International Journal of Electrical and Computer Engineering (IJECE)
Vol. 7, No. 5, October 2017, pp. 2474~2482
ISSN: 2088-8708, DOI: 10.11591/ijece.v7i5.pp2474-2482

Internet of Things: Surveys for Measuring Human Activities from Everywhere

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Article Info

Article history:

Received Nov 22, 2016
Revised Jun 17, 2017
Accepted Sep 11, 2017

Keywords:

Cloud computing
Embedded systems
Internet of things
Radio frequency identification
WSN

ABSTRACT

The internet of things (IoT), also called internet of all, is a new paradigm that combines several technologies such as computers, the internet, sensors network, radio frequency identification (RFID), communication technology and embedded systems to form a system that links the real worlds with digital worlds. With an increase in the deployment of smart objects, the internet of things should have a significant impact on human life in the near future. To understand the development of the IoT, this paper reviews the current research of the IoT, key technologies, the main applications of the IoT in various fields, and identifies research challenges. A main contribution of this review article is that it summarizes the current state of the IoT technology in several areas, and also the applications of IoT that cause side effects on our environment for monitoring and evaluation of the impact of human activity on the environment around us, and also provided an overview of some of the main challenges and application of IoT. This article presents not only the problems and challenges of IoT, but also solutions that help overcome some of the problems and challenges.

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1. INTRODUCTION

The term of the internet of things invented by Kevin Ashton, one of the founders of the original Auto-ID Center at the MIT which was introduced in 1999 during a presentation that was held at Procter gamble (P&G). The Internet of Things (IoT) is a computing concept that describes a future where every day physical objects will be connected to the Internet and be able to identify themselves to other devices. This paper presents a review of literature on the subject of the internet of things technologies and their applications domains and also the futuristic research areas. Several research studies have addressed and developed this topic with detailed studies synthesis about the fields of application of internet of things, and general visions [1], [2].

In this article, we aim to provide a global perspective on the concept and development of internet of things, including a critical review of application domains, enabling technologies and challenges of research. In fact, the community of active research on topics related to the (IoT) is still very fragmented, and, to a large extent, focused areas of simple applications or simple technologies. In addition, the participation of the communities for networking and scientific communication is still limited, despite the potential impact of their contributions on the development of the field [3], [4].

The technology of internet of things (IoT) establishes a connection between all things, and internet via detection of devices and smart tools identification and management. The means of remote sensing information includes RFID, infrared, GPS and laser sensor devices scanner. They are all connected to the internet to implement control and distance perception. IoT is widely applied in intelligent transportation,

environmental protection, the governmental jobs, public safety smart homes, fire control, industrial monitoring, and care for the older persons, health personnel stuff, etc.

2. OTHER SURVEYS ON IOT

In this part, we showed the main research areas considered by most surveys published in the field of the Internet of Things. To clarify that the IoT refers to several good surveys recently presented each display IoT from a different perspective: challenges [5] applications [6] standards [3], and security[7]. Among these investigations, a complete overview of IoT, and three different angles: things, Internet, and semantics, was presented by Atzori and her colleagues [8]. Another recent study, inspired by [9], presented a generic architecture of five layers to describe the overall design of IoT. There are several documents published survey covering different aspects of IoT technology. For example, the survey by Eleonora Borgia [10] covers the main communication enabling technologies, wired and wireless, and the elements of wireless sensor networks (WSN). In [11], the authors address the IoT architecture and the challenges of development and deployment of IoT applications. Enabling technologies and application services with a centralized view of cloud presented in [12]. The authors [13] provide an overview of IoT for wireless devices without using specialized clinical 6LoWPAN / IEEE 802.15.4, Bluetooth and NFC for mHealth and eHealth applications. In addition, [14] discusses the IoT in terms of enabling technologies focusing on RFID and its potential applications. An overview of the standards and challenges for current IoT presented in [15]. All that for IoT technologies and research challenges for the applications of the Internet of things, there are many surveys that address what this part of applications for example in [16] the authors come up with a solution to manage IoT bicycle parking very effectively is a parking for bicycles. A project for smart water monitoring and management of the water cycle was presented in [17]. Zhang [18] developed an intelligent control system to monitor the temperature / humidity inside refrigerated trucks using RFID tags, sensors and wireless communication technology.

To the best of our knowledge, however, no investigation has focused on industrial solutions of IoT. All the above investigations have reviewed the solutions proposed by academic and research communities and to refer to scholarly publications produced by the respective researchers. In this article, we review the problems, challenges, technologies and IoT applications that are proposed, designed, developed and marketed, and are useful for researchers and industrial organizations.

