Inline De-Duplication for Video Streaming

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Abstract*: As the new technologies for collection of video data has emerged in all fields of work, data collection has reached its epic heights from past decade. Since the volume of video data is huge, the storage space needed to store the data also becomes tremendously large. Even though many technologies support the challenges to process the huge volume of video data, the cost for data storage becomes a drawback. Inline deduplication is proposedto save the space and to optimize the capacity. It reduces the number of data copies before writing it in to storage device. In current years, many concepts are introduced to reduce video data volume. Inline deduplication is used here to reduce memory and to increase the transmission speed of video. The main purpose of this paper is to survey various techniques and concepts involved indeduplicationin video streaming with its counter measurements for the past decade.

Index Terms: Cloud Security, Searchable Encryption, Short lived Keyword Search, Secrecy, Access Policy.

I. INTRODUCTION

All types of data can be stored in the storage device or cloud. Storing and transmitting video and audio data is facing number of problems nowadays. It is a challenging task to transmit large video data because it consumes more transmission time. Storing the video data in a storage device or cloud is also facing many challenges.To overcome the challenges, many models have been proposed. In order to classify the video, deep learning based models are implemented for video classification[1]. Technique like incremental technique is used to find duplicates in the database[2]. Usually video classification is done by recognizing face and action [3]. The redundant frames can be deducted by a new network structure [4]. A dataset has been introduced [5] to find human action. All the actions were stored in database to find the motion detection. More over one more technique is used for object detection that removes the fixed size [6]. Then the unwanted and repeated frames were removed to reduce the size of the video so that space can be reduced.Reasons for compressing the video is to reduce the file size and save disk space[7]. It is also used to increase the transfer speed and allow real time transfer without any loss in quality[8]. Compression can be done in two ways. Firstly, a compression technique called Spatial is used to findresemblance in an image and those resemblances are compared.Secondlycompression technique called Temporal, it finds resemblance across the image andthe obtained resemblance is compressed[9] and stored in the storage device or cloud. Storage can be done in cloud, which is the advanced storage model for all multimedia and other purposes. Virtual storage is the initial step for storing large scale net data [10] and the total multicast traffic occurred while storing data can be reduced by a tree maintenance structure[11].

Convolutional Neural Network (CNN) have millions of parameters and with small dataset, it would run into an over-fitting problem therefore CNN algorithms require more processing. Therefore CNN algorithms require more memory. And also response time is slower because of more processing[12]. Figure 1 shows the simple process flow of data deduplication. Process happens in Source Virtual Machine(SVM) where the deduplicated data is extracted from the raw data that has many duplicates. Extraction is done by an agent where the actual preprocessing takes place to separate the duplicate data and the actual original data in SVM. Then the deduplicated data is sent to the backup repository for storage purpose or transmit it to where it is required.

In this paper, we are going to address some of the important frame classification model and we evaluate the importance of each.Many algorithms were explained to detect the video information from the video sequence.A technique called Feature comparison is discussed to find the similar frames in a video and those frames are removed. Thus the important frames are stored in the backup device.

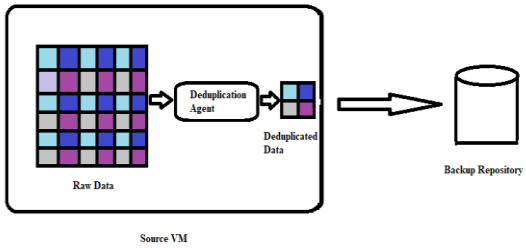

Figure 1 :Deduplication of data

Chapter 2 discusses about the video standards, chapter 3,4 and 5 discusses about the types of deduplication,applications of video streaming and the counter measurement of video deduplication techniques.

II. VIDEO STANDARDS

Video Standard is defined as the amount of colours displayed in monitor and the resolution of a video. Nowadays there are many video standards are available. Some of the video standards are discussed in this chapter.

There are more standards available like, JPEG, Flash(.flv) Format, AVI(.avi) video format, Quicktime (.mov) video format, MP4 (.mp4) video format, Mpg (.mpg) video format, Windows Media (.wmv) Format,.In this chapter we discussed some of the most important standards and its benefits.

The first compression standard introduced by some working authorities andnamedasMoving Picture

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Experts Group (MPEG)-2 video coding [14].The second compression standard introduced was Advanced Video Coding (AVC) video compression standard used in 2000 [15].The latest compression standard established in 2010 called High Efficiency Video Coding (HEVC) standard[16].

