

# Deep Multiple Instance Learning for Automatic Detection of Diabetic Retinopathy in Retinal Images

Ms. Kotankari Mounika

Department of Computer Science, Sri Venkateswara University, Tirupati

**Abstract**— This project proposes a method for Diabetic Retinopathy detection, which jointly learns features and classifiers from data and achieves a significant improvement on detecting DR images and their inside lesions. Specifically, a pre-trained Random Forest is adapted to achieve the DR estimation, and then global aggregation is used to make the classification of DR images. Further, the authors propose an end-to-end multi-scale scheme to better deal with the irregular DR lesions. For detection of DR images, they achieve an area under the ROC curve. GLCM is used for Feature Extraction for the purpose of DR image features. The image of DR affected and not affected will be classifier with higher accuracy.

## I. INTRODUCTION

Diabetes has now become one of our primary human health challenges. The number of diabetic patients will increase to 592 million by 2035, according to the International Diabetes Federation's estimate. Diabetic retinopathy (DR) can cause serious loss of vision and even blindness in this population as a prevalent complication of diabetes. It is not only an individual's private disaster, but also a danger to the economy of the nation. Fortunately, timely DR therapy can assist to decrease the likelihood of such loss of vision. It is essential to implement regular DR screening in the big diabetic population in order to diagnose DR soon enough for ideal therapy.

Many methods for automatic DR detection have been proposed over the past two decades. You can find a thorough evaluation. A typical approach taken by most techniques is to identify specific DR lesions before the entire retinal picture is diagnosed. Usually, supervised learning methods are used to classify segmented applicants or patches of images into ordinary and abnormal classes. Such techniques are based on the manual annotation of DR lesions, which cost clinicians much heavier workload compared to the retinal image grading of DR.

To save the expense of annotation and create more retinal images accessible for learning, separate study organizations researched a weakly supervised learning method called multiple-instance learning (MIL). With only image level labels, both DR image identification and DR lesions can be achieved by MIL. In particular, retinal images are treated as bags and their inside patches are treated as cases. Following the conventional premise that a DR picture contains at least one DR patch and that a normal picture includes only ordinary patches, different models were studied to determine these discriminative DR patches. So, it is possible to learn both DR patch classifiers and DR pictures using only image-level labels. These designs, however, still use handcrafted characteristics to characterize patches of images so far. They fail to take advantage of MIL's bigger data sets, often leading in lower detection efficiency compared to earlier monitored techniques of learning.

On the other side, profound learning methods, particularly the convolutional neural networks (CNNs), have accomplished phenomenal achievement in classifying natural images and detecting objects. By leveraging the strong representational learning capacity of CNNs, promising findings also emerge in the processing of medical images. However, for DR detection, big annotated sets of these lesions are lacking in training CNN-based classifiers for DR lesions. So far, only a few studies have been recorded on this path. Alternatively, owing to the accessibility of image-level DR grades, many scientists turn to achieving automatic DR grading for retinal images.

CNNs directly classify the entire retinal image into a unique stage, bypassing the detection of their internal lesions. A number of these works can be discovered in a Kaggle contest called 'detection of diabetic retinopathy', and Graham has accomplished outstanding performance, also recently showed impressive DR detection results. They have accomplished state-of-the-art efficiency for identifying referable DR by training their own CNNs with an even bigger and higher quality dataset. However, CNNs trained on full retinal pictures can still learn unwanted connections between DR grades and pictures, which can confuse clinicians.

In this document, we take advantage of the complementary benefits of deep learning and MIL, and suggest a profound MIL technique for both the identification of DR pictures and their DR lesions within them. Our technique seeks to improve detection efficiency by learning characteristics from big accessible datasets compared to current MIL methods. Our technique offers specific locations of DR lesions compared to the entire picture classification obtained by CNNs [14–16] so that the identified retinal pictures can be readily checked by clinicians. Our method's primary pipeline is defined as below. First, the pre-processing of pictures is applied to all retinal images, in order to estimate their DR probabilities, picture patches are obtained from the pre-processed pictures and fed into a CNN-based patch-level classifier. After that, all patch-level data is fused with a worldwide aggregation procedure. It functions as a classifier of picture level producing a DR map and a DR probability of picture level for each picture entry. The image level DR probability will be used during the training period to calculate the loss of the training. Stochastic gradient descent (SGD) and back propagation will be used to update the parameters of the CNN. Thus, characteristics and classifiers are taught in an end-to-end manner at the same time.

