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A Comprehensive State of Art Approaches on Clustering in Wireless Sensor Networks

Mahes

Government Arts College – Thirupanandhal

ABSTRACT

Clustering is considered one of the familiar topology management techniques in WSNs, assembling nodes for managing them and implementing numerous tasks in a distributed way, like resource management. Even though clustering methods were predominantly known for improving power utilization, there exist many quality-driven purposes which could be received via clustering. This article evaluates widely prevailing WSN clustering methods, its goals, and the network properties guided by such methods. Once refining above 500 clustering approaches, it extracts nearly 215 of them as very significant ones, that were further assessed, categorize on the basis of clustering purposes and the network properties like heterogeneity and mobility. Moreover, statistics are offered depending on the selected metrics, presenting more valuable insights into the design of clustering methods in WSNs.

Keywords: Cluster selection, Wireless sensor network, Base station, Fuzzy logic, Sensor nodes

I. INTRODUCTION

The quick development of wireless sensor networks (WSNs) has added to their wide use in numerous applications, for example, debacle the board [1], RFID networks, drone applications, and clinical applications [2]. Since WSNs are comprised of minimal expense and little estimated sensor hubs, they face a couple of constraints, for example, restricted battery limit, little memory size, and more limited correspondence ranges [3-4]. The energy utilization in WSNs is constant, as it is utilized during information detecting, information assortment, and the information communicating stage. The information communicating stage utilizes the most measure of energy by and large, where to send a solitary piece of information north of 100 m by radio costs similar measure of energy as executing 3000 directions [5]. Lately, the energy effectiveness issue has gotten more center in light of the fact that changing or re-energizing the battery supply isn't possible effectively for networks in huge scope or distant regions [6-8]. Besides, productive information move is one more issue looked at in WSNs. This is because of a fumble of WSNs that will expand the parcel payload size, which straightforwardly builds the likelihood of dropping information bundles. In that capacity, retransmission of information parcels will consume more energy also [9].

The most widely recognized issues confronted were the organization opening issue and the secluded hub issue [10]. The organization opening issue is additionally called an area of interest issue, where the CH close to the BS drains energy quicker when contrasted with the hubs far away from the BS in a multihop climate, as the greater part of the information compasses to the CH close to the BS for conglomeration and information move to the BS [11-13]. Then again, the disconnected hub issue is where hubs join no bunch and don't have a way to send information to the BS [14].

These issues are handled by proposing a couple of strategies and techniques like inconsistent clustering, portable BS, and productive CH choice strategy [15]. Inconsistent group development is where bunches close to the BS have a lower number of sensors contrasted with bunches far away from the BS. Subsequently, a CH close to the BS utilizes lesser energy to speak with its group individuals, and it can speak with other CHs that are a long way from the BS, making the heap adjusted [16]. A versatile BS is where the sink is moved now and again to gather the detected information from the bunch heads [17]. The two strategies require more exertion and consume more energy as far as group development and memory utilization to monitor the area of the versatile BS. This leaves us with the suitable CH determination technique, which has been generally investigated and examined lately [18-25]. CH choice is finished by setting a couple of determination measures like remaining energy of the hub and the distance between bunch individuals (CM), CH, and BS. In some exploration, the determination standards are embedded into a metaheuristic technique for quicker intermingling and better exactness of choosing CHs as well as guaranteeing a superior QoS of the organization [26].

This article, it evaluates widely prevailing WSN clustering methods, its goals, and the network properties guided by such methods [27]. Once refining above 500 clustering approaches, it extracts nearly 215 of them as very significant ones, that were further assessed, categorize on the basis of clustering purposes and the network properties like heterogeneity and mobility [28]. Moreover, statistics are offered depending on the selected metrics, presenting more valuable insights into the design of clustering methods in WSNs [29-31].

II. RELATED WORKS

[32] laid out BM-BWO with FL based HEED convention (BMBWFL-HEED). In BMBWFL-HEED, it is used the gathering of the assisted change based BM-BWO method with HEED convention for picking the more prominent RE. Particularly, the change time of the BWO strategy is improved with help of heading ordinary system (BM-BWO). The FL structure picks the hugest and ideal CH. [33] present a bio-persuaded and trust-based CH assurance technique for WSN got in ITS purposes. A trusted technique is arranged and used for enlisting a trust level to all hubs and BOA is utilized to pick the CHs.

