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Guest Editorial

Intelligent, smart and scalable cyber-physical systems

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The integration of human physical processes with the computation has created a new paradigm called Cyber-Physical Systems (CPS). The CPSs control the physical processes by utilizing the computational intelligence to acquire the deep knowledge of the monitored environment. Hence the CPSs are designed to be intelligent to provide highly accurate decisions and appropriate actions promptly. The rapidly growing interconnections between the virtual and physical worlds and the development of new intelligent techniques have created new opportunities for the research for next-generation CPS, that is intelligent cyber-physical systems (iCPS). The iCPS are large-scale software intensive and pervasive systems, which by combining various data sources (both from physical objects and virtual components) and applying intelligence techniques, can efficiently manage real-world processes and offers a broad range of novel applications and services. By equipping physical objects with interfaces to the virtual world, and incorporating intelligent mechanisms to leverage collaboration between these objects, the boundaries between the physical and virtual worlds become blurred. Interactions occurring in the physical world are capable of changing the processinga behavior in the virtual world, in a causal relationship that can be exploited for the constant improvement of processes. Intelligent, self-aware, self-managing and self-configuring pervasive systems can be built to improve quality of process across a variety of application domains, helping to address a number of contemporary social and environmental issues.

Components of an iCPS must have a high degree of autonomy while cooperating with each other in a robust, scalable and decentralized way. However, several challenges need to be overcome in order to realize such a paradigm, which is highly multidisciplinary. These challenges range from the design of intelligent physical infrastructures for sensing and communication, data stream processing, data analytics and machine learning techniques to build the intelligence core of these systems through the development of self-adaptive and context-aware software. Moreover, safety, social and behavioral issues also need to be considering, when including human beings as an integral part of these highly complex systems. As CPSs hold strong interactions between the cyber and physical components, it plays a significant role in the development of next-generation efficient-smart systems in various real-time applications. Due to the highly complex intertwining among different components, CPS poses fundamental challenges in multiple aspects, such as real-time data processing, efficient parallel computing, data sensing and collection, and distributed computing. The above-mentioned challenges require innovative technologies to meet the

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growing demands in the smart homes, connected vehicles, and smart energy systems. In this regard, the research on the merging and communication between centric systems and information-centric systems in the CPS perspective is deemed to be extremely promising.

This Special Issue aims to bring together researchers to publish state-of-art research findings in Smart Cyber-Physical Systems paradigm, focusing on both theoretical and applied techniques. We expect the papers of the special issue to serve as valuable references for a large audience from both academia and industry. After a stringent peer-review process, this special issue features fifty selected papers with high quality. In [1], the authors proposed a novel probability-based haptics model, which includes two parts: a force prediction model to obtain the most possible contact force according to the indentation depth, and a probabilistic model based on Gaussian distribution to describe the force uncertainty. Experiment results reveal that the contact force varying with the indentation depth presents the characteristics of non-linearity, dispersion, and individual difference. Model testing results confirm the effectiveness of the haptics model on force prediction and force uncertainty description. In [2], an energy efficient e-healthcare framework using HWPSO-based clustering approach is presented. In addition to development of new hybrid whale-PSO algorithm, a novel fitness function with a set of relevant criteria of edge devices such as energy factor, average intra-cluster distance, average distance to cluster leader over data analytics center, average sleeping time, and computational load has been taken into account in the selection of cluster leader. In [3], authors focus on the key subtask in sentiment analysis: aspect-based sentiment analysis. Unlike feature-based traditional approaches and long short-term memory network based models, this research work combines the strengths of linguistic resources and gating mechanism to propose an effective convolutional neural network based model for aspect-based sentiment analysis.

