INF1520

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This document contains a summary of the official study guide for the subject INF1520.

SUMMARY
Ver 2.0

1 INTRODUCTION TO HUMAN-COMPUTER INTERACTION

Purpose:

- Enhance the quality of the interaction between human and machine and to systematically apply knowledge about human purposes, capabilities, and limitations, as well as knowledge about machine capabilities and limitations.
- To develop or improve productivity and the functionality, safety, utility, effectiveness, efficiency, and usability of systems that includes computers (Preece et al., 2007)

Requires:

Understanding following:

- Computer technology
- People who interact with the computer technology
- Design of interactive systems and interfaces that are usable
- Broader impact of computer technology on society and on our social, personal and working environment

History:

- The term *human-computer interaction* (HCI) was adopted in the mid-1980s to denote a new field of study concerned with studying and improving the effectiveness and efficiency of computer use.
- The *early history* of computing can be traced back to the narrow aims of mathematicians, logicians, and astronomers who had particular calculations that needed to be performed
- Persian astrologer Al-Kashi (1393-1449) built a device to calculate the conjunction of the planets.
- German mathematician, Wilhelm Schickard (1592-1635) developed a much less sophisticated tool to perform simple addition and subtraction.
- Blaise Pascal (1612-1662) was forced to replicate much of Schickard's work but only succeeded in building an even more simplified version of that machine
- Charles Babbage (1791-1871) was a British mathematician and inventor. Created Difference Engine was designed to calculate a specific function (6th degree polynomials)
- Babbage's second machine, the Analytical Engine, was a more general computer which used:
- Punched cards were used and became perhaps the first solution to a user interface problem.
- Herman Hollerith (1860-1929) was recruited by the American census office to develop a computational device to calculate general statistics
- These early attempts led to the foundation of the Computer-Tabulating-Recording Company (1911).
- 1914 Thomas J. Watson (Snr) joined the organization and built it into the International Business Machines Corporation (IBM).
- The term 'computer' was originally used to describe the people who manually performed these calculations in the early twentieth century

- Alan Turing, an English logician and a founder of Computer Science, was employed to break the German encryption techniques. This led to the development of the Colossus (1943) that was perhaps the first truly interactive computer
- Many of the Colossus techniques were also introduced in the ENIAC machine (see Figure 1.2), the first all-electronic digital computer, produced around 1946 by J. W. Mauchly and J. P. Eckert in the United States
- In 1945 Vannevar Bush, an electrical engineer in the USA, published his 'As we may think' article in Atlantic Monthly. This article was the starting point of Bush's idea of the Memex system
- The Memex was a device in which individuals could store all personal books, records, and communications.
- 1957 IBM launched FORTRAN, one of the first high-level programming languages. FORTRAN was based on algebra, grammar, and syntax rules, and became the most widely used computer language for technical work.
- By the middle of the 1950s it became obvious that the computer could be used to manipulate pictures as well as numbers and text.
- Ivan Sutherland who, in 1963, developed the SketchPad system at the MIT Lincoln Laboratory. It was a sophisticated drawing package which introduced many of the concepts found in today's interfaces.
- Two of the most dominant influences are Doug Engelbart and Ted Nelson. Used concept of the Memex system and elaborated on it.
- Turning points in the development of computers that would allow it to become available to the man in the street occurred in the middle 1970s
- Apple Company was founded by Steve Jobs and Steven Wozniak in 1976. Produced a series of kit machines.
- **Before** the 1980s, personal computers were only used by enthusiasts. They were sold in kits and were distributed through magazines and electronic shops.
- Their user population consisted almost entirely of experts. They understood the underlying hardware and software mechanisms because they had built most of it
- In 1981, IBM introduced their first PC.
- As a result, 'casual users' began to appear for the first time.
- (GUI) had its roots in the 1950s it was not developed until the 1970s when a group at the Xerox Palo Alto Research Centre (PARC) developed the Alto, a GUI-based computer.
- Ben Shneiderman at the University of Maryland coined the term 'direct manipulation' in 1982 and introduced the psychological foundations of computer use.
- Apple has experimented beyond pure functionality as far as the aesthetics of their machines is concerned.

Internet:

- Early in 1962, Rand Corporation, one of America's leading military suppliers created solution (called ARPANET) was to grow into the Internet – a highly connected network of computer systems.
- Two major developments built on the Internet: e-mail & WWW & social networks.
- Until the late 1980s the growth in email was largely restricted to academic communities.
- WWW grew from the National Centre for Supercomputer Applications (NCSA), University of Illinois and from CERN.

- Application or client programs, called browsers, translate user request for information into the communications primitives that are necessary to transfer relevant data from remote servers.
- 2009 there were more than 230 million web sites and 1.73 billion internet users worldwide.
- Social network is a social structure that connects individuals (or organisations).
- *Facebook* 2004 by Mark Zuckerberg
- *Twitter* is a social networking and microblogging service that enables its users to communicate through created in 2006 by Jack Dorsey.
- Mobile computation can take place over large distances using cellular and satellite telephone links.
- They use one of two types of wireless access services when away from the home:
- Cellular broadband technology typically involves a cellular modem or card to connect to cell towers for Internet access
- WiFi uses radio waves to broadcast an Internet signal from a wireless router to the immediate surrounding area

Current Context:

- **Distributed systems**: The development of innovative user interfaces is increasing access to distributed information sources
- **Multimedia interfaces**: Text is still the most significant form of interaction with computer systems
- **Advanced operating systems**: Many of the changes described in section 1.2 have been being driven by changes in the underlying computer architecture.
- **HCI development environments**: On top of the new generations of operating systems, there are new generations of interface development software
- **Ubiquitous computing (UbiComp)**: This refers to computer systems that are embedded in everyday objects and thus, unobtrusively, become part of the environment
- **Mobile technology**: This has changed the context within which technology is used, the compilation of the user population, as well as the design of user interfaces. Computers (in their mobile form) can be used any time, any place

Future Directions:

- Mobile and ubiquitous computing will remain focus areas of the future.
- Harper, Rodden, Rogers, Sellen (2008) have identified five major transformations in computing:
- **The changing notion of 'the interface' -** Old ideas of what an interface is will not apply in the future era of ubiquitous computing.
- **Increasing dependency on technology -** younger generations who have always had these instantly available will not be able to function without them
- **Hyper-connectivity -** Communication technology will continue to improve and allow even more forms of connectivity among people.
- **Changes in the means of and reasons for recording information -** Things that were previously only stored in people's memories are now being recorded in digital format.
- **Increased creativity through technology -** Increasingly accessible and flexible computing devices can support new ways of playing, learning and creating

Definitions: HCI

- 'Set of processes, dialogues, and actions through which a human user employs and interacts with a computer' (Baecker and Buxton, 1987
- 'discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them
- (computer) is defined to include traditional workstations as well as embedded computational devices, such as spacecraft cockpits or microwave ovens, or specialized boxes such as electronic games
- human is defined to include a range from children to the elderly, computer aficionados to computer despisers, frequent users to hesitant users, big hulking teenagers to people with special needs
- 'The study of people, computer technology, and the ways these influence each other' (Dix et al., 2004).
- (Human) user is defined as whoever is trying to accomplish something using the technology and can mean an individual user, a group of users working together, or a sequence of users in an organization, each dealing with some part of the task or process.
- (Computer) is defined as any technology ranging from the general desktop computer to large-scale computer systems, a process control system, or an embedded system. The system may include non-computerized parts, including other people.
- Concerned with studying and improving the many factors that influence the effectiveness and efficiency of computer use.
- Combines techniques from psychology, sociology, physiology, engineering, computer science, and linguistics (Johnson, 1997).

