Enhancement of Rotated Face Detection and Image Duplication Methods

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***Abstract*—Pattern detection plays an important role in digital image. Scale invariant feature transform (SIFT) for image duplication method and face detection has been successfully applied in real world problem. However, the face detection method is limited to rotation invariant and SIFT method is limited to the speed performance. In order to overcome the issue above, this paper proposed enhancement of SIFT for image duplication detection and rotation invariant face detection into pattern detection method. The comparison result of the experiment shows that proposed solutions are better performance.**

Keywords—SIFT; Face Detection; Pattern Detection

I. INTRODUCTION

Ethic issue becomes serious nowadays. It is associated with language, action, and digital documents. One of the ethical issues in digital document is to store inappropriate digital image in the company. Nowadays, network storage provides the features quickly and efficiently execute information management such as manage access to data, survivability and also control costs (T.C. Jepsen, 2004). The computer technologies today could lead to such issue. For instance, computer network storage is to provide a service to allow other computers to access and share data across the network. However, there are some people utilize company's network storage to store inappropriate images such as adult images and personal image.

Besides that, managing digital image is another context in this research. Computer network storage technologies provide the advantages of flexibility but lack of intelligent feature to manage big data. There exist high-end enterprise storage systems been deployed in production environments to ensure no single point of failure, which are expensive due to customized hardware and multiple redundant components (K. Rao et. at., 2011). Improper managing digital image could lead to waste of company resources especially the high end storage with feature of data protection and backup. For instance, computer network storage allows users to manipulate data directly. The flexibility allowed the images can be easily manipulated directly by duplicating it in network storage. The unnecessary redundancy images could lead to insufficient storage capacity. Indirectly, the cost of storage is increasing every year.

There are many methods to govern the digital image issue in the company. One of the proposed methods is by using pattern detection techniques to manage it. It is vital for developing an intelligent system that can manage digital images in storage, which can classify inappropriate images and the duplication image in network storage.

II. RELATED WORK

In the literature, many approaches had been proposed. The researcher (J. Wu et. al., 2013) made a comparative study of SIFT and its variants such as PCA-SIFT, GSIFT, CSFIT, SURF, and ASIFT on time consumption in 4 situations. The result showed that SIFT and CSIFT performed better in scale & rotation situations. GSIFT performed better in blur or illumination image. ASIFT performed better in affine image. The fastest speed performance was SURF. The study showed that SIFT & its variants had its own benefits to solve real-time problems based on situations. (K. Liao et. al., 2013) proposed an improvement SIFT descriptor for image matching, which contains steps normalizing elliptical neighboring region, transforming to affine scale-space, improving SIFT descriptor with polar histogram orientation bin, and integrating the mirror reflection invariant. The result showed better distinctive than the original SIFT, MIFT, PCA-SIFT, GLOH, SIFT Gabor, and ZM phase. (Y. Sun et. al., 2014) proposed the L^2-SIFT algorithm to process large images in large-scale aerial photogrammetry. Block-SIFT method was proposed to cater the memory issue due to the larger image. Other method so called red-black tree structure was used in this algorithm. The result showed that the algorithm was able to efficiently extract high quality features and numbers of accurate match points in large-scale aerial photogrammetry. According to the researcher (G. Tong et. al., 2013) proposed multicore and NVIDIA's Compute Unified Device Architecture (CUDA)

GPU-based affine scale invariant feature transformation (parallel ASIFT), which improved speed performance of ASIFT. Based on the principle parallel implementation, multi-core CPU suitable for task level parallel computing, whereas ASIFT algorithm suitable for data-level parallel computing. The result showed that speed improvement and same precision with the serial ASIFT algorithm. (Y. Li et. al., 2014) proposed GA-SIFT for multispectral images. It followed the existing SIFT with new proposed methods to support multispectral image due to original SIFT algorithm unable to extract features from multispectral images. The reason was the original SIFT must converted to image to gray scale image as pre-processing image. The comparisons were done between feature extraction from multispectral and pseudo color images. The multispectral method result showed that correct-positive from the image reduced luminance and from images scaled with 50% are higher than other pseudo color method such as (standard SIFT, Hue-SIFT, OpponentSIFT, C-SIFT, and RGB-SIFT). This was the new SIFT method for multispectral image so called GA-SIFT method. (K.-Y. Park et. al., 2014) proposed improved Haar-like feature so called Haar Contrast Feature, which efficiently for object detection under various illumination. For the experiments, the proposed solution was compared with Haar-like feature with and without variance normalization, and local binary pattern (LBP) descriptor in trained face classifier, pedestrian classifier, and vehicle classifier. Images from the Extended Yale Database captured under various illumination conditions and vehicle images captured under relatively uniform illumination conditions. Result showed that the proposed solution was outperformed than the descriptor above. (Y. Ban et. al., 2014) proposed cascaded classifier based on Adaboost combined with Local Binary Pattern (LBP) and skin color emphasis instead of skin color segmentation or any parametric fitting or morphological operation. YCbCr space was used for skin color emphasis. Result showed the proposed solution had better tolerance to face pose variation and complex background compared to traditional booting-based classifier. However, it won't solve occlusion problem. (J.-M. Guo et. al., 2013) proposed improved DAISY for forgery detection. Adaptive non-maximal suppression (ANMS) was adopted to extract evenly distributed key points in this algorithm to cater insufficient or none key points problems. New DAISY was proposed due to DAISY method variant to rotation. The proposed solution above was evaluated on the Uncompressed Colour Image Database (UCID). The result showed outperformed in term of accuracy and speed performance than other researchers such as Huang et. al.'s method and Jing et. al.'s methods which used SIFT method for forgery detection. (G. Takacs et. al., 2013) proposed the rotation invariant fast features (RIFF) for large recognition and real-time tracking. The proposed solution was faster than SURF 15 times and retrieval results were comparable to SIFT. The researcher claimed that FAST corner detector was low complexity, but does not provide scale or orientation. CensurE method not efficient as FAST detector and provided lack of orientation but good in localizing features in scale-space. However, the accurate tracker result showed Kanade Lucas Tomasi (KLT) was the best then followed by RIFF then NCC. The reason the proposed methods were faster due to interest point detector had low complexity, proper anti-aliased and subsampled scale-space, and no pixel interpolation. (J. Yan et. al., 2013) claimed that Viola Jones detector still not satisfactory in real world scenes such as large appearance variants in pose, illumination, occlusion, expression, and imaging condition. The researcher proposed face detection by structural models by exploiting the co-occurrence between face and body. It solved the occlusion problem and better training performance. Experiments were evaluated on FDDB and AFW. (S. Kim et. al., 2014) proposed rotation and flipping region binary pattern for video fingerprint. Generally there were 2 types of methods to generate video fingerprint – spatial distribution and spatial structure. The proposed solution benefits from the robustness against rotation and flipping, high discrimination based on spatial structure, and compactness. Experiments were evaluated on MUSCLE VCD 2007 video set. The result of RBP showed the retrieval time was outperformed than FIFT, OM-1, OM02, TIRI, and CC. However, CC was fastest in extraction time because not required to do gray-conversion. In general, it was good in in term of extraction time, retrieval time, and store space.

I. PATTERN DETECTION METHOD

A. Pattern Detection Framework

As mentioned the motivation behind of this research in the previous section. All the problems can be formulated into one method so called pattern detection method. The idea of this method is to allow other application to access the functionality of the software library based on their specific requirement of the usage. Pattern detection method comprises inappropriate image detection and duplication image detection. It is explained as below.

B. Inappropriate Image Detection by Face Detection

Face detection technique can be used to solve the inappropriate image. The reason face detection is chosen as most of the inappropriate image contains human faces such as adult image and personal image that not related to work.

C. Duplication Image Detection by Feature Detection

Feature detection technique can be used to solve the duplication image. The reason is the unknown object in an image can be detected.

D. Challenge in Developing Pattern Detection Framework

Nowadays, it is easy to do text or numerical data processing such as data arithmetic and data comparison. However, it is challenging to do the digital image processing. To do text comparison, user just needs to use operator logic "==" to compare the text, whereas special algorithms are needed to compare objects in 2 different image files. The algorithm to detect objects in an image is much more complicated compared to human recognize it. Human can

recognize multi-object in image with less afford although the object in vary angles or scale. Angles or scale must be considered when implement the algorithm.

II. ENHANCEMENT OF ROTATION INVARIANT FACE DETECTION

In earlier works in face detection, there are many researchers had developed real-time face detection. One of the famous and successful methods was the Viola and Jones's (P. Viola et. al., 2004) face detection framework. The basic of the Viola and Jones's method was based on Haar feature. In order to speed up the process, Viola proposed to use integral image method. Adaboost was one of the machine learning. Viola utilizes it to classify face or non-face image. Bi Li (B. Li et. al., 2010) proposed to the rotated face detection based on viola jones's face detection. Rotated sub windows +15 and -15 were performed, the result showed high positive result compared to original viola Jones's method. This achieves the objective of speed performance and invariant properties such as transition, scaling, and rotation. To achieve rotation invariant rotated sub window for each step from 0^o to 360^o with added 15^o. Figure 1 shows the 5 basic Haar features. They are represented in two-rectangle features, three-rectangle features, and four-rectangle features. The value of the rectangle feature was the sum of the differences between black region and white region. Figure 2 shows the integral region by calculating area D. Formula to get the area D = (X4,Y4)+(X1,Y1)-(X2,Y2)-(X3,Y3). Figure 3 shows the comparison algorithm from proposed method by (B. Li et. al., 2010) versus enhancement of rotation invariant face detection method. Figure 4 shows the accuracy of rotation faces are detected.

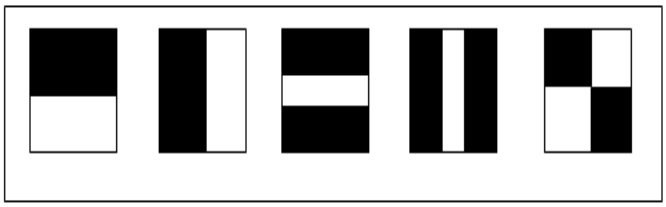

Figure 1 Haar Features

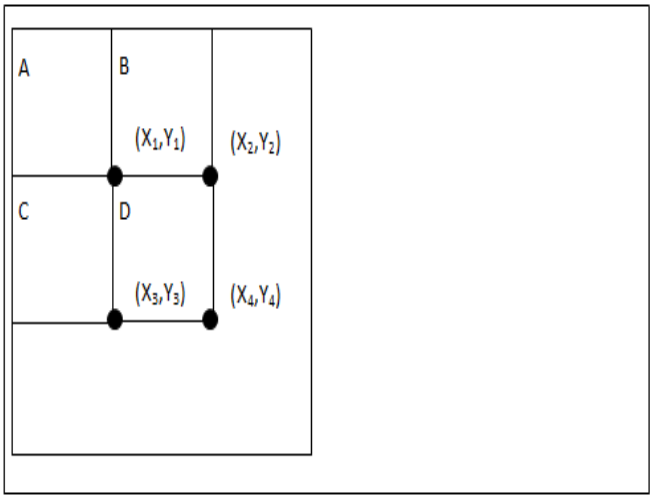

Figure 2 Integral Region of Image

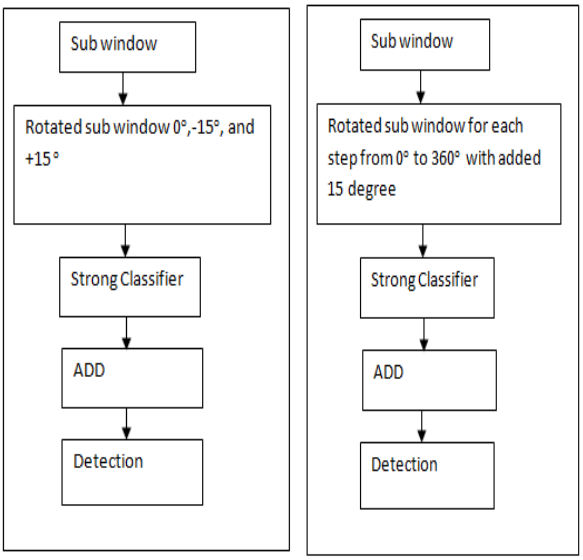

Figure 3 Comparison of Face Detection Algorithm

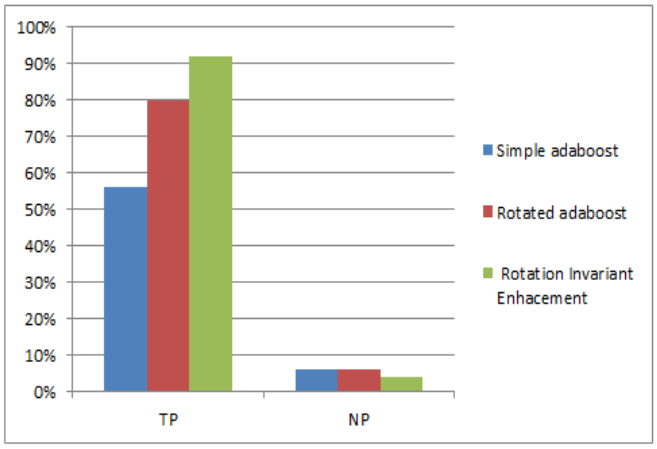

Figure 4 Accuracy of Rotated Face Detection

III. ENHANCEMENT OF SIFT FOR IMAGE DUPLICATION

In earlier works in object detection, there were many researchers had developed for object detection. One of the famous and successful methods was the Scale invariant feature transform (SIFT) (D.G. Lowe, 2004). The basic of the SIFT descriptors based on 4 steps below:

Step 1: Gaussian Smoonth Image.
Step 2: Scale Space Extrema Detection.
Step 3: Accurate Keypoint Localization by removing contrast and eliminating edge.
Step 4: Assign magnitude and orientation to keypoint.

SIFT supported the invariant properties such as transition, scaling, and rotation. However, speed performance not so good. In order to get better speed performance, a novel method is proposed. Pre-processing Binary Robert Cross edge detection is applied before SIFT. Binary Robert Cross edge detection is calculated based on the gradient image in x direction and y direction. Figure 5 shows the algorithm comparisons of binary edge SIFT. Figure 6 shows that the comparisons of speed performances of traditional SIFT, binary Sobel edge SIFT, and binary Robert Cross edge SIFT across 6 images. Processing time taken of binary Robert Cross edge SIFT is shorter than other methods across each image as shown in figure 6.

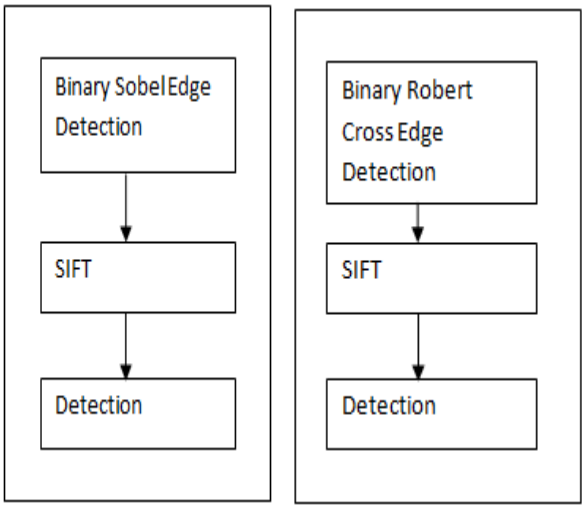

Figure 5 Comparison of Binary Edge SIFT Algorithm

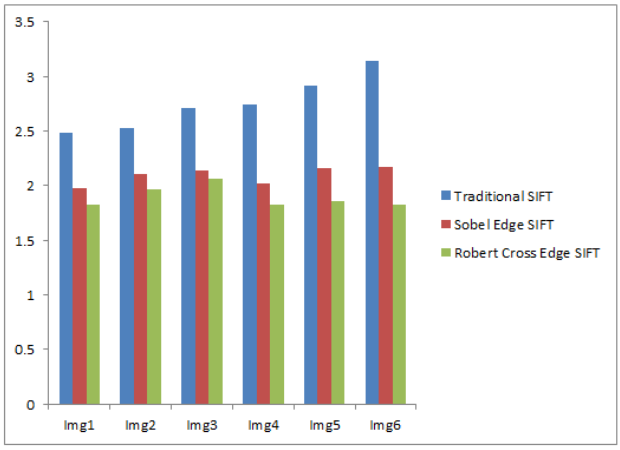

Figure 6 Speed Performance of SIFT with Other SIFT

IV. CONCLUSIONS & FUTURE WORKS

The comparison result of speed performance of SIFT by using Binary Robert Cross edge detection and improved rotated Adaboost (Viola Jones's Face Detection) by rotating 0^o-360^o with adding 15^o for each step shows outperformed than expected. With the intelligent methods above, it is suitable to apply to real world problems such as inappropriate image and image duplication. For future works, the proposed enhancement of rotation invariant face detection can be further enhanced by the speed performance. Besides that, the details of the image may lose if binary edge detection is applied before SIFT. Therefore, there must be a novel method to prevent loss of details of the image.

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