Human Computer Interaction
- An Introduction

Dr. Pradeep Yammiyavar
Professor,
Dept. of Design,
IIT Guwahati,
Assam, India

Dr. Samit Bhattacharya
Assistant Professor,
Dept. of Computer Science
and Engineering,
IIT Guwahati, Assam, India

Indian Institute of Technology Guwahati

Module 4:
Guidelines in HCI

Lecture 3:

Norman's Model of Interaction

Dr. Pradeep Yammiyavar

Introduction

Let us first understand the word " INTERACTION"

All man-made objects offer the possibility for interaction.

When an object is designed for a purpose (function) it affords interaction. Interaction is a way of framing the relationship between people and objects designed for them.

Interaction is thus a way of framing the relationship between the object & User.

All Design activities can be viewed as design for interaction. In fact not only objects but space & messages (communication) too involve interaction. Interaction is a key aspect of function, and function is a key aspect of design.

However often one notices that designers often use the word 'INTERACTION' rather carelessly .

Untrained Designers often tend to confuse 'Interaction' with ' Reaction'.

For example: Designers claim to be designing " Interactive web pages".

The fact is clicking on links to navigate to a new webpage is NOT " INTERACTION".
It is 'reaction' of input by the hyperlinked pages. The computer is automatically reacting to input because it has been programmed to do so.
This programmed action couples ' input' to ' output' in a fixed way.

Interaction is however a dynamic action that through a dialogue (involving feed back) adjusts to input and gives appropriate output.

In HCI - the feed back loop model of interaction treats a person as closely coupled with a dynamic system.
In HCI - Interaction is simply stated as two way communication between

USER ⟷ **SYSTEM**
(computer /device /object/ cyberspace)
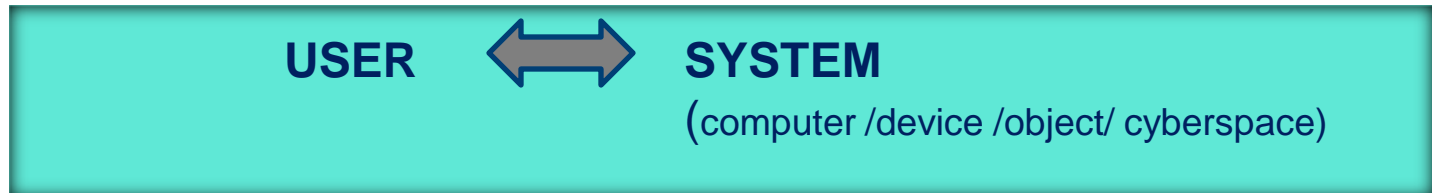
It should however be noted that due to the human complex cognitive system , representing interaction between a person and a dynamic system as a simple feedback loop can only be a good first approximation.

Definitions of some Terms of Interaction

Domain: expertise, knowledge in some real world Activity. In GUI domain concepts such as geometric shape, colour, Symbols etc are involved.

Task: operation to manipulate concepts in a domain.

Goal: desired output from a performed task. Ex in GUI: A button

Intention: specific action required to meet the goal

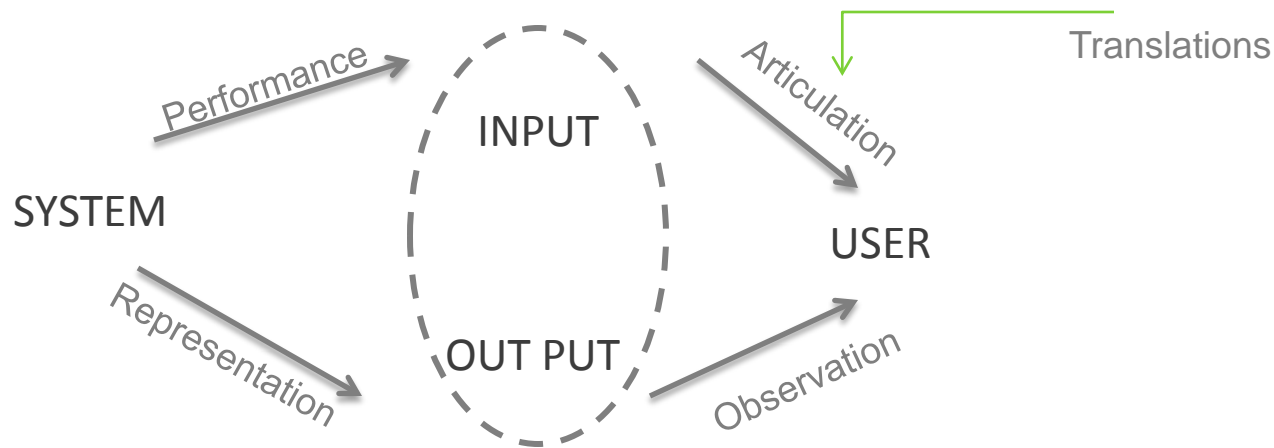**Task analysis: Study of the problem space**

