Guest Editorial Introduction to the Special Issue on Sustainable Solutions for the Intelligent Transportation Systems

THE intelligent transportation systems improve the transportation system's operational efficiency and enhance its safety and reliability by high-tech means such as information technology, control technology, and computer technology. In recent years, sustainable development has become an important topic in intelligent transportation's development, including new infrastructure and energy distribution, new energy vehicles and new transportation systems, and the development of low-carbon and intelligent transportation equipment. New energy vehicles' development is a significant part of green transportation, and its automation performance improvement is vital for smart transportation.

The development of intelligent transportation and green, low-carbon, and intelligent transportation equipment needs to be promoted, a significant feature of transportation development in the future. For intelligent infrastructure and energy distribution facilities, the electricity for popular electric vehicles and renewable energy, such as nuclear power and hydrogen power, should be considered.

The strategic development framework of a new generation of green and intelligent transportation includes a comprehensive transportation system, a transportation infrastructure system, an equipment, organization system, and a decision governance system. Although automated driving technology develops rapidly, it takes time to promote the automatic driving's application to develop low-carbon and intelligent transportation equipment. Low-carbon and intelligent transportation's development involves many technics, and multiple information systems in different fields need to be integrated to ensure effective information circulation and its working. In intelligent transportation system's construction, an ideal plan for its sustainable development and operation is in urgent need currently.

After a rigorous review, 59 papers have been accepted for this Special Issue. The evaluation process took into consideration factors pertaining to originality, technical quality, presentational quality, and overall contribution. Below is a brief introduction to each of them.

In [A1], Shang et al. propose a novel Relative Area Index (RAI) based on traffic assignment theory to quantitatively measure the robustness of URNs under global capacity degradation due to three different types of disruptions. They also compare the RAI with weighted betweenness centrality, a traditional topological metric of robustness. Their analysis shows that RAI is a more effective measure of the robustness of URNs when multi-scale URNs suffer from global disruptions. Also, the results highlight the importance of central management when URNs suffer from disruptions. Their novel method may provide a benchmark tool for comparing robustness of multi-scale URNs, which facilitates the understanding and improvement of network robustness for URNs.

In [A2], Jiang et al. propose a multi-depot electric bus scheduling model accounting for partial charging, vehicle-depot constraint and constraint on non-service travel and present a branch-and-price solution algorithm enhanced by heuristic procedures. Comprehensive numerical experiments are conducted based on the transit operation cases in Shenzhen, China. The results show that the proposed algorithm can generate high-quality solutions for large-sized problem instances with multiple bus routes and several hundred of timetabled trips.

In [A3], Ho et al. incorporate computer vision-based counting of EMs and internal combustion engine motorcycles in combination with ambient pollutant concentration monitoring. The measured pollutant concentration could be apportioned to EMs based on its proportion in the traffic flow. Results show that coarse particle number and PM 1.0 are significantly associated to the number of EMs. Authors also assess the potential change in ambient pollutant concentration through sensitivity analysis on motorcycle fleet electrification.

In [A4], Zhao et al. propose a novel deep model to effectively model flexible spatiotemporal dependency of traffic flow and offer flexible (multi-step) predictions. Specifically, A dual graph convolution module is designed to capture the local spatial dependency from two perspectives, namely road distance and adaptive correlation. To model the dynamic temporal dependency, a bidirectional gated recurrent layer is designed to capture the forward and backward sequential contexts of historical traffic flow, then combine the derived hidden states with their various contributions learned by a temporal attention mechanism. Finally, a spatial attention mechanism is designed to learn the latent global spatial dependency among all locations to facilitate the prediction.

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In [A5], Cruz et al. propose a solution to detect these attacks by analyzing abnormal network traffic through machine learning. The proposed model can be used alongside an IoT middleware to detect the occurrence of replication attacks.

In [A6], Li et al. propose authentication protocols with two diverse factors for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) networks, respectively, without depending on the stumbling block PKI/CA. In addition, a smooth projective hash function (SPHF) (a.k.a., a special case of the designated-verifier zero-knowledge proof system) guarantees any recipient can confirm the authenticity and integrity of the received messages without knowing the authentication factors. Thus, to optimize the communication round, SPHF is used to design a (group) two-factor authenticated key exchange (AKE) with low-interactive communication rounds.

In [A7], Xia et al. present BACKWATCH, a novel vehicle-mounted sensing system that uses a back view cabin camera monitoring the steering wheel rotations to track lane-change events. BACKWATCH consists of an encoder network to extract essential visual features of steering wheel rotations, and an inference network incorporating the visual and GPS speed features to detect the resulting lane changes. The proposed system does not rely on precise coordinate alignment between the monitoring device and the vehicle, nor the wearables worn by the driver, and is robust against different drivers, vehicles, driving speeds, and environmental settings.

In [A8], McCoy et al. propose a novel ensemble deep learning framework that has hybrid synthetic and deep features to detect unauthorized or malicious UAVs by using acoustic, image/video and wireless radio frequency (RF) signals.

In [A9], Tu et al. the optimal transmit power that maximizes energy efficiency (EE) in Longe Range (LoRa) networks is investigated by using the deep learning (DL) approach. Particularly, the proposed artificial neural network (ANN) is trained two times; in the first phase, the ANN is trained by the model-based data which are generated from the simplified system model while in the second phase, the pre-trained ANN is re-trained by the practical data. Numerical results show that the proposed approach outperforms the conventional one which directly trains with the practical data. Moreover, the performance of the proposed ANN under both partial and full optimum architecture is studied. The results depict that the gap between these architectures is negligible. Finally, authors' findings also illustrate that instead of fully re-trained the ANN in the second training phase, freezing some layers is also feasible since it does not significantly decrease the performance of the ANN.

In [A10], Adam et al. describe the 3D placement of multiple unmanned aerial vehicles (UAVs) in an IIoT network that supports non-orthogonal multiple access (NOMA). UAVs act as decode and forward (DF) relays. The 3D UAV placement problem is formulated which is highly non-convex in the coordinates. Therefore, authors employ an improved adaptive whale optimization algorithm (IAWOA) to handle the problem. Even with its improved performance, IAWOA is not suitable for real-time application. Hence, authors propose a path aggregation network (PANet) to handle the 3D UAV placement.

In [A11], Qian et al. a layered object model is proposed for operating systems in ITSs. The operating system object model is considered as a logic system with variables representing the objects, and a series of logic formulae for security and functional configurations in security of ITSs. A formal method is proposed to verify the operating system security properties and configurations in ITSs. The virtual memory management part of the self-designed operating system is used as an example to illustrate the model.

In [A12], Xu et al. used a deep data augmentation method, e.g. WGAN-GP network, to augment the original limited B-Scan GPR data of subgrade, and then carried out supervised learning for classification task. First, the dataset was initially enlarged through the traditional methods after noise filtering, gamma transform, and other processing methods. Then, the WGAN-GP network was adopted to generate new high-quality B-Scan images. Finally, the intelligent classification of subgrade distresses was realized by ResNet50 model with a satisfactory accuracy of 90.85.

In [A13], Ople et al. is about an evolutionary filter-wise pruning algorithm that generates a smaller neural model with an explicitly defined compression ratio. Authors applied this method to depth estimation models for smart on-field device deployability in ITS applications. It uses multiple genetic algorithms to generate pruned model architectures using evolutionary filter search. Specifically, the model size is manipulated by adding or removing convolution filters. When the model size is bigger, a genetic algorithm searches and deactivates filters that result in minimal performance decrease. Alternatively, if the proposed solution has a smaller model size than required, a genetic algorithm searches and activates filters that result in maximal performance increase. Finally, authors fine-tune the compressed model by following the training procedures of the original model. The resultant compressed models show a minimal discrepancy from the baseline model in terms of performance despite a smaller model size.

