Deep Belief Network-Based Machine Learning for Medical Imputation

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Abstract: Missing value research has been around for at least two to three decades, but imputation of missing values is a major challenge in keeping databases intact. Statistics-oriented imputation and non-statistics-oriented imputation are two types of missing value imputation. Numerous flaws in the statistics-based imputation method make it difficult to fine-tune or expect perfect imputation; it also has a number of execution-related limitations. This is a clue to the non-statistical practise known as machine learning, which we examined in this work. The Deep Belief Network (DBN) is a type of unsupervised probabilistic generative model used in machine learning applications. Restricted Boltzmann Machines are used to build it, and they perform a contrastive divergence and backpropagation to fine-tune the weights for the imputation process. DBN's stable imputation value is based on the contrastive divergences. Data from the UCI Repository's PIMA medical dataset was used in the experimentation Up to 90% of the time, the DBM with backpropagation is accurate. A maximum of 10% mean square error rate is supported by this method (DBN) compared to earlier imputation techniques. In order to evaluate the accuracy of DBN, nearly five additional imputation methods are linked to it. In comparison to other methods, DBN imputation provides 90% accuracy.

Keywords: Machine Learning, Unsupervised Learning, Deep Belief Network, Imputation, Artificial neural networks.

Introduction

There are numerous methods to handle missing data before data analysis [1]. If you're looking for a more robust agreement with missing data, a complete-case approach (listwise deletion) may be the best option [2]. If the omitted subjects are analytically different from those encompassed, it suggests that the analysis has less power and can introduce biases. Second, the mean of the available cases can be used to replace missing data [3-6]. When applied, it reduces data inconsistency and incorrectly estimates SDs and variances together. In a large survey-based or epidemiology study, missing data is a common procedural issue [7-12]. A regression model can be used to impute missing values by using data from other variables to calculate the value of a specific variable for which data are missing. Still, regression imputation overvalues the correlations between target and instructive variables and underestimates variances and covariances when used [13-16]. This tactic, known as hot-deck imputation in surveys, can be used to classify the non-respondents as those who share similarities and then impute missing data from those who are similar to the non-respondents [17-22]. This technique is used to calculate statistics for a population that differs from the one from which the data were collected, and it is called "converse probability weighting." An approximation of sampling probability can be used to increase the weight for subjects with a significant amount of missing data [23-27]. It is also possible to make use of multiple regression multiple imputations to fill in the blanks of missing data [28].

The proposed imputation practises may also have an impact on study outcomes [29-33]. When the assumptions of missing completely at random (MCAR) and missing at random (MAR) hold, it has been shown that the effort soundness of different probability weighting and multiple imputations [34-37]. As a result of this extensive effort, not a single tactic mentioned earlier is completely reasonable. There must be a strategy that does not affect the evaluation criteria [38-41]. The use of machine learning for missing data imputation has been on the rise in recent years, and researchers have found that machine learning methods outperform traditional statistical methods (such as mean imputation, hot-deck, and multiple imputations) when it comes to handling missing data, resulting in better prediction accuracy of patient outcomes [42].

ANN-based deep learning was first proposed in the early 1980s but has only recently been put into practise due to the prohibitive costs of time and computational resources required by then-current hardware [43-49]. By making large datasets and graphics processing units (GPU) more widely available, deep learning is on a fast track to becoming a household name within a few years (Hinton & Salakhu 2006) [50-54]. When it comes to speech recognition, language processing, and image classification, deep learning outperforms traditional machine learning methods like support vector machine (SVM) and fuzzy domain [55]. Using deep learning, it is possible to forecast the deterrence, diagnosis, treatment, and prognosis of the cerebral disease because of its ability to conclude abstract, high-level depictions. Alzheimer's disease, dementia, and attention deficit hyperactivity disorder (ADHD) are all included in a small study that recycled deep learning to categorise the disorders involved. When applied to large, high-dimensional datasets, deep learning-based approaches have been shown to be effective at filling in the blanks of missing data [56-59].

The goal of the study is to use deep learning to fill in missing data in a medical dataset, as stated in the study's scope [60-75]. For data imputation, we will use deep learning in conjunction with the UCI Repository of Machine Learning Databases. Our total sample size (N=768) was increased by combining samples from previous studies, and missing data for required features was imputed using a deep learning approach [76-82]. We assume that deep learning is capable of filling in the blanks in the medical dataset and generating a large imputed dataset that is as close to the original as possible in terms of its ability to distinguish missing features [83]. It is possible to measure a machine's ability to learn from data and accurately predict missing values using this deep learning approach. Using imputed features, we hypothesised hyperactivity-impulsivity behaviours [84-92].

Related Work

This is a framework of machine learning models used to detect anomalies and interferences in real-world systems [93-115]. For imputation, Chand and coworkers combined nine other machine learning models with SVM [116-119]. A group of well-known classifiers experimented with imputation of unknown values. On the basis of the host's user profiles constructed from normal usage data, dynamic behaviour models similar to the Hidden Markov Model were assumed to detect intrusions [120-125]. A hybrid model combining SVM, decision trees, and Nave Bayes was proposed in. For the classification of host states based on network traffic behaviour, Li et al. provided an online Support Vector Machine (SVM) with a decision tree. For missing value feeds, boosted SVM was used in [126-141]. In, Meng compared a variety of machine learning models, including artificial neural networks, SVM, and decision trees, to determine the best method for imputed missing values [142]. SVM and neural networks were employed to automatically compute the missing values [143]. To reduce the rate of false positives, fuzzy clustering was presented. In order to achieve scalable unsupervised intrusion detection, K-Means clustering was used [144-151].

Deep Belief Network

Deep Belief Network differs significantly from Deep Neural Network in two important respects: The network's structure [152-166]: A forward feed network with multiple hidden layers is known as a deep neural network [167]. The logistic/sigmoid activation function is typically customised by each hidden neuron [168]. Undirected connections between hidden layers of Restricted Boltzmann Machines are characteristic of the Deep Belief Network [169-171].

The backpropagation training process of a Deep Neural Network uses labelled data to adjust its weights [172-179]. Backpropagation is used to fine-tune the weights in the Deep Belief Network, which uses unsupervised pre-training by contrastive divergence and backpropagation [180]. Many balanced labelled datasets are required by Deep Neural Networks, but the maximum industry data shortage of such labels. Stacking Restricted Boltzmann Machines creates the Deep Belief Network, an unsupervised probabilistic multiplicative model [181-186]. The stacked Restricted Boltzmann Machines are able to process inputs using the CD procedure [187]. In this phase, labelled data is not needed because CD is unsupervised learning [188]. A supervised learning model, such as softmax/logistic regression or a linear classifier with gradient descent learning process, will be used in the second phase to adjust the pre-trained network [189-191]. This second phase only fine-tuned model input, as the Deep Belief Network inputs are nearly stable after CD [192-196]. As a result, Deep Belief Network requires fewer labelled data points [197].

Restricted Boltzmann Machine

Stochastic model Restricted Boltzmann Machine (RBM) has two layers. Invisible and visible layers are part of it. Visible states can be found in the visible layer. $V = (v_1, \ldots, v_n)$, while concealed layer has states $H = (h_1 \ldots, h_n)$ which can't be directly measured [198-199]. In between the two layers, all of the states are completely linked. States in the same layer are equally liberated, despite the fact that they have no connections to one another. One kind of energy-based model is the Restricted Boltzmann Machine. Each configuration of the variables of interest is accompanied by scalar energy. In order to form the necessary properties, one must regulate the energy function as part of the learning process. Equation (1), using an energy function, gives the joint probability distribution for (v, h) in a Restricted Boltzmann Machine.

$$p((v, h) = \frac{1}{z} e^{-E(v,h)} \tag{1}$$

The energy function $E(v, h)$ is distinct in Equation (2), where w_{ij} signifies the weight between concealed state h_i and visible state v_j. b_i and a_j are constant-valued offsets or partialities. In order to improve model performance, the bias is used to shift the energy function during training.
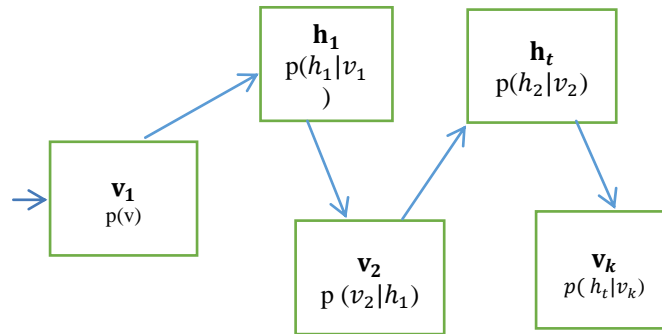
Restricted Boltzmann Machine Training