In HCI interaction models are translations between user and system
There are different Interaction Models mentioned in HCI

- Donald Norman's Interaction Model
- Abowd & Beale's model

A generalised Interaction Model (from Dix et al) has four components:
(i) System;   (ii) User;   (iii) Input &   (iv) Output.

SYSTEM

Performance

INPUT

Articulation

Translations

USER

Representation

OUT PUT

Observation

There are different Interaction Styles (nature of the dialogue)

And there are different Interaction Contexts
(Social, Organizational, Educational, Commercial etc)

We will discuss Donald Norman's Interaction Model

Norman's Model of Interaction

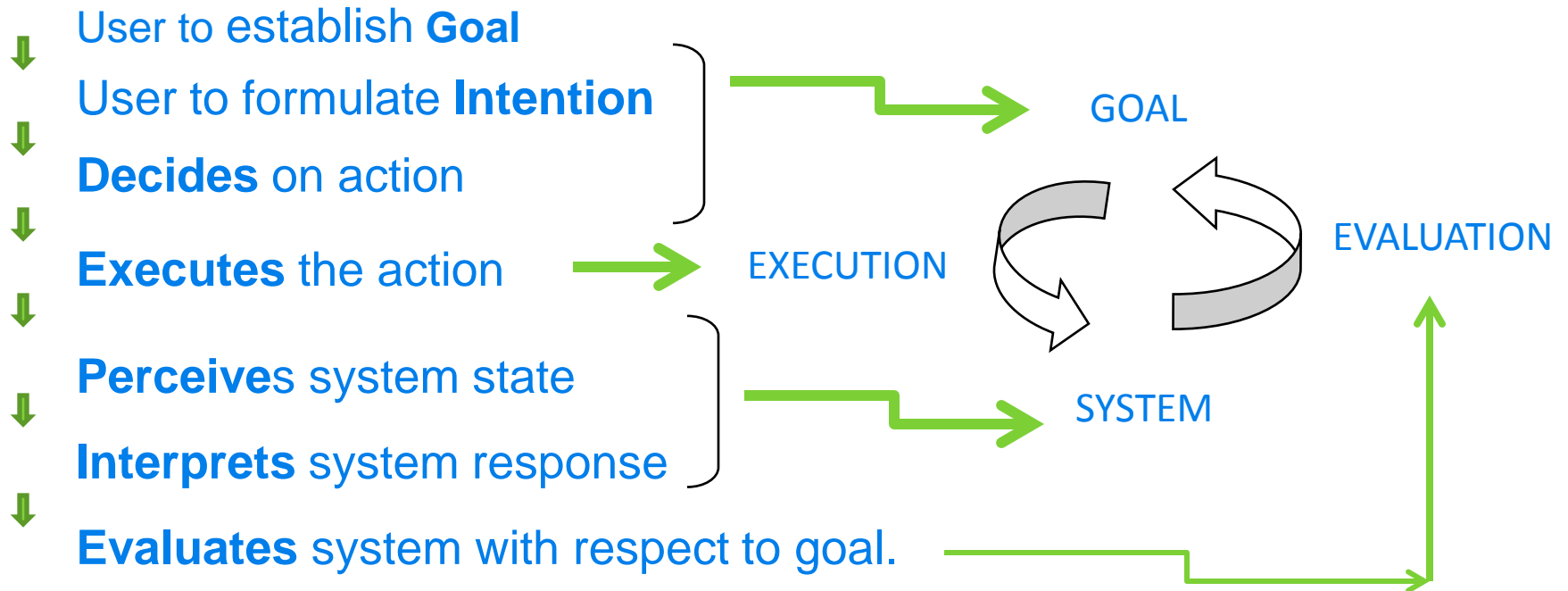Donald Norman's Interaction model concentrates on the Users Thought processes and accompanying actions.

