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ABSTRACT

Basic tasks and problems of market information management in economic organizations are presented in this paper. Identifying these problems – on the basis of the conducted survey – became the base to develop the general architecture of the agent system aiding market information management. *AgentBuilderPro1.4®* software of *Acronymics, Inc*. was chosen to be the development environment. Functions that the particular groups of software agents fulfill in the systems are explained on the basis of the proposed architecture. Particular attention has been paid to present the solutions applied to acquire data for the systems by the *Information Agents* being part of the *Information Gathering Subsystem.*

KEYWORDS

Software agent, agent system, market information, market information management.

INTRODUCTION

The enterprise's ability to compete efficiently on the market and maintain its position may be secured through the effective management of market information. However, man-created virtual information environment – on the basis of existing technological solutions – has taken the form of an abstract information system characterized by high level of complexity. Searching information, storing, securing and publishing it in this environment takes the form of complex tasks (Kiełtyka, Niedbał and Kucęba, 2005). Moreover, there are some advantages as well as disadvantages of constant growth of information resources available on the Internet. One advantage is that it is possible to find "almost all" vital from our point of view information. The disadvantage is that the surplus of information constitutes a problem, too. That is why all the methods of data and information processing automation on the level close to real human abilities are becoming of more importance nowadays. Much attention in this domain is devoted to software agents and built by means of them agent systems (Kierzkowski, 2004). It is their application that promises a chance to controlling the increasing complexity and diversity of the virtual information environment.

Basic issues concerning market information management are outlined in the first chapter of this paper. The conducted by the authors survey, which constituted the basis for working out the general architecture of the agent model of a system aiding market information management is indicated.

The second chapter presents general assumptions and the structure of the proposed model of the system. The functions that the particular groups of software agents perform are outlined as well as the applied programming environment. The proposed

in the paper approach to market information management may be a solution to the problems caused, among other things, by surplus of information or poor aggregation of information. Most of the techniques aiming at solving these problems are based on downloading data from the Web pages, which requires constant management of downloading, updating and storing information.

The solutions applied during data acquisition for the system by the *Information Agents Group* constituting a part of *The Information Gathering Subsystem* are outlined in the third chapter.

MARKET INFORMATION MANAGEMENT

The range and type of the gathered by enterprises information depend mainly on the profile of their activity and their strategic aims. The most frequently gathered information types include: market data (social-demographic, economic, political-legal, technical-technological one), customer data, competition data and data concerning own enterprise.

Market information can be classified in respect to, among other things, its form, aim, origin, subject, market and economy description, importance and function. For example, it can be divided:

- In respect of the subject using information (for example market information of the market participants – trade, service, production enterprises, customers, organizations).

- In respect of the market and economy description (for example macroeconomic market information, the one describing domestic market of a given country, market information in three-dimensional profiles – international and local relationship).

In general, information management is understood as running an enterprise or organization in such a way that information (data, text, image, etc.) and information resources (including staff as well as information carriers and systems) are treated as the basic material for enterprise's success. Providing proper data to controlling information about own enterprise and controlling the amount and kind of information concerning given enterprise that leaks outside constitute a part of information management. In a more limited meaning, this term refers to data processing within the computer systems – so called data management. The tasks of the information management include: strategic, administrative and operational ones (Pieczykolan, 2005).

Within the conducted by the authors research concerning the agent-based system and application of information flow integrators in market information management in enterprise, there was a survey conducted. The survey concerned, among other things, identifying problems in market information management and identifying by the respondents tasks that they would most willingly assign to a software agent to perform. The subject of the survey were Polish enterprises using in their operation the internet business model and the mixed business model – the traditional-internet one. Altogether, the survey was conducted in 172 enterprises (Kiełtyka and Niedbał, 2005).