This paper begins by providing a horizontal overview of the IoT. Next, we give an overview of some technical details that are relevant to the IoT enabling technologies. Compared to other documents from the field survey, our goal is to provide a more detailed summary of IoT technologies, research challenges, problems, and existing applications to enable researchers and application developers to see that they are the areas covered by the Internet of Things.

The contour of the contributions of this paper compared to the recent literature in the field can summarized as follows:

a. Compared to other documents from the field survey, this survey provides a deeper summary of the Internet of Things, which allows us to know what the Internet of Things is in details.
b. We provide an overview of some of the main challenges of IoT presented in recent literature and provide a summary of related research. In addition, we explore the relationship between the IoT and other emerging technologies: sensor networks, RFID technology, and cloud computing.
c. We express the need for better horizontal integration between IoT services
d. We also present the different fields of application of the Internet of Things in the human life, and the detailed futuristic applications to illustrate the further work in this area.

3. ESSENTIAL IOT TECHNOLOGIES

3.1. RFID technology (Radio Frequency Identification)

RFID is an automatic and contactless technology, providing a communication interface with the tagged objects through wireless data transmission to retrieve relevant information. [19] Radio frequency identification (RFID) allows automatic identification and data capture using radio waves, a tag, and a reader. The tag cab store more data than traditional barcodes. Three types of tags are used : Passive RFID tags, Active RFID tags, and Semi-passive RFID tags.

In IoT scenario, a key role is played by RFID systems, composed of one or more readers and several tags. These technologies help in automatic identification of anything they are attached to, and allow objects to be assigned unique digital identities, to be integrated into a network, and to be associated with digital information and services.

3.2. Wireless sensor networks (WSN)

A Wireless Sensor Network (WSN) can be defined as a network of small embedded devices, called sensors, which communicate wirelessly following an ad hoc configuration [20]. Wireless sensor networks (WSN) consist of spatially distributed autonomous sensor-equipped devices to monitor physical or environmental conditions and can cooperate with RFID systems to better track the status of things such as movements, pressure, temperature, and location. Wireless sensor networks (WSN) my provide various useful data and are being utilized in several areas like healthcare, government and environmental services (natural disaster relief), defence (military target tracking and surveillance), hazardous environment exploration, seismic sensing.

3.3. Cloud Computing

The essential aspects of cloud computing have been reported in the definition provided by the National Institute of Standard and Technologies (NIST): “Cloud computing is a model for on demand access to a shared pool of configurable resources (e.g., computers, networks, servers, storage, applications, services, software)” that can be provisioned as infrastructure as a service or software of the IoT is an enormous amount of data generated from devices connected to the internet. Cloud computing provides an ideal back-end solution for handling huge data streams and processing them for the unprecedented number of IoT devices and humans in real-time [21].

4. INTERNET OF THINGS: ARCHITECTURE AND PROTOCOLS

Provide a statement that what is expected, as stated in the "Introduction" chapter can ultimately result in "Results and Discussion" chapter, so there is compatibility. Moreover, it can also be added the prospect of the development of research results and application prospects of further studies into the next (based on result and discussion).

4.1. The IoT Architecture

The IoT should be able to interconnect billions or trillions of heterogeneous objects across the Internet, so there is a critical need for a flexible architecture layers. The growing number of available architectures has not converged to a reference model. Meanwhile, there are projects like IoT-A [22] who are trying to develop a common architecture based on the analysis of the needs of researchers and industry. In the variety of models on offer, the base model is a 3-layer architecture consisting in the application, network, and Perception layers, as shown in Figure 1.

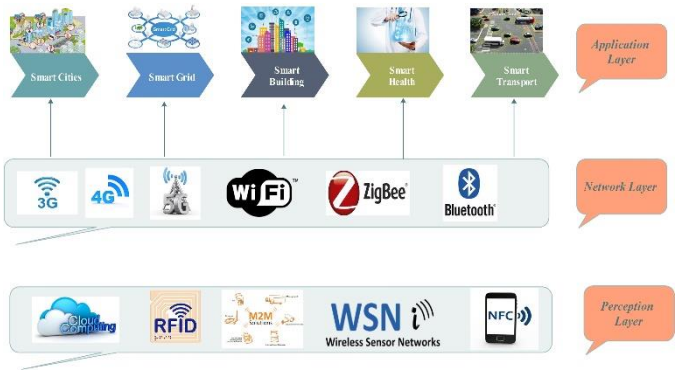

Figure 1. IoT architecture in three layers

The Perception layer:

This layer focuses on the identification of objects and collecting information. It is also known as "layer system". It composed of the physical objects and detection devices. Perception layer comprises terminals and sensor networks. The sensors may be RFID, bar code or 2D-infrared sensors depending on the object identification method. Depending on the type of sensors, information can be on location, temperature, direction, movement, vibration, acceleration, humidity, chemical changes in the air, etc. The collected information is transmitted to the network layer for transmission.

