Academy of Romanian Scientists
Annals Series on Biological Sciences

Volume 14, No. 2, 2025, pp. 47-51
Online ISSN 2285 – 4177
ORIGINAL PAPERS

AN EDITORIAL VIEW ON THE TECHNOLOGICAL ADVANCEMENT IN SCIENTIFIC RESEARCH: FROM THE MEDICAL FIELD TO CITIZEN SCIENCE FOR BIODIVERSITY MONITORING

Mădălina Borcă[1], Alin Ciobîcă[2,3,4,5]*,
Ioannis Mavroudis[4,6], Manuela Padurariu[7]

[1]University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania

[2]Center of Biomedical Research, Romanian Academy, Iasi Branch, B dul Carol I, no. 8, 700506 Iasi, Romania

[3]Department of Biology, Faculty of Biology, Alexandru Ioan Cuza University, B dul Carol I, no 11, 700506 Iasi, Romania

[4] Academy of Romanian Scientists, 3, Ilfov Street, 050045 Bucharest, Romania

[5]Preclinical Department, Apollonia University, Păcurari Street 11, 700511 Iasi, Romania

[6]Department of Neurology, Leeds Teaching Hospitals NHS Trust, Leeds LS2 9JT, UK

[7]"Socola" Institute of Psychiatry, Șoseaua Bucium 36, 700282 Iasi, Romania

*Corresponding author e-mail: alin.ciobica@uaic.ro

Abstract. *The acceleration of technological progress has dominated many areas of research, favoring the discovery of novel methods of diagnosis and treatment in the medical field, as well as in the monitoring of biodiversity or invasive species. In this sense, interdisciplinary research based on advanced technology has gained traction and is now a tool for describing new research horizons, both in medicine and in general citizen science. Patients benefit from personalized treatments, and current technology improves the doctor-patient relationship. At the same time, monitoring urban biodiversity, reporting and recognizing invasive species, and using GIS techniques to monitor species and habitats have resulted in better management of them. Artificial intelligence, virtual reality, and advanced GIS techniques have resulted in improved problem management in the medical field as well as biodiversity monitoring and conservation, causing these fields to evolve in response to the population's current needs.*

Keywords: technology advancement, medical research, biodiversity monitoring apps, citizen science, virtual reality.

DOI 10.56082/annalsarscibio.2025.2.47

Introduction

In recent decades, there has been a growing interest in integrating technology into various scientific research fields, such as medical research; at the same time, this integration has resulted in the expansion of biodiversity monitoring and conservation in a variety of habitats, including urban areas. Thus, modern

technologies make it more efficient to collect data from the field while also transmitting the collected information [1].

Simultaneously, in the field of medical research, new technologies based on artificial intelligence facilitate diagnosis and personalization of treatment according to the patient's needs [2].
The current article is a synthesis of new medical and citizen science technologies that enrich databases with species and facilitate biodiversity monitoring. Figure 1 depicts the major modern technologies used in the medical field and biodiversity monitoring.

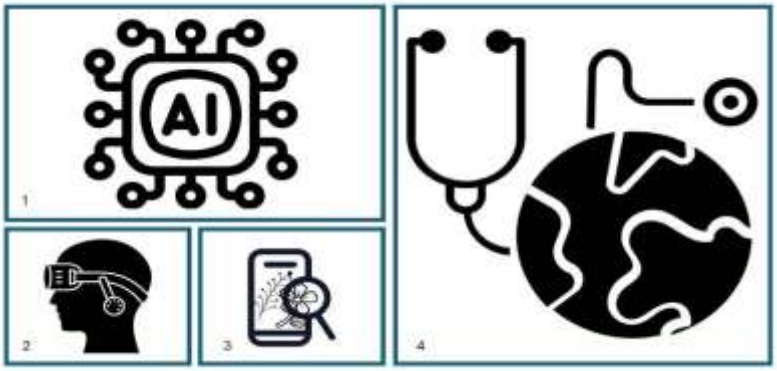

Figure 1. Schematic representation of the tools that contribute to the evolution of the medical field and the evolution of biodiversity monitoring. 1. Artificial Intelligence, 2. Virtual reality, 3. Smartphone apps for biodiversity monitoring, and 4, Global health- which includes ecosystem and human health.

