



Dr.P.Eswaran
Assistant Professor

Contact

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Academic Qualifications: M.Sc., M.Tech., Ph.D.

Course	University/ Institution	Duration	Subject	% of Marks	Class
Ph.D. (Regular)	Manonmaniam Sundaranar University, Dept. of Comp. Sci. & Engg., Tirunelveli.	2006 to 2010	Computer and Information Technology	-	Awarded 2010 August
M.Tech.	Manonmaniam Sundaranar University, Centre for IT & Engg., Tirunelveli.	2003 to 2005	Computer and Information Technology	79.04	First with Distinction
M.Sc.	Madurai Kamaraj University, Mannar Thirumalai Naickar College, Madurai.	2001 to 2003	Computer Science and Information Technology	75.17	First

Teaching Experience: 13.1 Years

Sl. No.	Position	Institution/University	Period	No. of Years
1	Assistant Professor	Alagappa University, Karaikudi.	31 st May 2012 to Till Date	10 .11 Years
2	Assistant Professor	PSN College of Engineering and Technology, Tirunelveli	Sep. 2010 to 30 th May 2012	1 Year and 9 Months
3	Guest Lecturer	Manonmaniam Sundaranar University, Centre for Information Tech. & Engg., Tirunelveli.	July 2005 to November 2005	5 Months

Research Experience: 17 Years

Sl. No.	Position	Institution/University	Period	No. of Years
1	UGC – SRF	Manonmaniam Sundaranar University, Department of Computer Science & Engg.	24 th April 2010 to 18.08.2010	4 Months
2	UGC – JRF	Manonmaniam Sundaranar University, Department of Computer Science & Engg.	24 th April 2008 to 23 rd April 2010	2 Years
3	USRF	Manonmaniam Sundaranar University, Department of Computer Science & Engg.	Jan. 2007 to April 2008	1 Year and 4 Months
4	Research Scholar – Full Time	Manonmaniam Sundaranar University, Department of Computer Science & Engg.	Oct. 2006 to Dec. 2006 (Non – Stipend)	3 Months

Additional Responsibilities

- **Deputy Director** – Data Management Centre 17.05.2021 to Till Date
- **Nodal Officer** – National Test Centre (NTA) 06.11.2019 to Till Date
- **Coordinator** – Coaching Scheme for NET Exam. 16.08.2019 to 18.04.2022
- **Deputy Coordinator** – Cultural Club 05.09.2018 to 18.04.2022
- **Single Point of Contact (SPOC)** of Alagappa University for Smart India Hackathon – 2022 From 16.02.2022 to 14.04.2022
- **Coordinator (Dept. Level) – SWAYAM 11.12.2017 to Till Date**

Research Supervision / Guidance

	Program of Study	Completed	Ongoing
Research	Ph.D.	08	02
	M.Phil.	27	Nil
Project	PG	57	Nil
	UG / Others	05	Nil

Areas of Research

1. Digital Image Processing,
2. Medical Data Mining and Classification,
3. Computer and Communication Networks

Publications

International		National		Others
Journals	Conferences	Journals	Conferences	Books / Chapters / Monographs / Manuals
68	20	Nil	Nil	08

h-index	:	22
i10 index	:	31
Total Citations	:	1349

Funded Research Projects

Completed Projects

S. No	Agency	Period		Project Title	Budget (Rs. In lakhs)
		From	To		
1	Alagappa University	March 2017	March 2018	Multilevel Number Plate Recognition (MNPR)	0.35
2					

Patents

1. 03 (Published)

Distinctive Achievements / Awards

1. Had University Grants Commission – **Junior Research Fellowship** Award
2. Had **USRF** (University Stipendiary Research Fellowship) Award
3. Received **Promising Researcher Award – 2022** with **Rs.3000/- Cash** from Alagappa University, Karaikudi recognition of the contribution made towards **Excellence in Research** at Alagappa University.
4. Received **Vallal Alagappan Research Recognition Award - 2020** from Alagappa University, Karaikudi for contribution towards the enhancement of Research Outcome of the university in the form of “h” index.
5. Received **Best Volunteer Award – 2002** at Mannar Thirumalai Naickar College, Madurai.
6. Honoured for Secured **First Place in Taluk Level Tamil Training Contest**, Periyakulam Taluk.1994.

