

Advancements and Application of 4D Printing in the Medical Field : A Comprehensive Review

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Abstract: 4D printing is an innovative and quickly expanding technology that combines the concepts of 3D printing with the addition of shape –shifting and self adaptable capabilities. The review paper investigates the advancement application of 4 D printing with the medical industry .we describe the fundamental concepts of 4D printing stressing its potential in the production of personalised patient –specific medical equipment tissue engineering drug delivery system and surgical tools. Additionally we evaluate the challenges and future possibility of 4D printing in healthcare.

Keywords: 4D printing

REFERENCES

- [1]. Greenberg S. 4D Printing in Healthcare. Blog.bccresearch.com. <https://blog.bccresearch.com/4d-printing-in-healthcare>. Published 2021. Accessed September 1, 2021.
- [2]. Quanjin M, Rejab M, Idris M, Kumar N, Abdullah M, Reddy G. Recent 3D and 4D intelligent printing technologies: A comparative review and future perspective. *Procedia Comput Sci*. 2020;167:1210-1219. doi:10.1016/j.procs.2020.03.434
- [3]. Bajpai A, Baigent A, Raghav S, Brádaigh C, Koutsos V, Radacsi N. 4D Printing: Materials, Technologies, and Future Applications in the Biomedical Field. *Sustainability*. 2020;12(24):10628. doi:10.3390/su122410628
- [4]. 4D printing promises biomedical applications – ASME. Asme.org. <https://www.asme.org/topics-resources/content/biotechnology-anticipates-4d-printing>. Published 2021. Accessed September 13, 2021.
- [5]. Li H, Go G, Ko S, Park J, Park S. Magnetic actuated pH-responsive hydrogel-based soft micro-robot for targeted drug delivery. *Smart Materials and Structures*. 2016;25(2):027001. doi:10.1088/0964-1726/25/2/027001
- [6]. <https://www.marketsandmarkets.com/Market-Reports/4d-printing-healthcare-market-196612645.html>. Published 2021. Accessed September 13, 2021.
- [7]. Zhang, F., Wang, L., Zheng, Z., Liu, Y., and Leng, J. (2019a). Magnetic programming of 4D printed shape memory composite structures. *Compos Part A Appl. Sci. Manuf.* 125, 105571. doi:10.1016/j.compositesa.2019.105571
- [8]. Zhang, Z., Demir, K. G., and Gu, G. X. (2019b). Developments in 4D-printing: a review on current smart materials, technologies, and applications. *Int. J. Smart Nano Mater* 10, 205–224. doi:10.1080/19475411.2019.1591541
- [9]. Zhang, Z., Wang, L., Zheng, W., Yin, L., Hu, R., and Yang, B. (2022). Endoscope image mosaic based on pyramid ORB. *Biomed. Signal Process Control* 71, 103261. doi:10.1016/j.bspc.2021.103261
- [10]. Zhao, Q., Li, C., Shum, H. C., and Du, X. (2020). Shape-adaptable biodevices for wearable and implantable applications. *Lab. Chip* 20, 4321–4341. doi:10.1039/D0LC00569J
- [11]. Zhu, W., Holmes, B., Glazer, R. I., and Zhang, L. G. (2016). 3D printed nanocomposite matrix for the study of breast cancer bone metastasis. *Nanomedicine* 12, 69–79. doi:10.1016/j.nano.2015.09.010

