IM-UH 2516
Virtual Reality Research and Applications
Fall 2024

Faculty Details	Professor
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Course Rationale

Virtual Reality (VR) has come a long way since its inception and first implementation in the 1960s. The past three decades have seen a huge amount of research devoted to the utilization of VR in various fields, including among others education and training, entertainment, healthcare, arts and heritage, design, and marketing.
In the past, VR was primarily used in research settings, in safe controlled environments, where researchers and practitioners were trained in the field and carefully designed scenarios to address experimental questions and minimize risk. Nevertheless, over the past decade, with the increasing popularity of VR and accessibility to the technology, there are now hundreds of VR experiences created by designers and developers who may not have the necessary knowledge or training. This can lead to ineffective experiences or even cause individuals psychological or physical harm. There are many new and exciting developments in a field which will continue to evolve and grow in the years to come, and it is of the utmost importance for future practitioners to learn how to carefully consider the limitations of new immersive technologies and to conduct ethical research to better understand its effects and potential risks. The aim of this course is to expose students to the knowledge gained through years of experimental research in the field of VR and the importance of relying on experimentation and evidence rather than assumptions and opinions in the design process, as well as the need for interdisciplinary collaboration in the development of VR experiences to ensure that the technology is used responsibly and effectively.

Course Description

The course is designed to introduce students to basic immersive virtual reality (VR) concepts and technology with a strong emphasis on the use of VR as a tool for conducting scientific research and developing scenarios for real-world applications in learning, psychology, neuroscience, and psychiatric and medical treatment. The course is comprised of lectures, in-class discussions on selected topics, and hands-on VR lab sessions where students will learn the basic principles of experimental design to be able to use VR technology to build immersive experiences for hypothesis testing. The goal is for students to gain both practical experience and to understand the fundamentals of human perception and cognition that should be considered when using the medium. Students will learn through first-hand experience of developing VR-based research applications how to assess and evaluate user

experiences, while maintaining best ethical practices. This work will be complemented by a series of guest lectures by researchers in the field from the industry and other institutions.

Course Learning Outcomes and Link to Program Learning Outcomes (PLOs)

Upon successful completion of this course the student will be able to:	Linked to Major PLOs (refer to Appendix I)
1. Understand how human perception and cognition relate to the design of VR technology and experiences.	PLO 1 PLO 2
2. Learn the fundamental aspects of designing and implementing rigorous experimental studies using VR.	PLO 1 PLO 2 PLO 3 PLO 4
3. Discuss VR applications for scientific research, training, medical and psychological rehabilitation.	PLO 1 PLO 3 PLO 4 PLO 6 PLO 8
4. Gain experience with using VR technology for the implementation of research studies, including tracking hardware, user input/output data, and 3D rendering software.	PLO 5 PLO 7 PLO 8
5. Develop critical thinking with respect to the use of VR technology for developing real-world applications while adhering to best ethical practices.	PLO 1 PLO 3 PLO 4

Teaching Methodology

This course will make use of a diverse range of learning and teaching methods to ensure the outcomes are addressed effectively and rigorously. These will include traditional lectures but with a focus on interactive and student-centered methods and experimentation. Much of the teaching will be in a hands-on environment, with significant self-directed work opportunities and peer-to-peer teaching. Students will be required to actively engage with current VR research by presenting and replicating studies and writing scientific papers. VR itself will be used as a teaching medium, where students will learn about the use of VR in learning to better understand it as an educational medium. Additionally, an external speaker program will be implemented where students can learn from and engage with senior researchers in the field.

Graded Activities

Activity	Grade Percentage	Submission	Link to PLOs
Homework - Participation	10%	Weekly reading responses	1,2,3,4
Attendance	10%	Ongoing	1,2,3,4
Assignment 1 - VR Research Paper Analysis	10%	Week 4	1,2,3,4,6,8
Assignment 2 - Experimental VR Design Presentation	10%	Week 7	1,2,3,4
Assignment 3 – Experimental VR Design Implementation	30%	Week 11	5,7,8
Assignment 4 - Final VR Study	30%	Week 14	1,2,3,4

*See Appendix II for assignment details and rubrics.

Required Bookstore Texts

Beilenson, Jeremy (2018) *EXPERIENCE ON DEMAND: What Virtual Reality Is, How It Works, and What It Can Do*. W. W. Norton & Company, 30 Jan 2018. ISBN 0393253708, 9780393253702

Other readings will be available on Brightspace:

Jones, Phil, Osborne, Tess (2022*) Virtual Reality Methods: A Guide for Researchers in the Social Sciences and Humanities.* Bristol University Press. ISBN-13: 9781447360759

Slater M. (2018) *Immersion and the illusion of presence in virtual reality*. Br J Psychol. 2018 Aug;109(3):431-433. doi: 10.1111/bjop.12305. Epub 2018 May 21. PMID: 29781508.

