Mobile Interaction (INFOMMOB) 2015/2016

Exam, Wednesday, June 29, 2016, 11:00-13:00, EDUC-GAMMA

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 12 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 (1 pt) In the chapter "Mobile Computing" of The Encyclopedia of Human-Computer Interaction, J. Kjeldskov lists "Seven waves of mobile computing". While these represent technology trends or developments that contributed to the development of mobile computing, each of them also introduced issues and disadvantage. Give one *disadvantage* of the first wave ***portability***.

Note that a short answer is sufficient. E.g., if the wave would be "miniaturization", something like this would be fine: "Small form factors make interaction more difficult"

Problem 1b (1 pt) In Section 3.1 of the aforementioned chapter, the author discusses "The role of context". Give an example for an app that uses context.

Key phrases are sufficient. Don't describe or name an actual app, but shortly state the context-related issue.

Problem 1c (1 pt) Related to the above, the authors of the paper "A Survey of Mobile Phone Sensing" talk about the "phone context problem" in relation to phone sensing apps. Give an example for such a problem.

Note that any convincing example is fine (not just the ones discussed in the paper). A short answer that clearly illustrates the context-related problem with respect to phone sensing apps *is sufficient.*

Problem 1d (2 pts) In the above paper on Mobile Phone Sensing, the authors discuss opportunistic and participatory sensing. Give an advantage for each of these approaches.

Advantage for opportunistic:

Advantage for participatory:

Note that a short answer is sufficient. Full sentences not required; key phrases are fine.

Problem 2 Technologies

Problem 2a (cameras, 1 pt) Give an example other than taking pictures where the camera is used as input in an app on a smartphone.

Key phrases are sufficient. Don't describe or name an actual app, but shortly state how the camera input is used.

Problem 2b (displays, 3 pts) Assume a 3D scene on a display that is modelled in a way that perfectly matches the FOV (field of view) of a person in front of the screen looking at it. When we move the display closer to the person, but we want to keep that "perfect match", the virtual camera of the scene should …

☐ be moved closer ☐ be moved further away ☐ stay at the same position

and the virtual camera's FOV should …

☐ be made wider ☐ be made more narrow ☐ stay the same.

Mark the correct solution. Hint: if you don't see it immediately, it might help to quickly sketch it.

Name one issue that could influence how well the quality of a display is perceived.

One word could be enough to get full credits.

Problem 2c (vibration motors, 3 pts)
Name two usages of vibration motors in mobile phones.

Note that one word per usage can be sufficient to get full credit. Yet, you do not have to use the two issues mentioned in the lecture. Other (convincing) usages are fine, too.

Name one potential disadvantage of using vibration motors in mobile devices.

Note that a few words / key phrases can be sufficient to get full credit. Other disadvantages than the ones mentioned in the lecture may exist and could give full credit as well.

Problem 2d (other sensors, 6 pts)
Are the following statements correct or not? Mark the right answer:

With a 3-axis accelerometer, we can implement 6DOF (degrees of freedom) interaction (cf. motion gestures).

☐ this statement is **correct** ☐ this statement is **wrong.**

With a gyroscope, we can implement 6DOF (degrees of freedom) interaction (cf. motion gestures).

☐ this statement is **correct** ☐ this statement is **wrong.**

Complete the following sentences so they form a correct statement:

a) Accelerometers give us orientation with respect to _____

b) Gyroscopes give us orientation with respect to _____

c) Magnetometers give us orientation with respect to _____

Assume you want to implement a stargazing app using **two** sensors where you can hold a tablet into the sky at night and then see the star constellation in the direction you are pointing at on your display. What two sensors would you use?

Note that it is sufficient to name these two sensors. No explanation required. Further note that there are multiple correct answers, but naming more than two sensors will give you zero credits.

Problem 3 Touchscreens & touch interaction design

Problem 3a (3 pts) Name a characteristic of touchscreens and give an example where this characteristic is positive for interface design, and one where it is negative.

