
A THEORETICAL APPROACH TO HUMAN-COMPUTER INTERACTION

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Abstract. The most important aspect of human-computer interaction is to ensure user satisfaction and comfort of this interaction. Since this interaction is studied by both humans and computers in science and technology, the knowledge and information obtained during the research is directly based on both the human factor and the computer factor. This interaction between computers and users is performed at the user interface level, which includes various software and hardware tools. Examples include images and objects displayed on display screens, data received through input devices, and other user interactions with large automated systems such as power plants. It is safe to say that human-computer interaction has an important role in our lives. The research work carried out includes the study of interaction between users and computers and the step-by-step planning of this interaction. In addition, the essence and content of the term interface are analyzed in detail in the article.

Keywords: Human-computer interaction, theoretical approach, principle, machine, design, interface.

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1 Introduction

As we know, human-computer interaction fields are classified according to different methods and tools. It is possible to define human-computer interaction into 2 broad groups according to the fields of application. These include the following.

1. Industrial design (creating various products such as mobile phones or laptops);
2. Information technologies (development of services, websites, applications and other web products).

Human-computer interface is a field of science focused on the creation and improvement of computer systems used by humans in an interactive mode. Interface means a set of methods, tools and interaction rules between system elements. Almost everything around us reflects a certain interface. Because each of them is revealed in mutual relations with others. For example: if we eat food, the spoon can act as an interface.

If we classify the research works carried out until today in the field of human-computer interaction, we can say that these studies consist of several broad groups. These groups consist of the following:

1. Design methods of new computer interfaces. Through these studies, optimization of designs for any feature such as learning, discovery, efficiency of use has been achieved.

2. Methods for studying human-computer use and its socio-cultural implications more broadly.
3. Methods of determining whether a user is a human or a computer.

If we carefully consider the conducted studies, we can witness that these studies are rarely approached, analyzed and analyzed using an empirical method. During this research work, these empirical methods were investigated, the purpose, importance and tasks of human-computer interfaces were determined, along with this, problems and perspectives were analyzed.

2 An analysis of the theory of Human-Computer Interfaces

Human-computer interaction can be understood as the process that allows users to communicate and control through computer programs. Therefore, this communication between human and computer is used in computing, word processing, graphics, drawing, music creation, e-mail, etc. is evaluated as a tool that serves to perform a certain task. As we mentioned earlier, the program that serves to facilitate communication and provides commands is called an interface. Because it is theoretically placed between the software and the user who is no longer represented by an expert or technical person (Aliguliyev et al., 2009).

Human-computer interfaces play an important role in our lives, and these interfaces serve to ensure the daily convenience and satisfaction of users. The main purpose of human-computer interfaces is to:

- to achieve a better interaction between users and the computer;
- adapting computers to the demands and needs of the user.

Human-computer interface has several user-oriented benefits. These benefits have a significant impact on the daily life of users and, according to research, significantly increase their level of satisfaction. The main benefits of human-computer interface are:

1. User-centered design plays an important role here;
2. Increases competitiveness through human-computer interaction research;
3. Users refuse to use a low-quality interface.

As we mentioned above, human-computer interfaces have become an integral part of our lives today. One of the most important questions that arise here is what is the purpose of this interface. The importance of human-computer interface that we have mentioned is as follows:

1. This interface is a tool through which many critical tasks are presented. These duties often have a direct impact on the organization's relationship with customers;
2. A well-designed interface and screen is extremely important to our users;
3. The layout and appearance of the screen affects the person in different ways.

It is this poor design presented to the user that may even drive some users away from the system permanently. In addition to the study, planning and design of human-computer interaction as a conceptual system of the interaction between users and computers, when we systematically analyze this interface, we can define the exchange of information between humans and computers as an interaction node. This interaction node is includes several aspects such as a task, machine, interface, input stream, output stream, reverse connection, etc (Fig. 1). We can categorize the mentioned aspects as follows (Calvo & D'Mello, 2010):

1. Interface area - meeting points that ensure the interaction of several elements;

2. Machine space - the environment in which the computer interacts;
3. Task area - user-oriented goals and conditions;
4. Feedback - evaluation, monitoring and validation of interaction nodes passing through the interface from the human through the interface to the computer and back;
5. Incoming flow - information exchange that starts in the taskbar when the user has various tasks that require the use of the computer;
6. Output flow - information exchange that occurs on the machine.

