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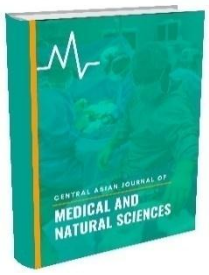

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An Automated Conversation System Using Natural Language Processing (NLP) Chatbot in Python

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Abstract: The purpose of this project is to build a ChatBot that utilises NLP (Natural Language Processing) and assists customers. A ChatBot is an automated conversation system that replies to users' queries by analysing them using NLP and assists them in every way it can. In this project, we are trying to implement a customer service chatbot that tries to converse and assist the user in some simple scenarios. This chat bot can take simple user queries as input, process them, classify them into one of the existing tags, and respond to them with an appropriate response. If the user's queries are too complex for the bot, it will re-direct the conversation to an actual person. The ChatBot is going to be based on a machine learning model that is built using PyTorch (Python Deep Learning library) and NLTK (Natural Language Tool Kit). The model used here is a feed-forward neural network. There are 3 layers in this neural network, i.e., the input layer, the hidden layer, and the output layer. The number of nodes in the input and hidden layers depends on the total number of distinct words present in the data set. whereas the output contains the same number of nodes as the number of distinct tags the data set is divided into. This kind of neural network is perfect for building simple chatbots as it does not require high computational power either for training or for deploying. The chatbot we built is for a coffee shop, and it performs actions like ordering coffee, telling a joke, suggesting a drink, etc. Although this chatbot is relatively simple, it is highly customizable, thus making it easy to implement it in any scenario.

Key words: Automated Conversation System, Natural Language Processing (NLP), Chatbot, and Python.

One of the main features of this ChatBot is that the dataset it is trained on is easy to customise and we can add new tags easily, but the neural network need not be altered in most cases, making this a very

reliable model. Many chatbots similar to this are being used in fields like medicine, government agencies, automated food ordering systems, etc. This feature also makes training and testing the chatbot very easy to customize.

Introduction:

Traditional chatbots were usually hardcoded for very specific scenarios [1]. This lack of flexibility and almost zero customization meant that the performance of these chatbots was really low [2-11]. To overcome this, we have designed a simple but effective chatbot system that anyone can easily customise for their personal use without compromising on the performance of the chatbot too much [12-16]. Using machine learning instead of hardcoding the chatbot adds many possibilities for the implementation of the bot [17-22]. Existing chatbots are either hardcoded to only converse in a limited sense or really large general-purpose chatbots that are trained on huge datasets for research purposes [23-33]. Due to this, there were not many chatbots that were actually being used or the ones that were implemented were not performing up to the mark [34]. The model we designed is as simple as a hardcoded chatbot but is far more capable. Since it's trained on a dataset that contains ideal conversations, it is more oriented towards engaging the user in a conversation [35-41]. The chatbot can also be easily extended to perform various tasks like ordering food, telling time, or booking a cab by utilising various APIs [42-55].

This project has a wide variety of applications in numerous fields, and the one we have focused on in this project is a simple cafeteria [56-71]. Apart from that, this bot can also be trained and utilised in fields like railways, hospitals, government agencies, and online services. This project makes it easier to handle the queries of a huge number of people as most of them tend to have simple queries that can be easily answered by the ChatBot [72-81]. In the case that the chatbot cannot answer the queries, it will redirect the query and the user to a real customer support person. This is really helpful in fields where repetitive questions are asked, like customer support [82-99]. The chatbot can troubleshoot many simple problems, saving time for employees and letting them focus on larger problems. When listed out, there are a number of applications for this project because of its method of implementation, reliability, and customizability, but these are the most important ones for it currently [100-111].

Added Applications

- This project has applications in medical and engineering fields as it is just a matter of changing the dataset it is trained on [112].
- This project can also be improved time to time based on its performance, which is estimated by the user ratings given as feedback [113].
- Using a feed-forward neural network means that the deep learning model is robust.
- Although it is an automated system, it is only for assisting users and employees; it is not capable of replacing any human staff [114].
- These chatbots are not only for practical applications but can also be used for research purposes, like in understanding how learning as a process actually works [115].

Objectives

We have a clear and straight-forward goal of improving the efficiency of traditional chatbots and other automated conversation systems by building a neural network based chatbot and also by adding extra features to the existing system [116-124]. Features like sending the bill via email, swear word detection, etc. can be easily added to the project. This makes it more reliable and secure to use. It is

flexible enough to be implemented in any field as long as there is a need and a data set to train it upon [125-132]. And also, the ChatBot itself is very resource efficient as it is built using the very optimised deep learning library 'PyTorch'. Using Python for this project has made many options available to me in terms of improving the ChatBot as the language has excellent support and many valuable libraries [133-145].

Methodology to Be Followed

This project is a fully functional chatbot that is built using Python and its libraries. The Deep Learning Model is built using the PyTorch library; the tools for Natural Language Processing were provided by NLTK (Natural Language Tool Kit) and the GUI for the application is built using Tkinter, which is also a Python library that is used for building simple GUI applications. The dataset used to train the neural network is a JSON (Java Script Object Notation) file that I created myself in order to demonstrate the flexibility and ease of customization for this project. PyTorch has a built-in function that can be used to store the model and its hyper parameters after the training is done [146-156].

Expected Outcomes

The ChatBot will converse with the user depending on the structure of the dataset that is used to train it. Any queries not understood by the bot will be redirected to staff [157-171]. This will ensure that the user gets a good experience and all their queries will be clarified [172-181].

Hardware and Software Requirements

- ✓ PC with Minimum of 4GB RAM II
- ✓ 64-bit Operating system
- ✓ Windows 7 or higher / Mac OS X or higher

Software Requirements:

- ➢ Visual Studio Code IDE II
- ➢ Python 3.6 or above
- ➢ NLTK and 'punkt' package
- ➢ PyTorch 1.12.0 (with or without Cuda toolkit) V JSON Library

NLTK – Natural Language Tool Kit

It is a free and open-source Python library that is extensively used in NLP (Natural Language Processing). It provides various methods, functions, and prebuilt models that can be used to perform various text and language analysis operations [182-192]. It is widely used in building all kinds of text, language, and sentiment analysis machine learning models [193-195]. It is using NLTK in this project for performing tokenizing, stemming, and the creation of bags of words. These operations are performed with the help of a special NLTK package called "punkt". The functions that perform these operations are written in the following file [196-199].

Utils.py

This file contains the functions that we created to perform tokenizing, stemming, and bag of words creation. The methods are obtained from a module in NLTK called PorterStemmer [200].

