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Not peer-reviewed version

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Posted Date: 7 September 2023

doi: 10.20944/preprints202309.0458.v1

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Article

The Future of Electronic Commerce in the IoT Environment

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Abstract: The Internet of Things (IoT) was born from the fusion of virtual and physical space and became the initiator of many scientific fields. Economic sustainability is the key to further development and progress. Today, the need for electronic commerce has become an economic priority in the transition period between Industry 4.0 and Industry 5.0. Unlike mass production in Industry 4.0, customized production in Industry 5.0 should reach its true potential in vertically organized management and decision-making systems. The authors focused their research on e-commerce based on the three-level vertical IoT environment and the edge, fog, and cloud computing. The paper presents hands-on machine learning (ML) algorithms to facilitate the transition from a flat to a vertical e-commerce concept. The authors also propose practical ML algorithms for a few e-commerce types: consumer-consumer relationships and consumer-company-consumer relationships. These algorithms are mainly composed of convolution neural networks (CNN), natural language understanding (NLU) and sequential pattern mining (SPM), reinforcement learning (RL for agent training), algorithms for clicking on the item prediction, consumer behavior learning, etc. All presented concepts, algorithms, and models are described in detail.

Keywords: Electronic Commerce (E-commerce); Internet of Things (IoT); Artificial intelligence; Machine Learning; Fuzzy Logic; Industry 4.0; Industry 5.0

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1. Introduction

The world around us is changing at an alarming rate. There is a need for more data processing and analysis to improve the existing and develop novel decision-making frameworks in the E-commerce space. "Nowadays, we are living in the age of Industry 4.0," historians like to say. Today's control and management (hardware and virtual) systems monitor real-time processes with the goal of decentralized hierarchical decision-making.

The term Internet of Things was coined to highlight the fusion of virtual and physical spaces. The IoT implementation should improve existing services and provide new services. [1]. The IoT is a virtual space composed of networked smart devices, virtual-physical assets, information technologies, and computer platforms. Since the end of the XX century, cyber and physical space fusion has become pivotal in improving communication and business.

Industrial revolutions unlike social revolutions, achieve their progress through evolution, not revolution. We have not yet been fully involved in the Industry 4.0 era, and it is already being said that the Industry 5.0 era is beginning. Industry 5.0 has its root in the concept of Industry 4.0 [2]. To understand these paradigms, we have to understand their main properties. The key features of Industry 4.0 are: smart technology, smart environment, mass production, Machine-to-Machine communication (M2M), full practical implementation of IoT with the edge, fog, and cloud computing, artificial intelligence (machine learning, big data, fuzzy logic, cognitive computing, collaborative robots, etc.), augmented reality, hierarchical data and information processing, and automated decision-making [3,4]. Using big data analytics on unstructured data can be challenging but rewarding. The

IoT was the driver of the development of Industry 4.0. Therefore, it is realistic to expect continued development in Industry 5.0.

The significant limitations and disadvantages of the Industry 4.0 are as follows [5,6]:

- High dependence on technology.
- Full hands-on IoT implementation. Development of IoT derivatives for better implementation in various industrial, business and commerce branches: Industrial Internet of Things (IIoT), Military Internet of Things (MIoT), Green Internet of Things (GIoT), Green Industrial Internet of Things (GIIoT), etc.
- An unevenness of mandatory initial investments in related economic areas.
- Demands for rapid comprehensive progress cause disruptions in the industry due to inconsistency in the industrial growth of certain industrial branches.
- The need for constant updates can cause disruptions in the sustainable development of certain companies.
- An economic gap exists between traditional and business models adapted to Industry 4.0 requests.
- The need for highly skilled experts.
- Increase in unemployment due to reduced need for a labor force (automated machines, unmanned vehicles, etc.).

There are high expectations for Industry 5.0 to overcome these disadvantages and reduce existing limitations. Industry 5.0 is human-centric and reorients priorities from shareholders to stakeholders. In Industry 5.0, custom-oriented production should decrease mass production and increase environmental awareness. It will be easy to carry out the planning and implementation of the green agenda under these circumstances. The initial actors in Industry 5.0 objectives should be manufacturers and consumers. The future environment should enable the interaction of human creativity and artificial intelligence in machines and robots, E-commerce, E-business, medicine, etc. The following challenges and opportunities should encourage the implementation of Industry 5.0:

- Advanced vertical and semi-vertical IoT concepts with clearly defined hierarchical computing at the edge, fog, and cloud levels [7].
- Flexible business and commerce models
- Future collaborative robots can take on and perform boring, tiring, and dangerous tasks.
- Readily available custom software.
- Future technologies should back people to the focus of production.
- Real-time monitoring by smart sensors and systems should ensure better environmental protection.
- Cognitive IIoT;
- Energy-harvesting techniques
- Mass application of artificial intelligence in decision-making algorithms should ensure timely decision-making, faster planning, and better maintenance.
- Better cyber security systems, based on in-depth strategies with customized machine learning algorithms, for faster and better detection of sophisticated intrusion.
- Green machine learning

Uncontrolled mass production generates a lot of industrial waste, unsold products, and storage problems. All this hurts the environment. Unfortunately, in the future, robotic and technology

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dependence will not be avoided. However, fortunately, custom-oriented production should decrease mass production and increase environmental awareness. It will be easy to carry out the planning and implementation of the green agenda under these circumstances.

