Smell Therapy with Augmented Reality

YUSUF TALHA YILMAZ , KEREM SALTIK , YUSUF ÇON, KEMAL GÖKHAN NALBANT
Department of Software Engineering
Istanbul Beykent University
Ayazağa, Hadım Koruyolu St. No:19, 34398 Sarıyer/Istanbul
TÜRKİYE

Abstract: This research investigates the potential of integrating odor-based stimuli with augmented reality (AR) technology for treating psychological disorders such as PTSD and anxiety. The sense of smell strongly affects the limbic system, which is closely associated with emotional regulation and memory, highlighting its relevance for therapeutic applications. The study reviews the relationship between odor, memory, and emotion from a neuroscientific perspective and evaluates the technical capabilities of existing digital olfactory technologies. Subsequently, an AR-supported olfactory therapy model is designed, and its theoretical framework and process flow are established. The findings indicate that this approach supports neuropsychological mechanisms and may contribute to the development of next-generation therapeutic tools in practical settings. By examining multisensory therapeutic experiences, the research provides an interdisciplinary perspective on olfactory and AR integration and proposes a promising and innovative approach for personalized digital therapies.

Key-Words: Augmented Reality (AR), Scent Therapy, Post-Traumatic Stress Disorder (PTSD), Multi-Sensory Experience, Digital Health Technologies, Virtual Environment Therapies

Received: May 19, 2025. Revised: June 24, 2025. Accepted: July 26, 2025. Published: December 31, 2025.

1 Introduction

Augmented reality technology has become quite popular, especially in recent times. If this popular technology is to be defined, it can be done as an interactive experience of digital objects produced by computers, enriched with sound, image, GPS data, without being disconnected from the real world. In other words, it can be defined as the superimposition of digital objects on the real world, [1]. This technology is already used in many areas of daily life. Examples of these areas include logistics, production and industry, health, construction, e-commerce, education and entertainment, [2].

If we talk about a specific field, especially when we look at the health field, which is important for people, there are many sub-fields where AR is used, such as surgical support, medical and nursing education, rehabilitation and therapy, [3].

The therapy field within the subfields is used to improve the psychological, emotional, physical and spiritual states of the person. Examples of these therapy methods are applications such as scent therapy (aromatherapy), physiotherapy, massage therapy.

Recent studies have shown that the sense of smell has a direct impact on human psychology. It is understood that this sense establishes strong connections with the limbic system, especially the brain regions related to memory and emotions, such as the amygdala and hippocampus, [4]. In this context, smells have been found to play a vital role in the retrieval of memories and emotional regulation. Sigmund Freud describes the sense of smell as a component of our animal instincts and considers it an important element in understanding behavioral pathologies, [5]. Especially during the COVID-19 process, the negative effects of loss of smell (anosmia) on the mental health of individuals are drawing attention, and this makes the importance of the sense of smell in healthy psychological functioning even more evident, [6].

In light of these developments, the integration of scents into augmented reality (AR) environments stands out as a solution-oriented method for the treatment of psychological disorders, especially post-traumatic stress disorder (PTSD) and anxiety. Thanks to advances in scent technologies, initiatives such as Osmo.ai make it possible to digitally store scent molecules and reproduce them in liquid form [7]. Likewise, innovative technologies such as Feelreal Mask, Olorama and Scentee Machina allow scents to be integrated into digital experiences in a controlled manner, [8]. However, there are some technical difficulties in the widespread use of these technologies, such as storage of odors, differences in perception among users, and economic and cost issues.

The study investigates how scents can be used as a therapeutic tool in augmented reality environments, and in particular, how positive scents associated with memories can be presented for the purpose of creating a safe space for individuals experiencing PTSD (Post-Traumatic Stress Disorder) and how this con-

tributes to psychological healing is examined. The study aims to respond to the current literature gaps in the field of augmented reality (AR)-supported scent therapies. In the literature review, it is seen that scent-supported AR applications are generally entertainment or marketing-oriented, while therapeutic systems are quite limited. The study, which aims to fill this gap, supports the relationship between scent, memory and emotional healing with neuroscientific foundations, while offering an original approach by integrating current scent technologies.

