Diagnosing Skin Disease Using Deep Features Based On Artificial Intelligence

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Abstract

Misdiagnosis of skin diseases is a common occurrence. Psoriasis is a skin disease that has many similarities with other diseases, and its incorrect diagnosis causes many problems in the treatment process. Misdiagnosis of this disease causes doctors to face problems during treatment. The lack of images of the disease and the database of skin diseases reduces the diagnosis and the coordination of diagnostic methods, therefore, diagnosis using different images is very useful. Today, diagnosis methods using deep features in medical images have received much attention. Artificial intelligence is one of the automatic methods of diagnosis. These methods can detect new data entering the system and keep it in memory. Therefore, in this article, two different groups of data have been identified using deep features based on artificial intelligence. In this method, the data of the first group in the form of training and testing and the data of the second group are studied gradually. If they are correctly identified, the next 0.1 chunks of data enter the network without testing. If they are wrongly recognized, they enter the training section and this reduces the training process. In this work, by training 20% of the data, i.e. the first 10% and the fourth 10%, there was no need for training because the accuracy was not less than 98%. In this article, deep features of images were first extracted using convolutional neural network, and then psoriasis and eczema were diagnosed with average accuracy of 98.3% and sensitivity of 97.9% in skin images using artificial intelligence.

Keywords: convolutional neural network (CNN), artificial intelligence, skin disease psoriasis and eczema, deep learning.
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1. Introduction

Human skin is the largest organ in the body. The mass of the skin is between six and nine pounds and is estimated to be about two square meters of surface area. The inner part of the body is separated by the skin. The skin also protects against fungal infection, bacteria, allergies, viruses and controls body temperature. Many people have skin diseases that are affected by bacteria or viruses. As many people ignore their skin health and take care of it. There are different types of skin diseases such as eczema, alopecia, ringworm and psoriasis.

There are about 3000 disorders in the world of dermatology. This large number of diseases includes many groups that include a wide range of diversity in terms of etiology: from disorders that are genetic to infectious diseases, diseases caused by exposure to environmental factors and many diseases that, although not fatal.

Most skin diseases are multifactorial. In general, it can be said that there are various reasons for the existence of a connection between the skin and the mind, that a skin disease can cause psychological problems in a person because of the unpleasant appearance it causes on the other hand, on the other hand, some psychological problems can skin manifestation such as dysmorphophobia, in another case these two can manifest a systemic underlying disease such as luposaritomatosis. Each person's personality as a determining factor that casts a shadow on all human behaviors and tendencies, due to incompatible traits and characteristics, can make him suffer from some psychological and even physical problems and disorders.

Skin disease is one of the most common diseases among people all over the world. There are different types of skin diseases such as basal cell carcinoma (BCC), melanoma, intraepithelial carcinoma and squamous cell carcinoma (SCC)[1].

Psoriasis is a common skin disease and about one to three percent of the world's population is affected by this disease [2]. This disease has a genetic background and the disease is influenced by some environmental factors such as stress, and in general it can be said that this disease is dependent on the genetics of the environment [3]. Medicines, hormonal and metabolic factors are sunlight. Studies conducted in England show that overweight men with this disease die on average 3.9 and 4.9 years earlier[4].

Often only experienced clinicians can achieve good diagnostic accuracy with these visual methods [5]. Histopathological examination of a suspicious lesion is the gold standard for the diagnosis of skin disease. Several examples of clinical images of common skin diseases are shown in Figure 1.

Fig.1. Examples of skin diseases

Therefore, the development of an effective method that can automatically differentiate skin diseases will be useful as an early screening tool. Differentiation of a skin disease by dermoscopic images may be inaccurate or unreproducible because it depends on the experience of dermatologists. In practice, the diagnostic accuracy of melanoma from dermoscopic images by an inexperienced specialist is in the range of 0:75 to 0:84[5].

One of the limitations of diagnosis performed by human experts is that it relies heavily on subjective judgment and varies greatly among different experts. In contrast, a computer-aided diagnostic (CAD) system is more targeted. By using manual features, traditional CAD systems for skin disease classification can achieve excellent performance in some skin disease diagnosis tasks [6]. The reason is that manual features are not suitable for universal diagnosis of skin disease. On the one hand, manual features are usually extracted specifically for a limited variety of skin diseases. They can hardly adapt to other types of skin diseases. On the other hand, due to the diversity of skin diseases, human-made features cannot be effective for every type of skin disease [6]. Generic valid features can be one of the solutions to this problem, which eliminates the need for feature engineering and extracts effective features automatically [7]. Many methods have been proposed for this task in the last few years [8]. However, most of them focused on the tasks of dermoscopy or histopathology image processing and mainly on the detection of mitosis and cancer markers[9]. Recently, deep learning methods have received much attention and have achieved excellent performance in various tasks such as image classification [10], image segmentation [11], object recognition [12], etc. Various researches [13] showed that deep learning methods are able to outperform humans in many computer vision tasks. One of the success factors of deep learning is its ability to learn semantic features automatically extracted from large data sets and used for classification and diagnosis[14].

