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Review Article

Use of Big Data Tools and Industrial Internet of Things: An Overview

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Big data is ever playing an important role in the industry as well as many other organizations. With the passage of time, the volume of data is increasing. This increase will create huge bulk of data which needs proper tools and techniques to handle its management and organization. Different techniques and tools are being used to properly handle the management of data. A detailed report of these techniques and tools is needed which will help researchers to easily identify a tool for their data and take help to easily manage the data, organize the data, and extract meaningful information from it. The proposed study is an endeavour toward summarizing and identifying the tools and techniques for big data used in Industrial Internet of Things. This report will certainly help researchers and practitioners to easily use the tools and techniques for their need in an effective way.

1. Introduction

With the passage of time, the volume of data is increasing. In today's digital world, the information surges with the extensive use of the Internet and global communication systems. This increase will create huge bulk of data which needs proper tools and techniques to handle its management and organization. Big data is ever playing an important role in the industry as well as many other organizations. Huge bulk of data is produced from the healthcare information systems, electronic records, wearables, smart devices, handheld devices, and so on. The recent increase in medical big data and the development of computational techniques in the field of information technology enable researchers and practitioners to extract and visualize big data in a new spectrum of use.

The industry is leading toward the spreading out and developments of IIoT with the incorporation of emerging technologies and applications of IoT. The aim of the IIoT is to achieve high efficiency of operations for management of industrial assets and to increase the productivity of industries. More attention is given to the applications of IoT with its integration to industries. The applications of IoT are obvious in every field of life from industry to education, healthcare, and to other places. A number of studies are available related to the applications, uses, and different approaches to handle big data [1–8]. Different techniques and tools are being used for extracting important information from big data. The data are mostly unstructured which need proper structure, shape, and management through which the data can easily be accessed and processed. The role of visualization is to capture the important information from the data and to visualize it for the easiness of practitioners. Some of the programming tools which deal with big data are Informatica PowerCenter, Apache Hadoop, and Tableau, which analyze data extremely efficiently and enable the visualization of meaningful insights extracted from big data.

To facilitate the management of data for easy access and to operate, there should be a detailed report on the existing tools and techniques which can easily access, manage, operate, and execute useful information from the data for different purposes. Therefore, to facilitate this process, a detailed report of the existing literature is presented in this study. This detailed report will help researchers and scholars to devise new algorithms, techniques, and tools for the analysis and management of big data.

The organization of the paper is as follows. Section 2 shows the related work to big data tools and support of the industry. Section 3 presents the existing approaches to support big data in IIoT. Section 4 shows the support of IIoT regarding big data tools and techniques. The paper is concluded in Section 5.

2. Big Data Tools and Support of the Industry

With the advancements in Industrial Internet of Things (IIoT) sensing, communication, technology characterizations, and high throughput instrumentation, the level of data generation is expected to grow exponentially [9]. Lin et al. [10] presented an approach of integrating sensing data from diverse sources and equipment to apply on IIoT. The industrial Micro Control Unit is connected to interface with actuator, data sources, and equipment. The experimental results show that IIoT can reduce the problem of heterogeneous protocol and database manufacturing data transmission. This article demonstrates the complexity and unique nature of multimedia big data (MMBD) computing for Internet of Things (IoT) applications as well as builds up an inclusive taxonomy used for MMBD abstracted into a new process model reflecting MMBD over IoT. Many research challenges linked with MMBD, for example, quality of service requirements, heterogeneity, reliability, accessibility, and scalability, are addressed by the process model. The process model is discussed through a case study [11]. In this work, architecture for flood forecasting and monitoring is proposed by means of convergence between HPC and big data. This architecture can analyze, store, and collect big data as well as help in the flood prediction result generation [12]. Mobile computing services can be used in IoT by using services of mobile phones, apps, or through M-Health care system [13]. Alexopoulos et al. [14] presented the IIoT architecture and its development details to support the industrial product service system life cycle.

