Mobile Interaction (INFOMMOB) 2016/2017

Exam, Wednesday, June 28, 2017, 11:00-13:00, RUPPERT-BLAUW

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 anything 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.

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

GOOD LUCK!

First name	Last name	Student ID

Problem 1 Introduction / general issues

Problem 1a (3 pts) In the chapter "Mobile Computing" of The Encyclopedia of Human-Computer Interaction, J. Kjeldskov describes *divergence* and *convergence* as two waves or trends of mobile computing that are in a way contrasting. Give one good interaction-related example that speaks in favor of divergence and one that speaks in favor of convergence by giving a task or application and stating why one would prefer to do that on a device that is representative for divergence, and one that is representative for convergence.

Task / application:

I would rather do this task / use this app on a mobile device representative for the wave of divergence, because:

I would rather do this task / use this app on a mobile device representative for the wave of convergence, because:

Short answers are sufficient. Make sure though that your reasons are convincing & clearly interaction-related.

Problem 1b (2 pts) The app store was one of the key issues for the iPhone's success. Give two reasons why.

Reason 1:

Reason 2:

A short answer or key phrases are sufficient. Hint: we discussed them in the lecture, but you can also find some in one of the papers for mandatory reading (although there they have been stated in a different context).

Problem 1c (1 pts) Give one reason why app stores for mobiles can have a benefit for scientific research in the domain of mobile interaction.

Hint: again, think about what we said in the lectures or what you read in the mandatory papers.

Problem 1d (2 pts) Apple was originally opposed to supporting pen input for their mobile devices (iPhone and iPads). Give a reason why that might have been.

Meanwhile, however, they also support pen input for some of their tablets (not the iPhone though). Give a reason why this might be the case. Also, shortly comment on why they probably don't do that for iPhones.

Hint: J.C. Lee provides the answer to this 2nd question in his video talk entitled "The myths of the dying mouse", although other reasons might be correct, too, and thus also give you full credit. The iPhone-related part of the question requires some speculation (because Apple won't tell us), so every reasonable and convincing reason will give you credits.

Problem 2 Basic technologies / sensors

Problem 2a (3 pts) In the paper "A survey of mobile phone sensing" by Lane et al., the authors state that "the ability of cheap embedded sensors initially included in phones to drive the user experience (...) is changing the landscape of possible applications." Give one example of such a sensor, state what type of user experience originally motivated its embedding into phones, and give an example of a new usage or application it enabled beyond that (e.g., by offering a new type of interaction).

Sensor:

User experience:

New application, usage, or interaction it can be used for:

Key phrases are sufficient. The paper gives a good example, but other correct solutions exist.

Problem 2b (4 pts) In the paper mentioned above ("A survey of mobile phone sensing"), the authors categorize sensing by its scale into three groups: *personal sensing*, *group sensing*, and *community sensing*. Give an example application or scenario for each of these three types.

Personal sensing:

Group sensing:

Community sensing:

Again, key phrases are sufficient, and good examples are listed in the paper, but other correct ones exist.

Each of these sensing approaches comes with various potential problems and unsolved issues. Give one of these issues that may apply in context of group sensing and community sensing, but not (or to a lesser degree) for personal sensing.

A potential problem or issue that has not been resolved for group and community sensing is:

Note: the paper lists several issues but doesn't distinguish between the different types of sensing. Make sure that your comment clearly reflects a problem that is more apparent in the latter two categories.

Problem 2c (1 pt) Name one non-technical issue (e.g., other than PPI, resolution, number of colors, etc.) that could influence how well the quality of a display is perceived.

Note: one word could be enough to get full credits.

Problem 2d (1 pt) Give one example application where a magnetometer (i.e., a digital compass) is used as input that is not map or navigation related and shortly state what the magnetometer is used for and why we need it (i.e., why we can't use other sensors commonly available on IMUs (inertial measurement units) and in modern smartphones for this task.

Problem 3 Touchscreens & touch interaction design

Problem 3a (4 pts)

For each of the following touch screen types, name one disadvantage or problem of traditional resistive touchscreens that they resolve or that doesn't exist with them.

