International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 22
November 2018

Deep Learning Methods for enhancing the performance of IoT

Mr. Mehamed Ahmed Abdurahman
PhD research scholar, Faculty of Engineering and Technology / IT Department, PIET
PARUL UNIVERSITY, LIMDA, WAGHODIYA
VADODARA-391760, GUJARAT-INDIA
Affiliated University, Aksum University, Tigray, Ethiopia
Email:mohammeda128@gmail.com

Abstract: Internet of things (IoT) is fastest emerging network and becoming most demanding, dynamic and rapid technology which is bringing radical changes in organizational methods and changing human life controlled through technology management. Hence, now days advanced organizations, are looking into IoT as next generation technology to enable better prospects for humans. In this paper we are assessing typical architectures and potential applications through which IoT contribution is giving benefits to human being. Despite the popularity of IoT, the data processing methods are not suitable for handling voluminous and diversified data gather via IoT devices. Deep Learning (DL), is one of the most prominent methods in machine learning and has acquired its application in the field of image mining, text, speech, pattern recognition and so on, that can enhance the performance of IoT . In the past few years, DL has played an imperative position in the area of IoT and associated fields like big data analytics.. To process and analyze big data precisely and accurately, the Iot devices are in a need for highly optimized algorithms and methods. DL techniques are used to process huge real-time data with higher efficiency.

Recent researches on DL and IoT, have put a light on different hybrid mechanisms to process real-time big data in a most competent way. One of the areas of focus of this paper is to present key opportunities and challenges in IoT and this paper outlines the architectures IoT and applications of machine learning in the area of IoT related fields such big data analytics and further research directions.

Keywords- IoT, Big data analytics, Deep Learning, real-time data, data processing

I. INTRODUCTION

The IoT is fastest emerging network which enable communication between physical and digital environment through connectivity medium i.e. internet. IoT play a farfetched role in improving the quality of human life [1] i.e it is changing the traditional organizational methods into the modern ones with promising technology. However, Processing and preparing data for these communications is a critical challenge for various organizations. To respond to this challenge, different kinds of data processing, such as analytics at the edge, stream analysis, and IoT analysis at the database, must be applied. Thus, the decision to apply any one of the aforementioned processes depends on the particular application and its needs [2]. For instance, Fog and cloud processing are two analytical methods adopted in processing and preparing data before transferring to the other things. The whole task of IoT is summarized as follows: first, sensors and IoT devices collect the information from the environment. Next, knowledge should be extracted from the raw data. Then, the data will be ready for transfer to other objects, devices, or servers through the Internet [3].

Machine learning is the latest approach to digital transformation, making our computing processes more efficient, cost-effective, and reliable. It is no longer the fancy of science fiction writers, but a bonafide, business-critical technology that will ultimately make decision-making a far more data-driven affair [4]. Furthermore, Deep Learning (DL) being as one of the most prominent methods in machine learning, has acquired its application in the field of image mining, text, speech, pattern recognition and so on. In the past few years, DL has played an imperative position in the area of IoT and associated fields like big data analytics. The conventional data processing methods are not suitable for handling voluminous and diversified data gather via IoT devices [5].

In recent years, though several surveys were published to emphasize the advancement of research activities in the IoT framework, applicability and models [6–11]. They mainly focus on general issues of IoT fundamentals or models. With the big data only security concerns were presented as a part of each survey and treated in a generic manner and security and privacy were often shown jointly as a single concept. Unfortunately, none of the previous surveys has detailed in-depth on performance concerns of the IoT, particularly with enhancing the process and preparing big data using IoT.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 22
November 2018

It is clear that all of the aforementioned surveys either did not consider enhancing security performance in the IoT framework and DL methods as a priority or were limited to a part of their issues. In our work, we consider typical examples of IoT, in some areas, with more focus on offering a classic survey, i.e. our intent is to present a roadmap for designers and practitioners of IoT to provide supplementary efforts in different and interesting areas to improve IoT big data analytics features, as supporter to the idea in [12].

The key methodology behind the survey depends on few factors of importance where earlier mentioned domains are deeply investigated based on their respective sub domains. Our survey is to provide significant knowledge on the following: architectural structure, applicability, and selection of DL methods considerations measure. A precise, concrete and concise conclusion is made at the end of this article based on the survey perception. The overall method behind the survey will support researchers to have insight on how DL methods are applied, into the sub domains, to enhance the performance of IoT using particular architectures.