In this article, a novel model is developed in the perspective of manufacturing progression that reviews the key big data analytics (BDA) capabilities. The findings are beneficial for the companies in order to understand big data potential implications as well as their analytics capabilities for their manufacturing processes and efficient BDA-enabler infrastructure design [15]. Boyes et al. [16] presented the concept of IIoT and the association to the ideas such as cyber physical systems and Industry 4.0. IoT-related taxonomies were analyzed and an analysis framework was developed for IIoT that can be used to list and characterize the devices of IIoT when analyzing security vulnerability and threats. For the big data sentiment analysis (BDSA) and for best or optimal decision selection, a framework was proposed and also applied as a mathematical algorithm [17]. In this study, for big data and Cognitive Internet of Things (CIoT), a new architecture is proposed. The planned architecture helps the computing systems through combining data lake (DL) and warehouse (DWH), and for the collection of heterogeneous data, a tool is defined [18]. Urquhart and Mcauley [19] presented an approach for the risks of IIoT drawn both on the regulatory and technical perspectives. In this study, functional and structural properties of cloud manufacturing (CMfg) were analyzed, and a business intelligence architecture was proposed that plans to empower distributing pertinent KPIs identified with intrigued process data, with the helpful layer of dependability [20].

An overview of big data in smart manufacturing was directed, and an applied framework was proposed from the viewpoint of item life cycle. This framework permits examining key advantages and potential applications, and the debate of future research directions and current challenges gives essential insights for the industry and scholarly world [21]. This paper examines the current big data analytics (BDA) technologies, strategies, and algorithms that can prompt the improvement of insightful Industrial Internet of Things (IIoT) frameworks. We devise a scientific classification by characterizing and classifying the literature based on essential factors (for example, analytics types, industrial analytics applications, requirements, analytics techniques, analytics tools, and data sources). The case studies and frameworks of different endeavours were presented which have been profited by BDA [22]. This paper investigates how firms can capture an incentive from big data to improve green commitment by giving an applied model through an exhaustive and all-encompassing writing that relates big data sources to the reception of various green systems. The principle finding of the examination is that organizations that need to execute clean innovation strategy frequently allude to outside accomplice to build up the essential architecture expected to abuse enormous information potentialities [23]. Apart from these approaches, the big data and IoT have several other applications in diverse issues of the real world [24–28].

3. Existing Approaches to Support Big Data in IIoT

Humayun et al. [29] presented a comprehensive report of the evolution, prevention, and mitigation of ransomware in the context of IoT. For smart factories, construction path and reference architecture were proposed by examining IIoT technology as well as their application in assembling workshops. Joined with the examination of business as usual and requirements of the discrete assembling undertaking workshops, this paper structures the overall theoretical model architecture of the framework [30]. In this examination, a blockchain-dependent data sharing scheme was proposed that entirely considers efficiency as well as security of data sharing. In this plan, a Hyperledger Fabric and identity authentication-dependent secure data sharing structure was designed for the data sharing security. Additionally, a network recognition algorithm was proposed to partition the customers into various data sharing networks as per the comparability of mark data. The exploratory outcomes demonstrate that the proposed colloboration is successful for efficient and secure data sharing among various customers [31].

This paper discusses about the IoT data management concepts and current and survey solutions, talks about the most encouraging solutions, and recognizes important open exploration issues on the theme giving rules to assist further contributions [32]. In this article, for a scalable pipeline to distribute as well as process data as of blend of shop-floor sources, an architecture was proposed. The architecture was implemented in order to explore the feasibility of this methodology and bring together ad hoc power data and MTConnect-compliant machine to help analytics applications [33]. This work presents a procedure data examination stage which worked around the idea of Industry 4.0. The platform uses the big data software tools, ML algorithms, and state-of-the-art IIoT platforms. The results indicated that in situations where process information about the procedure within reach is restricted, information-driven delicate sensors are helpful instruments for predictive data investigation [34]. For industrial data processing, an Industrial Internet of Things cloud-fog hybrid network (ITCFN) framework was proposed. The results have shown that the proposed framework effectively reduces the processing delay of industrial data [35].

