

Yu-Dong Zhang  
Tomonoby Senjyu  
Chakchai SO-IN  
Amit Joshi *Editors*



# Smart Trends in Computing and Communications: Proceedings of SmartCom 2020

# **Smart Innovation, Systems and Technologies**

Volume 182

## **Series Editors**

Robert J. Howlett, Bournemouth University and KES International,  
Shoreham-by-sea, UK

Lakhmi C. Jain, Faculty of Engineering and Information Technology,  
Centre for Artificial Intelligence, University of Technology Sydney,  
Sydney, NSW, Australia

The Smart Innovation, Systems and Technologies book series encompasses the topics of knowledge, intelligence, innovation and sustainability. The aim of the series is to make available a platform for the publication of books on all aspects of single and multi-disciplinary research on these themes in order to make the latest results available in a readily-accessible form. Volumes on interdisciplinary research combining two or more of these areas is particularly sought.

The series covers systems and paradigms that employ knowledge and intelligence in a broad sense. Its scope is systems having embedded knowledge and intelligence, which may be applied to the solution of world problems in industry, the environment and the community. It also focusses on the knowledge-transfer methodologies and innovation strategies employed to make this happen effectively. The combination of intelligent systems tools and a broad range of applications introduces a need for a synergy of disciplines from science, technology, business and the humanities. The series will include conference proceedings, edited collections, monographs, handbooks, reference books, and other relevant types of book in areas of science and technology where smart systems and technologies can offer innovative solutions.

High quality content is an essential feature for all book proposals accepted for the series. It is expected that editors of all accepted volumes will ensure that contributions are subjected to an appropriate level of reviewing process and adhere to KES quality principles.

**\*\* Indexing: The books of this series are submitted to ISI Proceedings, EI-Compendex, SCOPUS, Google Scholar and Springerlink \*\***

More information about this series at <http://www.springer.com/series/8767>

Yu-Dong Zhang · Tomonoby Senjyu ·  
Chakchai SO-IN · Amit Joshi  
Editors

# Smart Trends in Computing and Communications: Proceedings of SmartCom 2020



*Editors*

Yu-Dong Zhang  
School of Informatics  
University of Leicester  
Leicester, England, UK

Chakchai SO-IN  
Khon Kaen University  
Khon Kaen, Thailand

Tomonoby Senjyu  
University of the Ryukyus  
Nishihara, Japan

Amit Joshi  
Global Knowledge Research Foundation  
Gujarat, India

ISSN 2190-3018

ISSN 2190-3026 (electronic)

Smart Innovation, Systems and Technologies

ISBN 978-981-15-5223-6

ISBN 978-981-15-5224-3 (eBook)

<https://doi.org/10.1007/978-981-15-5224-3>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2021

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

# Preface

This SIST volume contains the papers presented at the SmartCom 2020: Fourth International Conference on Smart Trends for Computing and Communications. The conference was held during January 24–25, 2020, at Hotel Novotel, Siam Square, Bangkok, and organized by Global Knowledge Research Foundation with support from Knowledge Chamber of Commerce and Industry and InterYIT IFIP—International Federation for Information Processing.

The books presents the state-of-the-art as well as emerging topics pertaining to information, computer communications and effective strategies for its implementation for engineering and managerial applications.

The conference attracts a large number of high-quality submissions and stimulates the cutting-edge research discussions among many academic pioneering researchers, scientists, industrial engineers, students from all around the world and provides a forum to researchers on proposing new technologies, sharing their experiences and discussing future solutions for design infrastructure for ICT, providing common platform for academic pioneering researchers, scientists, engineers and students to share their views and achievements, enriching technocrats and academicians by presenting their innovative and constructive ideas and focusing on innovative issues at international level by bringing together the experts from different countries.

Research submissions in various advanced technology areas were received, and after a rigorous peer review process with the help of program committee members and 56 external reviewers for 262 papers from 20 different countries including Australia, China, Malaysia, Indonesia, Thailand, Bangladesh, Japan, South Korea and Sri Lanka, etc., out of which 50 were accepted with an acceptance ratio of 0.19.

This event's success was possible only with the help and support of our team and organizations. With immense pleasure and honor, we would like to express our sincere thanks to the authors for their remarkable contributions, all the Technical Program Committee members for their time and expertise in reviewing the papers within a very tight schedule and the publisher Springer for their professional help. This is the fourth conference of the series SmartCom in which proceedings is published as a CCIS volume by Springer. We are overwhelmed by our two

distinguished scholars and appreciate them for accepting our invitation to deliver keynote speeches to the conference and six technical session chairs for analyzing the research work presented by the researchers. Most importantly, we are also grateful to our local support team for their hard work for the conference. This series has already been made a continuous series which will be hosted at different locations every year.

This event's success was possible only with the help and support of our team and organizations. With immense pleasure and honor, we would like to express our sincere thanks to the authors for their remarkable contributions, all the Technical Program Committee members for their time and expertise in reviewing the papers within a very tight schedule and the publisher Springer for their professional help. This is the fourth conference of the series SmartCom in which proceedings is published as a SIST volume by Springer. We are overwhelmed by our three distinguished scholars and appreciate them for accepting our invitation to deliver keynote speeches including Prof. Mike Hinchey, President IFIP; Prof. Milan Tuba, Singidunum University, Serbia; and Dr. Chakchai So-In, Khon Kaen University, Thailand, in the conference and further six technical session chairs for analyzing the research work presented by the researchers. Most importantly, we are also grateful to our local support team for their hard work for the conference. This series has already been made a continuous series which will be hosted at different locations every year.

Bangkok, Thailand

Yu-Dong Zhang  
Tomonoby Senjyu  
Chakchai SO-IN  
Amit Joshi

# Contents

<b>1</b>	<b>Accurate Detection of Facial Landmark Points Using Local Intensity Information for Emotion Detection . . . . .</b>	<b>1</b>
	Payal Bhattacharjee and M. M. Ramya	
<b>2</b>	<b>Statistical Approach to Detect Alzheimer’s Disease and Autism Spectrum-Related Neurological Disorder Using Machine Learning . . . . .</b>	<b>17</b>
	Akhilesh Kumar Sharma and Devesh K. Shrivastav	
<b>3</b>	<b>The Development and Gap of Chinese and American Open Access Journals: From the Perspective of Network Influence . . . . .</b>	<b>25</b>
	Danyang Li, Xinlai Li, and Biying Gao	
<b>4</b>	<b>The Use of Mobile Apps to Facilitate Customers’ Choice-Making When Grocery Shopping . . . . .</b>	<b>39</b>
	Asle Fagerström, Niklas Eriksson, and Valdimar Sigurdsson	
<b>5</b>	<b>Implementation of Best Hybrid Adaptive and Intelligent MIMO Detector on Reconfigurable Architecture for 5G LTE/IoT Environment . . . . .</b>	<b>49</b>
	Tipparti Anil Kumar and Lokam Anjaneyulu	
<b>6</b>	<b>Automated Detection of Retinal Hemorrhage Based on Supervised Classifiers and Implementation in Hardware . . . . .</b>	<b>57</b>
	K. A. Sreeja, S. S. Kumar, and Arun Pradeep	
<b>7</b>	<b>Data Encryption as Security Measure in IoT-Enabled Healthcare . . . . .</b>	<b>69</b>
	M. Shankar Lingam, G. S. Raghavendra, Arun Kumar, V. Anand, and A. M. Sudhakara	
<b>8</b>	<b>Agents-Based Service Restoration in Electrical Secondary Distribution Network . . . . .</b>	<b>83</b>
	Rukia J. Mwifunyi, Nerey H. Mvungi, and Mussa M. Kissaka	

<b>9</b>	<b>Packet-Level and Physical-Level Cross-Technology Communications: A Brief Introduction</b> . . . . .	<b>95</b>
	Liwen Qiu, Qinglin Zhao, Lianbo Zhang, Shumin Yao, Jing Zhao, and Li Feng	
<b>10</b>	<b>Smart Traffic Navigation System (STNS) to Reduce Travel Time by Integrating Signals from Navigation and Traffic Systems</b> . . . . .	<b>101</b>
	S. Sripranav, Akshay Ravi, K. Gautham, and R. Leela Velusamy	
<b>11</b>	<b>Selective Sensor Control via Cauchy Schwarz Divergence</b> . . . . .	<b>113</b>
	Nida Ishtiaq, Sabita Panicker, Amirali K. Gostar, Alireza Bab-Hadiashar, and Reza Hoseinnezhad	
<b>12</b>	<b>Step-Factor Resampling Technique for Imbalanced Sequence Data Classification</b> . . . . .	<b>125</b>
	Iroshan Aberathne, Chamila Walgampaya, and Udara Rathnayake	
<b>13</b>	<b>Rice Disease Detection Based on Image Processing Technique</b> . . . . .	<b>135</b>
	Md. Asfaqur Rahman, Md. Shahriar Nawal Shoumik, Md. Mahbubur Rahman, and Most. Hasna Hena	
<b>14</b>	<b>Electromagnetic Radiation from Cell Phones Used in Dhaka City</b> . . . . .	<b>147</b>
	M. Quamruzzaman, Munima Haque, Shahina Haque, and Utpal Chandra Das	
<b>15</b>	<b>Expressing Opinions Application: A Case Study at Rajamangala University of Technology, Isan, Khon Kaen Campus</b> . . . . .	<b>159</b>
	Ekaphong Tangtrakul, Jatupol Nampromma, and Phoemporn Lakkhanawannakun	
<b>16</b>	<b>Toward Clarifying Human Information Processing by Analyzing Big Data: Comparing Response Time to Questionnaires Included Heteronym Word for Problem Solving Between Visually and Auditory Types</b> . . . . .	<b>171</b>
	Keiko Tsujioka	
<b>17</b>	<b>Mango Species Detection from Raw Leaves Using Image Processing System</b> . . . . .	<b>183</b>
	Most. Hasna Hena, Md. Helal Sheikh, Md. Shamim Reza, and Ahmed Al Marouf	
<b>18</b>	<b>Frequency Reconfigurable Planner Antennas for Wireless Applications: A Review</b> . . . . .	<b>193</b>
	Dinesh Yadav and Vivekanand Tiwari	
<b>19</b>	<b>Room Temperature Pt-Modified WO<sub>3</sub>/p-Si Film Gas Sensor for Detection of Methanol</b> . . . . .	<b>201</b>
	Anup Dey, Komal Kumari, Abir Jana, Bijoy Goswami, Poushali Nandi, and S. K. Sarkar	

<b>20</b>	<b>Graph Degree Linkage Clustering for Identify Student's Performance on <i>Kompetisi Sains Madrasah</i> in Indonesia</b> . . . . .	<b>211</b>
	Ahmad Hanif Asyhar, A. Umar, Dian Candra Rini Novitasari, Kusaeri, Ahmad Fauzi, Nurissaidah Ulinnuha, Dwi Rolliawati, Noor Wahyudi, Ahmad Yusuf, Ali Mustofa, and Zakiyatul Ulya	
<b>21</b>	<b>Stepwise Iterative Maximum Likelihood Clustering Based on <i>Kompetisi Sains Madrasah</i>' Scores for Identifying Quality of Junior High School Grading Distribution</b> . . . . .	<b>221</b>
	Kusaeri, Nanik Puji Hastuti, Ali Musthofa, Ahmad Fauzi, Ahmad Hanif Asyhar, Dian Candra Rini Novitasari, Dwi Rolliawati, Zakiyatul Ulya, Ahmad Yusuf, Nurissaidah Ulinnuha, and Noor Wahyudi	
<b>22</b>	<b>Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature</b> . . . . .	<b>231</b>
	Nita Merlina, Edi Noersasongko, Pulung Nurtantio, M. A. Soeleman, Dwiza Riana, and Sri Hadianiti	
<b>23</b>	<b>Design of a Novel Wideband Dipole Antenna for mm-Wave Frequencies</b> . . . . .	<b>241</b>
	Paikhomba Loktongbam, Chaitali Koley, Debashish Pal, and Ayan Kumar Bandhopadhyay	
<b>24</b>	<b>Forecasting Sea Surface Temperature in Java Sea Using Generalized Regression Neural Networks</b> . . . . .	<b>249</b>
	Dian Candra Rini Novitasari, Wahyu Tri Puspitasari, Rahmat Pramulya, Hetty Rohayani, R. R. Diah Nugraheni Setyowati, Dwi Rukma Santi, Muhammad Fahrur Rozi, and Ary Widjajanto	
<b>25</b>	<b>Natural Disaster Predictions of Whirlwinds in Cilacap Region of Central Java Using Adaptive Neighborhood Modified Backpropagation (ANMBP)</b> . . . . .	<b>259</b>
	Dian Candra Rini Novitasari, Fitria Febrianti, Arnita, Rinda Nariswari, R. R. Diah Nugraheni Setyowati, Putri Wulandari, Ahmad Zoebad Foeady, Moh. Hafiyusholeh, and Fajar Setiawan	
<b>26</b>	<b>Designing Memristor-Based Timing Circuits and Performance Comparison with CMOS Counterparts</b> . . . . .	<b>269</b>
	Abir Jana, Disha Bhattacharjee, Komal Kumari, Anup Dey, Bijoy Goswami, and Subir Kumar Sarkar	
<b>27</b>	<b>Identify Elementary Student Distribution Based on <i>Kompetisi Sains Madrasah</i> Data Using Probabilistic Distance Clustering</b> . . . .	<b>281</b>
	Ahmad Yusuf, Noor Wahyudi, Zakiyatul Ulya, Nurissaidah Ulinnuha, Dwi Rolliawati, Ali Mustofa, Ahmad Fauzi, Ahmad Hanif Asyhar, Kusaeri, Ratna Indriyati, Dian Candra Rini Novitasari, and Maryunah	

