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RELATIONSHIP IN IOT AND BIG DATA ANALYTICS: THE OPPORTUNITIES AND OPEN CHALLENGES

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Abstract: Internet of Things (IoT) is an up-and-coming technology that has a wide variety of applications. It empowers physical objects to be organized in a specialized framework to grow its convenience in terms of ease and time utilization. It is to convert the thought of bridging the crevice between the physical world and the machine world. It is also being use in the wide range of the technology in this current situation. One of its applications is to monitor and store data over time from numerous devices allows for easy analysis of the dataset. This analysis can then be the basis of decisions made on the same. In this study, the concept, architecture, and relationship of IoT and Big Data are described. Next, several use cases in IoT and big data in the research methodology are studied. The opportunities and open challenges which including the future directions are described. Furthermore, by proposing a new architecture for big data analytics in the Internet of Things, this paper adds value. Overall, the various types of big IoT data analytics, their methods, and associated big data mining technologies are discussed.

Keywords: IoT, Big Data, Architecture

Basic provisions. Discusses the relationship between the Internet of Things (IoT) and big data (BD), which has reached a point where massive amounts of data must be processed, transformed, and analysed at a rapid pace. Numerous surveys are conducted against the backdrop of big IoT data analytics. Following that, we discussed cutting-edge IoT and big data analytics solutions.

Current solutions for broad IoT data analytics are discussed, many of which are still in their infancy. There will be an increased demand for real-time analytical solutions capable of providing rapid insight in the future.

1. Introduction: Overview of Big Data

Big data is a scale of data, diversity, complexity require new architecture and techniques. Figure 1 indicates a collection of data that is huge in volume. It is a data set with such a large scale and complexity that traditional data processing tools cannot be stored or handled easily. Algorithms and analytics are used to manage it and extract value and hidden knowledge. The concept of big data is difficult to define, not least because data that appears to have a massive impact today will almost certainly appear to have a minor impact in the near future. The intricacy of big data Some partitioners argue that massive datasets are not always complex, while small data sets are always simple, emphasizing the importance of a dataset's complexity in determining its size. Big data is a new generation of technology and architecture that enables high velocity data capture, discovery, and analysis in order to economically extract value from very large volumes of a wide variety of data. The most pressing big data issue is revealing an incentive from informational collection of massive measurements.

The state-of-the-art in big data analytics can be seen in all dimensions of its implementations, from the hardware responsible for data processing to the data being analysed. Cloud computing provides a generalisation of prior service concepts such as infrastructure-as-a-service and data-as-a-service to software-as-a-service and software-as-a-service. This ensures that the software itself is hosted on the cloud, minimizing hardware and administration costs, and increasing the overall usage of resources and enhancing client interfaces instead of supplying data and resources for programs to be implemented locally. Understanding data analysis specifications may assist in designing and manufacturing sufficient hardware dedicated to the mission.

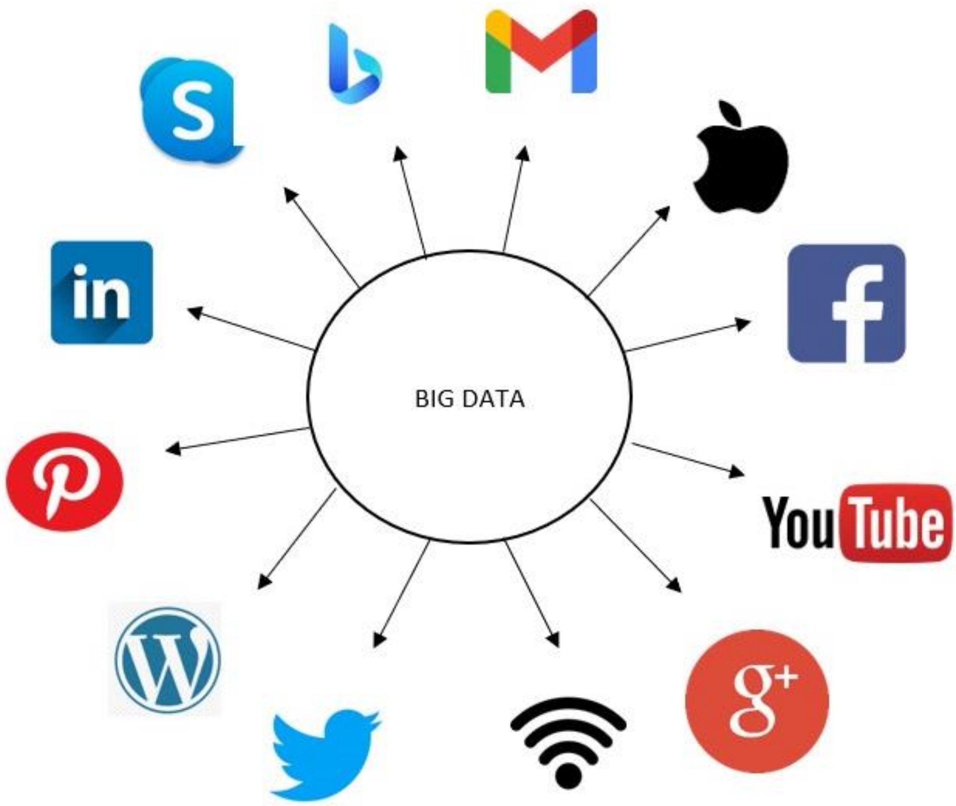

Fig. 1: *Big Data is a set of complex large data that cannot be handled by traditional methods*

Compared to general purpose processors, Field Programmable Gate Arrays (FPGAs) and Application Specific Integrated Circuits (ASICs) and certain dedicated video encoders/decoders can be used to minimize energy consumption. The program must also be up to the mark in order to keep up with and to take advantage of modern hardware. In scalable, distributed storage systems, applications like Apache Flume supports efficient data movement (Kambatla et al., 2014). For efficient querying and other Online Transaction Protocol (OLTP) workloads, it provides support for in-memory caching.

