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An Efficient and Reliable K-Nearest Neighbour Classifier for Fundus Image Classification Method

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ABSTRACT

In medical image processing, the automatic analysis of pathology localization and the segmentation of anatomical segmentation steps are more important. The Fundus images of Low resolution are not applicable to detect the retinal disease. So, we proposed the fundus image with Super-Resolution and its performance via the interest region. Therefore, Eigen MR inter-band feature, Energy MR intra-band feature, Shannon entropy and Sensitive Contrast Interest (SCI) are used to capture the clinical data from the selected region. Therefore, the Clinical Significance regions are determined by using Levenshtein based KNN classifier. Because of better classification outcomes, the higher resolution of the interpolated Bicubic method is exposed to the selected region. Experimentally, the implementation works are carried out in the platform of MATLAB with DRIVE and STARE database images are chosen. The super-resolution image performances are compared with different start of art techniques such as PSM, GR-SR, LLE and SpC-SR. Finally, higher efficiency with low computational super-resolution fundus images is collected.

Keywords: *Retinal image, Super-Resolution, Region, Fundus and KNN*

I. INTRODUCTION

Basically, the degeneration of age-related muscular, diabetic retinopathy disease and the retinal problem diagnosis are carried out by using Fluoresce in Angiographic (FA). In the diabetic population, the main reason for the blindness and low vision is Diabetic Macular Edema (DME). When compared to Proliferative diabetic retinopathy, the DME contains more visual loss. For ophthalmologists, the diagnosis and prediction of various eye diseases from the muscular area is an important task [1]. Hence, the progressive disease monitor and correct diagnosis are promoted by the small vessels with structural and functional evaluation. Moreover, the illnesses in eye sight like glaucoma, macular edema and age-related macular degeneration are diagnosed by using the network of micro vascular and the structure of retinal analysis [2]. By using scanning laser ophthalmoscope or fundus camera is to collect the retinal image. The fundus image of retinal analysis of diseases is critical detection. The increasing availability of screening retinal contains the fundus image with less cost and moveable growth [3]. The camera of the hand-held feature can deliver the image with low resolution and less quality. Hernandez et al [4] debated the method of SIFT key point for the registration of fundus image. Thus, the accuracy of registration is more when compared to the SURF method. The introduction of pose calculation is started and exact accuracy outcomes are produced because of the reduction in terms of minimal local optimization. The suitable and reduced computational cost is initialized with the accuracy registration is augmented. Thus, the elaboration and worldwide estimation display quantitative enhancements. Naguneri et al. [5] introduced a method of STORM for optimal image resolution. The sample resins with higher density and suitable flurophore assets are achieved. Therefore, the sampler antigenecity is decreased while it directs the density labeling antibody with a reduction in drastic. The post-embedding of label approach is used to equip the tissue samples of STORM images. Resulting in resolution imaging with synapses detection and accurate neuron identifications are done. Babacan et al [6] discussed the effective algorithm of super-resolution revival. The characteristic of micro-motion interconnection between the hyper acuity and retina of the human eye is more correct. It contains many more forward improving methods with the capacity of noise-suppression. There is less amount of stability is achieved. Thus, the super-resolution (SR) image depends on the micro-motion of the retina. Ghassabi et al. [7] explained the region detection architecture for the registration of retinal fundus image with higher resolution. This method produces better experimental results in terms of intensity, alteration of rotation, content alteration and small scale alteration respectively. Nevertheless, it never contains multimodal registration of retinal image. By using the segmentation method, the retinal images with its blood vessels are separated. From the blood vessels of retina, image features are predicted with the help of the SIFT method. Therefore, this algorithm is preferable to retinal image normal and pathological respectively but it contains larger computational difficulty. Molodij et al. [8] suggested the Arteriolar-to-venular accurate determination method of vessel architecture. The initial stages of retinopathy hypersensitive are diagnosed. Consequently, the less number of images with the enlarger retinal area is required. Our main contribution of this paper is to propose the information diagnostic of the fundus representation based on the approach of super-resolution (SR). Therefore, the features of retinal images have been suggested and the classification is carried out by using Levenshtein based KNN classifier.

II. METHODOLOGY

Based on the work motivation, the proposed methodology is described by using a selection of a region, feature extraction, classification of the region and the super-resolution (SR) of region section. Basically, the selected region size is quantified with less region survey and it never includes some diagnostic information. The suitable region has been selected. Uniformly, the fundus images with low resolution (LR) are cleaved into different size of non-overlapped image regions and the analytical information are discussed. We proposed retinal image regions with the diagnostic information are determined by using a number of features. Thus, the region selection and classification of image diagnosis is carried out by using Shannon entropy. The image region with Shannon entropy is calculated by using equ (1)

$$E_{nty} = -\sum_{j=1}^{M} P_j \log_2 P_j \quad (1)$$

Therefore, the pixel value of probability incident is denoted as P_j and it is received from the histogram patch. The image region with maximal gray value becomes M.

