

Supplementary Files

Table 1: A quick overview of the reviewed DT applications by Year, Authors, Domain, and Outcomes.

Reference	Year	Authors	Application Domain	Outcome
[1]	2023	Cappon, G. et al.	Type 1 Diabetes Management	A digital twin for pediatric diabetes, enhanced blood glucose control and reduced manual input through personalized insulin therapy
[2]	2020	Shamanna, P. et al.	Type 2 Diabetes Management	Improved glycemic control, reduced HbA1c, and minimized medication reliance through precision nutrition.
[3]	2023	Gazerani, P. et al.	Migraine Care	a virtual ally that predicts headaches, personalizes treatments recommendations, and keeps migraines in check using real-time biomarkers and biosignals
[4]	2022	Wickramasinghe, N. et al.	Dementia Care	A conceptual digital twin for dementia care: a smart companion for clinicians, matching patient cases to guide personalized care and support thoughtful treatment planning
[5]	2024	Abilkaiyrkyzy, A. et al.	Mental Health	Real-time mental health assessment and early detection of depression severity through conversational AI.
[6]	2023	Abirami, L. et al.	Parkinson's Disease Detection	A digital twin for early Parkinson's detection: a voice-based, accessible tool that spots early signs and enables tailored treatments, making proactive care possible through personalized vocal biomarker analysis
[7]	2023	Sarp, S. et al.	Chronic Wound Management	A digital twin for chronic wounds: a smart system that predicts healing and tailors treatment, making wound care proactive and personalized through real-time visualizations and data driven insights
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Table 1: Summary of Digital Twin Applications in Healthcare
(continued)

Ref.	Year	Authors	Application Domain	Results/Outcome
[8]	2024	Avanzato, R. et al.	Lung Health	Lung-DT: a digital twin for respiratory health that diagnoses lung diseases in real time, blending chest X-rays and sensor data for timely, precise, and remote lung care
[9]	2023	Kolekar, M. et al.	Precision Medicine (Lung Cancer)	Comp-Med: a platform for lung cancer survival prediction and tumor segmentation, supporting personalized treatment plans
[10]	2023	De Benedictis, A. et al.	Control Social Distancing	CanTwin: a digital twin for smart crowd control, ensuring social distancing and safe space management in busy industrial canteens through real-time monitoring and predictive insights
[11]	2024	Kumi, S. et al.	Stress Management	DTSM: Predictive stress monitoring and management using synthetic data from wearable devices
[12]	2024	Wang, Y. et al.	Clinical Trials	TWIN-GPT: a clinical trial digital twin that uses large language models to predict patient outcomes
[13]	2024	Makarov, N. et al.	Patient Health Forecasting	DT-GPT: a fine-tuned LLM model for patient health outcome prediction
[14]	2023	Moore, J. et al.	Oncology	ynTwin: a privacy-focused digital twin framework for accurate oncology mortality predictions using synthetic patient data
[15]	2023	Rouhollahi, A. et al.	Cardiac Care	CardioVision: a digital twin tool that brings precision to aortic stenosis surgery, making complex heart procedures personalized, faster, and more reliable
[16]	2024	Lwin, T.C. et al.	Fetal Heart Monitoring	A digital twin for fetal hearts: proactive prenatal monitoring that predicts and prevents complications, keeping an early pulse on newborn well-being
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(continued)

Ref.	Year	Authors	Application Domain	Results/Outcome
[17]	2023	Dervisoglu, H. et al.	Cardiovascular Disease Monitoring	Digital twins to monitor heart health in real time, with edge systems leading in speed and cloud frameworks scaling up for broader patient reach