The network layer:

This layer is also called to as "transmission layer". Its main function is the transmission and processing of information received from the perception layer, over long distances and safely. The transmission medium can be wired or wireless using a 3G, Wifi, Bluetooth, infrared or ZigBee, etc. The network layer includes various communication networks and integrated networks based on Internet, which are generally considered the most mature part. The network layer has the competence to improve the exploitation of information on the network. The role of the network layer is to connect all things together and let's share the information with other things connected. In addition, the network layer is able to aggregate information from existing IT infrastructures (e.g. business systems, transportation systems, power systems, health care systems, etc.) [23].

Application layer:

This layer provides overall management of the application on the basis of information treated objects in the network layer. The applications implemented by this layer can be: smart agriculture, smart home, smart city, smart transportation, etc. The application layer enables a connection between the IoT technologies and industrial technologies sector. This is a layer that finally realizes the deep mix between information technology and the sector. For the application layer, the key issue is to share information between communities and ensure safety [24].

The application layer is a connecting IoT technology, a layer for achieving broad intelligent application providing various solutions. For the application layer the key issue is to share information on communities and ensure information security.

4.2. The IoT Protocol

The IoT can be seen as an interconnection of wireless sensor networks. The objective is to acquire and transmit data from the surrounding physical world to one or more independently collection points. Thus the sensors form a network without infrastructure and self-organized [25].

There are many protocols for the Internet of Things, Figure.2 shows the essential protocols of Internet of Things.

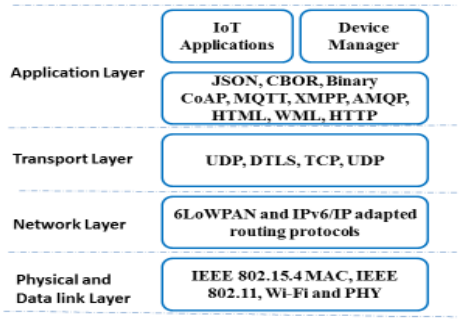

Figure 2. IoT Protocol

Most international standardization associations such as IEEE, IETF or W3C have standardized protocols such as 6LowPAN (IPv6 over Low power Wireless Personal Area Networks) or CoAP (Constrained Application Protocol) and it is believed that other IoT protocols will be standardized like the web standards used today. There are several application layer protocols that can be used for IoT. The future of IoT lies in standardizing the protocols used across network stack. These set of open and standard protocols like CoAP, MQTT (MQ Telemetry Transport) and 6LowPAN would eventually become as successful as the TCP/IP stack used across the web and Internet.

5. INTERNET OF THINGS FOR HUMAN ACTIVITIES

Internet of Thing can change style life of human. Recently there have been a number of independent researches that investigated the potential of integrating concepts of the Internet of Things (IoT) in human life. IoT can provide several benefits to improve the quality of life for citizens and prove lifestyle suggestions for welfare. In this part, we introduce several applications that are designed to give support to human activities

and especially in the fields of health, smart homes, smart cities and also applications for people with disabilities in order to survive normally.

5.1. Health care

The rising costs of health care and the increasing availability of new personal health devices are the ingredients of the vision of the Internet of Things in the connected healthcare. The vision of connected healthcare is growing because of the availability of new technological tools. By the application of the IoT and new technologies, it is possible to create a health application that appears every morning to request reading the level of glucose in the blood and collects data from the patient automatically. In the vision of connected healthcare, patients are those who take control of their health and being in good physical and mental health due to this application. Also, this leads to a good responsibility and control of heath by allowing a real scenario for the Internet of Things (IoT) in care health [26]. IoT will help doctors to respond quickly in emergency situations and allow them to cooperate with international hospitals to track the status of a patient. The IoT applications can be found also in home monitoring especially for elderly people with special needs or chronic illnesses such as diabetes, congestive heart failure [27]. There are also other applications of IoT such as patient identification, this application aims to reduce adverse events for patients, maintenance of comprehensive electronic medical records [28]. Internet of Things based on RFID tags in the medical domain enable rapid and accurate identification of every intelligent entity, enabling a universal and fast access to personal health records on an Internet of Things [29].