7. Received the **Special Service Project** Certificate for **National Integration Special Camp Project, NSS** (From 1.10.1994 to 10.10.1994).
8. Received the **Special Service Project** Certificate for **One Day Special Service Project, NSS** (From 24.06.1995 to 25.06.1995 and 08.07.1995).

Events organized in leading roles

Number of Seminars / Conferences / Workshops / Events organized: 04

1. **Coordinator** – organized one day national level seminar on “Career Opportunities in SMAC and IoT” in the Department of Computer Science and Engineering, Alagappa University, Karaikudi in association with ICT Academy of Tamil Nadu on 31st March 2015.
2. **Coordinator** – organized International Conference on “Innovations in Computer Science & Technology” in the Department of Computer Science and Engineering, Alagappa University, Karaikudi, Tamil Nadu on 4th & 5th April 2016.
3. **Organizing Secretary** - organized DST – PURSE Sponsored Two Day National Seminar on “Recent Research Trends and Developments in Computer Science” in the Department of Computer Applications, Alagappa University, Karaikudi, Tamil Nadu on 8th & 9th March 2018.
4. **Event Coordinator** – ALUTES 2016 organized by the Cultural Club, Alagappa University during October 3 – 5, 2016.
5. **Organizing Secretary** – Organized Internal Hackathon for Smart India Hackathon – 2022 at Alagappa University, Karaikudi on 12th April 2022.
6. **Co-organizing Secretary** – Organized 35th South Zone Inter University Youth Festival – 2019 in Collaboration with Association of Indian Universities (AIU), New Delhi at Alagappa University, Karaikudi on 18th to 22nd December 2019.

Events Participated (optional)

Conferences / Seminars / Workshops: 23

1. Conference:
 - i. International – 10
 - ii. National – 5
2. Seminar:
 - i. National – 5
3. Workshop:
 - i. International – 1
 - ii. National – 2

Other Training Programs

1. Participated in UGC Sponsored **Orientation Programme** at Academic Staff College, Madurai Kamaraj University from 17.12.2014 to 13.01.2015.

2. Participated in five days **Faculty Development Programme** on Cloud Infrastructure and Services Conducted by ICT Academy of Tamil Nadu From 23.02.2015 to 27.02.2015 at Alagappa University, Karaikudi.
3. Participated in **Orientation Programme** organized by Curriculum Development Cell, Alagappa University from 24.08.2012 to 31.08.2012

Membership in Professional Bodies

1. Member – International Association of Computer Science and Information Technology (IACSIT), Singapore (Member No.: 80332865).
2. Member, International Association Engineers (IAENG), Hong Kong. (Member No.: 187224)

Editorial Board

1. Co-Editor, International Conference on Innovations in Computer Science and Technology Organized by the Department of Computer Science and Engineering, Alagappa University, Karaikudi, Tamil Nadu on 4th & 5th April 2016.

Academic Bodies (such as Board of Studies etc.,)

1. Member – Board of Studies in PSN College of Engineering & Technology, Tirunelveli.
2. Chairman – Board of Studies in Alagappa University, Karaikudi. BCA Degree.
3. Member, Board of Studies in Manonmaniam Sundaranar University, Tirunelveli.
4. Member, Board of Studies in J. J. College of Arts and Science, Pudukkottai.
5. Member, Board of Studies in Yadava College, Madurai.
6. Member, Board of Studies in Mannar Thirumalai Naickar College, Madurai.

Others

1. Member, Doctoral Committee in Anna University, Chennai.
2. Member, Doctoral Committee in Manonmaniam Sundaranar University, Tirunelveli.
3. Member, Doctoral Committee in Sathyabhama University, Chennai.
4. Member, Doctoral Committee, Noorul Islam University, Nagercoil.
5. Member, Doctoral Committee in VIT University, Vellore.
6. Member, Syllabus auditing committee in V.V.Vanniaperumal Women's College, Virudhunagar.

Resource persons in various capacities

Number of Invited / Special Lectures delivered: 7

Others

1. Articles published in Newspapers / Magazines : Nil
2. Products developed : Nil
3. No. of PhD Thesis evaluated : 08
4. No. of PhD Public Viva Voce Examination conducted : 06

DATASET COLLECTED AND PUBLISHED

1. Jerlin RL, Eswaran P, Soundarapandian P (2015) UCI Chronic Kidney Disease dataset. School of Information and Computer Sciences. University of California Irvine. CA. USA. https://archive.ics.uci.edu/ml/datasets/Chronic_Kidney_Disease.

