

Review on the Techniques and Features of Forensic Examination of Image in Surveillance Video

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Abstract—With the widespread applications of surveillance video facilities, surveillance tape as evidence presented in the proceedings also becomes more and more popular in many cases. However, whether the video evidences forged or altered turns important before being considered as the support of the facts of cases. In this paper, several forgery techniques of the video image provided and the features of that analyzed

Keywords- surveillance video, forgery techniques, authentication, forensic science

I. INTRODUCTION

The authentication of human images in surveillance video system normally refers to the forensic identification of human images. Before the forensic identification of human images, the forensic authentication of video recordings of surveillance video shall be checked firstly. Some particular cases involve that the forensic authentication of video recordings of surveillance video shall be executed possibly. Therefore it is necessary to analyze those normal methods for the authentication of the reality of surveillance video and those normal methods for the authentication of images.

II. MAIN METHOD OF IMAGE FORGERY IN SURVEILLANCE VIDEO

Normally image of surveillance video is saved in computer with digital format. These digital files are easily proceeded and edited through every kind of video proceeding software. There are many video proceeding softwares on the internet which are easily downloaded and used. For example, Ulead Video Studio, Adobe Premiere Pro, Blaze Media Pro and Video Edit Magic are easily downloaded from internet.

Video edit can change the original video content through combination of multiple video, image, character and language by means of deleting, adding and editing. The forgeries of images of surveillance video actually adopt the normal method and technique of video edit.

A. *Deleting, copy and cutting of video images from the same camera*

If those video images from the same camera but different time points is cut and proceeded and then a new video image is formulated which is consistent with the same fixed scenery. Due to video images from the same camera, the quality of

images generally is common. While actually there are many discrepancies for those images taken by different time.

B. *Copy, cutting and admixture of images from different cameras*

The normal way of video edit is to proceed those images from different cameras, thus a new video file is formulated by combination of those images. Customarily in the key position of video image one part of other video image or other kind of video content is added, or one part of video image is firstly deleted and then one part of other video image which is not related to the original video image is added.

C. *Adding, deleting and editing of human beings or objects in surveillance video system*

The forgery of certain human beings or objects in original surveillance video system formulates the third way of surveillance video forgery which is not necessary to append image frame to original video. Those ways of falsification and re-proceeding mainly include appending one human or object to video image, deleting certain human in video image, substituting appearance of one human, appending one new object to video image, deleting one certain object, revising and editing shapes, color and property of objects.

D. *The falsification and alteration of voice information in surveillance video system*

Most of those video images only have images without voice information while some of surveillance video system records voice or other sound information. The falsification and alteration of voice information is a kind of method to transform the reality of surveillance video system.

The falsification and alteration of voice information mainly appears in case that the lawsuit needs to be certified by voice information and images. If voice information is nothing serious about the certification of lawsuit, there is nothing meaningful to alter voice information.

On basis of different ways of falsification and alteration, there are two kinds of situations. For the first situation voice information is appended to video image which originally has not voice information. For the second situation the original video image has voice information, then the real content can

be changed through deleting, copy, cutting or appending voice information.

E. Comprehensive utilization of above ways of falsification

During the falsification of surveillance video image, comprehensive utilization of the above ways or a few kinds of ways are used to forge video image. For surveillance video image is a 3D video including image, voice and video, the above corresponding ways of falsification will be used to reach the anticipated effect.

As new video equipment comes out and ways of falsification are being upgraded, some techniques and ways of surveillance video falsification shall be generalized, analyzed and studied to identify the reality of surveillance video.

III. THE FEATURES OF FORGERY SURVEILLANCE VIDEO IMAGE

A. The forgery of image property from different cameras

Compared with original image, those images from different surveillance cameras have the following characteristics.

1) *The change of fixed scenery in the system of surveillance video.* When image combination happens from different surveillance cameras, the forged image can not have completely equal scenery with the original image. So we can distinguish those forged images from fixed scenery if we observe those images carefully.

If the original video uses fixed surveillance camera to capture images, normally the scenery is fixed which will not change any more. If the fixed scenery shall be changed, we must move the surveillance camera. During the movement of camera, if it works normally, the change of scenery shall be slow without enormous transformation. And the change of human and object in video is very light. During the movement of the surveillance camera, if it works abnormally, the image of surveillance video shall not change enormously. Though during abnormal work period the surveillance system can not append image to video, when the surveillance system works normally again, it will not append new images to the old video file while appending to a new independent video file. Thus, no matter what kind of situation happens, the scenery of image shall be fixed or continuous change. Generally one surveillance video file shall not have enormous scenery alternation.

If the surveillance camera is not fixed, the scope of surveillance shall be in routine. The movement of surveillance camera is implemented by the platform fixed in surveillance camera. The platform can be controlled manually or automatically by computer program. The movement of platform can be front, back, up, down, left and right. No matter how the platform moves, the surveillance camera captures images under the condition that the platform is as the center. Thereby the scope of surveillance is also limited for moving surveillance camera. As normal surveillance video image can be controlled manually, the scenery of image will change wantonly. Thus the scope of

surveillance can cover largely. While with the same principle of movement of fixed surveillance camera, during the transportation of moving surveillance camera, the change of image scenery is continuously.

When images from different surveillance cameras are combined, due to different position and scenery from the original image, the proceeded or forged image shall not have continuously changed scenery.

2) *Different quality of images in surveillance video system.* Those images captured by different surveillance cameras shall not have the same quality for different camera vision angle, focal distance, image pixel and ray. Hereby when different quality images are combined, imprint of different images captured by different surveillance camera shall be kept.

The most common difference relies on surveillance camera vision angle or focal distance. Images of human being or object captured by different focal distance have different size. The pixel of image occupied by portrait is related to the distance between human and surveillance camera, the focal distance and the pixel of image. The portrait from the lens farther, imaging in the lens is small. The resolution ratio is much higher, pixel occupied by every unit will be much more. When images captured by surveillance cameras of different focal distance are mixed, the image scale of human and object will not coincide. Under such condition we can observe with eyes to differentiate or by calculation. Another important factor which put much influence over quality of image is surveillance camera vision angle. When vision angle of two surveillance cameras are not consistent with each other, normally such situation will result in different focal distance, which at last leads to different image scale. Though surveillance cameras with adjacent vision angle, the image quality will exist enormous differences. For example, images captured by wide-angle cameras, the distortion change of object and human possibly differentiate with one another. Linear objects captured by different wide-angle surveillance camera in the same position will have different bending position and different bending degree. Therefore, quality difference among images captured by different camera can be differentiated.

Light is also one of important factors which influence the quality of image. The size and strength of light will influence clarity and contrast ratio. On night those images captured will generally have partial red background, while those images captured in midday with strong light will have partial green background. If during the formation of image there is no big change of light, the background and the clarity will not change a lot.

In a word, quality of image exists difference if video images are mixed by the way of editing.

B. The characteristic of image captured by the same camera

1) *Exceptional picture.* Exceptional picture includes unnatural transition and repeated pictures.

The unnatural phenomenon of picture transition happens generally when other surveillance video file inserts in one video file, which have different object position of background, different clearance condition of floor, different human activity and different light condition. Thus when inserting new video segment, the transition of picture will possibly happen unnatural phenomenon. For example, it possibly emerges reluctant object, or it possibly disappears some object, or it lacks connection of human activity, or it happens instant light change.

Commonly pictures of video are continuously configured. The transition of image frame is in a natural way. Generally it will not happen unnatural transition of pictures.

The reason for happening repeated pictures relies on the edition of video image, which sometimes needs one certain image. Lots of forged cases usually emerges completely similar segment of images more than two times.

The existence of similar video image happens two kinds of situations. One kind includes the similar movement image of human and object. The other kind includes similar stable image. When the forgery of video image happens, it is necessary to forge movement image of human and object. Theoretically in different time there are no two absolutely similar images captured for the real scene and object will exist certain difference in certain video time, video light, video image compression and under the condition of different human activity. In one video image within relative short time it is abnormal to appear absolutely similar image.

2) *Exceptional color temperature change.* Color temperature represents the scale of light color of light source. During surveillance video, it represents the feeling of eyes to illuminant or white refractive body. It is a kind of feeling under the influence of physics, physiology, psychology and other complex factors. Generally red radiation will be more for low color temperature, which is called "warm light". When color temperature rises, the proportion of blue radiation enhances, which is commonly called "cold light". Color temperature associates with ray tightly. When sunlight becomes strong during midday, the image will appear cold color. While during night the image will appear warm color. The surveillance system can supply appropriate color temperature for images by means of enhancing and decreasing color temperature with software. For instance, the image will appear lower color temperature when red ray filter is added on lens of camera to decrease a little bit of red ray. Due to generally continuous change of light during video recording, that is to say, light energy change is continuous, then the change of color temperature is continuous. If there is no exceptional change of light during video recording, the color temperature of image will not happen jumping change. For the forged surveillance video, due to different light condition while recording the video compared with the original one, it will appear exceptional light temperature change in the surveillance system especially while there is big difference of light condition.

3) *Trace of time record forgery.* In the system of surveillance video, commonly the name of passageway, time of record and unit of surveillance video are put in the formed video image. When video recorded in different time is mixed together, time record of video image shall be altered or canceled.

If time information of surveillance video is not altered or canceled, through observing the change of time information we can judge whether the video tape exists edition. If you want to alter or cancel the time information, it is necessary to process the key frame data. Then image pixel of image with edition of time information will change. During the process it is very difficult to make every frame edition naturally. For background pixel of time record part changes generally in an even way, the situation of absolute uniformity or sudden change will not happen. Through careful differentiation the trace of time alternation or cancellation can be observed.

C. *The characteristic analysis of human image forgery in surveillance video*

In the original surveillance video, if one fragment of image is added, canceled or replaced, the following kinds of exceptional situation may happen. In certain authentication, the following factors can be used to analyze and judge.

1) *Disobey the depth of focus principle and the perspective rule.* Those details added into video images are fabricated manually after all, they do not exist in reality. When video image is forged, they can not consider every aspect of imaging rule. Anyway one aspect is considered while another one is ignored. The concrete is reflected in images, where objects and human disobey the depth of field principle and perspective rule.

The definition "depth of focus" is the abbreviation of object depth formulated clearly in films.

The "perspective" initially is studied through one transparent plane to view the object, and then the object is exactly described over the plane, which is called the perspective image of this object.

It is very easy to judge whether human or object is added through perspective rule. But if one human or object is deleted, there is no obvious change for the perspective rule.

2) *The process trace along edge of image.* When one human or object is deleted from the surveillance video, or one human or object which has great contrast between the background of image, it is very easy to appear exceptional pixel information such as trace of scratching, trace of erasing and burr if the process method is not adapted. These process traces are commonly left through image processing software. In the original video image, among different colors there is transitional color, which makes it looks natural through eyes. While for image after process we can discover process trace along image edge through eyes if there is no appropriate fuzzification process between two different colors.

3) *Exceptional distribution of image's saturation and contrast ratio.* In realistic image the saturation and contrast ratio is related to actual color of scenery, strength of ray and direction of ray. After the process of original image, the relationship of saturation and contrast ratio among each zone will change. Thus there may happen exceptional distribution of image's saturation and contrast ratio after the process.

4) *Format amendment of surveillance video.* Different surveillance video systems have different video image forms. When the concrete detail of one segment in the video is edited and reprocessed, commonly every frame of video shall be separated firstly and then contents of principal frame shall be edited one by one. At last those edited video images are organized to form a new video. When many video images are compressed, different frame structures shall be differentiated. Different type of frame processes different information. If forged video shall be recovered original compression form as before, it exists much difficulties. Therefore the forgery guy is easily to combine processed video into a new video with new form. Relatively speaking the video with new form is much easier to transit the image in a natural way, which make it difficult to discover the abnormal phenomenon by eyes. But if the form of video is changed, we can investigate the format changed video to discover those problems involved.

D. *Characteristic of forged voice information in surveillance video system*

Both forgery methods described above may exist the following exceptional situation.

1) *Exceptional shape of lips.* Another common characteristic of forged voice information is the inconformity between voice information and lips. The inconformity includes inconsistent time and inconsistent content. Inconsistent time refers to the situation that the contents of dialogue is consistent while voice information dose not synchronize with video information. Inconsistent content refers to the relationship that voice information dose not correspond to shape of lips. Normally inconsistent content situation means forged voice information. If voice information properly is in advance or delayed, it is necessary to check the concrete situation of surveillance video system.

2) *Exceptional sound spectrogram.* Under some conditions it is impossible to establish corresponding relationship between shape of lips and voice information for the speaker in video. The lip of the speaker in the video is not clear enough. But if the integrity of voice information exists problem, then it means voice information is edited.

We can also judge whether voice information is forged, edited or processed through the observation of sound spectrogram. If voice information exists the phenomenon of edition, it represents that the original voice information of surveillance video is partial added, deleted or replaced.

3) *File format exception.* If the video file formed by surveillance video system dose not include any voice information, while surveillance video file exist voice information, then we can investigate the source of video file to discover the truth of forgery.

When the authenticity of video information is checked or authenticated, we can ask the author for video file to supply information of video site, fabrication method and time. If it is necessary, site investigation shall be carried out, which can confirm the source of video file and also make it easier to discover the forgery voice information added. If video file form is not consistent with the original system, we can ask the author whether the form of video film is converted and the detail of conversion. Then according to those inquired information we can confirm the reason of file format exception.

IV. CONCLUSION

The forged surveillance video may happen during the authentication of video image. In this article it concludes kinds of normal forgery methods of surveillance video image and each corresponding characteristic. As the rapid development of computer technology the forgery method increases more and more and the level of forgery by criminal is enhanced day by day, which brings new challenge for digital image authentication and much higher requirement for forensic science. The forgery of surveillance video image is normal phenomenon. Therefore analysis and summarization of forgery method can strengthen the capacity of authentication, meanwhile it can also enhance the accuracy rate of lawsuit, which promotes the development of judicature.

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