

# **Some Key Trends and Emerging Technologies in Computer Science**

## Areas Covered

- Augmented Reality
- Big Data
- Block Chain
- COVID-19
- Conversational Commerce
- Customer Experience (Cx)
- Digital Transformation (Dx)
- Embedded Intelligence Systems
- Green ICT
- Industry 4.0 Technologies
- Internet of Things (IoT)
- Machine Learning
- Sentiment Analysis
- Sharing Economy
- Visualisation

## **Augmented Reality**

*Chen, P., Liu, X., Cheng, W., & Huang, R. (2017). A review of using Augmented Reality in Education from 2011 to 2016. Innovations in smart learning, 13-18.*

### Abstract

In recent years, there has been an increasing interest in applying Augmented Reality (AR) to create unique educational settings. This paper reports a review of literature on augmented reality in educational settings considering the factors include the uses, advantages, features, and effectiveness of augmented reality in educational settings.

*Kim, K., Billingham, M., Bruder, G., Duh, H. B. L., & Welch, G. F. (2018). Revisiting trends in augmented reality research: A review of the 2nd decade of ISMAR (2008–2017). IEEE transactions on visualization and computer graphics, 24(11), 2947-2962.*

### Abstract

We review the research that has been presented at ISMAR conferences since the survey of Zhou 2008 et al., at a time when both academia and the AR industry are enjoying dramatic technological changes. Here we consider the research results and trends of the last decade of ISMAR by carefully reviewing the ISMAR publications from the period of 2008-2017.

## **Big Data**

Casado, R., & Younas, M. (2015). *Emerging trends and technologies in big data processing. Concurrency and Computation: Practice and Experience*, 27(8), 2078-2091.

### Abstract

Big Data encompasses large volume of complex structured, semi-structured, and unstructured data, which is beyond the processing capabilities of conventional databases. The processing and analysis of Big Data now play a central role in decision making, forecasting, business analysis, product development, customer experience, and loyalty, to name but a few. In this paper, we examine the distinguishing characteristics of Big Data along the lines of the 3Vs: variety, volume, and velocity. Accordingly, the paper provides an insight into the main processing paradigms in relation to the 3Vs.

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). *Big data: the management revolution. Harvard business review*, 90(10), 60-68.

### Abstract

Exploiting vast new flows of information can radically improve your company's performance. But first you'll have to change your decision-making culture.

Sagiroglu, S., & Sinanc, D. (2013, May). *Big data: A review. In 2013 international conference on collaboration technologies and systems (CTS) (pp. 42-47). IEEE.*

### Abstract

The process of research into massive amounts of data to reveal hidden patterns and secret correlations named as big data analytics. These useful informations for companies or organizations with the help of gaining richer and deeper insights and getting an advantage over the competition. This paper presents an overview of big data's content, scope, samples, methods, advantages and challenges and discusses privacy concern on it.

Wu, X., Zhu, X., Wu, G. Q., & Ding, W. (2013). *Data mining with big data. IEEE transactions on knowledge and data engineering*, 26(1), 97-107.

### Abstract

Big Data concerns large-volume, complex, growing data sets with multiple, autonomous sources. With the fast development of networking, data storage, and the data collection capacity, Big Data is now rapidly expanding in all science and engineering domains, including physical, biological and biomedical sciences.

## **Blockchain**

Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018). *Blockchain challenges and opportunities: A survey. International Journal of Web and Grid Services, 14(4), 352-375.*

### Abstract

Blockchain has numerous benefits such as decentralisation, persistency, anonymity and auditability. There is a wide spectrum of blockchain applications ranging from cryptocurrency, financial services, risk management, internet of things (IoT) to public and social services. This paper gives the blockchain taxonomy, introduces typical blockchain consensus algorithms, reviews blockchain applications and discusses technical challenges as well as recent advances in tackling the challenges.

Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). *A systematic literature review of blockchain-based applications: Current status, classification and open issues. Telematics and informatics, 36, 55-81.*

### Abstract

This work provides a systematic literature review of blockchain-based applications across multiple domains. The aim is to investigate the current state of blockchain technology and its applications and to highlight how specific characteristics of this disruptive technology can revolutionise “business-as-usual” practices. We present a comprehensive classification of blockchain-enabled applications across diverse sectors such as supply chain, business, healthcare, IoT, privacy, and data management, and we establish key themes, trends and emerging areas for research.

Yaga, D., Mell, P., Roby, N., & Scarfone, K. (2019). *Blockchain technology overview. arXiv preprint arXiv:1906.11078.*

### Abstract

Blockchains are tamper evident and tamper resistant digital ledgers implemented in a distributed fashion (i.e., without a central repository) and usually without a central authority (i.e., a bank, company, or government). At their basic level, they enable a community of users to record transactions in a shared ledger within that community, such that under normal operation of the blockchain network no transaction can be changed once published. This document provides a high-level technical overview of blockchain technology.

## **COVID-19**

*Mbunge, E., Akinnuwesi, B., Fashoto, S. G., Metfula, A. S., & Mashwama, P. (2021). A critical review of emerging technologies for tackling COVID-19 pandemic. Human behavior and emerging technologies, 3(1), 25-39.*

### Abstract

COVID-19 pandemic affects people in various ways and continues to spread globally. As the pandemic continues to spread, current measures rely on prevention, surveillance, and containment. In light of this, emerging technologies for tackling COVID-19 including geospatial technology, artificial intelligence (AI), big data, telemedicine, blockchain, 5G technology, smart applications, Internet of Medical Things (IoMT), robotics, and additive manufacturing are substantially important for COVID-19 detecting, monitoring, diagnosing, screening, surveillance, mapping, tracking, and creating awareness. Therefore, this study aimed at providing a comprehensive review of these technologies for tackling COVID-19 with emphasis on the features, challenges, and country of domiciliation.

*Arshad, M. (2020). COVID-19: It's time to be thankful to our ICT professionals. Information Technology & Electrical Engineering, 9(2), 23-31.*

## **Conversational Commerce**

*Tuzovic, S., & Paluch, S. (2018). Conversational commerce—a new era for service business development?. In Service business development (pp. 81-100). Springer Gabler, Wiesbaden.*

### Abstract

Digitization, the rise of the Internet and mobile devices have changed the way people interact with each other and with companies. In recent years, the voice interface has become a growing feature in mobile devices. Industry reports indicate that in mid-2016, 20 percent of Android searches were voice-based and Siri received two bn. requests per week. ComScore predicts that by 2020, 50 percent of all searches will be voice searches. Furthermore, it is anticipated that voice will become the default method to control a variety of interfaces including mobile devices, Internet of Things (IoT) appliances, and automobiles.

*Balakrishnan, J., & Dwivedi, Y. K. (2021). Conversational commerce: entering the next stage of AI-powered digital assistants. Annals of Operations Research, 1-35.*

*Exalto, M., De Jong, M., De Koning, T., Groothuis, A., & Ravesteijn, P. (2018, October). Conversational commerce, the conversation of tomorrow. In Proceedings of the 14th European Conference on Management, Leadership and Governance, ECMLG (pp. 76-83).*

## **Customer Experience (Cx)**

*Jain, R., Aagja, J., & Bagdare, S. (2017). Customer experience—a review and research agenda. Journal of Service Theory and Practice.*

### Abstract

The purpose of this paper is to review the literature on customer experience to develop a better understanding of the concept and propose a research agenda. The review describes the relevance of experiential perspective, service experience and customer experience to attract, delight and retain customers. Customer experience is regarded as a holistic interactive process, facilitated through cognitive and emotional clues, moderated by customer and contextual characteristics, resulting into unique and pleasurable/un-pleasurable memories. The study provides a deeper understanding of the concept and research issues for customer experience.

*Kandampully, J., Zhang, T. C., & Jaakkola, E. (2018). Customer experience management in hospitality: A literature synthesis, new understanding and research agenda. International Journal of Contemporary Hospitality Management.*

### Abstract

The purpose of this study is to advance scholarly research on customer experience management (CEM) in the hospitality field. The proposed model takes a holistic perspective on managing a positive customer experience, through collaboration among marketing, operations, design, human resources and strategy, in association with technology and social media.

