PUNE INSTITUTE OF COMPUTER TECHNOLOGY

Information Technology Department

Cloud Computing Laboratory

Case Study No. : 02

Application of IOT/Ubiquitous Based on Cloud

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1. What is IoT?

- The Internet of Things (IoT) describes the network of physical objects "things" that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools. With more than 7 billion connected IoT devices today, experts are expecting this number to grow to 10 billion by 2020 and 22 billion by 2025. Oracle has a network of device partners.
- Over the past few years, IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects—kitchen appliances, cars, thermostats, baby monitors—to the internet via embedded devices, seamless communication is possible between people, processes, and things.
- By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. In this hyperconnected world, digital systems can record, monitor, and adjust each interaction between connected things. The physical world meets the digital world and they cooperate.
- The goal behind the Internet of things is to have devices that self-report in real-time, improving efficiency and bringing important information to the surface more quickly than a system depending on human intervention.

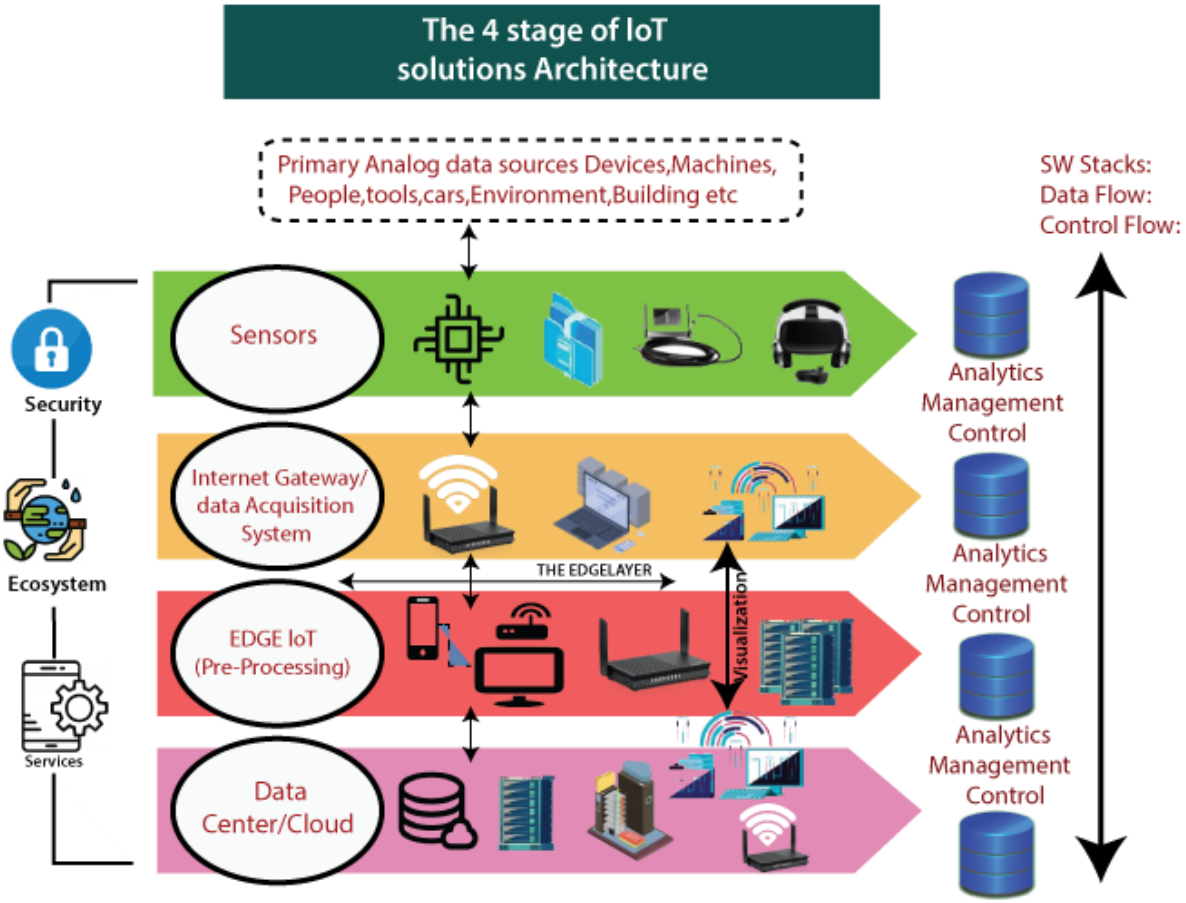
2. What is Ubiquitous system?

- Ubiquitous Computing is a term associated with the Internet of Things (IoT) and refers to the potential for connected devices and their benefits to become commonplace. Ubiquitous Computing is a term associated with the Internet of Things (IoT) and refers to the potential for connected devices and their benefits to become commonplace.
- Also called ambient computing or pervasive computing, ubiquitous computing can be described as the saturation of work, living, and transportation spaces with devices that intercommunicate.
- These embedded systems would make these settings and transportation methods considerably more enjoyable and convenient since through contextual data aggregation and application, seamless, intuitive access points, and fluid payment systems.
- A prime example of a ubiquitous computing experience would be an autonomous vehicle that recognizes its authorized passenger through smartphone proximity, docks and charges itself when needed, and handles toll, emergency response, and fast-food payments itself by communicating with infrastructure.

3. Draw necessary diagrams for both IoT and Ubiquitous systems.

a. IoT Architecture:

The stages of IoT architecture are as follows:



- **Sensing/Actuating:**
  A "thing" is an object equipped with sensors that collect data. The data transferred through the network and the actuators allow things to perform. For example, turn the light on or off, open or close the door, increase or decrease the speed of motor rotation, etc.

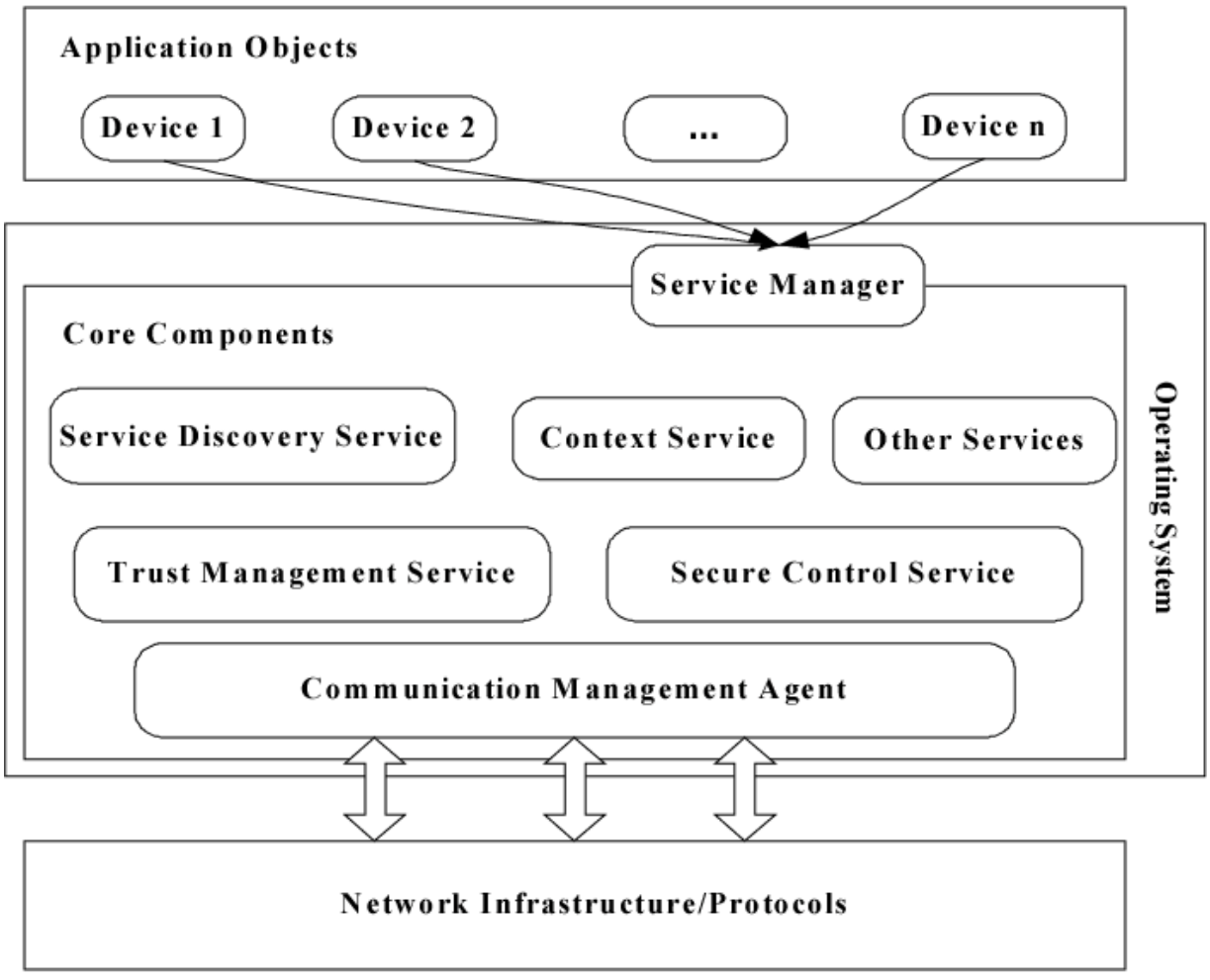
- **Data Acquisition Systems:**
  Although this stage in the IoT architecture still means working near sensors and actuators, Internet getaways and data acquisition systems also appear here. Specifically, the latest sensor network connections and general output, while Internet getaways run through Wi-Fi, wired LANs and perform additional processing. The importance of this stage is to process a large amount of information collected in the previous stage and reduce it to the optimum size for further analysis. Also, the necessary conversion in terms of time and structure occurs here.

- **Edge Analytics:**
  During this phase, between the stages of the IoT architecture, the prepared data is transferred to the world of IT. In particular, Edge IT systems perform improved analysis and pre-processing here. For example, it relates to machine learning and visualization technologies. At the same time, additional processing can take place here before the data centre entry phase.

- **Data Center/ Cloud (Analysis, management, and storage of data):**
  The main processes of the last stage of the IoT architecture take place in the data center or in the cloud. Precisely, it allows in-depth processing, as well as a follow-up review for comments. Here, the skills of IT professionals and occupational technology are needed. In other words, the phase already includes the highest-level analytical skills, both in the digital and human world. As a result, data from other sources can be included here to ensure an in-depth analysis.

b. Ubiquitous system:

The architecture for Ubiquitous system is as follows:



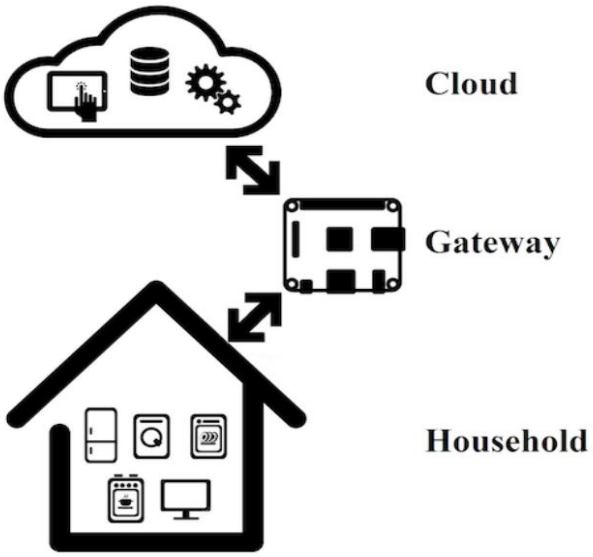
- The architecture is mainly composed of core services implemented with component and middleware technologies. The application objects can communicate with Service Manager, which is one of core components and responsible for providing invocation interfaces of various service components for application objects.
- Core components encompass several core services, as service discovery service, secure control service, trust management service, context service, communication management service, etc.
- Among the above components, communication management agent is responsible for communicating with network infrastructure or protocols, which may be frequently changeable in pervasive computing environments.
- The core components in our presented architecture make fully use of middleware technology, all the components in the architecture can be encapsulated into different types of middleware, such as service discovery middleware, context middleware, security control middleware, trust management middleware, and so on, then, theses various middleware services will be integrated to construct a complete system architecture for pervasive computing.

4. **What applications can be built using the Ubiquitous and IoT based cloud?**
   The following applications can be built using the Ubiquitous and IoT based on cloud:
   - **Healthcare:**

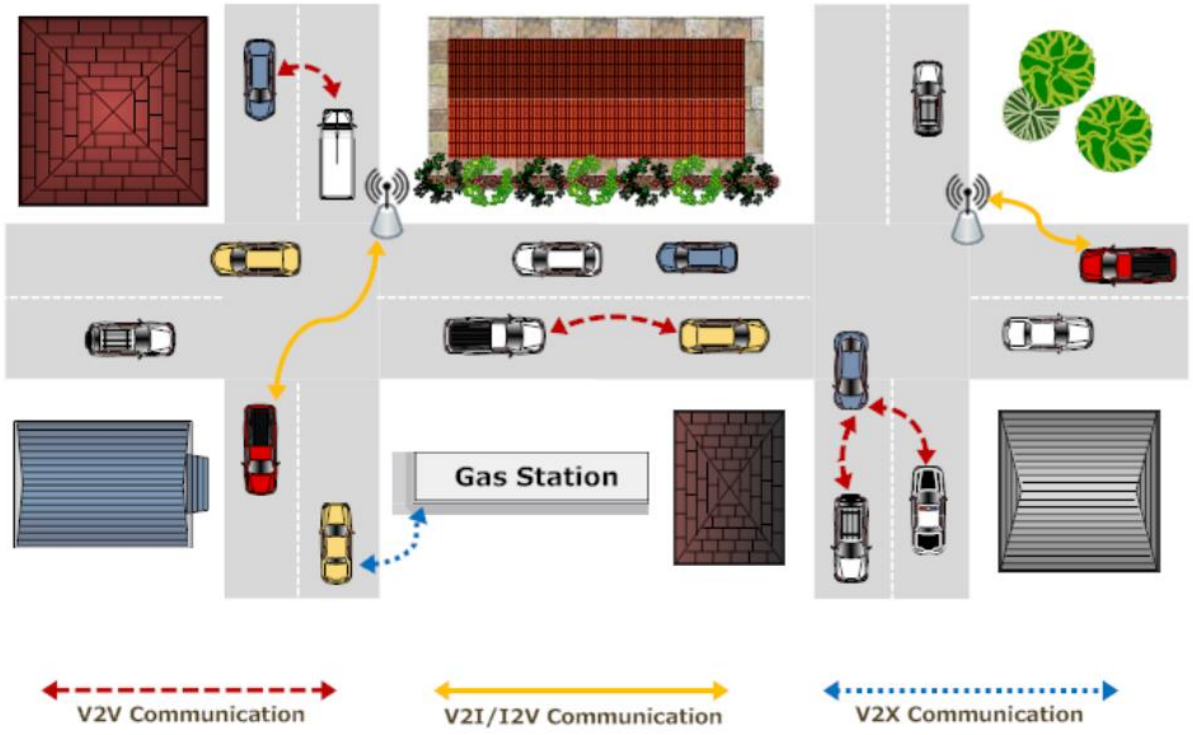
Pervasive healthcare applications utilizing body sensor networks generate a vast amount of data that need to be managed and stored for processing and future usage. Cloud computing among with the Internet of Things (IoT) concept is a new trend for efficient managing and processing of sensor data online. A platform based on Cloud Computing for management of mobile and wearable healthcare sensors, demonstrating this way the IoT paradigm applied on pervasive healthcare.

- **Home Automation:**

Cloud computing provides scalable computing power, storage space and applications, for developing, maintaining, running home services, and accessing home devices anywhere at any time. The rule-based event processing system provides the control and the orchestration of the entire advanced smart home composition and home automation system.



- **Transportation:**



With the increased capability of the cloud computing paradigm, along with the aspirations of utilizing the powerful computing resources available in smart vehicles, a new paradigm has emerged from integrating both vehicular networking and cloud computing. This emerging paradigm is known as the Vehicular Cloud (VC). Due to the promising capabilities of VCs, their architectures, features, and applications have been hot topics of research and investigation in the past few years.

- **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.

5. **Success stories as example for IoT and Ubiquitous based on cloud application with details.**

The success stories as example for IoT and Ubiquitous based on cloud application with details are as follows:

- **Azure based IIoT platform for Real-time Data Management & Analytics**:

  Headquartered in the USA, the American Instrumentation giant has grown from manufacturing a single product line of thermocouples to offering more than 100,000 state-of-the-art products. These are used for control & process measurement of temperature, pressure, humidity, force, strain, level, pH, flow and conductivity. The company builds Azure enabled IoT solution to cope-up with existing platform challenges like bi-directional communication set-up, scalability & data storage.

- **Volkswagen Uses AWS IoT to Build Industrial Cloud and Digital Ecosystem:**

  The Volkswagen Group is building its Industrial Cloud, a cloud-based digital production platform that will transform Volkswagen’s automotive manufacturing and logistics processes, on Amazon Web Services (AWS). Using AWS IoT services, the digital production platform will connect data from all machines, plants, and systems across Volkswagen's 124 factory sites to increase plant efficiency and uptime, enhance production flexibility, and improve vehicle quality.

- **Deutsche Telekom: “Cloud of Things” IoT:**
  The Deutsche Telekom “Cloud of Things” IoT platform powered by Cumulocity IoT allows enterprises to improve the reliability of globally dispersed equipment rapidly and efficiently, markedly improve product innovation and seamlessly adopt new service-based business models.

- **Cobundu smart workplace IoT platform:**
  Cobundu by Spacewell is an IoT platform designed for smart workplaces. It is capable of ingesting big data from various sources like IoT sensors and BMS and combining it with a system of records such as Axxerion or MCS Integrated Workplace Management System (IWMS) software. This combined solution enables new levels of insights made actionable in dynamic dashboards (powered by QLIK).

- **Amazon Alexa:**
  Alexa is Amazon's cloud-based voice service available on more than 100 million devices from Amazon and third-party device manufacturers. With Alexa, you can build natural voice experiences that offer customers a more intuitive way to interact with the technology they use every day.

6. Conclusion:

Hence, I understood the concepts like IoT and Ubiquitous computing along with their architecture. Also, I learnt about various cloud applications built using the Ubiquitous and IoT systems along with their success stories.