

Course title: NETWORKED SYSTEMS DEVELOPMENT

Lecturers	Full. Prof. Neven Vrček, Ph. D. Lovro Posarić, univ. bacc. inf.
Language of instruction	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	5 th (winter)
ECTS	6
Goal	Students are to be introduced to the architectural design of IoT systems, taking in consideration user requirements and peculiarities of business systems. In order to gain hands-on experience and a better understanding of IoT devices, students will participate in extensive lectures and project work focused on creating a smart business environment.
General and specific learning outcomes	
Content	<ol style="list-style-type: none">1. Introduction to IoT systems and platforms - from low-level sensors, microcontrollers and actuators to complete IoT services, comparison of low and high-level data models2. Analysis of business and existing physical systems and user requirements - smart environment, smart factory, implementation of Internet of Things in different spheres of human activities3. Documentation and creating a manufacturing plan - modelling of application and physical products, manufacturing technologies for producing IoT products4. Networked systems security and data security - user privacy on integrated devices, security protocols for IoT, low and high-level security5. Service and data modelling for efficient communication - modelling secure and efficient data models6. Communication protocols and telemetry - real-time tracking of the state of an embedded device, defining a telemetry protocol7. Embedded device prototyping - prototyping a smaller scale model of a part of a smart factory, data collection and using Cloud services8. Prototyping of interoperable IoT systems - exploring the problem of communication between different embedded devices and systems, defining architectural constraints and data models between systems that can efficiently communicate9. IoT system interface - physical, web and mobile user interfaces, user experience and interface design, visualization of data collected by IOT services
Exercises	Prototyping a simple IoT device Consuming simple services Comparison of different communication protocols (Lora, Sigfox, WiFi, ...) and serialization formats (JSON, ProtoBufs, ...) Prototyping a small system as a part of a smart factory
Realization and examination	Classes: Lectures, workshop and laboratory exercises Examination: Midterms, a project and an oral exam

Related courses	<ol style="list-style-type: none"> 1. Embedded System Design, Faculty of Electrical Engineering, https://www.fer.unizg.hr/en/course/esd_a 2. Distributed Systems, Manchester University, http://www.cs.manchester.ac.uk/ugrad/syllabus-05-06/CS3052.php 3. Introduction to the Internet of Things and Embedded Systems, Cousera course, available at: https://www.coursera.org/specializations/iot
Literature	<p>Martin De Saulles: The Internet of Things and Business (Routledge; 1st edition (December 2016))</p> <p>Song Guo, Deze Zeng: Cyber-Physical Systems: Architecture, Security and Application (Springer; 1st edition (September 2018))</p> <p>Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner: Enabling Things to Talk: Designing IoT solutions with the IoT Architectural Reference Model (Springer; 2013 edition (October 2013))</p>