Mobile Interaction (INFOMMOB) 2017/2018

Exam, Wednesday, June 27, 2017, 11:00-13:00, EDUC-ALFA

Do not start with the exam until being told to do so.
Read the comments on this page carefully.

- The questions for this exam are printed on 14 pages (including this title page).
  The back of each page should be empty.
  It is your responsibility to check if you have a complete printout.
  If you have the impression that something is missing, let us know.
- Use a pen, not a pencil. Do not use a red pen.
  Write your answers below the questions in the designated areas.
  If you need more space, please continue writing on the back of the *preceding* page.
- You may *not* use books, notes, and any other material or electronic equipment
  (including your cellphone, even if you just want to use it as a clock).
- You have max. 2 hours to work on the questions
  (notice that this includes distribution & collection of exams).
  If you finish early, you may hand in your work and leave,
  except for the first half hour of the exam.

GOOD LUCK!

First name	Last name	Student ID

1. Introduction / general aspects

Problem 1a (8 pts) In the chapter "Mobile Computing" of The Encyclopedia of Human-Computer Interaction, J. Kjeldskov describes seven waves or trends from the history of mobile computing, including *connectivity, convergence,* and *divergence.* We want to look at them now in the context of *mobile music players*, that is, devices that allow you to listen to music while you are on the go. *[Note: Short answers are sufficient.]*

Shortly describe what is meant by *convergence*.

Give one advantage of convergence in relation to music players;
that is, why or how did this trend improve mobile music players and their usage?

Shortly describe what is meant by *divergence.*

Give one advantage of divergence in relation to music players;
that is, why or how did this trend improve mobile music players and their usage?

Shortly describe what is meant by *connectivity*.

[Note: problem continues on next page]

**Give one advantage of connectivity in relation to music players;
that is, why or how did this trend improve mobile music players and their usage?**

If we look at today's situation, there are very few stand-alone mobile music players anymore. Instead, people tend to use their mobile phone for this purpose. **Discuss why this happened by providing some convincing reasons (hint: you can relate this to your answers from above).** *[Note: this part requires some speculation, so every reasonable and good argument will give credits. Make sure though to have a "complete" answer and not just provide one single reason.]*

Problem 1b (3 pts) Modern smartphones can support various types of input. Three of them are *touchscreen-based interaction using your fingers or thumbs, touchscreen-based interaction using a dedicated stylus,* and *voice commands using speech recognition. [Note: In the following, Short answers are sufficient. Make sure to give a convincing use case, task or action, not just an advantage and that the advantage clearly relates to the task.]*
Give one use case, task, or action where *touch screen-based interaction using your fingers or thumbs* would be preferred over the other two input types. Shortly explain why it is an advantage to use this method in this context.

[Note: problem continues on next page]

Give one use case, task, or action where *touch screen-based interaction using a dedicated stylus* would be preferred over the other two input types. Shortly explain why it is an advantage to use this method in this context.

Give one use case, task, or action where using *voice commands* would be preferred over the other two input types. Shortly explain why it is an advantage to use this method in this context.

2. Basic technologies / sensors

Problem 2a (2 pts) In the lecture, we mostly discussed interactions where users are actively providing input to a smartphone. The paper "A survey of mobile phone sensing" by Lane et al. discusses also interaction where the smartphone automatically gathers input. **Give an example where the accelerometer is used for active user input, and an example where it is used for passive input** (i.e., automatic information gathering while you are having your device with you, even when it is only in your pocket and you are not actively using it). **Shortly state the usage and what data is gathered for it from the accelerometer.** *[Short answers are sufficient. You do not have to give an example from the paper but any convincing one is fine.]*

Example for accelerometer usage in active interaction:

Example for accelerometer usage in phone sensing (passive input):

Problem 2b (6 pts) Assume you want to implement a stargazing app on a smartphone or tablet; that is, an app where, for example, when you are out on a clear night, take your phone, hold it to the sky, and then get exact information about the star constellations that you see in the direction that you are pointing at with your device.
What kind of sensors would you need to implement that? Name each sensor and shortly state why or for what purpose you need it.
[Short answers are sufficient. Note that different results are possible here and all correct solutions will get full credit (redundant information will not be credited though; this is to avoid that people are just randomly writing down some sensors in the hope that the few correct ones will give credit).]

