The Presentation of a New Method for Image Distinction with Robot by Using Rough Fuzzy Sets and Rough Fuzzy Neural Network Classifier

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Abstract
Distinguishing different images by robots and classifying them in distinct groups is an important issue in robot vision. In this paper we want to propose a new method for distinguishing images by robot via using Rough fuzzy sets' decreases method and Rough fuzzy neural network classifier. In this method, the image features like color, texture and shape are excluded and the redundant features are decreased by Rough fuzzy sets method. Then the Rough fuzzy neural network classifier is educated by the use of these decreased features. In next phase, the robot can properly classify the images; it has not seen or the examined images and put them in the correct group by the use of this system. We have compared our proposed method with Johnson decreased method, principal component analysis, and Rough sets, and also we have compared our classifier with the support vector- machine classifier, neural network and K-nearest neighbor. Our tests' bed is 1000 images of the COREL image set in ten semantic groups.
Keywords*: image Distinction, rough fuzzy sets, Rough Fuzzy Neural Network Classifier.*

1. Introduction

In recent years, the production of the robots which can satisfy human needs take a great value. These are the robots which work as a human and do house work or the robots which are aid worker in football games [12]. Another important feature of robots is their vision and distinction ability of an image by them [13,11]. Researchers have proposed different methods about how a robot distinguishes an image and classifying different images in related groups by robots. In this paper, we want to introduce a method based on Rough fuzzy sets and Rough fuzzy neural network classifier for distinguishing images by robots. The rest of the article is as follow: there is the proposed method's diagram in section 2, the experimental results of the proposed method are in section 3 and the conclusion is at the end.

2. The Proposed Method's Diagram

For the tests, we have selected ten concept groups of Africans, beach, bus, flower, mountains, elephant, horse, food, dinosaur and building from COREL image database. We have chosen 100 images from each of these concept groups. So, we have used 1000 images for our tests. Every concept group has come with its number in our results. For example, number 1 means Africans and 6 means elephant. Our proposed method is the combination of the Rough fuzzy sets decreased method in reference [1] and the Rough fuzzy neural network classifier in reference [2].
The phases of our work are as follows: first, we exclude the image features. We have excluded locally three kinds of low level features of color, texture and shape from each place of image. Each of these features has some characteristics [3]. You can see some of these characteristics in table 1.

Table1-some derivation characteristics in feature vector

Feature	***Characteristics***
Color	Average, mean, variance, third to fifth moment, etc
Texture	Energy, distinction, congruence, correlation in four main directions from first to fifth neighborhood
shape	First to fifth torque

In this paper, the length of our feature vector is 38. In second phase, we decrease the feature vector by Rough sets method [1]. Some different decreases were obtained by these methods; we use 9, 18, and 23 for our next tests. In training part, we educated the Rough fuzzy neural network classifier [2] by decreased features, and then we impose a new image at the stage of decreased features' test and get the group of the image from the classifier. The number of input neurons to the Rough fuzzy neural network is equal to the number of the decreased features of an image [8]. The network has to middle layers of 5 and 8 neurons, and has 11 output neurons; ten neurons for the content of different available images in the image database and 1 neuron for unrelated images. Every time, one neuron is activated and is meant the content of the available image. 11^{th} neuron, which is for unrelated image, is also answered for images that are out of the image database and it is activated for the

images out of the 1000 image database. The activation function for all layers is Sigmoid. The maximum number of repetition for education is 10000 and the amount of error is 0.01 for stopping education. In figure 1, the work processes' diagram is shown. Part (a) is the training phase and part (b) is the test phase.