In this study, a systematic strategy was used to review the weaknesses as well as strengths of open-source technologies for stream processing and big data to set up its usage for Industry 4.0 use cases [36]. A framework was developed for the additive manufacturing enterprises by combining sustainable smart manufacturing technologies, additive manufacturing, and big data analytics. The proposed framework is beneficial for additive manufacturing industry leaders to take the right decision at the beginning stage of the product life cycle [37]. The big data characteristic of the testbed was studied by using an inhouse-developed IoT-enabled manufacturing testbed [38]. A distributed service-oriented architecture was provided for the solution of problem of product tracing [39]. The distributions of droplet size with high-velocity airblast atomization were examined [40]. In this article, an interactive data investigation framework was proposed, which poses a service-oriented perspective on the smart factory [23]. This article investigates the potential of artificial intelligence (AI) as well as machine learning (ML) to lever big data and Internet of Things (IoT) in smart cities in personalised service development. IoT smart city applications are suggested so as to benefit from this work [41]. Gierej [42] presented the idea of a business model for the companies implementing IIoT technologies. The approach is developed to help traditional companies in the transition of the digital market.

The proof procurement challenge is examined. A contextual investigation of a smart city venture with IoT administrations gathering big data which are put away in the cloud processing condition is presented. The strategies can be summed up to other big data in the cloud environment [43]. A fault prediction technique dependent on industrial big data is presented, which legitimately exhumes the connection between the data, for example, the status as well as sound data, and the equipment faults by machine learning techniques [44]. Distributed growing self-organizing map (DGSOM) and a novel distributed self-adaptive neural network algorithm were presented to tackle unsupervised machine learning need of big data [45]. Younan et al. [46] presented a study with a comprehensive review of the existing challenges in the literature and recommended technologies for enabling the analysis of data and search in the future IoT search engines. Two case studies are presented to show promising growth on smartness and intelligence of applications of IoT based on the integration of information and communication technologies. The applications of smart phones enable the patients to know about their diseases after the analysis in the field of gynaecology and paediatrics [47]. In this article, an architecture based on Internet of Things is proposed for big data that is used for diverse smart cities. The results demonstrated that this kind of method has the potential of the applicability to give beneficial services of smart cities, for example, detection of travel profiles in smart transport, comfort in smart buildings, and management of the energy consumption [48]. Jiang [49] presented an approach which studies the IoT developments and technologies related to cloud computing and smart cities and then focussed on the IoT technologies and cloud computing. Dachyar et al. [50] conducted an in-depth analysis of the 26420 papers published in the area of IoT. This article aims to adapt and detect concept drift dependent on cognitive learning principles. The approach executes to detect concept drift, determines concept drift type as well as in automated time windows [51]. Table 1 shows the existing approaches, methods, and tools to support big data.

4. Support of IIoT regarding Big Data Tools and Techniques

Several studies exist related to the applications of big data in IIoT. The study presented an enhanced platform of industrial big data for the reduction of time and data storage space of data processing [54]. The aim of the paper is to assess the impact of different serialization and compression methods on the platform of big data and then attempt to select the most suitable method for the platform of industry. The aim of the study is to propose a fabric which is a technique of blockchain-based data transmission for IIoT [56]. The approach uses secret sharing mechanism based on blockchain. The paper presented an approach of city geospatial dashboard for the collection, sharing, and visualization of the data collected from different sources like satellite data, IoT devices, and other big data [58]. The contribution of the paper is to present the concept of constructing community-based platform of cross IIoT service through utilizing the existing mobile and fixed facilities as wireless IoT gateway in a city which facilitates the easy implementation of IoT gateway at local service for bringing economical and social values [59]. The study focussed on the spatiotemporal modeling to organize the data in temporal, attributive, and spatial dimensions [60]. To manage the multisource manufacturing data, ontology-based big data integration mechanism is presented. The authors proposed an ADTT—advanced distributed tensor-

Table 1: Existing approaches, methods, and tools to support big data.

