Information Retrieval Using Mobile Agent in Distributed Environment

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Abstract - Mobile Agent (MA), in information retrieval, plays a vital role in speeding up the searching process automatically as it supports disconnected operations varying from traditional client server approach which requires a dedicated connection. Today with the emerging use of internet for e-commerce transactions and increasing e-commerce websites which requires several interactions between clients and server sites, Mobile Agents provides a suitable model to effectively scale the processing. Several researchers worked on mobile agents in different implementation framework to bring this concept in work. There are also several other applications where mobile agents work such as network management, distributed data mining, weather forecast etc. This paper proposes the precise domain for specifically designing IR system for handling e-commerce websites to effectively and efficiently searching items matching the desired requirement of the user.

I. INTRODUCTION

Internet has evolved from an information space to a market space with not only thousands but potentially millions, of electronic shop fronts, auctions and other commercialized services. This creates great opportunities, but is not without problems. The information overload is an obstacle to the practical use of potentially useful information on the Web. The use of mobile agents in this kind of applications represents a novel approach and potentially solves most of the problems that exist in centralized client-server solutions, because they are programs with a robust identity which moves around a network and can communicate with this environment and other agents. From the papers read on Mobile Agents (MA), three different application domains are basically observed where MA’s can be deployed. First, data-intensive applications where the data is remotely located. Second, e-commerce applications where agents are launched by an appliance and third and maybe the most important is for extensible servers, where a user can ship and install an agent representing him/her more permanently on a remote server.

A. History of Mobile Agent

• 1969: Probably for the first time the idea to send code in an architecture-independent format to different hosts via a network was mentioned by Jeff Rulifson. He introduced the Decode-Encode-Language (DEL) which was published as RFC 54. The idea was to download an interpretative program at the beginning of a session, while communicating to a remote host.

• 1979: A group at Linkoping University in Sweden had the idea to build a packet-oriented radio network they called Softnet. Each packet is written in FORTH programming language and sent over the network where it get executed. Using this technique, every user was able to instruct every network node to provide new services.

• 1987: Joseph R. Falcone proposed to enable clients to program their specific interfaces themselves, using a well-defined new programming language NCL (Network Command Language). Thus, what we have here is primitive mobile code in both directions.

• 1994: James E. White, affiliated with General Magic Inc. published a white paper that initiated dedicated research on what we call mobile agents today. This paper was later republished in a book edited by Bradshaw in 1996. White introduced the Telescript technology which was the first one to coin the term “mobile agent” which supported mobility at the programming language level.

• 1996: Fukuda et al., proposed the MESSENGERS project which have the concept of autonomous objects. Messengers are able to migrate autonomously through a LAN of dedicated servers that accept these objects.

• 1999: A first standardization approach to mobile agent system was published by Milojicic et al.

• 2000: A comparison of object oriented mobile agent systems was done by Gschwind. The Mobile Agent System Interoperability Facility (MASIF) was backed by companies that were active in mobile agent research, e.g. IBM, General-Magic, and GMD Fokus and was published as OMG standard.

B. Mobile Agent

A Mobile Agent (MA) is an executing program that can migrate during execution from machine to machine in a heterogeneous network. It is basically a composition of computer program, execution state and data which is
able to move from one computer to another autonomously and continue its execution on the destination computer. The significant feature of MAs is to provide a new programming paradigm for building agile distributed system.

This paper is structured as follows: Section II comprises basic elements of MA System; section III comprises related work in Mobile Agents in IR systems especially in e-commerce, section IV comprises Proposed Approach and section V shows the conclusion.

II. BASIC ELEMENTS OF MA SYSTEM
Every MA System has the basic elements for implementation as:
A) Mobile Agent
The foremost element in Information Retrieval system is Mobile Agent.
1) Attributes of mobile agent: The Mobile Agent has four entities:
   i. Identification: A number in the format of 2-tuple (i, j), where I indicates the IP address of the dispatcher and J the serial number assigned to agents by the dispatcher. Each mobile agent can be uniquely identified by its identification.
   ii. Data space: The agent's data buffer which carries the partially integrated results. This result should provide progressive accuracy as the agent migrates from node to node.
   iii. Itinerary: The route of migration. It can be fixed or dynamically determined based on the current network status. Currently, we assume the itinerary is fixed.
   iv. Method: The processing task (or execution code) carried with the agent. Our focus in this paper is the development of distributed sensor integration algorithms.
2) Functions of Mobile Agent:
In Distributed Network Environment, the Mobile Agent performs these four following functions:
   i. Cloning: It creates duplicate copy of itself.
   ii. Dispatch: It dispatch the clones to other host in the network.
   iii. Retrieval: It retrieves the information from the respective host.
   iv. Processing: It processed the retrieved information and return the result back to the origin when the link is operational.
B) Distributed Databases
The most critical part of any Mobile Agent System for efficient Information Retrieval is to collect the data from different databases having data stored in various data formats, segregate them and finally represent them in a common structured format.

With the advent of internet and its growing usage many storefronts are introduced whose data formats are completely differ from one another. And these databases are all distributed over the network.

C) Implementation Platform
Several platforms that implement the mobile agents have emerged since the 1990s. Some of them are not maintained anymore or fade and others continued to be used in various research laboratories and even in some commercial products [6]:

Some of them are:
- Voyager: It is a Java platform that provides flexibility using both traditional techniques and distributed computing based on MAs to create network applications. It includes various models of mobile computing: peer-based, client / server and agent based. It also contains features that found in other ORBs (Object Request Broker), CORBA, RMI, Aglets and JADE.
- Trinity: It is mobile agent based framework which allows creating for wide range of mobile agent types. It allows rapid development of non-complex agents.
- JADE: The Java Agent Development Framework is a java software Framework. It allows implementation of multi-agent systems which complies with the FIPA specification. The agent platform can be distributed across several machines where the configuration is performed via a remote GUI. Several international projects, IST, ACST, E-CAP have been based on JADE.
- MAF: Mobile Agent Framework is based on Python research prototype which provides set of elementary requirements to facilitate the development of distributed mobile agent. It also provides a mechanism to incorporate and integrate with a variety of foreign agents written in other languages such as C and C++.
- TAgent: Travel Agent is a Java based platform which allows to develop Mobile Agents. It provides an easy service extending, an easy Agent development platform and a secure design for the agents. TAgent is Compliant with MASIF Standard of OMG.

III. RELATED WORK
The following architecture given by Prof. Y M Naik et al. [2] gives a potential solution to the information overload on the web resulted from the thousands of potentially evolved Storefronts, auctions and commercial services. Prof. Y M Naik et. al [2] uses MA as a novel approach to solve most of the obstacles faced in client-server paradigm as MAs having persistent identity and are programs that migrate around the network communicating other agents. The author
presented: the Data Agent System - a MA application for the retrieval of distributed structure information for several on-line bookstores. This system was developed in Java for Web-based distributed access to database system.

The system basically comprises three components: Interface Module, Control Module and Purchase Agents.

i. Interface Module: The component through which the user communicate with the system and places his/her order. This module is also responsible for displaying the result collected by the group of agents to the user.

ii. Control Module: This module is responsible for the creation and release of purchase agents to start the search as requested by the user. This module also combines the results searched by different agents. There is one control module for each product available in the system like one for book, one for CDs and so on. The important role of Control Module is when it receives a request to send an agent, an agent is created on the “aglet” layer and migrates through the runtime layer, which in turn converts the agent into an array of bytes and is passed on to the ATP layer – Agent Transfer Protocol, to be sent to its destination.

iii. Purchase Agent: The component makes contact with the stores by accessing their databases, place the order and interpret the results generated, converting them into a format that is understood by the control module. Before proceeding to their destination, the agents are coded in bit stream: the first segments are general information, such as the agent’s identification, and the last segment is the byte array, such as code and state. The goal of the agents is to check the information found at their destination address, selecting only the information considered relevant and recommended according to the pre-determined rules.

Another decentralized approach for efficient retrieval of information is given by Bo Chen [1] which improves the network efficiency in an e-commerce application since the processing is performed locally.

In Bo Chen [1] architecture Mobile Agents are used to search and then purchase products. The method is as follows. First, when the Buyer Server receives a buyer’s purchase request, it will generate a mobile agent and sends it to the Information Server to search all retailers who sell the product. Now after having a list of retailers, the Buyer Server dispatches a mobile agent which will visit these entire retailer’s. Then the mobile agent negotiates with retailer’s local seller agents and reports the offers to the Buyer Server. Then finally the Buyer Server evaluates all the offers, and sends a purchase mobile agent to the best offer retailer to make the final purchase.

IV. PROPOSED APPROACH

Using the literature survey of Mobile Agents in E-Commerce we can say that the searching operation can be made faster by making use of Mobile Agents over the Internet.

The four main objectives of this approach are:

i. Efficient searching method for faster retrieval of information.

ii. Reduce transaction cost involved in e-commerce, Business to Customer (B2C) transaction.

iii. Reducing complexity.

iv. Security to both host and mobile agent. Cryptography is used to maintain code and data privacy and integrity.
V. CONCLUSION

Mobile agents move the data to the remote distributed databases, not the databases to the data. Therefore, the proposed system has huge bandwidth savings and can overcome network latency. Mobile Agents have received a diverse range of applications in information retrieval, network management, e-commerce, transportation systems, Distributed control systems, and manufacturing. From the literature survey it was noted that mobile agents have several advantages over conventional client server paradigm like reducing network traffic, supporting disconnected operation, overcoming network latency, and roaming ability in heterogeneous platforms, which is vital in building ubiquitous e-commerce systems. As compared to traditional client server systems MAs also provide fast and efficient interaction in an emerging e-commerce model.

Mobile Agents are also efficient in working with M-Commerce which conducts commerce using mobile devices such as mobile phones and PDAs (Personal Digital Assistant). Due to physical and network constraints (low CPU speed, small memory size, poor network connectivity, and limited bandwidth), the implementation of client/server approach in m-commerce systems faces significant challenges. The mobile agent paradigm offers an appropriate solution to reduce network traffic and tolerate poor network connectivity in m-commerce systems.

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