Computational Intelligence Based Solutions for Vision Systems

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Edited by
Varun Bajaj and Irshad Ahmad Ansari
Electronics and Communication Engineering, PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur, India

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Dedicated to my father the late Mahendra Bajaj and family members.

—Varun Bajaj

Dedicated to my lovely daughter 'Eimaan'.

—Irshad Ahmad Ansari

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Preface

Currently, computational intelligence (CI) is being used in a variety of applications and is thus influencing people's lives in various ways. The growth in research in advanced computing and respective fields such as intelligent vision systems (IVSs) is assisting people by allowing rapid response and ease of use. The advancement of IVSs depends jointly on the development of advanced computing and knowledge of vision systems. IVSs help to achieve highly efficient performance (comparable to human vision) to allow a profound understanding of different scenarios and applications. IVSs provide the ability to handle and examine the big data generated by vision sensors and make decisions based on specific requirements. CI enables the different issues that influence IVSs and their practical use to be addresssed. Therefore, the merger of CI with IVSs can do wonders for the wellbeing of humans.

In recent times high performance computing has seen continued growth, affecting various fields and changing the computational domain altogether for the betterment of human life. Computer vision can be deemed as one of the most important fields which affects human life in a significant way. CI based computing can be very helpful in determining solutions for advanced vision systems as they required high-end processing capabilities. The in-depth analysis of large datasets is the basis for the development of IVSs and the same can be very helpful in vision and surveillance applications. Deep computational architecture and low level feature extraction, generation and understanding can provide new directions for the current research of vision systems.

Computer vision is a significant technology covering diverse fields. It plays an important role in the fields of information technology and intelligence. The combination of vision systems with CI is giving rise to IVSs. Computer vision is affecting different areas of human life such as surveillance, medical assistance, remote sensing, target detection, tracking, etc.

Computer vision plays a significant role in industry as well. Intelligent systems and computer vision find applications in various industrial phases such as the pre-processing, production and testing phases. Computer vision techniques are an important component of security and surveillance systems. An intelligent vision system using visible and infra-red sensors can track illegal activities and alert the user in the case of any incidents.

Considering the future issues of high performance computing and the need for IVSs, this book focuses on the advancements of this domain. This book is made up of contributions by invited research scholars, academic researchers and industry professional related to high performance computing for IVSs and related applications.

The chapters of this book are as follows. Chapter 1 provides insight into a drone based vision system, and its implementation and application for surveillance. Details of the system components, implementation steps and analysis of obtained result are provided. Chapter 2 highlights an important application of computer vision to automatically detect surface imperfections using a grey-level co-occurrence matrix

and a supervised classification technique. Chapter 3 demonstrates the use of machine learning for vision-based crowd management systems. This work utilizes a deep neural network based YOLOV3 model which is trained using the COCO dataset to detect the people in the frame. Chapter 4 develops a hybrid deep feature extraction model based on five pre-trained deep learning models and an ImRMR based feature selection model for skin cancer classification. Chapter 5 presents an analysis of human activity recognition systems and their importance in the current era. The author discusses the various applications of human activity recognition and the different methods available for automatic activity detection from videos. Chapter 6 explores three deep learning based object detection models, namely YOLOv3, YOLOv4 and SSD, based on mAP. A detailed description of data augmentation is also presented.

Chapter 7 introduces a forensic method to identify recaptured images by means of rich feature extraction from different noise residuals on multiple quantization values. The work focuses on a prominent feature in the spatial domain to classify the original images and screenshots taken from LED monitors. Chapter 8 offers multiple data augmentation approaches for boosting segmentation performance by utilizing DeepLabv3+ as the architecture and ResNet18/ResNet50 as the backbone. Chapter 9 proposes a novel multiscale object detection and location architecture for the classification of Parkinson's disease. The developed model utilizes 540 deep learning layers to learn from a wide range of features by using two unique attributes. Chapter 10 deals with the various AI-powered techniques that address several of the most critical societal health problems, including cardiovascular disease, cancer, dermatological conditions, neurological illnesses, breathing illnesses and gastro-intestinal issues. In addition, various imaging techniques, such as computerized tomography, magnetic resonance, radiographiy ultrasonography, dermoscopy, etc, are also discussed. Chapter 11 discusses the application of machine learning techniques in medicine. This chapter focuses on the diagnosis of skin cancer using a support vector machine (SVM) classifier.

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Varun Bajaj
Irshad Ahmad Ansari

Editors biographies

Varun Bajaj

Varun Bajaj (PhD, SMIEEE20) has been an Associate Professor in the department of Electronics and Communication Engineering at the Indian Institute of Information Technology, Design and Manufacturing (IIITDM) Jabalpur, India since July 2021. He was an Assistant Professor at IIITDM Jabalpur from March 2014 to July 2021. He also worked as visiting faculty at IIITDM Jabalpur from September 2013 to March 2014. He worked as an Assistant Professor in the Department of Electronics and Instrumentation, Shri Vaishnav Institute of Technology and Science, Indore, India during 2009–10. He received his PhD degree in Electrical Engineering from the Indian Institute of Technology, Indore, India, in 2014. He received his MTech degree with honours in Microelectronics and VLSI Design from the Shri Govindram Seksaria Institute of Technology and Science, Indore, India, in 2009, and his BE degree in Electronics and Communication Engineering from Rajiv Gandhi Technological University, Bhopal, India in 2006.