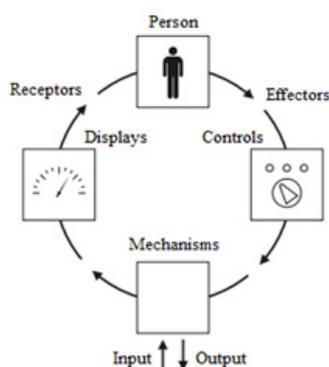


Figure 1: Information exchange between humans and computers

Human-computer interaction can be considered as "the discipline concerned with the design, evaluation, operation and related processes of interactive computing systems for human use". The most important indicator of human-computer interaction is user satisfaction. Since human-computer interaction is studied by both humans and computers, the knowledge gained during the research is based on both the human factor and the computer factor (Fig. 2). From the computer side, the study of computer graphics technologies, operating systems, programming languages and their development environments is very important. On the human side, factors such as communication theory, graphic and industrial design, linguistics, sociology, psychology and user satisfaction are important. Human-computer interaction is sometimes called "human-machine" interaction. Engineering and design are also very important here. An important criterion is to focus on human-computer interaction, as poorly designed interfaces can lead to many unexpected problems. It is more beneficial for new designs to excel in basic human-computer interaction (Dourish, 2004).

The main goal of human-computer interaction is to improve the interaction between humans and computers, to make computers more convenient to use, and to satisfy the needs of users. Other goals of human-computer interaction include:

1. interface design development and methodology;
2. methods of implementing interfaces (e.g., software tools, libraries, and rational algorithms);
3. methods of evaluation and comparison of interfaces;
4. development of new interfaces and methods of interaction;
5. description of interfaces and development of predictive models;
6. interaction theory.

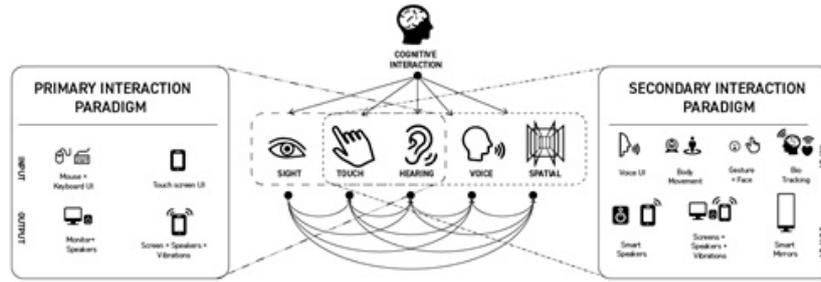


Figure 2: Human-computer interaction

Interface design development and methodology refers to designing the best interface within a given framework based on user requirements, learning and optimizing for required features such as efficiency of use. These optimization processes have a significant impact on the user’s daily life. The ultimate goal of human-computer interaction is to develop a perfect system that lowers the barrier between a person’s cognitive model of what they want to achieve and the computer’s understanding of the tasks it is given. Human-computer interaction specialists are typically developers who base their development techniques on real-world problems and their practical application. The work of such specialists often revolves around the development of graphics and other interfaces (Friedman et al., 2013).

Human-computer interaction researchers are constantly developing new design techniques, conducting observations with new hardware devices, creating new types of software systems, implementing new functions for interaction, and developing interaction theories and models. People can work with different forms of information, some of which are computer-based. Computer-aided collaboration focuses on the use of computing systems to support the collaboration of a group of people. Teamwork management principles extend the scope of computer-supported collaboration at the organizational level. Human-computer interaction differs from human factors in that human-computer interaction focuses more on users working with computers. Emphasis is placed on installing software and hardware to support human-computer interaction. In this regard, such interaction can sometimes be characterized as a human factor. Also, human-computer interaction is characterized by less emphasis on tasks and procedures than on human factors (Fehrenbacher, 2017; Grudin, 2015).

When evaluating an existing user interface or designing a new interface, following the principles below will help us achieve our goals more easily.

