

UNIT- I

1

Introduction

Syllabus

What is HCI ?, Disciplines involved in HCI, Why HCI study is important ? The psychology of everyday things Donald A. Norman, Principles of HCI, User-centered Design. Measurable Human factors.

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1.1 What is HCI ?

- HCI (Human Computer Interaction), is a study of how human beings / people interact with computers. It is a study of how we can extend or develop successful interaction for human beings.
- It is a combination of three words H, C, I
 - Human → The user
 - Computer → The computer
 - Interface → The way above two interact with each other.
- User : Any human being who uses the system. It may be individual or group of users working together. Users use their sensory organs such as sight, hearing and touch for interaction - majorly. Technology is not that much updated to involve remaining two senses like taste and smell. Different users have different conceptions or mental models of their interactions. Along with learning ability and knowledge of task and technology play a vital role. Cultural and national differences play an important role.

Computer :

- Computer means any interactive system from desktop computer to main frame computer and from devices from mobile phones to any electronic device, like microwave oven, refrigerator, remote control, etc. are also considered as computer.
- Interaction : It is an interaction between humans and machine. Humans and machines working is different. We should give the design in a such a way that both will interact with each other successfully. For that study of humans and computers is required and use it in design process. In real life budget and schedule play important role while designing.
- We have to give ideal system and sensible system for users.
- It is our goal to produce usable and functional systems along with safety.
- Before designing study of how people use technology is important.
- While designing user / people is most important factor. So study of their needs, capabilities, preferences of doing task should be studied by designer. Users should not change, we have to give a system in such a way that it will match user requirements.

Usability :

It is an important key point in HCI. Designing systems that should be easy to learn and use. Usable system include following points.

- Easy to learn and recall
- Effective and efficient
- Safe and enjoyable

The systems and products designed with less regard to usability leads to frustration, waste of time and errors. There is a huge list of interactive devices like computer, mobile phone, remote control, coffee / tea vending machine, ATM, ticket machines, kiosk, library information system, website, calculator, printer, video game, watch, etc. The study of HCI gives devices which will give systems easy to use, effortless and enjoyable systems.

1.1.1 Factors in HCI

There are so many factors which should be considered in HCI. Some important factors are :

- 1) **The user**
 - Cognitive process and capabilities
 - Motivation, enjoyment, experience, personality, satisfaction.
- 2) **Comfort factors**
 - Layout, seating, equipment
- 3) **User interface**
 - Input and output devices
 - Multimedia, colors and icons, navigation
 - Graphics, commands, dialogue boxes
 - Natural languages
- 4) **Organisation factors**
 - Job design, roles, training, work organization, politics, organization issues
- 5) **Environmental factors**
 - Lighting, ventilation, health and safety issues
 - Noise, heating, environmental issues.
- 6) **Constraints**
 - Money, time, hardware and software resources, human resources
 - Physical area

7) Task factors

- o Skills, easy, complex, monitoring

8) System functionality

- o Hardware, software, applications

9) Productivity factors

- o Increase quality, decrease cost, reduce errors, more innovation, more output

1.2 Disciplines Involved in HCI

SPPU : Oct.-19

In HCI lot of disciplines are involved. It is a huge list.

- | | |
|--|----------------------------------|
| 1) Physiology | 2) Sociology |
| 3) Art | 4) Design |
| 5) Engineering | 6) Computer Science |
| 7) Linguistics | 8) Philosophy |
| 9) Anthropology | 10) Ergonomics and Human Factors |
| 11) Artificial Intelligence | 12) Cognitive Psychology |
| 13) Social and Organizational Psychology | |

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1) Physiology

U PA

- o Understanding the user
- o Modelling the user
- o Physical capabilities

2) Sociology

- o Group behaviour is studied. Social science methods are used to analyse the system. Computer Supported Cooperative Writing (CSCW) is used for sharing hardware and softwares among group of people working together. By sharing resources maximum benefit can be achieved for all users.

3) Art

- o Design should include some aesthetic appealing design, so that user gets attracted to it.

4) Design

- o In user's knowledge and designer's knowledge there will be huge gap. User wants to achieve his / her objectives. User's requirements may be changing due to rules and regulations. Sometimes technical strategy or management issues design may be changed.

o From designers point of view, he/she knows all technical aspects. The problem with designer is they don't know about user's qualities and technical knowledge. In design colors, graphics design and design layout all are considered.

5) Engineering

- o In this tools, techniques and equipments are majorly considered. In engineering everything is according to model building. Using new tools and techniques good product would be designed.

- o There is huge impact of engineering in HCI. Interface designing is a part of software development life cycle. Engineering principles play an important role in HCI.

6) Computer Science

- o In computer science technology is considered software design, development and maintenance of system is analysed. In this User Interface Management System (UIMS) and User Interface Development Environment (UIDE) are studied. Graphics and prototyping tools are used in these kind of systems.

7) Linguistics

- o Linguistics means related to human languages.
- o It is a study of languages. Languages play an important role in interface. We generally use English language for interface. Command line language is a best example for linguistics.
- o In linguistics terminology is important. Another example of linguistics system is multi-lingual systems. In this multiple languages are used as interface. Users can use multiple language in same interface.
- o Natural language interface will be future of interface systems. In natural languages, whatever natural language of users is considered in an interface.

8) Philosophy

- o Philosophy means knowledge of everything is considered. Creating consistency is important while designing the products.

9) Anthropology

- o It is a study of social science, particularly social relationships of human beings. Computer Supported Cooperative Writing (CSCW). Types of softwares comes under this category.

- o In CSCW, multiple users can interact with each other from remote places using this kind of interfaces.

10) Ergonomics and Human Factors

- o Use of these ergonomics and human factors is to design such system which must be useful for different purposes, at very comfort level and support for their current environment.
- o It again study of capabilities and capacities of users. These kind of systems gives context of design. By considering these points we can give the system to the user which would be safe, efficient and reliable along with comfort and satisfaction. Such interfaces are widely adapted by users.

11) Artificial Intelligence (AI)

- o Using AI we can design intelligent systems, which will work as intelligent human user. Decision making or supporting systems are the examples of this kind systems. Computers games like chess is another example. Automated systems is the final product of such systems. This is achieved by intelligence softwares.

12) Cognitive Psychology

- o In these interfaces, human behaviour and mental process is studied. Whatever we are able to see, touch, feel, smell and taste all are considered while designing as a information.
- o These are considered as limitations and capabilities of user. Perception, attention, memory, learning and thinking of user is also analyzed in these systems, CSCW systems can be designed using cognitive psychology.

13) Social and Organizational Psychology

- o It is a study of human behaviour in a society. It is a study of influence of a person behaviour, group members attitude and behaviour.
- o It is study of attitude, behaviour and group work. It is a study of social and organizational structures.

Review Question

1. List and explain the various disciplines of Human Computer Interaction.

SPPU : Oct.-19, Marks 5

1.3 What is HCI ? Why it is important ?

- Human computer interface is a study of not only engineering but multiple streams. In this we have to study theory of Psychology, Ergonomics, Design and the ways how human interact and the way it uses the devices.
- It is a study of design, implementation and evaluation.
- Interaction means how human is interacting with computing devices for a given task. Interaction deals with software and hardware. Interaction and interface are different in meaning.
- In interface software part such as window, metaphor, widget, etc. are involved and hardwares such as monitor, mouse, keyboard are involved.
- In interface lot of tasks such as navigation selection, manipulation, data entry etc. are considered, where as in interaction model sequence, context, hierarchy, level of detail etc. are considered.
- HCI is more important because computers are used everywhere. In some devices computers are not used directly but embedded devices are used. As computers involved everywhere user should be happy with the design. For that how to design interaction is more important. Not only design but also implementation of interface is equally important. It is nothing but the term usability. Usability is a term which is a combination of effectiveness, efficiency and satisfaction along with safety and other parameters.
Usability = Effectiveness + Efficiency + Satisfaction
- If the devices are easy for use, efficient for assigned task with safety parameters and gives correct output, these devices are called as high usable devices. And this term is called as high usability. High usability devices gives high productivity. Such designs are widely accepted by users. This may be a reason for successful product.
- Many product based companies prefer simple aesthetic appeal of interfaces by satisfying the usability rules. It is requirement for commercial business of every company. Some brand names such as Apple, Microsoft etc. These companies products are distinct in design. These products are designed in such a way that users are pleased with their design and get satisfied with whole product. Even in market same type of devices are available at less price of their competitor companies but users prefer these branded companies product.
- These products generally have complete functionalities, high usability, aesthetic appeal with safety parameters.
- Examples for complete functionalities is smart phone, it is having functionalities like, calling, receiving, internet, messages, photos, camera, audio, video and many more.