.

II. IoT architectures and its potential applications

Under this part the works done so far by the scholars and scientists around the globe such as Intel research is prescribed.

According [13], various domain specific architectures based on the broad areas, such as: RFID, service oriented architecture, wireless sensor network, supply chain management, industry, healthcare, smart city, logistics, connected living, big data, cloud computing, social computing, and security are described in this section. The selection of theses domains depends upon current scenario of IoT applicability. It is has been tried to incorporate as directions into this article, but due to the size constraints, present limitations have been made.

IoT architecture may be preserved as a system which can be physical, virtual, or a hybrid of the two, consisting of a collection of numerous active physical things, sensors, actuators, cloud services, specific IoT protocols, communication layers, users, developers, and enterprise layer. Particular architectures do act as a pivot component of IoT specific infrastructure while facilitating the systematic approach toward dissimilar components resulting solutions to related issues [13]. In light to this, the dominant IoT architectures in respect to the potential applications are presented as follows:

A. IN HEALTHCARE UNITS

Now a day's, healthcare is an affliction factor for systems are struggling with aging population, prevalence of chronic diseases, and the accompanying rising costs. In response to these challenges, researchers have been actively seeking for innovative solutions and new technologies that could improve the quality of patient care meanwhile reduce the cost of care through early detection/intervention and more effective disease/patient management. It is envisaged that the future healthcare system should be preventive, predictive, personalized, pervasive, participatory, patient-centered, and precise [14].

When IoT is integrated with health infrastructures, healthcare units can have various applications that can serve patients in an elegant fashion. For instance, the authors in [15], the potential applications of IoT its related technologies in healthcare systems of South Africa, is highlighted. The applications include diabetes management, heart disease management, environmental health, occupational health, mental health, home and community based healthcare, emergency services, sports and fitness, baby care, oral health, disease surveillance, telemedicine, chronic medical management, and ambient-assisted living for aged people [1].

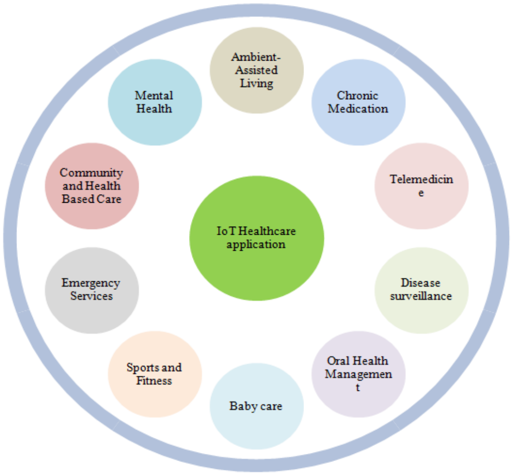

Fig.1. Potential Applications of IoT Healthcare [1].

B. IN ENVIRONMENT MONITORING UNITS

A WSN with 3 layered logical approach, the e-SENSE project has employed, to provide intelligent support to the user group by application, middleware, and connective measures [16]. In addition, another example of WSN based supportive system known as UbiSec & Sens with security layer is added as extra on top of it, which is similar to the e-SENSE, has been provided in [17], in which the functional design and implementation of a complete WSN platform can be used for monitoring of long-term environmental monitoring based IoT applications. The objectives of this design satisfy numerous parameters, such as: cheap structure, enablement of pool of sensors, fast deployment, longevity of device, less maintenance, and high Quality of Service. WSN based application has been devised on agriculture and forestry where IoT plays a key role [18]. An architectural design across the middleware, hardware, and network layer results in a unique WSN platform – ‘‘Sprouts”, which is versatile, open source, and multi-standard in nature [19]. However, several studies have found the challenges related to the usage of mobile phones as spontaneous gateways of WSNs in IoT systems, by showing the usage of a name-based Future Internet Architecture (FIA), while delivering the information of a temperature sensor data from an Android phone directly to multiple applications via in-network multicast over the same network test bed [20].