*Rose, S., Hair, N., & Clark, M. (2011). Online customer experience: A review of the business-to-consumer online purchase context. International Journal of Management Reviews, 13(1), 24-39.*

### **Digital Transformation (Dx)**

Reis, J., Amorim, M., Melão, N., & Matos, P. (2018, March). *Digital transformation: a literature review and guidelines for future research*. In *World conference on information systems and technologies* (pp. 411-421). Springer, Cham.d

#### Abstract

The aim of this paper is to provide insights regarding the state of the art of Digital Transformation. Among other things, the findings indicate that managers should adapt their business strategy to a new digital reality, adaptation of processes and operations management. Digital Transformation has expanded to all sectors of activity there are some areas with more prospects of being developed in the future than others.

Zaoui, F., & Souissi, N. (2020). *Roadmap for digital transformation: A literature review*. *Procedia Computer Science*, 175, 621-628.

#### Abstract

The paper's aim is supporting the companies in their digital transformation journey by initiating a reflection on the digital transformation processes that uses a literature review to better capture the concept and identify the different proposals for digital transformation roadmaps. This work allowed spotlighting the strategic character of the digital transformation.

Henriette, E., Feki, M., & Boughzala, I. (2015). *The shape of digital transformation: a systematic literature review*. *MCIS 2015 proceedings*, 10, 431-443.

#### Abstract

Through a systematic literature review, we found that digital transformation is more than just a technological shift. These transformations have had an impact on the business models, the operational processes and the end-users experience.

Matt, C., Hess, T., & Benlian, A. (2015). *Digital transformation strategies*. *Business & information systems engineering*, 57(5), 339-343.

#### Abstract

Initiatives to explore new digital technologies and to exploit their benefits frequently involves transformations of key business operations and affects products and processes, as well as organizational structures and management concepts. Companies need to formulate a digital transformation strategy that serves as a central concept to integrate the entire coordination, prioritization, and implementation of digital transformations within a firm.

### **Embedded Intelligence Systems**



*Dai, W., Nishi, H., Vyatkin, V., Huang, V., Shi, Y., & Guan, X. (2019). Industrial edge computing: Enabling embedded intelligence. IEEE Industrial Electronics Magazine, 13(4), 48-56.*

Abstract

Industrial Edge Computing refers to distributed platform integrating communication, computation, storage resources to perform real-time applications that can be directly accessed from the cloud. The industrial edge computing is designed to meet requirements of agile connectivity, real-time control, data optimization, intelligent applications, security, and privacy protection raised towards the revolution of Industrial Internet. Edge computing nodes bridge the gap between the physical world and the digital world by acting as smart gateways for assets, services, and systems.

## **Green ICT**

*Suryawanshi, K., & Narkhede, S. (2020). Green ICT in higher Education: the next frontier for sustainable growth. Know Your CSI, 12.*

### Abstract

Green Information Systems emerged as a crucial area for research to reduce organizations/society's carbon footprints and consequently, to achieve environment sustainability. This research paper provides an extensive systematic literature review in Green IS area to facilitate advance research in the area. The aim of the paper is to provide basic understanding of Green IS and to highlight the significant research conducted earlier in this area.

*Verdecchia, R., Ricchiuti, F., Hankel, A., Lago, P., & Procaccianti, G. (2017). Green ICT research and challenges. In Advances and New Trends in Environmental Informatics (pp. 37-48). Springer, Cham.*

### Abstract

This study presents a quantitative analysis, through a systematic literature review, of the main activities, trends and issues that can be found in the Green ICT literature.

## **Industry 4.0 Technologies**

*Kerin, M., & Pham, D. T. (2019). A review of emerging industry 4.0 technologies in remanufacturing. Journal of cleaner production, 237, 117805.*

### Abstract

This paper reviews the literature on the emerging digital technologies of Industry 4.0 (I4.0) focussed on the applicability of the Internet of Things (IoT), Virtual Reality (VR) and Augmented Reality (AR) in remanufacturing.

