Mobile Interaction 2014/2015
Exam, Monday, June 29, 2015, BBG 007

Do not open this exam until instructed to do so.
Read the instructions on this page carefully.

- The exam is printed on 6 pages (including the title page).
  It is your responsibility to check if you have a complete printout.
  If you have the impression that anything is missing, let us know.

- Use a pen, not a pencil to write your answers. Please do not use a red one.
  Write your answers on the separate exam paper provided by us.
  Make sure to put your name and student id of each paper that you hand in!

- You can **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.
  If you finish early, you may hand in your work and leave,
  except for the first half hour of the exam.

- Notice that some questions have hints or comments on how to answer them written in
  italics below them. Make sure to read those *before* answering them ;)

GOOD LUCK!

Question 1: Mobile computing – Trends / seven waves (max. 6 points)

In Chapter 9, "Mobile Computing" from the book *The Encyclopedia of Human-Computer Interaction* seven waves of mobile computing are discussed, two of which are *convergence* and *divergence*. While these waves usually represent opportunities or advantages, they might also come with potential negative aspects. Shortly explain the terms convergence and divergence with respect to these seven waves and give an example for a potential disadvantage.

Note: A rather short, high-level description is sufficient, e.g., if the wave would be "miniaturization", you could write something like this: "Miniaturization describes the ability to create smaller devices. One possible disadvantage is that the small form factor might make interaction more difficult."

Question 2: Technologies – Displays (max. 4 points)

Question 2a: PPI is one characteristic of screens. What does it stand for and how is it defined?

Question 2b: When designing the interface of a touchscreen-based smartphone, button and icon sizes are a critical issue (not too small so they can easily be hit, but not too large so they don't use up valuable screen estate). Yet, common mobile interface design guidelines often do not specify the optimum number of pixels for buttons, but express their recommendations in other ways. Shorty explain why this is the case.

Note: No detailed explanation required. One short sentence can be enough to get you full credit.

Question 3: Technologies – Sensors for interaction (max. 3 points)

Modern phones contain many sensors, some of which can be used to make interaction more natural and "human-like". Sight, hearing, and touch are three important human senses. For each of these three, name one sensor that can be found in modern phones and that can be used to address this sense when designing mobile interfaces.

Question 4: Touch interaction – Touch gestures (max. 15 points)

In the lecture, we discussed the following problems and potential disadvantages of touch gestures (notice that these key phrases are a copy from a related slide used in one of the touch lectures):

1. Gesture recognition

   a. How to recognize?
   b. How to distinguish and resolve conflicts between gestures?
   c. No hovering state

2. Gesture design

   a. Natural gestures? Intuitive gestures?
   b. Cultural differences?
   c. Good guidelines & standards?

3. Usage

   a. Learnability (incl. communication & documentation)
   b. Discoverability (cf. icons)
   c. Memorability

We also discussed "Swype" as a non-typing approach for text input (cf. image below). Swype can be considered as a special kind of touch gesture-based interaction.

Shortly evaluate Swype with respect to each of the key phrases listed above (1a-c, 2a-c, 3a-c). That is, for each key phrase, give a short statement if this potential problem appears with Swype and how. If you think one of these potential problems does not appear when using Swype, just write "not applicable". If you think it does indeed present a problem that may appear when using Swype, shortly explain why or how (e.g., by providing a short example).

Comments on this question:

Keep your answer short. An example to illustrate: assume an interface that is operated by face tracking. Nodding your head with an up and down motion is used to confirm an input, shaking it left and right is used to cancel. Then a good answer for the key phrase "cultural differences" could be: "This could be a problem, because in some cultures, moving your head left and right indicates 'no' or disagreement, whereas in others it indicates 'yes' or agreement." Also, make sure to give a reason (e.g., do not just write "1a could be a problem because it's difficult" but give, for example, an example illustrating why it is difficult)".

Notice that this is an open question that might not have a "perfect" answer and people might disagree on certain statements. The idea of it is to verify if you have enough understanding of the subject to critically analyze designs. It is more important to demonstrate this than giving a particular answer, so even if I do not fully agree with your comments, you can get full credits if I see a good idea or line of thought in your answer.

Question 5: Tracking-based interaction – Interaction design (max. 7 points)

In the paper "Use Your Head – Exploring Face Tracking for Mobile Interaction" published at ACM CHI 2006, Hansen et al. discuss and test different design options for mobile interaction using head-tracking with the user-facing camera.

Question 5a: In the paper, the authors illustrate that there are four dimensions that we can track in order to map them to actions in the related application. What are these?

Note: Just listing all four is sufficient to get full credit. An explanation is not required.

Question 5b: In a related local student project, we realized that when using the phone in portrait mode, it is actually better to hold the device upside-down when using this technique. Shortly explain why this was the case.

Hint: The paper by Hansen et al. does not discuss this, but addresses a much related issue; if you remember it, you should have no problem answering this question. We also mentioned this as a common problem for tracking-based interaction in one of the lectures.

Question 6: Tilting-based interaction – Technology & design (max. 11 points)

Question 6a: Modern smartphones contain various sensors giving us information about the device's orientation and location in the real world. This information is always given with respect to a particular reference point. For each of the following sensors, write down what information it gives us and with respect to which reference point:

1. Accelerometer
2. Gyroscope
3. Magnetometer / digital compass
4. GPS

To illustrate how this question should be understood and answered, here a mockup example for another, non-location or orientation-related sensor: "Light sensors give us information about the incoming light intensity with respect to a real-world light source".

