COURSE DESCRIPTION CARD - SYLLABUS

Course name

Smart systems with video feedback

Course

Field of study

Automation and robotics

Year/Semester

2/3

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

compulsory

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:

Damian Cetnarowicz, PhD. Eng.

email: damian.cetnarowicz@put.poznan.pl

phone: 61 647 5935

Faculty of Control, Robotics and Electrical Engineering

ul.Piotrowo 3a, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

Knowledge: The student starting this course should have basic knowledge of image processing and visual sequences and know the basic concepts of high-level programming.

Skills: Should have the ability to solve basic problems in the field of implementation of vision algorithms and the selection of parameters, as well as the ability to obtain information from the indicated sources. It should also be ready to work as 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 of vision algorithms for the implementation of industrial vision inspection systems.

2. Provide students with knowledge of the systems with visual feedback in terms of their design and implementation.

3. Developing students' skills in solving problems related to the selection of appropriate parameters, programming methods and equipment for the implementation of vision systems.

4. Shaping students' teamwork skills.

Course-related learning outcomes

Knowledge

1. The student possess specialist knowledge in the field of real-time systems using visual feedback - [K2_W3].

2. The student understands the methodology of designing specialized analog and digital electronic systems - [K2_W4].

3. The student knows and understands the principles of designing automation systems with visual feedback, has the knowledge necessary to implement automation systems with visual feedback.

Skills

1. The Student is able to integrate and program specialized robotic systems using visual feedback - [K2_U12].

2. The student is able to make a critical analysis of the operation of control systems and robotics systems; also has the ability to select automation systems with the use of programmable controllers - [K2_U19].

3. The student is able to identify elements and control systems and formulate a design specification of a complex control system, taking into account non-technical aspects - [K2_U21].

4. The Student is able to design and program a laboratory system with visual feedback.

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; can 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. Construction of a system with visual coupling: intelligent camera, programmable image processing module, programmable control module; discussion of existing solutions and development trends; construction of an intelligent camera - image converter CCD, CMOS, digital image representation, data processing processor, program, communication interface, input / output lines, lens, illuminator; use of intelligent cameras (automatic control, detection of defects and shortages, non-contact measurements, sorting, robot vision systems, code reading, OCR, biometrics, sensor networks, surveillance systems).

Light and its properties, photometric quantities: basic knowledge of geometric optics, image converters, lenses, filters, exposure time; basics of machine vision - morphological operations, detection of edges or other objects, comparison with a pattern by using the intensity or detected edges, length measurements, 3D images, 3D scanners; 3D scanner using structured light - operating principle, triangulation, calibration, distortion correction, measurement accuracy.

2. System with video coupling - NI Vision Assistant as an example: system features, installation, programming of image processing and control, use of NI LabVIEW VI or C language; NI LabVIEW graphical programming environment - vi implementation, data acquisition, modular applications, event programming, typical program diagrams, user interface, communication interface support, built-in functions.

3. Integration of the intelligent camera with the PLC controller: CPU central unit, discrete input module, discrete output module, analog input module, analog output module, high-speed counter, communication ports; protocols and communication networks - RS232, RS485, Modbus, Ethernet, Profibus, CANOpen, GSM / GPRS.

4. Programming languages according to IEC61131-1 standard, ladder LAD programming language: data types, relay functions, counters, arithmetic functions, relation functions, functions on bit sequences, conversion functions, control functions, PID function block.

5. The system supervising the course of the technological or production process: SCADA, distributed PLC control, telemetry, HMI, data logging; overview of selected SCADA systems; overview of PLC controllers from various manufacturers - ABB, Allen-Bradley, Fatek, GeFanuc, Honeywell, Kinco, Mitsubishi, Moeller Electric, Omron, Panasonic, Schneider Electric (Modicon), Siemens (Simatic), Unitronics, Vipa, LG.

6. Control of an induction motor by a PLC connected to the inverter: connection diagram, configuration of available parameters; using the PID controller to control the motor. Temperature control in a model real system by means of a PLC: hardware and software configuration related to the temperature sensor and the executive system; use of the PID controller.

Laboratory classes are conducted in the form of 2-hour exercises in the laboratory. Individual exercises are performed by teams of 2/3 people.

Laboratory exercises topics:

1. Introduction to the TIA Portal environment: getting to know the structure of the program window, configuration of the Simatic s7-1200 controller and creating a new project; an introduction to LAD programming.

2. Types of variables and data blocks: getting to know the types of variables supported by the Simatic s7-1200 controller, local and global variables, controller inputs and outputs, variable addressing; creating, configuring and using DB data blocks.

3. Functions and function blocks: getting to know the types of program blocks supported by the Simatic s7-1200 controller; OB organization blocks (organization block), FB function blocks (function block), FC functions (function).

4. Adding the operator panel to the project: configuration of communication between the controller and the HMI KTP600 Basic Color panel, programming of the panel screens.

5. Configuration of the Ethernet connection between two controllers: PROFINET protocol; IP addressing and subnet configuration.

6. Automatic vision inspection part 1: hardware configuration of the Keyence IV-500C vision sensor; getting acquainted with the vision inspection tools supported by the sensor, getting acquainted with the properties of the Position, Area, Color tools; implementation of test vision inspections.

7. Automatic video inspection part 2: independent implementation of a complex video inspection; integration of the operator panel, controller and vision sensor; consolidation and integration of acquired skills.

8. PID controller testing: selection of PID controller parameters with the use of the Siemens algorithm.

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. Kwaśniewski J., Sterowniki SIMATIC S7-1200 w praktyce inżynierskiej, Wyd. BTC, Legionowo 2013

Additional

1. Bogdan Broel-Plater, Układy wykorzystujące sterowniki PLC. Projektowanie algorytmów sterowania, Wydawnictwo PWN SA, Warszawa 2008

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	25	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	25	1

[1] delete or add other activities as appropriate