Software Agents for Assessing Environmental Quality: Advantages and Limitations

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Extended abstract

The last decades, there has been a remarkable change in modern societies. Environmental values are appreciated to a greater extent, as it has become evident that they are highly correlated with our quality of life. The aftermath of the growing societal interest in the environment and sustainable development was the emerging need for providing environmental information to the public. The challenge for Environmental Management and Assessment Information Systems is to provide efficient, accurate and timely electronic services to the public.

In this work, we examine the applicability of software agent technology for automating the environmental quality assessment process. Software agents are best suited in systems that are modular, decentralized, changeable, ill-structured and complex, according to Van Dyke Parunak (1999). Environmental management and assessment systems are of this kind, and employing software agents to realize them makes possible the provision of advanced features. However, certain limitations may arise. Both advantages and limitations of agent-based applications for environmental monitoring and assessment systems are connected with real-world functionality.

Environmental Management and Assessment Information Systems is a generic term that covers software systems responsible for

1. gathering environmental information from dissimilar data sources,
2. managing environmental data for supporting the decision making process involved in environmental assessment, and
3. post-processing data and facts for supplying citizens, industry, public institutions and government with information services related to the natural environment.

Developing such systems is a demanding task, which requires interdisciplinary efforts originated from natural and environmental sciences, social and economic sciences, and informatics and computer science. In a schematic representation, we con-

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sider Environmental Management and Assessment Information Systems to be built
upon the junction of environmental informatics, integrated assessment and decision
support systems, shown in Figure 1. For such systems the challenge is to take advan-
tage of the information technology tools, and integrate them seamlessly in the
current procedures for providing services to all peers, including the government, the
industry, public institutions and the society.

Advances in the Information Technology sector seem capable to meet the de-
manding requirements for building environmental information services. Current de-
velopments in software engineering have brought forth software agent technology.
The key abstraction used is that of an agent, i.e. a software entity characterized by
autonomy, reactivity, pro-activity, and social ability. Certain types of software
agents have abilities to infer rationally and support the decision making process.
Agent-based systems may rely on a single agent, but the advantages of this initiative
are revealed in the case of Multi-Agent Systems, which consist of a community of
co-operating agents. Several agents, structured in groups, can share perceptions and
operate synergistically to achieve overall goals (Jennings, Sycara and Wooldridge
1999). In this background, software agents could be considered in three distinct, yet
concurrent ways:

a. Agents as information carriers, i.e. as autonomous entities capable for process-
ing information.

b. Agents as decision-makers that comprehend their environment and respond to
it, taking advantage of their abilities to reason rationally and behave proactively.

c. Agents as societal illustrators, capable to achieve common goals synergistically,
through the collaboration of autonomous individual actions.

This triple view on software agents is illustrated in Figure 1. In our recent de-
velopments, we have combined these three approaches for building intelligent software
applications for environmental management and assessment (Athanasiadis and Mit-
Developing intelligent software applications for environmental management and assessment with agents is beneficial for all involved parties as the notion of an agent is easily comprehensible by natural scientists, environmentalists, economists, social scientists and software engineers. In this way, value conflict problems can be tackled efficiently. Also, agent technology benefits for rapid prototyping and software reusability can be also considered in the advantages of such an approach. However, the problem of lack of standardization in agent-based software engineering methods and tools still remains. Even so, agents acting as mediators seem suitable for delivering preprocessed information in distributed environments able to support new, efficient, modern information services to the public.

References