The analysis of the conducted survey showed that one of the most burdensome, and at the same time the most important activities for the managers in Polish enterprises is gathering information concerning prices of competitive products (7.6 points on the 10-point weight scale). This is the task that they would most willingly assign to a software agent to perform. Thus, there is a real need to automate this activity and implement such a solution. The other places on the list include:

- Downloading statistic data concerning products or components of interest from B2B exchange auction (7.1 points).

- Regular search of trade partners WWW servers and downloading new products list (6.9 points).

- Search for a large amount of generally available on the Internet information, so as to find regularities and relations that the enterprise is interested in (6.6 points).

FUNCTIONAL ARCHITECTURE OF THE AGENT-BASED MODEL OF THE SYSTEM

A system aiding market information management can be realized in the form of an agent-based system. Designing and creating the executable form of the agent software is a time-consuming process. That is why *AgentBuilderPro1.4®* of *Acronymics, Inc.* facilitating and aiding this process was chosen.

The proposed in the paper model of the system – Figure 1 – consists of the group of the software agents, whose task is acquisition, archiving, analyzing and making market information available to manager. The following elements were distinguished within the model:

- *The Information Supply Subsystem (The Interface Agent)* – its task is to facilitate the interaction of the manager with the system and present the results in an intelligible form; it is responsible for the form and syntax of the messages exchanged

between the user and the system; having logged and connected to *The Interface Agent* the user fills in a *HTML* form (containing query) using a internet browser and sends data from the form; the query parameters are extracted from the *HTTP* query metadata and then translated to *KQML (Knowledge Query and Manipulation Language)* message form; all the interactions within the system take place through *KQML* messages exchange.

- *The Information Management Subsystem (The Task Agent)* – its task is to analyze the task assigned by the manager and divide it into elementary tasks; it is responsible for all the functions connected with management of the information gathered in *The Information Repository* – among other things, controlling of the data in the system to be up-to-date and complete; if this condition is not satisfied *The Information Gathering Subsystem* is informed that it is necessary to update or complete missing information; *The Task Agent* takes care of the personalization aspect of *The Information Agents'* access to data sources; data required for personalization is obtained from the user and system interaction process.

- *The Information Gathering System (Information Agents Group)* – realizes elementary tasks, assigned to be carried out by *The Task Agent;* it returns the result of its operation to *The Interface Agent*; it is responsible for data gathering (coming from different sources) and converting it to the required by the system form (complying with the set in the system ontology of market information).
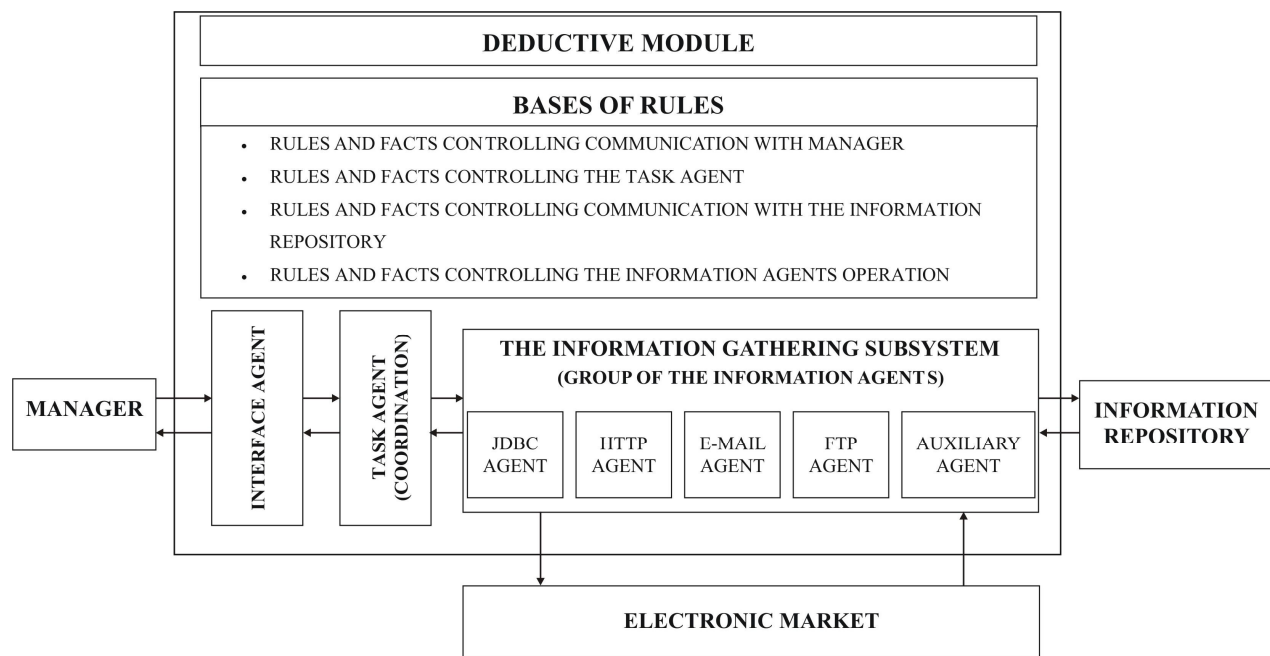

