

IoT based Future City: A Survey

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Abstract: This paper presents a survey and overview on IoT based future city.

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1. Introduction

A. Concepts

As we all know that the population density in the cities is growing very rapidly. So on the basis of infrastructure and services we need to provide the best necessities to the citizens.

There is a significant increase for digital devices that is sensor actuators and smart phones. All these devices can be interconnected and communicated with the help of IoT. We can establish a global network infrastructure using IoT. IoT is mostly considered as real objects broadly scattered with low storage capability.

B. Motivations

A smart city equipped with different electronic devices like street camera and sensors would be more safe and secure for all the citizens of the city. These devices can be integrated based on the geographic location and evaluated by using an analyzing systems.

Sensor services for the collection of particular data can be used with several occurring projects concerning the monitoring of vehicles public parking lots etc.

The revolution of the internet provides an infrastructure in which many people are able to interconnect to each other the next revolution of internet may take us to provide suitable interconnections among the objects.

2. Technologies

The IoT is a broadband network that uses standard communication protocols while its convergence point is the Internet. The main concept of the IoT is the universal presence of objects that can be measured, inferred, understood and that can change the environment. On this basis, IoT is enabled by the developments of various objects as well as communication technologies. Involved things in the IoT consist of smart devices including mobile phones and other objects like foodstuff, appliance, landmark, monument, work of art that can cooperate together to provide a common target. The impact of the IoT on the life of users can be considered as its key features. Some of the IoT-related technologies are discussed in the

following.

A. Radio-Frequency Identification (RFID)

These systems consisting of readers and tags are playing a key role in the context of the IoT. By applying these technologies to any involved object, it is possible to carry out their automatic identification and assign a unique digital identity to each object, in order to be incorporated in the network and related to the digital information and service.

B. Wireless Sensor network (WSN)

WSNs can provide different suitable data and also may be used in many cases such as healthcare, government and environmental services and seismic sensing. Furthermore, WSNs could be integrated with RFID systems to gain some goals like obtaining information regarding the position, movement, temperature, etc.

C. Addressing

As well as the Internet can enable a remarkable interconnection of people, the existing trend in the IoT can similarly provide an interconnection of objects and things, in order to establish smart environments. To this end, the capability of uniquely identifying objects is crucial for favorable outcomes of the IoT. This is due to the fact that uniquely addressing the large-scale combination of objects is vital for controlling them via the Internet. In addition to the mentioned uniqueness concept, reliability, scalability as well as persistence denote the key requirements to develop a unique addressing scheme.

D. Middleware

Process as a result of some issues related to the heterogeneity of contributing things, to the restricted storage and In the IoT context, devices can be integrated based on the geographic location and evaluated by using an analyzing system. Sensor services for the collection of particular data can be used with several occurring projects concerning the monitoring of cyclists, vehicles, public parking lots, etc. There are many service domain applications that use an IoT infrastructure in order to facilitate operations in air and noise pollution, the mobility of vehicles and surveillance systems. The revolution of the Internet provides an infrastructure in which many people are able to interconnect to each other. The next revolution of the Internet will make it possible to provide suitable interconnections among the objects. In 2011, the number of

objects that are interconnected together was much more than the number of people. Its capability, as well as to the enormous diversity of applications, the middleware plays a critical role in the interconnection of the objects to the application layer. The key objective of the middleware is, indeed, to concisely integrate the functionalities and communication capabilities of all involved devices.

E. Environmental pollution

A city cannot be considered as a smart one if its citizens are unhealthy. To this end, a smart city should monitor the environmental pollution and deliver the related information to citizens, especially to those with health care conditions. Reference also reported a separate module to achieve noise and environmental data.

F. Surveillance systems

In a smart city, security is the most important factor from the citizens' viewpoint. For this purpose, the whole smart city should be continuously monitored. However, analyzing the data and detecting crimes are very challenging. Reference has proposed new scenarios to enhance the security of the smart city.

