

Introduction to Mobile HCI for MSc

Mark McGill

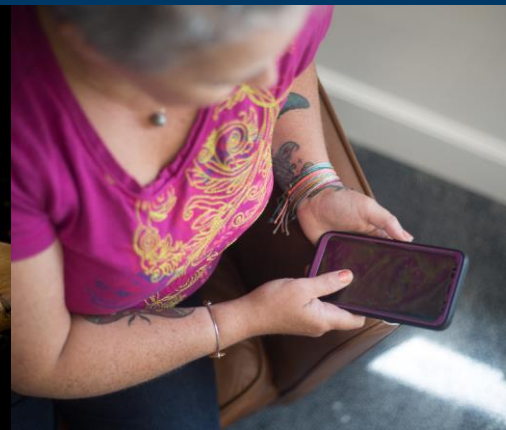
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Who am I?

- My research focuses on the **challenges and implications of mass adoption of Augmented and Virtual Reality technologies** (see my [Google Scholar page](#) if you're curious!)
- *The Disappearing Computer...* “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.” Mark Weiser, *The Computer for the Twenty-First Century*”



Welcome to Mobile HCI (MSc)!

This course will:

- Introduce you to **Mobile Human-Computer Interaction**;
- Outline the challenges of designing for **mobility**:
 - Small touchscreens, poor connectivity, interaction on-the-move, etc;
- Identify opportunities for **new interactions and capabilities**:
 - Embedded sensors, location/context sensing, wearables, AR/VR, etc;
- Learn how to prototype, design, and evaluate mobile interactions
- Explore challenging **mobile interactions**
 - E.g. “Very mobile HCI” - In-car, passengers, on-the-move
- Look at issues around **privacy, security, social acceptability**, etc., and the **societal impact** that mobile computing has.

Course Logistics – Every Week...

- Lectures: **Wednesday 1pm in-person** – they will be recorded where possible, but I'd advise you attend these. Slides provided on Moodle.
 - Where content will go beyond the hour slot (e.g. if I'm too slow!), additional slides/videos may be provided on Moodle to go through in your own time.
 - Keep an eye on the timetable – the University re-schedules things sometimes!
- Unassessed activities: **In your own time**
- Labs: **Thursday 10am** (teaching, activities, coursework)
- MS Teams for comms (e.g. ask on Q&A channel if you have questions/queries)

Week	Date	Unit	Lab
17	Wednesday 11/1/23	Unit 1: Intro & Overview; Mobile Device History.	No lab
18	Wednesday 18/1/23	Unit 2: Context	Lab: Assignment Intro + Teamwork
19	Wednesday 25/1/23	Unit 3: Prototyping	Lab: Storyboarding
20	Wednesday 1/2/23	Unit 4: Mobile Interaction	Lab: Sensor-based Interactions
21	Wednesday 8/2/23	Unit 5: Evaluation	Lab: Teamwork
22	Wednesday 15/2/23	Unit 6: Wearable Devices	Lab: Touchscreen-based Interactions
23	Wednesday 22/2/23	Unit 7: Mixed / Extended / Augmented Reality	Lab: Location-based Interactions
24	Wednesday 1/3/23	Unit 8: Virtual Reality and XR Interactions	Lab: Teamwork
25	Wednesday 8/3/23	Unit 9: Very Mobile HCI	TBD
26	Wednesday 15/3/23	Unit 10: Societal Challenges	Lab: Teamwork
27	Wednesday 22/3/23	Unit 11: Recap / Revision	No lab

Course Logistics

Coursework (40%): group exercise, covering all aspects of mobile design and development:

- Design, prototyping, implementation, evaluation;
- Focus on **interaction design** and **user experience**, not implementation;
- Written report + demonstration;

Exam (60%): in the April/May exam period.

Intended Learning Outcomes

ILO1: Design Challenges

“Explain problems associated with human-computer interaction in mobile and ubiquitous usage contexts.”

Key points:

- Mobile and ubiquitous computing devices have many **constraints** (size, power, connectivity, etc) and are used in many **contexts** (walking, etc);
- This course looks at how to address these challenges and take advantage of the opportunities afforded by mobility;

ILO2: Critically Analyse

“Critically analyse a proposed mobile interactive system considering its intended usage context.”