## II. LITERATURE SURVEY

### **Diabetic Retinopathy Detection by Extracting Area and Number of Microaneurysm from Colour Fundus Image**

This paper presents an improved diabetic retinopathy detection scheme by extracting accurate area and area number of microaneurysm from colour fundus images. Regular screening of eye is crucial for detection and dealing with diabetic retinopathy. Diabetic retinopathy (DR) is an eye disease which occurs due to damage of retina as a result of long illness of diabetic mellitus. Microaneurysms (MA) are tiny red spots on retina, shaped by inflating out of fragile part of the blood vessels. The recognition of MA at primary stage is very crucial and it is the first step in inhibiting DR. A variety of methods have been proposed for detection and diagnosis of DR. In this paper, there are two features namely; number and area of MA have been determined. Initially, pre-processing techniques like green channel extraction, histogram equalization and morphological process have been used. For detection of microaneurysms, principal component analysis (PCA), contrast limited adaptive histogram equalization (CLAHE), morphological process, averaging filtering have been used. Classification of DR has been done by linear Support vector machine (SVM). The sensitivity and specificity of DR detection system are observed as 96% and 92% respectively.

### **Diagnosis Of Diabetic Retinopathy By Using Image Processing And Convolutional Neural Network**

Diabetic retinopathy is a serious eye disease that originates from diabetes mellitus and is the most common cause of blindness in the developed countries. This study describes the use of image processing and deep learning to diagnose diabetic retinopathy from retinal fundus images. For retinal fundus images enhancement approach, a practical method which contains HSV, V transform algorithm and histogram equalization technics was used. Finally, Gaussian low-pass filter was applied to the retinal fundus image. After the image processing, the classification was made using the Convolutional Neural Network. The performance of the proposed method was assessed using 400 retinal fundus images in the Kaggle Diabetic Retinopathy Detection database. In experiments, classification work has been done for each stage of the image processing. The classification study performed after image processing. Twenty experiments were done for every stage and average values were found. In this experiment, the accuracy was 97%, the sensitivity was 96.67%, the specificity was 93.33%, the precision was 97.78%, the recall was 93.33%, and the Fscore was 93.33%. The obtained results show that the proposed method is very efficient and successful to diagnose diabetic retinopathy from retinal fundus images.

### **Survey of Diabetic Retinopathy Screening Methods**

This electronic document iDiabetic retinopathy is an abnormality which involves the small blood vessels that targets the central region like macula. It is a progressive disease and main reason that causes loss in vision. Diabetic retinopathy is a vascular illness of the retina which influences patients with diabetes. This harms the retina of eye and leads to visual impairment if level of diabetes is very high. Diabetic retinopathy has no early signs. In some cases, vision will get better or worse during the day. So, the importance of automatic assessment of macular enema increased. In this paper we have done a survey on the different techniques used for detection diabetic retinopathy. Diabetic retinopathy is composed of a characteristic group of lesions found in the retina of one having diabetes for several years. Detecting the exudates in early stage can prevent vision loss.

## **Diabetic Retinopathy Image Database (DRIDB): A New Database for Diabetic Retinopathy Screening Programs Research**

Diabetic retinopathy is one of the leading disabling chronic diseases, and one of the leading causes of preventable blindness in the world. Early diagnosis of diabetic retinopathy enables timely treatment and in order to achieve it a major effort will have to be invested into screening programs and especially into automated screening programs. For automated screening programs to work robustly a representative fundus image database is required. In this paper we give an overview of currently available databases and present a new diabetic retinopathy database. Our database is to our knowledge the first and only database which has diabetic retinopathy pathologies and major fundus structures annotated for every image from the database which makes it perfect for design and evaluation of currently available and new image processing algorithms for early detection of diabetic retinopathy using color fundus images.

