VIDZEMES AUGSTSKOLA

FACULTY OF ENGINEERING
STUDY COURSE DESCRIPTION

Course Title:	**Web based VR and AR applications**			
Course code (VAIS):	*DatZM022*			
Study programme:	**Virtual reality and smart technologies**			
Level of Study programme:	☐ 1st level professional higher education			
	☐ Professional Bachelor			
	☒ Professional Master			
	☐ PhD level			
Type of Study programme:	☒ Compulsory course (Part A)			
	☐ Professional specialization courses (Part B, compulsory)			
	☐ Professional specialization optional courses (Part B, optional)			
	☐ Elective courses (Part C)			
Course Workload:	**Credits/ ECTS**	**Academic hours**	**Contact hours**	**Independent work hours**
	6	160	48	112
Course Author/ Tutor:	**Alvis Misjuns**		**Arnis Cīrulis**	
	Vieslektors, Mg.sc.comp.		Assoc. Prof., Dr.sc.ing.	
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	Consultation: according to the schedule for each semester or per individual agreement.			
Course Form:	Full time			
Study year, semester:	1st year, 1st semester			
Language:	Latvian, English			
Prerequisites for the Course:	Basic knowledge and experience in programming languages – preferably Java programming language; knowledge / insight about development of information systems.			
Course Summary:	The aim of this course is to provide theoretical and practical knowledge about current mobile technology solutions for XR, including to gain insight about mobile application development environments, concepts, and particular development approaches. By performing practical assignments students will have an opportunity to improve their practical skill in area of mobile technology solutions development. The study course aims to give students knowledge of the development of augmented reality web-based applications (WebXR) using A-Frame to gain access to sensory data on augmented reality machines and consecutively project feedback camera view information. The course will look at project development in the Blender environment, with a particular focus on texture development, materiality and shaders. The study course is the preparatory step to enhance practical skills in development of mobile solutions and by combining them with VR/AR and other solutions to provide the foundation for multidisciplinary solutions development. Additionally, introduction to the development of WebGL 3D content using three JS and virtual reality output devices is provided.			
Course Methods:	Lectures, practical activities, group work, theory tests, final assessment (project work assignment) etc.			
Assessment:	Examination (project work assignment)			

Requirements for Credits:

1. Successful completion of workshops/practical work assignments (at least 60% points of totally available).
2. Passed theoretical tests.
3. Successful completion of project work assignment (at least 70% points of totally available).

Final assessment consists of: workshops/practical work assignments, group work evaluations; theoretical tests; project work assignment and project work assignment presentation.

All practical work assignments have to be accepted (i.e. at least with 60% evaluation) in order to get the final evaluation within this course. 250 points system is used to come up with final evaluation. Table below lists totally available points for each activity.

Work assignment or activity	**Points**
Practical work assignments	90
Theoretical tests	30
Participation in class work activities	15
Project work assignment (exam)	100
Project work assignment presentation (exam)	15
Total	**250**

Final course evaluation (mark) calculation based on 250 points system is done as it follows below:

>= 93% (232-points) = 10 >= 79% (197- points) = 6
>= 90% (225- points) = 9 >= 75% (187- points) = 5
>= 87% (217- points) = 8 >= 70% (175- points) = 4
>= 83% (207- points) = 7 < 70% (175- points) = 3

Missing practical work assignment deadline: each missed day counts for subtraction of 5% from totally available points. It is required to acquire at least 60% from totally available points (not counting potential delay) in order to accept practical work assignment as done.

Course Contents:

The course of study shall include the following concepts:
- Mobile OS application development for XR:

- Mobile technology solutions.
- Android user interface (UI). UX.
- Best practice UI and user input.
- Prototype development.
- Multimedia – audio and video camera.
- Data persistence (local / external solutions). Content Providers.
- Services. Basics. Location based services.
- Maps.
- SMS.
- Networking solutions. Web Services. JSON Services.
- Own service development.
- Google Play to distribute and monetize.
- Android testing. Testing concepts and possibilities. Best practice.

-Augmented reality services and mobile solutions:

- Eye tracking based technology testing of mobile solutions.
- Mobile application development framework for cross-platform solutions;
- JavaScript; development of solutions.
- AR possibilities within cross-platform solutions.

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- Android security and privacy.
- Wearable Apps. Development. Custom UI. Data and synchronization. Watch Faces.

-Basic principles of Canvas, Web GL and WebXR.
-Integration of virtual reality output devices using WebXR framework components using -A-frame
-A-Frame components.
-Project development with Blender
-Texture baking, Lightmaping
-Materiality and shaders
-Application demonstrations:

- Kamera
- Objekti
- Animācijas
- Gaismas
- Materialitāte un ēnotāji (Shaders)