Characteristic:

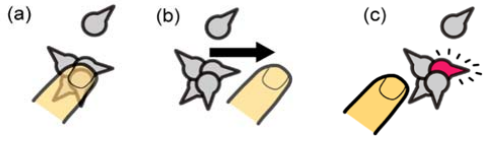
Positive example:

Negative example:

Note that a few words are sufficient if they clearly illustrate your point. An example (not for touchscreens but mobile phones in general) could be: Characteristic = Mobile phones are small, positive: You can take them anywhere, negative: The small form factor can cause more interaction mistakes.
Your touchscreen characteristic will likely be more specific than this general example, so make sure that the positive and negative examples are directly related to the characteristic. Notice that you will only get credits if you provide a correct positive AND negative example for the same characteristic (because it would be fairly easy to provide just one, and the purpose of this question is to verify if you can critically analyze both positive as well as negative aspects of an approach).

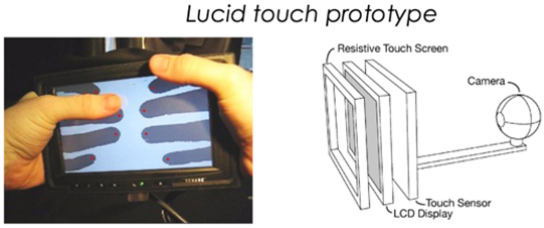
Problem 3b (touchscreen problems & interaction design, 4 pts)

"Shift callouts" is a technique where targets are selected by clicking on them and then making a gesture in the direction indicated by the target's visualization (cf. image). What touchscreen interaction problem does this approach solve?



Note that you just have to name the problem. No explanation is required.

The image to the right shows a prototype for a mobile that enables back of device touch. Name two common touchscreen problems that are solved by this design.



Note that you just have to name two problems. No explanation is required.

Give one possible disadvantage that such an approach might have.

Note that we didn't discuss this in the lecture, but you should be able to come up with a good, convincing idea yourself. A short statement is sufficient.

Problem 3c (touchscreen types & characteristics, 3 pts)

Assume the following touchscreen types:

(A) Standard capacitive touchscreen
(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 one above used for back of device touch)

For each of the following characteristics or statements, make a cross at the touchscreen technology if this statement is fulfilled for this technology.	(A) Capacitive	(B) Pneumatic	(C) Electrostatic	(D) Optical
This technology allows for location-dependent haptic feedback[1]	☐	☐	☐	☐
This technology does NOT support a hovering mode	☐	☐	☐	☐
This technology can be used to simulate the shape of a button	☐	☐	☐	☐

[1] That is, different haptics at different locations of the screen.

*Notice that you only get credits for each completely correct row, so think carefully about **all** your answers in one row. Leaving a cell empty is considered as answer "this statement is incorrect for this technology".*

Problem 4 Mobile evaluation

Problem 4a (2 pts) In the paper "Observational and Experimental Investigation of Typing Behaviour using Virtual Keyboards on Mobile Devices" by Henze et al. from ACM CHI 2012 the authors use an evaluation method with high external but low internal validity. Give an example for the opposite, i.e., a user study with high internal but low external validity and one advantage that such an approach might have compared to one with a high external but low internal validity.

Example:

Advantage:

Note that no detailed explanation is required. Short statements that illustrate why your example has a high internal validity are sufficient. The same goes for the advantage. Make sure though, that the advantage clearly reflects the difference between internal and external validity.

Problem 4b (2 pts) In the paper "Tactile Feedback for Mobile Interaction" by Brewster et al. from ACM CHI 2007 the authors evaluate the potential benefit of additional tactile feedback for text entry via touchscreens on handheld devices. One of these studies was done in the controlled environment of a lab, the other in the real-world context of a moving subway. Although the authors report that "results show that tactile feedback was less beneficial when users were mobile," they identified a potentially higher benefit for error correction in this case. Shortly explain why this might have been the case.

Note that a short statement is enough. E.g., the related part of the paper only has 14 words.
Notice however that you do not have to provide the authors' explanation,
but other possible reasons might be correct, too, and, if convincing, could give you full credit as well.

Problem 5 Interface & interaction design (including human aspects)

Problem 5a (1 pt) Assume two developers at a software company making mobile apps. Their development team makes prototypes for two new apps. Both use the RSVP technique (Rapid Serial Visual Presentation).

The first is an e-reader for books that allows you to read text faster by displaying it word by word using the RSVP technique.

The second is a search engine for a huge image archive where the results of an image search are not listed but represented image by image using the RSVP technique.