When received, data is considered "hot" and turns "cold" when archival approaches. This cold data is ideal for storage in Non-Volatile Memory (NVM), a newer Solid-State Drive (SSD) data storage technique (Castro et al., 2002). NVM software is quicker than disk and DRAM technology. These storage solutions include a constant change to memory-like data storage interfaces that improve efficiency and simplification through homogeneity. However, NVM technology is much more costly than the use of disks, and it will therefore take some time before the older technology is fully replaced.

To maximise the benefits of rapid networking and communication, bottlenecks caused by the compelling use of partition or aggregate architecture patterns in many large-scale web applications should be minimised. This bottleneck happens as requests are split into pieces from higher layers of the application and distributed out to lower layer staff. Each worker's output is compiled to produce a result. The Data Center Transmission Control Protocol (DCTCP), a newer version of TCP, resolves this issue by utilising the ECN protocol extension, which is implemented in the majority of modern commodity switches and enables end-to-end notification of network congestion without falling packets (Kambatla et al., 2014). To begin the process of converting to an all-optical switching fabric and removing all electrical components, the Network Interface Controller must be removed (NIC). This enables the processor to communicate directly with the network. Additionally, this conversion can be extended to processor-to-memory paths.

The use of Virtual Machines provides a platform for cloud computing systems between hardware and software. A software abstraction layer called Virtual Machine Monitor (VMM) allows the underlying hardware platform to be partitioned into one or more virtual machines, thus increasing the usage of resources. Analysis of big data requires a great deal of computational power, especially for parallel processing tasks, which can be done without increasing operational and administrative costs using VMs.

Our mapping study intends to bridge this gap; in line with (Kambatla et al., 2014), we intend to provide a wide overview of the state-of the-art in big-data analytics research for all education levels, to gain an insight into the core approaches taken and the challenges that remain, to identify the main research gaps, as well as to make few recommendations for future work. The main research questions driving our study are:

RQ1: What is the state of the art in big data analytics?

RQ2: What are the trends in scale and application landscape of big-data analytics?

RQ3: What are the current and future trends use cases in IoT and big data in addressing the massive datasets?

RQ4: What are the opportunities and open challenges currently employed and future trends to address the applications?

The following is the order of the paper: Following this introduction, Section 2 discusses the architecture of big data (BD) analytics and Internet-of-Things (IoT), with an emphasis on the relationship between IoT and big data analytics. Section 3 discusses the research methodology's application to IoT and big data use cases. Section 4 discusses the opportunities and unresolved issues, while Section 5 discusses the future directions. The concluding section of this paper summarises and concludes the paper.

Big Data Analytics

The Internet of Things (IoT) enables the arrangement of physical objects within a technical system in order to increase its usability in terms of ease and time consumption. It is to transform the concept of bridging the divide between the physical and digital worlds (Aldowah et al., 2017). The number of connected devices is growing at a breakneck pace, and numerous predictions have been made in this direction. Gartner predicted that by 2020, an estimated 20.8 billion new things will be connected. The Internet of Things is growing at a breakneck pace, from 6 billion in 2015 to 27 billion in 2025. (Shahla et al., 2017). Despite numerous reviews on the various applications of IoT in various fields (Abuarqoub et al., 2017; Aldowah et al., 2017; Al-Qaysi et al., 2020; Hassanien et al., 2020), there is a need to discuss the progress of implementing IoT applications in education, as this can provide insight into the challenges and limitations that remain to be overcome in the concerned area. The Internet of Things has enabled us to generate massive amounts of data, which can result in a visible income stream, but this is insufficient. To accomplish this goal, businesses must have an adequate infrastructure in place to capture, manage, and analyse sensor data (Riggins & Wamba, 2015). As a result, it is critical to devote sufficient attention to the issue of rapid and efficient data collection integration. Proper integration can assist businesses in capturing and evaluating data that can yield useful insights (Ahmed et al., 2017).

2.1 Existing analytics systems

IoT system data sources are growing in length, speed as well as complexity. Figure 2 shows the example of an IoT system. Analysis of this enormous amount of data produced at such a rapid pace can produce a lot of useful data and can also be applied in other fields. This includes smart city technologies, smart transport and grid networks, smart meters for electricity, and tracking devices for remote patient health care. Big data analytics is promptly evolving as a significance key IoT program to improve decision-making process due to the connectivity between devices provided by the IoT. This is applied in areas such as energy management, transportation monitoring and supply chain management. Real time analytics, off-line analytics and memory level analytics are some of existing data analytics. The continuous collection of data from the sensors is called real-time analytics. In these methods, the data from the sensors should be collected quickly and it is important to have a powerful and high-speed device to process the data very quickly. (Philip Chen & Zhang, 2014a) referred to this architecture that requires no rapid response. Examples of this architecture are: SCRIBE (Castro et al., 2002), Chukwa (Philip Chen & Zhang, 2014a). For this form of analysis, the cluster size limit can be applied to (Philip Chen & Zhang, 2014b). Real-time analytics are very responsive to details, which is why memory-level analytics should be used for them.