RECENT PUBLICATIONS - INTERNATIONAL JOURNALS

1. Jerlin Rubini, **Eswaran Perumal**, “Oppositional firefly optimization based optimal feature selection in chronic kidney disease classification using deep neural network”, Journal of Ambient Intelligent and Humanized Computing, 13:1799–1810, 2022. (**SCI Indexed – IF: 7.104**) <https://doi.org/10.1007/s12652-021-03477-2>
2. K. Shankar, Eswaran Perumal, Mohamed Elhoseny, et al., “Synergic Deep Learning for Smart Health Diagnosis of COVID-19 for Connected Living and Smart Cities” ACM Transactions on Internet Technology (TOIT), Volume 22, Issue 3, August 2022, Article No.: 61, pp 1–14 (**SCI Indexed – IF: 3.135**) <https://doi.org/10.1145/3453168>
3. Shankar, K., **Eswaran Perumal**, Tiwari, P. et al. “Deep learning and evolutionary intelligence with fusion-based feature extraction for detection of COVID-19 from chest X-ray images”, Multimedia Systems, 28:1175–1187, 2022. (**SCI Indexed – IF: 1.935**) <https://doi.org/10.1007/s00530-021-00800-x>
4. K. Shankar, **Eswaran Perumal**, V.G. Díaz et al., “An optimal cascaded recurrent neural network for intelligent COVID-19 detection using Chest X-ray images”, Applied Soft Computing (2021), (**SCI Indexed – IF: 6.725**) <https://doi.org/10.1016/j.asoc.2021.107878>.
5. K. Shankar, **Eswaran Perumal**, “Ant Colony Optimization based Optimal Steganography Technique for Secret Image Sharing Scheme”, Advances in Mathematics: Scientific Journal, vol. 10, no.1, pp. 453–461, January 2021, (**Scopus Indexed**) <https://doi.org/10.37418/amsj.10.1.45>
6. Shankar, K. and **Eswaran Perumal**, “Automated Detection and Classification of COVID-19 from Chest X-ray Images using Deep Learning”, Journal of Computational and Theoretical Nano Science, vol. 17, no. 12, pp. 5457-5463(7), December 2020. (**Scopus Indexed – IF: 0.220**) <https://doi.org/10.1166/jctn.2020.9439>
7. E.Laxmi Lydia, G. Jose Moses, Vijayakumar Varadarajan, Fredi Nonyelu, Andino Maselena, **Eswaran Perumal**, K. Shankar, “Clustering and Indexing of Multiple Documents using Feature Extraction Through Apache Hadoop on Big Data”, Malaysian Journal of Computer Science, Issue 1, pp., 108-123, November 2020. (**SCI Indexed – IF: 1.043**) <https://doi.org/10.22452/mjcs.sp2020no1.8>
8. K. Shankar, **Eswaran Perumal**, Mohamed Elhoseny and Phong Thanh Nguyen, “An IoT-Cloud Based Intelligent Computer-Aided Diagnosis of Diabetic Retinopathy Stage Classification Using Deep Learning Approach”, Computers, Materials & Continua, vol.66, no.2, pp.1665-1680, November 2020. (**SCI Indexed – IF: 4.89**). [Doi:10.32604/cmc.2020.013251](https://doi.org/10.32604/cmc.2020.013251)