JSON

JSON is a library that comes with any standard installation of Python that allows us to deal with.json files [201-203]. This file format is extensively used on the internet for sharing information because of

its well-structured way of storing data. In this project, the data set we have used to train the neural network is also a.json file. The JSON library comes with many methods and functions that allow us to easily access, manipulate, and even create.json files. Usually, the json.load function is used to load the contents of a.json file into a Python dictionary and vice versa can be done using the json.dump function [204-205].

Tkinter

Tkinter is a Python library that is used to build simple GUI applications. It comes with various functions that make the process of creating and customising a graphical user interface easier. It provides various widgets and features that make it the best choice for building practical applications and demo interfaces. In this project, we have used this library to create a graphical interface that the user can use to interact with the chatbot. This makes it easier for the user to use the chatbot, as additional features are provided in the GUI.

PyTorch

PyTorch is a free and open-source tensor library for the Python language that is widely used in building various deep learning and neural network models. It contains various modules and APIs that make it extremely handy when creating these machine learning models. It is also preferred when building NLP models when compared to other libraries. Being a fully open-source library, it is constantly being updated and improved by thousands of people who use it every day. This is one of the reasons it is the most popular deep learning and tensor library. In this project, we have used PyTorch to build the Feed-Forward Neural Network for the ChatBot. This neural network will be trained on the.json dataset and will be saved using PyTorch's own "save" function. The neural network we built contains 3 layers, i.e., an input layer, a hidden layer, and an output layer. The input layer has the same size as the total number of distinct words in the entire dataset. The hidden layer was tested with many values and was finally set to 8. The output layer's size is the same as the number of different tags the patterns in the dataset are divided into. PyTorch makes the process of building a deep learning model a little bit easier and also provides excellent ways to alter the model just by altering the hyper-parameters.

Dataset

A dataset is an accumulation of useful data that may or may not be structured and can be used to train machine learning and deep learning models to perform various tasks. There are many different factors that affect the reliability of a dataset, like the quality of the dataset, the size of the dataset, the variety of data and also the sources that generated this data. These factors are as important as the efficiency and performance of a machine learning model in a project. A good dataset can give great results for any machine learning or deep learning project. Datasets can also be artificially generated to test ideal case scenarios, but for real world applications, naturally generated datasets are used.

In this project, we have used a.json format dataset in order to train the feed-forward neural network for the chatBot. The dataset was built by myself by referring to some datasets that we found on Kaggle. All the data that is needed for the model to train, predict and respond to queries is present in the 'intents.json' file. This file contains all the data in the form of "tags," "patterns," and "responses." "tag" is the specific tag to which the pattern sentences belong. 'patterns' contains the sentences that are used to train the model so that it can classify input sentences to the appropriate tag."Responses" contains the sentences that are used to train the model so that it can classify input sentences to the appropriate tag." various sentences, among which one will be randomly selected to respond to the user's queries. If the input sentence is classified into some tag, then the responses under that tag will be used by the ChatBot. They are structured similarly to Python dictionaries, with lists inside them.

Hence, when the json file is imported, the data is stored in a python dictionary variable by using the function ‘json.load’. Given below is a snapshot of the dataset used to train this model (figure 1)

Figure 1: JSON file Structure

GUI Application

The GUI for the ChatBot is built using the Tkinter library. The interface is intentionally kept simple but is functional enough to work without any major problems. The interface consists of two main components. One is the chat log, where the messages of both the bot and the user are present, and the other component is the message entry box and send button. The interface is simple to use and works without any errors or bugs. The size of the entire interface is 1000 x 800.

Chat Log

This component displays the entire conversation between the user and the ChatBot. The log is stored as long as the current conversation has not ended. The Chat Log also has a scroll feature if the conversation becomes very lengthy. Above the chat log is a small label that contains the message "Welcome". This can be customised to any title suitable for the purpose and behaviour of the ChatBot. The messages in the log will be sent to the staff if the bot is unable to assist the user and the conversation is also redirected to the staff.

Message Entry Box and Send Button

In order to take the user's input, a message entry box is added to the interface. The user can enter the message in the entry box and press ‘enter’ to send it. There is also a dedicated ‘Send’ button beside the message entry box that works in a similar way to pressing ‘enter’. The widget is also programmed to discard any empty or unnecessary "enter" inputs (figure 2).

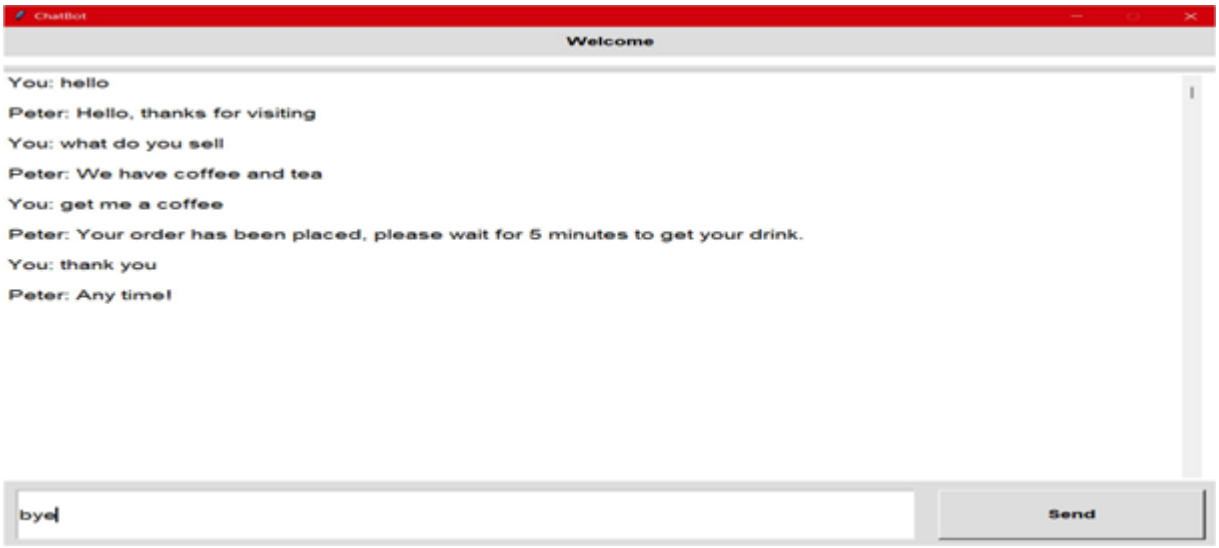

Figure 2: ChatBot GUI Layout

Implementation

Module 1: Neural Network

First of all, a stable version of the PyTorch library must be installed, either with or without the cuda tool kit and GPU support. And then import the Torch library and the Torch.NN module in order to build the neural network. The model code is present in the‘model.py’ file. The module torch.nn gives us a blueprint for building a neural network in a class format. We have extended this class with additional specifications and parameters. The class we created, i.e., NeuralNet, extends Torch.NN and also takes input size, hidden size, and the number of different tags as input during object creation. The neural network itself has three layers, i.e., the input layer, the hidden layer, and the output layer. The input layer has the same number of nodes as there is a total number of distinct words in the dataset. The hidden layer size was tested with varying values, and in the end, we decided to take the value of 8 as it seems to perform well. The output layer has the same number of nodes as there are different tags in the dataset.

