Human Computer Interaction

Lecture 3

Dr. Syed Asim Jalal
Department of Computer Science
University of Peshawar

Modeling the Human factors

- There are many ways to *represent* the human in interactive systems.
- The following is one way in which researchers model a human operator confronting a machine.

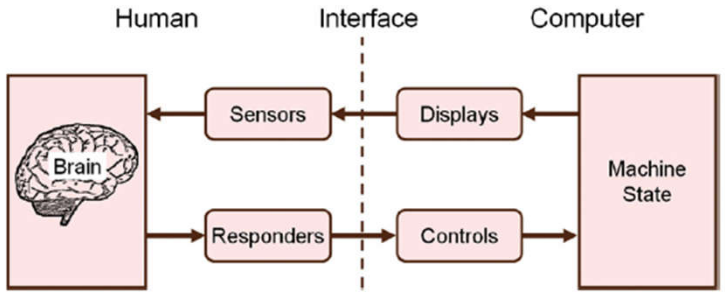


FIGURE 2.2

Human factors view of the human operator in a work environment.

(After Kantowitz and Sorkin, 1983, p. 4)

1. Computer System is basically a set of *states*.

- A state is any output or display at any particular time.
  - For example in an ATM machine: Enter PIN state, home screen, Cash Amount selection, Press Confirmation, Displaying Amount Balance etc. are different states.

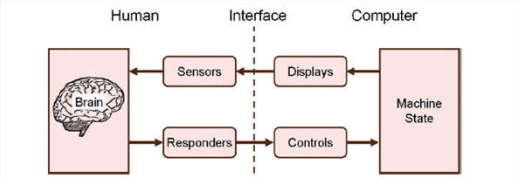
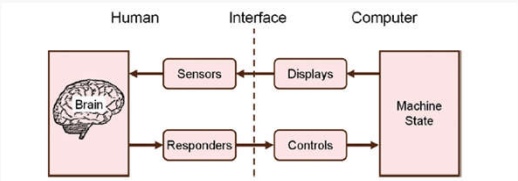


FIGURE 2.2
Human factors view of the human operator in a work environment.
(After Kantowitz and Sorkin, 1983, p. 4)

2. Computer conveys its states using "*Display*"

- A display in a wider sense does not mean only Graphical User Interface.
- A state may not be represented by just a specific colored light, a sound etc.



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(After Kantowitz and Sorkin, 1983, p. 4)

3. Humans use their *sensors* to observe *Display* in order to assess a computer's current state.

- Humans interact with computer systems by observing the states of the system through various sensory inputs like visual displays.
- This monitoring allows humans to understand the current status or condition of the system.
- For example, using eyes a human will observe different ATM machines different state and plan to respond.

4. The humans responds to different states of the computer using *responders* to change the states in order to complete a task.

- Responders include, hand, fingers, speech, and even eyes and a thought in brain.
- Human uses "responders" to respond to different states using the "controls" offered by the computer.

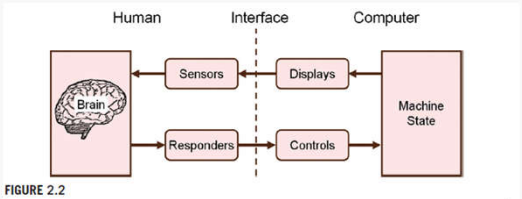


FIGURE 2.2
Human factors view of the human operator in a work environment.
(After Kantowitz and Sorkin, 1983, p. 4)

- 5. Computers offers to ***"Controls"*** for human's *"responders"* to interact with computer states in order to complete tasks.
  - Humans influence the states of the computer system through various controls or input devices.
  - These controls enable users to manipulate the system and transition it from one state to another.

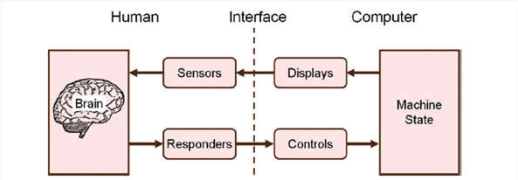
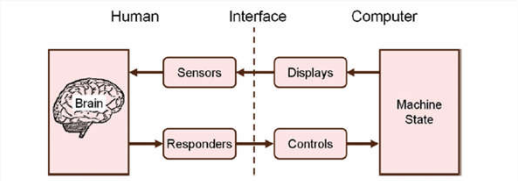


FIGURE 2.2
Human factors view of the human operator in a work environment.
(After Kantowitz and Sorkin, 1983, p. 4)

6. The dashed vertical line represents the *interface* where interaction takes place.
  - Interface is where researchers *observe* and measure the behavioral events that form the *interaction*.