Peck TC and Gonzalez-Franco M (2021) Avatar Embodiment. A Standardized Questionnaire. Front. Virtual Real. 1:575943. doi: 10.3389/frvir.2020.575943

Valentin Schwind, Pascal Knierim, Nico Haas, and Niels Henze. 2019. Using Presence Questionnaires in Virtual Reality. In Proceedings of CHI Conference on Human Factors in Computing Systems (CHI '19), May 4–9, 2019, Glasgow, Scotland UK. ACM, New York, NY, USA 12 Pages. https://doi.org/10.1145/3290605.3300590

U. Meyer, S. Draheim and K. von Luck (2019) *"A Model for Sensorimotor Affordances in Virtual Reality Environments," 2019 11th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games)*, pp. 1-4, doi: 10.1109/VS-Games.2019.8864514.

Slater M and Sanchez-Vives MV (2016) *Enhancing Our Lives with Immersive Virtual Reality.* Front. Robot. AI 3:74. doi: 10.3389/frobt.2016.00074

Roswell RO, Cogburn CD, Tocco J, Martinez J, Bangeranye C, Bailenson JN, Wright M, Mieres JH (2020), Smith L. *Cultivating Empathy Through Virtual Reality: Advancing Conversations About Racism, Inequity, and Climate in Medicine*. Acad Med. 2020 Dec;95(12):1882-1886. doi: 10.1097/ACM.0000000000003615. PMID: 32701556.

Hardee GM and McMahan RP (2017) FIJI: A Framework for the Immersion-Journalism Intersection. Front. ICT 4:21. doi: 10.3389/fict.2017.00021

Kern AC and Ellermeier W (2020) Audio in VR: Effects of a Soundscape and Movement-Triggered Step Sounds on Presence. Front. Robot. AI 7:20. doi: 10.3389/frobt.2020.00020

Ruhland, K. and Andrist, S. and Badler, J. B. and Peters, C. E. and Badler, N. I. and Gleicher, M. and Mutlu, B. and McDonnell, R (2014) Look me in the Eyes: A Survey of Eye and Gaze Animation for Virtual Agents and Artificial Systems. The Eurographics Association. DOI 10.2312/egst.20141036

Jan-Philipp Stein, Peter Ohler (2017) Venturing into the uncanny valley of mind—The influence of mind attribution on the acceptance of human-like characters in a virtual reality setting, Cognition, 160,Pages 43-50,ISSN 0010-0277, https://doi.org/10.1016/j.cognition.2016.12.010.

Chalmers, D. (2017). *The Virtual and the Real.* Disputatio, 9, 309 - 352.

Madary M and Metzinger TK (2016) Real Virtuality: A Code of Ethical Conduct. Recommendations for Good Scientific Practice and the Consumers of VR-Technology. Front. Robot. AI 3:3. doi: 10.3389/frobt.2016.00003

Slater M (2021) Beyond Speculation About the Ethics of Virtual Reality: The Need for Empirical Results. Front. Virtual Real. 2:687609. doi: 10.3389/frvir.2021.687609

Academic Policies

Attendance:

Attendance is mandatory. Every class builds off the preceding one, so it is vital to **be present and on time** for every lesson.
Unexcused absences or habitual lateness will negatively impact both your final grade for the class and your attendance grade. If you are going to be late or absent, please email me in advance. If you have an emergency, please let me know as soon as you can.
Arriving more than ten minutes late to class will count as an unexcused absence.
More than one unexcused absence will result in a 5-percentage point drop in your attendance grade per absence.
After four unexcused absences, you will fail the class.
Technical Workshop attendance is mandatory. If you miss a technical workshop, you will not be allowed to use or check-out equipment. There are no exceptions to this.

Class Participation:
Engaging in class discussions and offering advice, input, feedback, etc. during class is a major part of your grade. Participating in class is helpful for me to get to know you as an individual and keep track of your progress. What is equally important is that it provides you and your classmates with the opportunity to learn from each other through the sharing of failures, successes, and insights on the work you are doing.

Assignments:
All assignments must be turned in on time. Assignments submitted after the due date are docked 5 percent per day and will not be accepted for credit after a week. If you miss an assignment or presentation due to an illness or emergency, you must send notification to me by email prior to (or soon thereafter the due date if there are mitigating circumstances). Special arrangements will be made on a case-by-case basis.

Be prepared to work in groups on the assignments.

You are expected to present your work in class. Explaining your work to other people is a great way to better understand the material and answer questions for yourself.
Ask questions. If you do not ask questions, I can only assume you understand the material completely.

Integrity:
At NYU Abu Dhabi, a commitment to excellence, fairness, honesty, and respect within and outside the classroom is essential to maintaining the integrity of our community. By accepting membership in this community, students, faculty, and staff take responsibility for demonstrating these values in their own conduct and for recognizing and supporting these values in others. In turn, these values create a campus climate that encourages the free exchange of ideas, promotes scholarly excellence through active and creative thought, and allows community members to achieve and be recognized for achieving their highest potential.

Students should be aware that engaging in behaviors that violate the standards of academic integrity will be subject to review and may face the imposition of penalties in accordance with the procedures set out in the NYUAD policy:

https://students.nyuad.nyu.edu/campus-life/student-policies/community-standards-policies/academic-integrity/.

