Diabetic Retinopathy Identification And Severity Classification using Image Pre-Processing techniques

Submitted By:--
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Dataset

Summary statistics of dataset

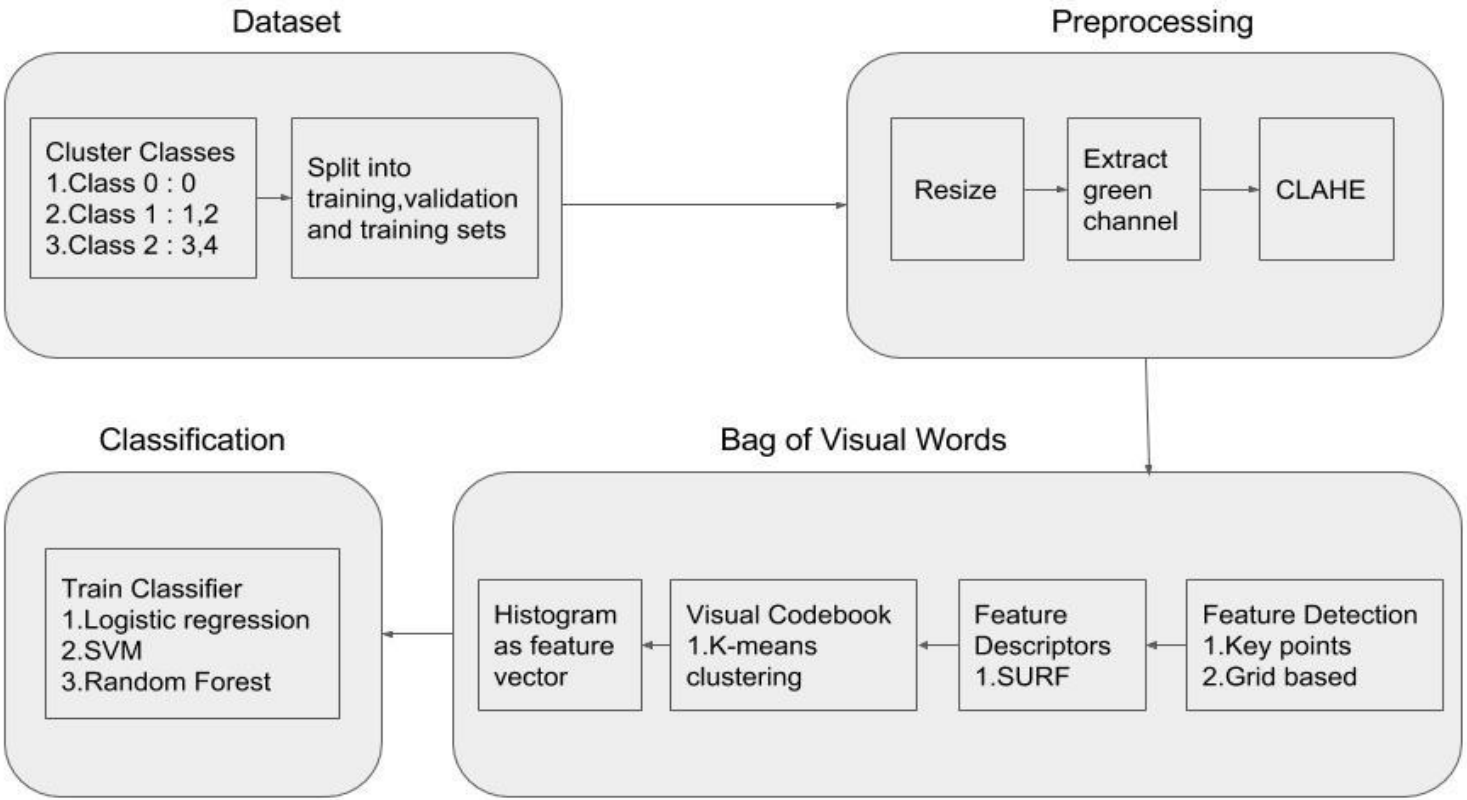
Class	Name	No. of Images	Percentage
0	Normal	25810	73.48%
1	Mild NPDR	2443	6.96%
2	Moderate NPDR	5292	15.07%
3	Severe NPDR	5292	2.48%
4	PDR	5292	2.01%

We used two methods to detect diabetic retinopathy using image pre-processing techniques

1) Create dictionary using extracted features from images and feed it to the classifier for classification

2) Extract location of exudates and area of optical disk for each image and feed it to classifier

Classification using Bags of visual words
Flow Graph



Method-1
Bags of Visual Words

1) Before creating visual dictionary we are pre-processing images and doing feature extraction using SURF feature extractor.

