Benyon, Designing Interactive Systems: A comprehensive guide to HCI and interaction design, 2nd Edition, © Pearson Education Limited 2011

Chapter 3

COMPUTER CHARACTERISTICS

Overview

- Designers also need to know about the features of interactive technologies and how to approach designing interactive systems.

- A computer system comprises various elements, each of which affects the user of the system.
- Input devices for interactive use, allowing text entry, drawing and selection from the screen:
- Output display devices for interactive use:
- Virtual reality systems and 3D visualization which have special interaction and display devices.
- Paper output and input: the paperless office and the less-paper office.

Technology

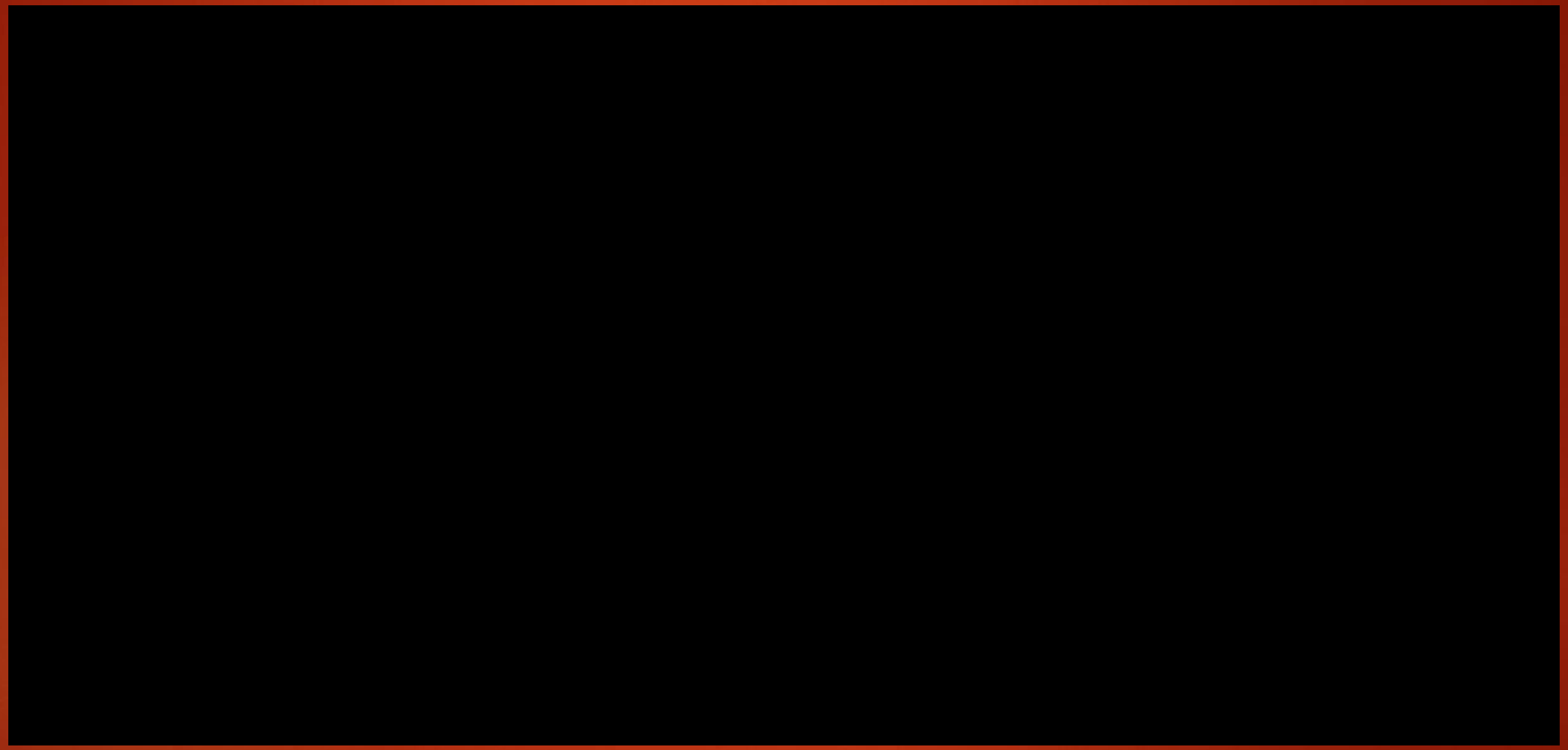
- Designers of interactive systems need to understand the materials they work with just as designers in other areas of design such as interior design, jewelry design, etc.

- Interactive systems can perform various functions and typically contain a good deal of data, or information content.
- Interactive systems typically consist of hardware and software components that communicate with one another and transform some input data into some output data.
- People using such systems engage in interactions and physically devices have various degrees of style and aesthetics.

Classifying Technologies

- It is also very difficult to classify technologies as they are continually being packaged in new ways and different combinations facilitate quite different types of interactions.
- Of course interactive technologies change at a fantastic rate and by far the best way for designers to keep abreast of the options available is to subscribe to web sites.
- For example, the multi-touch screen on an iPod Touch allows for quite different ways of navigating through your music collection and selecting particular tracks than the track wheel on an iPod Nano.
- Designers need to be aware of various possibilities for input, output, communication and content.