The activation function between the layers is the Rectified Linear Unit (ReLU). It is a commonly used activation function in neural networks that returns the output of a node if it is positive, and returns 0 if the output value is negative. And a SoftMax activation function is applied to the output layer of the neural network. The outputs of a neural network are independent probabilities, making it tough to classify the output properly. The SoftMax activation function takes the output of all the notes and returns mutually exclusive properties, allowing the neural network to properly classify the sentence into an appropriate tag.

Module 2: Training and Hyperparameters

Since the dataset was created by me, no preprocessing is required. The data is also present in a structured format. This makes the training process somewhat easier. In training the model, all the necessary libraries are imported, i.e., numpy, NLTK, PyTorch, random, JSON, and also the‘model.py’ into a python file called ‘training.py’.Before this, in a separate file, the code for operations such as tokenizing, stemming, and creation of bags of words was written by importing the NLTK library. This file is named 'utils.py', which is also imported in ‘training.py’. The data is extracted from the ‘intents.json’ file and all the different sections, i.e., tags, patterns, and responses, are stored separately. A new class called ChatDataset is created and the data is stored in this format.

A few methods to access the data are also created for this class to make training the model simpler. After this, an object of the NeuraNet class is created with the appropriate hyperparameters. Once the object is created, the dataset is loaded using the DataLoader function of the Torch library along with a few parameters and hyperparameters. The device for training, i.e., either a CPU or GPU, is selected based on its availability. CrossEntropyLoss is the loss function, and the Adam optimizer is selected for model optimization. The model is trained and goes through the dataset as many times as the value of the 'num_epochs' hyperparameter. After the training is done and if the final loss is found to be satisfactory, the trained neural network model and its hyperparameters are stored in the 'data.pth' file using the torch.save function to use the model in the Chat Interface.

Module 3: Graphical User Interface

The main objective of the graphical user interface is to make interacting with the chatbot much simpler than just using the terminal. This is achieved using the Tkinter library and its modules. The interface we built for the chat bot is simple but elegant and very functional. The interface has no errors or bugs, making it hassle-free. There are two main components in the graphical interface. One is the Chat Log, which contains the entire conversation between the user and the bot. This makes it easier to follow the conversation if the user's query is too complex for the bot and is redirected to staff. The staff member has to just go through it once in order to reply. The second component is the message entry box and send button. This helps in taking the user's query in a proper format that is more appealing to the user. The send button is used to send the user-entered text as input to the bot. Pressing 'enter' also performs the same action as pressing the send button.

Results and Other Added Features

The results exceeded my expectations for the ChatBot. The performance of the bot, both technically and practically, was really impressive. After testing with a couple of other data sets obtained on the internet, the performance of the bot was surprisingly good on the other datasets too. The changes were made to the model by only using the hyperparameters when training on other datasets. The neural network model used is simple to understand but is complex enough to implement on large datasets.

It added a couple more features, i.e., a fully functional GUI, a proper user feedback query at the end of every conversation, and also the function to send the bill of every order to the user's email if they choose. Any other extra features or tags can be easily added to this ChatBot. In most cases, it only requires a change in the dataset, which can be done by any non-programmer. But implementing a new technical feature requires programming knowledge but is relatively simple considering the Python language has good community support and a large number of libraries and APIs that are actively supported. And when the ChatBot is unable to understand the user query or classify it into at least one of the given tags, the conversation is redirected to a human support person. This means that the conversation is never interrupted on the user's side, and their issue is resolved a maximum number of times. This means that the overall customer satisfaction regarding the ChatBot is also very high (figure 3).

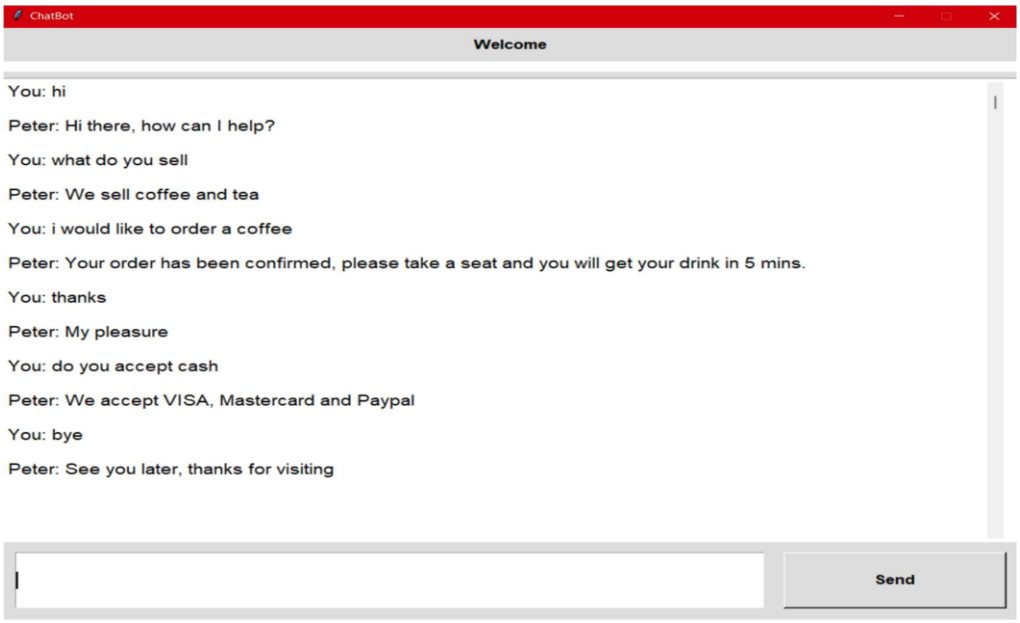

Figure 3: ChatBot Final Result

Conclusion

It had a clear vision of how the project was supposed to work, and the results matched and exceeded my expectations. Usage of the Python language meant that including extra features was simple and effective. Many of the previously existing chat bots were hardcoded, but in this project, it has used Natural Language Processing and Deep Learning in order to build a simple but automated conversation system that can be easily trained and implemented in any field. The implementation of this project is in such a way that it can be customised and altered endlessly. Since the behaviour of the chatbot is dependent on the dataset, its implementation in any field is possible as long as relevant data is available. Also, adding extra features is very easy because of this implementation.