2.2 Relationship between IoT and big data analytics

The connection between IoT and Big Data is depicted in Figure 3. IoT is all about phones, data, and networking. The true value of the Internet of Things is in the creation of smarter goods, the provision of smarter insights, and the generation of new business results. As millions of devices become connected, the Internet of Things will generate a massive inflow of big data. The primary challenge is visualizing and eliciting knowledge from various types of data (structured, unstructured, images, contextual, dark data, real-time) and applications. Furthermore, the amount of data produced on a continuous basis by digital sensors and a variety of other software applications. The number of digital devices that generate large amounts of structured, unstructured, or semi-structured data is growing rapidly. Databases are incapable of efficiently managing massive amounts of data., dubbed "big data" colloquially. Although the term "big data" has been used in the past, it is still relatively new in the business and information technology worlds. The next frontier of innovation, competition, and productivity is an illustration of a big data study. According to the McKinsey Global Institute, big data refers to data sets that are too large to be captured, stored, processed, and analysed using traditional database system tools. (Marjani, M., 2017). Big data technologies, according to the study "The Digital Universe," are a new generation of technologies and architectures that enable high-velocity data capture, discovery, and analysis.

2.3 Methods for big data analytics

Organizations require efficient methods for converting massive amounts of disparate data into concrete understandings in order to promote evidence-based decision-making (Gandomi & A. and Haider, 2015). The potential for big data (BD) use is virtually limitless, but it is hampered by the lack of big data analytics (BDA) technology, resources, and skills. According to Wikipedia, BDA refers to techniques for analysing and gaining intelligence from large datasets (Labrinidis & Jagadish, 2012). Thus, BDA can be viewed as a sub-process within the larger process of insight extraction from BD. It is certain that BD requires the best methods and techniques to be evaluated and classified efficiently and competently in order to achieve its objectives and progress in the market environment (Al Nuaimi et al., 2015).

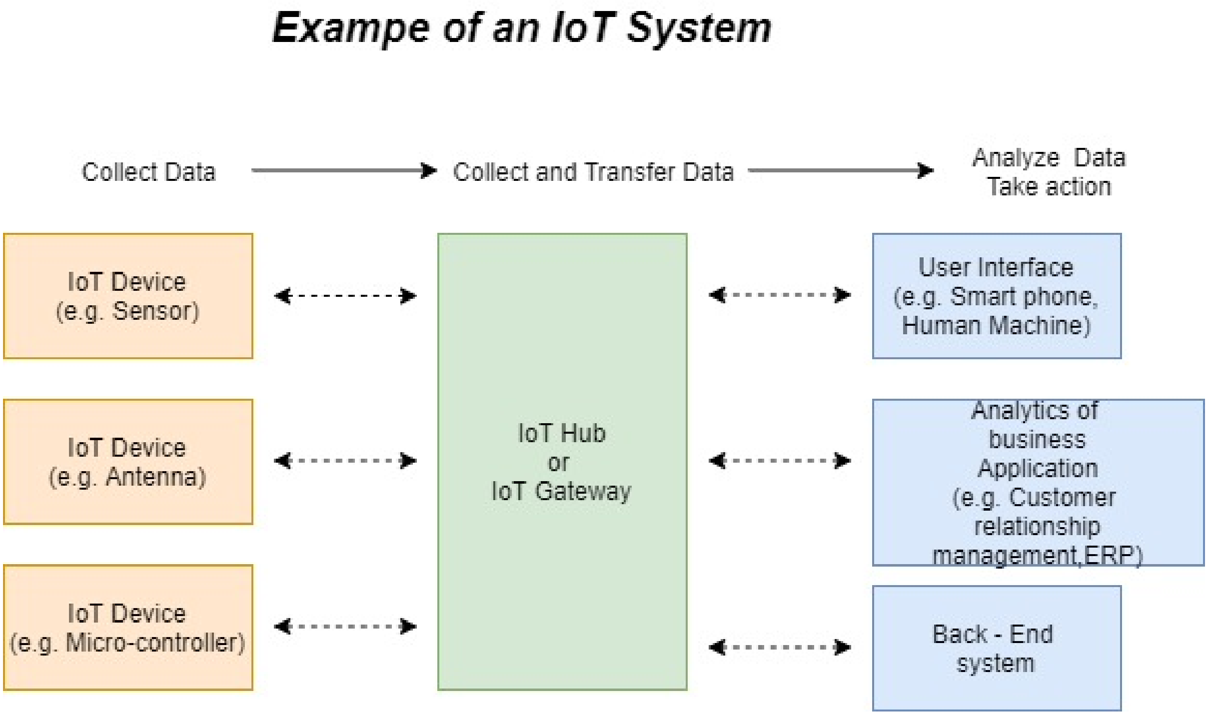

Fig. 2: *Web-enabled smart devices that use embedded systems to collect data. IoT will share data to other devices to be analyzed and most of the work is done without human intervention.*

