HUMAN COMPUTER INTERACTION

HCI – design, implementation, evaluation of interactive systems.
User – Computer – System – Interaction.

Model Human Processor

- Perceptual system – Sensory stimulus
- Motor system – Controls the actions
- Cognitive system – Provides processing to join ^

Also includes principles of operation.

I/O channels

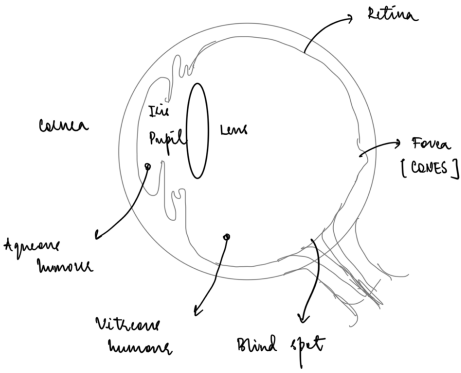
└ sight, Hearing & Touch

Effectors : fingers, limbs, eyes, head and vocal system.

→ VISION

Visual perception

Physical reception of stimulus — Processing & interpretation



Fovea → Concentration of cones [colour photoreceptors]

Retina → Ganglion cells [specialized nerve cells]

X cells : Pattern recognition
Y cells : movement Recognition

Visual acuity – ability to perceive visual detail.

Luminance – amount of light emitted by obj.
Measured w/ a photometer.

Luminance ∝ visual acuity
★ Negative contrast ∝ luminance ∝ flicker

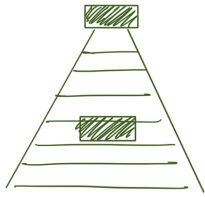
Components of colour — Hue
Intensity
Saturation

Visual Cues

1. Perceiving size & depth
2. Perceiving brightness
3. Perceiving colour.

Muller Lyer illusion: which line is longer?

Ponzo illusion: are they the same size?



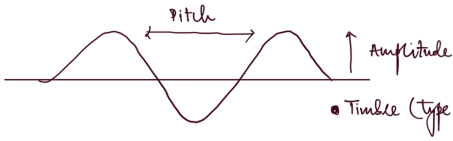
Saccade – fixation – Saccade – Regression

HEARING

Pinna
Auditory canal — Outer Ear

Tympanic membrane
Cochlea – cilia — Middle ear

Ossicles — Inner ear



Cocktail party effect ⟶ selective hearing

TOUCH – Haptic perception

Sensory receptors –

1. Thermoreceptors : temperatures
2. Nociceptors : intense pressure | heat | pain
3. Mechanoreceptors : pressure
   - Slowly adapting
   - Rapidly adapting

Kinesthesis : receptors in joints.

Fitts law for movement time:

$$a + b \log_2 (\text{distance} / \text{size} + 1)$$

MEMORY

- Sensory memory buffers
  - Iconic
  - Echoic
  - Haptic
- Short Term memory
  - Chunking
  - Recency effect
- Long Term memory
  - Episodic
  - Semantic

Total time hypothesis – Amount learned ∝ Amount of time spent learning

Distribution of practice effect – Learning time is most effective if distributed over time

Theories of forgetting
- Decay
  - Jost's law: If 2 memory traces are equally strong at a given time, the older one will be more durable.
- Interference
  - Retroactive interference
  - Proactive inhibition

REASONING

1. Deductive

Derives logically necessary conclusion from given premises

2. Inductive

Generalizing from cases we have seen to infer new cases.

3. Abductive

Reasons from a fact to the action / state that caused it.

PROBLEM SOLVING

① Gestalt Theory

Problem solving is both productive & reproductive.

insight & experience

② Problem Space theory

Newell & Simon.

Problem space comprises of problem states.

Generate problem states using legal state transition operators

Use heuristics to select appropriate operators.

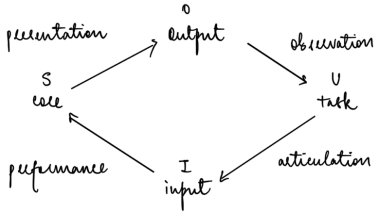
NORMAN'S MODEL OF INTERACTION

1. Establish the goal
2. Forming the intention
3. Specifying action sequence
4. Executing action state
5. Perceiving system state
6. Interpreting system state
7. Evaluating system state wrt goals & intentions.

System language — Core language

User language — Task language

Gulf of execution & evaluation



Grouping of controls:

1. Functional
2. Sequential
3. Frequency

Types of Cognitive models –

1. Hierarchical rep. of user's task & goal str.
2. Linguistic and grammatical models

3. Physical and Device level models

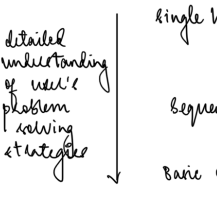
GOMS

→ Goals : Goals represent memory point → evaluate what should be done next.

→ Operators: Lowest level of analysis. Basic actions the user must perform to access the system.

→ Methods : Goal decomposition

→ Selection: Depends on the particular user and state of the system.



Analysis of goal structure yields measures of performance

Stacking depth of goal structure is used to estimate short term memory requirements

PROBLEM SPACE MODEL

1. Goal formulation
2. Operation selection
3. Operation application
4. Goal completion.

STAKEHOLDERS

Anyone who is affected by the success / failure of a system

- Primary - End users who use the system
- Secondary - Provide input / receive output to & from the system.
- Tertiary - Directly affected by success / failure.
- Facilitating stakeholders - design, development, maintenance.

APPROACHES OF MANAGEMENT

1) Management by presence
2) Management by objectives.