He is an Associate Editor of the *IEEE Sensors Journal* and the Subject Editor-in-Chief of *IET Electronics Letters*. He served as a Subject Editor of *IET Electronics Letters* from November 2018 to June 2020. He is a Senior Member of IEEE (from June 2020) and was a Member of IEEE (2016–2020), and has also contributed as an active technical reviewer for leading international journals published by IEEE, IET and Elsevier, etc. He has 128 publications which include journal papers (88), conference papers (31), books (9) and book chapters (10). The citation impact of his publications is around 3375 citations, with an h index of 30 and an i10 index of 73 (Google Scholar, November 2021). He has supervised seven PhD scholars (four completed and three in progress) and seven MTech scholars. He has been listed in the world's top 2% of researchers/scientists by Stanford University, CA (October 2021). He has worked on research projects funded by DST and CSIR. He is a recipient of various reputed national and international awards. His research interests include biomedical signal processing, AI in healthcare, brain–computer interfaces, pattern recognition and ECG signal processing.

Irshad Ahmad Ansari

Irshad Ahmad Ansari has been a faculty member in the department of Electronics and Communication Engineering at the PDPM Indian Institute of Information Technology, Design and Manufacturing (IIITDM) Jabalpur, India, since 2017. He received his BTech degree in Electronics and Communication Engineering from Gautam Buddh Technical University (formally UPTU), Lucknow, India, in 2010, and his MTech degree in Control and Instrumentation from Dr B R Ambedkar National Institute of Technology Jalandhar, Punjab, India, in 2012. He completed his PhD at IIT Roorkee with an MHRD teaching assistantship, and subsequently joined the Gwangju Institute of Science and Technology, South Korea, as a

postdoctoral fellow. His major research interests include image processing, signal processing, soft computing, brain–computer interfaces and machine learning. He is a Senior Member of IEEE. He is currently supervising three PhD scholars. He has authored more than 55 research papers in various reputed international journals/ conferences proceedings of publishers such as IEEE, Elsevier, Springer, IOP etc. He also serves as an active and potential technical reviewer for various journals of repute.

List of contributors

Areesha Anjum
Department of Computer Engineering, Zakir Husain College of Engineering and Technology, Aligarh Muslim University, Aligarh, India

Irshad Ahmad Ansari
PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur, India

Megha Arakeri
M S Ramaiah Institute of Technology, Bangalore, India

Varun Bajaj
PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur, India

Sheryl Brahnam
Missouri State University, Springfield, Missouri, USA

Daniela Cuza
University of Padua, Padua, Italy

Divyanshu
Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Sengul Dogan
Technology Faculty, Firat University, Elazığ, Turkey

Dipen Gohil
LJ Institute of Engineering and Technology, Ahmedabad, India

Monali Gulhane
Computer Science and Engineering, St Vincent Palloti College of Engineering and Technology, Nagpur, India

Himanshu Gupta
Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Saiful Islam
Department of Computer Engineering, Aligarh Muslim University, Aligarh, UP, India

Ankit Charan Janbandhu
PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur, India

K S Kavitha
M S Ramaiah Institute of Technology, Bangalore, India

Mayur Kashyap
Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Ranita Khumukcham
Indian Institute of Information Technology Senapati, Manipur, Mantripukhri, India

Alessandra Lumini
University of Bologna, Bologna, Italy

V M Manikandan
SRM University-AP, Andhra Pradesh, India

Loris Nanni
University of Padua, Padua, Italy

Chaitanya Krishna Pasula
SRM University-AP, Andhra Pradesh, India

Virginia Riego del Castillo
Departament of Mechanical, Computer Science and Aerospace Engineering, Universidad de León, León, Spain

Lidia Sánchez-González
Departament of Mechanical, Computer Science and Aerospace Engineering, Universidad de León, León, Spain

Gaurav Saxena
Indian Institute of Information Technology Senapati, Manipur, Mantripukhri, India

Siddarth Shah
LJ Institute of Engineering and Technology, Ahmedabad, India

Manan Shah
Pandit Deendayal Energy University, Gandhinagar, India

Rutvik Shah
Silver Oak College of Engineering and Technology, Ahmedabad, India

Sachin Sharma
Research Division, Jagadish Chandra Bose Research Organisation, Gautam Budh Nagar, Uttar Pradesh, 203207, India

Bhan Singh
Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Abdulhamit Subasi
Faculty of Medicine, University of Turku, Turku, Finland

Turker Tuncer
Technology Faculty, Firat University, Elazığ, Turkey

Om Prakash Verma
Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Orhan Yaman
Technology Faculty, Firat University, Elazığ, Turkey