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A Survey: IoT for Everyone!

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Abstract: ***Internet of Things has entered everyone's lives in one way or another. IoT has a wide range of applications from day-to-day activities to tasks in research fields. Its application can be seen in a simple tasks-reminder or in aircrafts for military. This paper depicts how IoT is within everyone's reach and it is not as complicates it looks. It also gives examples of application in everyday activities and in industries.***

Keywords: IoT, internet, RFID, smart homes

1. Introduction

Internet of Things is establishing connectivity between physical objects for objects to communicate with one another with constant internet connectivity. The concept of IoT[1] is quite simple. If all objects in daily life were equipped with identifiers, sensors and wireless connectivity, these objects could communicate with each other and be managed by computers. The connectivity among devices can be set up using RFID (Radio Frequency Identification) [2]. RFID devices are wireless microchips used for tagging objects for automated identification to begin the communication among devices. RFID identifies objects wirelessly without line-of-sight. RFID technologies have revolutionized the software industries with applications ranging from automated checkout to monitoring the medication of elderly.

The idea of IoT is quite popular today but its concept was introduced by Kevin Ashton in the early 2000's. Back in 2000's there were many shortcomings for implementation of IoT. Some of the questions raised were what type of wireless communication has to be used, can internet back then handle the load of n number of devices connected to one another, etc. All these questions were easily answered by the advent of new technologies since then.

2. Architecture

The Internet of Things is the interconnection of uniquely identifiable embedded computing devices within the internet infrastructure. The IoT architecture grows and changes constantly as per the application requirement. The architecture of IoT is drawn as a framework for the specification of a network's physical components and their functional organization and configuration, its operational principles, procedures as well as the data formats used in its operation.

Let us consider the below basic architectural model that is present in every evolved model of the system.

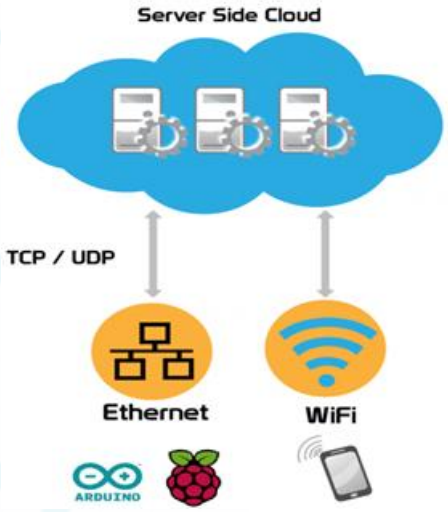

Figure 1: Basic architecture of IoT

In any IoT application architecture the above structure remains constant and the other requirements are built around it. The three layers shown in the above architecture are (i) Users (ii) Mode of internet connection (iii) Server side cloud. The server side and user board communicate using TCP or UDP protocols.

The most popular user device (chip) are Arduino, RasberryPi[3] and any smart phone. The Arduino board is a microcontroller. The Arduino is entirely focused on executing a specific task even if that task involves reading multiple sensors or controlling multiple components via output pins. The typical Arduino device has a very small amount of RAM, about 2KB, and 32KB of flash memory for your application storage. Its focus is on interacting with the hardware devices connected to the Arduino and transmitting data or receiving commands from another computer thought internet.

The Raspberry Pi is a full computer and powerful than Arduino. IoT application is directly loaded into flash memory itself. Since there is no operating system or file system to worry about the Rasberry Pi board can be powered up or down at any time. This is of great importance if the device to read the data from is located where power availability is intermittent. Full fledged computers, like the Raspberry Pi require some time to boot

up and need to be shut down in an orderly fashion to ensure no data is corrupted.

A modern smart phone is equipped with up to 10 sensors, able to capture anything from location to the device orientation to light conditions. These sensors produce a huge amount of data, both in unstructured form (picture or videos) as well as structured, such as GPS or acceleration data. The user devices Arduino, Rasberry Pi or smart phones as mentioned above are connected to the internet and communicate with the servers with communication protocols. Some of the communication protocols are TCP, UDP, MQTT, etc. The data are read from servers and sent to the user's device.

The era of IoT is just beginning. The advancement in technology will give a new turn to IoT applications and its evolution in industries.

3. Applications

The Internet of Things is becoming a part of every aspects of our lives. Its applications extend from smart connected homes to wearables to healthcare to IT industries. IoT applications are enhancing the comfort in life and giving better control by simplifying routine work life and personal tasks. The wide range of applications that fall in multiple domains are as follows:

1. Health care
2. IT industry
3. Smart homes

Let us discuss each of the domain and the applications in it in the next sections.

3.1 Health care

The consumerization of the healthcare industry is developing with such rapidity that the entire market is being recalibrated. Much of this change is the result of the revolution in data which is empowering people to live healthier lives by using connected devices such as tablets, wearables and hand-held devices. Because of IoT, consumers now have the power to take control of their own health in a highly personalized manner.

3.1.1 Elder care

The uses of IoT in elder care ranges from tracking wandering patients to monitoring the engagement and activities of elderly individuals in nursing homes and hospitals. Some of the popular applications are time driven reminders of daily activities [4]. The device sends reminder messages to wireless-enabled appliances. It takes necessary action in the lack of response. A reminder can be sent more times, after which a designated on-site personnel or a healthcare provider is notified. IoT is used by fall detector.

Figure 2: Fall detector system

The fall detector device is very small in size and can be used as a necklace pendant by the user[5]. When any incident occurs to the wearer, the device is activated and sends message and makes automated calls to the registered people with the device.

3.1.2 Patient Tracking System

The patient tracking system involves tracking healthcare objects that are readable, recognizable, locatable and controllable. These objects may be equipped with devices such as sensors, actuators, and RFID (Radio Frequency Identification) tags [6], in order to allow patients, doctors, equipments and other healthcare participants to be connected anytime and anywhere with designated person.