9. Shankar, K., **Eswaran Perumal**, “A novel hand-crafted with deep learning features based fusion model for COVID-19 diagnosis and classification using chest X-ray images”, *Complex & Intelligent System*, No.7, pp. 1277–1293, November 2020. (**SCI Indexed – IF: 3.791**) <https://doi.org/10.1007/s40747-020-00216-6>
10. Jerlin Rubini Lambert and **Eswaran Perumal**, “Hybrid Kernel Support Vector Machine Classifier and Grey Wolf Optimization Algorithm Based Intelligent Classification Algorithm for Chronic Kidney Disease”, *Journal of Medical Imaging and Health Informatics*, vol. 10, no. 10, pp. 2297-2307, October 2020. (**SCI Indexed – IF: 0.642**) <https://doi.org/10.1166/jmhi.2020.3177>
11. Jerlin Rubini Lambert and **Eswaran Perumal**, “Optimal Feature Selection Methods for Chronic Kidney Disease Classification using Intelligent Optimization Algorithms”, *Recent Advances in Computer Science and Communications* (August 2020) 13: 1, (**Scopus Indexed**). <https://doi.org/10.2174/2666255813999200818131835>
12. Joshi, G.P.; **Eswaran Perumal**.; Shankar, K.; Tariq, U.; Ahmad, T.; Ibrahim, A., “Toward Blockchain-Enabled Privacy-Preserving Data Transmission in Cluster-Based Vehicular Networks”, *Electronics* (August) 2020, 9, 1358. (**SCI Indexed – IF: 2.412**) <https://doi.org/10.3390/electronics9091358>
13. Pramila Arulanthu, **Eswaran Perumal**, “An Efficient Oppositional Crow Search Optimization-based Deep Neural Network Classifier for Chronic Kidney Disease Identification”, *International Journal of Innovative Computing and Applications*, vol. 12, no. 4, pp. 206-215, June 2021 (**Scopus Indexed**) DOI: [10.1504/IJICA.2021.116671](https://doi.org/10.1504/IJICA.2021.116671)
14. K.Shankar, **Eswaran Perumal**, Vidhyavathi,R.M, “Deep neural network with moth search optimization algorithm based detection and classification of diabetic retinopathy images”, *SN Appl. Sci.* 2:748, (March 2020), (**ESCI - WoS**). <https://doi.org/10.1007/s42452-020-2568-8>
15. Pramila Arulanthu and **Eswaran Perumal**, “An intelligent IoT with cloud centric medical decision support system for chronic kidney disease prediction”, *International Journal of Imaging Systems and Technology*, March 2020; 1-13. (**SCI Indexed – IF: 1.952**). <https://doi.org/10.1002/ima.22424>
16. Jerlin Rubini Lambert and **Eswaran Perumal**, “Efficient Classification and Prediction of Chronic Kidney Disease by using Multi-Kernel Support Vector Machine and Fruit Fly Optimization Algorithm”, *International Journal of Imaging Systems and Technology*, January 2020; 1-14. (**SCI Indexed – IF: 1.952**) <https://doi.org/10.1002/ima.22406>
17. Pramila Arulanthu and **Eswaran Perumal**, “Risk Factor Identification, Classification and Prediction Summary of Chronic Kidney Disease”, *Recent Advances in Computer Science and Communications*, January 2020, 13: 1. ISSN: Online: 2666-2566. (**Scopus Indexed**) <https://doi.org/10.2174/2666255813666200101100424>

18. K.Shankar and **P.Eswaran**, “RGB Based Multiple Share Creation in Visual Cryptography with Aid of Elliptic Curve Cryptography”, IEEE Journal of China Communications, Vol. 14, Issue 2, page(s): 118–130, February 2017. (**SCI Indexed – IF: 0.344**).
[DOI:10.1109/CC.2017.7868160](https://doi.org/10.1109/CC.2017.7868160)
19. K.Shankar and **P.Eswaran**, “RGB Based Secure Share Creation in Visual Cryptography Using Optimal Elliptic Curve Cryptography Technique”, Journal of Circuits, Systems, and Computers, (World Scientific) Vol. 25, No. 11, November 2016.
(**SCI Indexed – IF: 0.250**). <https://doi.org/10.1142/S0218126616501383>
20. S. Anantha Babu, **P. Eswaran** and C. Senthil Kumar, “Lossless Compression Algorithm Using Improved RLC for Grayscale Image”, Arabian Journal of Science and Engineering, Vol.41, page(s): 3061–3070, March 2016. (**SCI Indexed – IF: 0.728**).
<https://doi.org/10.1007/s13369-016-2082-x>
21. Ambika, I. Sadasivam, V and **Eswaran, P.** “An Effective Queuing Architecture for Elastic and Inelastic Traffic with Different Dropping Precedence in MANET”, EURASIP Journal on Wireless Communications and Networking, vol.155, 2014. (**SCI Indexed – IF: 0.627**).
<https://doi.org/10.1186/1687-1499-2014-155>
22. **Eswaran Perumal** et al., “Hi–Tech Authentication for Palette Images Using Digital Signature and Data Hiding”, International Arab Journal of Information Technology, Vol. 8, no. 2, page(s): 117–123, April 2011. (**SCI Indexed – IF: 0.344**).
23. S.Poonkuntran, R.S.Rajesh and **P.Eswaran**, “Energy aware Fuzzy Color Segmentation Algorithm–An application to criminal identification using mobile devices”, International Journal of Wavelets and Multi resolution Information Processing Systems (IJWMIP), vol. 6, no. 5, page(s): 707–718, 2008. (**SCI Indexed – IF: 0.500**).
<https://doi.org/10.1142/S0219691308002604>

