Natural Language Processing in Biomedical Research

Swagatika Khot*

Department of Information Medicine, Asan Medical Center and University of Ulsan College of Medicine, South Korea

Correspondence to:

Swagatika Khot
Department of Information Medicine,
Asan Medical Center and University of Ulsan College of Medicine,
South Korea
Email: khotswaga@unibe.ch

Citation: Khot S (2024). Natural Language Processing in Biomedical Research. EJBI. 20(3): 266-267.

DOI: 10.24105/ejbi.2024.20.4.266-267

Received: 01-Aug-2024, Manuscript No.ejbi-24-143176;
Editor assigned: 03-Aug -2024, Pre QC No. ejbi-24-143176 (PQ);
Reviewed: 17-Aug -2024, QC No. ejbi-24-143176;
Revised: 19-Aug 2024, Manuscript No. ejbi-24-143176 (R);
Published: 26-Aug -2024

1. Introduction

Natural Language Processing (NLP), a branch of artificial intelligence (AI) focused on the interaction between computers and human language, has significantly impacted biomedical research. By enabling the analysis and interpretation of vast amounts of unstructured textual data, NLP has facilitated advancements in various biomedical fields, including genomics, clinical research, and drug discovery. This article explores the role of NLP in biomedical research, highlighting key advancements, applications, and future directions [1].

The role of NLP in biomedical research

Biomedical research generates an immense amount of textual data, including scientific literature, clinical notes, patient records, and social media posts. NLP techniques are essential for extracting meaningful information from these unstructured texts, enabling researchers to identify patterns, generate hypotheses, and gain new insights [2].

Named Entity Recognition (NER) is a crucial NLP technique that identifies and classifies entities such as genes, proteins, diseases, and drugs within text. Tools like BioBERT and SciSpacy have been specifically trained on biomedical corpora, improving the accuracy of entity recognition in biomedical texts. NLP techniques are used to mine biomedical literature for relevant information. Systems like PubMed and LitCovid leverage NLP to retrieve and organize research articles based on user queries, aiding researchers in staying updated with the latest findings [3, 4].

Semantic analysis helps in understanding the meaning and context of words and phrases in biomedical texts. Ontologies and controlled vocabularies, such as the Unified Medical Language System (UMLS), enhance semantic analysis by providing structured representations of biomedical knowledge. Relation extraction identifies relationships between entities within text, such as drug-disease interactions or gene-protein associations. This technique is essential for constructing biomedical knowledge graphs and databases, facilitating integrative research. Natural Language Understanding (NLU) involves comprehending and interpreting the intent behind text. In biomedical research, NLU is used to analyze patient feedback, clinical notes, and health records, providing insights into patient outcomes and treatment efficacy [5, 6].

Applications of NLP in biomedical research

NLP tools are instrumental in analyzing genomic literature and databases. By extracting information about gene-disease associations, genetic mutations, and therapeutic targets, NLP aids in the development of personalized medicine approaches. For instance, NLP can help identify relevant genetic variants from scientific literature, supporting precision oncology efforts. NLP streamlines the process of identifying suitable candidates for clinical trials by analyzing electronic health records (EHRs) and patient data. By extracting relevant patient information, such as medical history, comorbidities, and treatment responses, NLP enhances patient recruitment and trial design [7].

In drug discovery, NLP facilitates the identification of potential drug targets, mechanisms of action, and adverse effects by mining biomedical literature and databases. NLP-based text mining tools can identify novel drug repurposing opportunities, accelerating the drug development process. NLP techniques are used to extract structured information from EHRs, transforming unstructured clinical notes into actionable data. This enables better patient management, decision support, and outcome prediction. For example, NLP can identify patients at risk of adverse events or readmissions, allowing for timely interventions. NLP plays a vital role in monitoring public health trends and disease outbreaks by analyzing social media, news articles, and health records. During the COVID-19 pandemic, NLP tools were used to track the spread of the virus, identify symptoms, and understand public sentiment, aiding in the public health response [8].