C. IN INFRASTRUCTURE MONITORING UNITS

Among the potentials applications of IoT, Tailings Dam Monitoring and Pre-alarm System – (TDMPAS), which IoT based dam safety application, has been developed and implemented which incorporates cloud services to accomplish with the real-time monitoring of the saturated water line, water level and dam deformation [21]. TDMPAS helps the engineers to acquire cautious alarm information remotely, prior to actual accident which would have been occurred. Moreover, another example of Infrastructure Monitoring system, Unified Sensing Platform (USP) a 3 layered (distribution middleware, USP, and application) USP architecture, has been designed as the blueprint of what enables the seamless integration of multi-dissimilar objects and their efficient use by efficient, reusable and context aware way [22]. Authors also present this architecture (as see Fig. 2), which stratifies publish/subscribe, message queues, data distribution services etc., through data and sensor based USP layer. Sensor and resource frameworks perform sensor oriented usage and control operations by efficient resource management catering contextual observation toward various top level applications.

D. IN AGRICULTURE UNITS

Agriculture based IoT is envisaged by developing a prototype platform [23] that controls network information integration to study the actual situation of agricultural production while operating from a remote location. This study employs WSN as the backbone of the implementation. A recent work has proposed a 6 layered agriculture architecture that incorporates WSN as a subsidiary element to enhance multi-culture analysis, user experience, and predictive analysis [24].

E. IN AQUACULTURE UNITS

To pursue the information of water quality via mobile internet and WSN to the users, an IoT based aquaculture while providing real-time information system called ‘‘E-Nose” has been developed. The system performs forecasting of the change of the trend of water quality based collected data [25].

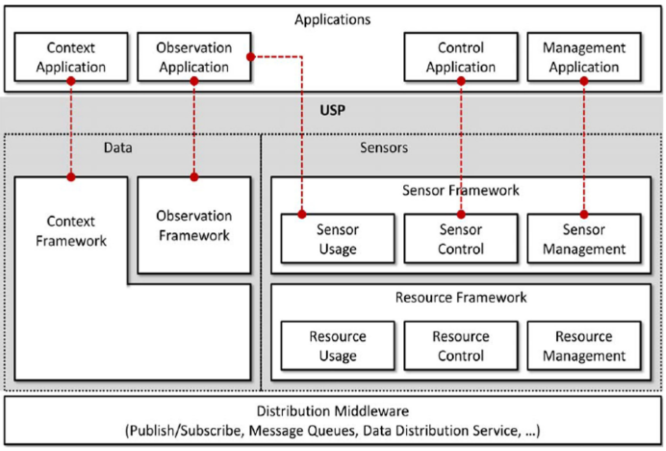

Fig. 2. Stratification in the USP architecture.[13]

III. Potential opportunities of Machine learning

Machine learning can be applied in several organizational smarter decision makers. For instance Machine learning methods particularly deep learning can help banks, insurers, and investors make smarter decisions in a number of different areas [4]. Thus, as shown in table 1, below we present few of the typical applications of machine learning:

Table 1: Typical applications of machine learning [4]

R.no	Application	Service provided
1	**Customer and client satisfaction.**	Machine learning helps financial services firms track customer happiness. By analysing user activity, smart machines can spot a potential account closure before it occurs. They can also track spending patterns and customer behaviour to offer tailored financial advice.

2	**Reacting to market trends**	Another application of machine learning is market analysis. Smart machines can be trained to track trading volatility or manage wealth and assets on behalf of an investor. These algorithms can identify trends more efficiently than humans and react in real-time (reducing the impact of major financial events such as Brexit).
3	**Calculating risk**	Smart machines can analyse a large number of disparate datasets (credit scores, spending patterns, financial data etc.) to accurately assess risk in both insurance underwriting and loan assessments, tailoring them to a specific customer profile.
4	**Remaining competitive**	This example of machine learning is perhaps the most relatable to management level execs, giving firms a clinical edge in a fierce industry, by helping them remain innovative. With the right machine learning algorithms, companies can act quickly on business intelligence, increasing productivity and opening up new streams of revenue.