JPEG: Jpeg is the standard compression technique for still images and it supports four modules of encoding like sequential, hierarchical, progressive and lossless. Jpeg is the most familiar format because the size of video file is not large, so that with the minimum file size, good high quality video can be seen.

AVI Format (.avi) : Microsoft developed a very useful format, named AVI. Audio and video data are stored in this format. It does not need much compression and all computers support this kind of format.

MP4(.mp4) Video Format: Online audio and video streams are stored by this format, and it is denoted as MPEG. The file size of MP4 format is very large when compared to other players. Moreover it gives you better video quality in high resolutions. Apple Player supports for playing this format. Likewise, it is supported by numerous media players.

WindowsMedia(.wmv) Video Format: Microsoft developed this format.It is mainly introduced for storing online video streaming.

III. TYPES OF DEDUPLICATION

Many types of deduplicationtechniques are available in video streaming to improve the quality and efficiency of the video storage. It can reduce the storage space up to 90 percentage. Many applications used the deduplication technique to enhance the backup and recovery actions. Various types of deduplicationsare discussed in this chapter to understand the functionality of each.

3.1. Source deduplication

It is a data deduplication technique. It removes the unwanted data before transmitting it in to back up device. It removes the duplicate data from the original device itself. But it is slower than the target deduplication. However the data transfer rate is better than target deduplication. It saves bandwidth and also storage space.

3.2. Target deduplication

Removes the unwanted data in the backup device using virtual tape library but it does not reduce the data amount while transmitting via LAN/WAN. Since the bandwidth constraints are lesser and performance is faster, target deduplication performs well than source deduplicaton. The only disadvantage is that it uses hardware at other end of remote sites.

3.3. Inline deduplication

It removes the unwanted data before writing the data in to storage device. Inline deduplication performs very well than other deduplication methods because storage space required is very less. This method does not store the unwanted data. The drawback of inline deduplication is, it reduces the speed during the backup process because inline deduplication process will be performed between servers and disk storage systems for backup. The method followed by inline deduplication is, it divides the whole data in to mini chunks that has individual hash identifier. The algorithm detects the repeated data by comparing each individual hash identifier.

3.4. Post process deduplication

The data to be stored is written in the disk cache before starting the deduplication process. The advantage of using post process deduplicationis, it takes less time. The disadvantage of this type is it needs more space to save the whole back up until the unwanted or duplicate data is eliminated.

3.5. Global deduplication

Removes all the unwanted data in multiple storage device. It provides high flexibility and high availability. It does not suit smaller organisations because it is more complex and handle large data. Combining cloud with globaldeduplication reduces the overall expenses of organisation.

IV. APPLICATIONSOFLIVE VIDEO

Many realtime applications are used for live video streaming. In this chapter we address some of the important application of video streaming. These videos can beset as a input of the deduplication technique to reduce the volume and increase the transmission time.FacebookLiveapplication shares the live video over internet to other users. Facebook users can monitor the live video that has been broadcasted. Live video is stored in the facebook without the acknowledgement of user which consumes storage space. Instagram live has overcome this challenge by displaying the live video for only 24 hours by default, unless user allow permission to store that video permanently. Live stream is an application that provides high quality video. IBM cloud video is also used to broadcast live videos. The only drawback of these applications is payment cost is very high.Twitch is an application especially developed for gamers. User can purchase games and can give commentary on other players.

V. VIDEO DEDUPLICATION

Many video deduplication techniques are proposed by different authors for different kind of usages and applications. It fall under two categories, they areoffline and live video streaming. Karen Simonyan, Andrew Zisserman[9] proposed a deep video classification model called Two Stream Convolutional network namely spatial stream and temporal stream. Actions are recognized by spatial stream in motionless video frames whereas for temporal stream, it is recognised from motion. Optical flow stacking and Trajectory stacking are used to detect motion representation. The limitation of this model is very complex implementation and requires more processing power. Proposed ConvNet methodology is good when compared to older systems but gives less efficient results for newer systems. Input records the optical flow through the trajectories, but spatial pooling does not choose the path followed by object in to account.HaoYe and et al. [1] evaluated two streamCNN to find implementation option that affects the performance of video classification. Many deep learning based models are introduced in recent years for solving many complex problems but on video data, deep learning results are worse. In this paper, they have processed two streams- the central pathway and dorsal pathway to process spatial

information and motion information. Same as like two stream CNN, Recurrent Neural Network(RNN) can also be used to model the temporal dimension of the video. Overall, the result shows that deep learning approaches are better than traditional techniques for video classification.

