Human and Computer Interaction

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Abstract: In this research paper we provide an overview of the subject Human and computer Interaction. The growth in the human and computer interaction field is not only in quality of interaction but it has also undergone many branches in HCI history. HCI specifically focuses on experimenting techniques that support human or make computer interface more effective for humans. HCI designers instead of designing regular interfaces now focus on the concept of multimodality by providing active interface rather than a passive interface.

This paper provides overview of how human interacts with the computer, tools used in interaction, Norman's interaction model which states the stages of how the interaction takes place, ergonomics, Interaction styles etc. It also offers the survey of existing systems and recent study in HCI and finally some description on the applications of HCI.

Keywords: Human Computer Interaction, Ergonomics, Norman's model, multimodality.

Introduction

Human and computer interaction as the name suggests is the study and planned design of human and computer interaction. It is also referred as man-machine interaction. HCI emerges with a reason that even if the machine is advanced or has all sophisticated functions it is worthless until it is used by people. Thus, the exploration of relationship between human and computer has become the most important field of study. Since HCI focuses on the interaction between human and computers it needs knowledge of human as well as computer.

Let us first understand what is human and what is a computer?

Human is a complex which is intelligent who has the power to take decisions, who can think does whatever he wants. Whereas a computer is a dumb machine which does what it is told, it cannot think until any kind of query or command is given to it. So basically, a human interacts with a dumb machine. Computer works on software which is programming language. Thus software engineering is concerned with the internal working of software and the front end i.e. the external part the UI(User Interface) is

concerned with HCI. HCI helps to access the software easily.

HCI Definition: HCI has been defined in various terminologies. We have defined HCI as follows:

Human and Computer Interaction (HCI) is concerned with user interface evaluation and implementation of computing system for human use.

The importance of HCI comes from how the functionality of the system help the intended user to achieve the purpose of the system. Therefore, it is important that not only the user interface must be good or attractive but it must also be effective, productive and safe in use. *Functionality* of the system in HCI is defined by set of actions performed on the system are efficiently utilized by user. For example, when user performs some operation then the system must respond with correct and effective result. *Usability* is defined as the specific goal is achieved by the system as per the user's requirement. Usability is based on the quality on how accessible or easy it is for the target audience. Usability is achieved by planning, taking into consideration the user needs and fulfilling the requirements as planned. The system is effective if there is proper implementation of functionality and usability. The system must not contain bad interfaces which are inconvenient or confusing.

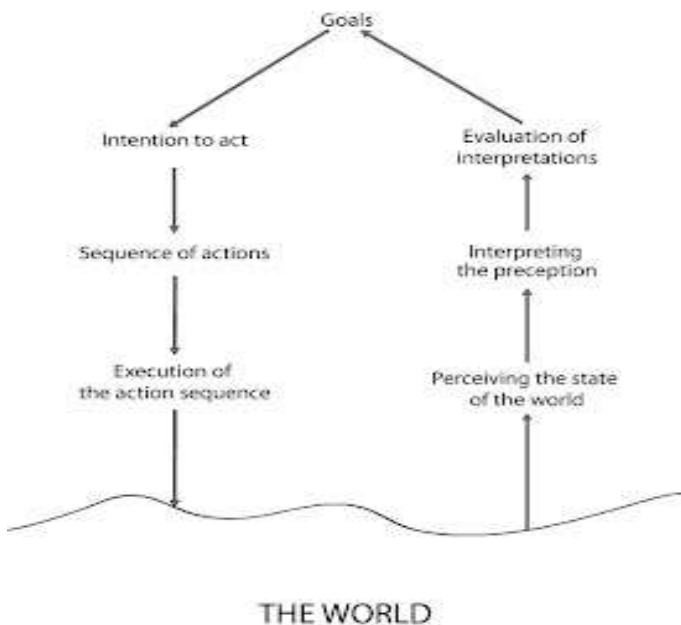Usability requirements must ensure the following terms:

- o Reliability: Data must be correct, s/w h/w must be trust worthy, privacy, secure.
- o Standardization: User interface across multiple applications must be common.
- o Integration: Support multiple file formats.
- o Consistency: Throughout the application the UI must be common.
- o Portability: Convertible across multiple hardware and software environments.
- o Schedule: Complete within the stipulated time period.
- o Budget: Requirements must be fulfilled within estimated budget.

