THE DYNAMICS OF THE UBIQUITOUS INTERNET OF THINGS (IOT) AND TRAILBLAZING DATA MINING (DM)

Bongs Lainjo

Cybermatic International, Canada

ABSTRACT

The research study intends to understand the thematic dynamics of the internet of things (IoT), thereby aiming to address the general objective i.e. "To explore and streamline the IoT thematic dynamics with a focus on cross-cutting data mining, and IoT apps evidence-based publication trends". To meet this objective, secondary research has been compiled as part of the analytic process. It was found from the research that IoT continues to evolve with significant degrees of proliferation. Complementary and trailblazing data mining (DM) with more access to cloud computing platforms has catalyzed accelerating the achievement of planned technological innovations. The outcome has been myriads of apps currently used in different thematic landscapes. Based on available data on app searches by users, and between 2016 and 2019, themes like sports, supply chain, and agriculture maintained positive trends over the four years. The emerging Internet of Nano-Things was found to be beneficial in many sectors. Wireless Sensor Networks (WSNs) were also found to be emerging with more accurate and effective results in gathering information along with processing data and communication technologies.

In summary, available data indicate that IoT is happening and has a significant implication on data mining. All indications suggest that it will continue to grow and increasingly affect how we interact with "things". A backdrop of concerns exists ranging from developing standard protocols to protecting individual privacy.

KEYWORDS

IoT, Data Mining (DM), Trail Blaze, Ubiquitous, Evolution

1. INTRODUCTION

Over time, information technology has evolved and transformed our daily way of living. The past three decades have witnessed an unprecedented evolution of high technology and its associated themes. Everyone can attest that their life quality has improved thanks to the incorporation of technology in various sectors such as business and it has increased people's motivation towards getting the best results possible. In general, there is very little doubt that technological innovations have served as an impetus behind these dynamics. The Internet of Things (IoT) has served and continues to demonstrate the usefulness of human-machine integration through sensors, and the transformation and manipulation of data through different data mining platforms. It was the increase in communication protocol development, network creations, and increased focus on Artificial Intelligence that birthed the IoT. According to Kong [1], the IoT involves the information of physical objects, including sensors, machines, cars, buildings, and other items, that allow interaction and cooperation of these objects for achieving specific goals. Others, such as Welbourne et al. [2], provided more detailed descriptions. That is, IoT was presented as a structure of computing that facilitates data transfer between digital and mechanical appliances

without involving human interaction. This makes it capable of data mining. For example, Hancock and Hancock [3] mentioned that IoT has three important ramifications including data collection, remote control capability, and communication between objects. Data cannot be useful when it stands alone since it is vital to have ways for transforming the data into useful information. In this regard, a literature review conducted by Chen et al. [4] observed that algorithms could be applied to IoT for extracting meaningful data. Consequently, the practice of identifying data patterns that are useful from huge datasets and utilizing for patterns or hidden information extraction is referred to as data mining (DM). DM can also be perceived as the exploration and transformation of data that ultimately generates information, which reveals historically undiscovered trends and patterns. These dynamics are useful in making informed decisions or predictions in significant cases.

In this paper, DM is specifically highlighted as an indication of its importance and cross-cutting role in data analytics. Its invaluable contribution in propagating the transformations involved with different IoT themes cannot be adequately emphasized. The logical layout of the article includes background, settings, thematic proliferation, thematic implications, prognoses, and more.

2. BACKGROUND

IoT and data mining are complementary platforms. These two technologies have also had a longstanding effect on various thematic areas including the development of IoT-enabled technologies such as sensors for data collection, IoT-based systems of communication and data transfer, and similar kinds of technologies [5]. The IoT and its impact on data mining have rich backgrounds beginning with the onset of the internet. This has been highlighted in the studies of Xia et al. [6] and WuHe et al. [5]. Some concerns associated with these platforms include security, future developments : future architectures, regulations, and standardizations.