Mental Health Awareness:
As a university student, you may experience a range of issues that can interfere with your ability to perform academically or impact your daily functioning, such as: heightened stress; anxiety; difficulty concentrating; sleep disturbance; strained relationships; grief and loss; personal struggles.

If you have any well-being or mental health concerns, please visit the Counseling Center on the ground floor of the campus center from 9am-5pm Sunday - Thursday, or schedule an appointment to meet with a counselor by calling: 02-628-8100, or emailing: nyuad.healthcenter@nyu.edu.

If you require mental health support outside of these hours call NYU's Wellness Exchange hotline at 02-628-5555, which is available 24 hours a day, 7 days a week.

You can also utilize the Wellness Exchange mobile chat feature, details of which you can find on the student portal. If you need help connecting to these supports, please contact me directly.

Weekly Schedule Overview

week 1 - Introduction to the course and VR; What is Virtual Reality? Some definitions and explanations

week 2 - VR technical framework; VR Design: perceptual and cognitive factors; Sensorimotor Contingencies in VR; Introduction to the Illusions in VR (PI, Psi, Agency, Embodiment)

week 3 - VR in Psychotherapy; VR in Physical Rehabilitation and Medical Training - Assignment 1: Paper Analysis Assignment Due

week 4 - VR in Education and Cultural Heritage; VR in Sports; VR in News and Documentary Films; Changes in Behavior, Perception, Cognition; Empathy

week 5 - QuickVR Framework Introduction and Use; Keyframe Animations and Unity Mechanim

week 6 - Human Audio Perception and embodiment illusions; Audio in Unity3D

week 7 - Introduction to Social VR; Application of Virtual Characters; Psychology of Social Interaction; Human-Avatar Interaction - Assignment 2: Project Presentation Due

week 8 - Virtual Human Project for Unity; Evaluation of Social Interaction

week 9 - Introduction Research Methods and Statistical reasoning; Data management Documentation

week 10 - Descriptive statistics

wee 11 - Ethics towards participants; Unethical studies; NYUAD IRB Protocol and Ethics report with Human Subjects; Assignment 3: Final VR Project technical implementation Due

week 12 - Data Collection Workshop

week 13 - Ethics of VR and Realism; The Need for Empirical Results

week 14 - Haptics; Assignment 4: Final paper Presentation Due

Week 1
Tue 08/27 – Introduction/Why Research in VR

- Introduction to the course and VR
- What is Virtual Reality?
- Why Research in VR?
- Some definitions and explanations
- Recurrent themes of the course
- Student introductions and experiences

Homework:
READ: Experience on Demand, Chapter 10; Infinite Reality, Chapter 3
WRITE: Join Discussions Week 1: Personal VR Experiences on Brightspace and briefly introduce yourself by answering the following three questions:

1. Who you are.
2. Why are you interested in Virtual Reality?
3. When was the first time you heard about the concept of Virtual Reality?
4. Give one example of your Virtual Reality experience! If you haven't tried VR, write down experiences you have heard from TV/internet/friends.

Please write a sentence or two about the first time you heard about Virtual Reality and read what your peers have said!
CHECKOUT: Oculus Quest IMLAB for semester*
* must return if dropping class.

Week 1
Thu 08/29 – The History of VR

- The history of VR
- Key terminology
- Types of VR technology
- Introduction to VR technical framework
- 360 videos and model-based VR
- Paper Analysis Assignment

Homework:
READ: Experience on Demand, Chapter 2; Lee, 2004
WRITE: post your thoughts under Discussions Week 2: VR Definition and Technology
What Do You Think VR Is? How do you define Virtual Reality? Write down your definition, in a sentence or two, without searching the internet!
Which Head Mounted Devices (HMDs) have you used? How was the experience? If you have used more than one HMD, please explain the differences.
CHECKOUT: Oculus Quest IMLAB for semester*
* must return if dropping class.

Week 2
Tue 09/03 - Three Illusions in VR (PI, Psi, Embodiment) – Quest 2 Set Up

- Immersion
- Introduction to the Three Illusions in VR (PI, Psi, Agency, Embodiment)
- Breaks in Presence
- Measuring Presence and VR Illusions
- Set Up Quest 2

Homework:
READ: Slater M. 2018; Schwind et al (2019); Peck & Gonzalez-Franco (2021)
WRITE: post your thoughts under Discussions Week 3: Why Immersive VR
Compare the experience of viewing something on a desktop and later the same application in VR. Try to disable head-tracking and compare the experience.

Thu 09/05 - VR Perceptual and Cognitive Factors

- **Sensorimotor Contingencies in VR**
- **Visuomotor vs Visuotactile**
- **The rubber hand illusion - RHI**
- **The Pinocchio Illusion**

Homework:
READ: Experience on Demand, Chapter 9; Makransky & Peterson, 2021; Meyer et al. 2017
WRITE: post your thoughts under Discussions Week 2: Perceptual Factors
Try both the Pinocchio Illusion and the rubber hand illusion with one or two friends. How did it feel? What constraints did you break? How did this change the illusion?

