IOT AND CLOUD COMPUTING TECHNOLOGIES TO SUPPORT INFORMATION SYSTEM: A SYSTEMATIC REVIEW

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ABSTRACT

The Internet of Things (IoT) will be a smart generator of data which support the Information Systems (IS) and Communication Technologies (CT). It offers the opportunity to exchange structured and unstructured data among devices in real time, to process data to be useful as information, from where we can extract out knowledge in this area. With M2M communication technology, IoT services can aims to understand connected devices reactions in order to optimize services and applications. IoT also is a technology which provides special service in cloud environment that can support storage, analyze and modeling IoT-Data phases. However, some resources (memory and CPU) in IoT, cloud and M2M communication systems are overloaded. Because of the different IoT-data features (source, nature and volume) as well as the way to manage this data in order to explain the complexity of IoT systems. In this review, we identify and describe the resources that are used in IoT Cloud environment. we study the possible scenarios that can help us to define relationships between IoT/CLOUD and M2M technologies. Further, we present the benefits of the information system and feature extraction technics that can be explored for the processes management of IoT-data.

Keywords: *IoT-data, Cloud, M2M communication, Sensors networking, Resources overload, Big data.*

1. INTRODUCTION

The internet of things (IoT) is a key technology that has many uses in deferent domains. It enabling devices to communicate among them without human intervention with an autonomous way [40]. IoT systems offers the opportunity to exchange structured and unstructured data among devices in real time considering the number of devices connected to the Internet, which has reached more than 30 million [1]. IoT represent a suitable environment to generate a huge amount of data or IoT-data in order to support the information systems (IS) and communication technologies (CT) [2,3]. Further, all of deferent massive data types comes from IoT-sensors and distributed by traditional systems has deferent features which is difficult to dealing it. In the cloud computing systems, memory and CPU resources may be overloaded in phase of processing and distribution of massive IoT-data. We argue that this difficulty may be depending on several factors: data types, absence or shortage of specific and effective resources. However, there is still a need for management this data in terms of support services and applications. The data produced by devices are not useful without analytic power [62]. Analyzing such big IoT-data is increasingly becoming a vital factor in industrial IoT and Cloud environments using the efficient practical resources and methods based on intelligent systems manufacturing [58,59]. It aims to facilitate enhanced decision making, increase productivity and accuracy for businesses and a standard of life improving paradigm in IoT environment [56, 60]. In addition, the integrating cloud environment and IoT can aims to support storage, analyze and modeling IoT-Data phases, and offers the solutions for management of sensor data [54,55]. Based on streams of IoT-Data, features extraction methods can adopt to support the process of knowledge extraction which can used to extract specific information's for smart cities development

[61]. The innovation of new intelligent services and applications, including healthcare, surveillance, agriculture, depends on the effort of researchers to identify the conventional relationship between IoT, cloud and big data systems [63]. Agriculture IoT is a fertile field to exploit the advancement of big data and intelligent systems with IoT technology to manage effectively the IoT-data produced by sensors, and to help in automation farming for efficient productivity [41]. These are used to develop and define powerful adaptive methods in the IoT environment which be presented in the next section.

The rest of this paper is illustrated over a few sections. The different issues and challenges raised during our study in IoT, cloud and M2M communication environments are presented in section 2. In the section 3 several state-of-the-art of IoT, cloud and M2M communication are studied and analyzed. In the section 4, some applications, frameworks and standards in IoT, cloud M2M communication environments are identified and presented. And finally, in the section 5 we will give a conclusion and future work.

2. ISSUES AND CHALLENGES

The need to make life more easily become a mean objective task in enormous research fields. to this end, a many issues and challenges in IoT/Cloud environments are presented and discussed.

2.1 Overloaded Cloud Resources

In this part, we present deferent works related to resource overload issues in the cloud IoT and M2M environments.

Increasing customer demands in cloud storage systems pose a major challenge. This can be expressed by the imbalance in query handling due to the overload of the system servers. Traditional cloud systems only achieve a space balance for data storage, but they are limited to simultaneously balancing space resources and system Input-Output, and then minimizing the probability of the overload obtained [4]. But this solution does not give an exact proof, as there is a lack of investment in this environment. The overworking of the data center resources (CPU, memory, disk) is causing the workload of the servers in the cloud. Trend analysis and time series adjustment are traditional mechanisms that can be exploited as a pillar of this problem, but they remain insufficient.

Cao, Rui, and al. [5] propose a Random Forest algorithm to predict server overload based on machine learning. It exploits a small amount of data with a smaller dimension, to ensure intelligent operation with a low cost. Despite these advantages, this solution needs an experimental analysis to verify the impact of this scheduling strategy in the real data centers. In [6], the authors suggest that the appearance of overhead in SIP networks is influenced by resource inefficiencies. It develops a probabilistic mechanism based on end-to-end overload control (PEOC). overloaded Session Initiation Protocol (SIP) servers become unstable due to the mechanism of retransmission of the initialization protocol per session [7]. The templates to be created are unable to evaluate the performance of these overloaded SIP servers. The fluid-flow model has been proposed to analyze the behavior of the priority based on the query planning mechanism (PRSM). This model is used to detect, in a precise way, the dynamic behaviors of the SIP servers with PRSM. Despite these advantages, this solution remains unable to parse all messages in a network that constitutes both conventional SIP and PRSM. In [8], the load balancing is developed as a mechanism of detecting overloaded nodes and then balance the load in the cloud network such as memory load, Computation (CPU) load, network load and so on. In [9], the authors suggest that overloaded hosts in the cloud data center are influenced by the resources (servers) using in the current system. Statistical analysis of historical data presents unoptimized results in the absence of explicit specifications suitable for QoS objectives. Dynamic consolidation of VMs dedicates to maximizing the means time to inter-migrate VMs. This method is used to detect overloaded hosts when parking with heterogeneous information sources. The trace-based real-time overload simulation shows that the DCVMs method has 88% performance over benchmark algorithms. The number of connected objects generates a massive volume of data, the lack of an uniform model that makes managing IoT data (represent, distribute, and so…) remains a major challenge. The storage and analysis solution: conventional database and analytical tools, is influenced by two factors: Unstructured massive data and lack of a shape representation. The objective is to develop and deploy a various IoT/M2M complex scenarios. In [10], a semantic model and unsupervised method are developed for automatic recognition of word categories with a correlation of 0,63. In [11], the authors propose a modeling language to describe massive data storage management in cyber-physical systems. Realizing Fog computing solutions for Smart Cities represents a very challenging task, because of the massive amount of data to process [12]. SPF Fog-as-a-Service platform is proposed for running Fog services on heterogeneous devices significantly different computational capabilities while also demonstrating remarkable ease of development and management characteristics. In [13], the authors propose a novel load balancing scheme for control channel in the Cellular IoT (CIoT) systems in order to support various Internet of Things (IoT) services. This scheme aims to solve the problems of traffic loads which might be unequal and difficult to release the traffic overload. The problem of traffic loads is influenced by the massive devices deployed in coverage systems. In [14], a feedback control mechanism to overcome overload protection of cloud-IoT applications of smart devices are introduced. This mechanism supports a coupling with the widely used threshold-based auto-scaling systems. It aims to provide intelligent operation with a low cost by using a small amount of data dimension. however, it's difficult to verify the impact of this paradigm in the real data centers because of the absence of experimental analysis. In [15], the authors propose a new mechanism using the IoT services in order to provide a systematic development of Smart Objects (SOs)-based systems. This mechanism using ACOSO framework and ELDA meta-model defined at different levels of abstraction aiming to develop analysis, design and implementation phases. In [16], a blockchain framework for IoT data quality is proposed based on a distributed and self-organized cooperative algorithm using game theory. it is applied in the data collected by an IoT devices to overcome malicious data inserted communications network overload, and overload of computing power at the central node. In [17], the authors present PatRICIA, a programing IoT applications on cloud platforms to support the development and management of large-scale IoT systems, based on the concept of intent and intent scope. The main objective is to handle large volumes and the diversity of IoT data in IoT systems. Although this model is sufficient to express many common behaviors of cloud-scale IoT applications, the execution environments dynamically and on demand is required.