Image Pre-Processing

1) Before applying SURF feature extractor we will pre process image
2) Pre-Processing of images include several steps which are mentioned as follows
    a) Green channel extraction of image
    b) Applying CLAHE (Contrast-Limited Adaptive Histogram Equalization)
    c) Then applying SURF (Speeded Up Robust Features) for extraction of features in images

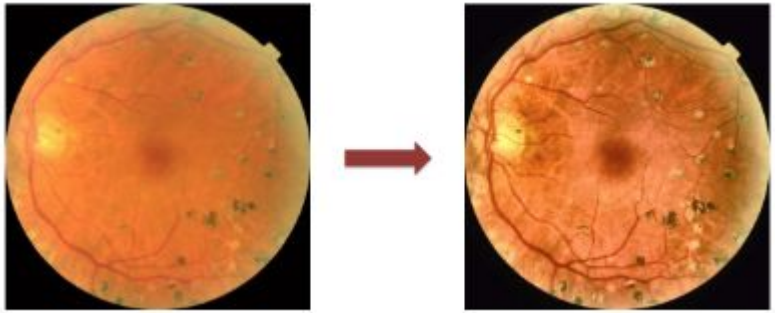
Why green Channel extraction?

We extract green component from given image as it has been observed that the lesions are most observable show the largest contrast in the green channel and hence are most easily identifiable in this channel.

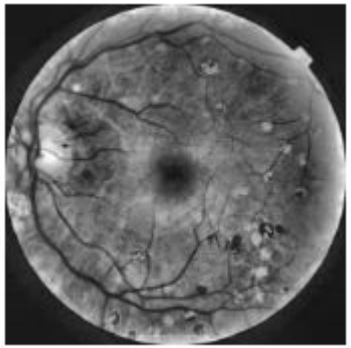
Why and What is CLAHE?

CLAHE:--Contrast-Limited Adaptive Histogram Equalization

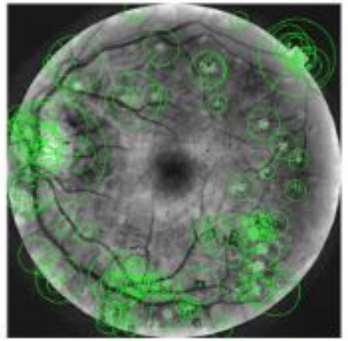
We apply CLAHE as contrast tends to diminish towards the edge of image. CLAHE operates on small regions of the image and improves their contrast by transforming the intensity through localised histogram equalization



Result after applying CLAHE



Green Channel extraction of image



Feature extraction on a pre-processed image

SURF (Speeded Up Robust Features)