<b>28</b>	<b>Classification of Tomato Plant Diseases Through Leaf Using Gray-Level Co-occurrence Matrix and Color Moment with Convolutional Neural Network Methods . . . . .</b>	<b>291</b>
	Anton Anton, Supriadi Rustad, Guruh Fajar Shidik, and Abdul Syukur	
<b>29</b>	<b>Leverage from Blockchain in Commodity Exchange: Asset-Backed Token with Ethereum Blockchain Network and Smart Contract . . . . .</b>	<b>301</b>
	Richard, Yaya Heryadi, Lukas, and Agung Trisetyarso	
<b>30</b>	<b>A Review of Focused Crawling Schemes for Search Engine . . . . .</b>	<b>311</b>
	Suresh Kumar and Manisha Gupta	
<b>31</b>	<b>Design and Simulation of Multi-channel V-TDMA for IoT-Based Healthcare Systems . . . . .</b>	<b>319</b>
	Anita Ramachandran, Malaika Afra Taj, Raghav Maheshwari, and Anupama Karuppiah	
<b>32</b>	<b>Design and Development of Tiny Humanoid Walking and Dancing Robot with Obstacle Detection for Visual Impaired People . . . . .</b>	<b>331</b>
	Amrita Ganguly, Jasmine Ara, and Bijan Paul	
<b>33</b>	<b>A Survey on DBN for Intrusion Detection in IoT . . . . .</b>	<b>339</b>
	Harsh Namdev Bhor and Mukesh Kalla	
<b>34</b>	<b>Organ Detection in Surgical Videos Using Neural Networks . . . . .</b>	<b>345</b>
	Amit Kumar, Anshu Gupta, and Ankita Pramanik	
<b>35</b>	<b>Implementation Aspects of Multi-bit Adders Using UTBSOI Transistors . . . . .</b>	<b>355</b>
	Rekib Uddin Ahmed and Prabir Saha	
<b>36</b>	<b>Accelerating Latency of Binary Division Through Vedic Methodology . . . . .</b>	<b>365</b>
	Deepak Kumar and Prabir Saha	
<b>37</b>	<b>Monitoring the torsional vibrations on the main propulsion plant of marine cargo ship installed two-stroke diesel engine: Theoretical case study . . . . .</b>	<b>379</b>
	Do Duc Luu and Cao Duc Hanh	
<b>38</b>	<b>Analysing Different Full Adder Based on 45 nm Technology . . . . .</b>	<b>393</b>
	Ankit Kumar, Shyam Akashe, and Seelam VSV Prabhu Deva Kumar	
<b>39</b>	<b>Design of RF Energy Harvesting Circuit at 900 MHz for Low-Powered DC Applications . . . . .</b>	<b>401</b>
	Anoop Chiluveru, Shyam Akashe, and Shailendra Singh Ojha	

<b>40</b>	<b>Noise Voltage: A New Dependability Concern in Low-Power FinFET-Based Priority Encoder at 45 nm Technology . . . . .</b>	<b>411</b>
	Vishwas Mishra, Abhishek Kumar, Shobhit Tyagi, Divya Mishra, and Shyam Akashe	
<b>41</b>	<b>Assessment of Suitability of Metaheuristics and Machine Learning for Task Scheduling Process: A Review of Aptness in Heavy Task Environments . . . . .</b>	<b>419</b>
	Shantanu Anandrao Lohi and Nandita Tiwari	
<b>42</b>	<b>A Review on Indian UID-Based Automated Electoral Roll Generation Mechanism Shunning Duplication and Redundancy . . .</b>	<b>427</b>
	Harish Vasant Rao Gorewar and Nandita Tiwari	
<b>43</b>	<b>A Review of Deep Learning Techniques for Identification and Diagnosis of Plant Leaf Disease . . . . .</b>	<b>435</b>
	Ravindra Namdeorao Jogekar and Nandita Tiwari	
<b>44</b>	<b>Analysis and Prediction of Student Data Using Data Science: A Review . . . . .</b>	<b>443</b>
	Sandeep S. Ganorkar, Nandita Tiwari, and Varsha Namdeo	
<b>45</b>	<b>Efficient Target Detection and Classification of SAR Images Using Z-Buffer Convolutional Neural Networks . . . . .</b>	<b>449</b>
	P. Vasuki, A. Shakin Banu, S. Mohamed Mansoor Roomi, and G. Maragatham	
<b>46</b>	<b>Context-Aware Deep Convolutional Neural Network Application for Fire and Smoke Detection in Virtual Environment for Surveillance Video Analysis . . . . .</b>	<b>459</b>
	Akm Ashiquzzaman, Sung Min Oh, Dongsu Lee, Jihoon Lee, and Jinsul Kim	
<b>47</b>	<b>Design and Development of Efficient Cost-Saving Algorithms for Guiding Customer Purchasing Patterns in Modern Consumerism Scenario Using Feed Forward Back Propagation Neural Networks . . . . .</b>	<b>469</b>
	Sonia Maria D’Souza and K. Satyanarayan Reddy	
<b>48</b>	<b>Mild Cognitive Impairment and Technology for Older Adults: A Review . . . . .</b>	<b>477</b>
	Nita Rosa Damayanti and Nazlena Mohamad Ali	
<b>49</b>	<b>Identify Education Quality Based on Islamic Senior High School Data in <i>Kompetisi Sains Madrasah</i> Using Fuzzy C-Means Clustering . . . . .</b>	<b>487</b>
	Dian Candra Rini Novitasari, Abdullah Faqih, Noor Wahyudi, Nurissaidah Ulinnuha, Zakiatul Ulya, Ali Mustofa, Ahmad Fauzi, Ahmad Hanif Asyhar, Kusaeri, Dwi Rolliawati, and Ahmad Yusuf	



**50 Obstacle Avoidance with Sensors Using Soft Computing Techniques . . . . . 497**  
Amit Yadav, Garima Jain, Divya Mishra, and Dharvendra P. Yadav

**Author Index. . . . . 507**

## About the Editors

**Prof. Yu-Dong Zhang** received his B.S. and M.S. degrees from Nanjing University of Aeronautics and Astronautics in 2004 and 2007, prior to completing his Ph.D. in Signal and Information Processing at Southeast University in 2010. From 2010 to 2012, he worked at Columbia University as a postdoc. From 2012 to 2013, he worked as a research scientist at Columbia University and New York State Psychiatric Institute. From 2013 to 2017, he worked as a Full Professor and doctoral advisor at the School of Computer Science and Technology, Nanjing Normal University. Since 2018, he has been a Full Professor at the Department of Informatics, University of Leicester, UK.

**Prof. Tomonoby Senjyu** received his B.S. and M.S. degrees in Electrical Engineering from the University of the Ryukyus, Nishihara, Japan, in 1986 and 1988, respectively, and his Ph.D. in Electrical Engineering from Nagoya University, Japan, in 1994. He is currently a Full Professor at the Department of Electrical and Electronics Engineering, University of the Ryukyus. His research interests include renewable energy, power system optimization and operation, power electronics, and advanced control of electrical machines.

**Prof. Chakchai SO-IN** has been with the Department of Computer Science at Khon Kaen University since 2010. Dr. SO-IN received his B.E. and M.E. degrees from Kasetsart University (KU), Bangkok, Thailand, in 1999 and 2001, respectively. He also completed M.S. and Ph.D. degrees in Computer Engineering at the Department of Computer Science and Engineering, Washington University, in St. Louis (WUSTL), MO, USA, in 2006 and 2010. He has authored more than 100 publications in prominent journals and proceedings, together with 10 books. His research interests include mobile computing/sensor networks, Internet of Things, computer/wireless/distributed networks, cyber security, intelligent systems and the future Internet. He is a senior member of the IEEE and ACM.

**Dr. Amit Joshi** is currently Director of the Global Knowledge Research Foundation, and an entrepreneur and researcher. Holding a B.Tech. in Information Technology and M.Tech. in Computer Science and Engineering, he has conducted extensive research in the areas of cloud computing and cryptography in medical imaging, with a focus on analyzing current government strategies and global forums concerning security. Dr. Joshi has more than 10 years of experience in academia and industry, having worked at prestigious organizations. He is an active member of the ACM, IEEE, CSI, AMIE, IACSIT Singapore, IDES, ACEEE, NPA, and many other professional societies. Currently, he is the International Chair of InterYIT at the International Federation of Information Processing (IFIP, Austria). He has presented and published more than 50 papers in national and international journals/conferences of the IEEE and ACM, and has edited more than 20 books for Springer, ACM, and other reputed publishers. He has also organized more than 40 national and international conference and workshops in association with the ACM, Springer, and the IEEE, e.g. in India, the UK, Thailand, and Europe.

## Chapter 22

# Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature



Nita Merlina, Edi Noersasongko, Pulung Nurtantio, M. A. Soeleman, Dwiza Riana, and Sri Hadianiti

**Abstract** Color image segmentation on cytoplasm Pap smear single cell image identified as normal condition is an interesting subject to study. It is caused by the image limitation and morphological transformation complexity of the cell structural part. Feature analysis on cytoplasm area is an important thing in the process of biomedical image analysis because of the noise and complex background and the bad cytoplasm contrast as well. Thus, an analysis on the feature area on cytoplasm automatically is an urge thing to do to identify Pap smear normal cell image based on feature analysis on cytoplasm area in single cell image identified as normal condition. The purpose of this research is to analyze how far the process color image segmentation on cytoplasm by using normal single cell image is able to produce features of texture and form analysis. To analyze the form of cytoplasm, this research used RGB color to HSV color conversion method which produces metric and eccentricity value. It is then continued to the process of threshold image and counting the wide area by changing threshold into binary image. On the other side, to analyze the texture, this research applied an analysis using gray-level co-occurrence matrix (GLCM) using  $K$ -means method to produce contrast, correlation, energy, and homogeneity parameters. The result of the research is the segmentation outcome to Pap smear normal single cell image sample to get metric, eccentricity, contrast, correlation, and energy features.

## 22.1 Introduction

Women are generally susceptible to cervical cancer, which ranks fourth as a very deadly disease [1]. Papanicolaou test also called Pap smear or Pap test is a health test method that can help prevent cervical cancer. The main purpose of a Pap smear

---

N. Merlina (✉) · E. Noersasongko · P. Nurtantio · M. A. Soeleman  
Universitas Dian Nuswantoro, Semarang, Indonesia  
e-mail: [nita@mhs.dinus.ac.id](mailto:nita@mhs.dinus.ac.id)

N. Merlina · D. Riana · S. Hadianiti  
STMIK Nusa Mandiri, Jakarta, Indonesia

© The Editor(s) (if applicable) and The Author(s), under exclusive license  
to Springer Nature Singapore Pte Ltd. 2021

Y.-D. Zhang et al. (eds.), *Smart Trends in Computing and Communications: Proceedings of SmartCom 2020*, Smart Innovation, Systems and Technologies 182,  
[https://doi.org/10.1007/978-981-15-5224-3\\_22](https://doi.org/10.1007/978-981-15-5224-3_22)

is to detect cell abnormalities that may occur or before the cancer develops. Correct interpretation of microscopic examination of cells and tissues is very important for the final diagnosis judgment of the disease [2]. However, the Pap smear testing process has weaknesses, especially in many developing countries where the number of pathologists who can examine slides is inadequate. In Indonesia, with a population of productive age women spread across 32 provinces with limited facilities and limited human resources, it is estimated that 80% of the coverage of examinations will be completed in five years with 7,992,486 Pap smear tests per year [3].

The classification of cervical cells in Pap smear images is an interesting thing because of image limitations and the complexity of morphological alterations in the structural parts of cells [4]. Pap smear image processing has been performed for single cell types and non-overlapping. Image segmentation process is expected to identify cytoplasm and nucleus images [5–7]. Segmentation is needed to define the area of interest (ROI) in a normal single cell image and is the basis of an automatic cervical cancer screening system. Efficient image segmentation enables extraction of significant information and streamlines image data for further analysis. Weak segmentation results in weak results during image analysis [8]. Analysis of features in the cytoplasm area in normal Pap smear cell images is interesting. That is due to image limitations and the complexity of morphological changes in the structural parts of cells. Analysis of features in the cytoplasm area is important in the process of analyzing biomedical images, and it is caused by background noise and complex and weak cytoplasm contrast. So, it is necessary to do an analysis of the features of the area in the cytoplasm by automation to identify the normal Pap smear cell image based on the analysis of the features of the cytoplasm area in a single cell image that is detected normally. The purpose of this research is to see the extent of the process of analyzing feature areas in the cytoplasm by using a normal single cell image so that features of texture and shape analysis can be produced. The results of this study are expected to facilitate the identification of cytoplasm images from Pap smear images.

This paper is divided into several sections. Section 22.2, related work, discusses about the methods used in the research. Section 22.3 describes the results and discussion, which will be enclosed with conclusions and further research plans.

## 22.2 Related Work

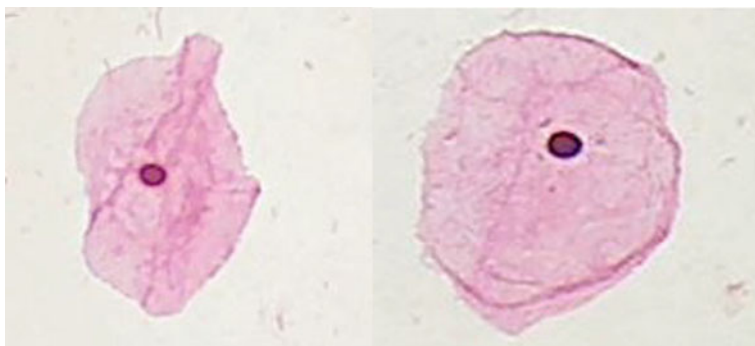
There are many methods used to identify the area of cytoplasm image, and this study attempts to do different things, which is to propose a segmentation method for cytoplasm area in a single Pap smear image that utilizes the GLCM feature. This GLCM feature has not been widely used in previous research. In the initial detection of a Pap smear image, a single cell image is easy to observe [9]. In the previous research, cytoplasm detection process has been successfully carried out by

color classification using *K*-means and joint shape matching. However, this research is limited only to determine the presence of cytoplasm and not to determine the extent of cytoplasm in detail [10, 11]. The gray-level co-occurrence matrix (GLCM) previous studies have been used, but they use a dataset from a nearby hospital and only discuss cervical cancer related without the Pap smear cell being used [12].

