Research on Automatic Storage of Remote Mobile Surveillance Video Information Based on Cloud Terminal

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Abstract. Cloud storage technology has become a trend of future storage development. Users can no longer buy hardware storage devices, and fully realize remote networked storage, which greatly reduces the user's use cost. At the same time, it can also provide faster and larger capacity storage and sharing functions. Therefore, in order to achieve the goal of effective storage of massive video, this paper proposes a remote mobile surveillance video information automatic storage method based on cloud terminals, constructs a remote mobile surveillance video information management model, optimizes the remote mobile surveillance video information automatic storage algorithm, and realizes the design goal of remote mobile surveillance video information automatic storage. Finally, the experiment proves that the research method of remote mobile surveillance video information automatic storage based on cloud terminals is highly effective and fully meets the research requirements.

Keywords: Cloud terminal · Remote mobile monitoring · Monitoring video · Information storage

1 Introduction

With the rapid development of mobile Internet, the demand for multimedia applications such as distance education, telemedicine and video conference is increasing greatly, and the demand for video management is also increasing. The progress of high and new technology, such as cloud terminal signal processing and image compression, has greatly promoted the development of multimedia technology. With the development of cloud terminal technology, remote video application has become a research hotspot in the field of computer, including video storage, memory management and scheduling, and video transmission on the network. Cloud terminals are multimedia files that are streamed over a network using streaming technology. They support streaming as they are downloaded and played, making it possible to transmit media data of unknown size [1]. Cloud terminal technology is widely used in video monitoring model. Large video monitoring model is composed of video management server, PTZ controller, video

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storage server, cloud terminal distributor and so on. Due to the limitation of front-end devices and backbone network bandwidth, when a large number of users access video resources concurrently, the backbone bandwidth is tight and the user access delay is increased [2]. The solution is to avoid the network bottleneck caused by large-scale concurrent traffic by various cloud terminal distribution. Because of the huge amount of video information, the storage space of video is always a problem that people care about. Storing video effectively can save the storage space greatly.

Qin et al. [2] proposed a blockchain based method for coal mine video monitoring data storage and sharing, which uses edge devices to transmit data, uses interstellar file systems to store detection data, and stores all videos in the cloud center. Liu et al. [3] proposed a design method of video monitoring and storage system based on FPGA, which uses flash as the storage unit, reasonably selects the working mode of storage, designs according to the standardized design idea and combines with the requirements of the task book, and realizes the storage of video monitoring data. The above two methods can realize the storage of video data, but the storage capacity is limited.

In order to solve the above problems, a cloud based automatic storage method of remote mobile surveillance video information is proposed. By building a remote mobile surveillance video information management model and optimizing the video storage data management and evaluation algorithm, the remote mobile surveillance video information can be automatically stored.

2 Automatic Storage of Remote Mobile Monitoring Video Information

2.1 Remote Mobile Monitoring Video Information Management Model

Cloud computing is the development of distributed processing, parallel processing and grid computing, in which huge computing processors are automatically split into numerous smaller subroutines over a network and submitted to a large model consisting of multiple servers, the results of which are computed and analyzed and sent back to the user. Through cloud computing, network service providers can process tens of millions or even billions of messages in seconds to achieve a network service as powerful as a "supercomputer". The goal of the cloud computing model is to migrate the individual, personalized operations running on a PC or a single server to a large number of server "clouds", where the cloud terminal is responsible for processing the requests of users and outputting the results. It is a model centered on data computation and processing.

According to the storage resource and storage strategy, the video storage server saves the frame data of the cloud terminal in the storage medium, and sends the saved frame data to the playback terminal to complete the storage and retrieval of the frame data of the cloud terminal. The functional modules are shown in Fig. 1.

The video storage technology not only stores the video data to the hard disk, but also needs to consider the subsequent retrieval function. In video monitoring model, manageability is the requirement of video storage technology, that is, users can retrieve and play back video according to their own needs at any time and anywhere. Therefore, efficient retrieval efficiency is an important goal of video storage technology [4].

