

Research on the Safe Broadcasting of Television Program

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Abstract. The existing way of broadcasting and television monitoring has a lot of problems in China. On the basis of the signal technical indicators monitoring in the present broadcasting and television monitoring system, this paper further extends the function of the monitoring network in order to broaden the services of monitoring business and improve the effect and efficiency of monitoring work. The problem of identifying video content and channel in television and related electronic media is conquered at a low cost implementation way and the flexible technology mechanism. The coverage for video content and identification of the channel is expanded. The informative broadcast entries are generated after a series of video processing. The value of the numerous broadcast data is deeply excavated by using big data processing in order to realize a comprehensive, objective and accurate information monitoring for the safe broadcasting of television program.

1 Introduction

The existing way of broadcasting and television monitoring has a lot of problems in China. Firstly, the existing way of monitoring is the front-end monitoring finished before scrambling, rather than the user terminal monitoring [1]. Therefore it is not true effect of broadcasting monitoring in the network. Secondly, the existing way of monitoring is based on the video server. Sampling frame is no used. The monitoring cost is too expensive. In addition, the special line transmission is used in the present monitoring, which requirement for network transmission is very high [2]. So it only cover city level monitoring and don't cover the county and is not suitable for the county level monitoring. Thirdly, the existing way of monitoring is manual and passive without the information processing and analysis of the monitoring data. Therefore it cannot be automatic signal processing and data mining to realize active monitoring [3].

On the basis of the signal technical indicators monitoring in the present broadcasting and television monitoring system, this paper further extends the function of the monitoring network in order to broaden the services of monitoring business and improve the effect and efficiency of monitoring work. Firstly, the new equipment of sampling and processing video signals is researched which fits to be widely deployed at a lower cost in actual network. Secondly, the automatic or semi-automatic intelligence analysis software system is researched for mass program video signal. Thirdly, the watermark technology is researched for tracking certification of signal and program attributes in the actual broadcasting environment. The main purpose of this

paper is the development of cheap monitoring hardware devices which can be widely deployed to the village, so the actual situation of the user terminal broadcasting can be monitored by the administration of radio, film and television. At the same time, the data mining and data statistical analysis of the monitoring data can make the monitoring data have a certain market value after deep processing of data information.

In order to achieve the above objectives, the main task of the paper are as follows. Firstly, the current central, provincial and prefecture level multistage program broadcasting management system and the cable, wireless and satellite broadcasting technology system are summarized and analysed. Using the cable television network as the breakthrough point, the technical architecture system suitable for identification of video content and television channels is studied and put forward. The technical architecture system must suit the actual situation needs of radio and television development and management in our country and has technical and economic feasibility of practical application promotion and deployment. Secondly, frame sampler with independent intellectual property right is developed which can recycle to sample, compress and store the frame of TV programs in the actual broadcasting network. Thirdly, the watermark recognition algorithm and image content recognition algorithm with independent intellectual property rights are developed for automatic or semi-automatic identification of the image/video, generating the broadcast channel information data and data mining in depth. The monitoring results and analysis, statistics and other information are output in a variety of forms such as reports and charts. Fourthly, according to the requirements of TV monitoring content and copyright

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protection, considering the technical characteristics of the watermark, a feasible technical scheme is put forward. The watermark is overlaid to the video signal in the source end. After the transmission through the actual network, finally the watermark is reliable to extract from the video signal at the receiving end [4].

2 The architecture of television program safe broadcasting system

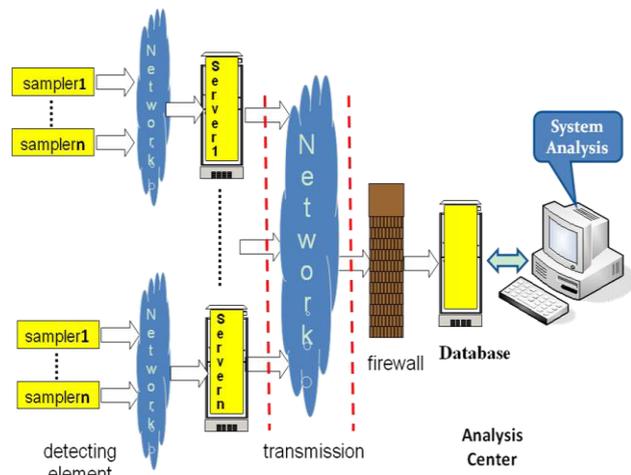


Figure 1. The architecture of television program safe broadcasting system.