### **Feature Selection Of Diabetic Retinopathy Disease Using Particle Swarm Optimization And Neural Network**

Currently, there are many medical experts who face difficulty in conducting early detection for diabetic retinopathy. This occurs because it is difficult to recognize the early symptoms of this disease. In order for this disease to be detected early, an accurate classification method is required. Data mining concept is one alternative in conducting classification. This study was conducted by applying particle swarm optimization (PSO) method to select the best Diabetic Retinopathy feature based on diabetic retinopathy dataset. Then, the selected feature is further classified using classification method of neural network. The study result shows that there is an increase in result by applying neural network-based particle swarm optimization (PSO) of 76.11%. This study also shows that there is an increase in classification result by using feature selection method of 4.35% from previous result of 71.76% by only applying neural network method.

## **III. PROPOSED WORK**

### **3.1 Pre-processing**

Mass screening retinal pictures may have different picture resolution, illumination, and contrast. Standardizing these variables enables to encourage the process of profound learning. The picture preprocessing is applied here as follows. First, all retinal images are resized to the same field of view (FOV) radius size. We set this radius size  $r = 384$  pixels to get an image size close to that used in. A technique for illumination equalization and improvement of contrast is then used

### **3.2 Segmentation**

Segmentation partitions a picture with comparable characteristics into different areas comprising each pixel. The areas should be heavily related to depicted objects or characteristics of interest in order to be relevant and helpful for picture assessment and interpretation. Significant segmentation is the first step from low-level picture processing to transform a gray or color picture into one or more other pictures into a high-level picture description of characteristics, items, and scenes. Successful image analysis relies on segmentation reliability, but precise picture partitioning is usually a very difficult issue.