In [4], an information entropy based event detection framework is proposed to identify the event and its location by clustering relatively high-density ratio of tweets using Twitter data. The Shannon entropy of target users, location, time intervals and hashtags are estimated to quantify the dissemination of events as "how-far about" in real- world using entropy maximization inference model. The experimental outcome determines the scope and significant dissemination direction of finding events from a new perspective which demonstrates 96% of improved event detection accuracy. In [5], authors propose a novel filter-based feature selection approach for the identification of informative features based on Rough Set Theory and Hyper-clique based Binary Whale Optimization Algorithm (RST-HCBWoA). Experiments were carried out by Power system attack dataset and the performance of RST-HCBWoA was evaluated in terms of reduct size, precision, recall, classification accuracy, and time complexity. In [6], authors present a intrusion detection system that identifies anomalies which are deviated from process-invariants in secured water treatment (SWaT) test-bed data obtained from Singapore University of Technology and Design (SUTD). Additionally, the research proposes process-invariants based timed automata wherein the attack and its detection model are represented as timed automata. The proposed system is implemented and validated using UPPAAL, a tool for validating real-time systems represented as networks of timed automata. The results conclude that the proposed system effectively identifies the attacks considered thereby recommending the timed automata as an operational tool for detecting the data-integrity attacks in critical infrastructures. In [7], contrast to conventional preprocessing aided spatial modulation (PSM), which carries partial information using the indexes of receive antennas, authors exploit one receive antenna to implicitly convey information and meanwhile harvest energy at the remaining antennas and propose two novel beamforming schemes. The first scheme is to maximize the sum energy harvested by the receiver. And the second scheme is to maximize the minimum receiving power on each antenna except for the antenna that conveys information.

In [8], authors attempt to develop a system to automate the feature extraction from fundus images and with the extracted features, eye diseases are predicted. This research presents a novel classification methodology that helps the experts and clinicians to classify Diabetic Retinopathy, Glaucoma and healthy eye images with more accuracy. It is inferred from the results that proposed method of classification using BoVW provided a maximum accuracy of 92% when compared to other state-of-the-art recent literature. In [9], a new model is presented considering a powerful spam filtering technique which includes both social network and email factors in addition to the email data analysis for spam classification. The incoming emails are subjected to header parsing for finding the trust and reputation of senders

with respect to the receivers and keyword parsing is applied to find the topic of interest using LDA with Gibbs Sampling method. Optical Character Recognition (OCR) method is applied to find the image spam e-mails. The experimental results and comparisons with the existing models vividly show the significant performance of the proposed classifier. In [10], design and empirical validation of machine learning based electric energy consumption forecasting systems, is presented. Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU) and Extreme Learning Machines (ELM) based models are designed and evaluated. One of the major aspects of the work is that the proposed consumption forecasting systems are designed as generalized models, i.e. one single model can be used to generate forecasts for any of the consumers considered, as opposed to the conventional technique of generating a separate model for each consumer. The forecasting systems are designed to generate half-hour-ahead and two-hour-ahead electric energy consumption forecasts. The proposed systems are validated on data for 485 Small and Medium Enterprise (SME) consumers in the CER electric energy consumption dataset. Results indicate that the models proposed in the present study result in good consumption forecast accuracy are hence, well suited for generating electric energy consumption forecast models. In [11], authors propose a recommendation model based on the Trust Relations (TR) and User Credibility (UC) because it is human nature that a person feels more comfortable when he gets a review from a person he knows on a first name basis. Also, the credibility of the reviewer is an important factor while providing importance to the reviews because every person is different from other and can have different expertise. The developed model takes into account the effect of credibility which is not used by any other recommendations models which increases the precision of the results of the new model.

In [12], a new system developed as a fuzzy ontology-based recommender system using Type-2 fuzzy logic to recommend foods and drugs for chronic (diabetic) patient. Extraction of risk factors for chronic patients is achieved via wearable sensors and IoT-based electronic medical records are linked with linked open data (LOD) to create a knowledge base. Since, patient data sets are huge; cloud services are used to store and retrieve data for further analysis. An experiment is conducted on patient datasets and the results illustrate that the proposed work is efficient for patient data enrichment, risk factor extraction and appropriate medical advice for chronic patients. In [13], a quickest, critical and energy efficient routing for the CPS based healthcare system is proposed. Simulations performed to convey the appropriateness of the quality of data transmission system according to the well-defined Service Level Agreement (SLA) formulation. Proposed energy and SLA cooperation in data transmission is beneficial for the tele-operated medical service. A medical practitioner is able to monitor a patient in real-time with the help of proposed dependable and energy efficient data transmission. The results shows that CPS with consideration of different constraints such as energy and SLAs have a severe effect on its performance parameters such as mean number of QSS s-t paths, average hop counts and average energy efficiency. In [14], a new technique is proposed to construct an extremely secure and efficient template for a user, by securing all features of the finger-print used for template generation. The proposed technique is robust against the effects of rotation as well as translation and meets the essential requirements of an efficient authentication systemThe proposed technique is evaluated by utilizing FVC2000, FVC2002, FVC2004, and IIT Kanpur fingerprint databases. The results obtained for the proposed technique are highly encouraging, and portrays its robustness.