Norman proposed that actions are performed by the users in cycle such as

(i)   Establishing a goal
(ii)   Executing the action
(iii)   Evaluating the results

Given a need a user sets about achieving the goal of fulfilling the needs.

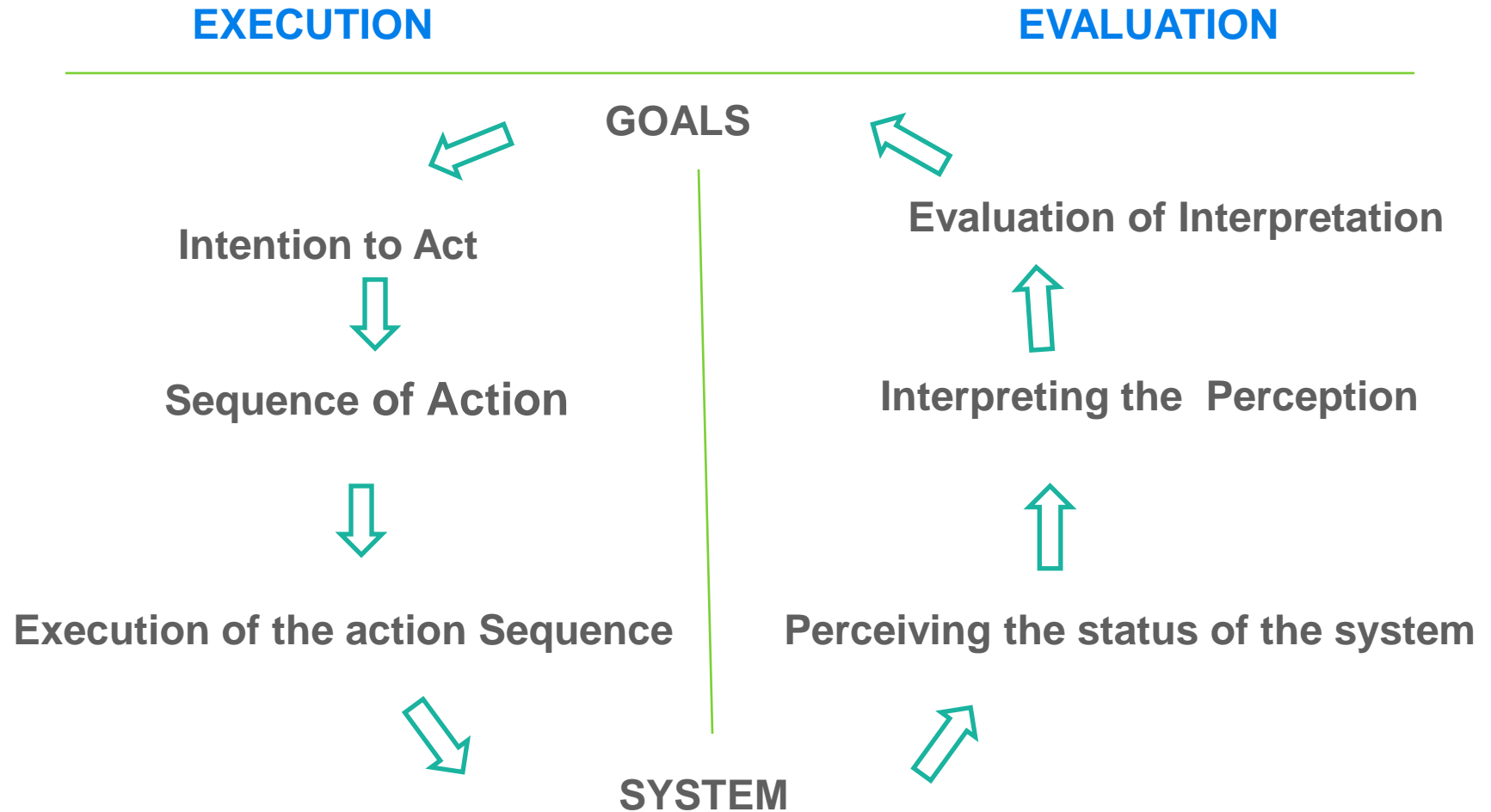A series of actions are performed – one leading to another – till the result expected is obtained.

