Human Computer Interaction

Lecture 3:
Interactive system design:
Usability Engineering

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Overview

UE

Usability Engineering

Outline of Usability Engineering

- The need for usability
- What do usability and UE mean?
- What happens without UE?
- UE lifecycle
- User-Centered Design Methodology (UCD)

Usability Engineering

• Jacob Nielsen: Usability Engineering (1993) Well known book.

• Xristine Faulkner (2000): defines it as follows

"UE is an approach to the <u>development of software</u> <u>and</u> <u>systems which involves user participation</u> from the outset and guarantees the usefulness of the product through the use of a **<u>usability specification</u>** <u>and</u> **<u>metrics.</u>**"

➢ UE thus refers to the USABILITY FUNCTION aspects of the entire **process** of conceptualising, executing & testing products (both hardware as well as software), from requirements gathering stage to installation / marketing & testing of their use.

Definition of usability

- **The extent to which a product can be used by specified users to achieved specified goals with effectiveness, efficiency and satisfaction in a specified context of use where,**
  - ➢ **Effectiveness** is the accuracy and completeness with which specified users can achieve specified goals in particular environments;
  - ➢ **Efficiency** is the resources expended in relation to the accuracy and completeness of goals achieved;
  - ➢ **Satisfaction** is the comfort (experience) and acceptability of the work system to its users and other people affected by its use.

User's Definition of Usability

USABILITY : The ability of a User to Use the product/ system / environment as desired Usability Engineering: The 'affordance' offered by a product that makes it usable.

Usability does not happen by it self. It has to be "engineered" into the product.

Usability is related to Human performance { Capabilities
Limits
Consequences }

Intuitiveness

Maximum success for first-time users, with minimum training, explanation or thought

Efficiency

Maximum success for long-term users, with minimum time, mental load, physical effort

Usability is conceptualised into the product by **DESIGN**

Usability has three major components in Design

Appearance
Visual Quality

Technology
Build Quality

DESIGN

Interaction
Use Quality

Definitions ....

➢ '**Usability**' **is the measure of the** *quality* **of a** <u>User's experience</u> **when interacting with a product or system**

➢ '**Usability Engineering**' **is the processes of deriving, specifying, measuring, constructing and evaluating** <u>usability features</u> **into products and systems.**

➢ **Usability Study is the systematic analysis based on heuristics and/or experimental evaluation of the interaction between people and the products including the environment of use.**
Psychology/ Cognitive Sc/ Behavioral Sc

➢ **Usability Testing is the scientific verification of the specified usability parameters with respect to the Users needs, capabilities, expectations, safety & satisfaction.**

Usability as applied to Product Design
Usability as applied to Human Computer Interaction   Usability as applied to Human Environment Interaction
Usability as applied to Systems (including Engineering systems)

The UE lifecycle

SYSTEM LIFE CYCLE						
FEASIBILITY		REQUIREMENTS		DESIGN	IMPLEMENT	RELEASE
USER REQs	CONTEXT OF USE	FUNCTIONAL	TECHNICAL	PROTOTYPE	USEABILITY TESTING	FEEDBACK

Design Stages

Task	Information produced
Knowing the user	User characteristics, User background
Knowing the task	User's current task, Task analysis
User requirements	User requirements specification
Setting usability goals	Usability specification
Design process	Design Specification
HCI Guidelines & heuristic analysis	Feedback for design iteration
Prototyping	Prototype for user testing
Evaluation with users	Feedback for freezing design
Redesign and evaluate with users	Finished product
Evaluate with users and report	Feedback on product for future systems

The goals of Usability Engineering

5 Es

- Effective to use   - **Functional**
- Efficient to use   - **Efficient**
- Error free in use   - **Safe**
- Easy to use   - **Friendly**
- Enjoyable in use   - **Pleasurable Experience**

Achieves 5 times Enhancement in Engineering value.