The IoT refers to a variety of things that are typically connected to the Internet to enhance the sharing of data with other things. IoT-connected machines and devices can improve how human beings work and live. An article by Kim et al. [7] suggested that IoT and its applicable technologies can integrate classical networks. Consequently, IoT has been serving a vital purpose ever since it appeared, contributing to innovative applications ranging from traditional equipment to general house hold devices. It has been attracting the researchers' attention from industry, government, and academia in the past years. The recent introduction of various transformative technology into IoT such as data mining have helped it to become more effective [8].

An article by Bin et al. [9] suggested that data mining entails discovering novel, potentially exciting patterns, particularly from large relevant data sets : data dredging and data archeology. The main aim of any data mining is to build an efficient descriptive or predictive model using a vast amount of the most appropriate and relevant data. There are various implications of IoT in data mining. Some are explained in the following paragraphs.

Firstly, an article by Dachyar et al. [10] mentioned that the term IoT first emerged in a published paper in the year 2006, showing the paradigm of the evolving concept of internet technology. The concept of IoT is very crucial in con temporary circumstances [11]. They further added that the technologies that both shape and support IoT have been in evolution for several years. In the study conducted by Chen et al. [4], data-center architectures are significantly growing and are found to be more distributed to accommodate the data that IoT is generating. The distributed strategy to edge computing is mainly designed to meet the real-time processing requirements needed for new IoT applications in the field [12]. Most business operations have extended their data centers to the public cloud to process, assess, and store vast volumes of IoT data.

In an article by Cai et al. [13], the researchers reveal that IoT devices, sensors, and machines generate a vast amount of data every second. It has further been found that cloud computing assists in both the storage and analysis of the data. This enables the enterprise to get the maximum gains of an IoT infrastructure [14]. Hence, the IoT solution connects people, things, and processes, while cloud computing plays a crucial role in this collaboration to enhance high visibility.

In a study conducted by Shi et al. [15], with the assistance of edge computing, intelligence in data mining moves to the edge. There are various scenarios where high-speed data is the key component of analytics, which assists in processing data with edge computing [16]. The critical cases of IoT for edge computing include security concerns and the evolution of cloud computing.

According to Ren et al. [17], trail blazers ranked trust issues as one of the significant concerns, ahead of technology issues. Besides, there are frequently two or three times the likelihood of more laggards to address privacy issues, data integrity, and cyber security, including other dimensions of trusted technology. For instance, trail blazers are probably more likely to think of matters concerning security at the start of the IoT initiatives or choose private networks that play a crucial role by limiting threat pressure [18].

IoT results in a massive amount of data. Literature reveals that this might possess some prognosis in the field of e-commerce [19]. First, making information and data available to people enhances government transparency. Transparency helps in ensuring proper insight and also reduces government waste. A good way that the enormous data gathered by IoT helps consumers and businesses is through empowering them towards better decision-making [20]. The IoT further gives users knowledgeable advice.

Firms are significantly turning to IoT as their sources of data because these are typically derived from regular monitoring of a vast range of things with in different situations, which become available. In a study conducted by Misuraca [21], the IoT brings with it new business ventures. The risks such as the lack of well-coordinated policies and regulations about IoT can significantly impede its application and implementation [22]. As a result, organizations should, therefore, develop policies and regulations and also consider their role in enabling the development of IoT very carefully. Any IoT corporation should demonstrate an inevitable out break growth to enhance developments [23].

In a study conducted by Saidu et al. [24], the authors indicate that the advent of the Internet has played a crucial role in information technology and has resulted in more effective modes of communication. Handheld devices, such as mobile phones, have made access to ambiguous information processing more feasible [25]. IoT has made it easier for most commercial operations as they can keep in touch with their clients.

The scope of IoT remains quite wide. If the number of peer-reviewed publications is any indication, the challenges and degree of IoT technological innovations continue to expand unabated at an alarming rate. As the adage goes, necessity is the mother of invention. IoT is no exception as confirmed by the abundant and growing number of related themes associated with IoT. An extensive and analytic perspective is presented else where in the paper.