3. Touchscreens & touch technology

Problem 3a (6 pts) In the paper "BackXPress: Using Back-of-Device Finger Pressure to Augment Touchscreen Input on Smartphones," Corsten et al. introduce a new interaction technique that lets users create BoD (Back-of-Device) pressure input. They created a prototype with a 2^{nd} phone on the back that provided transient pressure when pressed on the back, which in turn is used for input on the phone facing the user.

What two advantages does this approach have according to the authors? (Hint: we discussed one of them in the lectures, the other one was only in the paper)
First advantage:

Second advantage:

In their concluding design guidelines, the authors recommend using their approach for interaction with landscape-oriented devices (not portrait mode). Give a reason why.

[Note: problem continues on next page]

In the lecture, we discussed another prototype for BoD interaction. There, the authors used *optical touch* (i.e., camera-tracking of fingers) to register interaction on the back side. **Give one advantage that the touch-technology used in the BackXPress paper has compared to the solution with optical touch.**

Give an application, characteristic, or task where it would be better to use optical touch input for BoD interaction instead of the technology used by BackXPress.

The technology used by BackXPress for BoD interaction is the same as used in common high-end smartphones these days. **Give an example where optical touch would be better for regular (non-BoD) interaction, i.e., an application, task, or interaction feature that is useful, but can only be implemented with optical touch.** *[Short answer is sufficient, make sure though that it is clear why this is only possible with optical touch.]*

Problem 3b (2 pts) Standard touchscreens used in today's phones do not provide the rich haptic feedback we get when interacting with physical objects. Electrostatic touchscreens (i.e., the ones from Disney Research we saw in the lecture where electrostatic signals are used for tactile rendering) deal with this problem.

Shortly describe the haptic characteristic that is supported by these touchscreens (i.e., what kind of richer haptic feedback are they providing compared to standard touchscreens).

Give an example of a haptic feedback that would be useful for mobile phones but can <u>not</u> be created with this technology.

Problem 3c (1 pt) In the lecture, we discussed the paper "The generalized perceived input point model and how to double touch accuracy by extracting fingerprints" by Holz et al. There, the authors studied touch contact points when interacting with touch screens and identified a consistent offset from the target area. They then presented a prototype using a touchscreen with integrated fingerprint sensor to illustrate how accommodating for this offset can improve precision. **Give one reason why the fingerprint sensor in the touchscreen was needed here.** *[There are multiple ones, but it is sufficient to name one of them.]*

4. Touch interaction design and touch gestures

Problem 4a (3 pts) **Name three common touch problems when interacting with touchscreens that do <u>not</u> appear when using a mouse.** *[One phrase per problem can be sufficient to get full credits. Note that we listed three in the lecture, but others exist and can be correct as well.]*

Problem 1:

Problem 2:

Problem 3:

Problem 4b (4 pts) In the paper "Use the Force Picker, Luke: Space-Efficient Value Input on Force-Sensitive Mobile Touchscreens," Corsten et al. introduce an alternative design for the selection of values from long ordered lists that minimizes needed screen space and gesture space. The authors also list disadvantages of other techniques that minimize screen space. **For each of them, state one disadvantage.** *[Note that other disadvantages than the ones stated by the authors exist and can give full credits.]*

Speech input:

Tilt sensing:

Remapping existing physical controls like volume buttons:

[Note: problem continues on next page]

Give one characteristic or problem that the Force Picker solution might have that would prevent developers from including it into their apps. *[This is not directly discussed in the paper and thus multiple correct answers may exist.]*

Problem 4c (3 pts) In the BackXPress paper discussed in Problem 3a above, only discrete touch input was used, but no touch gestures. In the lecture, we discussed some issues and potential problems for touch gestures done at the front of the device (i.e., directly on the screen). **For the ones listed below, shortly discuss how these issues change when we use the BackXPress phone prototype for back-of-device gestures.** State if they apply there as well. If not, shortly explain why not. If yes, shortly state if they differ and how. If they do not differ, explain why. *[Mark the correct option below and then shortly explain your choice.]*

Potential problems with gesture recognition:

- How to recognize? ***Applies also for BoD gestures with BackXPress?***
  [No | Yes, but in a different way | Yes, in the same way]

- How to distinguish & resolve conflicts between gestures? ***Applies also for BoD gestures with BackXPress?***
  [No | Yes, but in a different way | Yes, in the same way]

- No hovering state. ***Applies also for BoD gestures with BackXPress?***
  [No | Yes, but in a different way | Yes, in the same way]

5. Mobile evaluation

Problem 5a (6 pts) In the paper “Subjective and Objective Effects of Tablet’s Pixel Density,” Lischke et al. study the effect of pixel density of tablet screens. In the paper “Influence of letter size on word reading performance during walking,” J. Conradi addresses the impact of letter size. In both cases, the authors also measured the distance between the head of the user and the device during the test.
Shortly state why this was done.