[34] based on an effective CH political race plan that turns the CH position among the hubs with predominant energy level when stood out from other. [35] present a methodology named the HQCA for making top notch groups. [36] introduced FEEC-IIR convention for WSN helped IoT system. To an ideal CH decision, AF-MCDM is used that is a join fluffy AHP, and TOPSIS strategy is introduced to an energy-productive clustering estimation. [37] oversees assurance of ideal way in directing which further develops network lifetime and organization's energy adequacy [38]. Different meta-heuristic procedures particularly PSO have been sufficiently used at this point with most terrible neighborhood ideal issue. The introduced procedure depends on PSO and Tabu pursuit algorithms[39- 45].

[46] direct a wide audit of introduced improved clustering plans nowadays. To evaluate them, we contemplate 10 boundaries. Considering this boundary, it tends to be introduced an assessment of these enhanced clustering methods. [47-52] presents a various leveled directing conventions subject to the k-d tree procedure, to take a different information construction of the space to figure out hubs as to groups. In [53], upgraded clustering hierarchy (ECH) model was introduced for achieving energy-productivity in WSNs by using dozing waking technique for covering and abutting hubs. [54] presents one more arrangement of recognizing assembled information exactness for gathering data in CHs in various leveled WSN subject to improving gathering of SVM. The ideal boundary SVM is completed by improved flower pollination algorithm (IFPA) to achieve classifier precision [55-58].

In [59], the method of CH decision is created as single-objective upgrade issue to find better gathering CHs to shape, one-jump bunches, to change energy use, and adaptability using GSA [60]. The issue has been tended to using particle swarm headway and GSA and investigates the result against LEACH convention. [61] present an energy proficient clustering directing method [62]. With respect to non-uniform traffic appropriations, it tends to be available a disproportionate bunch of improvement models for load changing and energy adequacy. Additionally, it is available a circled CH go framework to change energy use inside all bunches [63].

[64] presented a convention that considers a few clustering factors related to energy usage to pick CH like RE, distance from hub to BS, neighbors, and count of neighbors with weighting ultimately switches up the conversation of useful Clustering as to enhance of 2 boundaries [65]. [66] Propose a fluffy decision-making model to assurance of pack heads. The fluffy multiple attribute decision-making (MADM) model is used for picking CHs using three guidelines containing REs, count of neighbors, and the partition from the BS of the hubs [67].

III. CONCLUSION

In this paper, it evaluates widely prevailing WSN clustering methods, its goals, and the network properties guided by such methods. Once refining above 500 clustering approaches, it extracts nearly 215 of them as very significant ones, that were further assessed, categorize on the basis of clustering purposes and the network properties like heterogeneity and mobility. Moreover, statistics are offered depending on the selected metrics, presenting more valuable insights into the design of clustering methods in WSNs.

REFERENCES

[1] Vaiyapuri, T., Parvathy, V. S., Manikandan, V., Krishnaraj, N., Gupta, D., & Shankar, K. (2021). A novel hybrid optimization for cluster-based routing protocol in information-centric wireless sensor networks for IoT based mobile edge computing. Wireless Personal Communications, 1-24.

[2] Das, A. K., Mishra, D., Das, K., Mallick, P. K., Kumar, S., Zymbler, M., & El-Sayed, H. (2022). Prophesying the Short-Term Dynamics of the Crude Oil Future Price by Adopting the Survival of the Fittest Principle of Improved Grey Optimization and Extreme Learning Machine. Mathematics, 10(7), 1121.

[3] Mansour, R. F., Escorcia-Gutierrez, J., Gamarra, M., Gupta, D., Castillo, O., & Kumar, S. (2021). Unsupervised deep learning based variational autoencoder model for COVID-19 diagnosis and classification. Pattern Recognition Letters, 151, 267-274.

[4] Joshi, G. P., Alenezi, F., Thirumoorthy, G., Dutta, A. K., & You, J. (2021). Ensemble of deep learning-based multimodal remote sensing image classification model on unmanned aerial vehicle networks. Mathematics, 9(22), 2984.