- High usability is in Kiosk present at public places such as railway station, shopping mall, tourist places etc.
- Example for aesthetic appeal is mobile phones, ipad, headphones, etc.
- HCI has a huge impact on daily lives in computing devices. Such as touch screen are widely used than keyboard or keypad, even more than simply mouse click. User always wants easy interface, so command typing is not attractive solution. Similarly spread sheets are widely accepted than other similar kinds of tabular formats. Web browser is another good example of interfacing between user and internet. In computer games action oriented interfaces and body based interfaces are widely accepted. It is a redefining the required view and manipulation of information according to the user requirement.

Review Question

1. Explain in detail the need to study "Human Computer Interaction" for producing good interactive software ?

SPPU : Oct.-19, Marks 5

1.4 Psychology of Everyday Things by Donald A. Norman

- Some interaction designs are really confusing in nature example is door, whether to push or pull, another example washroom, whether for male or female.
- While designing we must take care of discoverability means possible actions, where and how to perform and understandings means how to use and settings and controls.
- Whatever the options and controls that must be visible to user. From visible options user must be able to get proper meaning. For that designer must give some symbols for actions or labels. User manuals and instruction set can be preferred for complex design.

1.5 Principles of HCI

SPPU : May-19, Oct.-19, Dec.-19

- HCI design is hard as compared to normal design. In almost all softwares multiple objectives are considered along with types of users, study of tasks, devices, abilities, technology change and many more. For HCI design knowledge of multiple streams is must required. Philosophers, researchers and developers gives some principles for good HCI design. These principles are basic principles and applicable for all HCI design. The main principles are as follows :

1) Know the user

First and most important term is to know your user. But as it looks simple but equally difficult to know because of the user types, HCI systems are generally called as user centered design. Understanding user is a difficult task because users are having variety in the form of education, gender, age, experience, cultural, social etc. backgrounds. Users having different mental and physical capabilities. All these information about user can be used for good interface design.

- In HCI design, study of users age play an important role. As young users adopt new technology and older age user are not ready to accept it. Another factor male users are good at spatial ability than female. Females are having some different qualities as carefulness and neatliness can be considered. Females require artistic design. There are so many aspects which are needed to be consider while designing along with knowledge about cognitive, psychology, ergonomics, anthropomorphic data, etc.

○ Designs for kids, female and elder should be different.

- User-centered design is nothing but universal usability means considering human. Universal usability design means this design must fulfill requirements of all age groups, skill levels, cultural backgrounds and disability levels. It is very difficult to satisfy users from multiple cultures.

- In some interfaces multiple languages, color-blind and visually challenged users should be considered. Additional type of user is novices and expert users. In this type of users, menu-driven interface is provided for novices. Whereas key-board based short-cut keys are provided for expert users. So, multiple options should be provided for single task.

2) Understand the task

- Another most important principle is based on TASK. The task means the job which is done by the user using interaction system. Understand the task is equally important like studying interaction modelling and user analysis.
- It is a study of the sequence and structure of subtasks at high level for typical user in an application. For example, network connection for experienced user is having knowledge about all related technical terms like bandwidth, signal strength, security level etc, whereas casual user, wants auto connection options.

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- Different users need different models of design. Human beings are adaptive in nature due to this nature only some interaction models are developed by considering general human capacities.

3) Reduce memory load

- Minimum memory load is the principle for HCI design. Humans can perform the task efficient which requires less memory. Humans are having long and short memories.
- Related to memory, there are two types of memories: Short Term Memory (STM) and Long Term Memory (LTM). The human's Short Term Memory (STM) capacity is about 5 to 9 chunks of information that is 5 to 9 times, numbers, etc. It is called as magic number.
- If we design such a system which gives less memory load, that system would be widely accepted. Task can be easily and quickly completed by user. In these systems there are less chances of errors. We can apply this concept in number of menus, items, substances, etc. Another good example are short names and mobile number, vehicle number etc.

4) Strive for consistency

- Consistency means familiarity. It is an important principle in design. Using this principle, we can reduce the memory load. We can apply this in application and in different applications. Also, we can apply in interaction model and interface implementation.
- Due to familiarity users widely accept designs users are not confused, less chances of mistakes, less number of errors, because same subtask are involved. In maintaining consistency same subtasks have to be involved in different application. Best example is Microsoft windows, all applications are familiar and consistent interface and widely accepted by users.

5) Remind users and refresh memory

- Sometimes users forget some important subtask, so there is a requirement of continuous reminder of important information. This concept is called as refresh the users memory. The human is having a tendency of move away from one point to another within fraction of second. This happens very quickly. This happens more in multitasking, when switching from one task to another.
- Human brain does rehearses information encoding while multitasking. Not only in multi-tasking but also in single task may go ahead in different directions.

- An example, is an online shopping application. In this application, user has to do entry of different types of information as item relations, delivery option, address, credit card number, number of items, colour, etc.
- In this interaction design, to complete the task correct responses, informative, momentary or continuous feedback will refresh human memory. It will help user to complete his task very easily.
- Informative feedback is giving current status of the system. This is required most at the time of closure of large process.
- Examples for this are giving information about correct entered credit card number and booking completed message. This type of closure gives satisfaction to the user.

6) Prevent errors / Reversal of action

- For a quick completion of tasks less number of errors are required. If some wrong entries by users, system should have reversal actions for users.
- If the system is error-free, task will get completed very quickly. So the interface and information can avoid confusion and memory overload. In system only the relevant information or actions must be given at required time.
- Example is inactive menu items. Users must have choice to choose menu items. An easy reversal of action is required because there are chances user can do mistakes. Due to these features user will be satisfied and comfortable.

7) Naturalness

- Naturalness means natural language and natural behaviour based conversational interface. It is very difficult to real life styles models for interaction. Examples for this, 3D softwares, 3D design, virtual reality.
- In these kind of interfaces real time communication, object selection, actual views from different angles, different shades are possible. In future more number of naturalness design will be developed.

Review Questions

- What can a system designer do to minimize the memory load of the user ?
SPPU : May-19, Marks 4
- Explain various principle of Human Computer Interaction.
SPPU : Oct.-19, Marks 5
- What can system designer do to minimize the memory load of the user ?
SPPU : Oct.-19, Marks 5
- Explain any 2 of the following HCI principles in brief.
 - Understand the task
 - Reduce Memory Load
 - Strive for Consistency
 - Prevent Errors/Reversal of Action.
SPPU : Dec.-19, Marks 5

1.6 User Centered Design

SPPU : May-19, Oct.-19, Dec.-19

- For design, we require knowledge of multiple streams. For example design of car.
- In car design multiple engineers working together irrespective of their basic branches. For such a design good management is required. Each stream has different perspectives in the form of price, affordance, reliability, appearance, functions, competition, service after sell, etc.
- There might be chances of arguments in different streams people. In that arguments aim is to make that product as a successful product.
- Manufacturing company believe in sales and profit. So their main goal is to give such a product that fulfill the above requirements. And the customer demands are more in less price.
- As a designer, we have to give a product which must satisfy user requirements and satisfy manufacturer as well. This is a nothing but a solution to make our product as a successful product.
- Many times user is unhappy to complete task using interface, due to many factors like errors, no proper steps defined, wrong output, technical faults, design problems and many more. In daily life we are not happy with some devices performance like ATM, Kiosk, automatic coffee / tea vending machine, automatic ticket booking, websites, softwares, etc.
- Many times the problems occurred due to misunderstandings of user only.
- To solve the problems from misunderstandings, the term 'user centered design' is introduced. In this kind of design user is at center means as per user convenience all the design will get shape.
- In such kind of designs, user is directly or indirectly involved in design process of find product user is involved during development cycle, like during requirement gathering, designing, usability testing and whenever required. Sometimes user is involved throughout the development process. Involvement of user makes great impact on design.
- The User Centered Design (USD) came from Donald Norman's research laboratory at University of California San Diego (UCSD) in 1980's. After that so many studies carried out about USD along with Psychology of Everyday Things (POET). POET gives need and interest of user for usability design. In that four suggestions are given for designing.