By tracking location of patients suffering from diseases like Alzheimer or sleep-walking, or tracking the health status of pregnant women, the doctors have information on their patients anytime and have an immediate telephonic consult if necessary. This reduces the chances of harmful incident occurrence by providing automated care and procedure auditing and medical information management.

3.2 IT industry

Machine to Machine and IoT projects follow a common technological paradigm like intelligent devices, seamlessly connected to the Internet, enable remote services and provide actionable data.

3.2.1 Data Center Asset Management

Data center assets include devices like servers, chillers, Air-Conditioners etc. These devices must run smoothly and efficiently throughout the day, month and year. Any discrepancies in these devices lead to breakdown of the websites and the whole company. Of course, there are backup servers running, but the cost, time and effort involved in getting the primary servers back on its feet is tremendous. To avoid this scenario completely, predictive maintenance through IoT is essential. This helps in monitoring the health of the devices it is attached to constantly. Therefore, if any failure is to arise in future, the IoT senses the possibility and alerts the administrator to provide a complete analysis and if need be, repair or replace the part of the device. This averts the possibility of

a potential server-down situation or any huge impact failure.

One of the widely used IoT application for data center asset management is IPMI (Intelligent Platform Management Interface)[7]. The Intelligent Platform Management Interface (IPMI) is a set of computer interface specifications for an autonomous computer subsystem that provides management and monitoring capabilities independently of the host system.

IPMI defines a set of interfaces used by system administrators for out-of-band management of computer systems and monitoring of their operation. The Baseboard Management Controller (BMC) is the heart of an IPMI-based system. It is responsible for monitoring and controlling all the manageable devices in the system.

Figure 3: Servers at a data center

The BMC contains nonvolatile RAM (NVRAM) storage for the system event logs, sensor data records, and asset information. The BMC also is responsible for sending and handling events. These events can be thresholds that have been exceeded or triggers such as chassis intrusion, temperature variation, etc.

3.2.2 Fire detection system in smart buildings

There is an immense need of implementation of automatic fire detecting system to protect lives and assets from fire hazards. Use of real-time control via the Internet or wireless network will extend the monitoring and control of fire safety systems outside of the building[8]. The status of the fire safety system and other building systems can be monitored at any time and from anywhere via the Internet or wireless network.

The fire safety systems located in many buildings will be controlled from one central facility office. This involves use of (i) a temperature sensor, which senses temperature of its surroundings and send details to a processing unit of Arduino board, (ii) a gas sensor, which detects gases that are released when there is fire in the environment which comprises of elements like carbon monoxide and carbon-di-oxide, and (iii) a microcontroller, that acts as a middleware that sends data and fire generation. All the output of the sensors are fed as an input to the microcontroller.

3.3 Smart homes

Smart home is a home that uses IoT to monitor the environment, control electric devices and for communication with outer world. The appliances are interconnected and allow the communication between them to achieve some activities. These type of house is not just able to be remotely controlled, but it will give warnings for appeared problems, will decide and action with predetermined actions for the real-world cases. Smart house represents the facts that it can be controlled from a smart phone, tablet or laptop not being necessary a remote controller for each individual device, a single mobile application managing to incorporate all the equipment and the control and monitor can be realized from anywhere[9].

The IoT integrates all applications and the intelligence behind it. The motion sensor used in the security system is integrated with the home's light control to switch off the lights and the heating when nobody is in a room. The same motion sensor, when the home security system is on, can be used to send an alarm if someone breaks in and is moving throughout the house.

Smart homes are founded on a symbiosis of applications that allow home owners to monitor and control a wide range of useful applications such as improved energy efficiency, access control, security, home monitoring and home care [10]. Most popular smart home applications are home monitoring, access control, lighting control, fire detection, energy efficiency, temperature monitoring, automated meter reading, family care, etc.

3.3.1 Google Home

Google Home is a voice-activated speaker powered by the Google Assistant [11]. The user can ask it questions or tell it to perform tasks. Just start the command with, "Ok Google" to alert the speaker that the user is giving the device a command. Google Home [12] includes home automation as a feature, enabling owners to use it to control devices as a central hub. Google has partnered with many product based companies like Nest, SmartThings, Philips Hue, and IFTTT for smart home device control with the Google Home device. Google Home can also be controlled by using its mobile application.

Figure 4: Google home speaker

With Google Home there are many categories of feature that provides wide range of applications. The main categories are:

1. Home control: Light control from anywhere within the voice command receiver's range, smart plugs to turn off the coffee maker, turn on the fan, turn on baby monitor, etc.

2. Entertainment: It includes streaming audio to multiple rooms, play music or radio, listen to news, volume control in TV or Podcasts etc.
3. Manage tasks: Set alarm, timer, shop for items from registered websites, store a shopping list, etc.
4. Planning the day: Check traffic status/updates to a destination, weather reports, flight information, etc.

Smart homes appliances are reachable to everyone these days and useful to every individual.

4. Conclusion

IoT promises to usher in a revolutionary, fully interconnected smart world, with relationships between objects and their environment and objects and people becoming more tightly intertwined. As technology advances everyday new methodologies arise with it. It is advisable to employ or update with the latest technology only it seems fit. The horizon of innovations and applications in IoT is expanding every day. IoT is applicable from a small office environment to healthcare to huge data centers and even at home.

While the potential ramifications are significant, a number of potential challenges may stand in the way of this vision particularly in the areas of security, privacy, interoperability and standards, legal, regulatory, and rights issues and the inclusion of emerging economies. Rather that focusing on potential perils, it is necessary to have informed engagement, dialogue, and collaboration across a range of stakeholders to plot the most effective ways forward.

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