[20240611] INFOMMOB - Mobile interaction - 4 - USP

Course: BETA-INFOMMOB Mobile interaction (INFOMMOB)

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The exam contains multiple questions, each with several sub-questions. Be aware that some questions have lots of sub-questions, others have much less. Also, some may just need a few words to answer, others may need more elaborate text. You can go back and forth between the questions and do not need to answer them sequentially.

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

Good luck!

Number of questions: 9

1 General context - The seven waves of mobile computing

In his article on "Mobile Computing," Jesper Kjeldskov describes seven "waves" of mobile computing.

1 pt. **a.** [max. 1 pt] One of these waves is **connectivity**. Describe in your own words what is meant by connectivity in this context.

1 pt. **b.** [max. 1 pt] Give an example of mobile computing (other than making phone calls) that clearly benefits from this technological achievement or would otherwise not be possible.

1 pt. **c.** [max. 1 pt] Another wave is **divergence**. Describe in your own words what is meant by divergence in this context.

1 pt. **d.** [max. 1 pt] Give an example of mobile computing that clearly benefits from this design trend.

1 pt. **e.** [max. 1 pt] The opposite of divergence is **convergence**. Describe in your own words what is meant by convergence in this context.

2 pt. **f.** [max. 2 pts] Give an example where there are advantages that speak in favor of divergence, but due to connectivity, people usually prefer devices that can be categorized under the wave of convergence. Shortly state why connectivity is so important here, that people chose for the latter despite the advantages speaking for divergence.

2 Camera-based interaction

Note: The first three sub-questions relate to each other. Read them all before answering the first one.

1 pt. **a.** [max. 1 pt] Give an example where the camera of a mobile phone is used for interaction.

1 pt. **b.** [max. 1 pt] Give a reason why using your phone's camera is an advantage in this context or why it has a benefit over other approaches.

1 pt. **c.** [max. 1 pt] Give a reason or describe a scenario in which using the phone's camera in the example above could cause problems and might motivate developers to implement additional interaction options and not solely rely on camera-based interaction.

1 pt. **d.** [max. 1 pt] The fact that smartphones are basically a mini computer with a touch screen also had an impact on picture taking. Give one example related to taking pictures of something that can be done with the camera of a mobile phone but not with a standard consumer camera that does not have high processing power or a touch screen display.

3 Displays (technology)

One important measurement for the quality of a display is its **ppi (pixels per inch)**.

1 pt. **a.** [max. 1 pt] How is the ppi of a display defined?

1 pt. **b.** [max. 1 pt] Why is it a better measure for the quality of a display than its resolution?

1 pt. **c.** [max. 1 pt] The displays of phones often have a higher ppi than the displays of tablets, although both are sold as high-quality and high-resolution devices. Why is that the case and why is it justified to advertise both as such?

2 pt. **d.** [max. 2 pts] In the lecture, we discussed a paper where they tested the perceived media quality of different media types depending on a display's ppi. The results showed a clear difference in perceived media qualities for text, but only a smaller effect for videos. What is a possible explanation for that?

Displays in mobile computing these days often feature some sort of **touch technology** to directly interact with them.

1 pt. **e.** [max. 1 pt] One of these technologies are vision- or camera-based touch screens. Give one convincing example where such touchscreens are better than regular ones or even essential to have.

1 pt. **f.** [max. 1 pt] One problem with capacitive and resistive touch screens is that they do not provide any kind of texture feedback. Give an example for a technology that does that. (*Just stating the name is sufficient. No explanation needed.*)

4 Displays (small screen sizes)

One problem with smartphones is that they need to be small and portable, often resulting in situations where interaction design is challenged with very limited screen estate. In the past, people came up with various innovative interaction designs to cope with this. Yet, many of those are not used these days anymore. Name two technical improvements that are the reason for this.

1 pt. **a.** [max. 1 pt] First technical improvement:

1 pt. **b.** [max. 1 pt] Second technical improvement:

1 pt. **c.** [max. 1 pt] Give one problem with small screen sizes that remains despite these two technical improvements.

1 pt. **d.** [max. 1 pt] Give one example for an innovative interaction design that is still used today despite these two technical improvements (even if it is just used to a lesser degree or only in dedicated cases).

5 Perception & interaction design

Common apps for podcasts often allow you to modify playback speed.

1 pt. **a.** [max. 1 pt] Give a short explanation why.

1 pt. **b.** [max. 1 pt] Give a short explanation why we often do not find this feature in music players.

Rapid Serial Visual Presentation (RSVP) is a technique where visual content is presented very fast to a user.

2 pt. **c.** [max. 2 pt] Give one convincing example where RSVP is used for mobile interaction and shortly explain how it works.

2 pt. **d.** [max. 2 pts] Both approaches, faster playback and RSVP, work well in certain contexts but are not useful for others. Give one example where neither of these approaches work well and shortly explain why.

6 Interaction design

Selecting targets on a touch screen can be challenging, especially when they are very small or close to each other. A reason for this is the so-called "fat finger problem."

2 pt. **a.** [max. 2 pts] Shortly explain what is meant by that in this context.

2 pt. **b.** [max. 2 pts] Give an example for an interaction design, that is, a software-based solution that solves this problem for a concrete use case or scenario.

2 pt. **c.** [max. 2 pts] Assume that to avoid the fat finger problem, you want to use tilt for target selection. That is, instead of selecting a target by touching it, you tilt the phone and select the target by clicking anywhere on the screen once a tilt-controlled cursor is over said target. Name one problem with such an approach and shortly explain it.

7 Mobile interaction design & games

Two popular interaction approaches for mobiles are touch interaction (via touch screens) and tilt-based interaction (by tilting your phone).