IoT requires data to either represent better services to users or enhance the IoT framework performance to accomplish this intelligently. In this manner, systems should be able to access raw data from different resources over the network and analyze this information in order to extract knowledge [3]. However, despite the massive amount of attention given to the IoT over the past couple of years, connected Products are essentially old news as large and expensive industrial equipment has been supervised Remotely for many years [26]. According these authors, the novelty associated with IoT also stems from its potential for widespread application as technical Barriers. For instance associated with automated surveillance have been gradually eroding, drastically decreasing the associated costs in its wake. The requisite technical equipment, such as computers and sensors, has gotten smaller and more power efficient. The rates for data traffic have decreased as an infrastructure of wireless, high-capacity networks has expanded at breakneck speed. The ability to create interfaces between network types (middleware) has improved, making it possible to accommodate multiple standards and formats and provide seamless connectivity [27].

IV. OPEN ISSUES IN BIG DATA

The various challenges related to big data analytics is still emerging as par with recent developments around the world, where every second millions of data were generated via IoT devices. To address these challenges, significant research efforts are required to advance the competence of data collection, data storage, data analysis and visualization.

According [3], IoT will be among the most significant sources of new data, data science will provide a considerable contribution to making IoT applications more intelligent. Data science is the combination of different scientific fields that uses data mining, machine learning (Deep learning), and other techniques to find patterns and new insights from data. These techniques include a broad range of algorithms applicable in different domains. The process of applying data analytics methods to particular areas involves defining data types such as volume, variety, and velocity; data models such as neural networks, classification, and clustering methods, and applying efficient algorithms that match with the data characteristics.

By following our reviews, the following is deduced: First, because data is generated from different sources with specific data types, it is important to adopt or develop algorithms that can handle the data characteristics. Second, the great number of resources that generate data in real-time are not without the problem of scale and velocity. Finally, finding the best data model that fits the data is one of the most important issues for pattern recognition and for better analysis of IoT data. These issues have opened a vast number of opportunities in expanding new developments. Big data is defined as high-volume, high-velocity, and high variety data that demands cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation [28].

With respect to the challenges posed by big data, it is necessary to introduce a new concept termed smart data, which means: ”realizing productivity, efficiency, and effectiveness gains by using semantics to transform raw data into Smart Data” [29]. A more recent definition of this concept is: ”Smart Data provides value from harnessing the challenges posed by volume, velocity, variety, and veracity of Big Data, and in turn providing actionable information and improving decision making.” [30].

Finally, smart data can act as a good representative for IoT data. To understand which algorithm is more appropriate for processing and decision-making on smart data generated from the things in IoT, it is essential to consider the following three concepts. First, the IoT application. Second, the IoT data characteristics and third, the data-driven vision of machine learning (deep learning) algorithms.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 22
November 2018

A number articles in the field of IoT data analysis are reviewed, revealing that there exist major groups of algorithms are applicable to IoT data. These algorithms can be categorized according to their structural similarities, types of data they can handle, and the amount of data they can process in a reasonable time. Having reviewed the real-world perspective of how IoT data is analyzed by several authors, many significant and insightful results have been revealed regarding data characteristics [3].

To gain a deeper insight into IoT smart data, patterns must be extracted and the generated data interpreted. Cognitive algorithms, using Deep learning methods undertake interpretation and matching, much as the human mind would do. Cognitive IoT systems previously learn from generated data and improve when performing repeated tasks. Cognitive computing acts as a prosthetic for human cognition by analyzing massive amount of data and responding to questions that humans might have when making certain decisions. Cognitive IoT plays an important role in enabling the extraction of meaningful patterns from generated IoT smart data [31].

V. DEEP LEARNING MODELS

DL is an emerging branch of supervised learning method in machine learning [5]. For example, in neural network, for a given neuron function, the activation function is applied on the deep layers to extract the abstractions from voluminous data. This is similar to a hierarchical structure where deep learning models are applied [31]. In the research domain, DL is a very promising and evolving area. DL has many highly developed algorithmic models such as convolution neural networks (CNNs), deep Boltzmann machines (DBMs), deep belief networks (DBNs), deep representation, recursive autoencoders and restricted Boltzmann machines (RBMs)[32].

Generally, DL models are applied to the huge volume of unsupervised data generated by IoT devices, to automate the extraction from data. DL has combined with allied domains such as artificial intelligence, which simulate the human brain function to analyze, learn and extract the meaningful insights from the data gathered. The research works addressed towards this challenge, has been a key objective to develop DL algorithmic models [33].