Generation Computer



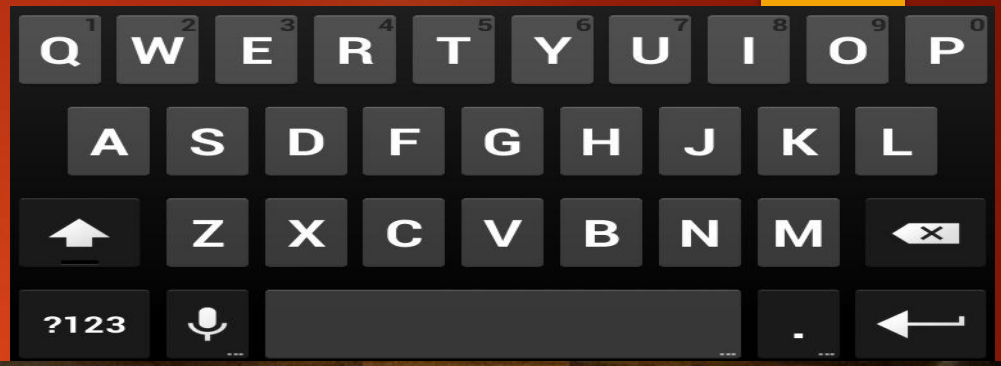
Source: locus Ng

Input Device

- Input devices are concerned with how people enter data and instructions into a system securely and safely.
- Switches and buttons facilitate a simple and direct method of issuing instructions (such as ‘turn on’ or ‘turn off’) but they take up space.
- On small mobile devices there is not enough room to have many buttons, so designers have to be careful which functions have their own button.
- On the iPhone, for example, a button on the side of the device is allocated to turning the sound off and on.
- The designers decided that this was such an important and often used function that it should have its own button.

Input Methods

- Alphanumeric data is usually input to an interactive device through a 'QWERTY' keyboard, invented by C. L. Sholes in 1868.
- The design is still with us today, despite some devices using an alphabetic keyboard where the letters are arranged in alphabetical order.
- Touchscreens are sensitive to the touch of a finger. They function through either infra-red sensitivity or electrical capacitance.
- Because of their lack of moving or detachable parts, they are suitable for applications intended for public places, and provided the interface is well-designed present an appearance of simplicity and ease of use.
- Many touchscreens only recognize a single touch, but multitouch screens enable zooming and rotating of images and text.



Mouse

- One of the most ubiquitous of input devices is the mouse, developed at Stanford University Research Laboratory in the mid-1960s.
- Mousepad or trackpad is a pointing device featuring a tactile sensor, a specialized surface that can translate the motion and position of a user's fingers to a relative position on the operating system that is outputted to the screen.
- The mouse consists of a palm-sized device that is moved over a flat surface such as the top of a desk.
- At its simplest (and cheapest) it rests on a rubber-coated ball that turns two wheels set at right angles. These two wheels translate the movement of the mouse into signals that the computer to which it is connected can interpret.
- One or two buttons sit on top of the mouse and are operated with the person's fingers.
- More contemporary mouse design includes a thumbwheel for scrolling through documents or web pages.
- A mouse may be cordless, using infra-red to communicate with the host computer.

Pointing Device

- Touchscreens make use of the person's finger as the input device which has the obvious benefit that people always have their fingers with them.
- The light pen was, arguably, the original pointing device. When it is pointed at the screen it returns information about the screen location to a computer which allows the item pointed at to be identified.
- Light pens are less expensive than touchscreens, can be armored (made very robust) and can be sterilized. They have a number of industrial and medical applications.
- Other forms of pointing devices include the stylus which is used on very small displays where a finger is too big to be used as the input device, and on many PDAs.

More Pointing Device

- A trackball is another pointing device which is best described as a mouse lying on its back.
- To move the pointer the user moves the ball.
- Again, like all other pointing devices, there are one or more buttons which can be used to select on-screen items.
- Trackballs are often found in public access kiosks because they are difficult to steal and do not require a flat surface to rest upon.
- A joystick is a handle which pivots from a central point. Viewing the joystick from above, it may be moved north, south, east and west (and all points between) to control an on-screen pointer, spaceship or any other on-screen object.
- Joysticks are used mostly for computer games, but they are also found in conjunction with CAD/CAM (computer aided design/manufacture) systems and VR (virtual reality) applications.

source: gaming.logitech

Keyboard

- It is used for entering textual data and commands. The vast majority of keyboards have a standardized layout.
- There are alternative designs which have some advantages over the QWERTY layout, which are DVORAK, chord keyboard and T9 entry.
- The QWERTY arrangement of keys is not optimal for typing, however. The reason for the layout of the keyboard in this fashion can be traced back to the days of mechanical typewriters.
- The reason for this is social – the vast base of trained typists would be reluctant to relearn their craft, whilst the management is not prepared to accept an initial lowering of performance whilst the new skills are gained.
- There is also a large investment in current keyboards, which would all have to be either replaced at great cost, or phased out, with the subsequent requirement for people to be proficient on both keyboards.

Pointing from the Distance

- Ultrasound
- Heliograph
- Telegraph
- Microwave
- Infrared
- Bluetooth
- Zigbee
- Z-Wave
- Hotspot (WiFi)
- DECT
- UMTS
- EDGE
- GPRS
- MyriaNed
- One-Net
- EnOcean
- RuBee
- LiFi
- Rontgen (X-Ray)
- Laser
- WACS
- RADAR
- Ultraviolet (UV)
- Gamma Ray
- RFID
- Barcode
- Satellite

And more…

Biometrics (Sensor)

- Technically, anywhere you can find biometric technology you can also find a sensor. New developments in biometric software, combined with the proliferation of connected cameras and microphones on mobile devices, have created a scenario in which even the basic components of a smartphone can be considered sensors in certain contexts.
- Since biometric identifiers are unique to individuals, they are more reliable in verifying identity than token and knowledge-based methods; however, the collection of biometric identifiers raises privacy concerns about the ultimate use of this information (Weaver, 2006).
- The biometrics market was expected to be worth $13.8 billion in 2015.
- Wilson (2008) lists sensors for detecting occupancy, movement and orientation, object distance and position, touch, gaze and gesture, human identity (biometrics), context and affect.

Neurotech (Brain)

- Neuro technology can be defined as technical tools to interact with the nervous system to change its activity, for example to restore sensory input such as with cochlea implants to restore hearing or deep brain stimulation to stop tremor and treat other pathological conditions.
- Potomac Institute (2015) list several trends in Neurotech that will benefit field of medicine, increase human intelligence and enhance the quality of life. There are Brain Computer Interface (BCIs), Cognitive Load Technology, Wearable Technology, Neuroimaging, Neuroprosthetic, Neuromodulation, Neurodiagnostic, etc.
- Neuroscience research has been on the rise for over 50 years, with publications in the field increasing at a steady rate (between 5-15% per year).
- New types of neural interface systems are now envisioned, ranging from those that can sense, compute, and interact directly with the nervous system to those that may shed new insights into neurological function and dysfunction, thereby enabling existing therapies to be retargeted and delivered more effectively (Shenoy & Nurmikko, 2012).

Speech (Voice)

- Speech technology relates to the technologies designed to duplicate and respond to the human voice. They have many uses. These include aid to the voice-disabled, the hearing-disabled, and the blind, along with communication with computers without a keyboard. They enhance game software and aid in marketing goods or services by telephone.
- There are several type of speech technology such as automatic speech recognition (ASR), speech synthesis, text-to-speech system, speech verification/identification, machine translation, facial animation, intelligent personal assistant and multimodal interface.
- Siri is a computer program that work as intelligent personal assistant (IPA) and navigator, as the example of advancement of speech technology. It uses natural language (objective C) to answer question, give recommendation and perform action by delegating the task to web service. Besides that, Cortana, Google Assistant, S Voice, Amazon Alexa and Lucida are other example of IPA.

Output Device

- Technologies for displaying content to people rely primarily on the three perceptual abilities of vision, hearing and touch.
- The most fundamental output device is the screen or monitor.
- Even a few years ago the default monitor used cathode ray tube (CRT) technology that required a large heavy box positioned on a desk or table.
- Nowadays flat screen monitors using plasma or TFT (thin film transistor) or LCD (liquid crystal display) technologies can be mounted on walls.
- Some of these can deliver very large displays that results in a significantly different interactive experience.

Other Display

- The physical dimensions of display devices are, however, only one of the factors involved in the resulting output.
- The output device is driven by hardware – a graphics card - that will vary with respect to the screen resolutions and palette of colors it can support.
- More generally, designing interactive systems to work with any and all combinations of hardware is very difficult. Typically, applications and games specify minimum specifications.
- One way past the problems with restrictive display 'real-estate' is to use a data projector.
- While the resolution is usually less than that of a monitor, the resulting projected image can be huge.