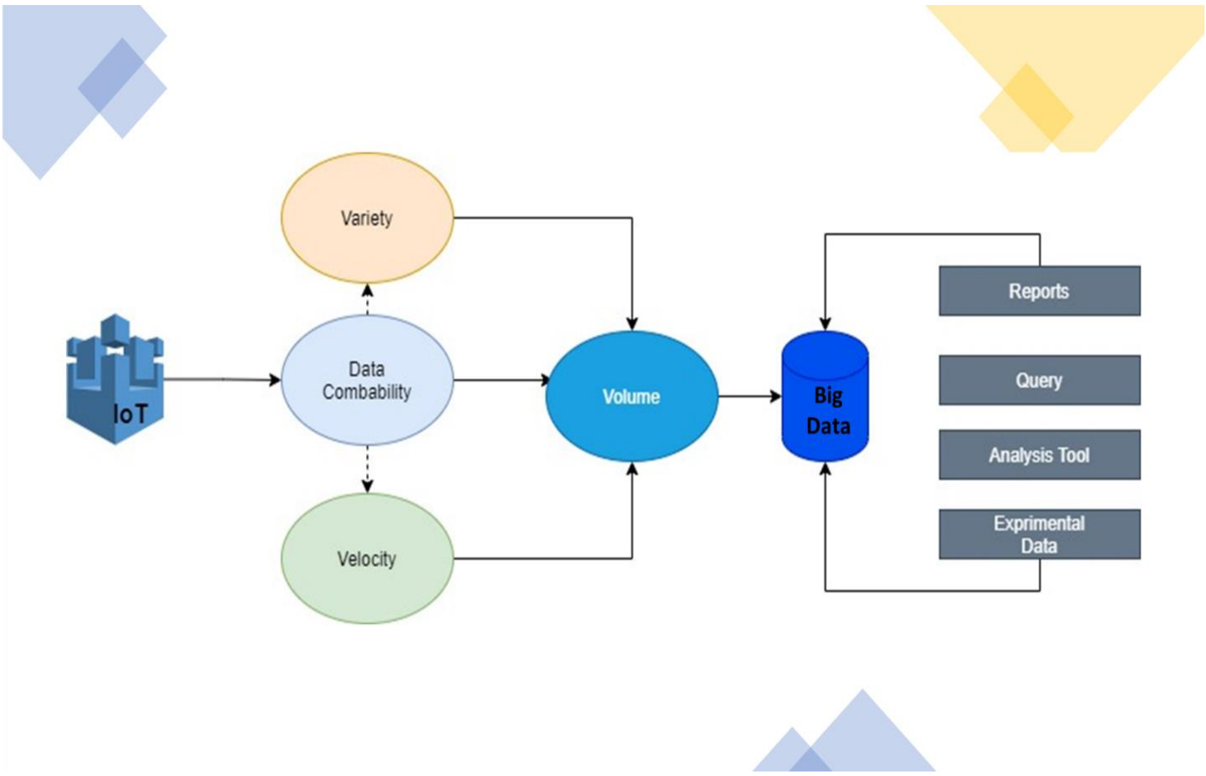

Fig. 3: *The Intersection of IoT and Big Data (BD) Analytics*

The potential benefit of BD is easily solved when it is integrated into the motor's decision-making phase. Numerous research studies have demonstrated that organisations can benefit significantly and gain a competitive advantage by making sound data-driven decisions (Davenport T.H. & Dyché J, 2020). However, BDA is more perplexing than simply tracing, classifying, comprehending, and quoting data. (Davenport T.H. & Dyché J, 2020) emphasise that while large companies routinely collect business intelligence and leverage analytics for decision support, SMEs struggle to improve top management decisions by incorporating more data into the research process. Integrating staff, technology, and organisational resources to transform into a data-driven business is challenging (Weill P & Ross J.W. IT savvy, 2009).

This is possible when a variety of analytical techniques are used to extract meaning from data, such as to describe the current state of a business situation. Descriptive analytics scrutinises data and information in such a way that trends, patterns, and exceptions become visible in the form of regular reports, ad hoc reports, and dashboards (Joseph R.C. & Johnson N.A., 2013). For instance, analytical drill-downs into data, statistical analysis, and factor analysis; investigative analytics is concerned with evaluating data in order to certify/reject business proposals. Forecasting and mathematical modelling are two aspects of predictive analytics that are used to assess potential outcomes.

Prescriptive analytics is about optimising and conducting randomised research to determine how businesses can improve their service quality while lowering costs; and Pre-emptive analytics enables organisations to take proactive measures in response to incidents that could adversely affect performance, such as detecting potential threats and suggesting far-ahead mitigation plans in time. The proponents argue that by making it more transparent and quantifiable, these types of empirical approaches facilitate decision-making and organisational efficiency, while also highlighting contradictions, as well as potential issues and opportunities.

