An Assembly-Oriented Design Framework for Additive Manufacturing*. Designs 2022, Vol.6, No.20.



- [2] Berry, K., Brown, E.M., Pothier, B., Fedorka, S., Akyurtlu, A., Armiento, C., Walsh, G.F., Shemelya, C. (2022). *Overcoming Variability in Printed RF: A Statistical Method to Designing for Unpredictable Dimensionality*. Designs 2022, Vol. 6, No. 13.
- [3] Liu, J., (2023). *Ideal Electronic Technology*, available at: [www.ietcharger.com](http://www.ietcharger.com) Accessed: 2023-05-23.
- [4] Chacón, A., Ponsa, P., Angulo, C. (2021). *Usability Study through a Human-Robot Collaborative Workspace Experience*. Designs 2021, Vol. 5, 35.
- [5] J.H. Wu, *A design methodology for form-based knowledge reuse and representation*, Inform. Manage. 46 (7) (2009) 365–375.
- [6] T. Wuest, *Product requirement modeling and optimization method based on product configuration design*, Procedia CIRP 36 (45) (2015) 1–5.
- [7] A-M Avramescu, *The ecological design of a 3 in 1 electrical household appliances: microwave, toaster and sandwich toaster*, ISB-INMA-THE 2015, 611–618.
- [8] P. Jerzy, O. Konrad, P. Jaroslaw, et al., *Conceptual and detailed design knowledge management in customized production-Industrial perspective*, J. Comput. Design Eng. 6 (4) (2019) 479–506.
- [9] K. Halskov, N.B. Hansen, *The diversity of participatory design research practice at PDC 2002–2012*, Int. J. Hum Comput Stud. 74 (2015) 81–92.
- [10] Avramescu, A., (2023). *The Importance and Necessity of New Bio-Based Materials in Industrial Design*, Materiale Plastice, 60 (1), pp. 121–127.
- [11] K.Y. Lin, C.F. Chien, R. Kerh, *UNISON framework of data-driven innovation for extracting user experience of product design of wearable devices*, Comput. Ind. Eng. 99 (2016) 487–502.
- [12] Ana-Maria AVRAMESCU, *A sensorial and instrumental investigation on the performance of bio-based material versus synthetic material*; U.P.B. Sci. Bull., Series B, Vol. 85, Iss. 3, 2023, ISSN 1454 – 2331, pp. 207–218.
- [13] Nicolau A-M. *Sustainable Perspectives Using Human Beings: The Sensory Properties of a Bio-Based Material Compared to a Synthetic Material—An Overall Assessment Based on an Innovative Blind Method*. Sustainability. 2023; 15 (12):9145.
- [14] T. Hartmann, A. Trappey, *Advanced engineering Informatics - Philosophical and methodological foundations with examples from civil and construction engineering*, 100020.1-100020.7, Develop. Built Environ. 4 (2020).
- [15] AVRAMESCU A.-M., *Etude prospective sur l'exploitation des matériaux naturels comparés aux matériaux synthétiques*, U.P.B. Sci. Bull., Series B, Vol. 85, Iss. 1, 2023, pp. 235–247.
- [16] [www.beko.ro](http://www.beko.ro) Accessed: 2024-03-23
- [17] Cabeza-Lainez, J. et al. (2022). *New Simulation Tool for Architectural Design in the Realm of Solar Radiative Transfer*. Designs 2022, Vol. 6, 72.
- [18] AVRAMESCU, A.-M., *Physical properties of the ecological materials versus artificial materials*; U.P.B. Sci. Bull., Series B, Vol. 77, Iss. 1, 2015 ISSN 1454 – 2331, pp. 149–156.
- [19] Hsu C-Y, Wu T-T. *Application of Business Simulation Games in Flipped Classrooms to Facilitate Student Engagement and Higher-Order Thinking Skills for Sustainable Learning Practices*. Sustainability. 2023; 15 (24):16867.
- [20] Yang J, Ren G, Wang Y, Liu Q, Zhang J, Wang W, Li L, Zhang W. *Environmental Prediction Model of Solar Greenhouse Based on Improved Harris Hawks Optimization-CatBoost*. Sustainability. 2024; 16 (5):2021.
- [21] Mooney, Q.D.; Imtiaz, M.H. *Sensory Augmentation Using Subdermal Haptic Feedback*. Eng. Proc. 2023, 31, 55.
- [22] Banzato, A.; Cerchiari, A.; Pezzola, S.; Ranucci, M.; Scarfò, E.; Berardi, A.; Tofani, M.; Galeoto, G. *Evaluation of the Effectiveness of Functional Chewing Training Compared with Standard Treatment in a Population of Children with Cerebral Palsy: A Systematic Review of Randomized Controlled Trials*. Children 2022, 9, 1876.
- [23] Allmendinger, L.; Hazubski, S.; Otte, A. *Conceptualization of an Anthropomorphic Replacement Hand with a Sensory Feedback System*. Prosthesis 2022, 4, 695–709.
- [24] Sato, M.; Mutai, H.; Iwanami, J.; Noji, A.; Sugimoto, S.; Ozawa, K.; Sagari, A. *Difference between the Effects of Peripheral Sensory Nerve Electrical Stimulation on the Excitability of the Primary Motor Cortex: Examination of the Combinations of Stimulus Frequency and Duration*. Brain Sci. 2022, 12, 1637.
- [25] Abella, A.; Llorach-Massana, P.; Pereda-Baños, A.; Marco-Almagro, L.; Barreda-Ángeles, M.; Clèries, L. *Perception of Recycled Plastics for Improved Consumer Acceptance through Self-Reported and Physiological Measures*. Sensors 2022, 22, 9226.
- [26] Babailov, S.P.; Zapolotsky, E.N.; Fomin, E.S.; Polovkova, M.A.; Kirakosyan, G.A.; Martynov, A.G.; Gorbunova, Y.G. *Structure Determination of Binuclear Triple-Decker Phthalocyaninato Complexes by NMR via Paramagnetic Shifts Analysis Using Symmetry Peculiarities*. Molecules 2022, 27, 7836.
- [27] Talens, C.; Llorente, R.; Simó-Boyle, L.; Odriozola-Serrano, I.; Tueros, I.; Ibargüen, M. *Hybrid Sausages: Modelling the Effect of Partial Meat Replacement with Broccoli, Upcycled Brewer's Spent Grain and Insect Flours*. Foods 2022, 11, 3396.
- [28] Imbesi, S.; Corzani, M.; Lopane, G.; Mincoletti, G.; Chiari, L. *User-Centered Design Methodologies for the Prototype Development of a Smart Harness and Related System to Provide Haptic Cues to Persons with Parkinson's Disease*. Sensors 2022, 22, 8095.
- [29] Cheng, S.; Zhai, Z.; Sun, W.; Wang, Y.; Yu, R.; Ge, X. *Research on the Satisfaction of Beijing Waterfront Green Space Landscape Based on Social Media Data*. Land 2022, 11, 1849.
- [30] Alraho, S.; Zaman, Q.; Abd, H.; König, A. *Integrated Sensor Electronic Front-Ends with Self-X Capabilities*. Chips 2022, 1, 83–120.
- [31] Li, W.-T.; Cheng, Y.-H. *Creating Sustainable Development of the Destination with Tea Public*