Multi Touch Surface

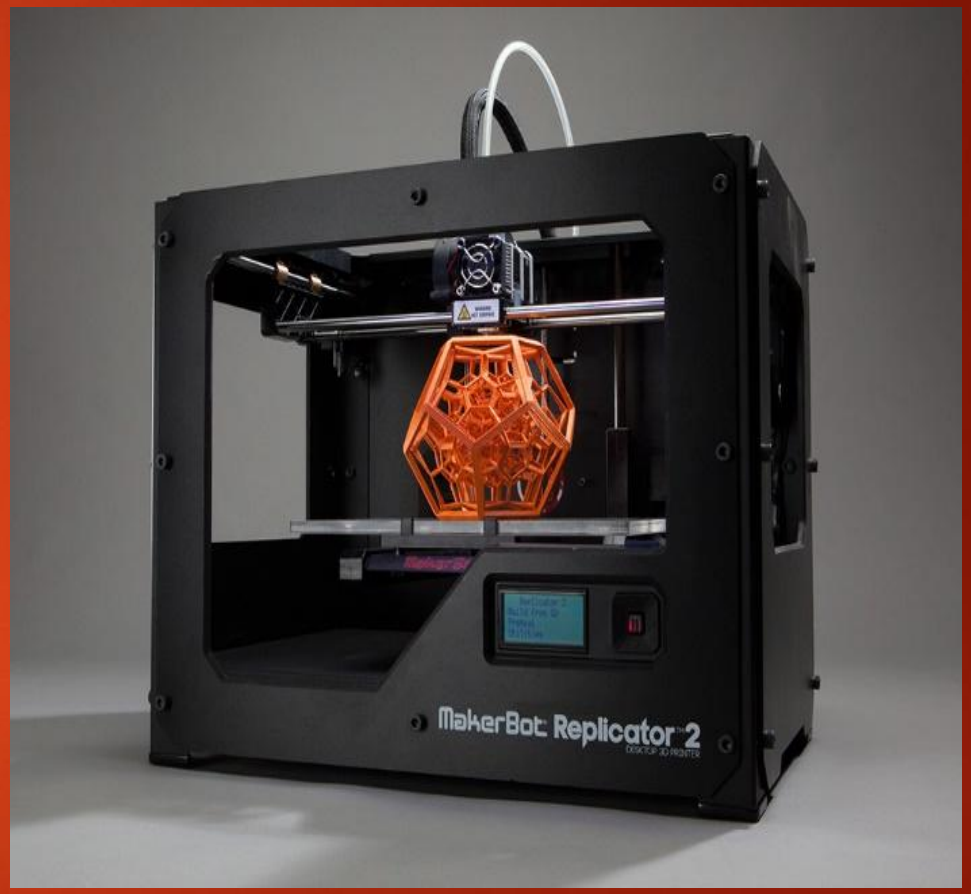
- Data projectors are shrinking in size at a remarkable rate and there are now mobile data projectors.
- These promise to have a big impact on interaction design as they get small enough to be built into phones and other mobile devices.
- Images can be projected onto any surface and pointing and other gestures can be recognized by a camera.
- In this way any surface has the potential to become a multi-touch display.

Sound

- Sound is an output medium that is significantly under-used.
- Ear cons and audio icons can be used to create and entire soundscape
- Speech output is also an increasingly popular option (e.g. in satellite navigation systems).
- With effective text to speech (TTS) systems simply sending a text message to the system results in clear spoken output.

Printer

- A printer is a device that prints text or illustrations on paper, while a plotter draws pictures or shapes.
- Plotters differ from printers in that they draw lines using a pen. As a result, they can produce continuous lines, whereas printers can only simulate lines by printing a closely spaced series of dots.
- Multicolor plotters use different-color pens.
- Several companies have developed three-dimensional printers.
- These machines work by placing layers of a powdery material on top of each other to create a real-life model of a digital image.
- 3D printers allow for the rapid prototyping of physical designs for new products.



Processing and Networks

- Speed of processing can seriously affect the user interface. These effects must be taken into account when designing an interactive system. There are two sorts of faults due to processing speed: those when it is too slow, and those when it is too fast! Besides that, the system should be test and maintain properly to prevent functional fault, in which the program do wrong thing.
- There are several limitation that can limit the interactive system, which are computational bound, storage channel bound, graphic bound and network capacity.
- Such networked systems have an effect on interactivity, over and above any additional access to distant peripherals or information sources. Networks sometimes operate over large distances, and the transmission of information may take some appreciable time, which affects the response time of the system and hence the nature of the interactivity.
- Another effect is that the interaction between human and machine becomes an open loop, rather than a closed one.

Memory and Storage

- The term memory refers to the amount of RAM installed in the computer, whereas the term storage refers to the capacity of the computer's hard disk.
- Computers that run interactive programs will process in the order of 100 million instructions per second.
- The speed and performance of your system depends on the amount of memory that is installed on your computer.
- Storage allows you to access and store your applications, operating system and files for an indefinite period of time.
- In 1965 Gordon Moore, co-founder of Intel, noticed a regularity. It seemed that the speed of processors, related closely to the number of transistors that could be squashed on a silicon wafer, was doubling every 18 months – exponential growth.

Data and Media Requirements

- Designers also need to know about the features of interactive technologies and how to approach designing interactive systems.

- Some activities, however, require very modest amounts of data, or data that does not change frequently and can make use of other technologies.
- In other activities there may be a need to display video or high quality color graphic displays.
- A library, for example, just needs to scan in a bar code or two, so the technology can be designed to exploit this feature of the activity.
- Just as important as data is the media that an activity requires.
- A simple two-tone display of numeric data demands a very different design from a full motion multimedia display.

Data Characteristics

- The characteristics of the data are important for choosing input methods.
- Content can be retrieved when required (known as pull technology) or it can be pushed from a server to a device.

