

ADVANCES IN LEARNING ANALYTICS FOR INTELLIGENT CLOUD-IOT SYSTEMS

# INTERNET OF MEDICAL THINGS (IOMT)

## HEALTHCARE TRANSFORMATION

*Edited By*

**R. J. HEMALATHA**

**D. AKILA**

**D. BALAGANESH**

**ANAND PAUL**



Scrivener  
Publishing



**WILEY**

# The Internet of Medical Things (IoMT)

**Scrivener Publishing**  
100 Cummings Center, Suite 541J  
Beverly, MA 01915-6106

## **Advances in Learning Analytics for Intelligent Cloud-IoT Systems**

**Series Editors: Dr. Souvik Pal and Dr. Dac-Nhuong Le**

**Scope:** The role of adaptation, learning analytics, computational Intelligence, and data analytics in the field of Cloud-IoT Systems is becoming increasingly essential and intertwined. The capability of an intelligent system depends on various self-decision making algorithms in IoT Devices. IoT based smart systems generate a large amount of data (big data) that cannot be processed by traditional data processing algorithms and applications. Hence, this book series involves different computational methods incorporated within the system with the help of Analytics Reasoning and Sense-making in Big Data, which is centered in the Cloud and IoT-enabled environments.

The series seeks volumes that are empirical studies, theoretical and numerical analysis, and novel research findings. The series encourages cross-fertilization of highlighting research and knowledge of Data Analytics, Machine Learning, Data Science, and IoT sustainable developments.

Please send proposals to:

Dr. Souvik Pal  
Department of Computer Science and Engineering  
Global Institute of Management and Technology  
Krishna Nagar  
West Bengal, India  
souvikpal22@gmail.com

Dr. Dac-Nhuong Le  
Faculty of Information Technology, Haiphong University, Haiphong, Vietnam  
huongld@hus.edu.vn

*Publishers at Scrivener*

Martin Scrivener (martin@scrivenerpublishing.com)  
Phillip Carmical (pcarmical@scrivenerpublishing.com)

# **The Internet of Medical Things (IoMT)**

## **Healthcare Transformation**

Edited by  
**R.J. Hemalatha**  
**D. Akila**  
**D. Balaganesh**  
and  
**Anand Paul**



**WILEY**

This edition first published 2022 by John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA and Scrivener Publishing LLC, 100 Cummings Center, Suite 541J, Beverly, MA 01915, USA

© 2022 Scrivener Publishing LLC

For more information about Scrivener publications please visit [www.scrivenerpublishing.com](http://www.scrivenerpublishing.com).

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, except as permitted by law. Advice on how to obtain permission to reuse material from this title is available at <http://www.wiley.com/go/permissions>.

### **Wiley Global Headquarters**

111 River Street, Hoboken, NJ 07030, USA

For details of our global editorial offices, customer services, and more information about Wiley products visit us at [www.wiley.com](http://www.wiley.com).

### **Limit of Liability/Disclaimer of Warranty**

While the publisher and authors have used their best efforts in preparing this work, they make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives, written sales materials, or promotional statements for this work. The fact that an organization, website, or product is referred to in this work as a citation and/or potential source of further information does not mean that the publisher and authors endorse the information or services the organization, website, or product may provide or recommendations it may make. This work is sold with the understanding that the publisher is not engaged in rendering professional services. The advice and strategies contained herein may not be suitable for your situation. You should consult with a specialist where appropriate. Neither the publisher nor authors shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages. Further, readers should be aware that websites listed in this work may have changed or disappeared between when this work was written and when it is read.