Terms:

- ***Ergonomics*** is the study of work.
- ***Human factor*** *is* a term used to describe the study of user interfaces in their working context.
    - Physiology, our physical characteristics such as height and reach.
    - Perception, our ability to sense information, hearing, touch, and sight.
    - Cognition, the way we process data, such as the information we extract from a display.
- ***Usability*** is defined by ISO as:
  The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.
    - Effectiveness: The accuracy and completeness with which specified users can achieve specified goals in particular environments.
    - Efficiency: The resources expended in relation to the accuracy and completeness of goals achieved.
    - Satisfaction: The comfort and acceptability of the work system to its users and other people affected by its use.
- ***User experience*** refers to how people feel about a product. How satisfied are they when using it, looking at it, or handling. You cannot design a user experience; you can only design *for* user experience.

- ***Interaction design*** is defined by Preece et al. (2007, p. xvii) as "designing interactive products to support the way people communicate and interact in their everyday and working lives". (Components)
    - *Developing* alternative designs according to the requirements.
    - *Building* prototypes of the designs so that they can be assessed
    - *Evaluating* the designs and the user experience
    - *Identifying* needs and establishing user requirements
- **Accessibility** Evaluating the designs and the user experience. Makes user interfaces perceivable, operable, and understandable by people with a wide range of abilities, and people in a wide range of circumstances, environments, and conditions.

People involved:

There is too much expertise here to be held by one person, even by the average design team The purpose of studying human-computer interaction is to improve the quality of interaction between human and machine by systematically applying knowledge about human capabilities and limitations, and machine capabilities and limitations; also, to improve the productivity, functionality, effectiveness, efficiency, and usability of technology. Human-computer interaction is about designing for people (users).

- Psychology and cognitive science
- Computer science and engineering
- Philosophy
- Graphics design
- Health and safety factors
- Linguistics
- Sociology
- Environmental factors
- Organizational factors

2 HUMAN ISSUES IN HCI

- Human information processing consists of three interacting systems:
    - Perceptual system
    - Cognitive system
    - Motor system
- Characterise human resources into 3 categories:
    - Perception: way that they detect information in their environment
    - Cognition: way they process information.
    - Physiology: way they move and interact with physical objects in environment.

1. Perception

- Perception involves the use of our senses to detect information.
- Human ability to interpret sensory input rapidly and initiate complex actions makes the use of modern computer systems possible.

Factors affect perception:

- Change in output
- Maximum and minimum detectable levels
- The field of perception
- Fatigue and circadian (biological) rhythms
- Background noise

Eyesight:

- Designers have to make sure that people can see or hear displays if they are to use them.
- Partial sight, ageing and congenital colour deficits all produce changes in perception that reduce the visual effectiveness of certain colour combinations
- *3 Aspects colour perception*:
    - Hue: perceptual attributes associated with elementary colour names.
    - Lightness: how much light appears to be reflected from surface in relation to nearby surfaces.
    - Saturation: colour's perceptual difference from white, black or grey of equal lightness. Slate blue example of desaturated colour

2. Cognition

Refers to processes that take place in our heads:

- STM and information processing
- LTM and learning
- Attention
- Problem solving
- Decision making
- Search and scanning
- Time perception

Attention:

- Attention is the process of concentrating on something at a specific point in time.
- Attention is influenced by the way information is presented as well as by people's goals.
- People differ in terms of their attention span.

Memory:

- Memory consists of a number of systems that can be distinguished in terms of their cognitive structure as well as on their respective roles in the cognitive process.
- Different authors have different views on how memory is structured.
- We should design interfaces that make efficient use of short-term memory
- General STM capacity, ***seven*** is often regarded as the 'magic number' in HCI.
- reduce the load on STM by placing information 'in the world' instead of expecting users to have it 'in the head'

STM	LTM
Relatively short retention period. Information or events from the immediate past, Retrieval is measured in seconds or sometimes minutes.	Store information over much longer periods. Holds information about events that happened hours, days, months or years ago and the information is usually incomplete.
Limited in the amount of information that it can keep	LTM, in contrast, has high capacity
Easy to retrieve information from STM.	Access is much slower
Effectiveness of STM is influenced by attention	Takes time to record memories there
Keep up to seven items	

Knowledge in World: Knowledge in Head:

	Knowledge in the *WORLD*	**Knowledge in the *HEAD***
Retrievability	*Easily retrievable* whenever visible or audible. (Depends on availability in the environment.)	*More difficult* to retrieve. Requires memory search or reminding.
Learning	Learning is *NOT* required, only interpretation.	To get information there *requires* learning
Efficiency of use	Tends to be *slowed up* by the need to find and interpret the external sources.	Can be very *efficient*.
Ease of use at first encounter	High	Low
Aesthetics	Can *be unaesthetic and inelegant*, especially if there is a need to maintain a lot of information. Can lead to clutter. Requires a skilled designer.	Nothing needs to be visible, which gives the designer *more freedom*.

3. Physiology

- Physiology involves the study of the human anatomy.
- When using a computer system, as a minimum requirement users must be able to view (or perceive) the interface and reach the input devices.

Guidelines:

- **Visual display** should always be positioned with the correct visual angle to the user
- **Keyboard and mouse** use: Prolonged periods of data entry place heavy stress upon the wrist and upper arm. A large range of low-cost wrist support is now available.
- It is worth investing in ***well designed chairs*** that provide proper lower back support and promotes a good posture at the computer
- **Placement of work materials**, Repeated gazing reduced by Paper and book stands.
- **Noise**: Distraction can be caused by the sounds of other workers, introduce screens around desks or cover devices such as printers.
- **Bright lighting** can cause distraction in interaction with computers, reduced by blinds and artificial lighting to reduce light in the room. Move furniture.
- A rule of thumb is: do not make interface objects so small that they cannot be selected by a user in a hurry.
- do not make disastrous options so easy to select that they can be started by accident

Urban myths (untruths) about the impact of computer systems:

- **Eyesight**: Computer use does not damage your eyes or eyesight. It may, however, make you aware of existing defects.
- **Epilepsy**: Computer use does not appear to induce epileptic attacks. Television may trigger photosensitive epilepsy but the visual display units of computers do not seem to have the same effect.
- **Radiation**: The National Radiological Protection Board in the UK states that VDU's do not 'significantly' increase the risk of radiation-related illnesses

4. Disabilities

- Preece et al. (2007) define **Accessibility** as 'the degree to which an interactive product is usable by people with disabilities.

Reasons designing systems that accessible people disabilities:

- Compliance with regulatory and legal requirements
- Exposure to more people
- Better design and implementation
- Cost savings

Vision Impairments:

- Visually impaired people mostly experience difficulties with output display.
- Text-to-speech conversion can help blind users to receive electronic mail or read text files.
- Speech-recognition devices allow voice-controlled operation of some applications.
- Enlarging portions of a display or converting displays to Braille or voice output.
- (GUIs) was a setback for vision-impaired users.
- Screen readers facilitate conversion of graphical information into non-visual modes.
- Frames or boxes cannot be translated accurately by screen readers
- Users with partial sight should be allowed to change the size, shape and colour of the onscreen mouse cursor, and auditory or tactile feedback of actions will be helpful.
- Keyboard use, visually impaired users require keys with large lettering, high contrast between text and background.

Motor Impairments:

- A significant proportion of the population have motor disabilities acquired at birth or through an accident or illness
- Low cost modifications can easily increase access and without much effort
- Another solution is provided through trackballs that allow users to move the cursor using only the thumb
- Either head operated or eye tracking devices are required to translate control onscreen cursor movements
- Speech input is another alternative, but there are still high error rates
- Keyboards need to be detachable, Individual keys should be separated by sufficient space, Oversized keyboards.

5. Culture

- The term '*culture'* is often wrongly associated with national boundaries.
- *Culture* should rather be *defined* as the behaviour typical of a group or class of people.
- Culture is conceptualised as a system of meaning that underlies routine and behaviour in everyday working life.
- It includes race and ethnicity as well as other variables and is manifested in customary behaviours, assumptions and values, patterns of thinking and communicative style.
- *Nisbett* (2003) compared the thought patterns of East Asians and Westerners classifying them as holistic and analytic respectively.