- Push e-mail, for example, is used on the Blackberry system so that e-mail is constantly updated.
- RSS feeds on web sites provide automatic updates when a web site's content is changed.
- Bar codes, for example, are only sensible if the data does not change often.
- Touchscreens are useful if there are only a few options to choose from.
- Speech input is possible if there is no noise or background interference, if there are only a few commands that need to be entered or if the domain is quite constrained.

Media Characteristics

- ‘Streamy’ outputs such as video, music and speech have different characteristics from ‘chunky’ media such as icons, text or still photographs.
- Most important, perhaps, is that streamy media do not stay around for long.
- Instructions given as speech output, for example, have to be remembered, whereas if displayed as a piece of text, they can be read over again.
- Animations are also popular ways of presenting content.
- 2D animation is generally produced using Abode’s Flash program and 3D style animation can be produced with papervision or games ‘engines’ such as 3D Studio Max and Maya.

Media Characteristics (cont.)

- A small amount of data has to be entered quickly.
- It must be obvious how to do this to accommodate visitors and people unfamiliar with the system.
- It needs to be accessible by people in wheelchairs.
- The output from the technology needs to be clear: that the security data has been accepted or not and the door has to be opened if the process was successful.
- Communication with a central database may be necessary to validate any data input, but there is little other content in the application.

Communication

- Communications between people and between devices is an important part of designing interactive systems.
- So too is feedback to people so that they know what is going on and indeed that something is going on! In some domains the transmission and storage of large amounts of data becomes a key feature.
- Here issues such as bandwidth and speed are critical.
- Communication can take place through wired connections such as a telephone line, or an Ethernet network often found in offices.
- Extremely fast communications over fibre-optic cables connect these nodes to each other and hence connect devices to other devices all over the world.
- Each device on this network has a unique address, its IP (Internet Protocol) address that enables data to be routed to the correct device.
- The number of IP addresses available will soon be used up and a new form of address, IPv6, will be needed.

Wireless Communication

- Wireless communication is becoming much more common and often a wireless 'hub' is attached to an Ethernet network.
- Wireless communications can take place over the wireless telephone network used for mobile phones or over a wi-fi connection.
- Wi-fiis quite limited in range and you need to be within a few metres of a wi-fi hub to get a connection, whereas over the telephone network, coverage is much wider.
- Unfortunately even the latest mobile telephone technology, 3G, transferring large amounts of data can be slow.
- Wimax promises to deliver much wider coverage using wi-fi.
- Short range communications directly between one device and another (i.e. not using the internet) can be achieved using a technology called Bluetooth.
- Near Field Communication (NFC) is used to connect devices simply by bringing them close to each other.
- All new mobile phones will soon have NFC capability, a feature which again will change the types of interaction that are possible.

Content

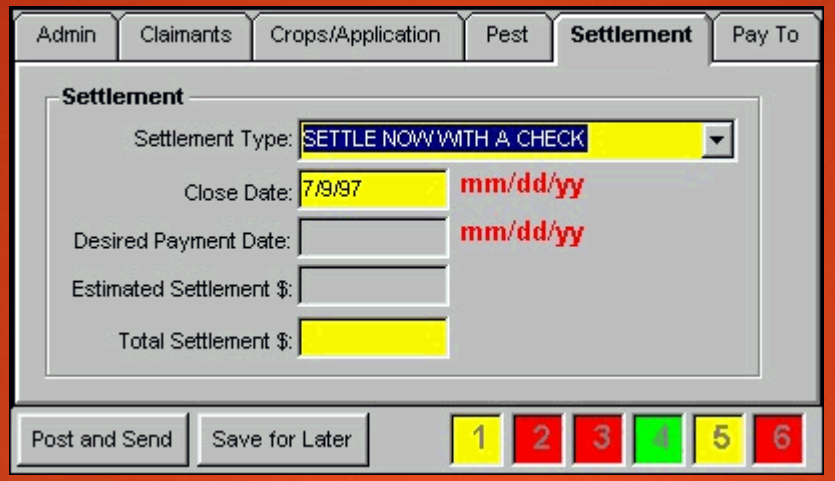
- Content concerns the data in the system and the form it takes.
- Considerations of content are a key part of understanding the characteristics of the activities as described above.
- The content that a technology can support is also critical.
- Good content is accurate, up-to-date, relevant and well presented.
- There is little point in having a sophisticated information retrieval system if the information, once retrieved, is out of date or irrelevant.
- In some technologies content is just about everything (e.g. websites are usually all about content).
- Other technologies are more concerned with function (e.g. a remote control for a TV).
- Most technologies have a mixture of function and content.

