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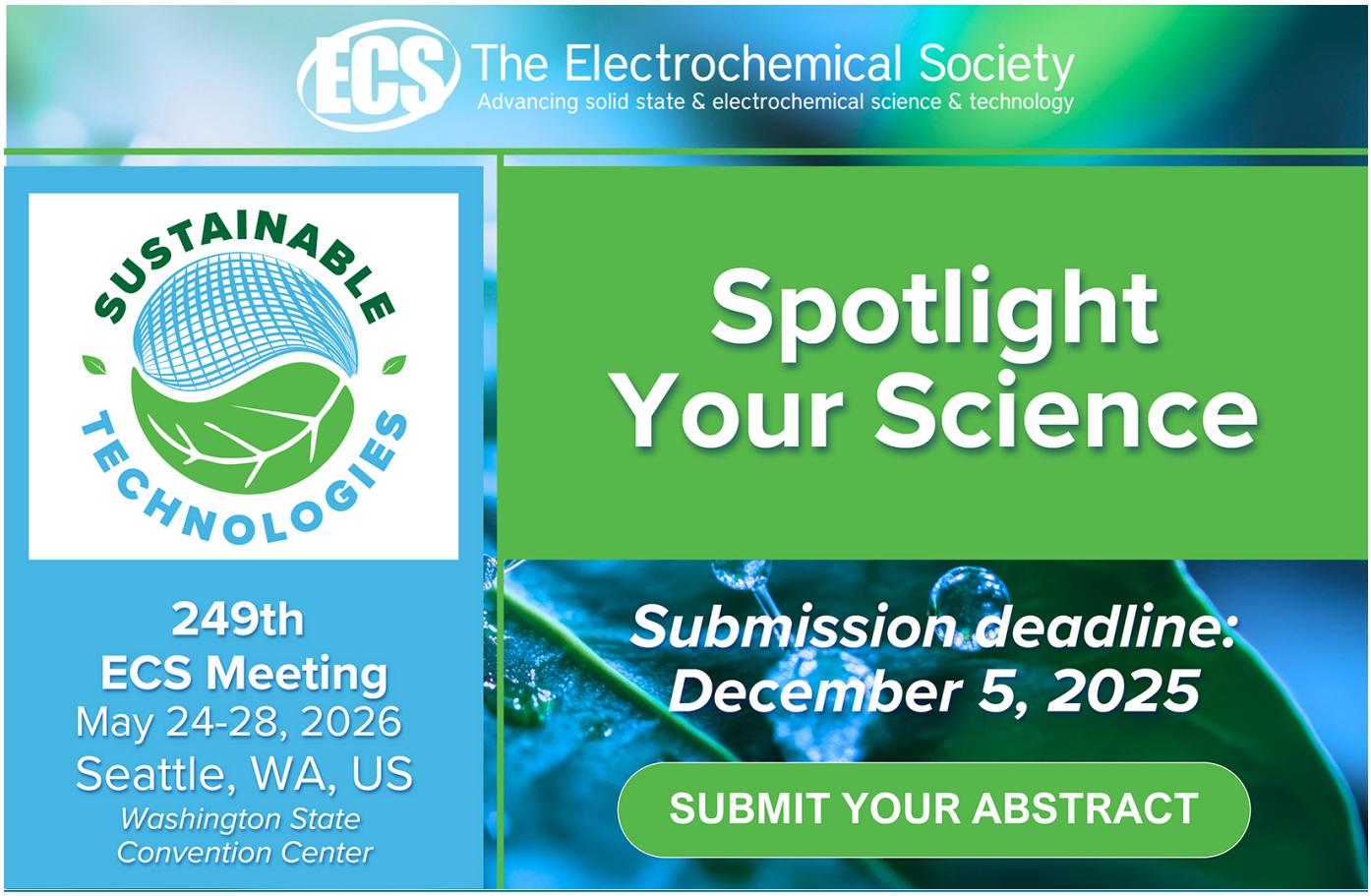
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Evolution of ubiquitous computing

T Velásquez-Pérez[1], **J A Camargo-Pérez**[1], **and A M Rodríguez-Chinchilla**[1]
[1] Grupo de Investigación en Tecnología y Desarrollo en Ingenierías, Universidad Francisco de Paula Santander, Seccional Ocaña, Colombia

