



BUSINESS SCHOOL
Te Kura Pakihi

DEPARTMENT OF INFORMATION SCIENCE

Multimedia User Experience –
Theory and Practice
INFO410

COURSE OUTLINE

Semester One, 2023

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 “2023 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.

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 3.25, Otago Business School; email: holger.regenbrecht@otago.ac.nz (Tel. 479 8322)

General Information:

- Thursdays, 9-11am Consultation and Discussion.
- Wednesdays, 2-3.30pm HCI group meeting (with presentations)
- Flipped classroom and student lecture model: closer to Humboldt and Oxbridge models
- Holger is your course co-ordinator
- Workload expectations per week:
 - 1-2 hour Consultation attendance
 - 1.5h HCI group
 - 6-8 hours of self-dependent work (includes ½-1 hour of blog writing)
- 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 five Student Lectures (40 minutes each). These Student Lectures (SL) are presented during the HCI group seminar.
- 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, 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) exam.

INFO410 presentation topics (Student Lectures)

Six (40' + discussion) Student Lectures to be presented to the HCI Group:

1. Defining our Terms: Virtual|Augmented|Mixed|Extended Reality (VR|AR|MR|XR); Immersion, Presence, Co-Presence, Tele-Presence, Social Presence, Tele-Co-Presence; including technological examples. [Wed 22 March]
2. Goal-Directed Design (Cooper, Reimann, Cronin): HCI design process, design research, personas, scenarios, requirements, design framework and refinement. [Wed 5 April]
3. Computer Graphics Beyond Triangles: light fields: optics and light rays, light "through a tube" model, plenoptic function, 4D light fields, two plane model (u,v,s,t), how are light fields (practically) constructed?, plenoptic cameras, LF rendering; Neural Radiance Fields (NeRFs): basic introduction (from MLP and DeepSDF to neural volume rendering); Volume graphics: basic introduction (cf Arie Kaufman) and direct/interactive voxel rendering (our approach) [Wed 26 April]

4. Mixed Reality Concepts and Technologies: historic and current hardware and software systems, mixing real and virtual (cf Collins et al.), mixed reality presence (cf Tanh et al.); common tracking and interaction technologies used in MR; Pervasive Augmented Reality; Extended Reality [Wed 10 May]
5. Computer Aided Design and Manufacturing CAD/CAM: 3D Models Representation and Rendering (brep, csg, volumetric); 3D CAD Basics: coordinate systems, operations, data storage, layers, file formats, modelling programs for architectural and industrial design; Additive Manufacturing (3D printing): FDM, SLA, others. [Wed 24 May]

INFO410 Student Project

The details will be discussed in the first seminar.

- Snap AR Spectacles (2021) and Lens Studio as platform for project
- Work together with Kushani Perera
- Overarching goal: interactive placement of visual-audio stickies in the HCI Lab environment

Steps:

1. **Setup** (1 week): Install Lens Studio, do basic tutorials, load example project, execute on PC, execute on Spectacles; produce short video of the resulting experience through the Spectacles (incl. donning, doffing).
2. **Cubes on table** (2 weeks): 3D model (e.g. with SketchUp or Blender) one of the tables in the lab, incl. textures; place a marker at well defined position; include marker in 3D model; visualise table correctly overlaid in Spectacles; allow for virtual table to appear and disappear; 3D model a Jaytee cupcake box (incl textures) and virtually place on table next to a real Jaytee box; visualise in Spectacles; try to make virtual box indistinguishable from real box (e.g. lighting and shadows); produce a short (see-through) video clip of user experience.
3. **Virtual PostIts** (2 weeks): 3D model / 3D reconstruct room 3.23 (no textures required, but as accurate as possible cubatures); 3D model realistically looking PostIt notes with different descriptions / scribbles on them explaining different parts of room; produce at least 20 of them and place them onto the cubature model(s); visualise with Spectacles; allow for switching on/off of virtual PostIts (all on or off) and for visibility of cubature model(s); implement interactive placement of (pre-defined) virtual PostIts by user; produce a short (see-through) video clip of user experience.
4. **Static Audio Stickies** (3 weeks): Record and assign sound/voice messages to each of the PostIts (aka audio stickies) and implement an interaction mechanism involving gaze direction and proximity to play audio stickies when experiencing them with Spectacles. Produce a short (see-through) video clip of user experience.
5. **Dynamic, multi-user Audio Stickies** (3 weeks): Implement a mechanism by which Spectacles users can record and leave audio stickies in the environment; Implement a multi-user version of this, i.e. multiple users can

leave and listen to audio stickies in a consistent way (requiring some sending and receiving of information regarding the placement of the stickies as well as their content). Produce a short (see-through) video clip of user experience from different users.

Blogging:

Each student writes a **lab book as a blog** (accessible to other INFO 410 students, as well as to Holger) 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; 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, 11am for the previous week
- First blog entry due on Monday, 13 March (please make sure that you share the blog)
- Recommended blogging platform: blogger.com

Marking:

- 20% Student Lectures (five per student), Quality of delivery to group, Powerpoint material quality, Examination questions
- 35% 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.
- 15% 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.

Compulsory Readings (“watchings”):

- Keiichi Matsuda Hyper-Reality clip:
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKewjR5sSJ7crgAhWcTWwGHZs4AbAQwqsBegQIFB AF&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DYJgo2ivYzSs&usg=AOvVaw38cfum2bKjVs4xbR-my_HF
- Collins, J., Regenbrecht, H., & Langlotz, T. (2017). Visual coherence in mixed reality: A systematic enquiry. *Presence*, 26(1), 16-41.
<https://www.hci.otago.ac.nz/papers/CollinsMITPresence2018Preprint.pdf>
- Langlotz, T., Regenbrecht, H., Zollmann, S., & Schmalstieg, D. (2013, November). Audio stickies: visually-guided spatial audio annotations on a mobile augmented reality platform. In *Proceedings of the 25th Australian computer-human interaction conference: augmentation, application, innovation, collaboration* (pp. 545-554).
<https://dl.acm.org/doi/pdf/10.1145/2541016.2541022>

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.
- 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
- Unity3D, Unreal, and SketchUp online tutorials
- ARIVE Lecture series