### ***Library of Congress Cataloging-in-Publication Data***

ISBN 978-1-119-76883-8

Cover image: Pixabay.Com

Cover design by Russell Richardson

Set in size of 11pt and Minion Pro by Manila Typesetting Company, Makati, Philippines

Printed in the USA

10 9 8 7 6 5 4 3 2 1

# Contents

<b>Preface</b>	<b>xv</b>
<b>1 In Silico Molecular Modeling and Docking Analysis in Lung Cancer Cell Proteins</b>	<b>1</b>
<i>Manisha Sritharan and Asita Elengoe</i>	
1.1 Introduction	2
1.2 Methodology	4
1.2.1 Sequence of Protein	4
1.2.2 Homology Modeling	4
1.2.3 Physiochemical Characterization	4
1.2.4 Determination of Secondary Models	4
1.2.5 Determination of Stability of Protein Structures	4
1.2.6 Identification of Active Site	4
1.2.7 Preparation of Ligand Model	5
1.2.8 Docking of Target Protein and Phytocompound	5
1.3 Results and Discussion	5
1.3.1 Determination of Physiochemical Characters	5
1.3.2 Prediction of Secondary Structures	7
1.3.3 Verification of Stability of Protein Structures	7
1.3.4 Identification of Active Sites	14
1.3.5 Target Protein-Ligand Docking	14
1.4 Conclusion	18
References	18
<b>2 Medical Data Classification in Cloud Computing Using Soft Computing With Voting Classifier: A Review</b>	<b>23</b>
<i>Saurabh Sharma, Harish K. Shakya and Ashish Mishra</i>	
2.1 Introduction	24
2.1.1 Security in Medical Big Data Analytics	24
2.1.1.1 Capture	24
2.1.1.2 Cleaning	25

2.1.1.3	Storage	25
2.1.1.4	Security	26
2.1.1.5	Stewardship	26
2.2	Access Control-Based Security	27
2.2.1	Authentication	27
2.2.1.1	User Password Authentication	28
2.2.1.2	Windows-Based User Authentication	28
2.2.1.3	Directory-Based Authentication	28
2.2.1.4	Certificate-Based Authentication	28
2.2.1.5	Smart Card-Based Authentication	29
2.2.1.6	Biometrics	29
2.2.1.7	Grid-Based Authentication	29
2.2.1.8	Knowledge-Based Authentication	29
2.2.1.9	Machine Authentication	29
2.2.1.10	One-Time Password (OTP)	30
2.2.1.11	Authority	30
2.2.1.12	Global Authorization	30
2.3	System Model	30
2.3.1	Role and Purpose of Design	31
2.3.1.1	Patients	31
2.3.1.2	Cloud Server	31
2.3.1.3	Doctor	31
2.4	Data Classification	32
2.4.1	Access Control	32
2.4.2	Content	33
2.4.3	Storage	33
2.4.4	Soft Computing Techniques for Data Classification	34
2.5	Related Work	36
2.6	Conclusion	42
	References	43
<b>3</b>	<b>Research Challenges in Pre-Copy Virtual Machine Migration in Cloud Environment</b>	<b>45</b>
	<i>Nirmala Devi N. and Vengatesh Kumar S.</i>	
3.1	Introduction	46
3.1.1	Cloud Computing	46
3.1.1.1	Cloud Service Provider	47
3.1.1.2	Data Storage and Security	47
3.1.2	Virtualization	48
3.1.2.1	Virtualization Terminology	49
3.1.3	Approach to Virtualization	50