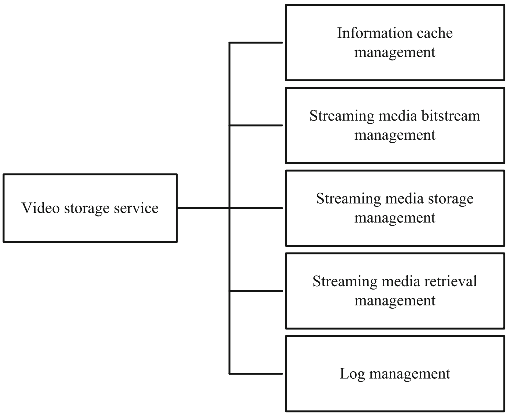

Fig. 1. Video storage service function module

If the stored video can not be retrieved, the video storage technology will lose its meaning of existence. In this paper, the software design of video network storage model is mainly embodied in two aspects: the software design of video network storage technology, and the implementation of iSCS protocol. But the storage design of video data adopts the classified storage strategy of time order, time-sharing, time-sharing and same channel. Video storage will also occur due to the large amount of video data caused by the lack of hard disk space, so in the design of video storage strategy, but also consider the hard disk coverage, video retrieval technology software design. The video retrieval strategy is designed according to the storage algorithm. This paper adopts the retrieval strategy of step by step, mainly through the query index table information to realize the retrieval and playback of data. The software design of video network storage can be divided into three modules, namely video storage module, ISCSI protocol module and embedded database module. These three modules cooperate with each other to complete the network storage of video data. Therefore, the design of the video network storage architecture module based on cloud terminals can be shown in Fig. 2.

Figure 2 deals with the sharing of data between the video capture process and the video storage process after the video capture process has been processed through a ring of shared buffer domains [5]. In this paper, the video data in shared memory is stored in the network storage server by video storage module, embedded database module and ISCSI module. The video stream data generated by the video monitoring model is massive, and these massive video data files pose a severe challenge to the storage model of the model.

2.2 Optimized Video Storage Data Management Evaluation Algorithm

For traditional file models, similar database functions and structures have been developed to meet the requirements of different types of file storage, while for video timeline sequential structures, such complex hierarchical lookups are redundant [6]. However, these two traditional file models are based on the disk allocation strategy of the first

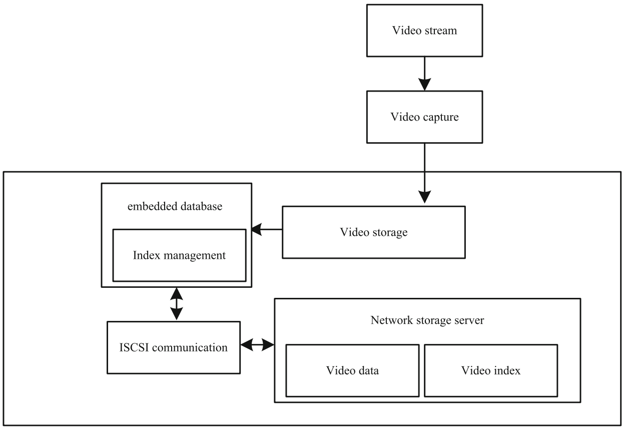

Fig. 2. Video network storage structure module based on cloud terminal

available area, which will cause the large file such as video data to be separated, and after a long time running, the time-related video data will have a high probability to be separated into different parts of the disk, thus resulting in spatial irrelevance, which requires the conversion of multiple pointers to achieve the purpose of lookup and reduce the efficiency of access [7]. Analog signal monitoring model is mainly composed of camera, video matrix, monitor, video recorder and so on. Video transmission line is used to connect video from the camera to the monitor. The host of video matrix is used to switch and control by keyboard. The video is recorded by a long time video recorder using magnetic tape, as shown in the figure. The traditional analog closed-circuit television monitoring model has many limitations (Fig. 3).

