Application of Machine Learning on Medical image Processing

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Abstract

Machine learning is an important preprocessing step in image based medical image analysis, image processing, the fundamental purpose of the reconstruction of the original image from the observation noise as accurate as possible, while preserving the details of the important characteristics, such as edge and texture image denoising. Disease in medical imaging, in order to accurate analysis the processing of medical images such as x-rays, CT (computed tomography), MRI (magnetic resonance imaging), PET (positron emission tomography imaging and SPECT (single photon emission computed tomography) is crucial, because in medical image in the specific areas of the catastrophe that resulted in the deaths of similar to the small loss. In order to alleviate the threat of the past few decades, image processing machine learning has been widely studied in the field of image and signal processing, and various de-noising techniques have been proposed. Each method has its own assumptions, advantages, and limitations. In this paper, a detailed survey method and their performance in medical image were carried out on the image processing of various mechanical learning methods.

Keywords: Machine learning; image processing;NaïveBeyesian(NB);k-NearestNeighbor (KNN);Support Vector Machine(SVM)

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I. Introduction

In China's urban and rural areas, various malignant tumors occur frequently. Among a variety of malignant tumors, the incidence and mortality of breast cancer, lung cancer and brain tumors topped the list, while medical image processing such as ray X and CT detection appeared. These patients bring the gospel, and the emergence of medical image processing allows doctors to lock lesions more quickly and provide effective solutions for clinical treatment, while machine learning methods improve the accuracy and speed of medical image processing, we can reduce The needs of doctors in rural or semi-urban areas, and will also inform patients in time to inform them of the disease and its solutions. In this article, we try to understand the detection and classification of various symptoms through some image processing and machine learning techniques. This paper introduces the application of machine learning in medical image processing. This paper focuses on its research results in brain detection, breast cancer detection and pulmonary nodule diagnosis.

II. Methods

2.1 Medical image processing

In order to perform medical image processing and disease detection, a series of image processing operations are required to improve quality acquisition of images and perform detection.

Generally speaking, medical image acquisition methods can be divided into X-ray images, spiral CT images, nuclear magnetic resonance images, MR cardiac images, etc. With the advancement of image processing technology, medical images are not limited to the diagnosis of diseases with obvious diagnostic features. It can solve the development of diseases with more complicated pathological structures and various human structures.

The most challenging image processing in the processing of medical images is generally concentrated in three aspects. The first aspect is to classify lung nodules, use image processing methods, and characterize the contours of lung nodules to diagnose patients' diseases. The second aspect is to deal with the head of the brain, to provide a strong basis for the examination of the patient's brain cavity problems; the third is for the image processing of various malignant tumors, through a certain means to deal with malignant tumor images, there are Help the doctor to clearly distinguish the patient's current condition and promptly propose an effective clinical diagnosis and treatment plan.

2.2 Machine learning

Naive Bayes: Naive Bayes classifiers have been extensively studied in the field of image processing, especially in the field of medical imaging. The NB classifier is one of the efficient and efficient classification algorithms by comparing NB with other popular classifiers such as logistic regression, nearest neighbors, decision trees, neural networks, and medical dataset-based rules. According to the area comparison classifier under the receiver operating characteristic (ROC) curve, Kononenko (2001) considers NB to be a benchmark algorithm. Compared with other machine learning algorithms, it does not require a large number of parameters, and the calculation is simple and efficient. Moreover, the algorithm is highly robust to noise data that is not available.

KNN: In all machine learning algorithms, the K-nearest neighbor algorithm is a simpler one. The K-nearest neighbor method is also called lazy learning because it does not require any training. In the k-nearest neighbor method, in the test phase, all data will be Used. This algorithm uses all the training data, so if we have a very large data set, then we need some special methods to process some of the data. Although classification is the main application of KNN, we can also use it for density estimation. When using knn for probability density estimation, its reliable parameter estimation is difficult to determine.