Figure 1. General architecture of the agent-based system of market information management
Source: own analysis

Main advantages of the proposed system include combining personalization of *The Information Agents* access to data sources and possibility of adding new services and data sources. The system user can change the *Information Agents'* behavior either changing subscription (understood as the demand to execute part of the agent's code after each alteration of its variables), or agent's code updating. The proposed system makes it possible to monitor on-line the data sources on the Internet and detect information change.

THE INFORMATION GATHERING SUBSYSTEM

The main task of *The Information Gathering Subsystem – Group of Information Agents –* is to acquire information from the Internet and save it in *The Information Repository*. This *Subsystem's* operation is based on so called "Web Farming". Its idea is to realize the following functions:

- Constant search for new information sources containing vital and useful for enterprise information on the Internet.

- Acquiring information in a way ensuring its presentation in a wider historical aspect.

- Structuring information so as to it can strengthen the database.

- Publishing information so as to it can aid proper people in decision making process.

- Systematic repetition of these tasks.

The above functions were realized through:

- Establishing *URL (Uniform Resource Locator)* address lists of so called "farm participants" creating "resource farm".

- Elaborating procedures of regular visiting the "farm participants" and downloading new information to update resources in the information repository – this job was assigned to software agents.

It was assumed that information would be downloaded form the reliable information sources, including providers offering content in the agreed form, frequently updated. They are primarily *Web pages* with *RSS (Really Simple Sindication)* information channels, electronic mail and data available on *FTP* servers. *The Information Gathering Subsystem* performs also the task of *The Information Repository* management, for example completing incomplete address information, phone numbers or updating data concerning product prices or services – susceptible to frequent changes. The *MySQL* database was accepted as the main repository.

The group of *The Information Agents* being part of *The Information Gathering Subsystem* constitute: *The HTTP Agent, The FTP Agent, The E-mail Agent, The JDBC Agent* and *The Auxiliary Agent*.

The *JDBC* (*Java DataBase Connectivity*) *Information Agent* is responsible for database handling, whereas *The Auxiliary Information Agent* is meant for communication in *KQML* language with other software agents.

