KNITTED FABRIC TEXTILE CLASSIFICATION BASED ON GLOBAL FEATURE

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ABSTRACT

In this paper, we reviewed and examined the classification methods for the knitted fabrics and acquired a fabricdataset to verify the results. We then proposed the global feature method to classify 290 knitted fabrics with 58 different textures and 5 different colors. Using the global feature method, the classification accuracy of knitted fabrics can be improved significantly. The result shows that our proposed method is better than the state-of-the-art method.

Key Words: KNITTED FABRIC, CLASSIFICATION, FEATURE EXTRACTION, BOW

1. INTRODUCTION

Manual inspection of knitted stitch has significant shortcomings, such as low accuracy, consuming time and intensive labor [1]. Direct recognition of knitting fabric has proven to be difficult and with low accuracy [2]. The focus of knitted fabric inspection has been transformed to classification using machines. Classification refers to assigning a unlabeled knitted fabric to a special knitted fabricusing a trained model with a set of known texture classes.

Tang-jun Lv and Hai-ru Long [1] applied the SURF algorithm to knitted fabric classification and recognition. They first performed Gaussian de-noise and then selected the local feature from the fabric image. Kuo and Kao used the Gray-level co-occurrence matrix (GLMC) feature and self-organizing map (SMO) network to classify the knitted fabrics [2]. The disadvantage of GLMC feature is that it can only detect very limited classes [3-4]. For example, in Kuo and Kao [2], there were only 6 classes to be identified which are plain weave, twill weave, stain weave, single jersey, double jersey, and non-woven fabric.

2. METHODS

Feature extraction [4,7] and classification method [9] both play important roles in image classification. In these experiments, we adopt three feature extraction methods and two classification methods.

Global features such as bag of virtual feature or bag of word (BOW) feature [9] has been widely used in image recognition and retrieval for many years. BOW was originated from the NLP (natural language processing) literature [8]. However, to the best of our knowledge, there are no literature which apply global features into knitting fabrics classification.

In this paper, two kinds of local features are extracted, namely SIFT (Scale-Invariant Feature Transform) [5] and SURF (Speeded-Up Robust Features) [6]. These two methods combined with the BOW are an integral feature extraction method. In the SIFT model, the key-points are defined as maxima and minima of difference-of-Gaussian functions applied in scale space to a series of smoothed and resampled images.

SURF detects points of interest of an image in a multi-resolution representation. The standard version of SURF is several times faster than SIFT and is claimed to be more robust than SIFT [6].

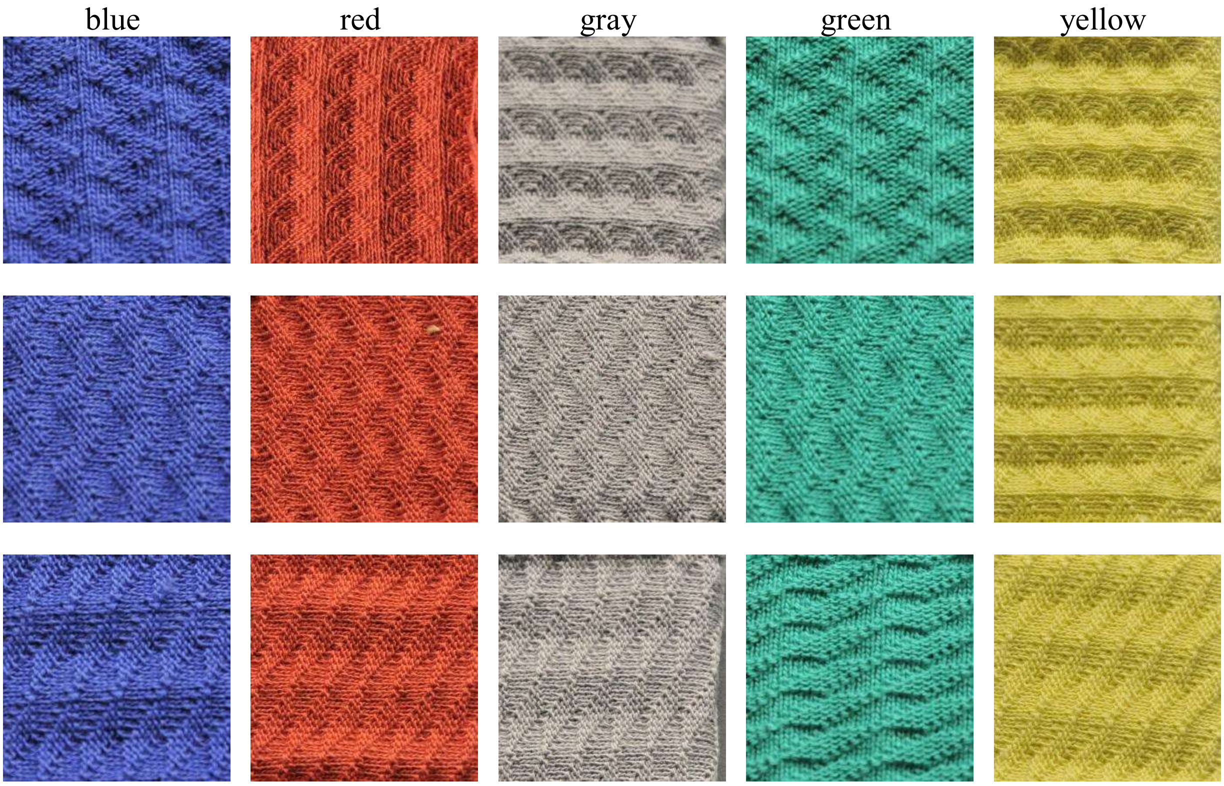
As another comparison, GIST [7] feature is adopted to extract global features. GIST uses a set of perceptual dimensions (i.e., naturalness, openness, roughness, expansion, ruggedness) to represent the dominant spatial structure of an image.

In the classification part, KNN and SVM methods are applied. Both of them are very popular classification methods in image retrieval [9].

3. **EXPERIMENTS**

A disadvantage of the previous work on knitted fabric classification and recognition is that the number of image used in experiments was very limited. In our work, we build a larger dataset and plan to make the dataset publicly available. Researchers in the same field can then verify and compare their algorithms and methods using our dataset.

Physical textile samples are fabricated by Shima Seiki knitting machine, with 5 colors including grey, red, yellow and blue. Each color yarn was knitted with one single jersey. These texture structures are also representative of the commonly used textiles in the knitwear industry. Then the images are acquired in an X-rite light cabinet and shooted by a Nikon D300 DSLR camera. Some of the knitted texture samples are shown in Figure 1:



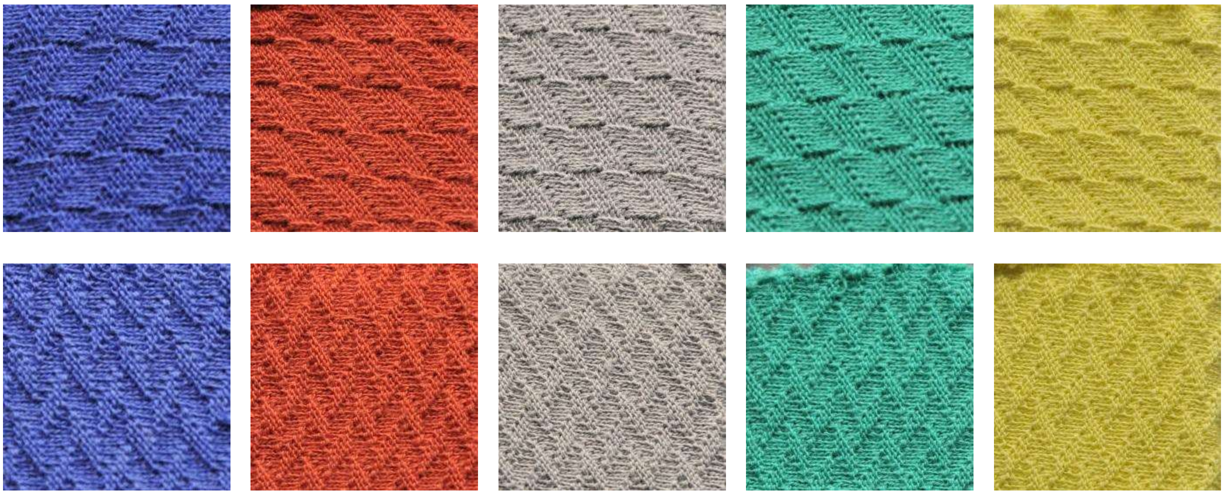


Figure 1. Examples of the knitted fabrics

Two groups of experiments are performed. In the first group, samples with colors of gray, red, green and yellow are set as training data, while the blue samples are set as testing data. In the other group, the training data are shuffled. Random samples with 4 colors are selected as training data and the remaining one as the testing data. In the first group, the testing data has the same color (i.e., blue). But in the second group, the testing data have different colors.