Week 3
Tue 09/10 - VR in Education/Cultural Heritage

Invited Speaker Dr Maria Roussou, Associate Professor, National and Kapodistrian University of Athens

Homework:
READ: Slater M and Sanchez-Vives MV (2016) and
WRITE: Post thought in Discussions Week 3: Enhancing our Lives with VR:
Which of the applications discussed in the paper do you think will play a more dominant role in the future? Is there anything else you think could happen? What do you think VR will be like 5 years down the road? And how about 10 years later?

Thu 09/12 - Changes in Behavior, Perception, Cognition

- Changes in Behavior, Perception, Cognition
- VR Empathy

Homework:

PREPARE: Synchronous Group Field Trips in Social VR (e.g., Horizon Workrooms, VRChat)
*Make sure you have your HMDs and VRChat set up. See Resources how to do that.
WORK: Install Unity 3D and watch introduction video tutorial to familiarize with UI.

Week 4
Tue 09/17 – VR Chat Online Class

- Meet Online in VR

Homework:

READ: Experience on Demand Chapter 3, IR, Chapters 5 and 6, FIJI: A Framework for the Immersion-Journalism Intersection, Nonny de la Peña's Ted talk on VR in journalism
WORK: ideation on experimental design assignment with team members. Be ready to present the main idea to the classroom.
SUBMIT: field-trip experience feedback under Discussions. Focus on interactions, body language, and avatar characteristics of yourself and others. What aspects did you like and find effective? What did not work well for you? Please elaborate in detail.

Thu 09/19 – VR Healthcare
Invited Speaker Dr Daniel Perez-Marcos, PhD, Senior Scientist at MindMaze, VR HealthCare

Homework:

FINISH: Assignment #1 DUE – Paper Analysis
WORK: on main project: create main project experimental scene using QuickVR framework. Check under Brightspace > Resources for instructions and tutorials how to install sidequest and build .apk files

Week 5
Tue 09/24 - VR in Chronic Pain and Psychological Interventions

Invited Speaker Dr. Justyna Świdrak, Senior Researcher August Pi & Sunyer Biomedical Research Institute, Spain

Homework:
WORK: on main project.

Thu 09/26 - Designing VR Illusion Experiments

- The QuickVR Library for Unity
  https://gitlab.com/eventlabprojects/quickvr.packages/com.quickvr.quickbase

- Keyframe Animations in Unity
- Glycon3D Mocap

Homework:
WORK on main project implementation.

Week 6
Tue 10/01 – Virtual Characters/Crowds Katja Zibrek

Invited Speaker Dr Katja Zibrek, Senior Researcher at Inria Centre at Rennes University

Homework:

READ: Ruhland, K. (2014) Look me in the eyes
WORK: Main project presentation and implementation.

Thu 10/03 – Virtual Characters

- Designing Virtual Characters (Avatar Libraries) - https://github.com/microsoft/Microsoft-Rocketbox
- Character Creator (https://www.reallusion.com/)
- Avatar SDK (https://avatarsdk.com/)
- Avatars from Text
- DAZ3D

Homework:
WORK: Work on main project: add audio (background, instructions, etc.) in project experimental scene using the QuickVR framework and other resources.
POST Discussions Week 7 - Body/Face/Gaze Examples:
Think of a really good example of a) body animation, b) gaze animation, c) facial animation that you have seen in a film, game or VR experience. Describe it to the other learners and explain why you like it. Find an online video and post a link of the animation.

Week 7
Tue 10/08 – Social VR & The Metaverse

Invited Speaker Esen Küçüktütüncü, PhD Candidate, EventLab, University of Barcelona, Spain & Intern at BIRD (Blended Interaction Research & Devices) @GoogleARVR. ex- EPIC Lab

Homework:
WORK: Main project presentation and implementation. Be ready to present during the next class. Arrive on time!
SUBMIT: Discussions Week 7: Body Language Around the World:
There are aspects of body language, facial expression and gaze that are pretty universal to human beings. But a lot is also very cultural and varies from culture to culture.
Think about body language in your culture. What things are particularly distinctive or different from other countries? Is there anything that VR creators would have to be careful about when creating characters for your culture?
PREPARE: Final Study Design, Material, Measurements and Procedures.

Thu 10/10 – Presentations VR Concepts

- Project Concept Presentations

Homework

FALL BREAK

Week 8
Tue 10/22 – Intro Research Methods

- ***Introduction Research Methods and Statistical reasoning***
- ***Population and Sample (experimental vs control group)***
- ***Data management***
- ***Documentation***
- ***Research Problem and Hypothesis***
- ***Repeated Measures***
- ***Variables of Interest/Disinterest***
- ***Virtual Human Project for Unity***

Homework:
READ: Jan-Philipp Stein, Peter Ohler (2017) Venturing into the uncanny valley of mind
WORK: on Project Implementation.

Thu 10/24 - Ethics VR/AR

- Invited Speaker, Dr. Despina Michael-Grigoriou, Department of Multimedia and Graphic Arts, Cyprus University of Technology, Director of the GET Lab - Microsoft Computer Games and Emerging Technologies Research Lab (getlab.org).

