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Guest Editorial

Soft computing and intelligent systems: Techniques and applications

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The aim of this special issue is to discuss various aspects and recent advances in the area of intelligent systems technologies and applications. The 50 papers were selected after a rigorous peer-review and recommendation of the guest editors. The special issue covers various topics such as computational intelligence, pattern recognition, machine learning, and their applications to a wide spectrum of domains including healthcare [1–10]; image processing, computer vision, and biometrics [11–18], social media, document analysis, natural language processing, and recommendation systems [19–27]; security, information hiding, and safety [28–35]; cloud computing services and management [36–38]; energy, control, industrial, and other applications [39–50].

Intelligent-Based Decision Support System for Diagnosing Glaucoma in Primary Eye Care Centers Using Eye Tracker [1]: It is quite alarming that the increase of glaucoma is due to the lack of awareness of the disease and the cost for glaucoma screening. The primary eye care centers need to include a comprehensive glaucoma screening and include machine learning models to enhance screening as decision support system. The proposed system considers the state of art of eye gaze features to understand cognitive processing, direction, and restriction of visual field. There is no significant difference in global and local ratios and skewness value of fixation duration and saccade amplitude, which suggests that there is no difference in cognitive processing. The significance value of saccadic extent along vertical axis, horizontal Vertical ratio (HV ratio), convex hull area, and saccadic direction show that there is restriction in vertical visual field. The statistical measures ($p < 0.05$) and Spearman correlation coefficient with class label validate the results. The proposed system compared the performance of seven classifiers: NaÃ¯ve Bayes classifier, linear and kernel Support Vector classifiers, decision tree classifier, Adaboost, random forest, and eXtreme Gradient Boosting (XGBoost) classifier. The discrimination of eye gaze features of glaucoma and healthy eye is efficiently done by XGBoost with accuracy 1.0. The decision support system is cost-effective and portable.

Lung Nodule Classification Using Combination of CNN, Second, and Higher Order Texture Features [2]: Lung cancer is the most common cancer worldwide and identification of malignant tumors at an early stage is needed for diagnosis and treatment of a patient thus avoiding the progression to later stage. Recently, deep learning architectures such as CNN have shown promising results in effectively

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identifying malignant tumors in CT scans. This paper combines CNN and texture features such as Haralick and Gray level run length matrix features to gather benefits of high level and spatial features extracted from the lung nodules to improve the accuracy of classification. These features are further classified using SVM instead of softmax classifier in order to reduce the overfitting problem. The presented model is validated using LUNA dataset and achieved an accuracy of 93.53%, sensitivity of 86.62%, specificity of 96.55%, and positive predictive value of 94.02%.

A Cost-Effective Computer-Vision Based Breast Cancer Diagnosis [3]: Over the last decade, there have been extensive reports on breast cancer from the world health organization (WHO) About 2.1 million women are affected every year and it is the second most leading cause of cancer death in women. Initial detection and diagnosis of cancer appreciably increase the chance of saving lives and reduce treatment costs. In this paper, the authors survey the techniques utilized in breast cancer detection and diagnosis using image processing, machine learning (ML), and deep learning (DL). Moreover, a novel computer-vision based cost-effective method is proposed for breast cancer detection and diagnosis. Along with the detection and diagnosis of breast cancer, the proposed method is capable of finding the exact position of the abnormality present in the breast that will help in breast-conserving surgery or partial mastectomy. The proposed method is the simplest and cost-effective approach that has produced highly accurate and useful outcomes when compared with the existing approach.

SLKOF: Subsampled Lucas-Kanade Optical Flow for Opto Kinetic Nystagmus Detection [4]: The neurological disorders develop in adults due to reduced visual perception. Opto Kinetic Nystagmus (OKN) is a clinical method to detect the visual perception. For objective measurements, a computational algorithm-based OKN detection is preferable rather than a clinical approach In this paper, a memory-efficient Subsampled Lucas-Kanade Optical Flow (SLKOF) is proposed. The proposal deals with the computation of OKN gain for different image Subsampling factors using the MATLAB platform. The experimental setup to observe OKN is performed using computer-based rotation control of the drum through a stepper motor. The results are compared with the well established Lucas-Kanade (LK) method for optical flow. It is observed that OKN gain corresponds to ¼th of a subsampled image of the SLKOF method, which correlates with the LK method for the majority of cases. This validation elucidates that the proposal is computationally efficient.

Colon Cancer Prediction on Histological Images Using Deep Learning Features and Bayesian Optimized SVM [5]: Colon cancer has one of the highest cancer diagnosis mortality rates worldwide. However, relying on the expertise of pathologists is a demanding and time-consuming process for histopathological analysis. The automated diagnosis of colon cancer from biopsy examination played an important role for patients and prognosis. Conventional handcrafted feature extraction requires specialized experience to select realistic features. Hence, deep learning processes have been chosen because abstract high-level features may be extracted automatically. In this paper we present the colon cancer detection system using transfer learning architectures to automatically extract high-level features from colon biopsy images for automated diagnosis of patients and prognosis. The image features are extracted from a pre-trained convolutional neural network (CNN) and used to train the Bayesian optimized Support Vector Machine classifier. Moreover, Alexnet, VGG-16, and Inception-V3 pre-trained neural networks were used to analyze the best network for detecting colon cancer. The proposed framework is evaluated using four datasets: two are collected from hospitals in India (with different magnifications 4X, 10X, 20X, and 40X) and the remaining two are public colon image datasets. Compared with the existing classifiers and methods using public datasets, the test results using the Inception-V3 neural network achieved the accuracy range of 96.5% - 99% as best suited for the proposed framework.

Comparative Classification Techniques for Identification of Brain States Using TQWT Decomposition [6]:

Brain Computer Interface provides and simplifies the communication channel for the physically disabled individuals suffering from severe brain injury related to brain stroke and lost ability to speak. It helps these patients to connect with the outside world. In the proposed work, electroencephalogram signal is used as input source taken from Bonn University database that is divided into three class of data consisting of 247 samples each. It is further processed by Tunable Q-Wavelet Transform signal decomposition technique where the signals are sub divided into various sub bands depending on the value of Q-factor, redundancy factor, and number of sub bands. A novel custom technique uses Q-factor of 3, redundancy value of 3 & 12 number of sub bands for high

pass filtering as well as Q-factor of 1, redundancy value of 3 & 7 number of sub bands for low pass filtering combined with nine statistical measures for feature extraction purpose. The classification is preformed by using multi class support vector machine giving the accuracy of 99.59%. The accuracy performs best when compared with the existing research results. Furthermore, the comparative study has been preformed on the same dataset by using deep neural network along with support vector machine giving accuracy of 100%. Other evaluation parameters such as precision, sensitivity, specificity, and F1 score are also calculated. The classified data help transform the signal into three communication messages that will help solve the speech impairment of disabled individuals.

A Novel Deep Learning Approach for the Automated Diagnosis of Normal Pressure Hydrocephalus [7]: Normal Pressure Hydrocephalus (NPH), an Atypical Parkinsonian syndrome, is a neurological syndrome that mainly affects elderly people. This syndrome shows the symptoms of Parkinson's disease (PD) such as dementia and walking, bladder control, and mental impairments. The Magnetic Resonance Imaging (MRI) is the aptest modality for the detection of the abnormal build-up of cerebrospinal fluid in the brain's cavities or ventricles, which is the major cause of NPH. This work describes an automated biomarker for NPH segmentation and classification (NPH-SC) that efficiently detect hydrocephalus using a deep learning-based approach. Removal of noncerebral tissues (skull, scalp, and dura) and noise from brain images by skullstripping, unsharp-mask-based edge sharpening, segmentation by markerbased watershed algorithm, and labeling are performed to improve the accuracy of the CNN based classification system. The brain ventricles are extracted using the external and internal markers and then fed into the convolutional neural networks (CNN) for classification. This automated NPH-SC model achieved a sensitivity of 96%, specificity of 100%, and validation accuracy of 97%. The prediction system with a CNN classifier is used to calculate test accuracy of the system and obtained promising 98% accuracy,

Fuzzy Hyperlattice Ordered Delta-Group and its Application on ABO Blood Group System [8]: This article deals with a fuzzy hypercompositional structure called fuzzy hyperlattice ordered delta-group (FHLO delta-G), the extension of the fuzzy hypercompositional structure namely fuzzy hyperlattice ordered group (FHLOG). Using FHLO delta-G, we can involve one additional non-empty set delta with FHLOG, which helps to develop new results and applications. The structural characteristics and properties of FHLO delta-G are analysed. Furthermore, an application of FHLO delta-G for ABO blood group system is proposed.

Towards Voice-Based Prediction and Analysis of Emotions in Children with ASD [9]:

The objective of this research is to identify the presence of Autism Spectrum Disorder (ASD) and to analyze the emotions of autistic children through their voices. The presented automated voice-based system can detect and classify seven basic emotions (anger, disgust, neutral, happiness, calmness, fear and sadness) expressed by children through source parameters associated with their voices. Various prime voice features are extracted and utilized to train a Multilayer Perceptron (MLP) classifier to identify possible emotions exhibited by the children thereby assessing their behavioral state.

A Comparative Analysis of Stroke Diagnosis from Retinal Images Using Hand-Crafted Features and CNN [10]: Stroke is a major reason for disability and mortality in most developing nations. Early detection of stroke is highly significant in bio-medical research that illustrates that signs of stroke are reflected in the eye and may be analyzed from fundus images. A custom dataset of fundus images has been compiled for formulating an automated stroke detection algorithm. In this paper, a comparative study of hand-crafted texture features and convolutional neural network (CNN) has been recommended for stroke diagnosis. The custom CNN model has been compared with five pre-trained models from ImageNet. Experimental results reveal that the recommended custom CNN model gives the best performance by achieving an accuracy of 95.8 %.

Face Recognition and Tracking for Security Surveillance [11]:

According to the National Crime Records Bureau, 63,407 children have been reported missing in India in 2016, i.e., almost 174 children every day while only 50% have ever been found. As these numbers are increasing, there is a need for machine assistance during the search activities. Since faces are part of the inherent identities of people, using face recognition technologies becomes essential for the development of applications using CCTV footage across a camera network to identify missing persons. In this research work, a technique is proposed using One-Shot learning for face recognition to identify stranded individuals in places such as mass gather-

ings. The same technology may also be used for the identification of criminals across the city as well as tracking people across a network of multiple non-overlapping cameras, with a feature to track the target's vehicle.

Portrait Photography Splicing Detection Using Ensemble of Convolutional Neural Networks [12]:

Forged portraits of people are widely used for creating deceitful propaganda of individuals or events in social media and even for generating fake pieces of evidence in court proceedings. Hence, it is very important to find the authenticity of images. This work proposes an ensemble learning technique by combining predictions of different Convolutional Neural Networks (CNNs) for detecting forged portrait photographs. In the proposed method, seven different pre-trained CNN architectures (AlexNet, VGG-16, GoogLeNet, ResNet-18, ResNet- 101, Inception-v3, and Inception-ResNet-v2) are utilized. After fine-tuning pre-trained networks for portrait forgery detection with illuminant maps of images as input, a majority voting ensemble scheme is utilized to combine predictions from the fine-tuned networks to improve the generalization capability of classification models. Experimental analysis is conducted using two publicly available portrait splicing datasets (DSO-1 and DSI-1). The results show that the proposed method outperforms the state-of-the-art methods using traditional machine learning techniques as well as the methods using single CNN classification models.

Automated Segmentation of Key Structures of the Eye Using a Light-Weight Two-Step Classifier [13]: In this work, an automated approach is presented using a two-step classifier to segment key structures of the eye (iris, pupil, and sclera) in images obtained through the application of Augmented Reality (AR)/Virtual Reality (VR). In the first step, an auto encoder-decoder network is used for pixel-wise classification of regions that comprise the iris, sclera, and background (pixels outside the region of the eye). In the second step, a pixel-wise classification is performed on the iris region to delineate the pupil. In the experimental work, images from the OpenEDS challenge are used to evaluate the segmentation accuracy and the computational cost. The proposed approach achieved a score of 0.93 on the leaderboard, outperforming the baseline model by achieving a higher accuracy and using a smaller number of parameters. These results demonstrate the great promise of pipelined models along with the benefit of using domain-specific processing and feature engineering in conjunction with deep-learning based approaches for segmentation tasks.

Decoding of Graphically Encoded Numerical Digits Using Deep Learning and Edge Detection Techniques [14]: In this paper, a self-created explicitly defined function for encoding numerical digits into graphical representation is described. The proposed system integrates deep learning methods to generate the probabilities of digit occurrence and edge detection techniques for decoding the graphically encoded numerical digits to numerical digits as text. This system also employs relevant preprocessing techniques to convert RGB image to text and image to Canny image. Techniques such as Multi-Label Classification of images and Segmentation are used for generating the probability of occurrence. A dataset of 1,000 images is created where 900 images are used for training and 100 images for testing. The model has achieved a precision of 89% for probability prediction.

Multi-Modal Medical Image Fusion Using LMF-GAN - A Maximum Parameter Infusion Technique [15]: The multi-sensor multi-modal composite design of medical images contributes to identifying features that are relevant to medical diagnoses and treatments. Although current image fusion technologies, including conventional and deep learning algorithms, may produce superior fused images, they require large volumes of images of various modalities. This solution may not be viable for situations where time efficiency is expected or the equipment is inadequate. This paper addresses a modified end-to-end Generative Adversarial Network (GAN), termed Loss Minimized Fusion Generative Adversarial Network (LMF-GAN), which is a triple ConvNet deep learning architecture for the fusion of medical images with a limited sampling rate. in contrast to conventional convolutional networks, the encoding network is combined with a convolutional neural network layer and a dense block called GAN. The loss is minimized by training the GAN's discriminator with all the source images by learning additional parameters to generate additional features in the fused image. In comparison with current fusion methods, experiments with standard data sets demonstrated that the proposed fusion method has the ability to achieve state-of-the-art quality in objective and subjective evaluation.

Effective Splicing Localization Based on Noise Level Inconsistencies [16]: People are used to exchange photos and videos using smartphones and social networking sites. However, the simplicity of

image editing tools leaves the validity of such pictures or videos questionable. In the field of image forensics, intensive work has been conducted over the past decades to validate their trustworthiness. This paper proposes an efficient way of identifying manipulated areas based on Noise Inconsistencies of image. Unlike the existing methods, the proposed approach extracts the local characteristics from individual objects and their surroundings as a background instead of using the entire image. A pair-wise dissimilarity obtained between foreground and background objects after extracting the local characteristics of each object and then locating the manipulated region that has the highest variance among other objects. The experimental results reveal the proposed method's effectiveness over other state-of-art methods.

Ontology Based Multiobject Segmentation and Classification in Sports Videos [17]:

The primary objective of this research work is to identify and segment the multiple partly occluded objects in an image. The proposed approach is performed starting with frame conversion. The preprocessing stage then employs a Gaussian filter for image smoothening. Subsequently, various objects are segmented by using a modified ontology-based segmentation method. Edges are then detected from the segmented image. From the edge detected frames, area is extracted, which results in object detected frames used to extract features such as area, contrast, correlation, energy, homogeneity, color, perimeter, and circularity. Finally, objects are categorized with a feed-forward back propagation neural network classifier (FFBNN) using the extracted attributes.

Weight Modulation in Top-Down Computational Model for Target Search [18]:

Computer vision research goal is to build models that acts as human-like systems. The recent development in visual information has been effectively used to derive computational models to address a variety of applications. Biological models help to identify the salient objects in the image. However, identification of the non-salient objects in the heterogeneous environment is a challenging task that requires better understanding of the visual system. In this work, a weight modulation based top-down model is proposed that integrates the visual features based on their importance for the target search application. The model is designed to learn the optimal weights such that it biases the target features from the other surrounding regions. Experimental analysis is performed using different scenes of a standard dataset. Metrics such as area under curve, average hit number, and correlation reveal that the proposed method is more suitable in identifying the target by suppressing the other dominant objects.

A Psychologically-Inspired Fuzzy-Based Approach for User Personality Prediction in Rumor Propagation Across Social Networks [19]: Social networks have recently emerged as a fertile ground for the spread of rumors and misinformation. The increased rate of social networking owes to the popularity of social networks among the common population. User personality has been considered as a principal component in predicting individuals' patterns of using social media. Several studies have been conducted to evaluate the psychological factors influencing the social network usage. However, only few have explored the relationship between the user's personality and their orientation to spread rumors. This research aims to investigate the effect of personality on spreading rumor on social networks. In this work, the authors propose a psychologically-inspired fuzzy-based approach grounded on the Five-Factor Model of behavioral theory to analyze the behavior of people highly involved in rumor diffusion. It categorize users into the susceptible and resistant group based on their inclination towards rumor sharing. Experiments are conducted in 825 individuals who shared rumor tweets on Twitter related to five different events. This study ratifies the truth that the personality traits of individuals play a significant role in rumor dissemination and the experimental results illustrate that users exhibiting a high degree of agreeableness trait are more engaged in rumor sharing activities while the users high in extraversion and openness trait restrain themselves from rumor propagation.

