

A Model for Digital Watermark Tracking using Intelligent Multi-Agents System

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Abstract—

E-commerce has become a huge business and a driving factor in the development of the Internet. Online shopping services are well established. Due to the evolution of 2G and 3G mobile networks, soon online shopping services are complemented by their wireless counterparts. Furthermore, in the recent years online delivery of digital media, such as MP3 audio or video or image is very popular and will become an increasingly important part of E-commerce. The advantage of internet is sharing the valuable digital data which lead to misuse of digital data. To resolve the problem of misuse of digital data on Internet we need to have strong Digital rights monitoring system. Digital Rights Management (DRM) is fairly young discipline, while some of its underlying technologies have been known from many years. The use of DRM for managing and protecting intellectual property rights is a comparatively new field. In this paper we propose a model for online digital image library copyright protection based on watermark tracking System. In our proposed model the tracking of watermarks on remote host nodes is done using active mobile agents. The multi agent system architecture is used in watermark tracking which supports the coordination of several component tasks across distributed and flexible networks of information sources. Whereas a centralized system is susceptible to system-wide failures and processing bottlenecks, multi-agent systems are more reliable, especially given the likelihood of individual component failures.

Keywords— Watermarking, Watermark, Mobile Agents, Multi- Agents, DRM.

I. INTRODUCTION

Digital Rights Management (DRM) is a paradigm that holds much promise for novel business models related to the distribution and access to digital content such as text, music, movies and software. Protecting the rights of author, proprietor and legal user is important focus of Digital Rights Management. Watermarking algorithms are the new methods to protect copyright and authenticate origin under the internet environment. But the digital watermark algorithms cannot prevent users' copying, it makes sure the behaviors of piracy by the afterwards watermark detecting. Watermark provides proof and tracking capability to illicit copying and distribution of multimedia information [1]. The watermark could be seemed as the legal evidence, and overawe the piracy behaviors. In internet plenty of multimedia information is available. To track the watermark on internet we required efficient models, the method is needed to detect the watermark quickly and effectively. For example, to detect the watermark of digital works, the search engines could be used to collect the digital works from the internet. In this case, the network servers need to download all digital works and run all processes to detect watermark, which could result the network servers overloaded. Mobile agents are the basis of an emerging technology that promises to make it very much easier to design, implement, and maintain distributed systems [2]. We found that mobile agents reduce network traffic, provide an effective means of overcoming network latency, and perhaps most importantly, through their ability to operate asynchronously and autonomously of the process that created them. Mobile agents help us to construct more robust and fault tolerant systems [3].

The new trend in networks involves using mobile agents to manage the distributed network system. The mobile agent can be used to retrieve data from the Management Information Base system to monitor the network flow in the distributed environment. That is, management tasks are assigned to an agent and the agent can be sent to remote hosts to execute the assignment. After completing the assignment, the results are carried back to the sender by the agent. [4]. Mobile Agents offer a new paradigm for distributed computation [5], but their potential benefits must be weighed against the very real security threats.

In this paper we propose Multi Agent-based digital watermark tracking system. The Agent could migrate on the internet using the characteristic properties of mobile Agents. The mobile agents will run on the identified remote host and the digital work with certain digital watermark could be shortly traced on the internet. Every mobile Agent could communicate and cooperate with each other to complete the complex copyright tracking task. The paper is organized as follows: In section 2, we describe the proposed model for Watermark tracking System using mobile multi agents. In Section 3, we describe the active elements of our model. In Section 4, we present the important functions of watermark multi agent server. Finally, in Section 5, we conclude our paper .

II. PROPOSED MODEL

Figure 1 shows proposed model for Digital Watermark Tracking system. The model contains the following components:

A. Author Server of Digital Data:

He is the creator of digital data and having all rights on this data. He embeds the watermark on his digital data using his private key and embedding algorithm. The Author server maintains the database of about the legal purchasers of his digital data. That includes the MAC address of client Machine, IP address of client Machine, date and time of purchase. The above said information about the client machine is extracted when client started to download the digital data from author server. The Author server shares data of about the client, watermark and private key with the watermark tracking Multi-agent server.