Homework:
READ: Chalmers, D. (2017). The Virtual and the Real (Chapter 7)
SUBMIT: Discussions Week 9: **Chalmers, D. (2017**). The Virtual and the Real (Chapter 7. The Value of Virtual Worlds)
Consider the following question: Are experiences in virtual reality less valuable than those outside it with respect to accomplishments, relationships, interference, disembodiment, birth and death? Chalmers states the following:
"I argue that virtual reality is a sort of genuine reality. In particular, I argue for virtual digitalism, on which virtual objects are real digital objects, and against virtual fictionalism, on which virtual objects are fictional objects. I also argue that perception in virtual reality need not be illusory, and that life in virtual worlds can have roughly the same sort of value as life in non-virtual worlds". Answer the following questions based on Chalmer's theory on the various points:
Relationships Are relationships in VR as valuable as relationships in physical reality?
Interference: Do we lose out on real experiences when we spend time in VR?
Disembodiment: Is VR disembodied?
Quality: Lower quality of VR compared to reality is not particularly important since this may not be permanent due to technical improvements that will overcome this. Can we go any further? Is the real value of VR to compare it with reality?

Transcience: “Not having a history” lessens the value of VR. Is this a mark against the value of VR?
Birth and Death: “There is no birth and death in VR” - Does the absence of birth or death in VR make it less valuable than reality?

Week 9
Tue 10/29 – Ethics VR/AR

- Ethics towards participants
- Unethical studies
- NYUAD IRB Protocol and Ethics report with Human Subjects

Homework:

- **WORK** on final Project Implementation
- **WATCH** Intro to R Studio or Excel for simple descriptive statistics

Thu 10/31 - Workshop

- Running a VR study LIVE workshop

Homework:

- **WORK** on final Project Implementation

Week 10
Tue 11/05 - Intro to Stats

- Descriptive statistics - Means, median, variance etc
- Inferential statistics - Null hypothesis, significance, confidence intervals
- Workshop: Running an experiment

Homework:

- **WORK** on final Project Implementation

Thu 11/07 – Sonic Interactions in VR

Invited Talk Dr. Stefania Serafin, Department of Architecture, Design and Media technology, Aalborg University, Denmark “Sonic Multi-sensory Design and Interactions in VR”

Homework:

- **WORK** on final Project Implementation

Week 11
Tue 11/12 –Mental.ae Invited

Invited Talk Yousef Tuqan Tuqan, Vice President, Business Development, MENTAL

- Present Implemented Study

Homework:

- **Final VR Project technical implementation DUE**

Thu 11/14 – ArtsIT 2024 Art, Technology & Game Creation

- Attend during Class time

Week 12
Tue 11/19 - Data Collection

- Data Collection

Homework:

- Continue with Data Collection

Thu 11/21 - Audio in VR Mark or Anatole or Stefania?

"Sonic Multi-sensory Design and Interactions in VR" - **Invited Speaker Prof Dr Stefania Serafin, Department of Architecture, Design and Media technology, Aalborg University, Copenhagen, Denmark**

Homework:

- Continue with Data Collection

Week 13
Tue 11/26 – EUROXR VR in Films Data Collection

Homework:

- Continue with Data Collection

Thu 11/28 – EuroXR 2024

Homework:

- Continue with Data Collection

Week 14
Tue 12/03 – NO CLASS NATIONAL DAY

Homework

- Data collection and analysis

Thu 12/05 - Final Project Worktime

In class work time

Homework

Data collection and analysis

FINISH your project and submit the link to poster and material via Brightspace

PRINT your poster and bring to end of semester show

Tue 12/10 - Final Project Presentation and Demo Preparation

PRINT your poster and bring to end of semester show

Appendix 1

Assignments

1. VR Research Paper Analysis *(individual assignment)*

In this assignment students will select a VR research paper for analysis from a given list of papers covering the fields of psychotherapy, medical VR and rehabilitation, cultural heritage, sports and e-entertainment. The goal is twofold: one, to identify and explain the argument that the authors are making, and two, provide one's own opinion about that argument.

Part of this assignment is to expose the students to the fact that even though research papers authors are highly qualified, they are still advancing an argument and providing evidence--their aim is to persuade you that their argument is true, not to just present facts. Once students recognize that these authors are making arguments, they can analyze whether they find their argument compelling. Some possible questions students can ask to evaluate arguments are:

• **Theoretical questions –** How do the authors understand the situation? What is the theoretical background?
• **Definitional questions -** Are all the concepts in the text clear? Do the authors define a concept vaguely to allow it to travel across different situations? If a concept can relate two seemingly different situations, is the concept meaningful?
• **Evidence questions –** How do the authors provide evidence that supports their argument? Is the evidence credible? Can you identify a bias in the evidence? Is the authors' argument consistent throughout the paper? Or does the conclusion seem to
offer a different argument than they presented in the introduction? Does the authors' background have important implications for their argument?