Exploring Fake News Identification Using Word and Sentence Embeddings [20]: The widespread of Internet and social media networks such as Facebook, Twitter, and WhatsApp have changed the way the news is created and published; accessing news has become easy and inexpensive. However, Internet and social media have also become breeding ground for the circulation of fake news. Fake news are deliberately created either to increase the readership or disrupt the peace in the society for political and commercial benefits. Hence, it is necessary to identity and filter out the fake news due to its high content in social media. Most existing methods for detecting fake news involve supervised learning, which is time consuming and inaccurate. In this work, features are selected cautiously by analyzing LIAR and ISOT datasets.Auto-encoders are used to detect fake news

while centrality measures are used to differentiate between true and fake news.

An Intelligent Approach for Automated Argument Based Legal Text Recognition and Summarization Using Machine Learning [22]: Computer programmers should generally provide a structured data feed to the computer program for its successful execution. The hardcopy document should be scanned to generate its corresponding computer-readable softcopy version of the file. This process proves to be a budget-friendly approach to disengage human resources from the process of record maintenance. Due to this automation, the workload of existing manpower is significantly reduced. This concept may prove beneficial for the delivery of any type of services to the ultimate beneficiary (citizen) in a minimal time frame. The administration has to deal with various issues of citizens due to the pressure of a huge population who seek legal help to resolve their issues, thereby leading to the filing of large numbers of pending legal cases at several courts of the country. To assist the victims with prompt delivery of justice and legal professionals in reducing their workload, this paper proposed a machine learning based automated legal model to enhance the efficiency of the legal support system with an accuracy of 94%.

Investigation of Automatic Mixed-Lingual Affective State Recognition System for Diverse Indian Languages [23]: Automatic recognition of human affective state using speech has been the focus of the research community for more than two decades. Currently, in multi-lingual countries such as India and Europe, population communicates in various languages. However, majority of the existing works have devised various strategies to recognize affect from various databases, each comprising single language recordings. There exists a great demand for affective systems to serve the context of mixed-language scenario. Hence, this work focuses on an effective methodology to recognize human affective state using speech samples from a mixed language framework. A unique cepstral and bi-spectral speech features derived from the speech samples classified using random forest (RF) are applied for the task. This work is first of its kind with the proposed approach validated and found to be effective on a self-recorded database with speech samples comprising from eleven diverse Indian languages. Six different affective states of angry, fear, sad, neutral, surprise, and happy are considered. Three affective models have been investigated. The experimental results demonstrate that the proposed feature combination in addition to data augmentation show enhanced affect recognition.

Analysis of Sentiment Based Movie Reviews Using Machine Learning Techniques [21]:

In this paper, the focus is on examining the sentiment expression and classification of a given movie review on a scale of negative and positive sentiments analysis for the IMDB movie review database. Due to the lack of grammatical structures to comments on movies, natural language processing (NLP) has been used to implement proposed model. Experiment is performed to compare the present study with existing learning models. At the outset, the described approach supplements the existing movie rating systems used across the web to an accuracy of 97.68%.

Impact of Cultural-Shift on Multimodal Sentiment Analysis [25]: Human communication is not limited to verbal speech and is infinitely more complex, involving many non-verbal cues such as facial emotions and body language. This paper aims to quantitatively show the impact of non-verbal cues, with primary focus on facial emotions, on the results of multi-modal sentiment analysis. We work with a dataset of Spanish video reviews. The audio is available as Spanish text and is translated to English while visual features are extracted from the videos. Multiple classification models are developed to analyze the sentiments at each modal stage: for the Spanish and English textual datasets as well as the datasets obtained upon coalescing the English and Spanish textual data with the corresponding visual cues. The results show that the analysis of Spanish textual features combined with the visual features outperforms its English counterpart with the difference in highest accuracy, thereby indicating an inherent correlation between the Spanish visual cues and Spanish text, which is lost upon translation to English text.

A Rule Based Approach for Aspect Extraction in Hindi Reviews [24]: Fast growth of technology and the tremendous growth of population has resulted in millions of people to be active participants on social networking forums. The experiences shared by the participants on various websites are highly useful not only to customers to make decisions but also help companies to maintain sustainability in businesses. Sentiment analysis is an automated process to analyze the public opinion behind certain topics. Identifying the targets of a user's opinion from text is referred to as an aspect extraction task, which is very crucial and important part of sentiment analysis. The system proposed in this paper is a rule-based approach to extract aspect terms from reviews. A sequence of

patterns is created based on the dependency relations between a target and its nearby words. The system of rules is evaluated on a benchmark dataset for Hindi. The results show significant improvement in extracting aspects over the baseline approach reported for the same dataset.