Technological advancements in medicine

In the field of medical research, technological advancements have resulted in the incorporation of virtual reality technology into the treatment of neuropsychiatric conditions [3] and traumatic brain injury [4], while virtual reality technology is widely used to relax patients who are anxious about medical procedures.

A specialized search engine has been developed to aid in the diagnosis of rare pathologies [5].

The use of artificial intelligence in medical research includes the analysis of images of skin conditions using a convolutional neural network and images of pigmented skin lesions to aid in the diagnosis of malignant and benign tumors [6].

Artificial intelligence is being used in medical research in three different areas: medical image analysis, omics analysis, and natural language processing [7], to improve diagnosis, treatment, and promote personalized medicine.

According to recent research, artificial intelligence can transform current diagnostic medical practices, resulting in improved medical screening performance [8]. The challenges associated with the use of artificial intelligence are presented to highlight the importance of healthcare practices supported by current technologies, as well as the need for patients worldwide to have access to these modern healthcare practices [9].

Technological advances in biodiversity monitoring

Multiple methods of assessment, awareness, and conservation have been developed over time for monitoring urban biodiversity, based on cutting-edge technologies that highlight the importance of monitoring in urban areas. Whether we are discussing invertebrate, plant, or bird species, it is important to note that non-specialized populations are increasingly monitoring them [10,11,12,13,14,15]. At the same time, there are applications that track invasive plant species, which spread quickly and compete for ecological niches with native species [16,17].

Also, GIS techniques make it easier to monitor habitats and population dynamics while also helping to conserve biodiversity in protected areas [18,19,20].

Future perspective and conclusions

Current research in biodiversity conservation and monitoring emphasizes the importance of utilizing cutting-edge technology in the context of the global biodiversity crisis and the mass extinction of many species valuable to the ecosystems to which they belong. In this sense, artificial intelligence helps to evolve wildlife monitoring, fill gaps in species ecology, and build species distribution models and phylogenetic trees [21]. In the era of robotics, there are studies that present the opportunities but also the barriers that robots implemented in the precision monitoring of species in all types of ecosystems on Earth, as well as the need to constantly interconnect specialists in biodiversity conservation with those in technology [22].

In terms of the evolution of the medical field with the implementation of technology, new possibilities for diagnosis and treatment have emerged, based on the personalization of the medical act to the patient's needs. Thus, precision medicine has gained momentum through artificial intelligence providing support in clinical decisions, optimizing drug doses, and virtual healthcare providing support in maintaining mental health using virtual reality technology [23].

As a result, an interdisciplinary approach is required, bringing together technology experts and those working in medicine and biodiversity conservation to ensure

that current technological advancements reach their full potential and facilitate the evolution of the research areas we have previously discussed.

R E F E R E N C E S

[1]. Newman, G., Wiggins, A., Crall, A., Graham, E., Newman, S., Crowston, K., 2012. The future of citizen science: emerging technologies and shifting paradigms. Frontiers in Ecology and the Environment 10, 298–304. https://doi.org/10.1890/110294

[2]. Chaurasia, A., Vats, S., Sengupta, A., Bansal, A., Narad, P., 2021. Practical Applications of Artificial Intelligence for Disease Prognosis and Management, in: Saxena, A., Chandra, S. (Eds.), Artificial Intelligence and Machine Learning in Healthcare. Springer, Singapore, pp. 1–36. https://doi.org/10.1007/978-981-16-0811-7_1

[3]. Bell, I., Pot-Kolder, R., Rizzo, A., Rus-Calafell, M., Cardi, V., Cella, M., Ward, T., Riches, S., Thompson, A., Alvarez-Jimenez, M., Valmaggia, L., 2024. Advances in the use of virtual reality to treat mental health conditions. Nature Reviews Psychology 3. https://doi.org/10.1038/s44159-024-00334-9

[4]. Demeco, A., Zola, L., Frizziero, A., Martini, C., Palumbo, A., Foresti, R., Buccino, G., Costantino, C., 2023. Immersive Virtual Reality in Post-Stroke Rehabilitation: A Systematic Review. Sensors 23, 1712. https://doi.org/10.3390/s23031712

[5]. Dragusin, R., Petcu, P., Lioma, C., Larsen, B., Jørgensen, H.L., Cox, I.J., Hansen, L.K., Ingwersen, P., Winther, O., 2013. FindZebra: a search engine for rare diseases. Int J Med Inform 82, 528–538. https://doi.org/10.1016/j.ijmedinf.2013.01.005