References

1. Govinda rajulu Lanke and T.Bhuvaneswari, "Giving Intelligence to SMEs Business," International Journal of Business Intelligent, vol. 04, no. 02, p. 5, 2015.
2. H. Bulut and R. F. Rashid , "The Zooplankton Of Some Streams Flow Into The Zab River, (Northern Iraq)", Ecological Life Sciences, vol. 15, no. 3, pp. 94-98, Jul. 2020
3. https://docs.python.org/3/library/json.html
4. https://docs.python.org/3/library/tkinter.html
5. https://github.com/3Vikram-K/ChatBot
6. https://numpy.org/
7. https://pytorch.org/docs/stable/index.html
8. https://www.nltk.org/
9. https://www.python.org/
10. J. A. Zarnan, W. M. Hameed , "On The Numerical Eigenvalues of a Spring-Mass System," International Journal of Computer Science and Mobile Computing, vol. 5(8), pp.51-54, Aug.2016.

11. J. A. Zarnan, W. M. Hameed , A. B .Kanbar, “A novel Approach for Solution of a Love’s Integral Equation Using Chebyshev Polynomials,” Int. Adv. Appl. Math. And Mech., 7(3), 96-101, March 2020.
12. J. A. Zarnan, W. M. Hameed, ”A comparison study between two approaches for solution of Urysohn integral equation by using statistical method,” Int. J. Adv. Appl. Math. and Mech., vol.5 (4) , pp.65-68, 2018.
13. 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.
14. 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.
15. Lanke, Govinda Rajulu, “The Certainty of Bi System For SME,” IJCSERD, vol. 1, no. 1, p. 4, 2014.
16. M. Raja and G. G. L. Priya, “An analysis of Virtual Reality usage through a descriptive research analysis on school students’ experiences: A study from India,” Int. j. early child. spec. educ., vol. 13, no. 2, pp. 990–1005, 2021.
17. M. Raja and G. G. L. Priya, “Conceptual origins, technological advancements, and impacts of using Virtual Reality technology in education,” Webology, vol. 18, no. 2, pp. 116–134, 2021.
18. M. Raja and G. G. Lakshmi Priya, “Using virtual reality and augmented reality with ICT tools for enhancing quality in the changing academic environment in COVID-19 pandemic: An empirical study,” in Technologies, Artificial Intelligence and the Future of Learning Post-COVID-19, Cham: Springer International Publishing, 2022, pp. 467–482.
19. M. Raja and Lakshmi Priya GG, “Factors Affecting the Intention to Use Virtual Reality in Education,” Psychology and Education, vol. 57, no. 9, pp. 2014–2022, 2020.
20. M. Raja, K. Srinivasan, and S. Syed-Abdul, “Preoperative virtual reality based intelligent approach for minimizing patient anxiety levels,” in 2019 IEEE International Conference on Consumer Electronics - Taiwan (ICCE-TW), 2019.
21. Pala, G., Caglar, M., Faruq, R., & Selamoglu, Z. (2021). Chlorophyta algae of Keban Dam Lake Gülüşkür region with aquaculture criteria in Elazıg, Turkey. Iranian Journal of Aquatic Animal Health, 7(1), 32-46.
22. Rashid, R. (2017). Karakaya Baraj Gölünde (Malatya-Türkiye) yaşayan aspius vorax'da yaş tespiti için en güvenilir kemiksi yapının belirlenmesi/Determination of most reliable bony structure for ageing of aspius vorax inhabiting Karakaya Dam Lake (Malatya-Turkey).
23. Rashid, R. F., & Basusta, N. (2021). Evaluation and comparison of different calcified structures for the ageing of cyprinid fish leuciscus vorax (heckel, 1843) from karakaya dam lake, turkey. Fresenius environmental bulletin, 30(1), 550-559.
24. Rashid, R. F., Çalta, M., & Başusta, A. (2018). Length-Weight Relationship of Common Carp (Cyprinus carpio L., 1758) from Taqtaq Region of Little Zab River, Northern Iraq. Turkish Journal of Science and Technology, 13(2), 69-72.
25. S. Pandya, T. R. Gadekallu, P. K. Reddy, W. Wang and M. Alazab, "InfusedHeart: A Novel Knowledge-Infused Learning Framework for Diagnosis of Cardiovascular Events," in IEEE Transactions on Computational Social Systems, doi: 10.1109/TCSS.2022.3151643.

26. Shamim, M. I. (2022). Exploring the Success Factors of Project Management. American Journal of Economics and Business Management, 5(7), 64-72.
27. Shamim, M. I. (2022). IT Skills Development Project and Economic Development in Bangladesh. Academic Journal of Digital Economics and Stability, 19(7), 13-21.
28. Shamim, M. M. I. (2022). The Effects of COVID-19 on Project Management Processes and Practices. Central Asian Journal of Theoretical & Applied Sciences, 3(7), 221-227.
29. W. M. Hameed, "The Role of Crossover on Optimization of a Function Problem Using Genetic Algorithms," International Journal of Computer Science and Mobile Computing, vol.5 (7), pp. 425-429, jul.2016.
30. W. M. Hameed, A. B. Kanbar, "Using GA for evolving weights in neural networks," Applied Computer Science, vol. 15 (3), pp.21-33. Sep.2019.
31. W. M. Hameed, A. B. Kanbar, J. A. Zarnan," Fast Algorithms To Find The Shortest Path Using Matrices," International Journal Of Scientific & Technology Research, vol. 7 (8),pp.159-161, Aug. 2018.
32. W. M. Hameed, A. B. Kanbar," A comparative study of crossover operators for genetic algorithms to solve travelling salesman problem," International Journal of Research– Granthaalayah, vol.5 (2), pp.284-291, Feb. 2017.
33. W.M. Hameed and N.A. Ali," Enhancing imputation techniques performance utilizing uncertainty aware predictors and adversarial learning," Periodicals of Engineering and Natural Sciences (PEN) , vol. 10(3), pp.350-367, Jun 2022.
34. Lanke, Govinda Rajulu. (2013), "Adaptation of Saas In B Usiness I Ntelligence For SME," IJOAR .org, vol. 1, no.3, p.14, 2013.
35. 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.
36. 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.
37. 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, doi: 10.1109/i-PACT52855.2021.9697011
38. 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.
39. 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.
40. 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.
41. 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.