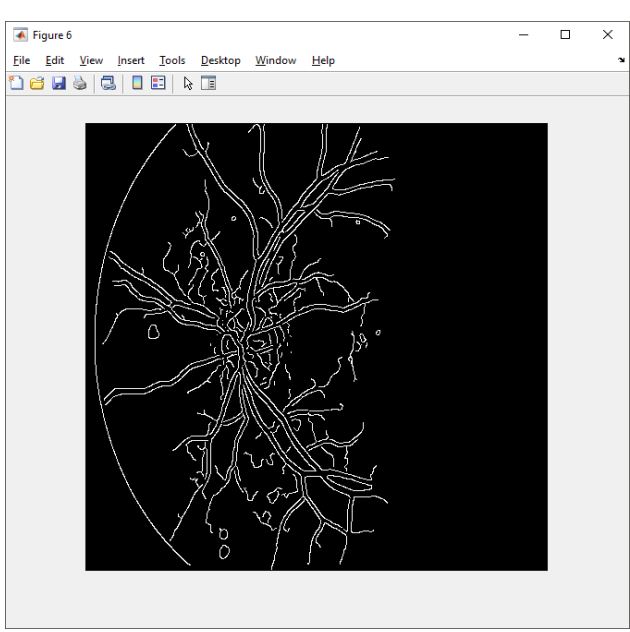
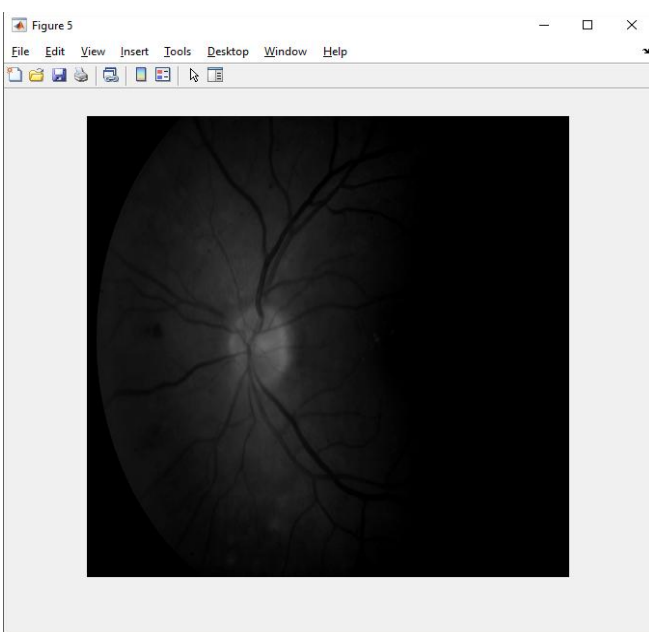
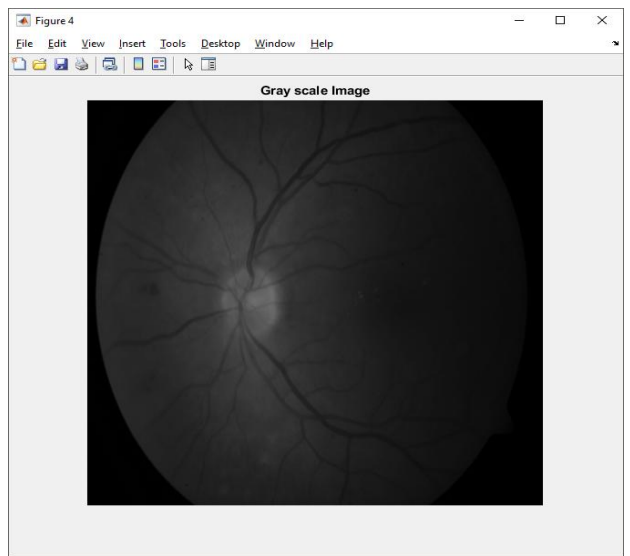
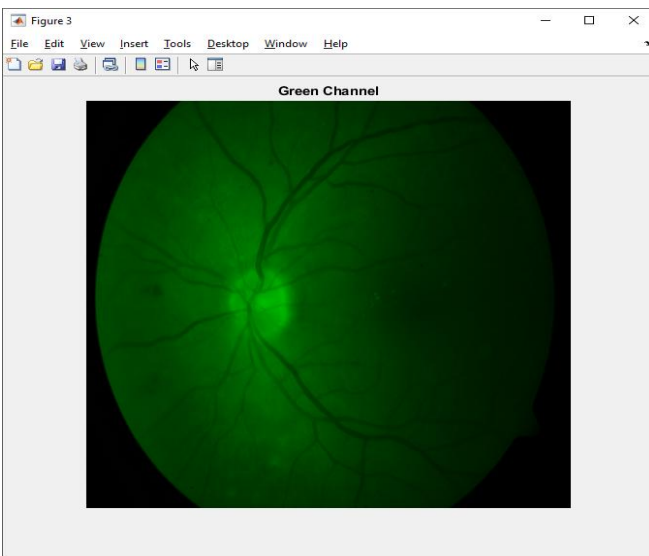
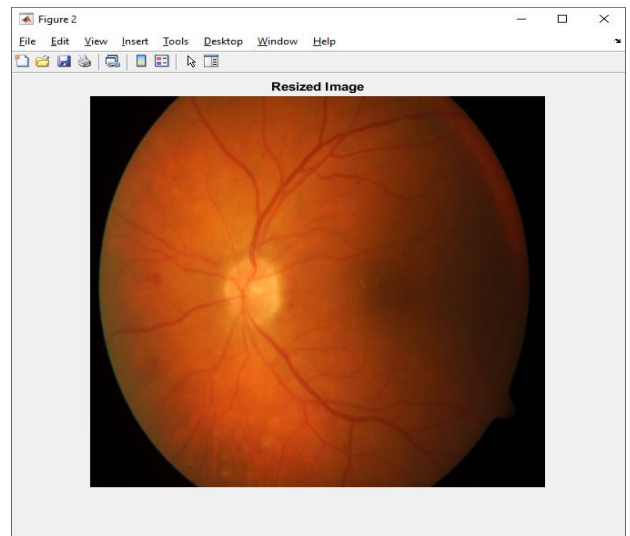
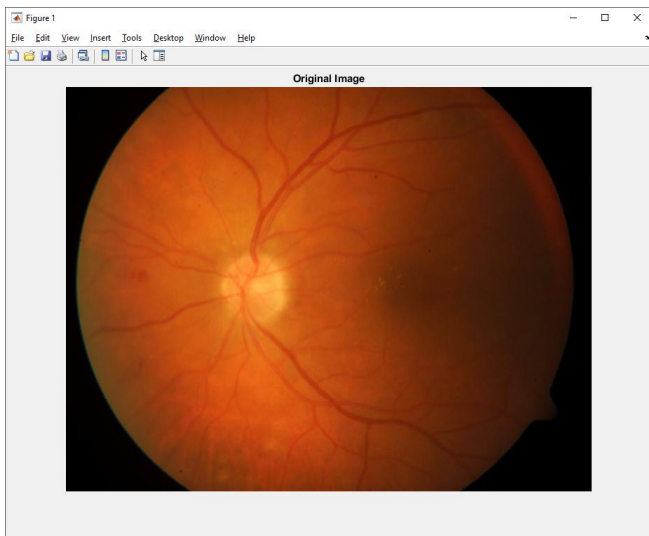
### **3.3 Feature extraction**