Holistically - Minded	*Analytically - Minded*
Tend to perceive a situation *globally.*	Tendency to perceive an object *separately* from the context and tend to *assign* objects to *categories.*
Scan the whole page in a non-linear fashion.	Employ a sequential reading pattern.

Span language and culture by using these approaches:

Internationalisation	*Localisation*
Single design that is appropriate for use worldwide, among groups of nations.	Involves the design of versions of a product for a specific group or community, with a unified language and culture.
Important concept for designers of web based applications User interface design concerns for internationalisation are many and full of pitfalls.	Problem here is the accurate translation of products Hardware concerns include character sets, keyboards and special input devices more effective localization will often produce a strong advantage

Factors to consider: before internationalisation or localisation

Overt Factors	Covert Factors
Tangible, straightforward and publicly observable elements	Elements that are Intangible and depend on culture or 'special knowledge'
dates, calendars, weekends, day turnovers, time, telephone number and address formats, character sets, collating order sequence, reading and writing direction, punctuation, translation, units of measures and currency.	Symbols, colours, functionality, sound, metaphors and mental models

6. Personality and Gender

- Some people dislike computers or are anxious about using them.
- A clear understanding of personality and cognitive styles can be helpful in designing systems for a specific community of users.
- Social network sites such as Facebook and Twitter tend to have more female subscribers.
- Majority of video-arcade game players and designers are young males.
- Largely male designers may not realize the effect on women users when the command names require the users to KILL a file or ABORT a program.
- Male and Females prefer different styles of games.

7. Age

- Historically, computers and computer applications have been designed for use by adults for assisting them in their work.
- There is a hidden assumption that the users are adults.
- User groups of different ages can have vastly different preferences with regard to interaction with computers.
- The average age of the user population affects interface design.
- Age also determines the level of perceptual and cognitive resources to be expected from potential users.
- Child – Adult – Elderly.

Children:

- Children make up a substantial part of the larger user population.
- Purpose of children's products is more likely to provide entertainment or engaging educational experiences.
- Applications designed for use by children in learning environments have completely different goals and contexts of use than applications for adults in a work environment.
- Young children's slower information processing skills that affect their motor skills and consequently their use of the mouse and other input devices.
- Computer technology makes it possible for children to easily apply concepts in a variety of contexts.
- It exposes them to activities and knowledge that would not be possible without computers.
- General agreement that young children should not spend long hours at a computer.
- 'computer' in child-computer interaction refers not only to the ordinary desktop or notebook computer, but also to programmable toys, cellular phones, remote controls, programmable musical keyboards, robots, and more.
- Develop technology that requires children to move around.

- accommodate children so that they can perform activities on the computer that are at their level of development

The Elderly:

- Due to advances in health care technologies and living standards the human life span is constantly increasing.
- The elderly have often been ignored as users of computers since they are assumed to be both dismissive of and unable to keep up with advancing technology.
- They do however experience impairments related to deterioration of vision, movement and memory capacity (Kaemba, 2008) that affect the way they interact with devices.
- Many senior users find the text size on typical monitors too small, and require more contrast between text and background.
- The needs and preferences of adult technology users can therefore not always be generalised to the elderly.

8. Expertise

- The way in which a system is designed, built, and sold differs if the intended users are 'experts' or 'novices.
- Novice user of a computer application will need procedural information about what to do next.
- Experts will have well-formed task models and may not need this guidance.
- *Three* levels of expertise:
    - (lowest level) Knowledge-based level uses general knowledge.
    - (middle level) Rule- based level uses idea users exploit rules to guide use of their sys.
    - (Top level) Skill-based level where we have slips and lapses.
- Designers should develop systems that are consistent.
- Two forms of consistency:
    - Internal consistency: similar operations being performed in similar manner within an application. Easy to achieve if designer has control over finished product.
    - External consistency: similar operations being performed in similar manner between several applications. Hard to achieve.
- Over time users will acquire the expertise that is required to operate a system.

9. Errors people make:

- People make errors routinely.
- Norman (1999) distinguishes the following main categories:
    - **Mistakes** (also called incorrect plans): This category includes incorrect plans such as forming the wrong goal, or performing the wrong action with relation to a specific goal.
    - **Slips**: Slips are observable errors and result from automatic behaviour
- Slips occur mostly in skilled behaviour, when the person is not paying proper attention.
- While still learning to do something, a people don't make slips.

Six Types of Slips:

- Capture errors: This occurs when an activity that you *perform frequently* is done instead of the intended activity
- Description errors: This occurs when instead of the intended activity, you *do something* that has *a lot in common* with what you wanted to do
- Data-driven errors: These errors are triggered by some kind of sensory input.
- Mode errors: These occur when a *device has different modes* of operation and the same action has a different purpose in the different modes
- Associative activation errors: These are *similar to description* errors but are triggered by internal thoughts or associations instead of external data.
- Loss-of-activation errors: These are errors due to forgetting.

Cause of Human Error:

- Often, what appears to be operator error is the *result of management* failures.
- Even if systems are designed and implemented, accidents can be caused because *operators are poorly trained* to use them.
- Further sources of error come from *poor working environments*.

How to prevent human error:

- There is *no simple way* to improve the operational safety of computer systems.
- Reason (1990) argues that errors are latent within each one of us and, therefore, we should never hope to engineer out human error.
- It is possible to engineer decision support systems that provide users with guidance and help during the performance of critical operations.
- It is also possible to improve working practices.
- When designing systems one should keep the kind of errors people make in mind.
- The final conclusion: there is no such thing as the *average user*.

3 DESIGN PROBLEMS AND SOLUTIONS

1. Design Problems

- Norman (1999) points out the following as being the most problematic:
    - The forces that work against evolutionary design.
    - Putting aesthetics first.
    - Designers regarding themselves as typical users.
- Norman (1999) coined the term 'evolutionary design' that refers to the process whereby a product is gradually improved over time.
- Evolutionary design occurs when a design evolves through a cycle of testing, identifying problems, modification, re-design, re-testing, re-modification, and so on, until a functional, aesthetically pleasing object results.
- Good features are kept unchanged while bad features are removed or replaced with improved versions.

Three forces that work against evolutionary design

- The demands of time: New versions of an object are already in the process of being designed before the old one has been released.
- Pressure to be distinctive: Each design must have features that distinguish it from previous models so that consumers can be lured with statements like 'a new improved version'. Often the new model doesn't even incorporate the good qualities of its predecessor.
- The curse of individuality and market differentiation: Every company that manufactures the same type of product has to come up with a unique design which carries their signature. This means that if one company perfects a product, all the others that produce it will create an inferior product in the name of individuality.

Common Design Mistakes

- Putting Aesthetics above Usability
- Thinking for the User
- Cluttering the Interface

Putting Aesthetics above Usability

- The competitive commercial environment provides good motivation to employ graphic designers and artists to create attractive interfaces.
- Unfortunately, these designers do not always understand the importance of usefulness and usability.
- An interface need not be an artwork to be aesthetically pleasing.
- One that is free of clutter, with the interface elements organised in a logical and well-balanced way, and that uses colour tastefully can provide a lot of visual pleasure to users who have to find their way through the interface.
- The target user group should be considered.

- Culture may also determine what the user finds aesthetically pleasing.

Thinking for the User

- Designers sometimes believe that they know what the user would want, thinking that they can put themselves in the shoes of the user.
- Designers are no different – they will subconsciously build interfaces according to their own preferences and knowledge.
- If designers continue to think in terms of engineering abstractions rather than the objects and operations in the users' task, then they are unlikely to produce successful interfaces.
- Mistake if they do not involve real users in design process.
- Another common error is to mistake the client for the end user and base the designs on the requirements specified by the client.
- The designers should first determine who the end users will be.

Cluttering the Interface

- It can be difficult for users to take in and understand the many different objects that are presented on the screen. Some may be missed entirely.
- The more objects you present on the screen at once, the more meanings users will have to unravel
- The more objects you present, the harder it is for users to find the ones that they really need
- The more objects there are on the screen, the smaller the average size of each object will be. This makes it harder to select and manipulate individual screen components.

