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IMAGE DUPLICATION AND ROTATION DETECTION METHODS FOR STORAGE UTILIZATION

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ABSTRACT

Data storage is growing rapidly without surprise for nowadays. There are several reasons that contribute to it are improper maintained and used including image duplication and inappropriate image. In order to solve the problems above, this paper proposed to enhance face detection (V-J) for inappropriate image and scale invariant feature transform (SIFT) for image duplication method. However, the enhancement of face detection (V-J) method is needed due to limited rotation detection. With the limitation above, this paper proposed simple rotation method to overcome the problem. Besides that, the SIFT method is also limited to the speed performance. In order to overcome the speed performance above, this paper also proposed to reduce the dimension of SIFT so that it increase the speed performance. With the enhancement above show that the proposed resulted better compared to previous researcher's methods. Hence, the proposed methods above have been proposed as pattern detection algorithms used for storage utilization.

Keywords: *Pattern Detection, Face Detection, Image Duplication*

1. INTRODUCTION

Nowadays our society facing serious ethical issue, it is related to language, action, and digital documents. Among ethical issue in modern society is digital documents; store inappropriate digital image in the company. Computer technologies have become part of our lives, both business and individuals for communication, education, health purposes, travel or business. Efficiently execute information includes data accessibility, cost control, and survivability, which are part of the network storage's advantages (T. C. Jepsen, 2004). However, it does can be misused and thus lead to ethics and compliance problems. For instance, computer network storage provides file sharing, which allowed a person to see their files present on another workstation. However, many employees are taking advantage of their employer-provided access to the company's network storage to store inappropriate images such as adult images and personal image which is distinctly non-work related. Additional, network storage also offers flexibility handling. For instance, a user can logon to any workstation on the network to access and manipulate his image files. User can duplicate their colleagues' image files for his own purposes. The flexibility has led to unnecessary redundant images increase the cost of storage. According to the Enterprise Strategy Group about 13% of a midsized company by industry analysis firm showed that 42% of the data storage had been increased from 2004 to 2008. (Geer, 2008). The reason duplication occurred is because user needs to work with them independently. On the other hand, managing company's resources are challenge and expensive. One of the approaches is data management. It supports daily business operation. Failure of data storage can cause high impact to the business's profit especially those big data and digital images file. (K. Rao et. at., 2011) stated that to develop a high-end enterprise storage systems are expensive because it required a multiple redundant components with customized hardware to prevent no single point of failure. Therefore, in order to prevent the company's resources that impact to business's profit, proper managing digital image is needed. As mentioned the proper managing the digital images are need to govern digital images. There exist a lot of methods. One of the methods is to use deduplication. (D. Geer, 2008) stated that deduplication method doesn't work with image files but work most type of the files including email file. (Z. Lei, Z. Li, Y. Lei, Y. Bi, L. Hu, and W.

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Shen, 2014; J. Min, D. Yoon, and Y. Won, 2011; W. Leesakul, P. Townend, and J. Xu , 2014; X. Zhao, Y. Zhang, Y. Wu, K. Chen, and J. Jiang , 2014) developed successfully in deduplication method. Both proposed methods are the extension of previous researcher's work. In order to classify inappropriate image based on face detection that are invariant to transition, scaling, and rotation, V-J face detection method is selected. But the V-J face detection is limited to rotated face detection. Another method to detect near-duplication image problem is to use the SIFT method that is invariant to transition, scaling, and rotation. But the SIFT method is slow. Enhancement needed for V-J rotated face detection and high speed SIFT method.

2. RELATED WORK

(Y. Sun et. al., 2014) proposed new method so called L^2-SIFT algorithm was implemented for large images in large-scale aerial photogrammetry purpose. Block-SIFT method was proposed to handle the memory issue of SIFT for photogrammetry. Besides that, red-black tree structure also was proposed to simplify the search. More features are extracted with high quality for accurate matching in large aerial photogrammetry. (K. Liao et. al., 2013) proposed an improvement SIFT descriptor for image matching and representation. The method provide robust in image matching for affine and mirror transformations. Besides that, the proposed method improved by using the SIFT descriptor with polar histogram orientation bin and mirror reflection invariant. Comparisons were done on existing methods such as MIFT, original SIFT, GLOH, PCA-SIFT, ZM phase, and SIFT Gabor. The results showed that the proposed methods are better in distinctive matching than existing methods above. (J. Wu et. al., 2013) have done a comparative study of SIFT and its variants such as SURF GSIFT, CSFIT, PCA-SIFT, and ASIFT on changes of blur, rotation, scaling, affine, and illumination. The result found that each method have its own advantages. SURF suitable for real-time application; CSIFT and SIFT performed better in scale & rotation changes condition. ASIFT performed better in affine change condition. GSIFT performed better in illumination image or blur changes condition. The study offers the knowledge for the selection of SIFT & its variants based on problems and solution. Based on the researcher (G. Tong et. al., 2013) proposed to improve the speed of ASIFT by using NVIDIA's Compute Unified Device Architecture (CUDA) GPU-based affine scale invariant feature transformation (multicore parallel ASIFT). The advantage of implementation of parallel of multicore CPU and GPU are the proposed solution is for data-level parallel computing, whereas CPU is for task-level parallel computing. The result showed that speed was faster than CPU with ASIFT algorithm and GPU-accelerated with ASIFT algorithm and without impact to the accuracy as well. (Y. Li et. al., 2014) proposed SIFT based on geometric algebra for multispectral images. The new proposed solution was introduced due to original SIFT algorithm not able to extract features from multispectral images. Loss of many image information including color information if grayscale conversion as pre-processing. However, this was done in original SIFT method. Comparisons were done with other SIFT methods including Hue-SIFT, C-SIFT, and et cetera. The proposed method performed better than others if the illuminant is reduced. There are few problems in V-J face detection method such as illumination, rotation variant, and occlusion. (J. Yan et. al., 2013) proposed structural models for face detection by developing the co-occurrence body and face. Unlike the Viola Jones detector limited to large appearance variants in pose, expression, illumination, and occlusion. The experiments data were evaluated from AFW and FDDB. The solution is resulted better performance. V-J face detection consists of Haar feature and Adaboost machine algorithm. Illumination of image also can affect the accuracy of the object detection. However, this can be solved by improved the Haar feature. (K.-Y. Park et. al., 2014) proposed Haar Contrast feature as feature for object detection. The experiments data from the Extended Yale Database, which contains various illumination conditions. Comparison among LBP, Haar-like feature with variance normalization, Haar-like feature without variance normalization and Haar Contrast feature were done. The solution was outperformed than others. This paper also discussed other methods that are invariant to rotation such as RIFF, DAISY, spatial distribution and structure. RIFF refer to rotation invariant fast features proposed by (G. Takacs et. al., 2013) for real-time tracking and large object recognition. Comparisons were done among Kanade Lucas Tomasi (KLT), NCC, SURF and SIFT for speed performance. KLT performed better than RIFF is because of the proper anti-aliased, no pixel interpolation, subsampled scale-space, and low complexity of interest point detector. However, RIFF was outperformed than both SIFT and SURF. (J.-M. Guo et. al., 2013) proposed enhancement of DAISY method for forgery detection. The purpose

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of the DAISY was applied was rotation invariant. Additional Adaptive non-maximal suppression (ANMS) was incorporate into the algorithm to support none or insufficient keypoints problem. The experiments were evaluated on the Uncompressed Colour Image Database (UCID). Comparisons were done on the existing methods who were Jing et. al. and Huang et. al.. The result of speed performance and accuracy were outperformed than them. (Y. Ban et. al., 2014) proposed skin color emphasis by using YCbCr space and Local Binary Pattern (LBP) combined with Adaboost cascaded classifier. Although the result showed that better detection for complex background and face pose variation. For future work, the proposed solution needs to be enhanced for occlusion problem. (S. Kim et. al., 2014) proposed new region binary pattern in video fingerprint for video copy detection against rotation and flipping transformation. To overcome the video copy detection can be categorized in 2 types of methods, which are spatial distribution and spatial structure. MUSCLEVCD 2007 video set were evaluated for experiments. Comparisons were done with few methods. Basically, the proposed solution performed better in term of retrieval time, store space and extraction time although CC method was the fastest in extraction due to no gray-conversion step.

3. PATTERN DETECTION METHOD

3.1 Pattern Detection Definition

The difference between pattern detection and pattern recognition are as described below. Pattern recognition is defined as "consists of identifying a given figure which is known to belong to one of a finite set of classes" whereas pattern detection is defined as "consists of examining an arbitrary set of figures and selecting those having some specified form" by (S. H. UNGER, 1959). (K. Sung and T. Poggio, 1998) proposed to find human faces by using pattern detection method. To find human faces in known set of collection is a process of face recognition. It also can be classified as pattern recognition method. Besides that, near-duplication detection also proposed to be considered as pattern detection method. Both methods are applied to deal with near-duplication image and inappropriate image problems in network storage. Both methods are also to be proposed as part of the taxonomy of image processing.

3.2 Inappropriate Image Detection by Face Detection

To classify inappropriate image is a difficult tasks. It required many criteria set in the system so that the system is able to detect inappropriate image automatically. The method is become more complex if there is new type of images. In order to simplify the process, the inappropriate image is detected by using face detection method. As long as image contains human face, it is classified as inappropriate image. For example, usually adult image and personal image contain human face. These kinds of images are non-work related. It is increasing the storage capacity and wasting company's resources. By using the system to automatically guard the network storage method can save a lot of resources. Nowadays face detection is common and widely used for other application such as face recognition.

3.3 Duplication Image Detection by SIFT

Another problems that contribute to increase the storage capacity and cost is image duplication. It is easily modify or copy and paste a image in network storage with simple clicks. This happened normally users need to work it independently. To match duplicate image is easy by compare the pixels value. However, near-duplication image in network storage can be a challenge due to object occlusion. To detect unidentified object in image for the matching can be done by using SIFT method. This method has been widely used for many applications such as forgeries and other security applications.

3.4 Pattern Detection Method Challenges

There exist many methods in pattern detection such as face detection, distinct object detection, texture detection. The challenges for pattern detection in image are to detect objects that are invariant to rotation, transition, scaling, and speed performance. The methods are then can be applied for object recognition. Pre-processing for image also need to be done due to noise, illumination, and et cetera. For post-processing, normally machine learning or Euclidean distance for matching is needed. For example, V-J face detection pre-process image by using variance normalization to remove the illumination. Machine learning Adaboost is used for feature selection. Whereas SIFT use Gaussian as pre-process and best bin first for post-processing.

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4. ENHANCEMENT OF DUPLICATION AND ROTATION ALGORITHMS

4.1 Enhancement of Duplication by SIFT

Scale invariant feature transform (SIFT) (D.G. Lowe, 2004) consists of 4 simple steps. 1st step is Different of Gaussian image, which is approximate of Laplacian method. The method is also considered as a blob-like. 2nd step is to do with scale space extrema detection. This is important to the scale invariant process. 3rd step is the accurate keypoint localization to remove contrast and eliminate edge response. Last but not least, assign keypoint magnitude and orientation. SIFT is famous due to the invariant to scale, transition, and rotation. It has been widely used for other applications. However, to apply the near-duplication image is not practical due to the speed performance. In order to gain better speed performance, binary Robert Cross edge SIFT is proposed to overcome the problem. The proposed method makes use of dimension reduction method to increase the speed. Binary Robert Cross edge is gradient image in y direction and x direction. Figure 2 shows that time taken to process the image of binary Robert cross edge SIFT is shorter than conventional SIFT and Sobel Edge SIFT. Although Sobel edge and Robert Cross edge are gradient image but Robert Cross edge performed faster. However the demerit of the Robert Cross edge is some of the salient feature might eliminated.

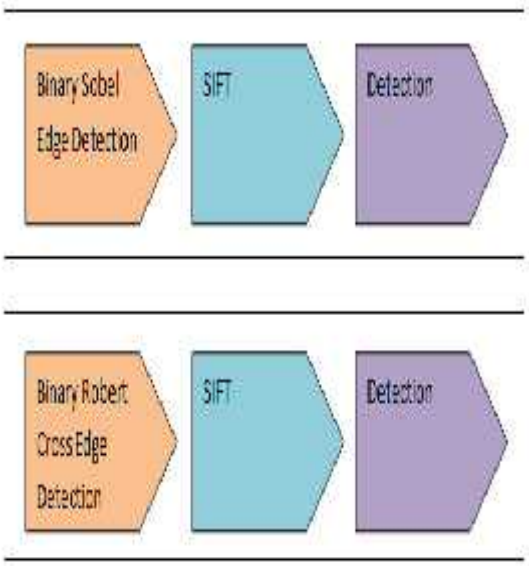

Figure 1: Comparison of Binary Edge SIFT Algorithm

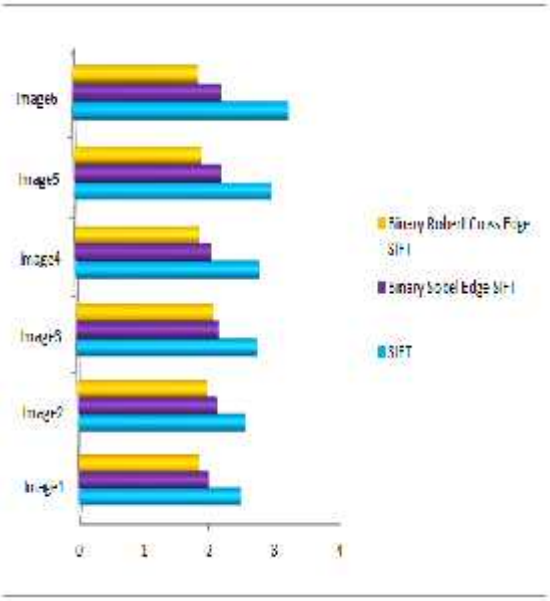

Figure 2: Speed Performance of SIFT with Other SIFT

4.2 Enhancement of Rotated Face Detection

Viola and Jones's face detection method (P. Viola et. al., 2004) also name it as V-J method. It consists of 4 simple steps. 1st step is to calculate the integral image. Figure 3 shows that the 5 basic Haar representation. To calculate the Haar features is just require sum of the black region between white region. Region D shown in figure 4 can be easily calculated based on (X4,Y4)+(X1,Y1)-(X2,Y2)-(X3,Y3). The speed performance is gain better if integral method is used compared to sum pixels value for each region. 2nd step is to perform variance normalization to remove noise. 3rd step is to perform Adaboost machine learning for the feature selection. Last step is the cascaded classifier. This step can increase the speed performance. V-J face detection is famous is due to the real-time face detection. There are many researchers have been developed successfully and applied in real-world problems. Bi Li (B. Li et. al., 2010) proposed to rotate image in $\pm 15^{o}$ as pre-processing before V-J method was applied. However, to detect inappropriate image by using V-J method might fail due to rotated face. Method proposed by Bi Li (B. Li et. al., 2010) can increase the rotated face. To further increase the accuracy, the improved method is proposed. Rotating image $\pm 15^{o}$ from 0^{o} to 360^{o} can increase the accuracy, so that, inappropriate image detection can be accurately detected. Figure 5 shows that the Bi Li's algorithm versus proposed improved algorithm. Figure 6 shows that the accuracy of rotation faces

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are detected. Rotated images are tested, the result of proposed method is accurate than Bi Li's method and original V-J face detection method. The merit of the new approach is to increase the accuracy rotated face detection. However, the demerit is the new approach might need more processing time to rotate the image.

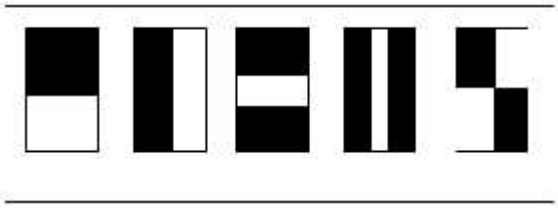

Figure 3: Haar Features (P. Viola et. al., 2004)

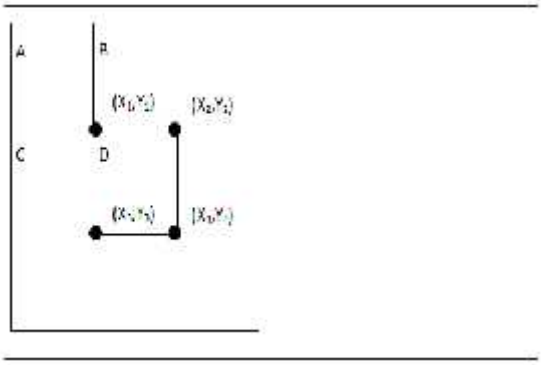

Figure 4: Integral Region of Image (P. Viola et. al., 2004)

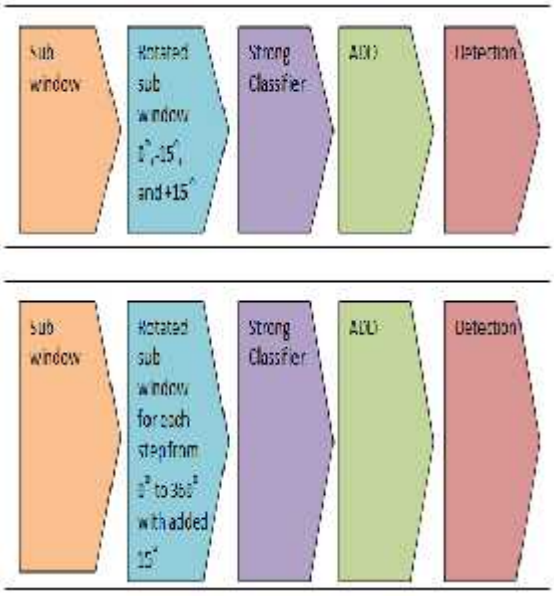

Figure 5 Comparison of Face Detection Algorithm

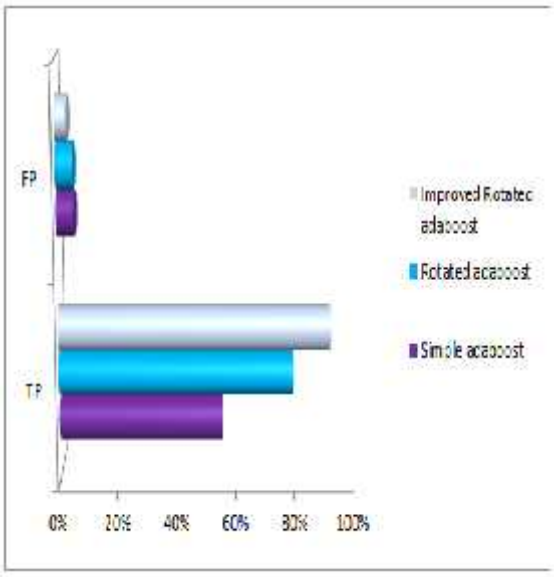

Figure 6 True Positive and False Negative of Rotated Face Detection

5. CONCLUSIONS & FUTURE WORKS

Figure 5 showed that the result comparisons of speed performance of conventional SIFT, binary Sobel edge SIFT, and binary Robert Cross edge SIFT. It is obvious that the proposed method is faster than the other two across 6 tested images. Figure 6 showed that the result comparisons of accuracy of rotated V-J face detection methods based on original V-J method, rotated images with $\pm 15^{o}$, and rotated images 0^{o}-360^{o} with adding 15^{o}. 3rd method is better accuracy then followed by 2nd method, and last is original V-J method. Both improved SIFT and V-J face detection are also have been incorporate into pattern detection method. Besides that, the pattern detection methods are applied to detect inappropriate image and near-duplication image. Additional, the pattern detection methods also classified as part of the taxonomy image processing. The proposed improved V-J face detection can be further enhancement for illumination invariant image and occluded face detection. Whereas the binary Robert Cross edge SIFT can be further test on other platform such as Android, iOS, and Symbian OS.

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