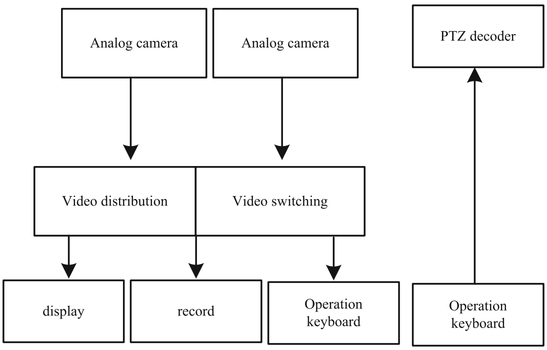

Fig. 3. Composition diagram of analog video monitoring system

Because of the large amount of video information, video monitoring model often needs a lot of hard disk storage space. Although it is possible to compress the video, if the monitoring time is too long, it still requires a lot of storage space, and most of the video recording is the same scene without change. This not only wastes storage space, but also has a lot of interference in finding important information [8]. Since the video compression can be stored and the image can be ingested at the same time, the motion information can be extracted from the ingested image sequence to judge whether the scene is changed. Record the video when the scene changes and stop recording when there is no change. The motion information of sequential images is reflected in the degree of change between two successive images respectively.

Take a frame of gray image $G = f(x, y)$ every time t. When G is empty, that is, the first frame, $G_{obl} = G$, otherwise $G_{nev} = G_0$. If $t = 1/4$s is taken in this test:

$$G_{diff} = \begin{cases} 0 \mid G_{nev} \ -G_{old} \leq \varepsilon \\ 1 \mid G_{nev} \ -G_{old} \mid \ > \varepsilon \end{cases} \tag{1}$$

Among them, ε is the threshold value, and the G_{diff} obtained from $\varepsilon = 8$ is a binary image. After processing G_{diff} with an improved projection method, a value that can be used to determine the difference between G_{nev} and G_{old} is obtained, assuming that the head is at a particular location, and if the probabilities of the location of the next data to be accessed occur at all locations of the disk, the expectation of the seek time required for the head to move to the next data access is defined as the average seek time at that particular location, that is:

$$T_{\text{avgi}} = G_{diff}\,\varepsilon_T - \text{D}\sum P_i T_i \tag{2}$$

where T_{avgi} is the average seek time at the i-th data block, ε_T is the expected value of a single seek time, D is the total number of data blocks, T_i is the probability of the ith data block, and P_i is the time required for the head to turn to the i-th data block. Due to the use of a fixed size data area to store video data, there is a strict one-to-one linear correspondence between the time stamp of the stored video frame and the disk space address, and the retrieved keyword happens to be the time stamp itself. Then we can use the address calculation function directly as the hash function to calculate the corresponding video storage address from the time stamp keyword, which further reduces the computational complexity to 0.1, The performance of search and location is greatly improved. The address calculation during storage includes:

$$A_{\text{target}} = T_{\text{avgi}}\,A_{\text{offset}} + \frac{t_{\text{now}} - t_{\text{begin}}}{T_{\text{timeperblock}}} \tag{3}$$

where A_{target} is the target address, A_{offset} is the start time offset address, t_{now} is the current time, t_{begin} is the start time, and $T_{\text{timeperblock}}$ is the duration represented by each BK. it is determined during formatting. Compared with the traditional file model based on file name search, the number of 10 is undoubtedly reduced, which greatly changes the performance of video data access. Based on the disk logical storage structure in this scheme, the minimum unit of data organization is block. Therefore, the size of V DB cache built in memory is an integer multiple of the size of block. Its calculation method is as follows:

$$VDBSize = \left\lceil \frac{BR/8 + (ML + HS) \times FR}{BS} \right\rceil \times A_{\text{target}} \tag{4}$$