After an expert on human perception reviews the two apps, the company decides not to release the e-reader but to publish the image search engine. Give a good reason why.

Note that a short answer is sufficient (mine has only 4 words).
Notice that your answer should clearly be related to an issue or characteristic of RSVP.

Problem 5b (6 pts) In the lecture, we discussed problems & potential disadvantages of touch gestures. Three of those issues were (excerpts from slide):

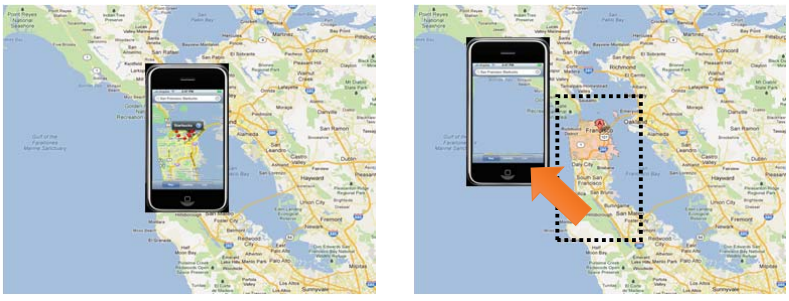
a. Gesture recognition: How to recognize?

b. Gesture design: Natural gestures? Intuitive gestures?

c. Usage: Discoverability (cf. icons)

Yet, these problems do not only apply to touch gestures, but others as well; for example, kinetic gestures. One such kinetic gesture was a dynamic keyhole interface, e.g., for map browsing (see image).

Dynamic keyhole navigation



For each of the three issues listed above, give a short(!) statement if this potential problem appears with this approach or not. If you think one of these potential problems does not appear, just write "not applicable". If you think it does indeed present a problem that may appear, shortly explain why or how (e.g., by providing a short example).

a. Gesture recognition: How to recognize?

b. Gesture design: Natural gestures? Intuitive gestures?

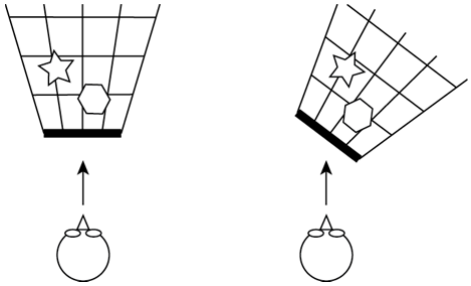
c. Usage: Discoverability (cf. icons)

*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 potential issue "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 "This 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.

Problem 6 Mobile virtual reality

(5 pts) The following image (left side) illustrates a user looking at a 3D scene on a tablet. The arrow indicates the viewing direction, the star and polygon are 3D objects from the scene that are shown on the screen (which is the bigger black bar). Now the user rotates the tablet as illustrated on the right (i.e., pushes the left side back and moves the right side closer. The visualization on the screen is updated as illustrated.



What type of sensor(s) can you use to create this effect on a mobile?
Mark all that apply (multiple answers are possible):

☐ Gyroscope	☐ Magnetometer	☐ Camera
☐ Touch screen	☐ Vibration motors	☐ Ambient light sensor

*Note that you only get credit for this question if you correctly mark **all** possible solutions.*

Complete the following sentences in a way that creates a correct statement:

For Fish Tank VR, the device's _____ is used to track_____

For Shoebox VR, the device's _____ is used to track_____

Problem 7 Mobile augmented reality

Problem 7a (mobile AR implementations, 4 pts)

a) Assume the AR app shown in the image, which features an information browser where you can point your mobile phone in the direction of a building and then get immediate information about it.

In addition to the camera, what sensors would be minimally need to implement such an app? Make sure to provide a "minimal solution", i.e., list all sensors that you need but no more. If there are sensors in a phone that give you comparable data, only list one of them!

Minimum sensors needed:

Note that as the phrasing of the question suggests, there are multiple correct answers.
You should only give ONE correct solution, and you will only get credit if you list all that are needed but no more.

