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Augmented and virtual reality technologies as the future sales' channel in the furniture industry

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Abstract: The furniture industry represents an important industry branch worldwide with a continuous demand. However, using advanced technologies in furniture design can take the industry to new heights by meeting the expectations of the users. The main focus of this paper is to highlight the importance of incorporating new future technologies in furniture design which meet user expectations more effectively. Integrating the augmented reality (AR) and virtual reality (VR) technologies in this process can create compelling results and exceptional experiences for customers, leading to increased business and customer satisfaction. AR and VR technologies allow us to bring furniture designs virtually into our homes, enabling us to see how it fits into the room's environment in real-time and at a real scale. This technology not only enhances the user experience but also allows accurate sales and maximum customer satisfaction.

Keywords: AR; VR; future technologies; furniture market; design methods; industrial design; modelling;

1. Introduction

The furniture industry is an evergreen market all over the world with a persistent demand, as people need in their surroundings furniture for both aesthetic and functional purposes. The last decade saw a boom in the furniture market. As human living standards have risen and technology has developed rapidly, there has been an increase in demand, which can not necessarily be met by mass-produced products, especially in terms of quality and customization. This growth has also led to an increasing need for added value. Many studies support the predominant importance of user centred design. Furthermore the user can also participates in the design process led by expert designers, where its opinions are considered (Norman, 1986). The main advantage of this approach is to ensure that the product will fit like augmented reality (AR) and virtual reality (VR) present new opportunities for the furniture industry. These technologies allow customers to visualize furniture in their homes before

making a purchase, which helps them make more informed decisions (Fleury et al. 2022). These technologies also allow designers to create personalized and unique products that meet the specific needs and preferences of individual customers. AR and VR technologies represent a promising future for the furniture industry as they provide new sales channels and enhance the design process. With the continued development and integration of these technologies, the furniture industry can meet the increasing demand for personalized and high-quality furniture while providing customers with a unique and engaging shopping experience. The main objective of this paper is to present the benefits of AR and VR technologies as future sales channels in the furniture industry.

1. Background

Drafting was still done by hand until relatively recently and prototypes in clay or heavy paper were mostly used to experience industrial design objects or architectures in three dimensions (Bertol, Foell, 1997). In furniture industry the full-scale functional prototyping has become widespread allowing to perform stability, strength and durability tests on the prototypes. One of the key developments in the computer graphic field was made by Ivan Sutherland (1962) in his PhD thesis, called “Sketchpad: a Man-Machine Graphical Communication System”. Considered by many a foundational work for modern computer graphics, the program uses drawing as a novel communication medium for the computer (Schodek, Bechtold, Griggs, Kao, Steinberg, 2005). Rozmus et al. found that using virtual reality in the design process enhances and expands the possibilities of working with virtual representations of the designed objects, complementing traditional 3D models. A process based on VR has been described by them for the design of underground routes in the coal mining industry (Rozmus et al. 2021). Fleury et al. proposed an innovative four steps process of furniture design based on VR technology. The steps were brainstorming, 3D scanning of the room, idea sketching in VR, 3D modelling and visualisation of the result in VR (Fleury et al. 2022). Prabhakaram et al. performed tests to ascertain primarily the impact of the application of interactive virtual reality on delivering furniture design selection and coordination tasks. This study proposes a step change in the way furniture design is communicated and coordinated through an immersive virtual experience (Prabhakaram et al. 2021). VR gives the impression of being completely inside a 3D interactive environment, while AR places virtual elements in the context of the user’s environment (Das, 2023). VR and AR technology was not so widely available in the beginning. The early models were created for the military to test fighter aircrafts without significant material damage and

without taking off. A major advance came in 1992 with Louis Rosenberg's complex Virtual Fixtures AR system for the US Air Force (Interaction Design Foundation, 2023). Thanks to technological advancements, these are now available to ordinary people even in their homes, mainly in the form of online and offline games. They are so widespread that we can reach them with an object that we carry in our pockets every day.

2. Description of technologies

Buying furniture is often a significant investment and we can't expect the customers to make an instant decision if they don't know how the product will look in their home. By using AR and VR technologies, shoppers can see how the selected furniture will fit in their room; likelihood of returns reduces and customer satisfaction increases.

2.1. VR technology

VR technology creates a fully immersive digital environment, allowing shoppers to experience furniture in a virtual showroom (see Fig 1.). It allows customers to explore different products and configurations, and even change colours and textures in real time. This technology offers a more immersive and interactive experience than traditional shopping methods do, making customers more likely to buy. This kind of virtual experience also requires customers to have special glasses, which are quite expensive. However, there are applications which can transform a smartphone into a virtual reality headset. After downloading the appropriate phone application, we can assemble the entire device with the help of our phone. All we need for this usage is a frame made of cardboard, in which we place the phone.