B. Watermark Tracking Multi-Agents Server:

This is the important part of watermark tracking system. It contains the following sub components

C. Knowledgebase:

The server maintains knowledge of about different authors. This knowledgebase contains information of about the author watermark, key of embedding, MAC address of legal purchaser of digital data, date and time of purchase. All these information are used to build the knowledge base of about different authors. After tracking the watermark server generates the report base of about the MAC addresses of illegal users of digital data. This report will be later send to the author server for taking appropriate action against illegal users of digital data.

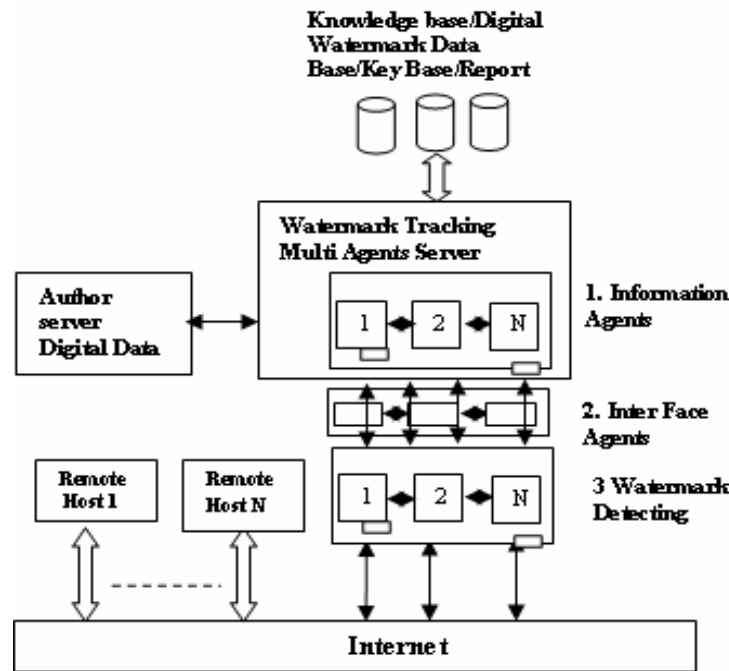


Fig. 1. Proposed Model for Watermark Tracking

Mobile Agents:

As shown in the Figure 2 the tracking of watermark is implemented by the three different multi agents. It uses the multi agent architecture to supports the coordination of several component tasks across distributed and flexible networks of information sources. This layered hierarchical structured representation of multi agents helps us to define fault tolerance and parallel environment. The functions of these three agents are explained as follows:

Information Agent:

Gets the knowledge of author from knowledge base, decides the legality of users and prepares the report of same and sends it author server.

Interface Agents:

It acts as interface to provide security between agents, security to report and communication channel between information and detecting agents.

Watermark Detecting Agents:

It deals with Identifying the remote host and file to execute detection algorithm, extract the watermark and send the appropriate report about user to interface agent.

III. ACTIVE ELEMENTS:

The active elements of our system are agents. This section describes about the active elements of our proposed system. Detailed agents functions and their work flow are explained in the following sections.