Key points:

- Appreciate the limitations of developing software for **constrained hardware** devices, sensing, and displays;
- Be able to identify difficulties imposed by the user's **environment** and **capabilities**
- Understand the **privacy**, **safety** and **security** issues associated with mobile and ubiquitous computing;

ILO3: Design for Mobility

“Design usable mobile interactive systems for a given problem or application area.”

Key points:

- Understand **who your users are**, and the constraints/limitations they may be under;
- Understand the **contexts** in which your users might interact with your apps/experiences and the **advantages/disadvantages** associated with these;
- The assessed exercise will give you direct experience of this.

ILO4: Prototype and Evaluate

“Develop and evaluate prototypes of mobile interactive systems using a variety of prototyping methods and evaluation techniques.”

Key points:

- Mobile and ubiquitous computing devices are used “in the wild” and may need to be evaluated in situ;
- Apply methods like paper prototyping, interface sketches and mock-ups, think-aloud evaluations, user studies, etc.
 - Particularly in the labs and assessed exercise
- Optional: introduces **Android** and **Extended Reality**;
 - Enough to get started, but self-study needed to master it;

ILO5: Novel Technologies

“Discuss cutting edge developments in mobile human-computer interaction, such as context-aware systems, sensor-based interaction, location-based interaction, and mixed reality.”

Key points:

- Mobile and ubiquitous computing devices have many novel capabilities, which create **novel opportunities for interaction**;
- Understand how to take advantage of context, location, sensing capabilities and the **privacy/security/safety** implications of these;

Coursework / Assessed Exercise

Coursework – 40% Group Project

- In teams of 3-5 people (4-5 preferred) you will be designing, prototyping, and evaluating an interactive artifact (e.g. an app, system, interaction technique) over the next 10 weeks.
- This will involve a final submission of a report and a video demonstration.



Coursework – First steps

- Read the Assessed Exercise brief on Moodle
 - Questions? Ask in the lab next week!
- Need to form yourselves into teams this week! See the Assessment area in Moodle for details.
 - **Deadline of Monday 1pm next week to submit your teams** via the supplied form.
- If you don't form yourselves into a team by the deadline, you will be randomly assigned one by the lab next Thursday.
- If you are not assigned one, let me know asap!
- If you don't get in a team promptly, or If you fail to engage in the project, you will fail this coursework.

What is HCI / Mobile HCI?

Human-Computer Interaction

“Human-computer interaction (HCI) is a multidisciplinary field of study focusing on the **design of computer technology** and, in particular, the **interaction between humans (the users) and computers**. While initially concerned with computers, HCI has since expanded to cover almost all forms of information technology design.”

Source: <https://www.interaction-design.org/literature/topics/human-computer-interaction>

Human-Computer Interaction

Human-Computer Interaction is a huge academic field!

- ACM CHI is one of the biggest computing science conferences in the world;
 - CHI was hosted in Glasgow in 2019, almost 4000 academics...
 - And ACM Mobile HCI started in Glasgow in 1998!
- HCI has made computing technology more usable and accessible, impacting everything from the design of user interfaces to how we communicate and collaborate digitally.
 - E.g. just look at Apple's Human Interface Guidelines <https://developer.apple.com/design/human-interface-guidelines/guidelines/overview/>

This course is mostly interested in **mobile** human-computer interaction;

- Several branches of HCI investigate issues relating to **mobile**, **ubiquitous**, **pervasive** and **wearable** computing;
- The definition of “mobile” is constantly evolving...
 - Handheld devices, wearable devices, in-vehicle interfaces, AR/VR devices, smart clothes and e-textiles

Mobile Device History

Motorola DynaTAC 8000x

- Released in 1983
- First 'mobile' phone
 - 30 minutes battery life (after 10 hours charging!)
 - Started the 'Brick' era
 - Named for size and lack of reliability...