Fig 1. Image produced with VR technology (Vas, 2022)

2.2. AR technology

Augmented reality has science-fiction roots dating to 1901. However, Thomas Caudell described this term as a technology only in 1990 while helping Boeing workers to visualise intricate aircraft systems (Interaction Design Foundation, 2023). AR technology is the integration of digital information with the physical environment, allowing customers to see and interact with virtual objects in the real world. Augmented reality systems combine digital information and the real world in such a way that the user experiences them as one (Gudlavalleti et al., 2022). AR technology can be used to create 3D furniture models that can be superimposed on images or videos of the customer's living space (see Fig 2.). This technology allows customers to see how the furniture will look in their home before they buy it, eliminating the need for physical showrooms or store visits.



Fig 2. The difference between a 3D visualisation and an AR image (Nagy, 2022)

3. Application

In order to use these technologies, it is necessary to draw the furniture in 3D, and create a 3D visualisation model. In the traditional design, the last step of the process is 3D modelling, from which a prototype can be made. By using new technologies, traditional design can be extended by a further step (added value to the presentation of the design), where the customer can not only see the visual design of the furniture, but also get information about its placement in space furthermore, in his/her respective home. Cornerstone of our activity is the design software packages, allowing us to carry out designs with appropriate quality. Programs are required to be able to create walkable 3D models. Our choice is Solidworks that allows 3D concept modelling of furniture. SketchUp, or Trimble SketchUP as it is officially called, is a 3D modeller program, which is already widely used in several different areas. It has a huge user base in architecture, mechanical engineering, and even in the fields of film and video games. It is popular for its ease of use and unique customization due to its factors which are called plug-ins. Other advantages include an online data storage library, which is available under the name

3D Warehouse. In addition to the fact that traditional design tasks can be performed in Sketchup, the program has a built-in AR viewing platform. The SketchUp Viewer for Mobile app offers augmented reality (AR) viewing capabilities enabling us to view our 3D models within the context of our existing physical space (see Fig 3.). With AR, a designer can iterate faster on designs by letting customers experience the models in 3D, and communicate his/her ideas more effectively.

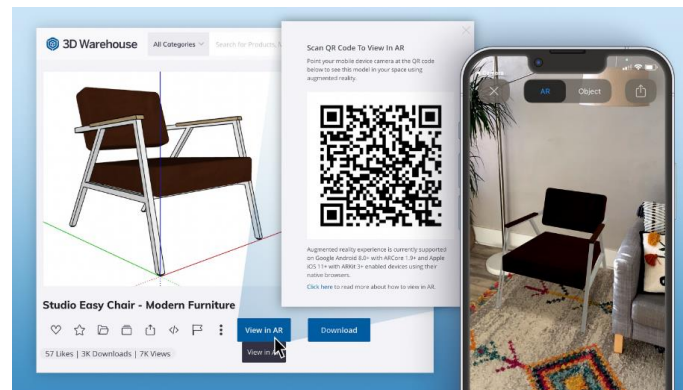


Fig 3. SketchUp: AR viewing via a QR code (Sketchup Team, 2022)

“The biggest problem an architect has is getting from the screen into physical space,” said architect Greg Lynn. SketchUp Viewer enables architects to fully immerse themselves and experience their ideas through 1:1 holographic scale models or AR models. SketchUp Viewer - Lynn states - “brings designs to life by bridging the gap between 2D, 3D and physical space.” Possessing a remote collaboration capability, the mixed-reality technology is set to transform the design process, empowering architects to more effectively visualise, present ideas and manage complex projects in real time (Addo-Atuah, 2018). This trend is also being applied to the furniture industry, with furniture being moved into physical space (see Fig 6.). IKEA is an example of this. IKEA has already launched an augmented reality (AR) application that allows users to test IKEA's products in real time through Apple iOS 11's ARKit technology. Dubbed IKEA Place, the iPhone- and iPad-compatible free application features realistically-rendered, true-to-scale 3D products. "The app automatically scales products, based on room dimensions, with 98 percent accuracy," noted a press release by the company (see Fig 4.). In order to visualise a product within a space, the application scans the expanse of a room through an iPhone or an iPad camera (Ayoubi, 2017).