2.2 Big Iot-Data Management Systems

Context-aware computing has proven to be successful in understanding sensor data for add value to all collected data which appreciate their findings and discuss their applicability towards the IoT [18]. In order to support capabilities system for analyzing and processing data massive in cluster-computing environments, [19] propose a big data management system (BDMS) using current distributed files systems and around-random partitioning scheme to represent a big data set based on distributed random sample data blocks. In the home energy management systems, [20] propose an online pattern-based data compression approach for the data generated by home appliance for energy-cyber-physical systems. This approach aims to reducing power costs, and decreasing consumer energy bills. It discovers the patterns of the time series data and then utilizes these patterns for the online data compression based on an online adaptive segmenting algorithm with incremental processing technique and a similarity metric based on piecewise statistic distance. [21] suggest that detecting IoT malware is a crucial role to support the safety of the Internet system and private data based on IoT malware and static-based detection methods. The energy consumption in real time is a new problem [22]. By distribution the data into the cloud, detailed consumption of energy will be available for every month, every day and every hour. This serves as a tool for energy management.

2.3 M2M Systems

Based on the existing works, set of relationships between M2M and IoT are identified in terms of optimized the capability of machine devices to autonomously communicate. Numerous heterogeneous machines that are widely distributed and frequently evolve need a specified system to manage its complexity. Machine-to-machine (M2M) systems aims to offer this task but is costly in terms of time and money. Also, an ontology-based framework designed for the self-configuration of M2M communications (FRAMESELF) are proposed [24].

2.4 Making Decision Methods For IoT

An emergency response system (ERS) aims to improve its capabilities to respond urgent and severe cases. The performance of an ERS depends on its data acquisition and processing system, which has been developed with information technology (IT). The role of ERSs has been increased by the rapid development of sensor networks, cloud computing and Internet of things [25]. The difficulties to make consensus decisions for services at different IoT edge nodes are a discussed obstacle. The origin of this problems is that the available information might be insufficient

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or overloaded. To solve this problem, a distributed consensus decision making (CDM) methods can provide an efficient and reliable means of synthesizing information by using a wider range of information than existing statistical methods [26].
A service in network performs machine learning based clustering of sensor data from a plurality of sensors in the network to form sensor data clusters [27]. The service maps the data clusters to symbolic clusters using a geometric conceptual space. The service infers a Domain Specific Language (DSL) from the symbolic clusters and from a domain specific ontology.

3. ANALYTICAL STUDY

In this section we introduce an analytical study on different overload detection scenarios in IoT and cloud environments. The results of this analysis may explore to support and propose a scalable performing and effectives services and applications. The mean objective study is presented in table as follow:

Table 1: Analytic Study of Overloaded Systems

Ref	Overload problem	Method	Advantage	Limit
[4]	In cloud memory, CPU resources	MICBF, and McCH (CMM)	Uniform utilization rate	Machine contains 3 desks SSD, SAS, SATA.
[5]	In cloud data center resources (CPU, memory, desk)	Machine Learning Forest Random	Reduced data with lower dimensions.	Lack of experimental analyzes for Scheduling strategy
[6]	Inefficient resources in Session Initialization protocol SIP networks	Probable end-to-end overload control (PEOC)	PEOC is a best of that benchmarks system	PEOC designed just for specified servers.
[8]	In cloud because of scheduling-g of user requests	Load balancing algorithm based - heuristic	Detected and balanced simultaneously in real time	
[9]	In hosts cloud data center because of the resource usage method.	Dynamic Consolidation Virtual Machines (DCVMs)	88 % in related among the benchmark algorithms.	