Structuring the Analysis

Introduction:

- What is the main topic of this article? (1 point)
- How did this article establish its attention-getter in the introduction? (1 point)

Literature Review:

- How did this article satisfy the reasons for the literature review? (1 point)
  1. Explaining terms and vocabulary: offer definitions.
  2. Previous findings and research needed.
  3. Explanation and rationalization for variables – theoretical framework
  4. Establishing argument for their study.
- How well was previous research presented in this article? (1 point)

Methods:

- How did they collect their data? (1 point)

Results and Discussion:

- Summarize the main results. (1 point)
- Summarize the main points for discussion. (1 point)
- Did they do a good job in the discussion? Did they offer practical suggestions well? (1 point)

Use of Images and References:

- Include images of the research presented or other images that feel relevant. (1 point)
- Include references appropriately cited in-text and in the bibliography following a conventional style (APA, MLA, Harvard etc.) (1 point)

Length: 2-3 pages without the images.

2. Experimental VR Design Presentation *(group assignment max 4)*

In this assignment students will be asked to choose an experimental study to replicate in VR as their final project. Students will have the option to setup their own experimental design if they wish or add additional research questions to the original research hypothesis they are replicating. At this stage the students will work in team of max 4 people to determine what the project will focus on, what is the research question, how they will go about implementing the project in the remainder of the semester and how and what measurements they will use to collect data through a pilot study.

Each team will be expected to give a presentation (20 minutes) discussing the design issues associated with their scenario, identifying some possible solutions, and briefly describing any implications of these solutions on the analysis. All members of the group should contribute to the presentation. Marks will be awarded based on the literature background and identification of the research hypothesis, understanding of the design issues, identification of design solutions and analytical approaches, and clarity of presentation (both visual and oral):

1. Did the presentation clearly state the motivation for the project. (i.e., who does it interest?)
2. Did the presentation clearly state the research question (hypothesis) of the experiment/study?

3. Did the presentation demonstrate that the students have a clear idea of what they will be working on and how they will achieve it in the next several weeks. (i.e., What are the steps they are going to accomplish in the rest of the semester?)
4. What data will the team collect about the experimental groups and how will the data be collected?

Rubric

Criteria	Unsatisfactory	Developing	Accomplished	Exemplary	Total
Content (Group grade)	**0-19 points**	**20-29 points**	**30-39 points**	**40-50 points**	/50
	Presentation content shows a lack of understanding of the topic. There is inadequate evidence of research and insufficient relevant information and facts. Content is confusing and/or contains frequent inaccuracies. Required elements are missing and/or randomly organized. Sources, if included, generally lack proper citation format.	Presentation content shows general understanding of the topic. There is limited evidence of research in locating relevant information and facts and/or supporting statements made. Content contains some inaccuracies, inconsistencies, misinterpretations, and/or somewhat unclear. A required element may be missing and/or some sources may be improperly cited.	Presentation content shows an adequate understanding of the topic. Some research effort is evident in locating relevant information and facts. Content is mostly accurate and reasonably organized. May contain some inconsistencies in content or some connections made may not be supported. Required elements are included and sources are properly cited for the most part.	Presentation content shows a thorough understanding of the topic. Substantive research effort is evident in locating relevant information and facts. Content is accurate and sequenced in a clear, logical way. All required elements are included, and sources are properly cited.	
Design (Group grade)	**0-11 points**	**12 points**	**13 points**	**14-15 points**	/15
	Slides generally lack visual appeal and are text-heavy with little or no visuals and/or exhibit an overuse of color or animations. Media, (e.g., images), if used, are rarely cited on each slide. No theme is evident, and the presentation appears disjointed rather than unified and/or frequent errors (grammar, punctuation, spelling, formatting, etc.) on the slides	Slides generally include a mix of white space, visuals, and/or text but not consistently and/or some overuse or inappropriate use of color or animations. Theme (e.g., template) is not consistently evident throughout the presentation and/or some errors (grammar, punctuation, spelling, formatting, etc.) on the slides.	Slides are effectively designed with visual appeal including white space, visuals, and minimal text for the most part. Color and animations are used appropriately. Theme (e.g., template) is evident in the presentation for the most part to produce a cohesive presentation and/or minor errors (grammar, punctuation, spelling, formatting, etc.) on the slides.	Slides are visually well designed, aesthetically pleasing with appropriate use of white space, visuals, and minimal text, on each slide. Color and animations are used judiciously. Theme (e.g., template) is evident throughout to produce a highly cohesive presentation. Free from errors (grammar, punctuation, spelling, formatting, etc.) on the slides.	
Oral Delivery (Group grade)	**0-11 points**	**12 points**	**13 points**	**14-15 points**	/15
	Ineffective in delivering the oral presentation demonstrating below average/poor communication skills. Substantially over/under the time limit to present and/or not all members presented. Lack of preparation was evident.	Somewhat effective in delivering the oral presentation demonstrating average communication skills. Slightly over/under the time limit. Some members presented more than others. More preparation was needed.	Effective in delivering the oral presentation demonstrating good communication skills and generally close to the time limit for the group to present (20 minutes total). All group members presented, and preparation was evident for the most part.	Highly effective in delivering a well-polished oral presentation within the time limit for the group to present (20 minutes total). All group members presented equally. Preparation was strongly evident.	