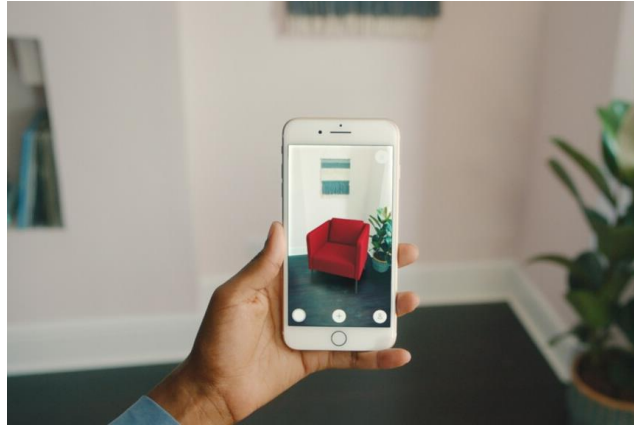


Fig 4. Courtesy Inter IKEA Systems (Ayoubi, 2017)

Virtual reality (VR) is also becoming more and more important in the construction industry, after devices that truly implement VR in a life-like manner have been put on the market in recent years. By adding the Oculus Rift, HTC Vive and Samsung Gear headsets, the user can enter any 3D simulation and feel as if he is really standing in the designed space (see Fig 5.). During such a tour, you can get an architectural plan accepted, or even sell an apartment much more convincingly, then relying only on plans and photographs.



Fig 5. An expected view of projected virtual reality contents
(Khan, Ahsan and Hussain, 2017)

This solution was also used by WING and Market during the press tour of the new Telekom headquarters, not only the giant office building under construction version, but also the completed version could be viewed - the latter with the help of VR (Szabó, 2018). The main advantage of the mixed use of VR and AR for us is that the two technologies work together to project an accurate image for our customers. In VR, the customer can walk through the product, experience the dimensions and the exact placements, can test the opening direction and operation, while in AR he/she can see the exact proportions and position of the placed model and the combined effect of colours and shapes in space. Using VR and AR, scale models can

be created that accurately illustrate function and style, which can be shaped and moulded in the further steps of the design process based on new requests and expectations. Multiple designs and layouts can be pre-designed as required (Nagy, 2022).



Fig 6. Realistic product presentation to customers based on a feature-rich interface
(Florentino et al., 2022)

Today, we can't even imagine our lives without our smartphones: has phone, alarm clock, it is a music player, connects to the social media, contains all of our favourite applications. Our lives are in our pockets and we can access them at the touch of a button. According to Statista data, the number of smartphone users is projected to increase from 3.6 billion in 2020 to approximately 4.3 billion by 2023, and smartphone adoption may also grow at a rapid rate. More than 50% of all Internet traffic comes from smartphones and tablets. By 2025, 72% of the users will access the Internet exclusively via smartphones – estimates Leftronic. With these numbers in mind, it becomes clear that focusing on mobile phone and the web can provide a significant competitive advantage over our competitors. People love using augmented reality—over 90% of Americans use or would use AR to shop. Research by Interactions Consumer Experience Marketing shows that furniture is the most popular purchase item with augmented reality (60%), followed by apparel (55%) and food (39%) (Retail Perceptions Report, 2017). The furniture industry is an incredibly visual industry and customers welcome any effort to bridge the gap between the online and in-store shopping experience. With this in mind, it is clear that VR and AR has a huge influence on the decision-making process in the furniture industry (see Fig 7.).



Fig 7. Viral marketing at the Duna Kapu Square in Győr (Nagy, 2022)

4. Results, conclusions

In conclusion, AR and VR technologies have the potential to revolutionise the furniture industry by creating new sales channels and enhancing customer experiences. One of the main benefits of AR and VR technologies in the furniture industry is the ability to reduce returns, the other is to reach customers who may not have access to physical store for example, customers in rural areas or those with limited mobility may not have easy access to stores. AR and VR technologies allow these customers to explore and purchase furniture from the comfort of their own homes. AR and VR technologies can also provide valuable data to furniture companies. By tracking customer behaviour and preferences, companies can gain insights into which products are popular and which configurations are most frequently chosen. This data can be used to improve product design and marketing strategies. As these technologies continue to develop and become more accessible, we can expect to see more furniture companies incorporating AR and VR into their sales strategies. The use of AR and VR technologies in the furniture industry means that the product will fully meet the expectations of the users. By using new technologies, traditional design can be extended with an added value of design presentation, where the customer can not only see the visual design of the furniture, but also get information about its spatial placement and its virtual placement in their own home. For us, the main advantage of using VR and AR together is that the two technologies work together to project an accurate image to the customer. All in all this allows for successful sales transactions for all parties involved and maximum customer satisfaction.