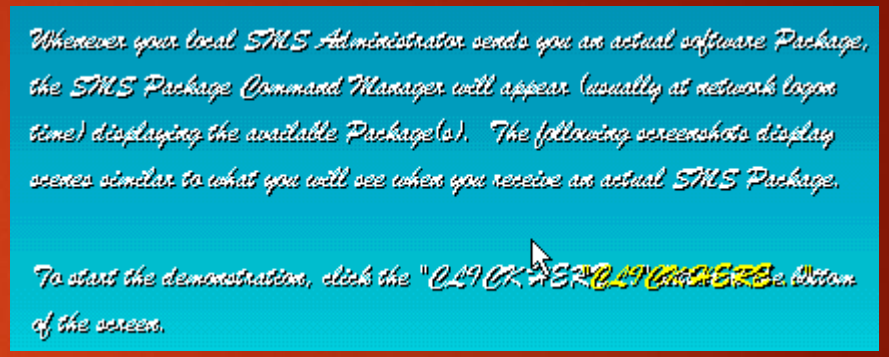
Bad and Good Design

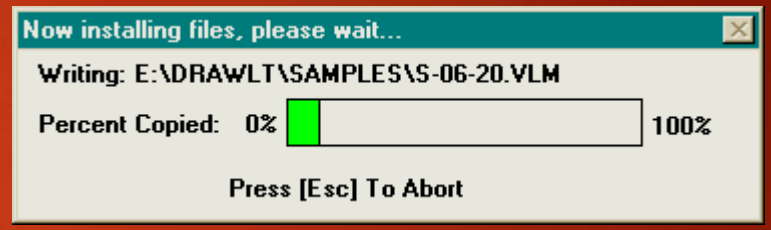
- Use of colors can enhance an interface, but it can also destroy it. A great deal of care must be chosen when picking colors. Not only should one strive for pleasing color combinations, but one must also consider issues like color blindness
- A good user interface should be easy to use. For one thing, it should be intuitive.
- Error messages need to be informative, yet not overly technical. Clarity is essential.
- The user of the software/computer should not need a technical background to operate it. Technical issues should be managed by the computer, and hidden from the human.
- The software should allow the user to undo the most recent action.
- Very few people read manuals before using a piece of software. A good interface can be "figured out" without resorting to the instructions.

source: cs.drexel.edu

Bad Design (Color)







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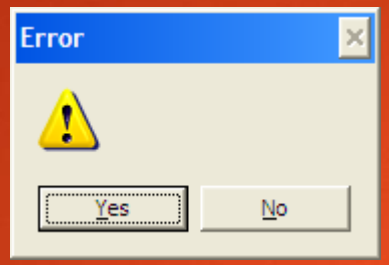
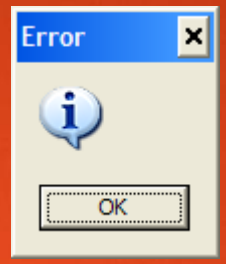
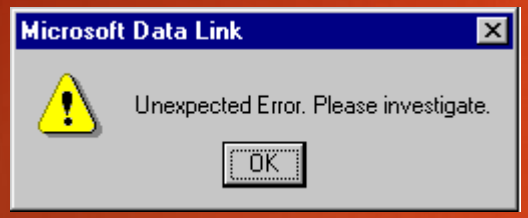
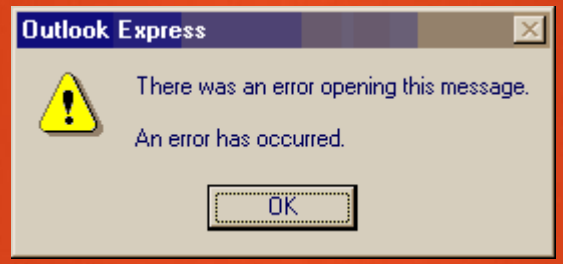
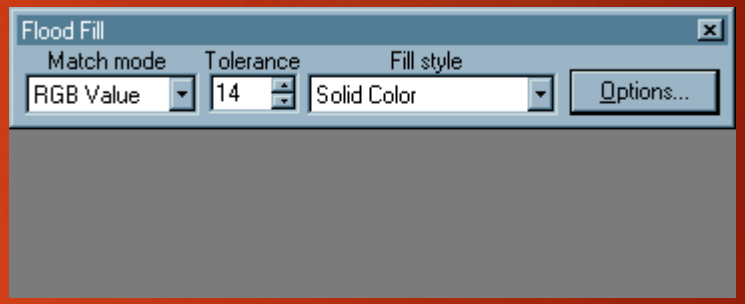
Bad Design (Error Message 1)