2. Electronic commerce in the IoT environments

IoT technology has strong penetration in all branches of electronic business [8]. Novel strategies and theories of E-commerce should adequately respond to the IoT, by adapting to all hierarchical levels (edge, fog, and cloud). The Internet of Things highlights and shapes the main aspects of Industry 4.0. E-commerce integrated into the flat IoT structure fully meets the requirements imposed by mass production and consumption. Along with mentioned, the IoT completely redefines the E-market with great business opportunities. Two main IoT concepts, flat and vertical are shown in Figure 1, Figure 2, and Figure 3 [9].

When it comes to E-commerce, IoT has numerous advantages [10]. Online orders provide opportunities for planning production and inventory. Some authors believe that the main advantage of IoT is inventory management and supply chain management over precise product tracking and locating [11]. The hands-on IoT applications enable the following improvements:

- High-quality commodity management (reducing warehouse costs and shortening delivery times).
- More efficient distribution and transport (goods tracking in real-time).
- The solving problem of asymmetric information.

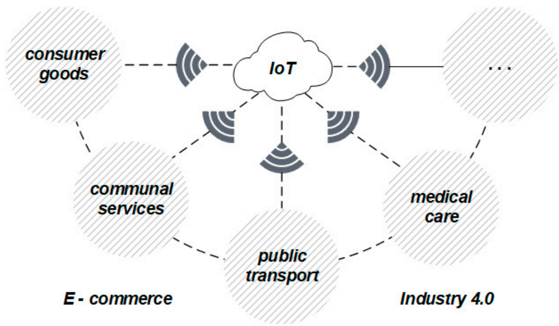

Figure 1. General flat IoT concept.

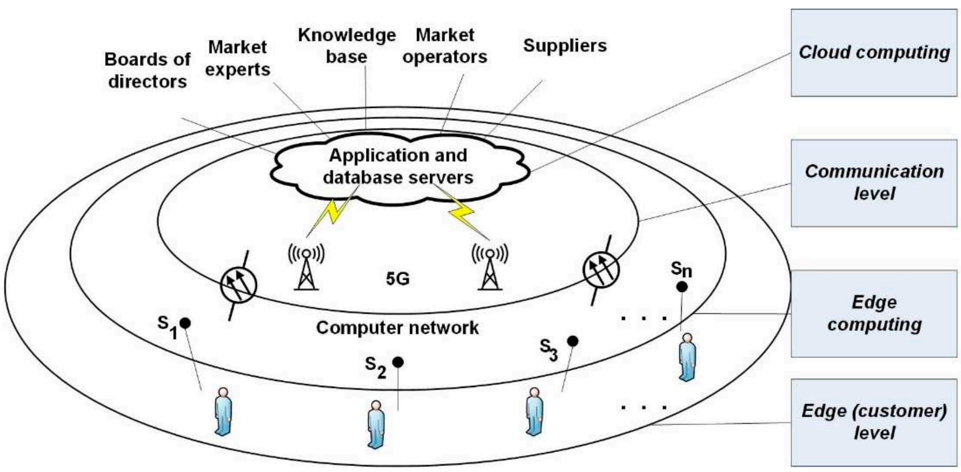

Figure 2. Flat IoT concept composed of cloud and communication levels.

One of the main drivers of the evolution of Industry 4.0 into Industry 5.0 is the need for environmental protection in a sustainable and human-centered industry in the digital age [12]. The commerce sustainability in Industry 4.0 depends on many factors and requires a combination of several

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scientific fields [13]. The evolution from Industry 4.0 to Industry 5.0 represents a fundamental shift from mass production to customized production.

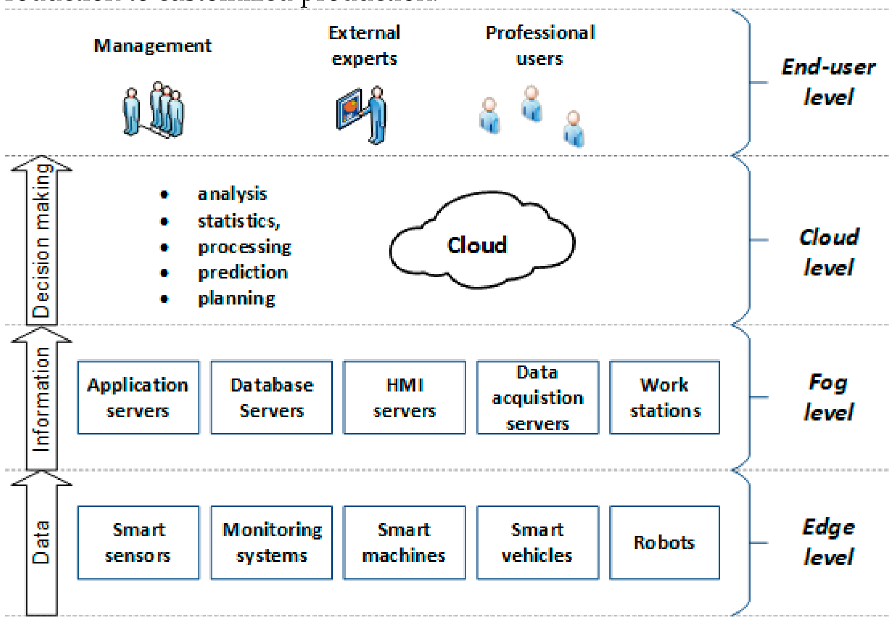

Figure 3. Vertical IoT concept.

In Industry 5.0, customized production should be seen as the one-direction multiphase process from customer needs to the final product. The need to focus on the end user should narrow the width of a flat business. In addition to the "brick and mortar" stores, E-commerce in Industry 5.0 requires a vertical organization of IoT.