2.4 IoT architecture for big data analytics

The architectural concept of IoT is defined in a variety of ways, all of which are based on the abstraction and identification of IoT domains. It provides a reference model for defining relationships between various Internet of Things verticals. This architecture is enabled by ubiquitous sensing, data analytics, and information representation, all of which are unified by the Internet of Things.

Use Cases in IoT and Big Data

3.1 Big Data Smart metering

Smart metres are used to collect a large amount of data from a variety of sources. It is a device that electronically records meter-to-control system data on electric strength utilisation. Utility companies must be adept at advanced analytics and managing large volumes of data.

3.2 Big Data Smart transportation

For the smart city model, this principle is a utility. Rain, fog, and several other causes interrupt the old transportation networks. They are focused on the processing of pictures, which is why they are so fragile. (Evizal et al., 2013) uses radio-frequency identification (RFID) for vehicle tracking and analysis. In addition, this technology can be used to control traffic congestion. Using satellite data linked to each device, we can optimize route handling for various vehicles to enhance lead quality (Sherly, J. & Somasundareswari, D., 2015).

3.3 Big Data Smart supply chains

Embedded sensor tools enable bidirectional communication and remote access to more than 1000000 elevators worldwide. Another use case is in-transit visibility, which, in the presence of IoT infrastructure, will be critical in future supply chains. Additional tracking information, location, and identity can be provided by cloud-based Global Positioning Systems (GPS) and

RFIDs. Big IoT data analytics allows a supply chain to make decisions and exert control over the external environment.

3.4 Big Data Smart agriculture

In the case of smart agriculture, sensors are the actors. They are installed in fields for moisture level data collection, plant trunking diameter, microclimate, and moisture level data collection. These data are routed to the analytics layer via an IoT gateway and the Internet.

3.5 Big Data Smart grid in Electricity Systems

The smart grid is a new generation of power grid in which electricity distribution and management between suppliers and consumers are enhanced through the use of two-way communication technologies. Grid sensors and devices generate data about control loops and protection on a continuous and rapid basis. Electricity systems require a smart grid to manage the volatile behaviour of distributed energy resources (DERs). The majority of energy systems, however, must abide by government laws and regulations.

3.6 Big Data Intelligent traffic light system

The intelligent traffic light system is composed of nodes that communicate with IoT sensors and devices in order to detect the presence of vehicles, cyclists, and pedestrians. These nodes communicate with adjacent traffic lights to determine the speed and distance travelled by approaching modes of transportation. The system's IoT data collection requires real-time analytics processing in order to perform necessary tasks.

Opportunities for IoT and Big Data Analytics

4.1 E-commerce

Analytics on big IoT data has a wide range of applications in nearly every industry. Analytics' primary areas of success are e-commerce, revenue growth, and forecasting accuracy. Convergence of big data and the Internet of Things introduces new challenges and opportunities for the development of a smart environment.

4.2 Smart cities

Big data collected from smart cities enables new avenues for efficiency gains. Numerous devices are connected to the internet to create a shared information and intelligent environment. Hadoop, in conjunction with the YARN resource manager, has provided the most recent advancement in big data technology for supporting and managing a wide range of workloads.

4.3 Logistics and Retail

IoT must play a role in logistics and retail as an evolving technology. RFID is used in logistics to track containers, pallets, and crates. Businesses can gain insights from the massive amounts of data generated by IoT technologies by using data analytics. Retailers can increase their profits by analysing customer data.

4.4 Healthcare

The market for smart health monitoring devices has exploded in recent years. Data analytics enables healthcare professionals to detect and diagnose serious diseases early on, potentially saving lives. Data analytics enhances the clinical quality of care and protects patients' safety. Additionally, a physician's profile can be reviewed by examining a patient's treatment history in order to increase customer satisfaction.

Open Challenges and Future Directions

5.1 Privacy

Privacy issues are critical because there is a huge risk in IoT and big data analytics concerning user personal information. Conscious users are not able to simply access these services on the go with current conscious tech-users and privacy, so the need for prime solid service-level agreement (SLA) must provide confident and standard sop in terms of handling user personal details, but the risk of external attack persists as the usual norm that states that there is no haven for any network dealing. Given the usual SOPs and other security tools to ensure the risk of data loss and abuse of personal data, the ethical aspect of the equation is where the information needs to be accessed and processed and used.

Given the enormous amount of data collected, transmitted, and exploited in IoT and big data operations, the probability of security risk is also rising. In the current IoT and big data systems background, measures described by (Daissaoui et al., 2020) are primitive, as previously discussed. IoT and big data platforms are considered emerging and can be viewed as a more recent phenomenon that creates complications due to the use of outdated algorithms and methods that are not well-suited to addressing new technologies (Lafuente-Arroyo et al., 2006). Thus, coping with the ever-changing existence of the data involved is difficult. To ensure privacy and reduce the possibility of data leakage, this also makes it important to accept the newest algorithm and more modified SLA signing.

5.2 Data mining

With the evolution of big IoT data and cloud computing platforms, data exploration and information extraction have become more difficult. Large data sets contain a greater number of anomalies and ambiguities, necessitating additional pre-processing steps. Researchers introduced parallel and sequential programming models and proposed a variety of algorithms for reducing query response time when dealing with large amounts of data. Algorithms must still be developed to ensure compatibility with the latest parallel architecture. This data mining method bottleneck has become an unresolved issue in big IoT data analytics. Figure 4 summarises the data mining process used to identify and describe feeding patterns. These data are required for data generation; however, the speed with which data is accessed for both reading and writing can be problematic when it consists of a variety of data.

