COURSE DESCRIPTION CARD - SYLLABUS

Course name
Networks and distributed control systems [S1AiR1E>PO3-SiRSS]

Course

Field of study
Automatic Control and Robotics

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
english

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Knowledge: A student starting this subject should have basic knowledge of electronics and basic programming. Skills: The student should have the ability to solve basic problems in the field of digital signal processing and the ability to obtain information from specified sources. He should also understand the need to expand his competences and be ready to cooperate in a team. Social competences: In addition, in the area of social competences, the student must exhibit such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

The aim of the course is to learn the theoretical foundations, principles of operation and possible applications of devices communicating with other objects of a distributed control system without human intervention (Machine to Machine, M2M) both wired and wirelessly through a global Internet network. The student after completing education should be able to: 1) develop a simple application for a mobile device allowing remote management of a selected item connected to the global network, 2) develop a device enabling communication with other objects on the Internet, 3) prepare the user interface for remote management of one and several objects.

Course-related learning outcomes

Knowledge:
Has a basic knowledge of the handling and use of IT tools for the design, rapid prototyping, simulation and visualisation of automation and robotics systems and for recording the design of mechanical constructions [K1_W10 (P6S_WG)].
Has a comprehensive knowledge of the structures and operating principles of analogue and discrete control systems (open-loop and feedback) and linear and simple non-linear analogue and digital controllers [K1_W16 (P6S_WG)].
Knows and understands to an advanced degree the structure and principles of operation of programmable industrial controllers, as well as their analog and digital peripheral systems; knows and understands the principle of operation of basic communication interfaces used in industrial control systems [K1_W19 (P6S_WG)].
Knows the methods, techniques, tools and materials used in solving simple engineering tasks in the field of automation and robotics [K1_W23 (P6S_WG)].
Skills:
Can determine and use models of simple electromechanical systems and selected industrial processes, and use them for analysis and design of automation and robotics systems [K1_U11 (P6S_UW)].
Be able to use selected rapid prototyping tools for automation and robotics systems [K1_U13 (P6S_UW)].
Is able to select parameters and settings of a basic industrial controller and configure and program an industrial programmable controller [K1_U18 (P6S_UW)].
Is able to evaluate the suitability of routine methods and tools for designing automation and robotics systems, and select and apply the appropriate method and tools [K1_U24 (P6S_UW)].
Be able to design and implement a local ICT network (including an industrial network) by selecting and configuring communication elements and devices (wired and wireless) [K1_U28 (P6S_UW)].
Social competences:
Is aware of the responsibility for his/her own work and is ready to follow the rules of teamwork and take responsibility for jointly implemented tasks; is able to lead a small team, set goals and determine priorities leading to the realisation of the task; is ready toto play a responsible professional role. [K1_K3 (P6S_KR)].
Is ready to prioritise in order to complete a task defined by himself or others [K1_K4 (P6S_KO)].
The graduate is aware of the need for a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which the equipment and its components can operate. The graduate is ready to observe the rules of professional ethics and to demand it from others, to respect the diversity of opinions and cultures [K1_K5 (P6S_KR)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Formative assessment:
a) in the scope of lectures:
based on answers to questions about the material discussed in previous lectures,
b) in the scope of the laboratory:
based on assessment of knowledge and understanding of current issues presented in the course of the subject.
Summative rating:
a) in the scope of lectures, verification of assumed learning outcomes is carried out by:
i. assessment of knowledge and skills demonstrated during the written test.
ii. discussion of test results,
b) in the scope of laboratory, verification of assumed learning outcomes is carried out by:
i. assessment of student's preparation for individual classes,
ii. continuous assessment, during each class (oral answers) - rewarding the increase in the ability to use known principles and methods,
iii. assessment of reports prepared partly during classes and also after their completion,
iv. development of a control and measurement system.
Obtaining additional points for activity during classes, in particular for:
i. independent construction of the electronic control and measurement system module and preparation of documentation
ii. effectiveness of applying the acquired knowledge while solving a given problem
iii. comments related to the improvement of teaching materials.

Programme content

The lecture program includes the following topics:
1. Elements and tasks of the Internet of Things application, system construction, market, development modules, programming environments. Motivation to learn. Data exchange format between systems - JSON, Restful interface.
2. Web applications with a restful interface developed in PHP.
3. Linux operating system configuration - GPIO, SPI, UART, I2C configuration.
4. Linux system - access rights, shell scripts, user creation, SSH remote access.
5. Applications for mobile devices with Restful interface.
6. Web interface structure - HTML, jQuery.
7. Web interface interaction - JS, jQuery.
8. Presentation of the web interface - CSS, Bootsrap.
9. Linux operating system configuration - CRON configuration, startup files, network settings.
10. Ethernet, IP, TCP, UDP protocols.
11. Addressing in the network - DHCP, ARP.
12. HTTP, application layer protocols, MQTT.
13. Security of network applications - TLS.
14. Mockups and application prototyping. Creating paper application mockups.
15. Summary.
The program of laboratory classes includes the following issues:
1. Organizational classes - familiarization with OHS apparatus and footnotes, introduction to the design environment. JSON data exchange format.
2. Implementation of the restful interface in PHP
3. Linux operating system configuration - GPIO, SPI, UART, I2C configuration
4. Developing an application for Linux to support GPIO, SPI, UART, I2C interfaces (preferably C language).
5. Paper user interface design.
6. Application development for Android - as a user interface.
7. Implementation of the interface for WWW - HTML, jQuey
8. Implementation of the interface for WWW - Boostrap, jQuey
9. Implementation of the web interface - charts and notifications.
10. Implementation of the C # application - as a user interface.
11. Application of signal processing algorithms to analyze signal features.
12. Development and testing of the control and measurement system.
13. Optimization of the user interface due to the refresh period.
14. System security.
15. Presentation of the final task: measurement and control system.

Teaching methods

1. Lecture: multimedia presentation illustrated with computer simulations and a real system
2. Laboratory classes: the use of single-board development modules with a set of sensors, programming environments for Internet applications

Bibliography

Basic
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2. Justin Hutchens, Skanowanie sieci z Kali Linux : receptury : bezpieczeństwo sieci w Twoich rękach!, Helion, 2015 / Justin Hutchens, Kali Linux Network Scanning Cookbook, 2014
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Additional
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3. Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. Protokoły i standardy, Wydawnictwa Komunikacji i Łączności 2008
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Breakdown of average student's workload

	Hours	ECTS
Total workload	120	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50