MahsaBaktashmotlagh and et al. [3] introduced an analysisofnon-linear stationary subspace. Many dimensionality reduction techniques are failed because a single portion of the signal has been distributed to every video belongs to the class. This proposed model comes with a solution to rectify this issue by splitting uponlythe stationary parts. Video classification is performed by action recognition, anomaly detection and face recognition. Stationary signal means sum of elements which have constant instantaneous amplitude and instantaneous frequency. This method shows the maximum, minimum and mean distance error between obtained source and true source for extracting stationary signals.Non-stationary signals are told as non-stationary, if one of the fundamental assumptions is no longer valid. It is a method to classify videos that extracts stationary portions from trainedvideos. The limitation of mentioned model is, it is not able to process noisy images. In processing high resolution images, efficiency is poor while compared to results with processing low resolution images.

Xiaoming He and et al.[8] formulated the allocation algorithm to select the location of cache through a centrality indicator. Greedy method is used to calculate the amount of cache assigned to nodes. In terms of experience Quality of Experience(QoE) is much better than Quality of Service (QoS) for Internet of Things (IoT). There are two ways to access QoE. First is based on the QoS value. These values are bind with individual network. Second, Mean Opinion Score(MOS) model which is defined as higher the MOS is, the experience of the user becomes elevated. The above two terms affect the QoE. In this paper, an algorithm named resource allocation is proposed to compute the maximum of QoE. Limitation of this model is that the QoE achieved with proposed model is not satisfactory when compared with latest methods.Li Zhou and et al.[7] proposed a new strategy for load balance across many servers in ORTHRUS systems. There are two types of typical cloud storage system, they are File level storage and Block level storage. Examples of File level storage are open stack,Hadoop, Amazon, Eucalyptus. These are distributed storage resources with high level security, higher scalability and better I/O efficiency. But in the case of Block level storage, User can generate own database. The problem is different server hasdissimilarcapacity. So delivering equal workload to different servers is not rational. To solve this problem, dynamic load balance strategy is implemented. To stabilize the load of two servers, genetic algorithm is used. Kernel Fusion is used for fusing the code bodies to remove redundancy in kernels. Data motion is also can be brought down in between GPU registers and memory as well as across GPU memory and CPU memory. However this model is very complex to implement and requires more processing power.

Ching-Chih Chuang and et al.[11] proposed a tree construction to reduce multicast data traffic. This model is used to reduce the overall traffic. In high speed wireless technologies like Microsoft, Google, IBM, the connectivity is fast. In traditional data transmissions, network congestions and unnecessary data transmissions occurs. An efficient algorithm is introducedtofind solution for tree building problem. A low complexity solution is proposed to solve tree maintenance problem. Polynomial time algorithm is used for node joining and node leaving. This paper has described a sequence of simulations to analyse the performance. The limitation of this paper is that the simulation results demonstrated are successful for multicast traffic minimization but there is huge amount of data loss in this case.

Kaiming He and et al. [6] proposed a new strategy called “Spatial Pyramid Pooling”. It is more powerful in object detection. Usually CNN requires input size as fixed. Spatial Pyramid Pooling layer is introduced in this paper to remove the fixed input size. Here the feature map is extracted only one time from the whole image. Thus the time consumption is very less when compared to older models. KhurramSoomro and et al. [5] introduced UCF101 which consists of different action datasets. Currently UCF101 is the big dataset for action. UCF101 has actions like movement of physical objects, movement of body while playing games, gym, cricket and so on. It has 101 action and 13 thousand clips with a total duration of 1600 min. It consists of min clip length of 1.06 sec and max clip length of 71.04 sec with the resolution 320 x 240. The videos in the database are very realistic and they are captured by the normal people, consists of camera motion and good lighting. The experiment is performed with “bag of words” approach to deliver output on UCF101. Result for action recognition for this new data set has overall accuracy of 43.9%. With the Two Stream ConvNet [1], the accuracy level for Spatial ConvNet and temporal ConvNet is given in the Figure 2,

