

Networked Embedded Systems (9 CFU)

Instructors: Giuseppe Anastasi, Francesco Marcelloni

OBJECTIVES. This course is intended to provide the theoretical background and the basic methodologies for developing networked embedded systems and applications. It enables students to design and implement applications, based on networked embedded devices, in several application domains, including smart cities, smart mobility, smart buildings, smart energy, etc.

TENTATIVE PROGRAM

PRELIMINARY CONCEPTS. Smart Environments. Networked Embedded Systems. Paradigms for pervasive communication. Infrastructure-based wireless networks. Wireless ad hoc networks. Intermittently-connected wireless networks. [8 hours]

SENSOR NODES. Physical Sensors: passive, semi-passive, and active sensors. Soft sensors. Sensor nodes. Hardware architecture. Operating systems for sensor nodes. Sensor platforms [6 hours]

WIRELESS SENSOR NETWORKS (WSNs). Architecture. Application Scenarios. The energy problem. Energy harvesting and energy conservation. Data aggregation and compression. Power management. Topology control. Networking Protocols. IEEE 802.15.4/ZigBee Standard. Wireless Sensor Networks for Critical Applications. IEEE 802.15.4e standard. [30 hours]

MOBILE SENSOR NETWORKS. Sensor networks with mobile nodes. Power Management and Mobile Node discovery. Data transfer to mobile nodes. Routing to mobile nodes. Sensor networks with *all* mobile nodes. Participatory sensing. [10 hours]

CYBER-PHYSICAL SYSTEMS (CPSs). Wireless Sensor and Actor Networks (WSAN). WSANs and CPSs. Some relevant examples (Smart Cities, Smart Buildings, Smart Grids, Intelligent Transportation Systems). WSANs and Internet of Things. [6 hours]

DATA MINING: Signal pre-processing, feature extraction, feature selection, classification models, performance evaluation. Sensor fusion. [14 hours]

CONTEXT-AWARENESS. Context. Context representation. Context detection. Context-aware applications. [6 hours]

APPLICATIONS. Applications for smart cities (pollution monitoring, smart lighting, context-aware applications), smart mobility (parking area management, intelligent transportation systems), smart buildings (home/building automation, energy efficiency). Social sensing applications. [10 hours]

REFERENCES

- Papers provided by instructors

ASSESSMENT

- oral examination + project discussion (design and implementation of an application based on networked wireless sensors/actuators).