2. Design Solutions

- Most basic principles for good interface design can be derived from Norman's (1999) good principles for the design of everyday things.

Normans Five Design concepts

- Affordance
- Constraints
- Mapping
- Visibility
- Feedback

Affordance

- Affordance is a property of an object or interface that refers to its perceived and actual properties that tells an observer or user how the object or interface can be used.

Constraints

- A constraint in HCI terms is a mechanism that restricts the allowed behaviour of a user when interacting with a computer system.
- *Not* all constraints are physical.
- Constraints can also rely on the meaning of the situation (semantic constraint)
- Constraints can also rely on accepted cultural conventions (cultural constraints).

- *Logical constraints* refer to constraints that rely on the logical relationships between functional and spatial aspects of the situation.
- *Natural mappings* work according to logical constraints.
- A *forcing function* is a type of physical constraint that requires one action before a next can take place (Norman, 1999).

Mapping

- Mapping refers to relationship between two things, for example, the relationship between a device's controls and their movements, and the results of the actual use of these controls.
- A good mapping is a mapping that enables users to determine the relationships between possible actions and their respective results.
- Natural mappings use physical analogy and cultural standards to support interpretation.

Visibility

- The parts of a system that is essential for its use must be visible.
- The visible structure of well-designed objects gives the user clues about how to operate them.
- These clues take the form of affordances, constraints and mappings.
- Sound can also used to make interface elements more 'visible'.

Feedback

- Feedback is information that is sent back to the user about what action has actually been performed, and what the result of that action is.
- Novices want more informative feedback to confirm their actions.
- Frequent users want less distracting feedback.
- Sound is an important feedback mechanism.
- The absence of sound can also be a form of feedback.

Guidelines, Principles & Standards

- The aim is to help designers to improve the usability of their products by giving them rules according to which they can make design decisions (Dix et al., 2004).
- Dix et al. classify design rules as standards or guidelines.
- Standards are usually set by national or international bodies, are ***high*** in authority and *limited* in application.
- Guidelines are more general in application.
- There are *two* types of design guidelines
    - **Low-level detailed rules** - are instructions that are application-specific and do not need much interpretation.
    - **High-level directing principles** - High-level principles are relatively abstract and applicable to different systems.
- The difference between design principles and usability principles:
- *Design principles* usually inform the design of a system. *Usability principles* are mostly used as the basis for evaluating prototypes and complete systems (Preece et al., 2007).
- *Usability principles* can be *more* prescriptive than design principles.

(Dix et Al)

- Dix et al. (2004) provide interface designers with a comprehensive set of high-level directing principles with the aim of improving the usability of interactive systems.
- They divide their principles into ***three categories***:
    - Learnability principles
    - Flexibility principles
    - Robustness principles

Learnability

- Ease with which users can enter a new system and reach a maximal level of performance.

Five Principles Affecting

Predictability	Support for the user to determine the effect of future action based on past interaction history.
Synthesisability	Support for the user to assess the effect of past operations on the current state.
Familiarity	The extent to which a user's knowledge and experience in other real-world or computer-based domains can be applied when interacting with a new system
Generalisability	Support for the user to extend knowledge of specific interaction within and across applications to other similar situations.
Consistency	Likeness in input-output behaviour arising from similar situations or similar task objectives.

Relate to

Operation visibility	The way in which the availability of possible next operations are shown to the user and how the user is informed that certain operations are not available.
Honesty	The ability of the user interface to provide an observable and informative account of any change an operation makes to the internal state of the system. It is immediate when the notification requires no further interaction by the user. It is eventual when the user has to issue explicit directives to make the changes observable

Guessability and affordance	The way the appearance of the object stimulates a familiarity with its behaviour or function.

Flexibility

- Flexibility refers to the many ways in which interaction between the user and the system can take place.

Principles Affecting

Dialogue initiative	Allowing the user freedom from artificial constraints on the input dialogue imposed by the system
Multi-Threading	Ability of the system to support user interaction pertaining to more than one task at a time.
Task migratability	The ability to pass control for the execution of a given task so that it becomes either internalised by user or system or shared between them
Substitutivity	Allowing equivalent values of input and output to be arbitrarily substituted for each other.
Customisability	Modifiability of the user interface by the user or the system.

Relating to

System pre-emptiveness	This occurs when the system initiates all dialogue and the user simply responds to requests for information. It hinders flexibility, but may be necessary in multi-user systems where users should not be allowed to perform actions simultaneously.
User pre-emptiveness	This gives the user freedom to initiate any action towards the system. It promotes flexibility, but too much freedom may cause the user to lose track of uncompleted tasks.
Concurrent/interleaved multithreading	Concurrent multi-threading allows simultaneous communication of information pertaining to separate tasks. Interleaved

	multi-threading permits temporal overlap between separate tasks, but at any time the dialogue is restricted to a single task.
Multi-modality	Separate modalities (channels of communication) are combined to form a single input or output expression.
Representation multiplicity	Flexibility for rendering of state information.
Equal opportunity	Blurs the distinction between input and output at the interface – the user has the choice of what is input and what is output; in addition, output can be reused as input.
Adaptability	Refers to user-initiated modification to adjust the form of input and output. Users may for example choose between different languages or complexity levels.
Adaptivity	Refers to system-initiated modification to customise the user interface automatically

Robustness

- Robustness refers to the level of support the user is given for successful achievement and assessment of their goals.

Principles Affecting

Observability	Ability of the user to evaluate the internal state of the system from its perceivable representation. The user compares the current state with his or her intention within the task-action plan.
Recoverability	Ability of the user to take corrective action once an error has been recognized
Responsiveness	How the user perceives the rate of communication with the system. Response time is the duration of time needed by a system to inform the user of state changes. When this is not instantaneous the system should give some indication that the task is

	in progress.
Task Conformance	The degree to which the system services support all of the tasks the user wishes to perform and in the way the user understands them.

Relating to

Browsability	This allows the user to explore the current internal state of the system via the limited view provided at the interface. The user should be able to browse to some extent to get a clear picture of what is going on, but negative side-effects should be avoided
Static – Dynamic defaults	Static defaults are defined within the system or acquired at initialisation. Dynamic defaults evolve during the interactive session (for example, the system may pick up a certain user input preference and provide this as the default input where applicable).
Reachability	The possibility of navigation through the observable system states
Persistence	Deals with the duration of the effect of a communication act and the ability of the user to make use of that effect. Audio communication persists only in the user's memory while visual communication remains available as long as the user can see the display
Backward recovery	Involves an attempt to undo the effects of previous interaction in order to return to a prior state
Forward recovery	Involves the acceptance of the current state and negotiation from that state towards the desired state.
Commensurate effort	If it is difficult to undo a given effect on the state, then it should have been difficult to do in the first place.
Stability	The invariance in response times for identical or similar computational resources

Task completeness	Refers to the coverage of all the tasks of interest and whether or not they are supported in a way the user prefers.
Task adequacy	This addresses the user's understanding of the tasks

(Preece et Al)

- TWO types of design goals in interaction design:
  - *Usability goals* - focus on aspects such as effectiveness and Learnability.
  - *User experience goals* - concerned with the quality of the user's experience with the system and focus on aspects such as aesthetics and enjoyment.

Usability Goals

Effectiveness	A general goal that refers to how well a system is doing what is what designed for
Efficiency	This has to do with how well a system supports users in carrying out their work. The focus is on productivity.
Safety	Protecting the user from dangerous conditions and undesirable situations
Utility	The extent to which a system provides the required functionality for the tasks it was intended to support. Users should be able to carry out all the tasks in the way they want to do them
Learnability	How easily users learn to use the system.
Memorability	How easy it is to remember how to perform tasks that have been done before

User Experience Goals

- how the user feels about a product irrespective of its efficiency, effectiveness, Learnability and so on, plays an important role in it being well accepted or not.
- Designers should attend to features that will make the product:
  - Satisfying
  - Enjoyable
  - Engaging
  - Pleasurable

    - Exciting
    - Entertaining
    - Helpful
    - Motivating
    - Aesthetically pleasing
    - Supportive of creativity
    - Cognitively stimulating
    - Rewarding
    - Fun
    - Proactive
    - Surprising
    - Emotionally fulfilling
    - Challenging
    - Enhancing sociability
- Avoid features that make a product boring, frustrating, annoying or overly cute.
- Factors that may support the fulfilment of these user experience goals include attention, pace, interactivity, engagement and style of narrative

Design Principles (Preece)

- design principles are prescriptive suggestions to help designers to explain or improve their designs
- Instead of telling the designer exactly how to design an interface, they *inspire* careful design, *telling* the designer what will work and what not.