Several practical case studies have shown that the Industrial IoT (IIoT) vertical concept represents a well-ordered hierarchical framework for management, control, monitoring, and "in-depth" cyber security [14,15]. The following five steps define the vertical concept of IIoT:

1. Measuring
2. Data gathering
3. Data processing
4. Information processing
5. Decision making

Following the above, the E-commerce transition needs should be achieved by the shift from the flat IoT concept to the vertical IoT concept, with substantial use of machine learning (ML) methods and algorithms. The IoT vertical structure implies hierarchical data and information processing distributed by IoT levels (edge, fog, and cloud). Even though an IoT environment produces a large amount of data, it is questionable how much can be directly used for IoT services [16]. From the "knowledge cycle value chain" aspect at the edge level, raw data transformation can be divided into four stages [17]: find, filter, format, and forward.

2.1. Frameworks and concepts

According to MESA International, the definition of smart manufacturing indicates a composition of the business, physical, and digital processes that make up the value chain. Companies should reshape their electronic business (E-business) and offer better digital services to support economic growth in the Industry 5.0 era.

To beat the competition, many trading companies make their approaches to E-commerce and E-business, consequently causing market confusion. Sustainable development includes novel branches such as internet trade, online merchandising, electronic commerce, and electronic business. The authors developed a common framework for E-commerce in the IoT environment to harmonize different commerce strategies, methods, and models. E-commerce is a part of the E-business that supports money transactions and information exchange. Nowadays, E-business is progressing rapidly because of the following fulfilled conditions: fast internet, a large flow of data and information, and the fusion of a few E-commerce types supported by artificial intelligence. Additional conditions are a stable social, economic, and business environment. The main advantages of E-commerce are: expanding the market, reducing business costs, greater efficiency, and 24/7 interaction with consumers. There are nine basic types of e-commerce:

1. G2G—Government to Government
2. G2B—Government to Business (Government to Company)
3. G2C—Government to Consumer (Government to Citizen)
4. B2G—Business to Government (Company to Government)
5. B2B—Business to Business (Company to Company)
6. B2C—Business to Consumer (Company to Consumer/Citizen)
7. C2G—Consumer to Government (Citizen to Government)
8. C2B—Consumer to Business (Consumer/Citizen to Company)
9. C2C—Consumer to Consumer (Citizen to Citizen))

Figure 3 shows the spatial allocation of consumer, business, and government e-commerce following the flat IoT concept that is the "trademark" of Industry 4.0. All these commerce types are arranged in three circular rings (levels) separated by two communication zones (Figure 4).

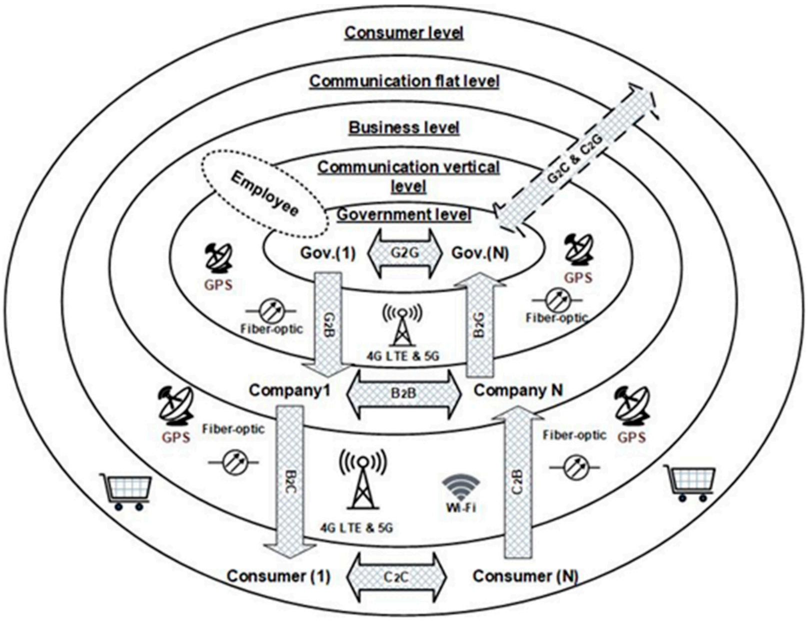

Figure 4. E-commerce and IoT (Industry 4.0)—flat concept.

The IoT concept improves E-commerce by applying the following steps (procedures, tasks, and activities): data and information processing; tracking and logistics; manufacturer and customer interactions and experiences; supply chain and inventory management; market and goods analytics; maintenance and warranties; and reducing costs and increasing income.

The implementation of the vertical IoT concept in Industry 5.0 implies the vertical framework of E-commerce (Figure 5). The main advantages of the proposed concept are as follows: better business security, reliable information, a faster decision-making process, and a better choice of ML algorithms for E-commerce needs.

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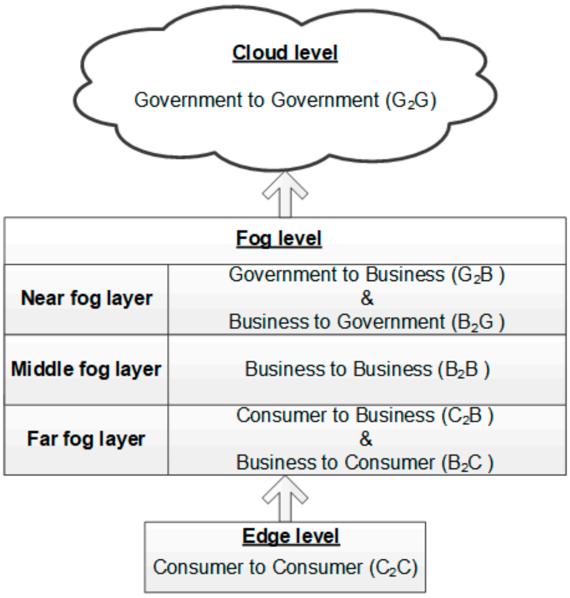

Figure 5. Vertical E-commerce framework in Industry 5.0.

