

Editorial

Special Issue on Recent Advances in Machine Learning and Applications

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Digital technologies for cyber-physical systems are rapidly advancing, and the ubiquity of the Internet of Things (IoT) has created significant challenges for academic, industrial, and service applications due to high dimensionality, noise contamination, incompleteness, inconsistency, and massive amounts of data. Artificial intelligence models based on machine learning (ML) are used in data analytics and process optimization, which play a significant role in many research areas. Since 2012, various machine learning technologies have quickly developed and proven to be of substantial practical value in various application domains. Several complex industrial problems have been solved with such technology in the AI community, including predictive maintenance, process optimization, task scheduling, quality improvement, supply and demand forecasting, defect detection, vibration signal recognition, and many others. Machine learning is one of the liveliest discussion areas and is central to the current technological development process. In manufacturing, service, and medicine, machine learning can be used to find bottlenecks in various processes.

This Special Issue of *Processes*, entitled “Recent Advances in Machine Learning and Applications” (https://www.mdpi.com/journal/processes/special_issues/machine_machine_applications, accessed on 11 November 2022), focuses on publishing high-quality original research studies that address challenges in the broad area of optimization and artificial intelligence in-process applications. Twenty-three high-quality papers were eventually selected based on the quality of their work, reviewers’ comments, and editorial judgment. This Special Issue covers a wide range of topics, and we believe that the papers published in it are highly relevant to researchers in the field. The contributions of these papers regarding the methods used are highlighted below.

1. Application of Manufacturing Processes

Machine learning technology can identify bottlenecks in R&D, design, production, manufacturing, and sales in manufacturing. Rapid analysis of technical documents helps a researcher understand the state-of-the-art technological advancements in a specific field by efficiently reading and understanding many technical papers, including patent documents. To extract and display chemical processes disclosed in patent documents. Trappey et al. [1] provide accurate and effective results using text mining, machine learning, and knowledge visualization techniques. For automatic paragraph text classification, a machine learning model called ALBERT is trained using a computer framework. In order to detect potential useful technical information hidden in patents and scientific papers, the authors propose a framework that combines patent analysis and scientific paper analysis. In Wang et al.’s [2] study, refrigerated containers were used to store the samples. The proposed framework demonstrated the ability to display the development trend of technology and identify potential opportunities for technological innovation directly and comprehensively.

Regarding the quality of manufacturing production, Cheng et al. [3] proposed a novel control chart of the pattern recognition (CCPR) technique based on an end-to-end 1D CNN model to deal with the data scarcity problem and explore the introduction of transfer



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learning techniques for monitoring process variation. Jen et al. [4], using empirical mode decomposition and intrinsic mode functions, the authors developed a control system for monitoring process anomalies in real-time using sound and vibration frequency signals. Moreover, simulated process data and ECG data confirm that the proposed approach is feasible. Non-traditional processing (NTM) uses the manual investigation of process parameters, which is time-consuming and costly. To develop predictive models for the NTM process, Shanmugasundar et al. [5] used three popular machine learning (ML) methods: linear regression, random forest regression, and AdaBoost regression. Luo et al. [6] propose a model based on deep Wasserstein generative adversarial networks with gradient penalty (DWGANP) to deal with imbalanced fault samples in industrial rotating machinery. In this model, synthetic samples will be generated from the unbalanced fault data set using the sample generation network. A one-dimensional convolutional neural network with a specific structure is then used as a fault diagnosis network to classify the reconstructed equilibrium samples.

On the applicability of the prediction problem, in semiconductor manufacturing plants, the inventory problem is caused by an uncertain demand for IC pallets. Wang et al. [7] proposed rolling forecast models using ARIMA and LSTM techniques, which are validated by importing them into actual data. Providing accurate order demand forecasts and effective and continuous inventory reduction is possible. Stier et al. [8] used the Multiresolution technique for forecasting time series to develop forecasting models that do not require user-set parameters based on the convenience of rapid implementation in R and Python. Using four applications to verify their validity, they schedule call centers, arrange electricity demand, forecast stock prices and stocks, and schedule a call center.

On the optimization of transport terminal planning, Inter-terminal transportation forms a complex transportation network in large ports, and the use of trucks in ITT operations leads to the inter-terminal truck routing problem (ITTRP). Adi et al. [9] propose a cooperative multi-agent deep reinforcement learning (RL) method to produce TO truck routes that minimize ETTC and truck waiting time. In addition, information security is also an essential issue in moving toward smart manufacturing. Khan [10] proposed an intrusion detection (ID) system for HCRNNIDS architecture to predict and classify malicious network attacks in networks by applying Deep learning techniques to the cyber-attack issue of information security.

On the energy forecast, 10.7 cm solar radio flux varies daily, and it can be challenging to predict the time series. To achieve end-to-end F10.7 prediction, Luo et al. [11] proposed a nonlinear approach, combining convolutional and long-term memory networks. The results show that 1–27-day predictions are generally better than single neural network predictions.

2. Application of Service Processes

During the service processes, voice recognition, email anomaly detection, and passenger prediction are the bottlenecks in practice. When speaking a foreign language or a second language, one's first language accent is likely to emerge, giving the individual a 'strange' accent. It is a very challenging problem in speech recognition. Jambi et al. [12] discuss Speak Correct, an interface for computerized linguists. According to an empirical study, feature-based combinatorial assessment approaches are more effective than other methods for assessing fluency. Amjad et al. [13] propose a novel approach to recognizing semi-natural and spontaneous speech emotions by combining multiple features and deep neural networks (DNNs). A framework is used to extract the most discriminatory features from a mixed set of acoustic features. After obtaining relevant features through fusion methods, support vector machine algorithms were used to determine the most discriminative audio feature maps.

For detecting mail quality problems, Twitter is one of the most popular networks in the Middle East. Due to the lack of effective technologies supporting the Arabic language, Arab countries are among the most targeted. Alhassun et al. [14] used two types of data to identify spam accounts, text-based data with a convolutional neural network (CNN) model and metadata with a simple neural network. Delays in software testing are a practical

concern. For making a trustworthy process for testing distributed software in a distributed development setting, Alharbi et al. [15] used the Fuzzy TOPSIS-based multiple-criteria decision-making approach to assist the software development team in understanding the various challenges of distributed software testing so that a trustworthy process or a reliable testing solution can be developed for distributed software testing amid the COVID-19 pandemic and to meet the user's needs.

Regarding the passenger forecast issue, the order cancellation prediction in the service industry suffers from class imbalance. Adil et al. [16] shortened this gap by introducing an oversampling technique to address class imbalance problems in conjunction with machine learning algorithms to predict hotel booking cancellations better. To forecast tourist arrivals based on search intensities indices (SII), Adil et al. [17] propose a bidirectional long-short-term memory (BiLSTM) neural network. Unlike a simple long-short-term memory network that can only remember information from left to right, the BiLSTM network can recall information from left to right and right to left. A seasonal and trend decomposition using the Loess (STL) approach is used to decompose time series tourist arrival data. This approach is called STL-BiLSTM. This method has been validated by predicting future visitor numbers more accurately than traditional methods. In addition, we include two articles on the intelligent interaction of sports performance prediction and learning processes.

For the outcome of the sports prediction process, Liu et al. [18] apply five machine learning methods, including classification and regression trees (CART), random forest (RF), stochastic gradient boosting (SGB), eXtreme gradient boosting (XGBoost), and extreme learning machine (ELM), to process by integrating adaptive weighted features and machine learning algorithms for score prediction of NBA basketball games. The negative emotions gradually accumulate without resolution, which can cause long-term adverse effects on students' physical and mental health. However, the demand often exceeds the counseling capacities due to the limited number of counselors/psychologists. Thus, students may not receive immediate counseling or treatments. Trappey et al. [19] combined the immersive virtual reality (VR) technique with the psychological knowledge base to develop a VR empathy-centric counseling chatbot (VRECC). Through multi-turn (verbal or text) conversations with the chatbot, the system can demonstrate empathy and give therapist-like responses to the users.

3. Application of Medical Processes

We collected four medical services and disease prediction issues in the medical process. Patients with diabetes and end-stage renal disease are at high risk of upper extremity vascular disease (UEVD) and atherosclerosis. Early detection of UEVD is possible using photodensitometers (PPG). Based on time-domain PPG analysis, Chen et al. [20] used a Duffing–Holmes system with a master system and a slave system to extract self-synchronization dynamic errors, which can track the differences in PPG morphology and time delay between healthy subjects and PAD patients. A one-dimensional convolutional neural network is established as a multilayer classifier for the automatic detection of UEVD. Liu et al. [21] propose an ensemble framework based on stacking model fusion to detect the etiology of cardiovascular disease, with the Logistic Regression (LR) simple linear classifier as the meta-learner to avoid overfitting caused by the base learners. Results can be used to predict patients with CVD and can be used to identify high-risk patients and target them for early clinical intervention to reduce the likelihood of CVD developing.

Regarding medical data anomaly detection, Alharbe et al. [22] proposed the development of a medical quality assessment model for Saudi Arabia based on big medical data collected by the National Center for Health Information using an outlier detection algorithm. Outlier indicators are calculated using statistical methods and an improved KNN algorithm. In addition, gender classification using facial images with masks during the pandemic era is one of the most challenging classification tasks. Rasheed et al. [23] using multiple pre-trained deep learning networks (DenseNet121, DenseNet169, ResNet50, ResNet101, Xception, InceptionV3, MobileNetV2, EfficientNetB0, and VGG16) to identify a person's gender (male/female) was proposed to analyze the effect of the mask when identi-

fying gender based on facial images of humans. Many applications, including intelligent human–computer interfaces, can benefit from this gender classification approach.

While there are still many exciting types of advances in machine learning and applications that have not been considered in this Special Issue, they need to be investigated to reveal valuable insights into topics that improve the process with innovation. We sincerely thank our anonymous reviewers for their valuable contributions to this Special Issue.

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