4. RESULTS AND DISCUSSION

Accuacy are measured by the correct classigied samples by the total testing samples. The results as shown in the Figure 2:

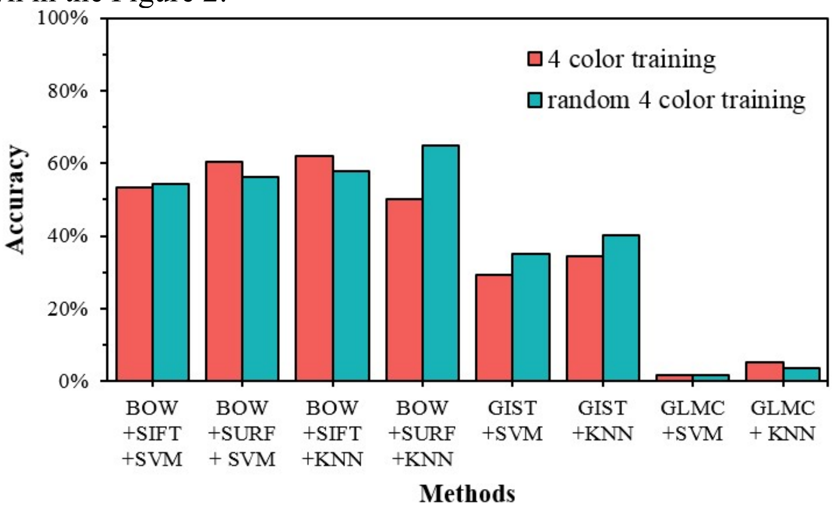


Figure 2. Accuracy comparision of each method

In our result, we find that the result of global feature BOW is much better than texture feature GLMC, whether using a constant color or random color for testing. Furthermore, we also find that when the testing color is not seen in the training set, the accuracy dose not change very dramatically. This shows that our proposed method is stable and insensitive to unseen data.

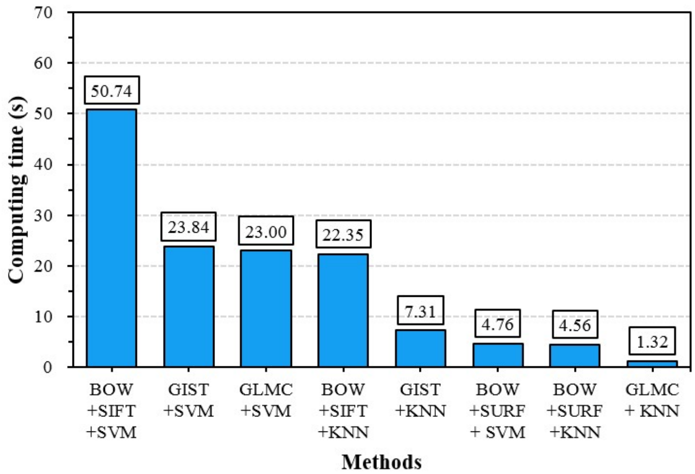


Figure 3. Time cost of each method.

Unit is secondThe time cost of each method is shown in Figure 3. Each item only calculate the testing time of the same 4 color training data. By comparison, we can find the SVM cost far more time than the KNN classification method and SURF cost less time than the SIFT method.

5. CONCLUSİON

In this paper, we reviewed the current methods for knitted fabric textile classification. We proposed using global feature extraction method to classify the images. In order to evaluate these methods, we builded a dataset including 58 textures and each texture has 5 colors. In our experiments result, we found that the use of global feature BOW could provide much accurate results than that of the state-of-the-art GLMC method using percentage of correct classifications. In addition, we also found that when a testing color was not seen in the training set, the accuracy was almost the same, which indicates that our proposed method is robust and insensitive to unseen data. Besides the time cost of KNN is far lower than SVM in our dataset with nearly equal accuracy.

6. REFERENCES

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