The consumer and business levels should be viewed as flat (IoT) concepts (as circular disks in vertical order) with clustered sets of the same or similar companies and consumers. These two levels are interconnected with each other by communication level. The communication level is composed of fiber-optic, Wi-Fi (router connection), cellular (4G LTE and 5G), and GPS telecommunication networks. Business and Government levels belong to the fog level and represent a vertical structure due to the strictly defined market positions of the company and government organizations. These two levels are also interconnected with each other by communication level. The technical solutions for the upper communication level imply the application of fiber-optic, cellular (4G LTE and 5G), and GPS telecommunication networks, while Wi-Fi networks are less prevalent.

The main disadvantage of information and communications technology (ICT) is cyber-attack vulnerability. Consequently, all types of business and trade on the electronic markets are exposed to security risks. Data and information protection should be key security targets of any commerce organization [18]. Sustainability is not attainable without personal data protection and well-organized e-commerce security. GDPR (General Data Protection Regulation) is a regulation enshrined in human rights and privacy laws and should be a security roadmap for doing business in Industry 5.0. In addition to well-known hardware and software protections against cyber-attacks, E-commerce in the vertical IoT concept is additionally protected thanks to the frequent use of private clouds and in-depth security strategy [7].

2.2. Cross-Border E-commerce

The digital trade, as a transaction based on Internet technology, is defined by US International Trade Commission [19]. The Internet emergence facilitates 24/7 global online electronic commerce. Electronic commerce overcomes the many challenges existing in traditional commerce: unique online marketplace, product accessibility global product accessibility, cost-efficiency of parcel delivery, mitigation of language barriers, overcoming currency differences, reliable and simple online payment methods, protection of personal data etc. Online customers are motivated (lower prices, a wide range of products, ...) to make purchases across borders. This type of e-commerce, known as cross-border e-commerce (CBeC), has been rapidly growing in recent years [20]. CBeC is the youngest (tenth) type of e-commerce involving buyers and sellers from all over the world [21]. Given the importance of E-commerce in smart environments and the digital market, the European Union has a contingent interest in the promotion of CBeC.

3. Artificial intelligence in E-commerce

Business and commerce are the silent drivers of social and technical progress. Strategies for achieving sustainable development goals depend on market trends, the financial climate, and the level of modernization, these strategies rely on economic methods and decision-making algorithms based on artificial intelligence. Artificial intelligence (AI) uses models, methods, and algorithms for prediction, classification, clusterization, control, management, and decision-making based on mathematical-simulated human intelligence. AI development encourages the development of a smart environment and electronic market.

3.1. Fuzzy logic in e-commerce

The decision-making process, based on data and information from different sources, different data categories, and various linguistic formalisms, is very complex. This process is further complicated by different expert opinions and insufficient, and unreliable information. The influence of unpredictable external factors (pandemic, war, natural disasters, etc.) also makes it difficult.

Fuzzy logic has widespread application in e-commerce [22]. The fuzzy rules are created based on the opinions of market experts. Due to their frequent disagreements and different points of view on market trends, it is very convenient to use fuzzy logic models based on fuzzy logic systems—type 2. Fuzzy logic systems are devoted to the fuzzy-decision-making process [23]. Figure 6 shows a fuzzy logic system type 2 (FLS-T2) that is improved and adapted for e-commerce.

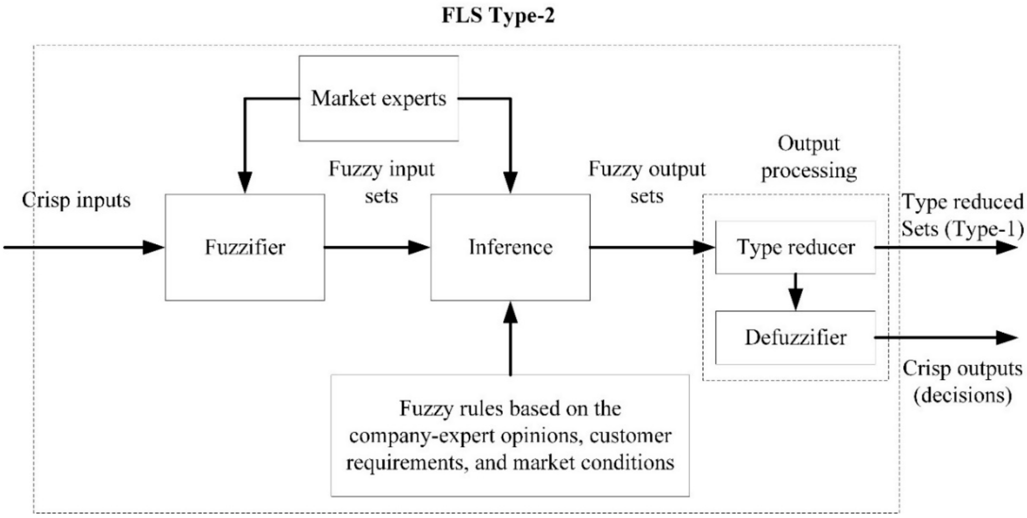

Figure 6. Improved Fuzzy logic system Type-2.

