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The internet of things vision: Features, applications, challenges and future

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Abstract
'The Internet of Things' is internet based approach in which everyday objects can communicate with one another and other services to accomplish some goal. The internet is moving; away from our computers and mobile phones and into our household appliances. As technology advances, there is an increasing demand for the internet to allow us to control every facet of our lives, usually from apps on our smartphones. It is the scenario where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention. Three C's of IOT, Communication, Control and Automation and Cost Savings Case Studies are presented. In the end, future scope and challenges are also discussed.

Keywords: communication, control and automation and cost savings

Introduction

The phrase "Internet of Things" was coined some 10 years ago by the founders of the original MIT Auto-ID Center, with special mention to Kevin Ashton in 1992 and David L. Brock in 2013 The climax of the Auto-ID Center reputation occurred in September 2003, when the EPC (Electronic Product Code) Executive Symposium taking place in Chicago (Illinois, USA) marked the official launch of the EPC Network an open technology infrastructure allowing computers to automatically identify man-made objects and track them as they flow from the plant to distribution centre to store shelves.

The term "Auto-ID" refers to any broad class of identification technologies used in industry to automate, reduce errors, and increase efficiency. These technologies include bar codes, smart cards, sensors, voice recognition, and biometrics. But since 2003 the Auto-ID technology on the main stage has been Radio Frequency Identification (RFID).

Internet of Things represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the Internet where it can be processed and utilized for various interesting purposes [1].

Fig 1

The Three Cs of IoT

Communication: IoT communicates information to people and systems, such as state and health of equipment and data from sensors that can monitor a person's vital signs. In most cases, we didn't have access to this information before or it was collected manually and infrequently. For example, an IOT-enabled HVAC system can report if its air filter is clean and functioning properly. Almost every company has a class of assets it could track. GPS-enabled assets can communicate their current location and movement. Location is important for items that move, such as trucks, but it's also applicable for locating items and people within an organization. In the healthcare industry, IoT can help a hospital track the location of everything from wheelchairs to cardiac defibrillators to surgeons. In the transportation industry, a business can deliver real-time tracking and condition of parcels and pallets.

Control and Automation: In a connected world, a business will have visibility into a device's condition. In many cases, a business or consumer will also be able to remotely control a device. For example, a business can remotely turn on or shut down a specific piece of equipment or adjust the temperature in a climate-controlled environment. Meanwhile, a consumer can use IoT to unlock their car or start the washing machine.

Cost Savings: Many companies will adopt IoT to save money. Measurement provides actual performance data and equipment health, instead of just estimates. Businesses, particularly industrial companies, lose money when equipment fails. With new sensor information, IoT can help a company save money by minimizing equipment failure and allowing the business to perform planned maintenance. Sensors can also measuring items, such as driving behavior and speed, to reduce fuel expense and wear and tear on consumables. New smart meters in homes and businesses can also provide data that helps people understand energy consumption and opportunities for cost savings [3].

Key IoT features

Table 1: Communication Features

Feature	Feature description
Different underlying networks	abstraction of the different underlying networks (e.g., wired, wireless, cellular), support for different communication modes (e.g., access point-based, p2p fashion)
Addressing modes	support of anycast/unicast/multicast/broadcast transmissions, dynamic replacing of broadcast with multicast/anycast to reduce network load
Massive device transmission	handling simultaneous or nearly simultaneous transmissions from huge number of devices (i.e., efficient MAC protocols)
High reliability	guarantee of connectivity/reliable transmissions based on different solutions (e.g., link adaptation protocols, modulation/coding schemes, multi-path establishment)
Enhanced access priority	management of priority levels of services and communications services (e.g., preemption mechanisms)
Path selection	optimization of communication paths based on different policies (e.g., network cost, delay, transmission failures), dynamic metric selection
Mobility	seamless roaming and mobility, communication management towards stationary and low-mobile devices
Sleeping devices	managing communication towards sleeping devices
Low power consumption	include mechanisms for reducing energy consumption
Notification and interaction	functions for supporting data acknowledgement, failure notifications, and interaction mode
Traffic profile	management of data traffic with different traffic profiles (e.g., continuous transmissions, long periods between two data transmissions, small amount of transmitted data, burst of data, bidirectional/unidirectional transmissions)
Time-dependent traffic	support of data traffic with different time requirements (e.g., time-controlled traffic,delay-tolerant traffic, extremely low-latency traffic)
Location reporting support	report the device/gateway location to other devices/applications continuously/upon request
Secure connections	integrity of communications and timestamps, anonymity of identity and location, detection of abnormal events