- 1) User should determine which possible actions at any moment.
 - 2) Make all options visible along with alternative actions and results of actions.
 - 3) It should be easy to evaluate the current state of the system.
 - 4) Do the natural mapping between intentions and required actions, actions and resulting effect, information that is visible and interpretation of the system state.
- All above points, gives an importance to the user that is user is at center of the design. The role of designer is as a facilitator to complete the task to the user.
 - Designers role is to check user must be able to use the designed product as required with minimum effort to complete and learn it. Norman suggested that rather than long and complicated user manuals give small and simple instructions, so user can read it quickly and use it properly.
 - Norman in 1988 suggested total seven principles of design for the designer.
 - 1) Use your knowledge and world knowledge create conceptual models and create manuals that should be understood easily by user but should be written before design is implemented.
 - 2) Reduce short term memory or long term memory load by simplifying the structure of tasks. As a constraint of human, user can remember five things at a time. Task should be consistent and user can easily recall the information from his memory. User should have control over the task.
 - 3) To bridge the gulfs of execution and evaluation things must be visible. User should get clear idea of right buttons or devices which are required to complete the operation.
 - 4) Graphics can be used to understand the things properly with proper mappings.
 - 5) Know the natural and artificial constraints.
 - 6) Errors are possible while using, so design should be for errors or mistakes. Predict errors, then design for possible errors. We have to give options for easy recovery from errors.
 - 7) When everything failed, we have to standardize the product. Use international standards or create your own standards.
 - 8) Ben Shneiderman in 1987, had given similar kinds of principles like Norman. That set of principles is called as Eight Golden rules.

- Normans aim was the product should be designed which fulfil the need and desire of user. User should be at center of the development process. He stated that actual user should be involved in the design process. The involvement of user is more effective, efficient and safer as product point of view. There will be very less chances of rejection and dissatisfaction by user of product.

1.6.1 How to Involve Users in Design ?

- User is the one who will use the final product. There are also other users. There are majorly two types of users, direct and indirect users. We can involve direct users in Design process.
- Eason who have mentioned in 1987, three types of users as primary, secondary, tertiary. Primary users are those who actually use the product. Secondary users who occasionally use the product or those users are also called as intermediary users.
- Tertiary users are those who will be affected by the use of product. This tertiary make an important role that is whether to buy this product or not. All stakeholder must be satisfied by the design, such or design is called as successful design. We cannot involve each and every type of user in the design process.
- We have to identify stakeholders who will involve in the design process. By knowing their needs, designers can give some alternative design solutions and that designs are evaluated by the users.
- In the beginning of design process all these design solutions can be simple paper and pencil drawings.
- After that listening to the users about alternative designs can improve the final design. It may give some more information that does not come in the beginning of requirement gathering process.
- We can get more information through interviews, observations and need analysis. Next step is prototype creations means limited versions of products are created and tested by the user. Designers will get the correct and important feedback about usability of that product.
- It is called as measurable usability it includes effectiveness, efficiency, safety, learnability, memorability, utility and users satisfaction. It is very difficult to designer to predict or imagine all the usability criteria which are important for the users.

- Designers can involve user from beginning to final stage as by taking interviews and questionnaires, focus groups means wide range of stakeholders, on-site observations, role playing, walkthroughs and simulations, usability testing and final interview and questionnaires.
- This is nothing but central role of usability testing in user centered design.

1.6.2 Usability Testing

- It is a testing of product by the actual user. It is to improve usability of product. It shows how users are doing their tasks using this product. Testers can observe as well as record the participants, can analyze the data obtained and to the changes accordingly.
- This usability testing focuses on requirements, empirical measurement and iterative design.
- Many iterations are performed before final product release in public. It is just like rehearsals for any play. Previously this usability testing was performed in laboratory by the experts which were good in user interface design and testing.
- This laboratory requires more cost so replaced by mobile usability testing kits.
- Another many techniques for usability testings are think aloud technique. In this technique user is asked to perform all the steps of actions. In videotaping, designers can get true review about the participants and problems in the design.
- In interviews and user satisfaction questionnaires, designer enable to evaluate the users.
- Through usability testing designer can get more information about time required to learn a specific function, speed of task performance, types and rate of errors, user retention of commands, over time, subjective user satisfaction.
- Even this testing is continued after product get released. After release, testing through the interviews and focus groups. This gives an important information about problems with functionality and user satisfaction. Data logs can be performed the testing.
- This usability testing is having same limitations as it is not covering all features of interface. As it is testing in laboratory only rather than actual environment.
- Usability testing should be done with experts where expert reviews play an important role. One problem with this usability testing is, it is expensive. Heuristic testing is the testing to reduce the load on short term memory is also performed to test the product.

- In usability testing, discount usability evaluation gives percentage of usability problems.

1.6.3 Participatory Design

- In such designs actual users are involved in design or development process along with designers. Cultural differences may be problem in between users and designers.
- Another problem is language difference in users and designers. To solve such problems prototype design is preferred, like three dimensional paper based representation, paper based screen of webpage or product.
- Using latest technologies prototyping may be possible like PICTIVE (Plastic Interface for Collaborative Technology Initiatives through Video Exploration) and CARD (Collaborative Analysis of Requirements and Design).
- In PICTIVE prototyping method, office products are used like pens, papers and sticky notes and actions of users are videotaped, whereas CARD uses playing cards with pictures of specific items.
- One more important example for participatory design is software for children in such softwares childrens should be involved. Participatory design is called as community centered design if the product or software is based on online communities.

1.6.4 Advantages and Disadvantages of UCD

Advantages

- More efficient, effective and safety.
- User get sense of importance.
- Design will be accepted by user.
- More satisfaction to the user
- Less redesign and integration

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Disadvantages

- More costly and time consuming
- More stakeholder requires
- Difficult to translate data into design
- Products may be for specific use and users only

5) We can transfer to other clients

6) Users may vary

One more type of usability testing is quick and dirty evaluation in which feedback is taken from few users early in design. Thus involvement of users in design gives more satisfaction in designs.

Review Questions

- Explain different User Centered Design Principles ?
- Explain why - "A design should be User-Centric".
- State and explain UCD principles.

SPPU : May-19, Marks 6

SPPU : Oct.-19, Marks 5

SPPU : Dec.-19, Marks 5

1.7 Measurable Human Factors

Once a determination has been made of the user community and the benchmark set of tasks, then the human factors issues can be examined. Again and again I returned to these five measurable human factors issues: - time to learn. How long does it take for typical members of the target community to learn how to use the task relevant set of commands.

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1. Time to learn

How long does it take for typical members of the target community to learn how to use the task relevant set of commands.

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2. Speed of performance

How long does it take to carry out the benchmark set of task ?

3. Rate of user errors

How many and what kind of errors are made in carrying out the benchmark set of tasks? Although time to make and correct errors might be incorporated into the speed of performance, error making is such a critical component of system usage that it deserves extensive study.

4. Retention of knowledge over time

How well do users maintain their knowledge after an hour, day, or week? Retention may be closely linked to ease of learning, frequency of use plays an important role.

5. Subjective satisfaction

How well did users like using aspects of the system? This can be ascertained by interview or written surveys which include satisfaction scales and space for free form comments.

Every designer would like to succeed in every issue, but there are often forced trade-offs. If lengthy learning is permitted, then task performance speed may be reduced. If rate of errors is to be kept extremely low, then speed of performance may have to be sacrificed. In some applications, subjective satisfaction may be the key determinant of success, while in others short learning times or rapid performance may be paramount. Project managers and designers must be aware of the trade-offs and make their choices explicit and public. Requirements documents and marketing brochures should make clear which issues are primary.

Importance of each is determined by nature of system, e.g.

1. life-critical systems
2. industrial and commercial systems
3. office, home, and entertainment applications
4. exploratory, creative (support creative activity), and cooperative systems

1.8 Multiple Choice Questions

Q.1 The simple model of human interaction was proposed by _____.

- a) Stuart K. Card
- b) Thomas P. Moran
- c) Allen Newell
- d) Card, Moran and Newell

Q.2 The scientific description of peoples and cultures with their customs, habits and mutual differences is called _____.

- a) cognitive science
- b) ethnography
- c) ergonomics
- d) psychology

Q.3 The human computer interaction is an important part of _____.

- a) system design
- b) requirement analysis
- c) unit testing
- d) implementation

Q.4 Cognitive science is the process of designing or arranging workplaces, products and systems so that they fit the people who use them.

- a) True
- b) False

Q.5 Simple model of human interaction was proposed in _____.

- a) 1990
- b) 1983
- c) 1985
- d) 1980

Q.6 Ethnography is the process of designing or arranging workplaces, products and systems so that they fit the people who use them.

- a) True
- b) False

Q.7 Mental model is a _____ for explaining how does a complex mechanism work.

- a) metaphorical structure
- b) standard structure
- c) cognitive structure
- d) data structure

Q.8 What are the goals of a good design ?

- a) Safety
- b) Utility
- c) Efficiency
- d) All of the above

Q.9 Which of the following is the most likely interface metaphor used by a smartphone calendar?