Unlike the well-known framework of the fuzzy logic system type-2 (FLS-T2) [24], Figure 6 shows an improved FLS-T2 framework that emphasizes the influence of market conditions and expert opinions. FLS-T2 has a "footprint of uncertainty" (FOU). The Takagi-Sugeno-Kang fuzzy model, which is characterized by high precision and few fuzzy rules, is most often used.

3.2. Machine learning in E-commerce

Nowadays, the prediction accuracies achieved by traditional methods are generally unacceptable [25]. The functional relationship between historical data and online data is a current issue that should be addressed with the help of data science (DS) and machine learning (ML). The efficiency and performance of ML models depend on the quality and quantity of the training features [26,27]. The data preparation focuses on data identification while the data pre-processing refers to data selection, cleaning, and transformation [28].

The application of machine learning in E-commerce is emerging as an important trend due to the availability of big data along with e-business goals that become increasingly difficult to predict. Among intelligent ML algorithms, a few are widely used for their excellent performance. Customer Relationship Management is defined as a process in which the business manages its interactions with

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customers using data integration from various sources and data analysis [29,30]. One of the main processes of E-commerce relies on the market-customer-product relationship, upon which we establish a database and data warehouse [31,32]. The E-commerce field requires continuous order-to-delivery process improvement by using omnichannel and multichannel marketing strategies. Since Industry 5.0 focuses on the consumer, the paper proposes ML algorithms used in C2C, C2B, and B2C business models. Figure 7 shows a vertical framework of four unified processes: data collecting and processing, information processing, and decision making.

The proposed vertical framework enables E-commerce sustainability by applying intelligent solutions that should meet the following requirements:

1. Customer segmentation
2. Customer behavior analytics
3. Intelligent demand forecasting
4. Intelligent pricing
5. Competitor price monitoring
6. Automated content generation
7. Product image analytics
8. Quality of cross-border import e-commerce (CBeC) services
9. E-commerce site search

The success of C2C commerce depends mainly on advertising. ML is used to predict target consumers and their purchasing behavior. Successful online C2C E-commerce is based on a user-centric approach (behavioral targeting, user profiling) or a content-centric approach (real-time bidding, contextual advertising). The most commonly used algorithms for advertising are the following [33,34]:

1. Sequential Pattern Mining (SPM) algorithm for extracting keywords from online content.
2. Click-through rate (CTR) set of algorithms for clicking on the item prediction. Most of these algorithms are based on Deep Neural Networks (DNNs).
3. The following algorithms are used to predict the audience attributes (gender, age, etc.): Support Vector Machine (SVM), Naive Bayes, and a few linear regression algorithms.

For behavior learning, the following algorithms are used: Limited-Memory Broyden-Fletcher-Goldfarb-Shanno (LM-BFGS) algorithm, Boosted Decision Trees (BDT), and some hybrid algorithms.

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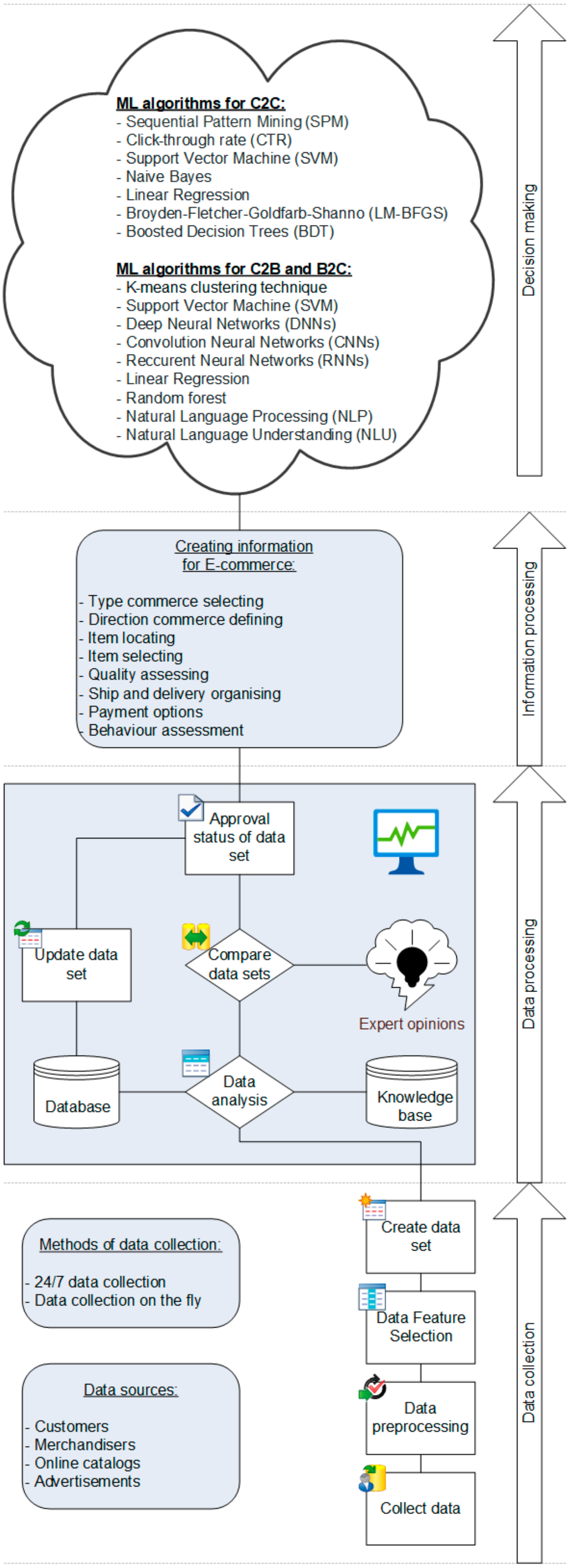

Figure 7. A vertical framework of four unified processes: data collecting, data processing, information processing, and decision making.

