

Computer Engineering for the Internet of Things

Distributed Systems and Cloud/Edge Computing for IoT

Projects

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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 from 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.



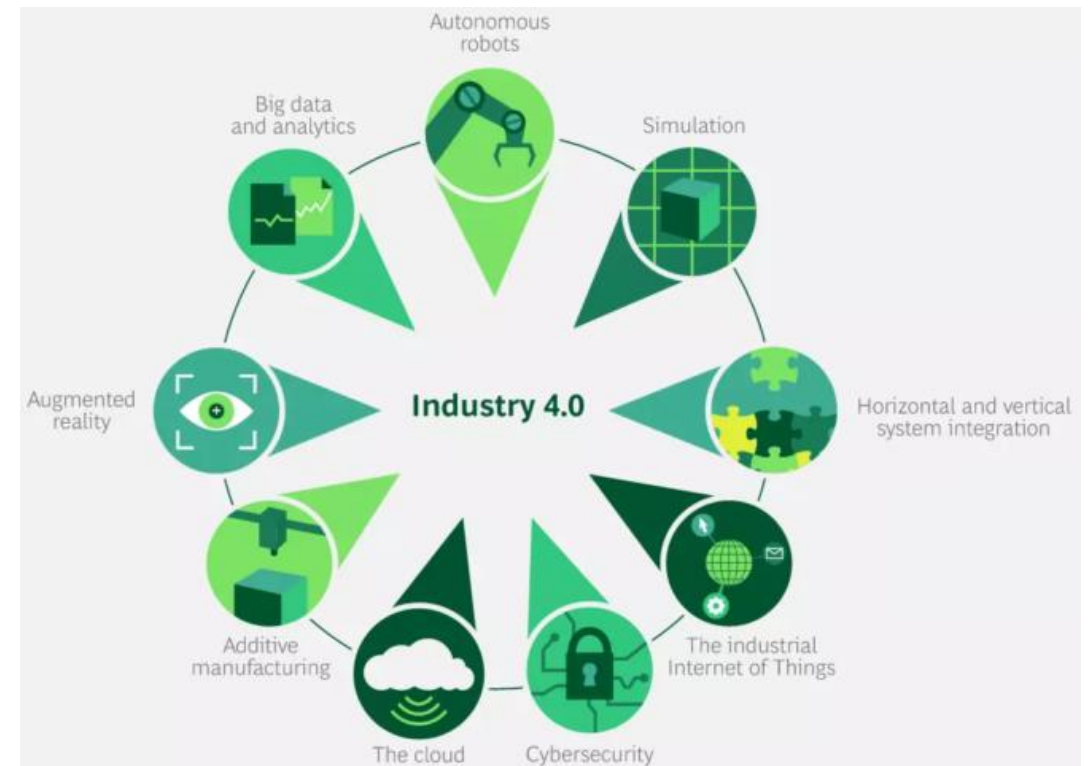
SMART FARM & AGRICULTURE 4.0

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