SVM: Machine Learning Support Vector Machine (SVM), also known as Support Vector Network, is a supervised learning model with learning data and learning patterns for learning patterns for regression and classification analysis. The general feature of machine learning supported vector machines is that it can use the known effective algorithm to find the global minimum of the target function, and the support vector machine classification method uses greedy algorith to search the space, therefore, it can only get the local maximum. Excellent solution. Given a set of training samples, each training sample is labeled as one of two categories, the SVM training algorithm creates a model, dividing the new example into one category or designing the other as a binary linear classifier. A support vector machine model is a representation of this example, which is assigned to different categories of examples.

HMM (Hidden Markov Model): The Markov chain we talk about here actually refers to the implicit state chain because there is a transition probability between the states implied in the entire Markov process. Then, if we can know the probability between all implicit states in advance, and the probability of all implicit states to all visual states, then we are quite easy to do simulations. Embedded HMMs can often portray finer and more characteristic data than ordinary one-dimensional HMMs, although it is more difficult to calculate than one dimension. This mode is more suitable for engraving the image of the picture because it makes better use of the important features of the face image.

AUC: AUC is part of performing logistic regression analysis and is a widely used assessment benchmark for binary classification problems, such as predicting the presence or absence of disease. If the nature of the environment is dynamic, then the model must be adaptive, ie it should be able to learn and map effectively. Limèreetal (2004) identified a model for enterprise growth using the decision tree induction principle. It gives interesting results and adapts the model to economic data such as growth capacity and resources, growth potential and growth aspirations. Hai Deng et al. (2006) developed a new framework for unified kernel machine learning for tagged and unlabeled data. The framework includes semi-monitoring learning, as well as semi-supervised learning and active learning. In addition, they have studied a spectrum kernel that effectively classifies given tagged data and unlabeled data.

III. Relative Research

Wang Qing et al. applied the improved KNN algorithm to brain imaging image processing and achieved good results. In this paper, they first used the boundary tracking method to propose the brain structure of the patient from the brain image, and used K-means to gather. The class method obtains the training samples required by the algorithm.

Image processing of brain imaging image analysis is a misdiagnosis of brain diseases and avoiding a series of misdiagnosis of muscle twitching or other symptoms caused by brain lesions, so it is particularly accurate to improve the accuracy and speed of brain imaging image processing. important.

There is always interference in image processing, and brain imaging image processing is no exception. For brain imaging images, the interference in the image is generally non-brain tissue. The images generated by these disturbances will be needed for the brain. The organization image segmentation causes certain interference, so the image must be preprocessed first, and the method of preprocessing the image in the text is the boundary tracking method. The idea is to convert the image into a binary image, which improves the detection in this process. Speed, and on this basis, reduces the space required for storage. In this paper, the left hand touch tracking method is used to detect the edge of the brain image, so as to obtain a clear brain decomposition line [1].

In this paper, we use the machine learning knn to obtain the training sample. After obtaining its clustering center, we search the entire brain image for pixel values close to the cluster center by setting a threshold value when one or some When the difference between the pixels and the cluster center is smaller than the threshold, the one or more pixels can be classified into one training sample. Then, several subsequent training samples are also given in this way. Finally, the k-nearest neighbor algorithm is used to classify pixels that have not been classified. The experimental results of the paper show that the knn algorithm is not as good as the improved KNN algorithm in terms of segmentation accuracy, and the article points out that in the K-nearest neighbor algorithm, the accuracy of segmentation depends to some extent on human experience. Then, the improved k-nearest neighbor algorithm greatly overcomes the shortcoming of the k-nearest neighbor algorithm that requires manual intervention, and the method in the text can make the segmentation in the image fully automatic, saving manpower and improving the accuracy of segmentation. The effectiveness of the improvement.