The use of NLP in biomedical research raises significant data privacy and security concerns. Protecting patient information while ensuring data accessibility for research purposes is a major challenge. Developing robust encryption methods and adhering to data protection regulations are crucial steps in addressing these concerns. Integrating NLP tools across different biomedical databases and systems requires interoperability and

standardization. Establishing common data formats, ontologies, and APIs can facilitate seamless data exchange and integration, enhancing the utility of NLP in biomedical research.

Enhancing accuracy and contextual understanding

Improving the accuracy of NLP models in understanding complex biomedical terminology and context remains a challenge. Advancements in deep learning and transfer learning, such as the development of domain-specific models like BioBERT, are promising steps towards enhancing the contextual understanding of biomedical texts. Processing large volumes of biomedical text requires significant computational resources. Developing scalable NLP solutions that can efficiently handle big data is essential for widespread adoption in biomedical research. Cloud-based platforms and distributed computing frameworks can help address these scalability challenges [9, 10].

2. Conclusion

NLP has emerged as a transformative tool in biomedical research, enabling the analysis and interpretation of vast amounts of unstructured textual data. From genomics and personalized medicine to drug discovery and public health, NLP techniques have significantly advanced our understanding of biomedical knowledge and improved patient care. Despite the challenges related to data privacy, interoperability, and computational resources, ongoing advancements in NLP hold great promise for the future of biomedical research. By addressing these challenges and leveraging the full potential of NLP, we can continue to drive innovation and improve health outcomes.

3. References

1. Kawaguchi A, Sharafeldin N, Sundaram A, Campbell S, Tennant M, et al. Tele-ophthalmology for age-related macular degeneration and diabetic retinopathy screening: a systematic review and meta-analysis. Telemed J E Health. 2018;24:301–8.
2. Ribeiro AG, Rodrigues RA, Guerreiro AM, Regatieri CV. A teleophthalmology system for the diagnosis of ocular urgency in remote areas of Brazil. Arq Bras Oftalmol. 2014;77:214–8.
3. Host BK, Turner AW, Muir J. Real-time teleophthalmology video consultation: an analysis of patient satisfaction in rural Western Australia. Clin Exp Optom. 2018;101:129–34.
4. Valpuesta Martin Y, Pacheco Callirgos GE, Maroto Martin TM, Piriz Veloso M, Hernandez Santamaria S, et al. Satisfaction of patients and primary care professionals with a teleophthalmology-based screening programme for diabetic retinopathy in a rural area in Castilla y Leon, Spain. Rural Remote Health. 2020;20:5180.
5. Ramchandran RS, Yilmaz S, Greaux E, Dozier A. Patient perceived value of teleophthalmology in an urban, low income US population with diabetes. PLoS One. 2020;15:e0225300–e.
6. Nankivil D, Gonzalez A, Rowaan C, Lee W, Aguilar MC, Parel J-MA. Robotic remote controlled stereo slit lamp. Transl Vis Sci Technol. 2018;7:1.
7. Caffery LJ, Farjian M, Smith AC. Telehealth interventions for reducing waiting lists and waiting times for specialist outpatient services: a scoping review. J Telemed telecare. 2016;22:504–12.
8. Saleem SM, Pasquale LR, Sidoti PA, Tsai JC. Virtual ophthalmology: telemedicine in a COVID-19 Era. Am J Ophthalmol. 2020;216:237–42.
9. Nair AG, Gandhi RA, Natarajan S. Effect of COVID-19 related lockdown on ophthalmic practice and patient care in India: results of a survey. Indian J Ophthalmol. 2020;68:725–30.
10. Moss HE, Lai KE, Ko MW. Survey of telehealth adoption by neuro-ophthalmologists during the COVID-19 pandemic: benefits, barriers, and utility. J Neuroophthalmol. 2020;40:346–55.