Contribution to Group (Individual grade)	**0-5 points** Group member rarely participated or contributed to the project towards achieving the goals and meeting the deadline. Did not share workload fairly and/or was a disruptive influence.	**6-10 points** Group member participated in the project, but emphasis was in completing own work. Allowed others to assume leadership and/or may have not shared workload fairly towards achieving the project goals and meeting the deadline.	**11-15 points** Group member participated in the project and shared the workload. Contributed to the development of the presentation. Worked towards achieving the project goals and meeting the deadline.	**16-20 points** Group member participated fully in the project and shared the workload fairly. Contributed to the development of the presentation and assisted in editing to produce a polished presentation.	/20
Timeliness* and Length of Presentation (Group grade) (* unexcused late)	**Deduct 11 points-overall failing** Collaborative presentation is completed 2-3 days (49-72 hours) or more after the deadline and/or substantially lacks/exceeds the required length.	**Deduct 6-10 points** Collaborative presentation is completed 1-2 days (25-48 hours) after the deadline and/or is somewhat lacking (or exceeds) the required length.	**Deduct 1-5 points** Collaborative presentation is completed within 1 day (24 hours) after the deadline and meets the required length.	**0 points deducted** Collaborative presentation is completed by the deadline and meets the required length.	/--
				TOTAL POINTS (sum of 5 Criteria)	**/100**

3. Experimental VR Project Implementation *(group assignment continue)*

In this assignment students will work towards implementing the final project from a technical point of view. They will apply the technical skills learned throughout the semester to develop the VR research project using the Unity3D engine with the goal to develop a fully functional VR experience which they will use to test with participants during a pilot study for their final project delivery. Students will be assessed on the overall functionality of the VR setup and the number of points they were able to implement/replicate from the research project they were basing their idea on.

Rubric

Criteria	Unsatisfactory	Developing	Accomplished	Exemplary	Total
	0-5 points	**6-10 points**	**11-15 points**	**16-20 points**	
Planning of Project Work	Time frame not properly specified	Time frame properly specified, but not being followed	Time frame properly specified but being followed partly	Time frame properly specified and being followed	/20
Design Methodology	**0-9 points** Partial division of problem into modules and methodology not defined properly	**10-19 points** Division of problem into modules but design methodology not defined properly	**20-29 points** Division of problem into modules but design methodology not properly justified	**30-40 points** Division of problem into modules and appropriate design methodology and properly justification	/40
Demonstratio	**0-9 points**	**10-19 points**	**20-29 points**	**30-40 points**	

n	Poor execution of VR implementation. Does not demonstrate learning from technical tutorials in class.	Work is slightly functional. Further work is need on technical execution.	Work is mostly Functional. Good understanding of VR framework for research but however work could be further improved.	Objectives achieved as per time frame Excellent technical execution. Excellent understanding of design for VR research.	/40
				TOTAL POINTS (sum of 5 Criteria)	**/100**

4. Final VR Study *(group assignment continue)*

For the final project students will use the experimental design and study implementation completed in Assignments 2 and 3 to run a small pilot study with classmates and compose a short presentation with the main results and discussion points expanding on the presentation of Assignment 2. Students will be graded on:

1. the experimental set-up conditions and following of the experimental procedures discussed and showcased in the classroom for conducting ethical research (hypothesis, dependent and independent variables),
2. the materials list including all the items that were used to complete the pilot study (forms, measurements, instruments, equipment),
3. the list of steps on exactly what was done,
4. data collection and statistical figures of the data,
5. main results and explanation of findings,
6. discussion, limitations, and real world uses relating to the research conducted and future directions.

Criteria	**Unsatisfactory**	**Developing**	**Accomplished**	**Exemplary**	**Total**
	0-5 points	**6-10 points**	**11-15 points**	**16-20 points**	
Set-up Conditions	Work lists no constants. inaccurate or incomplete. Ethical considerations not considered when running the study.	Work lists some constants; some inaccurate or incomplete. Ethical considerations fairly considered when running the study.	Work lists all constants; lacks detail or description of how the conditions are set up. Ethical considerations somewhat considered when running the study.	Work lists all necessary constants with good detail and description of set-up. Ethical considerations considered when running the study.	/20
Materials List (List of all the items that were used to complete the experiment.)	**0-5 points**	**6-10 points**	**11-15 points**	**16-20 points**	/20
	Lists confusing, or inaccurate materials; or lacks quantities or measurements. Gives confusing or nonsequential directions, or completely lacks detail to follow.	Lists partial, confusing, or inaccurate materials; or lacks quantities or measurements. Gives partial, confusing or nonsequential directions, or lacks enough detail to	Lists most materials used; lacks some detail about type, quantities or measurements. Gives most steps in the procedure, lacks proper sequence or enough detail to follow	Lists complete set of materials; sufficient detail to duplicate directions. Gives complete list of directions with detail such that the experiment could be duplicated by another.	