Legal Document Recommendation System: A Cluster Based Pairwise Similarity Computation [26]: Legal practitioners analyze relevant previous judgments to prepare favorable and advantageous arguments for an ongoing case. In legal domain, recommender systems (RS) effectively identify and recommend referentially and/or semantically relevant judgments. Due to the availability of enormous number of judgments, RS needs to compute pairwise similarity scores for all unique judgment pairs in advance, aiming to minimize the recommendation response time. This practice introduces the scalability issue as the number of pairs to be computed increases quadratically with the number of judgments. However, there is a limited number of pairs consisting of strong relevance among the judgments. Therefore, it is insignificant to compute similarities for pairs consisting of trivial relevance between judgments. To address the scalability issue, this research proposes a graph clustering based novel Legal Document Recommendation System (LDRS) that forms clusters of referentially similar judgments and within those clusters find semantically relevant judgments. Hence, pairwise similarity scores are computed for each cluster to restrict search space within-cluster only instead of the entire corpus. Thus, the proposed LDRS severely reduces the number of similarity computations that enable large numbers of judgments to be handled. It exploits a highly scalable Louvain approach to cluster judgment citation network, and Doc2Vec to capture the semantic relevance among judgments within a cluster. The efficacy and efficiency of the proposed LDRS are evaluated and analyzed using the large real-life judgments of the Supreme Court of India. The experimental results demonstrate the encouraging performance of proposed LDRS in terms of Accuracy, F1-Scores, MCC Scores, and computational complexity, which validates the applicability for scalable recommender systems.

Trust and Fuzzy Inference Based Cross Domain Serendipitous Item Recommendations (TFCD-SRS) [27]: Recommender System (RS) is an information filtering approach that helps the overburdened user with information in the decision making process and suggests items that might be of interest. While presenting recommendation to the user, accuracy of the presented list is always a concern for the researchers. However, the recent focus includes the unexpectedness and novel items on the list along with accuracy of the recommended items. To increase the user acceptance, it is important to provide potentially interesting items that are not obvious and are different from the items that the end user has rated. In this work, we have proposed a model that generates serendipitous item recommendation and also takes care of accuracy as well as the sparsity issues. Literature suggests that there are various components that help to achieve the objective of serendipitous recommendations. In this paper, fuzzy inference based approach is used for the serendipity computation because the definitions of the components overlap. Moreover, to improve the accuracy and sparsity issues in the recommendation process, cross domain and trust based approaches are incorporated. A prototype of the system is developed for the tourism domain and the performance is measured using mean absolute error (MAE), root mean square error (RMSE), unexpectedness, precision, recall, and F-measure.

Secure and Efficient WBANs Algorithm with Authentication Mechanism [28]: Due to the rapid growth in sensor technology and embedded technology, wireless body area network (WBAN) plays a vital role in monitoring the human body system and the surrounding environment. It supports many healthcare applications and are very much helpful in pandemic scenarios. WBANs may minimize human to human contact, which helps stop the spread of severe infectious diseases. The biggest concern is the maintenance of privacy and accuracy of data. It remains and active area of research due to nature of attacks that change and increase daily as well as for the sake of better performance. This paper proposes an algorithm that shows better results and needs comparatively fewer resources. The presented security framework offers authentication and the security of transmitted data, where only authentic entities may interact with the server, which has become obligatory for both sides, keeping data safe.

URLCam: Toolkit for Malicious URL Analysis and Modeling [29]: Web technology has become an indispensable part in human's life. However, cyberattacks are on the rise in today's modern Web-driven world. Therefore, effective countermeasures for the analysis and detection of malicious websites is crucial to combat the rising threats to the cyber world security. This paper systematically reviews the state-of-the-art

techniques and identifies approximately 230 features of malicious websites. They are classified as internal and external features. Furthermore, a toolkit is developed for the analysis and modeling of malicious websites. The toolkit has implemented several types of feature extraction methods and machine learning algorithms, which may be used to analyze and compare approaches to detect malicious URLs. The toolkit incorporates several other options such as feature selection and imbalanced learning with flexibility to be extended to include more functionality and generalization capabilities. Several use cases are demonstrated for different datasets.

New Results in Biclique Cryptanalysis of Full Round GIFT [30]: Security of a recently proposed bitwise block cipher GIFT is evaluated in this paper. Biclique cryptanalysis method is applied in order to mount full round attacks on the cipher. Both variants of the block cipher are attacked using Independent biclique approach. The proposed attack requires $2^{1}27.45$ full GIFT-64 encryption and 2^{8} chosen plain texts for recovering the secret keys of GIFT-64. For recovering the secret keys of GIFT-128, the proposed attack requires $2^{1}27.82$ full GIFT-128 encryption and $2^{1}8$ chosen plain texts. The attack complexity is compared with previously proposed attacks. The security level of GIFT is also compared with the parent block cipher PRESENT.

BAT Algorithm Based Feature Selection: Application in Credit Scoring [31]: Credit scoring plays a vital role for financial institutions to estimate the risk associated with a credit applicant. However, due to irrelevant features, the credit scoring models may lead to poorer classification performances and a higher complexity. In this work, the role of feature selection is emphasized to enhance the predictive performance of credit scoring model. Binary BAT optimization technique is utilized with a novel fitness function for feature selection. Furthermore, the proposed approach aggregates Radial-Basis Function Neural Network (RBFN), Support Vector Machine (SVM), and Random Forest (RF) for classification. The model is then validated on four benchmark credit scoring datasets from UCI repository. The results are reported for comparative performance analysis of various approaches.

A Robust and High Capacity Data Hiding Method for JPEG Compressed Images with SVD-Based Block Selection and Advanced Error Correcting Techniques [32]: In this paper, a frequency domain data hiding method is proposed for JPEG compressed images. This method embeds data in the DCT coefficients of the selected 8×8 blocks. According to the Human Visual Systems (HVS), human vision is less sensitive to perturbation of pixel values in the uneven areas of the image. This work proposes a Singular Value Decomposition based image roughness measure (SVD-IRM). We select the coarse 8×8 blocks as data embedding destinations. Moreover, to make the embedded data more robust against re-compression attack and error due to transmission over noisy channels, Turbo error correcting codes are employed. The data embedding is performed using a proposed variant of matrix encoding that is capable of embedding three bits by modifying only one bit in block of seven carrier features. Experiments validated the performance, the proposed method achieved better payload capacity and visual quality, and is more robust than some recent state-of-the-art methods reported in the literature.