In [15], a hybrid approach that employs Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) is used to determine the optimal solution for scheduling offloadable and non-offloadable components in an application, with the intent of significantly reducing the execution time of an application and energy consumption of the smart devices. With a new inertial weight equation, an Adaptive Genetic Algorithm – Particle Swarm Optimization (AGA-PSO) algorithm is proposed which uses GA's ability in exploration and PSO's ability in exploitation to make the offloading optimized without violating the deadline constraint of an application. In [16], a soft computing fuzzy technique is employed to maximize the efficiency from solar panel to give maximum power output. The various applications in power systems relating to energy storage system performance for energy management, controller for controlling the load-frequency in multi-area power system and for solar systems by considering the tracking efficiency which are utilized for synchronization into the grid. The fuzzy logic provides better improvement and efficiency when compared to conventional controllers. In [17], to accurately assess the threat of air multi-target in the complicated and changeable air

combat environment, an assessment method based on improved group generalized intuitionistic fuzzy soft set (I-GGIFSS) is proposed. Considering the characteristics of air target and the influence factors of threat assessment, a reasonable threat assessment system is established, and the appropriate assessment index is determined. The generalized parameter matrix provided by many experts is introduced into the generalized intuitionistic fuzzy soft set (GIFSS) to form the group generalized intuitionistic fuzzy soft set (GGIFSS) to compensate for the knowledge limitation and assessment error of a single expert in traditional GIFSS. In [18], an intelligent cultural space through the development of proximity detection method and the deployment of smart sense bricks is presented. The presented intelligent cultural space is supported by the CHXplorer-Information Management System to present multimedia content to the users through CHXplorer mobile decision-support tool. The CHXplorer is designed to enhance the satisfaction and enjoyment of the user visiting the cultural heritage sites, and it is capable of generating personalized recommendations to the active target user. The effectiveness and efficiency of the presented CHXplorer are experimentally evaluated and user study made establishes the users' positive feedback on the system.

In [19], proposed a method that identifies the junction of Left Atrium (LA) and Left Ventricle (LV) using neural networks. The features used for this purpose are based on shape, size and position. Then it uses traditional methods to track and stack the upper and lower slices based on neighborhood. I.e. a 3D model of the segmented LA and LV is reconstructed from the 2D format. This enhanced 3D image model helps in deducing quality information for the diagnosis of various heart diseases. The proposed algorithm shows acceptable performances for all planes of LV and LA. The proposed method have achieved 91.57% mean segmentation accuracy. The proposed algorithm is not effected by the thickness of the slices. It is simple and computationally less intensive than existing algorithms. In [20], a DC non-isolated converter model with high static voltage gain module is presented and the proposed converter has the feature of stable frequency and stable output voltage. It also achieves high voltage conversion, high efficiency, low voltage stress and less switching loss. The voltage tripler technique is implemented in the proposed model. In [21], a knowledge-driven reasoning is presented for inferring an initial activity model. The model is then trained using data-driven techniques to produce a dynamic activity model that learns users' varying action. This approach has been evaluated using a publicly available dataset and the experimental results show the learned activity model yields significantly higher recognition rates compared to the initial activity model. In [22], fuzzy-based group recommendation system is proposed and argues that communicating hesitation information will prove beneficial to generating recommendations. The proposed novel Parallel Computing Group Recommendation System, quantifies different approaches, chooses the right approach for group recommendation, and quickly generates optimal results. This proposed approach is an ensemble model of parallel ranking and matrix factorization that facilitates a diversified group recommendation list. Experimental evaluation signals that developed model achieves higher diversity positively packed with user satisfaction.

In [23], a new sparse fuzzy rule base generation method to support FRI is proposed. In particular, this approach uses curvature values to identify important rules that cannot be accurately approximated by their neighbouring ones for initialising a compact rule base. The initialised rule base is then optimised using an optimisation algorithm by fine-tuning the membership functions of the involved fuzzy sets. Experiments with a simulation model and a real-world application demonstrate the working principle and the actual performance of the proposed system, with results comparable to the traditional methods using rule bases with more rules. In [24], two secure models for sealed-bid spectrum auction are given based on Wang's generic spectrum auction mechanism. One is the basic model and another improved model based on the basic model is proposed, which maximizes Social welfare while it is a Privacy-preserving Spectrum auction mechanism with public Verification namely SPSV. The SPSV scheme achieves the properties of maximizing the social welfare but also, by using the double paillier cryptosystem, it is privacy-preserving for bidders' bids without revealing any sensitive information to auctioneer or agent during the entire spectrum auction. In [25], a new methodology for segmenting the brain tumor from the affected brain image in a significantly efficient way by using deep learning method is proposed. The neural network based deep learning architecture called DeepSegNet is designed for segmenting the CT image in semi-automated or fully automated manner for segmenting the brain tumor in significantly positive results. In [26], the

