

# Intelligent Agents in the Human-Computer Interaction

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**Abstract.** The number of intelligent agents has grown rapidly in the last decade. Communication between user and computer can still be improved thanks to many advanced features of intelligent agents. Virtual assistants, present in e-commerce models, prove to be promising tools for a fruitful cooperation among computer-users. This paper outlines strengths and weaknesses of the intelligent agents according to the Human-Computer Interaction aspect.

**Key words:** intelligent agent, artificial intelligence, virtual assistant, computer-user communication, user interface

## 1. Introduction

Whether we are aware of it or not, current agent-based systems are being explored in a great variety of applications. Information systems widely apply computer systems called agents in the field of information technology. Intelligent agents, which have their foundations in artificial intelligence and distributed computing technologies, are not only able to achieve automatically previously specified result, but also capable of flexible autonomous actions guided by their own intelligence.

Concepts of Human-Computer Interaction must face a compromise between providing sophisticated technology and keeping the software easy to use. An internet encyclopaedia, LaborLawTalk.com, describes the Human-Computer interaction as *an interdisciplinary field that studies interaction between people (users) and computers, and is related to many fields such as computer science, psychology, cognitive science, human factors (ergonomics), design, sociology, information science and artificial intelligence* [5]. Despite obvious differences between humans and machines, HCI attempts to ensure successful interaction between them by determining the most efficient way of presenting information to the user on a screen.

Nowadays usability, usefulness, and an appreciation of technology's social impact are widely accepted goals in computing. But we mustn't forget that means, which humans interact with computers by, continue to evolve rapidly. A commonly accepted definition describes intelligent agent as *"a computer system situated in some environment that is capable of flexible autonomous action in this environment in order to meet its design objectives"* [4]. It is not surprising then that agent technologies, based on autonomous intelligent agents, are technologies that promise to improve human factors in information systems.

Advances in computer technology, artificial intelligence and natural language processing have led to breakthroughs in an agent-based technology that offers significant implications for the HCI focuses, among which intelligent and personal agents are one of rapidly emerging technologies. Among many interesting topics concerning HCI, intelligent agent technology seems to be very promising in overcoming several user-interface problems. Although intelligent agents are commonly used abroad, Polish firms and users are still distrustful of them. The aim of this paper is therefore to present advantages and drawbacks of intelligent agents applications in a discipline of the Human-Computer Interaction.

## 2. Foundations and applications of intelligent agents

As long as computers have existed, people have been creating hardware and software that pretended to function as humans do. Early works in intelligent agents field have been motivated from simplifying distributed computing and overcoming user interface problems.[8] Intelligent agent researches are grounded on the researches in artificial intelligence and studies on improving the computer's task performance. Exploration of these problems contributed to a development of new computer applications that were supposed not only to react, but also to "think".

Conceptual foundation of researches in intelligent agents was the idea of imitating a human-human interaction. The realisation of CMC project (Computer Mediated Communications) in 1966 caused the apparition of the first group of simple, academic programs called agents. The prototype of all agents was Eliza – a program that simulated a psychotherapist session. Eliza identified key-words that contained a question and answered with standard sentences stored in her knowledge base. Nevertheless, after a 2- or 3-minute-conversation, the user realised facing a non-human, artificial entity: same answers repeated quite often, others were off-topic. Nowadays intelligent agents reveal advanced conversational skills on the base of natural language processing.

A notion of autonomous agent is distinct from a program. Software agent is something more, because a program must measure up to several marks to be an agent [2]. The terms bots, software agents, and intelligent agents are used interchangeably in current literature. Nevertheless, not all agents are “intelligent”: in order to be considered as intelligent, an agent has to prove, above all, its flexibility followed by other important features: autonomy, proactiveness, ability to learn and so-called social abilities, like ability to communicate and cooperate.

Intelligent agents help users fulfil specified goals. In order to act autonomously, without human intervention, agents have to communicate with users to learn of their preferences and needs. Customization of the user interface based on perceived or stated user preferences is one of the most attractive uses for intelligent agents in HCI [3]. They can individualize delivered news, automatically do intelligent searches and comparison-shopping activities.