The central task for Restricted Boltzmann Machine training is to learn the weight matrix $W = \{w_{ij}\}$ that takes full advantage of the log-likelihood $\log p(v)$. From Equations (2) and (3), we have,

$$\frac{\partial E(v,h)}{\partial w_{ij}} = v_j h_i \implies \frac{\partial \log p(v)}{\partial w_{ij}} = \langle v_j h_i \rangle^0 - \langle v_{jh_i} \rangle^\infty \implies \Delta w_{ij} = \in (\langle v_j h_i \rangle^0 - \langle v_{jh_i} \rangle^\infty) \tag{2}$$

where $\langle v_j h_i \rangle^t$, $t = 0, \ldots, \infty$ signifies the expectation of random variable $v_j h_i$ at sampling step t and $\in$ is the learning rate for weight updating. Sampling of $\langle v_j h_i \rangle^t$ successive a Markov chain can attain t to convergence through Gibbs choice. Visible states can be sampled instantly while assuming fixed values for concealed states in the Restricted Boltzmann Machine because the visible and concealed

states are conditionally liberated. Similarly, it is possible to simultaneously sample hidden states, given the visible states. So, assumed h_i^t or v_j^t at step t, h_i^{t+1} or v_j^{t+1} at step $t+1$ can be acquired by Equations (5) and (6). That is, h_i^{t+1} is set as 1 with probability $\sigma(b_i + \sum_j v_j^t w_{ij})$, and v_j^{t+1} is set at 1 with probability $\sigma(a_j + \sum_i h_i^{t+1} w_{ij})$. As $t \to \infty$, the samples will be approaching true samples from $p(v)$. Figure 1 illustrates this sampling process (figure 1).

Figure 1. Restricted Boltzmann Machine sampling process

The sampling process can be accelerated using Contrastive Divergence (CD). To begin, rather than randomly starting the Markov chain, training samples that are closer to the true distribution are used, resulting in a faster convergence of the chain. First of all, the CD doesn't wait for the Markov chain to converge. After the k steps of Gibbs' choice, however, it will come to a halt. Even with a small k (in practise, k is often set to 1), the algorithm produces near-maximum likelihood solutions even when k is large. Structure of the Deep Belief Network the Deep Belief Network is a stochastic model. Stacking Restricted Boltzmann Machines is the primary way to build the Deep Belief Network shown in Figure 2. It consists of a classifier and a stack of Restricted Boltzmann Machines. Pre-training and fine-tuning are part of the Deep Belief Network's training process (figure 2).
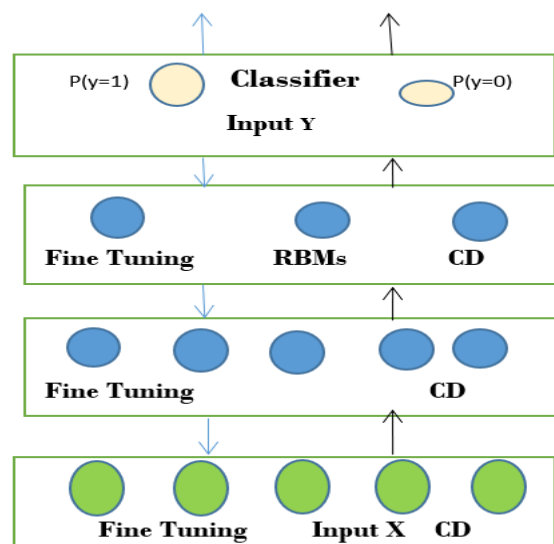
Figure 2: Architecture of Deep Belief Network

Experimentation and Result Outcome

Pre-preparation

To stack Restricted Boltzmann Machines, pre-training is required. There will be a visible layer in the next Restricted Boltzmann Machine that was hidden in the previous one. This is the pre-training procedure referred to as X, the input matrix.

➢ Practice the first layer of Restricted Boltzmann Machine on X to gain the weight matrix using Contrastive Divergence system

➢ Transmute X with the weight matrix to renovate different data X'.

Fine-tuning

Backpropagation and softmax regression are used to fine-tune the Deep Belief Network. (The uninspired chain principle on model errors uses backpropagation to regulate weights. The fault will propagate all the way up to the top of the stack. The size of the batch and the number of times it is run are two critical considerations. Fine-tuning is a process in which training samples are divided into equal-sized clutches. Samples in each clutch are fed to the dataset feature before weight updates can be made. The iterations of fine-tuning are linked to a number of epochs. More fine-tunings can be achieved with a smaller batch size or more periods (Gau et al., 2008). The conditional probability of Y=l (class l) given the output X', coefficient matrix C, and intercept d of stacked Restricted Boltzmann Machines. The class with the greatest likelihood of finishing is selected as the winner. (An extension to logistic regression known as Softmax regression, it can be used with more than two classes.

Dataset

This repository is a collection of databases, domain theories and data generators that are used by the machine learning community to test and evaluate algorithms. Attribute and instance types, names of data sets and default tasks are all part of the UCI Repository.

Table 1. PIMA Dataset descriptions

Data Set Characteristics:	Multivariate	Number of Instances:	768	Area:	Life
Attribute Characteristics:	Integer, Real	Number of Attributes:	8	Date Donated	1990-05-09
Associated Tasks:	Classification	Missing Values?	Yes	Number of Web Hits:	98164
Training Data Set	16				

In Table 1, the PIMA Dataset of the UCI repository is used in conjunction with the Deep Belief Network system for 768 instances. Multivariate, Integer, and Real are all included in the PIMA Dataset. Converging the,w-ij. weight offset assumed by the data set was an insistence of the dataset. ,w-ij has nine missing features, and the trained dataset was regulated for imputation nearly 8 times to find the,w-ij using these missing features. Figure 3 shows that four different types of value imputation were used for a single attribute's outcomes. It's DBN, Fuzzy Clustering, Penalized FCM (black corporates), and Statistical Mean (blue labels) (figure 3).
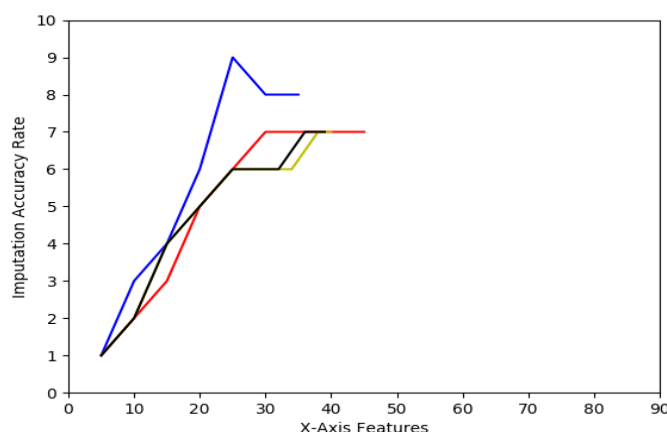
Figure 3. Assessment of imputation Accuracy

Only one figure is shown here. To a maximum of 90% (i.e. for attribute 3), the blue label of the Deep Belief Network approach achieves value imputation, with 10% of the total instances N=768 failing. Testing also implemented an interesting fact: the value imputation was limited to 65 percent, and the failed cases were limited to 35 percent. The remaining imputation approaches were red label 61 percent, green label 70 percent, and black label 70 percent.

Conclusion

Unsupervised machine learning Deep Belief Network is used to accomplish two main goals. An imputation for a missing place is the first and most important step. Improving imputation accuracy and stability are the primary goals of the Deep Belief Network procedure, which uses a backpropagation approach. Ninety percent of the imputations were accurate. To achieve high imputation accuracy, the medical dataset attributes are trained separately using machine learning techniques. CD plays a critical role in defining the stability of the imputation accuracy. Using a mapping of the work, pre-trained classifiers have been applied to the dataset. There are 768 different attributes associated with the dataset, and three of these characteristics are enforced. Depending on the other attribute, the attribute imputation ratio changes. The next step will be to reduce the inference by 10% in order to reduce the percentage of imputation in the future.

Reference

1. Baraldi AN, Enders CK. An introduction to modern missing data analyses. J School Psychol (2010) 48:5–37.

2. Bauermeister JJ, Barkley RA, Bauermeister JA, Martínez JV, McBurnett K. Validity of the sluggish cognitive tempo, inattention, and hyperactivity symptom dimensions: Neuropsychological and psychosocial correlates. J Abnormal Child Psychol (2012) 40:683–97.