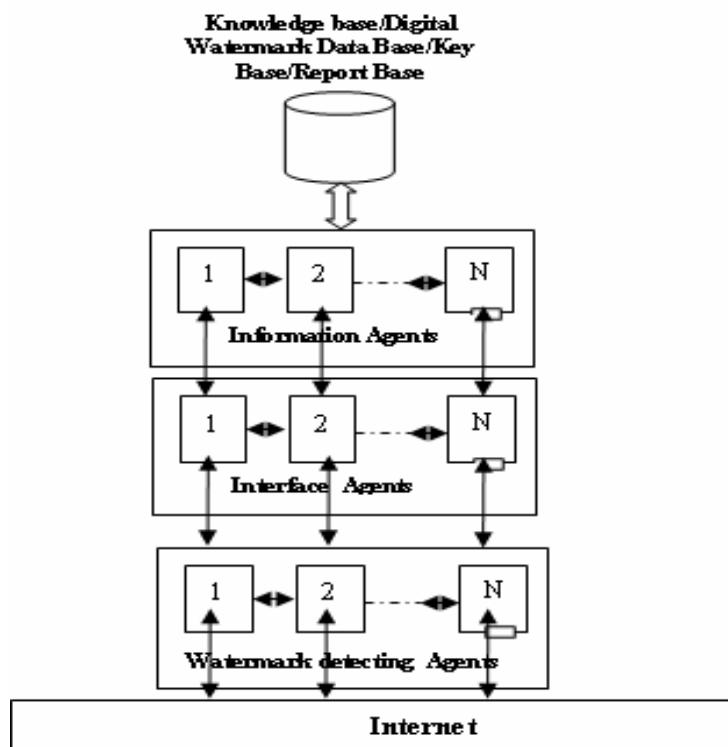


Fig. 2 Detailed agents interface representation

A. Information Agent:

The important part of proposed module is knowledge of about authors and legal purchaser. Thus the exchange of knowledge between the knowledge base of the server and the interface is done by information agents. As shown in the figure the information agents can exchange the knowledge between themselves. This helps to increase the speed of searching the knowledge base and minimizes the failure of search due to malfunctioning of agents. This agent receives the knowledge of about host machine and watermark from interface agent. Then this knowledge is processed to prepare report of about legal or illegal user of digital data. Based on the report Server will take an appropriate action against illegal host machine.

Work flow of Information Agent:

1. Read the MAC address and IP address of host from Interface Agent and search the same from multi-agent server data base.
2. If the address of host is not available in database report the same to interface agent, so that detection agent extracts the watermark.
3. If the information about host node is available report the interface agent to stop detection agent.
4. Read the report about the watermark, host address and date and time from interface and compare the same with knowledgebase to prepare a report about legality. Update the data base about recent report.

B. Interface Agents:

As name indicates these agent acts as interface between the information agents and watermark detecting agents. The secured communication between the information and detection agents is defined at these interface agents. This agent receives watermark data from detecting agent and transmits the same to information agent. Similarly this agent receives knowledge of author and transmits to detecting agents.

Work flow of Interface Agent:

1. Read a data about host machine from detecting agent and send the same to information agent.
2. Read the appropriate conformation messages about execution of detection algorithm from Information agent and send it to detection agent.
3. Read the report from detection agent and forward the same to information agent.

C. Watermark Detecting Agents:

The main function of watermark detecting Agent is to detect the watermark in digital works. Watermark detecting agent could be sent or migrate to the remote host, and visit the files in the host node. After filtering the unneeded files, the agent sequentially obtains the watermarks in corresponding files. The detection agent extracts information of about host environment, such as, date, time, MAC address and IP address of client machine, then transfers the same to interface agent.

Basic Characteristics of Watermark Detecting Agent:

Mobility: During the running process, detecting Agent could move from one to any other node in the internet to complete tasks.

Parallelism.: The different Detecting Agents might move to the appropriate network node to realize different command. In this process, all Detecting Agents are equal, and cooperate with each other as an autonomous system. Thus, all these movable Detecting Agents are composed to one contributed system.

Work flow of Watermark Detecting Agent:

1. Randomly Selects the remote host to run watermark detecting algorithm and transmits the MAC address and IP address of host node to interface agent.
2. Interface agent gives the confirmation of knowledge of about host machine.
3. If the knowledge of remote host is not available then, Search/Scan the files on this host machine, to classify the files of type needed and unneeded based on applications.
4. Select the needed file and apply watermark extracting algorithm using the private key of the author and send watermark data to interface agent.
5. Repeat the step2 for all needed files.