Lastly, IoT is changing the gravitational constant in our technological world. As it matures, the black holes of data gravity in which clouds have been placed will eventually be ripped part from the millions of smaller data planets [25]. The smaller planets will be situated in houses, factories, buildings, or any where else where the IoT runs to make the data actionable. Thus, we have to

keep all our applications blazing fast by running them at a hundred percent. In addition, we can not leave all our applications vulnerable to the so-called nature of the Internet.

3. SETTINGS

Jacob Morgan supposed that anything that can be connected would be connected [3]. Morgan referred to the future concerning IoT as an assertion based on an informed observation of the trend in the IoT space. For instance, according to Kong et al. [1], various countries have adopted strategies based on the rapid development of IoT technologies with good examples being China with its Made-in-China 2025 strategy, the US through its American Advanced Manufacturing Partnership Program, and Germany's German Industry 4.0 strategy. In light of these strategies accordingly, the IoT will continue to influence significant paradigm shifts, especially in data management and applications. Notably, Liu et al. [26] underlined that IoT devices collect high quality data that is utilized in new technological developments (see Figure 1). Some of these areas include IoT data mining and analytics, development of Sensors for data collection and management, e-health, and Big Data analytics.

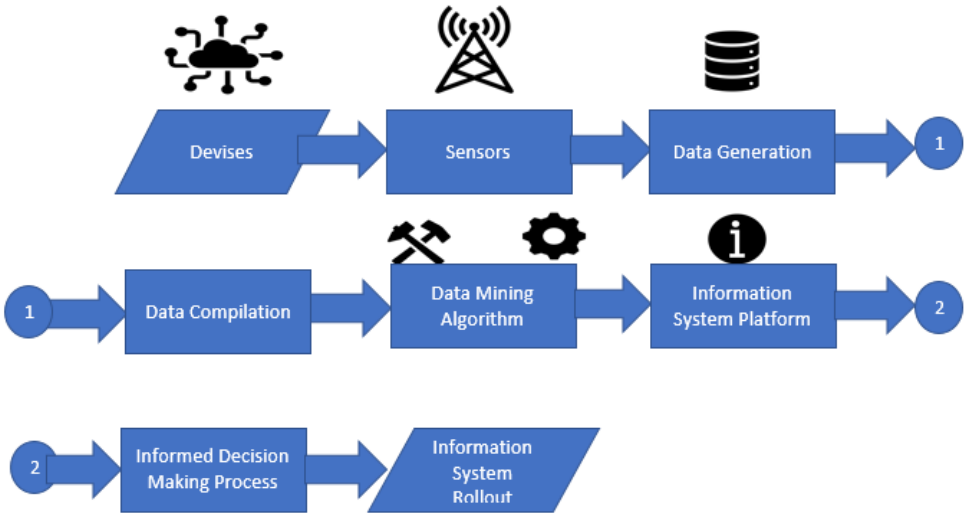

Figure 1. IoT Ecosystem Platform (Source: Author)a

4. THEMATIC PROLIFERATION OF IOT

During the period July 21 and 24, 2020, a four-year retrospective (2016 -2019) database was compiled through searches using the Goggle Scholar framework. The selection of the four years was influenced by accessibility to recent datasets. Besides, having a minimum number of points was also vital for facilitating possible trends' identification (see Figures 2 and 3).

In general, there were 103 themes. Among these and based on four-year means, the theme with the highest number of publications was the "resource management and access control" theme with 374000 publications. At the bottom, the theme with the least number of publications was "new human-device interaction with two publications".

The annual median publications for all the themes over four years were 5415, 8930, 11400, and 11700 for 2016, 2017, 2018, and 2019 respectively. The averages are not reported here because of their insensitivity to extreme values, which were quite prevalent in the data set. The annual

trends were as follows: Between 2016 and 2017, most (88 percent) of the themes had an increase in the number of publications. Between 2017 and 2018, 81 percent of themes had a positive change in the number of publications. And finally, from 2018 to 2019, the increase rate was 79 percent.

4.1. Select Themes

The reason for including the select themes in the detailed analysis was that the general population readership could resonate and recognize them. They include healthcare, education, engineering, household, transportation agriculture research, law enforcement, security and Trust, business, manufacturing, supply chains, resource management, location, smart cities, and social media.