Norman's Model of Interaction consists of seven stages as follows:

User to establish **Goal**

User to formulate **Intention**

Decides on action

Executes the action

Perceives system state

Interprets system response

Evaluates system with respect to goal.

GOAL

EXECUTION

EVALUATION

SYSTEM

Another way of depicting Normans 7 stage Action model

EXECUTION

EVALUATION

GOALS

Intention to Act

Evaluation of Interpretation

Sequence of Action

Interpreting the Perception

Execution of the action Sequence

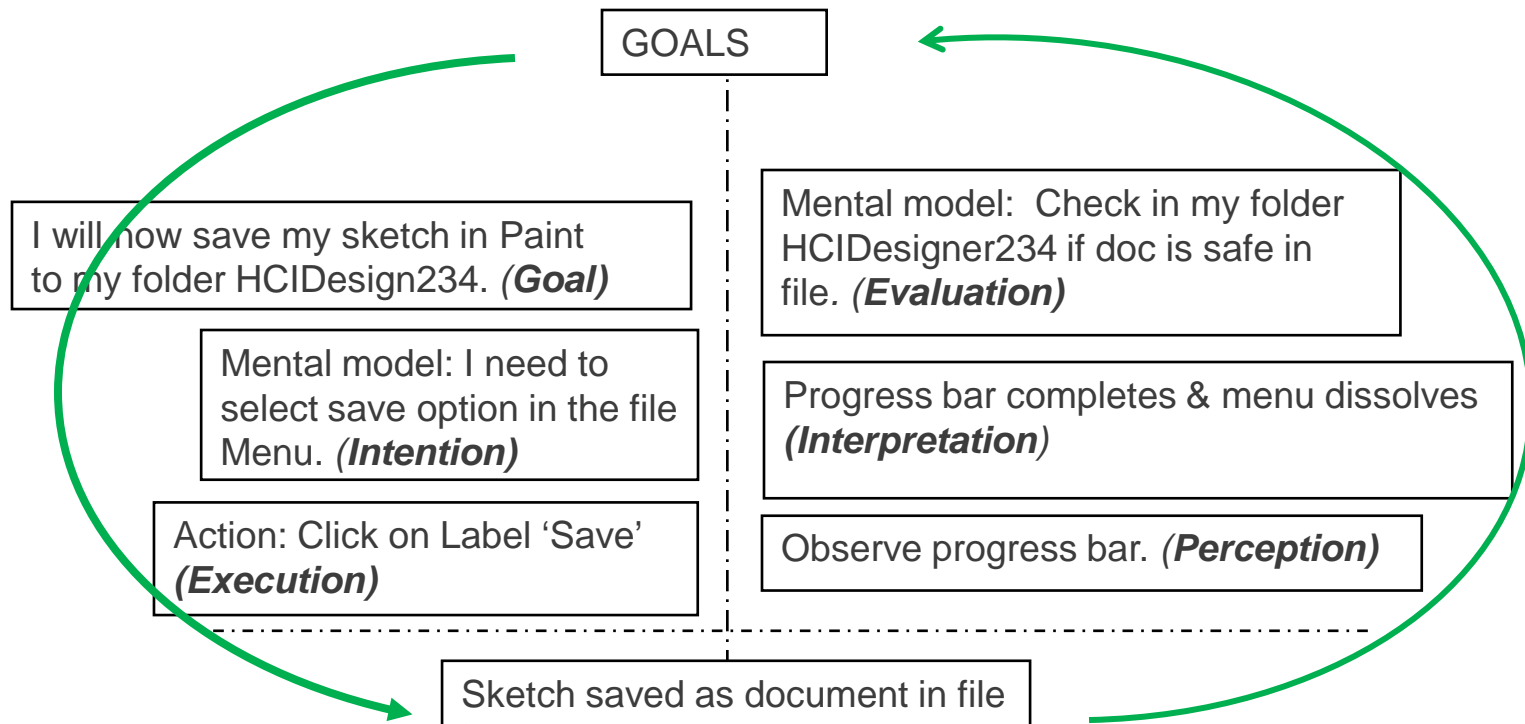**Perceiving the status of the system**

SYSTEM

Understanding Normans Model with Example:

Need: Documenting work done
Task: Save My Sketch
Goal: Safely store the sketch in a place which I can fetch it from