simplex search based global optimization method called a hybrid grey wolf optimization (GWO) for solving amplifiers circuit sizing problems. Simplex and GWO techniques were combined to improve the local search capabilities of the optimization method. CMOS 180 nm technology was utilized to finding the circuit performance using proposed optimization approach. Simulation result shows that the proposed method provides the better result for circuit performance parameters such as DC gain, phase margin, unity gain bandwidth and power dissipation.

In [27], shunt active power filter with fuzzy logic based control strategy is introduced to minimize the harmonics present in the system. The proposed topology is validated through dynamic simulation using the MATLAB/Simulink Power System Toolbox. Simulation results demonstrate that the proposed system injects power into the grid from hybrid system with harmonic mitigation. In [28], a new trust evaluating model is built upon Bayesian updating of the trust evaluation with each transaction, and identification and correction of purposefully misleading evaluations according to improved evidence theory. Simulations show that the algorithm's trust value increases slowly with successful transactions, but drops rapidly with a failed transaction, capturing the notion that trust is hard to establish, yet easy to destroy. Further simulations demonstrate the model has good robustness and error tolerance of trust evaluation against false recommendations at varying levels of deception. In [29], RIWT and QR Factorization Based Hybrid Robust Image Steganography Using Block Selection Algorithm for IoT devices is presented. A new methodology that captures an image using IoT sensors, which are subjected to lighter cryptographic operations for conversion into a cipher image, and is then sent to a home server. At the home server, a combined cryptography and steganography approach is employed to conceal the cipher image in a cover image, camouflaging the presence of the secret image, which is then sent to the IoT-Cloud server for storage. The experimental results indicate enhanced performance of the proposed scheme in terms of imperceptibility, robustness, and resistance to steganalysis attacks. In [30], a new image fusion algorithm for CPS is introduced. Compared with traditional multi-scale and multi-direction decomposition based algorithms, a more efficient MSMD based algorithm is proposed. The presented method is experimentally evaluated to show the best effects and the algorithm has better stability over state-of-art approaches.

In [31], Energy Aware Methodical Data Forwarding (EAMDF) Mechanism in Vehicular Ad hoc Networks is proposed. Information about the node is collected which is situated at the edge of radio range of the sender node and then the packet is transmitted by using the trustworthy greedy position based routing approach through that node. The key aspect of EAMDF mechanism is to prolong the energy of the nodes as well as increasing the packet delivery ratio. The results show that the through put is increased by 50%, packet delivery ratio is increased by 12.5% and also energy is prolonged in the network lifetime compared to other algorithms. In [32], authors present EXES as an experience based scheduling algorithm where SDN controller instructs zones to assign priority to various sites depending on number and length of tasks that were issued by those sites to that zone. EXES minimizes average waiting time of each batch conforming to the budget limit. Different weights are assigned to cost and weighting time, depending on the available budget. Binary search based computation of efficient waiting factors balance these two criteria. Simulation results show that EXES performs much better than its competitors. In [33], a new evolutionary approach for reconfiguration of radial systems is presented. The framework applied for optimization is Symbiotic Organism Search Algorithm (SOSA) and the algorithm is impressed by the interactive behavior opted by the living organisms for surviving and to propagate in the ecosystem. The presented approach is examined on 16-bus and 33-bus systems and the results show a significant reduction of real power loss. Based on the results calculated with distribution load flow algorithm the SOSA gives better results in terms of real power loss reduction and it is best suitable for digital automation systems. In [34], a three-phase scheduling method based on memory, energy and QOS in order to yield low energy consumption, maximum storage and the high level Quality of Service (QoS) is presented. Biggest Memory First and Biggest Access First is introduced with NUMA scheduler and cache scheduler for memory scheduling and the optimal VM resulting from the three phases of scheduling is determined by Grey Wolf Optimization (GWO) algorithm. To carry the security level of optimized VMs, Streamline Security and Introspection security analysis are exhausted for detecting the malware VMs. The proposed methodology is implemented using the Cloud Sim tool and the experimental result shows the efficiency of the proposed method in terms of security, time consumption, and cost.