The aim of the study is to strengthen the connection between individuals with PTSD and anxiety disorders and clinical experts seeking innovative methods in their therapy processes and to leave a resource for the literature. The research process comprehensively evaluates existing technologies, such as Osmo.ai, Olorama, Feelreal and Scentee Machina. In addition, discussions are made on user experiences, technical limitations and future development potential for the effective use of scents on digital platforms.

The aromatherapy to be discussed in the present study is an alternative medicine method in which essential oils obtained from the flowers, leaves and roots of plants are used for therapeutic purposes, [9].

2 Literature Review

As shown in Table 1 (Appendix), recent studies on the combination of augmented reality (AR) technologies and sensory activity methods reveal the possibility of enhancing users' experiences and therapeutic effects. These studies present various approaches and methods that investigate the therapeutic effects of AR technologies and olfactory stimuli.

The synthetic dataset developed in a recent study produces therapy dialogues reflecting emotional transitions that can be used in the treatment of post-traumatic stress disorder (PTSD). Despite the lack of data, this study aims to create an important foundation for artificial intelligence-supported therapy applications, [10].

In a systematic review conducted in 2023, augmented reality proves to be a promising tool in the treatment of anxiety. However, deficiencies in sample size and methodological diversity are observed and stated, [11].

Studies addressing the integration of olfactory inputs into therapies theoretically demonstrate the effect of smell on emotional memory and psychological healing, and reveal that this integration is still limited in clinical practice, [12], [13].

Research shows that AR-based phobia treatment yields similarly effective results to traditional methods, [14].

In another review, the psychological health effects of aromatherapy application with 3D virtual reality (VR) on elderly people living in a nursing home were investigated, and it was found that VR-supported aromatherapy sessions provided significant improvements in areas such as happiness, stress, sleep quality and life satisfaction, [15].

Similarly, a further study evaluates the effects of visual images presented in a virtual reality environment on individuals' odor recognition abilities and emotional reactions. It is emphasized that visual stimuli can significantly affect odor perception and that this combination can provide new methodological approaches in sensory analysis, [16]

Both reviews show that VR environments can be integrated into treatment processes and sensory training by providing not only a visual but also a multifaceted experience, which forms an important basis for personalized and effective treatment methods in the future.

Based on this literature, the current study aims to create an innovative, emotionally connected, and safe digital therapy environment for individuals with PTSD and anxiety by combining augmented reality technology with olfactory stimuli. Thus, it aims to make an original contribution to both technical and practical deficiencies.

3 Method

This research is of an exploratory nature to explore the therapeutic effects of augmented reality (AR) supported scent therapy systems. The research process is based on three topics:

- Literature review
- Analysis of existing technologies
- Conceptual model proposal

In the initial part of the research, a literature review is conducted on the use of augmented reality technologies in the health sector, the psychological effects of olfactory perception, and especially olfactory therapy applications in PTSD and anxiety disorders. In this context, published studies among academic sources are reviewed. In the systematic literature review, priority is given only to articles published in academic journals and clinical research, and entertainment and marketing-oriented augmented reality applications are excluded.

The second part provides a detailed review of the digital scent technologies available today. In particular, Osmo.ai's AI-assisted odorant molecule production, Feelreal Mask's multi-sensory integration,

Olorama's cinematic scent delivery system, and Scentee Machina's mobile-compatible devices are discussed. The potential of these technologies in therapeutic areas is evaluated in terms of data collection, user management, ease of use of the device, security, and cost.

In the third phase of the research, studies conducted by experts in psychology and technology (clinical psychologists, software engineers and neurologists) are taken into consideration. The findings obtained in these studies are evaluated with the qualitative content analysis technique and the theoretical infrastructure of the scent-assisted therapy model in the augmented reality environment is planned. During the research, the use of scents as emotional triggers, the potential of augmented reality environments to make the user feel safe and the need for personalization are emphasized.

The study did not conduct an applied experiment and only presents a conceptual proposal. Furthermore, since access to commercial versions of the technologies is limited, some evaluations are based on information provided by manufacturers and third-party user reviews. Therefore, the clinical validity of the proposed model can only be tested by future experimental studies.

4 Conceptual Framework

The theoretical basis of the study includes the idea of creating a digital therapy area that will support people's psychological healing processes by combining the neuroscientific infrastructure of olfactory perception with the sensory experience opportunities offered by augmented reality technology.