The show program source is gained from detecting cities. There are two types of program, type I superimposed by watermarking, type II without any watermarking. The pictures of each shown program are sampled from cable television network using frame samplers. Then the data is stored in the disk, encrypted and transmitted back to analysis centre using the Internet at night when network isn't busy. All the information enters the data storage structure through the Internet according to frame dispatching mechanism in the analysis centre. For type I, watermark is decoded. For type II, it is treated with image matching retrieval. The formation of the actual radio and television broadcast programs data and audience rating data is produced by the two ways. Then all the information data entries processing and management system. In management system, through radio and television broadcast content analysis software will do data mining and statistical analysis of various content [5].

The concrete modules of television program safe broadcasting system are as follows:

- frame sampler module
- frame sampler dispatching module
- television content watermark superimposition and recognition module
- image matching and recognition module
- program background information data module
- storage structure, database module
- broadcasting and television public opinion analysis software modules

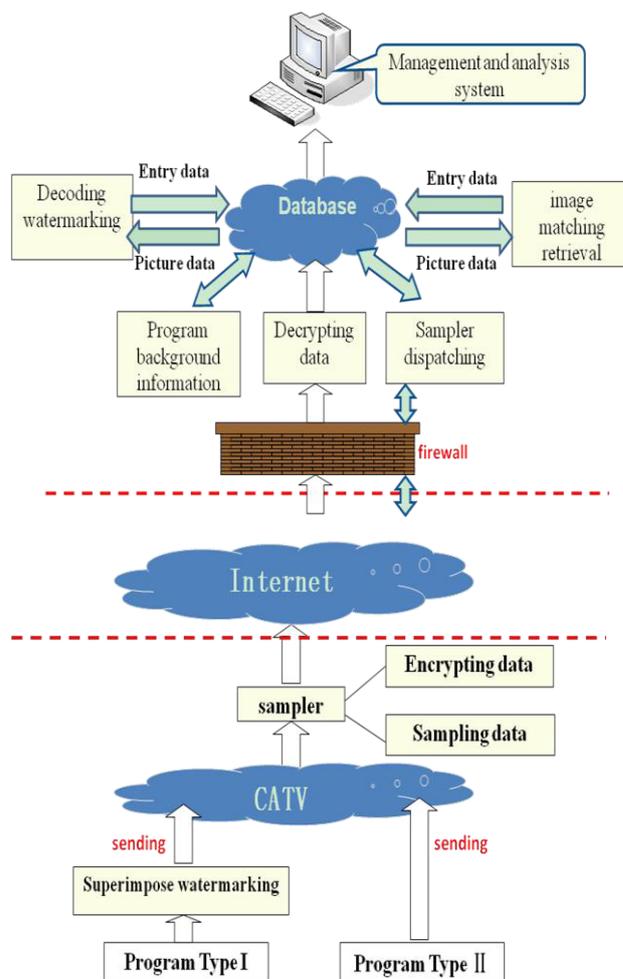


Figure 2. The concrete modules of television program safe broadcasting system.

The data collection layer is responsible for the original data collection at the bottom of the whole system. The original data refers to the key frames compressed and coded according to certain rules which are collected by the digital television sampler and the analog television sampler. Data collection layer is placed in cable TV network client. Daily work content of data collection layer is controlled and allocated by data scheduling layer.

The task of data transmission layer is to provide services for the communication between two nodes process. It includes the process of data scheduling layer sending instruction to data collection layer and the process of data collection layer sending data to the data storage layer, which are completed by the data transmission layer. Data transmission layer is deployed in the capital city of each province, directly connected with the provincial data collection layer.