- a) Take-out menu
- b) A paper diary
- c) Mobile technology
- d) A touchscreen

Q.10 Which one of these would not be found in a good HCI ?

- a) Icons that can have specific meanings.
- b) Common shortcuts, like CTRL+Z for undo.
- c) Sounds that convey meanings.
- d) A long command line to achieve a function.

Q.11 It is made with the purpose to improve quality in design of product, processes, overall environment considering review, feedback.

- a) Industrial design
- b) Interaction design
- c) Experience design
- d) None of these

Q.12 One of subsystem of human machine processor was _____.

- a) autonomic system
- b) motor system
- c) voluntary control
- d) somatic system

Q.13 Human computer interaction is a core subject of _____.

- a) psychology
- b) software engineering
- c) anthropology
- d) no ones

Q.14 Characteristic of a software that enable it to acquire requirement goal, easily is called _____.

- a) used
- b) reusable
- c) useful
- d) usable

Q.15 Psychology terms involve in HCI comes under _____.

- a) developmental psychology
- b) engineering psychology
- c) cognitive psychology
- d) consumer psychology

Q.16 Cognitive science is the study of thoughts, learning and behaviour.

- a) True
- b) False

Q.17 From the given following principle which is not the principle of HCI.

- a) Prevent errors and reversal of actions.
- b) Naturalness
- c) Interaction design.
- d) Strive for consistency.

Q.18 One of subsystem of human machine processor was _____.

- a) autonomic system
- b) motor system
- c) voluntary control
- d) somatic system

Q.19 Research related to human computer interaction was begin with title _____.

- a) individual-machine interaction
- b) person-machine interaction
- c) man-machine interaction
- d) user-machine interaction

Answer Keys for Multiple Choice Questions :

Q.1	d	Q.2	b	Q.3	a	Q.4	b
Q.5	b	Q.6	b	Q.7	c	Q.8	d
Q.9	b	Q.10	d	Q.11	c	Q.12	b
Q.13	b	Q.14	d	Q.15	c	Q.16	a
Q.17	c	Q.18	b	Q.19	c		

□□□

UNIT- II

2

Understanding the Human and Human Interaction

Syllabus

Input-output channels, Human memory, Human emotions, Individual differences, Psychology, Ergonomics, Human errors, Models of interaction, Paradigms of Interactions, Interaction styles, Interactivity, Context of interaction, User experience.

Contents

2.1	The Human	May-19, Dec.-19,	Marks 6
2.2	Input-Output Channels	May-19, Oct.-19,	Marks 6
2.3	Human Memory	May-19, Oct.-19,	Marks 6
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2.6	Psychology	Oct.-19,	Marks 5
2.7	Ergonomics	Oct.-19,	Marks 5
2.8	Human Errors		
2.9	Models of Interaction		
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2.11	Interaction Styles	May-19, Dec.-19, Oct.-19,	Marks 6
2.12	Interactivity		
2.13	The Context of the Interaction		
2.14	User Experience		
2.15	Multiple Choice Questions		

(2 - 1)

2.1 The Human

- Human is the user. Therefore for every interactive system the human is very important character. Every interactive system revolves around this character only. An interactive system must be designed as per the requirements of user only.
- As we are studying Human, so we have to start with human psychology as it comes under cognitive psychology.
- This looks we are not studying designing the computer systems but fact is that, we have to start with human psychology because our user is human being. So design can be completed until and unless we study the capabilities and limitations of human.
- In this study we can get the information that which things are easy and difficult to perform. Designer can use this information while designing.
- Cognitive psychology is how human process the information, how stores an information, how takes the computers, how solves the problems and techniques used for physical object manipulations.
- Before starting any design it is necessary to study how they are actually doing their tasks. This is called as simplified model.
- Model human processor, it is a specifying how the human processing important for interacting with computer systems. This model is having three sub systems as
 1. The perceptual system which handles sensory stimulus of outside world.
 2. The motor system which controls actions.
 3. The cognitive system which gives the processing needed to connect the perceptual and motor systems together.
- These subsystems have their own memory and processors. If the subtask is complex, obviously it increases the complexity of task as well.
- This model gives the detailed information about behavior of system under various conditions in the form of principles of operation.
- User is processing information itself. Information comes to user then stored and processed then passed out. So there are three parts of system as input-output, memory and processing.
- Human information processing system is brilliant because it is a collection of problem solving, learning and, consequently, making mistakes. In the human model, memory and processing is required at all levels.

- It is very important to study how human handles information. Human is affected by the factors like social and organizational environment which are not affecting in computer systems. To start design, it is very important to know the capabilities of information processing in the human.
- We will start to study with input output channels of human and then senses and responders.
- This is low level processing. Also study of human memory and working of human memory. Then study of Problem solving, learn ability, acquiring different skills, studying the mistakes by user. At last whether all these point are important in designing computer system.

2.2 Input-Output Channels

SPPU : May-19, Dec-19

- Human interact with outer world by receiving and sending information that is called as input and output.
- Human is interacting with computer by receiving information which is output by computer and give response by giving input to the computer.
- Here Human's output becomes the computer's input and Human's input is nothing but computer's output. Human input and output are called as human input and output channels.
- Some channels are used for both input and output like sight. It is used to receive information from computer and to provide information to the computer using an eye gaze system by fixating on a particular screen point.
- In human input is done through the senses and output through motor control of the effectors.
- Human is having five senses as sight, hearing, touch, taste and smell. For HCI sight, hearing and touch senses play an important role. Taste and smell are not currently useful in HCI. In future these two senses may involve in HCI for designing of special systems and in augmented reality systems.
- The limbs, fingers, eyes, head and vocal system are working as effectors. Fingers play very important job for typing and mouse handling. Eye, head, voice and body position is used while interacting with computer.
- While interacting with computers, we use Graphical User Interface like Windows, Icons, Menus using keyboard and Mouse. While interaction with computer, maximum information we receive from screen by eyes only. Other source of information is ear like beep for mistakes, for attention and voice message. Touch gives feedback which action you performed like key pressing, mouse click.

- We generally hit the keys and move the mouse to sent data to computer. Sight and hearing are generally used for receiving information. Now we will see in more detail the role and limitations of the three primary senses Vision, Hearing and Touch with motor controls.

2.2.1 Vision

- It is the main source of information for the every person. It is a complex activity. It is having physical and perceptual limitations. We see the object; it is called as visual perception. It is divided into two parts as the physical reception of the stimulus from the outside world and the processing and interpretation of that stimulus. So many things human cannot see if the information received is incomplete.
- The study of vision is important because it is related to design. Whatever our eyes see, this information is processed and we are able to see the colorful scenes with relative distances. We can perceive even size and depth. We can see the object due to light only. The reflected light from the object is received and same image is focused upside down on the back of the eye.
- The receptors in the eye transform this into electrical signals. These electrical signals are passed to the brain. An Eye has so many components like cornea, lens and retina. The retina is light sensitive. It contains two types of photoreceptor: rods and cones. Rods are highly sensitive to light. They are unable to resolve fine detail. They are subject to light saturation. So, the temporary blindness we get when moving from a darkened room into sunlight. The cones cannot operate as they are suppressed by the rods.
- Therefore temporarily we are unable to see at all. There are approximately 120 million rods per eye. Another receptor in the eye is Cones. They are less sensitive to light than the rods. They can tolerate more light. There are three types of cone, each sensitive to a different wavelength of light.
- This allows color vision. The eye has approximately 6 million cones, mainly concentrated on the fovea, a small area of the retina on which images is fixated. We perceive movement of object due to ganglion cells in retina. Brightness is levels of light. Luminance gives the amount of light emitted by an object. The luminance depends on the amount of light falling on the object's surface and its reflective properties.
- Contrast is related to luminance. We are not actually read character by character while reading. We actually see the visual pattern of word by word. Then syntactic and semantic analysis and operate on phrases or sentences.

2.2.2 Hearing

- The human ear, hearing starts with vibrations in the air or sound waves. The ear receives these vibrations and transmits them to the auditory nerves.
- The ear has three sections as the outer ear, middle ear and inner ear. The outer ear, it is a visible part of the ear. It has two parts as the pinna and the auditory canal. The pinna is attached to the sides of the head. The outer ear protects the middle ear. The auditory canal contains wax.
- The purpose of wax is to prevent from dust, dirt and over-inquisitive insects reaching the middle ear. Wax also maintains a constant temperature.
- The pinna and auditory canal amplify sound. The location of sound is identified by the two ears receive slightly different sounds along with time difference between the sound reaching the two ears. Intensity of sound reaching the two ears is also different due to head in between two ears.
- The limitation of human ear is can hear only frequencies from about 20 Hz to 15 kHz. The auditory system performs filtering of sound as noise is removed and only concentration on important information. In interface design we can use sound as warning and notification. Multimedia sound can be used in interface design.