In particular, a lot of work has been done on the use of deep learning methods in the diagnosis of skin diseases [15]. For example, [16] proposed a global skin disease classification system based on a pre-trained convolutional neural network (CNN). The top classification accuracy was 80%, significantly better than the performance of human experts. Deep Neural Networks (DNNs) can deal with large variations in skin disease images by learning effective features with multiple layers. Despite these technological advances, the lack of large amounts of labeled clinical data has limited the widespread application of deep learning in skin disease diagnosis.

During the last decade, many research articles, theses, and books have been published in the field of skin disease diagnosis [18]. In particular, there are several survey articles that have provided good reviews of methods used to diagnose skin diseases[19].

However, some of them mainly focused on traditional machine learning methods and mentioned deep learning methods with only a small part of the whole content [20]. As you can see, deep learning is developing rapidly with numerous articles published every year. Therefore, it is necessary to include the latest works to analyze the trend of this field. Furthermore, previous surveys [21] only discussed specific skin diseases (e.g., melanoma) or specific diagnostic tasks (e.g., classification of skin lesions), while other diseases (e.g., non-melanoma diseases) or tasks (e.g., skin lesion) were discussed. . And the skin diseases of eczema and psoriasis are presented less.

A number of comparative studies of skin color pixel classification for skin disease diagnosis. It is reported [22] in [23] that they compared three different methods on the Compaq database: red-green ratio thresholding, color space mapping with D1 marker and skin probability map.

Gaussian and Gaussian mixture models in 9 chrominance spaces in a set of 110 images of 30

individuals They compared the people of Asia and the Caucasus[24]. lassification of skin lesions into "benign" or "malignant" classes is a task using supervised learning [25]. Machine learning can be divided into many sub-areas. In particular, deep learning is a branch of machine learning and has developed rapidly in the past few years. Previously, designing a machine learning algorithm required domain information or human engineering to extract representative features that could be used for pattern recognition. However, a deep learning model consisting of multiple layers can directly transform the raw input data into the representation required for pattern recognition without much human intervention. The layers in a deep learning architecture are arranged sequentially and consist of a large number of predefined, non-linear operations, so that the output of one layer is fed into the next layer to form more complex and abstract representations. In this way, the deep learning architecture is capable of learning complex functions. People have witnessed the enormous development of deep learning algorithms and their widespread applications in various tasks such as object classification [26], machine translation [27] and speech recognition [28]. In particular, healthcare and medicine greatly benefit from the prevalence of deep learning due to the huge amount of medical data [29]. Three major factors have contributed to the success of deep learning to solve the complex problems of modern society, including:

- Availability of massive educational data. With the ubiquitous digitization of information in the recent world, vast amounts of data are publicly available for training complex deep learning models.
- Availability of powerful computing resources. Training complex deep learning models with massive data requires a lot of computing power. Only the availability of powerful computing resources, especially the improvement of graphics processing unit (GPU) performance and the development of methods to use GPUs for computations, have met such requirements in recent times.
- Availability of deep learning frameworks. People in various research communities are more and more willing to share their source code on public platforms. Easy access to implementing deep learning algorithms has accelerated the speed of diagnosing practical tasks day by day.

2. Method and Materials

In this study, two data sets including psoriasis and eczema skin diseases have been used.

A) First Database

DermNet NZ online freely available database was used [28]. It was launched in 1996 by a team of dermatologists from New Zealand. It has become a world-renowned source of information on skin diseases. In this study, 100 data of eczema and 100 data of psoriasis were used.

B) Seconde Database

Ater The data of the dermatologist of Hormozgan Hospital, which were labeled under the supervision of a dermatologist, were used.

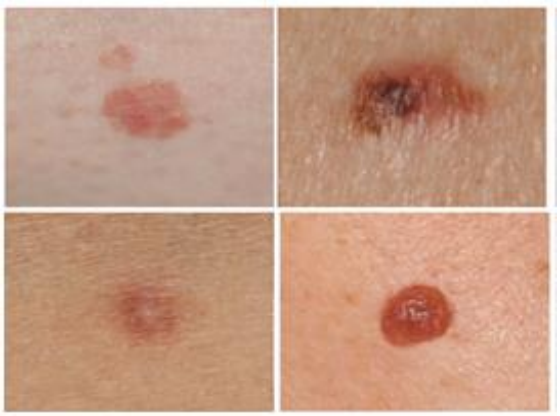
These data include 50 psoriasis patients and 50 eczema data. These data have been imaged by the operator from the site of the skin disease after diagnosis by a specialist doctor.

C) Deep image features

Feature extraction from images is a very widely used and sensitive task for recognition and classification. The better this feature extraction is done, the better the recognition and separation will be. Here, convolutional neural network with AlexNet architecture is used to extract deep features from images.

(a) (b)

Fig.2. Skin disease. (A) Psoriasis (B) Eczema.



(a) (b)

Fig.3. Skin disease. (A) Psoriasis (B) Eczema.

D) AlexNet architecture

Neural network architectures are seen as pre-trained networks that have the ability to distinguish 1000 classes. A typical AlexNet network has 8 layers, the first five layers are convolutional and the last three layers are fully connected. Figure 4 shows the general structure of the AlexNet network. In this

research, Alexnet neural network with three fully connected layers is used.

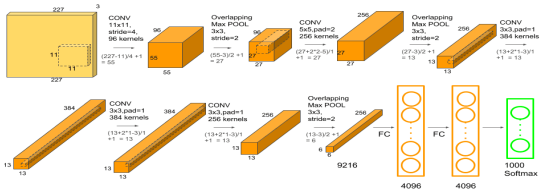


Fig.4. Image of AlexNet convolutional neural network

E) Learning based on artificial intelligence

In this research, the first group was studied first, in this way, the first 10% were trained and the next deciles (10%) were tested, and if the accuracy was not lower than 98%, the next decile was tested. This work continues. In the data of the first group, four parts (deciles) of the data were trained so that the accuracy reaches above 98%. But in the data of the second group, only two decimals were needed for training and the accuracy reached over 98%.

The working method is shown in Figure 5.

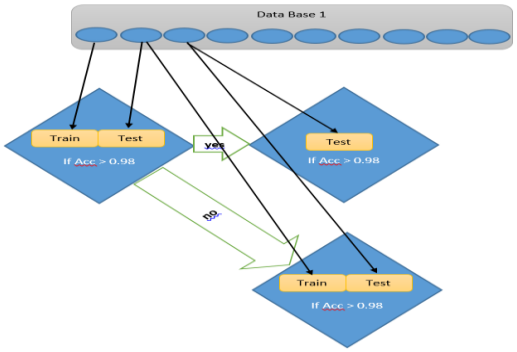


Fig.5. Flowchart of the work method

3. Results

In this article, the data were divided into 10 groups.The first decade of the first database was used as training data and the second decade was used for testing. If the data recognition was requested with high accuracy, the data of the third decile was used for testing and this continued. If the accuracy was low and it was wrongly diagnosed. This decile was also used as training data and the network used subsequent deciles as testing. This was used up to the end of the decimals to evaluate the network of all the data. With this, the processing time has been greatly reduced. Data were used only to test that the network was trained interactively and transfer learning was based on artificial intelligence.

In this article, the confusion matrix is used for accuracy and sensitivity results. Equations 1 and 2 have been used according to the confusion matrix to calculate accuracy and sensitivity.

$$\text{Accuracy} = (TP + TN)/(TP + TN + FP + FN) \quad (1)$$

$$\text{Sensitivity} = TP/(TP + FN) \quad (2)$$

Table 1 shows the accuracy and sensitivity results of the classifiers in the first stage. Table 2 shows the accuracy and sensitivity results of the classifiers in the second stage. This work continues for the second group without learning decimals and is done until the end.

Table.1.
The results of the first stage of classification (first 10% of training and second 10% of testing)

Classifier	Acc	Sen
AlexNet	98.69	97.78

Table.2.
The results of the second stage of classification (the second 10% of training and the third 10% of testing)

Classifier	Acc	Sen
AlexNet	98.32	98.15

Table.3.
The results of the third stage of classification (8th 10% of training and 9th 10% of testing)

Classifier	Acc	Sen
AlexNet	98.35	98.1

4. Discussion

The deep learning method is a very new and efficient method in diagnosis and classification without manual intervention. This makes the detection process completely automatic and systematic. Artificial intelligence methods are a method that reduces the dependence on databases and the need for specific data, and with this, a complication and disease can be recognized from the signals and images related to the disease. Tables 1 to 3 show the classification results of different methods, the accuracy and sensitivity of which was done with K Fold 10 cross-validation, and the results of the proposed method were detected with an average accuracy of 98.3% and a sensitivity of 97.9% for skin images. Table 4 shows the results and different algorithms in different datasets used.

As you can see in Table 4, the accuracy of the proposed classifier is different from other classifiers is higher and is selected as the preferred classifier. The main goal of this study is to provide a completely automated method without manual intervention using deep features based on artificial intelligence to distinguish psoriasis from similar diseases. In this project, deep features are extracted from images without manual intervention. This reduces the need for humans and eliminates the need for human review of images.

Table.4.
Results of other articles

ACC	Detect	Ref
96.73	psoriasis	**[29]**
97.87	psoriasis	**[30]**
98.68	Eczema & psoriasis	**My method**

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