The data processing layer is divided into data scheduling configuration system, data storage system and data analysis system. Data scheduling configuration system is task distribution and monitoring center. It is responsible for the output instruction of task allocation to the data collection layer, as well as the real-time condition monitoring of data collection nodes. It is also responsible for the monitor work of the system history data. The data scheduling configuration system is placed

in the monitoring control center. Data storage system is placed in the monitoring center console. It is the data storage center of the whole system. It is responsible for dealing with a large number of key frame data. The frame data is classified and stored according to the corresponding rules. The data analysis system mainly complete the real-time monitoring and identification of broadcast content. It realizes automatically monitoring of TV advertising, program and news content. How to detect monitoring content is the key to the system. The data analysis system is placed at the top layer in the architecture.

Monitoring system as a whole and complex system, has wholeness, hierarchy and correlation characteristics. In order to make full use of the system's internal potential, ensure the stability and safety, at the same time expand the mining depth and scope of application and make the system not only meet the business requirements but also meet the need of development in the future, the following principles must be followed at the time of design.

1. The principle of safety.

Because the monitoring system has special position and role in the broadcasting and television system, high security is required by the system. The network security of the system is used to give full consideration to in this paper. The equipment used to make up the system takes effective measures to prevent the illegal invasion from the network. The corresponding authentication and certification are needed when all modules are visited. The key encryption can be configured to access module. In addition to the network security, fault inspection, alarm and processing mechanism, and the corresponding redundant backup mechanism are used to ensure the safe and reliable operation of the whole system.

2. The principle of reliability.

This paper not only considers advanced technology but also considers the aspects of the system structure, technical measures, equipment performance, system management and maintenance to ensure reliability and stability of the system operation. The fault inspection, alarm and processing mechanism are used to ensure that the data is not lost or damaged by accident situation. Load balancing is realized by using flexible task scheduling mechanism to prevent "bottleneck". When system failure occurs, seamless rearrangement is used in order to ensure the reliable stability of the whole system. The system design and equipment selection focus on stable and reliable products and solutions of large-scale use and long time running to ensure safe and reliable system operation.

3. The principle of extensibility.

The flexibility and scalability of the system are fully considered by this paper. Modular design is adopted to system hardware and software. With the increase of business types and growth of amount in the future, the system can be a smooth upgrade.

4. The principle of practicality.

The functions of the system in this paper must be based on the actual system and close to the operating habits and processes of the existing system. Although the requirements of the storage capacity is very big, but the

image quality requirement of the playback is not high, which is good for long distance transmission.

The business model of the monitoring system is divided into two parts. One part is scheduling configuration business of the frame sampler on the client side in the network. The other part is data analysis and processing business of the sampled key frame. Scheduling configuration business of the frame sampler is completed by scheduling center and configuration center. With the aid of network transmission module, local real-time channel list can be obtained from the frame samplers deployed in the monitoring information network. The work task and work mode of each frame sampler are modified according to the specific tasks of monitoring center. Frame data analysis and processing business is completed through the task assignment components, combined with watermark identification, image matching automatic processing program and image artificial proofreading program. The analysis and processing of key frames data extracted by each frame sampler from each channel are completed in order to generate broadcasting entry information.

3 The key technology

The television program safe broadcasting system is intricate. We refine several key technologies as follows:

3.1. Analog/digital TV signal frame sampler

The mode of using frame sampling can reduce the amount of data. The existing radio and television broadcasting monitoring still do not use the way of key frames or I frame. This key technology provides a new way of thinking for the television program safe broadcasting monitoring.



Figure 3. Analog TV signal frame sampler.

Analog frame sampler is carried out more developed version and reaches the following indicators: 1) a video key frame is extracted. Any extracted adjacent odd field or even field in any channel consist of a frame, which is compressed according to JPEG2000 and stored in separate files. 2) JPEG file is added city code, time code, channel number and the extraction time (accurate to millisecond) in addition. 3) Frames sampled per second is not less than 10. It can be classified according to the type of image content in full screen view (718 * 289 pixels) and station caption (230 * 74 pixels).