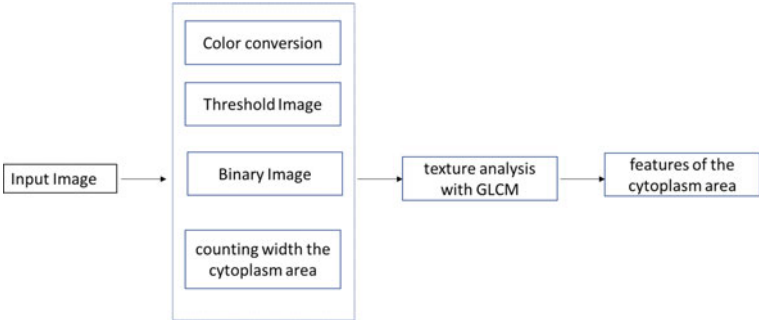
## 22.3 Method

Data processing techniques use the MATLAB application program on color and binary image matrices as well as analyzing textures. In order to determine the area in cytoplasm image, the initial step of this research is to convert RGB color to HSV color (hue, saturation, value). The HSV color model was formulated by searching the RGB color cube along the gray axis of the color wheel, where this model is more widely used than RGB in depicting color sensations. After the HSV color conversion is generated, the next step is to determine the threshold image and calculate the area of the area by changing the threshold image into a binary image that aims to calculate objects in a digital image in a simple way from the original image. In this process, we need a boundary value called the threshold value. Image intensity values that are more than or equal to the threshold value will be changed to white (1), while image intensity values less than the threshold value will be changed to black (0) [13]. Furthermore, to analyze the texture of the image of the area value that has been segmented by the *K*-means method and the researcher uses the Gray-Level Co-Occurrence Matrix (GLCM) so that the parameters obtained are contrast, correlation, energy, and homogeneity. The results of this research are the results of segmentation of a single Pap smear normal cell image sample so that it can be done well and is able to get the features of metric, eccentricity, contrast, correlation, and energy [14], where the texture has characteristics that can be extracted to distinguish an image with another image. Figure 22.1 shows the image of a single cell used in this study.

In this study, a research flow diagram is shown in Fig. 22.2 on the digital image of papers.



**Fig. 22.1** Example of a single cell image



**Fig. 22.2** Research stages

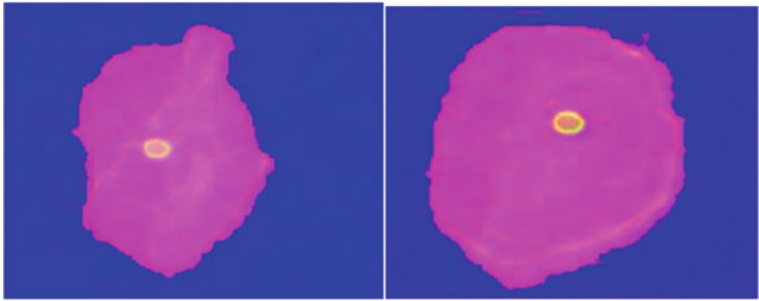
**22.4 Results and Discussion**

**22.4.1 Result**

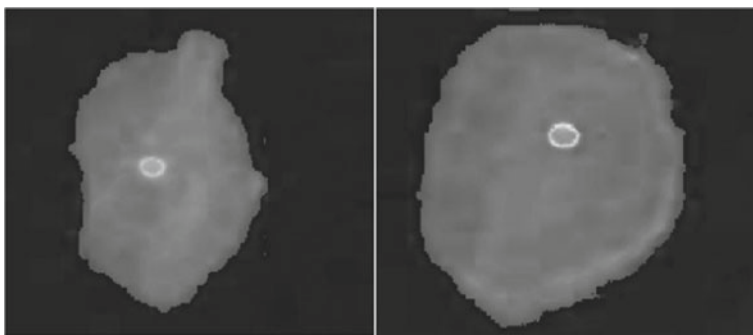
The stages of the research consisting of five stages of the process are evaluated on traditional Pap smear images. All of these images were obtained through a Logitech camera (Logitech HD C525 Webcam) adjusted to an optical microscope (Olympus CH20). 40× amplification is used, and the results are saved in JPEG format. The following are the results of the process of segmentation methods in each.

**22.4.1.1 Convert RGB Color to HSV Color**

The result of the conversion of RGB color into HSV color aims to detect the cytoplasm so as to produce an image as shown in Fig. 22.3, where the cytoplasm has a color that is more dominant than the nucleus.



**Fig. 22.3** Image results from color conversion



**Fig. 22.4** Image from threshold

#### **22.4.1.2 Threshold Image**

When analyzing an area in the cytoplasm, the initial process is to determine the edge of the object from a single normal cell. The results of edge detection in normal single cell images are taken from images that have been converted to HSV color, and Fig. 22.4 shows images of edge detection.

#### **22.4.1.3 Binary Imagery**

The calculation process of the attributes that exist in a single normal Pap smear cell can be simply done by the process of conversion to binary images; after the conversion process is carried out, the area calculation process can be carried out, along with pictures that present the results of binary images (Figs. 22.5, 22.6, and 22.7).



**Fig. 22.5** Binary image



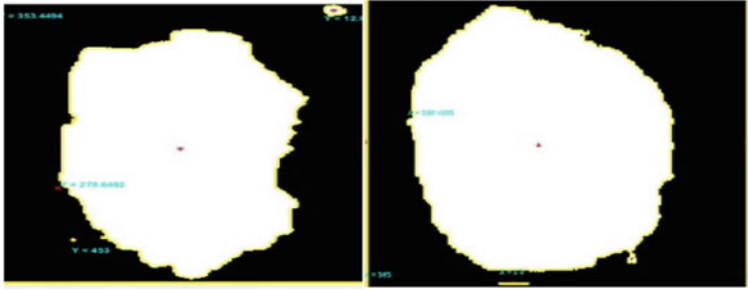


Fig. 22.6 Width binary image

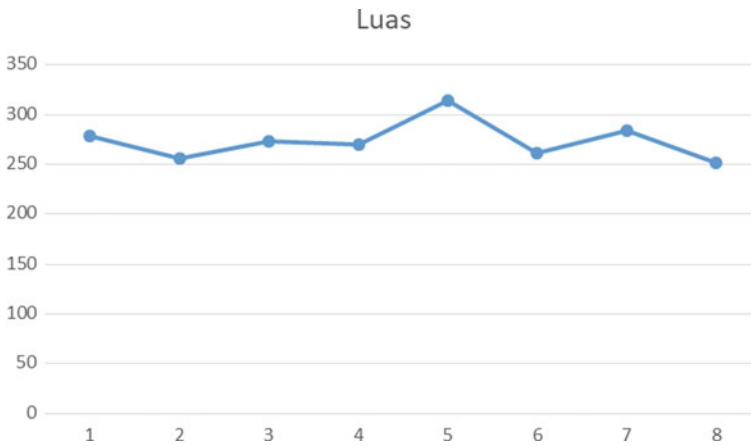


Fig. 22.7 Chart width of binary image

#### 22.4.1.4 Gray-Level Co-occurrence Matrix (GLCM)

The process of this GLCM is to analyze the texture of the cytoplasm area, so that this research results in segmentation of a single Pap smear normal cell image sample by producing metric, eccentricity, contrast, correlation, and energy features. The following are the formulas for calculating the metric feature, eccentricity, contrast, correlation, and energy:

$$\text{Contrast} = \sum_{i_1} \sum_{i_2} (i_1 - i_2)^2 p(i_1, i_2) \quad (22.1)$$

$$\text{Homogeneity} = \sum_{i_1} \sum_{i_2} \frac{p(i_1, i_2)}{1 + |i_1 - i_2|} \quad (22.2)$$

$$\text{Energy} = \sum_{i_1} \sum_{i_2} p^2(i_1, i_2) \quad (22.3)$$

**Table 22.1** Texture of the cytoplasm area

Metric	Eccentricity	Contrast	Correlation	Energy	Homogeneity
0.01	1	0.01	0.99	0.57	1
0.01	0.46	0.01	0.98	0.49	0.99
0.01	1	0.01	0.99	0.49	1
0.02	1	0.01	0.99	0.51	1
0.95	0.7	0.01	0.99	0.53	1
0.78	0.7	0.01	0.88	0.95	1
0.01	0.73	0.01	0.98	0.52	0.99
0.67	0.53	0.01	0.99	0.5	1

$$\text{Entropy} = - \sum_{i_1} \sum_{i_2} p(i_1, i_2) \log p(i_1, i_2) \tag{22.4}$$

$$\text{Eccentricity} = e = \sqrt{1 - \frac{b^2}{a^2}} \tag{22.5}$$

$$\text{Metric} = M = \frac{4\pi \times A}{C^2} \tag{22.6}$$

Table 22.1 gives the results of the GLCM calculations that have been carried out.

**22.4.2 Discussion**

In this study, we segmented Pap smear images by taking ten image from a single normal goal, but there are two images that are not segmented perfectly; this is because there is noise in the image, so the segmentation is done using the method taken less than perfect.

**22.5 Conclusion**

The results of this study are to see the extent of the cytoplasm color image segmentation process using normal single cell images so that features of texture and shape analysis can be produced. To analyze the shape of the cytoplasm, this study uses the method of converting RGB color conversion into HSV color conversion that produces metric and eccentricity values and then proceeds with the process to determine the threshold image and calculate the area of the area by changing the threshold image which becomes a binary image. For texture analysis, the analysis is done using the gray-level co-occurrence matrix (GLCM) method which uses the *K*-means method

to obtain contrast, correlation, energy, and homogeneity parameters. The results of this research are the results of segmentation of normal Pap smear single cell image samples so that they can be done well and are able to get the features of metric, eccentricity, contrast, correlation, and energy. The limitation of this study is that the number of samples used needs to be increased so that it will produce more feature data to get more extensive information. This research is a preliminary study for cytoplasm recognition. Further research will focus on segmentation of the cytoplasm in single Pap smear cells by adding new features besides GLCM. Another thing to do is research for group Pap smears.

## References

1. Irawan, F.: Statistik penderita kanker di Indonesia (2018)
2. Riana, D., Widyantoro, D.H., Mengko, T.L.: Extraction and classification texture of inflammatory cells and nuclei in normal pap smear images. In: 2015 4th International Conference on Instrumentation, Communications, Information Technology, and Biomedical Engineering (2015)
3. Kusuma, F.: Tes Pap Dan Cara Deteksi Dini Kanker Serviks Lainnya, Departemen Obstetri dan Ginekologi Fakultas Kedokteran Universitas Indonesia RSUPN Dr. Cipto Mangunkusumo, Prevention and Early Detection of Cervical Cancer (PEACE), Jakarta (2012)
4. Plissiti, S.E., Dimitrakopoulos, P., Sfikas, G., Nikou, C., Krikoni, O., Charchanti, A.: Dataset for feature and image based classification of normal and pathological cervical cells in pap smear images. In: 25th IEEE International Conference on Image Processing (2018)
5. Lu, Z., Carneiro, G., Bradley, A.P.: Automated nucleus and cytoplasm segmentation of overlapping cervical cells. In: International Conference on Medical Image Computing and Computer-Assisted Intervention, vol 8149. Lecture Notes in Computer Science, pp. 452–460 (2013)
6. Zhao, L., Li, K., Wang, M., Yin, J., Zhu, E., Wu, C., Wang, S., Zhu, C.: Automatic cytoplasm and nuclei segmentation for color cervical smear image using an efficient gap-search MRF 46. *Comput. Biol. Med.* **71**, 46 (2016). ISSN 00104825
7. Riana, D., Hidayanto, A.N., Widyantoro, D.H., Mengko, T.L.R., Kalsoem, O.: Segmentation of overlapping cytoplasm and overlapped areas in Pap smear images. In: Information, Intelligence, Systems & Applications (IISA), pp. 1–5 (2017)
8. Sun, G., Li, S., Cao, Y., Lang, F.: Cervical cancer diagnosis based on random forest. *Int. J. Performability Eng.* (2017)
9. Riana, D., Ramdhani, Y., Prasetyo, R.T., Hidayanto, A.N.: Improving hierarchical decision approach for single image classification of pap smear. *Int. J. Electr. Comput. Eng.* **8**, 5415–5424 (2018)
10. Riana, D., Tohir, H., Hidayanto, A.N.: Segmentation of Overlapping Areas on Pap Smear Images with Color Features Using K-Means and Otsu Methods (2018). <https://ieeexplore.ieee.org/xpl/conhome/8767368/proceeding>
11. Song, Y., Qin, J., Lei, B., He, S., Choi, K.-S.: Joint shape matching for overlapping cytoplasm segmentation in cervical smear images. In: 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019) Venice, Italy, pp. 191–194 (2019)
12. Nehra, S., Raheja, J.L., Butte, K., Zope, A.: Detection of cervical cancer using GLCM and support vector machines, pp. 49–53. <https://ieeexplore.ieee.org/xpl/conhome/8768798/proceeding>

13. Pamungkas, A.: Pemrograman Matlab (2019). [Online]. Available: <https://pemrogramanmatlab.com/pengolahan-citra-digital/segmentasi-citra>
14. Bhan, S., Vyas, A., Mishra, G.: Supervised segmentation of overlapping cervical pap smear images. In: 2016 International Conference on Signal Processing and Communications (2016)