[5] Vaiyapuri, T. (2021). Deep learning enabled autoencoder architecture for collaborative filtering recommendation in iot environment. CMC-COMPUTERS MATERIALS & CONTINUA, 68(1), 487-503.

[6] Namasudra, S., Chakraborty, R., Majumder, A., & Moparthi, N. R. (2020). Securing multimedia by using DNA-based encryption in the cloud computing environment. ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM), 16(3s), 1-19.

[7] Sekhar, P., Lydia, E. L., Elhoseny, M., Al-Akaidi, M., Selim, M. M., & Shankar, K. (2021). An effective metaheuristic based node localization technique for wireless sensor networks enabled indoor communication. Physical Communication, 48, 101411.

[8] M. Ragab, A. Algarni, A. A. Bahaddad and R. F. Mansour, "Machine learning applied to problem-solving in medical applications," Computers, Materials & Continua, vol. 69, no.2, pp. 2277–2294, 2021.

[9] Mukherjee, A., Jain, D. K., Goswami, P., Xin, Q., Yang, L., & Rodrigues, J. J. (2020). Back propagation neural network based cluster head identification in MIMO sensor networks for intelligent transportation systems. IEEE Access, 8, 28524-28532.

[10] Ragab, M., Ashary, E. B., Aljedaibi, W. H., Alzahrani, I. R., Kumar, A., Gupta, D., & Mansour, R. F. (2022). A novel metaheuristics with adaptive neuro-fuzzy inference system for decision making on autonomous unmanned aerial vehicle systems. ISA Transactions.

[11] Vaiyapuri, T., Lydia, E. L., Sikkandar, M. Y., Díaz, V. G., Pustokhina, I. V., & Pustokhin, D. A. (2021). Internet of Things and Deep Learning Enabled Elderly Fall Detection Model for Smart Homecare. IEEE Access, 9, 113879-113888.

[12] Manjari, K., Verma, M., Singal, G., & Namasudra, S. (2022). QEST: Quantized and Efficient Scene Text Detector using Deep Learning. Transactions on Asian and Low-Resource Language Information Processing.

[13] Namasudra, S. (2020). Fast and secure data accessing by using DNA computing for the cloud environment. IEEE Transactions on Services Computing.

[14] Lian, J., Jia, W., Zareapoor, M., Zheng, Y., Luo, R., Jain, D. K., & Kumar, N. (2019). Deep-learning-based small surface defect detection via an exaggerated local variation-based generative adversarial network. IEEE Transactions on Industrial Informatics, 16(2), 1343-1351.

[15] Dutta, A. K. (2020). Managing natural hazards in smart cities in Kingdom of Saudi Arabia using a technique based on interior search algorithm. Electronic Government, an International Journal, 16(1-2), 155-169.

[16] Pustokhina, I. V., Pustokhin, D. A., Lydia, E. L., Elhoseny, M., & Shankar, K. (2021). Energy efficient neuro-fuzzy cluster based topology construction with metaheuristic route planning algorithm for unmanned aerial vehicles. Computer Networks, 196, 108214.

[17] Escorcia-Gutierrez, J., Gamarra, M., Beleño, K., Soto, C., & Mansour, R. F. (2022). Intelligent deep learning-enabled autonomous small ship detection and classification model. Computers & Electrical Engineering, 100, 107871.

[18] Mansour, R. F., Escorcia-Gutierrez, J., Gamarra, M., Díaz, V. G., Gupta, D., & Kumar, S. (2021). Artificial intelligence with big data analytics-based brain intracranial hemorrhage e-diagnosis using CT images. Neural Computing and Applications, 1-13.

[19] Nair, R., Ragab, M., Mujallid, O. A., Mohammad, K. A., Mansour, R. F., & Viju, G. K. (2022). Impact of Wireless Sensor Data Mining with Hybrid Deep Learning for Human Activity Recognition. Wireless Communications and Mobile Computing, 2022.

[20] Mukherjee, A., Jain, D. K., & Yang, L. (2020). On-demand efficient clustering for next generation IoT applications: A hybrid NN approach. IEEE Sensors Journal, 21(22), 25457-25464.