S.No	Reference	Title
1	[9]	Big data analytics tool based on statistical process monitoring for smart manufacturing
2	[11]	Multimedia big data computation and applications of IoT
3	[12]	IoT, big data, and HPC-based smart flood management framework
4	[15]	Big data analytics for manufacturing processes
5	[17]	An algorithmic implementation of entropic ternary reduct soft sentiment set using soft computing technique on big data sentiment analysis for optimal selection of a decision based on real-time update in online reviews
6	[18]	Architecture for Cognitive IoT and big data
7	[20]	Challenges and opportunities for publishing IIoT data in manufacturing
8	[21]	A comprehensive review of big data analytics throughout product life cycle to support sustainable smart manufacturing
9	[22]	Role of big data analytics in IIoT
10	[23]	Big data and natural environment
11	[30]	Intelligent manufacturing production line data monitoring system for IIoT
12	[31]	A secure and efficient data sharing scheme based on blockchain in IIoT
13	[32]	Data management techniques for IoT
14	[33]	Scalable data pipeline architecture to support the IIoT
15	[34]	Industry 4.0-based process data analytics platform
16	[35]	Optimization of IIoT data processing latency
17	[36]	Big data and stream processing platforms for Industry 4.0 requirements mapping for a predictive maintenance use case
18	[37]	Framework of big data for sustainable and smart additive manufacturing
19	[38]	Feature engineering in big data analytics for IoT-enabled smart manufacturing
20	[39]	An architecture for aggregating information from distributed data nodes for IIoT
21	[40]	Application of big data analysis technique on high-velocity airblast atomization
22	[23]	Interactive data exploration as a service for the smart factory
23	[41]	Smart city services using machine learning, IoT, and big data
24	[43]	Digital forensics challenges to big data in the cloud
25	[44]	On fault prediction based on industrial big data
26	[45]	Apache spark-based distributed self-organizing map algorithm for sensor data analysis
27	[48]	Techniques of big data to smart city deployments
28	[51]	A cognitive data stream mining technique for context-aware IoT systems
29	[52]	Implementation of the FSO2
30	[53]	An intelligent outlier detection method with one class support tucker machine and genetic algorithm toward big sensor data in IoT
31	[54]	Big data-based improved data acquisition and storage system for designing industrial data platform
32	[55]	Cybersecurity in an IIoT environment
33	[56]	A secure fabric blockchain-based data transmission technique for IIoT
34	[57]	Concept drift detection and adaption in big imbalance IIoT data using an ensemble learning method of offline classifiers
35	[58]	City geospatial dashboard
36	[59]	A community-based IoT service platform to locally disseminate socially valuable data
37	[60]	The spatiotemporal modeling and integration of manufacturing big data in job shop
38	[61]	A big data-enabled consolidated framework for energy efficient software defined data centers in IoT setups
39	[62]	A parallel military dog-based algorithm for clustering big data in cognitive IIoT
40	[63]	Big data cleaning based on mobile edge computing in industrial sensor cloud
41	[64]	A highly efficient distributed tensor-train decomposition method for IIoT big data
42	[65]	Big data-driven edge-cloud collaboration architecture for cloud manufacturing

train—decomposition approach along with a computational method for the IIoT big data processing [64]. The existing literature was searched in order to identify the associated materials related to the proposed study. For this purpose, the popular libraries such as ACM, IEEE, ScienceDirect, and Springer were considered to show the related materials. The reason behind these libraries was that these libraries publish quality materials which are peer reviewed. Figure 1 shows the number of papers published in the given years in the library of ScienceDirect. The last five years were considered as the latest research published in these recent years.

Figure 2 shows the article type along with the number of publications in the given library.

Figure 3 shows publication titles and percentage of publications.

Figure 4 shows the articles types and number of publications in the library IEEE.

Figure 5 shows the publication topics and percentages of number of publications.

Figure 6 shows the media format and number of publications in the ACM library.

Figure 7 shows the publication types and number of papers published in the given library.

Figure 8 shows the number of publications in the given years.

Figure 9 shows the article types and percentages of publication in the Springer library.