1 pt. **a.** [max. 1 pt] Give one general advantage that touch interaction often or always has compared to tilt-based interaction (or an aspect, functionality, or solution that can be done more easily with touch compared to tilt).

1 pt. **b.** [max. 1 pt] Give one general advantage that tilt-based interaction often or always has compared to touch interaction (or an aspect, functionality, or solution that can be done more easily with tilt compared to touch).

1 pt. **c.** [max. 1 pt] Give one common disadvantage of tilt-based interaction that does not apply or to a lesser degree in the context of mobile gaming or might even be an advantage there.

People used to play with controllers for game consoles often complain about soft-buttons on a touch screen, stating that major problems are a "lack of interaction speed" and the fact that "one cannot rest one's fingers on the screen."

2 pt. **d.** [max. 2 pt] Why is "lack of interaction speed" mentioned as a problem more often in the context of mobile gaming than in other areas of mobile interaction?

1 pt. **e.** [max. 1 pt] Give a concrete example from mobile gaming where this (i.e., "not being able to rest your finger on the screen") is a problem.

Shortly discuss this in relation to "static or dynamic controls" described in Graham McAllister's blogpost "A Guide To iOS Twin Stick Shooter Usability." That is, answer the following sub-questions:

2 pt. **f.** [max. 2 pts] What are static and dynamic controls and what is the major difference between them?

1 pt. **g.** [max. 1 pts] In context of the "not being able to rest your fingers on the screen" problem, which of them provides the better solution and why?

8 AR&VR on mobiles

Because we have HD displays and various sensors in our phones, we can also use them to create a head-mounted display (HMD) for immersive virtual reality (VR). Explain how this is done. To do this, answer the following sub-questions:

4 pt. **a.** [max. 4 pts] List all sensors that are needed for this and what they are used for.

1 pt. **b.** [max. 1 pt] What else is needed for this besides a mobile phone? Be specific (e.g., not just "a case" but what characteristics or features it must have).

2 pt. **c.** [max. 2 pts] This can only be used to create a "limited" or restricted HMD VR experience. Explain why. That is, what is missing that prevents us from using such devices for a full, 360-degree immersive VR experience?

We also discussed how we can create VR-related experiences on a mobile device (phone or tablet) other than using HMDs. That is, ones where we do not "put the phone in a case" but hold it in our hands and can still explore a 3D environment. One of them was referred to as "fixed world VR." *(In case you need a memory refresh: That was the one where you hold your phone or tablet with both hands and the screen provides a window into a fixed virtual world surrounding you.)*

2 pt. **d.** [max. 2 pts] Explain if there is a difference in the implementation between both and if so, what it is.

1 pt. **e.** [max. 1 pt] Fixed world VR does not provide such a fully immersive experience as VR with HMDs does. Give one convincing example where this is also not needed or even not wanted.

We can also use our mobile phones to create Augmented Reality (AR), not just VR.

1 pt. **f.** [max. 1 pt] Shortly explain how this is done. Make sure to address both parts of AR, the "augmented" part and the "reality" part.

1 pt. **g.** [max. 1 pt] Compare this with the "fixed world VR" implementation. What are the differences we must address when implementing them? *(Note that only technical/implementation differences are asked for, not usage or user experience-related ones.)*

1 pt. **h.** [max. 1 pt] AR on your mobile phone does not provide such a fully immersive experience as AR with HMDs does. Give one convincing example where this is also not needed or even not wanted.

9 Comparison and evaluation of systems

You read two papers that both deal with the problem that parts of the screen are out of reach when operating the phone with one hand (out-of-reach problem). One of them was "Investigating Tilt-based Gesture Keyboard Entry for Single-Handed Text Entry on Large Devices" by Hui-Shyong et al. (2017) where they introduced an approach entitled SWiM. One was "ForceRay: Extending Thumb Reach via Force Input Stabilizes Device Grip for Mobile Touch Input" by Christian Corsten et al. (2019) where they introduced an approach entitled ForceRay.

1 pt. **a.** [max. 1 pt] Shortly explain how SWiM works.

1 pt. **b.** [max. 1 pt] SWiM was introduced as an approach for typing on large displays. The ForceRay was introduced for target selection on large displays. Give a good reason why ForceRay might not be the better choice for typing, although both deal with the out-of-reach problem.

2 pt. **c.** [max. 2 pt] Give an example (e.g., a scenario, use case, functionality) where we are faced with the out-of-reach problem and ForceRay would be the better solution compared to SWiM. Shortly explain why.

2 pt. **d.** [max. 2 pts] In the future work section, Corsten et al. state that the ForceRay was just designed for taps, not for gestures such as a swipe. Describe an idea of how the latter (i.e., using this concept also for swipe gestures at the top corner of the screen that is not reachable with one's thumb) can be realized. *(They present one in the paper, but other options may exist. Any convincing one will give full credits.)*

2 pt. **e.** [max. 2 pts] There are various ways to do user studies, including studies in a controlled lab environment and long-term studies in the field. In their paper, Corsten et al. tested the ForceRay with the first one (lab study) but also suggest a long-term field study in their future work section. Give one concrete reason why this would be good for the ForceRay technique. (*Note that the question asks for a reason directly related to the ForceRay technique, not a generic one for field vs. lab studies. They present one in the paper, but other reasons may exist. Any convincing one will give full credits.*)

Thank you for participating in the course. I hope you enjoyed the lectures and look forward to your project presentations.

Exam results will be available after the last project meetings (June 29, 2024). Once Caracal opens, I would appreciate it if you could give some feedback!