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Human factors view of the human operator in a work environment.
(After Kantowitz and Sorkin, 1983, p. 4)

7. Human brain is responsible for observing interface in order to make plans for taking a certain action through *responders.*

The human brain is also responsible for evaluating any changes as a result of their action through sensors.

Humans Sensors

Humans Sensors

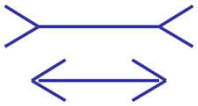
- The five classical human senses are
  - Vision
  - Hearing
  - Touch
  - Taste
  - Smell
- HCI mostly focus on Vision, Hearing and Touch sensors.
- Each brings distinctly different physical properties of the environment to the human brain.
- The human sensors receives and converts sensed information about physical phenomena such as sound waves, light rays, flavors, odors, and physical contact into electrical nerve signals.
- The brain receives signals and processes it.

Vision

- Two stages in vision
  - physical reception of stimulus
  - processing and interpretation of stimulus
- Eyes have mechanism for receiving light and transforming it into electrical energy.
- Light reflects from objects and received by eyes as shapes and colours.

- Vision is used to
  - Perceiving size and depth
  - Perceiving brightness
  - Perceiving color
    - 8% males and 1% females are colour blind.
    - It is the decreased ability to see colors or differences in colors.
- Optical illusions also occur:

the Ponzo illusion



the Muller Lyer illusion

Vision

- Vision is more than the human reception of electromagnetic waves having frequency and intensity.
- Through the eyes, humans look at and perceive the environment.
- In doing so, the eyes engage in two primitive actions, which are also important from HCI perspective:

1. Fixations
2. Saccades

- Fixations
  - During a fixation, the eyes are stationary, taking in visual detail from the environment.
  - Fixations can be long or short, but typically last at least 200 ms.
- Saccades
  - Changing the point of fixation to a new location requires a saccade— a rapid repositioning of the eyes to a new position. Saccades are inherently quick, taking only 30–120 ms.

- HCI research in eye movements has several themes.
- One example is analyzing how people read and viewed content on web pages.
- The *b* and *c* figures represents different tasks using eyes.

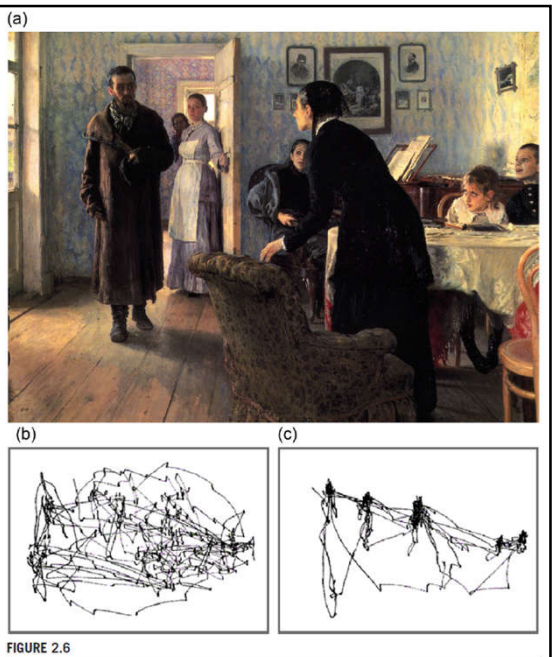


FIGURE 2.6

Yarbus' research on eye movements and vision (Tatler et al., 2010). (a) Scene. (b) Task: *Remember the position of the people and objects in the room.* (c) Task: *Estimate the ages of the people.*

- For instance, advertisers might want to know about viewing patterns and, for example, how males and females differ in viewing content.

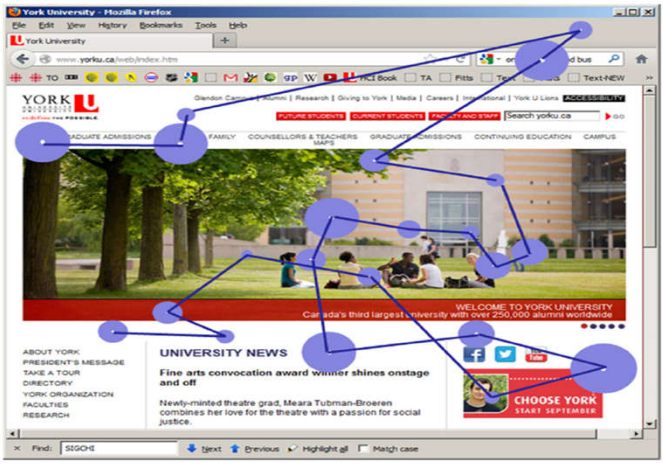


FIGURE 2.7
Scanpath for a user locating content on a web page.

Hearing (Audition)

- Hearing, or audition, is the detection of sound by humans. Sound is transmitted through the environment as sound waves—cyclic fluctuations of pressure in a medium such as air.
- Sound waves are created when physical objects are moved or vibrated, thus creating fluctuations in air pressure.
  - Sounds provide a surprisingly rich array of cues to humans, whether walking about while shopping or sitting in front of a computer typing an e-mail message.
  - Not surprisingly, sound is crucial for blind users, for example, in conveying information about the location and distance of environmental phenomena.

–HCI researchers are mostly interested to use sounds to provide different feedbacks and information where vision may not be suitable.

Touch (Tactition)

- Although touch, or tactition, is considered one of the five traditional human senses. Touch is just one component of the *somatosensory system.*
- The *somatosensory* system is the **part of the sensory system concerned with the conscious perception of touch, pressure, pain, temperature, position, movement, and vibration**, which arise from the muscles, joints, skin etc.
- This system includes sensory receptors in the skin, muscles, bones, joints, and organs that provide information on a variety of physical or environmental phenomena, including touch, temperature, pain, and body and limb position.

- Tactile Interaction in HCI
  - In HCI interfaces can use sense of Touch for different responses or information where needed.
  - A very basic example is use of vibration to alert about an in-coming call in mobile phones.
  - There can be many situations where this is needed.
  - Think about different situations and environments in which a visually dominant displays are either impractical or impossible or dangerous.

- **Gaming:**

- Haptic feedback is extensively used in gaming controllers to enhance immersion and realism by providing tactile sensations corresponding to in-game events.
- For example, when a player's character is hit or encounters an obstacle, the controller vibrates or provides varying levels of force feedback, adding to the gaming experience.

- **Touchscreens and Mobile Devices:**

- Mobile devices and touchscreens often incorporate haptic feedback to simulate the feeling of pressing physical buttons or keys.
- Users receive tactile feedback through vibrations or subtle movements when typing on a virtual keyboard, pressing buttons, or interacting with on-screen elements, improving user experience and responsiveness.

- **Accessibility Devices:**

- Haptic feedback technology is integrated into accessibility devices such as braille displays for visually impaired individuals.
- These displays convert digital text into tactile sensations, allowing users to read text through touch, enhancing accessibility and independence in accessing digital content.

Human Responders

Limbs

- Limbs
  - Human control over machines is usually associated with the limbs, particularly the upper body limbs.
  - With fingers, hands, and arms we type on keyboards, maneuver mice and press buttons, hold mobile phones and press keys, touch and swipe the surfaces of touchscreen phones and tablets, and wave game controllers in front of displays.
  - Of course, legs and feet can also act as responders and provide input to a computer.
  - For users with limited or no use of their arms, movement of the head can control an on-screen cursor.

Voice

- Voice
- The human vocal cords are responders.
- Through the combination of movement in the larynx, or voice box, and pulmonary pressure in the lungs, humans can create a great variety of sounds.
- Voice is used as a responder in
  - Voice recognition
  - Voice commands
  - Natural Language commands

Eyes

- Eyes are both Sensors as well as Responders.
- The eye is also capable of acting as a responder—controlling a computer through fixations and saccades.
- In this capacity, the eye is called upon to do double duty since it acts both as a sensor and as a responder.