Summary Preece design principles

Visibility	The more visible the available functions are, the better users will be able to perform their next task.
Feedback	This involves providing information (audio, tactile, verbal or visual) about what action the user has performed and what the effect of that action was
Constraints	These restrict the actions a user can take at a specific point during the interaction. This is an effective error prevention mechanism
Mapping	This has to do with the relationships between interface elements and their effect on the system
Consistency	This is similar to consistency as defined by Dix et al.
Affordance	

	This refers to an attribute of an object that tells people how it should be used. In an interface it is the perceived affordance of an interface element that helps the user see what it can be used for. Whereas a real button affords pushing, an interface button affords clicking. A real door affords opening and closing, but an image of a door on an interface affords clicking in order to 'open' it.

Shneiderman

- Principles for user-centred design are divided into three groups:
  - Recognition of diversity
  - Golden rules
  - Prevention of errors

Recognise Diversity

- Before the task of designing a system can begin, *information about* the intended users, tasks, environment of use and frequency of use must be gathered.
- Three aspects relating to the intended system:
  - Usage Profiles
  - Task Profiles
  - Interaction styles

Usage Profiles	• Designers must understand the intended users. • Designers should find out whether all users will be novices or if they will have experience with the particular kind of system • Different levels of expertise will require a layered approach whereby novices are given few options to choose from and are closely protected from making mistakes • Characteristics such as age, gender, physical abilities, level of education, cultural or ethnic background, and personality.
Task Profiles	A complete task analysis should be done and all task objects and actions identified.
Interaction Styles	Suitable interaction styles should be identified from those available. Here Shneiderman mentions menu selection, form fill-in, command language, natural language and direct manipulation. In Unit 4 we discuss most of the currently available

	interaction styles.

The Eight Golden Rules for Interface Design

- Shneiderman (1998) suggests eight principles of design that are applicable to most interactive systems

1. Strive for consistency.
2. Enable frequent users to use shortcuts.
3. Offer informative feedback.
4. Design dialogues to yield closure (the completion of a group of actions).
5. Offer error prevention and simple error handling.
6. Permit easy reversal of actions.
7. Support internal locus of control (the user should feel in control of the system and not vice versa).
8. Reduce short-term memory load.

Prevent Errors

- Errors are made by even the most experienced users.
- One way to reduce the loss in productivity due to errors is to improve the error messages provided by the computer system.
- A more effective approach is to prevent the errors from occurring.
- Understand the nature of errors.
- Organise screens and menus functionally.
- Designing commands and menu choices to be distinctive.
- Making it difficult for users to perform irreversible actions.

Three Techniques to reduce errors by ensuring complete and correct actions

- Correct matching pairs
- Complete sequences
- Correct commands

Design Standards

- Standards concern prescribed ways of discussing, presenting or doing something.
- The aim is to achieve consistency across products of the same type.
- Standards for interactive system design are usually set by national or international bodies to ensure compliance with a set of design rules by a large community.
- Standards can apply specifically to either the hardware or the software used to build the interactive system.

Benefits of Standardisation in interface design

- Provides a common terminology, so that designers know that they are discussing the same concept
- Facilitates program maintenance and allows for additional facilities to be added
- Gives similar systems the same 'look and feel' so that elements are easily recognisable

- Reduces training needs because knowledge can be transferred between standardized systems
- Promotes health and safety of users who will be less likely to experience stress or surprise due to unexpected system behaviour.

- User interface design rule that is rigidly applied without taking the target user's skills, psychological and physical characteristics or preferences into account, may reduce a product's usability.

- Standards must therefore always be used together with more general interface design principles such as those proposed.

Summary

- Design guidelines do not provide recipes for designing successful systems.
- Can only provide guidance and do not guarantee optimum usability.
- Designer should still make an effort to understand the technology and the tasks involved the relevant psychological characteristics of the intended users, and what usability means in the context of the particular product.
- Guidelines can help designers to identify good and bad options for the interface.
- They also restrict the range of techniques can be used and still 'conform' to a particular style, but they can be very difficult to apply.
- We cannot emphasise enough that users' tasks and basic psychological characteristics must be taken into account.

4 INTERACTION DESIGN

Interface Types (11)

- Advanced Graphical Interfaces (GUI)
- Web-based Interfaces
- Speech Interfaces
- Pen – Gesture & Touchscreen Interfaces
- Mobile Interfaces
- Multimodal Interfaces
- Shareable Interfaces
- Tangible Interfaces
- Augmented & Mixed Reality Interfaces
- Wearable Interfaces
- Robotic Interfaces

Advanced Graphical Interfaces

- The term graphical user interface (GUI) refers to any interactive system that uses pictures or images to communicate information.
- The term graphical user interface (GUI) refers to any interactive system that uses pictures or images to communicate information.
- Multimedia includes graphics, text, video, sound and animations that the user can interact with.

Advantages:

- Visibility
- Cross-cultural communication
- Impact and animation

Disadvantages:

- Clutter
- Ambiguity
- Imprecision – cannot convey enough info without textual annotation.
- Slow speed

Web-Based Interfaces

- Graphical interfaces that are located on servers connected to the Internet and are accessed by users through web browsers.
- Web design is restricted by the available bandwidth and the associated download time.

Advantages:

- Provides users with access to large volumes of information at the click of a button
- Sophisticated search engines such as Google makes it easy to search for information on specific topics.
- Another important advantage of web-based interaction is the social aspect. It allows people to connect very easily with anybody, anywhere in the world.

Disadvantages:

- Large amounts of irrelevant information to search through and, since practically anybody can load information onto the web; a lot of what is there is not trustworthy.

Speech Interfaces

- Allows the user to talk to a system that has the capacity to interpret spoken language.
- Commonly used in systems that provides specific information.
- Current technology allows for much more natural sounding speech than the early synthesized speech.

Advantages:

- Helpful to people with disabilities.
- Speech interfaces in applications for children who cannot yet read will expand the possibilities that technology can offer them

Disadvantages:

- relatively difficult to develop
- They may misinterpret what the user is saying
- Voice response may appear unnatural
- They may not be adaptable to different accents, voice pitch and speech defects

Pen – Gesture & Touchscreen Interfaces

- Pen-based interfaces are also suitable for large displays.
- process called 'digital ink' that uses sophisticated handwriting recognition and conversion techniques, text written on a PDA screen or tablet PC, for example, can be converted into digital text.
- Gesture-based input involves camera capture and computer vision to detect people's arm and hand gestures.
- This makes sign language interpreting systems possible.
- Touchscreen allow users to manipulate screen objects with their fingers

Advantages:

- Can increase the speed and accuracy of input.
- Users use natural gestures to interact.

Disadvantages:

- The flow of interaction may be interrupted.
- Incorrect options may accidentally be chosen.
- Movement and handwriting may be misinterpreted.

Mobile Interfaces

- Designed for handheld devices such as cell phones that are intended for use on the move.
- The space limitations compel designers to use buttons for multiple purposes.
- A number of cell phones have been designed specifically with elderly users in mind.

Advantages:

- Mobility

Disadvantages:

- Buttons multi-purpose which Elderly users find this particularly hard to use.
- The limitations on screen size restrict the font size and the amount of information that can be displayed on the screen.

Multimodal Interfaces

- Different ways of interacting – including touch, sight, sound and speech – are combined so that users can experience or control information in multiple different ways.
- Different input or output methods are used simultaneously.