3.1.4	Processor Issues	51
3.1.5	Memory Management	51
3.1.6	Benefits of Virtualization	51
3.1.7	Virtual Machine Migration	51
3.1.7.1	Pre-Copy	52
3.1.7.2	Post-Copy	52
3.1.7.3	Stop and Copy	53
3.2	Existing Technology and Its Review	54
3.3	Research Design	56
3.3.1	Basic Overview of VM Pre-Copy Live Migration	57
3.3.2	Improved Pre-Copy Approach	58
3.3.3	Time Series-Based Pre-Copy Approach	60
3.3.4	Memory-Bound Pre-Copy Live Migration	62
3.3.5	Three-Phase Optimization Method (TPO)	62
3.3.6	Multiphase Pre-Copy Strategy	64
3.4	Results	65
3.4.1	Finding	65
3.5	Discussion	69
3.5.1	Limitation	69
3.5.2	Future Scope	70
3.6	Conclusion	70
	References	71
<b>4</b>	<b>Estimation and Analysis of Prediction Rate of Pre-Trained Deep Learning Network in Classification of Brain Tumor MRI Images</b>	<b>73</b>
	<i>Krishnamoorthy Raghavan Narasu, Anima Nanda, Marshiana D., Bestley Joe and Vinoth Kumar</i>	
4.1	Introduction	74
4.2	Classes of Brain Tumors	75
4.3	Literature Survey	76
4.4	Methodology	78
4.5	Conclusion	93
	References	95
<b>5</b>	<b>An Intelligent Healthcare Monitoring System for Coma Patients</b>	<b>99</b>
	<i>Bethanne J. Janney, T. Sudhakar, Sindu Divakaran, Chandana H. and Caroline Chriselda L.</i>	
5.1	Introduction	100
5.2	Related Works	102
5.3	Materials and Methods	104
5.3.1	Existing System	104



5.3.2	Proposed System	105
5.3.3	Working	105
5.3.4	Module Description	106
5.3.4.1	Pulse Sensor	106
5.3.4.2	Temperature Sensor	107
5.3.4.3	Spirometer	107
5.3.4.4	OpenCV (Open Source Computer Vision)	108
5.3.4.5	Raspberry Pi	108
5.3.4.6	USB Camera	109
5.3.4.7	AVR Module	109
5.3.4.8	Power Supply	109
5.3.4.9	USB to TTL Converter	110
5.3.4.10	EEG of Comatose Patients	110
5.4	Results and Discussion	111
5.5	Conclusion	116
	References	117
<b>6</b>	<b>Deep Learning Interpretation of Biomedical Data</b>	<b>121</b>
	<i>T.R. Thamizhvani, R. Chandrasekaran and T.R. Ineyathendral</i>	
6.1	Introduction	122
6.2	Deep Learning Models	125
6.2.1	Recurrent Neural Networks	125
6.2.2	LSTM/GRU Networks	127
6.2.3	Convolutional Neural Networks	128
6.2.4	Deep Belief Networks	130
6.2.5	Deep Stacking Networks	131
6.3	Interpretation of Deep Learning With Biomedical Data	132
6.4	Conclusion	139
	References	140
<b>7</b>	<b>Evolution of Electronic Health Records</b>	<b>143</b>
	<i>G. Umashankar, Abinaya P., J. Premkumar, T. Sudhakar and S. Krishnakumar</i>	
7.1	Introduction	143
7.2	Traditional Paper Method	144
7.3	IoMT	144
7.4	Telemedicine and IoMT	145
7.4.1	Advantages of Telemedicine	145
7.4.2	Drawbacks	146
7.4.3	IoMT Advantages with Telemedicine	146
7.4.4	Limitations of IoMT With Telemedicine	147

7.5	Cyber Security	147
7.6	Materials and Methods	147
7.6.1	General Method	147
7.6.2	Data Security	148
7.7	Literature Review	148
7.8	Applications of Electronic Health Records	150
7.8.1	Clinical Research	150
7.8.1.1	Introduction	150
7.8.1.2	Data Significance and Evaluation	151
7.8.1.3	Conclusion	151
7.8.2	Diagnosis and Monitoring	151
7.8.2.1	Introduction	151
7.8.2.2	Contributions	152
7.8.2.3	Applications	152
7.8.3	Track Medical Progression	153
7.8.3.1	Introduction	153
7.8.3.2	Method Used	153
7.8.3.3	Conclusion	154
7.8.4	Wearable Devices	154
7.8.4.1	Introduction	154
7.8.4.2	Proposed Method	155
7.8.4.3	Conclusion	155
7.9	Results and Discussion	155
7.10	Challenges Ahead	157
7.11	Conclusion	158
	References	158
<b>8</b>	<b>Architecture of IoMT in Healthcare</b>	<b>161</b>
	<i>A. Josephin Arockia Dhiyya</i>	
8.1	Introduction	161
8.1.1	On-Body Segment	162
8.1.2	In-Home Segment	162
8.1.3	Network Segment Layer	163
8.1.4	In-Clinic Segment	163
8.1.5	In-Hospital Segment	163
8.1.6	Future of IoMT?	164
8.2	Preferences of the Internet of Things	165
8.2.1	Cost Decrease	165
8.2.2	Proficiency and Efficiency	165
8.2.3	Business Openings	165