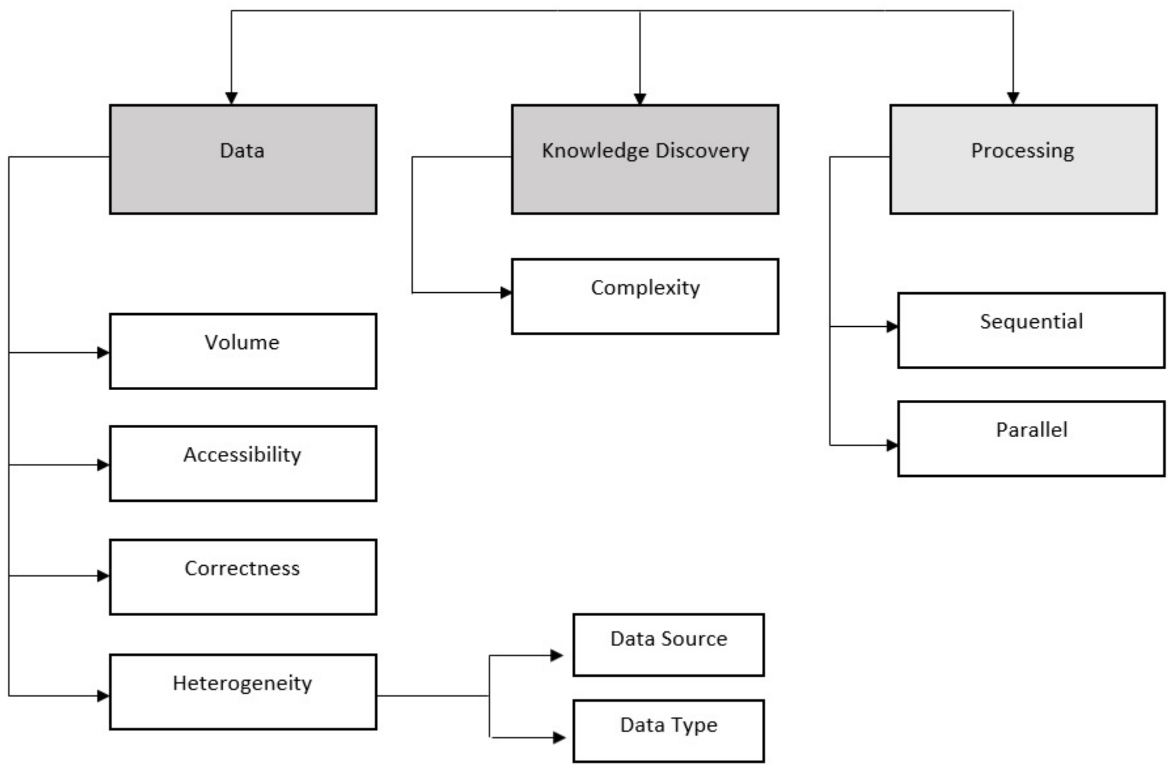

Fig. 4: *Data mining which is used for feeding patterns and description.*

5.3 Visualization

For any kind of data, visualization is a very significant term. When we have different data sources that can produce various kinds of data, it is more critical. This knowledge needs to be shown in a proper way and this is the place where visualization comes into the picture. But it is difficult for each type of data to be displayed as they have several dimensions. Therefore, to achieve the aim, the analytics of big data and visualization should work in tandem. Another challenge is to develop a proper visualization system to illustrate the different types of data. The issues with the current visualization program are response time, reliability, and low functionality. We should also be able to use these visualization techniques for normal users on basic devices such as cell phones and laptops.

5.4 Integration

Data integration creates a unified view of data that originates from multiple sources and reconciles disparate data views. Integrating disparate data types is a difficult task when combining multiple systems or applications. Overlapping identical data, enhancing performance and scalability, and enabling real-time data access are just a few of the data integration challenges that should be addressed in the future. Textual data can be mined for information such as entities and relationships using text mining, machine learning, natural processing, and information extraction technologies. However, new technologies for extracting images, videos, and other data from non-text formats of unstructured data should be developed.

Conclusion

This article discusses the relationship between the Internet of Things (IoT) and big data (BD) , which has reached a point where massive amounts of data must be processed, transformed, and analysed at a rapid pace. Numerous surveys are conducted against the backdrop of big IoT data analytics. Following that, we discussed cutting-edge IoT and big data analytics solutions. Additionally, the relationship between big data analytics and IoT is discussed. Additionally, an architecture for big IoT data analytics is proposed. Additionally, the authors discuss the forms, methods, and technologies associated with big data mining and big data analytics. Additionally, some verifiable instances of usage have been included. Furthermore, the domain is examined through an examination of the numerous opportunities presented by data analytics in the context of the IoT paradigm. Numerous open research challenges are discussed as possible research directions. Finally, current solutions for broad IoT data analytics are discussed, many of which are still in their infancy. There will be an increased demand for real-time analytical solutions capable of providing rapid insight in the future.

