Course: Human Computer Interface (HCI)

Week 8 - Norman's Philosophy of Design

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Learning outcomes Week 8 -

Norman's Philosophy of Design

At the end of the lecture, you will be able to:

(i) Describe Norman's execution and evaluation concepts

(ii) Describe the principles of good design

(iii) Describe Norman's philosophy of design for everyday interaction

Introduction:

Norman's Philosophy of Design for Everyday Interaction

- ✓Human beings interact with many devices and systems on a daily basis and some of these interactions are simple and intuitive, while others are hard and error prone.
- ✓Device designers are constantly trying to understand two issues: -

(i) What differentiates easy to use devices from those that are not easy to use?

(ii)How can one design systems that support easy user operation?

- ✓Don Norman's work provides insights to these questions stating that designers need to understand how humans interact with everyday things, their thought processes, how they perform actions and their perception of the world.
- ✓Don Norman provides detailed principles of good design that should be used by HCI designers to create systems which would work as humans expect them to.
- ✓These principles are summarized as a cycle with s**even stages of action;** one for goals, three for execution and three for evaluation.

How do humans interact?

According to the Norman's execution & evaluation cycle, humans interact with systems in two phases: -

A. The **Execution phase** where users perform actions on the world using devices or systems by: -

   a. Forming a goal;

   b. Forming an intention to carry out certain high-level actions to achieve the goal.

   c. Deciding on the set of actual low-level actions to be executed and

   d. finally performing them.

B. The **Evaluation phase** where the user assesses the state of the world, to evaluate the results of his actions by: -

a. perceiving the state of the system after execution,

b. interpreting the perception and

c. evaluating the interpretation against the expected results.

Stages of action under Normans cycle:

The execution & evaluation phases can be broken down into seven stages of action; one for goals, three for execution, and three for evaluation as follows[1]: -

1) Forming the goal
2) Forming the intention
3) Specifying an action
4) Executing the action
5) Perceiving the state of the world
6) Interpreting the state of the world
7) Evaluating the outcome

1. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 63

Within this interaction framework, there exists two gulfs and they are the source of the difficulties to HCI designers as they focus on an interaction interface.

1) Gulf of Execution – The difference between the actions that a user intends to take and the actual actions that the system allows the user to perform. Systems in which the intended user actions don't easily map into those allowed by the system, have a wide gulf of execution.

2) Gulf of Evaluation. It reflects the amount of effort that the person must exert to interpret the physical state of the system and how well the expectations and intentions have been met[2].

2. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 65-68

Principles of Good Design

- ✓ Good systems design is aimed at minimizing the gulfs of execution and evaluation.
- ✓ Don Norman considers the following human interaction characteristics to define principles of good design.
- ✓ *Good design should: -*
    A. Help the user build the correct conceptual model of the system
    B. Make the right parts visible.
    C. Provide memory aids to the user.
    D. Provide good feedback.
    E. Accommodate errors

A. Help the user build the correct conceptual model of the system

- ✓Users form a conceptual models about a system of each device or system that they use through which, they are able to map goals into intention.
- ✓This is because human beings are explanatory creatures and they make theories and explanation about the things that they interact with.

Conceptual Models…

- ✓ Conceptual models are often constructed from the actions that are made **visible** by the system and the **perceived relations** that exist between actions and the system generated results.
- ✓ If a system makes the choice of actions that the user can take easily visible then the relation between actions and results are clearly exposed, and this enables users to form the correct conceptual model.
- ✓ Where these relations are fuzzy, humans tend to misinterpret things, and form incorrect conceptual models.

Conceptual Models…

- ✓ Humans use *perceived* relations between actions and results to form the conceptual model.
- ✓ These perceived relations may not exist in reality; hence, people try to assign **casual relation** between two things that occur in succession.
- ✓ Something that happens right after an action appears to be caused by that action, even though in reality the two may be unrelated.
- ✓ Thus, humans are prone to false perception of relations between actions and events.
- ✓ Human beings use conceptual models of the devices they interact with and good system designs enable users to create the right conceptual model.

B. Visibility - Make the right parts visible.

- The **necessary and correct** parts of the system are made **visible** to the user and they must convey the correct message.
- These parts are determined by the actions available to the user.
- System design should provide visibility to all possible actions and one control for each action that the user can take should be made available.
- When the number of possible actions exceeds the number of controls, the system is apt to be difficult to use.
- However, **too much visibility** is **harmful** since it makes the system look complicated to use[3].

3. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 33

Mappings that exist between the visible system parts and the actions supported by those parts.

- ✓For immediate understanding of the system, there should be a **natural mapping** between the visible parts and the actions they support[4].
- ✓Good design cannot be achieved if proper and natural mappings don't exist.

4. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 91

✓Natural mappings are said to exist between a part and certain actions if the **affordances** and **constraints** of the part lend themselves to that action.

✓**Affordance** refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.

✓**Affordance** provide strong clues to the operation of things.

- ✓ **Constraints** limit the type of actions that can be performed with a part.
- ✓ Thus, each visible part should afford the action it is meant to support and should provide strong logical constraints to limit the action that can be performed[5].
- ✓ Apart from affordances and constraints of parts the **physical layout** of the parts is also important.
- ✓ Related controls should be placed together and opposite controls should be placed away from each other.
- ✓ Controls should be placed when there is a mapping between them and what they control[6].

5. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 91

6. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 39

C. Provide memory aids to the user.

- ✓Recall from lecture one that actions can be performed quickly when knowledge from memory compared to knowledge from the world.
- ✓Good design helps transfer knowledge from the world to memory by making sure that users don't have to remember arbitrary things. Instead, the design exploits **memory through explanation** by providing the user a means to create a good mental model of the system.

- ✓Humans rely on external cues and internal memory to decide the right actions to take, therefore, the system should be designed to provide knowledge in the world, as a reminder, to let users perform tasks without relying on memory.
- ✓It should also be easy to transfer knowledge from the world to memory.
- ✓This helps users to easily gain expertise in using the system.

- ✓ Once the users have formed their intentions to take particular actions, they need to decide the actual physical actions that need to be taken.
- ✓ While deciding these actions the users rely on their **past knowledge**, their **memory** and the **clues that** the appearance of the **system provides**.
- ✓ Novice systems users rely heavily on the clues provided by the system (knowledge in the world) while deciding the physical actions that they need to take.
- ✓ Expert users rely on their past knowledge of the system to decide the actions to be taken by recalling the knowledge in memory.

- ✓ Human knowledge and memory are imprecise and faulty, so even expert users require some kind of hints from the system, though not to the extent a naive user requires.
- ✓ Humans transfer knowledge from the world to knowledge in memory, if they are exposed to the system more and more and as they become familiar with the system.
- ✓ However, the system should lend itself to learnability for this transfer to occur smoothly.

D. Provide good feedback.

- ✓**Feedback** is another important design consideration and it involves sending back to the user information about the completed actions and the accomplished results.
- ✓The system should provide meaningful feedback to the user which is easy to understand and interpret[8].

8. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 43

- ✓Once users have actually performed the decided actions on the system, they look for feedback from the system.
- ✓Users get feedback by observing the system and noticing any changes that occur in the system, after they have taken the action.
- ✓To interpret the feedback, users turn to the conceptual model that they have about the system.
- ✓Depending on the received feedback, users may change their conceptual model of the system[9].

9. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 85

- ✓ Once feedback is interpreted, users determine if their goals have been met (successful user action) or not (error occurrence).
- ✓ If users have the correct conceptual model of the system, they can easily determine causes of error.
- ✓ If the conceptual model is not correct, humans may realize that the error was a result of this wrong mental model that they had about the system meaning, they will diagnose the reason for the error correctly and will try to correct the mental model.
- ✓ If users do not realize that they have the incorrect mental model, they will incorrectly diagnose the cause of error since humans tend to blame the wrong thing and this only leads to further misunderstanding.

E. Accommodate errors

- ✓ Systems should be designed to accommodate errors
- ✓ Designers must assume that errors will occur and design the system in a way to minimize error occurrences or their effects once they occur.
- ✓ Human is to error and if an error is possible someone will make it; two types of error that can occur are **mistakes** and **slips**.
- ✓ A ***slip*** occurs when the user commits an error while performing the physical actions required to achieve a goal.

- ✓ Errors usually result from lapses on part of the user but mistakes occur if the user forms the wrong goal or translates the goals into the wrong set of intentions.
- ✓ ***Mistakes*** occur because the user has the wrong conceptual model of the system and are more severe than slips.

✓While slips are inevitable, the system should minimize the chances of a mistake.

✓This can be done by making sure that the users have the right conceptual model of the system.

- ✓ Another way of minimizing mistakes from occurring is to make it hard for users to commit one.
- ✓ **Forcing functions** can be introduced to prevent errors from occurring and they provide strong constraints on the system. There are three types of *forcing functions* that may be used: -

(i) Interlock - Interlocks maintains a task sequence.

(ii)Lock-ins – Lock-ins prevents premature termination of a task sequence.

(iii)Lock-outs – Lock-outs prevent starting a faulty operation[10].

10. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 148-156

- ✓Systems should be designed to easily detect and communicate error occurrences through proper feedback
- ✓Provide a way to allow users to **reverse** the results of an error or to recover the state of the system without blaming users for error occurrences (hostile feedback).
- ✓Simplicity is key - Designers should reduce system complexity more so for modern devices, that incorporate the use of technology resulting in additions of a large number of features, making the devices very complex.

Conclusion

- ✓ Don Norman provides guidelines for designing usable systems providing a strong rationale behind these guidelines while recommending designers to **accept the responsibility** of creating easy to use systems.
- ✓ Designers need to consider the properties of all the system components including the humans as well as their interactions.

Conclusion

- ✓ Norman advises designers to think about the intended user for which the system is being designed and to adapt the design of the system for the user.
- ✓ Many failures of information systems are attributed to human error rather than design.
- ✓ Don Norman encourages designers to look at bad designs and to avoid the mistakes that designers of those systems made or else users will suffer continued failures until the design approach is changed.

Content Covered in Week 8 - Norman's Philosophy of Design

(i) We have described Norman's execution and evaluation concepts

(ii) We have described the principles of good design

(iii) We have discussed Norman's philosophy of design for everyday interaction

Course Text Books

1. Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004).

2. Designing for Effective Human/Computer Interaction (4th ed.), Schneiderman, B., Plaisant, C.: Pearson Education, Inc.: ISBN 0-321-19786-0, (2005).

3. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002).

4. Designing the user interface: Strategies for effective human-computer interaction (5th ed.), Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. New Jersey: Prentice Hall. ISBN-10: 0321537351, ISBN-13: 978-0321537355, (2009).