COURSE DESCRIPTION CARD - SYLLABUS

Course name
Multimedia and biometric technologies for the Internet of Things [S2Inf1-IP>TMIB]

Course

Field of study
Computing

Year/Semester
2/3

Area of study (specialization)
Internet of Things

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student starting this course should have basic knowledge in programming platforms and data analysis. Should have the ability to design and implement computer programs. He should be able to obtain information from the indicated sources (also in English). He should be ready to cooperate as a member of the team. Moreover, in terms of social competences, the student must present such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture and respect for other people.

Course objective

1. Providing students with an extended knowledge of computer systems, in the context of biometrics and multimedia systems, especially in the context of the Internet of Things. 2. Developing students" skills in solving problems related to the implementation of tasks linked with biometric technologies and understanding the operation of multimedia systems

Course-related learning outcomes

Knowledge:
the student has advanced and in-depth knowledge of broadly understood it systems, including multimedia, theoretical foundations for their construction and methods, tools and programming

environments used to implement them.
the student has structured, theoretically founded general knowledge in the field of computer systems applying multimedia and biometric techniques.
the student has the theoretically founded, detailed knowledge of selected issues in the field of computer science, such as: analysis, classification and compression of multimedia (biometric) data, e.g. speech signals.
the student has advanced detailed knowledge of selected issues in the field of biometrics.
the student knows advanced methods, techniques and tools for solving complex engineering tasks and conducting research in the field of multimedia and biometric techniques.
the student has advanced and detailed knowledge of the life cycle processes of rapidly developing multimedia systems.
the student has knowledge of the codes of ethics in research work in the field of biometric systems.

Skills:
the student can assess the usefulness of new achievements (methods and tools) and new it products.
the student can - when formulating and solving engineering tasks - integrate knowledge from various areas of computer science (and, if necessary, also knowledge from other scientific disciplines) and apply a systemic approach, also taking into account non-technical aspects.
the student is able to use experimental methods to formulate and solve engineering tasks and simple research problems.
the student is able to draw information from literature, databases and other sources (in the mother tongue and in english), integrate it, interpret and critically evaluate, draw conclusions, formulate and exhaustively justify opinions.
the student is able to solve complex it tasks using, among others, conceptually new methods including research tasks.
the student is able to define directions of further learning and implement the process of self-education.
the student is able to interact in a team, playing various roles.

Social competences:
the student understands the importance of the latest achievements in the field of security of information systems and the internet of things.
the student understands that knowledge and skills in computer science become obsolete in a short time.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomespresented above are verified as follows:
Formative assessment:
a) lectures
- on the basis of answers to questions about the material discussed in previous lectures,
b) laboratories
- on the basis of the current progress assessment and the results of tasks performed.
Summative assessment:
a) lectures
Verification of the assumed learning outcomes is carried out by:
- the assessment of the knowledge and skills demonstrated in the problem-based written test. The test consists of about 5-7 questions. Each question requires a good knowledge of the material and problem-solving skills. There is a requirement to obtain at least 50% of the pool of points. The test is summarizing and is scheduled at the end of the semester (13th or 14th week)
- discussion of the results of the test.
b) laboratories:
the verification of the assumed learning outcomes is carried out by:
- the assessment of answers to ad-hoc questions during lab sessions; the implementation of two projects on human recognition based on two different modalities; defense of the report documenting the implementation of the project,
Obtaining additional points for activity during classes is possible for:
- the discussion of additional aspects of the issue,
- the effectiveness of applying the acquired knowledge while solving a given problem,
- the ability to cooperate within a team practicallyperforming a detailed task,

-making remarks indicating the possibility of the improvement of teaching materials,
- identifying students" perceptual difficulties enabling ongoing improvement of the teaching process.

Programme content

Lectures:
The lecture program covers the following topics:
1. Introduction to multimedia technologies: review of fundamentals of 1D /2D digital signal processing , signal representation in time and frequency domains, the concept of content based descriptors, data similarity and classification; their application in biometric techniques.
2. Analysis and parametric representation of the speech signal as one of the biometric modalities; methods of speaker recognition.
3. Calculating the similarity of time series - DTW algorithm
4. MPEG7 audio standard as a reference approach to audio parameterization and retrieval
5. Lossy image compression - JPEG and JPEG 2000 standards
6. Moving image compression - the evolution of standards, H.264 and H.265
7. MPEG 7 image standard - reference approach to image description retrieval.
8. Lossless compression algorithms
9. Evolution of biometric systems - review of modalities
10. Characteristics of selected modalities: fingerprints, iris, hand, blood vessels, ear, face, steps, DNA.
11. Multimodal biometric systems, biometrics and the Internet of Things.
12. Compressive sensing.
13. New trends in multimedia and biometric techniques. Ethical issues related to their usage.
Lab sessions:
The laboratory program includes in-depth analysis of issues discussed during the lectures. There are exercises related to the analysis, compression, classification and search for sound signals and images. In addition, the students implement and defend two projects related to two biometric modalities.

Course topics

The course covers the fundamentals of multimedia and biometric technologies, including the analysis and representation of 1D and 2D signals, methods for speech signal parameterization and speaker recognition, time-series comparison algorithms (DTW), standards for audio, image, and video compression (mp3, JPEG, JPEG 2000, H.264, H.265), and image description techniques (MPEG7). It also explores the evolution of biometric systems, their modalities (fingerprints, iris, face, gait, DNA), multimodal solutions, and the application of biometrics in the Internet of Things (IoT).

Teaching methods

Lecture: multimedia presentation, illustrated with examples given on the board.
Laboratory exercises: a multimedia presentation, illustrated with examples given on the blackboard and carrying out the tasks given by the teacher - practical exercises.

Bibliography

Basic
1. Wybrane zagadnienia biometrii, K. Ślot, WKŁ, 2008
2. Cyfrowe przetwarzanie sygnałów w telekomunikacji : podstawy, multimedia, transmisja / red. nauk./ Tomasz P. Zieliński oraz Przemysław Korohoda, Roman Rumian, PWN 2014.
3. Obraz cyfrowy. Reprezentacja, kompresja, podstawy przetwarzania. Standardy JPEG i MPEG. Domański M., WKŁ, Warszawa 2010.
4. IET Biometrics (Journal), IEEEXplore DL
Additional
1. Kompresja danych – wprowadzenie, K.Sayood, Wydawnictwo RM, Warszawa 2002
2. Biometria, R.M. Bolle, J.H. Connel, S. Pankanti, R.N. Ratha, A.W. Senior, WNT, 2008

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,00
Classes requiring direct contact with the teacher	50	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	10	0,50