# Author Index

## A

Aberathne, Iroshan, 125  
Ahmed, Rekib Uddin, 355  
Akashe, Shyam, 393, 401, 411  
Ali, Nazlena Mohamad, 477  
Anand, V., 69  
Anil Kumar, Tippiarti, 49  
Anjaneyulu, Lokam, 49  
Anton, Anton, 291  
Ara, Jasmine, 331  
Arnita, 259  
Asfaqur Rahman, Md., 135  
Ashiquzzaman, Akm, 459  
Asyhar, Ahmad Hanif, 211, 221, 281, 487

## B

Bab-Hadiashar, Alireza, 113  
Bandhopadhyay, Ayan Kumar, 241  
Bhattacharjee, Disha, 269  
Bhattacharjee, Payal, 1  
Bhor, Harsh Namdev, 339

## C

Chiluveru, Anoop, 401

## D

Damayanti, Nita Rosa, 477  
Das, Utpal Chandra, 147  
Dey, Anup, 201, 269  
Diah Nugraheni Setyowati, R. R., 249, 259  
D'Souza, Sonia Maria, 469

## E

Eriksson, Niklas, 39

## F

Fagerstrøm, Asle, 39  
Faqih, Abdullah, 487  
Fauzi, Ahmad, 211, 221, 281, 487  
Febrianti, Fitria, 259  
Feng, Li, 95  
Foeady, Ahmad Zoebad, 259

## G

Ganguly, Amrita, 331  
Ganorkar, Sandeep S., 443  
Gao, Biying, 25  
Gautham, K., 101  
Gorewar, Harish Vasantrao, 427  
Gostar, Amirali K., 113  
Goswami, Bijoy, 201, 269  
Gupta, Anshu, 345  
Gupta, Manisha, 311

## H

Hadianti, Sri, 231  
Hafiyusholeh, Moh., 259  
Hanh, Cao Duc, 379  
Haque, Munima, 147  
Haque, Shahina, 147  
Hasna Hena, Most., 135, 183  
Hastuti, Nanik Puji, 221  
Helal Sheikh, Md., 183  
Heryadi, Yaya, 301  
Hoseinnezhad, Reza, 113

**I**

Indriyati, Ratna, 281  
Ishtiaq, Nida, 113

**J**

Jain, Garima, 497  
Jana, Abir, 201, 269  
Jogekar, Ravindra Namdeorao, 435

**K**

Kalla, Mukesh, 339  
Karuppiah, Anupama, 319  
Kim, Jinsul, 459  
Kissaka, Mussa M., 83  
Koley, Chaitali, 241  
Kumar, Abhishek, 411  
Kumar, Amit, 345  
Kumar, Ankit, 393  
Kumar, Arun, 69  
Kumar, Deepak, 365  
Kumar, Seelam VSV Prabhu Deva, 393  
Kumar, S. S., 57  
Kumar, Suresh, 311  
Kumari, Komal, 201, 269  
Kusaeri, 211, 221, 281, 487

**L**

Lakhanawannakun, Phoemporn, 159  
Lee, Dongsu, 459  
Lee, Jihoon, 459  
Leela Velusamy, R., 101  
Li, Danyang, 25  
Li, Xinlai, 25  
Lohi, Shantanu Anandrao, 419  
Loktongbam, Paikhomba, 241  
Lukas, 301  
Luu, Do Duc, 379

**M**

Mahbubur Rahman, Md., 135  
Maheshwari, Raghav, 319  
Maragatham, G., 449  
Marouf, Ahmed Al, 183  
Maryunah, 281  
Merlina, Nita, 231  
Min Oh, Sung, 459  
Mishra, Divya, 411, 497  
Mishra, Vishwas, 411  
Mohamed Mansoor Roomi, S., 449  
Mustofa, Ali, 211, 221, 281, 487

Mvungi, Nerey H., 83  
Mwifunyi, Rukia J., 83

**N**

Namdeo, Varsha, 443  
Nampromma, Jatupol, 159  
Nandi, Poushali, 201  
Nariswari, Rinda, 259  
Noersasongko, Edi, 231  
Novitasari, Dian Candra Rini, 211, 221, 249, 259, 281, 487  
Nurtantio, Pulung, 231

**O**

Ojha, Shailendra Singh, 401

**P**

Pal, Debashish, 241  
Panicker, Sabita, 113  
Paul, Bijan, 331  
Pradeep, Arun, 57  
Pramanik, Ankita, 345  
Pramulya, Rahmat, 249  
Puspitasari, Wahyu Tri, 249

**Q**

Qiu, Liwen, 95  
Quamruzzaman, M., 147

**R**

Raghavendra, G. S., 69  
Ramachandran, Anita, 319  
Ramya, M. M., 1  
Rathnayake, Udara, 125  
Ravi, Akshay, 101  
Reddy, K. Satyanarayan, 469  
Riana, Dwiza, 231  
Richard, 301  
Rohayani, Hetty, 249  
Rolliawati, Dwi, 211, 221, 281, 487  
Rozi, Muhammad Fahrur, 249  
Rustad, Supriadi, 291

**S**

Saha, Prabir, 355, 365  
Santi, Dwi Rukma, 249  
Sarkar, Subir Kumar, 201, 269  
Setiawan, Fajar, 259

Shahriar Nawal Shoumik, Md., [135](#)  
Shakin Banu, A., [449](#)  
Shamim Reza, Md., [183](#)  
Shankar Lingam, M., [69](#)  
Sharma, Akhilesh Kumar, [17](#)  
Shidik, Guruh Fajar, [291](#)  
Shrivastav, Devesh K., [17](#)  
Sigurdsson, Valdimar, [39](#)  
Soeleman, M. A., [231](#)  
Sreeja, K. A., [57](#)  
Sripranav, S., [101](#)  
Sudhakara, A. M., [69](#)  
Syukur, Abdul, [291](#)

**T**

Taj, Malaika Afra, [319](#)  
Tangtrakul, Ekaphong, [159](#)  
Tiwari, Nandita, [419](#), [427](#), [435](#), [443](#)  
Tiwari, Vivekanand, [193](#)  
Trisetyarso, Agung, [301](#)  
Tsujioka, Keiko, [171](#)  
Tyagi, Shobhit, [411](#)

**U**

Ulinnuha, Nurissaidah, [211](#), [221](#), [281](#), [487](#)

Ulya, Zakiyatul, [211](#), [221](#), [281](#), [487](#)  
Umar, A., [211](#)

**V**

Vasuki, P., [449](#)

**W**

Wahyudi, Noor, [211](#), [221](#), [281](#), [487](#)  
Walgampaya, Chamila, [125](#)  
Widjajanto, Ary, [249](#)  
Wulandari, Putri, [259](#)

**Y**

Yadav, Amit, [497](#)  
Yadav, Dharvendra P., [497](#)  
Yadav, Dinesh, [193](#)  
Yao, Shumin, [95](#)  
Yusuf, Ahmad, [211](#), [221](#), [281](#), [487](#)

**Z**

Zhang, Lianbo, [95](#)  
Zhao, Jing, [95](#)  
Zhao, Qinglin, [95](#)

**LEMBAR**  
**HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW**  
**KARYA ILMIAH : PROSIDING**

Judul Artikel : Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature  
Jumlah Penulis : 6  
Status Pengusul : 1  
Identitas Prosiding :  
a. Judul Prosiding : Smart Trends in Computing and Communications: Proceedings of SmartCom  
b. ISBN/ISSN : 978-981-15-5223-6/2190-3018  
c. Thn. Terbit, Tempat : 2020, 24-25 Januari, Bangkok  
d. Web Prosiding : [https://link.springer.com/chapter/10.1007/978-981-15-5224-3\\_22](https://link.springer.com/chapter/10.1007/978-981-15-5224-3_22)  
e. Terindex di : Scopus

Kategori Publikasi Prosiding (beri ✓ pada kategori yang tepat) :  
☐ Prosiding Internasional  
☐ Prosiding Nasional  
☒ Prosiding Terindex Scopus

**I. Hasil Penilaian Validasi :**

No	Aspek	Uraian/Komentar Penilaian
1	Indikasi Plagiasi	Tidak terdeteksi indikasi plagiat (22%).
2	Linieritas	Linear di bidang penulis (ilmu komputer).

**II. Hasil Penilaian Peer Review:**

Komponen Yang Dinilai	Nilai Maksimal Prosiding (isi kolom yang sesuai)			Nilai Akhir Yang Diperoleh
	Prosiding Internasional	Prosiding Nasional	Prosiding Terindex	
Kelengkapan dan kesesuaian unsur isi prosiding (10%)			4.0	3.1
Ruang lingkup dan kedalaman pembahasan (30%)			1.2	8.0
Kecukupan dan kemutakhiran data/informasi dan metodologi (30%)			1.2	10
Kelengkapan unsur dan kualitas Penerbit (30%)			1.2	10
Total = (100%)			4.0	18.6
Kontribusi pengusul: (contoh: nilai akhir peer X Penulis kedua : dibagi 2 penulis = 13 X 40% = 5.2 : 2.6 (nilai akhir yang diperoleh pengusul)				60%
Komentar/ Ulasan Peer Review :				
Kelengkapan kesesuaian unsur	Artikel ini disajikan dengan format yang baik dan menggunakan metode-metode standar penelitian ilmiah			



<p>Ruang lingkup dan kedalaman pembahasan</p>	<p>Karya ini cenderung membahas. pyramton object Cytoplasm yg membuat inti sel kanker. shg membuat object yg spesifik ttg di idetifikasi.</p>
<p>Kecukupan dan kemutakhiran data/informasi dan metodologi</p>	<p>Mendek 35. Sangat rapi sangat rapi. sehingga menjadi rujukan dalam penelitian selanjutnya. Data yg dibekal cukup lengkap dan memadai.</p>
<p>Kelengkapan unsur dan kualitas Penerbit</p>	<p>Penerbit adalah Springer 35 memberikan penerbitan High Level dalam unpublikasi Artikel ilmiah</p>

Penilai I



**Prof. Dr. Jufriadif Na'am, S.Kom., M.Kom.**

NIDN : 1003026702  
 Unit kerja : Universitas Nusa Mandiri  
 Bidang Ilmu : Ilmu Komputer  
 Jabatan Akademik (KUM) : Guru Besar (850KUM)  
 Pendidikan Terakhir : Strata 3 (Doktor)

**LEMBAR**  
**HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW**  
**KARYA ILMIAH : *PROSIDING***

Judul Artikel : Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature  
 Jumlah Penulis : 6  
 Status Pengusul : 1  
 Identitas *Prosiding* :  
     a. Judul *Prosiding* : Smart Trends in Computing and Communications: Proceedings of SmartCom  
     b. ISBN/ISSN : 978-981-15-5223-6/2190-3018  
     c. Thn. Terbit, Tempat : 2020. 24-25 Januari, Bangkok  
     d. Web *Prosiding* : [https://link.springer.com/chapter/10.1007/978-981-15-5224-3\\_22](https://link.springer.com/chapter/10.1007/978-981-15-5224-3_22)  
     e. Terindex di : Scopus

Kategori Publikasi *Prosiding*  
 (beri  $\checkmark$  pada kategori yang tepat) :  
☐ *Prosiding* Internasional  
☐ *Prosiding* Nasional  
☒ *Prosiding* Terindex Scopus

I. Hasil Penilaian Validasi :

No	Aspek	Uraian/Komentar Penilaian
1	Indikasi Plagiasi	Indikasi plagiasi rendah dengan tingkat similarity 22%
2	Linieritas	Isi paper linier sesuai dengan bidang ilmu penulis

II. Hasil Penilaian Peer Review:

Komponen Yang Dinilai	Nilai Maksimal <i>Prosiding</i> (isi kolom yang sesuai)			Nilai Akhir Yang Diperoleh
	<i>Prosiding</i> Internasional	<i>Prosiding</i> Nasional	<i>Prosiding</i> Terindex	
Kelengkapan dan kesesuaian unsur isi <i>prosiding</i> (10%)			4	3,65
Ruang lingkup dan kedalaman pembahasan (30%)			12	10,95
Kecukupan dan kemutakhiran data/informasi dan metodologi (30%)			12	10,95
Kelengkapan unsur dan kualitas Penerbit (30%)			12	10,95
<b>Total = (100%)</b>			<b>40</b>	<b>36,5</b>
Kontribusi pengusul: (contoh: nilai akhir peer X Penulis kedua : dibagi 2 penulis = $13 \times 40\% = 5,2 : 2,6$ (nilai akhir yang diperoleh pengusul))				$36,5 \times 60\% = 21,9$
Komentar/ Ulasan <i>Peer Review</i> :				
Kelengkapan kesesuaian unsur	kelengkapan isi paper baik, kesesuaian unsur sesuai kaidah ilmiah			



Ruang lingkup dan kedalaman pembahasan	Ruang lingkup dan kedalaman pembahasan cukup baik dan isi paper sesuai dengan lingkup yang dibahas.
Kecukupan dan kemutakhiran data/informasi dan metodologi	Kecukupan dan kemutakhiran data cukup jelas, metode yang digunakan sudah cukup bagus
Kelengkapan unsur dan kualitas Penerbit	Kelengkapan unsur dan kualitas penerbit sudah lengkap sesuai dengan penulisan, Paper ini dipresentasikan pada Prosiding Internasional terindex scopus tahun 2020

Penilai II



Linda Marlinda, M.M., M.Kom

NIDN : 0312077201  
 Unit kerja : Universitas Nusa Mandiri  
 Bidang Ilmu : Ilmu Komputer  
 Jabatan Akademik (KUM) : Lektor Kepala/700  
 Pendidikan Terakhir : S2

# Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature

*by* Nita Merlina

---

**Submission date:** 18-Apr-2023 08:57AM (UTC+0700)

**Submission ID:** 2067851600

**File name:** Width\_of\_Pap\_Smear\_Cytoplasm\_Image\_Based\_on\_GLCM\_Feature\_3.pdf (1.08M)

**Word count:** 6264

**Character count:** 35175

Smart Innovation, Systems and Technologies 182

Yu-Dong Zhang  
Tomonoby Senjyu  
Chakchai SO-IN  
Amit Joshi *Editors*



# Smart Trends in Computing and Communications: Proceedings of SmartCom 2020

 KES  
International

 Springer

# **Smart Innovation, Systems and Technologies**

Volume 182

## **Series Editors**

Robert J. Howlett, Bournemouth University and KES International,  
Shoreham-by-sea, UK

Lakhmi C. Jain, Faculty of Engineering and Information Technology,  
Centre for Artificial Intelligence, University of Technology Sydney,  
Sydney, NSW, Australia

The Smart Innovation, Systems and Technologies book series encompasses the topics of knowledge, intelligence, innovation and sustainability. The aim of the series is to make available a platform for the publication of books on all aspects of single and multi-disciplinary research on these themes in order to make the latest results available in a readily-accessible form. Volumes on interdisciplinary research combining two or more of these areas is particularly sought.