Interaction in HCI states the relationship between human and computer. The communication between user and system is interaction. The interaction in HCI is interpreted

by Interaction model, Ergonomics, Interaction styles, Context.

Donald Norman's Interaction model concentrates on human and computer nature. He proposed a concept which tells what action to be taken to execute any task. According to Norman, actions performed by the users are in a cycle. The cycle mainly focuses on execution and evaluation. Which are further elaborated as establishing goal, executing the actions and evaluation of result. For example, when user wants to switch on the light then he first sets the goal of which light etc, then performs actions to achieve the goal and continues the action until the expected result is obtained. Norman's model of Interaction consists of 7 stages as follows:
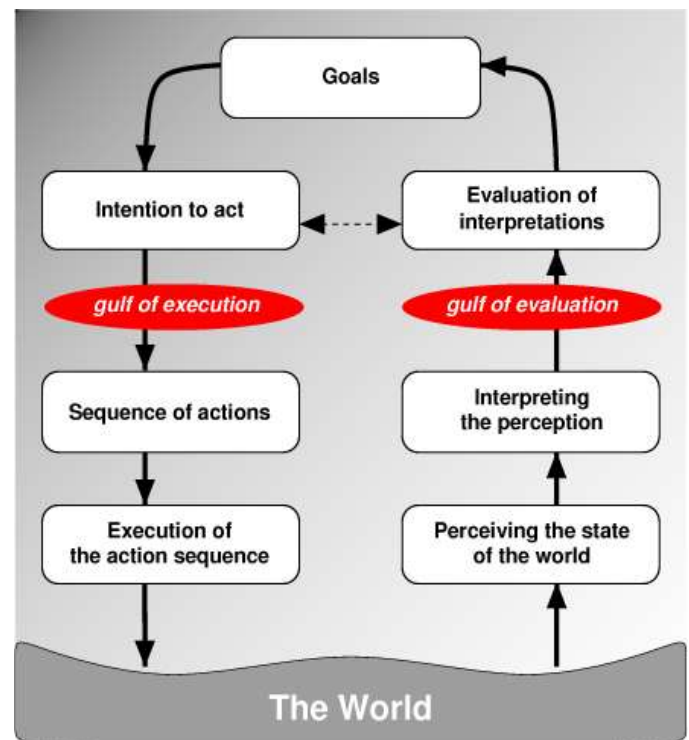
- o User establishes goal
- o User formulates intention
- o Specifies action at interface
- o Executes action
- o Perceives system state
- o Interprets system state
- o Evaluates system state with respect to goal

To understand these seven stages we see an example of sending SMS. You decide to send SMS, that is the goal you establish. From there you form intention to send SMS, you think about how to send the SMS, to send the SMS we need a mobile phone. Then you search for mobile phone. You try to get the mobile phone this is where you perform action to reach the interface. After reaching the interface which is a mobile here, you start executing the task of typing the message. This is where the execution part gets over and the evaluation phase begins. In perceiving the system's state you do the task of sending the SMS as per the decided

goal. After perceiving the system state you interpret the system by checking whether the SMS is sent or not. At last you evaluate the system with respect to goal, here the goal was to send SMS if the SMS is not sent then you will evaluate new state according to the original goal. There might be no Balance to send the SMS, network issues etc.

Norman places the reasons of interface failure from the users point of view for which he uses the term "Gulf of Execution" and "Gulf of Evaluation". *Gulf of Execution* is the difference between the human and computer interaction where the intentions of the user are not perceived by the system. For example, if a person wants to record a movie, that person hits the record button according to his intention. But for the system to record it needs some parameters like start and end time etc. This gap is defined as Gulf of execution. *Gulf of Evaluation* is the difference between the users expectation and systems presentation. For example, if the person recording should know whether the recording is active or not. Therefore, if the presentation of the system is not sufficient to lead the user to intended goal then, there is a gulf of evaluation. The following figure depicts the failure.