References

- [1] Cappon, G., Pellizzari, E., Cossu, L., Sparacino, G., Deodati, A., Schiaffini, R., Cianfarani, S., Facchinetti, A.: System architecture of twin: A new digital twin-based clinical decision support system for type 1 diabetes management in children. In: 2023 IEEE 19th International Conference on Body Sensor Networks (BSN), pp. 1–4 (2023). IEEE
- [2] Shamanna, P., Saboo, B., Damodharan, S., Mohammed, J., Mohamed, M., Poon, T., Kleinman, N., Thajudeen, M.: Reducing hba1c in type 2 diabetes using digital twin technology-enabled precision nutrition: a retrospective analysis. *Diabetes Therapy* **11**, 2703–2714 (2020)
- [3] Gazerani, P.: Intelligent digital twins for personalized migraine care. *Journal of Personalized Medicine* **13**(8), 1255 (2023)
- [4] Wickramasinghe, N., Ulapane, N., Andargoli, A., Ossai, C., Shuakat, N., Nguyen, T., Zelcer, J.: Digital twins to enable better precision and personalized dementia care. *JAMIA open* **5**(3), 072 (2022)
- [5] Abilkaiyrkyzy, A., Laamarti, F., Hamdi, M., El Saddik, A.: Dialogue system for early mental illness detection: towards a digital twin solution. *IEEE Access* (2024)
- [6] Abirami, L., Karthikeyan, J.: Digital twin based healthcare system (dths) for earlier parkinson disease identification and diagnosis using optimized fuzzy based k-nearest neighbor classifier model. *IEEE Access* (2023)
- [7] Sarp, S., Kuzlu, M., Zhao, Y., Gueler, O.: Digital twin in healthcare: a study for chronic wound management. *IEEE Journal of Biomedical and Health Informatics* (2023)
- [8] Avanzato, R., Beritelli, F., Lombardo, A., Ricci, C.: Lung-dt: an ai-powered digital twin framework for thoracic health monitoring and diagnosis. *Sensors* **24**(3), 958 (2024)
- [9] Kolekar, S.S., Chen, H., Kim, K.: Design of precision medicine web-service platform towards health care digital twin. In: 2023 Fourteenth International Conference on Ubiquitous and Future Networks (ICUFN), pp. 843–848 (2023). IEEE
- [10] De Benedictis, A., Mazzocca, N., Somma, A., Strigaro, C.: Digital twins in healthcare: an architectural proposal and its application in a social distancing case study. *IEEE Journal of Biomedical and Health Informatics* **27**(10), 5143–5154 (2022)
- [11] Kumi, S., Ray, M., Walia, S., Lomotey, R.K., Deters, R.: Digital twins for stress management utilizing synthetic data. In: 2024 IEEE World AI IoT Congress (AIIoT), pp. 329–335 (2024). IEEE
- [12] Wang, Y., Fu, T., Xu, Y., Ma, Z., Xu, H., Du, B., Lu, Y., Gao, H., Wu, J., Chen, J.: Twin-gpt: Digital twins for clinical trials via large language model. *ACM Transactions on Multimedia Computing, Communications and Applications* (2024)

- [13] Makarov, N., Bordukova, M., Rodriguez-Esteban, R., Schmich, F., Menden, M.P.: Large language models forecast patient health trajectories enabling digital twins. *medRxiv*, 2024–07 (2024)
- [14] Moore, J.H., Li, X., Chang, J.-H., Tatonetti, N.P., Theodorescu, D., Chen, Y., Asselbergs, F.W., Venkatesan, M., Wang, Z.P.: Syntwin: A graph-based approach for predicting clinical outcomes using digital twins derived from synthetic patients. In: *PACIFIC SYMPOSIUM ON BIOCOMPUTING 2024*, pp. 96–107 (2023). World Scientific
- [15] Rouhollahi, A., Willi, J.N., Haltmeier, S., Mehrtash, A., Straughan, R., Javadikasgari, H., Brown, J., Itoh, A., Cruz, K.I., Aikawa, E., *et al.*: Cardiovision: a fully automated deep learning package for medical image segmentation and reconstruction generating digital twins for patients with aortic stenosis. *Computerized Medical Imaging and Graphics* **109**, 102289 (2023)
- [16] Lwin, T.C., Zin, T.T., Tin, P., Ikenoue, T., Kino, E.: Enhancing fetal heart rate monitoring through digital twin technology. In: *2024 IEEE Gaming, Entertainment, and Media Conference (GEM)*, pp. 1–4 (2024). IEEE
- [17] Dervisoglu, H., Ülver, B., Yurtoglu, R.A., Halepmollasi, R., Haklidir, M.: A comparative study on cloud-based and edge-based digital twin frameworks for prediction of cardiovascular disease. In: *ICT4AWE*, pp. 159–169 (2023)