The series covers systems and paradigms that employ knowledge and intelligence in a broad sense. Its scope is systems having embedded knowledge and intelligence, which may be applied to the solution of world problems in industry, the environment and the community. It also focusses on the knowledge-transfer methodologies and innovation strategies employed to make this happen effectively. The combination of intelligent systems tools and a broad range of applications introduces a need for a synergy of disciplines from science, technology, business and the humanities. The series will include conference proceedings, edited collections, monographs, handbooks, reference books, and other relevant types of book in areas of science and technology where smart systems and technologies can offer innovative solutions.

High quality content is an essential feature for all book proposals accepted for the series. It is expected that editors of all accepted volumes will ensure that contributions are subjected to an appropriate level of reviewing process and adhere to KES quality principles.

**\*\* Indexing: The books of this series are submitted to ISI Proceedings, EI-Compendex, SCOPUS, Google Scholar and Springerlink \*\***

More information about this series at <http://www.springer.com/series/8767>

Yu-Dong Zhang · Tomonoby Senjyu ·  
Chakchai SO-IN · Amit Joshi  
Editors

# Smart Trends in Computing and Communications: Proceedings of SmartCom 2020

 Springer




*Editors*

Yu-Dong Zhang  
School of Informatics  
University of Leicester  
Leicester, England, UK

Chakchai SO-IN  
Khon Kaen University  
Khon Kaen, Thailand

Tomonoby Senjyu  
University of the Ryukyus  
Nishihara, Japan

 Amit Joshi  
Global Knowledge Research Foundation  
Gujarat, India

ISSN 2190-3018 ISSN 2190-3026 (electronic)  
Smart Innovation, Systems and Technologies  
ISBN 978-981-15-5223-6 ISBN 978-981-15-5224-3 (eBook)  
<https://doi.org/10.1007/978-981-15-5224-3>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2021

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

## Preface

This SIST volume contains the papers presented at the SmartCom 2020: Fourth International Conference on Smart Trends for Computing and Communications. The conference was held during January 24–25, 2020, at Hotel Novotel, Siam Square, Bangkok, and organized by Global Knowledge Research Foundation with support from Knowledge Chamber of Commerce and Industry and InterYIT IFIP—International Federation for Information Processing.

The books presents the state-of-the-art as well as emerging topics pertaining to information, computer communications and effective strategies for its implementation for engineering and managerial applications.

The conference attracts a large number of high-quality submissions and stimulates the cutting-edge research discussions among many academic pioneering researchers, scientists, industrial engineers, students from all around the world and provides a forum to researchers on proposing new technologies, sharing their experiences and discussing future solutions for design infrastructure for ICT, providing common platform for academic pioneering researchers, scientists, engineers and students to share their views and achievements, enriching technocrats and academicians by presenting their innovative and constructive ideas and focusing on innovative issues at international level by bringing together the experts from different countries.

Research submissions in various advanced technology areas were received, and after a rigorous peer review process with the help of program committee members and 56 external reviewers for 262 papers from 20 different countries including Australia, China, Malaysia, Indonesia, Thailand, Bangladesh, Japan, South Korea and Sri Lanka, etc., out of which 50 were accepted with an acceptance ratio of 0.19.

This event's success was possible only with the help and support of our team and organizations. With immense pleasure and honor, we would like to express our sincere thanks to the authors for their remarkable contributions, all the Technical Program Committee members for their time and expertise in reviewing the papers within a very tight schedule and the publisher Springer for their professional help. This is the fourth conference of the series SmartCom in which proceedings is published as a CCIS volume by Springer. We are overwhelmed by our two

distinguished scholars and appreciate them for accepting our invitation to deliver keynote speeches to the conference and six technical session chairs for analyzing the research work presented by the researchers. Most importantly, we are also grateful to our local support team for their hard work for the conference. This series has already been made a continuous series which will be hosted at different locations every year.

This event's success was possible only with the help and support of our team and organizations. With immense pleasure and honor, we would like to express our sincere thanks to the authors for their remarkable contributions, all the Technical Program Committee members for their time and expertise in reviewing the papers within a very tight schedule and the publisher Springer for their professional help. This is the fourth conference of the series SmartCom in which proceedings is published as a SIST volume by Springer. We are overwhelmed by our three distinguished scholars and appreciate them for accepting our invitation to deliver keynote speeches including Prof. Mike Hinchey, President IFIP; Prof. Milan Tuba, Singidunum University, Serbia; and Dr. Chakchai So-In, Khon Kaen University, Thailand, in the conference and further six technical session chairs for analyzing the research work presented by the researchers. Most importantly, we are also grateful to our local support team for their hard work for the conference. This series has already been made a continuous series which will be hosted at different locations every year.

Bangkok, Thailand

Yu-Dong Zhang  
Tomonoby Senjyu  
Chakchai SO-IN  
Amit Joshi

# Contents

<b>1</b>	<b>Accurate Detection of Facial Landmark Points Using Local Intensity Information for Emotion Detection . . . . .</b>	<b>1</b>
	Payal Bhattacharjee and M. M. Ramya	
<b>2</b>	<b>Statistical Approach to Detect Alzheimer’s Disease and Autism Spectrum-Related Neurological Disorder Using Machine Learning . . . . .</b>	<b>17</b>
	Akhilesh Kumar Sharma and Devesh K. Shrivastav	
<b>3</b>	<b>The Development and Gap of Chinese and American Open Access Journals: From the Perspective of Network Influence . . . . .</b>	<b>25</b>
	Danyang Li, Xinlai Li, and Biying Gao	
<b>4</b>	<b>The Use of Mobile Apps to Facilitate Customers’ Choice-Making When Grocery Shopping . . . . .</b>	<b>39</b>
	Asle Fagerstrøm, Niklas Eriksson, and Valdimar Sigurdsson	
<b>5</b>	<b>Implementation of Best Hybrid Adaptive and Intelligent MIMO Detector on Reconfigurable Architecture for 5G LTE/IoT Environment . . . . .</b>	<b>49</b>
	Tipparti Anil Kumar and Lokam Anjaneyulu	
<b>6</b>	<b>Automated Detection of Retinal Hemorrhage Based on Supervised Classifiers and Implementation in Hardware . . . . .</b>	<b>57</b>
	K. A. Sreeja, S. S. Kumar, and Arun Pradeep	
<b>7</b>	<b>Data Encryption as Security Measure in IoT-Enabled Healthcare . . . . .</b>	<b>69</b>
	M. Shankar Lingam, G. S. Raghavendra, Arun Kumar, V. Anand, and A. M. Sudhakara	
<b>8</b>	<b>Agents-Based Service Restoration in Electrical Secondary Distribution Network . . . . .</b>	<b>83</b>
	Rukia J. Mwifunyi, Nerey H. Mvungi, and Mussa M. Kissaka	

<b>9</b>	<b>Packet-Level and Physical-Level Cross-Technology Communications: A Brief Introduction . . . . .</b>	<b>95</b>
	Liwen Qiu, Qinglin Zhao, Lianbo Zhang, Shumin Yao, Jing Zhao, and Li Feng	
<b>10</b>	<b>Smart Traffic Navigation System (STNS) to Reduce Travel Time by Integrating Signals from Navigation and Traffic Systems . . . . .</b>	<b>101</b>
	S. Sripranav, Akshay Ravi, K. Gautham, and R. Leela Velusamy	
<b>11</b>	<b>Selective Sensor Control via Cauchy Schwarz Divergence . . . . .</b>	<b>113</b>
	Nida Ishtiaq, Sabita Panicker, Amirali K. Gostar, Alireza Bab-Hadiashar, and Reza Hoseinnezhad	
<b>12</b>	<b>Step-Factor Resampling Technique for Imbalanced Sequence Data Classification . . . . .</b>	<b>125</b>
	Iroshan Aberathne, Chamila Walgampaya, and Udara Rathnayake	
<b>13</b>	<b>Rice Disease Detection Based on Image Processing Technique . . . . .</b>	<b>135</b>
	Md. Asfaqur Rahman, Md. Shahriar Nawal Shoumik, Md. Mahbubur Rahman, and Most. Hasna Hena	
<b>14</b>	<b>Electromagnetic Radiation from Cell Phones Used in Dhaka City . . . . .</b>	<b>147</b>
	M. Quamruzzaman, Munima Haque, Shahina Haque, and Utpal Chandra Das	
<b>15</b>	<b>Expressing Opinions Application: A Case Study at Rajamangala University of Technology, Isan, Khon Kaen Campus . . . . .</b>	<b>159</b>
	Ekaphong Tangtrakul, Jatupol Nampromma, and Phoemporn Lakkhanawannakun	
<b>16</b>	<b>Toward Clarifying Human Information Processing by Analyzing Big Data: Comparing Response Time to Questionnaires Included Heteronym Word for Problem Solving Between Visually and Auditory Types . . . . .</b>	<b>171</b>
	Keiko Tsujioka	
<b>17</b>	<b>Mango Species Detection from Raw Leaves Using Image Processing System . . . . .</b>	<b>183</b>
	Most. Hasna Hena, Md. Helal Sheikh, Md. Shamim Reza, and Ahmed Al Marouf	
<b>18</b>	<b>Frequency Reconfigurable Planner Antennas for Wireless Applications: A Review . . . . .</b>	<b>193</b>
	Dinesh Yadav and Vivekanand Tiwari	
<b>19</b>	<b>Room Temperature Pt-Modified WO<sub>3</sub>/p-Si Film Gas Sensor for Detection of Methanol . . . . .</b>	<b>201</b>
	Anup Dey, Komal Kumari, Abir Jana, Bijoy Goswami, Poushali Nandi, and S. K. Sarkar	



<b>20</b>	<b>Graph Degree Linkage Clustering for Identify Student's Performance on <i>Kompetisi Sains Madrasah</i> in Indonesia</b> . . . . .	<b>211</b>
	Ahmad Hanif Asyhar, A. Umar, Dian Candra Rini Novitasari, Kusaeri, Ahmad Fauzi, Nurissaidah Ulinnuha, Dwi Rolliawati, Noor Wahyudi, Ahmad Yusuf, Ali Mustofa, and Zakiyatul Ulya	
<b>21</b>	<b>Stepwise Iterative Maximum Likelihood Clustering Based on <i>Kompetisi Sains Madrasah</i>' Scores for Identifying Quality of Junior High School Grading Distribution</b> . . . . .	<b>221</b>
	Kusaeri, Nanik Puji Hastuti, Ali Musthofa, Ahmad Fauzi, Ahmad Hanif Asyhar, Dian Candra Rini Novitasari, Dwi Rolliawati, Zakiyatul Ulya, Ahmad Yusuf, Nurissaidah Ulinnuha, and Noor Wahyudi	
<b>22</b>	<b>Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature</b> . . . . .	<b>231</b>
	Nita Merlina, Edi Noersasongko, Pulung Nurtantio, M. A. Soeleman, Dwiza Riana, and Sri Hadiani	
<b>23</b>	<b>Design of a Novel Wideband Dipole Antenna for mm-Wave Frequencies</b> . . . . .	<b>241</b>
	Paikhomba Loktongbam, Chaitali Koley, Debashish Pal, and Ayan Kumar Bandhopadhyay	
<b>24</b>	<b>Forecasting Sea Surface Temperature in Java Sea Using Generalized Regression Neural Networks</b> . . . . .	<b>249</b>
	Dian Candra Rini Novitasari, Wahyu Tri Puspitasari, Rahmat Pramulya, Hetty Rohayani, R. R. Diah Nugraheni Setyowati, Dwi Rukma Santi, Muhammad Fahrur Rozi, and Ary Widjajanto	
<b>25</b>	<b>Natural Disaster Predictions of Whirlwinds in Cilacap Region of Central Java Using Adaptive Neighborhood Modified Backpropagation (ANMBP)</b> . . . . .	<b>259</b>
	Dian Candra Rini Novitasari, Fitria Febrianti, Arnita, Rinda Nariswari, R. R. Diah Nugraheni Setyowati, Putri Wulandari, Ahmad Zoebad Foeady, Moh. Hafiyusholeh, and Fajar Setiawan	
<b>26</b>	<b>Designing Memristor-Based Timing Circuits and Performance Comparison with CMOS Counterparts</b> . . . . .	<b>269</b>
	Abir Jana, Disha Bhattacharjee, Komal Kumari, Anup Dey, Bijoy Goswami, and Subir Kumar Sarkar	
<b>27</b>	<b>Identify Elementary Student Distribution Based on <i>Kompetisi Sains Madrasah</i> Data Using Probabilistic Distance Clustering</b> . . . .	<b>281</b>
	Ahmad Yusuf, Noor Wahyudi, Zakiyatul Ulya, Nurissaidah Ulinnuha, Dwi Rolliawati, Ali Mustofa, Ahmad Fauzi, Ahmad Hanif Asyhar, Kusaeri, Ratna Indriyati, Dian Candra Rini Novitasari, and Maryunah	