IV. FUNCTIONS OF WATERMARK TRACKING SERVER

Following services carried by Watermark tracking multi agents Server

A. Creating and naming an agent

This is one of the important functions of server. Here agents are created with unique references and synchronized using threads. In multi-agent systems a unique identification for each agent is required. In the proposed system the unique ID of the agent will be a combination of the agent server IP address (a hexadecimal representation of it) and a locally unique 16 bit ID (a hexadecimal representation of it) assigned by the agent server. When an agent is created it is assigned a 16 bit Local Unique ID and this is freed up when the agent is destroyed. This implies that a host can have a maximum of over 65,000 generated agents outstanding at any one time.

B. Providing the execute environment for watermark agents

The fault tolerant Agent environment is supported by agent server. Fault tolerant environment is build by offering a decentralized architecture based on the notion of Virtual Agent Cluster, which provides fault tolerance capability by using separate Communication layers among different agents. The Virtual Agent Cluster works autonomously, regardless of the external environment events, providing a self healing, proactive abstraction on top of all instances of multi-agent systems. Also the architecture ensures high assurance using peer to peer architecture which brings scalability, fault tolerance and load balancing among distributed peer agents.

C. Realizing the transmission and communication protocol between watermark Agents:

The Communication protocol between agents must stimulate communication process. The message form and selected communication language explicitly plays important role in order to sustain cooperation strategy. Otherwise, it is a knowledge-level communication. The Agents participating in communication must know the semantic of language. There are two communication patterns for realizing the message transmission.

Direct communication: In this pattern, each Agent must know when and where they should send the message, which Agents can cooperate with and what capability they should have, etc. this requires each Agent in the system owns enormous information about other Agents. Communication through medium: in this pattern, many Agents that are nearer from each other transmit message and interact through facilitator, the long-distance Agents' interaction is completed by cooperation of facilitators that lie in local groups. Communication module mainly includes communication protocol interface, message searcher, buffer zone and processor etc.

D. Providing Security to Agents:

The Problem is how to defend the hostile attack on Agent from host and protect data in the transmitting procession. To defend the attack on communication between Agents, the communication protocol safety of multi-Agent system needs to

meet the demands of confidentiality, integrality, and authenticity. The confidentiality means that the communication Agents own the same cluster key k . One Agent sends encrypted message package that includes message m . The Agent receives the encrypted message package, and decipheres the message m by cluster key k . The un-authorized Agent cannot calculate the message m without cluster key k . To ensure the integrality and authenticity of the authentication, the cluster key k could be used to detect message valid code, and attached to message m to be sent to Agent for preventing message amending. For un-deniability, the sender needs calculate the digital signature of message valid code by private key k' , and attaches the digital signature on message to send to other agents. Because only sender owns the private key k' sender cannot deny sending this data package.

E. Creating and dispatching watermark agent to hosts:

Creation of agents and Dispatching agents on remote host is controlled by server. Using multi threading it controls the events like create, dispatch, clone and delete.

F. Protecting the watermark agent report and key:

This is achieved by using authentication and security algorithms at agent and Server interface level. Using classical cryptographic algorithm the report is protected from different types of attacks.

G. Collecting and dealing with the agent report:

After receiving agents report regarding remote host from different agent's server will take appropriate action against the report. If the host user is illegal then server tries to destroy the content of file available on remote host. Then the list of illegal user is sent to the author server to maintain the black list of users.

IV. CONCLUSIONS

Nowadays the Copyright protection is an important topic. This paper put forward system architecture for copyright protection and tracking base on digital watermark and mobile multi agents. Further more Mobile Agents can save network resources. Mobile Multi Agent-based digital watermark tracking system owns the high efficiency. Much sensitive data and protocols are carried on Mobile agents, thereby it is hard to discover them by attackers, thus Mobile Agents and data are safe greatly. It could be employed in practice application to trace the watermark across the internet.

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