[6]. Jinnai, S., Yamazaki, N., Hirano, Y., Sugawara, Y., Ohe, Y., Hamamoto, R., 2020. The Development of a Skin Cancer Classification System for Pigmented Skin Lesions Using Deep Learning. Biomolecules 10, 1123. https://doi.org/10.3390/biom10081123

[7]. Hamamoto, R., 2021. Application of Artificial Intelligence for Medical Research. Biomolecules 11, 90. https://doi.org/10.3390/biom11010090

[8]. Fahrner, L.J., Chen, E., Topol, E., Rajpurkar, P., 2025. The generative era of medical AI. Cell 188, 3648–3660. https://doi.org/10.1016/j.cell.2025.05.018

[9]. Rajpurkar, P., Chen, E., Banerjee, O., Topol, E.J., 2022. AI in health and medicine. Nat Med 28, 31–38. https://doi.org/10.1038/s41591-021-01614-0

[10]. European ladybird home page | European ladybirds [WWW Document], n.d. URL https://european-ladybirds.brc.ac.uk/ (accessed 10.15.25).

[11]. Record Butterflies | Butterfly Conservation [WWW Document], n.d. URL https://butterfly-conservation.org/our-work/recording-and-monitoring/irecord-butterflies (accessed 10.15.25).

[12]. Record Grasshoppers | Biological Records Centre [WWW Document], n.d. URL https://www.brc.ac.uk/app/irecord-grasshoppers (accessed 10.15.25).

[13]. Home | FIT Count [WWW Document], n.d. URL https://fitcount.ceh.ac.uk/ (accessed 10.15.25).

[14]. iMammalia App | Biological Records Centre [WWW Document], n.d. URL https://www.brc.ac.uk/app/imammalia-app (accessed 10.15.25).

[15]. iNaturalist [WWW Document], n.d. Naturalist. URL https://www.inaturalist.org/ (accessed 10.15.25).

[16]. Flora Incognita | EN – The Flora Incognita app – Interactive plant species identification [WWW Document], n.d. URL https://floraincognita.com/ (accessed 10.15.25).

[17]. EDDMapS Apps - EDDMapS [WWW Document], n.d. EDDMapS.org. URL https://www.eddmaps.org/apps.cfm (accessed 10.15.25).

[18]. Calka, B., Szostak, M., 2025. GIS-Based Environmental Monitoring and Analysis. Applied Sciences 15, 3155. https://doi.org/10.3390/app15063155

[19]. (PDF) Wetland shift monitoring using remote sensing and GIS techniques: Landscape dynamics and its implications on Isimangaliso Wetland Park, South Africa [WWW Document], 2018. . ResearchGate. URL https://www.researchgate.net/publication/334959332_Wetland_shift_monitoring_using_remote_sensing_and_GIS_techniques_Landscape_dynamics_and_its_implications_on_Isimangaliso_Wetland_Park_South_Africa (accessed 10.15.25).

[20]. Hwang, S.-O., Han, B.-H., Kim, H.-G., Kim, B.-H., 2025. Next-Generation River Health Monitoring: Integrating AI, GIS, and eDNA for Real-Time and Biodiversity-Driven Assessment. Hydrobiology 4, 19. https://doi.org/10.3390/hydrobiology4030019

[21]. Pollock, L.J., Kitzes, J., Beery, S., Gaynor, K.M., Jarzyna, M.A., Mac Aodha, O., Meyer, B., Rolnick, D., Taylor, G.W., Tuia, D., Berger-Wolf, T., 2025. Harnessing artificial intelligence to fill global shortfalls in biodiversity knowledge. Nat. Rev. Biodivers. 1, 166–182. https://doi.org/10.1038/s44358-025-00022-3

[22]. Pringle, S., Dallimer, M., Goddard, M.A. *et al.* Opportunities and challenges for monitoring terrestrial biodiversity in the robotics age. *Nat Ecol Evol* 9, 1031–1042 (2025). https://doi.org/10.1038/s41559-025-02704-9

[23]. Alowais, S.A., Alghamdi, S.S., Alsuhebany, N. *et al.* Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC Med Educ* 23, 689 (2023). https://doi.org/10.1186/s12909-023-04698-z