Extraction of feature and examination

The homogeneous and rich gradient of the selected region is classified by using a discriminative feature extraction process. Based on the statistical sense, the image region differences are calculated by using Shannon entropy. The sensitivity of contrast filters to provide the selected region of localized gradient information. In Shannon entropy, the feature from the sensitivity of contrast index (SCI) is additionally used. Next, to different scales, the information diagnostics are delivered by the analysis of multi-resolution (MR) and it never differences to single-scale correspondingly [10]. The feature localization with suitable resolution frequency is obtained with the usage of SCI and Shannon entropy of MR feature.

- **Entropy of Shannon**

- **Eigen features of Multi-Resolution (MR)**

The manner of signal randomness is enumerated by Shannon entropy and it is applicable in signal processing, electrocardiogram, electroencephalogram and image edge detection. In the presence of a different anatomical feature, the gradient rich region (GRH) contains higher intensity and the Shannon entropy is used to capture the variations. The variation process and diagnostic information of Shannon entropy are discussed in the region selection section. We use the Shannon entropy for powerful feature extraction process.

- **The sensitivity of the contrast index (SCI)**

The intensity values are changed by human eye responsive and its sensitive filter contrast (SFC) is given in equation (2)

$$SFC(F) = 2.6(0.0192 + 0.114\,F)\,e^{0.114F^{1.1}} \quad (2)$$

$$F = \sqrt{F_i^2 + F_j^2} \quad (3)$$

Here, the spatial frequencies are denoted as F_i and F_j . The characteristics of band pass with SFC are shown in Fig 3. At high and low frequencies contain less contrast sensitive and the intermediate frequencies are more sensitive by the human eye. The retinal anatomical feature difference is much less in GRH and the feature is effectively captured with the usage of SFC. Based on work motivation the feature extraction is carried out by using SCI and it never applicable to the retinal image in the field of data embedding and image compression.

- **Energy features of Multi-Resolution (MR)**

At various sub-bands the diagnostic information area determined by using MR wavelet and the retinal fundus image with anatomical segmentation, distortion is discovered by MR features. The sub-band of 3J+1 is obtained from the combination of discrete wavelet transform with two dimensional (DWT) of image analysis and decomposition of J-level respectively [11]. The five mother wavelet of Daubechies (Db5) with five level 2D-DWT decompositions is used for our work. The smooth region and horizontal vessel of wavelet coefficient level are $l \in \{1,2\}$ and the non distinguishable, random region is achieved.

Based on various sub-band, the wavelet coefficient of energy information is captured by MR inter-band energy feature and the correlations are never captured. Each level with matrix sub-band l is denoted as $W_l = [W_l^H \; W_l^V \; W_l^D]$. The different level of coefficient with the column vector is W_l^d with $d \in \{H, V, D\}$. At level l of the covariance matrix in MR is achieved using equation (6).

$$Vw_l = \frac{1}{M_l^d - 1} W_l^T W_l \tag{3}$$

Here, the Eigen-value of vector column and the diagonal matrix is given by Mw_l and Dw_l. In every level, three Eigen-values are produced by the decomposition process. From level $l \in \{3, 4, 5\}$, there are Eigen-values of nine has been take out from the feature and the Eigen feature of MR inter-band is formed by these nine Eigen-values. The Shannon entropy and SCI are the part of the 20-Dimensional feature vectors. From the brief sub-band $W_l^d, l \in \{3, 4, 5\}$ also $d \in \{H, V, D\}$ contains extracted energies of nine inter-band MR. Every matrix covariance of three Eigen-values with selected region i.e. $l \in \{3, 4, 5\}$ are attained. The features are classified by using KNN classifier.

3.3 Region classification

3.4 Selection of information from Super Resolution region

The rich gradient region is classified by using a selected region and the crucial clinical information is enhanced with the usage of correct super-resolution method. The smooth region is detected by the performance of bicubic interpolation. We suggested the nearer embedded method of super-resolution such as prediction of statistical representation (PSM), Sparse coding (SpC-SR), Gaussian regression (GR-SR) and linear locally embedding (LLE) methods were examined. Finally, the high-resolution image construction with less time is obtained from the sparse coding-based SR (SpC-SR) method and it is applicable in GRH. The patch of SR with low and high resolution is mutually learned dictionaries and the correlation is utilized by SpC-SR. The training patches in low and high resolution of SpC-SR [13] is represented in terms of E_p and E_q.