This study presents some approaches with its advantages and its limits. These features converge to support academical researches to give a general idea in order to overcome different scenarios based on IoT services. Also, it is a raison to explain some concepts of this technologies and its relationships. it outlines the interesting of overload detection methods in various domains. These allow us to open research to make a comparative study in known detection methods.

3. IOT, CLOUD AND M2M

In this part we present and discus some IoT data characteristics, and introduce an architecture that aims to describes the possible integrating of IoT, Cloud technologies in figure 1. The target object is optimizing and offer a high applications and performances based on deferent technologies such as cloud and IoT technologies.

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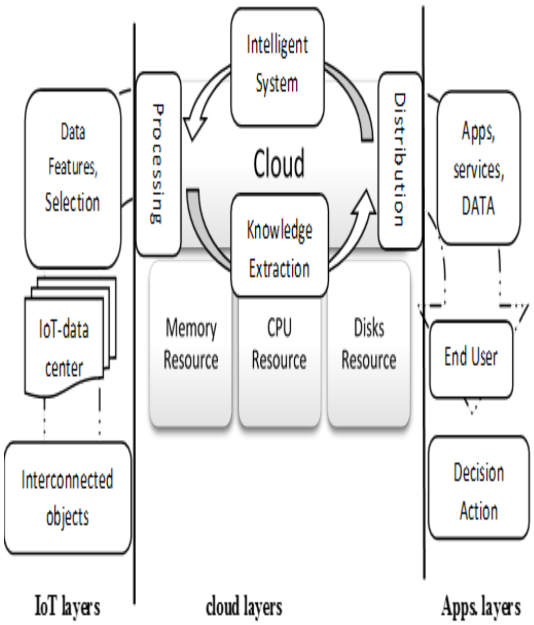

Figure 1: IoT and Cloud overview

4.1 IoT Cloud information systems

Few researchers have addressed the problem of management and sharing of resources in IoT based information systems. The smart object is an interesting element which IoT has provide humans the capability to manipulate operations and services [45].

In [46], a sophisticated Farm Management Information Systems (FMISs) which can manipulate large amounts of data and provide decision support capabilities are proposed.

4.2 IoT data characteristics

In this section, we start with an analysis of IoT data characteristic and then present a data management reference model for IoT.

IoT Data shares five distinct characteristics:

- ✓ Heterogeneity. The comportment of things is described by the coming information which IoT uses unstructured and semi-structured data types [28].
- ✓ Inaccuracy. The inaccuracy of the data produced is an interesting factor that limiting the wide spread adoption of IoT [29]. For example, experiments show that RFID systems is an example that can only capture 60% to 70% correct data [30].
- ✓ Massive Real-Time Data: IoT is designed to connect enormous of things in large scale. Communications between different entities in dynamic networks generate a large volume of heterogeneous data in the form of real-time, high-speed, uninterrupted data streams. Scalable storage, filtering and compression schemes are essential for efficient big data processing [31].
- ✓ Implicit Semantics: Natural IoT data is of low-level with weak semantics [32]. In order to support higher-level applications, such as smart home and intelligent healthcare, complex semantics need to be abstracted in event-driven perspective from the mass of low-level data.

4.3 Applications and approaches

An intelligent combination of technological advances such as IoT, Cloud Computing, Smart Grid and Smart Building allows tracking huge amounts of information; this combination creates an intelligent system known as Smart City. The basic idea of IoT is to let 'things'- such as sensors, actuators, mobile or desktop devices, etc. -be able to interact and cooperate with each other through wireless communication protocols, [33].

Several cities have employed Internet of Things (IoT) to monitor the performance of sewer systems and to provide useful data to managers and engineers [34].

4.3.1 Transportation

The traffic data provide the basis for both research and applications in transportation control, management, and evaluation, but real-world traffic data collected from loop detectors or other sensors often contain corrupted or missing data points which need to be imputed for traffic analysis. This work has demonstrated the effectiveness as well as efficiency of deep learning in the field of traffic data imputation and analysis [35].