C2B and B2C depend mainly on the E-commerce relationships between companies and consumers. It is necessary to understand customer requirements and their requirements for product customization to achieve E-commerce sustainability in Industry 5.0 [35]. Companies often use online services and smart devices and systems for better business:

1. Trust management technologies offer advanced solutions for E-commerce on an edge level. These solutions referee to the following algorithms: 1—ML models for clustering (K-means clustering technique) and 2—ML models for classification using models to identify the nonlinear boundaries of trustworthy and untrustworthy interactions (Support Vector Machine—SVM).
2. Online recommender systems for C2B and B2C business models predominantly use Deep Neural Networks (DNNs) and Convolution Neural Networks (CNNs). CNNs can work with unstructured data obtained from the online available database.
3. Natural Language Understanding (NLU) algorithms and Reinforcement Learning (RL for training agent) algorithms, for creating a chatbot or a personal assistant of Natural Language Processing (NLP), are useful for C2B and B2C commerce [36]. Recurrent Neural Network (RNN) and Reinforcement Learning (RL) algorithms are principally used for these needs. Reward-focused RL algorithms are ideal for dynamic online tracking of consumer behaviours.
4. Company forecasting models use the following ML algorithms [37]: Linear Regression, Random Forest, Support Vector Machine, Deep Neural Networks, Recurrent Neural Networks, Convolution Neural Networks, and Transformers (TensorFlow library) for natural language processing.
5. The application of neural networks for improving the quality of CBeC services, personal privacy, and shortening the delivery time [38].

3.3. Convolutional Neural Networks (CNN) in E-commerce

Thanks to convolutional neural networks (Figure 8), the many benefits in practical applications of machine learning in e-commerce have been achieved. Algorithms for image processing and classifying, and online tracking user behaviors provide an excellent prediction of user needs. A convolutional network is trained to minimize the output errors for a given training image set.

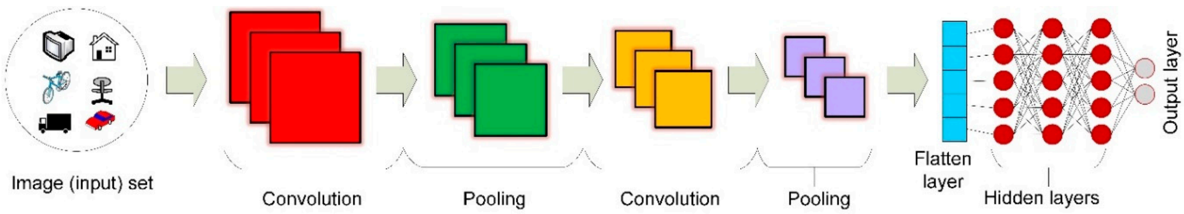

Figure 8. Convolution Neural Network (CNN).

During the CNN training process, filters (kernels) are learned that perform adequate transformations on the input image. It is necessary to define the CNN architecture, which must be tested on a big data set. The following python code demonstrates the use of basic TensorFlow libraries and functions to create a convolutional neural network:

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```
Import libraries
Import tensorflow as tf
from tensorflow import keras
from keras.models import Sequential
from keras.layers import Dense
Define CNN model (2D)
model = Sequential([
    Conv2D()        # 1. convolution layer
    Pooling2D()
    ...
    Conv2D()        # n-th. convolution layer
    Flatten()       # matrix to input array in neural network
    Dense()         # 1. hidden layer
```

E-Commerce portals are 24/7 generating plenty of data and much information from customer reviews. CNN can effectively use these data and information and extract effective features with high availability.

3.4. E-commerce sustainability

The real-time data and information exchange have significantly improved all E-business branches [39]. E-commerce (electronic commerce) is the buying and selling of goods and services, or the transmitting of funds or data, over an electronic network, primarily the internet. The following four factors affecting the long-term E-commerce sustainability in IoT have to emphasize [40,41]:

1. Quality of IoT services,
2. Security of IoT services
3. Operating cost of IoT services
4. IT knowledge of users

E-commerce site search engines should enable fast database searching and answers to questions about companies, products, and services. Flexible, intuitive, and quickly executable site-searching algorithms are very important for boosting visitor experience and building customer loyalty. The development of appropriate algorithms often implies the aggregation of several complex ML models and their constant improvement. The proper e-commerce positioning in a future environment (smart cities, smart industry, etc.) sets the requirements for business strategy improvements. Customer-oriented e-commerce in Industry 5.0 should create conditions for better cyber protection and environmental preservation.

4. Discussion

Today's social movements rapidly raise a large number of economic issues. The authors recognized the necessity of a hierarchical concept of E-commerce to respond to the strict requirements of Industry 5.0. Conceptualizing E-commerce in the vertical IoT framework is the first contribution of this paper.

Trend monitoring, multi-parameter analysis, and prediction have become essential for timely decision-making. ML algorithms and models are necessary for the hands-on implementation of the proposed concept. The proposed classification of machine learning algorithms applies to most business models.

The IoT utilize for improving various business-related activities In Industry 4.0. The presented hierarchical framework of four unified processes (data collecting, data processing, information processing, and decision making) is the logical and conceptual basis for E-commerce sustainability in the future orientation toward the consumers.

Artificial intelligence is rapidly developing, and this paper provides guidelines for using it for E-commerce needs in the IoT environment.

5. Conclusions

Economic sustainability is not possible without the continuous improvement of modern e-business strategies. The development of E-commerce models requires multidisciplinary knowledge from several scientific fields (economics, mathematics, artificial intelligence, information technologies, telecommunications, etc.).

This paper deals with hot E-commerce issues and the Internet of Things in the transition period between Industry 4.0 and Industry 5.0. The presented vertical data processing and decision-making concepts should support and accelerate the transition from mass production to customized production. The fundamental differences between the flat and vertical IoT concepts are explained. There are three main contributions of the presented work. The first contribution is the comprehensive analysis of the vertical IoT concept and the role of Data Science and Machine Learning (ML) algorithms in the proposed framework. The second one is the classification of ML algorithms according to nine basic types of e-commerce. The third contribution is the hierarchical E-commerce selection according to the flat (concentric rings) and vertical levels.

In future work, the authors will focus on the data sources and cyber-security at the edge level of the IoT.

Author Contributions: Conceptualization, A.L., D.V. and S.M.; methodology, A.L. and S.M.; investigation, A.L.; writing—original draft preparation, A.L. and S.M.; writing—review and editing, D.V. and A.Đ.; supervision, D.V. and A.Đ. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Xia, F.; Yang, L.T.; Wang, L.; Winel, A. Internet of things. *International Journal of Communication Systems* **2012**, *25*, 1101–1102.
2. Moller, D.P.F.; Vakilzadian, H.; Hass, R.E. From Industry 4.0 towards Industry 5.0. In Proceedings of the 2022 IEEE International Conference on Electro Information Technology (eIT), Mankato, USA, 19-21 May 2022.
3. Alexakis, T.; Peppes, N.; Demestichas, K.; Adamopoulou, E. A Machine Learning-Based Method for Content Verification in the E-Commerce Domain. Information 2022, 13, 116.
4. Yin, S.; Luo, X. A Review of Learning-Based E-commerce. In Proceedings of the 16th International Conference on Intelligent Systems and Knowledge Engineering (ISKE), Chengdu, China, 26–28 November 2021.
5. Fraga-Lamas, P.; Lopes, S.I.; Fernández-Caramés, T.M. Emerging Paradigms and Architectures for Industry 5.0 Applications. Applied Sciences 2022, 12, 10065.
6. Hua, Y.; Xi, Z. Research on the Application of IoT in E-Commerce. In Proceedings of the IEEE International Conference on Computational Science and Engineering (CSE) and IEEE International Conference on Embedded and Ubiquitous Computing (EUC), Guangzhou, China, 21–24 July 2017.
7. Milić, S.D.; Babić, B.M. Towards the Future—Upgrading Existing Remote Monitoring Concepts to IIoT Concepts. *IEEE Internet of Things Journal* **2020**, *7*, 11693–11700.
8. Korte, A.; Tiberius, V.; Brem, A. Internet of Things (IoT) Technology Research in Business and Management Literature: Results from a Co-Citation Analysis. *J. Theor. Appl. Electron. Commer. Res.* 2021, *16*, 2073-2090. https://doi.org/10.3390/jtaer16060116
9. Milić, S.D.; Đurović, Ž.; Stojanović, M.D. Data science and machine learning in the IIoT concepts of power plants. *International Journal of Electrical Power and Energy Systems* **2023**, *145*, 108711.
10. Shen, G.; Liu, B. Research on application of internet of things in electronic commerce. In Proceedings of the 2010 Third International Symposium on Electronic Commerce and Security, Nanchang, China, 29-31 July 2010.