1. Focus on users and tasks first.
2. Next, the number of users required to complete the task should be determined.
3. Based on selection, more suitable users who can perform this task should be identified.
4. Here, anyone who has never used the interface or will not use it in the future is considered a non-eligible user.
5. Next, it should be determined which tasks the users will perform frequently.
6. Empirical testing: the interface should be first tested with real users who use it every day.
7. If the user’s performance level does not accurately reflect actual human-computer interaction, then results may vary.
8. Quantitative characteristics of usability should then be determined. For example, the number of users performing the task, the time required to complete the task, and the number of errors made during the execution of the task should be determined.

9. Iterative design: after determining the number of users, tasks, empirical measurements, the following iterative development steps should be performed. At this time, the design user interface should be tested, the results should be analyzed and the previous steps should be tested repeatedly.

These principles can be repeated periodically until a usable user interface is created. While the principles are consistently implemented, special attention should be paid to screen development. This factor is designed to facilitate the perception of system variables and further processing of this information. At this time, the tasks to be performed by the display should be determined. The user or operator must be able to process any information that the system creates and displays, so the information must be displayed according to parameters that ensure perception and understanding (Jalalli (Sadigov), 2017).

The main tasks of the human-computer interface include:

1. creation of interfaces with informative libraries, simple software components and logical algorithms;
2. designing interfaces as convenient as possible for a certain target audience with high learning and efficiency rates;
3. development of new methods of interaction with user interfaces;
4. characterization and comparison of interfaces designed for different target audiences;
5. descriptive and predictive modeling for created products;
6. theoretical justification of human-computer interaction.

The key principle here is to understand the users and the tasks they intend to perform. User interfaces should perform these tasks in the most immediate and intuitive way possible. Therefore, the task analysis phase is also important. To understand this, you need to involve the end user in the design. Interface design should be oriented towards communication with end users. The main goal here is to carefully select the given elements, to define solutions that are clear, economical, convincing and quick to learn. Effective design is able to reduce elements to their essence, arrange them to prioritize their interpretation, and combine them for maximum use. Another important aspect of user interface design is how to structure the presentation. The designer must try to group elements, create sequence, represent relationships, show order between elements and finally find an overall balance. One of the main challenges affecting user interfaces is the continuous introduction of new types of interactive devices to the market. At this point, the resulting interaction becomes a more and more extensive interface experience. These resulting interfaces mainly present themselves graphically (Kaptelin, 2012; Rogers, 1996).

Interaction with graphical user interfaces can be direct or indirect depending on the mapping between the input and output fields. In touch screen interaction, if the input and output area are placed together on the screen itself, it is called direct interaction. If the input field and the output field are separated during interactions, this is called indirect interaction. In indirect interactions, the virtual object, that is, the user representation, demonstrates where and how the user's manipulations will take effect in the virtual world. User representations differ in appearance, typical input devices, and mapping functions. There are many different configurations of these features. Typical input devices are used to control the appearance of user representations. User representations can differ according to their morphological characteristics, the input device used to control them, the constructed mapping, the experienced visual perspective, the type of feedback (Aliguliyev & Aliyev, 2017).

The dialogical perspective of interaction means that the interaction between humans and computers is viewed as a dialogue between them. A user must interact with a computer program

to perform some tasks. Users must be able to express their intentions in the language of the computer interface. From this perspective, a user representation can be interpreted as a part of the interface that is used to determine which virtual object the dialog is directed to. Thus, user representation acts as a media structure that mediates communication between humans and computers.

Finally, let me say that the solution of all these problems has a common goal. That is, it is more important to consider the creation of a computer system that maximally understands human expectations and cognitive abilities.

3 Conclusion

During the conducted research, it was determined that one of the main goals of human-computer interaction is to develop perfect systems that lower the barrier between what a person wants to achieve and the computer's understanding of the tasks given to it. The creation of these systems will fundamentally allow to analyze the information exchange between a person and a computer as an interaction node. In addition, during the performed research work, it was clarified that this interaction node is divided into fields such as task, machine, interface, input flow, output flow, reverse connection. Here, the interaction between users and computers is performed at the level of the user interface.

One of the most important nuances is that there are principles to keep in mind when designing a new user interface. Those principles must be repeated periodically until a usable user interface is created. This will lead designers to develop a better quality and usable interface.

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