- Version Packaging Design by Obtaining Relational Space Concept*. Sustainability 2022, 14, 9256.
- [32] Wang, Y.; Zhao, Q.; Chen, J.; Wang, W.; Yu, S.; Yang, X. *Color Design Decisions for Ceramic Products Based on Quantification of Perceptual Characteristics*. Sensors 2022, 22, 5415.
- [33] G., Clarissa, Bram de Boer, M. Gabbay, C. Watkins, N. Wilson, H. Tetlow, and H. Verbeek. 2022. *Developing a Meaningful Garden Space in a Care Home with Staff and Family Members: A Qualitative Study* International Journal of Environmental Research and Public Health 19, no. 12: 7025.
- [34] C., Xing, Y. Liu, S. Li, and W. Sun. 2022. *Sensory Perception Mechanism for Preparing the Combinations of Stimuli Operation in the Architectural Experience* Sustainability 14, no. 13: 7885.
- [35] Bright, Tyrone, Sarp Adali, and Glen Bright. 2022. *Low-Cost Sensory Glove for Human–Robot Collaboration in Advanced Manufacturing Systems* Robotics 11, no. 3: 56.
- [36] Duivon, Askan, Pino Kirsch, B. Mauboussin, G. Mougard, J. Woszczyk, and F. Sanfilippo. 2022. *The Redesigned Serpens, a Low-Cost, Highly Compliant Snake Robot* Robotics 11, no. 2: 42.
- [37] Kantor, Jiří, Lucie Hlaváčková, Jian Du, Petra Dvořáková, Zuzana Svobodová, Kristýna Karasová, and Lucia Kantorová. 2022. *The Effects of Ayres Sensory Integration and Related Sensory Based Interventions in Children with Cerebral Palsy: A Scoping Review* Children 9, no. 4: 483.
- [38] Avramescu A.-M., Petcu P., Constantin I.-M. (2023), *Integrating the human factor and enviromental needs in the design of a new product*, International Journal of Manufacturing Economics and Management No. 2 / 2023:46.

#### Authors:

**Ana-Maria NICOLAU**, PhD Engineer, Lecturer, Department of Engineering Graphics and Industrial Design, National University of Science and Technology POLITEHNICA Bucharest, Romania, E-mail: avr\_ana@yahoo.com

**Petruța PETCU**, PhD Student Engineer, Assistant, Department of Engineering Graphics and Industrial Design, National University of Science and Technology POLITEHNICA Bucharest, Romania, E-mail: petruta.toderasc@yahoo.com