The Design of Softman-Based Digital Copyright Protection System in Internet

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***Abstract*—With the development of Internet, Network publishing has become the new trend of publishing industry. In the network environment, the communication and copy of digital contents become more and more convenient, which leads to the pirate problem of digital works. The conventional method of digital copyright protection is to search the digital works information with search engine, and download them to a server where all digital works would be authenticated. This method might lead to the overload of digital watermark server. A new digital watermark tracking system based on SoftMan is proposed in this paper, which can authenticate the digital watermark of digital works directly in the remote mainframe by using the distribution and mobile characters of SoftMan. Therefore the efficiency of copyright protecting and tracking is greatly improved. The digital watermark tracking SoftMan communication language, communication security and migration rules are also discussed in this paper. Finally, the mobile code technology for DWT SoftMan is discussed in this paper.**

***Keywords*—SoftMan, digital watermark, digital copyright protection**

I. INTRODUCTION

Along with the development of internet, the digital multi-media works get more and more popular, and the network publishing become the new trend of the publishing industry. It's simple to copy and modify the digital works in the network publishing, which has caused the serious piracy problem. The problem of how to protect the rights of author, proprietor and legal user, has become the scholars and engineers' research focus in the worldwide.

Digital watermark is the technique to protect the copyright of multi-media, and called as the last line of defense for the digital multi-media copyright protection. But the digital watermark cannot prevent users' copying. Actually, it makes sure the behaviors of piracy by the afterwards watermark detecting. The watermark could be seemed as the legal evidence, and overawe the piracy behaviors. For the watermark working efficiently, one method is needed to detect the watermark quickly and effectively out from the plenty of multi-media information on the network. For example, to detect the watermark of digital works, the search engines could be used to collect the digital works from network mainframes, and the digital works database with index should be founded to detect the watermark. In this case, the network servers need to download all digital works and run all processes, which could result the network servers overloaded and network bandwidth over-occupied. One SoftMan-based [1] digital watermark tracking (DWT) system is proposed in this paper. The DWT SoftMan could run on the under-detected remote mainframes, and migrated on the network. Utilizing the characters of DWT SoftMan, the digital work with certain digital watermark could be shortly traced on the network, and every DWT SoftMan could communicate and cooperate with each other to complete the complex copyright tracking task.

The technique of SoftMan-based digital copyright protection system and the architecture of DWT SoftMan are introduced in following.

II. THE ARCHITECTURE OF SOFTMAN-BASED DIGITAL COPYRIGHT PROTECTION SYSTEM

A. Concept and Characters of SoftMan

SoftMan is an artificial life of software, which lives in the software environment, moves in the network world, and has the characters of man, such as thinking, perception, behave, and emotion. SoftMan is also a virtual robot[2]. SoftMan is the research hot point in the AI domain, which is developed on the base of Agent [3, 4] with wide application.

SoftMan has following characters [5, 6]:

Mobility: During the running process, SoftMan could move from one to any other node in the network to complete tasks.

Contributed parallelity: In the system supporting SoftMan, one complex task could be decompounded as some smaller sub-task. And then, every sub-task should be distributed to different SoftMan. The different SoftMans might move to the appropriate network node to realize different command. In this process, all SoftMans are equal, and cooperate with each other as an autonomous system. Thus, all these movable SoftMans are composed to one contributed system.

Impersonate evolution: DWT SoftMan could produce the new members, and transmit the structure and the new learned functions to new generation members. There are some configuration differences between different generation members or even different members in the same generation. Based on the impersonate evolution, the DWT SoftMan member could gradually develop from simple to complex, and from low class to advanced one.

Initiative decision: DWT SoftMan could plan for the short-term behavior according to the aim and environment demands. According to the internal state and external environment, DWT SoftMan could initially act for the scheduled aim.

Learning ability: DWT SoftMan could accumulate knowledge according to the past experiences, and modify its own behavior to adapt to environment.

B. *The General Structure of Digital Copyright Protection System Based on SoftMan*

Shown in figure 1, the system architecture includes the digital watermark tracing (DWT) SoftMan server, computer network, and the DWT SoftMan service interface, the DWT SoftMan, the key base (KeyB), the report base (RB), the knowledge base (KB) and the digital watermark base (DWB).

