GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

| | | | |
|---|---|---|---|
| Subject name and code | Virtual Reality, PG_00058860 | | |
| Field of study | Informatics, Biomedical Engineering, Biomedical Engineering, Biomedical Engineering | | |
| Date of commencement of studies | February 2023 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-cycle studies | Subject group | Optional subject group<br>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 | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Jacek Lebiedź | |
| | Teachers | mgr inż. Jerzy Redlarski<br>dr inż. Jacek Lebiedź | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 15.0 | 0.0 | 15.0 | 15.0 | 0.0 | 45 |

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 | 45 | 8.0 | 47.0 | 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_W06] Knows and understands, to an increased extent, the basic processes taking place in the life cycle of devices, facilities and technical systems. | Student knows and understands the processes associated with the rapid technological changes, where fully functional virtual reality hardware or software no longer meets the current standards of use (so-called moral aging). | [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<br>[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 | 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 |
|---|---|---|
| Written exam | 53.0% | 34.0% |
| Project | 60.0% | 33.0% |
| Practical exercise | 60.0% | 33.0% |

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 | Adresy na platformie eNauczanie:<br>Rzeczywistość wirtualna - Moodle ID: 34429<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34429 |

| | |
|---|---|
| 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. |
| Work placement | Not applicable |