3. Chang L-R, Chiu Y-N, Wu Y-Y, Gau SS-F. Father's parenting and father-child relationship among children and adolescents with attention-deficit/hyperactivity disorder. Compr Psychiatry (2013) 54:128–40.

4. Chen C-H, Chen H-I, Chien W-H, Li L-H, Wu Y-Y, Chiu Y-N, et al. High-resolution analysis of rare copy number variants in patients with autism spectrum disorder from Taiwan. Sci Rep (2017) 7:11919.

5. Durstewitz D, Koppe G, Meyer-Lindenberg A. Deep neural networks in psychiatry. Mol Psychiatry (2019) 24:1583–98.

6. Eekhout I, de Boer RM, Twisk JW, de Vet HC, Heymans MW. Missing data: a systematic review of how they are reported and handled. Epidemiology (2012) 23:729–32.

7. Fukushima K, Miyake S, Ito T. Neocognitron: A neural network model for a mechanism of visual pattern recognition. IEEE Trans Syst Man Cybernet (1983) SMC-13:826–34.

8. Deo, G. S., Mishra, A., Jalaluddin, Z. M., & Mahamuni, C. V. (2020, September). Predictive analysis of resource usage data in academic libraries using the vader sentiment algorithm. In 2020 12th International Conference on Computational Intelligence and Communication Networks (CICN) (pp. 221-228). IEEE.

9. Deo, G. S., Totlani, J. A., Mamidi, K. E., & Mahamuni, C. V. (2020, May). Performance Analysis of BiMOS Differential Pair with Active Load, Wilson and Widlar Current Mirrors, and Diode Connected Topology. In 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS) (pp. 99-104). IEEE.

10. Deo, G., Totlani, J., & Mahamuni, C. (2022, April). Detection of COVID-19 and Prediction of Pneumonia from Chest X-Rays using Deep Learning. In 2022 IEEE 11th International Conference on Communication Systems and Network Technologies (CSNT) (pp. 232-238). IEEE.

11. Goud, C. S., Das, S., Kumar, R., Mahamuni, C. V., & Khedkar, S. (2020, July). Wireless Sensor Network (WSN) Model for Shrimp Culture Monitoring using Open Source IoT. In 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA) (pp. 764-767). IEEE.

12. Govinda rajulu Lanke and T.Bhuvaneswari, "Giving Intelligence to SMEs Business," International Journal of Business Intelligent, vol. 04, no. 02, p. 5, 2015.

13. Han GT, Chen Y-L, Tsai F-J, Gau SS-F. Temporal and reciprocal relations between ADHD symptoms and emotional problems in school-age children. J Attention Disord (2018) 24:1032–44.

14. Hernán MA, Robins JM. Estimating causal effects from epidemiological data. J Epidemiol Community Health (2006) 60:578–86.

15. Jose, J. M., Jose, J. V., & Vijaykumar Mahamuni, C. (2020). Multi-Biosensor based Wireless Body Area Networks (WBAN) for Critical Health Monitoring of Patients in Mental Health Care Centers: An Interdisciplinary Study. International Journal of Research in Engineering, Science and Management, 3.

16. Kuang D, Guo X, An X, Zhao Y, He L. Discrimination of ADHD based on fMRI data with deep belief network. Intelligent Computing in Bioinformatics. ICIC 2014. Lecture Notes in Computer Science, vol 8590. Springer, Cham (2014), p. 225–32.

17. Kumar, Dhurjati .Rajeswara , Lanke, Govinda Rajulu, "Survey Of Cloud Computing and Its Development And Problem Solving," International Journal of Innovative Research Explorer(ijire), vol. 6, no. 11, p. 8, 2018.

18. Lanke, Govinda Rajulu, "Strategic objectives modeling architecture for Real-Time Business Intelligence (BI)," International Journal of Scientific and Technology Research, vol. 2, no. 6, p. 4, 2013.

19. Lanke, Govinda Rajulu, "The Certainty of Bi System For SME," IJCSERD, vol. 1, no. 1, p. 4, 2014.

20. Lanke, Govinda Rajulu, "The Inevitability of BI systems for SME," International Conference On Emerging Trends In Science, Engineering And Technology, vol. 1, no. 3, p. 14, 2012.

21. Lanke, Govinda Rajulu. (2013), "Adaptation of Saas In B Usiness I Ntelligence For SME," IJOAR .org, vol. 1, no.3, p.14, 2013.

22. Mahamuni, C. V. (2015). Metamaterial based Electromagnetic Cloaking: A Survey. International Journal of Advance Foundation and Research in Science and Engineering (IJAFRSE), 2(5), 15-20.

23. Mahamuni, C. V. (2016). A military surveillance system based on wireless sensor networks with extended coverage life. In 2016 International conference on global trends in signal processing, information computing and communication (ICGTSPICC) (pp. 375-381). IEEE.

24. Mahamuni, C. V. (2016). Performance enhancement of microstrip patch antenna using metamaterial cover. In 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication (ICGTSPICC) (pp. 382-388). IEEE.

25. Mahamuni, C. V. (2020). Space-Time Adaptive Processing (STAP) Techniques for Mitigation of Jammer Interference and Clutter Suppression in Airborne Radar Systems: A MATLAB Implementation-Based Study. IUP Journal of Telecommunications, 12(4), 31-45.

26. Schafer JL, Graham JW. Missing data: our view of the state of the art. psychol Methods (2002) 7:147–77.

27. Song Y, Gao S, Tan W, Qiu Z, Zhou H, Zhao Y. Multiple Machine Learnings Revealed Similar Predictive Accuracy for Prognosis of PNETs from the Surveillance, Epidemiology, and End Result Database. J Cancer (2018) 9:3971–8.

28. Van Buuren S. Item imputation without specifying scale structure. Methodology (2010) 6:31–6.

29. Wu S-Y, Gau SS-F. Correlates for academic performance and school functioning among youths with and without persistent attention-deficit/hyperactivity disorder. Res Dev Disabil (2013) 34:505–15.

30. Mahamuni, C. V., & Jalauddin, Z. M. (2021, December). Intrusion Monitoring in Military Surveillance Applications using Wireless Sensor Networks (WSNs) with Deep Learning for Multiple Object Detection and Tracking. In 2021 International Conference on Control, Automation, Power and Signal Processing (CAPS) (pp. 1-6). IEEE.

31. Mahamuni, C. V., & Reddy, K. T. (2016). A Robust Coverage based on Optimal Backoff Sleep Time in Wireless Sensor Networks. ME Dissertation (Supervisor: Prof (Dr) KTV Reddy), Dept. of Electronics and Telecommunication Engineering, FCRIT-Vashi, University of Mumbai.

32. Mahamuni, C. V., & Reddy, K. T. V. (2017). Optimal Node Scheduling based on Randomized Sleep Assignment and Active Node Failure for Energy-Efficient Coverage of WSNs. Networking and Communication Engineering, 9(3), 72-80.

33. Mahamuni, C. V., Reddy, K. T. V., & Patnaik, N. (2016, November). Optimal backoff sleep time based protocol for prolonged network life with blacklisting of failure-prone nodes in wireless sensor networks. In 2016 Online International Conference on Green Engineering and Technologies (IC-GET) (pp. 1-6). IEEE.

34. Mahamuni, C., Reddy, D. K., & Patnaik, M. N. (2015, October). Dielectric Response of Rectangular Planar Antenna and Characterization of Metamaterial Superstrates As Low Loss Dielectric for Improved Radiation: A Study. In Proceedings of THINKQUEST 2nd International Conference on" Contours of Digital Technology"(ICCDT-2015) (pp. 46-52).

35. Mahamuni, C., Reddy, K. T. V., & Patnaik, N. (2015). An Energy Efficient Performance in Wireless Sensor Networks: A Literature Survey. Research Chronicler, A Multidisciplinary Research Journal, 3(7), 39-54.

36. Mahamuni, C., Reddy, K. T. V., & Patnaik, N. (2015). Study of Metamaterials as an Emerging Technology in Microwave and Millimeterwave Wireless Communication. Research Chronicler International Multidisciplinary Research Journal (RCIMRJ), 3(VII), 20-25.