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References

1. Abuarqoub, A., Abusaimeh, H., Hammoudeh, M., Uliyan, D., Abu-Hashem, M. A., Murad, S., Al-Jarrah, M., & Al-Fayez, F. (2017). A Survey on Internet of Things Enabled Smart Campus Applications. *Proceedings of the International Conference on Future Networks and Distributed Systems*, 1–7. https://doi.org/10.1145/3102304.3109810
2. Ahmed, E., Yaqoob, I., Hashem, I. A. T., Khan, I., Ahmed, A. I. A., Imran, M., & Vasilakos, A. V. (2017). The role of big data analytics in Internet of Things. *Computer Networks*, *129*, 459–471. https://doi.org/10.1016/j.comnet.2017.06.013

3. Al Nuaimi, Al-Jaroodi J, Al Neyadi H., & Mohamed N. (2015). *Applications of big data to smart cities Journal of Internet Services and Applications*. 1–15.

4. Aldowah, H., Ul Rehman, S., Ghazal, S., & Naufal Umar, I. (2017). Internet of Things in Higher Education: A Study on Future Learning. *Journal of Physics: Conference Series*, *892*, 012017. https://doi.org/10.1088/1742-6596/892/1/012017

5. Al-Qaysi, N., Mohamad-Nordin, N., & Al-Emran, M. (2020). A Systematic Review of Social Media Acceptance From the Perspective of Educational and Information Systems Theories and Models. *Journal of Educational Computing Research*, *57*(8), 2085–2109. https://doi.org/10.1177/0735633118817879

6. Castro, M., Druschel, P., Kermarrec, A.-M., & Rowstron, A. I. T. (2002). Scribe: A large-scale and decentralized application-level multicast infrastructure. *IEEE Journal on Selected Areas in Communications*, *20*(8), 1489–1499. https://doi.org/10.1109/JSAC.2002.803069

7. Daissaoui, A., Boulmakoul, A., Karim, L., & Lbath, A. (2020). IoT and Big Data Analytics for Smart Buildings: A Survey. *Procedia Computer Science*, *170*, 161–168. https://doi.org/10.1016/j.procs.2020.03.021

8. Davenport T.H. & Dyché J. (2020). Big data in big companies. International Institute for Analytics. *2013*. http://www.demonish.com/cracker/1431316877_1217a9641e/bigdata-bigcompanies-106461.pdf

9. Evizal, Rahman, T. A., & Rahim, S. K. A. (2013). RFID Vehicle Plate Number (E-Plate) for Tracking and Management System. *2013 International Conference on Parallel and Distributed Systems*, 611–616. https://doi.org/10.1109/ICPADS.2013.109

10. Gandomi & A. and Haider. (2015). *Beyond the hype: Big data concepts, methods, and analytics International Journal of Information Management*. 137–144.

11. Hassanien, A. E., Bhatnagar, R., Khalifa, N. E. M., & Taha, M. H. N. (2020). *Toward social Internet of things (SIoT): Enabling technologies, architectures and applications : emerging technologies for connected and smart social objects*. https://doi.org/10.1007/978-3-030-24513-9

12. Joseph R.C. & Johnson N.A. (2013). *Big data and transformational government IT Professional, 15 (6), pp. 43-48.*

13. Kambatla, K., Kollias, G., Kumar, V., & Grama, A. (2014). Trends in big data analytics. *Journal of Parallel and Distributed Computing*, *74*(7), 2561–2573. https://doi.org/10.1016/j.jpdc.2014.01.003

14. Labrinidis, A., & Jagadish, H. V. (2012). Challenges and opportunities with big data. *Proceedings of the VLDB Endowment*, *5*(12), 2032–2033. https://doi.org/10.14778/2367502.2367572

15. Lafuente-Arroyo, S., Maldonado-Bascon, S., Gil-Jimenez, P., Gomez-Moreno, H., & Lopez-Ferreras, F. (2006). Road Sign Tracking with a Predictive Filter Solution. *IECON 2006 - 32nd Annual Conference on IEEE Industrial Electronics*, 3314–3319. https://doi.org/10.1109/IECON.2006.347453

16. Marjani, M., Nasaruddin, F., Gani, A., Karim, A., Hashem, I. A. T., Siddiqa, A., & Yaqoob, I. (2017). Big IoT data analytics: architecture, opportunities, and open research challenges. ieee access, 5, 5247-5261

17. Philip Chen, C. L., & Zhang, C.-Y. (2014a). Data-intensive applications, challenges, techniques and technologies: A survey on Big Data. *Information Sciences*, *275*, 314–347. https://doi.org/10.1016/j.ins.2014.01.015

18. Philip Chen, C. L., & Zhang, C.-Y. (2014b). Data-intensive applications, challenges, techniques and technologies: A survey on Big Data. *Information Sciences*, *275*, 314–347. https://doi.org/10.1016/j.ins.2014.01.015

19. Riggins, F. J., & Wamba, S. F. (2015). Research Directions on the Adoption, Usage, and Impact of the Internet of Things through the Use of Big Data Analytics. *2015 48th Hawaii International Conference on System Sciences*, 1531–1540. https://doi.org/10.1109/HICSS.2015.186