In [35], Water Shower Model (WSM) with Circular Peak Time Services (CPTS) is proposed and the proposed model has reduced the execution time to 10ms comparing with Round Robin Algorithm. The load is shared among the data centers by predicting the type of request by the user as Read Only Request (ROR) or Read Write Request (RWR). The ROR will assign the load to an optimized Container and the RWR will assign the load to a Virtual Machine. The advantage of existing Dynamic Voltage Frequency Scaling (DVFS) techniques is used in the proposed model to optimize the resource allotment and adjust the power and speed in computing devices which allocates only the required minimal amount of power for performing a task. In [36], to enhance the performance of Collaborative Filtering Recommender System, swarm intelligence based clustering ensemble model is proposed. Four different swarm intelligent based cluster optimization algorithms were utilized to generate finite clusters. The experiment is conducted on two real-time social network dataset to exhibit the performance of the proposed CE-CFRS. The result shows that the clustering ensemble model outperforms a single clustering model in terms of assessment metrics. In [37], a system to identify occurrence of SARS at initial stage is presented. In the proposed system, resemblance factor is evaluated from the extracted keywords. In order to identify the difference between SARS affected and others, the proposed scheme fetches the inputs from user's displayed in the form of text. It is passed to deep recurrent neural network (RNN) model. It extracts useful information from the raw information given by the user. The J48graft algorithm is used to carry the classification based on the type of infection and symptoms of each user. The final experimental outcome reveals the performance of proposed system in terms of Success rate, failure rate, latency and accuracy. The proposed algorithm provides high level of accuracy when it is compared with other primitive methods.

In [38], a Spread Binary Artificial Fish swarm algorithm combined with a Double-fault measure for Ensemble Pruning (SBAFDEP) using a combination of diversity measures and heuristic algorithms is proposed. The classifiers in an initial pool are pre-pruned using a double-fault measure, which significantly alleviates the computational complexity of ensemble pruning. Then, the final ensemble is efficiently assembled from the retaining classifiers after pre-pruning using the proposed Spread Binary Artificial Fish Swarm Algorithm (SBAFSA). Simulation and experiment results on 25 UCI datasets show that SBAFDEP performs better than other state-of-the-art pruning approaches. The research provides a novel research idea for ensemble pruning. In [39], a system based on acoustic resonance spectroscopy for data acquisition using a V-shaped quartz tube and spectral classification of materials is presented. The results show that the classification accuracy of LDA over ARS datum for 3 samples is better than Naive Bayes. The overall classification accuracy of the system over an ARS datum range from 94–100% and the results concluded that the developed system coupled with fast signal processing system has shown a significant potential in classifying the different samples taken during the experiments. In [40], a context-aware system that considers the vehicle, driver and the environment for driver behavior classification as a safe or fatigue or unsafe driver using a Dynamic Bayesian Network (DBN) is proposed. The real-time data for DBN learning and testing has been collected on Chandigarh-Patiala National Highway, India using an Android smartphone. The proposed system yields an overall classification accuracy of 80–83%.

In [41], the problem of multiple robots moving towards individual goals within a common workspace without colliding amongst themselves is investigated. Two solutions for coordination namely Fuzzy Logic Controller (FLC) and Genetic Algorithm based FLC (GA-FLC) have been employed and the efficacy of cooperation strategies have been compared with their non-cooperative counterparts as well as with the fundamental potential field method (PFM). Proposed coordination schemes are verified through simulations with 100 scenarios. The obtained results show the efficacy of the proposed schemes over existing approaches. In [42], a trade-off analysis of several architectures using an FPGA-based design that implements ANNs (FPGA-ANN) for outdoor obstacle detection, focused in road safety is presented. The analyzed FPGA-ANN architectures merge outdoor data gathered by a Kinect sensor, images and infrared data, to construct an outdoor environment model for object detection, which allows to detect if there is an obstacle in the near surroundings of a vehicle. In [43], to aid secured key generation in this context, an optimized secret key generation based on Chebyshev polynomial with Adaptive Firefly (FF) optimization technique is proposed. The optimized key is utilized with process of shuffling, diffusion, and swapping to get a better encrypted image. At the receiver end, reverse process is applied with optimized key to retrieve the original input image. The