Publications – International Conference

1. Saravana Prabhu R., Prema A., **Eswaran Perumal**, “A Novel Cloud Security Enhancement Scheme to Defend against DDoS Attacks by using Deep Learning Strategy”, Proceedings of 6th International Conference on Electronics, Communication and Aerospace Technology (ICECA 2022), pp. 679-686, December 2022, **IEEE Conference Record** ISBN: 978-16654-8271-4, (**Scopus Indexed**).
2. Jerlin Rubini Lambert; Pramila Arulanthu; **Eswaran Perumal**, “Identification of Nominal Attributes for Intelligent Classification of Chronic Kidney Disease using Optimization Algorithm”, International Conference on Communication and Signal Processing (ICCSP), July 2020, pp. 0119-0125, **IEEE Conference Record**, ISBN: 978-1-7281-4988-2, (**Scopus Indexed**) [DOI:10.1109/ICCSP48568.2020.9182206](https://doi.org/10.1109/ICCSP48568.2020.9182206)
3. Pramila Arulanthu and **Eswaran Perumal**, “Predicting the Chronic Kidney Disease using Various Classifiers”, 4th IEEE International Conference on Electrical, Electronics, Communication, Computer Technologies and Optimization Techniques, pp. 70-75, December 2019, **IEEE Conference Record**, ISBN: 978-1-7281-3261-7, (**Scopus Indexed**)
<https://doi.org/10.1109/ICEECCOT46775.2019.9114653>

4. Anantha Babu, S and **Eswaran Perumal**, “Efficient Approach of Run Length Coding Technique using Lossless Grayscale Image Compression (E-RLC)”, 3rd International Conference on Inventive Computation Technologies (ICICT), page(s): 534-539, November 2018, **IEEE Conference Record**, ISBN: 978-1-5386-4985-5, (**Scopus Indexed**) [DOI:10.1109/ICICT43934.2018.9034377](https://doi.org/10.1109/ICICT43934.2018.9034377)
5. **Eswaran Perumal** and Pramila Arulanthu, “Multilevel Morphological Fuzzy Edge detection for Color Images (MMFED)”, IEEE International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques”, pp. 269–273, December 2017. **IEEE Conference Record**, ISBN: 978-1-5386-2361-9, (**Scopus Indexed**) [DOI: 10.1109/ICEECCOT.2017.8284680](https://doi.org/10.1109/ICEECCOT.2017.8284680)
6. K.Shankar and **P.Eswaran**, “A New k out of n Secret Image Sharing Scheme in Visual Cryptography”, Proceedings of the 10th International Conference on Intelligent Systems and Control (ISCO 2016), page(s): 369-374, January 2016. **IEEE Conference Record**, **Scopus Indexed**, ISBN: 978-1-4673-7807-9. [DOI: 10.1109/ISCO.2016.7726969](https://doi.org/10.1109/ISCO.2016.7726969)
7. K.Shankar and **P.Eswaran**, “Sharing a Secret Image with Encapsulated Shares in Visual Cryptography”, Procedia Computer Science, Elsevier, Vol. 70, pp. 462-468, 2015. <https://doi.org/10.1016/j.procs.2015.10.080>
8. **Eswaran Perumal** et al., “Fuzzy – PL Transformation Based Color Edge Detection” proceedings of the 16th International Conference on Advanced Computing and Communication (ADCOM 2008), page(s): 9–12, December 2008, (**Indexed by IEEE**), ISBN: 978-1-4244-2963-9, (**Scopus Indexed**), [DOI: 10.1109/ADCOM.2008.4760420](https://doi.org/10.1109/ADCOM.2008.4760420)
9. S.Poonkuntran, R.S.Rajesh, **Eswaran Perumal**, “A Reversible Watermarking with Low Warping: An Application to Digital Fundus Image”, Proceedings of the IEEE International Conference on Computer and Communication Engineering (ICCCE '08), page(s): 472–477, May 2008, **IEEE Conference Record**, ISBN: 978-1-4244-1691-2, (**Scopus Indexed**), [DOI:10.1109/ICCCE.2008.4580649](https://doi.org/10.1109/ICCCE.2008.4580649)