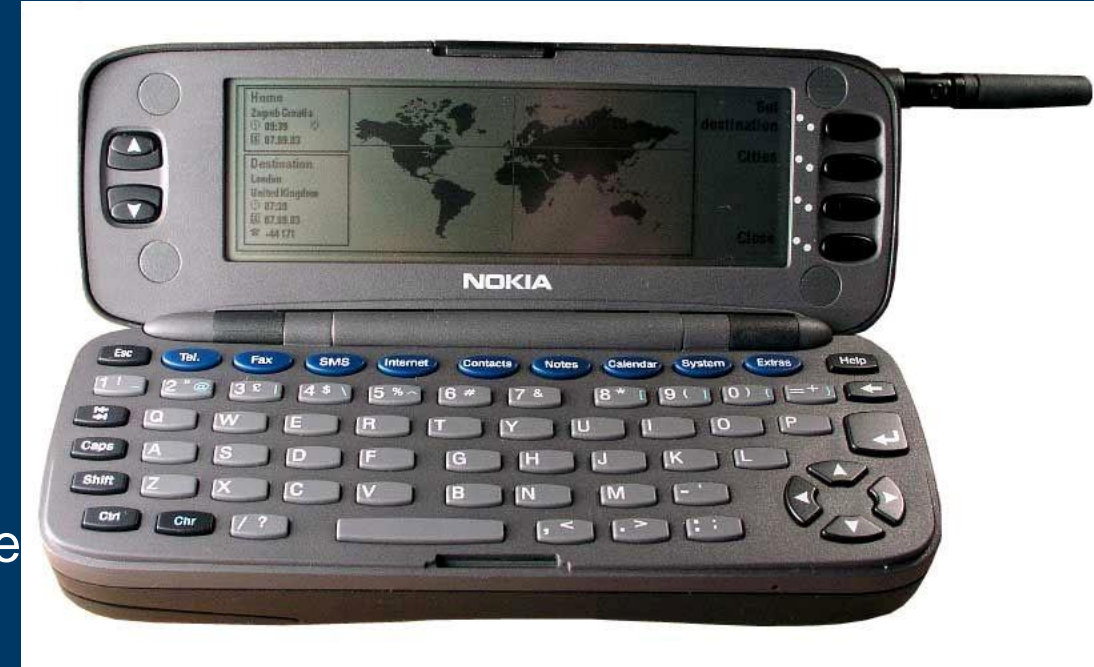
IBM Simon

- Released in 1994
- First **smartphone**?
 - Had 'apps' for email, calendar, notes, etc.
 - Touchscreen input (with stylus)



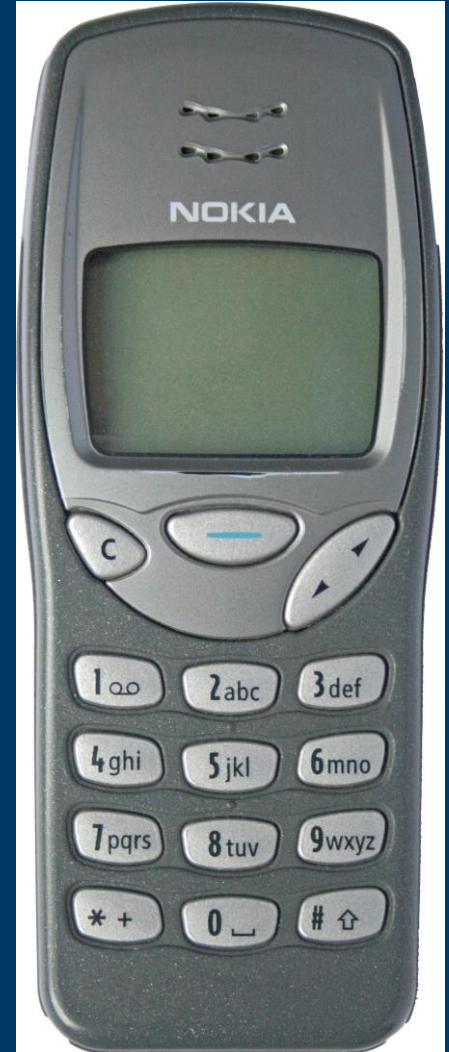
Nokia Communicator 9000

- Released in 1996
- First **smartphone**?
 - First to render web graphics
 - IBM Simon didn't have a web browser
 - Had two screens!
 - When closed, it worked like a normal phone