However, how can machine learning or deep learning algorithms be applied to IoT smart data? And what is the taxonomy of machine learning algorithms that can be adopted in IoT are still some research works as future directions.

CONCLUSION

Now days, the Internet of Things has entered in every field. The Internet has proved its existence in our lives. The IoT has added a new potential into internet by enabling communications between objects and human, making a smarter and intelligent planet. In this paper, we have discussed the potential architectures and applications of Internet of things in different sub domains or units. Further, some typical Deep Learning methods that are relevant for big data analytics and the how knowledge acquired from DL algorithms is successfully applied to big data analytics are highlighted. The two aspects of potential issues, one how DL methods are applied to specific problems of big data and how it could be improved to address the future challenges. The allied domains of big data, such as computer vision and speech recognition, have seen the application of Deep Learning in the larger extent to produce higher accuracy classification results within an optimized time complexity [4], are still need further to be research.

References

[1]. Varsha D.U. et.al. ,"Healthcare Services Using IoT: Opportunities and Challenges", INTERNATIONAL JOURNAL OF RESEARCH IN ELECTRONICS AND COMPUTER ENGINEERING (IJRECE), A UNIT OF I2OR, VOL. 6 ISSUE 3, ISSN: 2348-2281 PP 1412-1420 (JULY - SEPTEMBER 2018)

[2]. F. Bonomi, R. Milito, J. Zhu, S. Addepalli, Fog computing and its role in the internet of things, in: Proceedings of the first edition of the MCC workshop on Mobile cloud computing, ACM, 2012, pp. 13-16.

[3]. M.S. Mahdavinejad, M. Rezvan, M. Barekatain, P. Adibi, P. Barnaghi, A.P. Sheth, Machine learning for Internet of Things data analysis: A survey, Digital Communications and Networks (2017), doi: 10.1016/j.dcan.2017.10.002.

[4]. https://www.redpixie.com/blog/examples-of-machine-learning]

[5]. Renuka Devi.D ,, Diana Judith.I," Deep Learning Methods for Big Data Analytics", INTERNATIONAL JOURNAL OF RESEARCH IN ELECTRONICS AND COMPUTER ENGINEERING (IJRECE), A UNIT OF I2OR, VOL. 6 ISSUE 4, ISSN: 2348-2281 PP 24-26 (OCTOBER-DECEMBER 2018)

[6]. J. Gubbi, R. Buyya, S. Marusic, M. Palaniswami, Internet of things (Iot): a vision, architectural elements, and future directions, Future Gener. Comput. Syst. VOL 29 ISSUE7, PP 1645–1660, 2013.

[7]. L. Atzori, A. Iera, G. Morabito, The internet of things: a survey, Comput. Netw.VOL. 54 ISSUE 15, PP 2787–2805, 2010

[8]. D. Miorandi, S. Sicari, F. de Pellegrini, I. Chlamtac, Survey internet of things: vision, applications and research challenges, Ad Hoc Netw. VOL 10 ISSUE 7 PP 1497–1516, 2012.

[9]. C.C. Aggarwal, N. Ashish, A.P. Sheth, The internet of things: a survey from the data-centric perspective, in: C.C. Aggarwal (Ed.), Managing and Mining Sensor Data, Springer US, Boston, MA, 2013, pp. 383–428.

[10]. Said O.," Accurate performance evaluation of internet multicast architectures": hierarchical and fully distributed vs. service-centric, TIIS VOL 7 ISSUE 9, PP 2194–22, 122013.

[11]. C. Perera, A.B. Zaslavsky, P. Christen, D. Georgakopoulos, Context Aware Computing for the Internet of Things: A Survey, CoRR abs/1305.0982.

[12]. A. Riahi Sfar et al., "A roadmap for security challenges in the Internet of Things", Digital Communications and Networks VOL 4 PP 118–137, 2018. https://doi.org/10.1016/j.dcan.2017.04.003

[13]. Ray P.P. ,"A survey on Internet of Things architectures": Journal of King Saud University – Computer and Information Sciences VOL 30, PP 291–319, 2018.