37. Mahamuni, C., Reddy, K. T. V., & Patnaik, N. (2015, December). A Graphene Monolayer-based Plasmonic Patch Antenna for Microwave and Millimeterwave Wireless Communication. In Proceedings of 11th International Conference on Microwaves Antennas & Remote Sensing ICMARS-2015, Jodhpur, INDIA (pp. 190-193).

38. Mahamuni, C., Reddy, K. T. V., & Patnaik, N. A Literary Study of Coverage and Connectivity in Wireless Sensor Networks for Optimal Performance. International Journal of Engineering and Management (IJERM), 2, 28-31.

39. Mahamuni, C., Reddy, K. T. V., & Patnaik, N. A Relative Study and Analysis of Various Energy Efficiency Schemes in Wireless Sensor Networks. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), 4, 7919-7923.

40. Mishra, A., Jalaluddin, Z. M., & Mahamuni, C. V. (2022, April). Air Quality Analysis and Smog Detection in Smart Cities for Safer Transport using Machine Learning (ML) Regression Models. In 2022 IEEE 11th International Conference on Communication Systems and Network Technologies (CSNT) (pp. 200-206). IEEE.

41. S. Venkatasubramanian, D. A. Suhasini, and D. C.Vennila, "An Energy Efficient Clustering Algorithm in Mobile Adhoc Network Using Ticket Id Based Clustering Manager," International Journal of Computer Science and Network Security, vol. 21, no. 7, pp. 341–349, Jul. 2021.

42. Venkatasubramanian, S., Suhasini, A. and Vennila, C., "An Efficient Route Optimization Using Ticket-ID Based Routing Management System (T-ID BRM)". Wireless Personal Communications, pp.1-20, 2021

43. S. Venkatasubramanian, A. Suhasini, C. Vennila, "Efficient Multipath Zone-Based Routing in MANET Using (TID-ZMGR) Ticked-ID Based Zone Manager", International Journal of Computer Networks and Applications (IJCNA), 8(4), PP: 435- 443, 2021.

44. Venkatasubramanian, S.. "Optimized Gaming based Multipath Routing Protocol with QoS Support for High-Speed MANET", International Journal of Advanced Research in Science, Communication and Technology. vol. 9, No. 1, ,pp.62-73, September , 2021.

45. Venkatasubramanian.S., "A Chaotic Salp Swarm Feature Selection Algorithm for Apple and Tomato Plant Leaf Disease Detection", International Journal of Advanced Trends in Computer Science and Engineering, 10(5), pp.3037–3045,2021.

46. S.venkatasubramanian, "Multistage Optimized Fuzzy Based Intrusion Detection protocol for NIDS in MANET", International Journal Of Innovative Research In Technology, Volume 8 Issue 6, November, pp.301-311, 2021.

47. S.Venkatasubramanian,K., Senthil Kumar & J, Gnana & M, Ayeesha. "IoT and AI Based Recognition and Classification of Covid 19 Persons in Public Place", Turkish Online Journal of Qualitative Inquiry. 12. pp.7098-7110, 2021.

48. Srinivasan, Venkatasubramanian, "Detection of black hole attack using honeypot agent-based scheme with deep learning technique on MANET", Ingénierie des Systèmes d'Information, Vol. 26, No. 6, pp. 549-557., 2021.https://doi.org/10.18280/isi.260605.

49. S.venkatasubramanian, "Correlation Distance Based Greedy Perimeter Stateless Routing Algorithm for Wireless Sensor Networks", Int. J. Advanced Networking and Applications Volume: 13 Issue: 03 pp. 4962-4970,2021.

50. S.Venkatasubramanian, "Ambulatory Monitoring of Maternal and Fetal using Deep Convolution Generative Adversarial Network for Smart Health Care IoT System" International Journal of Advanced Computer Science and Applications(IJACSA), 13(1), 2022.

51. S. Venkatasubramanian, D. A. Suhasini, and D. Vennila, "A Review on Machine Learning Techniques for QoS in WSN", IJAST, vol. 28, no. 9, pp. 169 - 178, Oct. 2019.

52. Venkatasubramanian.S, et al. (2017). A Cross Layer Supported Non-Reservation Based Approach For Qos Provisioning In Mobile Ad Hoc Networks. International Journal of Innovative Research in Science and Engineering, vol.3, No.2, 184-189.

53. Venkatasubramanian, S., Suhasini, A., Vennila, C. "QoS Provisioning in MANET Using Fuzzy-Based Multifactor Multipath Routing Metric". In proceedings of Sustainable Communication Networks and Application. Lecture Notes on Data Engineering and Communications Technologies, vol 93. Springer, Singapore. https://doi.org/10.1007/978-981-16-6605-6_41

54. R. Harini, R. Janani, S. Keerthana, S. Madhubala and S. Venkatasubramanian, "Sign Language Translation," 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), 2020, pp. 883-886.

55. S. Venkatasubramanian, "Fruit-Fly Algorithm Based Dynamic Source Routing Algorithm for Energy Efficient Multipath Routing in MANET," 2022 International Conference on Computer Communication and Informatics (ICCCI), 2022, pp. 01-08, doi: 10.1109/ICCCI54379.2022.9740906.

56. Allugunti,V.R., Kishor Kumar Reddy, C., Elango, N.M., Anisha, P.R. (2021). Prediction of Diabetes Using Internet of Things (IoT) and Decision Trees: SLDPS. In: Satapathy, S., Zhang, YD., Bhateja, V., Majhi, R. (eds) Intelligent Data Engineering and Analytics. Advances in Intelligent Systems and Computing, vol 1177. Springer, Singapore. https://doi.org/10.1007/978-981-15-5679-1_43

57. Dang, N., Khanna, A., Allugunti, V.R. (2021). TS-GAN with Policy Gradient for Text Summarization. In: Khanna, A., Gupta, D., Pólkowski, Z., Bhattacharyya, S., Castillo, O. (eds) Data Analytics and Management. Lecture Notes on Data Engineering and Communications Technologies, vol 54. Springer, Singapore. https://doi.org/10.1007/978-981-15-8335-3_64

58. V. Reddy Allugunti and N. Elango, "Development of a Generic Secure Framework for Universal Device Interactions in IoT of Fifth Generation Networks," 2018 Second World Conference on Smart Trends in Systems, Security and Sustainability (WorldS4), 2018, pp. 238-245, doi: 10.1109/WorldS4.2018.8611592.

59. D.Jayaramaiah, A.Prasanth, A.Viswanatha Reddy, Dr.Anirban Basu, 2012, Multi Agent Management System for Next Generation Mobile Networks. [MAMS for NGMN], International Journal Of Engineering Research & Technology, Volume 01, Issue 07 (September 2012)

60. Prof. D. Jayaramaiah,A. Viswanatha Reddy,Srikishan. D. Agent based User Interface Design for Mobile Cloud Computing Environment (AUID) , International Journal of Engineering Innovations and Research, Volume 1 Issue 3, May 2012

61. Reddy, V., Allugunti, , M, E. & Reddy, C. K. (2019). Internet of things based early detection of diabetes using machine learning algorithms: Dpa. International Journal of Innovative Technology and Exploring Engineering, 8(10):1443–1447.

62. V. Reddy Allugunti and N. Elango, "Development of a Generic Secure Framework for Universal Device Interactions in IoT of Fifth Generation Networks," 2018 Second World Conference on Smart Trends in Systems, Security and Sustainability (WorldS4),2018,pp.238-245.

63. Allugunti, V., M, E. & Reddy, C. K. (2019). Diabetes kaggle dataset adequacy scrutiny using factor exploration and correlation. International Journal of Recent Technology and Engineering, 8(1 SpecialIssue4):1105–1110.

64. Allugunti V.R (2022). A machine learning model for skin disease classification using convolution neural network. International Journal of Computing, Programming and Database Management 3(1), 141-147.

65. Allugunti V.R (2022). Breast cancer detection based on thermographic images using machine learning and deep learning algorithms. International Journal of Engineering in Computer Science 4(1), 49-56.

66. Allugunti VR Reddy CKK , Elango NM (2021). Prediction of Diabetes Using Internet of Things (IoT) and Decision Trees: SLDPS, Intelligent Data Engineering and Analytics, 2021

67. Reddy DAB A. Viswanatha, Jayaramaiah D., Prasanth A. (2012). Multi Agent Management System for Next Generation Mobile Networks [MAMS for NGMN], International Journal of Engineering Research & Technology (IJERT), Vol.1

68. Kishan B M, Dr. D. Jayaramaiah. A Survey on Optimized QOS Provisioning for NGMN//. International Journal of Innovative Research in Computer and Communication Engineering. Vol. 3, Issue 4, April 2015.-p.p 2908 – 2915.