(A) Standard capacitive touchscreens:

(B) Pneumatic displays (i.e., the ones we saw in the lecture where pneumatics are used to created physical bumps or elevations on the display):

(C) Electrostatic touchscreens (i.e., the ones from Disney Research we saw in the lecture where electrostatic signals are used for tactile rendering):

(D) Optical (vision-based) touchscreens (e.g., the ones used in the interactive tables by Microsoft or the "back of device touch" prototypes shown in the lecture):

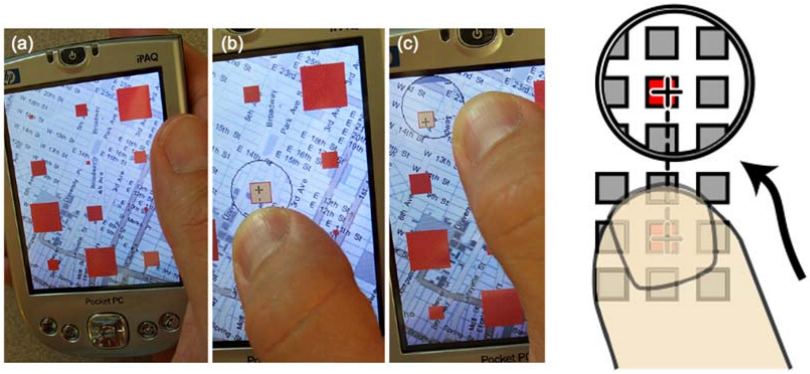
Make sure to clearly state the problem. Don't just rephrase the explanation of the technology from the question.

Problem 3b (1 pts)

"Back of device touch" on mobile phones can have certain advantages compared to standard touchscreens (cf. previous question, D). Yet, they also introduce potential disadvantages. Give an example of an interaction or situation where "back of device touch" on mobile phones would cause a problem or have an issue that does <u>not</u> happen or exist with standard touchscreens.

Make sure that your example illustrates a disadvantage compared to standard touchscreen interaction on mobile devices (i.e., your example should address a problem that does exist with one but not with the other technology).

Problem 3c (4 pts) In the lecture, we looked at an approach proposed by Vogel et al. called *Shift* for the selection of small targets on a mobile's touch screen, e.g., icons on a map (cf. images below). In this design, the touched area is shown in an enlargement above the position touched by the finger or thumb. Selection of the target is done when the finger or thumb is lifted from the screen.



What problem motivated this design and what is the cause of this problem?

A few words are sufficient to get full credits. Note however that it is important that you mention the cause of the problem as well as the issue(s) that it may lead to during interaction.

While variations of this technique can be found in today's devices (e.g., the lens above the keys on the iPhone's keyboard), it is commonly <u>not</u> used in map apps (e.g., Google Maps on Android or Apple Maps on the iPhone), although that was the motivating example used by the authors (cf. images above). Give a convincing reason why this might be the case.

Note that the answer to this question contains some speculation of course, because we don't know why app developers chose not to use it. There is an obvious and thus very likely reason though, but various answers might exist here that could result in full credit.

Problem 4 Interface & interaction design (including human aspects)

Problem 4a (9 pts) Assume we have perfect 3D finger tracking implemented on a mobile, i.e., you can use the user facing camera to track your index finger in 3D. Now we want to use the related data (x, y, z-values plus time stamp) for gesture-based interaction on a smartphone.

In the lecture, we discussed problems & potential disadvantages of touch gestures. Gestures based on finger tracking are different, but suffer from them as well. Below are some issues that were listed on a related slide about problems with touch gestures. Discuss them with respect to finger tracking-based gesture interaction, i.e., if this problem does not apply to it, shortly explain why, and if it does apply, shortly explain how or give a convincing short example.