42. 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.
43. 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.
44. 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.
45. 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.
46. 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.
47. 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.
48. 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.
49. 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.
50. 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.
51. 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.
52. 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, doi: 10.2478/mspe-2021-0015.
53. 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.
54. 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, doi: 10.3390/en15103622.
55. 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, doi: 10.1109/access.2022.3178711.
56. 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.

57. Ravi Kumar Gupta, “Adoption of Mobile Wallet Services: An Empirical Analysis”, Int. J. of Intellectual Property Management, 2022, DOI: 10.1504/IJIPM.2021.10035526
58. 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.
59. 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.
60. 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.
61. 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.
62. 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, doi: 10.1109/ACCESS.2021.3091502.
63. A.Al Shraah, A. Abu-Rumman, F. Al Madi, F.A. Alhammad, A.A. AlJboor, “The impact of quality management practices on knowledge management processes: a study of a social security corporation in Jordan” The TQM Journal. Vol. ahead-of-print No. Issue ahead-of- print. Apr 2021. DOI: https://doi.org/10.1108/TQM-08-2020-0183
64. 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.
65. 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.
66. 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.
67. 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.
68. 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.
69. 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.

70. 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.

71. 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.

72. 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.

73. 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.

74. 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.

75. 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.

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

77. Abu-Rumman, A. Al Shraah, F. Al-Madi, T. Alfalah, "The impact of quality framework application on patients’ satisfaction", International Journal of Human Rights in Healthcare, Vol. ahead-of-print No. Issue ahead-of- print. Jun2021. DOI: https://doi.org/10.1108/IJHRH-01-2021-0006.

78. Abu-Rumman, A. Al Shraah, F. Al-Madi, T. Alfalah, “Entrepreneurial networks, entrepreneurial orientation, and performance of small and medium enterprises: are dynamic capabilities the missing link?” Journal of Innovation and Entrepreneurship. Vol 10 Issue 29, pp 1-16. Jul 2021. DOI: https://doi.org/10.1186/s13731-021-00170-8

79. Abu-Rumman, Ayman. "Gaining competitive advantage through intellectual capital and knowledge management: an exploration of inhibitors and enablers in Jordanian Universities." Problems and Perspectives in Management 16, no. 3 (2018): 259-268.

80. 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.

81. 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.

82. 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.

83. 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.

84. 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.

85. 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.

86. 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.

87. Almomani, Reham Zuhier Qasim, Lina Hamdan Mahmoud Al-Abbadi, Amani Rajab Abed Alhaleem Abu Rumman, Ayman Abu-Rumman, and Khaled Banyhamdan. "Organizational Memory, Knowledge Management, Marketing Innovation and Cost of Quality: Empirical Effects from Construction Industry in Jordan." Academy of Entrepreneurship Journal 25, no. 3 (2019): 1528-2686.

88. Alshawabkeh, Rawan, Amani Abu Rumman, Lina Al-Abbadi, and Ayman Abu-Rumman. "The intervening role of ambidexterity in the knowledge management project success connection." Problems and Perspectives in Management 18, no. 3 (2020): 56.

89. 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. DOI: 1532-5806-23-5-218

90. 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

91. 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.

92. 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.

93. 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.

94. 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.

95. 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.

96. D.S. Hooda, Keerti Upadhyay and D.K. Sharma, "On Parametric Generalization of 'Useful' R-norm Information Measure" British Journal of Mathematics & Computer Science, Vol. 8(1), pp. 1-15, 2015.

97. 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

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

99. 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.

100. 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.

101. 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.

102. 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

103. 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.

104. 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.

105. 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.

106. 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.

107. 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.

108. 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.

109. 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.

110. 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.

111. 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. https://doi.org/10.1109/icces48766.2020.9137897

112. Rupapara, V., Thipparthy, K. R., Gunda, N. K., Narra, M., & Gandhi, S. (2020). Improving video ranking on social video platforms. 2020 7th International Conference on Smart Structures and Systems (ICSSS), 1–5. https://doi.org/10.1109/icsss49621.2020.9202153

113. 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

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

115. 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.

116. 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

117. 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.

118. 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

119. 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

120. Zafar, S.Z., Zhilin, Q., Malik, H., Abu-Rumman, A., Al Shraah, A., Al-Madi, F. and Alfalah, T.F. (2021), "Spatial spillover effects of technological innovation on total factor energy efficiency: taking government environment regulations into account for three continents", Business Process Management Journal, Vol. 27 No. 6, pp. 1874-1891. https://doi.org/10.1108/BPMJ-12-2020-0550

121. 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.

122. 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.

123. D.S. Hooda, Keerti Upadhyay and D.K. Sharma, "A Generalized Measure of 'Useful R-norm Information", International Journal of Engineering Mathematics and Computer Sciences, Vol 3(5), pp.1-11, 2014.

124. D.S. Hooda, Keerti Upadhyay and D.K. Sharma, "Bounds on Cost Measures in terms of 'Useful' R-norm Information Measures" Direct Research Journal of Engineering and Information Technology, Vol.2 (2), pp.11-17, 2014.

125. D.S. Hooda and D.K. Sharma, "Lower and Upper Bounds Inequality of a Generalized 'Useful' Mean Code Length" GAMS Journal of Mathematics and Mathematical Biosciences, Vol. 4(1), pp.62-69, 2013.

126. D.S. Hooda, Keerti Upadhyay and D.K. Sharma, 'Useful' R-Norm Information Measure and its Properties" IOSR Journal of Electronics and Communication Engineering, Vol. 8, pp. 52-57, 2013.

127. D.S. Hooda, Sonali Saxena and D.K. Sharma, "A Generalized R-Norm Entropy and Coding Theorem" International Journal of Mathematical Sciences and Engineering Applications, Vol.5(2), pp.385-393, 2011.

128. D.S. Hooda and D.K. Sharma, "Bounds on Two Generalized Cost Measures" Journal of Combinatorics, Information & System Sciences, Vol. 35(3-4), pp. 513-530, 2010.

