Multimodal Interaction 2011/2012

Final exam, Wed, April 18, 2012, EDUC-GAMMA

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

INSTRUCTIONS

- Write down your name and student number below and on every additional paper you want to turn in.
- Write your answers below the questions in the designated areas. If you need more space, you can use the additional paper provided by us. You are not allowed to use your own paper. Use a pen, not a pencil. Avoid usage of the color red.
- 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. If you finish early, you may hand in your work and leave, except for the first half hour of the exam.
- The exam consists of questions from 9 areas printed on 16 pages (including this one). It is your responsibility to check if you have a complete printout. If you have the impression that anything is missing, let us know.

Good luck!

YOUR NAME	YOUR STUDENT ID

DO NOT WRITE BELOW THIS LINE

INTODUCTION	
1-1 (max. 2)	
1-2 (max. 3)	
MOBILE DEVICES	
2-1 (max. 6)	
2-2 (max. 2)	
TRENDS	
3-1 (max. 2)	
3-2 (max. 2)	
3-3 (max. 6)	
TOUCH	
4-1 (max. 1)	
4-2 (max. 2)	

SUM (max. 26):

4-3	2
DEVICE MOTION	
5-1	4
5-2	2
USER MOTION	
6-1	3
6-2	3
6-3	3
MOBILE AR	
7-1	1
7-2	3
7-3	3
7-4	4

SUM (max. 28):

7-5	3
MOBILE 3D	
8-1	3
8-2	4
8-3	3
8-4	2
8-5	2
LITERATURE	
9-1	6
9-2	6
9-3	6
9-4	5
9-5	6

SUM (max. 46):

TOTAL NUMBER OF POINTS (max. 100):	GRADE:

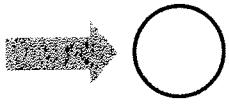
1. Introduction

Question 1-1 (2 pts)
In the lecture, we discussed different views to describe past and future trends of computing. One of them was the development from CLI to GUI to NUI interfaces. Here, CLI stands for Command Line Interface and describes an interface where users communicate with a computer via commands that are usually typed with a keyboard. Give a similar informal description of GUI, i.e. say what these three letters stand for, and how this type of interaction can be described informally.
(A short description as illustrated above for CLI could be sufficient to get full credits.)

Question 1-2 (3 pts)
Natural user interfaces come in many varieties. Give 3 examples of an interface or interaction mode that can be considered "natural" in this context.
(Listing 3 phrases could be sufficient to get full credit.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.



2. Mobile devices

Question 2-1 (6 pts)

PPI is a measure that is commonly used to describe the quality of a display.

a) What do the letters PPI stand for?
b) How can it be calculated?
c) Why is the PPI a good measure for the quality of a screen?
d) Although PPI is a good measure, it is often not used to advertise monitors. Give one reason why this might be the case.

(1-3 sentences could be sufficient to get full credits for c) and d). Notice that the last issue was not discussed in the lecture, and answering it involves of course some speculation.)

Question 2-2 (2 pts)

In the lecture, we identified interaction as one major bottleneck when using mobile devices such as smartphones. Give two reasons why.

(1-2 sentences – or even phrases – per reason could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

3. Current trends in interaction

Question 3-1 (2 pts)
What is the Gorilla arm effect?
(1-3 sentences could be enough to get full credits.)

Question 3-2 (2 pts)
Describe an interaction that we can do with a mouse, but not with a regular touch screen.
(1-3 sentences could be enough to get full credits.)

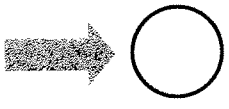
Question 3-3 (6 pts)
In the lecture, we identified touch gestures, gestures based on device motion, and gestures based on human motion as three major current trends in human computer interaction.

a) Give an advantage touch gestures could have over gestures based on device motion.
b) Give an advantage gestures based on device motion could have over gestures based on human motion.
c) Give an advantage gestures based on human motion could have over touch gestures.

(1-3 sentences per advantage could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.



4. Touch screens & touch interaction

Question 4-1 (1 pt)
Give one advantage of finger-based interaction with a touch screen compared to stylus-based interaction.
(1 phrase or sentence could be enough to get full credits.)

Question 4-2 (2 pts)
Give an example for an application where one would prefer stylus-based interaction over finger-based interaction. Justify your answer (i.e. shortly describe the feature(s) or characteristics of stylus-based interaction that make it a superior way of interacting in this context).
(1-3 sentences could be enough to get full credits.)