[21] Swati, S., Kumar, M., & Namasudra, S. (2022). Early prediction of cognitive impairments using physiological signal for enhanced socioeconomic status. Information Processing & Management, 59(2), 102845.

[22] Nair, R., Ragab, M., Mujallid, O. A., Mohammad, K. A., Mansour, R. F., & Viju, G. K. (2022). Impact of Wireless Sensor Data Mining with Hybrid Deep Learning for Human Activity Recognition. Wireless Communications and Mobile Computing, 2022.

[23] Althobaiti, M. M., Almulihi, A., Ashour, A. A., Mansour, R. F., & Gupta, D. (2022). Design of Optimal Deep Learning-Based Pancreatic Tumor and Nontumor Classification Model Using Computed Tomography Scans. Journal of Healthcare Engineering, 2022.

[24] Jain, D. K., Tyagi, S. K. K. S., Neelakandan, S., Prakash, M., & Natrayan, L. (2021). Metaheuristic optimization-based resource allocation technique for cybertwin-driven 6G on IoE environment. IEEE Transactions on Industrial Informatics.

[25] Althobaiti, M. M., Kumar, K. P. M., Gupta, D., Kumar, S., & Mansour, R. F. (2021). An intelligent cognitive computing based intrusion detection for industrial cyber-physical systems. Measurement, 186, 110145.

[26] Ismail, S. S., Mansour, R. F., El-Aziz, A., Rasha, M., & Taloba, A. I. (2022). Efficient E-Mail Spam Detection Strategy Using Genetic Decision Tree Processing with NLP Features. Computational Intelligence and Neuroscience, 2022.

[27] Chinnasamy, P., Deepalakshmi, P., Dutta, A. K., You, J., & Joshi, G. P. (2021). Ciphertext-Policy

Attribute-Based Encryption for Cloud Storage: Toward Data Privacy and Authentication in AI-Enabled IoT System. Mathematics, 10(1), 68.

[28] Gupta, A., & Namasudra, S. (2022). A novel technique for accelerating live migration in cloud computing. Automated Software Engineering, 29(1), 1-21.

[29] Dutta, A. K., Elhoseny, M., Dahiya, V., & Shankar, K. (2020). An efficient hierarchical clustering protocol for multihop Internet of vehicles communication. Transactions on Emerging Telecommunications Technologies, 31(5), e3690.

[30] Agrawal, D., Minocha, S., Namasudra, S., & Gandomi, A. H. (2022). A robust drug recall supply chain management system using hyperledger blockchain ecosystem. Computers in biology and medicine, 140, 105100.

[31] A. A. Eshmawi, H. Alhumyani, S. A. Khalek, R. A. Saeed, M. Ragab et al., "Design of automated opinion mining model using optimized fuzzy neural network," Computers, Materials & Continua, vol. 71, no.2, pp. 2543–2557, 2022.

[32] Ragab, M., Alshehri, S., Aldawsari, H. M., Noor, A., Ashary, E. B., Abou-Taleb, S. A. K., & Abdelazim, G. (2022). COVID-19 Identification System Using Transfer Learning Technique With Mobile-NetV2 and Chest X-Ray Images. Frontiers in Public Health, 102.

[33] Jain, D. K., Zareapoor, M., Jain, R., Kathuria, A., & Bachhety, S. (2020). GAN-Poser: an improvised bidirectional GAN model for human motion prediction. Neural Computing and Applications, 32(18), 14579-14591.

[34] Namasudra, S., Sharma, P., Crespo, R. G., & Shanmuganathan, V. (2022). Blockchain-Based Medical Certificate Generation and Verification for IoT-based Healthcare Systems. IEEE Consumer Electronics Magazine.

[35] Shankar, K., Perumal, E., Tiwari, P., Shorfuzzaman, M., & Gupta, D. (2021). Deep learning and evolutionary intelligence with fusion-based feature extraction for detection of COVID-19 from chest X-ray images. Multimedia Systems, 1-13.

[36] Kumar, S., Toshniwal, D., & Parida, M. (2017). A comparative analysis of heterogeneity in road accident data using data mining techniques. Evolving systems, 8(2), 147-155.