The HTTP (*Hypertext Transfer Protocol*) *Information Agent* – performs the function of acquiring information from the Web pages. This agent acts as a middleware between the agent system and the information suppliers. Its task is to parse the *Web pages* and transform the information obtained to the form stored in *The Information Repository*. The *Web pages* are loaded into memory (by means of the *HTTP Client* library) and parsed on the user's side. Its construction is based on classes included in *HTTP Interface PAC* library of *AgentBuilderPro1.4* (*Acronymics, Inc.*, 2004). *HTTP* protocol requires user's action. Despite introducing languages such as *PHP (Hypertext Preprocessor)*, *ASP (Active Server Pages)* or *JSP (Java Server Page)* the document returned in response to the demand is usually specified in HTML format. The syntactic of *HTML* language which allows simultaneous description of the look, content and links of the hypertext documents determined the success of WWW. Nowadays this feature has become a problem because the content is not described in a way facilitating information search. The first step taken was the introduction of *CSS (Cascading Style Sheets)* style sheets, still part of information remained mixed with the way of formatting. The partial solution to this problem became *XML (Extensible Markup Language)*, however it did not cause disappearance of *HTML* because *XML* describes data, and *HTML* the way it is displayed. Presently WWW network is evolving towards *Semantic WWW Network*. Yet, the WWW interface still constitutes the most important way of accessing its resources.

The listings below present syntax of activity rules of the *HTTP Information Agent*. The presented examples of rules are connected with initialization of an object of the *HttpInterface* class (the *HTTP Information Agent's* construction is based on this class) and downloading links from the specified Web page.

The E-mail (*Electronic Mail*) *Agent* – a software agent to handle electronic mail; in its operation it uses classes included in the *Email PAC Library*, among others *RsiPOPClient, RsiSMTPServer, RsiMessage, RsiFolder*. This agent can communicate with *POP3 (Post Office Protocol version 3)* mail server in order to collect messages and with *SMTP (Simple Mail Transfer Protocol)* in order to send messages.

The FTP (*File Transport Protocol*) *Agent* – a software agent to handle file transfer from *FTP* server; it uses *RsiFtpClient* class in *FTP PAC* library, which allows to add file transfer ability to the designed agent application, both in active and passive mode.

Listing 1. Rule *Initialization*

Name:	**Initialization**

   IF:

         1. (BIND *startupTime*)

   THEN:

         1. DO SystemOutPrintln ("Initialization")
         2. ASSERT ("*currentUrl*" *HttpInterface*("http://www.twoja-firma.pl/",
             PacCommSystem (*SELF.agentInfo*, "*HttpInterface:PAC*")))
         3. ASSERT ("*tempHttpInterface*" *HttpInterface* ("http://www.twoja-firma.pl/",
             PacCommSystem (*SELF.agentInfo*, "*HttpInterface:PAC*")))
         4. DO SystemOutPrintln ("Instance of *HttpInterface* class created")

Listing 2. Rule *Links downloading*

Name:	**Links downloading**

   WHEN:

         1. (%message.sender EQUALS "HttpInterface:PAC")
         2. (%message.contentType EQUALS String)
         3. (%message.content EQUALS "Done retrieving")

   IF:

         1. (depth NOT_EQUALS maxDepth)

   THEN:

         1. DO SystemOutPrintln ("Get Next Link")
         2. DO ReturnVar_1 = currentUrl.getNextLink ()
         3. DO ReturnVar_2 = currentUrl.compareUrls (ReturnVar_1.url)
         4. SET_VALUE_OF matchingUrls to ReturnVar_2
         5. ASSERT ("newUrl" ReturnVar_1.url)
         6. ASSERT ("linkUrl" ReturnVar_1.url)

CONCLUSION

In the proposed model of the agent-based system of market information management main attention is focused on The Information Gathering Subsystem. Application of Information Agents enables acquisition, updating and storing relevant information, which enables to decrease manager's workload in performing time-consuming tasks. The present form of the Internet network requires that each software agent is created individually. However, in future, when the Internet takes the form of Semantic Network, it will be possible to change the software agent's software in the architecture of the proposed system without changing the remaining part of the system. This is one of the important advantages of creating agent systems (Jennings and Wooldridge, 1998).

There are plans to integrate the system with the artificial intelligence package Statistica Neural Networks within the conducted research, which will enable acquisition of market information in a way ensuring their presentation in a wider historical aspect.

At present some steps have been taken to implement the proposed model of the agent system in the prototype system of market information management in the enterprise.

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