69. Jha, R. et al. (2021). Voice-Based Gender Identification Using qPSO Neural Network. In: Khanna, A., Gupta, D., Pólkowski, Z., Bhattacharyya, S., Castillo, O. (eds) Data Analytics and Management. Lecture Notes on Data Engineering and Communications Technologies, vol 54. Springer, Singapore.

70. Vikram K and K. V. L. Narayana, "Cross-layer multi channel MAC protocol for wireless sensor networks in 2.4-GHz ISM band," 2016 International Conference on Computing, Analytics and Security Trends (CAST), 2016, pp. 312-317.

71. Vikram K, K. Venkata Lakshmi Narayana, Yuvaraj P, A survey on Wireless Sensor Networks for Smart grid, Sensors & Transducers Journal, ISSN 1726-5479, U.K. vol. 186, Issue 3, pp.18-24, March 2015.

72. Vikram K, Sarat Kumar Sahoo, "Interference-Aware Adaptive Transmission Power Control for ZigBee Wireless Networks" Vol. 828, Pg. No: 56-69, June-2018, Communications in Computer and Information Science, Springer.

73. Vikram K, Sarat Kumar Sahoo, "A Collaborative Frame Work for Avoiding the Interference in 2.4GHz Frequency Band Smart Grid Applications" Vol. No. 22, No.1, Pg. No: 48-56, June-2018. Electronics Journal.

74. Vikram K, Sarat Kumar Sahoo, K. Venkata Lakshmi Narayana, "Forward Error Correction based Encoding Technique for Cross-layer Multi Channel MAC protocol", Vol. 117, Pg. No 847-854, September 2017, Energy Procedia.

75. Vikram K, Sarat Kumar Sahoo, K. V. L. Narayana, "A Survey on Interference Avoiding Methods for Wireless Sensor Networks working in the 2.4GHz Frequency Band", Vol. 13, Number 3, Pg No: 59 – 81, July-2020, Journal of Engineering Science and Technology Review,

76. Yuvaraj. P, Vikram K, K. Venkata Lakshmi Narayana, A Review on state of art variants of LEACH protocol for Wireless Sensor Networks, Sensors & Transducers Journal, ISSN 1726-5479, U.K. vol. 186, Issue 3, pp.25-32, March 2015.

77. V. Chaudhary, Z. Dalwai and Vikram Kulkarni, "Intelligent Distraction and Drowsiness Detection System for Automobiles," 2021 International Conference on Intelligent Technologies (CONIT), 2021, pp. 1-4, doi: 10.1109/CONIT51480.2021.9498562.

78. N. Verma, S. Patil, B. Sinha and Vikram Kulkarni, "Object Detection for COVID Rules Response and Crowd Analysis," 2021 Innovations in Power and Advanced Computing Technologies (i-PACT), 2021, pp. 1-6.

79. S. Kumar, and S. Mookiah, " Contemporary Scenario of Small Scale Industries in Tirunelveli District," Journal of Xi'an University of Architecture & Technology, vol. XII, no. II, p. 1155, 2020.

80. Waleed, ZongguoMa, FazliWahid, & S.Kumar, " Measuring the Perception of Chinese Residents in Response to Influence of COVID-19 on Tourism Industry in China," Linguistica Antverpiensia, no. 02, p. 2182, 2021.

81. Suriya Hamid, and S. Kumar, " Desicision Making Capability On Personal Life Along With Work Among Service Sector Women," International Journal of Pharmaceutical Research, vol. 13, no. 2, p. 4114, 2021.

82. S. Kumar, and Suriya Hamid, " The Role of Cultural Organizations, Leadership Services, Job Satisfaction towards Organizational Citizenship Behavior: A Path Analysis Study in Private Primary Schools," International Journal of Pharmaceutical Research, vol. 13, no. 2, p. 4120, 2021.

83. S. Kumar, and Suriya Hamid, " Neuro Robotic Learning Methodology: Successful Experiences through Robotics at the Initial, Primary and Secondary Level," International Journal of Pharmaceutical Research, vol. 13, no. 2, p. 4135, 2021.

84. T. Akila, A. Vadivukarasi, M. Swathi, A. Ramya, B. Poorani, and S.Kumar, " Search for Identity in Edward Albee's Who's Afraid of Virginia Woolf?," Journal of Positive School Psychology, vol. 06 no. 04, p. 9272, 2022.

85. S. Kumar, and U. Varsha, " Economic and Health Impact of Migrant Workers during Covid-19 Period in Musiri Block at Tiruchirappalli District," International Journal of Early Childhood Special Education (INT-JECS), vol. 14, no. 3, p. 9650, 2022.

86. S. Kumar, " A Study on the Impact of Covid – 19 Lockdown in Manapparai Steel Industry," Turkish Online Journal of Qualitative Inquiry (TOJQI), vol. 12, no. 4, p. 1329, 2021.

87. S. Kumar, " The Impact Of Gaja Cyclone On Paddy And Rural Infrastructure In Thettanviduthi Village, (Pudukkottai District) Tamil Nadu, India," Journal of Elementary Education Online, vol. 20, no. 6, p. 2867, 2021.

88. J. Żywiołek, J. Rosak-Szyrocka, M. A. Khan, and A. Sharif, "Trust in Renewable Energy as Part of Energy-Saving Knowledge," Energies, vol. 15, no. 4, p. 1566, 2022, doi: 10.3390/en15041566.

89. J. Żywiołek, J. Rosak-Szyrocka, and B. Jereb, "Barriers to Knowledge Sharing in the Field of Information Security," Management Systems in Production Engineering, vol. 29, no. 2, pp. 114–119, 2021.

90. S. Tiwari, J. Rosak-Szyrocka, and J. Żywiołek, "Internet of Things as a Sustainable Energy Management Solution at Tourism Destinations in India," Energies, vol. 15, no. 7, p. 2433, 2022, doi: 10.3390/en15072433.

91. J. Rosak-Szyrocka, J. Żywiołek, and M. Mrowiec, "Analysis of Customer Satisfaction with the Quality of Energy Market Services in Poland," Energies, vol. 15, no. 10, p. 3622, 2022.

92. J. Rosak-Szyrocka, J. Zywiolek, A. Zaborski, S. Chowdhury, and Y.-C. Hu, "Digitalization of higher education around the Globe during covid-19," IEEE Access, p. 1, 2022.

93. Ravi Kumar Gupta, "A Study on Occupational Health Hazards among Construction Workers in India", International Journal of Enterprise Network Management. Vol. 12, No. 4, pp. 325-339, 2021.

94. Ravi Kumar Gupta, "Adoption of Mobile Wallet Services: An Empirical Analysis", Int. J. of Intellectual Property Management, 2022.

95. Ravi Kumar Gupta, "Utilization of Digital Network Learning and Healthcare for Verbal Assessment and Counselling During Post COVID-19 Period", Technologies, Artificial Intelligence and the Future of Learning Post-COVID-19. Springer Nature, Switzerland, pp. 117-134, 2022.

96. P. Bhadola, B. Kunakhonnuruk, A. Kongbangkerd, and Y. M. Gupta, "Analysis of microenvironment data using low-cost portable data logger based on a microcontroller," ECS Transactions, vol. 107, no. 1, p. 15099, 2022.

97. Y. M. Gupta, K. Buddhachat, S. Peyachoknagul, and S. Homchan, "Novel DNA barcode sequence discovery from transcriptome of Acheta domesticus: a partial mitochondrial DNA," in Materials Science Forum, 2019, vol. 967: Trans Tech Publ, pp. 59-64.

98. Y. M. Gupta, K. Buddhachat, S. Peyachoknagul, and S. Homchan, "Collection of Mitochondrial tRNA Sequences and Anticodon Identification for Acheta domesticus," in Materials Science Forum, 2019, vol. 967: Trans Tech Publ, pp. 65-70. DOI: 10.4028/www.scientific.net/MSF.967.59

99. Y. M. Gupta and S. HOMCHAN, "Insect detection using a machine learning model," Nusantara Bioscience, vol. 13, no. 1, 2021.

100. S. Homchan, P. Bhadola, and Y. M. Gupta, "Statistical Analysis of Simple Sequence Repeats in Genome Sequence: A Case of Acheta Domesticus (Orthoptera: Gryllidae)," ECS Transactions, vol. 107, no. 1, p. 14799, 2022.