[37] Nayak, D. R., Padhy, N., Mallick, P. K., Bagal, D. K., & Kumar, S. (2022). Brain Tumour Classification Using Noble Deep Learning Approach with Parametric Optimization through Metaheuristics Approaches. Computers, 11(1), 10.

[38] M. Ragab, E. B. Ashary, M. F. S. Sabir, A. A. Bahaddad and R. F. Mansour, "Mathematical modelling of quantum kernel method for biomedical data analysis," Computers, Materials & Continua, vol. 71, no.3, pp. 5441–5457, 2022.

[39] Pavithran, P., Mathew, S., Namasudra, S., & Srivastava, G. (2022). A novel cryptosystem based on DNA cryptography, hyperchaotic systems and a randomly generated Moore machine for cyber physical systems. Computer Communications, 188, 1-12.

[40] Dutta, A. K., Aljarallah, N. A., Abirami, T., Sundarrajan, M., Kadry, S., Nam, Y., & Jeong, C. W. (2022). Optimal Deep-Learning-Enabled Intelligent Decision Support System for SARS-CoV-2 Classification. Journal of Healthcare Engineering, 2022.

[41] Shankar, K., Mohanty, S. N., Yadav, K., Gopalakrishnan, T., & Elmisery, A. M. (2021). Automated COVID-19 diagnosis and classification using convolutional neural network with fusion based feature extraction model. Cognitive Neurodynamics, 1-14.

[42] Lan, X., Zhang, W., Zhang, S., Jain, D. K., & Zhou, H. (2019). Robust multi-modality anchor graph-based label prediction for RGB-infrared tracking. IEEE Transactions on Industrial Informatics.

[43] Shankar, K., Perumal, E., Elhoseny, M., Taher, F., Gupta, B. B., & El-Latif, A. A. A. (2021). Synergic Deep Learning for Smart Health Diagnosis of COVID-19 for Connected Living and Smart Cities. ACM Transactions on Internet Technology (TOIT), 22(3), 1-14.

[44] Namasudra, S., & Roy, P. (2017). Time saving protocol for data accessing in cloud computing. IET Communications, 11(10), 1558-1565.

[45] Padmaa, M., Jayasankar, T., Venkatraman, S., Dutta, A. K., Gupta, D., Shamshirband, S., & Rodrigues, J. J. (2022). Oppositional chaos game optimization based clustering with trust based data transmission protocol for intelligent IoT edge systems. Journal of Parallel and Distributed Computing, 164, 142-151.

[46] Zhou, S., Luo, P., Jain, D. K., Lan, X., & Zhang, Y. (2019). Double-domain imaging and adaption for person re-identification. IEEE Access, 7, 103336-103345.

[47] Vaiyapuri, T., Mohanty, S. N., Sivaram, M., Pustokhina, I. V., Pustokhin, D. A., & Shankar, K. (2021). Automatic vehicle license plate recognition using optimal deep learning model. Computers, Materials and Continua, 67(2), 1881-1897.

[48] Tyagi, S. K. S., Mukherjee, A., Boyang, Q., & Jain, D. K. (2021). Computing resource optimization of big data in optical cloud radio access networked industrial Internet of Things. IEEE Transactions on Industrial Informatics, 17(11), 7734-7742.

[49] Mansour, R. F., El Amraoui, A., Nouaouri, I., Díaz, V. G., Gupta, D., & Kumar, S. (2021). Artificial intelligence and Internet of Things enabled disease diagnosis model for smart

healthcare systems. IEEE Access, 9, 45137-45146.

[50] Shankar, K., Perumal, E., Díaz, V. G., Tiwari, P., Gupta, D., Saudagar, A. K. J., & Muhammad, K. (2021). An optimal cascaded recurrent neural network for intelligent COVID-19 detection using Chest X-ray images. Applied Soft Computing, 113, 107878.

[51] Ragab, M., Albukhari, A., Alyami, J., & Mansour, R. F. (2022). Ensemble Deep-Learning-Enabled Clinical Decision Support System for Breast Cancer Diagnosis and Classification on Ultrasound Images. Biology, 11(3), 439.