2.2.3 | Touch

- It is called as haptic perception. This sense is less important than sight and hearing.
- Touch provides information about our environment. It gives us information like hot or cold. It provides us feedback when we touch the object like shape, surface. Touch plays an important role in virtual reality games. In Virtual Reality, objects are computer generated and manipulated by user by gestures. This sense is really very important for visually impaired users. For example, Braille language. We receive information through skin about cold, heat, pain and pressure through sensory receptors. This sense is also important for Human Computer interaction.

2.2.4 Movement

- Movement's time dependents on physical characteristics like age, fitness. Person can react to auditory signal in approximately 150 ms, to a visual signal in 200 ms and to pain in 700 ms. Movement factor is very useful in computer games. Speed and accuracy of movement are important in the design of interactive systems. Selecting item from menu list is easy than pie chart shape menu. Because the necessary movements required for pie chart shape are more.

Review Questions

1. The human eye has number of limitations. Give three example. For one of the limitations identified, describe how this should be taken into an account in the design of invisible interface.
SPPU : May-19, End Sem, Marks 6
2. Suggest ideas for an interface which uses the properties of sound effectively?
SPPU : Dec.-19, End Sem, Marks 5

2.3 Human Memory**SPPU : May-19, Oct-19**

Human some activities are depends on human memory. For interaction design, we must understand capabilities and limitations of human memory. Human is having three types of memories.

- 1) Sensory memory
- 2) Short term memory or working memory
- 3) Long term memory

1) Sensory memory

- It is a memory related to our sensory organs. Depending on sensory organ it may be iconic, echoic or haptic. Sensory memories works like a buffers for inputs from sensors.
- This sensory memory is for every sensory channel. As iconic memory for visual input, echoic memory for aural input and haptic memory for touch input.
- These memories works like buffer means regularly overwrite by new information. Example of iconic memory is if we move a finger in front of eye. We see more fingers.
- This example gives persistence of finger for some time in our memory. Another example is fireworks, moving sparklers-image remain in human memory. Iconic memory remains in memory for 0.5 seconds.
- Echoic memory gives us direction of sound. This is only possible because we receive information through both ears. Information received at different time with different frequencies of sound, so it is possible to get a direction of sound.
- From sensory memory information is send to short term memory if human gives attention only. So filtering is only required is subject of interest. Attention means concentration of mind over so many thoughts.
- This is because we are having some limits regarding capacity of sensory processor and mental processor. If we attend more inputs then overloading is done.

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- We are having choice for attend. It depends on need and area of interest. Sensory memories are stored in permanently only when overwritten other information lost.

2) Short term memory or working memory

- It works like a scratch pad. This memory access is very quick like 70 ms. And information may decay within 200 ms. It has limited capacity. Capacity is measured how much length of sequence is remembered and items recalled in any order. Normally, human can remember 7 + 2 or 7 - 2 digits. For example read following number

332409238923

- From above number it is possible to remember 5 to 9 digits to remember normally. If number is divided into parts then it is easy to recall.

332 409 238 923

- This is grouping of digits called chunk. Generally we can remember 7 + 2 or 7 - 2 chunks. Chunking can increase capacity of short term memory. The successful formation of a chunk is known as closure. Example is mobile number, pan card number, adhar card number.

- It is easy to remember meaningful information than meaning less information.

I am going to college

goi ngt oco lle geaim

- In above two sentences, first sentence is having meaning and in second sentence, characters are same first sentence but meaningless. It is easy to remember last word in the sentence than middle word, this is called as recency effect. Sometimes short term memory recall is damaged by interference of other information like old information or new information.

- Another problem with this short term memory is flush short term memory. Without closing current task start next task. For example, the mechanism of old ATM machine was, insert a card and do the transaction then machine gives you card back. But there are chances to forget to collect card. This is due to flush short term memory. So now days that ATM machines are replaced with just insert card, get card back and then do the transactions.

3) Long term memory

- It is totally different than short term memory. It is unlimited capacity. It is slow access as compared to short term memory. It varies from minutes to hours or days. Forgetting is slowly.

- Long term memory is used to store information for long time. It is possible to store information for long time, if information is rehearsed many times. It is having less decay as compared to short term memory.
- There are two types of long-term memory :
 - 1) Episodic memory
 - 2) Semantic memory

It is memory which represents our memory of events and experiences in a serial form. We can reconstruct the actual events that took place at a given point in our lives.

2) Semantic memory

FCS

- Semantic memory is a structured record of facts, concepts and skills which we have acquired. The information in semantic memory is derived from that in our episodic memory. We can learn new facts or concepts from our experiences.
- Semantic memory is structured in such a way that it allows access to information, representation of relationships between pieces of information and inference. Network structure is an example for semantic information. Items are associated with other in same classes. Items may inherit some properties from parent classes. Such a model is called as a semantic network.
- In long term memory three activities are performed that are storage or remembering of information, forgetting and information retrieval. Using rehearsal short term memory information is converted into long term memory. But sometimes only repetition is not sufficient, because if information is meaningless, it is very difficult to remember. It is easy to remember the set of words which represents objects than a set of words which represents words. It is easy to remember list of objects which we can visualize easily. Sentences are easy to remember. Familiarity also helps to remember.
- There are chances of forgetting the information. There are two theories that are decay and interference. Decay means information stored in long term memory may be forgotten. Nonsense information may decay rapidly.
- Interference also gives information loss. If we store new information in memory it gives loss of old information. This is called as retroactive interference. For example change in mobile number, due to new mobile number. It is difficult to remember old mobile number. Another possibility is, old mobile number makes difficult to remember new mobile number. This is called as proactive inhibition. Forgetting is also related to emotions. For example, we remember the positive information than negative information.

Review Questions

SPPU : May-19, End Sem. Marks 6

1. Discuss RAM and short-term memory(STM).
2. Explain significance of sensory memory in interface design ?

SPPU : May-19, End Sem. Marks 6

3. Compare STM and LTM of human with respect to capacity, access time and forgetting.

SPPU : Oct.-19, In Sem. Marks 5

2.4 Human Emotions

- Human are interactive with interacting devices by not only using perceptual and cognitive abilities but also by our emotional response as well. It is more complex than perceptual and cognitive abilities. Our performance is affected by emotional response. Our positive emotions make us to think more creatively for solving complex problems. And negative emotion gives us narrow and focused thinking. It is very easy to solve problem when we are relaxed. And when we are frustrated or afraid then it will be difficult to solve the problems.
- Psychologists are studying human emotions for so many years. This study gives us answers for the 'why we give a particular response when we are having specific emotion'. Emotion is interpretation of a psychological response. So, we respond to the emotion.
- Physiologically, we respond to an input or it is generally called as stimulus and then interprets that as emotion. Human are having emotions like happy, sad, sorry, guilty, angry, cry and etc. Our emotional reactions are very fast than physiological processes. We can easily distinguish the physiological responses are same for some emotional states like anger and fear.
- The emotions give different physical response. For example, in competition excitement and under attack we feel fear. Sometimes we get same physiological response from different situations. Those emotions are based on cognitive evaluation. It is also dependent on person's attributes. Emotions are involved in physical and cognitive events both. Actually our body gives response to the external stimulus and we interpret that as a particular emotion. This response is a biological response and it is called as affect. This changes the way of how we act for different situations. This gives how we interact with the computer systems. Donald Norman says that negative affect can make it harder to do even easy tasks and positive affect can make it easier to do difficult tasks.
- It is preferable that give the interfaces to the computer user which is easy to handle. People cannot handle complex situations or complex problems. People face difficulties while managing such interfaces.

- When people are relaxed then they will adjust if any design limitation. People does not excuse for bad interface designs. It is role of designer get positive response from the design itself. It is possible by providing aesthetics or reward. Such designs are more successful.

2.5 Individual Difference

- Every human is not having similar capabilities and limitations. So we can make generalized statements for all humans. We apply psychological principles and properties to the maximum people by sharing the common process. But users are not same. We must aware about individual differences. We must identified maximum differences so that we can include in the designs. The long term differences like sex, physical capabilities and intellectual capabilities. And short term includes the user's effect of stress or fatigue. Some differences are changing nature like time. Example is age. All these differences must consider while design. It is very useful for every design decision. Because there might be a group or groups of users may adversely affect by such decisions.
- Sometimes by mistake the designers may exclude a section of the user population. For example, we are designing the visual interfaces by considering all are having good vision. But unfortunately, some users are from the visually impaired category. The design must be useful by using other sensory channels. We must give the design in such a way that user must handle interface even he/she is under pressure, feeling sick, distracted, etc. our interface must not be given after knowing their perceptual and cognitive limits.

