Commentary: Trainable COSFIRE Filters for Keypoint Detection and Pattern Recognition

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1. Introduction

In the field of computer vision, image feature recognition is an important and critical part. However Existing methods encounter difficulties in the classification of the shape features of the picture because texture vague and difficult to draw interval. If these problems persist, it is difficult for computers to classify pictures well, and it is difficult for these technologies to be applied to real life. Because of that, computer vision is hard to implement in real life. In order to solve these problems, this paper is mainly focused to build a model that can better detect key points. Finally, this paper validated this algorithm, and it performed well in many data sets.

In many fields, if the model only chooses to divide and extract points in the picture, it is easy to misclassify and lead to errors. In contrast, focusing on the detection of contour-based patterns Is a better choice. The COSFIRE Filters introduced in this article first used Gabor filters and then shifting base on the result of the blurred responses. in a COSFIRE filter configuration process, the relevant configuration defines a keypoint is automatically analyzed. At last, the Adjusted filter can successfully detect similar patterns with high accuracy.

If this technology is successful, first of all, for machine vision practitioners, through the use of this algorithm, a higher accuracy rate can be obtained. And many better algorithms can be developed more easily based on this algorithm. In terms of medical treatment, computers can better help patients find the cause of the disease and give better treatment plans. In terms of unmanned driving, these cars can better recognize road signs and avoid car accidents. Finally, this technology can also be used in space exploration. There are many types of stars in the universe. It is difficult to classify them based on human observations, but these stars can be better classified through this technology.

2. Methods

The COSFIRE filter first uses Gabor filters and then performs Gaussian blurring on the results. After the results are obtained, they are converted and multiplying the shifted responses. In this process, a COSFIRE filter configuration process specifies how to perform blur and shift.

In this semester's study, we know that Gabor filter can delete spatial local frequency features and is an effective texture detection tool. So it can only filter features in one direction at a time, so it is usually used multiple times. In image recognition, it is difficult to adjust the direction of the Gabor filters classifier, but this article gives a good way to adjust the direction.

In the algorithm of the paper, Gabor filters first define two values that are both local maximums, and finally define the position of the third value based on these two values.After the Gabor filters get the result, Gaussian blurring will be applied to the result and SHITF processed. In the last, the algorithm computes the weighted geometric mean of all the blurred and shifted thresholded Gabor filter responses and gets the results.

Next is about the authors made the right choices in this article. First of all, I think instead of focusing on one point, the filter should pay more attention to contour-based patterns. In this article, the author puts their center in the area identification, which I think is a very important choice.

Using Gabor filters is a very good choice, because Gabor filters perform very well in all filters, but the difficulty of using it lies in its parameter adjustment. In this paper, the author is very good After dealing with this problem. I think this is also the reason why it can get a high rate of accuracy.

About the defects of the whole algorithm, I think the number of local parameters should be increased, because in real life there are many directions to choose from, but there are only four tuples in the article that can provide us with choices. In addition, I think the shift process may have very low benefits. From my point of view, the shitf step only improves the accuracy by a small part, but it doubles the amount of calculation in this step

3. Results

First, 62.62% of the features of interest can be detected after the first filter is deployed on the training set. After these features are obtained, the second filter is trained to obtain 50 features, 35 of which are overlapping features. When the two filters are used together, 82 different features will be detected. After configuring the additional two filters, all the features can be detected and no wrong response appears. When they applied these parameters to the comparison data set, they got recall R of 98.50 percent and a precision P of 96.09 percent. This is a very good result.

In this test, the author of the paper only tested the filter in the comparison data set, and the result is also compared with the original data set. It should be trained in a different type of data set to be more convincing.

Second, COSFIRE Filters also perform well in Handwritten digit recognition. This algorithm achieves a maximum recognition rate of 99.40 percent with 4,500 COSFIRE filters. In this test, the training results in this article are at the same level as the comparison training results, but the method in this article is more complicated to implement. In this test, the training results in this article are at the same level as the comparison training results, but the method in this article is more complicated to implement. COSFIRE Filters is only trained on this simple character training data set, and this data set contains only a few simple characters, which is not representative and does not mean that this filter can perform well in character recognition . If relevant tests are also performed on more complex data sets, the results will become more convincing.

Third, in The detection and recognition of specific objects, three COSFIRE filters are used in the paper to detect and recognize the corresponding traffic signs in the entire dataset of 48 images. The final result is that in all special scenes, the filter perfectly recognizes these pictures. In the third test, another algorithm was mentioned in the article. That algorithm is very complicated to calculate, so from the perspective of implementation, COSFIRE filter is easier to implement. In the third experiment, the recognition of special signs can increase the number of training sets. We can clearly see that the number of training sets is too small. This will cause training errors in some flawed training sets.

4. Conclusions

In conclusion, firstly, I described why the author used COSFIRE filter. Then analyzed how COSFIRE filter works and what methods are composed of, and finally I evaluated the training results in the paper.

Using 2D Gabor Filter in this article is a very good choice, because Gabor Filter is a very good filter, and we can also see in this article that it is very important for feature extraction. At the same time, the process of configuring the parameters of the Gabor Filter by the author is also very suitable. However, I think it is not enough for the trainer to only train on the four parameters. Optional parameters should be added. This way the algorithm will adapt to more complex environments.

This paper lacks the consideration of the running time of the algorithm, because a good algorithm is not only related to the difficulty of implementation, but also to the running time. If this algorithm is applied to unmanned cars, if it takes too long to identify special objects, it may cause devastating results. In future tests, a comparison of the time can be added on the three data sets mentioned above to test the time spent by this algorithm.

In the three tests, they all have the problem of insufficient training set. If this algorithm is tested in only one training set, it does not prove that this algorithm can be applied in reality, because the real environment will be more complicated.

If possible, the shift and blur methods can be changed in future improvements, such as median blur. And compare these methods to see which method can get the best results. The author may also consider using some methods related to deep learning to obtain relevant parameters, which may be able to obtain better results.

References