Since intelligent agents are supposed to perform tasks that humans don't want to do or in which they are superior to humans, e-commerce is a key focus of agent-based activity. *A flow of digital information creates the need of using software agents, and they will realize their potential to deal with this information*, argues Pattie Maes, a many-year-agent development researcher [7]. Intelligent agents can perfectly perform as a wide variety of tools featuring comparing prices, gathering information about users and providing on-line assistance.

### 3. HCI and intelligent agents' features

As already mentioned above, intelligent agents prove to be:

- autonomous
- communicative
- proactive
- responsive
- adaptive

Human-Computer Interaction, as a discipline that deals with design, evaluation and implementation of interactive computing systems for human use, is specifically interested in exploring communicative feature of intelligent agents. The effects of those researches are models and methods that optimize “human - intelligent agent” cooperation. Current world, digital and interactive, due to constant development of information technology, faces a creation of the intelligent agent interface that is not anymore a “traditional” one. This modern interface imitates several dimensions of social interaction.

The intelligent agent designed to communicate with humans must be equipped with a graphical user interface. Use of the interface must be both intuitive and human-like. Agent’s appearance needs to be attractive and natural, so as to involve emotionally the user in the dialogue-like communication. Moreover, this interface must be mature enough to provide assistance in many web activities, such as e-shopping or information-search. An agent interface becomes thus an important element of human-computer communication. In such context, virtual assistants prove their advantages as tools both intelligent and socially interactive that communicate with users in a form of a dialogue. Through the dialogue intelligent agent observes user’s behaviour and receives a feedback. If necessary, an agent can also ask other agent for advice in carrying out tasks. E-business applications can become nowadays more human and social with a help of virtual assistants.

#### 4. Intelligent agents in e-commerce applications

There is a large number of software agents in use today implemented in help systems, many search-engines and comparison-shopping tools. Taking into consideration Internet activities, intelligent agents implemented in the Internet can be classified into four groups:

1. Shopping agents
2. Selling agents

### 3. Marketing agents

### 4. Virtual assistants

From the HCI point of view, virtual assistants are the most interesting group of Internet agents. Virtual assistants usually serve as virtual representatives and online assistants, learning of users' habits, needs and preferences, and responding individually to behaviour of those users. Assistant's customization contributes to higher rates of return visits and greater customer loyalty as well as better perception of a company image. Virtual assistants collect the information about users through an observation of site visitors interests as they communicate. Profiles of users can also be enriched by the completion of online-questionnaires managed by other intelligent agents. Information gathered by agent is used to improve the relationship with customers and target special offers more effectively.

Various types of virtual assistants greet on-line customers, guide them across the Web site and offer help in solving problems or put customers directly in touch with support representatives [6]. Foreign (and above all American) Web sites are inhabited by many types of virtual assistants. Some of them blink, move their head and some even speak! Figure 1 presents a sample of SitePals invented and produced by Oddcast.



Figure 1. Various virtual assistants, source: <http://www.oddcast.com/sitepal>

Another example comes from a German site. SAP's manager, Jochen Keller, recruits potential workers by help of his virtual assistant, as shown on Figure 2.



Figure 2. Virtual recruiter in SAP, source: <http://www.sap.com/germany/aboutSAP/jobs>

German Ministry of Education employed Wolfgang Schuhmacher on its website. Wolfgang, shown on Figure 3, teaches graduates how to create a business plan and found their own enterprise. He explains the rules of market analysis and the firm management.