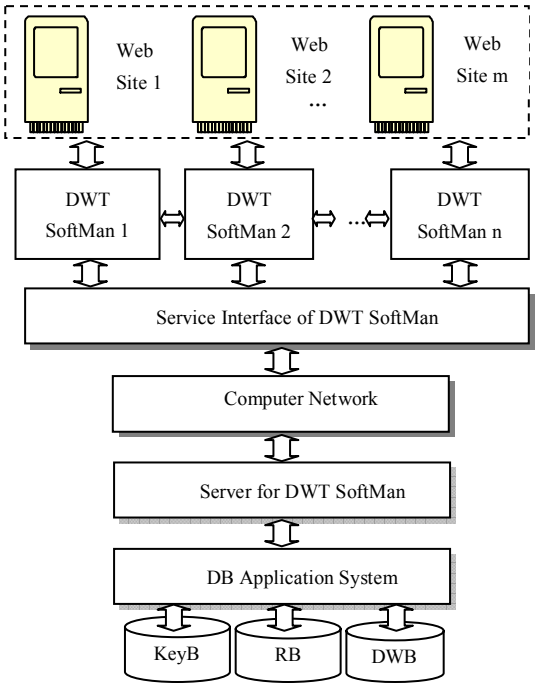

Figure 1. The general structure of digital copyright protection system based on SoftMan.

The main function of DWT SoftMan server is to manage SoftMan life period (including the ending of past SoftMan, the producing of new SoftMan, the upgrading of SoftMan functions), and process the feedback from the digital watermark detecting. The SoftMan service interface of DWT is mainly aimed to provide the service channel between the SoftMan server and SoftMans, and complete their communicating, commanding, information feedback and collection. The DWT SoftMan is used to explore, detect and trace the digital watermarks. Because there are plenty of network nodes and heavy digital watermark detecting and tracking tasks need to be processed, the DWT SoftMan could also arrange the job dividing, cooperation, plan, control and decision command of the SoftMan cluster, and provide the self-studying and self-evolving functions. The keys to detect watermark are kept in the key base. The watermark detecting reports from every server are kept in the report base, which record the copyright blacklist, times and contents of copyright piracy, and some other detailed information. The route strategies of DWT SoftMans are kept in knowledge base, which is an incremental database, and adds the behavior regulation according to the feedback result from SoftMan tracking. For example, one network site is detected to have illegal copy behavior, and then, the times of network SoftMan detecting could be increased. There are different detecting algorithms embedded in the digital watermark base (DWB). DWB sends the last digital watermark detecting algorithm to the SoftMan cluster charging the digital watermark detecting and tracking. DWB communicates with SoftMan cluster by the DWT service interfaces, DWT servers, and network.

III. DWT SOFTMAN

A. *TheStructure of DWT SoftMan*

The structure of DWT SoftMan is shown in figure 2.

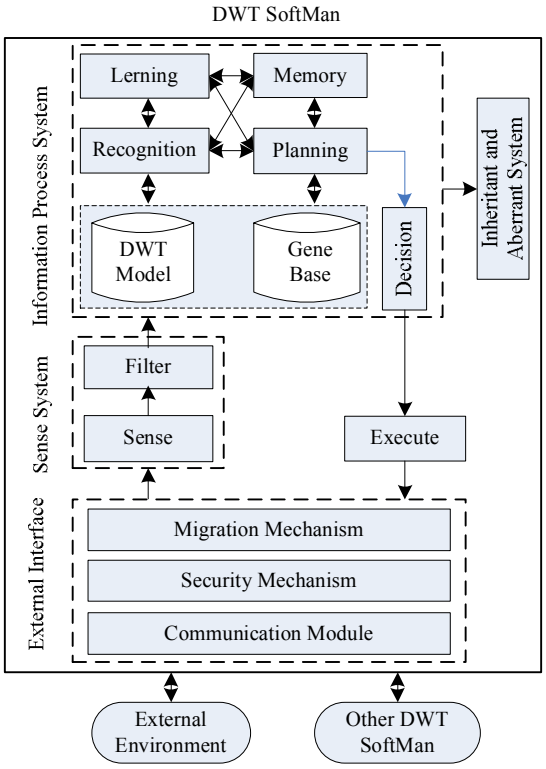

Figure 2. The structure of DWT SoftMan.