<b>28</b>	<b>Classification of Tomato Plant Diseases Through Leaf Using Gray-Level Co-occurrence Matrix and Color Moment with Convolutional Neural Network Methods . . . . .</b>	<b>291</b>
	Anton Anton, Supriadi Rustad, Guruh Fajar Shidik, and Abdul Syukur	
<b>29</b>	<b>Leverage from Blockchain in Commodity Exchange: Asset-Backed Token with Ethereum Blockchain Network and Smart Contract . . . . .</b>	<b>301</b>
	Richard, Yaya Heryadi, Lukas, and Agung Trisetarso	
<b>30</b>	<b>A Review of Focused Crawling Schemes for Search Engine . . . . .</b>	<b>311</b>
	Suresh Kumar and Manisha Gupta	
<b>31</b>	<b>Design and Simulation of Multi-channel V-TDMA for IoT-Based Healthcare Systems . . . . .</b>	<b>319</b>
	Anita Ramachandran, Malaika Afra Taj, Raghav Maheshwari, and Anupama Karuppiah	
<b>32</b>	<b>Design and Development of Tiny Humanoid Walking and Dancing Robot with Obstacle Detection for Visual Impaired People . . . . .</b>	<b>331</b>
	Amrita Ganguly, Jasmine Ara, and Bijan Paul	
<b>33</b>	<b>A Survey on DBN for Intrusion Detection in IoT . . . . .</b>	<b>339</b>
	Harsh Namdev Bhor and Mukesh Kalla	
<b>34</b>	<b>Organ Detection in Surgical Videos Using Neural Networks . . . . .</b>	<b>345</b>
	Amit Kumar, Anshu Gupta, and Ankita Pramanik	
<b>35</b>	<b>Implementation Aspects of Multi-bit Adders Using UTBSOI Transistors . . . . .</b>	<b>355</b>
	Rekib Uddin Ahmed and Prabir Saha	
<b>36</b>	<b>Accelerating Latency of Binary Division Through Vedic Methodology . . . . .</b>	<b>365</b>
	Deepak Kumar and Prabir Saha	
<b>37</b>	<b>Monitoring the torsional vibrations on the main propulsion plant of marine cargo ship installed two-stroke diesel engine: Theoretical case study . . . . .</b>	<b>379</b>
	Do Duc Luu and Cao Duc Hanh	
<b>38</b>	<b>Analysing Different Full Adder Based on 45 nm Technology . . . . .</b>	<b>393</b>
	Ankit Kumar, Shyam Akashe, and Seelam VSV Prabhu Deva Kumar	
<b>39</b>	<b>Design of RF Energy Harvesting Circuit at 900 MHz for Low-Powered DC Applications . . . . .</b>	<b>401</b>
	Anoop Chiluveru, Shyam Akashe, and Shailendra Singh Ojha	

<b>40</b>	<b>Noise Voltage: A New Dependability Concern in Low-Power FinFET-Based Priority Encoder at 45 nm Technology . . . . .</b>	<b>411</b>
	Vishwas Mishra, Abhishek Kumar, Shobhit Tyagi, Divya Mishra, and Shyam Akashe	
<b>41</b>	<b>Assessment of Suitability of Metaheuristics and Machine Learning for Task Scheduling Process: A Review of Aptness in Heavy Task Environments . . . . .</b>	<b>419</b>
	Shantanu Anandrao Lohi and Nandita Tiwari	
<b>42</b>	<b>A Review on Indian UID-Based Automated Electoral Roll Generation Mechanism Shunning Duplication and Redundancy . . .</b>	<b>427</b>
	Harish Vasant Rao Gorewar and Nandita Tiwari	
<b>43</b>	<b>A Review of Deep Learning Techniques for Identification and Diagnosis of Plant Leaf Disease . . . . .</b>	<b>435</b>
	Ravindra Namdeorao Jogekar and Nandita Tiwari	
<b>44</b>	<b>Analysis and Prediction of Student Data Using Data Science: A Review . . . . .</b>	<b>443</b>
	Sandeep S. Ganorkar, Nandita Tiwari, and Varsha Namdeo	
<b>45</b>	<b>Efficient Target Detection and Classification of SAR Images Using Z-Buffer Convolutional Neural Networks . . . . .</b>	<b>449</b>
	P. Vasuki, A. Shakin Banu, S. Mohamed Mansoor Roomi, and G. Maragatham	
<b>46</b>	<b>Context-Aware Deep Convolutional Neural Network Application for Fire and Smoke Detection in Virtual Environment for Surveillance Video Analysis . . . . .</b>	<b>459</b>
	Akm Ashiquzzaman, Sung Min Oh, Dongsu Lee, Jihoon Lee, and Jinsul Kim	
<b>47</b>	<b>Design and Development of Efficient Cost-Saving Algorithms for Guiding Customer Purchasing Patterns in Modern Consumerism Scenario Using Feed Forward Back Propagation Neural Networks . . . . .</b>	<b>469</b>
	Sonia Maria D'Souza and K. Satyanarayan Reddy	
<b>48</b>	<b>Mild Cognitive Impairment and Technology for Older Adults: A Review . . . . .</b>	<b>477</b>
	Nita Rosa Damayanti and Nazlena Mohamad Ali	
<b>49</b>	<b>Identify Education Quality Based on Islamic Senior High School Data in <i>Kompetisi Sains Madrasah</i> Using Fuzzy C-Means Clustering . . . . .</b>	<b>487</b>
	Dian Candra Rini Novitasari, Abdullah Faqih, Noor Wahyudi, Nurissaidah Ulinnuha, Zakkiyatul Ulya, Ali Mustofa, Ahmad Fauzi, Ahmad Hanif Asyhar, Kusaeri, Dwi Rolliawati, and Ahmad Yusuf	



**50 Obstacle Avoidance with Sensors Using Soft Computing Techniques** ..... 497  
Amit Yadav, Garima Jain, Divya Mishra, and Dharvendra P. Yadav

**Author Index** ..... 507

## About the Editors

**Prof. Yu-Dong Zhang** received his B.S. and M.S. degrees from Nanjing University of Aeronautics and Astronautics in 2004 and 2007, prior to completing his Ph.D. in Signal and Information Processing at Southeast University in 2010. From 2010 to 2012, he worked at Columbia University as a postdoc. From 2012 to 2013, he worked as a research scientist at Columbia University and New York State Psychiatric Institute. From 2013 to 2017, he worked as a Full Professor and doctoral advisor at the School of Computer Science and Technology, Nanjing Normal University. Since 2018, he has been a Full Professor at the Department of Informatics, University of Leicester, UK.

**Prof. Tomonoby Senju** received his B.S. and M.S. degrees in Electrical Engineering from the University of the Ryukyus, Nishihara, Japan, in 1986 and 1988, respectively, and his Ph.D. in Electrical Engineering from Nagoya University, Japan, in 1994. He is currently a Full Professor at the Department of Electrical and Electronics Engineering, University of the Ryukyus. His research interests include renewable energy, power system optimization and operation, power electronics, and advanced control of electrical machines.

**Prof. Chakchai SO-IN** has been with the Department of Computer Science at Khon Kaen University since 2010. Dr. SO-IN received his B.E. and M.E. degrees from Kasetsart University (KU), Bangkok, Thailand, in 1999 and 2001, respectively. He also completed M.S. and Ph.D. degrees in Computer Engineering at the Department of Computer Science and Engineering, Washington University, in St. Louis (WUSTL), MO, USA, in 2006 and 2010. He has authored more than 100 publications in prominent journals and proceedings, together with 10 books. His research interests include mobile computing/sensor networks, Internet of Things, computer/wireless/distributed networks, cyber security, intelligent systems and the future Internet. He is a senior member of the IEEE and ACM.

**Dr. Amit Joshi** is currently Director of the Global Knowledge Research Foundation, and an entrepreneur and researcher. Holding a B.Tech. in Information Technology and M.Tech. in Computer Science and Engineering, he has conducted extensive research in the areas of cloud computing and cryptography in medical imaging, with a focus on analyzing current government strategies and global forums concerning security. Dr. Joshi has more than 10 years of experience in academia and industry, having worked at prestigious organizations. He is an active member of the ACM, IEEE, CSI, AMIE, IACSIT Singapore, IDES, ACEEE, NPA, and many other professional societies. Currently, he is the International Chair of InterYIT at the International Federation of Information Processing (IFIP, Austria). He has presented and published more than 50 papers in national and international journals/conferences of the IEEE and ACM, and has edited more than 20 books for Springer, ACM, and other reputed publishers. He has also organized more than 40 national and international conference and workshops in association with the ACM, Springer, and the IEEE, e.g. in India, the UK, Thailand, and Europe.

## Chapter 22

# Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature



Nita Merlina, Edi Noersasongko, Pulung Nurtantio, M. A. Soeleman, Dwiza Riana, and Sri Hadiani

**Abstract** Color image segmentation on cytoplasm Pap smear single cell image identified as normal condition is an interesting subject to study. It is caused by the image limitation and morphological transformation complexity of the cell structural part. Feature analysis on cytoplasm area is an important thing in the process of biomedical image analysis because of the noise and complex background and the bad cytoplasm contrast as well. Thus, an analysis on the feature area on cytoplasm automatically is an urge thing to do to identify Pap smear normal cell image based on feature analysis on cytoplasm area in single cell image identified as normal condition. The purpose of this research is to analyze how far the process color image segmentation on cytoplasm by using normal single cell image is able to produce features of texture and form analysis. To analyze the form of cytoplasm, this research used RGB color to HSV color conversion method which produces metric and eccentricity value. It is then continued to the process of threshold image and counting the wide area by changing threshold into binary image. On the other side, to analyze the texture, this research applied an analysis using gray-level co-occurrence matrix (GLCM) using *K*-means method to produce contrast, correlation, energy, and homogeneity parameters. The result of the research is the segmentation outcome to Pap smear normal single cell image sample to get metric, eccentricity, contrast, correlation, and energy features.

### 22.1 Introduction

Women are generally susceptible to cervical cancer, which ranks fourth as a very deadly disease [1]. Papanicolaou test also called Pap smear or Pap test is a health test method that can help prevent cervical cancer. The main purpose of a Pap smear

---

N. Merlina (✉) · E. Noersasongko · P. Nurtantio · M. A. Soeleman  
Universitas Dian Nuswantoro, Semarang, Indonesia  
e-mail: [nita@mhs.dinus.ac.id](mailto:nita@mhs.dinus.ac.id)

N. Merlina · D. Riana · S. Hadiani  
STMIK Nusa Mandiri, Jakarta, Indonesia

© The Editor(s) (if applicable) and The Author(s), under exclusive license  
to Springer Nature Singapore Pte Ltd. 2021

Y.-D. Zhang et al. (eds.), *Smart Trends in Computing and Communications: Proceedings of SmartCom 2020*, Smart Innovation, Systems and Technologies 182,  
[https://doi.org/10.1007/978-981-15-5224-3\\_22](https://doi.org/10.1007/978-981-15-5224-3_22)

is to detect cell abnormalities that may occur or before the cancer develops. Correct interpretation of microscopic examination of cells and tissues is very important for the final diagnosis judgment of the disease [2]. However, the Pap smear testing process has weaknesses, especially in many developing countries where the number of pathologists who can examine slides is inadequate. In Indonesia, with a population of productive age women spread across 32 provinces with limited facilities and limited human resources, it is estimated that 80% of the coverage of examinations will be completed in five years with 7,992,486 Pap smear tests per year [3].

The classification of cervical cells in Pap smear images is an interesting thing because of image limitations and the complexity of morphological alterations in the structural parts of cells [4]. Pap smear image processing has been performed for single cell types and non-overlapping. Image segmentation process is expected to identify cytoplasm and nucleus images [5–7]. Segmentation is needed to define the area of interest (ROI) in a normal single cell image and is the basis of an automatic cervical cancer screening system. Efficient image segmentation enables extraction of significant information and streamlines image data for further analysis. Weak segmentation results in weak results during image analysis [8]. Analysis of features in the cytoplasm area in normal Pap smear cell images is interesting. That is due to image limitations and the complexity of morphological changes in the structural parts of cells. Analysis of features in the cytoplasm area is important in the process of analyzing biomedical images, and it is caused by background noise and complex and weak cytoplasm contrast. So, it is necessary to do an analysis of the features of the area in the cytoplasm by automation to identify the normal Pap smear cell image based on the analysis of the features of the cytoplasm area in a single cell image that is detected normally. The purpose of this research is to see the extent of the process of analyzing feature areas in the cytoplasm by using a normal single cell image so that features of texture and shape analysis can be produced. The results of this study are expected to facilitate the identification of cytoplasm images from Pap smear images.

This paper is divided into several sections. Section 22.2, related work, discusses about the methods used in the research. Section 22.3 describes the results and discussion, which will be enclosed with conclusions and further research plans.

## 22.2 Related Work

There are many methods used to identify the area of cytoplasm image, and this study attempts to do different things, which is to propose a segmentation method for cytoplasm area in a single Pap smear image that utilizes the GLCM feature. This GLCM feature has not been widely used in previous research. In the initial detection of a Pap smear image, a single cell image is easy to observe [9]. In the previous research, cytoplasm detection process has been successfully carried out by



color classification using *K*-means and joint shape matching. However, this research is limited only to determine the presence of cytoplasm and not to determine the extent of cytoplasm in detail [10, 11]. The gray-level co-occurrence matrix (GLCM) previous studies have been used, but they use a dataset from a nearby hospital and only discuss cervical cancer related without the Pap smear cell being used [12].

