PLTW COMPUTER SCIENCE

Activity 1.5.1

Human-Computer Interaction

Introduction

When you get a text message on your phone, how do you know? When responding to that text, what do you do?

Human-computer interaction (HCI) is a field of computer science that focuses on how computers and humans communicate with each other. HCI specialists design and study the interfaces we use to interact with computers. They ask about the effectiveness of devices like the keyboard and mouse and invent new devices. HCI specialists also design and analyze the graphical user interface used by a program or a website. The gestures now standard on touchscreens are recent HCI creations.

Most software has some interaction with a user. The user interface can be intuitive and fun to use, or it can be hard to figure out and frustrating. What makes an interface easy or fun?

A haptic glove. Haptic interfaces use human muscles and pressure or temperature on the skin to allow the user and the computer to communicate

Refer to your downloadable resources for this material. Interactive content may not be available in the PDF edition of this course.

Materials

- Writing utensil and paper

Procedure

1. Form new teams of two for the duration of Lesson 1.5, as directed by the teacher. Meet or greet each other to practice professional skills.

2. Combine two pairs, as directed by the teacher, to create a group of four for this particular activity. Meet or greet each other to practice professional skills.

3. HCI asks, “How do we get information from computing machines?” How do we provide information to the computer? As technology advances, new methods for HCI emerge. For example, in the near future we will obtain information from computers using three-dimensional displays. Computers could also give us information by applying pressure against our skin or stimulating our senses of taste and smell. In the future we will send information to the computer with body gestures and eye movements. Even mind reading is possible, since we now know more about how to detect and interpret the patterns of activity inside our brains. Can you think of other methods of communication between humans and computers?

4. **Accessibility** is also an important part of HCI. An interface can exclude people based on the language they speak, the type of computer they have, or disabilities they have. If HCI designers do their job thoughtfully, more people can benefit from computing. For example, a guideline for web pages is to include descriptive text that can be displayed instead of an image on the page so that a blind person can benefit from the content of the page. What guideline would make a web page accessible to a deaf person?

5. Extending human capabilities is another part of HCI. Our vision, for example, only detects a narrow portion of light: the visible spectrum. However, sensors can detect the entire electromagnetic spectrum. What interface could provide that information so that we can access it?

6. Think of a website, an app, or a program that you found so frustrating that you chose not to use it. Do you have advice about how it should have been designed?

7. Think about how you interact with technology on a daily basis. What are some human-computer interface methods that are currently in use today? With your partner in your team of two, list at least ten ways you interact with technology in your daily life. The list should contain specific elements of an interface; you could list hundreds of standard elements that are all performed with a mouse, for example.

8. Explain your list to the other pair in your group of four.

9. Your list of interface elements can be considered as a list of events and corresponding event handlers. The operating system keeps track of which application’s event handlers are notified and which applications can capture the event, in what order.

   Describe one event named by the other pair of students in your group of four and describe the corresponding event handler named by them.

10. From the examples of human-computer interfaces you've considered so far, which example do you think demonstrate the most creativity on the part of the HCI designers who created it?

11. As a group of four, discuss the interface elements you identified earlier and record which ones you think are the least accessible. That is, which interface element is unusable or ineffective for the largest number of people?

12. Some principles of user interface design are listed below. These principles help an HCI designer make an interface accessible. As a group, for each principle, think of an interface you have encountered that either fulfilled or violated the design principle. Record at least one example for each principle. Explain how the interface either fulfills or violates the principle.

- Structure: The interface should be organized, putting related elements together.
- Simple: Common tasks should be easy.
- Visible: Information and options should be easy to find, without the distraction of unnecessary information.
- Feedback: User should be informed of actions, changes in state, and errors.
- Tolerance: Mistakes should be easy to undo, and reasonable input should be interpreted.
- Reuse: Design should be consistent across components.

13. A huge advance in human-computer interaction was made in 1964 with the invention of the mouse by Doug Englebart. The team at Xerox PARC developed a graphical user interface to utilize the mouse for the operating system and several applications. Apple copied this innovation from Xerox, and Microsoft copied it from Apple.

    What were the methods of human-computer interaction before the mouse and GUI?

14. Resistance to change – inertia – plays an important role in HCI. Familiar interfaces are easy to use because users already know how to use them. A new interface might be better once you learn it, but the work required to learn the interface can prevent the interface from becoming standard.