How did Lischke et al. consider this measurement in their experiment and what was the consequence for the result?

How did J. Conradi consider this measurement in her experiment and what was the consequence for the result?

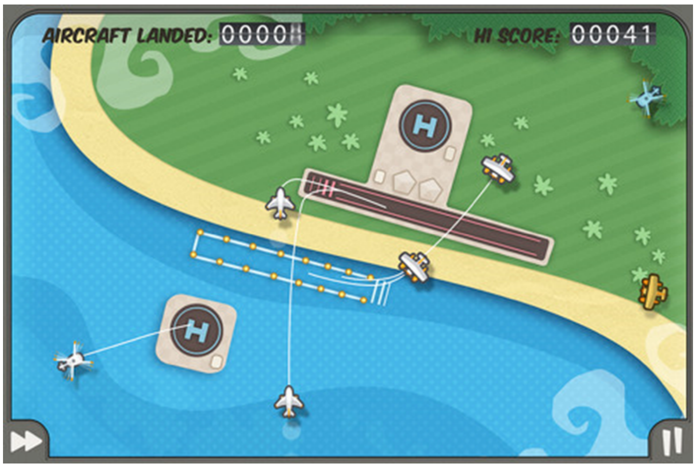
In the paper “BiTouch and BiPad: Designing Bimanual Interaction for Hand-held Tablets,” Wagner et al. do a pre-study investigating how people hold tablets in everyday use. They did <u>not</u> measure the distance between the head of the user and the device during this test. **Shortly explain why this was not necessary here.**

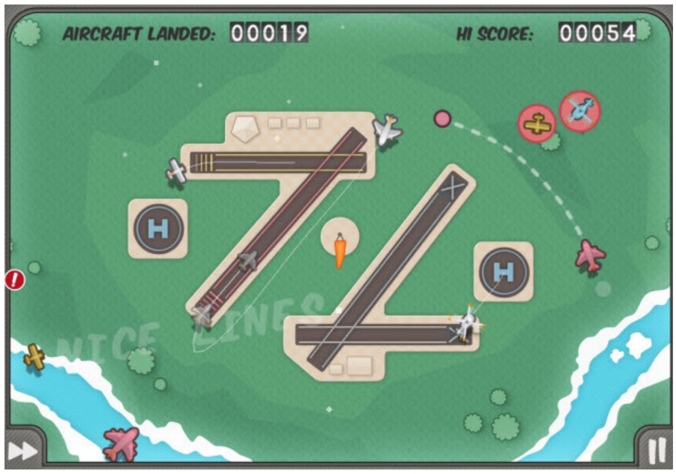
Problem 5b (1 pt) In the paper “Observational and Experimental Investigation of Typing Behaviour using Virtual Keyboards on Mobile Devices” by Henze et al., the authors state that: “To increase the study’s internal validity, the same keyboard is used for all devices.” **Give one aspect of their study that decreases internal validity**. *[Be specific and bring a reason related to the actual focus of the experiment. A generic statement such as “We don’t have background information about the participants” will not give you any credits.]*

6. Mobile gaming

Problem 6a (4 pts) The four aspects illustrated in the graphic to the right show different design options from the so-called Diegesis Theory.

Below, you see two images from the mobile game *Flight Control*. In this game, airplanes are coming randomly from all sides of the screen and it is your task to direct them to the airport, so they can land safely. You do this by clicking on a plane and drawing a trace to one of the runways. Once drawn, this trace appears as a white line on the screen (see left screenshot). The plane will then follow this trace. If planes get too close to each other, a red circle around them appears to indicate an impending crash (see right screenshot). You can change and redraw an existing trace at any time. At the top of the screen it shows how many aircrafts you have landed and the high score of the game. *[Note: this might be an oversimplified explanation of the game, but it contains all info that is needed to answer this question.]*





For each of the four aspects of the Diegesis Theory indicate if they are applied in this game design. If your answer is YES, give one example how (one word or phrase referring to the above game description could be sufficient in most cases). If your answer is NO, shortly explain what the respective term means and why you think it is not present (again, a few words are sufficient). Answers with no explanation will get no credits.

a) Non-diegetic Representations are used in this game: ☐ ***NO, because:*** ☐ ***YES, for example:***