efficiency of the proposed method is assessed by the exhaustive experimental study. The results show that the proposed methodology provided correlation coefficient of 0.21, Number of Pixels Change Rate (NPCR) of 0.996, Unified Average Changing Intensity (UACI) of 0.3346 and Information Entropy of 7.995 as compared with the existing methods. In [44], loss of energy in a cognitive radio system and to check loss in packets the Markov Chain process is proposed. The performance results show that proposed algorithm is performs better than other existing algorithms when compared in terms of throughput which is improved by 0.42 Kbytes/sec, total encryption and decryption time which is identified decreased with existing system and thus providing a better time by 5.72 seconds, Packet Delivery Ratio is increased by 99 % and energy consumption is also improved in proposed by 3.425 J.

In [45], a new controller by implementing a novel Monkey King Evolution Algorithm (MKEA) for grid connected converters is designed. The motive of this work is to increase the overall effectiveness of the power system by controlling the inverter without affecting its output. Also, it aims to provide a secure and convenient controller for the power converters. The information that is obtained from the system which includes real power, distorted power due to load, reactive power of load, and apparent power of inverter are taken as the input. During simulation, the efficiency of the controller is analyzed by using the measures of phase voltage, phase current, active power, reactive power, apparent power, grid voltage, and output voltage. The Total Harmonic Distortion (THD) is effectively reduced by using the MKEA based controller design. In [46], a novel framework is proposed to generate recommendations independently of the count and type of context dimensions, hence pertinent for real life recommender systems. In the framework, k-prototype clustering technique is used to group contextually similar users to get a reduced and effective set. Additionally, particle swarm optimization technique is applied on the closest cluster to find the contribution of different context features to control data sparsity problem. Also, the proposed framework employs an improved similarity measure which considers contextual condition of the user. The results of experiments using two context enriched datasets showcasing that the proposed framework increases the accuracy of recommendations over other techniques from the same domain without consuming extra cost in terms of time. In [47], a hybrid visual crypto-steganography approach to protect image based secret in communication is proposed. The proposed method is applied on standard images in the literature and images captured using standard digital camera. Comparison study with existing methods shows that the proposed method performs better in terms of NIST metrics.

In [48], an intelligent automatic system to detect behavior of the human in public places is presented. The framework to detect suspicious human behavior as well as tracking of human who is doing some unusual activity such as fighting and threatening actions and also distinguishing the human normal activities from the suspicious behavior is proposed. The human activity is recognized by extracting the features using the convolution neural network (CNN) on the extracted optical flow slices and pre-training the activities based on the real-time activities. The performance of the system is evaluated, by using different standard datasets having different objects and achieved 95% performance. In [49], a set of hybrid heuristics and an ensemble heuristic to improve the solution quality is proposed. The simulation results show that the proposed heuristics are highly scalable and economical in comparison with the individual heuristic-based approaches. The proposed hybrid and ensemble heuristics have established a promising effect and reduced cost of resource allocation by 0.5% in terms of active physical machines to host the given VM requests. It is observed that the placement efficiency is improved by the proposed Hybrid-VM NeAR (HIDE) heuristic over the individual VM NeAR heuristics H, I, D and E. Finally in [50], a synchronization protocol for cluster-based WSNs called a Simple Hierarchical Algorithm for Time Synchronization (H-SATS) has been proposed and its performance is tested on a densely deployed large-sized WSN testbed in different LOS conditions. Further, H-SATS has been compared with the traditional regression-based method, which is the core synchronization scheme for different synchronization protocols in clustered WSNs. Experiments show that H-SATS outperforms the regression method in terms of synchronization accuracy to a maximum of 26.7% for a 30-node network.

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References

[1] K. Li, Y. Fang, Y. Zhou, Z. Ju and H. Liu, Haptics Model for Human Fingertips Based on Gaussian Distribution, *Journal of Intelligent & Fuzzy Systems* **36**(5), 3945–3955.

[2] A. Majumdar, N.M. Laskar, A. Biswas, S.K. Sood and K.L. Baishnab, Energy Efficient e-Healthcare Framework using HWPSO-based Clustering Approach, *Journal of Intelligent & Fuzzy Systems* **36**(5), 3957–3969.

[3] D. Zeng, Y. Dai, F. Li, J. Wang and A.K. Sangaiah, Aspect based sentiment analysis by a linguistically regularized CNN with gated mechanism, *Journal of Intelligent & Fuzzy Systems* **36**(5), 3971–3980.

