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Maize Disease Recognition via Fuzzy Least Square Support Vector Machine

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Abstract. In this paper, we propose a new approach to recognize the maize disease, which is based on fuzzy least square vector machine (FLSVM) algorithm. According to the texture characteristics of Maize diseases, it uses YCbCr color space technology to segment disease spot, and uses the co-occurrence matrix spatial gray level layer to extract disease spot texture feature, and uses FLSVM to class the maize disease. In this method, the sample mean is calculated, and the center of each class is got; then the distance between the sample and the center is calculated, according to the distance sample's initial membership is got; by finding K neighbors for each sample point, the sample membership degree is calculated according to the fuzzy K nearest neighbor method. Extensive experiments on public datasets show that the algorithm can effectively identify the disease image, the accuracy was as high as 98% or more.

Keywords: Maize disease; Support vector machine; Image processing; traffic sign

1. Introduction

China is the largest rice-producing country in the world, and food production is a major issue which has great impact on people's livelihood. Com is the most important food crop in China, and it plays a decisive role in food production. However, in recent years, the com diseases have had a trend to aggravate year by year, and the yield and quality of com have badly affected by diseases. Therefore, dealing with the com diseases is an important and urgent task. Accurate type of information of diseases can provide scientific basis for integrated control of plant diseases. Throughout the disease control system, disease classification and recognition technology play a crucial role. Nevertheless, the traditional method of disease identification has a slow speed, a high cost and a poor real-time [1]. With the development of science and technology, machine vision, digital image processing and pattern recognition techniques have been greatly developed and applied, and it has also made fruitful application in agriculture.

Maize disease pathogens lead to different types of leaf spots of different textures because of its different pathogenic properties. They can be based on computer image processing technology to extract the com lesion characteristics. This Article is based on YCbCr [2] color space segmentation lesion images, using the space gray matrix to extract three kinds of texture features which have the greatest effect on classification, combining with fuzzy least square vector machine (FLSVM) to accurately identify and classify the com disease.

A least square SVM (LSSVM) approach [3] is very popular. Relative to Vapnik's SVM, the LSSVM can transform a quadratic programming problem into a linear programming problem thus reducing the computational complexity. The main motivation of this study is to use a relatively new machine learning method to the field of credit risk evaluation and compare its performance with some typical credit risk evaluation techniques.

In many practical applications，some elements of training set are often not clear，there are even some noise，these training points on the surface to determine the classification does not make sense，So if we want to reduce the impact of these points ,we need to calculate the degree of membership of the class point，this will be extended to support vector machine theory with Fuzzy Information Support Vector Machine[4].

2. THE PREPROCESSING STEPS

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2.1. IMAGE SEGMENTATION

YCbCr color system is a common color system,which is applied by the most widely used JPEG image.YCbCr uses Y, Cb and Cr, which respectively indicates a luminance component and two color component signals. Different from other color models, YCbCr color model is orthogonal, which fully takes important factors of composition of RGB from other colors into account. YCbCr color space model is Ofien used in image compression. Application of YCbCr color model of color information encoded signals from at least redundant information.

$$Y = 0.299*R+0.587*G+0.114*B$$
$$Cr=(R-Y)*0.713+ 128$$
$$Cb=(B-Y)*0.564+ 128 \quad (1)$$

(a) original image (b) the segmented result

Figure 1. The image segmentation

3. THE PROPOSED TRAFFIC SIGNS DETECTION METHOD

Visual saliency often appears in all kinds of visual scales, different regions also have different visual attention. In order to comprehensively consider locality and integrity for the image saliency region, in this paper, we present an improved algorithm (MPCA) on the basis of Duan's model to compute traffic sign saliency map. And then we extract traffic sign part from original image using automatic segmentation method obtained by loading auto-generated strokes.

3.1. Least Square support vector machine algorithm

LSSVM models are an alternate formulation of SVM regression [5] proposed by [6]. Let the patterns to be classified be denoted by a set of *m* row vectors $A_i (i = 1,2...m)$ in the *n*-dimensional real space R_n, where $A_i = (A_{i1}, A_{i2},...A_{in})^T$ .Also, let $y_i \in \{-1,1\}$ denote the class to which the *i*th pattern belongs. We first consider the case when the patterns belonging to the two classes are strictly linearly separable. Then, the plane described by

$$w^T \cdot x+b=0 \quad (2)$$

Distance of closest point on hyperplane to origin can be found by maximizing the *x* as *x* is on the hyper plane. Similarly for the other side points we have a similar scenario. Thus solving and subtracting the two distances we get the summed distance from the separating hyperplane to nearest points. Maximum Margin = M = 2 / ||w||.

Now maximizing the margin is same as minimum. Now we have a quadratic optimization problem and we need to solve for w and b. To solve this we need to optimize the quadratic function with linear constraints. The solution involves constructing a dual problem and where a Langlier's multiplier α_i is associated. We need to find *w* and *b* such that $\Phi(w) = \frac{1}{2}|w'||w| + \gamma\frac{1}{2}\sum_{k=1}^{N} e_k^2$ is minimized, for all $\{(x_i, y_i)\}$: $y_i (w * x_i + b) \geq 1$.

Now the classifying function will have the following form:

$$f(x) = \Sigma\alpha_i y_i x_i * x + b \quad (3)$$

The hyper-plane can be obtained by minimizing $\frac{1}{2}\|w\|^2 + C\sum_{i=1}^{l}\xi_i$, where ξ_i is a slack variable to allow the boundary singular *C*, also called punishment parameter, is a parameter comprised between wide boundary and small boundary singular, and the constraint is:

$$y_i f(\mathbf{x}_i) \geq 1 - \xi_i, \xi_i \geq 0 \text{ for all } i = 1,2...N \quad (4)$$

Applying Lagrange optimization methods and statistical theory converts the solution problem into: