Computer Engineering for the Internet of Things

Distributed Systems and Cloud/Edge Computing for IoT

Practical Lesson 1

Riccardo Cantini

Mail: *rcantini@dimes.unical.it*
Website: *https://riccardo-cantini.netlify.app/courses/ds4iot/*

Academic year 2019/2020

TOPICS

- Smart Home
- Self-Driving Cars
- Smart City
- Smart Grid
- Body Sensor Network
- Smart Health
- Smart farming
- Industry 4.0

SMART HOME

- **Home automation** or **domotics** is about building automation for a home, called a **smart home**.

- A home automation system allows:
    - **Monitoring for home security**
        - ➢ Smart cameras and motion detectors
        - ➢ Water, fire and smoke detectors
        - ➢ Door and window monitoring sensors
    - **Monitoring for energy consumption**
        - ➢ Smart plugs and meters
    - **Smart services for comfort**
        - ➢ Lighting, climate, entertainment systems and appliances control (smart lamps, …).

- Devices in a smart home are easily controllable by remote and can act autonomously in a smart way, maybe inferring the home owner behaviour.

SELF-DRIVING CARS

- A **self-driving car**, also known as an autonomous vehicle (*AV*), is a vehicle that is capable of sensing its environment and moving safely with little or no human input.

- Such a system is characterized by:
    - **Low-latency communication**: a self-driving car must be able to take precise decisions quickly.

    - **Handling voluminous data**: embedded sensors generate a huge amount of data that needs to be processed and used for decision making.

    - **Heavy long-term processing**: data generated by the system can be classified, stored in the cloud and used for driving style analysis and system performance improving.

SMART CITY

- A **Smart city** is an urban area that uses IoT sensors to collect data, using insights gained from gathered data to manage assets, resources and services efficiently.

- This includes data collected from heterogeneous devices, processed and analyzed to monitor and manage:
  - Traffic and transportation systems
  - Power grids
  - Water supply networks
  - Waste management
  - Crime detection
  - Information systems
  - Hospitals
  - ...

SMART GRID

- A **Smart grid** is an electrical grid which includes a variety of operation and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficient resources.

- Smart grids allow for controlling the production and distribution of electricity.

- Smart grids applications can be integrated with smart home automation system, using data gathered form smart meters to analyze the power consumption trends of different groups of homes.

- A smart meter can give an estimate of how much energy will be needed in a future moment, minimizing energy trading.

BODY SENSOR NETWORK & SMART HEALTH

- A **Body Sensor Network** (BSN) is a wireless network of wearable computing devices.

- The main application of BSNs are related to the **healthcare** domain, where BSNs are used for continuous monitoring and logging vital parameters of patients suffering from chronic diseases, such as diabetes, asthma and heart attacks.

- Can alert the hospital, even before they have a heart attack, through measuring changes in their vital signs.

- Can auto inject insulin through a pump on a diabetic patient, as soon as his insulin level declines.

- Other applications of this technology include sports, military or security.

SMART FARM & AGRICULTURE 4.0

- **Smart Farm**, also known as **Precision Agriculture** (PA), is the application of different IoT technologies to agriculture.

- PA provides a decision support system for whole farm management by collecting, measuring and analyzing data gathered from the field.

- Main applications:
  - Soil preparation
  - Crop status monitoring
  - Irrigation
  - Insect and pest detection
  - Animal health status monitoring

INDUSTRY 4.0

- **Industry 4.0** refers to the use of automation and data exchange for creating a **smart factory** where machines, systems, and humans communicate with each other in order to coordinate and monitor progress along the assembly line.

- According to the **Boston Consulting Group** there are nine principal technologies that make up Industry 4.0:
  - Autonomous Robots
  - Simulation
  - Horizontal and Vertical System Integration
  - Industrial Internet of Things
  - Cybersecurity
  - Cloud
  - Additive Manufacturing
  - Big Data analytics
  - Augmented Reality
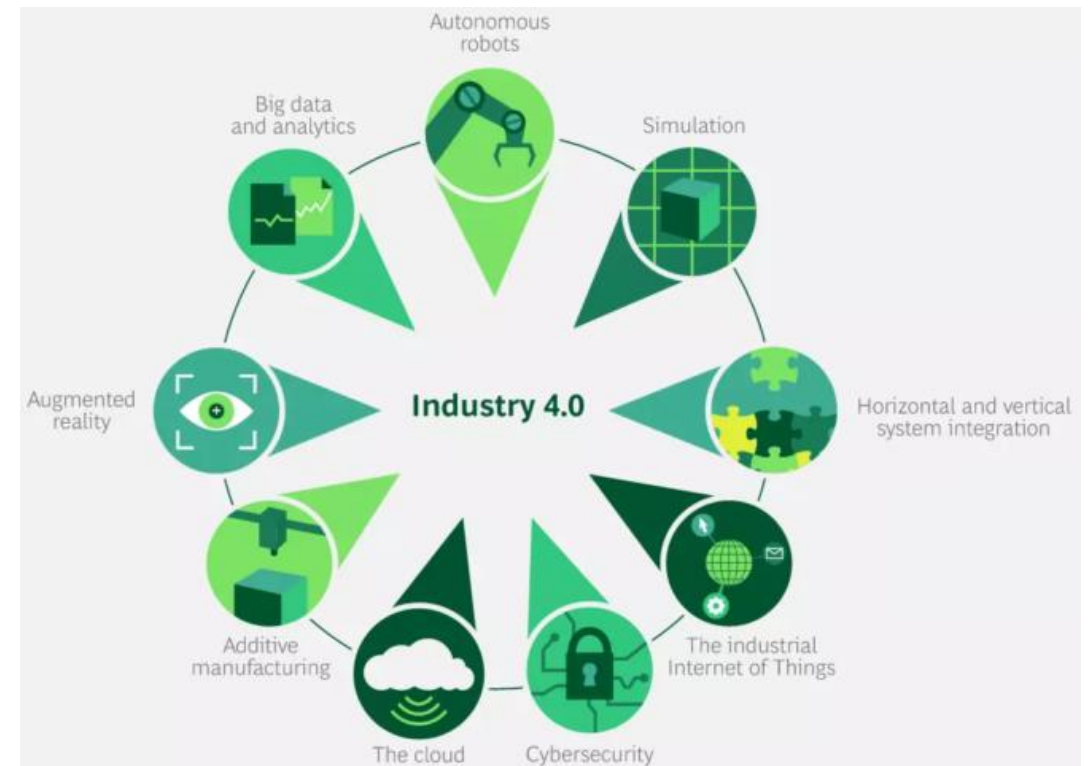
PROJECT REQUIREMENTS: MAIN STEPS

1. Study of the **state-of-art** solutions (Edge/Fog, Cloud, IoT) related to the selected topic.

2. Modeling and Simulation using **iFogSim**:
   compare different configurations selecting the best one, according to your needs;
   a comparison of the obtained results is required in terms of:

   - Latency

   - Network usage

   - Energy consumption

3. Implement some functionalities of the modeled system using frameworks provided by Eclipse IoT, focusing on different layers (e.g. client and server side MQTT-based communication using Eclipse Paho and Mosquitto respectively).

4. Write a **report** and deliver it at least <u>seven days before the exam</u>.

5. Prepare a **presentation** that will help you explain, during the exam, the work done in your project.