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EDITORIAL

Editorial: deep learning for 5G IoT systems

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In recent years, deep learning (DL) architectures, such as: deep neural networks, deep belief networks, recurrent neural networks and convolutional neural networks; have been successfully applied to many fields, where deep learning systems have produced results comparable to and in some cases better than human experts.

There is an increasing number of 5G IoT systems, due to the advancement of electronics and communication techniques (e.g., wearable electronics, IoT devices, and 5G telecommunication solutions). These technologies have enhanced the quality and performance of urban and suburban services, including healthcare, transport, energy, traffic, to name few.

In recent years, with the prevalence of 5G IoT systems, DL technologies enable more autonomous and intelligent functions. The secure intelligent IT solutions of these systems have become more and more important as more and more personal data are generated and communicated through such modern 5G IoT systems, and increasing number of devices and servers process large volume of data in real-time.

This special issue consists of articles, which are recent advances in this area. The summary of these papers is as follows.

Paper "Top view multiple people tracking by detection using deep SORT and YOLOv3 with transfer learning: within 5G infrastructure" presented multiple people tracking framework, which uses 5G infrastructure. To perform a person tracking, deep learning-based tracking by detection framework is proposed, which includes detection by YOLOv3 and tracking by Deep SORT algorithm. The model is pre-trained using the frontal view images, and gives good detection results. In order to further enhance the accuracy of the detection model, the transfer learning approach is adopted. In this way, a detection model takes advantage of a pre-trained model appended with an additional trained layer using top view data set.

The paper "Improved VGG model based efficient traffic sign recognition for safe driving in 5G scenarios" proposed an improved VGG convolutional neural network. To optimize the overall architecture and accelerate calculation, they removed convolutional layers and the number of parameters of VGG-16 network. To improve the accuracy, they added the BN (batch normalization) layer and GAP (global average pooling) layer.

The paper "Sentence Pair Modeling Based on Semantic Feature Map for Human Interaction with IoT Devices" proposes a novel neural model called Semantic Feature Map (SFM) for more effectively performing the Sentence pair modeling (SPM) task. First, SFM utilizes a 1D CNN on character-granularity and word-granularity respectively to construct multi-dimensional semantic feature maps. Then, SFM utilizes a 2D CNN to capture semantic features within sentences and interactive features between sentences.

The paper "Routing Protocol for Low Power and Lossy Network–Load Balancing Time-Based" proposes time based load balancing, deploys a modified trickle timer algorithm to act as the constructor of the destination oriented directed

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acyclic graph, and to control the messages distribution between nodes.

The paper "Clone Detection in 5G-enabled Social IoT System using Graph Semantics and Deep Learning Model" uses component-based Control Flow Graph (CFG) features to parse android applications for semantic-based clone detection.

The paper "A multiple-kernel clustering based intrusion detection scheme for 5G and IoT networks" proposes an intrusion detection method based on multi-core cluster (MKC) algorithm. This method can effectively improve the clustering accuracy of incomplete sampled data, at the same time it can reduce the sensitivity of the anomaly detection model to the selection of traffic feature, and has a better tolerance for poor-quality traffic sampled data.

The paper "Recurrent Autonomous Autoencoder for Intelligent DDoS Attack Mitigation within the ISP Domain" proposes the recurrent ensemble approach to improve the unsupervised model; utilizes the reference target to direct the unsupervised model. Moving threshold to classify the data makes the model less sensitive to feature selection.

The paper "An Intelligent prediction model for UCG state based on dual-source LSTM" proposes the equivalent gradient to characterize the trends, and the UCG-state-discriminations-standard is established to evaluate the UCG state. A dual-source long short-term memory (LSTM) prediction model is developed for UCG state.

The paper "Ensemble Machine Learning Approach for Classification of IoT Devices in Smart Home" analyzes the possibilities of applying network traffic features of IoT devices for classifying devices. This kind of classification is necessary for a dynamic and heterogeneous environment, such as a smart home. The logistic regression method enhanced by the concept of supervised machine learning (logitboost) is used to develop such a classification model.

The paper "Localizing pedestrians in indoor environments using magnetic field data with term frequency paradigm and deep neural networks" considers the positioning problem as a document classification problem and adopts the Term Frequency (TF) paradigm to solve the problem.

The paper "A Reinforcement Learning Optimization for Future Smart Cities Using Software Defined Networking" proposes Mixed-Integer and Reinforcement Learned Network Optimization method considering latency and convergence time. A Reinforced Q Learning model is designed for communication and computation time.

The paper "IoT Enabled Depthwise Separable Convolution Neural Network with Deep Support Vector Machine for COVID-19 Diagnosis and Classification" presents an IoT enabled Depth wise separable convolution neural network (DWS-CNN) with Deep support vector machine (DSVM) for COVID-19 diagnosis and classification. The proposed DWS-CNN model effectively detects both binary and multiple classes of COVID-19 using Chest X-ray (CXR) image dataset.

The paper "Optimal Deep Learning based Convolution Neural Network for Digital Forensics Face Sketch Synthesis (FSS) in Internet of Things" proposes an IoT-enabled Optimal Deep Learning based Convolutional Neural Network (ODL-CNN) for FSS to assist in the suspect identification process. The ODL-CNN model automatically draws the sketches of the input images following which it undergoes similarity assessment, with a professional sketch being drawn as per the directions from eyewitnesses. When the similarity between both the sketches are high, the suspect gets identified.

The paper "Energy and spectrum aware unequal clustering with deep learning based primary user classification in cognitive radio sensor networks" proposes ESAUC protocol, improves fairness by achieving residual energy balance among the sensor nodes and enhances the network lifetime by reducing the overall energy consumption in cognitive radio sensor network. Deep Belief Networks is exploited to predict the spectrum holes. ESAUC improves the stability of the cluster by optimally adjusting the number of common channels. ESAUC uses a CogAODV based routing mechanism for inter-cluster forwarding.

The paper "Generating Transferable Adversarial Examples Based on Perceptually-Aligned Perturbation" explored models with adversarial training, which are sensitive to the perceptually-relevant gradients; to enhance the transferability of adversarial examples against robust models by methods that synthesize perceptually-aligned features, to optimize the loss function over an ensemble of random noised inputs; then to improve the transferability through the edge preserving Perona-Malik filter.

The paper "Reduced PAPR Model Predictive Control based FBMC/OQAM Signal for NB-IoT Paradigm" proposed a novel cost-effective and low complexity solution to utilize Model Predictive Control (MPC) algorithm for the optimization of PAPR of FBMC/OQAM transmitted signal. A significant reduction in PAPR of the FBMC/OQAM signal has been observed with negligible change in the BER of the system.

The paper "Adversarial Examples: Attacks and Defences in the Physical World" presents a comprehensive overview of adversarial attacks and defense in the real physical world, and proposes potential research directions for the attack and defense of adversarial examples.

The paper "DDoS Detection in 5G-Enabled IoT Network Using Deep Kalman Backpropagation Neural Network" presents a DDoS intrusion detection model that can be implemented in IoT dynamic environments.

The paper "Deep Transfer Learning-based Network Traffic Classification for Scarce Dataset in 5G IoT Systems" presents a traffic classification method based on deep transfer

learning for 5G IoT scenarios with scarce labelled data and limited computing capability, which trains the classification model by weight transferring and neural network fine-tuning.

In summary, this special issue can be a useful reference to academia, researchers, and industrial practitioners who are interested in recent advancement in deep learning techniques and 5G IoT systems.

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