BÖLÜM
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SANAL GERÇEKLİK VE METAVERSE'İN ADLİ TIP VE ADLİ BİLİMLERDEKİ UYGULAMALARI

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SANAL GERÇEKLİK (VİRTUAL REALİTY) NEDİR?

Sanal gerçeklik (SG) kavramı, ilk kez 1970' li yıllarda Jaron Lenier tarafından kullanılmış ve 21. Yüzyılın (yy.) başından itibaren yaygınlaşmaya başlamıştır. Kökeni Latince de "virtualis" olan sanal gerçeklik, nesneleri çeşitli yazılım ve donanımlar sayesinde üç boyutlu dünya ile etkileşimimizi sağlayarak, katılımcılara gerçekmiş hissi veren, karşılıklı iletişim olanağı tanıyan bir simülasyondur (1-2).

En geniş tanımıyla sanal gerçeklik; bireylerin konumlarını ve eylemlerini algılayabilen, bir veya birden fazla duyuyu etkileyen, çevreleme ve bulunma hissi sağlayabilen ve giyilebilir teknolojiler aracılığı ile deneyimlenebilen üç boyutlu bilgisayar simülasyonları olarak açıklanabilmektedir (3). Sanal gerçeklik teknolojisi, bireylerin çok daha karmaşık sorunları çözmek için bilgisayarlarla doğrudan etkileşimde bulunabilecekleri bir araçtır ve sanal gerçekliğin en önemli özelliği gerçek ortamları taklit etmesidir (2).

21. yüzyıl da üç boyutlu lazer tarama, fotoğraf veya videolardan geometri yakalama gibi bilgi giriş öğeleri sayesinde sanal gerçeklik teknolojisi hızla gelişmiştir. Bu teknoloji eğitimden sağlığa, mimariden inşaat alanına, satış pazarlama ve organizasyondan eğlenceye kadar birçok alanda kullanılmaktadır. Yapılan yeni çalışmalarla da başka alanlarda da yeni yaklaşımları beraberinde getirmektedir (1).

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KAYNAKLAR

1. Şekerci, C. Sanal gerçeklik kavramının tarihçesi. Uluslararası Sosyal Araştırmalar Dergisi, 2017;54(10).
2. Bayraktar, E., Kaleli, F. Sanal gerçeklik ve uygulama alanları. Akademik Bilişim, 2007;*1*(6).
3. Geriş, A., Tunga, Y. Sanal Gerçeklik Ortamlarında Bulunma Hissi. Manisa Celal Bayar Üniversitesi Sosyal Bilimler Dergisi, 2020; *18*(4): 261-282.
4. Atsikpasi, P., Fokides, E. A scoping review of the educational uses of 6DoF HMDs. *Virtual Reality*, 2022;*26*(1): 205-222.
5. Jani, G., Johnson, A. Virtual reality and its transformation in forensic education and research practices. *Journal of Visual Communication in Medicine*, 2022; *45*(1): 18-25.
6. Tredinnick, R., Smith, S., Ponto, K. A cost-benefit analysis of 3D scanning technology for crime scene investigation. *Forensic Science International: Reports*, 2019; *1*.
7. Edl, M., Mizerák, M., Trojan, J. 3D laser scanners: History and applications. *International Scientific Journal about Simulation*, 2018; 4:1-5.
8. Vasamsetty, P., Pss, T., Kukkala, D. 3D printing in dentistry–Exploring the new horizons. *Materials Today: Proceedings*, 2020; 26: 838-841.
9. Ebrahim, M., Abdel B. 3D laser scanners techniques overview. *International Journal of Science and Research*, 2015; *4*(10): 323-331.
10. Ponto, K., Smith, S., Tredinnick, R. Methods for detecting manipulations in 3D scan data. Digital Investigation, 2019; 30: 101-107.
11. González-Jorge, H., Zancajo, S., González-Aguilera, D. Application of Kinect gaming sensor in forensic science. *Journal of forensic sciences*, 2015; *60*(1): 206-211.
12. Bailenson, J. N., Blascovich, J., Beall, A. C. Courtroom applications of virtual environments, immersive virtual environments, and collaborative virtual environments. *Law & Policy*, 2006: *28*(2); 249-270.
13. Houck, M. M., Crispino F., McAdam T. The Science Of Crime Scenes. Oxford: Academic Press; 2012.
14. Wang, J., Li, Z., Hu, W. Virtual reality and integrated crime scene scanning for immersive and heterogeneous crime scene reconstruction. *Forensic science international*, 2019; *303*.
15. Ebert, L., Flach, P., Schweitzer, W. Forensic 3D surface documentation at the Institute of Forensic Medicine in Zurich – Workflow and communication pipeline. Journal of Forensic Radiology and Imaging, 2016; 5: 1–7.
16. Ebert, L. C., Nguyen, T. T., Breitbeck, R. The forensic holodeck: an immersive display for forensic crime scene reconstructions Springer US 2014; 10: 623-626.
17. Yu, S. H., Thomson, G., Rinaldi, V. Development of a Dundee ground truth photography protocol for recording indoor crime scenes to facilitate virtual reality reconstruction. *Science & Justice*. 2023; 63(2): 238-250.
18. Ma, M., Zheng, H., Lallie, H. Virtual reality and 3D animation in forensic visualization. *Journal of forensic sciences*, 2010;*55*(5); 1227-1231.
19. Sieberth, T., Seckiner, D., Dobay, A. The forensic holodeck–Recommendations after 8 years of experience for additional equipment to document VR applications. *Forensic Science International*, 2021; *329*.
20. Sieberth, T., Dobay, A., Affolter, R. A toolbox for the rapid prototyping of crime scene reconstructions in virtual reality. *Forensic science international*, 2019; *305*.
21. Edelman, G. J., Aalders, M. C. Photogrammetry using visible, infrared, hyperspectral and thermal imaging of crime scenes. *Forensic science international*, 2018; 292: 181-189.
22. Villa C., Olsen K., Hansen S. Virtual animation of victim-specific 3D models obtained from CT scans for forensic reconstructions: Living and dead subjects, *Forensic science international*. 2017: 278; 27–33.

