[20220628] INFOMMOB - Mobile interaction - 4 - UITHOF

Cursus: BETA-INFOMMOB Mobile interaction (INFOMMOB)

Tijdsduur: 2 uur

Aantal vragen: 9

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Cursus: Mobile interaction (INFOMMOB)

The exam contains nine questions, each with several sub-questions. Be aware that some questions have lots of sub-questions, others have much less. You can go back and forth between the questions and do not need to answer them sequentially.

You have 120 minutes and can get a maximum of 76 points. Notice that the points do not necessarily reflect the level of difficulty of the sub-question. Therefore, it might well be that a sub-question that gives you the similar number of credits than another one can take longer to answer.

Good luck!

Aantal vragen: 9

In totaal zijn 76 punten voor deze toets te behalen, 38 punten zijn nodig om voor de toets te slagen.

1 General aspects of mobile interaction

In the chapter "*Mobile Computing*" of *The Encyclopedia of Human-Computer Interaction*, J. Kjeldskov describes the history of mobile computing by discussing seven waves or trends. In the following, we want to look at them with a concrete example: **mobile handheld gaming**, which can be done on your smartphone or via a dedicated device (such as the Nintendo Game Boy).

1 pt. **a.** [max. 1 pt] One of the waves described by Kjeldskov is **divergence**. Shortly describe in your own words what this means.

1 pt. **b.** [max. 1 pt] Give one convincing example in relation to mobile handheld gaming that would speak for divergence.

1 pt. **c.** [max. 1 pt] Another wave is **convergence**. Shortly describe in your own words what this means.

1 pt. **d.** [max. 1 pt] Give one convincing example in relation to mobile handheld gaming that would speak for convergence.

1 pt. **e.** [max. 1 pt] Kjeldskov also talks about the wave of **connectivity**. Shortly explain in your own words what this means.

1 pt. **f.** [max. 1 pt] Give one convincing example how mobile handheld gaming can benefit from this wave and the resulting opportunities.

Later in the article, Kjeldskov also discusses **the role of context** for mobile interaction. Context can make mobile interaction harder and more challenging, but also provides new opportunities for it.

1 pt. **g.** [max. 1 pt] Give one convincing example related to mobile handheld gaming where context makes the interaction harder or more difficult and thus must be considered in the interaction design.

1 pt. **h.** [max. 1 pt] Give one convincing example related to mobile handheld gaming where context provides new opportunities, that is, where context is used as part of the game design in a way that is impossible without it or that significantly improves the game.

Today, many people do not use dedicated mobile handheld devices anymore, but instead play games on their smartphones. This also opens new opportunities, because smartphones contain various technologies and sensors that were not part of traditional dedicated mobile gaming devices. Although integrated in smartphones for a non-gaming-related purpose, they can be used in the context of gaming as well, thus offering new possibilities for mobile game design.

2 pt. **i.** [max. 2 pts] Give one example for such a technology or sensor and a convincing usage in mobile gaming. That is, name this technology or sensor and its original main purpose, and shortly explain with a concrete example how it can be used nowadays in the context of mobile handheld gaming.

2 Sensors for interaction

Today's smartphones contain many technologies and sensors that relate to the human senses, that is, they can be used (to some degree) to simulate how we as humans experience our environment (which is why they can be used for input in interaction design) and also provide related sensory information to us (which is why they can be used for output in interaction design).

1 pt. **a.** [max. 1 pt] Name a technology in mobile phones that relates to the human sense of **sight** and is used for **input** in mobile interaction design.

1 pt. **b.** [max. 1 pt] Name a technology in mobile phones that relates to the human sense of **sight** and is used for **output** in mobile interaction design.

1 pt. **c.** [max. 1 pt] Name a technology in mobile phones that relates to the human sense of **hearing** and is used for **input** in mobile interaction design.

1 pt. **d.** [max. 1 pt] Name a technology in mobile phones that relates to the human sense of **hearing** and is used for **output** in mobile interaction design.

1 pt. **e.** [max. 1 pt] Name a technology in mobile phones that relates to the human sense of **touch** and is used for **input** in mobile interaction design.

1 pt. **f.** [max. 1 pt] Name a technology in mobile phones that relates to the human sense of **touch** and is used for **output** in mobile interaction design.

The location and orientation of a smartphone can be used for mobile interaction design as well. Various sensors are used for that.

1 pt. **g.** [max. 1 pt] What data do we get via **GPS** that can be used for mobile interaction? Shortly explain and give a convincing example of its usage in mobile interaction.

1 pt. **h.** [max. 1 pt] What data do we get from a **magentometer/compass** that can be used for mobile interaction? Shortly explain and give a convincing example of its usage in mobile interaction.

1 pt. **i.** [max. 1 pt] What data do we get from a **gyroscope and accelerometer** that can be used for mobile interaction? Shortly explain and give a convincing example of its usage in mobile interaction.

One example that we saw in the lecture that uses the orientation of a smartphone for interaction is called **SWiM** (Shape Writing in Motion).