Spatial ConvNet	Temporal ConvNet	Fusion Method	Accuracy
Pre-trained + last layer	bi-directional	averaging	85.6%
Pre-trained + last layer	uni-directional	averaging	85.9%
Pre-trained + last layer	uni-directional, multi-task	averaging	86.2%
Pre-trained + last layer	uni-directional, multi-task	SVM	**87.0%**

Figure 2 : Accuracy of Two-Stream ConvNet[9]

Hao Liu and et al. [10] proposed a strategy for storing data virtually. This model is proposed to achieve Software as a Solution (SaaS) and massdatastorage. OBS (Object Based Storage) is used to ingress data at a sky-high speed rate. FSR (Fair-Share Replication) strategy and weight-computing method is introduced in this paper to find the best candidate node and to achieveoptimum storage node. The experimental result shows that, the efficiency of storage rate has improved than other storage system. Therefore virtual storage is used in huge scale net data storage and it will get more support in future.Gianni Costa and et al. [2] proposed a technique called incremental. This technique is used to identify the duplicates in large databases of textual sequences. Hash based index approach is adopted to search for duplicates. The experimental result shows the evaluation of effectiveness on synthetic and real data. The challenge is to calculate the total dissimilaritiesbetween tuples. However, the proposed clustering algorithm is not efficient and effective when the input strings are too small and different.ChenhanXu and et al. [12] proposed aanalytics called Hybrid stream big data. In this method, a new CNN algorithm is introduced to identify important frames and unimportant frames. Frame load reduction is used to drop the unwanted frames. To make sure the quality of video, minimal correlation and minimal redundancy technique is used.

Figure 3 : Video action detection (Source : Google)

The experiment results have shown that this algorithm reduce network and storage overload. Figure 3 gives a clear idea of video action detection by comparing two frames.Chen Zhu and et al. [4] proposed a new network structure called Redundancy Reduction Attention(RRA). This model reduces the unwanted frames in video. Video is a collection of frames that contains a lot of repeated and many unessential frames. This paper focussed on establishing redundancy reduction technique to solve the problems related to redundancy in videos by gathering two video datasets and some of new data sets. This method is evaluated and experiments were performed on RGB, flow of Kinetics and RGB frames of Activity Net. Then this method is compared with state-of-the-arts method. The result shows that it reduces the redundant activations.

VI. FUTURE SCOPE OF LIVE VIDEO STREAMING

In 2007, the first live video streaming is launched. In 2005, you tube was launched with many videos. Initially YouTube didn't invent the live video concept. Later YouTube broadcasted the live video streaming among people. Many application now started live streaming such as facebook, instagram etc. The level of security is good than previous technology. Nowadays you can give restrictions like who wants to see and who doesn't want to see.

Nowadays live video streaming is becoming trend in all social related media. Many experimental results has showed that people viewed live streaming videos more than the normal stored videos. Since the screen clarity is moderate in live video streaming, steps should be taken to improve the resolution. Live video can be captured by cameras like web cam, security camera, video camera. There are many cameras with different specification like with audio control, with both video and audio control etc. IP Cameras are connected with the cloud for storage and can be used for security purpose.

Video surveillance is done by surveillance cameras in many places like roads, forests, offices and shops. Cameras on roads can be helpful to regulate the traffic and it is used to investigate the accidents on roads. Camera on forest is used to calculate the population of animals and to study the behaviour of mammals. In order to prevent the theft or any miscellaneous works, video surveillance is done in offices or in working place. However the storage space needed is huge and detecting the action movement is a challenging task. Therefore advanced technique should introduce to overcome such issues.

VII. CONCLUSION

Deduplication techniques are discussed in this paper in various aspects and the role of inline deduplication in video streaming is discussed in detail.Themerits and demerits of each model and also the limitation of each model isdiscussed. This paper discussed the comparison between many models and methods and has shown many existing works on removing redundancy techniques in a video and the ways to store video data. Also this paper tried to analyse the different techniques used for video compression. The major drawback of removing duplicate frames from a video affects the quality of video. Therefore biggest challenge is to provide high quality video even after the removal of redundancy frames. Some of the major applications which we use in present days in video streaming using inline deduplication were also discussed. The proposed research work will be helpful to plan and construct new model. Lot of research challenges can be overcome by proposing new algorithms towardsremoving the duplicate frames from video sequence and enhance the video quality.

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