Reversible Data Hiding in an Encrypted Image Using the Homomorphic Property of Elliptic Curve Cryptography [33]: Reversible Data Hiding (RDH) schemes have recently gained much interest in protecting the secret information and sensitive cover images. For cloud security applications, the third party's data embedding can be performed (cloud service). In such a scenario, to protect the cover image from unauthorized access, it is essential to encrypt the image before embedding it. This can be archived by combining the RDH scheme with encryption. However, the key challenge in integrating RDH with encryption is that the correlation between adjacent pixels begins to disappear after encryption and reversibility cannot be accomplished. In this paper, RDH with elliptic curve cryptography (ECC-RDH) is proposed to overcome this challenge. By adopting additive homomorphism property, the stego image decryption gives the sum of the original image and confidential data. The significant advantages of the proposed method are: the cover image is transferred with high security and the embedding capacity is 0.5 bpp (bit per pixel) with a smaller location map size of 0.05 bpp. The recovered image and secrets are the same as in the original thus proving the 100% reversibility.

ExypnoSteganos - A Smarter Approach to Steganography [34]: With the ever-rising threat to security, multiple industries are in search of safer communication techniques. Multiple security institutions agree that any systems security may be modeled around three major concepts: confidentiality, availability, and integrity. This work attempts to reduce the deficiencies in these concepts by developing a Deep

Learning based Steganography technique. It shows that it is possible to compress and encode data efficiently to solve critical problems of steganography. The deep learning technique, which comprises an auto-encoder with a Convolutional Neural Network (CNN) as its building blocks, not only compresses the secret file but also learns how to efficiently hide the compressed data in the cover file. The proposed techniques may encode secret files, theoretically of any type, of the same size as the cover. In some sporadic cases, even larger files can be encoded.

A Novel Statistical Approach to Predict Road Accidents in the State of Haryana Using Fuzzy-Analytical Hierarchy Process [35]: Road accidents cause social and financial burden to any nation or society and are one of the most dominating problems that need to be resolved. Road accidents are not reducing despite the efforts of multiple road safety agencies and stakeholders to solve this issue by proper planning, designing, analysis, and management. This paper introduces a multi-dimensional novel approach called Fuzzy-Analytical Hierarchy Process (F-AHP) to assign the priorities to the factors responsible for the occurrence of road crashes in the state of Haryana. The primary advantage of using the F-AHP technique is that it includes a predetermined goal, criteria for making decisions, and different alternatives as a complete structure leading to more accurate and reliable results. The data of road accidents in the state are collected through the Right-to-Information (RTI) Act and government reports of the state of Haryana. The implementation of statistical analysis and frequency of effective factors in this Multi-Criteria Decision Making (MCDM) approach improved the accuracy and safety performance of the model on a micro-level. The results indicated that this methodology could be used and implemented for planning and developing phase of roads in any state with a similar accident scenario.

Cost-Enabled QoS Aware Task Scheduling in the Cloud Management System [36]: Maintaining the quality of service (QoS) parameters is an important issue in cloud management systems. The lack of such QoS parameters discourages users from using the services of cloud service providers. Existing task scheduling algorithms consider QoS parameters such as the latency, make-span, and load balancing to satisfy the user requirements. These parameters cannot sufficiently guarantee the desired user experience or that a task will be completed within a predetermined time. Therefore, this study presents a cost-enabled QoS-aware task (job) scheduling algorithm to enhance user satisfaction and maximize the profit of commercial cloud providers. The proposed scheduling algorithm estimates the cost-enabled QoS metrics of the virtual resources available from the unified resource layer in real time. Moreover, the virtual machine (VM) manager frequently updates the current state-of-the art information about resources in the proposed scheduler to make appropriate decisions. The proposed approach guarantees profit for cloud providers in addition to providing QoS parameters such as make-span, cloud utilization, and cloud utility, as demonstrated through a comparison with existing time-based and cost-based task scheduling algorithms.

Cloud Service Negotiation Framework for Real-Time E-Commerce Application Using Game Theory Decision System [37]: Developing a Service Level Agreement (SLA) based negotiation framework in the cloud is of a major demand. To provide personalized service access to consumers, a novel Automated Dynamic SLA Negotiation Framework (ADSLANF) is proposed using a dynamic SLA concept to negotiate service terms and conditions. The existing frameworks exploit a direct negotiation mechanism where the provider and consumer can directly talk to each other, which may not be applicable in the future due to increasing demand on broker-based models. The proposed ADSLANF will take shorter total negotiation time due to complicated negotiation mechanisms using a third-party broker agent. Furthermore, a novel game theory decision system will suggest an optimal solution to the negotiating agent at the time of generating a proposal or counter proposal. This optimal suggestion will make the negotiating party aware of the optimal acceptance range of the proposal and avoid the negotiation break off by quickly reaching an agreement.