E-mail: tvelasquezp@ufpso.edu.co

Abstract. Ubiquitous computing understood as the integration of the machine to man is applied in interactive environments where tools such as mobile devices produce this continuous change. This article presents an analysis on the evolution of the internet of things, based on the research found on the science websites, whose objective was based on knowing in depth the conceptual evolution of the internet of things and the context in which it has developed. It is chosen to use a methodology of science mapping that allowed an analysis of scientific productions through cluster analysis and multidimensional scaling, bibliometrics is a scientific discipline that is based on the search for statistically regular behaviors over time in the different elements related to scientific production. A conglomerate of articles was found that were adjusted to the search equations used in the science website, which within the analysis carried out can be used as a reference for other researchers in their research, which that allows enriching the field of research discussed here, this research is important insofar as it allowed to imply in a greater degree of depth the IoT and its evolution over the years.

1. Introduction

The internet of things (IoT) is not a new idea, Mark Weise introduced the concept of ubiquitous computation in the early 1990s. The author advocated a future where computation would become an integral part of daily life, the idea of the internet of things. things have taken practical relevance thanks to the rapid evolution of electronics during the last decade [1]. The ubiquitous computing paradigm is a paradigm which aims to provide intelligent computing systems that adapt to the user, and whose interfaces allow the user to make intuitive use of the system, integrating mobile devices into the physical environment in search of enabling the benefits of these and digitized information at all times and everywhere [2]. Furthermore, with the advent of smart homes, smart cities and everything smart, IoT emerged as an area of incredible impact, potential and growth, with Cisco Inc. predicting to have 50 billion connected devices by 2020 [3]. IoT is made up of vertically oriented platforms for things. Developers who want to use them must negotiate access individually and must adapt to the platform-specific API and information models, having to make these efforts for each platform. Often outweighs potential gains for app developers to adapt their apps to multiple platforms [4].

The analysis and evaluation of information and knowledge resulting from a scientific activity is an essential element for all public research, technology, and development programs that are implemented in society; and that is where information science provides invaluable help, by developing techniques and instruments to measure the production of knowledge and its transformation into goods [5]. It is important to know how things have evolved to understand the current context in which a specific topic is developed. Within the bibliographic analysis carried out in the research, an understanding of the evolution of the Internet of Things in the world was sought through publications of a scientific nature

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presented by researchers from all over the world, there are different techniques for analyzing scientific activities and one of them is bibliometric, which is a discipline for the quantitative evaluation, and in some qualitative way, of scientific production [6].

Bibliometric implies a statistical analysis of descriptive information, contributions, and citation of scientific productions of a bibliographic nature. From a thematic perspective, which allows detecting the research fronts from the topics treated there so that useful summary information can be obtained to establish analytical relationships. This identification of topics can be done using the traditional content analysis method, generally used in qualitative studies on small numbers of documents, or using statistical modeling, which allows us to extract and analyze information from large text collections, applying unsupervised algorithms [7]. This research is important insofar as it allows understanding the conceptual traceability of the Internet of Things from the scientific publications of researchers throughout the years. This allows us to detect through the years the learning curve and the evolution around the subject of study. Within the bibliometric analysis, there are tools such as VOSviewer that can display maps constructed using any suitable mapping technique. Therefore, the program can be used not only to display maps constructed using the vos mapping technique but also to display maps constructed using techniques such as multidimensional scaling. VOSviewer runs on a large number of hardware platforms and operating systems and can be started directly from the Internet [8]. Distance-based maps are maps in which the distance between two elements reflects the strength of the relationship between the elements. A shorter distance generally indicates a stronger relationship. In many cases, the elements are distributed quite unevenly on distance-based maps [8].

IoT was chosen as the subject of analysis, to which a bibliometric study was carried out, based on the main web of science, the IoT allows physical objects to see, listen, think and perform work, to share information and to coordinate decisions. The IoT transforms these objects from being traditional to intelligent by exploiting its underlying technologies such as ubiquitous and widespread computing, integrated devices, communication technologies, sensor networks, Internet protocols, and applications [9]. IoT is characterized by devices with limited resources such as sensors, smartphones, portable devices and machines connected to the internet. The IoT established a basis for the digitalization of the physical world that can be described in terms of machine-friendly data. Once sampled or generated, this data can be automatically processed and interpreted to provide innovative services in various areas [10]. The large-scale implementation of IoT is expected to introduce billions of additional devices with limited resources connected to the internet [11]. Additionally, IoT technology depends on cloud computing, thousands of data from millions of devices connected to the Internet are bulky and demand to be processed within the cloud [12].