The rapid development of the Internet of Vehicles has substantially boosted the prevalence of vehicular social networks (VSN). However, content security has gradually been a latent threat to the stable operation of VSN. The VSN is a time-varying environment and mixed with various real or fake contents, which brings great challenges to the sustainability of VSN. To establish a sustainable VSN, it is of practical value to possess a strong ability for fake content detection. Related works can be divided into the global semantics-based approaches and the local semantics-based approaches, though both with limitations. Leveraging these two different approaches, in [A14], Guo et al. propose a fake content detection model based on the mixed graph neural networks for sustainable VSN.

In [A15], Qi et al. a transfer learning framework is proposed to transfer spatial-temporal dependency information for cross-domain traffic state forecasting. The proposed framework incorporates a graph-based deep learning approach and a privacy-preserving multi-source knowledge transfer strategy. The combination of the GraphSAGE and gated recurrent neural network is used to cope with traffic state data with

spatial and temporal dependency. Based on hypothesis transfer learning, knowledge, instead of source data, is transferred from data-rich source regions to a data-poor target region, coping with the situation where data in the source region is unavailable.

In [A16], Liu et al. investigate collaborative task computing and on-demand resource allocation. The collaborative computing framework in vehicular edge computing is provided to support deep collaboration and intelligent management of heterogeneous resources widely distributed in vehicles, edge servers, and cloud. Based on this framework, the joint optimization problem of distributed task offloading and multi-resource management is formulated with the aim to maximize the system utility by making the optimal task and resource scheduling policy, the novelty of which lies in the exploration of available vehicle resources and the consideration of service migration. In view of the dynamics, randomness and time-variant of vehicular networks, the asynchronous deep reinforcement algorithm is leveraged to find the optimal solution.

In [A17], Mou et al. reduce the carbon emissions in the scheduling process and compensate for the energy consumption of various parts of the scheduling when optimizing the carbon emissions of the workshop and the factory. Aiming at the problems of carbon emissions and energy consumption, a new intelligent scheduling strategy is proposed based on the actual transportation dynamic scheduling case of the engine workshop production line. A fuzzy stochastic opportunity constraint programming model with energy consumption is established, and a multi-strategy parallel genetic algorithm based on machine learning is proposed. The effectiveness of the algorithm is verified by example, which can effectively adjust the completion time and energy consumption ratio.

In [A18], Li et al. propose a new feature extraction network for segmentation by adding an encoder-decoder structure, which can extract the multiscale local feature information from the feature map. In their opinion, the merged multiscale features obtain a better feature matrix, which improves the performance of the segmentation tasks.

In [A19], Gupta et al. introduces an aggregated zero-knowledge proof and blockchain-empowered system for privacy-preserving identity verification in the mixed fleet platooning environment. The correctness proof and the security analysis of the proposed authentication scheme are provided, highlighting its increased security and fast performance in comparison to a single-proof design. The blockchain performs the role of verifier within the authentication scheme, reducing unnecessary communication overhead. Moreover, the blockchain improves system resilience by providing fault tolerance to the decentralized verification process. Platooning records are stored directly on the digital ledger to guarantee data immutability and integrity, while the programmable access control policies ensure data privacy. The experimental results demonstrate that the proposed approach can perform authentication on the order of milliseconds, regardless of the number of proofs, highlighting feasibility for real-world deployment in truck platooning.

In [A20], Abbas et al. considers a vehicle-to-infrastructure network where each vehicle in the network has a stream of data for transmission to the roadside unit (RSU). The information from vehicles is collected when they enter the communication range of an RSU as timely as possible. The freshness requirement of these status updates systems is achieved by optimizing the scheduling policy adopted by the vehicles while transmitting their information to the RSU. This paper proposes a hybrid access mechanism consisting of both orthogonal and non-orthogonal multiple access that schedules the transmission of packets from vehicles to the RSU where each vehicle has a finite length queue. The transmission of the packets is modeled using a Markov decision process, where a specific cost function is optimized to collect maximum information from the vehicles in minimum time. OMA gives higher AoI and probability of packet drops while its outage probability is lower, while NOMA gives lower AoI and probability of packet drops before transmission while the outage probability of NOMA is higher which does not always make NOMA better choice. The proposed hybrid scheduling method outperforms the conventional in optimizing the AoI and packet drops probability by switching between OMA and NOMA.