[4] A. Bhuvaneswari and C. Valliyammai, Information Entropy based event detection during disaster in Cyber-Social Networks, *Journal of Intelligent & Fuzzy Systems* **36**(5), 3981–3992.

[5] S. Priyanga, M.R. Gauthama Raman, S.S. Jagtap, N. Aswin, K. Kirthivasan and V.S. Shankar Sriram, An improved rough set theory based feature selection approach for intrusion detection in SCADA systems, *Journal of Intelligent & Fuzzy Systems* **36**(5), 3993–4003.

[6] K.S. Umadevi, P. Balakrishnan and G. Kousalya, Intrusion detection system using timed automata for cyber physical systems, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4005–4015.

[7] H. Huang, S. Zeng, A.K. Sangaiah and J. Wang, Beamforming aided SSK modulation for MIMO system with energy harvesting, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4017–4023.

[8] R. Sundaram and K.S. Ravichandran, An automated eye disease prediction system using bag of visual words and support vector machine, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4025–4036.

[9] C.C. Kiliroor and C. Valliyammai, Social network based filtering of unsolicited messages from E-Mails, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4037–4048.

[10] A. Jayanth Balaji, D.S. Harish Ram and B.B. Nair, A deep learning approach To electric energy consumption modeling, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4049–4055.

[11] M. Poongodi, V. Vijayakumar, B. Rawal, V. Bhardwaj, T. Agarwal, A. Jain, L. Ramanathan and V.P. Sriram, Recommendation model based on trust relations & user credibility, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4057–4064.

[12] S.N. Senthil, S. Vairavasundaram and L. Ravi, Fuzzy ontology-based personalized recommendation for internet of medical things with linked open data, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4065–4075.

[13] A. Sharma and R. Kumar, Service level agreement and energy cooperative cyber physical system for quickest healthcare services, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4077–4089.

[14] S.S. Ali, I.I. Ganapathi and S. Prakash, Fingerprint shell with impregnable features, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4091–4104.

[15] R. Ezhilarasie, M.S. Reddy and A. Umamakeswari, A new Hybrid Adaptive GA-PSO computation offloading algorithm for IoT and CPS context application, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4105–4114.

[16] N. Kiran Kumar and V. Indra Gandhi, Implementation of fuzzy logic controller in power system applications, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4115–4126.

[17] Z. Qiang, H. Junhua, F. Jinfu and L. An, Air multi-target threat assessment method based on improved GGIFSS, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4127–4139.

[18] L. Ravi, S. Vairavasundaram, S. Palani and M. Devarajan, Location-based personalized recommender system in the internet of cultural things, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4141–4152.

[19] I. Ahmad, F. Hussain, S.A. Khan, U. Akram and G. Jeon, CPS-based Fully automatic cardiac left ventricle and left atrium segmentation in 3D MRI, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4153–4164.

[20] T. Arunkumari and V. Indragandhi, A fuzzy controlled high gain DC-DC converter for renewable power generation, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4165–4176.

[21] A.S.A. Sukor, A. Zakaria, N.A. Rahim, L.M. Kamaru-Din, R. Setchi, and H. Nishizaki, A hybrid approach of knowledge-driven and data-driven reasoning for activity recognition in smart homes, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4177–4188.

[22] S. Natarajan, S. Vairavasundaram and L. Ravi, Optimized fuzzy-based group recommendation with parallel computation, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4189–4199.

[23] Y. Tan, H.P.H. Shum, F. Chao, V. Vijayakumar and L. Yang, Curvature-based sparse rule base generation for fuzzy rule interpolation, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4201–4214.

[24] J. Wang, M. Karuppiah, S. Kumari, F. Wei and W. Shi, A privacy-preserving spectrum auction scheme using paillier cryptosystem with public verification, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4215–4226.

[25] A. Veeramuthu, S. Meenakshi and K. Ashok Kumar, A neural network based deep learning approach for efficient segmentation of brain tumor medical image data, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4227–4234.

[26] S. Asaithambi, M. Rajappa and L. Ravi, Optimization and control of CMOS analog integrated circuits for cyber-physical systems using hybrid grey wolf optimization algorithm, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4235–4245.

[27] K.C. Ramya, K. Vinoth Kumar, M. Irfan, S. Mesforush, K. Mohanasundaram and V. Vijayakumar, Fuzzy based hybrid incorporating wind solar energy source by reduced harmonics, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4247–4256.