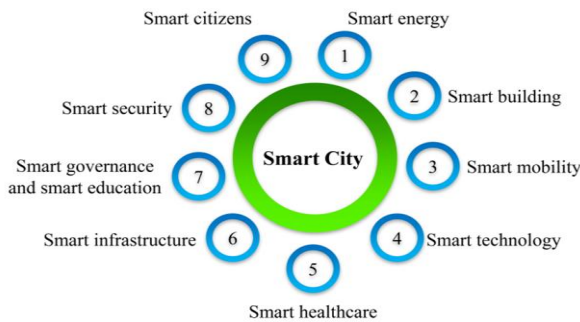


Fig. 1. Smart city features

3. IoT applications for smart cities

The IoT utilizes the Internet to incorporate heterogeneous devices with each other. In this regard and in order to facilitate the accessibility, all available devices should be connected to the Internet. In order to achieve this target, sensors can be developed at different locations for collecting and analyzing data to improve the usage.

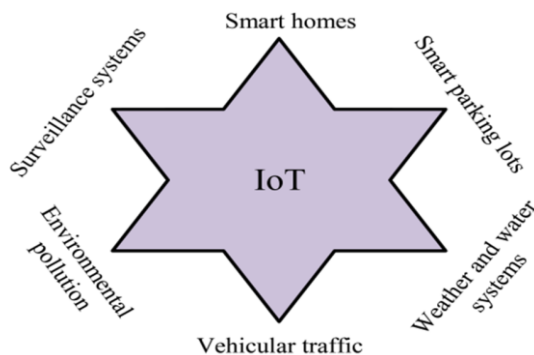


Fig. 2. IoT applications for smart cities

A. Smart homes

Smart homes could be monitored by using the data that are generated by the sensors. For instance, innovative demand response (DR) functions can be implemented or by monitoring the pollution, it will be possible to alert customers if the pollution exceeds its marginal limit.

B. Smart parking

IoT's by enabling smart parking, arrival and departure of various vehicles can be tracked for different parking lots distributed in the city. Consequently, the smart parking lots should be designed in a way to consider the number of cars in each zone. Moreover, new parking lots should be established where a higher number of vehicles are available. Correspondingly, the data of smart parking lots can bring advantages for both vehicle owners' and merchants' daily lives in a smart city.

C. Weather and water systems

Weather and water systems can utilize some sensors to provide suitable information like temperature, rain, wind speed, and pressure and can contribute to enhance the efficiency of the smart cities.

D. Vehicular traffic

Vehicular traffic data are one of the most important data sources in a typical smart city in which, by using these data and applying a suitable analysis, citizens and the government will benefit greatly. Citizens could be also able to use the vehicular traffic data to determine the arrival time to a destination.

4. IoT potential applications for smart cities

This section indicates some of the future applications of the IoT for the smart cities that are discussed in this section.

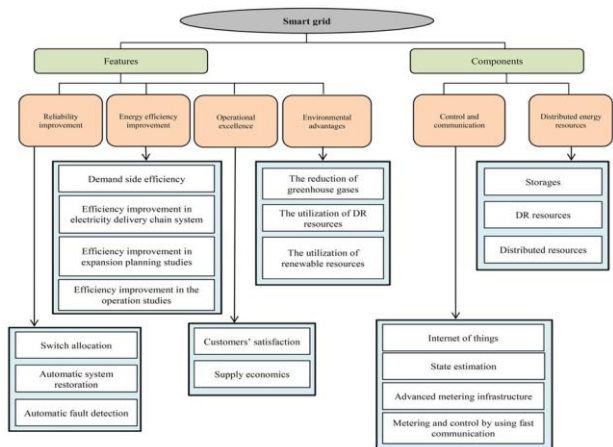


Fig. 3. Smart grid features and components

A. Smart cities and communities

The implementation of the IoT can result in the generation of some services that have an interaction with the environment. Hence, it could introduce some opportunities for

contextualization and geo-awareness. Furthermore, collective intelligence will improve the processes of decision making and empower the citizens. In addition, a common middleware could be available for future services of the smart city by using the IoT. It should be mentioned that sensor virtualization could be utilized to decrease the gap among the current technologies and the potential customers.