In [A21], Namasudra et al. propose a decentralized and secure cab-sharing system using blockchain technology to solve these problems. The proposed scheme uses the blockchain structure to preserve the driver's and rider's information. Furthermore, it implements the reputation feature to rate drivers and riders based on their travel history without any centralized authority. The proposed scheme is deployed using the Ethereum platform and functionality is designed using smart contracts.

In [A22], Ahmad et al. propose a modified approach based on GRA-WSM, named MA (Modified Approach based on GRA-WSM) for the identification of critical edges that form the backbone of the Chinese air route network. MA is a two-step process: Initially, important nodes are identified using the proposed GRA-WSM, and second, a novel approach is used for the computation of critical edges. Previously, researchers have used edge betweenness centrality measure to identify vital edges. But it took into account the global information of a node. This research work considers different centrality measures as the multi-attribute of the network, to take advantage of each centrality measure. The proposed MA approach aims to minimize the robustness of the network after the removal of some edges and the result is the set of critical edges. The critical edges found by the proposed MA approach are different from the edges that are topologically more important. These findings provide new perspectives on how to better understand other real-world networks.

In [A23], Tan et al. propose a distinctive vehicle-assisted aggregate authentication mechanism for infrastructure-less vehicular networks to deal with unpredictable abnormal situations caused by artificial or natural disasters such as earthquakes and floods. With assistance from the neighboring vehicles, the homomorphic signature involving all requesting vehicles is generated and forwarded to the remaining functional RSUs. Meanwhile, vehicular group communication

among the validated entities is enabled. Additionally, the fault-tolerant verification method is adopted such that the ineffective entities can be easily distinguished and removed without interfering with other requesting vehicles.

In [A24], Li et al. a novel data-driven method is proposed to realize signal phase optimization and recommendation solely using limited amount of real signalized intersection samples. Firstly, all of discrete features related to signal phase design, decoded by one-hot representation, are sampled by the Gumbel-SoftMax distribution, which is a continuous approximation to a multinomial distribution. And with this approximation distribution, the generative adversarial network (GAN) is applied to produce the most acceptable signal phase samples among all acceptable choices, dealing with the problem of too few samples and uneven sample distribution in real world. Thirdly, a decision-tree-based classifier is established to realize signal phase recommendation automatically.

In [A25], Xu et al. propose a novel GNN model, GWCN, to forecast the traffic flow, and allocate edge resources according to the forecast results. Then, a computation offloading algorithm driven by DDPG is designed to obtain a task offloading scheme for edge servers.

In [A26], Sun et al. construct an unmanned aerial vehicle (UAV) enabled MEC system, in which the data generated from IoV applications is processed by offloading to UAVs with MEC servers to ensure the efficiency of data processing and the response time of IoV applications. In order to approximate real-world UAV enabled MEC system, authors consider the stochastic offloading and downloading processing time. Moreover, the priority constraints of sensors from the same vehicle are taken into consideration since they have different importance degrees. Then, they propose an Markov network-based cooperative evolutionary algorithm (MNCEA) to search out the optimal UAV scheduling solution to guarantee the shortest response time, in which the solution space is divided into multiple sub-solution spaces with the help of MN structure and parameters. Finally, they construct multiple simulation experiments with different probability distributions to simulate uncertainty factors.

In [A27], Jemmali et al. focus on improving the efficiency of solar energy plants by proposing a new method to optimize the flying time of battery-based drones to enhance solar plant performance. The proposed method aims to solve scheduling problems that involve monitoring the solar plant within specific time constraints. The main goal is to maximize the drone's minimum total flying time, which can improve the availability and reliability of the solar plant monitoring system. To calculate battery life, time-to-empty values are determined based on battery degradation rates. This problem has been shown to be very difficult to solve. To address this challenge, four categories of enhanced algorithms were developed to schedule drone tasks in managing various activities within large solar parks. The objective is to achieve maximum efficiency in the monitored power plant.

