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Recent Trends and Challenges in Development of Smart Systems

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Introduction

The term "Smart Systems" is used to explain the meeting of persistent computing and global data networking. The goal of smart systems is to integrate all intelligent devices with networked systems that are self-sensing, self-controlling, and self-optimizing—automatically, without even human intervention. It would not be far-fetched to call such systems "self-aware."

Smart systems incorporate sensing, actuation and control. They can describe and analyze situations by making analytical, adaptive decisions based on the available data and consequently performing smart actions. The smart system frontier includes machines, devices, people, cyber and physical sub systems and information all connected and interacting in a seamless, adaptive manner. These smart systems have shifted the focus from individual technologies to overall system intelligence, which results in fundamental changes in how the goods and services of tomorrow will be shaped, delivered and monetized.

How is it related to IOT

The prospective for IoT is vast as the data and number of devices connected to internet is exponentially increasing. Connectivity enables us to find resourceful information, at all times and from everywhere. IoT allows for virtually endless opportunities and connections to take place, many of which we can't even think of or fully understand the impact of today. With billions of devices being connected together, what can people do to make sure that their information stays secure? Will someone be able to hack into your toaster and thereby get access to your entire network? The IoT also opens up companies all over the world to more security threats. Then we have the issue of privacy and data sharing. Another issue that many companies specifically are going to be faced with is around the massive amounts of data that all of these devices are going to produce. Companies need to figure out a way to store, track, analyze and make sense of the vast amounts of data that will be generated.

Conversations about the IoT are taking place all over the world as we seek to understand how this will impact our lives. For now the best thing to be done is to do is educate ourselves about what the IoT is and the potential impacts that can be seen on how we work and live.

IOT and Web of Things

The Internet of Things is a system of physical objects that can be discovered, monitored, controlled or interacted by using electronic devices which can communicate over various networking interfaces, and can be connected to the Internet.

Earlier, the world through sensors existed only in science-fiction novels. But today, such scenarios are increasingly becoming reality, just because of the progress in embedded devices which brought a new class of objects called Smart Systems.

The things in the Internet of Things ranges from very simple tagged products such as your courier package with an Auto-ID tag (Automatic IDentification methods, such as bar codes, QR codes) attached to it so that can be tracked from the shipping center to your door; to more complex, and wirelessly connected products, devices or machines such as security systems, car or a factory assembly line; and a building or even a city. It simply means that the thing can be accessed and processed by other applications through the existing internet infrastructure. This does not mean that the thing must be physically connected to the internet. The communication network used can be an Auto-ID technology, short-range radio (e.g., Bluetooth) or a local Wi-Fi network in a building.

To build a single global ecosystem of things that can communicate with each other flawlessly is virtually impossible today.Till today there is no unique and universal application protocol for the Internet of Things that can work across the many networking interfaces. The IoT of today is a collection of isolated Intranets of Things that can't really interact with each other.

For the IoT to make a reality, we need a single universal application layer protocol for devices and applications to talk to each other, no matter how they are physically connected. Instead of creating yet another protocol we can simply reuse something that is already widely used for building scalable and interactive applications, like the web. This is what the Web of Things is all about that is to reuse and control readily available and widely popular web protocols, standards and blueprints to make data and services offered by objects more accessible to a larger team of developers.

In Web of Things, devices and their services are fully integrated in the web because they use the common standards and techniques in the web sites. This means that we can write applications which interact with the embedded devices in exactly the same way as we interact with any other web service which uses web application interfaces and in using REST architectures.

REST is an architectural style which is used for developing distributed applications and is used for building the modern web. The fundamental nature of REST is to focus on creating loosely coupled services that can be easily reused, which is implemented using URIs, HTTP, and standardized media types. Abstracting the services from their application-specific semantics thanks to a uniform interface makes it easy to build

loosely coupled services as it provides a simple mechanism for clients to select the best possible representations for interactions. This makes the web an ideal for building a universal architecture and Application Programming Interface to interact with things.

Although the Web of Things emphasizes on the usage of web standards to exchange data between devices, it does not imply anything about how the devices should be physically connected to each other. In other words, devices can be openly connected to the web and publicly accessible by anyone just like web sites. They can work equally well in local networks e.g., the Intranet of your company or your home network.

Things to have a public URL and be openly accessible over the web can be very efficient. For example, traffic or pollution sensors in a city operated by the public authorities. In this case, devices can also be crawled and indexed by search engines like any other web page and allow users to Google the physical world, or bookmark the URL of a smart object and share it with others. The objects connected through web can also become active and participate to the web just by connecting with other users, by publishing their blogs and talking to each other using the APIs of services.

Fig.1 IOT and connected smart systems

Applications in various fields

- Health Care

  The development of smart systems will be a boon to health care, providing benefits especially for the disabled and the elderly. "In the coming decade there will be huge demand for home medical alert systems, and the market will respond to that need. Health will be a bigger driver than environmental issues," as said by **Hal Varian**, chief economist at Google.

- Smart automobiles

When smart systems are adopted, an essential driver will be the difference they will make in energy costs and environmental sustainability. "Homes will get more efficient because it will cost more and more to waste energy. The devices will become simpler because no one likes being outsmarted by their thermostat," as said by **David Weinberger**, a senior researcher at Harvard University's Berkman Center for Internet & Society.

- Assisted living

The Assisted Living Service System has much to offer for the safety of home, especially for senior citizens who want to live at home as long as possible. The system increases the security of everyday life with multiple features such as the activity motion sensors, pressure sensors, contact sensors in windows and doors and medical dispensers. Signs of any irregular activity are transferred automatically to an emergency centre. The system also enables medical and social services or social gatherings by using video chats or virtual cafés thus adding social contacts and preventing loneliness, which so often troubles the elderly. As a cloud based solution, Assisted Living Service System offers third party service solutions for registered users. It collects data from various other sources and services, so that each user can order the exact preferred combination. The user interface is simple and designed in co-operation with end users. The system helps individuals at their homes but also gives new kind of tools for healthcare service providers by making it easier to follow their customers wellbeing.Our life expectancy gets longer than ever. Systems that help us maintain the quality of life, like living at home, even when our physical condition deteriorates are more than welcome. With the help of IoT we can do this.

- Smart City

Smart Cities are already reality. They are ecosystems in which many innovative technologies serve residents by making cities safer, greener and more efficient. New business models are emerging and while cities and industry gets smarter our quality of life is improving. The challenges of climate change, over population, traffic growth and city expansion have led to urgent need to create technologies to face the ever-increasing problems. Big data collected from various sources to IoT hubs allow cities to improve sustainability and economic development. It helps optimizing energy use and reduce carbon di-oxide. Analyzed and capitalized information gives tools to plan more eco-efficient future.

- Smart Traffic

Intelligent Transport Systems and Services (ITS) gather together a broad range of information that improves the performance and safety of the transportation infrastructure. Traffic conditions and any

signs of irregularities are transferred in real-time enabling a better management of traffic flow. This means that road users can get traffic and weather updates quickly, and plan their movements accordingly. The public transport will be more lucrative with real-time timetables and easy to access route information services. Automated incident detection can lead to quicker responses. At its best, ITS can reduce congestion, optimize the traffic conditions and even save lives.

Challenges

- Simplicity is better than complexity since people desire more simplicity, not complexity. Our ancestors have to be able to understand these systems and there is not enough evidence yet about whether many of the systems will be easy much to use or not. **Mike Leibhold**, senior researcher and distinguished fellow at the Institute for the Future, said, "People have simply too much to do already to focus scarce attention on properly managing their resource consumption in fine detail. Also, people seem to resist the idea as invasive of smart grid top-down monitoring and control of resource consumption. Conservation technologies are promising, but behavior changes will be *very* slow."

- Economy in the country is the major problem. The bad economy is going to delay progress; current smart systems are not affordable and people are focused on other things when it comes to change. **Kevin Novak**, a vice president with the American Institute of Architects and co-chair of the eGov Working Group of the World Wide Web Consortium, noted, "The technology and available systems will not be the impediment to adoption. The financial costs will be."

- The home isn't the real locus of change rather it's the smartphone with its apps. "The Home of the Future will be a mobile home since everything will be controlled by a single device. Everything that people need to be connected and efficiently manage utilities, shopping, communications, and everyday life matters will be accessible anywhere they are via a mobile device and their mobile or Wi-Fi provider. This is not likely to be everywhere by 2020, and the wired-up smart homes envisaged a decade ago are only practicable for new builds. In time, the only thing a household will need is broadband Wi-Fi point of connectivity," said **Jane Vincent**, visiting faculty fellow at the University of Surrey Digital World Research Centre.

- There are concerns over centralized control of systems trumping individual will while filling the funds of service providers. "We are already witnessing rejection of many smart-grid initiatives. It is perceived as an intrusion in people's lives, as a way to shift the balance of power from the individual to the utilities," wrote **Christian Huitema**, distinguished engineer at Microsoft Corporation. **Brian Harvey**, a lecturer at the University of California-Berkeley predicted, "Energy will be conserved, but at a huge privacy cost. And sooner or later the smart meters will start imposing rationing." And **Steven Swimmer**, a consultant who previously worked in a digital leadership role for a major broadcast TV network, said there's a power struggle now gearing up. "The bigger question will be

how is the hub controlled?" he said. "Will it be via a home-based computer, a set-top media box, a black box, or a purely cloud-based system? Expect large battles for companies to try to own this space by offering free or subsidized devices and/or apps. Will it be your phone company, your cable/satellite company, Google, Microsoft, Amazon, Apple, Cisco, or some other big player?"

- Nobody really wants a smart home—they like their homes to be dumb; the smart home of tomorrow is just a wish upon a star. **Tracy Rolling**, product user-experience evangelist for Nokia, she wrote. "Smart homes. Yeah. No. Nobody really wants a smart home. Also, proprietary technology and a lack of organized protocols and formats means that this is not going to take off for a very, very long time. My iPhone won't want to talk to my GE smart toaster and my Bosch smart refrigerator won't connect to my generic smart coffee maker. People don't seem to want this stuff very much. They like for their homes to be dumb. How many people do you know who have bought one of those alarm-clock coffee pots, loved them for a month, and then stopped using the alarm-clock feature all together? Smart homes are like that on a grand scale."

- Security will be an essential requirement for the smart system.As sensors propagate all around us, we want to be assured that our privacy is protected from snooping and that our identity and financial resources are safe from malicious attack. Data encryption is important, but best security practices and strong authentication procedures for users, devices, services, and applications are also required.

- We will need to pay careful attention to overall resilience, and services will need to cope with rapidly peaking demand loads. Dealing with a heterogeneous mix of device vendors and versions can be addressed through abstraction layers and best practices, with so many devices at work it is inevitable that some will fail, either through hardware faults or software bugs. Services will have to be designed to tolerate failures, including the ability to employ appropriate workarounds when sensor readings are interpreted as implausible. Cyberthreats can challenge resilience. Countering these will require some careful attention to fix security flaws, closely monitoring anomalous behavior, and employing defenses such as security zones.

- Authentication or verifying identity is important for devices, users, applications, and services as part of end-to-end security and for trust management. We cannot assume that "users" in the WoT or IoT are present and able to authenticate themselves. Therefore, trust management will need developing measures for verifying metadata: the origin of data, a given sensor's location, and various other identifiers. Such trust can be built based on known brands and even crowdsourcing in terms of reputation management.

Conclusion

The smart systems will change the world in an even more profound way than has the Internet. If we ask children today about how the world existed before Internet, they have no idea about it. They have no

knowledge of how people could communicate or even live their lives without the common place tools we have today. The same will happen with the smart systems.

A decade from now, we will be dependent on the knowledge derived from the continuous stream of data from our wearables and our smart home devices, and we will have no idea how we managed the world and our lives before. We will be able to make better informed, more accurate and more timely decisions; and decisions that will improve our lives, save us money, and may even save our planet. The smart systems and IoT will make the difference. Transportation, education, home security will all be affected by smart machines.

The convergence of networked computing and large scale data management with real time machine intelligence is driving the integration of the physical and virtual worlds. The intersection of these trends – the Internet of Things, Data and People will create unimagined new values.

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