User-Centric Framework to Facilitate Trust Worthy Cloud Service Provider Selection Based on Fuzzy Inference System [38]: The widespread adoption of cloud computing by several companies across diverse verticals of different sizes has led to an exponential growth of Cloud Service Providers (CSP). Multiple CSPs offer homogeneous services with a vast array of options and different pricing policies, making the suitable service selection process complex. Our proposed model simplifies the IaaS selection process that can be used by all users including clients from non-IT background. The reach of the proposed framework amidst novice users allows to express their requirement in natural language format consolidated through well designed queries along with

options. These options are mapped with the relevant service types offered by multiple competent service providers. It exhaustively explores all options and enlist them with the best possible ranking along with incurred cost. Hence, an amateur client may exercise best possible provider with an appealing cloud instance to suit to immense audience. This framework is validated on a mutli-player online gaming application use case.It has outperformed the online tools thus making it an exemplary model.

Hybrid Online Model Based Multi Seasonal Decompose for Short-Term Electricity Load Forecasting Using ARIMA and Online RNN [39]: In this study, a hybrid online model is proposed that combines Online AutoRegressive Integrated Moving Average (Online ARIMA), Online Recurrent Neural Network (Online RNN), and multi-seasonal decomposition to forecast real-time time series with multiple seasonal patterns. The original time series is first decomposed into three components: trend, seasonality, and residual. The seasonal patterns are modeled using Fourier series, which is a flexible method allowing multiple periods to be incorporated. For trend and residual components, Online ARIMA and Online RNN are employed for predictions. Hourly load data of Vietnam and daily load data of Australia are used as case studies to verify the proposed model.

Neuro-Fuzzy Based Estimation of Rotor Flux for Electric Vehicle Operating Under Partial Loading [40]: The primary objective of this work is to optimize the induction motor rotor flux so that maximum efficiency is attained in the facets of parameter and load variations. The conventional approaches based on loss model are sensitive to modelling accuracy and parameter variations. The problem is further aggravated due to nonlinear motor parameters in different speed regions. Therefore, this work introduces an adaptive neuro-fuzzy inference system-based rotor flux estimator for electric vehicle. The proposed estimator is an amalgamation of fuzzy inference system and artificial neural network where fuzzy inference system is designed using artificial neural network. The training data for neuro-fuzzy estimator is generated offline by acquiring rotor flux for different values of torque. The conventional fuzzy logic and various calculation methods are also developed for comparative analysis. The efficacy of developed system is established by analysing it under varying load conditions. The results reveal that suggested methodology provides an improved efficiency: 94.51% in comparison to 82.68% for constant flux operation.

Real-Time Day Ahead Energy Management for Smart Home Using Machine Learning Algorithm [41]: The recent adoption of smart meters makes it easier to access electricity readings with precise resolutions. This source of available data can, therefore, be used to build predictive models. In this study, Prophet Forecasting Model (PFM) is proposed for the application of forecasting day-ahead power consumption in association with the real-time power consumption time series dataset of a single house connected with a smart grid near Paris, France. The PFM is a special type of Generalized Additive Model. The time series power consumption dataset has three components: trend, seasonal, and holidays. Trend component is modeled by a saturating growth model and a piecewise linear model. Multi-seasonal periods and holidays are modeled with Fourier series. The Power consumption is forecasted using Autoregressive Integrated Moving Average (ARIMA), Long Short Term Neural Memory Network (LSTM), and PFM. The comparative results show that the PFM outperforms the other two models in prediction. The LSTM is next with smaller error.

Task Aware Optimized Energy Cost and Carbon Emission Based Virtual Machine Placement in Sustainable Data Centers [42]: Management of IT services is rapidly adapting to the cloud computing environment due to optimized service delivery models. Geo-distributed cloud data centers act as a backbone for providing fundamental infrastructure for the delivery of cloud services. Conversely, their high growing energy consumption rate is a major problem to be addressed. In this work, a multi-cloud environment is modeled as geographically distributed data centers with varying solar power generation corresponding to its location, electricity price, carbon emission, and carbon tax. The energy management of the workload allocation algorithm is strongly dependent on the nature of the application considered. The task deadline and brownout information is used include variation in task types. The renewable energy-aware workload allocation algorithm adaptive to task nature is proposed with migration policy to explore its impact on carbon emission, total energy cost, and brown and renewable power consumption.

Redox Reaction on Homomorphism of Fuzzy Hyperlattice Ordered Group [43]: This paper introduces the concept of homomorphism on fuzzy hyperlattice ordered group (FHLOG). It considers how the binary and the fuzzy hyperoperations of a FHLOG can be transformed into the binary and the fuzzy hyperoperations of another FHLOG. The

notion of fuzzy hypercongruence relation on FHLOG is also defined. The paper also establishes the redox reaction of three different metals (copper, gold, and americium). Furthermore, homomorphism and composition function of FHLOGs using the redox reactions are developed.

An Intelligent System to Identify Coal Maceral Groups Using Markov-Fuzzy Clustering Approach [44]: Coal is the mixture of organic matters (called as macerals) and inorganic matters. Macerals are categorized into three major groups: vitrinite, inertinite, and liptinite. The maceral group identification serves an important role in coking and non-coking coal processes that are used mainly in steel and iron industries. Hence, it becomes important to efficiently characterize these maceral groups. Currently, industries use the optical polarized microscope to distinguish the maceral groups. However, the microscopical analysis is a manual method, which is time-consuming and provides subjective outcome due to human interference. Therefore, an automated approach that can identify the maceral groups accurately in less processing time is strongly needed in industries. Computer-based image analysis methods are revolutionizing the industries because of its accuracy and efficacy. In this study, an intelligent maceral group identification system is proposed using Markov-fuzzy clustering approach. This approach is an integration of fuzzy sets and the Markov random field, which is employed for maceral group identification in a clustering framework. The proposed model shows better results when compared with the standard cluster-based segmentation techniques. The results from the proposed model have been validated against the outcome of manual methods The feasibility is tested using performance metrics.