In [A28], Deveci et al. present an efficient hybrid decision-making model based on OPA and RAFSI methodology under q-ROFSs for evaluating the personal mobility alternatives of AVs in the metaverse using 12 criteria grouped under four main aspects: technological, societal, legal and ethical, and transportation. A novel hybrid model based on q-rung orthopair fuzzy sets (qROFSs) is presented to define the framework, calculate weight coefficients, and rank alternatives. First, the problem is structured. Second, qROFSs-based OPA algorithm calculates criteria weights. q-ROFSs based RAFSI (Ranking of Alternatives through Functional mapping of criterion subintervals into a Single Interval) is used to choose the best alternative among the three. AVs in the metaverse controlled by the same central system are determined as the best alternative.

In [A29], Wu et al. a learning-based construction framework is proposed to solve Airport Ground Handling (AGH) problems in an end-to-end fashion. The operation scheduling in AGH involves the interplay among different operations, resulting in an NP-hard problem with complex constraints, including precedence, time windows, and capacity. To improve computation efficiency and mitigate the needs of domain expertise, the model AGH as a complex multiple-fleet vehicle routing problem (VRP), which is then decomposed into sub-problems in fleets. A neural construction heuristic policy is trained with reinforcement learning to solve all subproblems.

In [A30], Tao et al. propose a large-scale coordinated vessel platooning program to minimize transportation energy costs and optimize traffic efficiency while guaranteeing safety. The proposed method is able to minimize transportation energy costs by coordinating platoon formation using a distributed framework of controllers. The most prominent finding to emerge from this study is that the scheduling strategy combines vessels into vessel platooning, which transportation costs and efficiency are better than a fixed origin route in the waterway network.

In [A31], Almutlaq et al. propose a two-stage intrusion detection system (IDS) in Intelligent Transportation Systems (ITS) to protect against cyber-attacks in Internet of Vehicles (IoVs) networks. Deep learning models have been used in IDSs but their black-box nature limits their use in decision systems and requires powerful processing capabilities. To address these issues, the proposed IDS system uses rule extraction methods from deep neural networks in two stages to analyze network traffic and distinguish between normal and attack traffic. Three variants of rule extraction are proposed, with homogeneous $DeepRed$ being the most effective in all cases tested on benchmark datasets, including external network communications and in-vehicle communications. The IDS system combines rule extraction and a two-stage architecture to reduce resource consumption and improve classification accuracy.

In [A32], Dong et al. propose a configuration of multi-source traction system for urban rail transit, together with a coordinated control strategy considering power profile of the system, based on the existing traction substation. The proposed system, including conventional traction system, renewable energy source, and energy storage system, has been modelled first. After that, considering the system dynamic performance and energy storage capacity, a coordinated control strategy is designed to manage the system energy flow. The coordinated control strategy considers the substation voltage

as control signal which is optimized by proposed performance index.

In [A33], Deveci et al. four different alternatives, which are the operation of autonomous buses for special uses, the operation of autonomous buses for last-mile uses, the operation of autonomous vehicles in mixed traffic, and the operation of autonomous buses in closed systems, are evaluated based on eleven different criteria, which are grouped under four main aspects. Authors propose an Ordinal Priority Approach (OPA) method for determining the criteria weights and application of Dombi Bonferroni (DOBI) methodology for evaluation of alternatives.

In [A34], Sangaiah et al. the proposed approach optimizes intergroup communication. Hierarchical clustering divides clusters into sub-clusters, enhancing data storage and processing. Authors promote information sharing by strategically clustering vehicles and forming relevant dendrogram-based clusters. Their method demonstrates superior Quality of Service (QoS) outcomes, with significant advantages over AIVISN in delay, PDR, overhead, and Dropped packets.