*Oztemel, E., & Gursev, S. (2020). Literature review of Industry 4.0 and related technologies. Journal of Intelligent Manufacturing, 31(1), 127-182.*

### Abstract

While academic research focuses on understanding and defining the concept of Industry 4.0 and trying to develop related systems, business models and respective methodologies, industry, on the other hand, focuses its attention on the change of industrial machine suits and intelligent products as well as potential customers on this progress. It is assumed that the robots will be more dominant in manufacturing, implanted technologies, cooperating and coordinating machines, self-decision-making systems, autonom problem solvers, learning machines, 3D printing etc. will dominate the production process. Wearable internet, big data analysis, sensor based life, smart city implementations or similar applications will be the main concern of the community.

## **IoT**

*Li, S., Da Xu, L., & Zhao, S. (2015). The internet of things: a survey. Information Systems Frontiers, 17(2), 243-259.*

### Abstract

In this survey, the definitions, architecture, fundamental technologies, and applications of IoT are systematically reviewed.

*Naskar, S., Basu, P., & Sen, A. K. (2020). A literature review of the emerging field of IoT using RFID and its applications in supply chain management. Securing the internet of things: Concepts, methodologies, tools, and applications, 1664-1689.*

### Abstract

The Internet of Things (IoT) envisions an ecosystem where smart and interconnected objects can sense surrounding changes, communicate with each other, process information and take active roles in decision making. Radio Frequency Identification (RFID) is helping organizations to build automated and interconnected smart environment by object identification and tracking, motivating the first step towards an IoT-enabled world. This chapter attempts to understand extant literature studying applications of RFID in implementing the IoT in supply chain management.

## **Machine Learning (ML)**

Cioffi, R., Travaglioni, M., Piscitelli, G., Petrillo, A., & De Felice, F. (2020). *Artificial intelligence and machine learning applications in smart production: Progress, trends, and directions. Sustainability, 12(2), 492.*

### Abstract

With the introduction of the Industry 4.0, AI and ML are considered the driving force of smart factory revolution.

Carvalho, T. P., Soares, F. A., Vita, R., Francisco, R. D. P., Basto, J. P., & Alcalá, S. G. (2019). *A systematic literature review of machine learning methods applied to predictive maintenance. Computers & Industrial Engineering, 137, 106024.*

### Abstract

The aim of this paper is to present a systematic literature review of ML methods applied to PdM.

Sharma, R., Kamble, S. S., Gunasekaran, A., Kumar, V., & Kumar, A. (2020). *A systematic literature review on machine learning applications for sustainable agriculture supply chain performance. Computers & Operations Research, 119, 104926.*

### Abstract

In order to tackle the ever-increasing complex problems in agricultural production systems, advancements in smart farming and precision agriculture offers important tools to address agricultural sustainability challenges. Disruptive ICTs such as machine learning, big data analytics, cloud computing, and blockchain can address several problems such as productivity and yield improvement, water conservation, ensuring soil and plant health, and enhance environmental stewardship.

Azeem, M. I., Palomba, F., Shi, L., & Wang, Q. (2019). *Machine learning techniques for code smell detection: A systematic literature review and meta-analysis. Information and Software Technology, 108, 115-138.*

Kang, Z., Catal, C., & Tekinerdogan, B. (2020). *Machine learning applications in production lines: A systematic literature review. Computers & Industrial Engineering, 149, 106773.*

Jain, P. K., Pamula, R., & Srivastava, G. (2021). *A systematic literature review on machine learning applications for consumer sentiment analysis using online reviews. Computer Science Review, 41, 100413.*