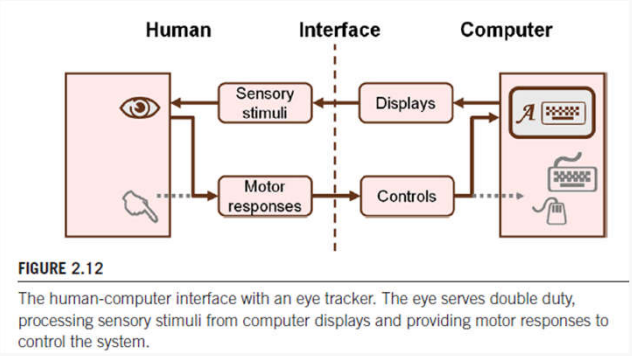


FIGURE 2.12
The human-computer interface with an eye tracker. The eye serves double duty, processing sensory stimuli from computer displays and providing motor responses to control the system.

- Interface for using eyes as responders for typing text.

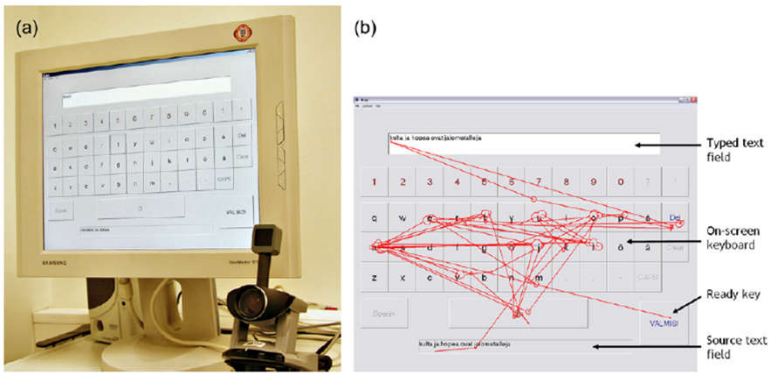


FIGURE 2.13

Eye typing: (a) Apparatus. (b) Example sequence of fixations and saccades (Majaranta et al., 2006).

The brain

- The brain is the most complex biological structure known.
- With billions of neurons, the brain provides humans with a multitude of capacities and resources, including pondering, remembering, recalling, reasoning, deciding, and communicating.
- While sensors (human inputs) and responders (human outputs) are nicely mirrored, it is the brain that connects them.

Cognition

- Among the brain's vital faculties is cognition—the human process of conscious intellectual activity, such as thinking, reasoning, and deciding.
  - HCI focuses on Designing Interfaces while considering the human cognitive abilities in mind.
  - Systems should be designed so that they would not put strain on brain and easy to remember its operation.

Example of Designing Interfaces considering the human cognitive abilities

DESIGN FOCUS

Cashing in

Closure gives you a nice 'done it' when we complete some part of a task. At this point our minds have a tendency to flush short-term memory in order to get on with the next job. Early automatic teller machines (ATMs) gave the customer money before returning their bank card. On receiving the money the customer would reach closure and hence often forget to take the card. Modern ATMs return the card first!

Memory

- Memory is the human ability to store, retain, and recall information.
- In the brain, memory has two major types of memory systems.
- A *declarative/ explicit* area stores information about events in time and objects in the external world.
- A *Non-declarative memory* system stores information where there are no conscious components but are important for skills learnt or habits.

DESIGN FOCUS

7 ± 2 revisited

When we looked at short-term memory, we noted the general rule that people can hold 7 ± 2 items or chunks of information in short-term memory. It is a principle that people tend to remember but it can be misapplied. For example, it is often suggested that this means that lists, menus and other groups of items should be designed to be no more than 7 items long. But use of menus and lists of course has little to do with short-term memory – they are available in the environment as cues and so do not need to be remembered.

On the other hand the 7 ± 2 rule would apply in command line interfaces. Imagine a scenario where a UNIX user looks up a command in the manual. Perhaps the command has a number of parameters of options, to be applied in a particular order, and it is going to be applied to several files that have long path names. The user then has to hold the command, its parameters and the file path names in short-term memory while he types them in. Here we could say that the task may cause problems if the number of items or chunks in the command line string is more than 7.