where, *FR* is the video code rate, *BS* is the length, *BR* is the size of the video frame header, *HS* is the frame rate, and *ML* is the size of the data unit in the disk structure. Data storage scheme provides data storage and video management interface for network video monitoring model, which determines the storage efficiency, management performance and reliability of video data. This chapter designs the data storage scheme from the disk logical storage structure, video index information management, data cache mechanism and data reconstruction method, and realizes the storage operation interface of disk formatting, data reading and writing, video retrieval and data reconstruction [9]. In order to improve the efficiency of video storage, optimize the performance of video retrieval and enhance the security of video data, a video data caching mechanism and data reconstruction method based on cloud terminal are designed. According to the characteristics of data storage in network video monitoring model, a logical storage structure of disks is designed, based on which all data are organized in format and stored directly in bare disks. The disk logical storage structure is shown in Fig. 4.

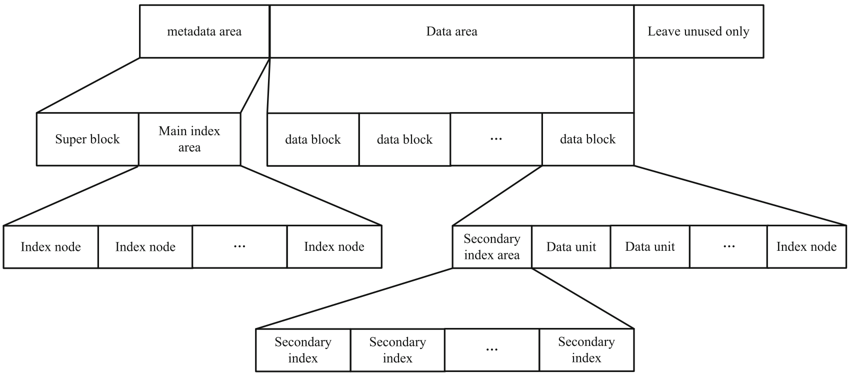

Fig. 4. Disk logical storage structure

Disks are logically divided into metadata area and data area. The metadata area is composed of two parts: super block and main index area, which is used to record the structure information of disk and video segment index information. The data is divided into equal sized data blocks for storing video data, picture data and sub- index information, and video and picture mixed storage. The remaining disk space is reserved unused. In order to realize the optimization of remote mobile surveillance video information automatic storage algorithm.

2.3 Realization of Automatic Storage of Surveillance Video Information

The new storage scheme is no longer considered from the point of view of optimizing the timing long storage mode, but adopts the fixed space storage mode. That is, the total space is initialized at one time into a number of fixed-size data files, each of which may be stored for a different length of time in the cloud terminal, and the data file is not deleted during cycle coverage, but is rewritten and the index is updated [10]. The new scheme effectively avoids the generation of disk fragmentation, but at the same time brings the following problems: maintenance of the cloud terminal storage time period index becomes very complicated; when the remaining space of the data file is not enough to store the cloud terminal of one second, this remaining space will be idle, resulting in a loss of space utilization, this situation is called “one-second tail”; the length of the alarm cloud terminal varies greatly, and the storage is bounded by events, if each alarm is stored in a different data file, a large amount of remaining space will be idle, this situation is called “event tail”. The data deployment for the storage unit is shown in Fig. 5.

