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Intelligent Agents – Inevitable Tools for Teleworkers

Introduction

In this lecture we will take a closer look at an often forgotten type of teleworker: the self-employed teleworker. There have been very high expectations for the number of these teleworkers over the years, but they could only be reached (if even then) by loosening the definition of teleworkers. This can be at least partly explained by the fact, that electronic communication even today tends to be complicated and can yield unexpected results like many unwanted mails. Therefore it is necessary to support communication by intelligent agents, which ease the workload for the user. These agents add an additional meta-layer of teleworking (moving the work to the employee instead of the employee to the work): Instead of moving the user to the information (e. g. via a web-browser), let the agents move the specific information to the user.

Entrepreneurial teleworkers

A self-employed (also called entrepreneurial or freelancer) teleworker can be defined as a self-employed person, who conducts his or her business mainly from his home or a telecenter by using information technology and means of electronic communication. A major problem for them is the anonymity. It is difficult to promote oneself only through electronic communication (WWW, E-mail...) and to get a contract with clients who never saw you. But there are also advantages, like being able to work for people all around the world instead of being limited to a rather short range, or working independent of traffic congestion and usual work-time.

Intelligent agents – What are they?

There exist many definitions for intelligent agents, according to the number of fields of science involved in the topic and varying with the main area of interest: artificial intelligence, software engineering, networking, etc. In this context we will use the following definition:

Intelligent agents are software programs for the realization of specific tasks for an owner, using a degree of intelligence allowing them to carry out the work at least partly autonomous by interacting with their environment in a sensible way.

Some of the advantages of intelligent agents are higher efficiency in work, i. e. less time is needed by the user as agents work autonomously and more effectively because agents can search huge amounts of information and filter out important things which would be impossible for humans. This opens new opportunities like a comprehensive price comparison for a product.

Agents have been discussed since about 30 years but are still at an early stage of development. With the rise of the Internet the interest in agents also grew, resulting in a number of environments focusing on different aspects. The very high expectations for artificial intelligence could not quite be met, so agents are today only semi-intelligent. This does not exclude some specialist agents, which can do their (limited) task with an appearance of high intelligence.

Especially teleworkers are concerned by the difficulties that have arisen by the mass-usage of electronic communication. Some of these problems are dealing with unsolicited mail like

advertisements, answering standard mails (e.g. checking date/time for a meeting) or searching for specific information in the WWW. Another necessity for self-employed teleworker is to be constantly looking for job opportunities, which means watching websites or mailing lists. A rather ordinary, but increasingly important, problem is searching for a bargain through the web, which will rise with the steady increase of electronic commerce for end users. All these are, amongst many others, typical areas of application for intelligent agents.

The FIM-project

At the FIM, an environment for autonomous and learning agents is currently under development. Using this environment a number of sample agents will be developed, which will not only aid the institute in its work (E-Mail automation) but also provide additional services to students (personalization of the Web-server). Additionally the possibilities of agents paying services by carrying money with them will be examined in a more theoretical way, although demonstration agents will be constructed. We will now look at these three areas in more detail:

- **E-Mail automation:**

Entrepreneurs and small companies also have need for customer support, but this can be quite a problem as the example of the FIM shows: A very successful shareware program creates approx. 50 e-mails per day, so that the two developers spend a considerable part of their work time for support instead of further development. It is therefore a necessity to ease this load by intelligent agents. This starts with simple filters, as are already widely in use, to sort the mails (problems, requests for extension, bugreports...) and continues with replies to usual questions (arising mostly from not reading the help or FAQ) or sending an immediate reply with answers which could match the question. This also decreases the response time, which is important, even if e-mail is an asynchronous medium. Sorting out unimportant mails (e.g. „Can I have it for free, because...“) has to be handled cautiously, as only few things are worse for a company than ignoring mails from customers, where an answer is expected. So deletion would most probably be used only for unsolicited advertisements. Another possibility is to answer questions immediately with a special form, which, when returned, can easily be parsed by an agent increasing the accuracy of the answers, allowing detailed replies. This also allows automatic distribution of e-mail from a central mail-address to the different persons, whom the message concerns.

- **Personalization:**

The WWW is a huge pool of resources, but only a very tiny part of it is of interest to a person. To address this problem, it is necessary to tailor a view of the Web to the needs of the user. This can either be done by agents residing at the user side, e. g. aiding them by exploring links from the currently viewed page and recommending links to follow. Another approach are server-side agents, which remember users when they visit a site and point out topics of special interest (e. g. NewsWatcher). The second version has already been adopted by several content providers but is, at least theoretically, inferior, as it is only a personalization of one site instead of the whole WWW. In addition, this strategy allows to collect valuable information on the users, as an identification is necessary, and it is easy to get a usage profile from the pages visited. This latter form will also be used in the FIM project, where active notification will also be included: Students visiting the webpage of the institute will be shown where pages concerning their courses have changed since the last visit and receive periodical e-mails on this if they wish.

- **Agents and electronic money:**

Some very successful examples of E-Commerce show the possibilities of selling goods online. An extension of this thought are mobile agents, which roam the web, looking for things, the

owner wants to buy. According to the intelligence of the agent, the orders may range from "Buy me the book XXX from YYY for cheapest/fastest delivery" to "Get me a birthday present for my aunt up to 100 Euro". That implies, that the agent carries money (electronic cash, credit card number...) and is able to pay for goods or services it uses. Especially if this is some form of electronic cash, it is safe to predict that rogue agents will be created, who try to get the money without service in return. Therefore, these agents must be very reliable and additional measures have to be taken. The usual assumptions, that agents never lie and always do their best to fulfill their task, must be abandoned. This also includes secure encryption for the transmission and trusted agents for exchange of the results, so no agent can move on with the payment without delivering the promised work. One problem is, that it is impossible to protect a program from the computer it is running on. This means, that either a trusted piece of software (e. g. the OS; could also fulfill the task as an impartial third) protects the agent from other malicious programs or that security measures are added to the hardware. Another problem might be, that companies perhaps would try to block buying agents, as those allow very fast and effective price-comparison (one agent can check **all** providers on the web in a very short time), which would not be possible for humans. This total transparency has many advantages for customers, but is probably not wanted by enterprises. Also required are cheap and fast micro-payments, as the high transaction costs are obstructing the online-business at the moment. This would allow companies to charge small sums for successful inquiries from agents, possibly increasing their acceptance. Conclusion: The three most important principles for agents managing money must be security (the agent must keep its information private), reliability (it may not crash) and trustworthiness (it must do what the user intends).

Future developments - Where are we going?

Yet many questions remain open: How to ensure that the agent fulfills the desires of this owner? What rules apply to taking of responsibility for actions of agents? Nevertheless intelligent agents are starting to appear in more and more fields of application and their number will increase substantially in the near future, especially in the Internet. Some of the areas for future development are:

- More intelligence for trusted agents
- Worldwide runtime-environment standard for mobile agents
- Standards for fast and secure transaction of small amounts of money

With their abilities to reduce the ties between the place, where the work is done, from the place, where the results are needed, by simplifying communication and doing the travelling for the owner, intelligent agents will be inevitable tools for teleworkers.