Multimodal Interaction 2012/2013
Final exam, Wed, April 17, 2013, 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 is printed on 18 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

PLEASE DO NOT WRITE BELOW THIS LINE

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

1. Introduction

Question 1-1 (3 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 NUI, 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)
NUIs 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:

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continue writing on a separate paper.
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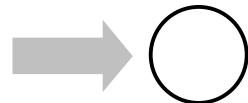
2. Mobile devices

Question 2-1 (6 pts)
The quality of a display can have a significant influence on usability and immersion in mobile computing.
Give three different characteristics that could influence the quality of a display.
(Listing 3 criteria could be sufficient to get full credits.)

Question 2-2 (2 pts)
Phones and tablets are becoming more and more powerful. Yet, interaction remains a major bottleneck
when using them. Give two reasons why.
(1-2 sentences – or even phrases – per reason could be enough to get full credits.)

Question 2-3 (3 pts)
What are the three most obvious current trends in interaction (not necessarily just mobile)?
*(If you agree with the 3 trends that were given in the lecture, just listing them could be enough to get full
credit. If you disagree and think that there are other, more important trends, a short and convincing
justification is required.)*

ANSWERS:

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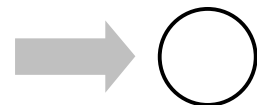
3. Touch screens & touch interaction

Question 3-1 (4 pt)
Give two advantages that interaction using a mouse could have compared to using a touch screen.
Give two advantages that interaction using a touch screen could have compared to using a mouse.
(1 phrase or sentence per advantage could be enough to get full credits.)

Question 3-2 (2 pt)
Give one advantage that interaction using a pen could have compared to using a finger on a touch screen.
Give one advantage that interaction using a finger could have compared to using a pen on a touch screen.
(1 phrase or sentence per advantage could be enough to get full credits.)

Question 3-3 (2 pt)
Give one example of an alternative keyboard layout and shortly explain in what situation it might be better than the common QWERTY layout.
(It is not required to draw the actual design. A short informal description of how the keys are organized and 1-2 sentences or phrases justifying the motivation of this layout could be enough to get full credits.)

Question 3-4 (1 pt)
Give one advantage that a virtual keyboard on a mobile phone could have over physical buttons.
(1 phrase or sentence could be enough to get full credits.)

Question 3-5 (4 pts)
Shortly describe the difference between a capacitive and a resistive touch screen and one major advantage of each technology when compared against each other.
(1 sentences or phrase to describe each technology plus 1 sentence or phrase to describe the major advantage of each could be enough to get full credits.)

ANSWERS:

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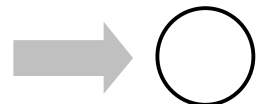
4. Device motion & related gestures

Question 4-1 (2 pts)
With respect to navigation and character control in 3D games and virtual worlds:
Give one advantage an onscreen joystick on a touch screen could have compared physical keys.
Give one advantage tilting of the device could have compared to onscreen joysticks on a touch screen.
(1 phrase or sentence for each advantage could be enough to get full credits.)

Question 4-2 (9 pts)
Assume you want to implement a 3D game on a mobile device (phone or tablet). Your game will feature a character moving and looking around in a first person view. Further assume three options:
1. In the 1st, your implementation only uses the accelerometer,
2. in the 2nd, your implementation uses the accelerometer and magnetometer/compass, and
3. in the 3rd, your implementation uses the accelerometer, magnetometer/compass, and GPS data
in order to control your character. For each of these three cases, give an example that justifies your selection of sensors (i.e. why you need this but not any other).
*(1-2 sentences per case could be enough to get full credit. For example something like:*
- *If the character only needs to jump up and down, case 1 is sufficient because accelerometers give you movement of the device along the z-axis.*
- *If the character has to do pushups as well, case 2 is sufficient because the compass also gives you information about how tired the user is.*
- *If the character has to sing while exercising, case 3 is necessary because GPS is connected to the microphone and thus provides sound input.*
Obviously, these answers are not *correct but just illustrate the expected style of answer.)*

ANSWERS:

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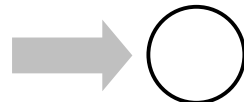
5. **User motion & related gestures**

Question 5-1 (1 pt)
Cameras have been introduced to mobile phones to take pictures (who would have guessed that?) but are now used for other purposes as well, e.g. mobile AR. Name one other usage of cameras in mobile phones that is related to mobile interaction.
(1 phrase could be enough to get full credits.)

Question 5-2 (4 pts)
Using a camera and human motion tracking on mobiles has various challenges and potential issues considering both the technical realization as well as usability. Give two technical challenges or potential problems and two potential usability issues. (Make sure to clearly mark which issues are technical and which are related to usability.)
(1 sentence or phrase for each of the four issues could be enough to get full credits.)