The four-year average (Figure 1) position "Resource Management" at the top with 374250 publications, followed by "Social Models "with 251000 publications. The bottom two themes were "household" and "supply chain" with 2420 and 1398 publications respectively.

Highlights of the selected themes are also included to explore further a more complementary perspective of these themes. Among these 18 themes (Figure 2), the number of publications in 22 percent had an annual decline in four years; seventeen percent declined on the fourth year only with "smart city" the only theme with two consecutive declines during the last two years. The rest had an increasing number of publications over that time frame. Concerning inching trends, "supply chains" increased the most (102 percent) between 2016 and 2017; 50 percent between 2017 and 2018, and 56 percent between 2018 and 2019. On the other side of the spectrum, "localization technologies" had a downward trend of 26 percent between 2016 and 2017, 41 percent and 18 percent fall in the number of publications between 2018 and 2019 with the "resource management" dropping 41 percent in its number of publications between 2017 and 2018. There was not a single theme with the trend change of annual publications higher than the preceding year.

In summary, these dynamics suggest the extent to which IoT technological innovations can serve as a proxy to the number of IoT thematic publications. There is also the likelihood that these innovations can be used to predict ongoing research themes. The implications range from thematic knowledge sharing to exponential research challenges.

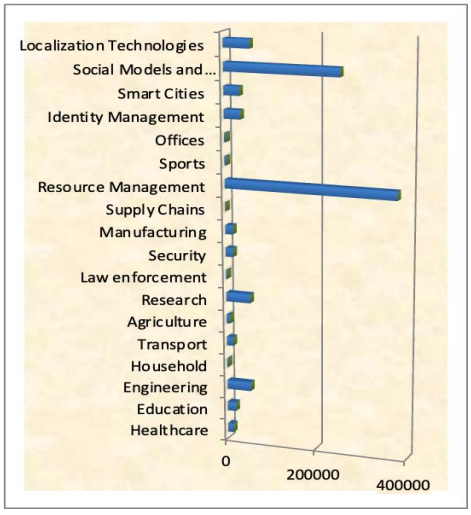

Figure 2. 4-year Averages of Select IoT Themes (Data Source: Google Scholar, Author)

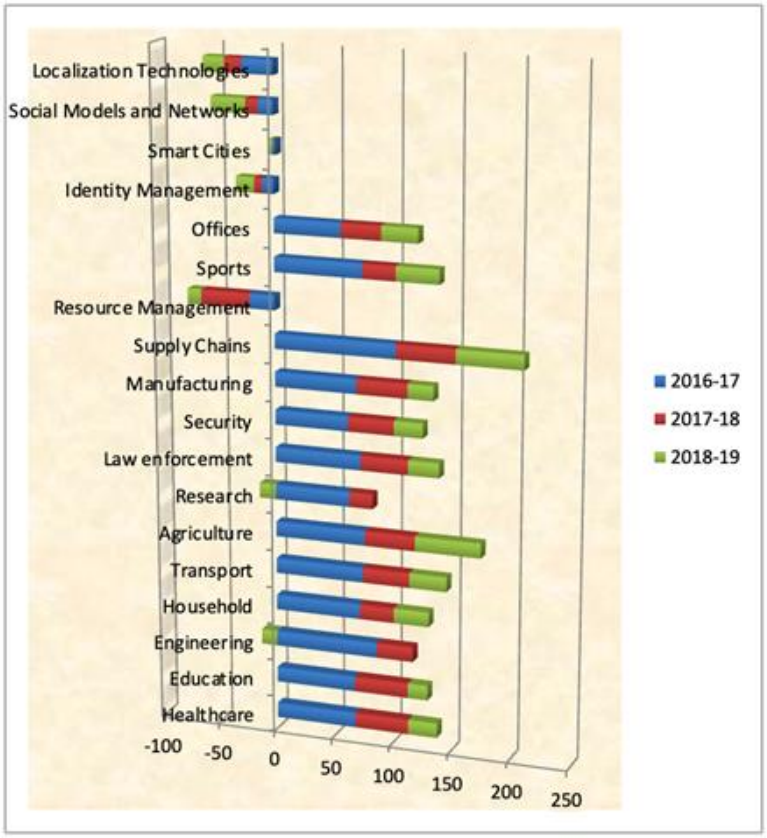

Figure 3. Select IoT Thematic Trends - 2016-2019 (Data Source: Google Scholar, Author)