In [A35], Yuan et al. focus on the basic stochastic gradient descent (SGD) algorithm and propose a decentralized parallel SGD algorithm (DPSGD-WB) for the complex IIoV. The algorithm is based on weight-balancing to overcome the difficulty caused by the dynamic and asymmetric connectivity in IIoV.

In [A36], Khosravi et al. describe a unique way to assess crowd condition, which expands the scope of human-vehicle interactions. Moreover, they use fuzzy logic ranking to improve the system's ability to detect anomalies in crowds. In order to improve decision-making, a novel deep transfer learning (DTL) technique is applied to the UAV's received frames.

In [A37], Cai et al. utilize and improve the trust model to prevent the waste of computation resources. Meanwhile, they introduce a Trusted Parallel Optimization on Route Planning based on Dual-level Grid index to continuously handle the process of route planning in parallel. Considering the evolving traffic condition, they employ a Long Short-Term Memory neural network to periodically predict the weights of roads.

In [A38], Chougule et al. show how sleep staging varies from microsleep prediction in the presented research work. The suggested model uses an attention-based mechanism that combines the advantages of Wavelet transform with Short Time Fourier Transform (STFT) Spectrogram. Furthermore, the research demonstrates a robust deep-learning model with separate "time-dependent" and "time-independent" portions that can capture contexts from a sequence of features while simultaneously learning intra-epoch relations.

In [A39], Cao et al. propose a novel "knowledge + data" co-driven solution for TSR, which realizes the model's reasoning ability to zero-shot TSR based on prior knowledge of traffic sign design standards.

In [A40], Liu et al. introduce fuzzy sets into the visual tracking process to assess the quality of the tracking detection map. Fuzzy inference is used to analyze the tracking accuracy, and diversified target apparent features are mined from historical frame information. Based on this, they propose an enhanced template update strategy that adds high-quality matching templates to the template pool. When the quality of the tracking detection map was poor, they matched the template from the constructed template pool to address the challenges of target deformation, occlusion, and background clutter in intelligent transportation scenarios.

In [A41], Gu et al. a new transferable Takagi-Sugeno-Kang (TSK) fuzzy classifier with multi-views is developed for EEG-based driving fatigue recognition in intelligent transportation. Especially, the view-specific consequent regularizer and the view-shared consequent regularizer with the principle of multi-view learning are constructed in consequent parameter learning. In view-specific consequent regularizer learning, the strategies of ridge regression, maximum mean discrepancy, manifold regularization is adopted, and the $2,1\ell$-norm sparsity constraint is used to simplify fuzzy rules. The principle of multi-view learning consensus and complementarity is adopted in the view-shared consequent regularizer learning. The $2,1\ell$-norm sparse constraint is also implemented on the view-shared consequent regularizer to capture the local structure of multi-view data. Finally, the TSK fuzzy classifier in the target domain is constructed based on view-specific regularizers and view weights.

In [A42], Li et al. the transportation router is presented to form a large-scale automatic transportation solution based on the established transportation switching and routing models. By separating the control plane and the transport plane of the transportation router, the software- defined transportation (SDT) is presented to further enhance transportation routing and provide Internet-like transportation capabilities such as centralized intelligent control, terminal plug-and- play, and open application ecology.

In [A43], Bucchiarone et al. present an end-to-end solution, called Play&Go Corporate, for enabling urban cyclability and its concrete exploitation in the realization of a home-to-work sustainable mobility campaign (i.e., Bike2Work) targeting employees of public and private companies. To evaluate the effectiveness of the proposed solution they developed two analyses: the first to carefully analyze the user experience and any behaviour change related to the Bike2Work mobility campaign, and the second to demonstrate how exploiting the collected data they can potentially inform and guide the involved municipality (i.e., Ferrara, a city in Northern Italy) in improving urban cyclability.

In [A44], Cheng et al. propose a 3D vehicle object tracking algorithm based on bounding box similarity measurement. The algorithm includes state prediction, temporal association, trajectory management, state update, and other processes. Also incorporated is a vehicle object temporal association method based on a siamese encoder.