Question 5-3 (3 pts)
Assume you have a "perfectly working" human motion tracking system on your phone that uses the user facing camera. Give one example where such human motion tracking could be used beneficially despite the two usability issues that you mentioned above and shortly justify your answer.
(Be concrete here, i.e. something such as "It's cool" will not give you credit. Hence, an estimate about how much to write is difficult. I'd suspect 3-5 short sentences as a good rule of thumb, but less (or more) might work as well.)

ANSWERS:

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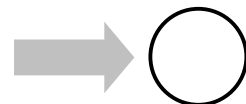
6. Mobile augmented reality

Question 6-1 (2 pts)
Shortly describe the "virtuality continuum" introduced by Milgram and Kishino in their paper from 1994. You do not have to use the exact same terms from the original paper (or related slide in the lecture), but an informal description using the three terms that we used in the course is fine.
(1-2 sentences could be enough to get full credits.)

Question 6-2 (2 pts)
What is the difference between immersive and non-immersive augmented reality?
(1 sentence could be enough to get full credits.)

Question 6-3 (3 pts)
Shortly describe what kind of mobile augmented reality one can implement on a mobile phone if we have access to the accelerometer and magnetometer/compass data but no other sensors. In this implementation, what is the main feature from the traditional scientific definition of augmented reality that we can *not* implement?
(1-2 sentences for the first question and 1 sentence for the second one could be enough to get full credits.)

Question 6-4 (3 pts)
Shortly describe the difference between marker tracking and natural feature tracking for mobile augmented reality. Give one advantage for each of the approaches.
(1 sentence for the first question and 1 sentence for the second one could be enough to get full credits.)

Question 6-5 (4 pts)
Give one example for interaction in mobile augmented reality where touch screen based input might be better than finger tracking based input.
Give one example for interaction in mobile augmented reality where finger tracking based input might be better than touch screen based input.
(1-2 sentences for each of the two examples could be enough to get full credits.)

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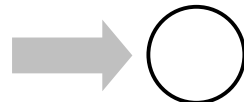
7. Mobile 3D & virtual reality

Question 7-1 (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 7-2 (4 pts)
The shoebox VR visualization concept creates a more realistic 3D representation (if we assume a fixed position of the user in front of the device) by changing the perspective projection depending on the tilt angle of the phone or tablet. Yet, there are other depth cues that contribute to how humans perceive 3D data. Some of the most important ones are: occlusion, texture gradient, depth-of-focus, shading, binocular depth cues (stereoscopy), and motion related cues (such as motion parallax and kinetic depth). Two of these also contribute to an improved depth perception in the shoebox VR concept. Which are those two and why do they contribute?
(1 sentence for each of the explanations could be enough to get full credit.)

Question 7-3 (4 pts)
When doing the user study utilizing the shoebox VR concept for visualization, you probably realized that it didn't look as impressive or realistic as it usually does in videos (e.g. the ones that I showed in the lecture). Give a short explanation why.
(1 sentence or even phrase could be enough to get full credit.)

Question 7-4 (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 or phrases for questions 1 and 2, respectively, could be enough to get full credits.)

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continue writing on a separate paper.
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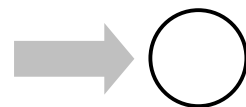
8. **Mandatory literature**

Question 8-1 (5 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 two 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?

(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 other reasonable other answer as well.)

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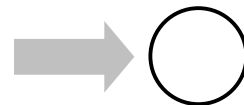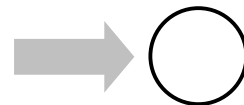
(Mandatory literature, cont.)

Question 8-2 (5 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.)

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 8-3 (4 pts)

In their paper "Use Your Head – Exploring Face Tracking for Mobile Interaction," Hansen et al. discuss different interaction options utilizing head tracking on a mobile device. 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.

a) 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.)

b) 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.)

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continue writing on a separate paper.
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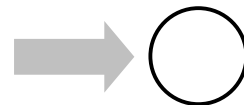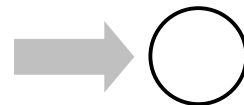
(Mandatory literature, cont.)

Question 8-4 (4 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)   List three of 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.)

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 8-5 (5 pts)
The article "A survey of visual, mixed, and augmented reality gaming" provided an overview of different techniques and approaches for, well, a special kind of games. One way to categorize them is using five different form factors, i.e.: indoor with HMD, handheld, and projector, and outdoor with HMD and handheld. The form of AR that we discussed in the course was mostly related to handheld AR. Give two differences between such handheld AR and projector based AR (both indoor). One difference should illustrate an advantage of projector based AR (i.e. illustrate something that we cannot do on handheld AR or that we can do better with projection based AR) and the other should illustrate an advantage of handheld AR.
(Notice that this is an open question and the answer to it was neither given in the lecture nor the paper. Its purpose is rather to verify if you are able to apply the knowledge from the lecture and the mandatory literature to a related case study. As a rule of thumb, about 3-4 sentences could be enough to get full credit, but less or more might be suitable as well.)

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.