Advantages:

- Allow more flexible interaction.
- Can support users with disabilities or very young users.

Disadvantages:

- Input needs to be calibrated for accurate interpretation.
- Input needs to be calibrated for accurate interpretation.
- Still very expensive.

Sharable Interfaces

- Allow more than one user to interact with the system.
- Providing multiple (sometimes simultaneous) inputs.

Advantages:

- Shareable interfaces provide large interactional space
- supports flexible group work and sharing of information

Disadvantages:

- Separating personal and shared workspaces requires specialised hardware and software and correct positioning at the interface.
- These interfaces are also expensive to develop.

Tangible Interfaces:

- Hornecker and Buur (2006) describe tangible interaction as encompassing 'a broad range of systems and interfaces relying on embodied interaction, tangible manipulation and physical representation (of data), embeddedness in real space and digitally augmenting physical spaces'
- These interfaces use sensor-based interaction.
- Physical objects that contain sensors react to user input which can be in the form of speech, touch or manipulation of the object.
- Sensors are typically RFID tags which can be stickers, cards or disks that can be used to store and retrieve data through a wireless connection with a RFID transceiver.
- Used for urban planning and storytelling technologies.
- Good for learning, design and collaboration.
- Physical representations of real-life manipulable objects enable visualisation of complex plans.
- Physical objects and digital representations can be positioned, combined, and explored in dynamic and creative ways.

Advantages:

- Tangibles can also help children develop understanding of abstract concepts, as these are often based on their understanding of spatial concepts and how they use their bodies in space

Disadvantages:

- Development cost.
- Accurate mapping between actions and their effects.
- Incorrect placement of digital feedback.

Augmented & Mixed Reality Interfaces

- Augmented reality interface- virtual representations are superimposed on physical devices and objects.
- Mixed reality environment views of the real world are combined with views of a virtual environment.
- Mixed reality systems have been used for medical applications.

Advantages:

- These interfaces may enhance perception of the real-world, and can thereby support training and education (flight simulators).

Disadvantages:

- Added information could become distracting, and users may have difficulty to distinguish between real and virtual worlds.

- These systems are also very expensive.

Wearable Interfaces

- Involve input and output devices that are integrated with normal apparel, such as headgear or spectacles.

Advantages:

- They are mobile and less restrictive than desk-based technologies or even mobile technologies.
- They can create a sense of realism, and provide a means of immediate feedback.
- This immediate feedback can be especially helpful in the detection of medical conditions.

Disadvantages:

- They are uncomfortable because of size and weight factors.
- They are restricted by battery life.

Robotic Interfaces

- Enable users to move and steer a remote robot.
- Robots are computational devices that have the physical appearance and behaviours of humans or animals.
- They contain embedded sensors that detect user behaviours and respond to them.

Advantages:

- They can be built to go into places too small or dangerous for humans, manual repetitive tasks.
- Domestic robots can be manipulated to help in the house and they can be especially useful for the disabled.
- Pet-like robots have been developed to host events or act as companion.

Disadvantages:

- None mentioned but cost could be very high.
- Complex to develop?

Interaction Design Techniques

- According to *Preece*, et al. (2007) the iterative interaction design process involves:
    - Identify users' need s and requirements.
    - Develop alternative designs
    - Building interactive versions – prototypes.
    - Evaluate the users' experience

- *Williges and Williges* (1984) produced classic model of software development whereby interface design drives the overall design process.
- Their standpoint is that by identifying user requirements early in the software development process, code generation and modification effort will be reduced.

- **HCI Lifecycle**:
    - Stage1 - Initial Design
    - Stage2 – Formative Evaluation
    - Stage3 – Summative Evaluation
- Stage1
    - Design objectives
    - Task Analysis
    - Focus on Users
    - Design Guidelines
    - Structured Walk-through
- Stage2
    - Rapid Prototyping
    - User-Defined Interfaces
    - User-Acceptance Testing
- Stage3
    - Operational Software Interface
    - Benchmarking
    - Formal Experimentation

Prototypes

- Preece, et al. (2007) define a prototype as 'a limited representation of a design that allows users to interact with it and to explore its usability.
- It can take the form of a simple, *paper-based* storyboard of the interface screens to a *computer-based*, functionally reduced version of the actual system.

Prototype functions:

- They provide a way to test out different design ideas
- They act as a communication medium within the design team – the members can test their different ideas on the prototype and the team can discuss these ideas
- The act as communication medium between designers and users or clients – using one or more prototypes designers can explain their own understanding of what the system should look like and what it should be able to do to users and clients. The users can then respond to that by explaining how the prototype does or does not address their needs.
- They help designers to choose between alternative designs.

Low-Fidelity Prototypes

- Cheap mock-up of a system.
- Does *NOT* use the material that the final product will be built of and it may not even look a lot like the intended system.
- useful if the designers are just beginning and still need to explore different ideas
- *NOT* meant to become part of the real system – they are usually thrown away when they have served their purpose.

Pros:

- Cheap and can be produced very quickly.
- Be adapted very easily and without much cost.

Cons:

- Don't usually resemble the final system.

Examples:

- Storyboards
- Sketching
- Index cards
- Wizard of OZ – basic software-based prototype lacks functionality

High-Fidelity Prototypes

- Resemble the final system and usually use the same materials that would be used in the final product.
- Requires software tools and programming skills.
- Windows programming languages such as Delphi and Visual Basic are very powerful prototyping tools that can be used with only basic programming skills.
- The developers of these prototypes are also more reluctant to change them because of the effort put into them

Pros:

- Can gradually develop into the final product so the time and resources put into it can be worthwhile – this is called evolutionary prototyping.

- Resembles final system.

Cons:

- Time-consuming and can be expensive.
- Cannot be adapted easily to changing ideas or requirements.
- A software prototype can create high expectations and make it look as if more is possible than can actually be done.
- One bug in a computer-based prototype system will make it impossible to use.

Conceptual Design

- Involves turning the users' needs and requirements into a conceptual design (Preece et al., 2007).
- Define a conceptual model as a 'high-level description of how a system is organised and operates.
- It is not a description of the interface – it gives an idea of what users can do with a system and what concepts they need to be familiar with in order to use it.
- Using prototypes is one way of getting the conceptual model of the intended system right.

Principles (Preece)

- Keep an open mind but always think of the users and their context.
- Discuss the design ideas with all stakeholders as often as possible.
- Use *low-fidelity* prototyping to get quick feedback.
- Continue doing the above over and over until you are sure you have the correct conceptual design.

Conceptual design process requires

- Designer determines how the functions to be performed will be divided between the system and the users.
- How these functions relate to each other.
- What information should be available to perform these functions?

Two important factors in CD:

- Interface Metaphors
- Interface Type

Interface Metaphors

- It provides a structure that is similar to some aspects of a familiar entity, but that also has it own behaviours and properties.
- We use them to explain something that is hard to grasp by comparing it with something that is familiar and easy to grasp.
- The metaphor that is chosen for an interface must fit the task and it must be suitable for the intended users.
- Metaphors can also be used to turn something that is potentially boring into an engaging experience.
- The purpose of a metaphor is to provide a familiar structure for interaction.

Interface Types

- When doing the conceptual design, designers should preferably not be influenced by a specific, predetermined interface type.
- Having a specific interface type in mind may stifle the design process and potentially good solutions may be overlooked.
- Any system comes with constraints on the type of interface that can be used.

Evaluation of Interaction Systems

- Evaluation is a key aspect of human-computer interaction.
- Refers to the validation of an interactive system against human-computer interaction requirements.
- Any design should be assessed and all systems tested to ensure that they meet the users' requirements.
- Evaluation is not a single phase that comes at the end of the design process, but rather an activity that is used throughout the design process to provide feedback on the design right from the beginning.
- The three main goals of evaluation are:
    - assess the extent of the system's functionality
    - assess the effect of the interface on the user
    - identify specific problems with the system
- Dix et al. (2004) and Williges and Williges (1984) (see Figure 4.4) distinguish between formative and summative evaluation.