GOALS

I will now save my sketch in Paint to my folder HCIDesign234. *(Goal)*

Mental model: I need to select save option in the file Menu. *(Intention)*

Action: Click on Label 'Save' *(Execution)*

Mental model: Check in my folder HCIDesigner234 if doc is safe in file. *(Evaluation)*

Progress bar completes & menu dissolves *(Interpretation)*

Observe progress bar. *(Perception)*

Sketch saved as document in file

As a basis for his Interaction Model Norman proposed the following levels of abstraction of knowledge of the user

- **Task Level**

- **Goal Level**

- **Semantic level**

- **Syntax level**

- **Lexical level**

- **Physical Level**

Task Level: task level is to analyze the user's needs and to structure the task domain in such a way, that a computer system can play a part in it. The task level describes the structure of the tasks which can be delegated to the computer system.

Semantic level describes the set of objects, attributes, and operations, the system and the user can communicate. Semantics is about how the user interprets it and makes meanings out of the system.

Syntax level describes which conceptual entities and operations may be referred to in a particular command context or system state.

Lexical level: language , wording.

Norman's HCI model consists of three types:
User's Mental Model ; **System Image Model** ; **Conceptual Model.**

The **User's Mental Model** is the model of a machine's working that a user creates when learning and using a computer. It is not technically accurate. It may also be not stable over time.

User's mental models keep changing , evolving as learning continues.

In a way Mental Models are models people have of themselves, others and environment.

The mental model of a device is formed by interpreting its perceived actions and its visible structure.

The **System image Model** is the visible physical part of the computing system / device.

The Conceptual Model.

This is the technically accurate model of the computer / device / system created by designers / teachers/researchers for their specific internal technical use.

Users too have a Conceptual model but it is their mental model unless the user is a technically qualified as the evaluator. In a way as far a the user is concerned mental models and conceptual models are inherent to each other. Designer's too have Mental models of the system. So a Conceptual model of the system needs to be as close as possible to the System's Image Model.

The User model *(what the user develops in the self to explain the operation of the system)* and the system image *(the system's appearance, operation way it responds)* is usually a blend of the **users mental model and conceptual model** all rolled into one.

Interaction Model and device /system Design

A good device / system will emerge when the starting point of the design process is the user- his/her mental model' (in turn derived through user research- task analysis , walk thoughts Contextual inquiry etc) being the basis of the system image and its conceptual model

The Conceptualisation of the Designer had in his/her mind is called the *design model* .

Ideally, the design model and user model have to be as close as possible for the systems acceptance.

The designer must ensure that the system image is consistent with and operates according to the proper conceptual model.

Norman applies the Model to explain why some interfaces cause problems to the users.

He uses the terms "**Gulf of execution'** and ' **Gulf of evaluation'**. Normans model (also some times called as Gulf Model) is useful in understanding the reasons of interface failures from the users point of view. The Seven stages of action model is an elaboration of the Gulf model.