20. Shahla, G., Shahbaz, A., & Muhammad, Y. (2017). A Survey on Role of Internet of Things in Education. *International Journal of Computer Science and Network Security, Vol.20, No.9*. http://cloud.politala.ac.id/politala/1.%20Jurusan/Teknik%20Informatika/19.%20e-journal/Jurnal%20Internasional%20TI/IJCSNS/2017%20Vol.%2017%20No.%2005/20170520%20A%20Survey%20on%20Role%20of%20Internet%20of%20Things%20in%20Education.pdf

21. Sherly, J. & Somasundareswari, D. (2015). *INTERNET OF THINGS BASED SMART TRANSPORTATION SYSTEMS.*

22. Szongott C., Henne B., & von Voigt G. (2012). Big data privacy issues in public social media. *(DEST)*, 1–6.

23. Weill P & Ross J.W. IT savvy. (2009). *What top executives must know to go from pain to gain Harvard Business Press.*

LOT БАЙЛАНЫСЫ ЖӘНЕ ҮЛКЕН ДЕРЕКТЕРДІ ТАЛДАУ: МҮМКІНДІКТЕР МЕН АШЫҚ МІНДЕТТЕР

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Түйін. *Заттардың интернеті (IoT) - кең ауқымды қолданбалы перспективалы технология. Ол физикалық нысандарды қарапайымдылық пен уақытты пайдалану тұрғысынан пайдалану мүмкіндігін арттыру үшін арнайы құрылымға ұйымдастыруға мүмкіндік береді. Ол физикалық әлем мен машиналар әлемі арасындағы алшақтықты жою туралы ойды өзгертуі керек. Қазіргі жағдайда ол әртүрлі технологияларда да қолданылады. Оның қолданбаларының бірі деректер жиынын талдауды жеңілдете отырып, әртүрлі құрылғылардан деректерді бақылау және сақтау болып табылады. Бұл талдау содан кейін оның негізінде шешімдер қабылдауға негіз бола алады.*

Бұл зерттеу Интернет заттары мен үлкен деректердің тұжырымдамасын, архитектурасын және өзара байланысын сипаттайды. Бұдан әрі зерттеу әдістемесінде заттар интернеті мен үлкен деректерді пайдаланудың бірнеше жағдайлары қарастырылады. Мүмкіндіктер мен ашық міндеттер, оның ішінде болашақ бағыттары сипатталған. Бұған қоса, бұл құжат Интернет заттарындағы үлкен деректерді талдау үшін жаңа архитектураны ұсыну арқылы құндылық қосады. Жалпы, IoT үлкен деректер талдауының әртүрлі түрлері, олардың әдістері және оларға байланысты үлкен деректерді өндіру технологиялары талқыланады.

Түйінді сөздер*.* *Интернет заттары, үлкен деректер, архитектура.*

ВЗАИМОСВЯЗЬ В IOT И АНАЛИТИКА БОЛЬШОГО ОБЪЕМА ДАННЫХ: ВОЗМОЖНОСТИ И ОТКРЫТЫЕ ПРОБЛЕМЫ

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Резюме. *Интернет вещей (IoT) - это перспективная технология, которая имеет широкий спектр приложений. Он позволяет физическим объектам быть организованными в специализированную структуру, чтобы повысить ее удобство с точки зрения простоты и использования времени. Он должен преобразовать мысль о преодолении разрыва между физическим миром и миром машин. В нынешней ситуации он также используется в широком спектре технологий. Одно из его приложений - отслеживать и сохранять данные с различных устройств с течением времени, что позволяет легко анализировать набор данных. Затем этот анализ может быть основой решений, принимаемых на его основе. В этом исследовании описываются концепция, архитектура и взаимосвязь Интернета вещей и больших данных. Далее изучаются несколько вариантов использования Интернета вещей и больших данных в методологии исследования. Описываются возможности и открытые вызовы, в том числе будущие направления. Кроме того, этот документ добавляет ценность, предлагая новую архитектуру для анализа больших данных в Интернете вещей. В целом обсуждаются различные типы аналитики больших данных Интернета вещей, их методы и связанные с ними технологии интеллектуального анализа большого объема данных.*

Ключевые слова: *Интернет вещей, большой объем данных, архитектура.*

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THE IMPACTS OF COVID-19 PANDEMIC ON THE GLOBAL SEMICONDUCTOR INDUSTRY

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Abstract: *The impact of COVID-19 pandemic to manufacturing companies has been horrendous that panic attack has occurred among the companies, as well as semiconductor companies. Many companies have been declared bankrupt due to this pandemic and a new normal have been born such as remote working, following by certain Standard Operating Procedures (SOPs) implemented by the government to avoid infection of this COVID-19 virus and practice social distancing at the workplace. Apart from the new normal, there are some effects to the semiconductor companies in a way that could present a negative impact to the future of the companies. There are some drastic measures being implemented to adapt with the new normal as well as keeping the production running as usual. The main motive of analyzing the current situation is to avoid complete down fall of production of semiconductor companies which may affect the global economy.*

Keywords: *COVID-19 pandemic, new normal, semiconductor companies, global economy.*

Basic provisions. Financial crisis can be considered to be the main impact. To run the business, employees are needed and the employees must be paid with commensurate salary