		follow.			
Data Collection (Chart with the data that was measured in the experiment.)	**0-5 points**	**6-10 points**	**11-15 points**	**16-20 points**	/20
	No data shown; No Graph shown; elements incomplete or inaccurate	Most data shown; some data missing, or not organized in chart form, or missing units or average. Graph shown; some elements incomplete or inaccurate	Proper chart shown with complete data and average; missing some units, labels or fewer than 10 trials. Proper graph shown; most elements complete and accurate	Proper chart shown with complete data; 10 or more trials and average; all units, labels, and detail present. Proper graph shown; all elements complete and accurate	
Results/ Explanation	**0-5 points**	**6-10 points**	**11-15 points**	**16-20 points**	/20
	Lists no results, statements inaccurate or incomplete. Explanation statement no present.	Lists some results, some statements inaccurate or incomplete. Explanation statement present but inaccurate or incomplete.	Lists most results, most statements are accurate and complete. Explanation statement present and accurate; but incomplete.	Lists all results accurately and with detail. Explanation is accurate and with specific detail.	
Discussion/ Limitations/ Future Directions	**0-5 points**	**6-10 points**	**11-15 points**	**16-20 points**	/20
	Findings and limitations are not discussed or No uses are stated; no future directions.	Findings and limitations are somewhat discussed or incomplete. States one or more uses; but incomplete, inaccurate, or lacks details.	Findings and limitations are discussed but are incomplete. States several possible uses with some detail; or more uses with incomplete detail or uses are not all related to research topic.	Findings are discussed; limitations stated. States three or more possible uses related to the research question; with good detail.	
				TOTAL POINTS (sum of 5 Criteria)	**/100**

Participation

- Class participation is essential. The material requires hands-on experience with the object of study, as well as analysis and discussion during research and experimenting.
- Students are expected to attend **ALL** classes and be actively engaged. Contributing to class discussions and offering advice, input, feedback, etc during class is a major part of your grade. Participating in class is helpful for me to get to know you as an individual and keep track of your progress. Equally importantly, it provides you and

your classmates the opportunity to learn from each other through the sharing of failures, successes, and insights on the work you are doing.

- Be prepared to work in groups in class and for assigned projects, and to support classmates with experimenting and feedback outside of class. Being a thoughtful and generous critic helps you become critical in your own experimental practice.
- All assignments must be turned in on time. Be ready to present your work at the start of the class on the day the project is due. Each day an assignment is late will result in a lower assignment grade (i.e., B+ to B).
- Ask questions—in class, outside of class, or through emails. Let me know if you have any concerns about the course or if you would like extra help. You can email me, stop by my office, ask for a scheduled meeting, or speak with me before or after class.
- You are responsible for making up material missed due to an absence.

Rubric

10: Excellent preparation by in-depth reading of the assigned material, leads/contributes in a significant way to discussions, demonstrates consistent active involvement, and offers thoughtful analysis and critique of the course material.
8: Good preparation (knows facts, considers implications), offers interpretation and analysis, leads/contributes well to discussion and is consistently involved in the class.
6: Adequate preparation (knows basic facts of the readings but does not show evidence of trying to interpret and analyze), does not participate voluntarily in discussions, demonstrates sporadic involvement
4: Poor preparation (has a superficial knowledge and understanding of the readings), tries to respond when called on, infrequent involvement in discussions. Or speaks without engaging with the reading or classmates' comments.
2: Very poor preparation (no evidence for reading assigned material), does not respond substantially when called on, participates very rarely in discussions.
0: No participation

Criteria	Unsatisfactory	Developing	Accomplished	Exemplary	Total
	0 points	2 points	4-6 points	8-10 points	
participation	No participation	Very poor preparation (no evidence for reading assigned material), does not respond substantially when called on, participates very rarely in discussions.	Poor preparation (has a superficial knowledge and understanding of the readings), tries to respond when called on, infrequent involvement in discussions. Or speaks without engaging with the reading or	Adequate preparation (knows basic facts of the readings but does not show evidence of trying to interpret and analyze), does not participate voluntarily in	/10

			classmates' comments.	discussions, demonstrates sporadic involvement	

Homework

Appendix 1

Interactive Media Program Learning Outcomes

Upon completion of the major in Interactive Media at NYU Abu Dhabi, all students are expected to have fulfilled the following:

1. Research and Understanding: IM students will cultivate a substantive understanding of the past, present, and future landscape of Interactive Media.

2. Analytical Thinking: IM students will be challenged to answer fundamental questions relating to the field of Interactive Media.

3. Conceptual Thinking: IM students will develop conceptual skills through the use of computational and interactive media tools to create project-based work and project oriented research.

4. Critical Thinking: IM students will refine their critical thinking skills by analyzing and critiquing work in cultural, social, historical, ethical, and aesthetic contexts.

5. Technical Implementation: IM students will cultivate technical skills with contemporary media technologies to execute their coursework.

6. Creative Processes: IM students will gain the ability to explore, innovate, and realize creative ideas in multiple fields of inquiry and interest.

7. Organization and Communication: IM students will develop professional practices of delivering and sharing their work.

8. Collaboration: IM Students will gain experience in collaboration through active participation in group and team-based work.