COURSE DESCRIPTION CARD - SYLLABUS

Course name
Internet of Things in Monitoring and Visualization of Processes

Course

Field of study
Computing

Year/Semester
1/2

Area of study (specialization)
Internet of Things

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

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

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
dr inż. Mariusz Nowak
e-mail: Mariusz.Nowak@put.poznan.pl
tel. (061) 665-2921
Faculty of Computing and Telecommunications
ul. Piotrowo 3, 60-965 Poznań

Responsible for the course/lecturer:
prof. dr hab. inż. Andrzej Urbaniak
e-mail: Andrzej.Urbaniak@put.poznan.pl
tel. (061) 665-2905
Faculty of Computing and Telecommunications
ul. Piotrowo 3, 60-965 Poznań

Prerequisites

A student who begins classes in the subject of Internet of Things in Monitoring and Visualization of Processes should have knowledge of the basics of automation, embedded systems and intelligent control systems. He should also have the ability to obtain information from indicated sources and be ready to cooperate within the team.

Course objective

The aim of this course is to present basic knowledge about the design and operation of systems that use the Internet of Objects to monitor and visualize objects and processes and to familiarize students with the software of monitoring and process visualization systems. The course also aims to develop students' skills in solving problems arising during the operation of systems for monitoring and visualization of processes using IoT.

Course-related learning outcomes

Knowledge

1. has an orderly, theoretically based general knowledge of algorithms and complexity, computer system architecture, operating systems, network technologies, graphics and human-computer communication, artificial intelligence, databases, decision support,

2. has advanced knowledge in: visual programming, real-time operating systems, artificial intelligence, embedded systems,

3. has knowledge of development trends and the most important new developments in IT and selected related scientific disciplines and fields such as automation, control theory, SCADA systems,

4. has detailed knowledge about the life cycle of IT systems in the field of monitoring and visualization of processes - hardware and software,

5. is familiar with advanced methods, techniques and tools used in solving complex engineering tasks and conducting research in the area of process monitoring and visualization in the field of: industrial database design, industrial network configuration, real-time operating system configuration.

Skills

1. is able to acquire knowledge about monitoring and visualization systems from literature and scientific articles, is able to critically evaluate knowledge and draw conclusions,

2. is able to use analytical, simulation and experimental methods known from numerical and automation methods to formulate and solve engineering tasks and simple research problems,

3. is able to integrate knowledge from different areas of computer science (and, if necessary, knowledge from other scientific disciplines, such as automation) and apply a system approach, including non-technical aspects, when formulating and solving engineering tasks,

4. is able to assess the usefulness and possibility of using new achievements (methods and tools) and new IT products in the field of computer process monitoring and visualization systems,

5. is able to cooperate in a team during the design and programming of a process monitoring and visualization system, assuming different roles during teamwork,

6. is able to determine the directions of further learning in order to acquire new knowledge about data acquisition systems and visualization of measurement data.

Social competences

1. understands that in computer science, knowledge and skills quickly become obsolete,

2. understands the importance of using the latest IT knowledge to solve problems related to the construction of modern process monitoring and visualization systems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by the colloquium realized during the last lecture. The colloquium consists of 5 open questions. The threshold is 50%. The credit issues on the basis of which the questions are prepared will be embedded on the lecturer's website at least one week in advance.

The skills acquired during the laboratory classes are verified on the basis of a report presenting the developed system of monitoring and visualization of the selected process using IoT. The report is prepared according to the diagram provided by the lecturer. The given scheme organizes the rules of assessment.