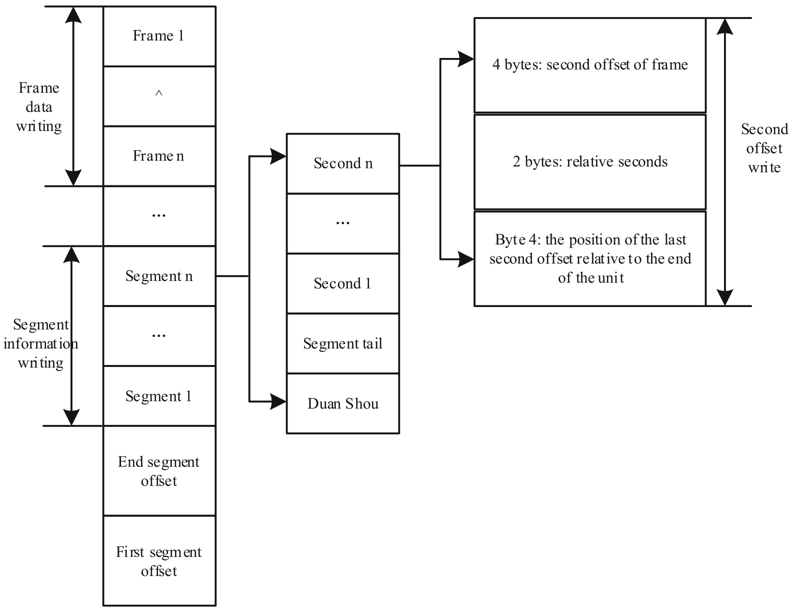

Fig. 5. Data deployment of storage unit

The video network retrieval strategy is designed according to the storage strategy, and adopts the method of progressive retrieval (hard disk index, file index, frame index) to realize the video retrieval of video channel, time and type. When the user needs to replay a certain video, the ARM target board will query the index information according to the user’s retrieval interface, that is, search conditions to find eligible video data in turn. The module of video retrieval is similar to the storage design. The structure design of the concrete video retrieval module is shown in Fig. 6.

The storage and transcoding of massive video data based on cloud terminals, and the solution of management model are proposed. It not only improves the performance of video transcoding, but also provides convenience for users. Users can view video through the ordinary player, and also realize the management of video data based on cloud terminals. As shown in Fig. 7, the management model of the entire monitoring video function is presented.

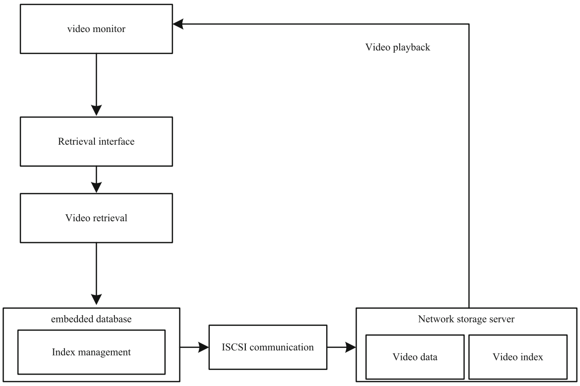

Fig. 6. Composition of video retrieval module

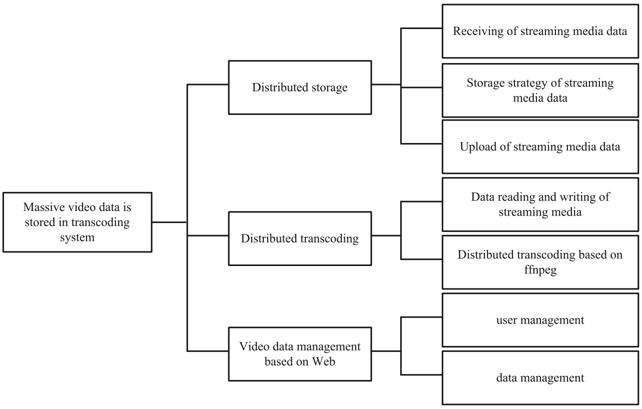

Fig. 7. Management model of various functions of monitoring video

Set the frame cache and segment index cache when the storage unit is written, and the cache time is set to 5 s to avoid frequent writes. If the current storage location of the channel is full, set the pre-allocation location to the current location and set the status of the corresponding location in the storage location index to used. The frame data is written backwards, and the index is written backwards. When the index is written, the end time of the segment is written even if the segment does not actually end, and the end time of that cell in the channel storage unit index is updated. Based on the above design, spatial strategy and index management are designed to solve the problem of "1 s tail" and "event tail" effectively. Although the complexity of the index is increased, the cost is worth it. Under the new storage management scheme, the cloud terminal frame data storage process is shown in Fig. 8.