2 pt. **j.** [max. 2 pts] The SWiM approach solves two problems. What are these?

1 pt. **k.** [max. 1 pt] Shortly describe how SWiM solves these problems.

You also read a paper by Corsten et al. where they introduced a technique called **ForceRay**, which addresses one of the problems that SWiM resolves, too.

1 pt. **l.** [max. 1 pt] What kind of sensor does ForceRay use for that?

1 pt. **m.** [max. 1 pt] Shortly explain how ForceRay solves this problem.

You also read a paper by Voelker et al. where they introduce a technique called **HeadReach**, which addresses this problem as well.

1 pt. **n.** [max. 1 pt] What kind of sensor does HeadReach use for that?

1 pt. **o.** [max. 1 pt] Shortly explain how HeadReach solves this problem.

3 Mobile evaluation

For user studies, we often distinguish between internal validity and external validity.

1 pt. **a.** [max. 1 pt] Shortly describe what is meant by **internal validity**.

1 pt. **b.** [max. 1 pt] Shortly describe what is meant by **external validity**.

In the paper *Understanding user strategies when touching arbitrary shaped objects*, Q. Roy et al. (2021) present "a quantitative controlled experiment to empirically verify which model is the most representative of touch behavior on arbitrary shapes" (quote from paper).

If you need to refresh your memory, here some relevant quotes from the paper: They "used a computational approach to automatically extract 15 arbitrary shapes out of a set of icons" and picked "two sizes of shapes relative to the finger size, more precisely 25% larger than the participants' fingertips or 25% smaller." Then they gathered touch data from 12 participants with different finger sizes and compared "this data with our models' predictions to identify the one best able to predict pointing behavior."

3 pt. **c.** [max. 3 pts] Shortly discuss the experimental design of their controlled experiment (i.e., not the pre-study) with respect to internal and external validity. That is, explain if it has a high or low internal validity and external validity and why.

3 pt. **d.** [max. 3 pts] Internal and external validity often behave opposed to each other (i.e., a high internal validity often comes at the price of a low external validity and vice versa). What are the major changes that you would make in the experiment design above to increase the lower of the two (but still keeping the other one high)?

4 Touch screens

The so-called **Gorilla arm** is an ergonomic problem that can happen when touch screens are used on desktop PCs and laptops.

1 pt. **a.** [max. 1 pt] Shortly explain what it is and why it happens in this context.

1 pt. **b.** [max. 1pt] The Gorilla arm is generally not a problem when touch screens are used on mobile phones. Shortly explain why.

1 pt. **c.** [max. 1 pt] Even if the Gorilla arm is not an issue for touch interaction on mobile phones, there are other ergonomic problems with touch interaction on mobiles. Give one example.

1 pt. **d.** [max. 1 pt] While the Gorilla arm is generally not a problem for touch interaction on mobile phones, there are mobile interaction approaches where it can be an issue. Give an example for one and shortly explain why it can happen there.

Optical touch screens use cameras and sensors to "see" where and how they are touched.

1 pt. **e.** [max. 1 pt] Give an example of a use case or functionality that could be achieved because of that but is not possible with the capacitive touch screens that are currently used in most mobile devices.

5 Human aspects & UI design

Some mobile interaction designs use the so-called **Gestalt laws**.

1 pt. **a.** [max. 1 pt] Shortly explain that the Gestalt laws are. (A short, high-level description is sufficient.)

2 pt. **b.** [max. 2 pts] Give one example where Gestalt laws are used in a beneficial way in mobile interaction design and shortly explain how. (You can give a concrete example or a high-level description of a concrete issue that can be addressed with them. A short explanation is sufficient.)

Overview+Detail and **Focus+Context** are two well-known visualization approaches. Yet, we hardly find them in mobile interaction design anymore (or at least to a much lesser degree than we used to).

1 pt. **c.** [max. 1 pt] What is the reason for this, that is, why don't we see them in mobile interaction design that much anymore?

1 pt. **d.** [max. 1 pt] Give a convincing example where either of these visualization concepts is or could still be used beneficially in today's mobile interaction design.

6 Gestures and touch interaction

In the lecture, we saw a video where they introduced so-called **MicroRolls**, which are a special kind of small touch gestures done with your thumb. A use case that they demonstrated were "Copy&Paste" actions. You also saw a video where the authors introduced the so-called **Force Picker**, where pressure sensitive touch input is used for interaction. A use case that they demonstrated was the selection of an input value.

1 pt. **a.** [max. 1 pt] Give one potential advantage that the Force Picker approach could have compared to the MicroRolls approach.

1 pt. **b.** [max. 1 pt] Give one potential advantage that the MicroRolls approach could have compared to the Force Picker approach.

In addition to **touch gestures**, we can also use **kinetic gestures** when interacting with our mobile phones. Let's look at them in relation to **navigation apps** and use cases with geospatial data.

1 pt. **c.** [max. 1 pt] Give one good example for a touch gesture in this context. It should be convincing, that is, there should be a clear benefit or reason why one would use a touch gesture in this example and not a kinetic gesture.