In [A45], Andreou et al. a novel framework is proposed to optimise the network's coverage within the intelligent transportation ecosystem. The proposed method enhanced the roadside units' network by deploying an innovative algorithmic technique that constructs Voronoi diagrams using circles. In addition, the Poison point procedure was used to determine the optimal installation locations for the transceivers. After

the required iterations, the simulation results presented a full network coverage for the tested area.

In [A46], Anbalagan et al. propose an Intelligent IDS (IIDS) to enhance intrusion detection and categorize malicious AVs using a modified Convolutional Neural Network (CNN) with hyperparameter optimization approaches for IoV systems. The proposed IIDS framework works in a 5G Vehicle-to-Everything (V2X) environment to effectively broadcast messages about malicious AVs. Thus IIDS aids in preventing collisions and chaos, enhancing safety monitoring in the traffic.

In [A47], Li et al. a periodic attentional graph convolutional spatio-temporal network model is proposed for the demand of traffic analysis in intelligent transportation system, which includes a bicomponent attention graph convolution model and a periodic attentional gated recurrent unit model. The former uses GCN to extract spatial features from pointwise and edgewise graphs; the latter uses the spatial feature vectors extracted from the former with external information as input, and uses GRU to extract temporal features from feature data of different periods. Finally, the attention mechanism and POI requirement model are used to integrate the extracted spatio-temporal information to derive prediction results.

In [A48], Fong et al. take an in-depth look into vehicle-to-infrastructure (V2I) network and a vehicular cloud integrated solution for micromobility sustainability in the context of smart city development. Micromobility's inherent characteristics, such as reduced carbon emissions and alleviated traffic congestion, improve air quality to meet the sustainable goals of smart cities. Leveraging vehicular communication technologies by using artificial intelligence to optimize micromobility deployment. The design and implementation of real-time data platform that supports the efficient allocation and management of micromobility resources to tackle challenges associated with parking and road congestion in a sustainable smart city environment through adaptability, safety enhancement, and equitable access. Sustainable smart city infrastructure design ensures that micromobility services are accessible to all segments of society from commuters to vulnerable populations.

In [A49], Xu et al. propose a lightweight real-time semantic segmentation network called LETNet. LETNet combines a U-shaped CNN with Transformer effectively in a capsule embedding style to compensate for respective deficiencies. Meanwhile, the elaborately designed Lightweight Dilated Bottleneck (LDB) module and Feature Enhancement (FE) module cultivate a positive impact on training from scratch simultaneously.

In [A50], Cheng et al. propose a novel class-imbalanced ship motion data-based cross-scale model for SSE. The model consists of three major components: a multi-scale feature learning module, a cross-scale feature learning module, and a prototype classifier module. The multi-scale and cross-scale feature learning modules are designed to learn abundant coarse and fine-level features from the ship motion data. The prototype classifier is utilized to overcome the limitation of the conventional softmax classifier to produce better estimates. Ablation and sensitivity studies, emphasize the critical role of each model component. The findings underscore the model's robustness and its potential to advance time series classification in diverse domains.

In [A51], Guo et al. propose a scale region recognition network. It has two key components, termed scale level awareness (SLA) module and object region recognition (ORR) module. The SLA module aims to encode the representations at multiple scales, which are beneficial to address the scale variation. The ORR module is designed to suppress background interference through the visual attention mechanism. Extensive experimental results on four crowd counting datasets and five vehicle counting datasets have demonstrated the superiority of the proposed SRRNet in both counting accuracy and robustness compared with the mainstream competitors. Meanwhile, substantial ablation studies have proved the effectiveness of the proposed SLA and ORS modules.

In [A52], Li et al. a novel two-stage robust model for the design of electric Demand-Responsive Transit routing and partial recharging schedule is proposed to dynamically integrate recharging plans with flexible transit service schedules. A tailored two-phase Adaptive Large Neighborhood Search heuristic exploiting the problem structure is presented. Numerical studies to verify the superior performance in both dynamic and deterministic settings.

