

Analysis SURF feature extraction and SVM classification for the facial image recognition from various angles

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Abstract. Biometric is a series of procedures used to measure the physical properties of a person based on your physical characteristics of a person's behavior in identification and verification. One facial biometrics ie, feature extraction Speed Up Robust Feature (SURF) will be suitably used for extracting the characteristics of the face image. Support Vector Machine (SVM) will be used as a method of classification. The face data used in this study were obtained from the National Cheng Kung University (NCKU). SVM classification results with the help of SURF as a model feature extraction with the determination of the number of $k = 50$ gained 94.60% accuracy rate, $k = 500$ acquire a 100% accuracy rate and the number of $k = 1000$ classification results decreased with 93.70% accuracy rate.

1. Research background

Face recognition one area of research that is very popular in pattern recognition and computer vision. Facial recognition basically identify a person in a digital image or video by analyzing and linking pattern. It is widely biometric very often used in security systems such as biometric iris or fingerprint recognition system [1].in the context of pattern recognition, the face has a unique pattern compared to other biometrics, pattern recognition (pattern recognition) itself is a science that is often used to classify something based on a quantitative measure of the features (characteristics) or the main properties of an object.

According to [2] approach to pattern recognition (pattern recognition) can be grouped into three categories: statistical pattern recognition, syntactic pattern recognition and neural pattern recognition. Statistical pattern recognition is a pattern characteristic measurement model obtained from the probabilistic. Syntactic approach is the approach to analyze the structure of the pattern and contour (boundary edges) object from an image. The third approach is a combination of statistical approaches and syntactic approach or often known as neural pattern recognition, this approach is one part of recognition pattern by using artificial neural networks. So the more frequent training on increasingly intelligent systems is also a system generated. Pattern recognition will not run away from the edge detection, edge or the edge is the boundary between the two groups of regions in the image that have different characteristics based on some features (such as the texture of the image, gray levels, and color image) [3].

In essence, humans can distinguish the pattern of an object based on a visual form that has the physical characteristics or traits of the face. As differentiate a person's face pattern on

a good image that looks forward and side view of the face. However, the computer can not recognize the face pattern, because computers only recognize the digits 0 and 1.

In a previous study using a local feature for feature extraction. The use of local features as feature extraction shown to provide better accuracy in Image Retrieval. Some examples of local feature method is Scale invariant Feature Transform (SIFT) [4] and speeded Up Robust Features (SURF) [5] which produces a characteristic key point of image

Speed Up Robust Features (SURF) is a scheme to classify images based on pixel values in the image [6]. By using interest point detection and extraction of interest points, SURF take the unique characteristics of the image that can distinguish the patterns contained in an image. In social interaction human face greatly affects the central role, therefore it is not surprising that the automatic information processing faces an important subfield and very active in the research of pattern recognition.

The face of a complicated display various information about the identity, age, sex, race and state of emotional and attention. This study aims to measure the performance of face classification using SVM. Where in previous studies, found the problem in determining the amount of the value of k in mengelompokkan feature extraction results into clusters according to the scheme of bag of visual words.

In the process scheme bag of visual words has 4 stages in such classification; using interest point detection and extraction of interest points, clustering features using the k-means algorithm, the formation of the histogram generation and classification using as klasifier support vector machine (SVM).

In the method of speed-up robust features (SURF) for the detection of interest points and extraction of interest points. In another study [7] explains that SURF is more efficiently used as a detection and extraction of interest points. Therefore in this study will also be used interest point detection and extraction of SURF. According to [8] bag of visual word with the value of $k = 500$ is only capable of classifying facial expressions with 69% accuracy. SURF feature extraction is better than GLCM feature extraction with the help of SVM as the classification method of classifying the face by using datasets National Cheng Kung University (NCKU) classification results with 85% SURF models with models GLCM whereas only 50%.