[28] X. Zhang, Y. Gong and M. Spece, Trust decision model for online consumer evaluation: Deeper uncertainty integration in evidence theory approach, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4257–4264.

[29] S. Arunkumar, S. Vairavasundaram, K.S. Ravichandran and L. Ravi, RIWT and QR factorization based hybrid robust image steganography using block selection algorithm for IoT devices, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4265–4276.

[30] L. Chen, X. Yang, L. Lu, K. Liu, G. Jeon and W. Wu, An image fusion algorithm of infrared and visible imaging sensors for cyber-physical systems, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4277–4291.

[31] J.H. Narasappa and D. Rekha, Energy aware methodical data forwarding (EAMDF) mechanism in VANET, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4293–4303.

[32] A. Banerjee and D.M. Akbar Hussain, Experience-based efficient scheduling algorithm (EXES) for serving requests in cloud using SDN controller, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4305–4317.

[33] C. Kumar, K. Sathish Kumar, V. Indragandhi, V. Vijayakumar and B.S. Rawal, A novel distribution system reconfiguration for loss minimization using symbiotic organism search algorithm, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4319–4326.

[34] D. Dhanya and D. Arivudainambi, Resource allocation through optimized three-phase scheduled VMs by grey wolf optimization and introspection security analysis, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4327–4340.

[35] G. Anusooya, V. Vijayakumar and V. Neela Narayanan, Reducing the carbon emission by early prediction of peak time load in a data center, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4341–4348.

[36] M. Devarajan, F.N. Sabiyath, S. Vairavasundaram and L. Ravi, Swarm intelligence clustering ensemble based point of interest recommendation for social cyber-physical systems, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4349–4360.

[37] R.S. Raghav and P. Dhavachelvan, Bigdata fog based cyber physical system for classifying, identifying and prevention of SARS disease, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4361–4373.

[38] X. Zhu, Z. Ni, L. Ni, F. Jin, M. Cheng and J. Li, Spread binary artificial fish swarm algorithm combined with double-fault measure for ensemble pruning, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4375–4387.

[39] M. Khana, M.Q. Rezaa, A.K. Salhan and S.P.S.M.A. Sirdeshmukh, Acoustic resonance spectroscopy based simple system for spectral characterization and classification of materials, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4389–4397.

[40] R. Chhabra, C.R. Krishna and S. Verma, Smartphone based context-aware driver behavior classification using dynamic bayesian network, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4399–4412.

[41] B. Pradhan, V. Vijayakumar, N.B. Hui and D.S. Roy, Intelligent navigation of multiple coordinated robots, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4413–4423.

[42] A.-B. Ignacio, M.-R.L. Alberto, H.-G.C. Arturo, C.-V.J. Crescenciano, P.-B. Daniel and M.-S. Miguel, Real time FPGA-ANN architecture for outdoor obstacle detection focused in road safety, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4425–4436.

[43] R.K. Sinha and S.S. Sahu, Adaptive firefly algorithm based optimized key generation for image security, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4437–4447.

[44] S. Srinivasan and K.B. ShivaKumar, HMAC-RSA: A security mechanism in cognitive radio for enhancing the security in a radio cognitive system, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4449–4459.

[45] K. Vijayakumar, K. Rajesh, G. Vishnuvardhanan and S. Kannan, Evolutionary algorithm based control strategy for enhanced operation of multifunction grid connected converters, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4461–4478.

[46] V.S. Dixit and P. Jain, Recommendations with context aware framework using particle swarm optimization and unsupervised learning, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4479–4490.

[47] A. Hasnat, D. Barman and S. Sarkar, Color image share cryptography: A novel approach, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4491–4506.

[48] S. Ramachandran, L.H. Palivela and C. Giridharan, An intelligent system to detect human suspicious activity using deep neural networks, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4507–4518.

[49] S. Jangiti, E.S. Ram, L. Ravi and V.S. Shankar Sriram, Scalable hybrid and ensemble heuristics for economic virtual resource allocation in cloud and fog cyber-physical systems, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4519–4529.

[50] G.S.S. Chalapathi, V. Chamola and S. Gurunarayanan, A testbed validated simple time synchronization protocol for clustered wireless sensor networks for IoT, *Journal of Intelligent & Fuzzy Systems* **36**(5), 4531–4543.