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A Brief Overview of Intelligent Interfaces in Production Systems

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Abstract—This paper presents a state of the art in field of intelligent user interfaces, which are the main elements that make the interaction between humans and machines in the most efficient, natural, effective way. As an interdisciplinary product, the design of user interfaces represents the combination of models from disciplines like software engineering, artificial intelligence, human-computer interaction and other disciplines (sociology, psychology, etc.). In the process of design and operation of production systems, an important factor is its responsiveness and the ability to have integrated the capacity to change over time and functionally. To achieve a high level of structural configuration and feasibility, a production system must have a compatible interface

Keywords—intelligent user interfaces; human-computer interaction, adaptability, intelligent agents, production systems.

I. INTRODUCTION

Communication between humans and computers is a field that has been studied for a considerable period. The subject of interfaces had a progressive change from graphical ones to the most natural, cognitive and adaptive interaction with the user. Thus, the term Intelligent interfaces has been conceived, as a result of a combination of techniques deriving from artificial intelligence and human-computer interaction.

Intelligent interfaces attempt to solve the problems of human-computer interaction by providing new methods of communication and adapting to the user and making the use of the system in the most appropriate, intuitive and intelligent manner [1], [2]. In terms of intelligence, in this case, is the ability to use the information properly and not the cognitive aspect of this definition [2].

In the process of design and operation of production systems, an important factor is its responsiveness and the ability to have integrated the ability to change over time and functionally. To achieve a high level of structural configuration and feasibility, a production system must have a compatible interface [3].

Intelligent user interfaces are part of production systems and socio-technical production systems, which

would successfully unite people with the cyber and physical world for mutual understanding [4], [5].

Research into new communication methods focuses on natural language systems, gesture recognition, image recognition, and multimodal interfaces [1], [6], [7], [8]. User adaptation is achieved using artificial intelligence methods to perform reasoning and learning, generate user simulation examples, and recognize plans.

The keyboard of the cell phone, as an amalgam of machine intelligence and human-computer interaction, is an example of an intelligent user interface that attracts researchers' attention. The research on the use of text input, keyboard correction and prevention of errors, is described in papers [9],[10], especially in cell phone use, the behaviour of the users and the learning innovations are the challenges that are encountered when designing or creating intelligent user interfaces.

The cultural aspect of intelligent user interfaces is treated in the paper [11], as an important factor of the end-users ambient due to the boundless acquisition of mobile communication devices.

II. INTELLIGENT USER INTERFACES

The main objective of intelligent user interfaces to be achieved is the interaction between humans and machines in the most efficient, natural, and affective way [12]. As an interdisciplinary product, the design of user interfaces represents the combination of models from disciplines represented in figure 1.

In [13], it is mentioned the use of intelligent agents in intelligent interfacing that behave like assistants to help the user in the process of interfacing. It could be entities that could perform autonomously, accomplish certain purposes or communicate with other agents or people.

A representation of human-computer interaction in which both the user and the interface are partners and have the same components is shown in the figure (fig. 2):

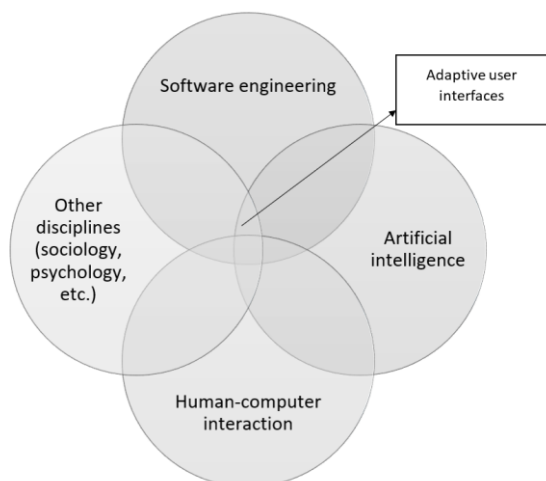


Figure 1. Different fields inter-connection in intelligent user interface creation [12].