Operations on Complex Intuitionistic Fuzzy Soft Lattice Ordered Group and CIFS-COPRAS Method for Equipment Selection Process [45]: This paper introduces new operations on complex intuitionistic fuzzy lattice ordered groups such as sum, product, bounded product, bounded difference, and disjoint sum, verifying its pertinent properties. The research exhibits the CIFS-COPRAS algorithm in a complex intuitionistic fuzzy soft set environment. Furthermore, the proposed method was applied for the equipment selection process.

A Metaphor-Less Based AI Technique for Optimal Deployment of DG and DSTATCOM Considering Reconfiguration in the RDS for Techno-Economic Benefits [46]: The advent of distributed energy resources is undoubtedly transforming the nature of the electric power system. The crisis of conventional energy sources and their environmental effects resulted in the integration of Distributed Generators (DGs) into the distribution system. Simultaneous application of optimum network reconfiguration, DGs, and Distribution Static Compensator (DSTATCOM) unit's placement in the Radial Distribution Systems (RDS) comes with a raft of technical, economic, and environmental benefits. Benefits include improved power quality, reliability, stability, mitigation of power losses, and voltage profile improvement. In this paper, the combinational process of optimal deployment of DGs and DSTATCOM units in RDS with suitable network reconfiguration to achieve positive benefits has been analyzed. A recent metaphor-less based artificial intelligence (AI) technique named the Rao-1 method is employed to overcome this combinational nonlinear optimization problem. The objective functions are to mitigate the power losses, enhance the voltage profile, and voltage stability index of the RDS considering the net economic cost-benefit to the distribution utility. The simulation study of this pragmatic approach problem is carried out on IEEE 33-bus RDS. The comparison of the results obtained by the Rao-1 method with other existing meta-heuristic optimization methods has been performed to show its efficacy.

Data Reconciliation Using MA-PCA and EWMA-PCA for Large Dimensional Data [47]: In process industries, measurements usually contain errors due to the improper instrumental variation, physical leakages in process streams and nodes, and inaccurate recording/reporting. Thus, these measurements violate the laws of conservation and do not conform to process constraints. Data reconciliation (DR) is used to resolve the difference between measurements and constraints. DR is also used in reducing the effect of random errors and more accurate estimation of the true values. Principal Component Analysis (PCA) is a multivariate technique used to obtain estimates of true values while preserving the most significant inherent variation. PCA is used to reduce the dimensionality of the data with minimum information loss. To improve the performance of DR and obtain more accurate and consistent data, two new DR techniques are proposed in this paper: moving average PCA (MA-PCA) and exponentially weighted moving average PCA (EWMA-PCA). These DR techniques are compared based on RMSE. Furthermore, they are analyzed for different values of sample size, weighting factor, and variances.

StimulEye: An Intelligent Tool for Feature Extraction and Event Detection from Raw Eye Gaze Data [48]: In this paper, the authors propose an intelligent tool called StimulEye that helps to detect and classify eye gaze events and analyze various metrics related to these events. The algorithms for eye event detection in use today heavily depend on hand-crafted signal features and thresholding, which are computed from the stream of raw gaze data. These algorithms leave most of their parametric decisions to the end user, which might result in ambiguity and inaccuracy. StimulEye uses deep learning techniques to automate eye gaze event detection. It neither requires manual decision making nor parametric definitions. StimulEye provides an end-to-end solution that takes raw streams of data from an eye tracker in text form and analyzes them to classify the inputs into the events (saccades, fixations, and blinks). It provides the user with insights such as scanpath, fixation duration, and radii.

QALO-MOR: Improved Antlion Optimizer Based on Quantum Information Theory for Model Order Reduction [49]: Metaheuristics-based algorithms inspired by nature or physical phenomena have provided near-ideal (optimal) solutions to several complex real-world problems. Ant lion Optimization (ALO) has been inspired by the hunting behavior of antlions searching for food. In spite of a unique idea, it has some limitations such as a slow rate of convergence and sometimes local solutions (optima). Therefore, to enhance the performance of a classical ALO, quantum information theory is hybridized with classical ALO (QALO), which may overcome the limitations of basic ALO and also produce stability between processes of explorations followed by exploitation. In the experimental work, the CEC2017 benchmark set is adopted to estimate the performance of QALO compared with state-of-the-art algorithms. Moreover, QALO is extended further to solve the model order reduction (MOR) problem with preferably better performance than other compared techniques.

FEM Simulation of Palladium Thin Film Coated Surface Acoustic Wave Hydrogen Sensor for High Frequency Applications [50]: A higher operating frequency is desirable for Surface Acoustic Wave (SAW) based sensors as they become more sensitive at high frequencies. The acoustic wave becomes more confined near the surface at high frequencies and becomes more sensitive to the external stimulations. This makes SAW devices a suitable device for sensing gaseous state chemicals. SAW devices have become the basic building block of wireless sensor networks with its advantages enabling remote sensing. In this paper, a SAW based hydrogen sensor is realized through the Finite Element Analysis tool ANSYS. Even though has a significant role in many industries, hydrogen's explosive nature demands constant monitoring. SAW delay line made up of XY-LiNbO3 as substrate with a thin layer of palladium coated along the delay length as the sensing element is modeled. Palladium with its high affinity for hydrogen absorbs the same and undergoes changes in properties such as density and stiffness. This disturbs the surface wave propagation and, in turn, affects the operating frequency, which is the sensor response parameter. The frequency shift of 1.91 MHz for hydrogen concentration of 0.3 a.f. is compared to 0.49 MHz with YZ-LiNbO3. The operating frequency also shifts to a higher range as the acoustic velocity of the substrate increases.

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