Programme content

The lecture program includes the following issues: Properties of human perception system. Ways and examples of presentation of the state of control objects and executive devices and the process flow using commercial and open source tools. Principles of designing systems for monitoring and process visualization - principles of synoptic screen configuration, construction and hardware configuration and communication channels. Industrial communication protocols. Structures of monitoring and visualization systems. Methodology of designing process operator interface. Principles of operator panels configuration - basic objects to operate the system, graphic objects, objects providing information, object properties, signaling alarm states, tag configuration. Technical means of monitoring and control - construction and principles of operation: operator panels, touch screens Software for process monitoring and visualization systems. Application of multimedia techniques and virtual reality to the construction of industrial process monitoring and visualization systems. Systems supporting industrial process operators. Scattered monitoring and visualization systems. Review of process monitoring and visualization systems - the most popular SCADA systems - commercial environments: WinCC, InTouch, Proficy iFix, Asix, Citect, FactoryTalk. The process of designing a monitoring and visualization system for use in such areas as: environmental protection, environmental engineering, environmental restoration, intelligent buildings, production process supervision systems, security engineering systems. Distributed control, monitoring and visualization system SIMATIC PCS 7. OPC server. Security of network process monitoring and visualization systems. Remote access to the monitored process from mobile devices. Using IoT and IIoT for process monitoring and visualization. Cloud computing.

Laboratory classes are conducted in the form of fifteen 2-hour meetings, with a 1-hour instructional session at the beginning of the semester. Laboratory exercises are carried out by 2 ,3-person teams of students. The laboratory classes program includes the following issues, to be chosen by the student group: object/process identification (e.g.: flow-level, flow-temperature, flow-pressure). Design of control algorithms (manual/automatic work). Design of synoptic screens. Implementation of control algorithms on PLCs. Implementation of a synoptic screen on a touch panel (industrial computer) or PC class computer. Verification and validation of the developed control, monitoring and visualization systems. Identification of objects and executive devices in the production line model. Design of control algorithms (manual/automatic operation) of the production line. Design of synoptic screens. Implementation of control algorithms on PLCs in master-slave configuration. Implementation of synoptic

screens on touch panels (industrial computer) or PC class computer and on mobile devices. Performing the process of verification and validation of the developed control systems, monitoring and visualization of the production line model for mobile devices. Design of a monitoring and visualization system for measurement data using a single-platform computer and cloud computing.

Teaching methods

Lecture: multimedia presentation, multimedia show, demonstration of monitoring and visualization system operation.

Laboratory classes: performing experiments, teamwork, workshops, demonstration of developed systems for monitoring and visualization of processes and objects that are equipped in the laboratory of computer control systems.

Bibliography

Basic

1. Graficzne, zintegrowane środowiska programowe do projektowania komputerowych systemów pomiarowo-kontrolnych, Nowak J., Stanik S., Winiecki W., Mikom, Warszawa, 2001

2. Podstawy programowania systemów SCADA, Jakuszewski R., Wyd. Pracownia komputerowa Jacka Skalmierskiego, Gliwice, 2009

3. Programowanie systemów SCADA, Jakuszewski R., Wyd. Pracownia komputerowa Jacka Skalmierskiego, Gliwice, 2006

4. Programowanie paneli operatorskich, Kamiński K., Wyd. Gryf, Gdańsk, 2007

Additional

1. Programowanie systemów SCADA Proficy HMI/SCADA ? iFIX 4.0 PL, Jakuszewski J., Wyd. Pracownia komputerowa Jacka Skalmierskiego, Gliwice, 2008

2. Zagadnienia zaawansowane programowania systemów SCADA, Jakuszewski R., Wyd. Pracownia komputerowa Jacka Skal-mierskiego, Gliwice, 2009

3. Nowak M., Innowacyjne rozwiązania informatyczne wspomagające systemy sterowania, monitorowania i wizualizacji w inżynierii środowiska, [w:] Zaopatrzenie w wodę, jakość i ochrona wód, Zbysław Dymaczewski, Joanna Jeż-Walkowiak, Mariusz Nowak, Andrzej Urbaniak (red.), Wyd. PZiTS O/Wielkopolski, ISBN 978-83-64959-04-2, Poznań, Polska 2018 r., (233-244)

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	40	1,5

[1] delete or add other activities as appropriate