Question 6b: Assume a car racing game on a smartphone where left and right tilt-motions of the device are mapped to left and right steering actions in the game. What kind of sensor(s) would you use to implement that? Give one possible advantage of such an interaction and one possible disadvantage.

Note: Without a concrete proof or evaluation, possible advantages and disadvantages are of course always debatable. Make sure to provide one that illustrates that you understood related design problems when implementing such a game.

Question 7: Mobile evaluation – User study design and options (max. 12 points)

Question 7a: In the paper "Observational and Experimental Investigation of Typing Behaviour using Virtual Keyboards on Mobile Devices" published at ACM CHI 2012, Henze et al. present an evaluation with high external validity and discuss the advantages and disadvantages of such an approach compared to one with high internal but low external validity. Shortly explain what is meant by "external validity" and give one advantage of it compared to a study with high internal but low external validity.

Question 7b: Give an example for a user study with high internal validity and one advantage that such an approach might have compared to one with high external but low internal validity.

Question 7c: In relation to field studies, we shortly discussed the Experience Sampling Method (ESM) where, for example, people get short notifications on their mobile phone during their daily routine. Once they get the notification, they have to fulfill a certain task, which can then be evaluated with respect to the concrete context a user is in when fulfilling it. Discuss this approach with respect to internal and external validity, i.e., shortly describe if it has high or low external validity, high or low internal validity, neither, or both.
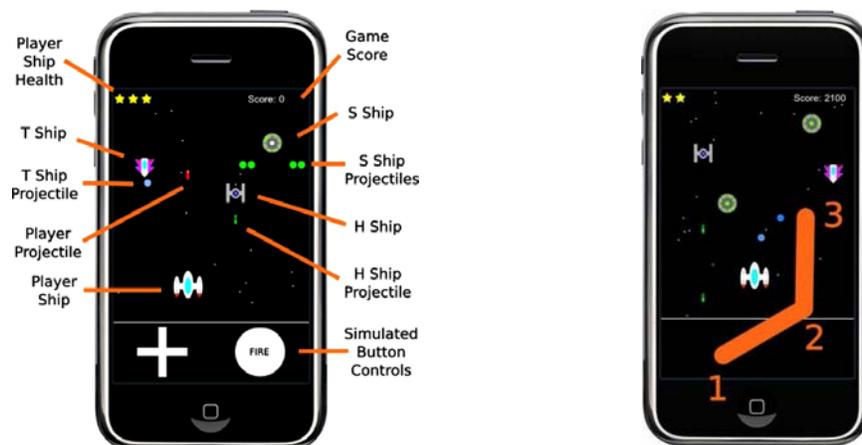
Note: A short description can be sufficient to get full credits. Obviously, there isn't a 100% correct answer here as it depends on the concrete study design, so just make sure that it becomes clear from your answer that you understood what internal and external validity means in this context.

Question 8: Mobile evaluation – User study design (max. 4 points)

The example below (which we discussed in the lecture about mobile gaming) illustrates the interface of a game that was used in a comparative study of three interaction designs: one was on-screen buttons (left image), and the other two were touch gestures and tilting (right image). In the latter two cases, the area used to show the on-screen buttons in the left image is replaced by an empty black area.

Question 8a: Give the reason why the authors of the related paper have decided to do this instead of using this empty space to display actual game content.

Question 8b: Give one reason that might speak against this decision, i.e., why one might have opted to decide otherwise and extend the visualization of actual game content across the whole screen for the touch gesture and tilting interaction designs.

Question 9: Mobile gaming – Interface and interaction design (max. 12 points)

Question 9a: Touchscreen-based games on mobile devices are faced with the same interaction and interface design challenges as all touch-based interfaces. Yet, there are also some additional issues that are particularly critical or characteristic for games. Give two examples, i.e., list two potentially critical issues that are typical for touchscreen-based mobile games but not that much for non-game applications on touchscreen-based smartphones.

Note: We mentioned some of them in the lectures, but you are welcome to list some that we didn't discuss as well.

Question 9b: When implementing an on-screen joystick, one design option is to make it dynamic or static. Give one example or reason that would speak for a dynamic design, and one that would speak for a static design.

Question 9c: Diegesis theory is a categorization in video game UI design that classifies interface visualizations in four groups. Spatial representation is one of them and it is often used in mobile games. Give a short explanation why this might be the case.

Note: Since this is a speculative question, there is no 100% correct answer. A short explanation what spatial representation is and a good reason why it might be an advantage to use it in mobile game design is sufficient to get full credit.

Question 10: Mobile gaming – Interface and interaction design (max. 10 points)

Question 10a: In the paper "Comparing order of control for tilt and touch games" published at IE 2014 by Teather and MacKenzie, the authors discuss two game control schemes that are predominant in actual commercial games. One of them is direct touch input; the other is indirect touch input. Shortly explain what is meant by that, i.e., briefly describe each of these two game control schemes.

Question 10b: In the lectures, we actually discussed a third one that is not covered in Teather and MacKenzie's paper. Shortly describe it.

Note: You don't have to use the exact terms that we had in the lecture – they were not consistent anyhow – but a short description or key phrases illustrating it with respect to the above mentioned control schemes can be sufficient to get full credits. Hint/comment: You could also consider this 3rd option as a sub-category of indirect touch input.

Question 10c: There was not much of a performance difference between tilt and touch interaction in the evaluation presented in this paper. This might have come as a surprise. Yet, in the discussion the authors note that the size of the touch strip used in their interface may have negatively affected the related results. Shortly explain why this might have been the case.

Note: You can but you don't have to quote the concrete case from the paper. A general description of the related problem is okay, too.