4.2. The Matic Implications

Concerning the research topic i.e. IoT and DM, several implications have been identified in the existing literature. Deloitte [27], in its report, underlined information system platforms' influence in the development of a huge scope for future improvements through its effects on the current dynamics. For instance, IoT cloud platforms are becoming increasingly important in the global market. Hence, the IoT cloud platform market was worth 6.4 billion USD in the year 2020. With this, the IoT solution segment has been significantly dominated by the IoT monetization market. Hence, due to this reason, it has been estimated that the cloud platform market has an immense scope in its future growth, thereby generating about 11.5 billion USD by the year 2025. This further infers that the trend will continue in the future because more organizations have started to adopt these solutions [27].

Considering the potential of IoT to avail intelligent platforms, Hassan [28] stated that it has a significant scope of providing intelligent platforms to facilitate the collaboration of distributed objects through wired networks or local-area wireless networks. Furthermore, information system platforms have been specifically integrated by healthcare organizations through IoT health monitoring systems. These platforms offer an effective environment of intelligence for assisting and monitoring patients in remote areas. Specifically, these devices are used by IoT systems for ensuring that they can be controlled and queried by other platforms, applications, and controllers. This further coordinates with multiple objects without the human users' interference. Even in the aquarium environment, such kinds of platforms have been used, such as in the case of Libelium. This platform used sensors that monitored several aspects of water and utilized actuators along with pump devices that regulated and administered medicines. Most importantly, it was

responsible for sending wireless information, which is gathered by the sensors. Additionally, actions are initiated by the actuators to the mobile interface or web interface accordingly [28].

Gubbi et al. [29] affirmed that cloud computing provided an appropriate platform, which acts as a receiver of data from ubiquitous sensors. It also played the role of a computer that interpreted, as well as analyzed the data along with availing the users with web-based visualization, which becomes easy to understand. Besides, to develop ubiquitous healthcare, IoT has been providing proper platforms so that body area sensors can be used for uploading the data to the servers [29]. However, Elkhodr et al. [30] argued that IoT incorporation needs proper standards for enabling horizontal platforms, which are programmable, communicable, and operable across devices irrespective of their model or industry applications. It was also observed that several studies reported privacy issues while using mobile applications on relevant phone platforms. Therefore, it has been suggested "it is most likely that privacy incidents will grow rapidly with the increase in penetration of the IoT in our daily life. Thus, privacy remains a major problem as IoT develops. When it comes to IoT, anonymity does not count as privacy. IoTs are designed to automatically collect data, store them, and easily share and analyse personal data, which can have potential adverse effects on individuals."[30].

Another prominent platform, which that has been taken into consideration in Figure 1 is the data mining algorithm. In this context, Sunhare et al. [31] asserted that if a proper data mining algorithm is processed with different types of data, then valuable knowledge can be gathered. Nevertheless, a challenging aspect evident in such instances is that it is difficult to synthesize or select the most feasible data mining algorithm. Chen et al. ([4] further stated that these kinds of algorithms can be efficiently used to gather private or hidden information from the available data. It has also highlighted that more devices are being connected to IoT and hence, a large amount of data must be analyzed. Furthermore, the latest algorithms must be modified for applying them to big data. It also estimates that big data-related mining systems will be most appropriate to be developed in the future for obtaining better results. Specifically, it has been noted in this study that data mining involves the application of algorithms to the gathered data for finding patterns and evaluating the same related to discovered knowledge [4]. Data compilation is another important platform associated with IoT, which is essential in the concerned environment, wherein the issue of data compression, storage, analysis, and visualization were duly addressed with the help of data curation of IoT sensor data in the cloud platform. It has also been found that for edge-based machine learning, as well as energy-efficient data, a compression approach was suggested in terms of IoT [32]. Besides, Brous et al. [33] found out that informed system rollout and informed decision-making are also involved in the IoT ecosystem platform. This is because the IoT has been adopted for reconfiguring the processes of decision-making, especially in asset management. Furthermore, there is the future scope of better utilization as well. Hence, it has been suggested that it is important to gather the right information for attaining the best outcomes [33].