1 pt. **d.** [max. 1 pt] Give one good example for the usage of a kinetic gesture in this context. Explain the advantage of using this gesture in this context compared to a touch gesture.

Assume you have perfect hand tracking implemented on your mobile phone, that is, your hand and fingers can accurately be tracked at various levels of granularity in the 3D space covered by the range of the phone's cameras.

1 pt. **e.** [max. 1 pt] There are several obvious problems when such a method is used for mobile interaction. Name one of them.

1 pt. **f.** [max. 1 pt] Yet, there are also good use cases and examples where such hand tracking would be useful as input. Provide one of them.

1 pt. **g.** [max. 1 pt] In the lecture, I also shortly mentioned Google Soli, which is a "miniature radar-based interaction enabling motion understanding at various scales" (quote from slides). Give one advantage that such an approach has compared to the hand tracking approach described above.

7 **Mobile gaming**

A common interaction design for mobile games that is inspired by controllers from video game consoles are **twin stick shooter** buttons. One design option when implementing them on a touch screen is to realize them as static controls or as dynamic controls.

2 pt. **a.** [max. 2 pts] Explain what that means, that is, what is a static control design, and what is a dynamic control design?

Implementations of such twin sticks on touch screens leads to several problems that do not exist for hard buttons on controllers. One of them is the fat finger problem. Another one is the drift problem.

4 pt. **b.** [max. 4 pts] Discuss the **fat finger** problem in this context. First, explain what is meant by that, that is, what kind of problem(s) occur because of this in the context of twin sticks. Then, discuss it with respect to static and dynamic controls, that is, shortly describe if the problem appears in either of these implementations and how (or why not, if it doesn't).

3 pt. **c.** [max. 3 pts] Discuss the **drift problem** in this context. First, explain what is meant by that, that is, what it is and why it happens. Then, discuss it with respect to static and dynamic controls, that is, shortly describe if the problem appears in either of these implementations and how (or why not, if it doesn't).

In the paper *Investigating on-screen gamepad designs for smartphone-controlled video games*, M. Baldauf et al. (2015) used a similar implementation of on-screen controller elements to control a video game on a distant screen.

1 pt. **d.** [max. 1 pt] Name one problem that does not exist for on-screen controllers in this context compared to mobile games played on your phone.

8 3D and around body interaction

In their design paper Way Out: A Multi-Layer Panorama Mobile Game Using Around-Body Interactions, S.-Y. Teng et al. (2017) propose a game where you can "navigate an omnidirectional panorama by moving the device around the body, as if the display is a peephole to another world" (quote from paper).

2 pt. **a.** [max. 2 pts] Describe what kind of sensors they used to implement this and why (i.e., what kind of data was needed from them to achieve this).

Because their paper was a design paper and not a research paper, they did not compare it with other approaches to navigate 3D spaces on mobiles. Yet, we can make educated guesses. Assume you want to set up an experiment comparing this approach with 3D navigation by tilting of the device around its own axes (we discussed this latter approach in various contexts including mobile gaming).

2 pt. **b.** [max. 2 pts] Phrase a hypothesis highlighting one aspect where the authors' approach might be better than tilting and explain why you make this assumption.

A short answer can be sufficient. For example, something like this (different context, just to illustrate a possible phrasing): I expect that walking is better for losing weight than cycling because it is considered a weight-bearing activity, while cycling isn't.

2 pt. **c.** [max. 2 pts] Phrase a hypothesis highlighting one aspect where tilting might be better than the authors' approach and explain why you make this assumption.

As above, a short answer can be sufficient.

Around body interaction has various advantages (e.g., it might benefit from spatial memory). Yet, there are sometimes situations where the implemented behavior that is evoked by certain motions of the device feels counterintuitive.

1 pt. **d.** [max. 1 pt] Give one example for this where the output on the screen may feel obvious to some users but counterintuitive to others.

9 Mobile augmented reality (AR)

AR can be achieved in various ways, for example, via head-worn AR glasses, but also via handheld devices such as mobile phones and tablets.

2 pt. **a.** [max. 2 pts] Give one convincing example, use case, or situation where a handheld AR solution would be sufficient if not better than one with head-worn AR glasses. Shortly explain why.

2 pt. **b.** [max. 2 pts] Give one convincing example, use case, or situation that can be achieved with head-worn AR glasses but not or much worse with mobile handheld AR. Shortly explain why.

2 pt. **c.** [max. 2 pts] Give one convincing example for handheld mobile AR where full registration in 3D is <u>not</u> necessary but it could still be considered AR.

Ray picking selects the first object that is hit by a ray "shot" from the device towards the AR scene shown in the device's display.

1 pt. **d.** [max. 1 pt] Explain how you can select an object with ray picking that is placed behind the first one hit by the ray.

1 pt. **e.** [max. 1 pt] Explain how you can rotate or move an object in 3D using ray picking.

Thank you for participating in the course.
I hope you enjoyed it.
Now have a nice summer vacation!

PS: If you haven't done so already, please fill out the Caracal evaluation to help me improve the course. Thanks!