2.6 Psychology

SPPU : Oct.-19

- Human receive information, process and store information. Human also solve problems and acquire skills. All these must apply while designing interactive systems. Sometimes straight forward conclusions are preferred. For example, a conclusion that recognition is easier than recall. Designers must provide list in the form of menu instead of input by typing commands.
- In most of computer interaction design problem found that are not simple. That designs are dangerous and due to wrong generalization which goes to wrong. We must apply a psychological principle or result properly in design. We must understand its context. It must suites according to the psychology and according to the actual experiments, measures, subjects which are related to the design.

- Novice designer wants to acknowledge the relevance of cognitive psychology but background doesn't match to derive appropriate conclusions. Principles and guidelines must be used carefully while designing. Models for design and techniques must be properly studied by the designer. All these must be used properly which will support the design process.

2.6.1 Guidelines

- For interactive design it is necessary to study strengths and weaknesses of human cognitive and perceptual process. But in maximum cases we are not using it directly for design. This is because by using these we will get a very simple interactive design. Sometimes it gives partial design. It may give us the feel that psychology offers this much only. There are guidelines and general design principles are given in the form theories of interactive design. Some are straightforward like for help recall some clue or hint is provided wherever possible. And some are context dependent and more complex. Out of all principles and guidelines maximum are derived from psychological theory.

2.6.2 Models to Support Design

- Along with principles and guidelines, psychological theory gives predictive models of user behavior and the development of analytic.
- These give a specific model of human problem solving. Some are giving model of physical activities. Others give a more comprehensive view of cognition. Some models can easily predict how a typical user will behave with interactive design in a given situation. Some models can analyze why such kind of user behavior happened. All these models are totally based on cognitive theory.

2.6.3 Techniques for Evaluation

- It is very necessary to understand the theoretical understanding of the user as a human. Psychology also provides the techniques which are derived from experiment and observation rather than theory. It gives wide range of techniques. These techniques can be used for evaluation of designs and whole system as well. Without knowing the scope and benefits of each and every technique we can use it effectively. These techniques we can use in the specific conditions only.

Review Question

1. Explain the following terms : i) Human psychology ii) Design principles

SPPU : Oct.-19, In Sem, Marks 5

2.7 Ergonomics

- Ergonomics is the study of the one of the attribute of interaction i.e. physical characteristics. It can be described by asking some questions like how controls can be designed. How physical environment plays role in interaction when it takes place? How layout of the screen looks like? And attribute as physical qualities.
- Set of controls should be grouped logically so as to ease the access and actions can be performed faster. It becomes very crucial when we used in safety-critical applications such as aviation, plant control and air traffic control.
- The absolute and correct organization will depend on the domain and the application.
 - Functional** controls and displays are organized such that those that are functionally related are placed together.
 - Sequential** controls and displays are arranged to reflect the order of their use in interaction.
 - Frequency** controls and displays are arranged according to how often they are used.
- The whole system interface must be organized properly in relation to the user's location. Critical displays should be at eye level for easy eyesight. Lighting should be organized to avoid glare and reflection misleading displays. Controls should be space out to offer satisfactory room for the user to handle.

2.7.1 The Physical Environment

- Ergonomics is related with the design of the working environment only. It tells about where the system will be used? Who will use the system? Users sitting, standing or moving positions Again, It largely depends on the domain of the system.
- The first and most important consideration is the size of the users here. Critical displays should be in eyesight of all the users so that they can see comfortably.

2.7.2 Health Issues

- While designing interaction we should keep in mind the probable consequences of the designs on user's health and safety.

- Physical position** : For users it should be possible to reach all the controls easily and visualize all displays.
- Temperature** : Extremes of hot or cold should be avoided as it affects the performance of user in excessive cases.
- Lighting** : Sufficient lighting should be facilities to allow users to visualize the screen of computer comfortably and without eyestrain.
- Noise** : Excessive noise can be dangerous to health; it causes user pain and in severe cases leads to loss of hearing.
- Time** : The time spent by users on the system should also be kept in the limit so to avoid strain.

2.7.3 The Use of Color

- It is ergonomics issue the effective use of color in displays should be seen. Distinct colors should be used in display as maximum as possible. To display critical information blue should not be used.
- Red color is easily noticeable so may be used for critical information. The colors should also resemble to common conventions. Conventions should not be dishonored without any good reason.
- Cultural associations awareness of the of color is predominantly important in designing the interaction systems and interactive websites for a global market.

Ergonomics and HCI

Ergonomic factors are well established in general and are so used as the foundation for standardizing designs of hardware.

Review Question

1. What is Ergonomics ? List and explain the various disciplines of Ergonomics.

SPPU : Oct.-19, Marks 5

2.8 Human Errors

- An air crash may give a hundred lives; an industrial accident gives millions of pounds' worth of damage. Disaster is inherent in the design or installation of the human interface. Bad interfaces are boring or give error while using it. Bad interfaces price money and price lives.
- We are not foolproof consistent creatures, but often make slips, errors and omissions. It is the nature of humans to do mistakes and systems should be created

to reduce the likelihood of those mistakes and to reduce the consequences when mistakes happen [Under stress, arcane or inconsistent interfaces will give errors.]

- You must understand the way human mistakes occur and create the rest of the interface accordingly.
- Human are having good capability of interpreting and manipulating information. We do mistakes sometimes serious and sometimes temporary inconvenience to us.
- There are many types of errors like familiar errors, incorrect understanding of model, situation, system.
- People use their own theories to understand the causal behavior of systems. This is called as mental models. These models have a number of characteristics. These models are partial most of the times, because the person cannot understand the working of whole system. Understanding may be unstable and changing. These mental models are inconsistent, unscientific and based on superstition. These models are based on an incorrect interpretation of the evidence.
- For example, user will be confused for electric switch board for multiple switches. Because, switches are not proper synchronize. It is not specified which button is to control tube light, fan or other equipment. Another example, lift button and lobby light button. Both should be different than each other, at least with good labels so user can understand the button for lift and lobby light.

2.9 Models of Interaction

The use of models of interaction helps us to understand precisely what is going on in the interaction and it also classifies the likely complications. Models of interactions also provide us the framework to associate different interaction styles and to identify interaction problems.

2.9.1 Interaction Terms

- Conventionally, the objective of an interactive system is to facilitate a user in achieving goals from various application domains. A domain comprises of concepts that highlight its significant aspects. Tasks are procedures to manipulate the ideas of a domain.
- A goal is the anticipated output from an accomplished task. The System and User are each explained by means of a language which can express the concepts that are relevant in the area of the application.

- The System's language may be referred as the core language and the User's language may be referred as the task language.
- The core language explains the computational features of the domain that are appropriate to the system state, task language explains psychological characteristics of the domain that are relevant to the User state.

2.9.2 The Execution - Evaluation Cycle

- Norman's model of interaction is most influential and referred model in Human-Computer Interaction. According to model the interactive process can be divided into two main phases: execution phase and evaluation phase. These phases then can further be subdivided into seven stages. Norman's model of interaction stages are as follows :
 1. Establishing the goal.
 2. Forming the intention.
 3. Specifying the action sequence.
 4. Executing the action.
 5. Perceiving the system state.
 6. Interpreting the system state.
 7. Evaluating the system state with respect to the goals and intentions.
- Norman illustrates this taking simple example of light switching to demonstrate the cycle. Visualize that a person is sitting reading as evening falls. Person decides that he needs more light; that is his establishment of the goal as to get more light.
- From there you/we form an objective to switch on the desk lamp and you/we postulate the actions to be executed. After executing the actions he should perceive the result as either the light is on or it is off and he interprets this. If the result is negative that means light does not come on, he should evaluate the fresh state in accordance to the earlier stated original goals as is there now adequate light ? If it is so, the cycle is assumed to be complete.
- If it goes wrong, he needs to frame a fresh intention to look for the switching of the main ceiling light. Here the language of the system is referred as the core language and the task language is referred as language of the user. It focuses exclusively on the user's interpretation of the interaction. It does not addresses the issue of dealing with the system's communication through the interface.

2.9.3 The Interaction Framework

- The interaction framework tries a more accurate description of interaction by incorporating system explicitly and it breaks into four key components as shown in Fig. 2.9.1, as the System, the User, the Input and the Output.