Nokia 3210

- Released in 1999
- First 'fun' phone, not a 'business' phone
 - Mobile games, including Snake
 - Compose your own ringtones
 - Had a precursor to emojis
 - Colourful replaceable plastic covers



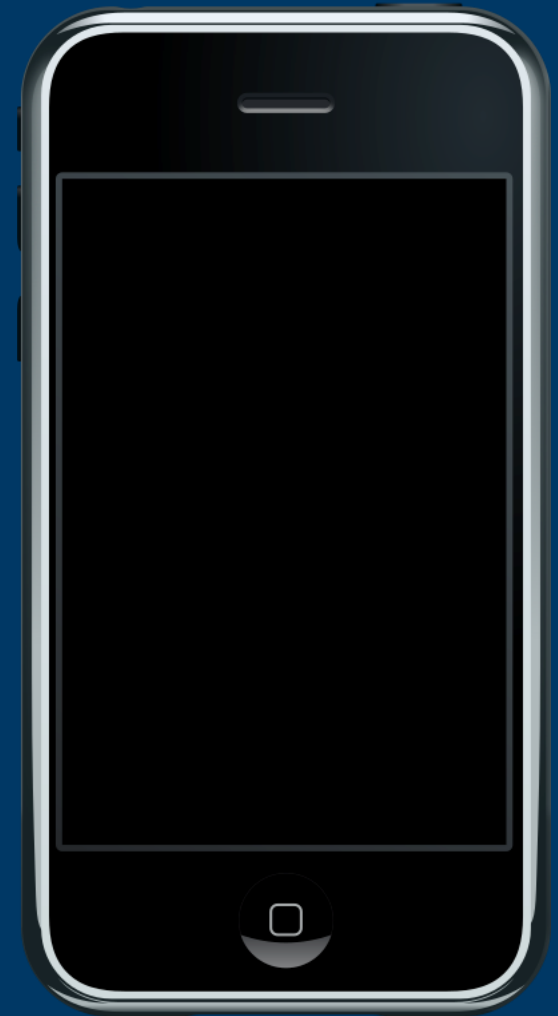
Motorola Razr V3

- Released in 2004
- First 'stylish' phone:
 - Emphasised sleek design and slim profile
 - Started the trend of slimmer, lighter phones



Apple iPhone

- Released in 2007
- First 'touch' phone:
 - Not really (LG had touchscreens first)
 - But Apple made better use of touch, creating a new interaction language based on **swiping**, **scrolling** and **tapping** with **multiple fingers**



HTC Dream/G1

- Released in 2008
- First **Android** phone:
 - An 'open' attempt to take on Apple's closed platform
 - Form factor mostly unrecognisable now
 - Integrated wheel for 2D pointing
 - Several physical buttons
 - Slide-out keyboard



Then it all gets a bit boring...

In the past few years, most phones are just a 'better' version of the same thing...

Technical improvements:

- Many-core processors, dedicated GPUs
- Co-processors (e.g., Tensor for activity tracking)

Camera improvements:

- Multi-lens cameras, better sensors, dynamic focus



... until now?

New sensors

- Soli radar in Google Pixel 4 (video)
- Grip pressure in Google Pixel 3
- 3D Touch in Apple iPhone 6

New sensors can enable new interaction techniques

- More than just tapping or swiping
- Introduces new design challenges: how do users discover, learn and efficiently use new interaction styles?



... until now?

New form factors

- Samsung Galaxy Z Fold (top)
- Motorola Razr (right)
- Huawei Mate XS (bottom)

New form factors can support **new ways of interacting** with content;

- Introduces new design challenges: how do you design apps for screens with several configurations?



What about other devices?

This course is not just about smartphones;

Mobile and ubiquitous computing devices can be:

- **Held in your hand**: phones, tablets, etc
- **Worn on the body**: watches, rings, glasses, headsets, shoes, clothes, etc
- **Embedded in the environment**: beacons, IoT devices, sensors, etc
- **Inside your body?**: implants, 'smart tattoos', etc

In most cultures, mobile phones are seen as 'essential': always with you when you leave the house;