8.2.4	Client Experience	166
8.2.5	Portability and Nimbleness	166
8.3	IoMT Progress in COVID-19 Situations: Presentation	167
8.3.1	The IoMT Environment	168
8.3.2	IoMT Pandemic Alleviation Design	169
8.3.3	Man-Made Consciousness and Large Information Innovation in IoMT	170
8.4	Major Applications of IoMT	171
	References	172
<b>9</b>	<b>Performance Assessment of IoMT Services and Protocols</b>	<b>173</b>
	<i>A. Keerthana and Karthiga</i>	
9.1	Introduction	174
9.2	IoMT Architecture and Platform	175
9.2.1	Architecture	176
9.2.2	Devices Integration Layer	177
9.3	Types of Protocols	177
9.3.1	Internet Protocol for Medical IoT Smart Devices	177
9.3.1.1	HTTP	178
9.3.1.2	Message Queue Telemetry Transport (MQTT)	179
9.3.1.3	Constrained Application Protocol (CoAP)	180
9.3.1.4	AMQP: Advanced Message Queuing Protocol (AMQP)	181
9.3.1.5	Extensible Message and Presence Protocol (XMPP)	181
9.3.1.6	DDS	183
9.4	Testing Process in IoMT	183
9.5	Issues and Challenges	185
9.6	Conclusion	185
	References	185
<b>10</b>	<b>Performance Evaluation of Wearable IoT-Enabled Mesh Network for Rural Health Monitoring</b>	<b>187</b>
	<i>G. Merlin Sheeba and Y. Bevish Jinila</i>	
10.1	Introduction	188
10.2	Proposed System Framework	190
10.2.1	System Description	190
10.2.2	Health Monitoring Center	192
10.2.2.1	Body Sensor	192

10.2.2.2	Wireless Sensor Coordinator/ Transceiver	192
10.2.2.3	Ontology Information Center	195
10.2.2.4	Mesh Backbone-Placement and Routing	196
10.3	Experimental Evaluation	200
10.4	Performance Evaluation	201
10.4.1	Energy Consumption	201
10.4.2	Survival Rate	201
10.4.3	End-to-End Delay	202
10.5	Conclusion	204
	References	204
<b>11</b>	<b>Management of Diabetes Mellitus (DM) for Children and Adults Based on Internet of Things (IoT)</b>	<b>207</b>
	<i>Krishnakumar S., Umashankar G., Lumen Christy V., Vikas and Hemalatha R.J.</i>	
11.1	Introduction	208
11.1.1	Prevalence	209
11.1.2	Management of Diabetes	209
11.1.3	Blood Glucose Monitoring	210
11.1.4	Continuous Glucose Monitors	211
11.1.5	Minimally Invasive Glucose Monitors	211
11.1.6	Non-Invasive Glucose Monitors	211
11.1.7	Existing System	211
11.2	Materials and Methods	212
11.2.1	Artificial Neural Network	212
11.2.2	Data Acquisition	213
11.2.3	Histogram Calculation	213
11.2.4	IoT Cloud Computing	214
11.2.5	Proposed System	215
11.2.6	Advantages	215
11.2.7	Disadvantages	215
11.2.8	Applications	216
11.2.9	Arduino Pro Mini	216
11.2.10	LM78XX	217
11.2.11	MAX30100	218
11.2.12	LM35 Temperature Sensors	218
11.3	Results and Discussion	219
11.4	Summary	222
11.5	Conclusion	222
	References	223