User Requirement Analysis

USER CENTRED DESIGN PROCESS

Conceptual design

Implementation

Usability Evaluation & Testing

- UE is based on a **User-Centered Design (UCD)** approach to analysis and design. It concentrates on those aspects of products & services that have a bearing on their effective, efficient & pleasurable USE by humans.

Programmer

Developer

Interface Designer

IT Engg

Marketer

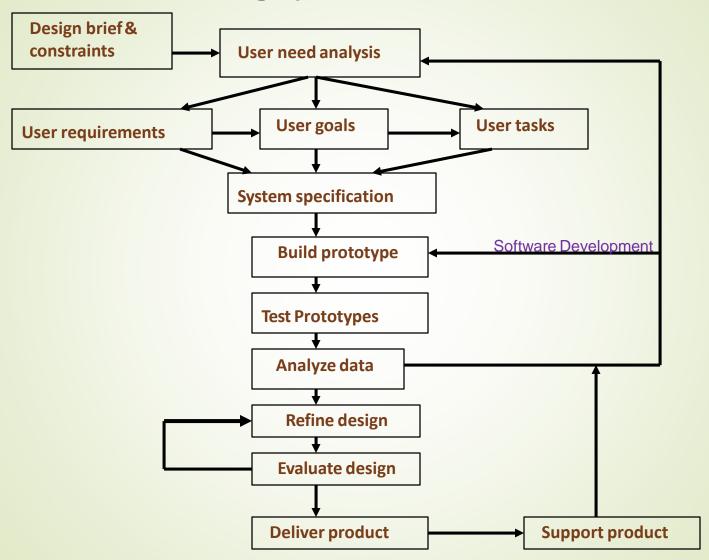User

ISO 13407, 1999

"Human-centered design is an approach to interactive system development that focuses specifically on making systems usable.
It is a multi-disciplinary activity."

The UCD Methodology.
User centered design processes : UCD

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┌─────────────────┐          ┌─────────────────────┐
│ Design brief &  │ ───────▶ │  User need analysis  │ ◀──────────┐
│ constraints     │          └─────────────────────┘            │
└─────────────────┘              │      │      │                 │
                         ┌───────┘      │      └───────┐         │
                         ▼              ▼              ▼         │
┌──────────────────┐   ┌─────────────┐   ┌─────────────┐        │
│ User requirements│──▶│  User goals │   │  User tasks │        │
└──────────────────┘   └─────────────┘   └─────────────┘        │
             └────────┐      │      ┌──────────┘                │
                      ▼      ▼      ▼                           │
              ┌─────────────────────────┐                      │
              │  System specification   │                      │
              └─────────────────────────┘                      │
                         │                                     │
                         ▼                  Software Development│
              ┌─────────────────┐ ◀──────────────────          │
              │  Build prototype │                              │
              └─────────────────┘                              │
                         │                                     │
                         ▼                                     │
              ┌─────────────────┐                              │
              │  Test Prototypes │                              │
              └─────────────────┘                              │
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              ┌─────────────────┐ ─────────────────────────────┘
              │  Analyze data   │
              └─────────────────┘
                         │                          ▲
                         ▼                          │
              ┌─────────────────┐                   │
        ┌────▶│  Refine design  │                   │
        │     └─────────────────┘                   │
        │                │                          │
        │                ▼                          │
        │     ┌─────────────────┐                   │
        └─────│  Evaluate design│                   │
              └─────────────────┘                   │
                         │                          │
                         ▼                          │
              ┌─────────────────┐    ┌──────────────────────┐
              │  Deliver product │──▶│   Support product    │
              └─────────────────┘    └──────────────────────┘
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Definition of UE & other Related fields

HCI : Human Computer Interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. *ACM - Association for Computing Machinery.*

