



BUSINESS SCHOOL
Te Kura Pakihi

DEPARTMENT OF INFORMATION SCIENCE

Multimedia User Experience –
Theory and Practice
INFO410

COURSE OUTLINE

Semester One, 2021

Introduction

What is an interactive system? What is Mixed Reality? What theoretical frameworks do we need to understand in order to design an effective system? Which degree of "information richness" is suitable for a given problem? What methodologies and technologies are out there to design usable, enjoyable and desirable systems? These are some of the issues and questions that this one semester paper will seek to find answers to. INFO410 introduces students to the main areas of human-computer interaction (HCI) development leading to an understanding of the underlying principles of visual computing using theoretical frameworks. The focus areas of the course are Mixed Reality Systems and Computer Aided Design. We are following a research-informed, problem-based learning approach with a flipped classroom model.

Students are greatly encouraged to take ownership of a problem. In the process, develop lifelong learning skills such as critical, analytical and creative thinking, and communication. Different, sometimes contradicting interaction design methodologies will be introduced and reflected by the students.

Students are required to read technical and academic literature, critically reflect on it and discuss this literature in class.

The "2021 edition" of INFO410 focuses on the main conceptual and technological principles of Virtual, Augmented, and Mixed Reality, also known as XR. In a project-based learning format students will learn how to develop a meaningful XR system as a "minimum viable product" (MVP) with conceptual and practical input given in a small class seminar style.

The project work topic for this course will be the development of an MVP to experience a virtual recording studio to be interactively demonstrated at the International Science Festival in Dunedin in July. The visual and acoustic properties of the recording studio will be reconstructed for a user wearing an immersive head-mounted display which is tracked in real space.

All raw data (from a real recording studio) for the reconstructions will be provided (photographs, laser scans, impulse response sweep recordings).

After successfully finishing the course students will (1) be able to conceptually design and develop an XR application, (2) know the basic principles of XR models and are able to practically apply CAD in a XR context, (3) know the main technical components and concepts comprising a Visual Computing system, and (4) be able to present XR research & development to a technical audience.

Staff

- Holger Regenbrecht (co-ordinator), Room 9.07, Otago Business School; email: holger@infoscience.otago.ac.nz (Tel. 479 8322)
- Noel Park (PhD student), Room 3.25, Otago Business School
email: noel.park@otago.ac.nz

General Information:

- Tuesdays, 11am - 1pm, Lectures and Presentations followed by Consultations and Discussions (OBS 3.26)
- Thursdays, 11am - 1pm, Show & Tell with milestone/assignment checks followed by Consultations and Discussions (OBS 3.26)
- Flipped classroom and student lecture model: closer to Humboldt and Oxbridge models
- Holger is your course co-ordinator, supported by Noel Park as tutor
- Workload expectations per week:
 - 2-4 hours Seminar attendance
 - 1-2 hour Consultation attendance

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- 6-8 hours of self-dependent work (includes ½-1 hour of blog writing)
- all INFO410 students are invited to join the HCI group meetings on Wednesdays, 2pm-3.30pm, OBS 3.26
- all INFO410 students are encouraged to go to the CS/IS seminars on Fridays 1-2pm, G34, Owheo Bldg.

Intended Learning Outcomes

- You are able to conceptually design and develop an MR application.
- You know the basic principles of Computer Aided Design and can practically apply CAD in a Mixed Reality context.
- You know the main technical components and concepts comprising a Visual Computing system.
- You are able to present VC/MR research & development to a technical audience.

4th-year study in general and INFO410 study in particular is about:

- Methodologies & Self-Regulated Learning
 - Research and Exploration
 - Building Self-Confidence
 - Independency in Gathering Knowledge
 - Knowledge Construction (not Consumption)
- Communication and Presentation

Presentations:

- Each student will give two Student Lectures (45 minutes each). These Student Lectures (SL) are presented during seminar time on Tuesdays, 11.00 – 13.00.
- The PowerPoint slides for each SL have to be provided, also to be handed in electronically on USB thumb drive with all files required e.g. embedded videos etc.,)
- What you present you have to understand!
- You have to acknowledge all sources in your slides.
- Initial pointers to resources will be given by Holger and Noel, but you have to find more and have to provide the content
- For each presentation, you have to provide five potential exam questions with model answers; Holger will pick from those for the end of year (oral/written) exams.