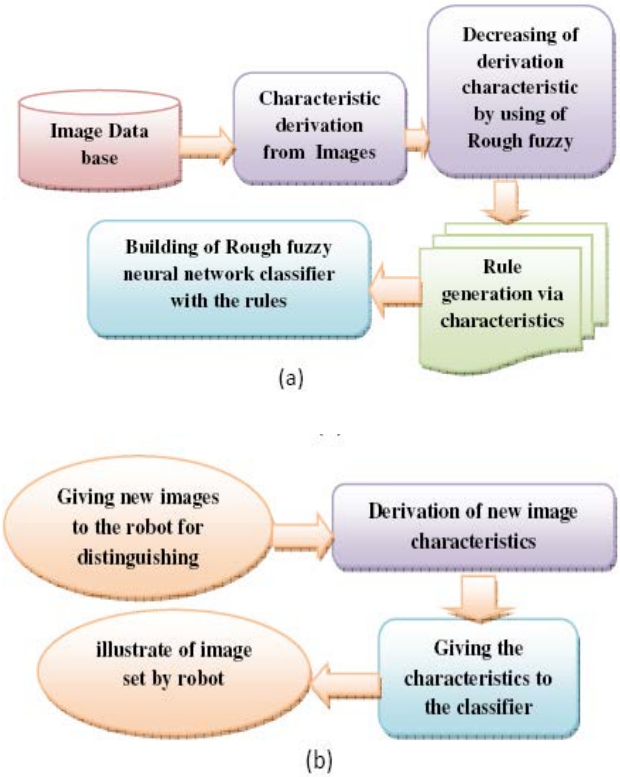

Fig.1-(a) training phase (b) Test Phase

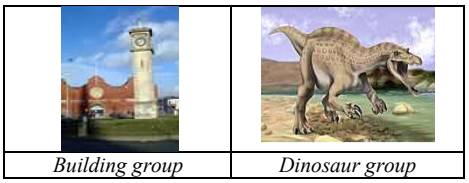

Fig.2. Examples from each semantic concept groups of the image database

3.Experimental Results

3.1 The Comparison of Different Decreased Methods in order to Increase the Robot's Classifying Precision

In this paper, the three decrease methods of Rough sets [4], principal component analysis [5], and Johnson are used to compare with the decrease method of Rough fuzzy set. In table 2, after decrease by these methods, the Rough fuzzy neural network classifier has been used and the precision of the classifier has been evaluated by robot.
As you can see, the Rough fuzzy set with 18 features has higher precision than other decrease methods in most of the times. In most of the cases, the image contents also show the superiority of the Rough fuzzy sets with 18 features. The reason of this superiority is the use of efficient theories of Rough and fuzzy that can decide in vague places.

3.2 The Comparison of Different Classifiers in order to Increase the Robot's Classifying Precision

To compare the classifying precision of the Rough fuzzy neural network, three classifiers of K-nearest neighbor [6], the support vector-machine [7], and neural network have been used. In this test, the features of the Rough fuzzy decrease method with 18 features have been used.
As you can see in table 3, in the most cases the Rough fuzzy neural network classifier has higher precision. Also, for other content image, the Rough fuzzy neural network classifier has higher precision. The reason of the superiority of the Rough fuzzy neural network classifier is the content structure of the Rough and fuzzy in neural network that can increase the neural network predicting precision. When the classifier's precision is increased, the robot can easily classify the images in their correct classes.

3.3 The Robot's Classifying Precision for All Image Contents

In this test, we use the Rough fuzzy decrease method with 18 features and the Rough fuzzy neural network. 100 images will be given to the classifier for each content at each time, and the precision will be investigated. The precision of the proposed method will be compared with two other image classifying methods and the superiority of proposed method will be proved.
As you can see in table 4, our proposed method has higher precision in most of the times in comparison with other methods. The reason of this superiority is the correct decision in the vague places of the images.

3.4 The Robot's Classifying Precision by Using the Proposed Method

We have implemented the Rough and neural networks method, principal component analysis, and the support vector-machine, Johnson, and the K-nearest neighbor and have compared the results of these three methods with Rough fuzzy sets and Rough fuzzy neural network. We have got the classifying precision of the robot by use of these four methods on ten images content. Figure 3 shows that our proposed method has higher precision than other methods.

3.5 The Robot's Classifying Precision of the Proposed Method for Images Out of the Image Data-Base

We have selected 45 images out of the database for our test, so we can also evaluate the precision of the classifiers for these images. In this case, just when the 11^{th} neuron is activated for unrelated images, the right answer is gotten. Considering table 5, the superiority of our method is proved again. Because of the efficient excluded features by Rough fuzzy sets method, we have excluded more useful rules that are so useful for education of the classifier. The Rough fuzzy neural network classifier that is educated by these rules has higher precision in comparison with other classifying methods. So, we can obtained better results by using our proposed method; i.e., Rough fuzzy decrease method and Rough fuzzy neural network classifier, both for data-base images and images out of the data-base. The robot also can properly classify the images in their classes.