It includes five systems. The external environment interface is composed of migration mechanism, security mechanism and communication module. Migration mechanism is used to realize the migration control of SoftMan and decide the migration route of DWT SoftMan according to a certain route strategy. Security mechanism is used to implement the security strategy of DWT SoftMan, and prevent the external illegal access to DWT SoftMan. Communication module is used to implement the cooperation with other SoftMan. The sense system includes the sensor and filter which can filter the redundant and useless perception information to current behavior requirement of DWT SoftMan. The information process system processes the perception information, and takes charge for the recognition, learning, thinking, memory and decision of DWT SoftMan. The inheritance and aberrance

system can reproduce next generation of SoftMan according to the inheritance genes in gene base. The execution system can run independently, and produce action according to the results of information process system.

The method of general operator model is adopted to design the sub system module of the DWT SoftMan structure. The general operator model can be expressed as

$$O=K(\bullet)I \quad (1)$$

where the expression means that general output O is the result of input I transformed by general operator K(•).

For the sense system, I is the data from external environment, O is the filtered data, and the operator K(•) means filtering the sensed data. For the information process system, I is the filtered data, O is the decision information, and the K(•) means recognition, learning, thinking and memorization of the filtered data before making a decision. In the execution system, I is the decision information, O is result of behavior, and the K(•) means the corresponding action of executive parts. In the inheritance and aberrance system, I is the gene of SoftMan, O is the newly generated sub SoftMan, and the K(•) means transferring the gene to sub SoftMan.

B. The Functions of DWT SoftMan

DWT SoftMan is based on the SoftMan, and some new functions are added to the DWT SoftMan. DWT SoftMan has the functions of both SoftMan and DWT.

The main function of DWT SoftMan is to detect the watermark in digital works. The DWT SoftMan could be sent or migrate to the remote mainframe, and visit the files in the SoftMan server. After filtering the unneeded files, the DWT SoftMan sequentially obtains the watermarks in corresponding files, and detects whether the copyright in watermark and the environment information (such as place, time, and user) are matched. If there is an illegal user, the DWT SoftMan might apply the relevant action according to the control center's preset. After all detections, the DWT SoftMan reports to control center, and obtains the new update commands. According to the migration model, the SoftMan calculates the next target, and copies itself, and then, migrates to next mainframe.

DWT system runs in a large-scale contributed network, which supports the SoftMan's distribution and performance. Users send the traced digital work type and corresponding watermark to SoftMan center by interface, and then, the SoftMan server explores the needed key for this watermark in key base. The SoftMan server generates the watermark SoftMan according to key and center knowledge base. SoftMan decides its location and movement based on its route strategy, which is released according to the center knowledge base. While moving to the target mainframe, SoftMan contacts with SoftMan server on mainframe, and set up the SoftMan performance environment. While SoftMan running, the watermark of local digital works on mainframe should be detected. After this process, SoftMan sends detection report to SoftMan center, and makes its copy that should move to the next target mainframe to complete the migration. The SoftMan center analyzes the reports from SoftMans, and saves them into the report base, and then updates the record in center knowledge base.

C. The WorkingFlow of DWT SoftMan

For the independent SoftMan server applications, all semantemes are packaged in DWT SoftMan. The performance flow of DWT SoftMan is: DWT SoftMan is allocated to the remote mainframe; DWT SoftMan contacts with local SoftMan server; getting the digital works from mainframe system after obtaining running environment; recovering watermarks form digital works, and reading the information embedded in watermarks, such as the copyright owner, the copy times, and user name; obtaining the current environment parameters at the same time, such as IP address and current time; comparing the copyright rules and facts according to watermark copyright strategy, if there is any illegal behavior, the piracy phenomenon could be indicated; According to the piracy level, DWT SoftMan might warn to mainframe or directly destroy the illegal files; DWT SoftMan sends reports to SoftMan center by email; DWT SoftMan makes its copy and decides its following mainframe address according to the route strategy; Copy of DWT SoftMan is sent to the next mainframe by watermark server to complete the following watermark tracking task.

IV. MOBILE CODE TECHNOLOGY FOR DWT SOFTMAN

Mobile code technology is the one that can realize the migration of agent by transferring the mobile codes with some functions among network notes and running the mobile codes in the destination note. Through modification, the mobile code technology can be used for the transferring of SofMan. Generally, mobile code technology can be realized by constructing the isomorphic execution environment MCF (mobile code framework) in the isomerous network. Generally, MCF includes MCD (mobile code daemon), MF (migration facility), CF (communicate facility), SF (security facility) and managed resource interface.