Question 4-3 (2 pts)
Give an example for a potential future touch screen technology and shortly mention why or in which context it would improve existing technology.
(2-3 sentences could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

5. Device motion & related gestures

Question 5-1 (4 pts)
Assume we want to implement a game in which you can navigate a character through a 3D virtual environment by tilting the device.

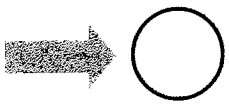
a) What kind of sensor would you use to implement that? Shortly explain how you would do that and why you would use this particular sensor.
b) Give a reason why a game designer might decide *not* to use tilting but instead rely on an onscreen joystick.

(2-3 sentences could be enough to answer part a). Notice that multiple answers might be correct. You only have to give one – plus the related explanation. 1-2 sentences could be enough to get full credits for b).)

Question 5-2 (2 pts)
Rotations of a device are often described as a combination of pitch, yaw, and roll rotations. Which of these three can not be measured with an accelerometer and why?
(1 sentence could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.



6. User motion & related gestures

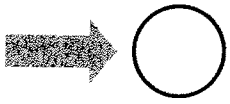
Question 6-1 (3 pts)
Camera-based interaction requires image processing. List three potential problems or difficulties that we are faced with when implementing this on a mobile phone or tablet.
(1 sentence or phrase per issue could be enough to get full credits.)

Question 6-2 (3 pts)
Give three potential advantages of camera-based human motion tracking for interaction with mobile devices (smartphones and tablets).
(1 sentence or phrase per advantage could be enough to get full credits.)

Question 6-3 (3 pts)
Give three potential issues or problems with interaction based on human motion tracking. ()
(1 sentence or phrase per issue could be enough to get full credits. Note that you will not *get any credit here for listing the same issues as in question 6-1.)*

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.



7. Mobile augmented reality

Question 7-1 (1 pt)
What is the difference between immersive and non-immersive augmented reality?
(1 sentence could be enough to get full credits.)

Question 7-2 (3 pts)
What is the traditional definition of augmented reality?
(If I tell you how many issues you need to list here, I would give away parts of the answer ;)

Question 7-3 (3 pts)
Look at the images to the right.

a) What kind of sensors would you need to implement such mobile AR applications?
b) Does this implementation fulfill all characteristics specified by the traditional definition of augmented reality (cf. previous question)? Explain your answer.

(1 sentence or phrase per issue could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

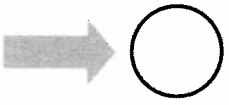
(Mobile augmented reality, cont.)

Question 7-4 (4 pts)
Give two potential advantages and two potential disadvantages that finger tracking with the away facing camera could have in a mobile augmented reality setting compared to touch screen interaction.
(1 sentence or phrase per advantage or disadvantage could be enough to get full credits.)

Question 7-5 (2 pts)
Look at the image to the right. Is it possible to implement something like this with today's devices? If yes, shortly explain how. If no, shortly explain why not.
(2-3 sentences could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.



8. Mobile 3D & virtual reality

Question 8-1 (3 pts)
How can we explore a virtual environment on a mobile phone by looking around in ...

a) ... the mobile fish tank VR concept?
b) ... the standard mobile VR concept?
c) ... the fixed world VR concept?

(1 sentence per sub-question could be enough to get full credit.)

Question 8-2 (4 pts)
Let's compare the fish tank VR approach with the shoebox VR approach on mobile devices.

a) What kind of sensors do you need for mobile fish tank VR?
b) What kind of sensors do you need for shoebox VR?
c) What kind of limitations do we have for mobile fish tank VR (compared to shoebox VR)?
d) What kind of limitations do we have for shoebox VR (compared to fish tank VR)?

(1 sentence per sub-question could be enough to get full credit.)

Question 8-3 (3 pts)
What is the definition of positive, zero, and negative parallax of a stereoscopic screen?
What are two potential problems when combining touch screen interaction with stereoscopic screens?
(1 and 2 sentences for questions 1 and 2, respectively, could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

(Mobile 3D & virtual reality, cont.)

Question 8-4 (2 pts)
In the user study with 3D interfaces, the shoebox effect was applied when the device was tilted left and right, but not when it was tilted up and down. Explain why the interface designer decided to use the shoebox concept only in the horizontal direction and not the vertical one.
(2-3 sentences could be enough to get full credits. Notice that I also explained this in the lecture, so you should be able to answer this question even if you did not do the actual user study or don't remember it.)