This Table summarizes the main communication features that are necessary for the correct establishment of M2M communications [4].

Applications

Some future consumer applications envisioned for IoT sound like science fiction, but some of the more practical and realistic sounding possibilities for the technology include:

- Receiving warnings on your phone or wearable device when IoT networks detect some physical danger is detected nearby
- Self-parking automobiles
- Automatic ordering of groceries and other home supplies
- Automatic tracking of exercise habits and other day-to-day personal activity including goal tracking and regular progress reports

The IoT can find its applications in almost every aspect of our daily life. Below are some of the examples.

1) Prediction of natural disasters: The combination of sensors and their autonomous coordination and simulation will help to predict the occurrence of land-slides or other natural disasters and to take appropriate actions in advance.
2) Design of smart homes: The IoT can help in the design of smart homes e.g., energy consumption management, interaction with appliances, detecting emergencies, home safety and finding things easily, home security etc.
3) Medical Applications: IOT helps in monitoring the patient's vital signs i.e. Blood Pressure, Heart beat, monitoring medicines intake and monitoring other activities.
4) Smart Security: Smart city is another powerful application of IoT generating curiosity among world's population. Smart surveillance, automated transportation, smarter energy management systems, water distribution, urban security and environmental monitoring all are examples of internet of things applications for smart cities.

IoT will solve major problems faced by the people living in cities like pollution, traffic congestion and shortage of energy supplies etc. Products like cellular communication enabled Smart Belly trash will send alerts to municipal services when a bin needs to be emptied. By installing sensors and using web applications, citizens can find free available parking slots across the city. Also, the sensors can detect meter tampering issues, general malfunctions and any installation issues in the electricity system.

5) Smart Retail: Smartphones will be the way for retailers to remain connected with their consumers even out of store. Interacting through Smartphones and using Beacon technology can help retailers serve their consumers better. They can also track consumers path through a store and improve store layout and place premium products in high traffic areas.
6) Smart Home: Wouldn't you love if you could switch on air conditioning before reaching home or switch off lights even after you have left home? Or unlock the doors to friends for temporary access even when you are not at home. Don't be surprised with IoT taking shape companies are building products to make your life simpler and convenient [5].

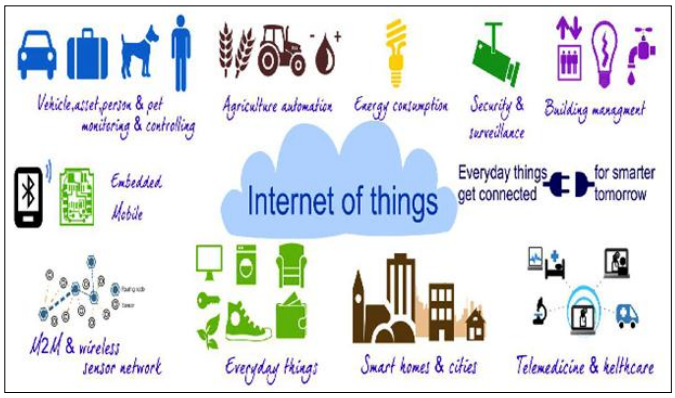

Fig 2

Challenges

For IOT to achieve its goal, number of challenges needs to overcome. These challenges include applications of IOT, policy and technical. In a real world where all things are connected with each other to share data and resources at a central hub. One important factor to the success of IoT is being to managing the identity and provides right access to the right person. IoT is interacted with between people, devices, and apps. In IoT world to enable identity management connections with requisite data, security, privacy management, performance, and personalization, resulting in protected data and better customer performance. Some factors should be considered for challenges:

1. Privacy: IAM solutions that allow customers to self-manage preferences such as opting in or out of communications and granting their consent for data sharing. IoT IAM is aggregating customer preference data captured from different interaction points into a single profile. IoT IAM preference management enables is the ability to set notification alerts.
2. Policy Based Data Access Governance: Policy-based governance controls are needed to apply for access to different levels and contexts. For instance, data access can be granted or denied according to IP address, industry or geographic regulatory constraints, time frames, corporate mandates and individual customer consent, among other criteria.
3. Adaptive Authentication scenarios: Authentication requirements are different for each person's identity, each type of device, each use case and each context. An IAM solution that supports adaptive authentication allows organizations to tailor the level of authentication for different people and devices scenarios [6].
4. Virtualization: Multiple sensors aggregated, or a sensor shared by multiple users
5. Semantic technologies: Information and data models for interoperability [7].

India is the future of the Internet of Things

Juergen Hase, a telecom industry vet and CEO of Reliance Group's internet of things unit Unlimit thinks India is positioned to become a global leader in the industry in the next 2-3 years, according to Entrepreneur India.

The growth of Internet of things companies in India is projected to reach $15 billion by 2020 thanks to the increased adoption of the technology across sectors like manufacturing, automotive, transportation and logistics, according to India's Economic Times. Hase says that those businesses will likely further capitalize on the accelerating growth by linking up with India's rising startups. He highlights 3 trends in India that back up these claims:

- Aggressive startups: Hase explains how startups are on the rise in India, especially among the younger generations. He added that almost all of India's innovation is coming from these startup companies.
- Strong demand: India's focus on megacities will invoke demand for IoT technology in all sectors. "This demand is being met by the government's push for investments in key projects like the public transport system."
- Technological Advancement: India is price sensitive and looking to implement cheaper, low-powered technology. If India achieves their IoT target in the next five years, the country would largely benefit on exports [8].

Conclusion

In the present world the rate of internet uses rapidly increases. Today everything need to seamless connectivity to another for sharing data, information on worldwide dynamic network. For this connectivity everyone need a proper package of rules.

Here, in this paper we have defined the three C's of IoT in which the IoT records vital signs of patients, start and shut down the equipment without the intervention of the human being and how we can save the time and money. IoT works on different underlying networks, multiple support addressing modes, High reliability, Enhanced access priority, Path selection, Mobility etc. It is the promise of IoT improving the lives of people through automation. The effectiveness of IoT saves the time and money of people.

The future ubiquitous IoT will make it possible for virtually any object around us to exchange information and work in synergy with each other in order to dramatically increase the quality of our lives.

We will be wearing smart clothes, made of smart fabrics, which will interact with the Climate Control of our cars and homes, selecting the most suitable temperature and humidity levels for the person concerned; smart books of the future will interact with the entertainment system, such as a multi-dimensional, multi-media Hypertext bringing up on the TV screen additional information on the topic we are reading in real time; and so on.

The Internet of Things will change our society, and will bring seamless 'anytime, anywhere' business, entertainment and social networking over fast reliable and secure networks. This means the end of the divide between digital, virtual and physical worlds. In the vision of Internet of Things, intelligent/smart wireless identifiable devices and embedded devices will offer their functionality as a web service, and will be able to discover and cooperate with other devices and services in a peer to peer manner [9].

This paper surveyed some of the most important aspects of IoT with particular focus on what is being done and what are the issues that require further research. While the current technologies make the concept of IoT feasible, a large number of challenges lie ahead for making the large-scale real-world deployment of IoT applications. In the next few years,

addressing these challenges will be a powerful driving force for networking and communication research in both industrial and academic laboratories.

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