5.2. Smart Home

With the development of the economy and the advent of the information society, the needs of people for living conditions are increasing. Build intelligent home is based on the application of technologies for the Internet of Things gradually becomes more and more imperative [30].

IoT allows users of smart houses to adjust lights, climate control, management of the security system, monitored household appliances and other devices, and even lock and unlock the doors and checked all the equipment of the house through a computer, tablet or smartphone [31]. Instrumented buildings with IoT technologies can help to both reduce resource consumption associated with buildings (electricity, water), as well as improving the standard of living of living. Sensors and actuators distributed in homes can make our lives more comfortable in many aspects. A simple application based on RFID and Web technology to develop a search engine for things that allows users to view the last recorded position of the marked objects or their search for the location of a particular object. A similar application allowing the user whether certain objects are moved in a given area, indicating that the object is stolen. For example, the application can send a text message to users when the stolen goods leave the building without permission [32].

5.3. Smart Cities

Internet of Things in the field of smart cities has several advantages for locals and those benefits are deployed in many services as:

Table 1. Services and benefits in the field of smart cities

Waste management	The IoT solution is: the use of smart waste containers, which detect the charge and allow optimization of the route collection trucks, can reduce the cost of waste collection and improve the quality of recycling.
Air Quality	IoT may provide means for monitoring the air quality in specific areas such as parks. [33] The realization of this service requires sensors air quality and pollution are deployed across the city and the sensor data made available to all citizens.
Noise Control	IoT can provide noise monitoring service for measuring the amount of noise produced at a given time in places that adopt service.
Traffic Congestion	The traffic monitoring can be performed using the detection capabilities and GPS installed on modern vehicles. This information bears great significance for the city authorities and citizens.
Energy Consumption	Monitoring the energy consumption of the entire city (public lighting, transportation, traffic signals, control cameras, etc.) using different types of sensors and actuators that control the lights, temperature and humidity.
Smart Parking	Using the short-range communication technologies such as RFID and NFC, it is possible to realize an electronic verification system for indicating spaces reserved for residents or people with disabilities. Smart parking systems can guide the driver to the nearest parking space based on the location of the conductors. Sensors placed on parking locations can also help municipalities detect vehicles illegally parked. . [16]
Smart Lighting	This service optimizes the intensity of the street lamp depending on the time of day, weather conditions, and the presence of people in the streets.
Fight against fire	IoT has been used in the field of fire safety to detect a potential fire and provide early warning for possible fire hazards. Early warning fire and rescue in an emergency, as required [34].
Smart Grid	The smart grid is defined as an intelligent electricity distribution system that provides energy flows from producers to consumers in a bidirectional manner. The energy produced by customer's microarrays (solar panels, wind turbines) is sent to the grid, which, in turn, appropriately manages the stock of energy and left a professional manner to customers need energy.

5.4. People with disabilities

People who are hearing impaired can benefit from external or internal devices (implanted in the ear) to improve hearing. On the other hand, a wireless low cost glove designed to help the deaf communicate with those who are not familiar. It recognizes hand signals and converts them into voice interface with a Java-enabled monitoring station (mobile phone). The glove is equipped with bending sensors along the fingers. The blind navigation system help people with visual impairments to find their way into a store. The RFID system of the store can use software to guide the visually impaired in shopping. The supermarket is divided into cells containing a shelf and cells pass. RFID tags are distributed across the floor. The IoT is also used to monitor and control various components in cars. Ford and Intel have teamed up in 2014 to explore new possibilities to customize the user experience by using facial recognition software and an application of mobile phone. To provide better privacy controls and identify the various drivers and automatically adjust the characteristics according to the preferences of an individual. [35]

6. DOMAIN OF APPLICATION

Today, the IoT is one of the most interesting areas in the research that will be there to help us every day. We divided the IoT applications in six categories, figure 3 shows the percentages of IoT applications in several areas.

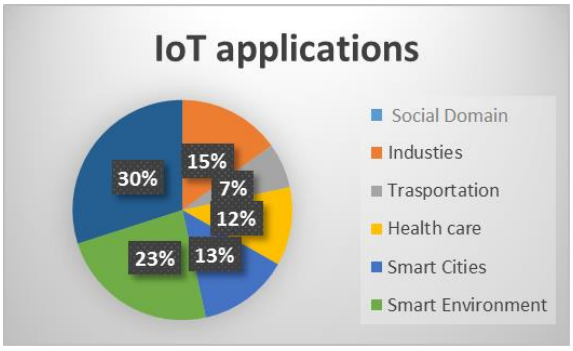

Figure 3. The most popular Internet of Things applications right now.