The device does not store other types of files, and is dedicated to storing video files. This condition is used as a precondition for the policy. Prior to storage, the storage device is pre-initialized, that is, several empty files are created according to the specified size,

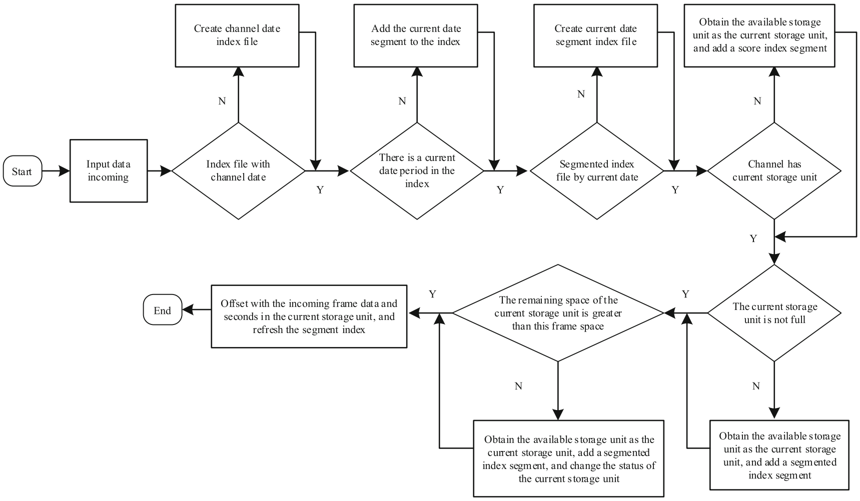

Fig. 8. Cloud terminal frame data storage process

and a structure is used to describe the information of the pre-allocated files, including file name, file usage status, video encoding channel, file backup status and other information, a table is used to maintain the allocated file information, and a part of the storage space is divided to record the information of the table, and the remaining space is used to store the video files. If there are multiple partitions, the same partition is made for each partition's storage space. When data is stored, the file record table is queried, an empty file is obtained from the table, and the write operation is started. Storage Strategy Design an assistant program to check the status of storage devices and files regularly to ensure that empty files are available; if the storage device is full, give a hint or circular storage, overwrite the earliest video files with the latest video stream in 68 cases. Figure 9 shows the video storage strategy.

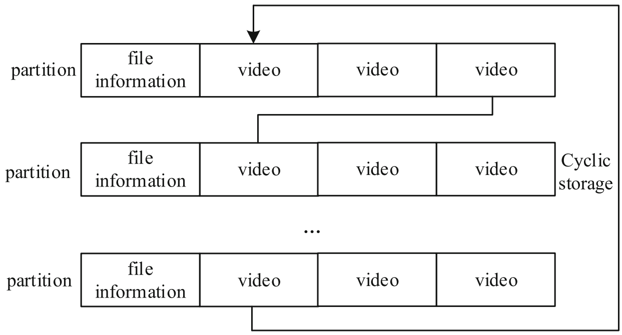

Fig. 9. Video storage strategy

During the operation of the model, the model accesses the storage device, the model detects the storage device, acquires the capacity of the storage device, calculates the maximum number of files that can be stored according to the capacity and the size of the pre-allocated empty files, and creates a continuous file of fixed size. When storing video data, the file information table is read first, and the available empty files are determined by looking up the status information of the files in the table; without the empty files, the earliest created files can be found again to store the video information, so the latest files can be used to overwrite the oldest files for circular storage; or the storage space is full and the files still need to be saved, the user is prompted to change the storage device. Because of the use of tables to maintain device file information, a secondary storage program is needed to manage the files, provide available files for the application to store video data, and update the latest information of the files in the table. In the process of storing information on the video server, the available empty files are obtained first, and then the video data is written. Helper programs need to periodically detect the condition of storage devices and files to ensure that empty files are available; if storage devices are full, prompt or circulate storage to overwrite the oldest video files with the latest video streams.

