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REVIEW ARTICLE

Mobile Agent: A Comparison Review

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Abstract:

Mobile agent is a software program that migrates from one node to another while performing given tasks on behalf of a user [1]. Mobile agent is widely used in distributed systems. A mobile agent can communicate with other mobile agents, can stop its execution at any time, communicate with another host, and resume its execution at any time because it is a state-full agent. Mobile agent is growing very fast especially in distributed systems. Therefore many challenges are facing this approach. A comparison study for different issues in mobile agent will be discussed in this paper. Evaluation for these issues will be determined and based on this evaluation, results and recommendations will be published.

1. Introduction

A mobile agent is a software program that can travels from one node to another node on behalf of the user with the features of autonomy, social ability, learning, adaptivity, reactivity, mobility etc [2][3]. Mobile agents are defined as objects. These objects have their state, location, and behavior. Mobile agents are used in many areas such as networking, information retrieval, military, distributed systems, distributed database, etc. Each agent is typically composed of the agent code, the agent execution thread along with an execution stack, and the agent data part, which corresponds to the values of the agent's global variables [4]. Mobile agent has features that can reduce network overload, overcome network latency, synchronous and autonomous execution, robustness and fault-tolerance, system scalability and operating in heterogeneous environments. [5] has explained mobile agent as the following: any autonomous entity that is able to perform actions in an environment perceived by him. He classified mobile agents based on a set of criteria into seven types: collaborative, interface, mobile, information, Reactive, Hybrid, and Intelligent. Mobile agents may save space, reduce network traffic, support heterogeneous systems,...etc

2. Related Work

Mobile agents are applied in different areas:

2.1 Networking Area.

[6] describes possible benefits by using mobile agents in networking by Table 1.

Possible Benefit	Justification
Efficiency savings	CPU consumption is limited, because a mobile agent executes only on one node at a time. Other nodes do not run an agent until needed.
Space savings	Resource consumption is limited, because a mobile agent resides only on one node at a time. In contrast, static multiple servers require duplication of functionality at every location. Mobile agents carry the functionality with them, so it does not have to be duplicated. Remote objects provide similar benefits, but the costs of the middleware might be high.
Reduction in network traffic	Code is very often smaller than data that it processes, so the transfer of mobile agents to the sources of data creates less traffic than transferring the data. Remote objects can help in some cases, but they also involve marshalling of parameters, which may be large
Asynchronous autonomous interaction	Mobile agents can be delegated to perform certain tasks even if the delegating entity does not remain active.
Interaction with real-time systems	Installing a mobile agent close to a real-time system may prevent delays caused by network congestion. In Network Management systems NM agents usually reside close to the hardware, so this advantage might not be as clear as others.
Robustness and fault tolerance	If a distributed system starts to malfunction, then mobile agents can be used to increase availability of certain services in the concerned areas. For example, the density of fault detecting or repairing agents can be increased. Some kind of meta-level management of agents is required to ensure that the agent-based system fulfills its purpose
Support for heterogeneous environments	Mobile agents are separated from the hosts by the mobility framework. If the framework is in place, agents can target any system. The costs of running a Java Virtual Machine (JVM) on a device are decreasing. Java chips will probably dominate in the future, but the underlying technology is also evolving in the direction of ever-smaller footprints
Online extensibility of services	Mobile agents can be used to extend capabilities of applications, for example, providing services. This allows for building systems that are extremely flexible
Convenient development paradigm	Creating distributed systems based on mobile agents is relatively easy. The difficult part is the mobility framework, but when it is in place, then creating applications is facilitated. High-level, rapid application development (RAD) environments for agents will be needed when the field matures. It is quite probable that the flourishing tools for object-oriented programming will evolve into agent-oriented development environments, which will include some functionality to facilitate agent mobility.
Easy software upgrades	A mobile agent can be exchanged virtually at will. In contrast, swapping functionality of servers is complicated; especially, if we want to maintain the appropriate level of quality of service (QoS).

Table 1: Potential benefits from the use of mobile agents [6]

2.2 Information Searching and Filtering Area

The objectives of Information filtering and information retrieval are similar [7]. Each one of them wants to retrieve information according to the user request; they try to exclude as much as possible the amount of irrelevant information. But, there are key differences between information retrieval and information filtering [8], as noted in Table 2 [9]. Filtering agent [10, 11] acts an interface between the user and the document system, and helps the user to find the relevant topics of a given topic through the user agent. The main advantage of this is the reduction of the user' time and effort in locating the relevant document through the specialized domain knowledge it possesses.

	Information retrieval	Information filtering
Information need	Dynamic	Static
Information source	Static	Dynamic
User profile	Not necessary	Essential
Scope	Generalized	Specific
Information seeking Behavior	Short term	Long term
User Query	Short term	Description or explanation of the information
User interaction with the system	Single information seeking episodes	Series of information seeking episodes

Table 2: Information retrieval vs filtering system [9]

2.3 Multimedia Area

Mobile agents in Multimedia Systems allow a high number of multimedia elements to be reachable anywhere and anytime by using a various types of handheld devices, also characterized from limited computational and storage resources [12]. In mobile networks, entities need to communicate with each other using real time media such as text, audio, images and video by using mobile multimedia system that can integrate various real time and discrete media data. Multimedia Service system for mobile applications and users not only incorporate various multimedia information distributed over networks but also provides it to users in accordance with the mobile user's requirements and device profile in real time. These conditions must be met even though the mobile and network resources change statically or dynamically [13]. [14] has pointed out that multimedia services must activate intermediate nodes for QoS-enabled service provisioning by operating on traversing data flows and reserving intermediate network resources at runtime. A middleware technology suitable for developing and deploying active services can be emerged by using Mobile agents.

2.4 Internet

The World Wide Web (WWW) contains unstructured contents of information resources. The information can be located anywhere, dynamically migrate, get distributed, and rearranged. The ways of representing this structure varies from simple by using HTML to a complex structure by using database. Traditional tools that search the Internet usually retrieve increasingly redundant

information and do not offer a proof for completeness. The rise of several new Internet-oriented applications motivates the design and programming of new paradigms [15]. The current interest in the mobile agent paradigm is widely justified by the advantages it provides over traditional approaches in Internet applications [16]:

1. mobile agents can significantly save bandwidth by moving locally to the resources they need.
2. mobile agents can carry the code to manage remote resources.
3. mobile agents do not require continuous network connections.

2.5 e-Learning Platforms

The implementation of an Agent Search System offers important features not available in traditional used e-learning systems. Simultaneous theoretical research and practical development work open the unique opportunity of testing how new ideas perform in real life and lets us acquire valuable experimental data.

Moreover, analysis of the history of the users' activities, made possible by our system, in connection to analysis of LOM fields, is a significant step towards creation of an intelligent Learning Object search engine, which will present search results in a way as close to the user's expectations as possible.

The Agent Based Search System is stable and easy for management and development [17].

2.6 Intrusion Detection Systems

Applying mobile agent (MA) to intrusion detection design is a recent development and it is aimed at effective intrusion detection in distributed environment. [18] proposed a way of classifying typical IDS and then strategically reviews the existing mobile agent-based IDSs focusing on each of the categories of the classification, for example architecture, mode of data collection, the techniques for analysis, and the security of these intelligent codes. Mobile agent is of the features of reducing network overload, overcoming network latency, synchronous and autonomous execution, robustness and fault-tolerance, system scalability and operating in heterogeneous environments.

3. CONCLUSION

Mobile agents can be effectively used in gathering, filtering, sharing, monitoring, recommending, comparing information, guiding Web surfers, email filtering, auto responders and negotiating. Table 3 maps the functions which can be done by mobile agents to applications domains [19].

	Gt	Fi	Sh	Mn	CI	Gws	Ef	N
NM	X	X	X	X	X			X
EC	X	X	X	X	X			
EMM	X	X	X	X	X			
WMS	X	X	X	X	X			X

GCnDS	X	X	X	X	X	X		X
DDM	X	X	X	X	X		X	X
MM	X	X	X		X			X
HT	X	X	X	X	X			X
S	X	X	X	X	X		X	X
R	X	X	X	X	X	X	X	X
SWS	X	X	X	X	X	X	X	X

NM	Network Management	Gt	Gathering
EC	Electronic Commerce	Fi	Filtering
EMM	Energy Efficiency and Metering	Sh	Sharing
WMS	Wireless Multimedia Sensors	Mn	Monitoring
GCnDS	Grid Computing and Grid Services	CI	Comparing Information
DDM	Distributed Data Mining,	Gws	Guiding eb surfer
MM	Multimedia	Ef	Email filtering
HT	Human Tracking	N	Negotiating
S	Security		
R	Recommendation		
SWS	Semantic Web Services.		

Table 3: Mobile agent functions in different application areas [19].

It is clear from this study that by using mobile agents in different areas, the efficiency gets increased.

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