Evaluation Experiments for Multi-Label Classification of Japanese Pattern Images

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***Abstract*—A multi-labeled Japanese pattern image dataset containing multiple Japanese pattern categories was created. The dataset consists of 18 categories of Japanese patterns and more than 600 images. Classification experiments with multi-labels were conducted using this dataset, and effective results were obtained for existing labels as well as for unknown labels.**

I. Introduction

The term "Japanese patterns" refers to traditional Japanese patterns, and there are many different types and meanings of Japanese patterns used in traditional clothing, such as kimonos. In Japan, it is customary to wear kimonos with motifs of Japanese patterns that have meanings corresponding to the content of the event, and it is necessary to have an expert identify the Japanese patterns. Many Japanese patterns are so similar that it is difficult to distinguish them with the human eye, and Japanese patterns are declining as a culture as the number of people who can distinguish them decreases. Since some Japanese patterns have new meanings, it is important to recognize two Japanese pattern categories at the same time. The multi-label detection method can also be used to address categories that are not in the dataset. Therefore, the goal of this research is to create a recognition model that supports multi-labeling, and to simultaneously recognize multiple categories and categories that are not in the data set as unknown categories.

II. Experimental Conditions and Results

Fig. 1. Japanese pattern image containing only one category (left) and Japanese pattern image containing multiple categories (right)

The Japanese pattern images that are the subject of this study are as shown Fig. 1. One image may contain only one Japanese pattern category as shown on the left of Fig. 1, or it may contain multiple Japanese pattern categories, as shown on the right of 1. For this purpose, Japanese pattern images were collected, and multi labeling was manually applied to each Japanese pattern image to construct a Japanese pattern image dataset. The Japanese pattern image dataset contains 18 categories, 572 training data, and 90 test data, for a total of 662 images. Next, each image was input to the ResNet-18 model [1], which has been pre-trained with Japanese pattern images, and features were extracted from the hidden layer. The trained model used here was trained on a Japanese pattern dataset labeled with only a single category. Because the number of training data was small, the extracted features were dimensionally reduced by principal component analysis (PCA). Specifically, the number of dimensions before compression was reduced from 512 to 64, and then the features were used for training and evaluation. For each category, an SVM was trained to estimate whether the category was included in the image.

After SVM training, test data was input to each SVM for evaluation. Out of 106 positive samples in the test data, 65 samples were correctly classified, with an average classification accuracy of 61%. Out of 1,514 negative samples, 1,484 samples were correctly classified, with an average classification accuracy of 98%.

Fig. 2. Image with multi-label (left) and images with unknown labels (center and right)

The image shown on the left of Fig. 2 contains two categories, "butterfly" and "cherry blossom," and is an example of successful multi-label detection. The image shown in the center of Fig. 2 is the unknown category "scale," and the image shown on the right of Fig. 2 is the unknown category "paulownia." These two images were input to 18 SVMs, which correctly classified them as unknown categories.

III. Future Prospects

The final goal is to build a system that can automatically acquire Japanese pattern image data, store the data, and store knowledge through learning. We believe that the acquisition and storage of Japanese pattern image data can be achieved by providing a system in a format that can be used by general users. The system is designed to classify Japanese patterns input by the user, and to retrieve and display the meaning of the patterns to the user. Data storage is also realized by storing the image information. Once this system is established, it is expected that users will have more image data to use the system with, which will improve accuracy through learning.

References

[1] Miyu Oura, Ryou Mutou, Kazuya Ueki, "Dataset construction and validation of classification accuracy for Japanese Pattern Retrieval System," Dynamic Image processing for real Application workshop (DIA2023), 2023. (in Japansese)

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