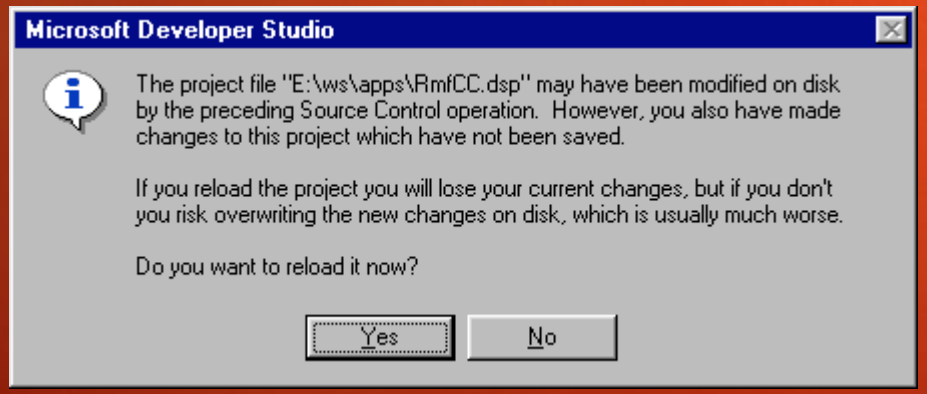












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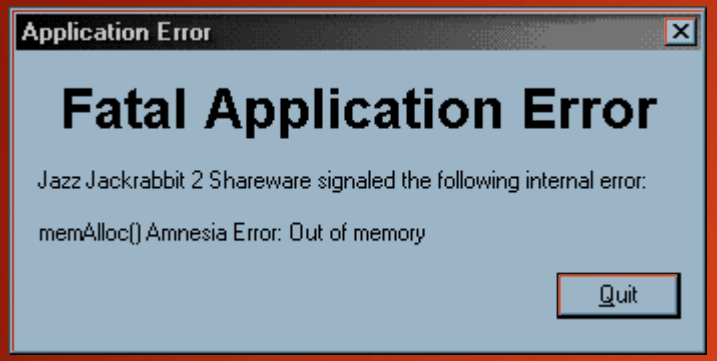