[14]. Boda P. & Mr Raveendra B.N.," IoT based Healthcare Monitoring System" INTERNATIONAL JOURNAL OF RESEARCH IN ELECTRONICS AND COMPUTER ENGINEERING (IJRECE), A UNIT OF I2OR, VOL. 6 ISSUE 3, ISSN: 2348-2281 PP 1319-1324 (JULY - SEPTEMBER 2018)

[15]. Dlodlo, N. "Potential Applications of The Internet of Things Technologies for South Africa's Health Services". Conference on ICT for Africa , pp.1-17, 2013.

[16]. Arsenio, A. et al.. Internet of intelligent things: bringing artificial intelligence into things and communication networks. Stud. Comput. Intell. vol 495. Springer, Berlin, Heidelberg, PP 1–37, 2014.

[17]. Mihai T. Lazarescu:" Design of a WSN Platform for Long-Term Environmental Monitoring for IoT Applications.":IEEE Journal on Emerging and Selected Topics in Circuits and Systems. Volume: 3 , Issue: 1 ,PP 45 – 54, March 2013.

[18]. Bo, Y., Wang, H., "The application of cloud computing and the internet of things in agriculture and forestry. In: Proceedings of International Joint Conference on Service Sciences (IJCSS)", pp. 168–172, 2011.

[19]. Kouche, A.E., Towards a wireless sensor network platform for the Internet of things: sprouts WSN platform. In: Proceedings of IEEE International Conference on Communications (ICC), PP 632–636, 2012..

[20]. Li, L., Technology designed to combat fakes in the global supply chain. Bus. Horiz. VOL 56, ISSUE 2, PP 167–177, 2013.

[21]. Enji, S., Zhanga, X., Lib, Z., The internet of things (IOT) and cloud computing (CC) based tailings dam monitoring and prealarm system in mines. Saf. Sci. VOL 50, ISSUE 4, PP811–815, 2012., http://www.ist-e-sense.org

[22]. Gazis, V. et. al.," Architectural blueprints of a unified sensing platform for the internet of things.": Proceedings of 22nd International Conference on Computer Communications and Networks (ICCCN), pp. 1–5, 2013.

[23]. Zhao, J.C.et. al., "The study and application of the IOT technology in agriculture.": Proceedings of 3rd IEEE International Conference on Computer Science and Information, Technology (ICCSIT), VOL. 2, PP. 462–465, 2010.

[24]. Ray, P.P.," Towards an internet of things based architectural framework for defence": Proceedings of IEEE International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), pp. 411–416. 2015

[25]. Ma, D. et. al. Prototype of an aquacultural information system based on internet of things ENose. Intell. Autom. Soft Comput.VOL 18 ISSUE 5, PP 569–579, 2012.

[26]. Wünderlich, N. V. et al.. Futurizing smart service: Implications for service researchers and managers. Journal of Services Marketing, Volume 29, Issue 6/7,PP 442—447. 2015

[27]. T. Saarikko et al." The Internet of Things: Are you ready for what's coming?", Kelley School of Business, Indiana University. Published by Elsevier Inc. Business Horizons, Volume 60, Issue 5, Pages 667-676, 2017. http://dx.doi.org/10.1016/j.bushor.2017.05.010

[28]. J. Manyika, M. et. at. " Big data: The next frontier for innovation, competition, and productivity."

[29]. A. Sheth, "Transforming big data into smart data: Deriving value via harnessing volume, variety, and velocity using semantic techniques and technologies", in: Data Engineering (ICDE), IEEE 30th International Conference on, IEEE, 2014, pp. 2-2, 2014.

[30]. A. P. Sheth, "Transforming big data into smart data for smart energy: Deriving value via harnessing volume, variety and velocity."

[31]. A. Sheth, "Internet of things to smart iot through semantic, cognitive, and perceptual computing, IEEE Intelligent Systems, Volume 31, Issue 2, PP 108-112, 2016.

[32]. S. Bin, L. Yuan, W. Xiaoyi," Research on data mining models for the internet of things", in: International Conference on Image Analysis and Signal Processing, IEEE, pp. 127-132, 2010.

[33]. H. Gonzalez, J. Han, X. Li, D. Klabjan," Warehousing and analyzing massive rfid data sets", in: 22nd International Conference on Data Engineering (ICDE'06), IEEE, pp. 83-83, 2006.