4.3. Prognoses

In a statement by Hancock and Hancock [3], authors indicate that it is hard to know the size or state of the IoT because it is evolving so rapidly. A similar opinion is observed by Kong, et al. [1] where an increase in data mining and consequent demand for data storage is predicted. It has been understood that in the future, the IoT technologies will better integrate with the internet for developing accurate solutions to interchange and communicate information through sensing devices. It has been estimated that in the future, wider technological trends will be evidenced through the enablers such as manufacturing, energy, communication, standards, integration, intelligence, and interoperability. Additionally, RFID technology will be considered mainstream

in the retail sector. Besides, ambient intelligence will be mastered alongside interacting virtual world with that of the physical one [34].

Hussein [35] asserted that "Owing to the fact that IoT has become a vital element as regards the future of the internet with its increased usage, it necessitates a need to adequately address security and trust functions" (p. 80). It has been further understood that IoT along with DM has several future applications and a scope of improvement. In the future, IoT can be applied to develop smart cities, which would require using sensors and radio frequency identification. The application of the Internet of Nano-things (IoNT) can also be explored in the field of healthcare, which will enable organizations to collect new medical data. It will further be responsible for conducting better diagnoses and discoveries (see Figure 4). Smart agriculture, as well as water management, can also be done by implementing IoT and DM in the future. The IoT ecosystem platforms can also be used in the logistics and retail sector, which will contribute to improving the small living standards of the citizens. Additionally, IoT can also be explored in collaboration with blockchain technology in the future for enhancing overall security and privacy or security issues [35]. It has also been understood that IoT will explore all kinds of application areas in near future. These areas also involve big data analytics, which enables organizations to undertake accurate decisions for developing enhanced IoT systems [36].

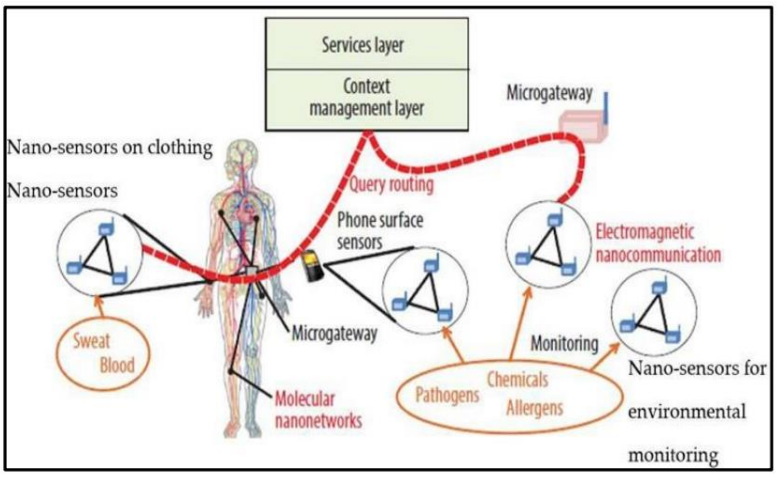

Figure 4. Internet of Nano-Things. (Source: Hussein, 2019)