Every network note runs its own MCD to accept the SoftMan who has passed the security protection. SF makes the security authentication to the SoftMan.

Because DWT SoftMan is an open system, it becomes a key problem how to defend the hostile attack on DWT SoftMan from mainframe and protect data in the transmitting procession. To defend the attack on communication between SoftMans, the communication protocol safety of multi-SoftMan system needs to meet the demands of confidentiality, integrality, authenticity and undeniability.

The confidentiality means that the communication SoftMans own the same cluster key k_0. One SoftMan sends encrypted message package that includes message m. The SoftMan receives the encrypted message package, and deciphers the message m by cluster key k_0. The un-authorized SoftMan can not calculate the message m without cluster key k_0.

Insuring the integrality and authenticity of the authentication, the cluster key k_0 could be used to detect message valid code, and attached to message m to be sent to SoftMan for preventing message amending. For undeniability, the sender needs calculate the digital signature of message valid code by private key k_p, and attaches the digital signature on message to send to other SoftMans. Because only sender owns the private key k_p, sender can not deny to send this data package.

In order to ensure all SoftMans belonging to one communication group own the same cluster key, the cluster key management server is used and keeps upgrading: (1) key timely upgrading to avoid the cluster key being cracked; (2) key upgrading while group member joining to avoid the former communication data being decrypted by the new SoftMan; (3) key upgrading while group member leaving to avoid the communication data being decrypted by the leaving SoftMan.

MF defines the migration strategies from one network note to another one. While completing the watermark detecting on one mainframe, the watermark SoftMan could decide the next migration target. To raise the working efficiency of system, the migration strategy of "huge range considering, and focus caring". "Focus" is the mainframe might be illegal used before, or frequently visited by other mainframes. Deciding migration target mainly depends on the following information: the log file of the WEB server in present mainframe, the illegally used mainframe that is detected by control center database before, the mainframe that is doubted to be illegally used. The present algorithm is to make these information weighted sum, and ensure the migration target as the mainframe with maxim weight.

Supposing N is the present mainframe, N' is a probable target mainframe. The probability of choosing N' could be calculated by the following formula:

$$P(N')=R*W_1+U*W_2+V*W_3+V/T*W_4 \quad (2)$$

In this formula, if N is a doubtable site, then R is assigned as 1, otherwise assigned as 0. U is the times that N' visits N in the unit time, V is the illegal times that N' has been detected, T is the times that all SoftMans visit N', W_1~W_4 is the corresponding weight. The node with highest P(N') should be the migration target in the neighboring nodes.

When the DWT SoftMan doesn't know which mainframe has been visited, SoftMan might migrate between different mainframe times, and bring out the endless loop. The problem about endless loop could be resolved by the control center's cooperation. All the mainframes that DWT SoftMan visited are recorded in the center database by control center, and these mainframes' name would be deleted from the probable migration mainframe list, which avoids the endless loop.

CF provides the communication mechanism between SoftMans. Knowledge Query and Manipulation Language (KQML) is a mature SoftMan communication language and protocol, which provides the standard format for message expression and transaction, and supports the real-time knowledge sharing among SoftMans. KQML could realize the cooperation transacting by knowledge sharing between application program and intelligent system. It includes a series of expandable behavior performatives, which define the SoftMan operation on knowledge and targets.

KQML could be divided into three layers [7] of communication, message, and content: communication layer stipulates the protocol about all technique communication parameters, message layer stipulates the language behavior about messages, and content layer stipulates the message contents.

KQML is one popular language about SoftMan communication, which defines the message format and message transmission system, and provides the general frame for SoftMan system communication and cooperation. The marked character of KQML is extendable, which could define the different ontology, and add performatives and parameters to extend the functions of KQML.After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

V. CONCLUSIONS

SoftMan-based digital copyright protection system owns the high efficiency, and could be widely used. If enduing other watermark detection functions to SoftMan, this system could also derive the copyright protect and tracking system on audio, video, image, design graphics and texts. The mobile code technology is used to make sure the confidentiality and the system security.

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