INFO410 presentation topics (Student Lectures)

The topics will be discussed in the first seminar and the Course Outline will be updated in due course.

1. Introduction to Course, HCI, VR/AR, CAD/CAAD (Holger)
2. Introduction to Computer Graphics (Noel)
3. Theory and Practice of Textures, Lights, and Materials (student lecture)
4. 3D Models Representation and Rendering (brep, csg, volumetric) (student lecture)
5. 3D CAD Basics: coordinate systems, operations, data storage, layers, file formats, modelling programs for architectural and industrial design (student lecture)
6. Introduction to 3D reconstruction (Steve Mills or Holger R)
7. Concepts and Practice of photogrammetric 3D reconstruction (student lecture)
8. Scenegrph APIs—OpenSceneGraph vs. Unity3D (Noel)
9. 3DUI and Navigation in XR (student lecture)
10. Tracking technologies and VR/AR/MR Head-mounted displays: technology and applications (student lecture)
11. Acoustics and Spatial Sound Rendering in XR (student lecture)

12. Ethics and Professionalism and XR (student lecture)
13. Wrap up (Holger)

INFO410 Student Project

The details will be discussed in the first seminar.

Blogging:

Each student writes a **lab book as a blog** (accessible to other INFO 410 students, as well as to Holger and Noel) with reports on progress (positive and negative), screenshots, photos, references to work and web sites visited, video clips; spend ½ - 1 hour per week on this!

The Reflective Blog is a way to reflect critically and on a regular basis on your journey through the INFO410 work. It will be the device to gather resources, project stages and artefacts of your work. The main reason, however, of writing a reflective blog is that this should help you to embed reflective practice into your day-to-day work.

Apart from gathering material on the way (text blocks, illustrations, screen shots, video clips, URLs, related work summaries, ...) we ask you to reflect on the following aspects (if applicable):

- What have been the goals for the week and what did I achieve?
- What (parts of the workflow/research/development) was working well and why?
- What (parts of the workflow/research/development) was not working well and why?
- What would I do differently if I would be faced with the same situation or goals?
- What did I learn this week and/or what am I proud of or satisfied with?

Rules for the blog:

- Private blog to be shared with Holger & Noel; after the last session the blog will also be shared with one additional academic staff member
- One or more blog entries per week
- Blogs need to be published by Monday, 9 am for the previous week
- First blog entry due on Monday, 8 March (please make sure that you share the blog)
- Recommended blogging platform: blogger.com

From CAD and 3D reconstruction to Mixed Reality

There will be three demonstrable MVPs: (1) a prototype application for the immersive exploration of the HCI Lab (2) a prototype application for the immersive exploration of the Albany St recording studio, and finally (3) an interactive demonstrator to experience musicians playing in the virtual recording studio to be exhibited at the Intl. Science Festival.

Weekly tasks and **assignments** (to be adjusted along the way)

1. Assign roles and responsibilities within group. Division of labour for upcoming tasks based on skills, expertise, and interests. Do basic tutorials on SketchUp, Unity3D, and Unreal.
2. Modelling of the cubature (no furniture, no textures, but with windows, doors, openings) of the HCI lab rooms (3.22 – 3.26) with SketchUp. Production of an architectural walk-through movie (<1 minute).
3. Texturing and Lighting of HCI lab model. Furnishing of HCI lab model (tables, chairs, bookshelves; all textured). Production of an architectural walk-through movie (<1 minute).
4. Interactive Walk-through through HCI lab model using Unity3D and Oculus Rift HMD; Ability to interactively switch on/off individual furniture. Production of walk-through movie (<2 minutes).

