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A SURVEY ON VIDEO FILE RESTORATION

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Abstract—A large amount of video files have been available due to the wide spread use of surveillance camera, CCTVs, mobile cameras etc .Chances of corruption or damage of video file is a critical condition in investigation cases. Video file sometimes play a crucial role in criminal cases. Recovery of a corrupted or damaged video file is critical in digital forensics. A forensic analyst examining a disk may encounter many fragments of deleted digital files, but is unable to determine the proper sequence of fragments to rebuild the files. File restoration can be done using several approaches which include file based approach and a frame based approach. This paper surveys various techniques used for video file restoration. By analyzing we found that video file restoration using a frame based approach provide a better efficiency compared to other techniques. And also we can recover fragmented as well as partially overwritten files using frame based recovery

Keywords-— Video file restoration, frame based recovery , smart carving, video retrieval,codec

I. INTRODUCTION

Recently, a large amount of video contents have been produced due to the wide spread use of surveillance cameras and mobile devices with built-in cameras, digital video recorders, automobile black boxes etc. Recovery of corrupted or damaged video files has played a crucial role in role in digital forensics. In criminal investigations, video data recorded on storage media often provide an important evidence of a case. As an effort to search for video data recorded about criminal, video data restoration and video file carving has been actively studied.

File fragmentation normally is an unintended consequence of deletion, modification, and creation of files in a storage device. Therefore, a forensic analyst investigating storage devices may come across many scattered fragments without any easy means of being able to reconstruct the original files. In addition, the analyst may not easily be able to determine if a fragment belongs to a specific file or if the contents of the fragment are part of the contents from a particular file type (image, video, etc.). The reconstruction of objects from a collection of randomly mixed fragments is a problem that arises in several applied disciplines, such as forensics, archaeology, biology and art restoration. Most of the video data restoration techniques attempt to restore the source data using meta-information recorded in the header of a file system. The meta-information of file system contains file information such as file name, time of modification, physical location, link, etc. The digital forensic equivalent of the reconstruction of fragmented objects problem, which we call *reassembling fragmented documents*, however, has received little attention. Some proposed techniques were signature based file restoration technique, bit fragment gap carving technique, smart carving technique, frame based recovery etc. Out of these most efficient one is frame based recovery where instead of file systems we are dividing video files into frames which are minimum meaningful unit of a video file. Some of the existing file restoration technique introduced the method of providing signature to the file system.ie, providing header and footer to the file system. But this technique does not provide efficiency when overwriting or fragmentation is present.

Conventional file restoration techniques find the metainformation of the deleted files to search for physical locations containing the actual file contents. However, the file cannot be restored if not all the file links are connected. Since a video file typically has a large volume of the data, it is highly likely to be fragmented although the meta-information remains in the file header. When part of the file was overwritten, restoration of a video file with meta-information only may not be

successful in most situations. To tackle these problems, various techniques have been proposed by which if the file start markers and end markers are discovered based on the file signature, relevant data are collected to restore the video data. In such case also system fails when fragmentation or overwriting is present. But frame based recovery is a simple, yet powerful video data restoration method that can recover a portion of the file even when a complete restoration of the file is not possible. This scheme can restore the video regardless of a file system. This approach can restore a video data from fragmented data stored on a corrupted or damaged video file. Since large size multimedia file tend to have a large amount of fragments, a file based restoration technique may not be successful. File-based restoration of conventional methods is extremely difficult if the physical locations of all fragmented data are unknown or a part of file is overwritten.

II. LITERATURE SURVEY

File restoration is important in case of damaged video file if the file plays a crucial role in some investigation cases. For restoration earlier conventional file restoration method was used which uses the meta information stored on the header of the file system. Meta information include file name, time of modification, physical location, link, address etc. These metainformation were used to restore the corrupted video file. First proposed system for the recovery of a corrupted video file was a file restoration tool called sleuth kit. This kit was implemented on a software toolkit. This program is based on the information from the file and directory structure of a storage file system. But when file system meta information is not available, file restoration fails.

To overcome this disadvantage File Carver proposed signature based video restoration technique. In this method, a database of file header and footer is created which contain the beginning mark and end mark of the file. This method specifies a set of rules for a specific file type. The signature based system doesnot use meta information of the file system. So it overcomes the problem of the previous system. Signature based video restoration technique identifies the fragmented video portions from the storage unit by examining the header and footer which are already stored. But the system fails when header or footer is fragmented. When fragmented we cannot identify the fragmented video portion, thus this technique also fails.

Scalpel proposes another technique that does not rely on a file system to restore a video file. This technique requires an indexing step to find the file header and footer from a whole disc as well as a restoration step to recover indexed header and footer. We do not use file system metadata to restore the data between the header and footer to a file. This method is limited to the cases when the files are unfragmented. This method does not recover partially overwritten video files.

Garfienkel proposed another technique to recover the damaged video content even if the header or footer is fragmented. Here he uses an extension of the signature based file restoration that is we can recover damaged file even though footer is not present. This technique also does not make use of the metainformation stored on the header of the file system. In this technique additional information like file size or length is added to the header of the video file's portion. So when fragmentation occurs and the footer is removed we can restore the file based on the length information. But this technique fail when overwriting occurs in the file. In such cases the system fails to identify the original length portion of the file .

Bit fragment Gap Carving technique is also used to restore a video file. In this method a combination of region containing file header and footer are found out and tested whether the video sample containing the combination of region produces a valid result, that is whether it matches with the original video file. By doing this process the difference between two data regions are computed and checked whether the difference passes the predefined validation procedure. The procedure is repeated until the gap passes the validation test. However, this method can only be applied to a video file with two fragments and this technique has limitation when the gap between the two file fragments is large.

Cohen considered the recovery of fragmented files and described the carving process as being equivalent to estimating a mapping function between bytes copied from an image of storage media to the recovered file. Files could be recovered using a generator that produces all possible mapping functions. Results of these mapping functions are evaluated for their validity. The downside of this approach is the vast number of combinations Cohen also discussed another critical component of a file carving system: the discriminator. This component can tell if a recovered file is corrupt or likely to be correct. It's result is fed back into the mapping function generator. This way the recovery process can be improved by excluding mappings that are incorrect before they are evaluated for their correctness. Cohen described mapping function generators for the PDF and ZIP file formats.

Smart carving technique was proposed to restore a file without giving any consideration to the number of fragments. If fragmentation is identified, the fragmented parts are identified and performs a permutation combination process and thus identifying the order of frames and then return it back to the original video file and checks whether it creates a meaningful playable video file. This technique consist of three steps: preprocessing, collation, and reassembly. In the preprocessing step, they collect the called block part, which was not allocated to a file, using the file system information to reduce the size of the data to analyze. The collation step categorizes the collected blocks in the preprocessing step according to a file format. The reassembly step determines fragmented parts and merges them into a file. Then they check whether a playable video file is generated or not.

Smart carving technique was extended to apply to multimedia files. In the reassembly step, they increased the restoration rate of multimedia file by assigning a weight to each fragment using the decoded frame difference. However, the method presented in, which is also a file-based approach, has a limitation to restore a video file when a part of video file is overwritten.

Recently another recovery technique was introduced which is graph theoretical carving proposed by which the k-vertex disjoint graph is created to piece together the fragmented parts. This technique propose various greedy heuristics restoration technique which is used as the matching technique. In this technique general procedure for automated reassembly of scattered image evidence. Experimental results show that even by using a simple greedy algorithm where the best candidate probabilities are used results in most images being reconstructed in their entirety. However, by making the enhancements to the greedy algorithm and then using simultaneous reassembly techniques or SPF algorithms we can further improve the reassembly results. Even those few images that are not reconstructed in their entirety tend to have a large number of fragments that are in the correct order. This is helpful because, if an analyst can identify
proper subsequences in these candidate reorderings, they can combine these subsequences to form unit fragments and iterate the process to eventually converge on the proper reordering with much less effort than if they were to perform the task manually.Most of previous technique bases its file restoration on a file unit, however, so only when a whole file is restored can the video be obtained. In general, the signature-based file carving techniques mentioned above consist of the following three steps

1)Identification Phase: To identify a video fragment in storage medium and to connect it to the previous fragment.

2) **Validation Phase:** To validate if all connected videofragments successfully form a playable video file.

3) **Validate by Human Expert:** To sort out false positive video segments by human expert.

The validation step checks if a restored video file is a playable video file. Conventional file-based video restoration techniques may fail to validate a restored video when a part of video is overwritten. On the other hand, the proposed frame-based method carry out video restoration frame by frame, and is therefore applicable to restoration of partially overwritten video file.

Recently a new technology was introduced known as Frame based recovery of corrupted video file using video codec specification. In this technique a video file is converted into video frames where each frame is a minimum meaningful unit of a video file. Each video frame is encoded

using a codec specification. Each frame also contain decoding header information at the start and end of a frame which is used to decode the video frame. So in this method restoration is done using video frame and decoding header information.

The proposed technique is applied to MPEC-4 Visual and H.264 video coding schemes, two popular video coding standards widely used in CCTVs, mobile devices and automobile black boxes. For recovery of the damaged video file the proposed technique incorporates two phases: extraction and connection phase.In extraction phase data is extracted from unallocated space using various forensic tools like Encase and WinHex. From the extracted unallocated space frames are extracted based on MPEC 4 and H.264. The extracted frames are then verified using a decoder. Decoder also returns the size of the frame

In the connection phase, the frames verified by the decoder forms the frame set. For connecting, the frames size returned from the decoder along with the information from the STSZ box which is present on the header of the file system is also used.

The advantage of the system is that if the metadata information that is present on the STSZ box is not available also restoration is possible. Another advantage of the paper is that if fragmentation or overwriting is present also recovery is made possible .Experiments were conducted and the results shows that most of the frames were restored. The proposed technique increases file restoration technique. The proposed frame-based file recovery technique increases restoration ratio. From the experiment for fragmented video files, 40 □ 50% of the data was recovered from a corrupted video with 50% overwriting regardless of the amount of fragmentation. For the experiments with overwritten video files, the portion of the video file not overwritten was recovered regardless of fragmentation. The proposed method restores almost frames in damaged or corrupted video files without being affected by the number of fragmentations. Especially, the proposed technique can restore the frames of the non-overwritten portions in partially overwritten files

	Fragmentation is present	Overwriting is present	Meta information is not available	implementation
Carrier approach	System fails	System fails	System fails	Implementation is expensive
Signature based video restoration	System fails	System fails	System works	Can be implemented
Scalpel's method	System fails	Full restoration is not possible	System works	Implementation is difficult
Garfienkel method	System works	System fails	System works	Can be implemented
Bit fragment gap carving technique	System works when fragmentation is less	System fails	System works	Implementation is difficult
Smart carving technique	System works regardless of the no of fragments	System fails	System works	Implementation is easier
Frame based recovery	System works efficiently	System works efficiently	System works	Implementation is easier

Table 1:Table of comparison between different video file restoration technique

III. CONCLUSION

As a result of the wide spread use of surveillance camera, mobile devices, CCTVs etc large amount of video files are present. Because of this, chances of corruption or damage of a video file is a common scenario. There are several techniques proposed to recover the corrupted or damaged video file. This paper makes a survey on various techniques that are used for video file recovery. Based on the survey performed it is found that the frame based recovery of corrupted video file is much better compared to other technique. In this technique file is divided into frames and then recovery is performed based on the frames and recovery is possible when fragmentation and overwriting is also present. If overwriting is more than 50% then non overwritten parts are recovered using codec specification which are not possible in other previous techniques. Restoration is also done in an efficient way in this technique. So the survey concludes that compared to other previous technique frame based recovery is more efficient.

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