129. 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.

130. 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.

131. 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.

132. 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.

133. 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.

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

135. Suman Rajest S, P. Suresh, "An Analysis of Chetan Bhagat's Revolution -2020: Love, Ambition, Corruption" in International Journal of English Language, Literature in Humanities, Volume: V, Issue IX, September 2017, Page No.: 52-62.

136. Suman Rajest S, P. Suresh, "Galapagos: Is Human Accomplishment Worthwhile" in Online International Interdisciplinary Research Journal (OIIRJ), Volume: VII, Special Issue II, September 2017, Page No.: 307-314.

137. Suman Rajest S, P. Suresh, "The white Tiger by Aravind Adiga: Depiction of Fermentation in Society" in International Journal of Information Movement, Volume: II, Special Issue VI, October 2017, Page No.: 189-194.

138. Suman Rajest S, P. Suresh, "Confrontation on Modernism or Postmodernism Changes after the World War" in New Academia: An International Journal of English Language, Literature and Literary Theory, Volume: VII, Special Issue I, January 2018, Page No.: 50-76.

139. Suman Rajest S, P. Suresh, "The Post-War Novel as Catch-22: The Chronology and Ex-P.F.C Winter Green" in International Journal of Research Culture Society, Volume: II, Special Issue II, February 2018, Page No.: 64-68.

140. S. Suman Rajest; Anbarasi, "The Postwar Novel as Postmodern: Billy Pilgrim's Imagination and the Critical Tendency towards Teleology, Slaughterhouse – Five", International Journal of Advance Research, Ideas and Innovations in Technology, Volume 3, Issue 4, pp.37-41 (2017).

141. Suman Rajest S, P. Suresh, "Necessary Heads Which are Used for Writing a Scholarly Journal" in New Man International Journal of Multidisciplinary Studies, Volume: V, Issue III, March 2018, Page No.: 5-21.

142. Suman Rajest S, P. Suresh, "Impact of 21st century's different heads of learning skills for students and teachers" in International Journal of Multidisciplinary Research and Development, Volume: V, Issue IV, April 2018, Page No.: 170-178.

143. Suman Rajest S, P. Suresh, "21st Century Learners' Student-Centered Learning Various Stages" in International Conference, Age and Content in Journey of Language by VISTAS (Tamil Department), Volume: I, Issue I, April 2018, Page No.: 474-492. (International Conference Paper)

144. Suman Rajest S, P. Suresh, "American Postmodern Novelist Thomas Pynchon's The Crying of Lot 49: Structure and Absurd Realism" in Proceedings of the IOSRD, 73rd International Conference on Future Trends in Engineering and Business, Volume: 73, May 2018, Page No.: 32-41.

145. Suman Rajest S, P. Suresh, "The "Four Cs" Education For 21st Century's Learners" in Research Guru Online Journal of Multidisciplinary Subjects, Volume: XII, Issue I, June 2018, Page No.: 888-900.

146. Jerusha Angelene Christabel G, Suman Rajest S, "A Short Review on Fragmented Narration in Select Works of Sarnath Banerjee", American Journal of Social and Humanitarian Research, Vol. 3 No. 4, pp. 12-31, (2022).

147. 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

148. 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. https://doi.org/10.17605/OSF.IO/HBGCN

149. 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.

150. 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.

151. Suman Rajest S, P. Suresh, "The Problematizing of History Concentrated on The Poetics of Historiographic Metafiction by Postmodernism and How It Influences Postmodern Fiction" in International Journal of Pure and Applied Mathematics (IJPAM), Volume: 119, Special Issue 16, July 2018, Page No.: 2457-2469.

152. Suman Rajest S, P. Suresh, "Themes and Techniques from Modernism to Postmodernism: The Dubious Continuance of Gravity's Rainbow" in International Journal of Pure and Applied Mathematics, Volume: 119, Special Issue 16, July 2018, Page No.: 2373-2384.

153. Suman Rajest S, P. Suresh, "Absurd Realism and Structure in Thomas Pynchon's The Crying of Lot 49" in Journal of Advanced Research in Dynamical and Control Systems, Volume: 10, Special Issue 11, August 2018, Page No.: 571-580.

154. Suman Rajest S, P. Suresh, "The Deducible Teachings Of Historiographic Metafiction Of Modern Theories Of Both Fiction And History" in Eurasian Journal of Analytical Chemistry, Volume: 13, Special Issue 04, July 2018, Page No.: 110-117.

155. Suman Rajest S, P. Suresh, "The Dialog on Postmodernism Intertextuality, Parody, The Talk of History and The Issue of Reference" in International Journal of Recent Technology and Engineering, Volume-7, Issue-5C, February 2019, Page No.: 244-7.

156. Suman Rajest S, P. Suresh, "An Analysis of Psychological Aspects in Student-Centered Learning Activities and Different Methods" in Journal of International Pharmaceutical Research, Volume: 46, Special Issue 01, March 2019, Page No.: 165-172.

157. Md. Salamun Rashidin, Sara Javed, Bin Liu, Wang Jian, Suman Rajest S, "Insights: Rivals Collaboration on Belt and Road Initiatives and Indian Recourses" in Journal of Advanced Research in Dynamical and Control Systems, Volume: 11, Special Issue 04, 2019, Page No.: 1509-1522.

158. Dr. P.S. Venkateswaran, Dr. A. Sabarirajan, S. Suman Rajest And R. Regin (2019) "The Theory of the Postmodernism in Consumerism, Mass Culture and Globalization" in The Journal of Research on the Lepidoptera Volume 50 (4): 97-113

159. Desfiandi, A., Suman Rajest, S., S. Venkateswaran, P., Palani Kumar, M., & Singh, S. (2019). Company Credibility: A Tool To Trigger Positive CSR Image In The Cause-Brand Alliance Context In Indonesia. Humanities & Social Sciences Reviews, 7(6), 320-331.

160. K.B. Adanov, S. Suman Rajest, Mustagaliyeva Gulnara, Khairzhanova Akhmaral (2019), "A Short View on the Backdrop of American's Literature". Journal of Advanced Research in Dynamical and Control Systems, Vol. 11, No. 12, pp. 182-192.