Gesture recognition:

- How to recognize?
  Applies [yes / no]

- How to distinguish and resolve conflicts between gestures?
  Applies [yes / no]

- No hovering state.
  Applies [yes / no]

Gesture design:

- Natural gestures? Intuitive gestures?
  Applies [yes / no]

- Cultural differences?
  Applies [yes / no]

- Good guidelines & standards?
  Applies [yes / no]

Usage:

- Learnability
  Applies [yes / no]

- Discoverability
  Applies [yes / no]

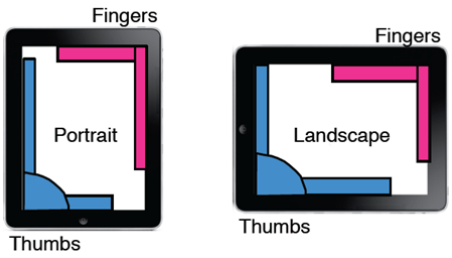
- Memorability
  Applies [yes / no]

Note 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. Thus, even if I do not fully agree with your comments, you can get partial or even full credits if I see a good idea or line of thought in your answer.

Problem 4b (2 pts) Apps to playback podcasts or e-lectures often allow you to modify the playback speed (e.g., enabling up to two times faster playback). Give a reason why and shortly state the human auditory ability related to that.

A short answer stating the human auditory ability and why it is useful in this context is sufficient to get full credits.

Problem 4c (2 pts) In their paper "BiTouch and BiPad: Designing Bimanual Interaction for Hand-held Tablets", Wagner et al. propose an interaction design for bimanual interaction that uses the so-called "support-hand interaction zones" illustrated to the right.



Name or describe one human aspect, characteristic, or ability that is (positively) considered in this design and shortly state how. Then, name or describe one human aspect, characteristic, or ability that might cause a problem with this approach compared to a standard interaction design.

Human aspect that is positively considered and how:

Human aspect that might cause problems and why:

Short answers are sufficient and encouraged. Notice that the first one is not explicitly stated in the paper, but implicitly given. The second one is not stated, and every answer might be debatable unless you back it up with a scientific study. Thus, every answer that reflects a good understanding of the issue you are stating and how it relates to this design will give full credits.

Problem 5 Mobile evaluation

Problem 5a (6 pts) In the paper "BiTouch and BiPad: Designing Bimanual Interaction for Hand-held Tablets", Wagner et al. did a preliminary study about how people are commonly holding tablets, with the following participants (quote from paper):

> *Participants. Six men and two women, average age 30. Four owned iPads, four had never used a tablet.*

Discuss this setup with respect to the two contrary characteristics of internal and external validity of a user study. Do this by shortly stating what the characteristic means and how this study relates to it. Then shortly state why this could be a problem when interpreting the results. Finally, shortly state why these results are still useful and the authors made a good decision in choosing this approach and setup.

Internal validity describes:

The internal validity of this study is:

Because:

External validity describes:

The external validity of this study is:

Because:

Thus, we must be careful when interpreting these results, because:

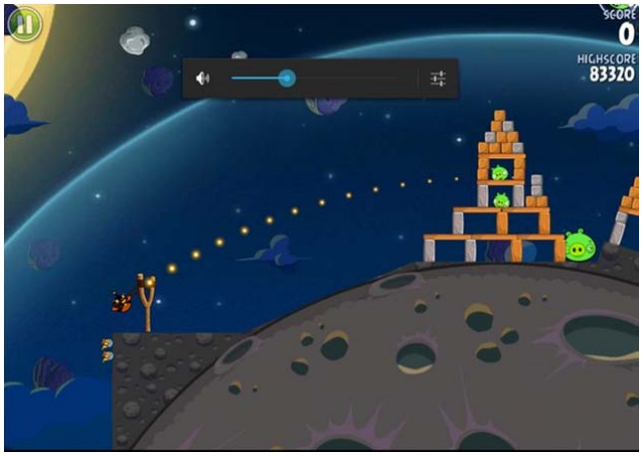
Yet, the decision of the authors to go with such a setup was still reasonable, because:

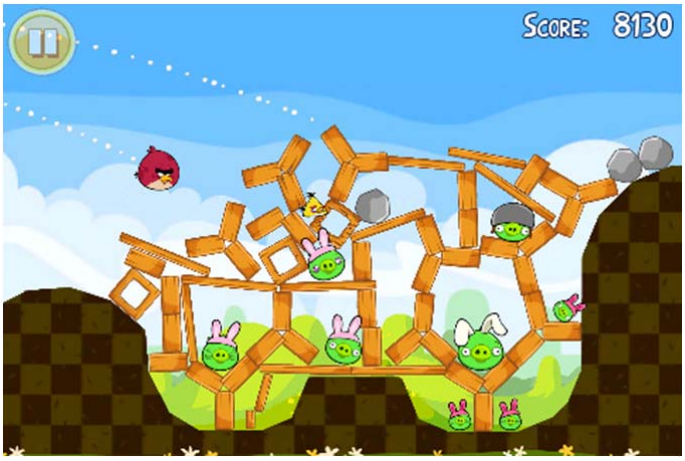
Note: one can come up with different reasons to answer the last question. One of them is sufficient to get full credit.

Problem 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 *Angry Birds* video game series with your score at the top right of the screen and gamen environment with gameplay elements in the rest of it. In case you are not familiar with this game, the goal is to shoot birds with a slingshot at structures and destroy them to kill the pigs hiding there. You shoot the bird with a simple gesture that strains the sling shot, and when you release your finger from the screen, the bird follows the trajectory that is illustrated when straining the sling shot (see left image). Pigs might not die immediately, but might need to be hit several times, as illustrated in the second image; the pig in the center at the top has a black eye, illustrating that it was hit before and another small hit will likely cause it to die.





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:***

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

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

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

Problem 6b (6 pts) In the lecture, we discussed the interaction of the game *Leo's fortune*, which is a simple platformer game where a character navigates a 2D landscape. The character is controlled by the player by changing its direction (move left or right), make him jump or duck. The game offers different selectable options to the player to do these actions. One is via pressing onscreen buttons, illustrated on the left below (the arrows on the left are pressed to make the character move left or right, the ones on the right are used to make the character duck or jump). Another option is to use gestures: dragging your finger to the left or right on the left side of the screen moves the character left or right, dragging your finger up or down on the right side of the screen makes the character jump or duck. In the case of gestures, there is also an option to visualize feedback on the screen (e.g., see screenshot on the right, which shows the feedback indicating that the player dragged his/her finger to the right, causing the character to move in that direction).

Give an advantage that using the onscreen button design can have over using the gesture design.

Give an advantage that using the gestures design can have over using the onscreen button design.

What is a possible advantage of showing feedback in the gesture design?

What is a possible disadvantage of showing feedback in the gesture design?

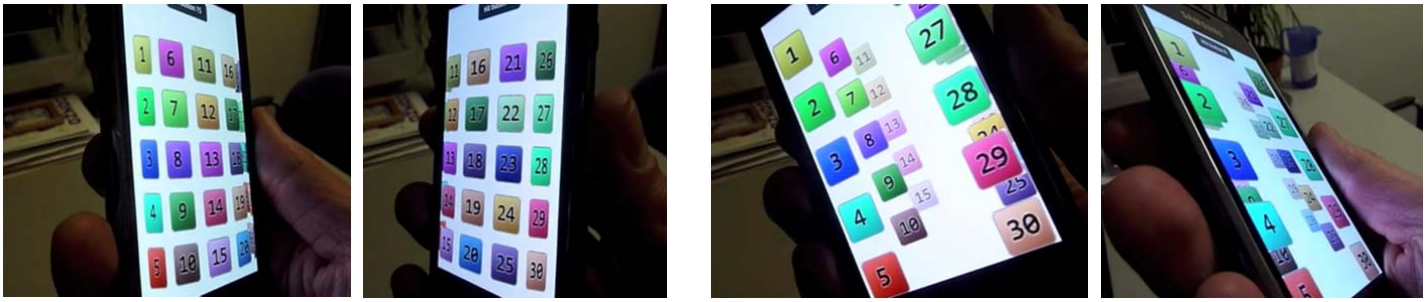
What speaks in favor of providing different interaction modes and let the user chose which one to use, as done in this game?