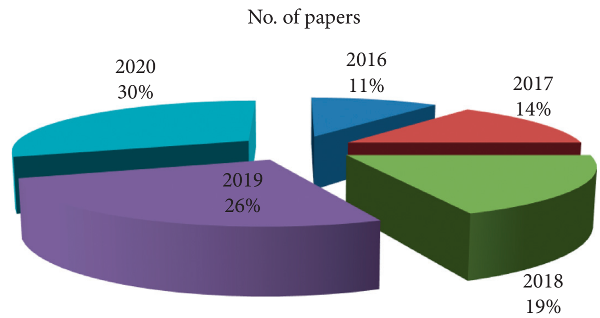

Figure 1: Number of papers in the given year for ScienceDirect.

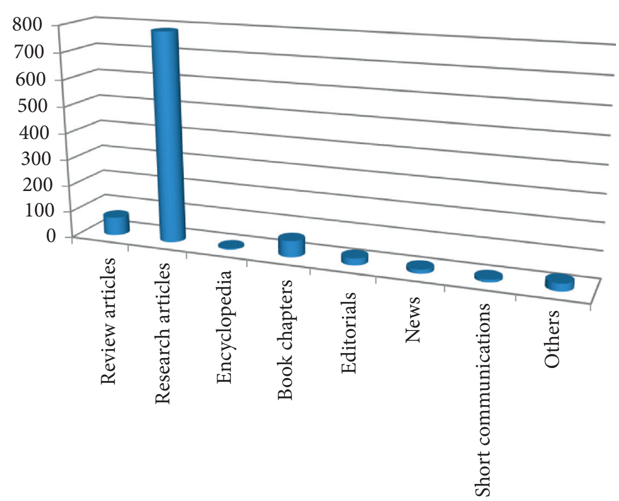

Figure 2: Article type and number of publications.

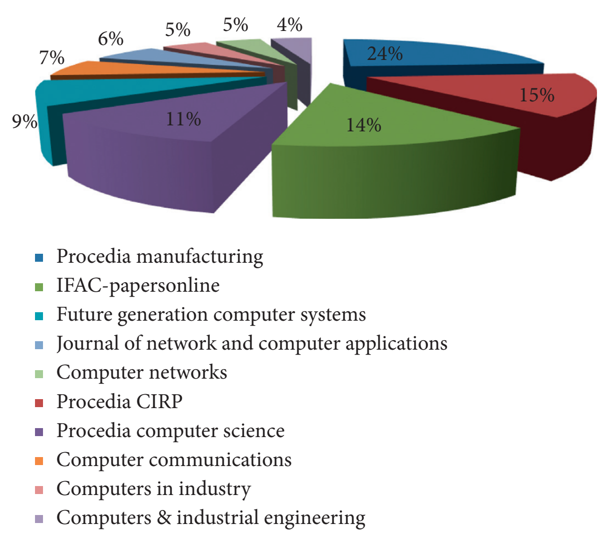

Figure 3: Publication titles and number of publications.

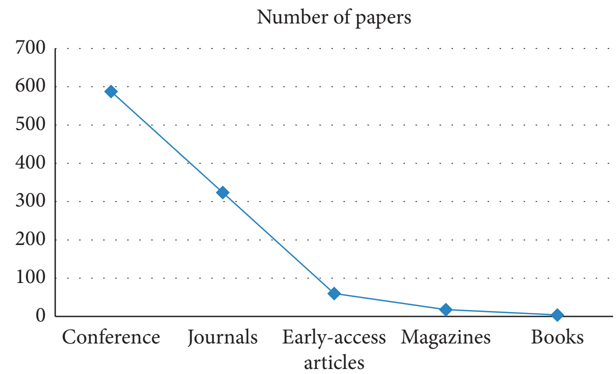

Figure 4: Articles type and number of publications.

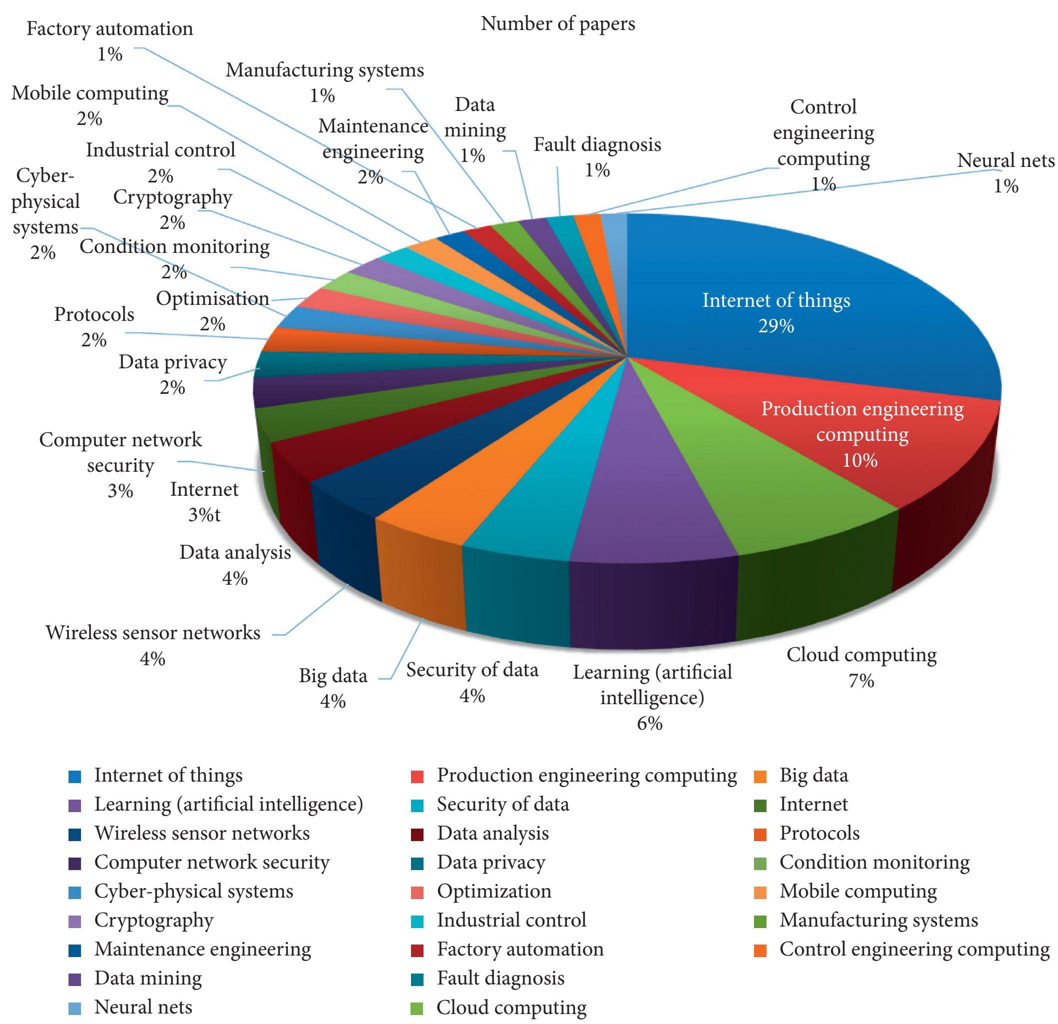

Figure 5: Publication topics and percentage of publications.

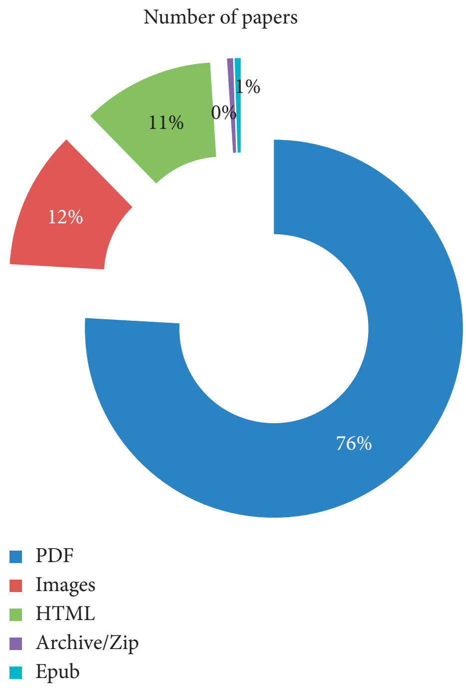

Figure 6: Media format and number of publications.