Question 8-5 (2 pts)
In the lecture, we discussed several depth cues for 3D perception. What two depth cues are the major reasons why depth perception most likely increases for the shoebox approach compared to standard mobile VR?
(2 phrases could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

9. Mandatory literature

Question 9-1 (6 pts)
In their paper "Observational and Experimental Investigation of Typing Behaviour using Virtual Keyboards on Mobile Devices," Henze et al. present a study related to touch behaviour when using virtual onscreen keyboards on smartphones. Instead of lab studies – which are a common and dominating way of doing user studies in HCI – they decided to do a large scale study by publishing a mobile typing game on the Android market.

a) Give three reasons for their motivation, i.e. three issues that we often have with controlled lab experiments that might not be a problem with the large scale user study done by the authors.
b) At the end of their paper, they also briefly mention some problems that their type of evaluation might have. Can you list two of them?

(3 and 2 sentences for part a) and b), respectively, could be enough to get full credits. Notice that for both questions, it is not required to list the same issues as in the paper, but you are free to provide any reasonable other answer as well.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

(Mandatory literature, cont.)

Question 9-2 (6 pts)

In their paper "Sensing-Based Interaction for Information Navigation on Handheld Displays," Rohs and Essl implemented and evaluated different approaches for navigation on small displays using various types of sensors. Two of the implemented navigation approaches are *halo* and *semantic zooming*.

a) Shortly describe the halo approach. Do not just explain it, but also shortly mention why it might be a good approach to visualize targets that are off screen.
b) Shortly describe how semantic zooming can be implemented on a mobile phone and how it can be used for, e.g., searching and navigating maps.

(About 3 sentences for each part could be enough to get full credits.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

(Mandatory literature, cont.)

Question 9-3 (6 pts)

In their paper "Use Your Head – Exploring Face Tracking for Mobile Interaction," Hansen et al. claim that by tracking your head with the user facing camera, you can implement 1-4 dimensional input.

a) Shortly describe what they mean by "4 dimensional" input.
(1 sentence could be enough to get full credits.)

In relation to the actual face tracking, the authors mention that in such an implementation does not only enable interaction by moving the device within the interaction space, but also by tilting it.

b) Describe a situation in which this could be an advantage, i.e. in which you would rather like to tilt the device than move it.
(About 2 sentences could be enough to get full credit. Notice that you do not have to give the exact same statement that the authors used, but any valid argument will give you full credit.)

c) Describe a situation in which this could be a disadvantage, i.e. in which it would be better to have an implementation where tilting does not cause an interaction.
(About 2 sentences could be enough to get full credit. Notice that the answer to this question was not given in the paper, but if you understood its content, you shouldn't have a problem coming up with a decent example.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

(Mandatory literature, cont.)

Question 9-4 (5 pts)

In his Alertbox newsletter entitled "Kinect Gestural UI: First Impressions," Jakob Nielsen discusses usability issues when using Kinect-style interactions for human computer interaction.

a) What are the four most important disadvantages identified in his studies?
b) What is the major advantage?

(1 phrase for each disadvantage and advantage could be enough to get full credit.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.

(Mandatory literature, cont.)

Question 9-5 (6 pts)

In their paper "pCubee: A Perspective-Corrected Handheld Cubic Display," Stavness et al. describe the realization of a special, cube-shaped display technique using the Fish Tank VR concept.

a) In the related work, they discuss Volumentric and Geometric Displays. What is the difference between the two of them?
(About 2 sentences could be enough to get full credit. Notice that we didn't discuss Volumetric Displays in the course, but we did talk about Geometric Displays, although we didn't use this term to describe them.)

b) To realize their pCubee system, the authors use head tracking (as commonly done in Fish Tank VR approaches). Assume you have four smartphones that feature common sensors (e.g. accelerometer and gyroscope). Would it be possible to build a "pBoxe", i.e. a box-shaped device where the four longer sides are made of the smartphones, and their displays feature the same visual feedback (and thus the same interaction experience) as the pCubee installation?
Shortly discuss:
- ... to what degree this is possible,
- ... what the possible disadvantages and limitations are, and
- ... what possible advantages are.

(Notice that this is an open question. Please keep your answer short. It is not necessary to give a long detailed explanation, but as long as you get the main issues and provide some reasonable insight, you can get full credit.)

ANSWERS:

If you need more space, make a cross on the right and continue writing on a separate paper.
Make sure to clearly mark the question number there. Thanks.