Figure 4. Digital TV signal frame sampler.

Digital frame sampler is carried out by a joint research group and reaches the following indicators: 1) a video I frame is extracted. The frame is compressed according to JPEG and stored in separate files. 2) JPEG file is added city code, time code, channel number and the extraction time (accurate to second) in addition. 3) Frames sampled per second is not less than one. The type of image content is only full screen view (720 * 576 pixels).

The functions of this key technology are as follows: Firstly, television signal frame sampler can be deployed to the bottom of the TV user terminal in an inexpensive way. Secondly, the amount of per frame data extracted by frame sampler is about 20 k bytes. The transmission bandwidth pressure of network is small by the way of sampling frame for television program safe broadcasting monitoring. The requirement of storage is also small.

3.2 Image watermark recognition

The vision image watermark identification process is as follows: Before the broadcasting, watermark is embedded into uncompressed video program with a watermark embedding device. The watermark includes information such as program copyright, etc. Watermark detection/extraction device tests I frame of broadcasting video programs, including the video programs with and without watermark, to identify the watermark and the content of the watermark. The identification results, namely the watermarking information is stored into the database. Watermark embedding device and watermark detection/extraction device must be matched. Several attacks which are one of the biggest impact on the watermark recognition rate and accuracy influence the actual use in television networks. The watermark system is relatively complex. We made a preliminary validation. For uncompressed program, watermark is superposed frame by frame. The superposition watermark includes embedding information for copyright. The program has no watermark visibility. The watermarking algorithm, the watermarking algorithm has compression resistance and can be blind detection. The watermarking algorithm has resistance to attacks such as stack, geometry transformation. It can enhance the information extraction speed and the recognition rate by using the image watermark identification.

3.3 Image matching and recognition

Image matching and recognition module mainly completes two tasks: station caption recognition and program content recognition. The feature extraction of original program frame samples is acquired including colour characteristic, shape characteristic and the texture characteristics, etc. The feature extraction of front-end broadcasting program frame samples is also needed. Using the image matching technology, the original program frame and broadcasting program frame sample feature matching samples. Whether the original program and the broadcasting program are the same is judged according to the matching result. The function of image matching and recognition is quick identification and to improve efficiency of information processing.

3.4 Data scheduling and processing

Data scheduling and processing system consists of three parts including the network server, the data centre server and database. Put in data analysis centre, extract entries information of all of the node distribution servers and extract JPEG image the hard disk from some frame sampler if necessary. It is to guarantee the effectiveness and reliability in the large amounts of data transmission in the limited bandwidth. According to the user access speed and trunk speed, we can make flexible configuration dispatching mechanism. The network server is a hub of data transmission in the whole project. The data flows are dispatched among the modules and the components by the network server as the role of a data centre station. The data centre processes large amount of data frames from the network server. The key information will be stored in the database. The frame data files are stored to disk at the same time. Data centre is responsible for saving and processing of the network server information and the frame extractor information at the same time. Database is responsible for the data itself and all kinds of information storage.

3.5 Program monitoring analysis

It is necessary to filter data in the database, including city, broadcasting television station, broadcasting time, broadcasting duration, program categories, keywords of program, program production company, broadcasting date. Graphics drawing pattern is set when statistical graphics are drawn after filtering data, which makes the final result of the statistical analysis more practical. Program monitoring analysis mainly includes statistical analysis based on program production companies, statistical analysis based on program type, etc.

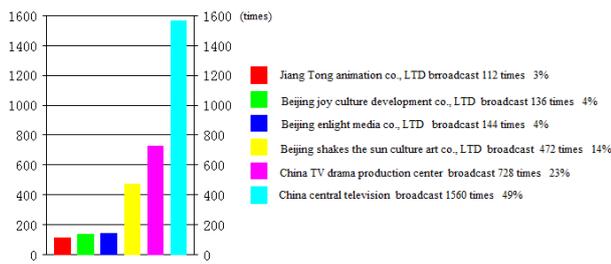


Figure 5. The ranking information of program production companies broadcast on CCTV-1.

4 Summary

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