GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Virtual Reality, PG_00063900		
Field of study	Informatics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Intelligent Interactive Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Jacek Lebiedź	
	Teachers	dr inż. Jacek Lebiedź	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	15.0	0.0	60

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	8.0	32.0	100

Subject objectives

The purpose of education is to acquire the skills to design and implementation of virtual reality systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study	The student knows and understands the rapid processes of moral obsolescence of virtual reality equipment.	[SW1] Assessment of factual knowledge
[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science	Student manages multimedia data, selects the model visualized object and image generation method, uses specialized libraries for data processing and visualization	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	Student is able to design and implement software to support a selected virtual reality device (eg VR goggles)	[SU1] Assessment of task fulfilment

Subject contents	Course content – lecture 1. Rules of credit for a course, bibliography 2. Basic concepts: virtual reality (VR), telepresence, augmented reality 3. Three I's – features of VR: interaction, immersion, imagination 4. History of early VR – devices without interaction: Sensorama, head-mounted television 5. First chronological devices with three I's: HMDs, Virtual cockpit, VIVED, Aspen Movie Map 6. Early gloves and haptic displays 7. Other historical VR devices: Videoplace, LEEP Optical System, BOOM 8. Cave Automatic Virtual Environment (CAVE), PDC Cube 9. State of the art of VR devices, future of VR devices 10. VR system architecture – VR engine and input/ output devices 11. Interaction – input devices of VR, tracking of six degrees of freedom (x, y, z, yaw, pitch, and roll), tracking performance parameters 12. Trackers: mechanical, magnetic, ultrasonic 13. Trackers: optical, hybrid inertial 14. Navigation/manipulation interface: tracker based interface, trackballs, 3D probes 15. Gesture interface – sensing gloves, sensor types: electrical, fiber-optic, capacitive, strain gauge 16. Immersion – output devices of VR, human visual system, human auditory system, human haptic system 17. Personal graphics displays: head-mounted displays, face-mounted displays, hand-supported displays, floor-supported displays, desk-supported displays, autostereoscopic monitors, virtual retinal displays 18. Monitor-based large-volume displays, projector-based displays, workbench displays 19. Sound displays, 3D virtual sound, head-related transfer function HRTF 20. Haptic feedback, tactile feedback interfaces: tactile mice, vibrotactile feedback gloves, temperature feedback gloves 21. Force feedback interfaces: force feedback joysticks, haptic arms, force feedback gloves 22. Virtual studio – bluescreen (blue box) technique, chroma and distance keying 23. Generating shadows of the virtual objects on the real scene, generating shadows of the real objects on the virtual scene 24. Other special effects used in the film, television, and entertainment industry 25. Physical interactive simulation – simulators of vehicles: flight simulators, marine simulators, train simulators; other simulators 26. History of simulation 27. Modeling for simulation: physical, mathematical, and numerical model; collision detection, interaction with other objects 28. Physical model for simple example – simplified equations of ship motion 29. Analytical solution of simplified equations of ship motion – conclusions 30. Real physical model for ship motion – equations of motion: force of gravity, buoyancy force, driving force, drag forces 31. Real physical model for ship motion – virtual mass, sea surface waves, power transmission system model, control system model 32. Real physical model for airplane flight – equations of motion: force of gravity, aerodynamic lift, driving force, drag forces 33. Real physical model for airplane flight – power transmission system model, control system model 34. Modeling of natural phenomena: fire, smoke, water, rain, fog 35. Modeling of living organisms: plants, animals, people 36. Behavior modeling, artificial life 37. VR in arts, artistic installation using virtual reality and augmented reality, virtual galleries 38. Reconstruction of historical objects or events with using of augmented reality (AR) 39. Other examples of AR applications 40. Medical applications of VR and AR – examples 41. VR and AR in education, arts, and entertainment – examples 42. Military VR and AR applications – examples, wearable computer systems 43. Social impact of VR, influence of VR on human behavior, interpersonal communication, and cognition (virtual genetics) 44. User's performance during VR simulations – influence of interaction techniques, system characteristics and responsiveness, multimodality 45. Health – direct effects of VR simulations on users, cybersickness, adaptation and aftereffects
Prerequisites and co-requisites	No requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Practical exercise	60.0%	33.0%
Project	60.0%	33.0%
Written exam	53.0%	34.0%

Recommended reading

Basic literature	1. O. Bimber, R. Raskar: Spatial Augmented Reality, Merging Real and Virtual Worlds. A. K. Peters Ltd 2005. 2. G. C. Burdea, P. Coiffet: Virtual Reality Technology (Second Edition). Wiley-Interscience 2003. 3. Riener R., Harders M.: Virtual Reality in Medicine. Springer-Verlag London 2012. 4. W. R. Sherman, A. B. Craig: Understanding Virtual Reality: Interface, Application, and Design. Morgan Kaufmann, San Francisco 2003.
Supplementary literature	1. M. DeLoura: Perełki programowania gier. Tom 1 i 2. Vademecum profesjonalisty. Helion 2002. 2. J. D. Foley, A. van Dam, S. K. Feiner, J. F. Hughes: Computer Graphics: Principles and Practice, Second Edition. Addison-Wesley, Reading 1990. 3. M. Harders: Surgical Scene Generation for Virtual Reality-Based Training in Medicine. Springer-Verlag 2008. 4. J. Sanchez, M. Canton: Direct 3D - Programowanie grafiki trójwymiarowej w DirectX. Biblia. Wydawnictwo Helion 2000. 5. R. S. Wright jr, M. Sweet: OpenGL. Księga eksperta. Helion 1999.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. Project and implementation of the vehicle simulator based on the steering wheel and a set of 3 monitors. 2. Project and implementation of the walk simulator based on cybernetic helmet and joystick.
Practical activites within the subject	Not applicable

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