

# Distinguishing Psoriasis from Eczema and skin inflammation using Fuzzy method

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## ABSTRACT

Misdiagnosis of skin diseases is a very common event around the world. Eczema, psoriasis, and inflammation are three very similar diseases, and patients' responses to the symptoms of these diseases are similar, making the work difficult for physicians. Also, these three diseases have many similarities in terms of appearance, making it difficult to diagnose them by a system. Their correct, accurate and reliable diagnosis is crucial. This article aims to distinguish three diseases with acceptable and high accuracy using the fuzzy method. In this article, most of the important features in image processing such as HOG and BRISK, FAST, etc. are extracted (a total of 200000), and then, a total of 42 optimal features were selected through feature selection and neighborhood component analysis for classification (FSCNCA) method. Finally, skin diseases were distinguished using valid methods of NN, LDA, KNN, SVM and fuzzy methods and the accuracy of diagnosis was obtained at 10.89%, 49.59%, 47.94%, 83.47% and 93.39%, respectively. This study shows that the proposed method distinguishes skin diseases with acceptable accuracy.

**Keywords:** Fuzzy system, Psoriasis skin disease, Eczema, Skin Inflammation, Disease Diagnosis

## Introduction

Psoriasis is a chronic inflammatory skin disease that affects more than 2% of the population<sup>[1]</sup>. Various environmental factors such as trauma, infections, and drugs can exacerbate the disease and it can be manifested in susceptible people<sup>[2,3]</sup>. In histology, hyperkeratosis, parakeratosis and epidermal acanthosis along with dilation and torsion of vessels and infiltration of inflammatory cells (lymphocytes) are observed<sup>[4]</sup>. Psoriasis is a systemic disease in which 20-30% of the patients are affected by psoriatic arthritis. In patients with moderate to severe psoriasis, there is an increased relative risk of metabolic syndrome and atherosclerotic cardiovascular disease<sup>[5,6]</sup>. This disease is associated with increased mortality and disability due to heart

diseases, although the pathogenesis of atherothrombosis caused by this disease has not been fully recognized<sup>[7]</sup>.

Many studies suggest pro-atherogenic lipoproteins in the pathogenesis of the disease, including hypertriglyceridemia, elevated LDL-C and VLDL-C levels, and reduced HDL-C levels<sup>[8,9]</sup>. Thus, there are several methods to diagnose psoriasis and medical engineers are increasingly trying to improve the accuracy, reliability and precision of its diagnosis<sup>[10]</sup>. In this study, 200000 features that are used in image processing and are appearance and deep features were used. Among these features, 42 optimal features were selected by FSCNCA method. Finally, using these features and using valid methods of classification, the three diseases were distinguished with 93.38% accuracy.

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## Materials and Methods

### Database

In the present study, three datasets of psoriasis, skin inflammation) and eczema were used from the DermNet database<sup>[11]</sup>. A total of 57 eczema data, 21 inflammation data and 43 psoriasis data were used here. DermNet NZ was launched in 1996 by a group of Dermatologists from New Zealand. It has

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become a world-renowned resource of skin disease information.



**Figure 1-** Skin diseases: eczema on the right, inflammation in the middle and psoriasis on the left

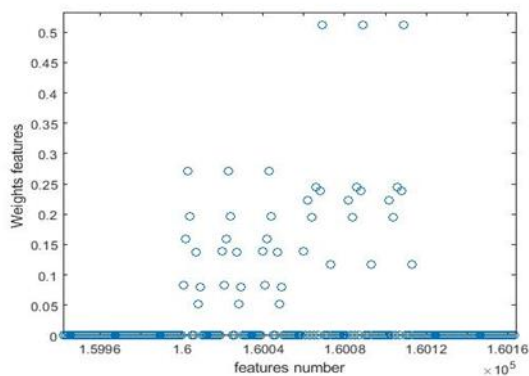
Figure 1 illustrates an image of each of the skin diseases used in this study.

### Feature extraction

In this article, 200000 features including HOG, BRISK, FAST and sparsefilt were extracted<sup>[12,13]</sup>. After that all features were extracted, we move on to the next step, which is to select features with higher optimal features to reduce the computational burden and cost.

### Selection of features

Feature selection is performed using neighborhood component analysis for classification (FSCNCA) method. FSCNCA learns feature weighting using diagonal adaptation of neighborhood component analysis (NCA). This method is proposed to reduce the number of features in achieving real-time processing and reduce computation time. Finally, 42 features were selected.



**Figure 2.** Feature selection output

After selecting the feature, using the optimal features and using all the valid methods of SVM, LDA, KNN, NN and fuzzy system, skin diseases were distinguished and the best method was selected and announced.

