

NANOBIOMEDICINE

FUNDAMENTALS AND IMPLEMENTATION IN THERANOSTIC APPLICATIONS

Editors:

Soumik Podder

Amallesh Samanta

Bentham Books

Nanobiomedicine: Fundamentals and Implementation in Theranostic Applications

Edited by

Soumik Podder

*Department of Basic Science & Humanities
Institute of Engineering & Management, New Town
University of Engineering & Management
Kolkata, India*

&

Amalesh Samanta

*Division of Microbiology & Pharmaceutical Biotechnology
Department of Pharmaceutical Technology
Jadavpur University
Kolkata, India*

Nanobiomedicine: Fundamentals and Implementation in Theranostic Applications

Editors: Soumik Podder & Amalesh Samanta

ISBN (Online): 979-8-89881-312-3

ISBN (Print): 979-8-89881-313-0

ISBN (Paperback): 979-8-89881-314-7

© 2025, Bentham Books imprint.

Published by Bentham Science Publishers Pte. Ltd. Singapore, in collaboration with Eureka Conferences, USA. All Rights Reserved.

First published in 2025.

BENTHAM SCIENCE PUBLISHERS LTD.

End User License Agreement (for non-institutional, personal use)

This is an agreement between you and Bentham Science Publishers Ltd. Please read this License Agreement carefully before using the ebook/echapter/ejournal ("**Work**"). Your use of the Work constitutes your agreement to the terms and conditions set forth in this License Agreement. If you do not agree to these terms and conditions then you should not use the Work.

Bentham Science Publishers agrees to grant you a non-exclusive, non-transferable limited license to use the Work subject to and in accordance with the following terms and conditions. This License Agreement is for non-library, personal use only. For a library / institutional / multi user license in respect of the Work, please contact: permission@benthamscience.org.

Usage Rules

1. All rights reserved: The Work is the subject of copyright and Bentham Science Publishers either owns the Work (and the copyright in it) or is licensed to distribute the Work. You shall not copy, reproduce, modify, remove, delete, augment, add to, publish, transmit, sell, resell, create derivative works from, or in any way exploit the Work or make the Work available for others to do any of the same, in any form or by any means, in whole or in part, in each case without the prior written permission of Bentham Science Publishers, unless stated otherwise in this License Agreement.
2. You may download a copy of the Work on one occasion to one personal computer (including tablet, laptop, desktop, or other such devices). You may make one back-up copy of the Work to avoid losing it.
3. The unauthorised use or distribution of copyrighted or other proprietary content is illegal and could subject you to liability for substantial money damages. You will be liable for any damage resulting from your misuse of the Work or any violation of this License Agreement, including any infringement by you of copyrights or proprietary rights.

Disclaimer

Bentham Science Publishers does not guarantee that the information in the Work is error-free, or warrant that it will meet your requirements or that access to the Work will be uninterrupted or error-free. The Work is provided "as is" without warranty of any kind, either express or implied or statutory, including, without limitation, implied warranties of merchantability and fitness for a particular purpose. The entire risk as to the results and performance of the Work is assumed by you. No responsibility is assumed by Bentham Science Publishers, its staff, editors and/or authors for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products instruction, advertisements or ideas contained in the Work.

Limitation of Liability

In no event will Bentham Science Publishers, its staff, editors and/or authors, be liable for any damages, including, without limitation, special, incidental and/or consequential damages and/or damages for lost data and/or profits arising out of (whether directly or indirectly) the use or inability to use the Work. The entire liability of Bentham Science Publishers shall be limited to the amount actually paid by you for the Work.

General

1. Any dispute or claim arising out of or in connection with this License Agreement or the Work (including non-contractual disputes or claims) will be governed by and construed in accordance with the laws of Singapore. Each party agrees that the courts of the state of Singapore shall have exclusive jurisdiction to settle any dispute or claim arising out of or in connection with this License Agreement or the Work (including non-contractual disputes or claims).
2. Your rights under this License Agreement will automatically terminate without notice and without the

need for a court order if at any point you breach any terms of this License Agreement. In no event will any delay or failure by Bentham Science Publishers in enforcing your compliance with this License Agreement constitute a waiver of any of its rights.

3. You acknowledge that you have read this License Agreement, and agree to be bound by its terms and conditions. To the extent that any other terms and conditions presented on any website of Bentham Science Publishers conflict with, or are inconsistent with, the terms and conditions set out in this License Agreement, you acknowledge that the terms and conditions set out in this License Agreement shall prevail.

Bentham Science Publishers Pte. Ltd.