Formative and Summative Evaluation

Formative	Summative
Formative evaluation is done early in the design process and continues through the design cycle to support design decisions	Summative evaluation is done at the end of the design cycle and tests the end product
formative evaluation tends to be exploratory	summative evaluation is often focussed upon one or two major issues
If formative evaluation is to guide development, then it must be conducted at regular intervals during the design cycle	Its aim is to demonstrate that the completed system fulfils its requirements or to identify problems users have with the system.
Low cost techniques such as low-fidelity prototyping are suitable for formative evaluation	Usability testing with real users is suitable for summative evaluation
	If sufficient formative evaluation has been performed, then this may be a trivial task.

Evaluation Summary

- Early Stages:
    - Predict the usability of a product or an aspect of it
    - Check the design teams understanding of user requirements by seeing how an existing system is being used in the field.
    - Test ideas quickly and informally as part of envisioning a possible design
- Later:
    - Identifying user difficulties, so that the product can be more finely tuned to meet their needs.
    - Improving an upgrade of the product.

How to Evaluate

- Evaluation can be done in laboratories or in the real-life environment where the system will be used.
- Preece et al. (2007) identified three main evaluation approaches:
    - *Usability Testing*
    - *Field Studies*
    - *Analytical Evaluation*
- Cooperative Evaluation Techniques
- Scenario-Based Evaluation
- Query Techniques
- Heuristic Evaluation

Usability Testing

- Usability laboratories with sophisticated audio and video recording facilities, specialised hardware and software for recording and analysing users' behaviour when using a system, are often used for usability testing.
- Gives the evaluator controls over the conditions of the study, but it removes the natural context.
- During usability testing, typical users perform selected tasks while their actions are recorded.
- For this approach to be successful, it requires specialist skills in HCI.
- Evaluators should not directly interact with the user in a way that can skew the results.
- The intention is to derive some measurable observations that can be analysed using statistical techniques.

Field Studies

- This type of evaluation is done in natural settings.
- The aim is to understand what users do naturally and how the technology affects them in the real-life environment.
- The evaluator can be an outsider that observes and records what is happening, or an insider or participant that enters the world of the user to experience the impact of the technology first-hand.

- Evaluation done in the real environment of use provides the natural context of use but it may be more difficult to set up the required equipment.
- The problem with this approach is that it requires a considerable amount of skill.

Analytical Evaluation

- This either a heuristic evaluation, that involves experts who use heuristics and their knowledge of typical users to predict usability problems, or walkthroughs where experts 'walk through' typical tasks.
- Users need not be present and prototypes can be used in the evaluation.
- There are circumstances where combinations of the three techniques will be appropriate.
- Popular heuristics such as that of Nielsen (2001) were designed for screen-based applications and are inappropriate for technologies such as mobiles and computerised toys.

Cooperative Evaluation Techniques

- Cooperative evaluation techniques are particularly useful during the formative stages of design.
- They are less clearly hypothesis-driven and are an extremely good means of eliciting user feedback on partial implementations.
- The approach is extremely simple.
- The evaluator sits with the user while they work their way through a series of tasks.
- Designers can either use low-fidelity prototyping or partial implementations of the final interface.
- Designers can either use low-fidelity prototyping or partial implementations of the final interface.
- This low cost technique is very good for providing rough and ready feedback.
- A limitation of cooperative evaluation is that it provides qualitative feedback and not measurable results.
- The process produces opinions and not numbers.
- Cooperative evaluation is extremely ineffective if designers are unaware of the political and other pressures that might bias.

Scenario-Based Evaluation

- Scenarios are informal narrative descriptions of possible situations
- This approach forces designers to identify key tasks in the requirements' gathering stage of design.
- Typically, they are asked to comment on the proposed design in an informal way.
- This can be done by presenting them with sketches or simple mock-ups of the final system.
- The benefit of scenarios is that different design options can be evaluated against a common test suite.
- Direct comparisons can be made between the alternative designs.
- The problems with this approach are that it can focus designers' attention upon a small selection of tasks.
- Some application functionality may remain untested.
- A further limitation is that it is difficult to derive measurable data from the use of scenario-based techniques.

Query Techniques

- Interviews
- Questionnaires

Interviews

- Involves asking users questions about their experiences with the system being evaluated.
- For an interview to be effective, the interviewer will plan it carefully, preparing specific questions or making a list of topics to address.
- Interview should not be overly structured, so that the interviewer can easily adapt the questioning to suit the specific user.
- A good compromise is a semi-structured interview which is based on leading questions, but has the flexibility to investigate promising or unanticipated directions.
- Advantages of interviews are that the evaluator can vary the level of questioning to suit the context.
- Evaluator can probe the user for more information on relevant issues which arise spontaneously during the interview.

Questionnaires

- Consists of fixed questions relating to interaction with the system being evaluated.
- This technique is less flexible than interviews but it has several advantages.
- A larger number of users can be included in the evaluation
- as it is less time-consuming and labour intensive
- And the results can be analysed more rigorously.
- Questionnaires can be completed in fixed sessions, but they can also be administered independent of time and place, and without the presence of an evaluator.
- Different styles of questions can be used, namely open-ended questions
- Closed questions such as multiple choice or ranked questions.

Heuristic Evaluation

- Developed by Jakob Nielsen and his colleagues (Nielsen, 1994)
- User interface design experts evaluate the user interface according to usability principles known as heuristics.
- Heuristic evaluation involves three steps:
    - Briefing: experts are told what to do.
    - Evaluation: each expert spends a few hours taking at least two passes through the interface, using the heuristics to identify problems.
    - Debriefing: experts meet to discuss their evaluations, prioritize problems and suggest solutions.
- The advantage of heuristic evaluation is that there are fewer practical and ethical issues to take into account as users are not involved.
- Disadvantage is that the experts often identify problems that aren't really problems.
- Preferably be used along with other techniques and that several evaluators should take part in the evaluation.

Nielsen's Evaluation Questions:

- How good is the visibility of system status?
- Is there a clear match between the system and the real world?
- Does the user have control when needed and are they free to explore when necessary?
- Does the user interface display consistency and adherence to standards?
- Does the interface help users recognise, diagnose, and recover from errors?
- How good is the error prevention?
- Does the interface rely on recognition rather than on recall?
- How flexibility and efficient is it to use?
- How good is the interface in terms of aesthetics and minimalist (clear and simple) design?
- Is there adequate help and documentation available?

Conclusion

- Without doing some form of evaluation it is impossible to know whether the system fulfils the needs of the users and how well it fits the physical, social and organisational context in which it will be used.

5 SOCIAL ASPECTS OF COMPUTER USE

Impact of Information Technology on Society

Business and E-Commerce

- Physical distance no longer puts a restriction on the way businesses are structured.
- A company can have divisions located in different countries and responsibilities can be divided between countries on the basis of the skill and expertise located there.
- Manufacturing can be allocated to where it can be done most efficiently.
- Network infrastructure and online availability of services and information have made sales clerks, stock brokers and travel agents redundant.
- Digital music has completely changed the functioning of the music industry world-wide.
- There is now much more competition – any artists can easily market and sell their music on the Internet without the help of a record company.
- Advances in computer technology have also impacted the recording and production of music.
- Shipping and distribution costs are reduced.

Online business Reduces costs by:

- No physical store needs to be set up and maintained
- Simplification of order placement and execution
- Providing 24 hour customer support
- Staffing requirements are reduced
- A retail business does not need to carry the inventory of a physical store
- No restriction on retail hours

Disadvantages:

- e-commerce creates opportunities for fraud and theft
- Measures to prevent this and insurance against it may add cost to the business.
- Quite easy to get unlawful access to digital music on the Internet.