<b>12 Wearable Health Monitoring Systems Using IoMT</b>	<b>225</b>
<i>Jaya Rubi and A. Josephin Arockia Dhivya</i>	
12.1 Introduction	225
12.2 IoMT in Developing Wearable Health Surveillance System	226
12.2.1 A Wearable Health Monitoring System with Multi-Parameters	227
12.2.2 Wearable Input Device for Smart Glasses Based on a Wristband-Type Motion-Aware Touch Panel	228
12.2.3 Smart Belt: A Wearable Device for Managing Abdominal Obesity	228
12.2.4 Smart Bracelets: Automating the Personal Safety Using Wearable Smart Jewelry	228
12.3 Vital Parameters That Can Be Monitored Using Wearable Devices	229
12.3.1 Electrocardiogram	230
12.3.2 Heart Rate	231
12.3.3 Blood Pressure	232
12.3.4 Respiration Rate	232
12.3.5 Blood Oxygen Saturation	234
12.3.6 Blood Glucose	235
12.3.7 Skin Perspiration	236
12.3.8 Capnography	238
12.3.9 Body Temperature	239
12.4 Challenges Faced in Customizing Wearable Devices	240
12.4.1 Data Privacy	240
12.4.2 Data Exchange	240
12.4.3 Availability of Resources	241
12.4.4 Storage Capacity	241
12.4.5 Modeling the Relationship Between Acquired Measurement and Diseases	242
12.4.6 Real-Time Processing	242
12.4.7 Intelligence in Medical Care	242
12.5 Conclusion	243
References	244
<b>13 Future of Healthcare: Biomedical Big Data Analysis and IoMT</b>	<b>247</b>
<i>Tamiziniyan G. and Keerthana A.</i>	
13.1 Introduction	248
13.2 Big Data and IoT in Healthcare Industry	250
13.3 Biomedical Big Data Types	251

13.3.1	Electronic Health Records	252
13.3.2	Administrative and Claims Data	252
13.3.3	International Patient Disease Registries	252
13.3.4	National Health Surveys	253
13.3.5	Clinical Research and Trials Data	254
13.4	Biomedical Data Acquisition Using IoT	254
13.4.1	Wearable Sensor Suit	254
13.4.2	Smartphones	255
13.4.3	Smart Watches	255
13.5	Biomedical Data Management Using IoT	256
13.5.1	Apache Spark Framework	257
13.5.2	MapReduce	258
13.5.3	Apache Hadoop	258
13.5.4	Clustering Algorithms	259
13.5.5	K-Means Clustering	259
13.5.6	Fuzzy C-Means Clustering	260
13.5.7	DBSCAN	261
13.6	Impact of Big Data and IoMT in Healthcare	262
13.7	Discussions and Conclusions	263
	References	264
<b>14</b>	<b>Medical Data Security Using Blockchain With Soft Computing Techniques: A Review</b>	<b>269</b>
	<i>Saurabh Sharma, Harish K. Shakya and Ashish Mishra</i>	
14.1	Introduction	270
14.2	Blockchain	272
14.2.1	Blockchain Architecture	272
14.2.2	Types of Blockchain Architecture	273
14.2.3	Blockchain Applications	274
14.2.4	General Applications of the Blockchain	276
14.3	Blockchain as a Decentralized Security Framework	277
14.3.1	Characteristics of Blockchain	278
14.3.2	Limitations of Blockchain Technology	280
14.4	Existing Healthcare Data Predictive Analytics Using Soft Computing Techniques in Data Science	281
14.4.1	Data Science in Healthcare	281
14.5	Literature Review: Medical Data Security in Cloud Storage	281
14.6	Conclusion	286
	References	287