B. Smart homes

Through the IoT platform in the home, the heterogeneous devices will enable the automation of common activities. In fact, by transforming objects into information appliances that are connected to each other by using the Internet may perform services via the web interfaces. A large number of smart-home applications use sensor networks. The mentioned applications realize smart devices' connection to the Internet to observe or control them remotely. For example, smart lighting has been highly investigated in recent years. Nineteen percent of global electricity consumption is for lighting that may cause six percent of emission related to greenhouse gasses. In this regard, up to forty five percent of the required energy for lighting could be saved by using the smart lighting control mechanisms.

C. Responsive customers

Transactive controllers and many other smart devices can be utilized to manage smart homes. In a home gateway is introduced in order to allow the home controller to cooperate with the aggregator who is responsible to collect data from many homes. Based on the signals from transactive controllers, the aggregator is able to specify the electricity purchasing prices from the electricity market and send the signals about the acceptance/rejection of bids to these devices. The possibility for monitoring and controlling the electrical appliances can enhance the participation of the active customers in the operation of the system that is well-known as demand response. Demand side activities are reported by the International Energy Agency (IEA) to be the key option in every energy policy decision, due to the operational and economic advantages. According to DR, electricity consumers can adjust the electricity usage pattern with the aim of reliability enhancement or to prevent the power price spikes. The predictions about future electrical systems are highly concentrated on the importance of smart grids, renewable generations, pollution decrement programs, as well as enhanced DR. Smart grids focused on the environmental based programs combining different renewable generations and DR in order to provide different options for consumers and improve the usage of facilities.

D. Smart energy and smart grids

The utilization of the IoT can furnish intelligent management of energy distribution and consumption in heterogeneous circumstances. The IoT nodes have some abilities such as sensing and networking which raise the possibility of optimal scheduling of energy suppliers. This

management can also be extended to emergency conditions. One of the most important results of this extension is fault location, isolating and service restoration (FLISR). Implementing this property thanks to the IoT provides an advanced tool which determines the position of the defective parts, separates them, and applies switching task to recover the largest number of healthy part of the affected energy feeder. Also, at the advanced level, this function can be developed by using self-healing methods that are able to activate the participation of the customers as well as of dispersed generation units. Implementing these strategies leads to increase the reliability, power quality and profits. Some of the main specifications of the smart grids are categorized in this.

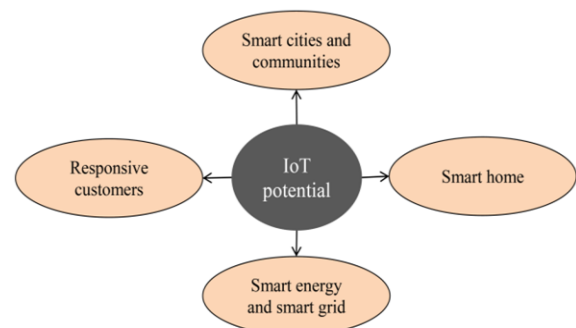


Fig. 4. IoT potential

5. Practical experiences till now

Based on the US National Intelligence Council report, the IoT is one of the most effective tools on the US interests on the way to 2025. As mentioned before, the number of interconnected devices surpassed the population in 2011. This trend was significantly growing as the number of interconnected devices was about 9 billion in 2012 and they will reach 24 billion until 2020. Based on the mentioned numbers, the IoT will definitely be one of the major resources of big data in future. The main policies and outcomes of smart cities are recorded in the Intelligent Community Forum awards from 1999 to 2010, for the following cities: Suwon and Seoul (South Korea), Taipei (Taiwan), Mitaka (Japan), Singapore, Waterloo and Calgary (Canada), Glasgow (Scotland), New York City and Georgia (USA), and Tehran (Iran) that were acknowledged for their attempts and achievements in establishing broadband networks and eservices supporting advance ecosystems.