101. Eliwa, M. M. The effect of some different types of learning within training programs in terms of self-determination theory of motivation on developing self-Academic identity and academic buoyancy and decreasing of mind wandering among university students in Egypt. Journal of Education -Sohag University, 92(92), 1–29, 2021.

102. Eliwa, M. M; Al Badri, A.H. Long and Short-Term Impact of Problem-Based and Example-Based STEM Learning on the Improvement of Cognitive Load among Egyptian and Omani Learners. Journal of Scientific Research in Education (JSRE)- Ain Shams University, 22(3), 713-742, 2021.

103. Eliwa, M. M. The Effectiveness of Digital Transformation of Learning on Students' Learning Experience, Students' Engagement and Perceived Intellectual Competence: A Mixed-Method Approach. Journal of Educational and Psychological Sciences- Fayoum University,15(3), 848-890, 2021.

104. Eliwa, M. M; Alshoukary, H. A. (2022). Modeling Causal Relationships between Academic Adjustment, Academic Striving and Future Expectations on Psychological Resilience and Cognitive Modifiability among Elementary School Students. Journal of the Faculty of Education Beni-Suef University(JFE), 19(116), 655-694. https://dx.doi.org/10.21608/jfe.2022.242784

105. SS Priscila, M Hemalatha, "Improving the performance of entropy ensembles of neural networks (EENNS) on classification of heart disease prediction", Int J Pure Appl Math 117 (7), 371-386, 2017.

106. S Silvia Priscila, M Hemalatha, " Diagnosisof heart disease with particle bee-neural network" Biomedical Research, Special Issue, pp. S40-S46, 2018.

107. S Silvia Priscila, M Hemalatha, " Heart Disease Prediction Using Integer-Coded Genetic Algorithm (ICGA) Based Particle Clonal Neural Network (ICGA-PCNN)", Bonfring International Journal of Industrial Engineering and Management Science 8 (2), 15-19, 2018.

108. Jalil, N.A., P Prapinit, M Melan, AB Mustaffa (2019). Adoption of Business Intelligence-Technological, Individual and Supply Chain Efficiency. Proceedings of the 2019 International Conference on Machine Learning, Big Data and Business Intelligence. Year: 2019, Volume: 1, Pages: 67-73.

109. Jalil, N.A., Hwang, H.J. (2019). Technological-centric business intelligence: Critical success factors. International Journal of Innovation, Creativity and Change, Volume 5, Issue 2, August, 2019, Pages 1499 to 1516.

110. Nasir Abdul Jalil and Koay Kian Yeik. 2019. Systems, Design and Technologies Anxieties Towards Use of Self-service Checkout. In Proceedings of the 2019 3rd International Conference on Education and E-Learning (ICEEL 2019). Association for Computing Machinery, New York, NY, USA, 122–127.

111. B. Singh, N. A. Jalil, D. K. Sharma, S. R, K. Kumar and D. Jebakumar immanuel, "Computational systems overview and Random Process with Theoretical analysis," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 2021, pp. 1999-2005, doi: 10.1109/ICACCS51430.2021.9441739.

112. Roy Setiawan, Luigi Pio Leonardo Cavaliere, KartikeyKoti, Gabriel Ayodeji Ogunmola, N. A. Jalil, M. Kalyan Chakravarthi, S. Suman Rajest, R. Regin, Sonia Singh, "The Artificial Intelligence and Inventory Effect on Banking Industrial Performance"Turkish Online Journal of Qualitative Inquiry (TOJQI). Volume 12, Issue 6, July, 2021: 8100-8125.

113. Roespinoedji, D., Juniati, S., Hasan, H., Jalil, N.A., Shamsudin, M.F., 2019. Experimenting the long-haul association between components of consuming renewable energy: ARDL method with special reference to Malaysia. Int. J. Energy Econ. Policy 9, 453–460. https://doi.org/10.32479/ijeep.8694.

114. D. K. Sharma, N. A. Jalil, V. K. Nassa, S. R. Vadyala, L. S. Senthamil and T. N, "Deep learning Applications to classify Cross-Topic Natural Language Texts Based on Their Argumentative Form," 2021 2nd International Conference on Smart Electronics and Communication (ICOSEC), 2021, pp. 1580-1586.

115. D. K. Sharma, N. A. Jalil, R. Regin, S. S. Rajest, R. K. Tummala and T. N, "Predicting Network Congestion with Machine Learning," 2021 2nd International Conference on Smart Electronics and Communication (ICOSEC), 2021, pp. 1574-1579, doi: 10.1109/ICOSEC51865.2021.9591897.

116. Nasir Abdul Jalil and Mikkay Wong Ei Leen. 2021. Learning Analytics in Higher Education: The Student Expectations of Learning Analytics. In 2021 5th International Conference on Education and E-Learning (ICEEL 2021). Association for Computing Machinery, New York, NY, USA, 249–254.

117. Fazle Rabbi , Nasir Abdul Jalil , S. Suman Rajest , R. Regin, " An Approximation For Monitoring The Efficiency Of Cooperative Across Diverse Network Aspects", Webology, Volume 17, No 2, 2020, Pages: 1234-1247.

118. D. Kem, "Strengthening online education: Challenges and opportunities in India," International Journal of Humanities and Social Science Invention, vol. 11, no. 05, pp. 01-12, 2022.

119. D. Kem, "Personalised and adaptive Learning: Emerging learning platforms in the era of digital and smart Learning,", International Journal of Social Science and Human Research, vol. 05, no. 2, pp. 385-391, 2022.

120. D. Kem, "Policy discourse and communication strategies in India.", Journal of the Kerala Sociological Society, vol, XXXIII, No. 2, pp. 37-48, 2005.

121. D. Kem, "'Adolescents and the Mass Media: Contemporary Issues in the Literature, Journal of the Kerala Sociological Society, Thiruvananthapuram, Kerala, vol. XX no. 2, pp. 43-60, 2006.

122. D. Kem and M. Jena, "Social responsibility of science.", Journal of the Kerala Sociological Society, vol, XXXV, no. 2, pp. 37-48, 2007.

123. Farouk, A., Alahmadi, A., Ghose, S., & Mashatan, A. (2020). Blockchain platform for industrial healthcare: Vision and future opportunities. Computer Communications, 154, 223-235.

124. Zhu, F., Zhang, C., Zheng, Z., & Farouk, A. (2021). Practical Network Coding Technologies and Softwarization in Wireless Networks. IEEE Internet of Things Journal, 8(7), 5211-5218.

125. Adil, M., Song, H., Ali, J., Jan, M. A., Attique, M., Abbas, S., & Farouk, A. (2021). EnhancedAODV: A Robust Three Phase Priority-based Traffic Load Balancing Scheme for Internet of Things. IEEE Internet of Things Journal.

126. Adil, M., Jan, M. A., Mastorakis, S., Song, H., Jadoon, M. M., Abbas, S., & Farouk, A. (2021). Hash-MAC-DSDV: Mutual Authentication for Intelligent IoT-Based Cyber-Physical Systems. IEEE Internet of Things Journal.

127. Adil, M., Ali, J., Attique, M., Jadoon, M. M., Abbas, S., Alotaibi, S. R., ... & Farouk, A. (2021). Three Byte-Based Mutual Authentication Scheme for Autonomous Internet of Vehicles. IEEE Transactions on Intelligent Transportation Systems.

128. Adil, M., Khan, M. K., Jamjoom, M., & Farouk, A. (2021). MHADBOR: AI-enabled Administrative Distance based Opportunistic Load Balancing Scheme for an Agriculture Internet of Things Network. IEEE Micro.

129. Mendonça, R. V., Silva, J. C., Rosa, R. L., Saadi, M., Rodriguez, D. Z., & Farouk, A. (2021). A lightweight intelligent intrusion detection system for industrial internet of things using deep learning algorithm. Expert Systems, e12917.

130. Adil, M., Attique, M., Khan, M. M., Ali, J., Farouk, A., & Song, H. (2022). HOPCTP: A Robust Channel Categorization Data Preservation Scheme for Industrial Healthcare Internet of Things. IEEE Transactions on Industrial Informatics.

131. Adil, M., Khan, M. K., Jadoon, M. M., Attique, M., Song, H., & Farouk, A. (2022). An AI-enabled Hybrid lightweight Authentication Scheme for Intelligent IoMT based Cyber-Physical Systems. IEEE Transactions on Network Science and Engineering.