2. Methodology

The methodology used in this research is descriptive with a quantitative approach, the data in which the research was carried out was based on an analysis using statistical methods, these methods are implicit in the software used, and the data was analyzed under unsupervised learning that is characterized by generating grouped patterns. The extracted document data was imported into VOSviewer version 1.6.10. The functionality of VOSviewer is especially useful for displaying large bibliometric maps in an easy to interpret [9] way. Figure 1 shows the result of the publications in the last 10 years according to the search criteria used for this research, the figure shows the traceability of the publications in a 10-year interval, for the years 2018 and 2019 the increase in the number of investigations in the area is observed.

3. Results

The database was selected to identify and extract the most important documents, in this case, it was the science website, the search criteria were as follows: ts = internet * or things or IoT, and su = computer science refined by [excluding] types of documents: editorial material or news item or book review or letter or early access or book chapter or correction or retracted publication or reprint or meeting abstract or biographical item or retraction or software review or bibliography, and best articles: very cited in the

field or popular articles in the field, period: 2003-2019. Indices: science citation index expanded (SCI-Expanded.

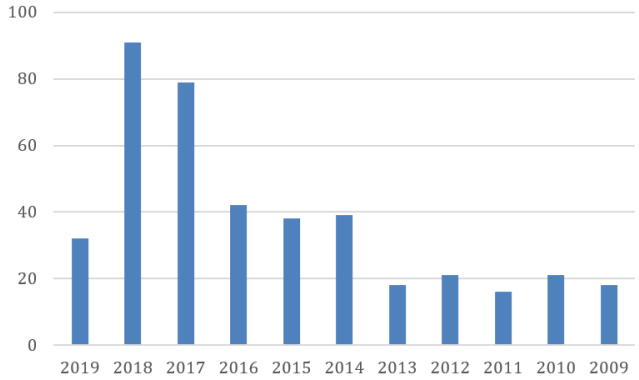


Figure 1. Number of published documents per year.

Once the request was sent in the search engine of the science website, 396 scientific products were obtained as results, these documents correspond to the most cited in the Web of Science between 2003 and 2019, according to the result obtained the total of articles obtained an h-index 154 and a total number of 78530 citations in 56404 different articles.

It was determined that in the results produced by the articles, there is a relationship between security and the IoT, found in groups 3 and 5, respectively, obtaining the highest values of co-occurrence and total link strength in both. These groups were the most prominent in the analysis, this means that there is a close relationship between the IoT and security, these problems are addressed in the different researches of the researchers. In Figure 2 the lines represent co-occurrence links between two keywords, the closer two keywords are, the higher their level of co-occurrence [13].

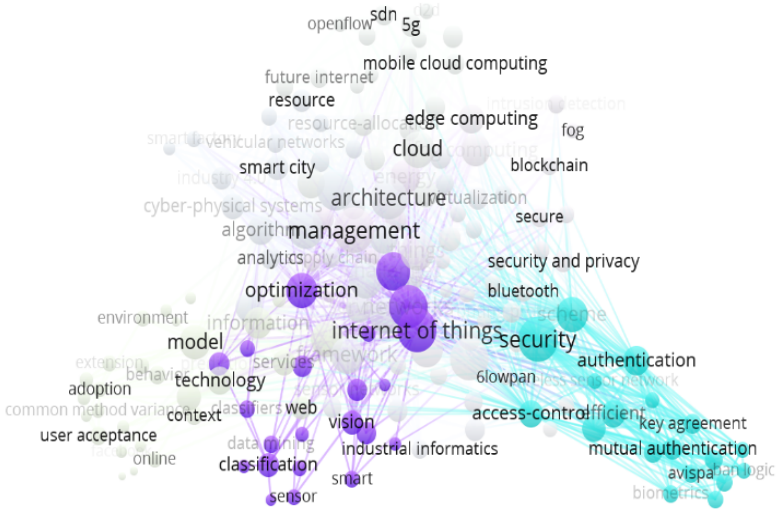


Figure 2. Relationship between clusters 3 and 5.