23. Maksymowicz, K., Tunikowski, W., Kościuk, J. Crime event 3D reconstruction based on incomplete or fragmentary evidence material–case report. *Forensic science international*, 2014: 242; 6-11.
24. Pringle, J. K. Educational egaming: the future for geoscience virtual learners?. *Geology Today*, 2014: 30(4); 147-150.
25. Pringle, J. K., Stimpson, I. G., Jeffery, A. J. eXtended Reality (XR) virtual practical and educational eGaming to provide effective immersive environments for learning and teaching in forensic science. *Science & Justice*, 2022: 62(6); 696-707.
26. Mayne, R., Green, H. Virtual reality for teaching and learning in crime scene investigation. *Science & Justice*, 2020: 60(5); 466-472.
27. Weech, S., Kenny, S., Barnett-Cowan, M. Presence and cybersickness in virtual reality are negatively related: a review. *Frontiers in psychology*, 2019: *10*; 158.
28. Gök, Ş. Adlî tıp. Ankara: Filiz kitabevi; 1962.
29. Thali, M. J., Jackowski, C., Oesterhelweg, L. VIRTOPSY–the Swiss virtual autopsy approach. *Legal Medicine*, 2007: *9*(2); 100-104.
30. Çelik M. Virstopside çok kesitli bilgisayarlı tomografinin önemi (Uzmanlık Tezi). Sivas: Cumhuriyet Üniversitesi; 2008.
31. Franklin, D., Swift, L., Flavel, A. 'Virtual anthropology'and radiographic imaging in the Forensic Medical Sciences. *Egyptian Journal of Forensic Sciences*, 2016: *6*(2); 31-43.
32. Bolliger, S. A., Thali, M. J., Ross, S. Virtual autopsy using imaging: bridging radiologic and forensic sciences. A review of the Virtopsy and similar projects. *European radiology*, 2008: 18; 273-282.
33. Kottner, S., Ebert, L. C., Ampanozi, G. VirtoScan-a mobile, low-cost photogrammetry setup for fast post-mortem 3D full-body documentations in x-ray computed tomography and autopsy suites. *Forensic science, medicine, and pathology*, 2017: 13; 34-43.
34. Timonov, P., Novakov, S., Sivkov, S. The advantage of the virtual forensic autopsy-a new approach which could benefit forensic expertise. *Journal of Forensic and Legal Medicine*, 2019: 62; 69-71.
35. Bolliger, S. A., Thali, M. J. Imaging and virtual autopsy: looking back and forward. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 2015: *370*(1674).
36. Ruder, T. D., Kraehenbuehl, M., Gotsmy, W. F. Radiologic identification of disaster victims: a simple and reliable method using CT of the paranasal sinuses. *European journal of radiology*, 2012: *81*(2); 132-138.
37. Ruder, T. D., Thali, Y., Bolliger, S. A. Material differentiation in forensic radiology with single-source dual-energy computed tomography. *Forensic science, medicine, and pathology*, 2013:*9*; 163-169.
38. Koller, S., Ebert, L.C., Martinez, R.M. Using virtual reality for forensic examinations of injuries. Forensic Science International, 2019: 295; 30–35.
39. Filograna, L., Pugliese, L., Muto, M. A practical guide to virtual autopsy: why, when and how. In *Seminars in Ultrasound, CT and MRI*, 2019 February (pp. 56-66).
40. Buck, U., Naether, S., Braun, M. Application of 3D documentation and geometric reconstruction methods in traffic accident analysis: with high resolution surface scanning, radiological MSCT/MRI scanning and real data based animation. *Forensic science international*, 2007:*170*(1); 20-28.
41. Filograna, L., Bolliger, S. A., Spendlove, D. Diagnosis of fatal pulmonary fat embolism with minimally invasive virtual autopsy and post-mortem biopsy. *Legal medicine*, 2010: 12(5); 233-237.
42. Balzli, D., Rehberg, D., Ebert, L. C. 3D multimodal teaching of human anatomy and autopsy with real human data. *Forensic Imaging*, 2022: *28*.