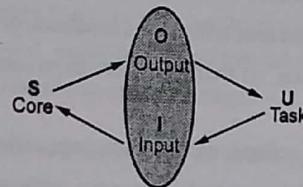


Fig. 2.9.1

- As the interface lies in between the System and the User, interactive cycle consists of four steps corresponds to a translation from one component to another component, as shown by the arcs with labels as shown in Fig. 2.9.2.

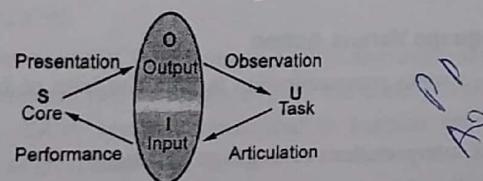


Fig. 2.9.2

- Translations included in the interaction are divided into four main parts :
 1. Articulation
 2. Performance
 3. Presentation and
 4. Observation
- The *input* are get converted to stimuli for the *system*. As a when a state transition has happened within the *System*, the interaction's execution phase is treated as complete and the evaluation phase initiates. The user necessity interprets the output to estimate what has occurred. The answer from the *output* is converted to stimuli for the *user* which activates the assessment. The interaction framework is represented as a means to evaluate the overall usability of a whole interactive system.

2.10 Paradigms for Interaction

Interactive system must be practical. The maker of an interactive system is presented with two questions :

1. How usability can be ensured while designing interactive system.
 2. How the usability of an interactive system can be confirmed or counted?
- One of the approach may be by answering these questions with example, in which successful interactive systems are usually believed to improve usability and that's why serve as paradigms for the growth of upcoming products.

2.10.1 Time Sharing

- The major advances in computing are due to introduction of new hardware technologies. The explosion of development in computing power would be lost if there was not a corresponding explosion of ideas about how to channelize that power.
- One of the key contributions to address this is new emphasis in research was time sharing concept. In time sharing a single computer is supported by multiple users.
- The computer states itself as a dedicated object with each user as individually and thus the increased output of information flow between user and computer system permissible the human to become a more responsive and natural collaborator. With the development of time sharing, human-computer interaction was now possible in real sense.

2.10.2 Video Display Units

- Display screens could offer a more appropriate medium than a paper printout to present huge quantities of strategic information for quick assimilation. In 1962 Ivan Sutherland a graduate student at the Massachusetts Institute of Technology (MIT), presented his *Sketchpad* program, that the abilities of visual images were realized.
- Sketchpad* demonstrated two important ideas.
 1. Computers might be used for more than just data processing.
 2. Sutherland's efforts proved how significant the contribution of one creative mind (coupled with a dogged determination to see the idea through) could be to the whole history of computing.

2.10.3 Programming Toolkits

- Douglas Engelbart's determination since the early 1950s was to use computer technology as a way of complementing human problem-solving activity.

Engelbart's impression as a graduate student at the University of California at Berkeley was to use the computer to teach humans.

- Many of the thoughts that Engelbart's team developed at the Augmentation Research Center - such as word processing and the mouse - only achieved mass commercial success decades after their creation.
- The power of programming toolkits is that minor, well-understood elements can be composed in fixed ways in order to generate larger tools. Once these larger tools become understood, they can remain to be composed with other tools and the process continues.

2.10.4 Personal Computing

- A graphics programming language for kids called LOGO. The inventor, Seymour Papert, desired to construct a language that was simple for children to use. He and his colleagues from MIT and elsewhere developed a computer-controlled mechanical turtle. That dragged a pen along a surface to trace its path.
- A child could easily make-believe they were 'inside' the turtle and direct it to trace out simple geometric shapes, such as a square or a circle. Alan Kay view of the upcoming computing was embodied in small, strong machines which were devoted to single users that are *personal computers*.

2.10.5 Window Systems and the WIMP Interface

- A personal computer system which motivates the user to progress in order through all of the responsibilities required to achieve some objective, from start to end without any diversions, does not relate to that standard working pattern.
- If the personal computer is to be an operational dialog partner, it must be as flexible in its capability to 'change the topic' as the human is. The *window* is the usual mechanism related with these physically and logically separate display spaces.

2.10.6 The Metaphor

- Metaphors are used quite effectively to teach new concepts in terms of ones which are previously understood. Metaphors are used to define the functionality of many interaction widgets, such as windows, menus, buttons and palettes. A more exciting example of metaphor occurs with *virtual reality systems*.

2.10.7 Direct Manipulation

Rapid feedback is just one attribute of the interaction method known as *direct manipulation*. Aspects of a direct manipulation interface are as below :

- Visibility of objects of interest
- Incremental act at the interface with rapid feedback on all actions
- Reversibility of all actions, so that users are motivated to discover without severe penalties
- Syntactic accuracy of all actions, so that each user action is a legal operation
- Replacement of difficult command languages with actions to operate directly the visible objects (and, hence, the name direct manipulation).
- The first actual commercial achievement which demonstrated the inherent usability of direct manipulation interfaces for the common public was the Macintosh personal computer.

2.10.8 Language Versus Action

The user - system communication is with the help of indirect language instead of direct actions.

Meaningful interpretations to language paradigm.

- 1) It needs that the user understands how the fundamental system functions and the interface as interlocutor require not perform much translation.
- 2) Interpretation doesn't need the user to know the underlying system's structure. The action and language parameters need not be completely separate.

2.10.9 Hypertext

- In 1945 an inventive and revolutionary information storage and retrieval apparatus - the memex - was constructed. The memex was fundamentally a desk with the capability to produce and store a massive amount of photographic copies of documented information.
- In accumulation to its huge storage capacity, the memex could keep track of links between parts of various documents.
- The linear layout for information does not offer much support for random and associated browsing task. Nelson coined the phrase hypertext in the mid-1960s to reflect non-linear text structure.

2.10.10 Multi-modality

- A *multi-modal* interactive system is a system that depends on the use of numerous human communication channels.
- Designers have required to mimic this flexibility in both articulation and observation by extending the input and output expressions an interactive system will support. Multi-modal, multimedia and virtual reality systems form a large core of current research in interactive system design.

2.10.11 Computer - Supported Cooperative Work

- It is interesting to consider that as computer networks became common; individuals retained their powerful workstations but now required to reconnect themselves to the remaining of the workstations in their immediate working environment and even throughout the world! One result of this rejoining was the development of collaboration between individuals via the computer - called computer-supported cooperative work, or CSCW.
- The main difference between CSCW systems and interactive systems intended for a single user is that designers can no longer neglect the society within which any single user operates. CSCW systems constructed to support users working in groups are referred to as *groupware*.

2.10.12 The World Wide Web

- The internet is a collection and network of computers each computer is linked data connection. Data connection may be of slow telephone line and modem or may be of optical connection of high bandwidth.
- A layer of network protocol (http) is used to build the web. A standard markup language (such as HTML) for laying and designing out web pages and a global naming scheme called as domain name system (uniform resource locators or URLs).
- Web pages may contain text and multimedia data like images, movies, sound. It may contain the hypertext links to other web pages so as to navigate through system.
- The web is one of the main reasons that new users are joining to the internet and is rapidly becoming a chief activity for people. The person may at work or it may use it for leisure.

2.10.13 Agent - based Interfaces

- Software agents represents on behalf of users inside the electronic world. Agents may perform monotonous tasks, watch and set the same time respond to events in the absence of user and even may learn from the user's own activities. Some agents simply follow the order. For example, many email systems permit you to make the rules for filters. Now a days Agents may use artificial intelligence techniques to understand user's actions and learn from it.

2.10.14 Ubiquitous Computing

- Ubiquitous computing is new area of research. Alternative popular term for this developing paradigm is pervasive computing, the word pervasive computing was coined by IBM. The intention is to make a computing infrastructure that permits physical environment so much that we do not see the computer any in future.
- Many technologies are converging so as to make the dream of ubiquitous computing come true. These technologies consists of wireless networking, camera and vision systems, voice recognition, pen-based computing and positioning systems

2.10.15 Sensor - based and Context - aware Interaction

- There are a growing number of projected and existing technologies that enrich computation even deeper and can be used into day-to-day life. We may think through the extreme situation where the user is totally not aware of interaction which taking place. Information may be collected from sensors in the around.
- The implied nature of interaction understood by sensing creates a human-computer association that becomes so smooth there is no sensible interaction at all.