New Interaction Opportunities

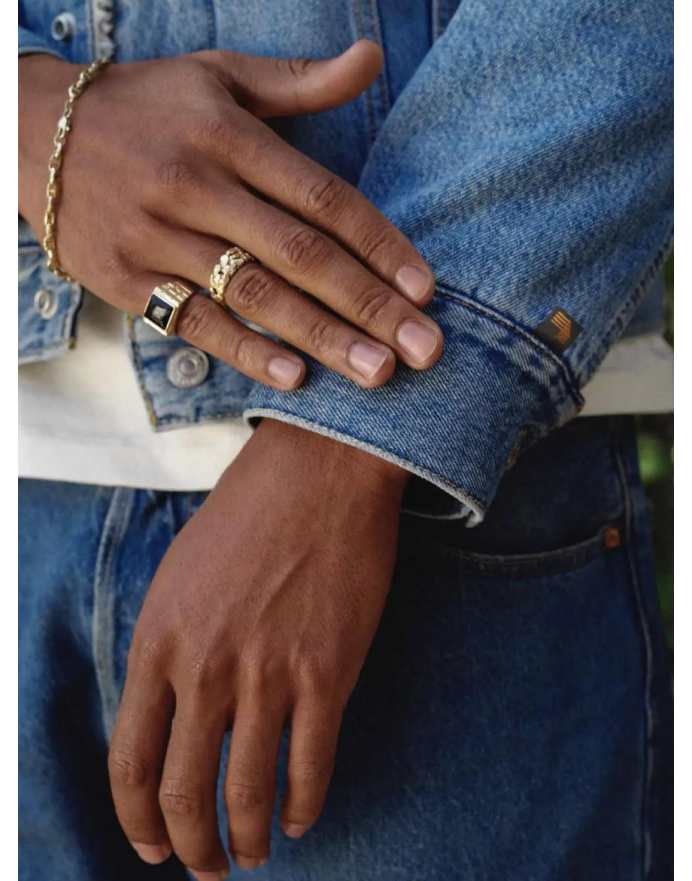
Mobile devices have many capabilities lacking in 'fixed' devices:

- **Cameras** (nowadays, really good cameras...)
- **Sensors:**
 - Location, motion, orientation, magnetic, ambient light, temperature, heart-rate, microphones, proximity, radar, pressure/grip
- **Wireless communication:**
 - Radio, Wi-fi, Bluetooth, ANT+, NFC, RFID

Example: Interactive Clothing

New sensing methods are changing what 'computing devices' look like...

E.g., **Project Jacquard** from Google sees interaction literally woven into clothing;



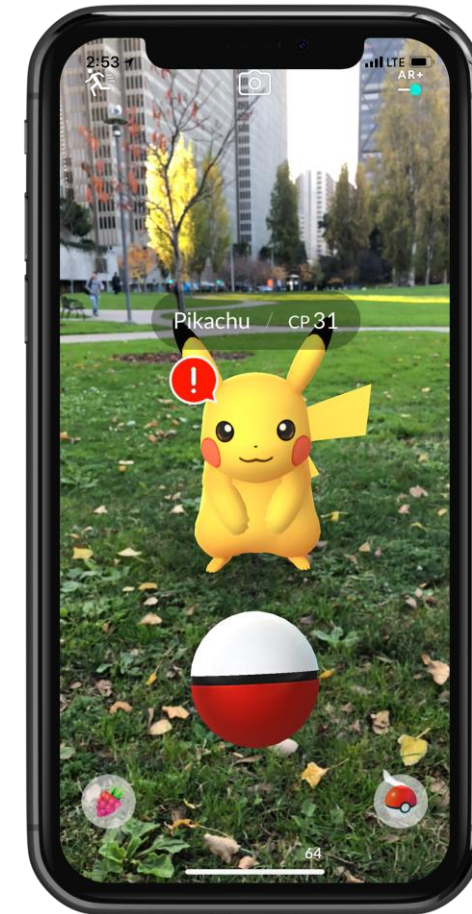
Google Project Jacquard: <https://atap.google.com/jacquard/>

Example: New Sensors for Wearables



Google Project Soli, full video: <https://www.youtube.com/watch?v=0QNiZfSsPc0>

Example: Augmented / Mixed Reality



Ubiquitous and Wearable Computing

Ubiquitous or “Pervasive” Computing

ACM UbiComp started in Seattle in 1998;