References

Addo-Atuah, K. (2018). Step Inside Your Architectural Models Using Augmented Reality. Online resource. <https://architizer.com/blog/author/kweku-addo-atuah/>

- Ayoubi, A. IKEA Launches Augmented Reality Application. Architect. Online resource. <https://www.architectmagazine.com/technology/ikea-launches-augmented-reality-application>, 2023.04.17
- Bertol, D., Foell, D.(1997). Designing Digital Space: An Architect's Guide to Virtual Reality, Wiley, 368 p. ISBN: 0471146625
- Das, Soumyajit (2023): An Article On: Augmented Reality Contrast to Ergonomic Design. Online resource. <https://doi.org/10.6084/m9.figshare.22134869.v1>
- Fleury,S., Nollet,A., Chaniaud, N., Poussard, B., Blanchard, P. and Richir, S. (2022). Virtual Reality as a tool for furniture design. 2022 International Conference on Cyberworlds (CW), Kanazawa, Japan, 218-219. doi: 10.1109/CW55638.2022.00051
- Florentino, M., Ricci, M., Evangelista, A., Manghisi, M.V. and Uva, A.E. (2022). A Multy-Sensory In-Store Virtual Reality Customer Journey for Retailing: A Field Study in a Furniture Flagship Store. Future Internet, 14 (812): 381. doi: 10.3390/fi14120381
- Gudlavalleti, R., Pandey, A., Malviya, M., Gandhi, S., Kasar, M. (2022). A Comparative Study of Interior Designing Using Markerless Augmented Reality. IJIRT, 9 (2), 470-474. <https://ijirt.org/Article?manuscript=155976>
- Interaction Design Foundation (2023). AR's Place in the World of Extended Reality. Online resource. <https://www.interaction-design.org/literature/topics/augmented-reality>. 2023.04.17
- Nagy, V. (2022).Marketing planning for a new furniture business based on VR and AR technology. University of Sopron. Sopron. 84 p. (in Hungarian). <http://diploma.uni-sopron.hu/id/eprint/9633>
- Norman, D.A. (1986). User-Centered System Design: New Perspectives on Human-computer Interaction. In: Norman, D.A. and Draper, S.W., Eds., Cognitive Engineering, Lawrence Erlbaum Associates, Hillsdale, 31-61.
- Prabhakaran et al. (2021). The effectiveness of interactive virtual reality for furniture, fixture and equipment design communication: an empirical study. Engineering, Construction and Architectural Management, 28 (5), 1440-1467. doi: 10.1108/ECAM-04-2020-0235
- Retail Perceptions (2017). What Shoppers Want from Retail Technology. Online resource. <http://www.retailperceptions.com/2017/05/what-shoppers-want-from-retail-technology/>. 2023.04.17
- Rozmus, M., Tokarczyk,J., Mishalak,D., Dudek,M.,Szewerda, K., Rotkegel,M., Lamot,A. and Roser, J. (2021). Application of 3DScanning, Computer Simulations and Virtual Reality in the Redesigning Process of Selected Areas of Underground Transportation Routes in Coal Mining Industry. Energies, 14 (9), 2589. 1-21. <https://doi.org/10.3390/en14092589>
- Schodek, D., Bechthold, M., Griggs, J.K., Kao, K., Steinberg, M. (2004). Digital Design and Manufacturing: CAD/CAM Applications in Architecture and Design. Google Books, Wiley, 6 Dec. 2004, https://books.google.com/books/about/Digital_Design_and_Manufacturing_CAD_CAM.html?id=UZpjQgAACAAJ.

Sketchup Team (2022). 3D Warehouse AR View: See your models in a whole new dimension. Online resource. <https://blog.sketchup.com/products/3d-warehouse-ar-view-see-your-models-in-a-whole-new-dimension>. 2023.04.17

Szabó, Á. (2018). Milyen technológiai újítások várnak az építőiparra 2018-ban? Magyar Építők. Online resource. <https://magyarepitok.hu/iparagi-hirek/2018/02/milyen-technologiai-ujitasok-varnak-az-epitoiparra-2018-ban>. 2023.04.17

Vas, Zs. (2022): RP-Pano_konyha. Online resource. <https://kuula.co/profile/ImagineInteriorDesign>. 2022.04.1

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Vivien NAGY received her M.Sc. from the University of Sopron, Faculty of Wood Engineering and Creative Industries in 2023. She is an individual entrepreneur who manages her own business. In cooperation with other companies, she designs large office and residential spaces. She is passionate about interior and furniture design, at the same time she is involved in several projects and workshops of such kind.

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