Review Questions

- How does making a call differs when using : i) Cell phone ii) Smart phone ? Consider the kinds of user, type of activity and context of use.
- Explain following WIMP interface elements with respect to any text editor.
Icons
Menus
Toolbars
Dialog boxes

SPPU : Dec.-19, End Sem, Marks 5

SPPU : Oct.-19, In Sem, Marks 5

2.11 Interaction Styles

Following are a common interface styles which includes :

- Command line interface
- Menus
- Natural language
- Question/answer and query dialog
- Form-fills and spreadsheets
- WIMP
- Point and click
- Three-dimensional interfaces.

C
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P

2.11.1 Command Line Interface

- It is one of the ways of giving instructions directly to the computer; Instructions can be given using function keys or single characters. Abbreviations or whole-word commands can be also used. They are very powerful as it provides direct access to functionality of the system.
- They are also very flexible. This flexibility and power sometimes leads to difficulty in use and learning. This is the reason that these types of interfaces are better for expert users than for new users.

2.11.2 Menus

- The set of choices accessible to the user is displayed on the screen and user can select using the mouse, alphabetic keys or numeric keys.
- It basically relies on recognition. It does not rely on recall. Often hierarchically order is followed in menu design due to this option required is not accessible at the higher layer of the hierarchy.

2.11.3 Natural Language

- Natural language understanding is the subject of interest and research in computer which includes both speech and written input, unfortunately it becomes very difficult to address due to ambiguity of natural language.
- It makes very difficult for a machine to understand the natural language. Although a sentence's structure is clear, you may find ambiguity while drawing the meaning of the words used.

- Apple is very good. From this sentence it is not clear that it tells about brand or fruit. Then also use of natural language in some restricted domains is comparatively successful.

2.11.4 Question/Answer and Query Dialog

- The user is presented a series of questions consisting of mainly with yes/no responses, multiple choice, or codes. This leads through the interaction one by one step.
- These type interfaces are very easy to understand and learn and may be used for new users or casual users. Query languages are the example of this interaction.
- It requires exact syntax and good knowledge of the database structure. Hence using this technique becomes tedious and complex when multiple attributes are included. A specialized example of this interaction is the web search engine.

2.11.5 Form-Fills and Spreadsheets

- In data retrieval applications form-filling interfaces are very useful. The user is asked to fill form which resembling a paper form on display with slots to fill in. Many times the form display is designed by following actual form with which the user is interacted earlier.
- It makes easier to use interface. Primarily for data entry applications this interaction style is useful. It is easy to learn and use for learner.
- However, considering a design which allows flexible entry, it is also appropriate for expert users in some cases. Spreadsheets are variation of form filling in a sophisticated way.
- These types of interface more flexible and natural and form filling we observe from very early age.

2.11.6 The WIMP Interface

- WIMP is the short form for windows, icons, menus and pointers. WIMP interfaces is followed by many systems including MacOS, Microsoft Windows, X Windows.

2.11.7 Point-and-Click Interfaces

- This style is closely related to the WIMP style. All actions virtually take only a single click. The philosophy it is simpler and more closely refers the ideas of hypertext.

2.11.8 Three-Dimensional Interfaces

- Three-dimensional effects are newly presented in user interfaces design. The simplest technique may be ordinary WIMP elements includes buttons, scroll bars, etc., these are given a 3D appearance using shading. A more multifaceted technique uses interfaces with 3D workstations.
- As objects get away further they take up fewer screen space. Virtual reality and information visualization systems are their in which user can move within a computer-generated 3D world.

Review Questions

- Describe briefly four different interactions styles used to accommodate the dialog between user and computer, Specify advantages and disadvantages of each interaction style ?
SPPU : May-19, End Sem, Marks 6
- How does making a call differs when using : i) Cell phone ii) Smart phone ? Consider the kinds of user, type of activity and context of use.
SPPU : Dec.-19, End Sem, Marks 5
- Describe briefly five different interactions styles used to accommodate the dialog between user and computer.
SPPU : Oct.-19, In Sem, Marks 4
- Explain following WIMP interface elements with respect to any text editor.
Icons
Menus
Toolbars
Dialog boxes
SPPU : Oct.-19, In Sem, Marks 5

2.12 Interactivity

- Looking at an interface, it is simple to concentrate on the visually different parts but the dynamics, the way they respond to a user's actions, are less obvious. It is usually not used at a granular level of detail and purposely ignores the 'semantic' level of an interface. Users must interact with visualization in real time, altering parameters and looking the effect. Interactivity is essential in determining the 'feel' of a WIMP environment.
- In previous computer systems, the sequence of interaction was mainly determined by the machine. Application will not permit you to do something else until the dialog box has been accomplished or cancelled. Particularly annoying example is when the dialog box asks a question, perhaps only for confirmation of an action, but the information you want to answer is hidden by the dialog box! One must minimize the use of pre-emptive components, permitting the user full flexibility.

- Capability to detect and correct is vital both at the small scale of button presses and keystrokes and also at the large scale.

2.13 The Context of the Interaction

- Physical aspects in the environment can directly impact the quality of the interaction. This is part of the context in which the interaction takes place. The existence of other people in a work atmosphere affects the performance of the worker in any task.
- However, when it comes to acquirement of new skills, the existence of these groups can affect performance owing to the fear of failure. Consequently, privacy is essential to allow users the opportunity to experiment.
- If a system makes it hard for the user to execute necessary tasks, or is annoying to use, the user's job satisfaction and subsequently performance, will be impacted.
- The system introduced may therefore enforce a way of working that is disappointing to the users. If this occurs there may be three results:
 - The system is rejected
 - The user is resentful and unmotivated,
 - The user adapts the intended interaction to his own requirements.
- On the other hand, the introduction of new technology may prove to be a motivation to users. Providing appropriate and relevant feedback is an imperative source of motivation for users. If system delays occur, feedback can be used to avoid frustration on the part of the user.

2.14 User Experience

- It is not enough that people can use a system; they should want to use it.
- Experiential features of interaction are as below.

2.14.1 Understanding Experience

- Experience is a hard thing to pin down. If you do something that you are aware of you can do it is not engaging; you can do it automatically while thinking of something else, or you may simply become bored.
- Alternatively, if you do something totally outside your abilities you may become anxious and, if you are half way up a rock face, afraid. Flow comes when you are shaking at the edge of your abilities, stretching yourself to or a slight beyond your limits.

2.14.2 Designing Experience

- If we consider the example design of virtual Christmas crackers. These are somewhat like electronic greetings cards, but are based on crackers. The virtual cracker does not crack to fully replicate each feature of the physical phenomena and process of pulling the cracker, otherwise seeks to reproduce the experience. Table 2.14.1 shows the features of the experience deconstructed and reconstructed in the virtual cracker.

Table 2.14.1 The crackers experience

	Real cracker	Virtual cracker
Surface elements	---	—
Design	Cheap and cheerful	Simple page/graphics
Play	Plastic toy and joke	Web toy and joke
Dressing up	Paper hat	Mask to cut out
Experienced effects	---	—
Shared	Offered to another	Sent by email, message
Co-experience	Pulled together	Sender can't see content until opened by recipient
Excitement	Cultural connotations	Recruited expectation
Hidderness	Contents inside	First page – no contents
Suspense	Pulling cracker	Slow... page change
Surprise	Bang (when it works)	WAV file (when it works)

2.14.3 Physical Design and Engagement

Certain physical interfaces were suitable for various contexts. Designers came across with many limitations.

- Ergonomic : You cannot physically push buttons if they are too small or too close.
- Physical : The nature or size of the device may force certain positions or styles of control.

- Legal and safety : Cooker controls must be sufficient from the pans that you do not burn yourself, but also sufficient to restrict small children turning them on.
 - Context and environment : Plastic controls for an easy clean microwave.
 - Aesthetic : The controls must look decent.
 - Economic : It must not costly.
- These constraints are many times contradictory and need trade-offs to be made.

2.14.4 Managing Value

- If we need people to want to use a device or application we require to understand their personal values. Their personal values, if we ask somebody to do something or use something they are only likely to do it if the value to them surpasses the cost.
- This is difficult by the fact that for many systems the costs such as acquisition cost, download time of a free application, learning effort are experienced up front, whereas often the returns - faster work, enjoyment of use - are seen later.
- We must know people's value systems, but we must be capable to deal gains sooner as well as later or at least produce a very decent demonstration of possible future gains so that they have a perceived present value.

2.15 Multiple Choice Questions

Q.1 The photoreceptors of eyes that allows color vision are called _____.

- a rods b lens
 c cones d cones

Q.2 Generally, the computer input in human computer interaction is _____.

- a computer output b computer input
 c user input d user output

Q.3 Knowing the grass is green is the example of _____.

- a episodic memory b iconic memory
 c semantic memory d sensory memory

Q.4 Iconic Memory is related with _____.

- a sight b hearing
 c touch d smell