In [A53], Liu et al. propose a deep reinforcement learning-based approach to automatically configure Internet of Vehicles (IoV) network settings. Specifically, they use a collection of neural networks to convert the observations of a communication environment (channel power gain, cross-channel power gain, etc.) into key features, which are then supplied to a deep Q neural network (DQN) as input for training. Afterward, the DQN selects the optimal network configuration for vehicles in the IoV environment. In addition, their approach considers both centralized and distributed training strategies. The centralized training strategy conducts the DQN training process on a roadside server, while the distributed training strategy trains the DQN on vehicles locally.

In [A54], Li et al. an innovative fuzzy group decision-making model is designed for assessing regional transportation sustainability, focusing on the correlation between various attributes of the evaluation system. The focus of this model is the partitioned Maclaurin symmetric mean operator because of its better applicability when considering attribute correlation and attribute grouping. The modified spherical fuzzy partitioned Maclaurin symmetric mean operator is proposed, which has superior application scope. Its weighted form and special cases are discussed. Then, the extended statistical variance method and the evidence-based Bayes approximation method are used to obtain weight vectors of attributes and experts. In addition, a fuzzy assessment model of sustainable transportation is developed. Finally, a numerical example of regional transportation sustainability assessment and a comparison with previous studies are presented to illustrate the feasibility and universality of this method.

In [A55], Dong et al. present IoV-based motor vehicle (V2V) models for energy trading. A fog-based architecture for real-time EV communication and a system that maximizes energy transfer while considering costs and profits are challenges. The research introduces a computationally efficient

double-sided auction for bidding techniques that maximizes social welfare and energy trading volume.

In [A56], Li et al. propose a blockchain-based intelligent and fair IoV charging service system. According to the multi-factor constraints between vehicles and charging piles, a multi-factor IoV branch and bound algorithm is proposed to intelligently recommend charging piles for vehicles and maximize the overall energy saving. The paper proposes the cross-area consensus protocol to achieve low latency in vehicle communication. In addition, the proposal ensures the fairness between charging and payment through a payment channel protocol based on verifiable encrypted signatures.

In [A57], Luo et al. propose BSL, a novel multi-exit split learning-based collaborative inference system. The key innovation of BSL is the introduction of multi-exit to the split network, enabling network training and collaborative inference between distributed device nodes and the cloud in a split manner. Specifically, BSL allows the device node to dynamically collaborate with the cloud by introducing the edge mode and collaboration mode, ensuring that intelligent services provided to the device will be sustained even if the communication is interrupted, which is crucial in ITS systems.

In [A58], Mansourian et al. present a prediction-based IDS framework for detecting anomalies and attacks on a CAN bus. Two prediction modules, an LSTM and a ConvLSTM network, are introduced to analyze and predict temporal and spatiotemporal correlations in message contents, respectively. Anomalies are classified using a Gaussian Naïve Bayes classifier based on prediction errors. The proposed IDS is evaluated against other classifiers and existing works using the Car Hacking Dataset. Results show its superior accuracy, achieving almost 100% F-scores and detection accuracy. The paper also includes a comparison of the suggested architectures and their use cases, highlighting the effectiveness of the proposed method in detecting CAN bus anomalies and attacks.

In [A59], Liu et al. propose a DeepFM-based nonparametric model (DFMNP) for predicting passenger car sales in sustainable way. They use a big data platform to provide data for the DFMNP model. The DFMNP model uses feature engineering to expand the number of explicit features, a multilayer neural network to extract implicit features, and a Bayesian neural network to replace the neural network with fixed weights for inferring predictive values. In addition, a factorization machine is used in the prediction function to take into account the cross information of implicit features. The combination of the above improvement points can be used to improve the model's expressive and predictive power for unknown data.

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APPENDIX: RELATED ARTICLES

[A1] W.-L. Shang et al., "Benchmark analysis for robustness of multi-scale urban road networks under global disruptions," *IEEE Trans. Intell. Transp. Syst.*, early access, Feb. 16, 2022, doi: 10.1109/TITS.2022.3149969.

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