161. D Datta, S Mishra, SS Rajest, (2020) "Quantification of tolerance limits of engineering system using uncertainty modeling for sustainable energy" International Journal of Intelligent Networks, Vol.1, 2020, pp.1-8, https://doi.org/10.1016/j.ijin.2020.05.006

162. 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. DOI: 10.4108/eai.13-7-2018.165523

163. S. Suman Rajest Dr. Bhopendra Singh, P. Kavitha, R. Regin, Dr.K. Praghash, S. Sujatha, "Optimized Node Clustering based on Received Signal Strength with Particle Ordered-filter Routing Used in VANET" Webology, Vol.17, No.2, pp. 262-277, 2020.

164. K.K.D. Ramesh, G. Kiran Kumar, K. Swapna, Debabrata Datta, and S. Suman Rajest, "A Review of Medical Image Segmentation Algorithms", EAI Endorsed Transactions on Pervasive Health and Technology, 2021, doi: 10.4108/eai.12-4-2021.169184

165. R. Regin, S. Suman Rajest and Bhopendra Singh, "Fault Detection in Wireless Sensor Network Based on Deep Learning Algorithms", EAI Endorsed Transactions on Scalable Information Systems, 2021, https://eudl.eu/doi/10.4108/eai.3-5-2021.169578

166. Worakamol Wisetsri, Krishnabhaskar Mangalasserri, Luigi Pio Leonardo Cavaliere, S. Suman Rajest, Praveen Mittal, M. Kalyan Chakravarthi, Kartikey Koti, Ashish Gupta, R. Regin, "The Impact of Marketing Practices on NGO Performance: The Pestel Model Effect", Turkish Online Journal of Qualitative Inquiry, Volume 12, Issue 3, July 2021:2884- 2903.

167. Roy Setiawan, V. Ramesh Kumar, S. Suman Rajest, M. Kalyan Chakravarthi, Klinge Orlando Villalba-Condori, Cesar Gonzalo Vera-Vasquez,Tamil Selvan Subramaniam, Kartikey Koti, Regin Rajan., The Empirical Results of Conditional Analysis of Principals' Reasons in Bullying Teachers, Turkish Online Journal of Qualitative Inquiry, Volume 12, Issue 3, July 2021:2737-2756.

168. Luigi Pio Leonardo Cavaliere, S. Suman Rajest, Balbir Singh, M Jagadish Kumar, Kartikey Koti,M. Kalyan Chakravarthi, S. Arun, R. Regin, Sonia Singh., Achieving United Nations Goals Throughout the Youth Leadership, Turkish Online Journal of Qualitative Inquiry, Volume 12, Issue 3, July 2021:2859- 2883.

169. Tribhuwan Kumar, S. Suman Rajest, Klinge Orlando Villalba-Condori, Dennis Arias-Chavez, K. Rajesh, M. Kalyan Chakravarthi, "An Evaluation on Speech Recognition Technology based on Machine Learning, "Webology, Volume 19, Number 1, January, 2022, pp. 646-663.

170. Chutimon Narawish, Dilip Kumar Sharma, S. Suman Rajest, R. Regin, "Importance of Cost Efficiency in Critical Aspect of Influences the Decision-Making Process in Banks", "Turkish Journal of Physiotherapy and Rehabilitation; 32(3), pp. 47184-47212, 2021.

171. 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.

172. Rao, A. N., Vijayapriya, P., Kowsalya, M., & Rajest, S. S. (2020). Computer Tools for Energy Systems. In International Conference on Communication, Computing and Electronics Systems (pp. 475-484). Springer, Singapore.

173. Gupta J., Singla M.K., Nijhawan P., Ganguli S., Rajest S.S. (2020) An IoT-Based Controller Realization for PV System Monitoring and Control. In: Haldorai A., Ramu A., Khan S. (eds) Business Intelligence for Enterprise Internet of Things. EAI/Springer Innovations in Communication and Computing. Springer, Cham

174. Sharma M., Singla M.K., Nijhawan P., Ganguli S., Rajest S.S. (2020) An Application of IoT to Develop Concept of Smart Remote Monitoring System. In: Haldorai A., Ramu A., Khan S. (eds) Business Intelligence for Enterprise Internet of Things. EAI/Springer Innovations in Communication and Computing. Springer, Cham

175. Ganguli S., Kaur G., Sarkar P., Rajest S.S. (2020) An Algorithmic Approach to System Identification in the Delta Domain Using FAdFPA Algorithm. In: Haldorai A., Ramu A., Khan S. (eds) Business Intelligence for Enterprise Internet of Things. EAI/Springer Innovations in Communication and Computing. Springer, Cham

176. Singla M.K., Gupta J., Nijhawan P., Ganguli S., Rajest S.S. (2020) Development of an Efficient, Cheap, and Flexible IoT-Based Wind Turbine Emulator. In: Haldorai A., Ramu A., Khan S. (eds) Business Intelligence for Enterprise Internet of Things. EAI/Springer Innovations in Communication and Computing. Springer, Cham

177. Rajasekaran R., Rasool F., Srivastava S., Masih J., Rajest S.S. (2020) Heat Maps for Human Group Activity in Academic Blocks. In: Haldorai A., Ramu A., Khan S. (eds) Business Intelligence for Enterprise Internet of Things. EAI/Springer Innovations in Communication and Computing. Springer, Cham

178. S. Suman Rajest, D.K. Sharma, R. Regin and Bhopendra Singh, "Extracting Related Images from E-commerce Utilizing Supervised Learning", Innovations in Information and Communication Technology Series, pp. 033-045, 28 February, 2021.

179. Souvik Ganguli, Abhimanyu Kumar, Gagandeep Kaur, Prasanta Sarkar and S. Suman Rajest, "A global optimization technique for modeling and control of permanent magnet synchronous motor drive", Innovations in Information and Communication Technology Series, pp. 074-081, 28 February, 2021.

180. Jappreet Kaur, Tejpal Singh Kochhar, Souvik Ganguli and S. Suman Rajest, “Evolution of Management System Certification: An overview”, Innovations in Information and Communication Technology Series, pp. 082-092, 28 February, 2021.

181. R. Regin, S. Suman Rajest and Bhopendra Singh, “Spatial Data Mining Methods Databases and Statistics Point of Views”, Innovations in Information and Communication Technology Series, pp. 103-109, 28 February, 2021.

182. D. K. Sharma, B. Singh, E. Herman, R. Regine, S. S. Rajest and V. P. Mishra, "Maximum Information Measure Policies in Reinforcement Learning with Deep Energy-Based Model," 2021 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE), 2021, pp. 19-24, doi: 10.1109/ICCIKE51210.2021.9410756.