132. Aoudni, Y., Donald, C., Farouk, A., Sahay, K. B., Babu, D. V., Tripathi, V., & Dhabliya, D. (2022). Cloud security based attack detection using transductive learning integrated with Hidden Markov Model. Pattern Recognition Letters, 157, 16-26

133. Naseri, M., Heidari, S., Baghfalaki, M., Gheibi, R., Batle, J., Farouk, A., & Habibi, A. (2017). A new secure quantum watermarking scheme. Optik, 139, 77-86.

134. Abdolmaleky, M., Naseri, M., Batle, J., Farouk, A., & Gong, L. H. (2017). Red-Green-Blue multi-channel quantum representation of digital images. Optik, 128, 121-132.

135. Farouk, A., Batle, J., Elhoseny, M., Naseri, M., Lone, M., Fedorov, A., ... & Abdel-Aty, M. (2018). Robust general N user authentication scheme in a centralized quantum communication network via generalized GHZ states. Frontiers of Physics, 13(2), 1-18.

136. Farouk, A., Zakaria, M., Megahed, A., & Omara, F. A. (2015). A generalized architecture of quantum secure direct communication for N disjointed users with authentication. Scientific reports, 5(1), 1-17.

137. Naseri, M., Raji, M. A., Hantehzadeh, M. R., Farouk, A., Boochani, A., & Solaymani, S. (2015). A scheme for secure quantum communication network with authentication using GHZ-like states and cluster states controlled teleportation. Quantum Information Processing, 14(11), 4279-4295.

138. Metwaly, A. F., Rashad, M. Z., Omara, F. A., & Megahed, A. A. (2014). Architecture of multicast centralized key management scheme using quantum key distribution and classical symmetric encryption. The European Physical Journal Special Topics, 223(8), 1711-1728.

139. Abulkasim, H., Farouk, A., Alsuqaih, H., Hamdan, W., Hamad, S., & Ghose, S. (2018). Improving the security of quantum key agreement protocols with single photon in both polarization and spatial-mode degrees of freedom. Quantum Information Processing, 17(11), 1-11.

140. Abulkasim, H., Farouk, A., Hamad, S., Mashatan, A., & Ghose, S. (2019). Secure dynamic multiparty quantum private comparison. Scientific reports, 9(1), 1-16.

141. Zhou, N. R., Liang, X. R., Zhou, Z. H., & Farouk, A. (2016). Relay selection scheme for amplify-and-forward cooperative communication system with artificial noise. Security and Communication Networks, 9(11), 1398-1404.

142. Abulkasim, H., Alsuqaih, H. N., Hamdan, W. F., Hamad, S., Farouk, A., Mashatan, A., & Ghose, S. (2019). Improved dynamic multi-party quantum private comparison for next-generation mobile network. IEEE Access, 7, 17917-17926.

143. Naseri, M., Abdolmaleky, M., Parandin, F., Fatahi, N., Farouk, A., & Nazari, R. (2018). A new quantum gray-scale image encoding scheme. Communications in Theoretical Physics, 69(2), 215.

144. Naseri, M., Abdolmaleky, M., Laref, A., Parandin, F., Celik, T., Farouk, A., ... & Jalalian, H. (2018). A new cryptography algorithm for quantum images. Optik, 171, 947-959.

145. Heidari, S., Abutalib, M. M., Alkhambashi, M., Farouk, A., & Naseri, M. (2019). A new general model for quantum image histogram (QIH). Quantum Information Processing, 18(6), 1-20.

146. AlAjmi, Mohamed F., and Shakir Khan. "The Utility of New Technologies in Enhancing Learning Vigilance in Educationally Poor Populations." EDULEARN12 (4th International Conference on Education and New Learning Technologies). 2012.

147. Khan, Shakir. "Artificial Intelligence Virtual Assistants (Chatbots) are Innovative Investigators." International Journal of Computer Science and Network Security 20.2 (2020): 93-98.

148. AlAjmi, Mohamed F., and Shakir Khan. "Collaborative Pharmacy Student Learning Outline for Mobile Atmosphere." International Journal of Advanced Computer Science and Applications 5.3 (2014).

149. Khan, Shakir, and Mohamed F. AlAjmi. "The Open Source Software (OSS) Utilization in Project Scattered Computing Environments." International Journal of Scientific Research 2.2 (2013): 177-178.

150. Alajmi, M., and S. Khan. "Effective Use of Web 2.0 Tools in Pharmacy Students' Clinical Skills Practice During Field Training." iceri2011 proceedings (2011): 6649-6653.

151. AlAjmi, Mohamed F., Shakir Khan, and Abdulkadir Alaydarous. "Data Protection Control and Learning Conducted Via Electronic Media IE Internet." International Journal of Advanced Computer Science and Applications 5.11 (2014).

152. Khan, Shakir, Mohammed AlAjmi, and Arun Sharma. "Safety Measures Investigation in Moodle LMS." Special Issue of International Journal of Computer Applications (2012).

153. Shakir Khan and Mohammed Alshara, "Fuzzy Data Mining Utilization to Classify Kids with Autism", IJCSNS International Journal of Computer Science and Network, Vol. 19 No. 2, pp. 147-154, 2018 http://search.ijcsns.org/07_book/html/201902/201902018.html

154. Shakir Khan and Mohammed Alshara, "Arabic Evaluations' Development in Information Retrieval", International Journal of Advanced and Applied Sciences, 6(12) 2019, Pages: 92-98. https://doi.org/10.21833/ijaas.2019.12.011

155. Khan, Shakir, and Mohammed Ali Alshara. "Adopting Open Source Software for Integrated Library System and Digital Library Automation." International Journal of Computer Science and Network Security 20.9 (2020): 158-165.

156. S. Khan, "Business Intelligence Aspect for Emotions and Sentiments Analysis," 2022 First International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT), 2022, pp. 1-5, doi: 10.1109/ICEEICT53079.2022.9768485.

157. Khan, S., Fazil, M., Sejwal, V.K., Ali Alshara, M., Alotaibi, R.M., Kamal, A., Baig, A., BiCHAT: BiLSTM with deep CNN and hierarchical attention for hate speech detection, Journal of King Saud University - Computer and Information Sciences (2022), doi: https://doi.org/10.1016/j.jksuci.2022.05.006

158. Parvathi K, Santhi T, Makeswari M, Nirmaladevi V, Rathinam R. Ricinus Communis Activated Charcoal Preparation, Characterization and Application for Methyl Red Adsorptive Removal. Orient J Chem 2022;38(1), Pg. 110-117.

159. Rathinam R, Brindha T, Petchiammal M, Mohamed Ibrahim A, Photo-Electrocatalytic Degradation Of Aqueous Rhodamine B Dye Using Titanium Electrodes Coated With RuO2/IrO2/TaO2, Indian Journal of Environmental protection, 41(12), pp.1365-1371, 2021.

160. Umadevi M, Rathinam R, Brindha T, Dheenadhayalan S, Pattabhi S, Application of Electro-Chemical Oxidation for the Treatment of Reactive Red 195 using Graphite Electrode, Asian Journal of Biological and Life Sciences, 2022,10 (3), 620-625.

161. Brindha T, Rathinam R, Dheenadhayalan S, Sivakumar R. Nanocomposite Coatings in Corrosion Protection Applications: An Overview . Orient J Chem 2021;37(5), Pg.1062-1067.

162. H. Shatnawi, C. Lim, F. Ismail and A. Aldossary, "An optimisation study of a solar tower receiver: the influence of geometry and material, heat flux, and heat transfer fluid on thermal and mechanical performance", Heliyon, vol. 7, no. 7, p. e07489, 2021. Available: 10.1016/j.heliyon.2021.e07489

163. Aakanksha Singhal and D.K. Sharma, "Seven Divergence Measures by CDF of fitting in Exponential and Normal Distributions of COVID-19 Data", Turkish Journal of Physiotherapy and Rehabilitation, Vol.32(3), pp. 1212 - 1222, 2021.

164. D.K. Sharma and Haldhar Sharma, "A Study of Trend Growth Rate of Confirmed cases, Death cases and Recovery cases in view of Covid-19 of Top Five States of India", Solid State Technology, Vol.64(2), pp. 4526-4541, 2021.

165. D.K. Sharma, "Information Measure Computation and its Impact in MI COCO Dataset", IEEE Conference Proceedings, 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Vol.1, pp. 2011-2014, 2021.

166. Aakanksha Singhal and D.K. Sharma, "Keyword extraction using Renyi entropy: a statistical and domain independent method", IEEE Conference Proceedings, 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Vol.1, pp. 1970-1975, 2021.