<b>15 Electronic Health Records: A Transitional View</b>	<b>289</b>
<i>Srividhya G.</i>	
15.1 Introduction	289
15.2 Ancient Medical Record, 1600 BC	290
15.3 Greek Medical Record	291
15.4 Islamic Medical Record	291
15.5 European Civilization	292
15.6 Swedish Health Record System	292
15.7 French and German Contributions	293
15.8 American Descriptions	293
15.9 Beginning of Electronic Health Recording	297
15.10 Conclusion	298
References	298
<b>Index</b>	<b>301</b>



## Preface

---

It is a pleasure for us to put forth this book, *The Internet of Medical Things (IoMT): Healthcare Transformation*. Digital technologies have come into effect in various sectors of our daily lives and it has been successful in influencing and conceptualizing our day-to-day activities. The Internet of Medical Things is one such discipline which seeks a lot of interest as it combines various medical devices and allows these devices to have a conversation among themselves over a network to form a connection of advanced smart devices. This book helps to know about IoMT in the health care sector that involves the latest technological implementation in diagnostic level as well as therapeutic level. The security and privacy of maintaining the health records is a major concern and several solutions for the same has been discussed in this book. It provides significant advantages for the wellbeing of people by increasing the quality of life and reducing medical expenses. IoMT plays a major role in maintaining smart health-care system as the security and privacy of the health records further leads to help the health care sector to be more secure and reliable. Artificial Intelligence is the other enabling technology that helps IoMT in building smart defensive mechanisms for a variety of applications like providing assistance for doctors in almost every area of their proficiencies such as clinical decision-making. Through Machine Learning and Deep Learning techniques, the system can learn normal and abnormal decisions using the data generated by the health worker/professionals and the patient feedback. This book demonstrates the connectivity between medical devices and sensors is streamlining clinical workflow management and leading to an overall improvement in patient care, both inside care facility walls and in remote locations. This book would be a good collection of state-of-the-art approaches for applications of IoMT in various health care sectors. It will be very beneficial for the new researchers and practitioners working in the field to quickly know the best methods for IoMT.

- Chapter 1 concentrates on the study of the three-dimensional (3-D) models of lung cancer cell line proteins (epidermal growth factor (EGFR), K-Ras oncogene protein and tumor suppressor (TP53)). The generation and their binding affinities with curcumins, ellagic acid and quercetin through local docking were assessed.
- Chapter 2 focuses on cloud computing and electronic health record system service EHR used to protect the confidentiality of patient sensitive information and must be encrypted before outsourcing information. This chapter focuses on the effective use of cloud data such as search keywords and data sharing and the challenging problem associated with the concept of soft computing.
- Chapter 3 elucidates the study of cloud computing concepts, security concerns in clouds and data centers, live migration and its importance for cloud computing, and the role of virtual machine (VM) migration in cloud computing. It provides a holistic approach towards the pre-copy migration technique thereby explore the way for reducing the downtime and migration time. This chapter compares different pre-copy algorithms and evaluates its parameters for providing a better solution.
- Chapter 4 concentrates on Deep Learning that has gained more interest in various fields like image classification, self-driven cars, natural language processing and healthcare applications. The chapter focuses on solving the complex problems in a more effective and efficient manner. It elaborates for the reader how deep learning techniques are useful for predicting and classification of the brain tumor cells. Datasets are trained using pre-trained neural networks such as Alexnet, Googlenet and Resnet 101 and performance of these networks are analysed in detail. Resnet 101 networks have achieved highest accuracy.
- Chapter 5 illustrates an intelligent healthcare monitoring system for coma patients that examines the coma patient's vital signs on a continuous basis, detects the movement happening in the patient, and updates the information to the doctor and central station through IoMT. Consistent tracking and observation of these health issues improves medical assurance and allows for tracking coma events.