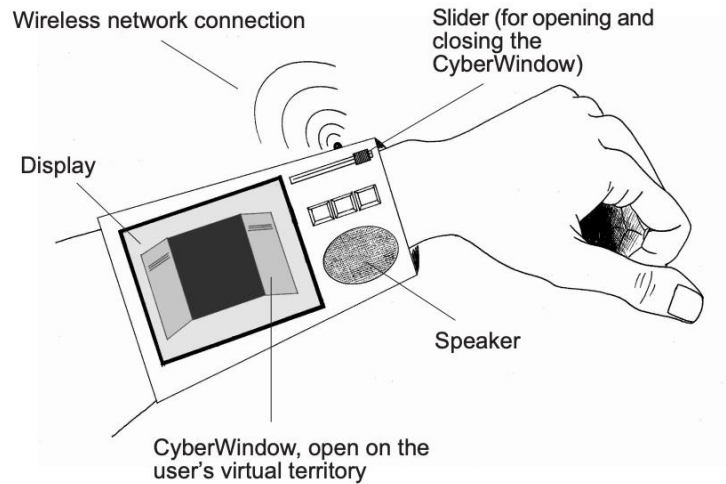


Figure 1. Tentative sketch of a wearable CyberWindow

From “Supporting Social Awareness on the World Wide Web” by Liechti et al.
(Handheld CSCW 1998)



See: <http://www.teco.edu/hcscw/>

Contemporary Mobile HCI

Today's devices are more refined than those in the 90s;

- ... but the tasks we do with them haven't changed much;
- ... and the interaction challenges aren't solved yet;

Today's devices and design practices are inspired by the past two decades of research;

- ... and today's research shows what the future of mobile computing might look like;

Wearable Computing



Right: Thad Starner (now at Google Glass) at MIT in 1995

Why is Mobile interaction challenging?

Why is mobile interaction challenging?

Hardware constraints:

- Small screen sizes, limited tactile feedback, lack of device stability, etc.

Interaction is affected by the **environment**:

- Poor connectivity in rural areas, difficult to type when walking, cannot see the screen when cycling, hard to hear when on the subway, etc.

Challenging Environments

Mobile devices are used in many contexts:

- E.g., when walking, running, driving, on the train;

Interaction subject to many challenges and disturbances:

- Noise, movement, inconsistent lighting, etc.
- Users must **divide their attention** with their surroundings and other tasks;
 - Leading to “**fragmented**” interaction in “**micro-bursts**”

Both **input** and **output** are affected by the environment:

- E.g., difficult to type when walking, difficult to hear on the subway

Social Acceptability



Source: <http://www.metrocf.or.jp/manners/poster.html>

Impact on Society

Is ubiquitous computing always a good thing?

- New capabilities enrich our lives, but what are the long-term impacts?

Computing is now “**always-on**”:

- Difficult to disconnect – impacts on mental health?
- A continuous distraction – impacts on social interaction?
- “There’s an app for that” – relying on tech too much?
- Continuous video & audio sensing – privacy and security implications?



“I Forgot My Phone” by Miles Crawford: <https://vimeo.com/73085316>



Windows Phone advert (2010): <https://www.youtube.com/watch?v=4mhrKWVQ0sk>

Lecture Summary

Exciting new features and hardware designs.

- How do we **take advantage** of these **new capabilities**?

Mobile devices come in all shapes and sizes:

- What are the **new opportunities** for interaction?

Mobile devices used in different contexts for different purposes:

- How can mobile devices enrich our lives and bring new benefits?
 - And what are the **challenges**?
 - Use in challenging contexts - connectivity, noise, movement, lighting, social, divided attention, etc.
 - Negative impacts on 'always on' computing - Mental health, (anti-)social interaction, privacy, security, safety

For next week...

- Find yourself a group for the team project! See Moodle for details, and read the assessed exercise document in full!
- No lab this week - Use the time to find a team for the project, and start discussing the assessed exercise.
- Next weeks lecture will dive deeper into context, context awareness, context ambiguity, and ubiquitous computing.
- Next weeks lab will be about getting to know your team, and kickstarting discussions around the project.
 - There will be a short overview of the assessment in next weeks lab, and I'll be on-hand for any general questions in the lab.