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5. 3D reconstruction of HCI Lab room 3.23/3.24 from photographs. Production of a movie demonstrating the process and the outcome (<3 minutes).
6. Development of a combined, hybrid CAD modelled and 3D reconstructed 3.23/3.24 model. Interactive Walk-through through model using Unity3D and Oculus Rift HMD; Production of walk-through movie (<1 minute).
7. Interactive walk-through through Albany St studio laser-scanned model using Unreal and Oculus Rift HMD, incl. teleport navigation (replication of existing project). Production of walk-through movie (<1 minute).
8. Voxelvideo recording (visually and acoustically) of a musician in HCI lab. Post-processing of data. Integration into Albany St studio model. Production of walk-through movie (<1 minute).
9. Development of MVP, incl. UI suitable for public display and interaction
10. Technical Testing; Development of MVP
11. Development of MVP
12. Usability Testing (Heuristic Evaluation); Development of MVP
13. Development of MVP and Presentation

Timetable

week	topics		date	comment
1	1	Introduction	02/03	
	2	<i>Project: Assign Roles</i>	04/03	
2	3	Computer Graphics	09/03	
	4	<i>Project: SketchUp HCI Lab</i>	11/03	
3	5	Textures etc.,	16/03	
	6	<i>Project: Texturing/Lighting</i>	18/03	
4	7	3D Model Representations	23/03	
	8	<i>Project: Unity3D HMD walk through</i>	25/03	
5	9	CAD Basics	30/03	
	10	<i>Project: 3D Reco HCI Lab</i>	01/04	
6	11	Intro 3D Reconstruction	13/04	
	12	<i>Project: Hybrid 3D Reco HMD</i>	15/04	
7	13	Praxis 3D Reconstruction	20/04	
	14	<i>Project: Albany St Studio HMD</i>	22/04	
8	15	Scenegrph APIs	27/04	
	16	<i>Project: Voxelvideo Recording</i>	29/04	
9	17	3DUI and Navigation	04/05	
	18	<i>Project: MVP</i>	06/05	
10	19	Tracking and HMDs	11/05	
	20	<i>Project: MVP</i>	13/05	
11	21	Acoustics	18/05	
	22	<i>Project: MVP</i>	20/05	
12	23	Ethics and Professionalism	25/05	
	24	<i>Project: MVP</i>	27/05	
13	25	Wrap Up	01/06	
	26	Project Presentation	03/06	

Marking:

- 30% Student Lectures (two per student), Quality of delivery to class, Powerpoint material quality, Examination questions
- 20% Project Work and Milestone Achievements (indiv. & group)
It is expected that all members of the group should contribute equal effort. However, roles may differ, based on agreement within the group. The course coordinator reserves the right to award lower marks to a group member who does not contribute sufficiently to the group work.
- 20% Blog Reporting (indiv.)
- 10% Class Participation and Engagement (indiv.)
- 20% End of Year Oral Examination (indiv.)
In order to pass this paper, you must obtain 40% or greater in the final exam.

Recommended Readings:

(to be updated, dynamic)

- Cooper, A., Reimann, R., & Cronin, D. (2007). About Face 3: The Essentials of Interaction Design. John Wiley.
- Kelly, T. (2002). The Art of Innovation: Success Through Innovation the IDEO Way. Profile Books Ltd.
- Shneiderman, B. & Plaisant, C. (2005). Designing the User Interface (4th edition). Addison Wesley.
- Preece, J., Rogers, Y., & Sharp, H. (2002): Interaction Design: Beyond Human-Computer Interaction. John Wiley.
- Bowman, D., Kruijff, E., LaViola, J., & Poupyrev, I. (2005). 3D User Interfaces – Theory and Practice. Addison Wesley.
- Norman, D. (2002). The Design of Everyday Things. Basic Books.
- Norman, D. (2005). Emotional Design: Why We Love (or Hate) Everyday Things. Basic Books.
- Saffer, D. (2007). Designing for Interaction. Berkeley/CA: New Riders.
- Haller, M., Thomas, B. & Billingham, M. (2006). Emerging Technologies of Augmented Reality: Interfaces & Design. Hershey/PA: Idea Group Publishers

- OpenGL Programming for the X Window System by Mark J. Kilgard (Aug 15, 1996)
- Steuer, Barfield Presence papers on VR
- Azuma Presence papers on AR
- Computer Graphics: Principles and Practice (3rd Edition) by John F. Hughes, Andries van Dam, Morgan McGuire and David F. Sklar (Jul 20, 2013)
- Design Patterns: Elements of Reusable Object-Oriented Software by Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides (Nov 10, 1994)
- Extreme Programming Pocket Guide by chromatic (Jul 31, 2003)
- Unity3D, Unreal, and SketchUp online tutorials