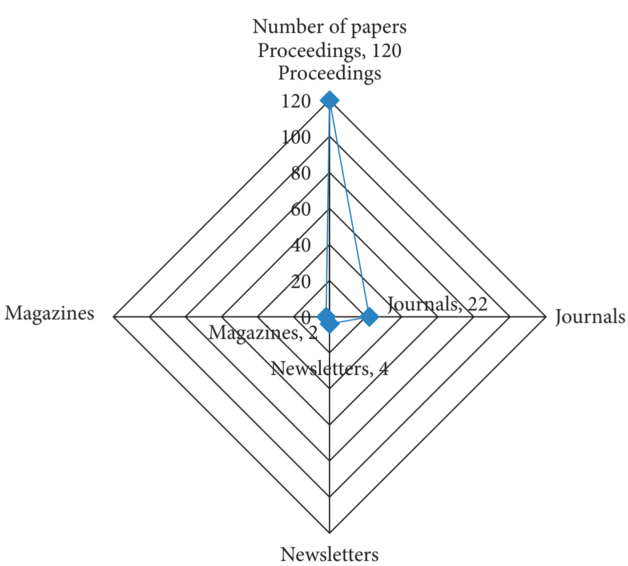

Figure 7: Publication types and number of papers.

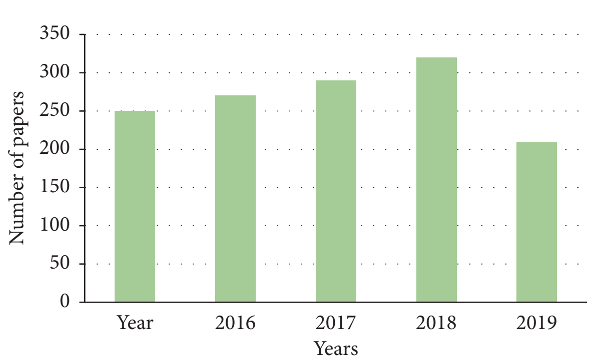

Figure 8: Number of papers in the given years.

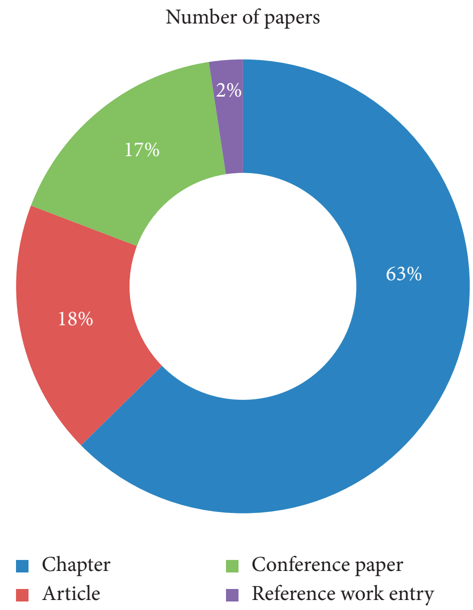

Figure 9: Content types and percentage of publications.

5. Conclusion

With the passage of time, the volume of data is increasing. This increase will create huge bulk of data which needs proper tools and techniques to handle its management and organization. Big data is ever playing an important role in the industry as well as many other organizations. Huge bulk of data is produced from the healthcare information systems, electronic records, wearables, smart devices, handheld devices, and so on. The recent increase in medical big data and the development of computational techniques in the field of information technology enable researchers and practitioners to extract and visualize big data in a new spectrum of use. Different techniques and tools are being used to properly handle the management of data. A detailed report of these techniques and tools is needed which will help researchers to easily identify a tool for their data and take help to easily manage the data, organize the data, and extract meaningful information from it. The proposed study is an endeavour toward summarizing and identifing the tools and techniques for big data used in IIoT. This report will help researchers and practitioners to easily use the tools and techniques for their need in an effective way and will devise new solutions for the industry of big data.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this paper.

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