III. EXAMINATION OF FEATURES

Furthermore, the interest region size 32×32 is chosen from the given low-resolution fundus image with the magnification factor 2 is used. From this chosen region with 20-dimensional vector features are extracted. The student's test- T is used to enumerate the class difference and it delivers both T and P values.

Therefore, the data vector dimension is $\bar{v}_1$ and $\bar{v}_2$, the variance is η_1^2 and η_2^2, means values m_1 and m_2. Experimental representation of lower p-value is (< 0.5) and higher T value becomes (≥ 3). The Intra-band MR energy features with T-test outcomes are illustrated in table 1. In horizontal, vertical and diagonal with p-values is less than 0.001. The inter-band with nine eigenvalue features are depicted in Fig 1. The Shannon and SCI features with T and p values are obtained.

Table 1: Intra-band MR energy feature with T-test

Intra-band MR energy feature	D_5	H_5	V_5	D_4	H_4	V_4	D_3	H_3	V_3
T-value	9.98	10.98	9.67	17.34	13.56	12.56	20.03	17.56	13.67

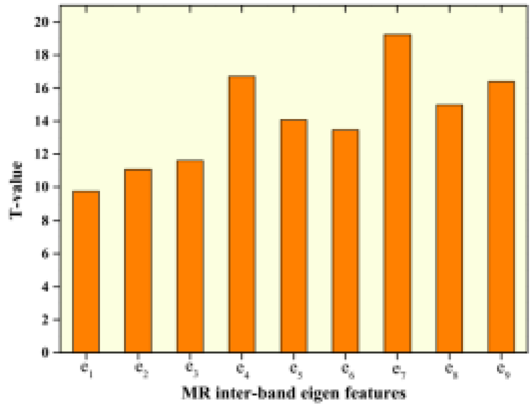

Fig 1: Inter-band of MR Eigen features

4.2 Classification Analysis

For the purpose of classification, the KNN classifier to receive the point of 20 feature vector. The performance of five cross-validations is to produce the unbiased classification. The fundus images are physically glossed to the SZ and GRH, the image is calved into the non-overlapped size of 32×32. From the DRIVE and STARE database with 2700 and 5019 patches are received. The total dataset is separated into five disjoint fold in the presence of cross-validation with equivalent surveillance. Hence, the fold of 4/5 for trained and 1/5 for the tested classifier. The total dataset with an average performance of classification in each fold is obtained. The optimal parameter *(m, l)* becomes (10, 2) for the training phase of KNN classifier. Therefore, the enhanced performances of KNN classifier are approved in conditions of accuracy, specificity and sensitivity [15].

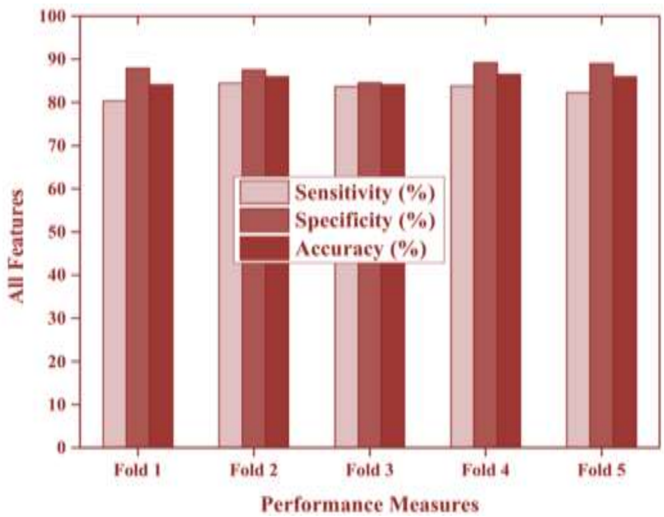

Figure 2: Performance measures of STARE

IV. CONCLUSION:

The diagnostic information depends on the selected region with super-resolution concept is suggested in this paper. The proposed features of Eigen MR inter-band feature, Energy MR intra-band feature, Shannon entropy and Sensitive Contrast Interest (SCI) used to detect the information from the selected region. The classifier of Levenshtein based KNN delivers a better accuracy of 86.78% in the clinically significant region. Experimentally, the images are taken from the database of DRIVE and STARE and it produces the performance measures of a better result. Finally, the different state of the art performance of PSM, GR-SR, LLE and SpC-SR with optic disk, blood vessel, exudates and smooth region performance is achieved.

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