The perception of smell is the only sensory system that has a direct connection to the limbic region of the brain. Thanks to its connections with the amygdala and hippocampus in particular, smells have a strong effect on emotional reactions and memories. This situation reveals that smells can be useful tools in terms of providing emotional balance and reorganizing traumatic information in therapy processes. In this context, it is estimated that presenting smells in a safe, controlled and personalized augmented reality environment can create positive emotional responses in the individual.

AR technology is a structure that creates a sensory integrity by integrating virtual content into the real world. This technology provides a reliable interaction area with virtual elements, especially by preserving the user's understanding of reality. Within the framework of this research, the fact that the AR system presents olfactory, visual and auditory data together supports the therapy environment to be realistic, impressive and valuable for the individual.

The psychological intervention method used in the study is based on regulating emotions and reviving positive memories. Especially in cases such as post-traumatic stress disorder, it is important for people to be able to cope with negative experiences by activating positive memories and feeling safe. At this stage, the aim is to reach the individual's subconscious sense of security and increase positive emotions with scents.

Considering that the sense of smell is different for each individual, it is important for the augmented reality environment to be created to have a user-centered design approach. For this reason, it is recommended that the system has flexible features such as supporting the matching of smells with memories based on the individual's history and the ability to personalize the intensity and timing of the smell.

5 Implementation Process and Evaluation

In this section, how the presented model for augmented reality-based olfactory therapy can be implemented, its technical requirements, scenario development process and evaluation stages are discussed in detail. This model is based on the organization of olfactory sensory stimuli in AR environments for the treatment of psychological problems such as PTSD (Post-Traumatic Stress Disorder) and anxiety disorders.

5.1 Dataset Used and Case Study Description

This research does not include direct numerical data. Instead, a conceptual model is developed based on relevant literature reviews, qualitative case studies, and existing treatment methods. The case studies focus on the creation of safe spaces that aim to reconstruct the positive emotional states of people living after trauma. In this context, it is aimed to select the smells associated with positive memories from the individuals' past and present them in an appropriate manner in an augmented reality environment.

5.2 Model Implementation Steps

The proposed system consists of the following items:

- Client Profile and Clinical Assessment: Using psychological analysis methods (e.g., CAPS-5, GAD-7), the person's current traumatic events and triggers are examined. Places and smells associated with positive feelings in the person's past are identified.

- Scent Selection and Emotional Mapping: Scents associated with emotions in the literature (e.g. lavender – peace, mint – brain clarity) are examined through client interviews and a personal scent profile is prepared. At this stage, the Proust effect is referred to.
- Scenario-Based Design of the AR Environment: Using platforms such as Unity or Unreal Engine, a scene is created based on the client's preferred safe area definitions. This scene can be designed in a way that can be experienced with VR/AR glasses.
- Integration of Olfactory Technologies: Digital scent diffusers such as Feelreal, Olorama or Scentee Machina are made compatible with augmented reality systems. Sensory consistency is achieved by planning the scent dispersion at certain triggering events in the scenario.
- Clinical Prototyping and Feedback: User trials are conducted in the prototype area. In this process, the effect is measured with biometric feedback (pulse, skin conductance) and psychological assessment tools.

5.3 Process Flow and Technical Diagram

Below, the process of implementing the model is explained in steps, as shown in Table 1.

Table 1: AR + Scent Therapy Model Application Steps

Stage	Explanation
1	Psychoeducational and clinical evaluation of the client is performed; past positive memories and odor associations are identified.
2	Scents that create positive emotional associations through the sense of smell are selected and matched with the client.
3	Augmented reality environments suitable for the selected scents are designed (e.g. seaside, forest, childhood home, etc.).
4	Digital scent devices that work simultaneously with AR glasses are integrated. Scents are linked to in-environment scene transitions.
5	The client experiences the prototype environment. Sensory responses, therapeutic effects and anxiety levels are assessed.

Source: Created by the Authors

5.4 Validity, Scope and Limitations

The proposed model is designed at a theoretical level and needs to be validated by future clinical experiments. In particular, individual differences in smell and sensation may limit the universality of the model. Furthermore, the availability of the technologies used and the prices of the devices prevent its widespread application.
However, the key benefits of the model are:

- Creating personalized therapeutic environments,
- Providing higher emotional impact through multi-sensory stimulation (visual, auditory, olfactory) in the AR environment,
- Smell is linked to the limbic system, which directly affects anxiety regulation.