Human Factors & Ergonomics : Stress on human physical issues (physiology) and on optimising work processes
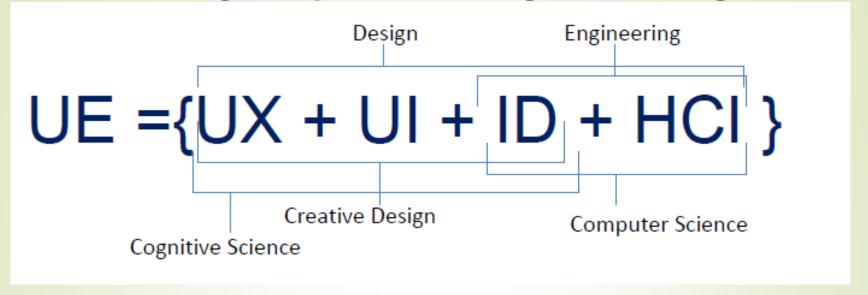
User Interface Design: Focuses on interface layer assuming all deeper functions are fixed.

HCD- Human Centered Design: Approaches to software engineering with user focus at all stages of software design

ID – Interaction Design : wider scope in terms of devices beyond computers. More emphasis on cognitive & experiential factors.

UE- Usability engineering focuses on design & implementation processes. It is essentially research & design based activity .
There are overlaps in the above fields. Each is independent. UE has all of them.

Relationship between UE & Human Computer Interaction; Interaction Design; Experience Design; GUI Design

- ➤ UX = User Experience
- ➤ UI = User Interface
- ➤ ID = Interaction design
- ➤ HCI= Human Computer Interaction
- ➤ UE = Usability Engineering

UE vs Software Engineering

➢ Key difference (Karat and Dayton, 1995):

"In most cases of the design and development of commercial software, <u>usability is not</u> dealt with at the same level as other aspects of SE, (e.g.

- Clear **usability objectives** are not set; and
- Resources for appropriate activities are not given priority by project management)."

- To produce *usable* interactive products requires (Mayhew, 1999):
  - **UI design principles** and guidelines.
  - **Structured methods** for achieving usability.

Usability Testing & UE – the difference

Usability engineering

- Methodical approach to producing user interface + Experience + function + aesthetics
- A way to deliver a product that works

Usability Testing

- Part of process of UE
- Real users performing real tasks

Usability Testing

- **Analytical evaluation:**
  - ➢ By simulating *how* the user's activity will be performed.
  - ➢ Heuristic evaluation measures design against a list of usability factors.

- **Empirical evaluation:**
  - ➢ By building and testing a *prototype*.
  - ➢ Formal usability testing tests a component of the design under controlled conditions - actual users.
  - ➢ Formal usability testing requires a usability laboratory.

Cost-justifying usability

$1 spent on usability = $10 saved (Nielsen, 1993).

Rs. 50 spent saves Rs 500 worth of trouble shooting due to poor design

Ignoring UE ....
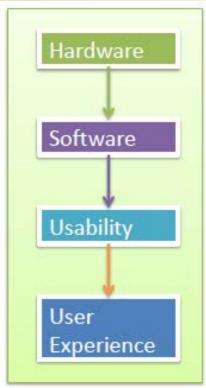
Frustrated users
Low productivity
   Poor user interface design is the cause
High costs
Support/Help desk costs *Entering data incorrectly Deleting data Loss of market share , good will Competitors rush in.*

Mobile / Tablet / Device companies now are heavily investing in UE as the value adder as well as product differentiator.

They do not consider 'cost' as a constraining factor as far as UE is concerned.

Evolution of HCI and understanding of Users

Hardware → **Software** → **Usability** → **User Experience**

- User as 'cog' in the system – (1970's)
- User a source of error (80's),
- User a social actor (90's)
- User as a consumer now (2000's)

Previous approaches are insufficient

- When user is a consumer, his needs to be understood in order for the product to stay in the market….

- User experience with interactive products start determining which ones will sell.