Working life

- Communication & Groupware
- Access
- Office Hours & Location

Communication & Groupware

- E-mail and Skype that allow workers to correspond cheaply and instantly over long distances.
- Collaborative work can be done by people who reside in different countries and who might never meet face to face
- Web 2.0 technology is commonly used by organisations to support collaborative work.
- Utilisation of Web 2.0 within a secure environment developed into what is sometimes called Enterprise 2.0.
- Computer Supported Cooperative Work (CSCW) is historical term for collaborating via computers.
- The physical systems through which CSCW manifests are collectively referred to as Groupware.
- Systems never gained widespread popularity due to technical and design issues such as hardware and operating system incompatibilities and the inability to understand the effects of how groups and organizations function.

Problems CSCW:

- Synchronous and asynchronous systems: difficult to know exactly who else is using the system.
- Contention: two or more users want to gain access to same shared resource.
- Interference: one user frustrates another by getting in their way.

Access

- Easy access to information has also impacted on the work environment
- Employees are empowered by the electronic availability of company reports and policies on internal networks.
- Further empowerment comes with e-mail that makes it easier for employees at lower levels to communicate with their superiors.
- Managers have become more accessible.

Office Hours & Location

- Mobile technology allows people to do their work anywhere, anytime.
- Centralised office may not be important any longer.
- Benefit companies who can cut down on office space.
- Employees who will have more flexible work hours.
- People do not need to live close to the office.

Problems:

- Become difficult to separate one's personal and working lives.
- Being connected at all times heightens the need for skills such as:

- Prioritising
- Focusing
- Working without interruption

Education

- A learning management system such as myUnisa makes it possible for students to communicate with their lecturers, participate in discussion with their fellow students, submit their assignments (at the last minute), check their examination and assignment schedules, and more.
- There is a vast amount of educational resources available on the Internet.
- M-learning (mobile learning) that involves the use of cell phones and other mobile devices as a delivery mechanism in education.
- Cell phones are therefore an ideal platform to distribute learning material to students

Problems:

- Unfortunately there is probably more low quality, unreliable information than there are trustworthy academic sources.
- however introduce a design challenge – how does one present the material on such a small display (m-learning)
- The younger generations (i.e. the students) may expect more from technology than what the older generation (the lecturers) feel comfortable with or may think is possible to do.
- Another has to do with the digital divide discussed in section 5.3 below – not everybody has access to the technological resources required for e-learning and m-learning.
- Require access to fast internet connections and sufficient bandwidth. Not all students will have this.

Information Processing

- Processing power of supercomputers has made it possible to process huge amounts of data in relatively short periods of time.
- Now possible to develop computer models of complex systems.
- Without this capacity the aim of establishing a human DNA sequence could not have been reached.

Advantages to society:

- Improved the understanding of pandemics, contagion and global health trends
- Better prediction of the impact of climate change on the environment, the economy and on humans in general.
- Better prediction of natural disasters and their impact so that effective response plans can be set up

Problems Associated with the Information Age

- However, our everyday safety is almost entirely dependent upon information technology.
- Three specific problems:
    - Problem of keeping information private and secure.
    - Difficulty of filtering reliable information.
    - Dependence on technology.

Privacy & Security Issues

- The increase in computing and communications power poses a threat to both the public and the private.
- People regard digital data as different from physical information.
- This is a dangerous assumption.
- Unsolicited mass mail that is sent to millions of users daily.
- The increasing value of the information being stored and transferred across the world's computer networks is also increasing the importance of security.
- The technological sophistication of the general population is increasing. This means that more and more people have the knowledge and ability to 'beat the system'.
- Software that is developed for the sole purpose of doing harm or gaining unlawful access to information is referred to as '*malware*'
    - *Trojan horses:* a malicious piece of code is hidden inside a program that appears to offer other facilities.
    - *Time bombs:* These are, typically, left as a means of retaliating when an employee is dismissed. Program might be scheduled to run once every month
    - *Worms:* These are self-replicating programs. Represent a major threat because they will gradually consume more and more of your resources. The main difference between a virus and a worm is that a worm does not need a host to cause harm.
- Producers of malware are referred to by names such as black hats, hackers, and crackers.
- legitimate programmers call themselves 'hackers' because they hack the code into shape
- prefer the term 'crackers' for people who attack systems
- It is generally assumed that most security violations within large organisations come from within that organisation, either through malicious actions or through carelessness
- One of the most effective means of breeching security is to act as a repair technician and copy the disks of any machine that you are working on

Information Overload

- New information leads to new invention, and consequently, contributes to the evolution of humankind.
- The *Internet* has taken this to a different level – we now have more information to our disposal than is good for us.
- People are spending large amounts of time searching through and taking in irrelevant or useless information just because it is there.
- Much of what appears on the Internet is incomplete, unsubstantiated and incorrect.
- people now have access to harmful information such as:
    - Instructions to build explosive devices.
    - Genome of influenza virus so can be reconstructed.
    - Political propaganda.
    - Pornographic and violent material.

- There is a need for research to determine how people judge the credibility of information and systems need to be developed to help people survive the information overload.
- Being able to filter information is a skill that has become extremely important and mechanisms have to be developed to help those who struggle with this.

Social Networking Technologies

- Chat Rooms
- Instant messaging (IM)
- Blogs
- Social Networking Sites

Chat Rooms

- Chat rooms are locations on the Internet where people meet to have online conversations in real time.
- They are usually open for anyone to join and often relate to a specific topic.
- The messages are normally visible to all current visitors but users can participate in private conversations not observable by others.
- Many have no restrictions on what may be discussed or in what kind of language.
- Danger that young users can be targeted by sexual predators.
- Chat rooms have been losing popularity among teenagers since 2000.

Instant Messaging

- It is a real-time communication tool that allows two or more users who are connected to the system to interact with each other synchronously.
- IMs are different from chat rooms in the sense that the sender must know the user name of the recipient to send a message.
- Privacy settings make it possible to block out messages from unknown users or messages from specific individuals.
- MXit, whatsapp, viber etc.

Blogs

- Blogs are like online journals.
- Blogs are also popular amongst children.
- 24% of all children between 9 and 16 in the United Kingdom had their own blog.

Social Networking Sites

- Social networking sites are sometimes referred to as web communities or online communities.
- Users create profiles with descriptive personal information and photographs and write messages on message boards or walls.
- Users communicate through different kinds of messaging mechanisms.
- Communication can be synchronous (like ‘chatting’) or asynchronous (like blogs or e-mail)
- Users can limit access to their profiles through privacy settings or they can leave it public and allow anybody to view their information.

- Users can limit access to their profiles through privacy settings or they can leave it public and allow anybody to view their information.
- An important issue linked to online social networks is privacy.
- This indicates that people are becoming more aware of the privacy risks associated with these sites.
- It is a cheap and easy way for family and friends to stay in touch while physically removed.

Advantages of social networking:

- Low cost of creating a web presence.
- Making personal connections
- Making connections for career purposes
- For businesses it has the advantage that they can get additional information on someone before employing them.
- It is a way to find out if people have lied in their applications or CVs.

Disadvantages of social networking:

- Lack of anonymity or privacy
- Identity theft
- It wastes time, to such an extent that some companies block access to these sites during working hours.
- Mining of users' data for advertising purpose.
- Cyberbullying
- Cyberstalking
- Inappropriate content such as political propaganda.

The Digital Divide

- Digital divide refers to unequal access to technology that separates people into those who have it and those who do not (Attewell et al., 2003).
- Contributing factors:
    - Financial constraints
    - Lack of skills
    - Unavailability of basic infrastructure
    - Carelessly designed systems
- In developing countries where technology and internet access are relatively widely available, there are still problems with fast internet access.
- Lack of adequate cognitive resources is an important contributor to the digital divide.
- Interacting with computers requires basic skills that will enable a user to recognize the need for information, find the information, process and evaluate the information for its appropriateness, and apply it in a meaningful way.
- The digital divide is not only a reflection of the separation between developed and developing economies.
- It can also exist among population groups within the same nation.
- Many attempts are being made to bridge the divide, for example the Digital Doorway project.
- Keep yourself informed of the pervasive impact that computers have on our world.

<End of Summary>