As it is represented in the following figure 2, the components of the image can be described as follows:

- An ontology, i. e. a model of the environment in which it acts, which could be used to decide on various courses of action. The environment model can be represented both by artificial neural networks and in symbolic form, by knowledge bases;
- A partner's model, which is often a part of the elaboration of an ontology (for example, in intelligent computer-assisted instruction systems, the student model contains the part of the ontology that the student knows as well as the erroneous knowledge that the student has);
- The goals, beliefs, intentions, and commitments assumed;
- The following plans

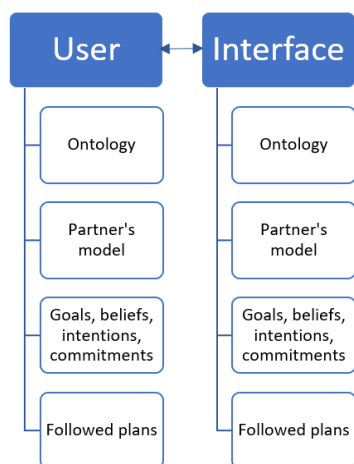


Figure 2. Intelligent interfaces [13]

III. THE FUNCTIONS OF INTELLIGENT USER INTERFACES

The main functions of the intelligent interfaces can be listed as follows [14]:

1. Communication function. It is assumed that a non-programming user will communicate with a computer in a limited natural language that is due to the specific purpose - the formulation of problems that the computer is required to solve. The range of tasks in the mass introduction of computers in various types of human activity can be very wide. With the help of computers, computational problems are being solved, as well as problems related to controlling the logical reasoning, information retrieval, office work and other types of human activity. Therefore, the natural language that is valid at the input of an intelligent interface cannot be too unsatisfactory. Its limitations are manifested not in the volume of the dictionary, but rather in the organization of texts entered by the user into the computer. It is important that the text that is entered be understandable to the computer. The term "understanding" can be perceived at the level of intuition.

When implementing the function of communication, an important role is played by the means of the graphic display of information and the possibility of replacing texts with a set of actions ("objectification" of the text). Therefore, the communication system included in the intelligent interface is not only a system of communication-based on text messages, but also all kinds of input-output systems for voice messages, graphical interaction tools, and cursor-type tools.

2. Function of automatic synthesis. The user's message must be converted into an executable program for the computer. This requires resources for implementing procedures in a computer as part of an intelligent interface that is usually performed by a human programmer. To make this possible, it is necessary to make it possible to translate the user's original message into some precise specification language, and then generate a working program from this record. Such a transformation requires special knowledge that must be available in the computer's memory.

3. Justification function. A user who does not understand or poorly understands how a computer converts his task into a working program and what methods it uses to obtain a solution has the right to demand from the computer to substantiate the solution obtained. He can ask the computer how it converted his problem into a program, what method it used to

find the solution, how this solution was obtained and how it was interpreted at the output. Thus, the justification function includes both the explanation function, which is characteristic of modern expert systems and the trust function, the purpose of which is to increase the degree of user confidence in the computer.

4. Learning function. When a user approaches a computer for the first time, he has the right to expect that he will be able to obtain information about working with it quite easily. For household appliances that he has previously encountered, it is enough to read a simple and small instruction to immediately understand how to handle this appliance. A computer, of course, is more complicated than all those devices that a person has come across in everyday life.

An instruction that would allow the user to master all the capabilities of a computer, to understand the basic principles of working with it, would turn out to be too voluminous and inconvenient for him.

Therefore, computers of new generations are supplied with special tools (tutors), with the help of which the user gradually comprehends how to work with a computer and the subtleties of successful communication with it.

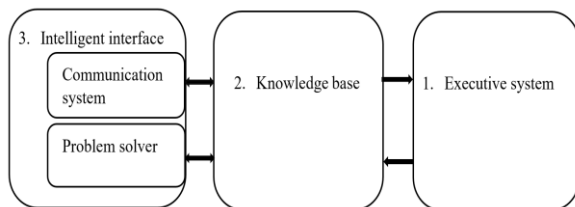


Figure 3. The structure of a modern system for solving applied problems [16]

The structure of the system, as can be seen in figure 3, which satisfies the requirements of the technology for solving problems, consists of three components [15]:

- the executive system, which is a set of tools that ensure the implementation of programs;
- knowledge base containing a system of knowledge about the problem environment;
- an intelligent interface that provides the ability to adapt the computing system to the user.