4. Conclusions

In recent years, the ability increasing of the robot for doing works is an important research base. Most of the researchers in this field try to improve the robot's work and increase the precision of the work which a robot does. One of the issues which have a great value about robot's vision is classifying the images by a robot. In this article, a method for robot image classifying by using of Rough fuzzy sets and Rough fuzzy neural network was proposed. We compared the proposed method with other methods and found the superiority of our method. By the use of two efficient theories of Rough and fuzzy, our proposed method causes increase in the classifying precision. The content structure of Rough and fuzzy in neural network can increase the neural network predicting precision and by the use of image excluded features, the Rough fuzzy method can produce more useful rules that are so helpful for classifier's education. A robot can classify the images with a high precision by the use of our proposed method and put them in proper classes. Our proposed method also shows a well precision for the out of database images.

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Table2-Comparing between different decreasing methods for increasing of robot classifying precision

Image Concepts	Rough set	PCA	Jonson	Fuzzy rough with 18 features	Fuzzy rough with 9 features	Fuzzy rough with 23 features
Horse	٪81.47	٪89.22	٪75.67	**%92.34**	٪77.41	٪87.18
Dinosaur	٪81.23	٪82.43	٪77.23	**%94.74**	٪76.69	٪89.65
food	٪78.15	٪85.76	٪80.18	٪88.56	٪81.49	٪90.24

Table3- Comparing between different classifying methods for increasing of robot classifying precision

Image Concepts	Neural network-MLP	SVM	KNN	fuzzy rough neural network
African people	٪82.17	٪88.78	٪86.23	**%93.34**
Elephant	٪83.47	٪89.48	٪85.78	٪87.95
Mountain	٪80.26	٪89.56	٪91.21	**%95.28**

Table4- Comparing between proposed method and other methods of image classifying

Image Concepts	Proposed Method	Classifying method[10]	Classifying method[9]
African people	**%93.34**	٪89.34	٪87.23
Beach	٪87.23	٪90.12	٪85.34
Bus	**%96.45**	٪80.14	٪91.32
Flower	**%94.43**	٪90.15	٪87.78
Mountain	**%95.28**	٪89.23	٪86.76
Elephant	٪87.95	٪91.34	٪88.20
Horse	**%92.34**	٪85.78	٪89.16
Food	٪88.56	٪86.34	٪91.45
Dinosaur	**%94.74**	٪85.19	٪86.23
Building	**%90.16**	٪88.23	٪84.89

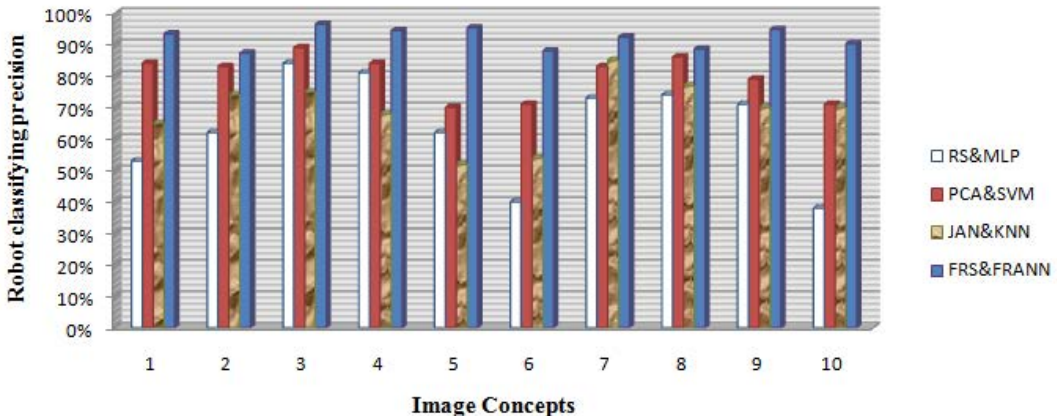

Fig.3- robot classifying precision Comparing

Table 5- precision evaluating for out of data base images

	Rough and MLP	SVM and PCA	Jonson and KNN	Proposed Method
classifying precision	%68.23	%79.16	%75.49	**%83.33**