Pulmonary nodules are difficult to determine the specific nature of the clinical, and lack of specific symptoms in clinical diagnosis, which brings great difficulties to doctors. In the past without medical image processing, misdiagnosis often occurs, and medical images The emergence of success has avoided this phenomenon and greatly increased the probability of clinical cure.

The detection and clinical screening of lung diseases is still very difficult now, but machine learning has brought great convenience to the detection of tuberculosis. More and more people are beginning to study the use of machine learning to detect pulmonary nodules. Greatly improve the detection accuracy and efficiency of lung nodules.

Chen etal. used three different machine learning algorithms to process 106 cases of lung disease data. The final conclusion is that in the detection of pulmonary nodules, the SVM method is used for classification, which has the highest accuracy. And applied to clinical pulmonary nodule diagnosis and treatment, 19 patients were thus recovered. The learning process and the prediction process are shown in Figure 1.

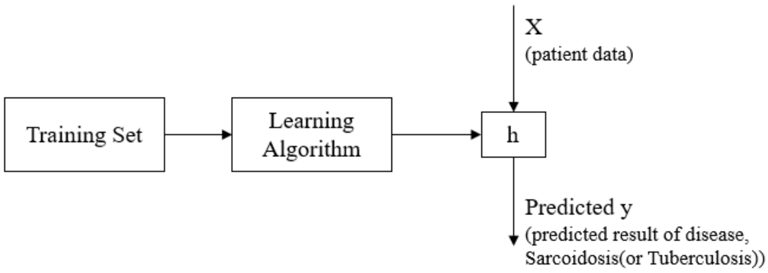

Figure 1. ADST system workflow

The experiment is based on various types of data on existing sarcoidosis and tuberculosis patients, and even some non-data representations, including clinical data such as patient's main claims, clinical symptoms, and other clinical data, constitute training samples. Three kinds of machine learning algorithms, SVM, Naive Bayes, and decision tree classification, are used for separate training. There are also three indicators for measurement, which are the area under the ROC curve, the accuracy of training, and the accuracy of the test.

Because in clinical tests, usually marked by some non-quantitative texts, they processed these symptoms during the experiment and transformed them into features, resulting in nearly 100 features and making ADST. database.

They select a vector as the patient, the elements in the vector are the symptoms of the patient, and the Boolean variables are used as the classification information, thereby obtaining the training data and training set of the patient.

First, the discretized data is predicted by the simplest and easy to implement naive Bayesian algorithm, and the maximum posterior probability is selected as the diagnosis result.

The second method is the decision tree classification. The following figure is a typical use case for a decision tree for diagnosing heart disease [2]:

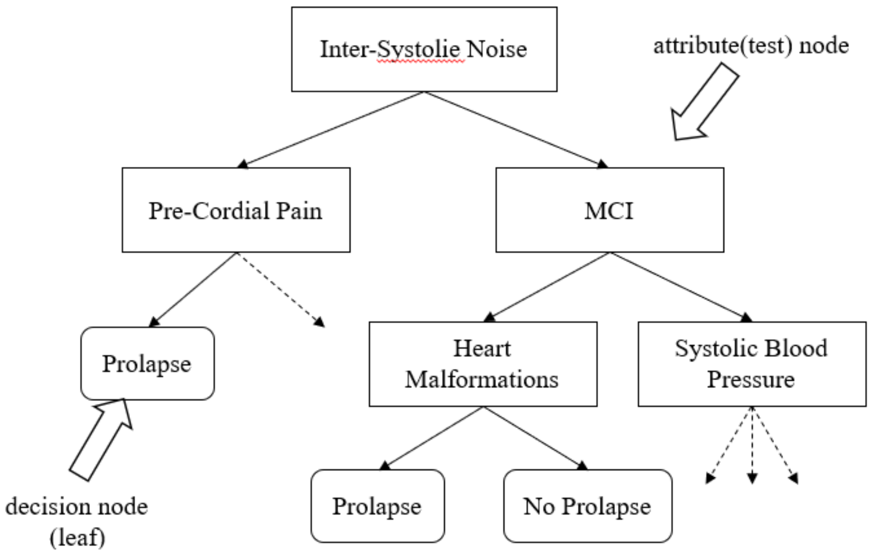

Figure 2. Decision tree model for heart disease

In order to solve the computational complexity of finding the minimum average depth in the decision tree, quinlan gives a width-first heuristic search technique ID3 algorithm, and ID3 preferentially selects those attributes with the least uncertainty for the decision tree. Construction [3]. After constructing the decision tree, they enter the patient's data y, then y will start from the root node and check each pair of attribute values to see which point the y will fall on until the leaf node is tracked, because the experiment only contains Two leaf nodes, if shown as positive, represent the table with sarcoidosis in the patient y, and if negative, it indicates that there is no sarcoidosis in the patient y.

The third method is support vector machine. The support vector machine is more efficient than the previous method because the number of vectors of svm is far less than the number of training samples, and the predicted result is only related to the patient's data y and training samples. Internal product related.

Through three experiments, DCT, NB and SVM are proved. The results of the three methods are satisfactory. According to the first index we just mentioned, the area under the ROC curve of SVM is the largest among the three, and the training time is the shortest, but the training time is the shortest. SVM also has drawbacks. Due to the nature of the SVM algorithm itself, researchers are unable to obtain indicators with the meaning of classification effects. However, the DCT and NB methods, which are not effective, have reached five very meaningful classification indicators.

In modern society, the patient population of cancer is gradually becoming younger, and breast cancer is increasingly threatening the health of urban women. It has become the most common cancer in today's society, and because of the particularity of breast cancer cells, it is easy to spread in the human body, which in turn causes Cancer metastasis, the life of a crisis patient. Unlike other cancers, in the early stages of breast cancer, it is often overlooked by patients, causing serious consequences. Therefore, screening and testing of breast cancer is particularly important.

In the classification and identification of breast cancer, machine learning has also played a very good role. Lu Wei et al. demonstrated the great role of machine learning in the classification of breast cancer.

They used two sets of different X-ray images of the tumor. Morphological and texture features were extracted for classification, and 35 dimensions and 31 dimensions were extracted for training. Among the classified indicators, there are also some innovations. The two-category index is used to characterize its performance, namely sensitivity and specificity. Among them, the most worthy of our reference are the F and G values given in the paper, and F is the overall classification accuracy and sensitivity.

The weighted harmonic mean, G is the geometric mean of the overall classification accuracy and sensitivity [4].

In this paper, we choose neural network algorithm and learning vectorization to set up two networks, and set them separately. In this experiment, they choose a single hidden layer back propagation network, and set 110 nodes, using the traingdx function as the transmission. Function, use the logsign function as a training function, select the appropriate step size and gradient. The ELM only needs to set the number of hidden layer nodes, in 11-101, and in steps of 15 and use it to verify the optimal number of nodes for search, and the excitation function selects the sigmod function.

The two neural algorithms used in the experiment are more specific, but there is not much sensitivity in sensitivity, and the sensitivity of LVQ is superior to other classifiers. The length of time consumed by the BP network for iteration is not stable enough, and it is easy to fall into local optimum, which affects the performance of the algorithm in the whole process.

At the end of the experiment, the authors show that the limit has better performance than the ordinary artificial neural network, and the execution speed is faster than the artificial neural network. In terms of computational complexity, it is also easier, in more complicated computing scenarios.

IV. Conclusions

Recently, machine learning has been used more and more in the identification of eye diseases, and is used to rescue more and more patients suffering from eye pain. Recently, Google proposed to cooperate with NHS to apply deep learning to fundus scanning image recognition, identify diseases and reduce Blindness identifies the patient's identity at the same time, and this is more accurate than scanning other body parts. The future combination of machine learning and medical image processing will continue to bring the gospel to patients.

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