Applications can be grouped into sex main areas: industrial domain, smart city, intelligent environments, social domain, Transportation Domain and the domain of health. Each domain is not isolated from the others, but it is partially overlapping because some application are shared. An example is the tracking of products, which is in common between industrialists and the domain of health because they can be used for the monitoring of food, but it is also able to monitor the delivery of pharmaceuticals.

6.1. Transportation and logistics

The importance of the sector of transport and logistics is measured also by its direct impact on the competitiveness of the economic fabric as well in terms of export as import that is why one finds several application in this field such as logistics, and assisted driving in Table 2.

Table 2. Application IoT in Transport sector

Logistics	RFID can be attached to an object and allows identification of materials and products, such as clothing, or food and liquids. Their use helps to effectively manage ware houses and simplify inventory by providing a precise knowledge of the current inventory, while reducing inventory inaccuracies [36].
Assisted Driving	Cars, trains and buses as well as roads are equipped by sensors and actuators to provide important information to the driver. Also government authorities would benefit from these applications at the level to have more accurate information on road traffic patterns.

6.2. Health care domain

The internet of things will play an essential role to develop intelligent services and to support and enhance the activities of the society and the people. These services enable peoples to live independently, and

to improve their health for this there are many benefits offered by the internet of things technologies include: tracking objects and people (staff and patients), medical parameters monitoring and administration of the drugs, the identification and authentication of people, collects data automatic and remote sensing.

6.3. Smart environments domain

An intelligent environment domain is a field concerned by the easy and comfortable use with comfortable workplaces and offices and also the intelligence of content objects, be it a house, an industrial establishment, or a leisure environment.

Comfortable offices: Sensors and actuators in the offices can make our life more comfortable in several respects: rooms heating of office lighting can change according to the hour of the day, appropriate monitoring and alarm systems, and also energy can be saved by automatically switched off of electricity equipment when not required.

Leisure environments: like the Museum and the gym are two intelligent environments of leisure, For example the Museum can expose different historical periods with widely divergent of the climatic conditions. The premise of the Museum automatically adjusts with the external conditions (temperature, humidity…). In the gym, or trainers can download the profile of the exercise in the training for each player machine, when the player takes the machine, it will be automatically recognized through the label RFID connected to the machine.

6.4. Personal and social domain

By analogy with the services of social networks for human beings, the internet of things introduces the concept of the social relationships between the objects. The advantages are the possibility of giving the internet of objects that can be shaped as needed to ensure the airworthiness of the network [37]. In this area there are applications that enable the user to interact with others to maintain and build social relationship. Indeed, things can automatically trigger the transmission of messages to friends so that they know what we do or what we have done in the past, share a few things in common.

6.5. Industrial domain

A number of industrial projects of the internet of things were conducted in different areas such as agriculture, processing of industrial food, environmental monitoring, security and surveillance. For example transport and logistics companies can conduct surveillance in real-time to move physical objects from the first to the last element through the chain supply including manufacturing, shipping, distribution and so on. Intelligent environments also helps improve the automation in industrial installations with a massive deployment of RFID related to the production parts. [38]

7. FUTURE DIRECTIONS AND CONCLUSION

According to our survey on the IoT, much research is needed to make IoT a reality paradigm. Future research directions suggested are:

1. Development of many applications near or directly applicable to our present life, such as personal and social areas, mobility and transport, business areas and fields of industry.
2. Security and privacy issues should be considered very seriously since IoT. Cyber-physical environments should be protected from all forms of malicious attacks.
3. Identify, classify and categorize IoT technologies, devices and services that will boost the development and support IoT vision.
4. Architectural design standards have defined abstract data models, interfaces and protocols, software, objects or intelligent devices.
5. Development of new frameworks addressing global identification programs, identity management, coding of identity / encryption, authentication...

The internet of things gives the possibility of merging seamlessly the real world and the virtual world. Thanks to the huge deployment of embedded systems, in fact, the entire range of design for IoT systems options is quite wide, across the open and standardized protocols is much smaller.

The internet of things became a focus for research and development in the last 15 years. A large amount of investments for internet of things was and is still being made by government agencies and industry worldwide.

As described in this document, the internet of things gives an idea of the possibilities offered by a number of existing and future technologies which, together, could in the next 5-10 years, change the mode of functioning of our societies in depth. It is an evolution of our information and communication systems that will result in the internet of things but the acceptance of IoT by the company will be strongly linked to

respect for privacy and the protection of personal data we hope that this survey will be useful for researchers and practitioners in the field, helping them to understand the huge potential of IoT and what are the main fields of application of the internet of objects that are capable of transforming the IoT to a vision of research actually.

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