The UE processes is based on **four fundamental axioms of Design**

- **User is the only constant entity of an artificially created system.**
- **User is the starting point of all design**
- **User is the final datum of reference for all design decisions**
- **User is the measure of all things**.

Nielsen (1993) identified five attributes that contribute to usability:

•**Learnability**. The user should be able to promptly start performing their tasks with the system.

•**Efficiency**. Once the user has learned the system, a high level of productivity should be possible.

•**Memorability.** The casual user should be able to return to the system after not having used it for some time, without having to relearn everything.

•**Errors.** Users should not make many errors using the system, and if they do, they should be able to easily recover from them. Catastrophic errors should not occur.

•**Satisfaction.** Users should like using the system and should be subjectively satisfied when using it. The system should be pleasant to use.

PRINCIPLES TO SUPPORT USABILITY

The principles we present are first divided into three main categories:

➢ **Learnability** – the ease with which new users can begin effective interaction and achieve maximal performance.

➢ **Flexibility** – the multiplicity of ways in which the user and system exchange information.

➢ **Robustness** – the level of support provided to the user in determining successful achievement and assessment of goals.

We will subdivide these main categories into more specific principles that support them.

- **Learnability:**
  - ➤ **Predictability:** It makes use of the user past knowledge of interacting with a similar system to ease the new system interaction.

  - ➤ **Synthesizability:** Synthesizability the ability of the user to assess the effect of past operations on the current state.

  - ➤ **Familiarity:** The principle of familiarity is to make use of the new users past experience with other applications.

  - ➤ **Generalization:** Generalizability can be seen as a form of consistency.

  - ➤ **Consistancy:** Consistency relates to the similarities in behavior arising from alike situations or alike task objectives.

- **Flexibility:**
  - ➤ **Dialog Initiative:** There is two ways to achieve that. One of them is User pre-emptive. In this communication model, the user is the one to initiate an action on the system.

  - ➤ **Multithreading:** It is the ability to support more than one task of the user system dialog interaction at a time.

  - ➤ **Task Migratability:** Task migratability is the ability to transfer the control for task execution between system and user.

  - ➤ **Substitutivity:** It requires that equivalent values can be substituted for each other.

  - ➤ **Customizability:** It refers to the modifiability of the user interface by the user or the system.

- **Robustness:**
  - ➤ **Observability:** Observability allows the user to evaluate the internal state of the system by means of its perceivable representation at the interface. It is further broken down into five other principles:
    - ▪ **Browsability**
    - ▪ **Default**
    - ▪ **Reachability**
    - ▪ **Persistance**
    - ▪ **Task Performance**

  - ➤ **Recoverability:** It is the ability of a system to recover in case of an error.

  - ➤ **Rsponsiveness:** Responsiveness deals with the time needed for the system to communicate with the user.

  - ➤ **Task Conformance:** Task conference ensure that the system allows a user to perform task he needs and in an expecting way.

Digging Deeper into Usability

● **Learnability**   ● **Effectiveness**   ● **Attitude**   ● **Flexibility** ● **Compatibility**

Learnability : A product/system should allow users to reach acceptable levels
of competency /performance within a specified time.

Learnability	**- Help the users to master the system**
Consistency	**- Let the users have to learn only once**
Familiarity	**- Build on users' prior knowledge**
Standards	**- Respect established cultural and**
	- application specific conventions .
Self-descriptiveness	**- Make objects and controls intuitive**
Help	**- Provide easy access to 'help' resource**

**'Intuitive' User Interfaces do not require investing resources in 'Learning'.
Such interfaces follow the User's Mental Model of Interaction**

Assignment

Usability Evaluation

Conduct a quick Usability evaluation of your mobile phone &
Compare it with the evaluation of your friends phone.

Effective to use	- Functional	Rating out of 10	
Efficient to use	- Efficient		
Error free in use	- Safe		
Easy to use	- Friendly		
Enjoyable in use	- Pleasurable		
	Total :		