22.3 Method

Data processing techniques use the MATLAB application program on color and binary image matrices as well as analyzing textures. In order to determine the area in cytoplasm image, the initial step of this research is to convert RGB color to HSV color (hue, saturation, value). The HSV color model was formulated by searching the RGB color cube along the gray axis of the color wheel, where this model is more widely used than RGB in depicting color sensations. After the HSV color conversion is generated, the next step is to determine the threshold image and calculate the area of the area by changing the threshold image into a binary image that aims to calculate objects in a digital image in a simple way from the original image. In this process, we need a boundary value called the threshold value. Image intensity values that are more than or equal to the threshold value will be changed to white (1), while image intensity values less than the threshold value will be changed to black (0) [13]. Furthermore, to analyze the texture of the image of the area value that has been segmented by the *K*-means method and the researcher uses the Gray-Level Co-Occurrence Matrix (GLCM) so that the parameters obtained are contrast, correlation, energy, and homogeneity. The results of this research are the results of segmentation of a single Pap smear normal cell image sample so that it can be done well and is able to get the features of metric, eccentricity, contrast, correlation, and energy [14], where the texture has characteristics that can be extracted to distinguish an image with another image. Figure 22.1 shows the image of a single cell used in this study.

In this study, a research flow diagram is shown in Fig. 22.2 on the digital image of papers.

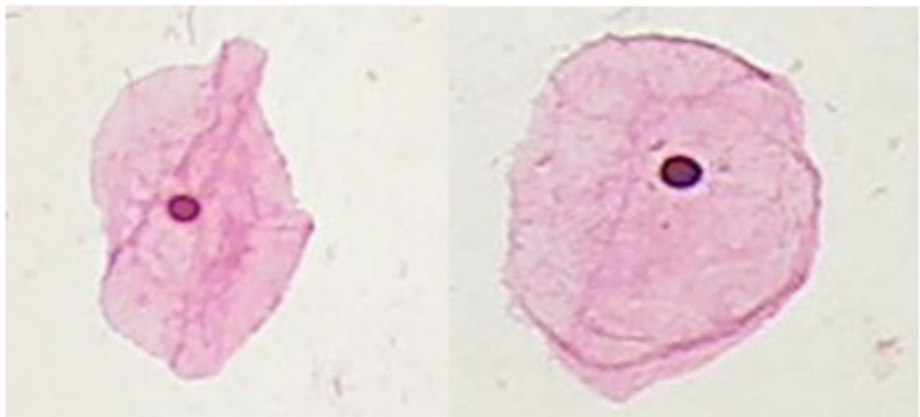


Fig. 22.1 Example of a single cell image

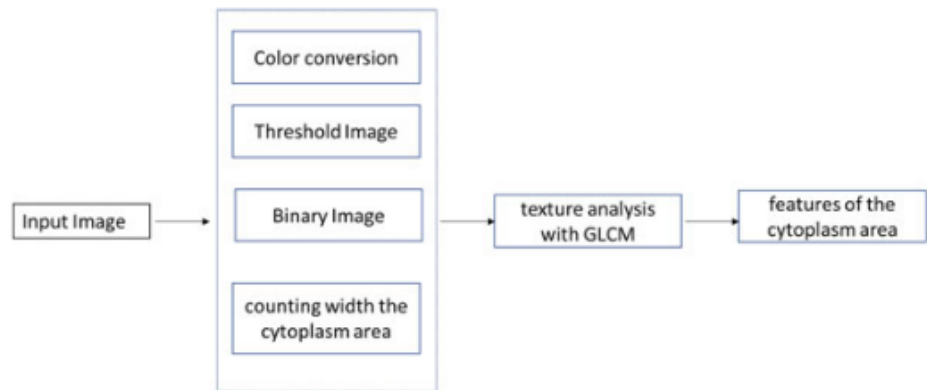


Fig. 22.2 Research stages

22.4 Results and Discussion

22.4.1 Result

The stages of the research consisting of five stages of the process are evaluated on traditional Pap smear images. All of these images were obtained through a Logitech camera (Logitech HD C525 Webcam) adjusted to an optical microscope (Olympus CH20). 40× amplification is used, and the results are saved in JPEG format. The following are the results of the process of segmentation methods in each.

22.4.1.1 Convert RGB Color to HSV Color

The result of the conversion of RGB color into HSV color aims to detect the cytoplasm so as to produce an image as shown in Fig. 22.3, where the cytoplasm has a color that is more dominant than the nucleus.

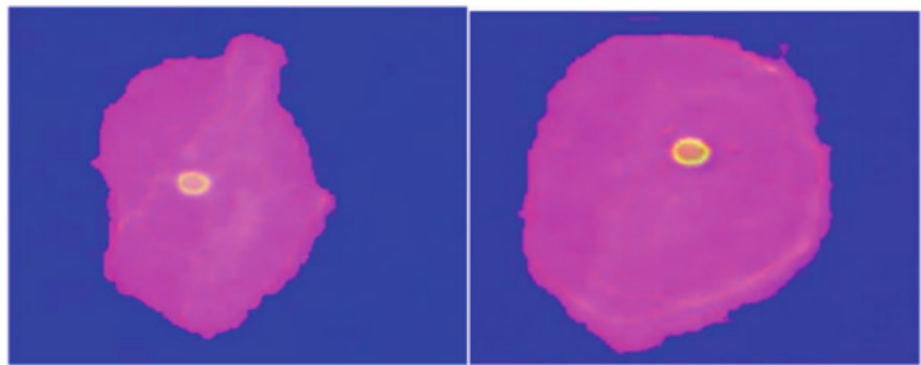
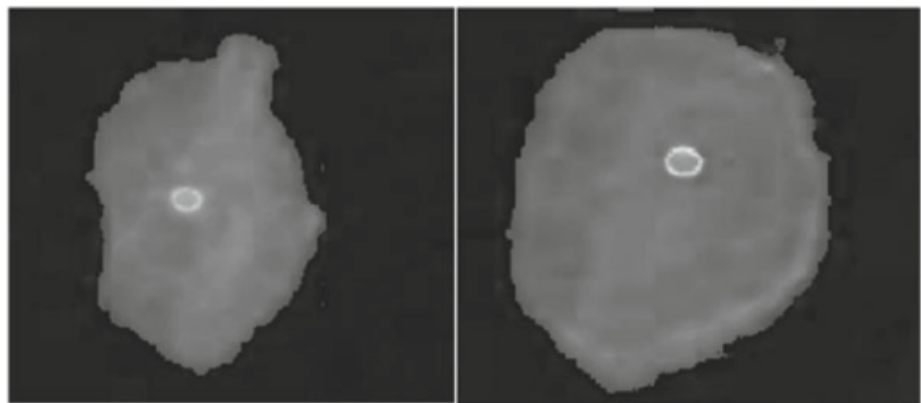


Fig. 22.3 Image results from color conversion



**Fig. 22.4** Image from threshold

**22.4.1.2 Threshold Image**

When analyzing an area in the cytoplasm, the initial process is to determine the edge of the object from a single normal cell. The results of edge detection in normal single cell images are taken from images that have been converted to HSV color, and Fig. 22.4 shows images of edge detection.

**22.4.1.3 Binary Imagery**

The calculation process of the attributes that exist in a single normal Pap smear cell can be simply done by the process of conversion to binary images; after the conversion process is carried out, the area calculation process can be carried out, along with pictures that present the results of binary images (Figs. 22.5, 22.6, and 22.7).



**Fig. 22.5** Binary image



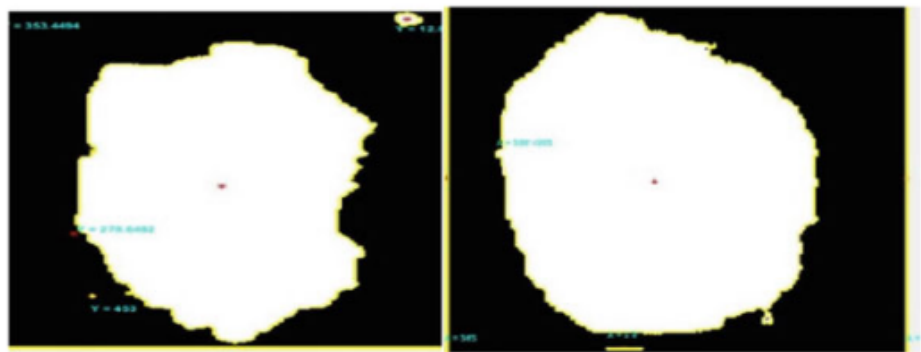


Fig. 22.6 Width binary image

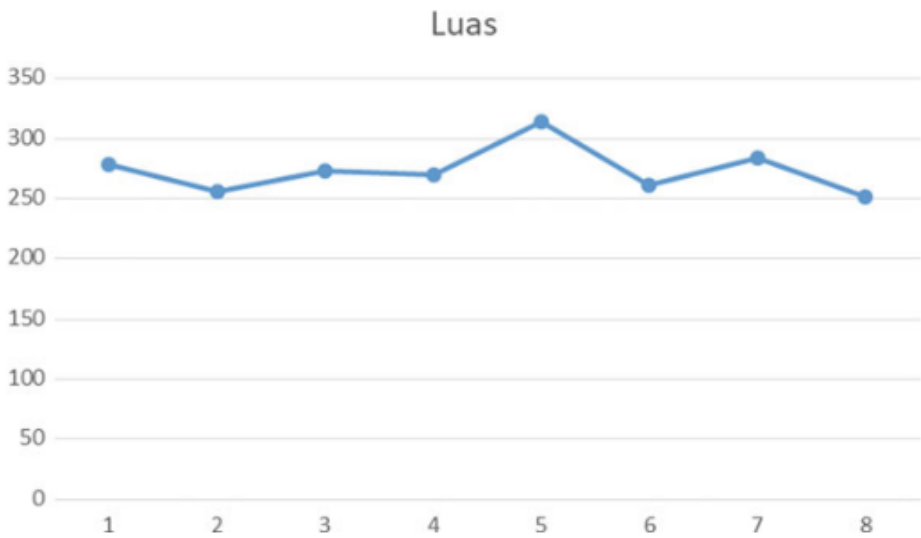


Fig. 22.7 Chart width of binary image

22.4.1.4 Gray-Level Co-occurrence Matrix (GLCM)

The process of this GLCM is to analyze the texture of the cytoplasm area, so that this research results in segmentation of a single Pap smear normal cell image sample by producing metric, eccentricity, contrast, correlation, and energy features. The following are the formulas for calculating the metric feature, eccentricity, contrast, correlation, and energy:

$$\text{Contrast} = \sum_{i_1} \sum_{i_2} (i_1 - i_2)^2 p(i_1, i_2) \tag{22.1}$$

$$\text{Homogeneity} = \sum_{i_1} \sum_{i_2} \frac{p(i_1, i_2)}{1 + |i_1 - i_2|} \tag{22.2}$$

$$\text{Energy} = \sum_{i_1} \sum_{i_2} p^2(i_1, i_2) \tag{22.3}$$

**Table 22.1** Texture of the cytoplasm area

Metric	Eccentricity	Contrast	Correlation	Energy	Homogeneity
0.01	1	0.01	0.99	0.57	1
0.01	0.46	0.01	0.98	0.49	0.99
0.01	1	0.01	0.99	0.49	1
0.02	1	0.01	0.99	0.51	1
0.95	0.7	0.01	0.99	0.53	1
0.78	0.7	0.01	0.88	0.95	1
0.01	0.73	0.01	0.98	0.52	0.99
0.67	0.53	0.01	0.99	0.5	1

$$\text{Entropy} = - \sum_{i_1} \sum_{i_2} p(i_1, i_2) \log p(i_1, i_2) \tag{22.4}$$

$$\text{Eccentricity} = e = \sqrt{1 - \frac{b^2}{a^2}} \tag{22.5}$$

$$\text{Metric} = M = \frac{4\pi \times A}{C^2} \tag{22.6}$$

Table 22.1 gives the results of the GLCM calculations that have been carried out.

**22.4.2 Discussion**

In this study, we segmented Pap smear images by taking ten image from a single normal goal, but there are two images that are not segmented perfectly; this is because there is noise in the image, so the segmentation is done using the method taken less than perfect.

**22.5 Conclusion**

The results of this study are to see the extent of the cytoplasm color image segmentation process using normal single cell images so that features of texture and shape analysis can be produced. To analyze the shape of the cytoplasm, this study uses the method of converting RGB color conversion into HSV color conversion that produces metric and eccentricity values and then proceeds with the process to determine the threshold image and calculate the area of the area by changing the threshold image which becomes a binary image. For texture analysis, the analysis is done using the gray-level co-occurrence matrix (GLCM) method which uses the *K*-means method

to obtain contrast, correlation, energy, and homogeneity parameters. The results of this research are the results of segmentation of normal Pap smear single cell image samples so that they can be done well and are able to get the features of metric, eccentricity, contrast, correlation, and energy. The limitation of this study is that the number of samples used needs to be increased so that it will produce more feature data to get more extensive information. This research is a preliminary study for cytoplasm recognition. Further research will focus on segmentation of the cytoplasm in single Pap smear cells by adding new features besides GLCM. Another thing to do is research for group Pap smears.