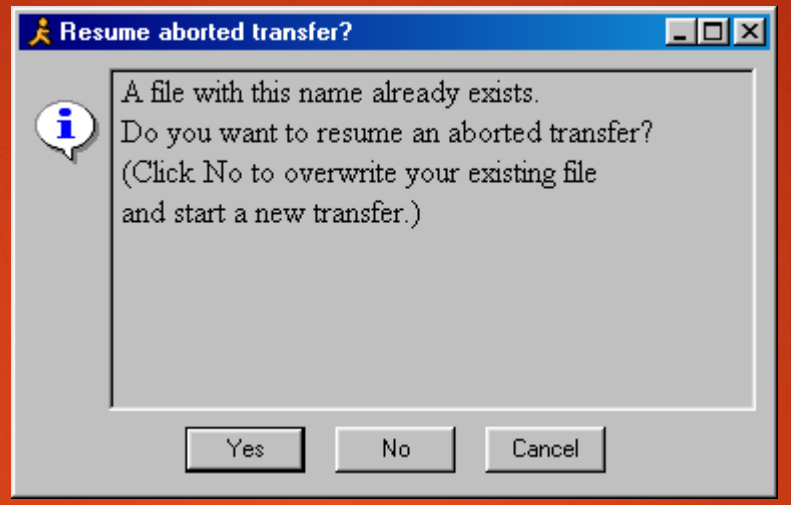

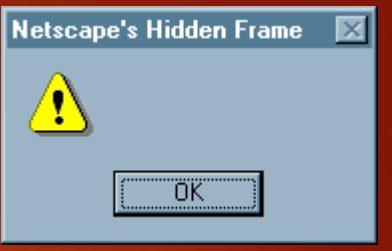

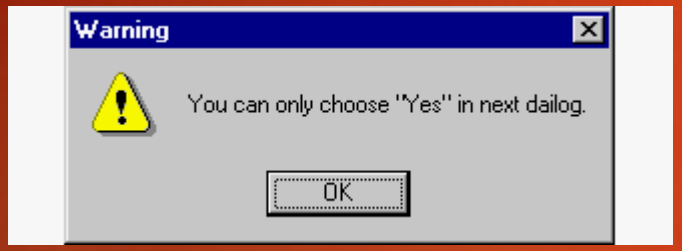

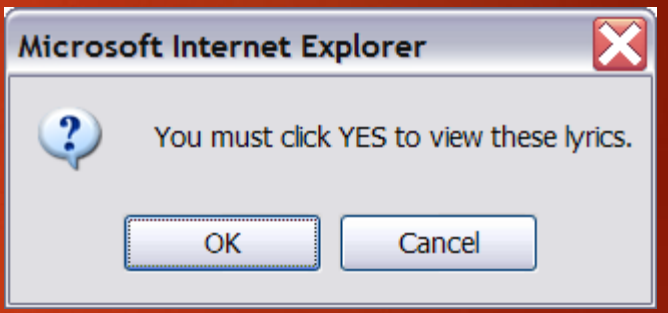

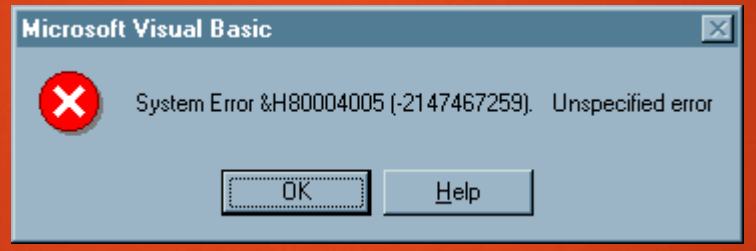

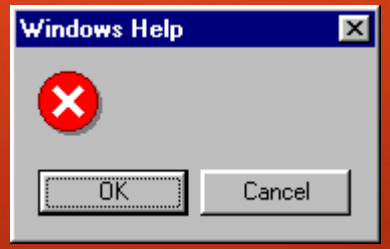

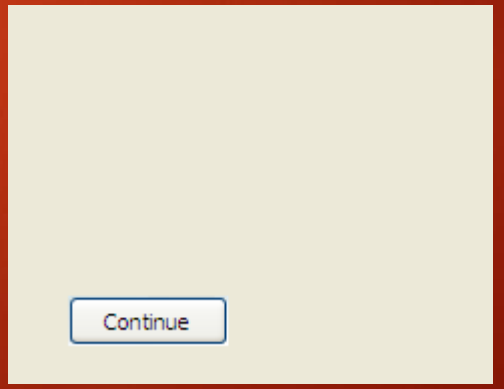

source: cs.drexel.edu

Real Life Example

Product System	Bad Approach	Why?	How?
ATM Machine	ATM's that spit out your card after the cash	ATM users are waiting for one thing: cash. So when the cash dispenses their immediate reaction is to leave.	it's imperative that the cash comes out last— people are far less likely to forget their card if it comes out before the cash
Emergency Door	Doors that don't indicate which side to push	You have a 50% chance of getting this door right. So the direction and sign in front of door ease the use.	It should consider the purpose and the route use in particular event— people often lose control in the time of disaster and tend to be unaware when search the way out.

Design Thinking

- Sources of competition and disruption can appear anywhere—not just disruption in products, services, and technology, but also in channels to market, policy, talent, brands, and supply chains.
- The designer needs to be aware of the properties of the devices with which a system is built. This includes not only input and output devices, but all the factors that influence the behavior of the interface, since all of these influence the nature and style of the interaction.
- There are three spaces to keep in mind: inspiration, ideation and implementation. Think of inspiration as the problem or opportunity that motivates the search for solution; ideation as the process of generating, developing and testing ideas; and implementation as the path that leads from the project stage into people's lives.
- One of biggest impediments is simply fear of failure. The notion that there is nothing wrong with experimentation or failure, as long as they happen early and act as a source of learning, can be difficult to accept. But vibrant design thinking culture will encourage prototyping- quick, cheap and dirty- as part of creative process and not just as a way of validating finished idea.

Advanced Technology: Future Design

Mixed Reality

- Head-mounted displays (HMDs)
- 360° video
- Mediality continuum
- Interreality physics
- Computer-generated VR

IT Business Alignment

- Holistic Approach
- IT Risk Spectrum
- Cost-based Analysis
- IT Service Delivery

Social Media Based

- Knowledge Management
- Technoself
- Virtual Communities
- Consumer Generated Media

Ubiquitous Computing

- Pay-as-you-Go
- Smart Device
- Wearable Technology
- Radio Frequency Identification Tags (RFID)

The Task-Artifact Cycle

- Beyond (Off) Desktop
- Continual Exploration Domain
- Re-engineering
- Monitoring and Maintenance

Front-End Development

- Responsive Web Design
- Cross Platform
- Intelligent Web
- Content Management System
- Version Control System

Future Design (Cont.)

- Since we are in effect constructing a future trajectory, and not just finding it, the cost of missteps is high.
- The co-evolution of activity and artifacts evidences strong hysteresis, that is to say, effects of past co-evolutionary adjustments persist far into the future.
- For example, many people struggle every day with operating systems and core productivity applications whose designs were evolutionary reactions to misanalyses from two or more decades ago.
- Of course, it is impossible to always be right with respect to values and criteria that will emerge and coalesce in the future, but we should at least be mindful that very consequential missteps are possible.

If Only Remember a Few Things

You are a designer

- If you're thinking tangibly and strategically about a new solution, you're designing.
- Listen to people and find inspiration in their needs.
- Be confident in your own intuition and creativity.

Be comfortable not knowing

- Let yourself learn.
- Be willing to experiment. Take risks.
- Be okay with not having the "right" answer. Trust that you'll find one.

If Only Remember a Few Things

Get out there

- Step out of your comfort zone.
- Learn from the world.
- Be open to the new.

Be optimistic

- See problems as opportunities.
- Start with, “What if?” instead of “What’s wrong?”
- Do not forget to Pray!

JUST
WALK
OUT

Case Study: What are the differences?

- Walmart Pay
- Google Wallet
- Apple Pay
- PayPal

- Google Glass
- SixthSense
- PlayStation VR
- Oculus Rift

- Xbox One
- PlayStation Pro
- Steam Machine
- Nintendo WiiU

- How do you think new, fast, high-density memory devices and quick processors have influenced recent developments in HCI?
- Do they make systems any easier to use?
- Do they expand the range of applications of computer systems?

Summary

- We can learn a lot from the mistakes that others have made. It's almost painfully obvious why some of these are the worst designs imaginable. But it's also easy to assume that you wouldn't make the same mistake yourself.
- Designer needs to be aware of the properties of the devices with which a system is built. This includes not only input and output devices, but all the factors that influence the behavior of the interface, since all of these influence the nature and style of the interaction.

Reference Books

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