Trends of IoT

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Abstract: *The Internet of Things (IoT) is the network of physical objects or "things "embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020. The IoT is enabled by the latest developments in RFID, smart sensors, communication technologies, and Internet protocols. The basic premise is to have smart sensors collaborate directly without human involvement to deliver a new class, of applications. The current revolution in Internet, mobile, and machine-to-machine (M2M) technologies can be seen as the first phase of the IoT. In the coming years, the IoT is expected to bridge diverse technologies to enable new applications by connecting physical objects together in support of intelligent decision making. IOT mainly contains six elements to manage its operations identification, sensing, communication, computation, services and semantics. Single Board Computers (SBCs) integrated with sensors and built-in TCP/IP and security functionalities are typically used to realize IoT products (e.g., Arduino Yun, Raspberry PI, Beagle Bone Black, etc.). Such devices typically connect to a central management portal to provide the required data by customers. IOT uses IPv6 addresses to exchange the data between physical objects. IoT protocols are divided into four broad categories, namely: application protocols, service discovery protocols, infrastructure protocols and other influential protocols. Common Operating Systems that are used in IoT environments are Tiny OS, Contiki, Lite OS, Riot OS and Android. Smart buildings, Smart home, smart Grids, smart City and smart healthcare are different services that are provided by IoT.*

Keywords: *RFID, M2M, SBCs*

I. Introduction

British entrepreneur Kevin Ashton first coined the term in 1999 while working at Auto-ID Labs (originally called Auto-ID centers, referring to a global network of objects connected to radio-frequency identification, or RFID)[3,4] Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The **Internet of Things** (**IoT**)[1] is the network of physical objects—devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity—that enables these objects to collect and exchange data.[1] The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure The **Internet of Things** (**IoT**) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction[2]. There are also other domains and environments in which the IoT can play a remarkable role and improve the quality of our lives. These applications include transportation, healthcare, industrial automation, and emergency response to natural and man-made disasters where human decision making is difficult. The IoT enables physical objects to see, hear, think and perform jobs by having them "talk" together, to share information and to coordinate decisions. The IoT transforms these objects from being traditional to smart by exploiting its underlying technologies such as ubiquitous and pervasive computing, embedded devices, communication technologies, sensor networks, Internet protocols and applications. Smart objects along with their supposed tasks constitute domain specific applications (vertical markets) while ubiquitous computing and analytical services form application domain independent services (horizontal markets). Fig. 1 illustrates the overall concept of the IoT in which every domain specific application is interacting with domain independent services, whereas in each domain sensors and actuators communicate directly with each other.

Various Icons Of Internet Of Things

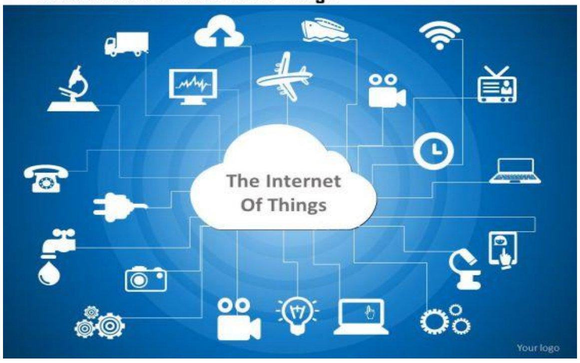

Fig: 1

Over time, the IoT is expected to have significant home and business applications, to contribute to the quality of life and to grow the world's economy. For example, smart-homes will enable their residents to automatically open their garage when reaching home, prepare their coffee, control climate control systems, TVs and other appliances.

II. Device Identification and Sensing in IOT

A) Identification

Identification is crucial for the IoT to name and match services with their demand. Many identification methods are available for the IoT such as electronic product codes (EPC) and ubiquitous codes (uCode). Furthermore, addressing the IoT objects is critical to differentiate between object ID and its address. Object ID refers to its name such as "T1" for a particular temperature sensor and object's address refers to its address within a communications network. In addition, addressing methods of IoT objects include IPv6 and IPv4. 6LoWPAN [3] provides a compression mechanism over IPv6 headers that make IPv6 addressing appropriate for low power wireless networks. Distinguishing between object's identification and address is imperative since identification methods are not globally unique, so addressing assists to uniquely identify objects. In addition, objects within the network might use public IPs and not private ones. Identification methods are used to provide a clear identity for each object within the network.

B) Sensing

The IoT sensing means gathering data from related objects within the network and sending it back to a data warehouse, Database or cloud. The collected data is analyzed to take specific actions based on required services. The IoT sensors can be smart sensors, actuators or wearable sensing devices. For example, companies' like Wemo, revolve and Smart Things offer smart hubs and mobile applications that enable people to monitor and control thousands of smart devices and appliances inside buildings using their smart phones. Single Board Computers (SBCs) integrated with sensors and built-in TCP/IP and security functionalities are typically used to realize IoT products (e.g., Arduino Yun, Raspberry PI, Beagle Bone Black, etc.). Such devices typically connect to a central management portal to provide the required data by customers.

C. Communication

The IoT communication technologies connect heterogeneous objects together to deliver specific smart services. Typically, the IoT nodes should operate using low power in the presence of lossy and noisy communication links. Examples of communication protocols used for the IoT are WiFi, Bluetooth, IEEE 802.15.4, Z-wave, and LTE-Advanced. Some specific communication technologies are also in use like RFID[7], Near Field Communication (NFC) and *ultra-wide bandwidth* (UWB). RFID [9] is the first technology used to realize the M2M concept (RFID tag and reader). The RFID [7] tag represents a simple chip or label attached to provide object's identity. The RFID reader transmits a query signal to the tag and receives reflected signal from the tag, which in turn is passed to the database. The database connects to a processing center to identify objects based on the reflected signals within a (10 cm to 200 m) range. RFID tags can be active, passive or semi-passive/active. Active tags are powered by battery while passive ones do not need battery. Semi-passive/active tags use board power when needed. The NFC protocol works at high frequency band at 13.56MHz and supports data rate up to 424 kbps. The applicable range is up to 10 cm where communication between active readers and Passive tags or two active readers can occur. The UWB communication technology is designed to support communications within a low range coverage area using low energy and high bandwidth whose applications to connect sensors have been increased recently. Another communication technology is WiFi that uses radio waves to exchange data amongst things within 100 m range. WiFi allows smart devices to communicate and exchange information without using a router in some *ad hoc* configurations. Bluetooth presents a communication technology that is used to exchange data between devices over short distances using short-wavelength radio to minimize power consumption. Recently, the Bluetooth *special interest group* (SIG) produced Bluetooth 4.1 that provides Bluetooth Low Energy as well as High-speed and IP connectivity to support IoT. The IEEE 802.15.4 standard specifies both a physical layer and a medium access control for low power wireless networks targeting reliable and scalable communications. Maintaining the Integrity of the specifications.

III APPLICATIONS OF IOT

A) Environmental monitoring

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection[10] by monitoring air or water quality,[15] atmospheric or soil conditions,[11] and can even include areas like monitoring the movements of wildlife and their habitats.[12] Development of resource constrained devices connected to the Internet also means that other applications like earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be mobile. It has been argued that the standardization IoT brings to wireless sensing will revolutionize this area.

B) Infrastructure management

Monitoring and controlling operations of urban and rural infrastructures like bridges, railway tracks, on- and offshore- wind-farms is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk [14]. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT.

c) Manufacturing

Network control and management of manufacturing equipment, asset and situation management, or manufacturing process control bring the IoT within the realm on industrial applications and smart manufacturing as well. The IoT intelligent systems enable rapid manufacturing of new products, dynamic response to product demands, and real-time optimization of manufacturing production and supply chain networks, by networking machinery, sensors and control systems together. Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IoT. But it also extends itself to asset management via predictive maintenance, statistical evaluation, and measurements to maximize reliability.] Smart industrial management systems can also be integrated with the Smart Grid, thereby enabling real-time energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are provided by a large number of networked sensors.

The term IIOT (Industrial Internet of Things) is often encountered in the manufacturing industries, referring to the industrial subset of the IOT.

D. Energy management

Integration of sensing and actuation systems, connected to the Internet, is likely to optimize energy consumption as a whole. It is expected that IoT devices will be integrated into all forms of energy consuming devices (switches, power outlets, bulbs, televisions, etc.) and be able to communicate with the utility supply company in order to effectively balance power generation and energy usage. Such devices would also offer the opportunity for users to remotely control their devices, or centrally manage them via a cloud based interface, and enable advanced functions like scheduling (e.g., remotely powering on or off heating systems, controlling ovens, changing lighting conditions etc.)[18]. In fact, a few systems that allow remote control of electric outlets are already available in the market, e.g., Belkin's WeMo, Ambery Remote Power Switch, Budderfly, Telkonet's EcoGuard, WhizNets Inc., etc.

Besides home based energy management, the IoT is especially relevant to the Smart Grid since it provides systems to gather and act on energy and power-related information in an automated fashion with the goal to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. Using Advanced Metering Infrastructure (AMI) devices connected to the Internet backbone, electric utilities can not only collect data from end-user connections, but also manage other distribution automation devices like transformers and recluses.

E. Medical and healthcare systems

IoT devices can be used to enable remote health monitoring and emergency notification systems. These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers or advanced hearing aids.[48] Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well [15]. Other consumer devices to encourage healthy living, such as, connected scales or wearable heart monitors, are also a possibility with the IoT. More and more end-to-end health monitoring [6] IoT platforms are coming up for antenatal and chronic patients, helping one manage health vitals and recurring medication requirements. Distinct advantages over similar products from the US and Europe are cost-effectiveness and personalization for chronic patients. Doctors can monitor the health of their patients on their smart phones after the patient gets discharged from the hospital [5].

F. Building and home automation

IoT devices can be used to monitor and control the mechanical, electrical and electronic systems used in various types of buildings [17] (e.g., public and private, industrial, institutions, or residential) in home automation and building automation systems [13].

G. Transportation

Variable speed limit digital speed limit sign The IoT can assist in integration of communications, control, and information processing across various transportation systems. Application of the IoT extends to all aspects of transportation systems, i.e. the vehicle, the infrastructure, and the driver or user. Dynamic interaction between these components of a transport[16] system enables inter and intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance.

IV Commonly used SBCs of IOT

A)Raspberry Pi

The Raspberry Pi is a single-board computer developed in the UK by the Raspberry Pi Foundation. The Raspberry Pi is a credit-card sized computer that plugs into your TV and a keyboard. It's a capable little PC which can be used for many of the things that your desktop PC does.

B) *BeagleBone Black*BeagleBone Black is a community-supported development platform for developers and hobbyists. Boot Linux in under 10 seconds and get started on development in less than 5 minutes with just a single USB cable.

C)Arduino Yun

Arduino Yún is the combination of a classic Arduino Leonardo with a Wifi system-on-a-chip running Linino.When the Yún is turned on for the first time, it becomes an Access Point, creating a Wi-Fi network named "Arduino

D) UDOO

It is a multi-development platform solution for Android, Linux, Arduino and Google ADK 2012. The board, which is built upon an ARM Cortex-A9 CPU and Atmel | SMART SAM3X8E ARM Cortex-M3 CPU, is designed to provide a flexible environment that lets Makers explore the new frontiers of the Internet of Things and switch between Linux and Android in a matter of seconds, simply by replacing the MicroSD card and rebooting the system.

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