6. Challenges

This section deals with the typical challenges raised by the application of the IoT-based smart cities.

A. Security and privacy

When all the data are collected and analyzed in a common IoT platform, the system can be subjected to several attacks (e.g., cross-site scripting, and side-channel). Besides, such a system is exposed to important vulnerabilities. Furthermore, multi-tenancy of this system can also bring out the security

issues and cause the leakage of data.

B. Heterogeneity

The IoT system has typically evolved with distinguished solutions in which every system component is knitted to the particular application context. Accordingly, the authorities must analyze their target scenarios, determine the required computing hardware and software and then integrate these heterogeneous subsystems. The existence of such infrastructures and the provision of a suitable collaborating scheme between them can be truly a big challenging task for the IoT system.

C. Reliability

There are some reliability issues that have arisen in the IoT based system. For instance, because of the vehicles' mobility, the communication with them is not reliable enough. Furthermore, the presence of numerous smart devices will cause some reliability challenges in terms of their failure.

D. Large scale

Some specified scenarios require the interactions between large numbers of embedded devices which are possibly distributed over wide area environments. The IoT systems provide a suitable platform that can analyze and integrate data coming from different devices. However, such large scale of information requires suitable storage and computational capability collected at high-rate which makes typical challenges harder to overcome. On the other hand, the distribution of the IoT devices can affect the monitoring tasks because these devices must handle the delay related to dynamics and connectivity.

E. Legal and social aspects

The IoT system may be service based on the user-provided information. For such cases, the service provider has to be in accordance with different local and international laws. Also, the users should have enough incentives to participate in the defined scenarios and data collection. It will be more convenient if opportunities are given to the users to select and take part in submitting data which denote a thing. Reference deals with the issues of systems which incorporate humans as a data resource to provide a secure interaction.

F. Big data

Considering about 50 billion devices, it is certainly necessary to pay attention to transferring, storing and recalling and also analyzing such a huge amount of data produced by them. It is obvious that the IoT infrastructures will be some of the major resources of big data.

G. Sensor networks

Sensor networks can be considered as one of the most important technologies to enable the IoT. This technology is able to shape the world by providing the ability of measuring, inferring, and understanding environmental indicators. Recent developments and improvements in technologies have provided devices with high efficiency and low-cost to employ remote sensing applications in large-scale. In addition, smartphones are associated with a diversity of sensors and, consequently, they enable a variety of mobile applications in several areas of IoT. To this end, the major challenging task is to process the large-scale data of the sensors in terms of energy and network limits and various uncertainties.

H. DR barriers

Although the IoT can facilitate the participation of the responsive loads in the system, there are still various kinds of barriers that can limit the penetration of DR. Such barriers are classified into three main sets, namely; consumers' barriers, producers' barriers, and structural barriers.

7. Conclusion and future trends

The recent literature was reviewed to investigate variant features and characteristics of the IoT systems as well as the effective motivations of using them. Since implementation of the IoT infrastructures could enable a number of opportunities, firstly the highest research motivations are described and then some useful applications outlined. It is described how daily activities can be developed and enhanced by utilizing them. Also, the challenges which arise when implementing the IoT system were thoroughly explained. In this regard, the combination of the IoT platform with other autonomous and intelligent systems for providing smart and widespread applications is one of the most interesting future trends. Furthermore, providing a mechanism to overcome some of the essential challenges like the privacy right of the citizens is still an area of interest. The IoT with its functionality and features should, in fact, utilize intelligent systems and sensors to preserve the rights of the smart city citizens.

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