COURSE DESCRIPTION CARD - SYLLABUS

Course name

Human-robot interfaces

Course

Field of study

Automation and robotics

Year/Semester

2/4

Area of study (specialization)

Automation and robotics systems

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

Polish

Form of study

part-time

Requirements

elective

Number of hours

Lecture

12

Laboratory classes

12

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

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Prerequisites

Knowledge: The student starting this course should have knowledge of the basics of signal theory and signal and information processing.

Skills: Should have the ability to solve basic problems in the field of signal processing, computer science, information theory and the ability to obtain information from indicated sources, including the Internet and the IEEE Xplore database of scientific publications. They should also understand the need to expand their competences and be ready to cooperate in a team.

Social Competence: In addition, it should show such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. Provide students with knowledge about the methods used in human-robot interfaces and in the field of digital signal processing in vision systems.

2. Developing students' ability to solve data processing problems in human-robot interfaces.

3. Shaping students' teamwork skills and the use of software and laboratory equipment available during classes to perform specific tasks.

Course-related learning outcomes

Knowledge

1. The student possess extended and deepened knowledge of selected mathematics departments necessary to formulate and solve complex tasks in the field of control theory, optimization, modeling, identification and signal processing - [K2_W1].

2. The student possess detailed knowledge of artificial intelligence methods and their application in automation and robotics systems - [K2_W2].

3. The student possess detailed knowledge of the construction and use of advanced sensory systems - [K2_W6].

Skills

1. The tudent is able to use advanced methods of signal processing and analysis, including video signal, and to extract information from the analyzed signals - [K2_U11].

2. The student is able to integrate and program specialized robotic systems - [K2_U12].

Social competences

1. The student is aware of the responsibility for their own work and readiness to submit to the rules of teamwork and responsibility for jointly performed tasks; is able to lead a team, set goals and define priorities leading to the implementation of the task - [K2_K3].

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 answers to questions about the material discussed in previous lectures

b) in the scope of laboratories, assesment of the assumed learning outcomes is based on:

i. assessment of student's preparation for individual sessions of laboratory classes ("entrance" test)and assessment of skills related to the implementation of laboratory exercises,

ii. continuous assessment, during each class (oral answers) -rewarding the increase in the ability to use known principles and methods,

iii. assessment of the laboratory reports prepared partly during the classes and partly at home; this assessment also includes teamwork skills.

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

i. discuss of additional aspects of the issue,

ii. effectiveness of applying the acquired knowledge while solving a given problem,

iii. ability to work as part of a team that practically performs a specific task in the laboratory,

iv. comments related to the improvement of teaching materials,

v. indicating students' perceptive difficulties enabling ongoing improvement of the didactic process.

Summative assessment:

a) in the scope of lectures the verification of the assumed learning outcomes is carried out by:

i. assessment of the knowledge and skills shown in the exam - written work containing problem questions and written calculation tasks; getting 50% of the number of total points give a positive rating, the questions are a detailed version of the issues made available to students in order to prepare for the exam,

ii. discussion about exam results,

b) in the scope of laboratories , it is a resultant assessment resulting from the formative assessments.

Programme content

The lecture covers the following topics:

1. Modern converters of information signals: converters used for human-machine communication - from a microphone, through an image converter, to three-dimensional scanners.

2. Artificial intelligence algorithms: algorithms processing information signals from transducers, formulation of the feature vector, dimensionality reduction (selection, extraction); machine learning, data classification.

3. Speech as a communication signal: methods of speech signal representation, classification algorithms allowing for the identification of the speaker or for speech recognition.

4. Image as information about the robot's surroundings: signal processing algorithms from the image sensor, face recognition, recognition and tracking of moving objects.

5. Gestures as communication signals: recognition of visual gestures used to control the robot.

6. Hardware circuits for signal processing: platforms with microcontrollers and signal processors, allowing the implementation of information signal processing algorithms.

Laboratory classes are conducted in the form of 2-hour exercises in the laboratory. Exercises are carried out by teams of 2/3 people.

Laboratory exercises topics:

1. Stereovision interfaces for image acquisition and visualization - methods of acquisition of stereoscopic images, methods of viewing of three-dimensional images, creating a three-dimensional image visualization based on stereoscopic images, evoking a three-dimensional impression as a result of image processing.

2. Stereovision interfaces based on the calculation of the robot's distance to objects - image depth map, creating three-dimensional images based on a depth map, the relationship between the distance to the object and the shift of image views, 2D to 3D conversion, the mechanism of formation of information gaps and information redundancy in the image, filling information gaps in the image.

3. Use of one-dimensional barcodes in human-robot interfaces - existing barcode systems, the use of barcodes, analysis of information content in barcodes, problems with barcode reading, EAN-13 barcode, barcode correctness verification, Matlab test program for processing EAN-13 code.

4. Application of two-dimensional barcodes in human-robot interfaces - QR codes, methods of QR code detection, processing of two-dimensional barcodes with the use of image processing methods.

5. Automation systems in human-robot interfaces - simulation of chosen automation systems in human-robot interfaces, chosen problems and methods used in human-robot interfaces.

6. Stereovision system for recognition of the details of images - demonstration and summary of the classes.

Teaching methods

1. Lecture: multimedia presentation, presentation illustrated with examples given on the board, solving problems

2. Laboratory classes: problem solving, practical exercises, conducting experiments, case studies, teamwork

Bibliography

Basic

1. Marcin Sikorski, Interakcja człowiek-komputer. Polsko-Japońska Wyższa Szkoła Technik Komputerowych

Additional

1. Simon T. Machine, Vision and Human-machine Interface: Technologies, Applications and Challenges.

2. Jean-Philippe Thiran, Ferran Marques, Herve Bourlard, Multimodal Signal Processing. Theory and Applications for Human-Computer Interactions, Elsevier Ltd. 2010

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	26	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	24	1

[1] delete or add other activities as appropriate