

Smart Technology: A Primer

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ABSTRACT

Everyday use of technology has evolved. The combination of availability, accessibility, affordability, and ease-of-use has made smart technologies indispensable tools in everyday business, economy, medicine, and politics. These technologies embed computer chips that gather information and respond within a range of preset parameters. Smart technologies will change the world in the same way as the industrial revolution. This paper provides a primer on smart technologies.

KEYWORDS: smart technology, intelligent technology

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INTRODUCTION

Technology is developing and improving rapidly. The increased availability of smart devices such as smartphones has provided greater opportunities for global participation in meaningful ways. The ubiquitous nature of smart devices presents new opportunities and responsibilities for users seeking to incorporate them into mundane duties such as calling, texting, driving, emailing, etc [1]. The combination of availability and ease-of-use has made smartphone and tablet technology ("smart technology") an increasingly useful tool in the medical community.

Smart technologies refer to the use of digital and communications technologies. They have given us new, powerful tools to work. They include a growing array of technologies, such as smart appliances, smart equipment, smart heating controls, smart lighting systems, and building energy management systems. These technologies go hand-in-hand with a new technology called the Internet of things (IoT).

SMART TECHNOLOGY CONCEPT

A smart technology (ST or Smart-Tech) is a self-operative and corrective system that requires little or no human intervention. The term "smart" originally comes from the acronym "Self-Monitoring, Analysis and Reporting Technology" but became widely known as "smart" because of the notion of allowing inanimate things or objects to communicate. There has been a seemingly ever-increasing use of the synonymous adjectives "smart" and "intelligent" to describe a diverse range of systems and technologies. A technology is smart if it performs a task that an intelligent person can do.

Typically, a smart technology has three elements (sensors, control unit, and actuators) to provide three basic capabilities (sensing, processing and decision making, and acting). The elements are explained as follows [2].

- **Sensors:** These are an integral part of the structure which collect information on a stimulus. The sensing ability provides the capacity to extract information from sensors and communicate with external devices.
- **Control Unit:** This embodies the control algorithm and microprocessor on which the software can be run, together with interconnections to the arrays of sensors and actuators. The control algorithm will almost always be embodied in the form of software and for the inference to be genuinely intelligent this software will need to be trainable.
- **Actuators:** These are an integral part of the structure which implements the change in configuration determined by the control algorithm.

A smarter technology has the capabilities of accurate sensing, fast processing, and reliable control (i.e., decision making and acting). It possesses the ability to learn from operations. For example, optical sensors, structural composites capable of incorporating integral sensors or actuators, compact microprocessors and artificial intelligence may all in one sense be regarded as "smart technologies." Smart technologies have been widely used in Singapore for monitoring traffic conditions and enforcing rules and regulations [3]. Like modern familiars, our mobile phones are also affecting our relationships.

EXAMPLES OF SMART DEVICES

A smart device is an electronic device, connected to other devices or networks and uses wireless protocols such as Bluetooth, Zigbee, NFC, Wi-Fi, LiFi, 3G, etc. Smart devices are composed of a hardware layer, a network layer, and an application layer. They have some automation and can be easily programmed. Examples of smart devices include [4,5]: smartphones, smart cars, smart thermostats, smart doorbells, smart locks, smart refrigerators, smart cards, smart key, smart speakers, smart oven, smart coffeemaker, smart washer, smart thermostat, smart microwave, smart dishwasher, smart blinds, smart kettle, smart sockets, smart toaster, smart air conditioner, smart dust, smart antennas, smart watch, smart security camera, smart TV, etc. Some of these are discussed as follows.

1. **Smart Fridge:** This is a high-tech programmed refrigerator that is able to detect the type of items stored in it. It allows a user to know which items in the refrigerator without opening it, by simply checking the display list on the display. The refrigerator communicates with other devices.
2. **Smart Key:** This is a key with digital features that can facilitate more than just unlocking a physical or digital lock system. The use of smart keys has become widespread in industries, especially automotive and hospitality industries.
3. **Smartphone:** This is a mobile phone with highly advanced features. A smartphone is expected to have a more powerful CPU, more RAM, greater connectivity options and larger screen than a regular cell phone. It allows you to call, text, play games, browse the Web, use navigation system, etc.
4. **Smart Meter:** Smart meters are wireless, high-tech, digital communication devices that will replace the old, analog electricity meters and allow remote electricity readings. Using smart meters provides us with some environmental benefits as well as eliminating the need for manual meter reading. Smart meters possess the ability to engage in two-way communication between the utility and the end consumer. A typical smart meter helps the consumers to understand the billing procedures and usage of electricity so that they can control the usage accordingly [6].
5. **Smart Antenna:** A smart antenna basically consists of an antenna array combined with signal processing in both time and space. They are different from common antennas in that they have adaptive (non-fixed) lobe patterns. They exploit the fact that interferers rarely have the same location as the users. Although smart antennas make wireless systems more complex, they provide real improvements in critical areas needed to make wireless service more universal and reliable [7].

APPLICATIONS OF SMART TECHNOLOGIES

The following applications use elements of smart technologies.

- **Smart City:** A smart city is a high-tech urban area that connects people, information and technologies in order to increase life quality. It uses networking and computing technologies to create efficiencies, improve sustainability, create economic development, and enhance quality of life for those living and working in the city. It connects various items such as street lighting, smart buildings/homes, smart factories, smart hospitals, smart mobility, urban manufacturing, and

urban farming. The major aim of a smart city is to use smart technology to enhance the quality of living for its citizens. It uses information and communication technologies (ICT) to enhance the performance of urban services such as energy, transportation, and tourism. ICT can make cities more accessible and attractive for both residents and visitors [8]. A typical smart city is shown in Figure 1 [9].

- **Smart Grid Technology:** This is the smartest technology of generating and distributing power throughout the country in an effective manner. Smart grid technology is providing with this unique feature due to some characteristics that differentiates it from the existing traditional grid. The grid is made smart by using protection system of the grid and central control through supervisory control and data acquisition (SCADA) system. Smart grid can monitor the entire system from both user and supplier end [10]. A typical smart grid is depicted in Figure 2 [11].
- **Smart Home Technology:** This uses devices connected to the Internet of things (IoT) to remotely monitor, control, and provide services. It allows users to control and monitor their connected home devices/systems (such as lighting, smoke detectors, security system, refrigerators, laundry machines, etc.) from smart home apps whether they are home or away. The smart home may include a restroom that determines the user's blood pressure, temperature, and blood sugar. One goal of smart home is to have the energy follow the people and avoid the supply of services to empty rooms. The smart home technology is now being used to create smart cities [12]. Homes and their occupants can be more obviously connected to network operations more than before. The fully smart/connected homes (by most definitions) are extremely rare [13]. A typical smart home technology is shown in Figure 3 [14].
- **Smart Metering Technology:** The smart grid vision incorporates smart metering technology (SMT) at the consumer's location, both household and commercial consumers. The smart meters would allow two-way metering of power and to provide detailed information about usage to both utility companies and consumers. They will also enable consumers to actively manage the electricity they consume [15].
- **Smart Healthcare:** Healthcare has lagged behind in the use of smart technologies compared with such industries as financial services, defense, and higher education. In an environment where mistakes can mean life or death, smart technology is proving to be highly valuable. Smart technology in healthcare refers to the combined use of ICT and health monitoring devices. It has the potential as a tool to support independent living for a person with dementia to live independently. Since diabetes patients are involved in the management of their disease, smart technology is key to helping them stay healthy. Smart technology can be a great asset for individuals with intellectual disabilities for better managing their healthcare needs. It should help raise the quality of healthcare, reduce its cost, and enable consumers and providers to make smarter choices [16].

➤ **Wearable Smart-Technology:** This portable technology allows for easy access to the communication device. It is breakthrough that allows both the patient and provider to delve into critical health data to improve outcomes. Voice-recognition software will be another one of the key components in the development of this application. Voice-recognition technology is becoming more and more commonly used in everyday interactions. Wearable technology can also play an underlying role in improved incidental learning and literacy for the deaf [17].

Other applications include smart tourism, real estate, law, education, smart classroom, transport system, hospitals, smart materials, and autonomous systems.

BENEFITS AND CHALLENGES

Smart devices and technologies are invaluable for considering what they might do to us. Smart technologies are being used to tackle sustainability challenges that are threatening cities. They have the potential to significantly enhance the engineered built environment, have a positive impact on energy, consumer bills, and energy security.

There are a number of challenges associated with developing and using of technologically based interventions. Smart technology is recording our behavioral reactions and altering our social and moral worlds. It is thus reducing the scope of our moral lives in some ways through nudges and surveillance. For example, smart car beeps to warn us when a door is unlocked door or a seat belt is unfastened; the sensor systems nudge us toward safe driving behaviors, and we may not be able to override them [18]. Smart technologies could permanently affect workers, either by sending them to lower paid jobs or to simply put them out of jobs. When a hacker gain access to one device, such as a smartphone or smart watch, they can potentially hack into other systems the device is connected to. Smart technologies can enhance the overall safety and efficiency of the transport system. It presents opportunities for controlling goods in light of the ease of vertical integration of software and hardware [19]. Smart healthcare faces formidable barriers because of their complexity and cost, fear of arousing popular anxieties about privacy, and deep-seated professional and institutional resistance. Implanting a chip into individuals so this crucial information is not lost sounds controversial to some. Other challenges include new risks, new failure modes, new regulations, and inadequate funding.

CONCLUSION

The combined autonomy and ambience of smart technologies simultaneously provides the conduit through which our choices are affected. The development of fast and miniaturized microprocessors has enabled the design of embedded systems with distributed control capabilities. It is evident that smart technology is making use smarter. Smart technology is an area fostering large amounts of innovation that will have important impacts on the future energy system. There are some forward-looking companies that are leveraging smart technologies to find new ways to achieve goals and enhance services. More information about smart technologies and their applications can be found in books in [20-28].

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Figure 1 A typical smart city [9].

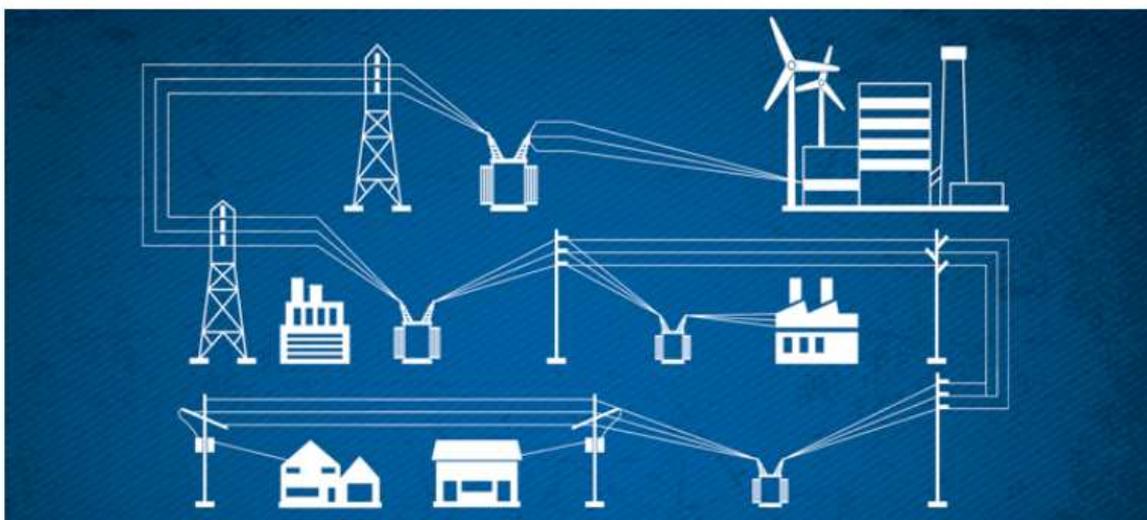


Figure 2 A typical smart grid [11].

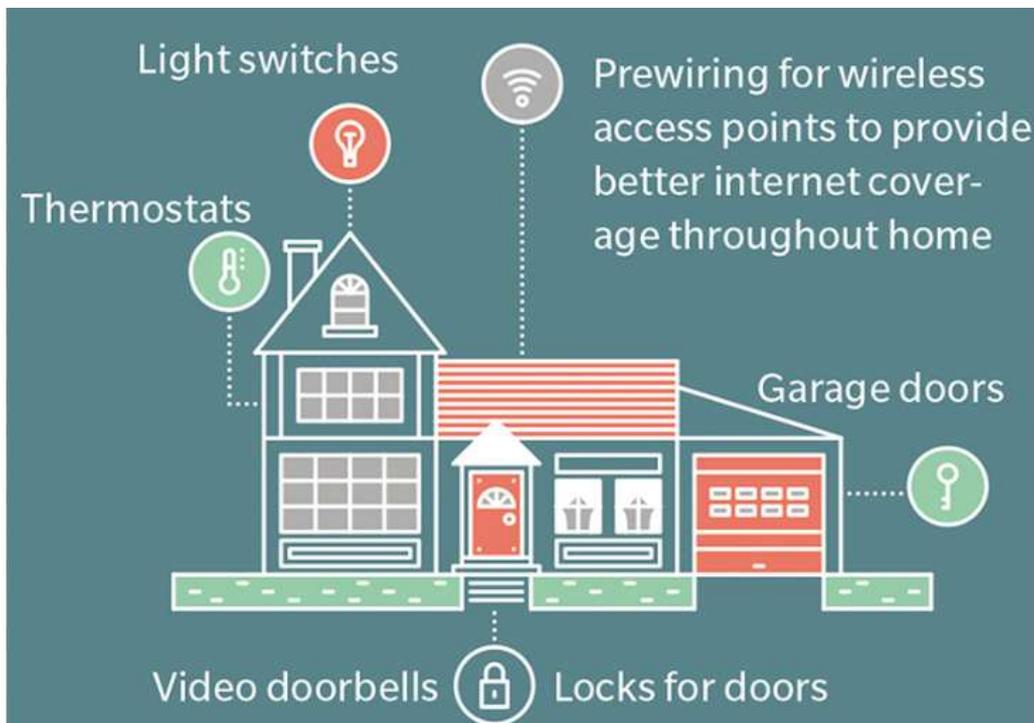


Figure 3 A typical smart home technology [14].