3.1. Co-authorship and citation analysis

Among the articles analyzed, 1360 authors were found, of which 20 had written more than 5 articles, the most cited article obtained 5683 citations corresponding to Buyya Rajkumar who wrote 5 documents. Most of the article was written in the People's Republic of China with 176 articles followed by the United States with 150. Within the analysis we took a list of articles from which we obtained information

about the internet of things, about security, vulnerabilities among other elements, below we present some perspectives of the most cited and most relevant authors on the web of the science.

The IoT plays a remarkable role in all aspects of our daily lives. It covers many fields, including healthcare, cars, entertainment, industrial appliances, sports, homes, the omnipresence of IoT facilitates some daily activities, enriches how people interact with the environment and increases our social interactions with other people and objects. However, this holistic view also raises some concerns, such as what level of security could IoT provide and how does it offer and protect the privacy of its users? [14] according to (will handle) in recent years, IoT devices are continuously generating bulky data that are often called large data.

In general, it is difficult to process and analyze large quantities to find meaningful information. Also, data security is a key requirement in the system. For (praises f) IoT has recently become an important research topic. It provides the integration of different sensors and objects to communicate specifically with each other without human interference. Also, the requirements for large-scale IoT deployment are rapidly increasing with the main security concerns. Although the definition of "things" has changed as technology evolved, the main objective of making a computer make sense of information without the help of human intervention remains the same.

The radical evolution of the current Internet in a network of interconnected objects that not only collects information from the environment (detection) and interacts with the physical world (performance/command/ control), but also uses existing internet standards to provide transfer services information, analysis, applications, and communications [15]. In reality, many challenging problems have yet to be addressed and both technological and social knots must be unleashed before the idea of IoT is widely accepted. The central problems are making possible total interoperability of the interconnected devices, providing them with an ever-greater degree of intelligence by allowing their adaptation and autonomous behavior, while guaranteeing trust, privacy and security.

In addition, the idea of IoT raises several new problems related to network aspects. Also, the idea of IoT raises several new problems related to network aspects. They make up the IoT will be characterized by low resources in terms of computation and energy capacity. Consequently, the proposed solutions should pay special attention to resource efficiency in addition to the obvious scalability problems [16]. Within the group of articles found on the science website, Khan mentions a series of important elements in terms of security among.

Data privacy, confidentiality and integrity. As IoT data travels through multiple hops in a network, a proper encryption mechanism is required to ensure the confidentiality of data. Due to a diverse integration of services, devices and network, the data stored on a device is vulnerable to privacy violation by compromising nodes existing in an IoT network. The IoT devices susceptible to attacks may cause an attacker to impact data integrity by modifying the stored data for malicious purposes [17].

Authentication, authorization, and accounting. To secure communication in IoT, the authentication is required between two parties communicating with each other. For privileged access to services, the devices must be authenticated. The diversity of authentication mechanisms for IoT exists mainly due to the diverse heterogeneous underlying architectures and environments which support IoT devices. These environments pose a challenge for defining a standard global protocol for authentication in IoT. Similarly, the authorization mechanisms ensure that access to systems or information is provided to the authorized ones. Proper implementation of authorization and authentication results in a trustworthy environment that ensures a secure environment for communication. Moreover, accounting for resource usage, along with auditing and reporting provide a reliable mechanism for securing network management [17].

Availability of services. The attacks on IoT devices may hinder the provision of services through the conventional denial-of-service attacks. Various strategies including the sinkhole attacks, jamming adversaries or the replay attacks exploit IoT components at different layers to deteriorate the quality of service (QoS) being provided to IoT users [17].

4. Conclusions

The results obtained show that the trajectory of the IoT, in global terms, shows important changes throughout the last years and, together with ubiquitous computing, demonstrates how information processing is strongly integrated into everyday activities and objects and how there is an intrinsic relationship between ubiquitous computing and the IoT, it also poses a change in our daily lives, in an environment where intelligent components and devices communicate and will most likely lead us to change our vision of the environment by triggering social and economic changes that will be projected in personal life.

On the other hand, an element with a tendency to grow made reference to the issue of security, it is notable that as technologies have evolved, the number of computer attacks also increases, in which countries more attention should be paid and they should begin to face new challenges in an increasingly interconnected world.

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