### **Sentiment Analysis**

1. Bakshi, R. K., Kaur, N., Kaur, R., & Kaur, G. (2016, March). *Opinion mining and sentiment analysis*. In *2016 3rd international conference on computing for sustainable global development (INDIACom)* (pp. 452-455). IEEE.
2. Drus, Z., & Khalid, H. (2019). *Sentiment analysis in social media and its application: Systematic literature review*. *Procedia Computer Science*, 161, 707-714.
3. Kumar, A., & Jaiswal, A. (2020). *Systematic literature review of sentiment analysis on Twitter using soft computing techniques*. *Concurrency and Computation: Practice and Experience*, 32(1), e5107.
4. Liu, B. (2012). *Sentiment analysis and opinion mining*. *Synthesis lectures on human language technologies*, 5(1), 1-167.
5. Ravi, K., & Ravi, V. (2015). *A survey on opinion mining and sentiment analysis: tasks, approaches and applications*. *Knowledge-based systems*, 89, 14-46.
6. Hemmatian, F., & Sohrabi, M. K. (2019). *A survey on classification techniques for opinion mining and sentiment analysis*. *Artificial Intelligence Review*, 52(3), 1495-1545.

## **Sharing Economy**

*Puschmann, T., & Alt, R. (2016). Sharing economy. Business & Information Systems Engineering, 58(1), 93-99.*

### Abstract

*Cheng, M. (2016). Sharing economy: A review and agenda for future research. International Journal of Hospitality Management, 57, 60-70.*

### Abstract

This paper provides an objective, systematic and holistic review of the sharing economy (SE) academic literature to uncover the theoretical foundations and key themes underlying the field by using co-citation analysis and content analysis. This paper revealed three broad areas of foci with sharing economy research in general: (1) SE's business models and its impacts, (2) nature of SE, and (3) SE's sustainability development.

*Dillahunt, T. R., Wang, X., Wheeler, E., Cheng, H. F., Hecht, B., & Zhu, H. (2017). The sharing economy in computing: A systematic literature review. Proceedings of the ACM on Human-Computer Interaction, 1(CSCW), 1-26.*

### Abstract

The sharing economy has quickly become a very prominent subject of research in the broader computing literature and especially in HCI. We conducted a systematic review of sharing economy articles published in the Association for Computing Machinery Digital Library to investigate the state of sharing economy research in computing.

*Sutherland, W., & Jarrahi, M. H. (2018). The sharing economy and digital platforms: A review and research agenda. International Journal of Information Management, 43, 328-341.*

### Abstract

Over the last few years the sharing economy has been changing the way that people share and conduct transactions in digital spaces. Drawing on a collection of 435 publications on the sharing economy and related terms, we identify some trends in the literature and underlying research interests. Specifically, we organize the literature around the concept of platform mediation, and draw a set of essential affordances of sharing economy technologies.

## **Visualization**

*Merino, L., Ghafari, M., Anslow, C., & Nierstrasz, O. (2018). A systematic literature review of software visualization evaluation. Journal of Systems and Software, 144, 165-180.*

### Abstract

We identify common problems in the evaluation of software visualizations with the goal of formulating guidelines to improve future evaluations.

*Gorodov, E. Y. E., & Gubarev, V. V. E. (2013). Analytical review of data visualization methods in application to big data. Journal of Electrical and Computer Engineering, 2013.*

### Abstract

This paper describes the term Big Data in aspects of data representation and visualization. We make a review of existing methods for data visualization in application to Big Data.

*Moore, J. (2017). Data visualization in support of executive decision making. Interdisciplinary Journal of Information, Knowledge, and Management, 12, 125-138.*

### Abstract

This paper seeks to understand what executives value in data visualization. Results point to the relevance of understanding and effectively presenting the data source and the data journey, using the right data visualization technology to fit the nature of the data, creating an intuitive platform which enables collaboration and newness, the data presenter's ability to convey the data message and the alignment of the visualization to core the objectives as key criteria to be applied for successful data visualizations.

*O'Halloran, K. L., Tan, S., Pham, D. S., Bateman, J., & Vande Moere, A. (2018). A digital mixed methods research design: Integrating multimodal analysis with data mining and information visualization for big data analytics. Journal of Mixed Methods Research, 12(1), 11-30.*

### Abstract

This article demonstrates how a digital environment offers new opportunities for transforming qualitative data into quantitative data in order to use data mining and information visualization for mixed methods research.

*West, V. L., Borland, D., & Hammond, W. E. (2015). Innovative information visualization of electronic health record data: a systematic review. Journal of the American Medical Informatics Association, 22(2), 330-339.*