The definition of AR provided by Azuma lists three characteristics that an AR system should fulfil. Does the above system comply with all these? Mark the correct answer (and complete the sentence if you think the correct answer is NO; no explanation is needed if you mark YES as correct answer):

☐ YES ☐ NO, it does not fulfil the following characteristic(s):

If you think that more than one characteristic is not fulfilled, make sure to list them all.
You only get credit if your answer is completely correct, i.e., if all conditions that may not be fulfilled are listed.

Now assume the AR app shown in the image, which uses a marker on the table to create a tower defense game where you have to defend the virtual tower always shown in the right perspective on the marker from approaching enemies.

In addition to the camera, what sensors would be minimally need to implement such an app? Make sure to provide a "minimal solution", i.e., list all sensors that you need but no more. If there are sensors in a phone that give you comparable data, only list one of them!

Minimum sensors needed:

Note that as the phrasing of the question suggests, there are multiple correct answers.
You should only give ONE correct solution, and you will only get credit if you list all that are needed but no more.

The definition of AR provided by Azuma lists three characteristics that an AR system should fulfil. Does the above system comply with all these? Mark the correct answer (and complete the sentence if you think the correct answer is NO; no explanation is needed if you mark YES as correct answer):

☐ YES ☐ NO, it does not fulfil the following characteristic(s):

If you think that more than one characteristic is not fulfilled, make sure to list them all.
You only get credit if your answer is completely correct, i.e., if all conditions that may not be fulfilled are listed.

Problem 7b (vision-based mobile AR, 3pts) For vision-based AR tracking, commonly either fiducial markers or natural feature tracking is used. For each of these two approaches, give a disadvantage that it has over the other. Then, give one disadvantage that both of these approaches have.

Disadvantage fiducial markers:

Disadvantage natural feature tracking:

Disadvantage of both:

Note: Make sure that the disadvantages that you give for the first two are not general disadvantages but ones compared to the respective other approach (i.e., the other approach should NOT suffer from this issue).

Problem 7c (mobile AR implementation, 1pt)

Give a reason why the above image is likely not a photo of a real AR app, but a fake created with photo editing software.

Reason:

Note that a short answer is sufficient. Statements / key phrases are sufficient; full sentences not required.

Problem 7d (mobile AR interaction, 1pt)
Remember the AR implementation shown in the lecture where a user's thumb and index finger in front of the device were tracked and used to move or manipulate virtual pawns on an AR board game. When using this in an evaluation with real and virtual pawns, we realized that people often had difficulties accurately grabbing the real pawns. Why is that the case?

Reason:

Note that a very short answer is sufficient. The one provided in the lecture are just two words.
If you don't remember them, you can describe it in your own words of course.

Problem 8 Mobile gaming

Problem 8a (game design, 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 an image from the mobile game "The Simpsons™: Tapped Out". The icons on the left side indicates tasks that you have to assign to game characters. On the bottom left, you see some game information, such as which level you are on and how much money and donuts you have. On the bottom right you have buttons for other actions (e.g., visit friends, build things). The dollar signs above the houses indicate that you can collect income tax, and the thumbs hovering above the characters indicate that these characters have finished a task assigned to them.

For each of the four aspects of the Diegesis Theory indicate if they are applied to this game. If your answer is YES, give one example how (one word or phrase referring to the above game description is sufficient; no explanation is needed if your answer is NO).

a) Non-diegetic Representations are used in this game:

☐ NO ☐ YES, for example:

b) Spatial Representations are used in this game:

☐ NO ☐ YES, for example:

c) Meta Representations are used in this game:

☐ NO ☐ YES, for example:

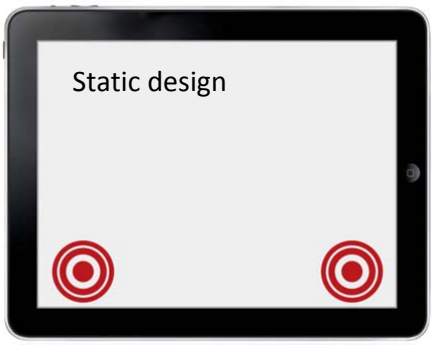
d) Diegetic Representations are used in this game:

☐ NO ☐ YES, for example:

Problem 8b (interaction design, 1 pt)

Give one example that a static onscreen-joystick design might have compared to a dynamic one.

Example:



Note that a short answer is sufficient. Statements / key phrases are okay; full sentences not required.