11. Manogaran, G.; Chilamkurti, N.; Hsu, C.-H. Internet of Things for Electronic Markets. *Electronic Markets* **2021**, *31*, 13–15.
12. European Commission—The European Commission's priorities. Available online: https://ec.europa.eu/info/strategy/priorities-2019-2024_en (accessed on 30 October 2022).
13. European Commission—Research and innovation. Available online: https://research-and-innovation.ec.europa.eu/research-area/industry/industry-50_en (accessed on 30 October 2022).Security Measures for Personal Data Processing—Guidance, European Data Protection Supervisor, Article 22 of Regulation 45/2001. Available online: https://edps.europa.eu/sites/edp/files/publication/16-03-21_guidance_isrm_en.pdf (accessed on 30 October 2022).
14. Security Measures for Personal Data Processing—Guidance, European Data Protection Supervisor, Article 22 of Regulation 45/2001. Available online: https://edps.europa.eu/sites/edp/files/publication/16-03-21_guidance_isrm_en.pdf (accessed on 30 October 2022).
15. Milić, S.D. Fuzzy-Decision Algorithms for Cyber Security Analysis of Advanced SCADA and Remote Monitoring Systems. In *Cyber Security of Industrial Control Systems in the Future Internet Environment*, Stojanović, M.D., Boštjančić, S.V.; IGI Global: USA, 2020; pp. 131–155.
16. Jayasinghe, U.; Lee, G.M.; Um, T.-W.; Shi, Q. Machine Learning Based Trust Computational Model for IoT Services. *IEEE Transactions on Sustainable Computing* **2019**, 4, 39–52.
17. Pai, R.Y.; Shetty, A.; Shetty, A.D.; Bhandary, R.; Shetty, J.; Nayak, S.; Dinesh, T.K.; D'souza, K.J. (2022). Integrating artificial intelligence for knowledge management systems—synergy among people and technology: a systematic review of the evidence. *Economic Research-Ekonomska Istraživanja* **2022**, 35, 7043–7065.
18. Bolek, V.; Romanova, A.; Korček, F. The Information Security Management Systems in E-Business. *Journal of Global Information Management* **2023**, 31, 1–29.
19. Liu, Q. The Development Relationship between Cross-Border e-Commerce and Internet of Things Technology Coupling in Digital Economy Based on Neural Network Model. *Computational and Mathematical Methods in Medicine* **2022**, 8981618.
20. Hsiao, Y.H.; Chen, M.C.; Liao, W.C. Logistics service design for cross-border E-commerce using Kansei engineering with text-mining-based online content analysis. *Telematics and Informatics* **2017**, 34, 284–302.
21. Hazarika, B.B.; Mousavi, R. Review of Cross-Border E-Commerce and Directions for Future Research. *Journal of Global Information Management* **2021**, 30, 1–18.
22. Beheshti, H.; Alborzi, M. Using Fuzzy Logic to Increase the Accuracy of E-Commerce Risk Assessment Based on an Expert System. *Engineering, Technology and Applied Science Research* **2017**, 7, 2205–2209.
23. Feng, G. A Survey on Analysis and Design of Model-Based Fuzzy Control Systems. *IEEE Transactions on Fuzzy Systems* **2006**, 14, 676–697.
24. Mendel, J. M. General Type-2 Fuzzy Logic Systems Made Simple: A Tutorial. *IEEE Transactions on Fuzzy Systems* **2014**, 2, 1162–1182.
25. Beheshti-Kashi, S.; Karimi, H.R.; Thoben, K.-D.; Lutjen, M.; Teucke, M. A survey on retail sales forecasting and prediction in fashion markets. *Systems Science and Control Engineering* **2015**, 3, 154–161.
26. Pandey, A.C.; Rajpoot, D.S.; Saraswat, M. Feature selection method based on hybrid data transformation and binary binomial cuckoo search. *Journal of Ambient Intelligence and Humanized Computing* **2020**, 11, 719–738.
27. Korbel, J.J.; Siddiq, U.H.; Zarnekow, R. (2022). Towards Virtual 3D Asset Price Prediction Based on Machine Learning. *Journal of Theoretical and Applied Electronic Commerce Research* **2022**, 17, 924-948.
28. Alasadi, S.A.; Bhaya, W.S. Review of Data Preprocessing Techniques in Data Mining. *Journal of Engineering and Applied Science* **2017**, 12, 4102–4107.
29. Kracklauer, A.; Passenheim, O.; Seifert, D. Mutual customer approach: How industry and trade are executing collaborative customer relationship management. *International Journal of Retail & Distribution Management* **2001**, 29, 515–519.
30. Matuszelański, K.; Kopczewska, K. Customer Churn in Retail E-Commerce Business: Spatial and Machine Learning Approach. *Journal of Theoretical and Applied Electronic Commerce Research* **2022**, 17, 165–198.
31. Cao, X.; Zhang, J. Preference learning and demand forecast. (2021). *Marketing Science* **2021**, 40, 62–79.
32. Zhang, S.; Liao, P.; Ye, H.-Q.; Zhou, Z. Dynamic Marketing Resource Allocation with Two-Stage Decisions. *Journal of Theoretical and Applied Electronic Commerce Research* **2022**, 17, 327–344.

33. Geron, A. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd ed.; Publisher: O'Reilly Media, Inc., Sebastopol, USA, 2019; pp. 915–921.
34. Choi, J.-A.; Lim, K. Identifying machine learning techniques for classification of target advertising. *ICT Express* **2020**, *6*, 175-180.
35. Song, X. Research on the Realization of C2B Mode in the Commercial Intelligence Era. *Open Journal of Social Sciences* **2021**, *9*, 167–176.
36. Wolf, T.; Debut, L.; Sanh, V.; and all. Transformers: State-of-the-Art Natural Language Processing. In Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP), Online, 16-20 November 2020.
37. Benitez, J.; Chen, Y.; Teo, T.S.; Ajamieh, A. Evolution of the impact of e-business technology on operational competence and firm profitability: a panel data investigation. *Information and Management* **2018**, *55*, 120–130.
38. Chen, M.; Feng, Z. Platformance-Based Cross-Border Import Retail E-Commerce Service Quality Evaluation Using an Artificial Neural Network Analysis. *Journal of Global Information Management* **2022**, *30*, 1–17.
39. Radmehr, R.; Ali, E.B.; Shayanmehr, S.; Saghaian, S.; Darbandi, E.; Agbozo, E.; Sarkodie, S.A. Assessing the Global Drivers of Sustained Economic Development: The Role of Trade Openness, Financial Development, and FDI. *Sustainability* **2022**, *14*, 14023.
40. Ghouchani, B.E.; Jodaki, S.; Jodaki, M.; Balati, A.; Rajabiuon, L. A model for examining the role of the Internet of Things in the development of e-business. *VINE Journal of Information and Knowledge Management Systems* **2020**, *50*, 20–33.
41. Policarpo, L.M.; Eugênio da Silveira, D.; Righi, R.R.; Stoffel, R.A.; André da Costa, C.; V. Barbosa, J.L.; Scorsatto, R.; Arcot, T. Machine learning through the lens of e-commerce initiatives: An up-to-date systematic literature review. *Computer Science Review* **2021**, *41*, 100414.