- Chapter 6 details the Deep Learning process that resembles the human functions in processing and defining patterns used for decision-making. Deep learning algorithms are mainly designed and developed using neural networks performing unsupervised data that are unstructured. Biomedical data possess time and frequency domain features for analysis and classification. Thus, deep learning algorithms are used for interpretation and classification of biomedical big data.
- Chapter 7 discusses how the electronic health records automates and streamlines the clinician's workflow and makes the process easy. It has the ability to generate the complete history of the patient and also help in assisting for the further treatment which helps in the recovery of the patient in a more effective way. The electronic health records are designed according to the convenience depending on the sector it is being implemented. The main aim of electronic health records was to make it available to the concerned person wherever they are, to reduce the work load to maintain clinical book records and use the details for research purposes with the concerned persons acknowledgement.
- Chapter 8 elaborates technical architecture of IoMT in relation to biomedical applications. These ideologies are widely used to educate people regarding the medical applications using IoMT. It also gives a detailed study about the future scope of IoMT in healthcare.
- Chapter 9 provides knowledge on the different performance assessment techniques and types of protocols that suits best data transfer and increases safety. The chapter provides the best protocol which helps in saving energy and is useful for the customer. It will help the researchers to select the best IoT protocol for healthcare applications. Testing tools and frameworks provide knowledge to assess the protocols.
- Chapter 10 addresses the issue of a Health Monitoring Centre (HMC) in rural areas. The HMC monitors and records continuously the physiological parameters of the patients in care using wearable biosensors. The elderly suffering from chronic diseases is monitored periodically or continuously under the care of the physician. To enhance the performance of the system a smart and intelligent mesh

backbone is integrated for fast transmission of the critical medical data to a remote health IOT cloud server.

- Chapter 11 concentrates on Diabetes Mellitus (DM) which is one of the most widely recognized perilous illnesses for all age groups in the world. The patients need to settle on the best-individualized choices about day-by-day management of their diabetes. Noninvasive glucose sensor used to find out the glucose value of patients from its fingertip and other sensors also connected to the patient to get relevant data. A completely useful IoT-based eHealth stage that wires humanoid robot help with diabetes and planned successfully. The created platform encourages a constant coupled network among patients and their caretakers over physical separation and, in this manner, improving patient's commitment with their caretakers while limiting the cost, time, and exertion of the conventional occasional clinic visits.
- Chapter 12 explores the concepts of wearable health monitoring systems using IoMT technology. Additionally, this chapter also provides a brief review about challenges and applications of customized wearable healthcare system that are trending these days. The basic idea is to have a detailed study about the recent developments in IoMT technologies and the drawbacks, as well as future advancements related to it. The recent innovations, implications and key issues are discussed in the context of the framework.
- Chapter 13 provides knowledge on biomedical big data analysis which plays a huge impact in personalized medicine. Some challenges in big data analysis like data acquisition, data accuracy, data security are discussed. Huge volume of data in healthcare can be managed by integrating biomedical data management. This chapter will provide brief information on different software that are used to manage data in healthcare domain. Impact of big data and IoMT in healthcare will enhance data analytics research.
- Chapter 14 concentrates on blockchain which is a highly secure and decentralized networking platform of multiple computers called nodes. Predictive analysis, soft computing (SC) and optimization and data science is becoming increasingly important. In this chapter, the authors investigate privacy issues around large cloud medical data in the remote cloud. Their proposed framework ensures data privacy,

integrity, and access control over the shared data with better efficiency. It reduces the turnaround time for data sharing, improves the decision-making process, and reduces the overall cost while providing better security of electronic medical records.

- Chapter 15 discusses the evolution of electronic health record starting with the history and evolution of the health record system in the Egyptian era when the first health record was written, all the way to the modern computerized health record system. This chapter also includes various documentation procedures for the health records that were followed from the ancient times and by other civilizations around the world.

We thank the chapter authors most profusely for their contributors written during the pandemic.

**R. J. Hemalatha**  
**D. Akila**  
**D. Balaganesh**  
**Anand Paul**  
January 2022