GOAL
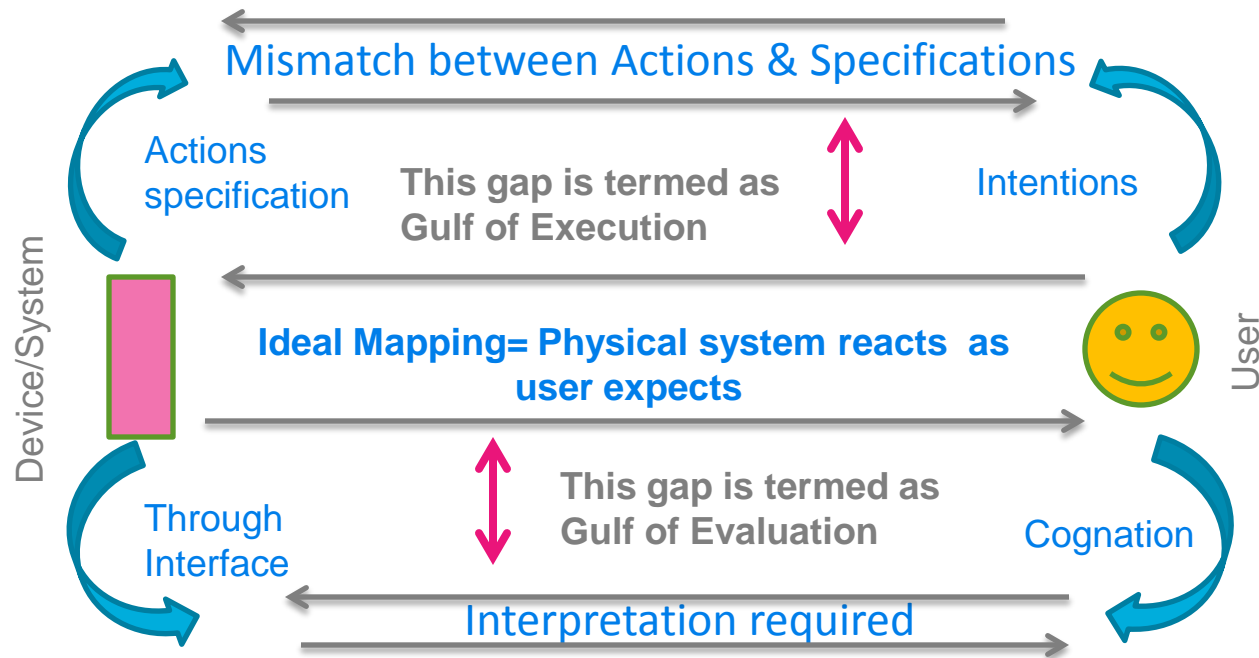
EVALUATION
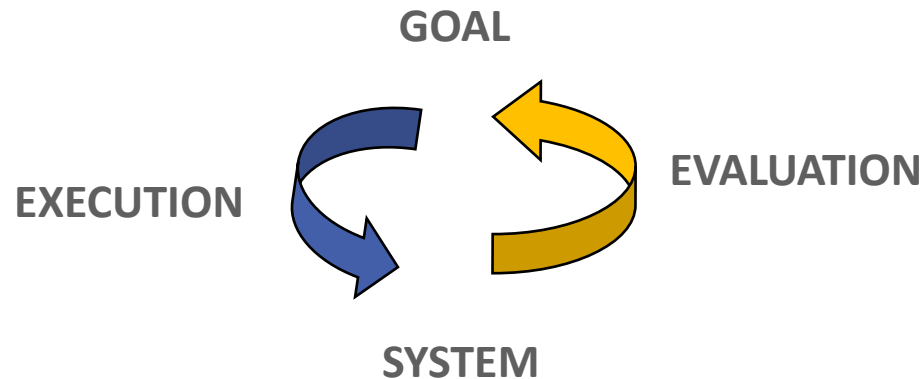
EXECUTION

SYSTEM

Gulf of Execution represents the difference between user's formulation of the action to reach their goals and the actions allowed by the system.

User's formulation of action   ≠   Actions allowed by the system.

The Gulf of Evaluation is the difference between physical presentation of system state and the expectations of the user.

User's Expectation ≠ system's presentation.

Mismatch between Actions & Specifications

Actions specification

This gap is termed as Gulf of Execution

Intentions

Device/System

Ideal Mapping= Physical system reacts as user expects

User

Through Interface

This gap is termed as Gulf of Evaluation

Cognation

Interpretation required

Interaction Styles

Having understood Interaction Frame work as a model let us
Look at Interaction Styles

Some common interaction styles
- Command line interface
- Menus
- Natural language
- Question/answer and Query dialogue (Ex: SQL)
- Form-fills and spreadsheets
- WIMP – [Windows; Icons; Menus; pointers]

- Three–dimensional interfaces
- Gestural Interfaces
- Vice operated commands
- Thought (mind) operated commands (Evolving rapidly at Laboratory level)

Conclusions

Interaction models are conceptualisations of the process of Interaction between
the user and the system.

Normans seven stage Interaction model explains interactivity from the user's point of view.

There is a Gulf of (i) EXECUTION & (ii) EVALUATION

There could be a number of reasons why an interaction can fail at a number of points in the dialogue.

The interaction model can be a useful tool for analysing as well as conceptualising dialogue between a system and user.

Assignments

Draw the Users Mental Model for a Transfer of Money from one account to another on an ATM

Using Normans seven principles draw a Normans Interaction Diagram for 2 Tasks in any application software of your choice.

References

Nielsen, Enhancing the exploratory power of usability heuristics. Proceedings of the ACM CHI'94 Conference .

D. A. Norman ; The Design of Every day Things. Doubleday , New York 1988.

Dix.A, Finlay J; Abowd G.D & Beale R; Human Computer Interaction, 3rd edition, Pearson Education 2005.