The limitations are summarized below:

- Odor memory varies among individuals,
- Technical challenges of real-time odor emission (e.g., latency, odor intensity control),
- Insufficient number of clinical samples and lack of controlled experimental environments.

Taking all these factors into consideration, the model is intended to be combined with biofeedback-based sensory therapy systems in the future.

6 Findings and Discussion

This research presents a conceptual and technical analysis examining the theoretical background of the augmented reality (AR)-based olfactory therapy model and its therapeutic potential. The proposed model combines existing technologies with neuroscience-based sensory healing methods and is presented as a new digital therapy alternative, especially in the treatment of psychological problems such as PTSD and anxiety. In this context, the obtained data were examined in three main dimensions: technological adequacy, treatment validity and user-centeredness.

6.1 Technological Assessment Findings

The system review determined the integration levels of currently available digital scent technologies (Osmo.ai, Feelreal, Olorama, Scentee Machina) into augmented reality systems. Table 2 shows the comparative technical specifications of these devices.

Table 2: Comparative Analysis of Digital Scent Technologies

Device	Year	Release Mode	AR Compatibility	Mobile Support
Osmo.ai	2024	Molecular synthesis	Medium	None
Feelreal	2020	Cartridge based	High	Limited
Olorama	2021	Air based diffusion	High	Available
Scentee Machina	2022	Microcapsule release	Middle	High

Source: Created by the Authors

This comparison shows that Feelreal and Olorama

devices are more suitable for treatment purposes in augmented reality-based systems. However, Osmo.ai's AI-supported odor molecule production infrastructure is a remarkable feature in terms of customization possibilities for future research.

6.2 Therapeutic Potential Findings

The main advantage envisioned in the conceptual model is that individuals achieve emotional balance through the activation of positive memories through neurobiological means. The therapeutic effects of the model developed for this purpose are examined in line with the data in existing studies. For example, significant improvements in stress and sleep quality were observed in a study (2020) using VR-supported aromatherapy applications, [15]. Similarly, it is emphasized (2021) that odors function in activating sensory memory, indicating that odor is useful in reappraising traumatic memories, [13].

6.3 Comparative Evaluation with Literature

The research results are largely similar to some prominent studies in the existing literature. In augmented reality (AR)-based phobia treatment studies (2016), it is stated that preserving the perception of reality increases the sense of psychological safety, [14]. In this respect, it is anticipated that our study may increase the level of psychological safety by adding scent to the augmented reality experience.

However, unlike existing studies, the proposed model is not limited to visual and auditory components only, but also aims to effectively control olfactory elements such as smell. In this respect, our research offers the opportunity to fill the gap in the literature on the therapeutic effects of multisensory experience.

6.4 Theoretical and Practical Contributions

The theoretical contribution of this study is that augmented reality technology can be incorporated not only for entertainment or educational purposes, but also into emotional healing and neuroscience-based therapy methods. The strong relationship between the sense of smell and the limbic system suggests that our research offers a new perspective on how emotional regulation can be stimulated in a technological environment.

In terms of application, the proposed conceptual model serves as a different digital therapy tool for clinical psychologists, psychiatrists and therapists. This study provides useful guidance for developing portable systems that can be used in home environments, especially for individuals with limited access.

6.5 Conflict with Expectations and Limitations

The expected benefits of the model are largely similar to the theoretical foundations found in the literature. However, the model has not yet been tested experimentally, which affects the clinical relevance of the findings. Furthermore, individual differences in odor perception necessitate tailoring of therapeutic efficacy. Furthermore, the cost-effectiveness and technical limitations of digital olfactory devices may hinder wider application of the model.

Considering all these factors, although the proposed model has a conceptually high therapeutic potential, this potential needs to be supported by practical applications. In future research, clinical trials, user experience evaluations and technical prototype development processes will be vital to increase the validity of the model.