Thus, the intelligent interface has the structure shown in Figure 3. The central place in this structure is covered by the knowledge base.

IV. THE NECESSITY OF USING INTELLIGENT INTERFACING

The need for intelligent interfaces and the creation of systems containing intelligent interfaces could be rationalized for following reasons [2]:

- The complexity of applications is rising rapidly along with the necessity of guidance for users on a distinct part of a program, that is rarely used.
- The large amount of information managed by applications. The pertinence of the information that is displayed to the user to not overwhelm the user with data.
- The use of intelligent interfaces as a solution of easing the use of information systems by non-experts in a particular field.
- The use of computers in special or extreme situations or by special users, like military or medical software or high-stress applications. In this case, intelligent interfaces would contribute to the use of multimodal communication and knowledge of the system performance of the user. Intelligent interfaces can induce the accessibility of computers to users, with limited potential for effective use of computers, like people with visual or motor afflictions by using multimodal communication and interface adaptability,

The input of the information could be tactile or visual and the output could be vocal, tactile or typed, depending on the user's model required. Using natural language in the creation of the system, makes it more intuitive for the user, offering a higher degree of independence [2], [14].

To represent intelligent interfaces, we will present the diagram represented in the following figure 4:

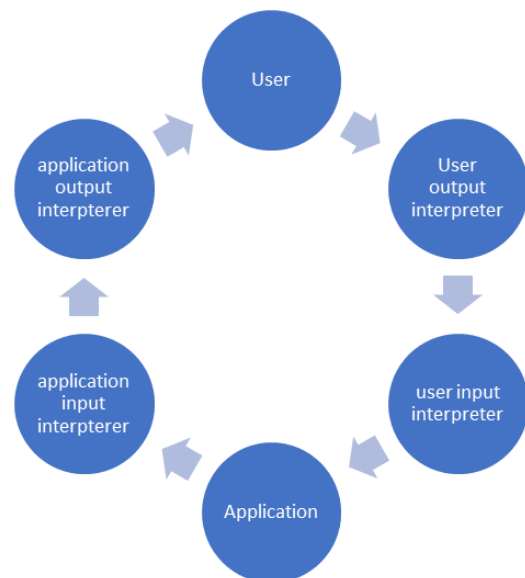


Figure 4. A basic model for intelligent interfaces [2].

As is presented above, the description of the figure could be made as follows:

- User Input Interpreter refers to the part of the system that makes the process of data input more accessible to the user. At this phase, the functions are spell checking, the completion of commands, mouse click detection, etc.
- Application Input Interpreter. At this stage, the interpretation of the user's commands is happening.
- Inside the program. The phase where the inside working on the programs takes place.
- Application Output Interpreter. The part of the program refers to the interpretation of the machine's data into information for the user.
- User Output Interpreter. The stage of displaying the data to the user.

V. CONCLUSIONS

As computer systems become more sophisticated, the use of intelligent interfaces can enhance the use of applications that are continuously improving and making it difficult for users the effectively use the systems.

The main goal of intelligent user interfaces is to achieve the level of usability of the computer systems and simulate the competencies of humans by machines [17].

In the last decades, many techniques from artificial intelligence have been applied in intelligent user interfaces, but still, research continues to finally be able to give to the user the most natural human-computer interaction. The use of computer systems depends on the user's level of comfort during the interaction with the machine. Thus, even though the system will perform the given tasks, the interface that does not achieve a high level of understanding, communication and intelligence with the user will not have a sufficient degree of usability. Research has shown that production and technology development and the production are linked directly to the interfaces, as the decisions made during the process an influence on the result of the product [18]. Thus, the user could even participate virtually a manufacturing process due to an automation tool [19]

The term of the renaissance of production found in [20] shows the meaning of bringing digital innovations to the physical world and intelligent interconnection in production, interacting with the manufacturer, at the same time as the development of Industry 4.0 in the last decades.

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