Based on previous research no one has addressed the classification of facial images from various angles, namely $+90^\circ$, $+85^\circ$, $+80^\circ$, $+75^\circ$, $+70^\circ$, $+65^\circ$, $+60^\circ$, $+55^\circ$, $+50^\circ$, $+45^\circ$, $+40^\circ$, $+35^\circ$, $+30^\circ$, $+25^\circ$, $+20^\circ$, $+15^\circ$, $+10^\circ$, $+5^\circ$, 0° , -5° , -10° , -15° , -20° , -25° , -30° , -35° , -40° , -45° , -50° , -55° , 60° , -65° , -70° , -75° , -80° , -85° , -90° so in this study will be performed classifying facial image from different angles by using SVM and its SURF as ekstraksi.

The research objective is to analysis performance of SVM classifying faces with different angles face position with the help of SURF as its extraction.

2. Proposed method

2.1 stages Research

At the stage of the study, the research procedure will be conducted in accordance with the study of literature and consultation with a supervisor. Having found the problem and the problem can be formulated so research can be continued on the next process.

2.2 Research Work Flow Diagram

Workflow diagrams in this study is illustrated in Figure 1:

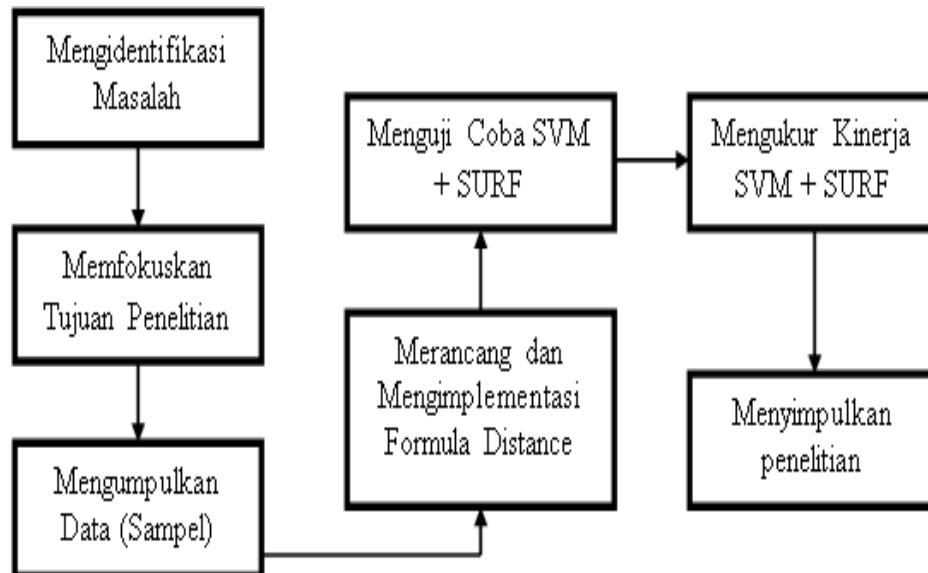


Figure 1. General research workflow

2.3 Step Research

General research step pattern recognition built in this study is illustrated in Figure 2:

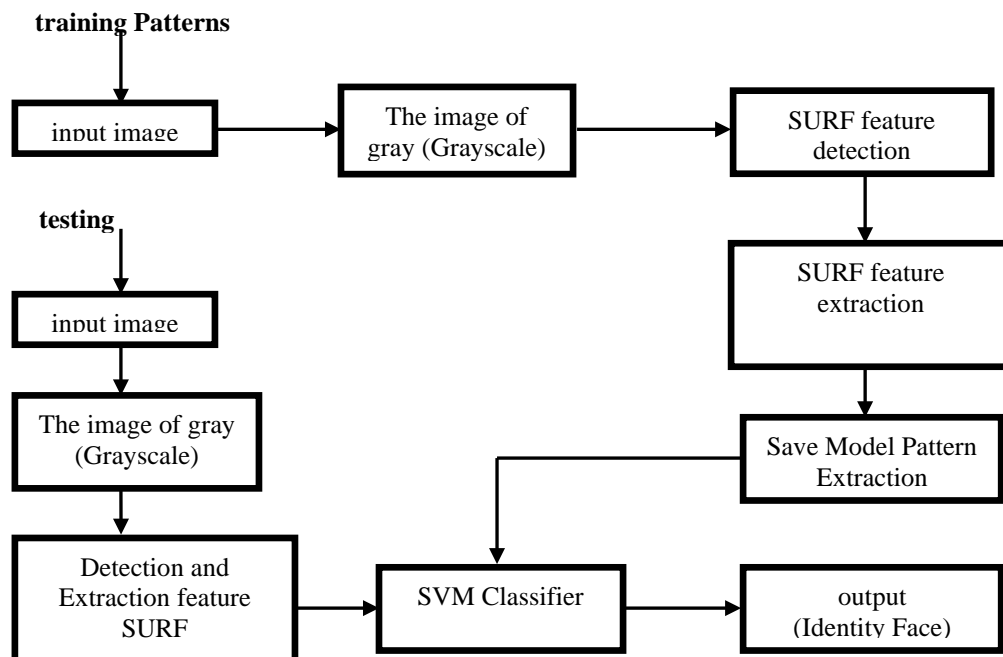


Figure 2. Step Research In General

Overall research measures that will be built in this study is illustrated in Figure 3 for the SVM classifier and SURF feature extraction.