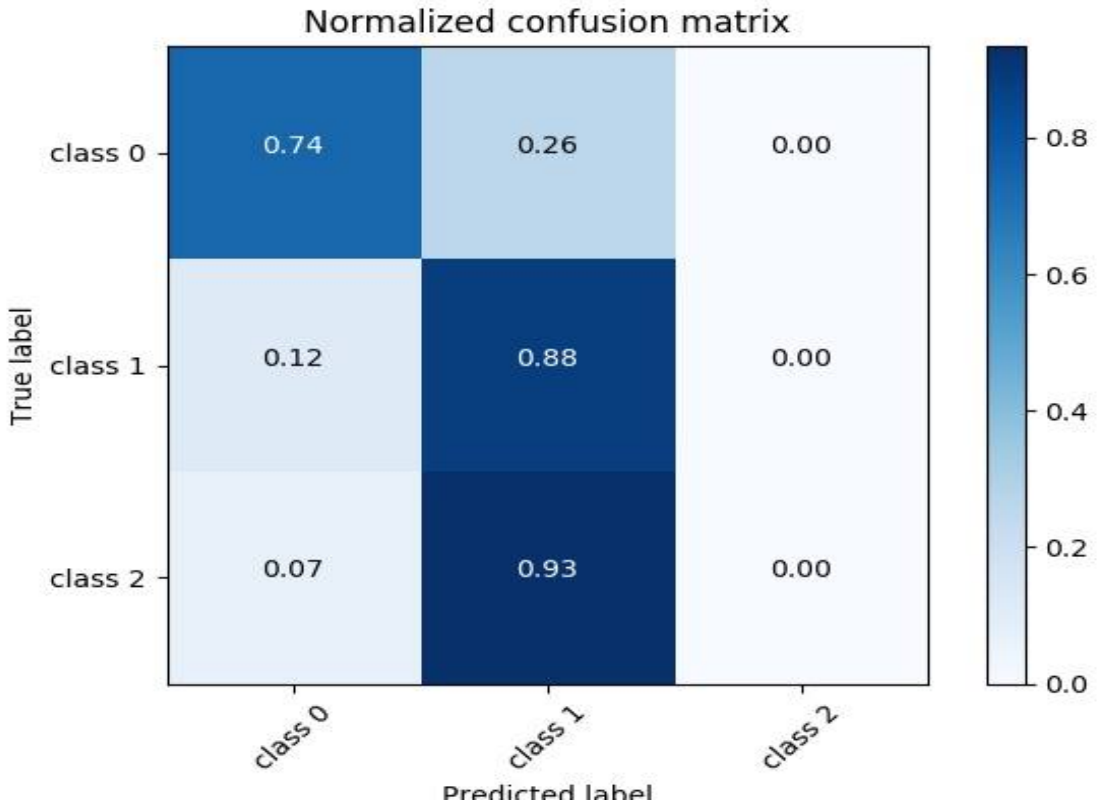
It captures keypoint in the image and provides a “feature description” of the image using local features of these keypoint, also known as keypoint descriptors. The algorithm selects keypoints using the Hessian blob detector and the feature descriptors are obtained using the sum of the Haar wavelet response around the interest point. For each interest point, SURF descriptor vector of length 128 is obtained.

Bag Of Visual Words:-- It is used for image classification and recognition Bag of Visual Words is an extension to the NLP algorithm Bag of Words used for image classification. Other than CNN, it is quite widely used.

The final step for the BoW model is to convert vector-represented patches to "codewords" (analogous to words in text documents), which also produces a "codebook" (analogy to a word dictionary). A codeword can be considered as a representative of several similar patches. One simple method is performing k-means clustering over all the vectors.[5] Codewords are then defined as the centers of the learned clusters. The number of the clusters is the codebook size

Then after creating dictionary and assigning a codeword to each vector-represented patches for each image we feed our data to our classifier. The dimension of dataset is equal to the number of clusters made in dictionary.

Confusion Matrix with Normalization for SVM



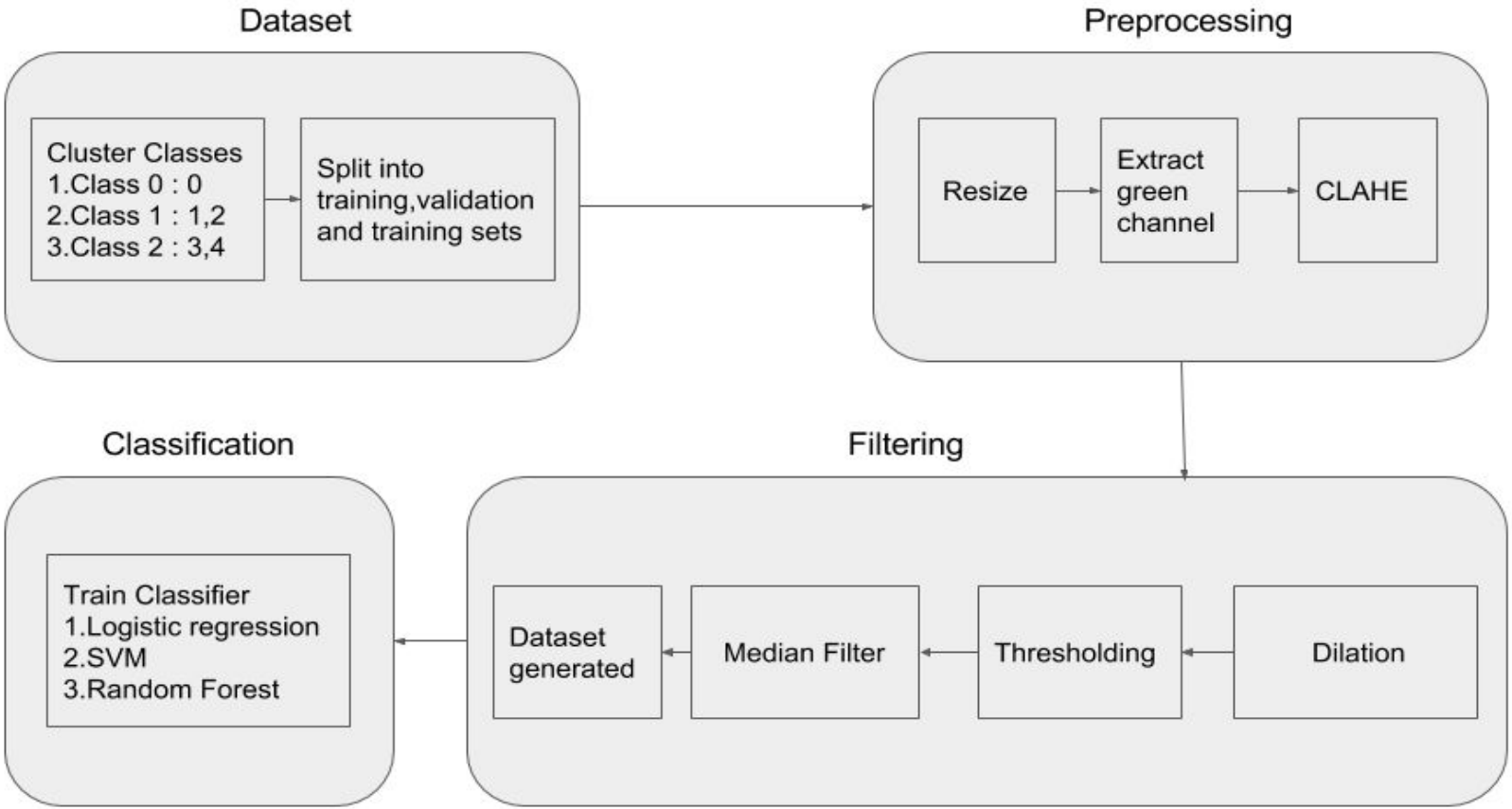
The results we achieved from three different classification techniques are:

a) Support Vector Classification achieved an accuracy of 70%

b)Random Forest technique achieved an accuracy of 68%

c)Logistic Regression technique achieved an accuracy of 58%

Classification using filtering on images



Feature Extraction

- The same process of feature extraction is applied to data once again i.e
  - Resize an image
  - Extract green channel
  - Clahe

Image Filtering

The dataset still contains various discrepancy and noise and thus to get a better classification various methods are applied :-

a)Median Filter: This technique ensures that common prominent features present in all eye images that are not indicative of DR, are subdued and only the relevant differentiating features are accentuated.

Image Filtering

b)Thresholding: This technique divides the dataset to three different classes based on certain threshold. If the data is above certain constant then it will belong to one class, if between two different constant then it will belong to second class and if less than a certain constant then it will belong to third class.

c)Dilation: It is typically applied to binary images, but there are versions that work on grayscale images. The basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (i.e. white pixels, typically).

Classification

a)Logistic Regression: The first model we used is multinomial logistic regression, a natural extension of logistic regression uses a softmax function for prediction.implemented in sklearn library for python as Logistic Regression().

b)Support Vector Machine: This classification method used L1 regularization, in this we tune the error value using cross validation.

Classification

c)Random Forest :- This is an ensemble learning method which uses decision trees. Random Forests build a number of decision trees from new datasets that were sampled with replacement from the original one and predict a class by taking the trees majority vote. They also restrict the features considered in every split to a random subset of a certain size.

Models

Summary:

1) SVM/Random forest/logistic using Bag of words and SURF as feature extractor=> suraj,Prashant
2) SVM/Random forest using location of exudates and area of optical disk -> pratik,Rohit

Results

The results we achieved from three different classification techniques are:

a) Support Vector Classification achieved an accuracy of 68%

b)Random Forest technique achieved an accuracy of 67%

c)Logistic Regression technique achieved an accuracy of 60%

Conclusion

Thus we have achieved better accuracy using both the techniques. But still we can improve the accuracy in bag of words method using better feature selection technique and in filtering method using extra features and their parameters.

Thank You