## References

1. Irawan, F.: Statistik penderita kanker di Indonesia (2018)
2. Riana, D., Widyantoro, D.H., Mengko, T.L.: Extraction and classification texture of inflammatory cells and nuclei in normal pap smear images. In: 2015 4th International Conference on Instrumentation, Communications, Information Technology, and Biomedical Engineering (2015)
3. Kusuma, F.: Tes Pap Dan Cara Deteksi Dini Kanker Serviks Lainnya, Departemen Obstetri dan Ginekologi Fakultas Kedokteran Universitas Indonesia RSUPN Dr. Cipto Mangunkusumo, Prevention and Early Detection of Cervical Cancer (PEACE), Jakarta (2012)
4. Plissiti, S.E., Dimitrakopoulos, P., Sfikas, G., Nikou, C., Krikoni, O., Charchanti, A.: Dataset for feature and image based classification of normal and pathological cervical cells in pap smear images. In: 25th IEEE International Conference on Image Processing (2018)
5. Lu, Z., Carneiro, G., Bradley, A.P.: Automated nucleus and cytoplasm segmentation of overlapping cervical cells. In: International Conference on Medical Image Computing and Computer-Assisted Intervention, vol 8149. Lecture Notes in Computer Science, pp. 452–460 (2013)
6. Zhao, L., Li, K., Wang, M., Yin, J., Zhu, E., Wu, C., Wang, S., Zhu, C.: Automatic cytoplasm and nuclei segmentation for color cervical smear image using an efficient gap-search MRF. *Comput. Biol. Med.* **71**, 46 (2016). ISSN 00104825
7. Riana, D., Hidayanto, A.N., Widyantoro, D.H., Mengko, T.L.R., Kalsoem, O.: Segmentation of overlapping cytoplasm and overlapped areas in Pap smear images. In: Information, Intelligence, Systems & Applications (IISA), pp. 1–5 (2017)
8. Sun, G., Li, S., Cao, Y., Lang, F.: Cervical cancer diagnosis based on random forest. *Int. J. Performability Eng.* (2017)
9. Riana, D., Ramdhani, Y., Prasetyo, R.T., Hidayanto, A.N.: Improving hierarchical decision approach for single image classification of pap smear. *Int. J. Electr. Comput. Eng.* **8**, 5415–5424 (2018)
10. Riana, D., Tohir, H., Hidayanto, A.N.: Segmentation of Overlapping Areas on Pap Smear Images with Color Features Using K-Means and Otsu Methods (2018). <https://ieeexplore.ieee.org/xpl/conhome/8767368/proceeding>
11. Song, Y., Qin, J., Lei, B., He, S., Choi, K.-S.: Joint shape matching for overlapping cytoplasm segmentation in cervical smear images. In: 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019) Venice, Italy, pp. 191–194 (2019)
12. Nehra, S., Raheja, J.L., Butte, K., Zope, A.: Detection of cervical cancer using GLCM and support vector machines, pp. 49–53. <https://ieeexplore.ieee.org/xpl/conhome/8768798/proceeding>

13. Pamungkas, A.: Pemrograman Matlab (2019). [Online]. Available: <https://pemrogramanmatlab.com/pengolahan-citra-digital/segmentasi-citra>
14. Bhan, S., Vyas, A., Mishra, G.: Supervised segmentation of overlapping cervical pap smear images. In: 2016 International Conference on Signal Processing and Communications (2016)

# Author Index

## A

Aberathne, Iroshan, [125](#)  
Ahmed, Rekib Uddin, [355](#)  
Akashe, Shyam, [393](#), [401](#), [411](#)  
Ali, Nazlena Mohamad, [477](#)  
Anand, V., [69](#)  
Anil Kumar, Tipparti, [49](#)  
Anjaneyulu, Lokam, [49](#)  
Anton, Anton, [291](#)  
Ara, Jasmine, [331](#)  
Arnita, [259](#)  
Asfaqur Rahman, Md., [135](#)  
Ashiquzzaman, Akm, [459](#)  
Asyhar, Ahmad Hanif, [211](#), [221](#), [281](#), [487](#)

## B

Bab-Hadiashar, Alireza, [113](#)  
Bandhopadhyay, Ayan Kumar, [241](#)  
Bhattacharjee, Disha, [269](#)  
Bhattacharjee, Payal, [1](#)  
Bhor, Harsh Namdev, [339](#)

## C

Chiluveru, Anoop, [401](#)

## D

Damayanti, Nita Rosa, [477](#)  
Das, Utpal Chandra, [147](#)  
Dey, Anup, [201](#), [269](#)  
Diah Nugraheni Setyowati, R. R., [249](#), [259](#)  
D'Souza, Sonia Maria, [469](#)

## E

Eriksson, Niklas, [39](#)

## F

Fagerstrøm, Asle, [39](#)  
Faqih, Abdullah, [487](#)  
Fauzi, Ahmad, [211](#), [221](#), [281](#), [487](#)  
Febrianti, Fitria, [259](#)  
Feng, Li, [95](#)  
Foeady, Ahmad Zoebad, [259](#)

## G

Ganguly, Amrita, [331](#)  
Ganorkar, Sandeep S., [443](#)  
Gao, Biying, [25](#)  
Gautham, K., [101](#)  
Gorewar, Harish Vasant Rao, [427](#)  
Gostar, Amirali K., [113](#)  
Goswami, Bijoy, [201](#), [269](#)  
Gupta, Anshu, [345](#)  
Gupta, Manisha, [311](#)

## H

Hadianti, Sri, [231](#)  
Hafiyusholeh, Moh., [259](#)  
Hanh, Cao Duc, [379](#)  
Haque, Munima, [147](#)  
Haque, Shahina, [147](#)  
Hasna Hena, Most., [135](#), [183](#)  
Hastuti, Nanik Puji, [221](#)  
Helal Sheikh, Md., [183](#)  
Heryadi, Yaya, [301](#)  
Hoseinnezhad, Reza, [113](#)

**I**

Indriyati, Ratna, [281](#)  
 Ishtiaq, Nida, [113](#)

**J**

Jain, Garima, [497](#)  
 Jana, Abir, [201](#), [269](#)  
 Jogekar, Ravindra Namdeorao, [435](#)

**K**

Kalla, Mukesh, [339](#)  
 Karuppiah, Anupama, [319](#)  
 Kim, Jinsul, [459](#)  
 Kissaka, Mussa M., [83](#)  
 Koley, Chaitali, [241](#)  
 Kumar, Abhishek, [411](#)  
 Kumar, Amit, [345](#)  
 Kumar, Ankit, [393](#)  
 Kumar, Arun, [69](#)  
 Kumar, Deepak, [365](#)  
 Kumar, Seelam VSV Prabhu Deva, [393](#)  
 Kumar, S. S., [57](#)  
 Kumar, Suresh, [311](#)  
 Kumari, Komal, [201](#), [269](#)  
 Kusaeri, [211](#), [221](#), [281](#), [487](#)

**L**

Lakkhanawannakun, Phoemporn, [159](#)  
 Lee, Dongsu, [459](#)  
 Lee, Jihoon, [459](#)  
 Leela Velusamy, R., [101](#)  
 Li, Danyang, [25](#)  
 Li, Xinlai, [25](#)  
 Lohi, Shantanu Anandrao, [419](#)  
 Loktongbam, Paikhomba, [241](#)  
 Lukas, [301](#)  
 Luu, Do Duc, [379](#)

**M**

Mahbubur Rahman, Md., [135](#)  
 Maheshwari, Raghav, [319](#)  
 Maragatham, G., [449](#)  
 Marouf, Ahmed Al, [183](#)  
 Maryunah, [281](#)  
 Merlina, Nita, [231](#)  
 Min Oh , Sung, [459](#)  
 Mishra, Divya, [411](#), [497](#)  
 Mishra, Vishwas, [411](#)  
 Mohamed Mansoor Roomi, S., [449](#)  
 Mustofa, Ali, [211](#), [221](#), [281](#), [487](#)

Mvungi, Nerey H., [83](#)  
 Mwifunyi, Rukia J., [83](#)

**N**

Namdeo, Varsha, [443](#)  
 Nampromma, Jatupol, [159](#)  
 Nandi, Poushali, [201](#)  
 Nariswari, Rinda, [259](#)  
 Noersasongko, Edi, [231](#)  
 Novitasari, Dian Candra Rini, [211](#), [221](#), [249](#),  
[259](#), [281](#), [487](#)  
 Nurtantio, Pulung, [231](#)

**O**

Ojha, Shailendra Singh, [401](#)

**P**

Pal, Debashish, [241](#)  
 Panicker, Sabita, [113](#)  
 Paul, Bijan, [331](#)  
 Pradeep, Arun, [57](#)  
 Pramanik, Ankita, [345](#)  
 Pramulya, Rahmat, [249](#)  
 Puspitasari, Wahyu Tri, [249](#)

**Q**

Qiu, Liwen, [95](#)  
 Quamruzzaman, M., [147](#)

**R**

Raghavendra, G. S., [69](#)  
 Ramachandran, Anita, [319](#)  
 Ramya, M. M., [1](#)  
 Rathnayake, Udara, [125](#)  
 Ravi, Akshay, [101](#)  
 Reddy, K. Satyanarayan, [469](#)  
 Riana, Dwiza, [231](#)  
 Richard, [301](#)  
 Rohayani, Hetty, [249](#)  
 Rolliawati, Dwi, [211](#), [221](#), [281](#), [487](#)  
 Rozi, Muhammad Fahrur, [249](#)  
 Rustad, Supriadi, [291](#)

**S**

Saha, Prabir, [355](#), [365](#)  
 Santi, Dwi Rukma, [249](#)  
 Sarkar, Subir Kumar, [201](#), [269](#)  
 Setiawan, Fajar, [259](#)

Shahriar Nawal Shoumik, Md., [135](#)  
Shakin Banu, A., [449](#)  
Shamim Reza, Md., [183](#)  
Shankar Lingam, M., [69](#)  
Sharma, Akhilesh Kumar, [17](#)  
Shidik, Guruh Fajar, [291](#)  
Shrivastav, Devesh K., [17](#)  
Sigurdsson, Valdimar, [39](#)  
Soeleman, M. A., [231](#)  
Sreeja, K. A., [57](#)  
Sripranav, S., [101](#)  
Sudhakara, A. M., [69](#)  
Syukur, Abdul, [291](#)

**T**

Taj, Malaika Afra, [319](#)  
Tangtrakul, Ekaphong, [159](#)  
Tiwari, Nandita, [419](#), [427](#), [435](#), [443](#)  
Tiwari, Vivekanand, [193](#)  
Trisetyarso, Agung, [301](#)  
Tsujioka, Keiko, [171](#)  
Tyagi, Shobhit, [411](#)

**U**

Ulinnuha, Nurissaidah, [211](#), [221](#), [281](#), [487](#)

Ulya, Zakiyatul, [211](#), [221](#), [281](#), [487](#)  
Umar, A., [211](#)

**V**

Vasuki, P., [449](#)

**W**

Wahyudi, Noor, [211](#), [221](#), [281](#), [487](#)  
Walgampaya, Chamila, [125](#)  
Widjajanto, Ary, [249](#)  
Wulandari, Putri, [259](#)

**Y**

Yadav, Amit, [497](#)  
Yadav, Dharvendra P., [497](#)  
Yadav, Dinesh, [193](#)  
Yao, Shumin, [95](#)  
Yusuf, Ahmad, [211](#), [221](#), [281](#), [487](#)

**Z**

Zhang, Lianbo, [95](#)  
Zhao, Jing, [95](#)  
Zhao, Qinglin, [95](#)

# Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature

ORIGINALITY REPORT

22%  
SIMILARITY INDEX

20%  
INTERNET SOURCES

15%  
PUBLICATIONS

7%  
STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

9%  
★ "ICT Systems and Sustainability", Springer Science and Business Media LLC, 2023  
Publication

Exclude quotes      On  
Exclude bibliography      On

Exclude matches      < 2%





# Pusat Penelitian dan Pengabdian Masyarakat **STMIK Nusa Mandiri**

## **SURAT TUGAS** **627/3.01/PPPM-NM/IX/2020**

Tentang

**PENELITIAN YANG DIPUBLIKASIKAN DALAM PROSIDING**

**Menulis Pada Springer Link, 2020**

**Judul:**

**Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature**

- Menimbang : 1. Bahwa perlu diadakan pelaksanaan Tri Dharma Perguruan Tinggi dalam bentuk Penelitian.  
2. Untuk keperluan pada butir 1 (satu) di atas, maka perlu diberikan surat tugas yang berkaitan dengan penelitian yang dipublikasikan dalam Jurnal Ilmiah.

### **MEMUTUSKAN**

Pertama : Menugaskan kepada saudara

**Nita Merlina, M.Kom**

Sebagai Penulis yang mempublikasikan Penelitiannya pada Jurnal Ilmiah

Kedua : Mempunyai tugas sbb:  
Melaksanakan tugas yang diberikan dengan penuh rasa tanggung jawab.

Ketiga : Keputusan ini berlaku sejak tanggal ditetapkan, dengan ketentuan apabila dikemudian hari terdapat kekeliruan akan diubah dan diperbaiki sebagaimana mestinya.

Jakarta, 01 September 2020

Ketua PPPM

Sekolah Tinggi Manajemen Informatika dan Komputer Nusa Mandiri

Norma Yunita, M.Kom

Tembusan :

- Ketua Sekolah Tinggi Manajemen Informatika dan Komputer Nusa Mandiri
- Arsip
- ybs



**SmartCom**<sup>2020</sup>  
24<sup>th</sup> - 25<sup>th</sup> January 2020

Fourth International Conference on  
**Smart Trends for Computing & Communications**

*Certificate*

This is to certify that

**Nita Merlina, Edi Noersasongko, Pulung Nurtantio, M.A Soeleman, Dwiza Riana, SriHadianti**

has contributed a paper titled

**Detecting the Width of Pap Smear Cytoplasm Image Based on GLCM Feature**

in Fourth International Conference on Smart Trends for Computing & Communications (SmartCom 2020)  
held during January 24-25, 2020 at Hotel Novotel, Siam Square, Bangkok, Thailand.

We wish the authors all the very best for future endeavors.



**Chakchai so-in**  
Khon Kaen University,  
Thailand



**Nilanjan Dey**  
TPC Chair  
SmartCom 2020



**Amit Joshi**  
Conference Secretary  
SmartCom 2020