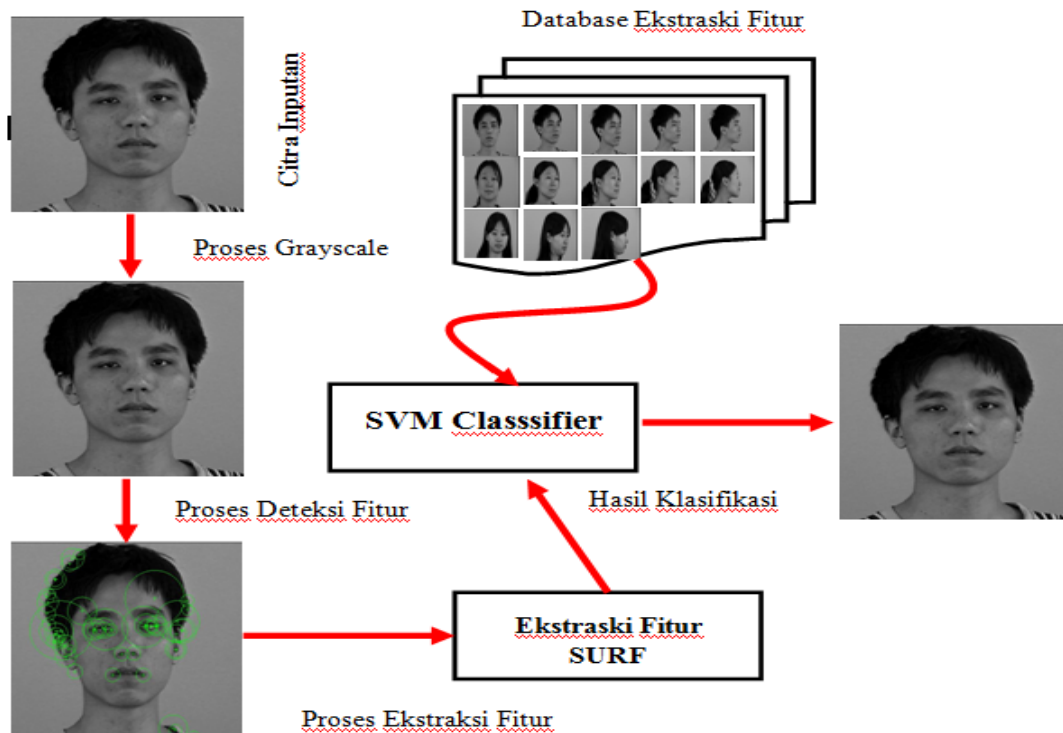


Figure 3. Step Extraction Research Surf and Classification SVM

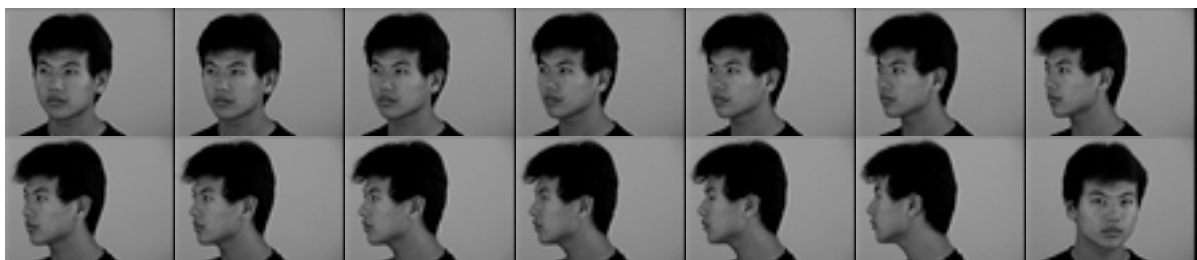
3. Result and analysis

3.1.result

Results were discussed include the selection of training samples facial patterns, determination of coordinates and detection of interest points, with variations in the number of clusters Testing, Testing the overall sample.

3.1.1.Facial pattern training samples

Training samples facial pattern used in this study amounted to 740 samples representing the position angle view of a face that is different, ranging from $+90^\circ$, $+85^\circ$, $+80^\circ$, $+75^\circ$, $+70^\circ$, $+65^\circ$, $+60^\circ$, $+55^\circ$, $+50^\circ$, $+45^\circ$, $+40^\circ$, $+35^\circ$, $+30^\circ$, $+25^\circ$, $+20^\circ$, $+15^\circ$, $+10^\circ$, $+5^\circ$, 0° , -5° , -10° , -15° , -20° , -25° , -30° , -35° , -40° , -45° , -50° , -55° , -60° , -65° , -70° , -75° , -80° , -85° , -90° vector in different patterns. Figure 4.attach some samples of face patterns from different points of view.



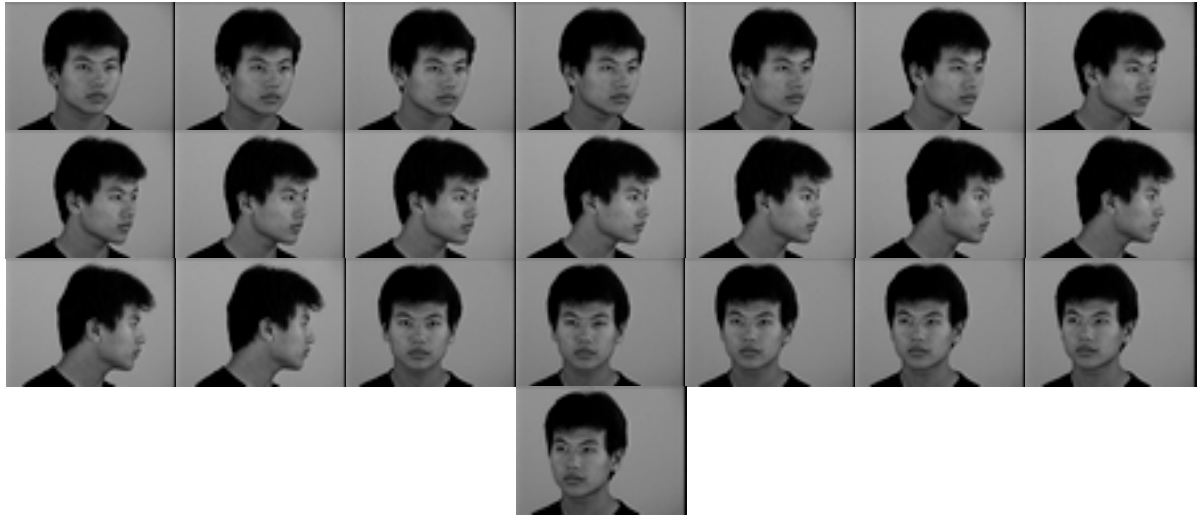


Figure 4. Samples used face training

3.1.2 Determination of coordinates and detection of interest points

Determination of coordinates of interest points in the face image using a grid step 8, where the distance between both the interest next point coordinates x (width) and y (height) that is 8 pixels. After the determination of the coordinates of interest points specified then the pixel value / important information of an image is detected interest point with marked blob in the image, as an example can be seen in Figure 5:

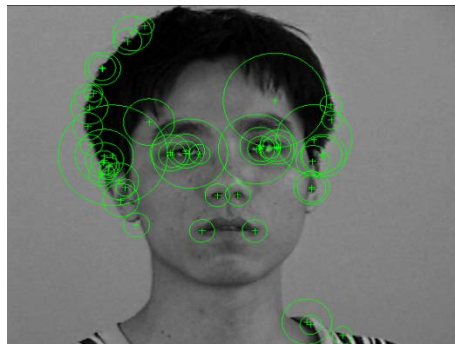


Figure 5. Detection of interest points $k = 50$

3.1.3 Testing with a variation of cluster

In testing the data subject with a number of different clusters, in order to obtain the highest level of accuracy, the number of clusters examined, ie the number of clusters $k = 50$ test results of the cluster can be seen in Table 1:

Table 1. Testing by the number of clusters $k = 50$

<i>known</i>	<i>Subject01</i>	<i>Subject02</i>	<i>Subject03</i>	<i>Subject04</i>	<i>Subject05</i>	<i>Subject06</i>	<i>Subject07</i>	<i>Subject08</i>	<i>Subject09</i>	<i>Subject10</i>
<i>Subject01</i>	0.90	0:00	0:00	0:07	0:00	0:00	0:00	0:03	0:00	0:00
<i>Subject02</i>	0:00	0.73	0:27	0:00	0:00	0:00	0:00	0:00	0:00	0:00
<i>Subject03</i>	0:00	0:00	1:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
<i>Subject04</i>	0:00	0:00	0:07	0.90	0:00	0:00	0:03	0:00	0:00	0:00

In table 3 the test results with the number of clusters $k = 1000$, generally on a cluster $k = 1000$ decreased classification results from the classification results on the number of clusters $k = 500$ and achieved an average accuracy of 93.70%.

4. Conclusion

Based on the research that has been done it can be concluded that:

1. SVM classification results with SURF in the face image with various angles on the number of $k = 500$ achieve maximum accuracy results are very recognizable facial image properly with 100% accuracy percentage
2. The results of the classification on the number $k = 50$ with SURF SVM can not be classified properly, because the number of $k = 50$ is too narrow as the information will be processed for the classification accuracy of 94.60%
3. The results of the classification on the number $k = 1000$ SVM with SURF instead become inaccurate in the process of introduction of the facial image as the number $k = 1000$ is too broad as an information center of an image so that a lot of information on that image there was an error in the selection of index values of k results in classification results, the number $k = 1000$ classification results declined by about 6% so that the accuracy is only 93.70%

References

- [1] Sharma, S., & Sachdeva, K. (2015). Face Recognition Using PcaAndSvm With Surf. International Journal of Computer Applications, 129 (4).
- [2] Gonzales, RC, Woods, RE, 2008, Digital Image Processing Third Edition, Pearson Prentice Hall, New Jersey.
- [3] Marques, Oge. 2011. Practical Image and Video Processing Using Matlab. Wiley Blackwell: New Jersey
- [4] Azhar, R., Tuwohingide, D., Kamudi, D., Sarimuddin, & Suciati, N. (2015). Batik Sift Image Classification Using Feature Extraction, Bag Of Features And Support Vector Machine. Procedia Computer Science (pp. 24-30). Elsevier.
- [5] Anand, B., & Shah, PK (2016). Face Recognition Using Surf Features AndSvm Classifier. International Journal of Electronics Engineering Research, 1-8.
- [6] Farhangi, Mohammad Mehdi, Soryani, Mohsen, and Fathy, Mahmood. Informative 2013.Construction to Improve Visual Words Bag of Words Image Representation. IET Image Process 8 (5): 310-318.
- [7] Shukla, Tuhin, Mishra, Nishchol& Sharma, Sanjeev. 2013. Automatic Image Annotation using SURF Features. International Journal of Computer Applications 68 (4): 17-24B
- [8] Muhathir. (2018). Facial Expression Classification Using Bag Of Visual Words. JITE (Journal Of Informatics And Telecommunication Engineering), 1 (2), 73-82.