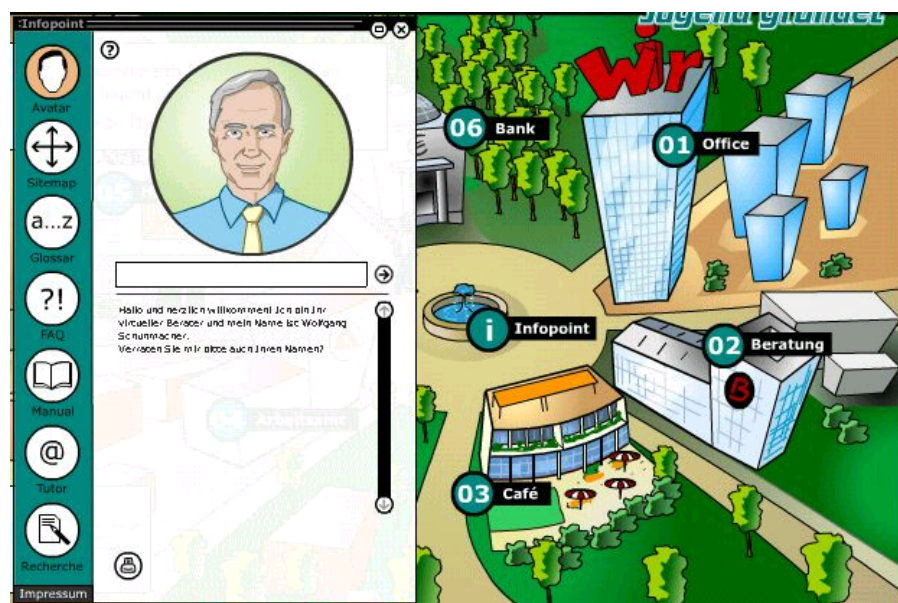


Figure 3. Assistant in German Ministry of Education, source: <http://jug.internet-simulation.com>

In spite of the popularity of hundreds of virtual representatives on foreign Web sites, Polish virtual assistants' world is represented by only six personalities, three of them being demonstrative ones. At the present there exist only two enterprises that take part in virtual assistants market: Fido Interactive (licensed by German Kiwilogic.com) and SztucznaInteligencja (genuine Polish firm).

The youngest Polish virtual assistant - implemented in 2005 - Hubert, greets the customers of Ergo Hestia. As an insurance specialist, he informs his interlocutors on damage liquidation procedures and explains professional notions concerning the insurance market. He knows the actual share price of his employer and basic exchange indexes.



Figure 4. Hubert – a specialist on damage liquidation procedures, source: <http://www.hestia.pl>

The oldest Polish assistant, Fido, introduced in 2002 by Fido Interactive, advertises services of his employer in applications of virtual assistants. His colleague, Adam, is a specialist in an electronic signature field and works on Ster-Projekt website. They both are shown on figure 5.

Assistant Joanna chats with users and conducts surveys on other virtual assistants. Consultant Tytus informs users about debts and vindications. He is employed by EGB Investments, leader on a domestic receivable market. On figure 6 Tytus explains the term “vindication” and Joanna explains her daily task.



Figure 5. Fido and Adam, source: <http://www.fido.pl> and <http://www.sterprojekt.com>



Figure 6. Joanna and Tytus, source: <http://www.sztuczna inteligencja.pl> and <http://www.egb.pl>



## 5. Advantages and drawbacks of intelligent agent applications in the HCI context

Experts in information systems predict that during the next few years intelligent agents will significantly affect many company's activities. Agents are expected to increase their ability in communicating both with user and with one another, so they will find many important applications in business and management [8]. Among one hundred customers that visit a website, only two of them do e-shopping and return to the site once more. Remaining 98% of potential customers quit the site most probably for the following reasons:

- 1) the search engine is inefficient and doesn't provide the information needed,
- 2) FAQ lists and help documents are incomplete or misleading,
- 3) there is no on-line real time support, neither automatic nor human-like,
- 4) process of filling in an on-line formulary or doing an on-line registration are often complicated, lengthy and tiring.

Virtual assistants seem to be a “technological cure” for difficulties mentioned above. They give required information through a simple conversation with a human user. They operate by dissecting the user request and then generating the appropriate information, all in a chat-room format. Virtual assistants work as a helpdesk day and night without a word of complaint. They greet customers, gather marketing data, guide users across the Web site, offer FAQs and put customers in touch with the support representatives when necessary.