Ergonomics comes from a greek word where ergon means work and nomic means natural law. Ergonomics is defined as the study of human interaction with physical things like phone, laptop etc. It focuses on physical characteristics on how people interact with things. Its main aim is to improve the environment for humans and to reduce the risk of getting injured. It makes sure the products are appropriate

for human use i.e. the products are productive, safe, comfortable. For example, in a workplace to reduce stress, computer eye strain etc. The work environment is created by considering ergonomics where the desk and the chairs are aligned so as to reduce neck, back problems. The chairs provided are comfortable. An ergonomic environment is essential in workspace as it leads to increased productivity of work, high staff morale.

Interaction Styles in HCI describes the nature of human and system. HCI comprises of some interaction styles which are as follows.

- o Command line interface
- o Menus
- o Natural language
- o WIMP
- o 3D interfaces

Command line Interface is the earliest form of interaction. In this the user instructs the computer directly. It offers direct access to the system functionality. It is better if it is used by experts rather than novices. The commands used must be meaningful. Example, UNIX.

Menus is a set of options provided to the user. When menu is selected it results in the change of the interface as per the options. Menus are often understandable which leads the user to accomplish the execution of task. They help in saving screen space as they are pull-down or drop down menus. They provide categories, hierarchical groups etc. Example, notepad menus like File, Edit etc.

Natural Language user interfaces where text written or speech spoken act as user interface controls to select or modify data in software applications. In speech recognition the text meaning may vary because of ambiguous input. Therefore, natural language interface may not work as expected always. Example, Ask is a search engine which works on natural language interface.

WIMP in HCI stands for Windows, Icons, Menus, Pointer. It describes the GUI of computer systems. WIMP based systems are operated through keyboard and mouse, since they are the sources of input. Window is a viewing area on interface where multiple views can be part of GUI. Icons are shortcuts created for actions. Menus are the drop downs of options which on selection executes the task. Pointer is symbol on the user interface of computer which controls the selection of items on the screen.

In 3D Interfaces both the user and system both do not have the same programming language, therefore for communication to take place, the interfaces do the translation between them. Example, Virtual reality.

Existing Technologies

HCI considers many aspects of human nature. The complexity of human in interaction with a system is invisible compared to the easy interaction. The existing interfaces differ in functionality, usability as well as economic factors. For example, a website can have limited functions but the usability to attract customers is complex. In HCI the user activity has 3 levels: Physical, Cognitive, affective. The physical aspect determines the communication between human and computer. The cognitive aspect focuses on how human interacts with the interface of system in multiple ways. The affective aspect deals with how the system keeps on updating or involving new techniques which leads the user to continue the use of system. This paper focuses on Multi-Modal Interaction which advances in physical aspect. Multimodal interfaces includes variety of combinations of gesture, facial expressions, speech etc. For example, in tracking lip movement where visual as well as audio based methods are used for tracking the input. The existing physical technologies are basically categorized on human senses like vison, audition and touch.

The input devices that rely on vison are either switch-based or pointing devices. Switch-based devices comprises the interface which uses buttons. The pointing devices are trackballs, pen-based input etc. The devices that depend on audition are more advanced which uses speech recognition. To build output auditory devices is easy than to create a input auditory device. The most difficult and costly deices are haptic devices. They require sensations from the skin and muscles by touch. They are usually build for virtual reality.

The recent technologies in HCI are trying to combine networking and animations. The advances can be categorized as wearable devices, wireless devices and virtual devices. The current research focuses on embedded computation, augmented reality, social computing, brain-computer interfaces. The recent advances mostly focuses on Ubiquitous computing. The idea behind ubiquitous computing was to embed computer everyday and everywhere in the environment so that multiple access is possible through wireless communication.

Applications

There are many applications that include many human body movements as input. Following are some of the applications.

Gaze based user authentication

Gaze based user authentication assists the people who are disable to make normal use of keyboard and pointing

devices. Gaze user authentication is useful when entering password etc. By using the common methods of user authentication like entering passwords through keyboards, mouse touch etc. can cause to attacks like shoulder-surfing, password snooping etc.

Conclusion

Human and computer interaction is an important part of systems user interface. The system is accepted only if it is presented to the user appropriately and it is used by the user. The new technology about speech recognition is further extended by pronunciation. In pronunciation, the word will be recognized by the pronunciation. The cost of the devices recognizing voice must be reduced. The sound quality can be increased. More complex commands must be executed at a time. Computer and Human Interaction increase effectiveness and reduce time of work.

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