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b) Spatial Representations are used in this game: ☐ ***NO, because:*** ☐ ***YES, for example:***

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c) Meta Representations are used in this game: ☐ ***NO, because:*** ☐ ***YES, for example:***

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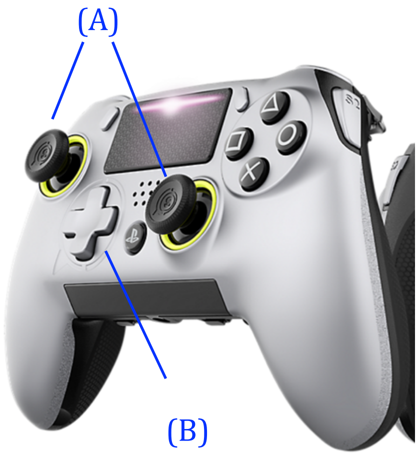
d) Diegetic Representations are used in this game: ☐ ***NO, because:*** ☐ ***YES, for example:***



Problem 6b (4 pts) In the blog post "A Guide To iOS Twin Stick Shooter Usability," G. McAllister discusses the pros and cons of four main design decisions when implementing the controls for twin stick shooters. These controllers usually resemble the joystick-like sticks you have on common game controllers (see (A) in image on the right). Yet, there are also other controls, e.g., ones that only allow for a discrete input in four directions (up/down/left/right; see (B) in image on the right). In the following, we refer to this as a "discrete joystick". Now we want to address two of McAllister's design decisions with respect to such discrete joysticks. *[Note that in both cases below there might be pros and cons. If you think both sides are relevant, include them into your justification.]*

For the design decision "static or dynamic controls": Which of the two options would you recommend for the implementation of a discrete joystick? Shortly justify your answer.

For the design decision "active outside of the VJR (virtual joystick region)": Which of the two options would you recommend for your implementation of a discrete joystick. Shortly justify your answer.

7. Mobile VR & 3D interaction

Problem 7a (5 pts) When looking at 3D graphics on a mobile device's screen, it can happen that the perspective is not correct (even if it was implemented correctly). **What is the cause of this?**

We can apply perspective correction to deal with this issue (Amazon calls this "dynamic perspective"). In the lecture, we talked about two approaches to do this; one is called "Fishtank VR", to the other we referred to as "Shoebox VR". **For each of them, state which sensor is used to realize it.**

Sensor used for Fishtank VR:

Sensor used for Shoebox VR:

What is an obvious limitation of a Shoebox VR implementation compared to a Fishtank VR implementation?

Shortly explain why in everyday usage of mobile devices, this shortcoming might not be a problem.

Problem 7b (2 pts) In the paper "Around-Body Interaction: Sensing & Interaction Techniques for Proprioception-Enhanced Input with Mobile Devices", Chen et al. discuss how moving the device in the 3D space around your body can be used for interaction.

Give one advantage of such an "around-body interaction" implementation.

Give one disadvantage of it.

8. Mobile AR

Problem 8 (4 pts) Ray casting or ray picking is a technique that is often used for mobile AR interaction.

Shortly explain how ray picking works. *[Note: one sentence is sufficient to answer this question correctly.]*

What is the major problem with ray picking? *[Again, one sentence could be enough here.]*

In the lecture, we discussed possible solutions to this problem. Explain the basic principle of one of them. *[A short description of the basic idea behind the approach is sufficient. You do not have to describe the details. It is also not required to remember the name of the approach, if you describe the idea behind it correctly (but don't mix the two; focus on one).]*

9. Mobile video

Problem 9 (6 pts) *Flicking* is a touch gesture that is often used to quickly skim large lists; by quickly swiping your finger over the screen, the list is "pushed" in the direction of the swipe, that is, it scrolls in that direction, first with a high speed, then gradually decreasing until it stops or the user interrupts the scrolling by a tap on the screen.

Assume you want to implement such a flicking gesture to quickly and interactively skim through the content of a video. When doing this, you have to make (at least) two critical design decisions. **What are these and why is it not straightforward how to implement them?** *[Note that there might be more than two and it is debatable which decisions are the most critical ones. If you come up with any other than the ones we discussed in the lecture and they answer this question well, you will get full credit, too.]*

First design decision:

Difficult / not easy to resolve because:

Second design decision:

Difficult / not easy to resolve because:

Give one advantage and one disadvantage that such an approach would have compared to a standard fast forward and fast backward scrolling as it is implemented in standard video players.

Advantage:

Disadvantage: