COMPARATIVE ANALYSIS OF SIFT AND SURF FACE FEATURE DESCRIPTORS UNDER VARYING CONSTRAINTS

Ramesha Shettigar[1], Sneha Pai[2]
[1,2]Department of Computer Science and Engineering
NMAMIT, Nitte, India

Abstract

Face or image contains relevant information called Features. From the face important features are selected for feature extraction. Feature descriptors are detected by considering only robust feature from bulk of key points. This paper uses Scale-Invariant Feature Transform (SIFT) and Speeded Up Robust Features (SURF) which are two feature detector and descriptor. When change scale, blur, rotation, change in illumination and affine transformation these 2 robust feature descriptors will not affected. Extraction of features from the images done using SIFT algorithm. SURF is same as SIFT in performance and but requires less time for computation.

Index Terms: SIFT, SURF, Feature, Face detection.

I. INTRODUCTION

Using face recognition secure our property by hacking. Study is going on face recognition from last 10 years. It has ability to find human emotions. Here main problem is caused due to a change in illumination, variation in pose, changes in face background etc. Based on Feature and Holistic psychologist findings. Holistic or feature based approach used to extract feature from local feature of the face. Before all face information is used. Holistic will give better result compared to feature approach. Holistic approach will not change due to variation in lighting. Matching of face done based on feature. Here we introduce Scale-Invariant Feature Transform (SIFT) and Speeded Up Robust Features (SURF) which are two feature extraction algorithms.

David G Lowe, in 2001 introduced new algorithm called SIFT. Local feature of the images can be extracted using SIFT. Main advantage of this algorithm when changes in rotation, affine invariance it will not affected.

SIFT implementation consisting of five steps they are- 1. Scale-space extreme detection, 2. Eliminating unwanted key points, 3. Direction of key points, 4. Feature description key points, 5. Feature matching.

Bay and colleagues introduced the algorithm called SURF. It is same as that of SIFT but processing time is less.

SURF implementation consisting of four steps they are-1. key point extraction, 2. Orientation assignment, 3. SURF descriptors, 4. Interest point matching

In this paper comparison done between SIFT and SURF algorithm these two are feature extraction descriptor algorithm.

II. LITERATURE SURVEY

Haiyan Li et al. [1], Discussed about original SIFT. This uses algorithm Haar Descriptor which is not able to retrieve all feature points. It can be solved using improved SURF it makes use of complete information of face. For matching we have to find distance between first nearest distance and second nearest distance. So, SIFT consume more time compared to SURF algorithm.

J Krizaj et al. [2] proposed GSIFT (Grid Scale Invariant Sift Algorithm) this algorithm used for face for recognition using this algorithm we can overcome the disadvantage of SIFT algorithm. This paper also tells about working of PCA-SIFT along with Graph-Based algorithm it will help in better recognition of face. Main

advantage of proposed is it will give better performance in changes in illumination and also high robustness. We can improve GSIFT technique for future work.

Patrik Kamencay et al. [3] proposed method make use of PCA and SIFT algorithm for identification of face. Using SIFT extract the feature from face and then matching is done between this and other representative.87% of result can be obtained for recognition of face using PCA. But using PCA along with SIFT get better matching of face that is 92%.

Ye Jihua, et al. [4] Proposed method make use of LLE along with SIFT algorithm using this algorithm we can reduce dimensionality and amount of data and it can reduce the time required for matching of face. Main advantage of LLE-SIFT algorithm is high robustness and good accuracy and also feasibility.

Luo Juan and OubongGwum [5] Proposed three feature descriptors they are RANSAC algorithm (Random sample Consensus) and KNN algorithm (K- Nearest Neighbor) using this we can analyse face recognition results. Using KNN we can find features between two different faces. Reject images which are not matched correctly using RANSAC. By experiment we came to know that SIFT is slow compared to SURF. And SURF is same as that of but required less time for processing compared to SIFT. So PCA-SIFT algorithm gives better result.

Lei Yunqi et al. [6] Proposed SIFT will not effected when changes in affine, rotation and scale transformation. First using FLD (Fisher Linear Discriminant) extract feature of face. Then by using Euclidian, similar face features are recognized. Through experiment, 99.5% achieved using ORL database.98.6% archived using UMIST database. And also tells that SURF is faster compared to SIFT. Feature work is done by using different type of databases to find face recognition.

Han Yanbin et al. [7] proposed applying Gaussian to image obtained different scale space of image. Face is described using the scale space of image. First using SIFT extract the feature from test image and also extract the feature of training image face. Training and testing face databases are used for face features matching. So, by extracting features using SIFT can obtain high performance and high robustness on facial expression.

JanezKrizaj et al. [8] proposed in training face image candidate key points find using SIFT algorithm. By applying clustering procedure to achieve k=100 centroid using this we can find key points descriptor. Recognition face done by matching two images.

Haeseong Lee et al. [9] In this paper they discussed about feature detection and description methods. They used total eight algorithms they are Harris Corner Detector, Scale Invariant Feature Detector, Speeded Up Robust Feature, Features from Accelerated Segment Test, Binary Robust Independent Elementary Features, Oriented Fast and Rotated Brief, Binary Robust Invariant Scalable key points and Fast Retina Key point. Using this algorithm, we can find Robust features. Also, these algorithms applied to image and showed each algorithms performance. Recent trends are to get high performance, low memory and accuracy. Using this paper, we can find correct feature algorithm for the image.

III. FACE FEATURE DESCRIPTOR

SIFT

David G Lowe, in 2001 introduced new algorithm called SIFT. Local feature of the images can be extracted using SIFT. Main advantage of this algorithm when changes in rotation, affine invariance it will not affected.

SIFT implementation consisting of five steps they are-

A. Scale-Space Extreme Detection

From image key points are detected using SIFT algorithm. Difference-Of-Gaussian function applied to obtain Scale space from image. Using scale-space of image maxima and minima key points are obtained. Image can find using Gaussian $G(x,y,\sigma)$with an input image $I(x,y)$ as-

$$L(x,y,\sigma) = G(x,y,\sigma) * I(x,y)$$

Where Gaussian kernel $G(x,y,\sigma)$ is-

$$G(x,y,\sigma) = \left(\frac{1}{2\pi\sigma^2}\right)e^{-(x^2+y^2)/(2\sigma^2)}$$

Where,

(x,y) is the pixel coordinates of input image.

σ is Scale factor.

$L(x,y,\sigma)$ is the scale space images.

Local Maxima or Minima of $D(x,y,\sigma)$ of two Gaussian images can separated by multiplicative factor k equation is –

$$D(x,y,\sigma) = (G(x,y,k\sigma) - G(x,y,\sigma)) * I(x,y)$$
$$= L(x,y,k\sigma) - L(x,y,\sigma)$$

Comparing point, same scale of eight neighbors and a corresponding neighboring pixels in each of the neighboring scale used to calculate Maxima and minima of $D(x, y, \sigma)$. Candidate key points denoted as pixel only when comparison done between local maximum or local minimum of all pixels.

B. Eliminate key points which are not required.
Based on stability final key points are selected. Producing the extreme key points as there is too many key points. Using this step, we can eliminate unreliable and unstable key points. Sensitive key points can also remove using this. key points are removed when it meets some threshold value.

C. Direction of Key points
For key points directions are detected, features rotation changes can tell using this. So that module and phase are given below-

$$m(x,y) = \sqrt{((L(x+1,y) - L(x-1,y))^2 + (L(x,y+1) - L(x,y-1))^2}$$

$$\theta(x,y) = \tanh(L(x,y+1) - L(x,y-1))/(L(x+1,y) - L(x-1,y))$$

D. Feature Description of Key points
To find 16×16 key point neighborhood using key Descriptor by using gradient magnitude and orientation of all images. Using Gaussian window calculate neighbor and weight and convert weight to 4×4 orientation histogram. Every histogram has 8bins and key point descriptor contains 4×4×8=128 elements of features.

E. Feature Matching
Matching Feature done using testing image and training image. Find distance between key point using of Euclidian distance. Then test image and key point descriptor is matched. Best match find using neighbor in the database. Which key point has less matched that are removed. Result is calculated based on distance between first closest neighbor key point to the second closest neighbor key point based on this accepting and rejecting image can be done.

SURF
Bay and colleagues, introduced new algorithm called SURF. This algorithm is same as SIFT but has less processing time.

A. Key point extraction
First, we have to extract corner points, edge points, spot points which are features from given image. Repeated key points are more reliable.

Maxima value points can be obtained using Hessian Matrix.

Hessian matrix is defined as following which has scale σ and point X = (x, y) in image.

$$H(X, \sigma) = \begin{bmatrix} Lxx(x,\sigma) & Lxy(x,\sigma) \\ Lxy(x,\sigma) & Lyy(x,\sigma) \end{bmatrix}$$

Here, convolution of the Gaussian is $Lxy(x,\sigma)$ which is given as $\frac{\partial^2}{\partial x^2} g(\sigma)$

On further processing image, we get second order derivative at X,

Where $g(\sigma) = \frac{1}{2\pi\sigma^2} e^{-\frac{(x^2+y^2)}{2\sigma^2}}$

SURF speed is same as that of SIFT that can be increased by computing Box filter using integral images also filter size, which is independent of calculation.

B. Orientation Assignment
Key orientation can be found using Haar Wavelet. For a set of pixels, x direction and y direction has circular radius 6σ in neighborhood which is required to detect Haar wavelet. Dominant orientation find using Haar wavelet by sliding window size π/3. Adding the x direction and y direction responses which is obtained using local orientation at each location within contention window. Interest point can be find using longest vector from window orientation.

C. Surf Descriptors
Descriptors are calculated using interest point. Based on Haar wavelet and integral images. First step is to build square region around key point. This square region is divided in to 4×4 square to from sub region. Here x and y detected using wavelet response. Interest areas are calculated and also Gaussian cantered at the interest point using this we can get robustness for deformations and translations. SURF algorithm not effected due to changes in light.

D. Interest Point Matching
Interest point is matched in this step using Euclidean distance. Testing image and training image is matched by finding distance between key points.

IV. CONCLUSIONS

Here we compared two methods they are face detector and descriptor methods. Using Scale Invariant Transform (SIFT) key points are detected from the image. Speeded up Robust Feature algorithm (SURF) is same as that of the SIFT but give fast and good result. SURF detect more features than that of the SIFT using our experiment. Also, execution time of SIFT is more compared to SURF. In future face recognition done by using other feature extraction algorithm and finding best feature extraction method.

REFERENCES

[1] Haiyan Li, Tingrong Xu, Jie li and LiXio Zhang, "Face recognition based on improved SURF "School of computer science and technology ,2013 Third international conference on Intelligent System Design and Engineering Applications.

[2] J Krizaj, V.Struc, N Pavesi "Adaptation of SIFT Features for Face Recognition under Varying Illumination" MIPRO 2010, May 24-28,2010, Opatija, Croatia.

[3] PatrikKamencay, Martin Breznan, Dominik Jeslsovka, and Martina Zachariasova, "Improved Face Recognition Method based on Segmentation Algorithm using SIFT-PCA".

[4] Ye Jihua, Shi Shuxia, chan Yahui, "A Face recognition Algorithm Based on LLE-SIFT Feature Descriptors" The 10th International-Conference on Computer Science and education (ICCSE 2015) July 22-24,2015. Fitzwilliam College, Cambridge University, UK.

[5] Luo Juan, OubongGwum, "A Comparison of SIFT, PCA-SIFT and SURF".

[6] Lei Yunqi, Jiang Xutuan, Shi Zhenxiang, Chen Dongjie, LiQingmin, "Face Recognition Method Based on SURF Feature"

[7] Han Yanbin, Yin Jianqin, Li Jinping, "Human Face Feature Extraction and Recognition based on SIFT", 2013 Third International conference on Intelligent System Design and Engineering Applications.

[8] JanezKrizaj, Vitomir Struc, Nikola Pavesic, "Adaptation of SIFT Feature for Robust Face Recognition".

[9] Haeseong Lee, Semi Jeonl, Inhye Yoon, Joonki Paik, "Recent Advances in Feature Detectors and Descriptors: A survey" IEIE Transactions on Smart Processing Computing, vol5, no.3, June2016 http://dx.doi.org/10.5573/IEIESPC.2016.5.3.153.