No. 9 Raffles Place

Office No. 26-01

Singapore 048619

Singapore

Email: subscriptions@benthamscience.net



Active Targeting and Challenges	91
An Immune Barrier due to Protein Corona	93
Passive Targeting Vs. Active Targeting	94
Design Parameters for Developing Actively Targeted Nanomedicine	94
Stimuli-Responsive Controlled Switch Nanomedicines	95
Integration of Multimodal Theranostics	97
VARIOUS NANOMEDICINES FOR CANCER CLINICAL CARE	97
Inorganic Nanoparticles for Cancer Theranostics	98
<i>Upconversion Nanoparticles</i>	100
<i>Plasmonic Nanoparticles</i>	102
<i>Magnetic Nanoparticles</i>	104
<i>Mesoporous Silica Nanoparticles</i>	106
Other Inorganic Nanoparticles	107
<i>Calcium Phosphate (CaP)</i>	107
<i>Quantum dots (QDs)</i>	108
<i>Prussian Blue Nanoparticles</i>	108
Organic Nanoparticle in Cancer Theranostics	111
<i>Lipid-Based Nanocarriers</i>	113
<i>Liposomes</i>	113
<i>Solid- Lipid Nanoparticles (SLNs)</i>	114
<i>Nanostructured Lipid Carriers (NLCs)</i>	115
<i>Polymeric Nanoparticles</i>	116
<i>Carbon Nanomaterials</i>	118
PROSPECTS AND CHALLENGES OF NANOMEDICINE IN CANCER TREATMENT	118
Prospects	118
Challenges	119
CONCLUSION	120
REFERENCES	120
CHAPTER 6 AN EFFICIENT MACHINE LEARNING-BASED APPROACH TO DETECT THE ALZHEIMER'S DISEASE	136
<i>Suparna Biswas, Moloy Dhar, Soumik Podder and Suparna Karmakar</i>	
INTRODUCTION	136
LITERATURE REVIEW	139
PROPOSED METHOD	141
EXPERIMENTAL RESULTS AND DISCUSSION	142
CONCLUSION	144
REFERENCES	144
CHAPTER 7 ARTIFICIAL INTELLIGENCE IN DRUG DELIVERY: AN ALTERNATIVE APPROACH TO TRADITIONAL NANO-THERANOSTIC SYSTEMS	147
<i>Shreeja Sinha, Sucharita Bhattacharyya, Sayani Konar and Soumik Podder</i>	
INTRODUCTION	148
Drug	148
On the Basis of Administration [5]	149
On the Basis of Function [6]	150
Drug Delivery	150
Toxicity Profile of a Drug [8]	152
Artificial Intelligence in Drug Delivery	153
AI Technologies for Customized Access [16]	156
Datasets	158
Design of an AI Bot Providing Enhanced Medications	162

An Efficient Machine Learning-based Approach to Detect the Alzheimer's Disease

Suparna Biswas^{1,*}, Moloy Dhar¹, Soumik Podder² and Suparna Karmakar¹

¹ *Guru Nanak Institute of Technology, Panihati, West Bengal, India*

² *Department of Basic Science & Humanities, Institute of Engineering and Management, New Town, University of Engineering & Management, Kolkata, India*

Abstract: The primary reason behind dementia, which is distinguished by a decrease in cognition, freedom within everyday tasks, is Alzheimer's Disease (AD), a disorder that causes brain cells to deteriorate. AD is addressed as a complex illness, with the cholinergic and amyloid hypotheses proposed as two primary theories underlying its pathology.. Additionally, a number of risk factors, such as aging, genetics, head trauma, vascular disease, pollution, as well as environmental elements, all participate in the illness. In this chapter, we have presented machine learning-based automatic identification of Alzheimer's Disease (AD). As features, Socioeconomic Status, Mini-Mental State Examination, Estimated total intracranial volume, Normalized whole-brain volume, and the Clinical Dementia Rating have been used. For classification, the KNN classifier has been used with different distance metrics and by varying the number of K-values. Here are mainly three types of distance metrics: Euclidean distance, Manhattan distance, and Minkowski distance, among others, to compute the performance measures of Accuracy, Recall, Precision, and F1-values.

Keywords: Alzheimer's disease, Accuracy, F1-values, Euclidean distance, KNN classifier, Machine learning, Manhattan distance, minkowski distance, Precision, Recall.

INTRODUCTION

A considerable reduction in cognitive function that affects an individual's capacity to carry out daily tasks is referred to as dementia. More than two-thirds of dementia cases in those 65 years of age and older are caused by AD, a neurological illness that gradually impairs both mental and behavioral abilities. Recall, understanding, language, focus, logic, and verdict are some of these abilities. Although AA does not directly cause mortality, it does significantly

* **Corresponding author Suparna Biswas:** Guru Nanak Institute of Technology, Panihati, West Bengal, India;
E-mail: suparna.biswas@gnit.ac.in

- [23] Tabaton M, Piccini A. Role of water-soluble amyloid- β in the pathogenesis of Alzheimer's disease. *Int J Exp Pathol* 2005; 86(3): 139-45.
[<http://dx.doi.org/10.1111/j.0959-9673.2005.00428.x>] [PMID: 15910548]
- [24] Available from: <https://www.kaggle.com/datasets/brsdincer/alzheimer-features>