4.3.2 Agriculture

The world is facing shortage of food source due to lack of integration and utilization of technology in agriculture [36]. To overcome this problem, emerging of technology with farming practices could be a good solution to meet the growing world demand of food and nutrition. Based on a huge information available online about

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cultivation, Big Data can be used for efficient agriculture operation which is explored to provide a high volume, speed and assortment required for particular innovation and explanatory strategies. So, from Enormous information, it can be utilized to give knowledge about cultivating tasks, drive constant operational choices and upgrade business forms for diversion and expansion.

In [37], The engineer and developer are based on an approach of model driven development, called meta-model, for the IoT solutions. This IoT solution model has been designed to support its automatic processing and its implementation. As a smart energy efficient home automation system is proposed that can access and control the home equipment from every corner of the world.

According to [39], IoT events processing approaches are presented as follow:

In Automata-based CEP Model, event is constructed into corresponding automata, set of states and transition functions in automata-based model. In graph-based model, complex events are expressed in tree structure with its leaf nodes represent the primitive events. In Petri-net-based CEP Model, complex event is transformed into corresponding petri net in petri-net-based CEP model.

In the following table we present a classification of IoT events processing approaches:

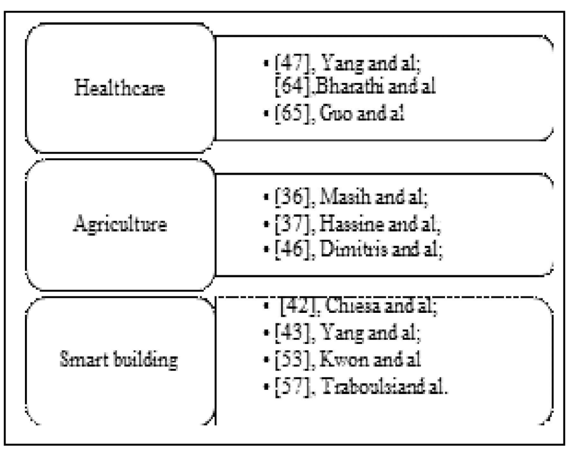

Figure2: IoT based-existing works

According to [44], an IoT framework with smart location-based automated and networked energy control, which uses smartphone platform and cloud-computing technologies to enable multiscale energy proportionality including building-, user-, and organizational-level energy proportionality.

In [47], the authors focused on the protection of data confidentiality using a novel distributed secure data management with keyword search system based on the high value of medical data and the openness character of health IoT. According to [51], A real-time linked dataspace for the internet of things are presented.

Table2. IoT Based Machine Learning Technology Systems Information

Application domains	Methods	Mechanisms
Energy production	Machine learning	Prediction
ENERGY-efficient [48],	Cloud and edge	DATA Aggregation
Industrial IoT [49],	Machine learning frameworks	Supported
Energy cloud, [50]	Load balancing: wind driven and firefly algorithms	Supported

In the table II, we introduce machine learning and load balancing algorithms technologies that can support various applications and services in deferent domains: Energy production, Industrial IoT, Cloud and edge, etc.

5. CONCLUSION AND FUTURE WORK

In this paper, we introduced a background of Internet of Things, cloud and M2M communication. Also, we outlined several interesting distinguishing characteristics of produced and distributed data. Further, we introduced and discussed an analytical study in environments of IoT cloud and M2M communication approaches. Some issues and challenges in IoT and cloud in information and telecommunication systems are presented. Based on this analytical study it can be explore that the intersection among M2M communication, IoT and Cloud. represents a big family which has the possibility both communication and understand any things, anywhere.

In the future work, we will discuss the possible challenges and applications in IoT agricultures using IoT/cloud and deep learning technologies. The result of this research can be used for management of the IoT-data produced, support applications and services, and development the IoT architectures performance.

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