Smart Software Systems: Its Evolution and Application

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Abstract: The primary vehicle in the quest for intelligent software has been the gradual recognition of
the central role played by data and information rather than the logic and functionality of the application.
Smart software agents have the capability of reacting to its environment, being autonomous, goal-orientation
and persistence as well as exhibit flexible behavior, reactive and proactive nature with some degree
of social ability. This study focused on the evolution of smart software agents; four essential types of
intelligent software agents; the importance of smart software agents. Furthermore, these capabilities were
examined by designing an ecommerce website for Delta State University bookshop which was test-run by
different users. It was concluded that smart software agents have come to stay as they are pre-defined
clients within user systems and perform internal functions that are necessary for the particular user to deliver
its services.

Key words: Software agents, artificial intelligence, intelligent agents, expert systems, smart software agents,
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INTRODUCTION

The concept of an agent can be traced back to
Hewitt’s Actor model (Hewitt, 1997). A self-contained,
interactive and concurrently-executing object, possessing
internal state and communication capability. Software
agent systems are a direct evolution from Multi-Agent
Systems (MAS) which evolved from Distributed
Artificial Intelligence (DAI), Distributed Problem Solving
(DPS) and Parallel AI (PAI) thus, inheriting all
characteristics (good and bad) from DAI and AI.
(Phillips-Wren and Jain, 2005). The primary vehicle in
the quest for intelligent software has been the gradual
recognition of the central role played by data and
information, rather than the logic and functionality of the
application.

Thus, the three milestones in this evolution have
been: the separation of data management from the internal
domain of the application; the development of standard
data exchange protocols such as the Extensible Markup
Language (XML) and the ability to build information
models that are rich in relationships and are thereby
capable of supporting the automated reasoning
capabilities of software agents (Phillips-Wren and Jain,
2005).

Nwana (1996), Wooldridge (2002, 2003), Russell and
Norvig (2003) and Phillips-Wren and Jain (2005) have
proposed different definitions of agents and these
commonly include concepts such as persistence
(code is not executed on demand but runs continuously
and decides for itself when it should perform some
activity), autonomy (agents have capabilities of task
selection, prioritization, goal-directed behavior, decision
making without human intervention), social ability
(agents are able to engage other components through
some sort of communication and coordination, they
may collaborate on a task), reactivity (agents perceive
the context in which they operate and react to it
appropriately).

This study focuses on the evolution of smart
software agents; four essential types of intelligent
software agents; the importance of Smart Software
agents and their capabilities were examined by
designing an ecommerce website for Delta State
University bookshop which was test-run by different
users.

LITERATURE REVIEW

Software agent can be termed to be a program
that acts for a user or other program in a
relationship. In other words it has the authority
to decide which (and if) action is appropriate.
The idea is that most agents are not strictly
invoked for a task but activate themselves (Artificial
intelligence).
These software agents are called intelligent agents when they exhibit some aspect of learning and reasoning, autonomous agents when they modify the way of achieving their objective, distributed agents when being executed on physically distinct computer, multi-agent systems when the distributed agents communicate with other agents in order to achieve an objective, mobile agents when they have the capability to relocate their execution on different processors and Smart software agents when they have the capability to reason, learn, work together and modify ways of achieving objectives. Therefore, smart software agents (Fig. 1) have the capability of reacting to its environment being autonomous, goal-orientation and persistence as well as exhibit flexible behavior, reactive and proactive nature with some degree of social ability.


MATERIALS AND METHODS

The fact-finding techniques used in information gathering were document review, research and site visit as well as designing an ecommerce website for Delta State University bookshop which was test-run by different users to demonstrate the role of software agents in delivering services.

Intelligent software agents (smart software agents): The internet allows different activities to be performed and thus different smart software agents are needed to achieve such purposes. According to Haag (2006), there are only four essential types of intelligent software agents; buyer agents or shopping bots, user or personal agents, monitoring-and-surveillance agents and data mining agents.

The buyer agents (shopping bots): Retrieve information about goods and services by using the technology known as collaborative filtering (amazon.com).

User agents (personal agents): They are intelligent agents that help perform the tasks of checking e-mail and sending alert when important emails arrives, play computer games as the opponent, assemble customized news reports, find information on the choice of subject, fill out forms on the web automatically and stores the information for future reference, discuss topics with the user ranging from deepest fears to sports, facilitate with online job search duties by scanning known job boards and sending the resume to opportunities who meet the desired criteria and profile synchronization across heterogeneous social networks.

Monitoring and surveillance (predictive) agents: These are used to observe and gives report on equipment like the computer systems. These agents keep track of company inventory levels, observe competitors’ prices and relay them back to the company, watch stock manipulation by insider trading and rumors service monitoring as well as monitor complex computer networks that can keep track of the configuration of each computer connected to the network.

Data mining agents: Uses information technology to find trends and patterns in an abundance of information from many different sources. This agent operates in a data warehouse discovering information and can also detect major shifts in trends or a key indicator and can detect the presence of new information and alert one.

The importance of smart software agents: Advancements in computer technology have made it possible to store vast amounts of data in electronic form. Typically, data file and database management methodologies focused on the storage, retrieval and manipulation of data transactions rather than the context within which the collected data would later become useful in planning, monitoring, assessment and decision-making tasks (Pohl, 2004). It relates to the complexity of networked
computer and communication systems and the increased reliance of organizations on the reliability of such information technology environments as the key enabler of their effectiveness, profitability and continued existence. For instance is the TeGRID Semantic Web Application by Gollery and Pohl (2002) shown in Fig. 2 and 3.

**Application of smart software agents:** The software agents are innovative technologies that may offer various benefits to their end users by automating complex or repetitive tasks (Serenko and Dettlor, 2004.) Software agents are able to quickly search the internet, identify the best offers available online and present this information to the end users.

Therefore, users may not need to manually browse various websites of individual merchants; they are able to locate the best deal in a matter of seconds.

Fig. 2: Transition from data to knowledge

Fig. 3: Human interpretation of data

Fig. 4: E-commerce for DeISU bookshop
Fig. 5: Web page programming option

Fig. 6: Generation of Master Credit card

Fig. 7: For searching the books in the store

Fig. 8: Shop cart for the user

Fig. 9: Compiled server programs flow chart

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Fig. 10: Book details

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![Login interface with ISBN, book name, and author fields]

Fig. 11: Search for books

In illustrating the role of smart software agents an ecommerce website for Delta State University bookshop was designed and test-run (Fig. 4-11). The program creates an HTML document to be sent to the client browser.

RESULTS AND DISCUSSION

According to Gollery and Pohl (2002) and Pohl (2004), a more complete information management environment considers data to be the bottom layer of a three-layer architecture, namely: data layer (that integrates heterogeneous data sources into accessible and purposefully ordered data), mediation layer (that defines the logical data models, data transfer formats, data transformation rules and also serves as a translation facility for bridging between data with structural relationships) and information layer (that consists of many functionally oriented planning and decision assistance software applications).

In such a three-layered information management environment, the mediation layer continuously populates the information models of the applications in the information layer with the data changes that are fed to it by the data layer. This in turn automatically triggers the reasoning capabilities of the software agents. Thus, the agents can be looked upon as intelligent dynamic tools that continuously monitor changes in the real world. They utilize their reasoning and computational capabilities to generate and evaluate courses of action in response to both real world events and user interactions as a result the human user is relieved of many of the lower level filtering, analysis and reasoning tasks that are a necessary part of any useful planning and problem solving process.

In the test-run of the DelSU bookshop site, the capabilities of the smart software agent were observed through the ability of an executing software entity to extend its information model by gaining access to portions of the information model of another executing software entity; ability of several semantic web services to collaboratively assist each other and human users during time of critical decision-making processes; ability of a software agent to automatically reason about events in near real-time under time critical conditions and ability of a semantic web service to create an agent to perform specific situation monitoring and reporting functions.

The reasoning capabilities are performed by software agents that are components of the players (Wooldridge and Jennings (1995). In other words, agents are predefined clients within computer systems and perform internal functions that are necessary for the particular system to deliver its services.

Disadvantages/Pitfalls of smart software agents: The implementation of agents also requires additional
resources from the companies, places an extra burden on their networks and requires new security procedures. The cultural effects of the implementation of software agents include trust affiliation, skills erosion, privacy attrition and social detachment. Some users may not feel entirely comfortable fully delegating important tasks to software applications.

In order to act on a user’s behalf, a software agent needs to have a complete understanding of a user’s profile including his/her personal preferences. This in turn may lead to unpredictable privacy issues. When users start relying on their software agents more, especially for communication activities, they may lose contact with other human users and look at the world with the eyes of their agents. It is these consequences that agent researchers and users need to consider (Serenko et al., 2007).

CONCLUSION

Computers have been shown to have learning-like capabilities and computers can discover information through associations and pattern matching (Phillips-Wren and Jain, 2005). Furthermore, there is an urgent need for intelligent computer capabilities due to the mounting expectations of accuracy, quality and timeliness in a globally connected environment of rapidly increasing complexity.

It is clear therefore that the continued expansion of networks such as the Internet and its successors will provide seamless connectivity among countless nodes on a global scale and smart software agents will always be a necessity in the networked environment.

REFERENCES