5. THE FUTURE OF TECHNOLOGY

The preceding literature has presented IoT and its implication on data mining as rapidly growing [3], [4]. Some have described it as ever-growing, while others have illustrated its future as hard to quantify due to available possibilities for growth [3]. For instance, when Jacob Morgan mentions that eventually "anything that can be connected will be connected", it signifies that the implication of IoT on data mining will be significant. For instance, even Kong, et al. [1], mentioned that with the increase in IoT business, the demand for data storage and computing will put pressure on the ability of cloud computing. In this regard, data mining's scope in the future must also be explored. Hence, it was estimated by Venkatadri and Reddy [37] that data mining also has a vast scope in the upcoming days. This is because soft computing approaches can be explored, for instance, genetic programming, fuzzy logic, and neural networks. These kinds of techniques can be incorporated with the help of cloud computing and multi-agent technologies. The prime areas, wherein these technological advancements can be applied involve medical diagnosis, business, social networking, research and scientific analysis, and the web [37]. Apart from these areas, healthcare applications can also be highly estimated. This is because "IoT in

healthcare has the potential to make a reality that All staff in hospital areas can benefit from access to an up-to-date electronic health record detailing the patient's condition and treatment, and affording access to their information, medical history, services and diagnostics" (p. 4). The power of DM has also been identified in this study, wherein it has been found that "Recent AI technology allows to expand the fields of Data Mining as well as the speed under the new evolution of storage and processing performances of computing machines" [37].

5.1. Findings

There are considerable implications of IoT on data mining. Some of the already experienced effects include increased efficiency in data capture and processing, more accurate statistics, facilitation of collection and transfer of big data, among other implications [5], [26]. The paper also finds potential challenges including data security and impact on privacy through IoT-enabled data mining. Additionally, Deloitte [27] asserted that IoT platforms such as IoT orchestration, which is a single platform, have been offering organizations the ability to integrate the existing systems and workflows with IoT. This helps in integrating data from future and current connected systems and devices. Highlighting the effect of these platforms on the current dynamics, the author indicated that organizations incurred low costs for computing data and storing them on the cloud platform. Even edge computing has been trending in the present scenario. It has also been noted that with the help of these platforms, the costs of devices, connectivity, and sensors have been reduced. These have further enabled the development of mobile application platforms and smartphone penetration enhancement [27].

Intelligent platforms have also been optimally using interconnected and heterogeneous networks, including the internet. These advancements have been possible with the successful development of Radio Frequency Identification (RFID) technology along with wireless communication technologies [28]. Concerning information system platforms, it has been understood that "Intelligence may be contained completely within a device, combined with platform intelligence in the cloud, or reside almost completely within a platform to which the device connects to perform some functions" [28].

The data mining algorithm is a vital IoT platform, which is responsible for facilitating valuable analytics, managing services and networks efficiently, and estimate future events precisely irrespective of all constraints. Herein, it has been highlighted that when new raw data are processed with the help of traditional data mining algorithms then accurate insights are not gained. This is the reason why a responsive and intelligent environment is not established by the system. In this context, it has been stated that "we predicted astronomically huge heterogeneous network of IoT devices with data mining algorithms to subsist as a seamless fabric, covering and synthesizing the intelligent environment" [31]. All these depict the importance of developing a precise 'data mining algorithm' so that flexible, open, and dynamic ad-hoc IoT services can be made possible. These algorithms when applied to input data can enable the extraction of personal, as well as useful information. However, the fulfillment of all these aspects is highly challenging concerning IoT [31].

IoT devices have been increasingly used for enhancing the lifestyle of people in society. They are also useful in conserving energy, enhancing sectors such as health, agriculture, and transportation, thereby adopting the smart approach. The data retrieved from those devices are helpful in increasing knowledge on trends and patterns that further increase the efficiency of companies and improve economies and the global community. Considering the usage of IoT and its impact on the current dynamics, it has been understood that it enables exploiting data analytics and big data. This helps in facilitating data preprocessing, combining, gathering, and categorizing along with decision-making [38]. Besides, focusing on trailblazing DM, it has been found that the

data mining framework is highly effective in applying IoT. In this concern, "IoT generates enormous amount of heterogenous valuable data. To convert this data into knowledge, data mining systems are developed" [39]. It has also been understood that there are several limitations for considering IoT data, as it must be analyzed on a real-time basis. Therefore, improving personal security in the future and enhancing people's overall quality of life will require considering effective solutions such as cloud computing and deep learning to derive knowledge from new situations [40].