43. Petekkaya S. Adli otopsi eğitiminin tıp fakültesi öğrencilerinin bilgi, tutum ve duygudurumuna etkileri (Uzmanlık Tezi). İzmir: Dokuz Eylül Üniversitesi; 2012.
44. Baiker, M., Petraco, N. D., Gambino, C. Virtual and simulated striated toolmarks for forensic applications. *Forensic science international*, 2016: 261; 43-52.
45. Guarnera, L., Giudice, O., Livatino, S. Assessing forensic ballistics three-dimensionally through graphical reconstruction and immersive VR observation. *Multimedia Tools and Applications*, 2022: 1-27.
46. Altınsoy E. İz deliller, Öğünç G.İ. (Ed.) Kriminalistik içinde. Ankara: Jandarma ve Sahil Güvenlik Akademisi yayınları; 2021. p. 47-62.
47. Larsen, H., Budka, M., Bennett, M. R. Technological innovation in the recovery and analysis of 3D forensic footwear evidence: Structure from motion (SfM) photogrammetry. *Science & Justice*, 2021: 61(4), 356-368.
48. Komar, D. A., Davy-Jow, S., Decker, S. J. The use of a 3-D laser scanner to document ephemeral evidence at crime scenes and postmortem examinations. *Journal of forensic sciences*, 2012: 57(1); 188-191.
49. Kurum M., Bilgiç A., Çardak B. Metaverse ve terörizm tehdinin metamorfozu: meta-terörizm. Ankara: Jandarma ve Sahil Güvenlik Akademisi Yayınları; 2022.
50. Joshua, J. Information bodies: computational anxiety in neal Stephenson's snow crash. *Interdisciplinary Literary Studies*, 2017: *19*(1); 17-47.
51. Deng, T., Zhang, K., Shen, Z. J. M. A systematic review of a digital twin city: A new pattern of urban governance toward smart cities. *Journal of Management Science and Engineering*, 2021: *6*(2); 125-134.
52. Davis, A., Murphy, J., Owens, D. Avatars, people, and virtual worlds: Foundations for research in metaverses. *Journal of the Association for Information Systems*, 2009: *10*(2); 1.
53. Aghayev, E., Staub, L., Dirnhofer, R. Virtopsy–the concept of a centralized database in forensic medicine for analysis and comparison of radiological and autopsy data. *Journal of forensic and legal medicine*, 2008: 15(3); 135-140.
54. Chen, Y. R., Chang-Liao, Y. Q., Lin, C. Y. Forensic science education by crime scene investigation in virtual reality. In *2021 IEEE International Conference on Artificial Intelligence and Virtual Reality (AIVR),* 2021 November (pp. 205-206).
55. Dirnhofer, R., Jackowski, C., Vock, P. VIRTOPSY: minimally invasive, imaging-guided virtual autopsy. *Radiographics*, 2006: 26(5); 1305-1333.
56. Campana, L., Breitbeck, R., Bauer-Kreuz, R. 3D documentation and visualization of external injury findings by integration of simple photography in CT/MRI data sets (IprojeCT). *International journal of legal medicine*, 2016: *130*; 787-797.
57. Villa, C. Forensic 3D documentation of skin injuries. *International journal of legal medicine*, 2017: *131*(3); 751-759.
58. Re, G. L., Salerno, S., Terranova, M. C. Virtopsy and living individuals evaluation using computed tomography in forensic diagnostic imaging. In *Seminars in Ultrasound, CT and MRI,* 2019 February (pp. 67-78).