183. F. Arslan, B. Singh, D. K. Sharma, R. Regin, R. Steffi and S. Suman Rajest, "Optimization Technique Approach to Resolve Food Sustainability Problems," 2021 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE), 2021, pp. 25-30, doi: 10.1109/ICCIKE51210.2021.9410735.

184. G. A. Ogunmola, B. Singh, D. K. Sharma, R. Regin, S. S. Rajest and N. Singh, "Involvement of Distance Measure in Assessing and Resolving Efficiency Environmental Obstacles," 2021 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE), 2021, pp. 13-18, doi: 10.1109/ICCIKE51210.2021.9410765.

185. A. Raja and S. Singh, "Event Study on Appointment and Removal of Chairman: Case of Tata Group", Amity Business Review, vol. 19, no. 1, pp. 1-9, 2018.

186. Abdulbaqi, A., Younis, M., Younus, Y., Obaid, A. (2022). A hybrid technique for EEG signals evaluation and classification as a step towards to neurological and cerebral disorders diagnosis. International Journal of Nonlinear Analysis and Applications, 13(1), 773-781. doi: 10.22075/ijnaa.2022.5590

187. Abdulreda, A., Obaid, A. (2022). A landscape view of deepfake techniques and detection methods. International Journal of Nonlinear Analysis and Applications, 13(1), 745-755. doi: 10.22075/ijnaa.2022.5580

188. Adhikari, S., Hutaihit, M., Chakraborty, M., Mahmood, S., Durakovic, B., Pal, S., Akila, D., Obaid, A. (2021). Analysis of average waiting time and server utilization factor using queueing theory in cloud computing environment. International Journal of Nonlinear Analysis and Applications, 12(Special Issue), 1259-1267. doi: 10.22075/ijnaa.2021.5636

189. Azmi Shawkat Abdulbaqi, Ahmed J. Obaid & Maysaa Hameed Abdulameer (2021) Smartphone-based ECG signals encryption for transmission and analyzing via IoMTs, Journal of Discrete Mathematical Sciences and Cryptography, DOI: 10.1080/09720529.2021.1958996

190. D. Hemavathi, V. R. Kumar, R. Regin, S. S. Rajest, K. Phasinam and S. Singh, "Technical Support for Detection and Prediction of Rainfall," 2021 2nd International Conference on Smart Electronics and Communication (ICOSEC), 2021, pp. 1629-1634, doi: 10.1109/ICOSEC51865.2021.9591762.

191. D. K. Sharma, B. Singh, M. Raja, R. Regin and S. S. Rajest, "An Efficient Python Approach for Simulation of Poisson Distribution," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 2021, pp. 2011-2014, doi: 10.1109/ICACCS51430.2021.9441895.

192. 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.

193. Ibrahim, K., Obaid, A. (2021). Fraud usage detection in internet users based on log data. International Journal of Nonlinear Analysis and Applications, 12(2), 2179-2188. doi: 10.22075/ijnaa.2021.5367

194. Jayakumar P., Suman Rajest S., Aravind B.R. (2022) An Empirical Study on the Effectiveness of Online Teaching and Learning Outcomes with Regard to LSRW Skills in COVID-19 Pandemic. In: Hamdan A., Hassanien A.E., Mescon T., Alareeni B. (eds) Technologies, Artificial Intelligence and the Future of Learning Post-COVID-19. Studies in Computational Intelligence, vol 1019. Springer, Cham. https://doi.org/10.1007/978-3-030-93921-2_2

195. Obaid, A. J., Ibrahim, K. K., Abdulbaqi, A. S., & Nejrs, S. M. (2021). An adaptive approach for internet phishing detection based on log data. Periodicals of Engineering and Natural Sciences, 622-631.

196. Pandey, D., Wairya, S., Al Mahdawi, R., Najim, S., Khalaf, H., Al Barzinji, S., Obaid, A. (2021). Secret data transmission using advanced steganography and image compression. International Journal of Nonlinear Analysis and Applications, 12(Special Issue), 1243-1257. doi: 10.22075/ijnaa.2021.5635

197. Rajest, D. S. S., G, J. A. C., & Galiya, D. S. (2022). Modern Spinsters in the Family and Kinship in the 21st Century. Central Asian Journal of Social Sciences and History, 3(8), 37-55. Retrieved from https://cajssh.centralasianstudies.org/index.php/CAJSSH/article/view/413

198. S. Joghee, A. Dubey and S. Singh, "Investigation of green marketing practices of UAE hypermarkets", International Journal of Enterprise Network Management, vol. 12, no. 4, p. 367, 2021.

199. S. Kamal, D. Rahman and D. Singh, "Covid-19 Related Factors Associated with Antenatal Care in Rural Bangladesh: A qualitative study", Asia Pacific Journal of Health Management, vol. 17, no. 1, 2022.

200. S. Singh and S. Das, "Impact of post-merger and acquisition activities on the financial performance of banks: a study of Indian private sector and public sector banks", Revista Espacios, vol. 39, no. 25, pp. 25-40, 2018.

201. S. Singh, S. Mondal, L. Singh, K. Sahoo and S. Das, "An Empirical Evidence Study of Consumer Perception and Socioeconomic Profiles for Digital Stores in Vietnam", Sustainability, vol. 12, no. 5, p. 1716, 2020.

202. Shahzad, F., Abid, F., Obaid, A., Kumar Rai, B., Ashraf, M., Abdulbaqi, A. (2021). Forward stepwise logistic regression approach for determinants of hepatitis B & C among Hiv/Aids patients. International Journal of Nonlinear Analysis and Applications, 12(Special Issue), 1367-1396. doi: 10.22075/ijnaa.2022.5717

203. Sharma, G., Kumar, J., Sharma, S., Singh, G., Singh, J., Sharma, A., . . . Obaid, A. J. (2021). Performance of diesel engine having waste heat recovery system fixed on stainless steel made exhaust gas pipe. Materials Today: Proceedings.

204. Singh, V. Shukla and S. Singh, "An Empirical Study of Shift from SMS to Chat-App among University Student", International Journal of Recent Technology and Engineering, vol. 7, no. 64, pp. 1-6, 2019.

205. Srivastava Y., Ganguli S., Suman Rajest S., Regin R. (2022) Smart HR Competencies and Their Applications in Industry 4.0. In: Kumar P., Obaid A.J., Cengiz K., Khanna A., Balas V.E. (eds) A Fusion of Artificial Intelligence and Internet of Things for Emerging Cyber Systems. Intelligent Systems Reference Library, vol 210. Springer, Cham. https://doi.org/10.1007/978-3-030-76653-5_16