A virtual assistant can monitor the actions taken by user in the interface, learn of user preferences and provide assistance in the Web navigation. Thus, the assistant acts as an autonomous agent that cooperates with the user in accomplishing different tasks. In the meantime, virtual assistant learns to assist better its user in four crucial ways, which are:

- by observing and imitating the user
- by receiving feedback from the user
- by receiving explicit instructions from the user
- by asking other agents for advice (optionally)

Intelligent agents can help with two main problems concerning HCI:

1. On the basis of previous observation of user habits and preferences, they enable a customization of computer interfaces and adaptation to individual needs.
2. They enable the computer interfaces to accommodate the increase in complexity of technology.

Thus, virtual assistants enable computer interfaces to become more social while interacting with mortal users, especially when those assistants are combined with sophisticated technology such as speech recognition [1]. Virtual assistants have many advantages, and their capabilities still evolve. The range of virtual assistants' application is very wide thanks to their flexibility and the possibility of application in various areas of knowledge. Up to this time, assistants proved to be useful in e-commerce, consulting, public relations, e-marketing, administration, education and entertainment. Their main strengths are as follows:

- individualization
- ability to accomplish many tasks (a virtual shop assistant can be also a marketing tool gathering customer data)
- a tool that increases rates of return visits by attracting new users to a website
- capability of creation a customer loyalty as well as better perception of a company image
- unrestrained availability (24-hour-help-desk)
- ability of collecting information about users through an observation of site visitors
- possibility of connection with other enterprise systems (call center, customer data base)

Advantages of virtual assistants are not only theoretical – they can be also quite precisely measured. Enterprises that employ virtual assistants point out that they brought about to:

- 15% increase in return visits rates
- 20% - 30% increase in the number of on-line transactions

- cost reduction through prevention of unnecessary phone calls and e-mails (one virtual assistant answers 500 up to 1000 questions daily, and therefore replaces about 30 help-center consultants)
- 15% - 40% cut of the cost of providing online customer service

Virtual assistant Adam, implemented in 2003, talked with almost 50 thousand users and answered over 0,5 million questions during the first eight months of his work on Ster-Projekt website. His presence on the site caused almost 6-time increase in site visits.

Another assistant called Hubert, has been implemented recently in the Ergo Hestia website. From January till March 2005 his work resulted in 4 thousand conversations and increased in site visits by about 30%.

The application of intelligent e-mail processor system in Heyah website caused cut in cost by triplication of the e-mail quantity that can be answered daily.

Intelligent agents have developed extremely quickly during the last decade. They are no longer “narrow-minded” creatures that appear in the desktop environment. They are able to process data flow and manage data information, they intermediate in electronic commerce and contribute to get customer loyalty. As we can see, intelligent agents are necessary software elements, and they appear more and more often in everyday life.

Virtual assistants based on intelligent agent technology are nowadays intensively explored, and seem to be a very promising tool in the close future. Researchers and experts consider them as one of the five most important technologies in information systems. Developing intelligent agents is a challenge not only for engineers and programmers but also for economists and managers for the reason of the increasing role of intelligent agents in Internet, business and management. Many possibilities of intelligent agents’ application have not been discovered yet. Virtual assistants are implemented both on commercial and non-commercial websites, public administration sites. Specialists are working on virtual assistants’ application in self phone technology, in a direction of WAP and SMS development. Therefore, human – intelligent agent partnership would go far beyond what has been studied in the field of HCI - an agent fills the role which is concerned with partnership between human beings and intelligent agents [8].

## 6. Summary

Intelligent agents improve interaction between computer and user. Virtual assistants, which are based on intelligent agent technology, serve as a polyvalent Internet tool. They accomplish autonomously many e-commerce related tasks. They provide assistance on websites, they gather and compute information and communicate with potential customers in a form of dialogue. Virtual assistants provoke an increase in website visits, prevent of unnecessary phone calls and reduce cost of providing online customer service. They observe and imitate the user, receive instructions from him and sometimes ask other agents for advice.

Intelligent agents will contribute to automatize many e-business processes and will efficiently support e-commerce actions, but it is obvious that they will never replace humans. Some point out that intelligent agents have very low level of intelligence, others criticize narrow-mindedness of agents' personalities. All in all, agent-based technologies matures rapidly and in very short period of time intelligent agents will reveal their advanced skills.

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