-Ievads interneta pārlūku darbībā balstītu 3D aplikāciju vēsturē, izmantotajās ietvarsistēmās un rīkos.
-Three JS struktūra, saturs un detalizēts pielietoto metožu, objektu, materiālu un šeideru (shaders) apskats.
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<tr><td rowspan="15">Learning Outcomes; the evaluation methods and criteria</td><td>Learning Outcomes</td><td>The evaluation methods and criteria</td></tr>
<tr><td colspan="2">Knowledge</td></tr>
<tr><td>Knowledge on current mobile technology solutions and with focus on Android.</td><td>Development of particular mobile technology solution concept. Passed theoretical test.</td></tr>
<tr><td>Knowledge on Android user interface (UI) solutions, UX, and data persistence options.</td><td>Development of particular mobile technology solution concept. Passed theoretical test.</td></tr>
<tr><td>Knowledge on services, types of them, areas of application, commercialization, testing concepts and options.</td><td>Development of particular mobile technology solution concept. Passed theoretical test.</td></tr>
<tr><td>Knowledge on cross-platform solutions and AR options within, options in Wearable Apps area, consideration of Android security & privacy.</td><td>Development of particular mobile technology solution concept. Passed theoretical test.</td></tr>
<tr><td>Knowledge of web based VR and AR theory and terminology.</td><td>Practical work, home work, test</td></tr>
<tr><td>Knowledge of current state and devices available in the market.</td><td>Practical work, home work, test</td></tr>
<tr><td>Knowledge of available frameworks for use to create VR, AR contents for the web.</td><td>Practical work, home work, test</td></tr>
<tr><td>Knowledge of basic and advanced functionality that can be realized.</td><td>Practical work, home work, test</td></tr>
<tr><td colspan="2">Skills</td></tr>
<tr><td>To develop mobile technology solution medium complexity user interface (UI), including by usage of fragments and views, as well as prototyping.</td><td>Developed practical group work.</td></tr>
<tr><td>To develop mobile technology solution based on different (both local and</td><td>Developed practical group work.</td></tr>
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	external) data persistence approaches.	
	To develop medium complexity cross-platform mobile technology solution by using specific development framework JavaScript.	Developed practical group work.
	To develop mobile technology solution in area of Wearable apps.	Developed practical group work.
	Skills to create use API's and link various libraries and software modules.	Practical work, home work, test
	Skills to design and develop interactive environments for web browsers.	Practical work, home work, test
	Skills to use WebGL, Three.js, WebXR.	Practical work, home work, test
	Competency	
	Use correct mobile technology solutions terminology. To choose appropriate technological approaches for particular assignment implementation.	Course project development and presentation.
	Independently perform mobile technology solutions development design and architecture.	Course project development and presentation.
	To solve mobile technology solutions basic issues, to perform testing and debugging assignments in all levels of development.	Course project development and presentation.
	The ability to determine which elements to use to develop a project with required functions.	Practical work, home work, test
	Ability to customize requirements and plan a workflow.	Practical work, home work, test
	Ability to respect and integrate requirements related to performance and security.	Practical work, home work, test
Course Compulsory literature:	1. J. F. DiMarzio. Beginning Android Programming with Android Studio, 4ed, Wrox, 2016. 2. F. Ghayour, Real-Time 3D Graphics with WebGL 2: Build interactive 3D applications with JavaScript and WebGL 2 (OpenGL ES 3.0), 2nd Edition, ISBN: 1788629698, 2018	
Course additional literature:	1. M. Yener, E. Hellman, O. Dundar. Expert Android Studio, John Wiley & Sons Inc, 2016. 2. D. Smith, E. Hellman. Android Recipes: A Problem-Solution Approach, 5th ed. APress. 2016. 3. K. Holmqvist, et.al. Eye Tracking: A Comprehensive Guide to Methods and Measures. Oxford University Press, 2015. 4. J. Dirksen, Learn Three.js: Programming 3D animations and visualizations for the web with HTML5 and WebGL, 3rd Edition 3rd Edition, ISBN-13: 978-1788833288, 2018.	
Course confirmation date:	*22.05.2024*	
Date of course description update:		

Study Course Plan:

Date	Theme	Academic hours	Study Form

		Contact hours	Independent work hours	
	Mobile technology solutions. Android user interface (UI). UX. Best practice UI and user input. Prototype development. Multimedia – audio and video camera. Data persistence (local / external solutions). Content Providers.	4	10	Theoretical lecture. Several topics covering practical work. Group work.
	Services. Basics. Location based services. Maps. SMS. Networking solutions. Web Services. JSON Services. Own service development. Google Play to distribute and monetize.	4	10	Theoretical lecture. Several topics covering practical work. Group work
	Android testing. Testing concepts and possibilities. Best practice.	4	4	Theoretical lecture. Several topics covering practical work. Group work
	Eye tracking based technology testing of mobile solutions. Mobile application development framework for cross-platform solutions; JavaScript; development of solutions. AR possibilities within cross-platform solutions.	4	4	Theoretical lecture. Several topics covering practical work. Group work
	Android security and privacy. Wearable Apps. Development. Custom UI. Data and synchronization. Watch Faces.	4	4	Theoretical lecture. Several topics covering practical work. Group work
	Introduction and history in we based 3D applications, used frameworks	2	4	Lecture, practical work / home work.
	Basic principles of Canvas, Web GL and WebXR. Three JS structure and components. Used tools for development and usage of components, as camera, mesh objects, animations and lighting.	8	26	Lecture, practical work / home work.
	Usage of Three JS components as input controls,	5	26	Lecture, practical work / home work.

	effects, geometry and shaders. WebXR components implementation. Principles of WebXR emulation without hardware.			
	Groups work	9	-	Exam
	Final examination	4	24	Course project development and presentation.
	Hours total	***48***	***112***	

Note: lecturer keeps the rights to make changes in the course plan.