### Results

In this article, using five classifiers, three types of diseases were distinguished and compared and the results were presented. Classifiers were implemented using optimal features.

**Table 2. Results of time and accuracy of calculations using LDA method**

method	accuracy	time (sec)
LDA	49.59 %	6.33

Table 2 shows the simulation and classification results by the LDA using the optimal features.

**Table 3. Results of time and accuracy of calculations using SVM method**

method	accuracy	time (sec)
SVM	83.47 %	2.69

Table 3 shows the results of simulation and classification by SVM using optimal features.

**Table 4. Results of time and accuracy of calculations using NN method**

method	accuracy	time (sec)
Neural Network	23.97 %	10.89

Table 4 shows the results of neural network simulation and classification using optimal features.

**Table 5. Results of time and accuracy of calculations using fuzzy method**

method	accuracy	time (sec)
Fuzzy	%93.39	14.51

Table 5 shows the results of simulation and classification by the fuzzy system using the optimal features.

**Table 6. Results of time and accuracy of calculations using fuzzy method**

method	accuracy	time (sec)
KNN	47.94 %	4.95

Table 6 shows the results of simulation and classification by the fuzzy system using the optimal features

### Discussion

In this section, the results are discussed and finally the best option is selected.

The main aim of this study is to present a new method for distinguishing psoriasis from similar diseases. This article tries to diagnose skin disease using a new method that has acceptable accuracy. It will save the time and money significantly. Many features are extracted and the best features are selected and entered into the next step.

In this article, a correct and reliable method is used to obtain the desired result. In this article, the NN, SVM, KNN, Fuzzy and LDA classifiers were used and examined.

**Table 7- Results of accuracy of all classifiers**

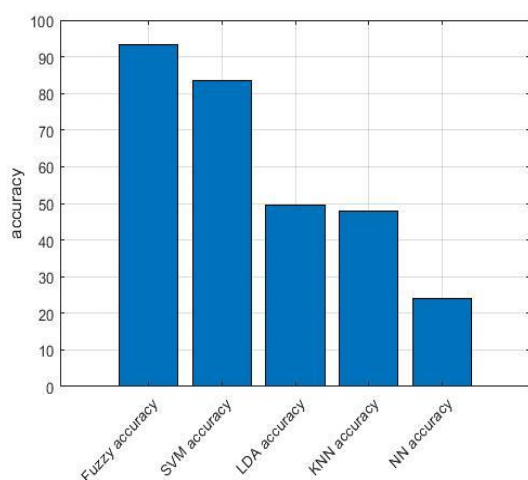
classifier	KNN	FUZZY	NN	SVM	LDA
accuracy	47.94 %	93.39%	23.97%	83.47%	49.59%

Table 7 shows the results of the classifiers

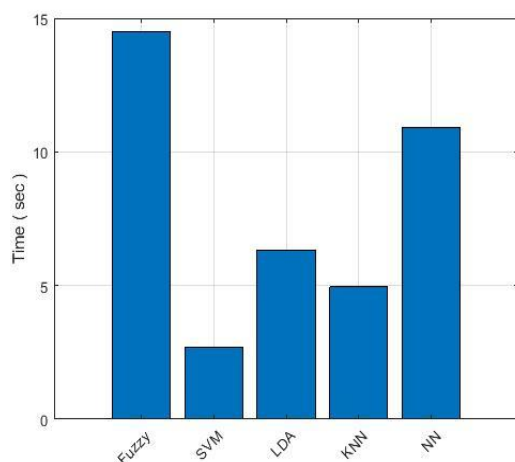
**Table 8 Results of computation time of classifiers**

classifier	KNN	FUZZY	NN	SVM	LDA
Time of classification	4.95	14.51	10.89	2.69	6.33

Table 8 shows the results of the classification time of classifiers.



**Figure 3-** Chart of accuracy of classifiers



**Figure 4-** Chart of computation time of calculators

According to Table 7 and Figure 3, the classifier using the fuzzy system has a higher accuracy than others, which helps us greatly in distinguishing the mentioned diseases. Also, based on Table 8 and Figure 4, it can be seen that the fuzzy classifier is ranked last in terms of computation time, but considering the time of approximately 11 seconds, the neural network performed better in this regard. Also, given 2.7 seconds time of the SVM classifier, which has a better time than the fuzzy system, the

fuzzy system gives us 10% more accuracy with 10 seconds more time. In these diseases, real time is not the main criterion for diagnosis, so accuracy plays a major role. For this reason, fuzzy method with an accuracy of 93.39 is ranked first and is selected in this study.

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