7 Conclusion

This research proposes a new digital therapy model for the treatment of psychological problems such as post-traumatic stress disorder (PTSD) and anxiety through the integration of the sense of smell in an augmented reality (AR) environment. Scent therapy has great potential in terms of stimulating sensory memory and eliciting positive emotional responses from a neurobiological perspective. Combining this therapeutic potential with augmented reality systems constitutes an important development step towards creating a personalized and multi-sensory therapy experience.

7.1 Summary of Key Findings

The proposed structure is created by evaluating the technical capabilities of existing digital perfume technologies, building the therapeutic effect mechanisms on a neuroscientific basis, and planning the integration with augmented reality systems at a conceptual level. As a result of comparative studies with virtual reality or augmented reality-based therapy studies in the literature, the positive effects of multisensory interaction on psychological regulation are proven. It is observed that the sense of smell plays an important role in the neurological reconstruction of traumatic memories, especially due to its direct connection with the limbic system.

7.2 Theoretical and Applied Contributions

On a theoretical level, this study aims to fill a new research niche at the intersection of augmented reality and olfactory therapy disciplines. Integrating the sense of smell into AR experiences provides much more intense and effective sensory feedback compared to traditional treatment methods. Therefore, the

study makes an important contribution to the literature in the field of multisensory cognition and neurotechnology.

In terms of practical contributions, this model can serve as a guide for clinical psychologists, therapists, and digital health technology developers to create next-generation therapy systems. Especially considering the increasing needs for remote therapy in the post-pandemic period, there is an increasing tendency towards digital therapy solutions that are portable, customizable, and offer rich sensory experiences.

7.3 Limitations and Restrictions

The most important limitation of the study is that the proposed model has not yet been tested in a practical or clinical setting. Although a conceptually sound and consistent structure has been proposed, experimental studies on real patient groups are needed to verify the therapeutic efficacy. In addition, individual differences in odor perception (perception variability, reactions based on personal experiences) may limit the generalizability of treatment results.

Technological limitations include the limited odor-producing capacity of current digital olfactory devices, difficulties in integrating the devices, and issues regarding economic access. Furthermore, physiological or psychological side effects associated with long-term use of the system have not yet been studied.

7.4 Future Recommendations

It is recommended that the following aspects be addressed in further studies:

- Randomized controlled experimental designs should be applied to measure the effectiveness of the conceptual model.
- User experience, ease of use, and therapy satisfaction levels should be examined with qualitative research methods.
- The synthesis capabilities of digital scent technologies should be increased and a richer range of scents should be offered.
- To adapt to the psychological states of individuals, AI-supported smart AR therapy applications can be developed by offering scent and content recommendations.
- Multicultural experimental studies should be conducted considering the differences in odor perception in cultural context.

In conclusion, this research presents a multidisciplinary solution proposal in the combination of technology, neuroscience and psychology, and presents an innovative perspective on the future of digital therapy applications. Studies on the applicability and sustainability of augmented reality and odor-based treatments in clinical settings will accelerate scientific developments in this field.

References:

[1] F. Arena, M. Collotta, G. Pau, and F. Termine, An overview of augmented reality, *Computers*, Vol.11, No.2, 2022, pp. 28, doi:10.3390/computers11020028, https://doi.org/10.3390/computers11020028.

[2] P. Parekh, S. Patel, N. Patel, and M. Shah, Systematic review and meta-analysis of augmented reality in medicine, retail, and games, *Visual computing for industry, biomedicine, and art*, Vol.3, 2020, pp. 1-20, doi:0.1186/s42492-020-00057-7, https://doi.org/10.1186/s42492-020-00057-7.

[3] A. Oun, N. Hagerdorn, C. Scheideger, and X. Cheng, Mobile devices or head-mounted displays: a comparative review and analysis of augmented reality in healthcare, *IEEE Access*, Vol.12, 2024, pp. 21825-21839, doi:10.1109/ACCESS.2024.3361833, https://doi.org/10.1109/ACCESS.2024.3361833.

[4] R. S. Herz, The Role of Odor-Evoked Memory in Psychological and Physiological Health, *Brain Sciences*, Vol.6, No.3, 2016, doi:10.3390/brainsci6030022 ,https://doi.org/10.3390/brainsci6030022.

[5] S. Freud, Three Essays on the Theory of Sexuality, *Basic Books (translated edition)*, 1905, ISBN:9781784783587.