Besides, advancements in designing sensors are also found to be an important aspect. This is because with improved sensors real-time data collection and analysis could be possible, which further has contributed to the development of IoT dynamics along with that of DM. Specifically, wireless sensor networks (WSNs) are increasing in importance, as it has contributed in developing the quality of information, as well as communication technologies. These networks have also been responsible for integrating and connecting the internet in a wide area of application, for instance, industries [41]. Even Elkhodr et al. [30] acclaimed that "Todays' sensors can monitor temperature, ambiance, soil makeup, pollution in the air, noise, presence of objects or movements among other actuating functionalities triggered based on some sensed information" [30].

6. THE USEFULNESS OF THE PRESENT RESEARCH

The findings presented have clearly shown that the existing research can benefit people's knowledge on the impacts of advancing the IoT dynamics and how it links to the DM aspects. Besides, it has also been found that various platforms such as sensors are also getting evolved with IoT, which, in turn, have led to the development of better IoT solutions for addressing all the issues that have been persisting.

6.1. Added Value to Current Research

Herein, it needs to be mentioned that the information gathered from varied existing literature and studies carried forth by numerous researchers have significantly added value to the current research. This is because the general objectives of the research paper have been effectively addressed. Besides, the exploration of future scope and implications of IoT and DM have contributed to the existing literature, which makes the present research a significant resource for future reference.

7. DISCUSSION

The findings and information gathered from the above sections have highlighted that IoT has become an emerging technology and has an immense scope in enabling better solutions. The above-made analysis also indicates that the IoT dynamics are ubiquitous and evolving. This has been particularly understood by examining cross-cutting trailblazing DM [17], [27], [29]. With these evolutions, several platforms associated with the IoT ecosystems have also been developed in the current era. This includes devices, data generation, sensors, data compilation, information system platforms, data mining algorithm, information system rollout, and an informed decision-making process. Besides, their advancements are expected to be more evident in the future, which will further enhance the outcomes [4], [28], [29], [30], [32], [33]. Additionally, developments have also been evident in designing sensors. With the evolution of several technologies and WSNs, the sensors are gradually becoming more intelligent [41].

8. CONCLUSIONS

The preceding discussion has indicated that IoT is happening and has a significant implication on data mining. All indications suggest that it will continue to grow and increasingly affect how we interact with "things". A backdrop of concerns exists. Some of the matters raised by researchers include the rate of growth of the technology against the ability to regulate implementation, challenges in standardization, information integrity, and data security [42], [43]. Accordingly, the implications of IoT on data mining will continue to be felt in what can be described as an unprecedented manner similar to what was mentioned in the paper, as many "things" continue to be connected and communicated through IoT, a significant effect will continue to be noticed in data mining.

9. FUTURE RESEARCH

The present study has effectively addressed the general objective throughout the paper. The study understood that the IoT dynamics are ubiquitous, as the IoT has been evolving with time. Particularly, by emphasizing data mining, it has been understood that the IoT ecosystem platforms also evolved, which made the future implications more promising and effective for making the life of people better. However, the present study still had some limitations. One of the limitations was the exclusion of primary data. Hence, future researchers must consider primary research for obtaining more accurate outcomes. Besides, the present study is found to be qualitative. However, integrating statistical analysis with the help of quantitative research would generate better results. Furthermore, the present research paper is found to be wider as it has covered all the aspects of data mining and IoT ecosystems. However, with a more focused aim, the research would have generated detailed information. Hence, these aspects need to be considered in future research so that the study area is explored to the fullest.

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AUTHORS

Bongs Lainjo, MASc, Engineering, is an RBM systems consultant with expertise in program evaluation. Bongs is a former UN Senior Advisor of Program Management, Reproductive Health Commodity Security (RHCS) and Evaluation. Prior to that, he worked for USAID as a Logistics and Management Information Systems Advisor (LISA). He also served as COP/Senior Data Management Advisor for Columbia University after spending close to a decade teaching as a professor at a number of Canadian academic institutions. Bongs has worked in several countries in Africa, Asia, Pacific Island Countries, Canada, and the United States.