What speaks against providing different user-selectable interaction modes when developing a game (this or any other)?

Problem 7 Mobile VR & 3D

Problem 7a (6 pts)

In the lecture, we looked at different concepts and visualizations of virtual reality (VR) on handheld devices such as smartphones and tablets. We also discussed how these could be used for the visualization of 3D data in general, that is, not restricted to virtual environments. One example was 3D interfaces, e.g., a 3D visualization of buttons or icons. We saw an implementation in a video where the idea was to visualize all buttons on a 3D shape or in a 3D space and exploring this shape or space from different perspectives by tilting the device. That way, we can show more buttons on the screen at a time than we could with a standard 2D visualization. Below two examples: The one on the left shows how the view of the buttons, which are mapped onto a cylinder, changes when the device is tilted left or right. The right one shows a visualization where the buttons are stacked over each other and tilting the device left or right enables the user to see the ones in the back of the two stacks on each side of the screen because of the change of perspective.



There are two possible ways to create this. Depending on the sensor(s) used, we named them differently. Give the names of the two VR concepts that realize this type of 3D visualization, and state what sensor(s) we need to create each of them.

One option is called:

And the sensor/sensors used to create it is/are:

The other option is called:

And the sensor/sensors used to create it is/are:

Name one advantage that the first option has compared to the second one:

Name one advantage that the second option has compared to the first one:

In the actual implementation, the 3D visualization only changed its perspective when tilting the device left and right, but not when tilting it up and down. It was purposely decided to do this. Give a good reason why the developer may have decided to implement it this way.

Note that we didn't discuss this explicitly in the lecture, but if you understood the concept and think about this particular usage of it, you should be able to come up with a good explanation.

Problem 7b (2 pts)

Dynamic keyhole interfaces are a variation of the mobile VR concept we entitled *fixed world VR.* Assume we apply it to the above implementation, i.e., we have a large set of buttons that we want to show on the screen of a mobile, but the screen is too small to show them all. Instead of mapping them onto a 3D shape to deal with this, we are using a dynamic keyhole interface approach, that is, we see additional buttons when we point the device to the left or to the right.

Give one advantage that such a keyhole interface solution might have compared to the approach shown in 7a.

Give one disadvantage that it might have compared to the approach shown in 7a.

Problem 8 Mobile augmented reality (AR)

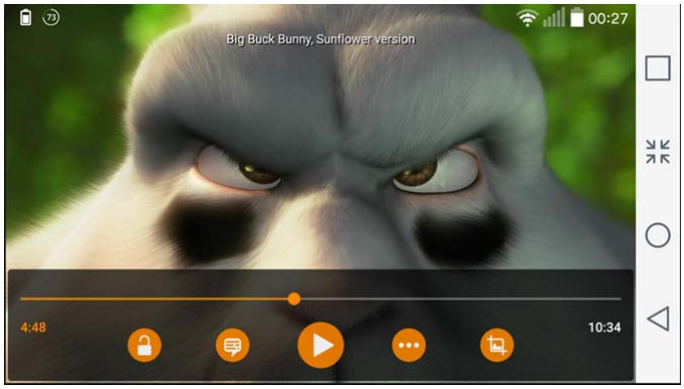
(2 pts)

Name one disadvantage that touch screen based interaction can have when used in mobile handheld AR applications.

Name one disadvantage that gesture based interaction can have when used in mobile handheld AR applications.

Problem 9 Mobile video

(5 pts) Assume a mobile video player like the one below with a slider at the bottom that represents the length of the video. Dragging the slider along this timeline enables you to go to the related position in the video and displays the content of the video in real-time, thus allowing you to interactively scroll through the video.



What problem are you faced with when you do this to scroll through, let's say a movie or a long TV show?

Assume a different design now, where the timeline of the video is not mapped onto a linear slider at the bottom, but onto a circle around the center of the screen. Thus, you can scroll through the video in real-time by making circular gestures around the center of the screen. How does that change the situation described above, and to what degree is it an advantage?

Give three potential problems or disadvantages of such a "circle design".