COURSE DESCRIPTION CARD - SYLLABUS

Course name
Designing advanced HMI and M2M interfaces

Course

Field of study
automatic control and robotics

Year/Semester
1/2

Area of study (specialization)
intelligent control systems

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	30	
Tutorials	Projects/seminars	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Knowledge: Students starting this subject should have knowledge of automation and robotics corresponding to level 6 of the Polish Qualifications Framework, in particular knowledge of programming, data structures, microprocessor systems and the basics of network communication.

Skills: The student should have the ability to solve and implement programming problems in the field of automation and robotics, as well as 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

1. Providing students with knowledge of the construction and exchange of information in real time for human-machine and machine-machine interfaces.

2. Developing students' skills to develop human-machine and machine-machine data exchange interfaces for the control and measurement system as well as their implementation and launch in a programming environment.

3. Developing in students the importance of knowledge of technology and recommendations related to the construction and programming of data exchange interfaces.

Course-related learning outcomes

Knowledge

1. The student has ordered and in-depth knowledge related to control systems and control and measurement systems; [K2_W11]

2. has basic knowledge about the life cycle of automation and robotics systems as well as control and measurement systems; [K2_W13]

Skills

1. Student is able to select and integrate elements of a specialized measurement and control system including: control unit, executive system, measurement system as well as peripheral and communication modules; [K2_U13]

2. is able to make a critical analysis of how control and robotics systems work; also has the ability to select automation systems using microprocessor controllers; [K2_U19]

3. can design improvements (improvements) in existing design solutions for automation and robotics components and systems; [K2_U20]

4. is able to design and implement a complex device, object or system taking into account non-technical aspects; [K2_U23]

Social competences

1. The student is aware of the need for a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which devices and their components can function; [K2_K4]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) in the scope of lectures:

based on homework assignments and 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 on the written credit in the form of a test

ii. discussion of passing 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 tasks prepared partly during classes and also after their completion.

Obtaining additional points for activity during classes, in particular for:

i. independent construction of a distributed control and measurement system consisting of several electronic modules with microprocessors communicating in real time 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. Determining the functional requirements of the interface. Interfaces supporting selected groups of recipients (e.g. the elderly and the disabled).

2. Modern technologies in supporting human-computer communication (voice commands, gestures). Biometric methods in the application of human-machine communication interfaces.

3. Augmented reality and HMI interfaces.

4. Analysis of biometric signals. Interface security.

5. M2M solutions.

6. Field networks and smart objects.

7. HMI development taking into account functional limitations.

8. M2M development taking into account functional limitations.

9. Designing new interfaces for innovative products / processes.

The program of laboratory classes includes:

1. Interface prototyping for specific functional restrictions.

2. Selected M2M protocols (MQTT, CoAP).

3. Selected M2M protocols (AMQP, HTTP).

4. Graphic interface template for the microprocessor system (STM32 TouchGFX).

5. Graphical interface event handling for the microprocessor system (STM32 TouchGFX).

6. Presentation of measurement data in real time (STM32 TouchGFX).

7. Processing and presentation of measurement data in real time (CMSIS-DSP and STM32 TouchGFX).

8. Restful interface of the microprocessor system (STM32, LwIP, FreeRTOS, HTTP server).

9. Responsive web interface for the microprocessor system (STM32, LwIP, FreeRTOS, HTTP client and server). Presentation of information from remote resources.

10. Processing of voice commands with available API in M2M communication.

11. Algorithms for analyzing signal properties in real time from available measurement interfaces.

12. Digital signal analysis algorithms used for speech recognition.

13. Digital signal analysis algorithms used for gesture recognition.

14. Digital signal analysis algorithms used to recognize behavior.

15. HMI and M2M performance and responsiveness.

Teaching methods

1. Lecture: presentation of creating HMI and M2M interfaces for control and measurement system, multimedia presentation illustrated with literature data and sample projects

2. Laboratory classes: the use of a microprocessor system with a touch screen and an Ethernet interface, environment for HMI design and M2M implementation

Bibliography

Basic

1. STM32F7 documentation (online)

2. TouchGFX documentation (online)

3. Interfejs API : strategia programisty, Daniel Jacobson, Greg Brail, Dan Woods, Helion, 2015.

Additional

1. Mikrokontrolery STM32 w systemach sterowania i regulacji, Maciej Szumski, BTC, 2018

2. A Model-Driven Mobile HMI Framework (MMHF) for Industrial Control Systems, 2020, https://doi.org/10.1109/ACCESS.2020.2965259

3. Designing an Adaptive Interface: Using Eye Tracking to Classify How Information Usage Changes Over Time in Partially Automated Vehicles, 2020, https://doi.org/10.1109/ACCESS.2020.2966928

4. Łuczak D., „Remote laboratory with WEB interface", Computer Applications in Electrical Engineering, Vol. 9, str. 257-268, Poznań, 2011, ISSN 1508-4248

5. Łuczak D., „DSP implementation of electric drive control system", Proc. of 8th IEEE, IET Int. Symposium on Communication Systems, Networks and Digital Signal Processing, Poznan, Poland, 18-20 July 2012, pp. 6, ISBN: 978-1-4577-1472-6.

6. Łuczak D. i inni : „Microprocessor temperature measurement system", Proc. of the 5th International Interdisciplinary Technical Conference of Young Scientists, InterTech 2012, Polska, Poznań, 16-18 maj 2012, str. 261-264, ISBN 978-83-926896-4-5.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	30	1,0

[1] delete or add other activities as appropriate