[52] Jain, D. K., Boyapati, P., Venkatesh, J., & Prakash, M. (2022). An Intelligent Cognitive-Inspired Computing with Big Data Analytics Framework for Sentiment Analysis and Classification. Information Processing & Management, 59(1), 102758.

[53] Shankar, K., Taniar, D., Yang, E., & Yi, O. (2021). Secure and Optimal Secret Sharing Scheme for Color Images. Mathematics, 9(19), 2360.

[54] Vaiyapuri, T., Dutta, A. K., Sikkandar, M. Y., Gupta, D., Alouffi, B., Alharbi, A., ... & Kadry, S. (2022). Design of Metaheuristic Optimization-Based Vascular Segmentation Techniques for Photoacoustic Images. Contrast Media & Molecular Imaging, 2022.

[55] Pustokhina, I. V., Pustokhin, D. A., Aswathy, R. H., Jayasankar, T., Jeyalakshmi, C., Díaz, V. G., & Shankar, K. (2021). Dynamic customer churn prediction strategy for business intelligence using text analytics with evolutionary optimization algorithms. Information Processing & Management, 58(6), 102706.

[56] Alqaralleh, B. A., Vaiyapuri, T., Parvathy, V. S., Gupta, D., Khanna, A., & Shankar, K. (2021). Blockchain-assisted secure image transmission and diagnosis model on Internet of Medical Things Environment. Personal and ubiquitous computing, 1-11.

[57] Jain, D. K., Li, Y., Er, M. J., Xin, Q., Gupta, D., & Shankar, K. (2021). Enabling Unmanned Aerial Vehicle Borne Secure Communication with Classification Framework for Industry 5.0. IEEE Transactions on Industrial Informatics.

[58] Dutta, A. K. (2021). Detecting phishing websites using machine learning technique. PloS one, 16(10), e0258361.

[59] Al-Wesabi, F. N., Obayya, M., Hamza, M. A., Alzahrani, J. S., Gupta, D., & Kumar, S. (2022). Energy Aware Resource Optimization using Unified Metaheuristic Optimization Algorithm Allocation for Cloud Computing Environment. Sustainable Computing: Informatics and Systems, 35, 100686.

[60] Ragab, M., Eljaaly, K., Alhakamy, N. A., Alhadrami, H. A., Bahaddad, A. A., Abo-Dahab, S. M., & Khalil, E. M. (2021). Deep ensemble model for COVID-19 diagnosis and classification using chest CT images. Biology, 11(1), 43.

[61] Vaiyapuri, T., Dutta, A. K., Punithavathi, I. H., Duraipandy, P., Alotaibi, S. S., Alsolai, H., ... & Mahgoub, H. (2022, April). Intelligent Deep-Learning-Enabled Decision-Making Medical System for Pancreatic Tumor Classification on CT Images. In Healthcare (Vol. 10, No. 4, p. 677). MDPI.

[62] Alqaralleh, B. A., Mohanty, S. N., Gupta, D., Khanna, A., Shankar, K., & Vaiyapuri, T. (2020). Reliable multi-object tracking model using deep learning and energy efficient wireless multimedia sensor networks. IEEE Access, 8, 213426-213436.

[63] Vaiyapuri, T., & Gupta, M. (2021). Traffic accident severity prediction and cognitive analysis using deep learning. Soft Computing, 1-13.

[64] Kumar, S., & Nezhurina, M. I. (2019). An ensemble classification approach for prediction of user's next location based on Twitter data. Journal of Ambient Intelligence and Humanized Computing, 10(11), 4503-4513.

[65] Sharma, P., Moparthi, N. R., Namasudra, S., Shanmuganathan, V., & Hsu, C. H. (2021). Blockchain-based IoT architecture to secure healthcare system using identity-based encryption. Expert Systems, e12915.

[66] Metawa, N., Nguyen, P. T., Le Hoang Thuy To Nguyen, Q., Elhoseny, M., & Shankar, K. (2021). Internet of things enabled financial crisis prediction in enterprises using optimal feature subset selection-based classification model. Big Data, 9(5), 331-342.

[67] Paikrao, P., Mukherjee, A., Jain, D. K., Chatterjee, P., & Alnumay, W. (2021). Smart emotion recognition framework: A secured IOVT perspective. IEEE Consumer Electronics Magazine.