★ Presence increases perceived worth.

SOCIOTECHNICAL APPROACH

1. The problem being addressed
What problem does the technology intend to solve?
2. The stakeholders affected together w/ goals & tasks
3. The workgroups within the organization, both formal & informal.
4. The changes or transformations that will be supported.
5. The proposed technology & how it works within the organization.
6. External constraints, influences, performance measures.

USTOM Methodology

- Based on USTM [User skills & Task match] approach

- Applied at initial stage of design when product opportunity has been identified so that the emphasis is on capturing requirements.

1. Describe organizational context primary goals, physical characteristics, economic bg.
2. Identify and describe stakeholders
3. Identify and describe work groups
4. Identify and describe task object pairs
5. Identify stakeholder needs
6. Consolidate and check stakeholder requirements

OSTA Methodology

1. Primary task which technology must support is described in terms of users goals.
2. Identify task inputs
3. Describe external environment
4. Transformation processes are described in terms of actions performed on with objects.
5. Social system is analysed (work groups & relationships)
6. Technical system is described.
7. Performance satisfaction criteria is established.
8. New technical system is specified.

DFDs & textual descriptions.

PARTICIPATORY DESIGN

- Makes design context on work oriented rather than system oriented.
- Characterised by collaboration
- Iterative process.

Brainstorming

Storyboarding

Workshops

Pencil & paper activities

ETHICS – Effective Technical and Human Implementation of Computer based systems

– Consultative

– Representative

– Consensus

by Enid Mumford

TASK ANALYSIS

Study of the way people perform tasks with existing systems

1. Task Decomposition
2. Knowledge based techniques
3. Entity relation based analysis

→ HTA – Hierarchical Task Analysis

P x C rule : P → probability C → cost (mistake)

→ Knowledge based Task Analysis

1. List all objects & actions

2. Build TAXONOMIES of them.

TAKD – Task Analysis for Knowledge Description

TDH – Task Description Hierarchy.

TAKD – uniqueness property: TDH can distinguish 2 specific objects.

/ | \

AND XOR OR

KAG – Knowledge Representation Grammar

Each object is represented by a unique path in hierarchy

DIALOGUE – completeness & determinism

A conversation between two or more entities

Structure of the conversation b/w human & comp.

1.	Lexical	Shape of icons keys pressed	sounds spellings
2.	Syntactic	Order of i/o Structure of i/o	grammar
3.	Semantic	Meaning of DSA	meaning

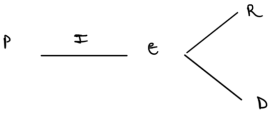
STNs – State Transition Networks
– Used for dialogue description

Petri Nets – Graphical formalism designed for reasoning about concurrent activities.
– Counters and toggles
– Interactive Cooperative Objects [ICO]

WYSIWYG – Observability
Predictability
Reachability
Undo

PIE model – Black box model
Program Interpretation Effect

L Diff. b/w ephemeral displays / permanent results



Init : state transition function

Init : $E \times P \longrightarrow E$

SEA – Status Event Analysis – Used to understand the interplay b/w more instantaneous events and more continuous phenomena.

GROUPWARE

- where and when
- information shared
- co-operation aspects supported

HCI – psychology computing

CSCW – sociology computing

	same time	diff time
	synchronous	asynchronous
same place collocated	shared table	public displays
diff place remote	video call figma	invite blog

TIME – SPACE MATRIX

CMC – Computer Mediated Communication

ISDN – Integrated Service Digital Network

SMS – Structured message systems.

U2

Main approaches to prototyping –

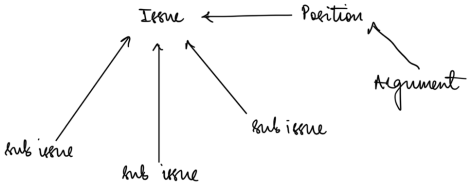
- Throwaway
- Incremental
- Evolutionary

DESIGN RATIONALE

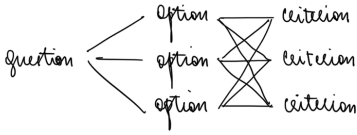
Information that explains why a computer system is the way it is, including structural and functional descriptions.

- Process oriented design rationale
  integrated within the design process.
- Structure oriented design rationale

(i) IBIS – Issue Based Information System
  - hierarchical structure
  - root issue identified
  - potential resolutions are depicted as descendants



(ii) Design space analysis
  - goc notation – Questions, Options, Criteria



(iii) Decision representation knowledge
  Decision problem, alternatives, goals
    goc – sparse language – insufficient

(iv) Psychological Design rationale
  Task – Artifact cycle

DESIGN RULES — Authority – Generality

Standards & principles

Principles
- Learnability
  - Predictability
  - Synthesizability
  - Familiarity
  - Generalizability
  - Consistency
- Flexibility
- Robustness

ISO Standard 9241

Usability — Metrics

- Effectiveness — Suitability for task, Appropriate
- Efficiency — Learnability
- Satisfaction — Error tolerance

SCHNEIDERMAN'S 8 GOLDEN RULES

1. Strive for consistency in action sequence, layouts and terminologies
2. Enable frequent users to use shortcut
3. Offer informative feedback
4. Design to yield closure
5. Offer error prevention & simple error handling
6. Permit easy reversal of actions
7. Support internal locus of control
8. Reduce short term memory load

SSM – Soft Systems Methodology

- Clients — Receive output / benefit from system
- Actors — Perform activities within system
- Transformations — Changes effected by the system
- Weltanschauung — How the system is perceived
- Owners — Authorize changes to the system
- Environment — world in which system operates.