167. Aakanksha Singhal and D.K. Sharma, "Generalization of F-Divergence Measures for Probability Distributions with Associated Utilities", Solid State Technology, Vol.64(2), pp. 5525-5531, 2021.

168. Aakanksha Singhal and D.K. Sharma, "A Study of before and after Lockdown Situation of 10 Countries through Visualization of Data along With Entropy Analysis of Top Three Countries", International Journal of Future Generation Communication and Networking, Vol.14(1), pp. 496-525, 2021.

169. Aakanksha Singhal and D.K. Sharma, "Generalized 'Useful' Rényi & Tsallis Information Measures, Some Discussions with Application to Rainfall Data", International Journal of Grid and Distributed Computing, Vol. 13(2), pp. 681-688, 2020.

170. Reetu Kumari and D. K. Sharma, "Generalized `Useful non-symmetric divergence measures and Inequalities", Journal of Mathematical Inequalities, Vol. 13(2), pp. 451-466, 2019.

171. D.S. Hooda and D.K. Sharma, "On Characterization of Joint and Conditional Exponential Survival Entropies", International Journal of Statistics and Reliability Engineering, Vol. 6(1), pp. 29-36, 2019.

172. Reetu Kumari and D. K. Sharma, "Generalized `Useful' AG and `Useful' JS-Divergence Measures and their Bounds", International Journal of Engineering, Science and Mathematics, Vol. 7 (1), pp. 441-450, 2018.

173. D.S. Hooda, Reetu Kumari and D. K. Sharma, "Intuitionistic Fuzzy Soft Set Theory and Its Application in Medical Diagnosis", International Journal of Statistics in Medical Research, Vol. 7, pp. 70-76, 2018.

174. D.K. Sharma and Sonali Saxena, "Generalized Coding Theorem with Different Source Coding Schemes", International Journal on Recent and Innovation Trends in Computing and Communication, Vol. 5(6), pp. 253 – 257, 2017.

175. A.K. Gupta, Y. K. Chauhan, and T Maity, "Experimental investigations and comparison of various MPPT techniques for photovoltaic system," Sādhanā, Vol. 43, no. 8, pp.1-15, 2018.

176. A.K. Gupta, "Sun Irradiance Trappers for Solar PV Module to Operate on Maximum Power: An Experimental Study," Turkish Journal of Computer and Mathematics Education (TURCOMAT), Vol. 12, no.5, pp.1112-1121, 2021.

177. A.K. Gupta, Y.K Chauhan, and T Maity and R Nanda, "Study of Solar PV Panel Under Partial Vacuum Conditions: A Step Towards Performance Improvement," IETE Journal of Research, pp.1-8, 2020.

178. A.K. Gupta, Y.K Chauhan, and T Maity, "A new gamma scaling maximum power point tracking method for solar photovoltaic panel Feeding energy storage system," IETE Journal of Research, vol.67, no.1, pp.1-21, 2018.

179. A. K. Gupta et al., "Effect of Various Incremental Conductance MPPT Methods on the Charging of Battery Load Feed by Solar Panel," in IEEE Access, vol. 9, pp. 90977-90988, 2021.

180. D.K. Sharma and D.S. Hooda, "Generalized Measures of 'Useful' Relative Information and Inequalities" Journal of Engineering, Management & Pharmaceutical Sciences, Vol.1(1), pp.15-21, 2010.

181. D.S. Hooda and D.K. Sharma (2010) "Exponential Survival Entropies and Their Properties" Advances in Mathematical Sciences and Applications, Vol. 20, pp. 265-279, 2010.

182. D.S. Hooda and D.K. Sharma, "Generalized 'Useful' Information Generating Functions" Journal of Appl. Math. and Informatics, Vol. 27(3-4), pp. 591-601, 2009.

183. D.S. Hooda and D.K. Sharma, "Non-additive Generalized Measures of 'Useful' Inaccuracy" Journal of Rajasthan Academy of Physical Sciences, Vol. 7(3), pp.359-368, 2008.

184. D.S. Hooda and D.K. Sharma, Generalized R-Norm information Measures-Journal of Appl. Math, Statistics & informatics (JAMSI), Vol. 4 No.2 , 153-168, 2008.

185. Dilip Kumar Sharma, "Some Generalized Information Measures: Their characterization and Applications", Lambert Academic Publishing, Germany, 2010. ISBN: 978-3838386041.

186. Rupapara, V., Narra, M., Gonda, N. K., & Thipparthy, K. (2020). Relevant Data Node Extraction: A Web Data Extraction Method for Non Contagious Data. 2020 5th International Conference on Communication and Electronics Systems (ICCES), 500–505.

187. Rajest, D. S. S., & G, J. A. C. (2022). A Brief on Past and Present a Tug of War in the Select Works of Kurt Vonnegut. Central Asian Journal of Literature, Philosophy And Culture, 3(4), 59-79. https://doi.org/10.17605/OSF.IO/52KAM

188. G, J. A. C., & Rajest, D. S. (2022). Fragmented Narration in Corridor's Thematic, Language and Imagery. Central Asian Journal Of Arts And Design, 3(4), 15-37.

189. Steffi. R, D.K. Sharma, S. Suman Rajest, R. Regin, A. J. Obaid, and G. Jerusha Angelene Christabel, "Perceptron in Supervised, Semi-Supervised, Unsupervised Learning and Artificial Neural Network", CAJOTAS, vol. 3, no. 5, pp. 176-199, May 2022.

190. Leo Willyanto Santoso, Bhopendra Singh, S. Suman Rajest, R. Regin, Karrar Hameed Kadhim (2021), "A Genetic Programming Approach to Binary Classification Problem" EAI Endorsed Transactions on Energy, Vol.8, no. 31, pp. 1-8.

191. A, V. V. ., T, S. ., S, S. N. ., & Rajest, D. S. S. . (2022). IoT-Based Automated Oxygen Pumping System for Acute Asthma Patients. European Journal of Life Safety and Stability (2660-9630), 19 (7), 8-34.

192. U. Zulfiqar, S. Mohy-Ul-Din, A. Abu-Rumman, A. E. M. Al-Shraah, And I. Ahmed, "Insurance-Growth Nexus: Aggregation and Disaggregation," The Journal of Asian Finance, Economics and Business, vol. 7, no. 12, pp. 665–675, Dec. 2020. https://doi.org/10.13106/jafeb.2020.vol7.no12.665

193. Al-Shqairat, Z. I., Al Shraah, A. E. M., Abu-Rumman, A., "The role of critical success factors of knowledge stations in the development of local communities in Jordan: A managerial perspective," Journal of management Information and Decision Sciences, vol. 23, no.5, pp. 510-526, Dec. 2020.

194. Abu-Rumman, Ayman. "Transformational leadership and human capital within the disruptive business environment of academia." World Journal on Educational Technology: Current Issues 13, no. 2 (2021): 178-187.

195. Ishaq, A., Sadiq, S., Umer, M., Ullah, S., Mirjalili, S., Rupapara, V., & Nappi, M. (2021). Improving the Prediction of Heart Failure Patients' Survival Using SMOTE and Effective Data Mining Techniques. IEEE Access, 9, 39707–39716. https://doi.org/10.1109/access.2021.3064084

196. Rustam, F., Khalid, M., Aslam, W., Rupapara, V., Mehmood, A., & Choi, G. S. (2021). A performance comparison of supervised machine learning models for Covid-19 tweets sentiment analysis. PLOS ONE, 16(2), e0245909. https://doi.org/10.1371/journal.pone.0245909

197. Yousaf, A., Umer, M., Sadiq, S., Ullah, S., Mirjalili, S., Rupapara, V., & Nappi, M. (2021b). Emotion Recognition by Textual Tweets Classification Using Voting Classifier (LR-SGD). IEEE Access, 9, 6286–6295. https://doi.org/10.1109/access.2020.3047831

198. Sadiq, S., Umer, M., Ullah, S., Mirjalili, S., Rupapara, V., & NAPPI, M. (2021). Discrepancy detection between actual user reviews and numeric ratings of Google App store using deep learning. Expert Systems with Applications, 115111. https://doi.org/10.1016/j.eswa.2021.115111

199. Rupapara, V., Narra, M., Gonda, N. K., Thipparthy, K., & Gandhi, S. (2020). Auto-Encoders for Content-based Image Retrieval with its Implementation Using Handwritten Dataset. 2020 5th International Conference on Communication and Electronics Systems (ICCES), 289–294.