3 Analysis of Experimental Results

Apache-tomcat60 36 as the running web server, MyEclipse 90 is used as the development tool of the whole software. The versions of the three frameworks of struts 2 + Spring + Hibernate. At the same time, the cloud terminal version used is the same as the version deployed in the cluster in the previous section. Cloud terminal-0.2. In order to develop a rational storage scheme, this paper compares the monitoring storage scheme with the previous storage scheme. The results are shown in Table 1:

As can be seen from Table 1, although the expression form of monitoring storage data is the same as that of previous image storage, reflecting the irregular and unstructured characteristics, it is structured in the organization mode and has strong regularity, which is its biggest feature and the difference from the traditional storage model.

By further comparing the data upload rate, it can be concluded that with the increase of the number of redundant backups, the file upload rate will be reduced due to the time overhead of the cloud terminal pipeline. Based on this, the data storage time consumption with different number of redundant backups is compared, as follows:

As can be seen from Fig. 10, for the same total amount of video data with different slice sizes, the required download time is basically unchanged. Because the overhead of cloud terminal pipeline is not required in the download process, the time required for downloading is less than that for uploading the same data. When the number of redundant backups changes, the result is the same. Use the fast multimedia storage information model on the disk volume to test the same items as the above cloud terminal monitoring video information storage information model. Since there is no concept of file fragments, there is only one case. The test data are shown in Table 2:

Further analysis of the total data throughput and read-write ratio of storage information can be obtained:

The results in Fig. 11 show that the performance of video storage of cloud terminal monitoring video information storage model is lower than that of fast multimedia storage

Table 1. Comparison of characteristics between monitoring storage and traditional storage files

Project	Past storage		Monitoring storage
	Database table	Text/image	Image/audio
Data representation	Structured	Unstructured	Unstructured
Data organization	Unstructured	Unstructured	Structured
Data saving time	Disordered, indefinite duration	Disordered, indefinite duration	Delete and update regularly
Data update method	Disorderly, uncertain way	Disorderly, uncertain way	Orderly, increasing from the tail
Data reading and writing mode	Disorderly, repeatedly read and write	Disorderly, repeatedly read and write	Orderly, write a small amount of read/no read at a time
Storage block size	9-65KB	512B-1MB	64KB-1MB
performance requirement	10PS	10PS	Broadband
Storage hotspot	2/9 principle, 20% of data carries 80% of access	2/9 principle, 20% of data carries 80% of access	Equal access to data
Data importance	Important, high data value	Uncertain	Mostly useless data

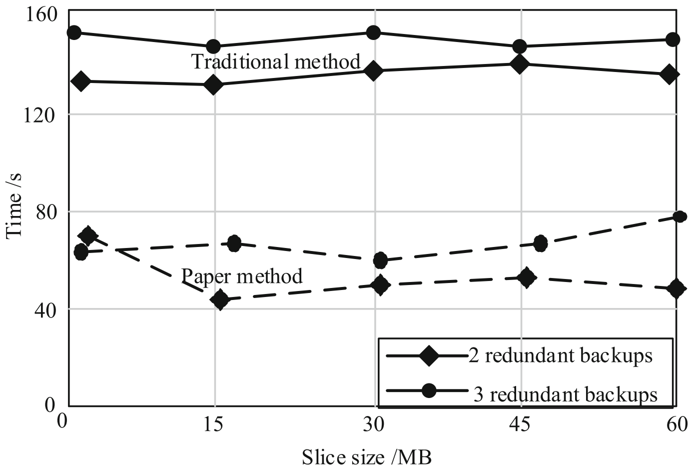

Fig. 10. Comparison of data storage time with different backup quantities

information model on the whole. When the cloud terminal monitoring video information storage is initially written into a large file, because there is no file fragment, the efficiency