    The familiar QWERTY keyboard, for example, was designed to force typists to type *slowly*! It kept mechanical typewriter keys from becoming jammed. Typists already know how to type on a QWERTY keyboard. The newer, “better” Dvorak keyboard puts high-frequency letters in the fingers' home positions on the keyboard. It is more **ergonomic**, which means its design is better for human health. Specifically, it lowers the risk of **repetitive strain injuries** during typing. Very few learn how to use it because the QWERTY keyboard is the standard. Can you think of another example in society in which an improvement is not adopted because people are accustomed to an existing system?

15. There is a need for new ways to define how humans interact with computers in a 3-D **virtual reality (VR)** environment. Virtual reality is a computer-simulated environment that makes the user feel like they are experiencing being somewhere else, real or imagined. They are primarily visual environments right now, with haptic technology included in advanced systems. Haptics provide tactile sensations for the user, like squeezes and forces.

    

    A VR parachute trainer

    Assume your group is part of a team that is helping to design the gestures that software engineers will encode and put into the 3-D virtual reality interface. Other members of the design team are asking that you reserve as much of the gesture space as possible for authentic gestures of a mechanical avatar. Brainstorm with your group to identify gestures that could be used to communicate each of the following.

    - Communicate to the computer as the user that you want to taste an object in the VR.

- Assume your company owns 100 mechanical **avatars** on Mars. An avatar is usually a user's representation or presence in a virtual reality, but these are physical avatars in a physical reality that is projected as a virtual reality to the user. Your company's VR interface allows the user to occupy one Mars-landed mechanical avatar at a time, with the avatar's motions imitating the user's, and the user's experience echoing what she would experience if she were where the avatar is.

  Communicate to the computer that you as the user want to transfer your virtual reality to the persepective of a different Martian avatar.

  Record tags for your ideas here as you brainstorm.

- Make up an HCI user story and brainstorm solutions:

  To state the user story, fill in the blanks of this sentence: I am a _____ and I want to _____ so that I can _____.

  Record the ideas during your brainstorming session.

16. Describe ways in which HCI can provide experiences or abilities to people with disabilities that they would not otherwise be able to have.

17. For the AP CS Principles *Explore* Performance Task you must find three recent, credible sources of information about a computing innovation that:

    - Has or could benefit and harm society, economy, or culture
    - Consumes, produces, or transforms data
    - Raises a storage, privacy, or security concern regarding data.

    In each unit of this course, you will investigate particular impacts of computing innovations on society. In this activity, find one or more articles referenced in the ACM TechNews archive, **http://technews.acm.org/archives.cfm**, about the impact of a computing innovation related to one of these areas:

    - human-computer interaction
    - accessibility
    - the extension of human capability

    Read the summaries from the ACM TechNews as well as the original articles referenced by the ACM TechNews.

    Task part 1. Create an audio, video, or visual artifact that illustrates, represents, or explains the computing innovation's purpose, function, or effect. (3 page/1 minute/30MB max)

    Task part 2. Essays

    - Name the innovation and its purpose and function. Describe how your artifact illustrates, represents, or explains the computing innovation's purpose, function, or effect. (Approximately 100 words.)

- Describe the tools, technique, and process you used to produce the artifact. (Approximately 100 words.)
- Explain the beneficial AND harmful effect(s) the innovation has or could have on society, economy, or culture. (Approximately 250 words.)
- Describe the data; the consumption, production, or transformation of data; and the storage, privacy, or security concern(s) directly related to the innovation. (Approximately 250 words.)
- Use APA-style citations to correctly reference the article(s).

Note: This step is adapted from the official College Board Explore Performance Task but it does not duplicate the content of College Board Task or Rubric. The task provided here contains elements that are different than the College Board Performance Task and Rubric. Please reference official College Board materials.

Conclusion

1. Pretend you are a job recruiter trying to attract creative people to study HCI in college in order to fill jobs your company is having a difficult time filling. Write a summary explanation you would give them. Your summary should explain what the field of human-computer interaction is about, how it affects people's lives, and how it will engage their creativity. Include one or more examples that you can think of or discover that have not been mentioned in your work during this activity.
2. What do you think will be major developments in human-computer interface development in the next ten years?