[6] V. Parma, K. Ohla, M.G. Veldhuizen, M.Y. Niv, C.E. Kelly, A.J. Bakke, K.W. Cooper, C. Bouysset, N. Pirastu, M. Dibattista, R. Kaur, M.T. Liuzza, M.Y. Pepino, V. Schöpf, V. Pereda-Loth, S.B. Olsson, R.C. Gerkin, P.R. Domínguez, J. Albayay, M.C. Farruggia, S. Bhutani, A.W. Fjaeldstad, R. Kumar, A. Menini, M. Bensafi, M. Sandell, I. Konstantinidis, A. Di Pizio, F. Genovese, L. Öztürk, T. Thomas-Danguin, J. Frasnelli, S. Boesveldt, Ö. Saatci, L.R. Saraiva, C. Lin, J. Golebiowski, L.-D. Hwang, M.H. Ozdener, M.D. Guàrdia, C. Laudamiel, M. Ritchie, J. Havlícek, D. Pierron, E. Roura, M. Navarro, A.A. Nolden, J. Lim, K.L. Whitcroft, L.R. Colquitt, C. Ferdenzi, E.V. Brindha, A. Altundag, A. Macchi, A. Nunez-Parra, Z.M. Patel, S. Fiorucci, C.M. Philpott, B.C. Smith, J.N. Lundström, C. Mucignat, J.K. Parker, M. van den Brink, M. Schmuker, F.P.S. Fischmeister, T.

Heinbockel, V.D.C. Shields, F. Faraji, E. Santamaría, W.E.A. Fredborg, G. Morini, J.K. Olofsson, M. Jalessi, N. Karni, A. D'Errico, R. Alizadeh, R. Pellegrino, P. Meyer, C. Huart, B. Chen, G.M. Soler, M.K. Alwashahi, A. Welge-Lüssen, J. Freiherr, J.H.B. de Groot, H. Klein, M. Okamoto, P.B. Singh, J.W. Hsieh, GCCR Group Author, D.R. Reed, T. Hummel, S.D. Munger, J.E. Hayes, More than smell—COVID-19 is associated with severe impairment of smell, taste, and chemesthesis, *Chemical Senses*, Vol.45, No.7, 2020, pp. 609-622, doi:10.1093/chemse/bjaa041, https://doi.org/10.1093/chemse/bjaa041.

[7] Osmo.ai, Giving computers a sense of smell, *https://www.osmo.ai/*, 2024, (Accessed: 25-Apr-2025).

[8] N. Ranasinghe, K. Karunanayaka, A. D. Cheok, O. Fernando, H. Nii, P. Gopalakrishnakone, Digital taste and smell communication, *BodyNets*, 2011, pp. 78-84, doi:10.4108/icst.bodynets.2011.247067, https://doi.org/10.4108/icst.bodynets.2011.247067.

[9] S. E. Lakhan, H. Sheafer, and D. Tepper, The effectiveness of aromatherapy in reducing pain: A systematic review and meta-analysis, *Pain research and treatment*, Vol.2016, No.1, 2016, pp. 8158693, doi:10.1155/2016/8158693, https://doi.org/10.1155/2016/8158693.

[10] S. BN, A. M. Sherrill, R. I. Arriaga, C. W. Wiese, and S. Abdullah, Thousand voices of trauma: A large-scale synthetic dataset for modeling prolonged exposure therapy conversations, 2025, arXiv:2504.13955, https://doi.org/10.48550/arXiv.2504.13955.

[11] Ç. N. Bakır, S. O. Abbas, E. Sever, A. O. Morey, H. A. Genc, T. Mutler, Use of augmented reality in mental health-related conditions: A systematic review, *DIGITAL HEALTH*, Vol.9, 2023, pp. 20552076231203649, doi:10.1177/20552076231203649, https://doi.org/10.1177/20552076231203649.

[12] M. P. Aiken and M. J. Berry, Posttraumatic stress disorder: possibilities for olfaction and virtual reality exposure therapy, *Virtual Reality*, Vol.19, 2015, pp. 95-109, doi:10.1007/s10055-015-0260-x, https://doi.org/10.1007/s10055-015-0260-x.

[13] R. S. Herz, Olfactory virtual reality: A new frontier in the treatment and prevention of posttraumatic stress disorder, *Brain Sciences*, Vol.11, No.8, 2021, doi:10.3390/brainsci11081070, https://doi.org/10.3390/brainsci11081070.

[14] C. Botella, M. Á. Pérez-Ara, J. Bretón-López, S. Quero, A. G. Palacios, R. M. Banos, In vivo versus augmented reality exposure in the treatment of small animal phobia: a randomized controlled trial, *PloS one*, Vol.11, No.2, 2016, pp. e0148237, doi:10.1371/journal.pone.0148237, https://doi.org/10.1371/journal.pone.0148237.

[15] V. Y. Cheng, C. M. Huang, J. Y. Liao, H. P. Hsu, S. W. Wang, S. F Huang, J. L. Guo, Combination of 3-dimensional virtual reality and hands-on aromatherapy in improving institutionalized older adults' psychological health: Quasi-experimental study, *J Med Internet Res*, Vol.22, No.7, 2020, pp. e17096, doi:10.2196/17096, https://doi.org/10.2196/17096.

[16] A. H. B. Zulkarnain, D. Radványi, D. Szakál, Z. Kókai, and A. Gere, Unveiling aromas: Virtual reality and scent identification for sensory analysis, *Current Research in Food Science*, Vol.8, 2024, pp. 100698, doi:10.1016/j.crfs.2024.100698, https://doi.org/10.1016/j.crfs.2024.100698.

Contribution of individual authors to the creation of a scientific article (ghostwriting policy)

Yusuf Talha Yılmaz led the research concept, designed the methodology, managed the project, and prepared and revised the manuscript.
Kerem Saltık managed the proposed models, validated the results, and contributed to the preparation of the manuscript.
Yusuf Çon assisted in reviewing the manuscript.
Kemal Gökhan Nalbant supported the research activities and assisted in reviewing the manuscript (provided guidance throughout the process and supervised the manuscript).

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself
No funding was received for conducting this study.

Conflict of Interest
The authors have no conflicts of interest to declare that are relevant to the content of this article.

A Appendix

Table 1: Results of Literature Review on Augmented Reality and Scent Therapy

Article Authors (Year)	**Dataset and Sample Numbers**	**Methods**	**Results**	**Deficiencies**	**Future Contributions**	**Platform**
BN et al. (2025) [10]	3,000 synthetic therapy dialogues, 500 cases	Prolonged Exposure based synthetic data generation	Realistic emotion transitions provided	Lack of real data	Infrastructure for clinical training and AI therapies	Synthetic dataset
Bakır et al. (2023) [11]	48 studies reviewed	Systematic review (PRISMA)	AR effective in treating anxiety	Small sample sizes	Larger sample studies recommended	Various AR platforms
Aiken (2015) [12]	Literature review	Integration of olfactory inputs into VR therapy	Olfactory inputs may be effective in treating PTSD	Integration limited	Personalized VR therapies suggested	VR platforms
Herz (2021) [13]	Literature review	Integration of olfactory inputs into VR therapy	Olfactory stimuli have potential in the treatment of PTSD	Practical application is limited	May enable personal VR therapies	VR platforms
Botella et al. (2016) [14]	63 participants (31 in vivo, 32 AR)	phobia therapy with AR	No difference between traditional and AR	Long-term effects unknown	Potential of AR should be investigated	AR headgear
Cheng et al. (2020) [15]	60 nursing home residents, 2-hour sessions per week for 9 weeks, 48 participant data	A program that included 3D VR experiences and homemade aromatherapy products	Significant improvements in psychological health indicators were observed in the experimental group ($p<.001$).	Individual effects of VR and aromatherapy are not examined separately, long-term effects (after 12 months) are not examined.	This approach offers a feasible method for supporting psychological health in nursing homes. VR-supported education can facilitate staff implementation of the program with short-term training.	VR platforms
Zulkarnain et al. (2024) [16]	60 participants, odor identification test in a virtual sensory laboratory environment.	The effect of visual representation on odor perception in a VR environment is examined.	Visual representation affects odor perception. VR can be a new methodological approach in sensory analysis.	Applicability in real-world conditions may be limited, studies with larger sample groups are recommended.	VR technology can reduce human bias in sensory analysis and provide more effective training environments.	VR platforms

Source: Created by the Authors