PUBLICATION – BOOK

1. K.Shankar, **Eswaran Perumal**, Deepak Gupta, “Artificial Intelligence for the Internet of Health Things”, CRC Press, Taylor and Francis Group, May 2021. ISBN: 978-0-367-74497-7, <https://www.routledge.com/Artificial-Intelligence-for-the-Internet-of-Health-Things/Shankar-Perumal-Gupta/p/book/9780367744977>

PUBLICATIONS – Book Chapters

1. Denis A. Pustokhin, Irina V. Pustokhina, Eswaran Perumal, K. Shankar, “Intelligent Robots in the Disease Recovery Process Using a Whale Optimization-Based Feature Selection and Classification Model”, Robotic Technologies in Biomedical and Healthcare Engineering, June 2021, (**Taylor & Francis – Scopus Indexed**) ISBN: 9781003112273, DOI <https://doi.org/10.1201/9781003112273>
2. Andino Maselena, Wahidah Hashim, Eswaran Perumal, M. Ilayaraja, and K. Shankar, “Access control and classifier-based blockchain technology in e-healthcare applications”, Intelligent Data Security Solutions for e-Health Applications, pp. 151-167, August 2020, (**Elsevier – Scopus Indexed**), ISBN: 978-0-12-819511-6, <https://doi.org/10.1016/B978-0-12-819511-6.00008-X>

3. K. Shankar, Mohamed Elhoseny, Eswaran Perumal, M. Ilayaraja, K. Sathesh Kumar, “An Efficient Image Encryption Scheme Based on Signcryption Technique with Adaptive Elephant Herding Optimization”, *Cyber security and Secure Information Systems, Advanced Sciences and Technologies for Security Applications*, pp. 31-42, June 2019, **(Springer – Scopus Indexed)**, ISBN: 978-3-030-16837-7, https://doi.org/10.1007/978-3-030-16837-7_3
4. P. Manickam, K. Shankar, Eswaran Perumal, M. Ilayaraja, K. Sathesh Kumar., “Secure Data Transmission Through Reliable Vehicles in VANET Using Optimal Lightweight Cryptography”, *Cybersecurity and Secure Information Systems, Advanced Sciences and Technologies for Security Applications*, pp. 193-204, June 2019. **(Springer – Scopus Indexed)**, ISBN: 978-3-030-16837-7, https://doi.org/10.1007/978-3-030-16837-7_9
5. K.Shankar, M.Ilayaraja, K. Sathesh Kumar, Eswaran Perumal, “Mobility and QoS Analysis in VANET Using NMP with Salp Optimization Models”, *Emerging Technologies for Connected Internet of Vehicles and Intelligent Transportation System Networks. Studies in Systems, Decision and Control*, vol. 242, pp. 15-26, July 2019, **(Springer – Scopus Indexed)** ISBN: 978-3-030-22773-9, https://doi.org/10.1007/978-3-030-22773-9_2
6. Karthika Velu, Pramila Arulanthu, Eswaran Perumal, “Energy Reduction Stratagem in Smart Homes using Association Rule Mining”, *Innovative Data Communication Technologies and Application, Lecture Notes on Data Engineering and Communications Technologies*, vol. 46. pp. 188-193, January 2020, **(Springer – Scopus Indexed)**, ISBN: 978-3-030-38040-3, https://doi.org/10.1007/978-3-030-38040-3_22
7. K.Shankar, Eswaran Perumal., “An Efficient Image Encryption Technique Based on Optimized Key Generation in ECC Using Genetic Algorithm”, *Artificial Intelligence and Evolutionary Computations in Engineering Systems. Advances in Intelligent Systems and Computing*, vol. 394, pp. 705-714, February 2016, **(Springer – Scopus Indexed)**, ISBN: 978-81-322-2656-7, https://doi.org/10.1007/978-81-322-2656-7_64