Table 2. Performance test results of fast storage files

Parameter model	Data throughput (MB/s)	
	Paper method	Traditional method
Sequential storage	81.65	59.62
Sequential readout	69.58	33.62
100% random write	9.52	2.4
100% random readout	7.95	3.1

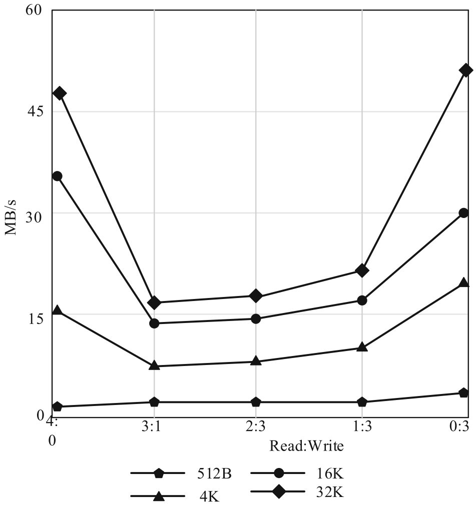

Fig. 11. Relationship between total data throughput of storage information and read-write ratio

is very high, which is close to the storage limit value. Because each frame needs to be written to the index, the rate is lower than the limit value. However, in the long run, the cloud terminal monitoring video information storage will operate with low efficiency, so the efficiency of cloud terminal monitoring video information storage is still higher in the long run. Select video streams with different bit rates as the data input source to test the storage efficiency. The video stream data is written to the disk device according to the writing mode, and the average storage bandwidth is calculated by recording the time spent continuously writing video data. In order to compare the storage efficiency with the traditional file model storage scheme, the storage efficiency of the traditional file model storage scheme is tested in the same environment and in the same method. The test result curve is shown in Fig. 12.

The test results show that the data storage scheme in this paper has high data storage efficiency and can fully meet the storage requirements of various common video bit rates. At the same time, compared with the file model, this scheme can effectively reduce the number of data network transmission and disk consumption. Under the same amount

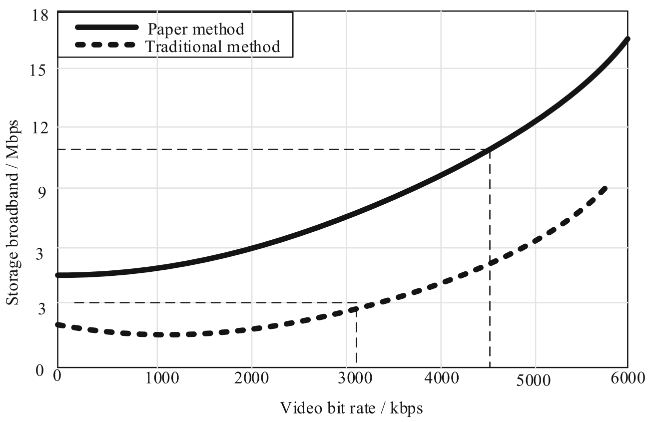

Fig. 12. Storage effect comparison test results

of data, the smaller the bit rate, the more the number of reduction, and the greater the improvement of storage efficiency. In order to save the cost of storage resources, the 512 Kbps low bit rate video stream commonly used in the current video monitoring model is used for video storage. Through the analysis of the curve in the figure, it can be seen that the improvement effect of storage efficiency under these two bit rates is very significant.

4 Conclusion

Using cloud terminal to realize video acquisition and video storage, using improved projection method to obtain video information from the differential image of sequence image, and then decide whether to record video according to the size of video, which can greatly save hard disk storage space and improve the storage proportion of useful video information. The method proposed in this paper has fast speed and good effect. It is a good video storage method, which fully meets the research requirements.

5 Fund Project

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