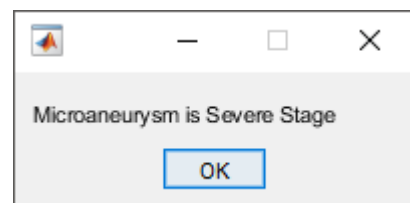
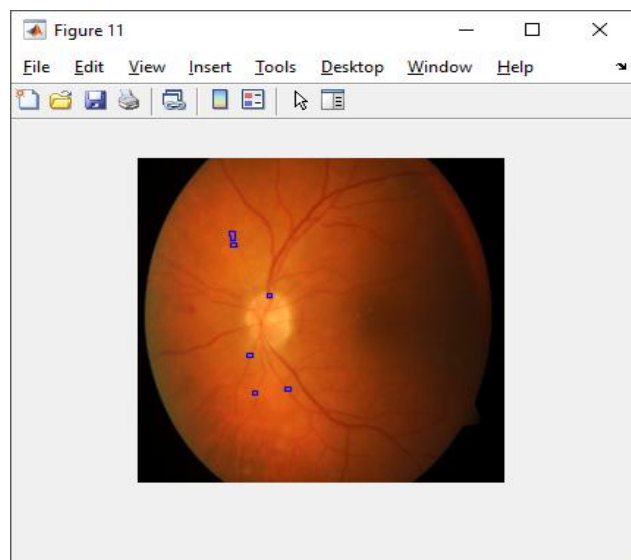
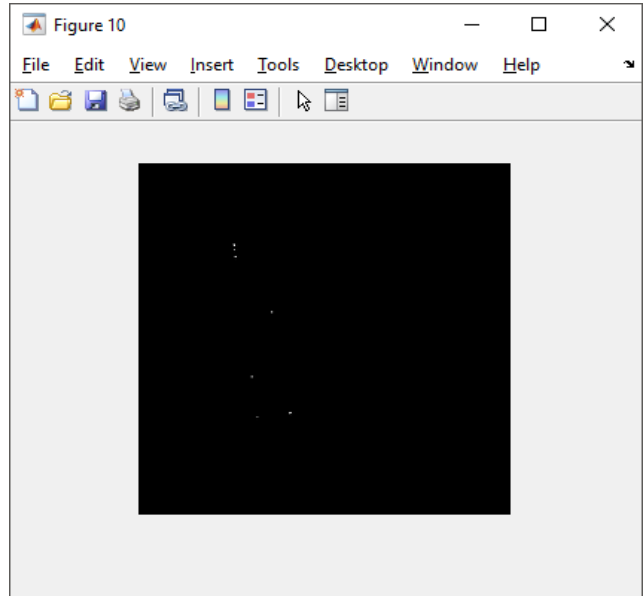
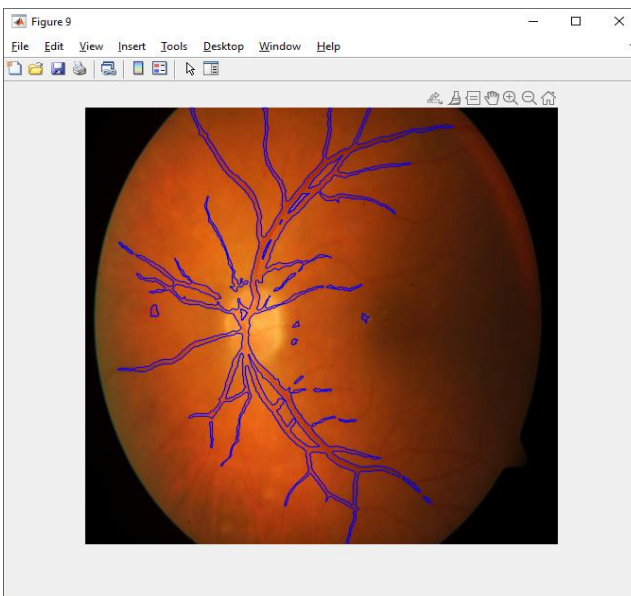
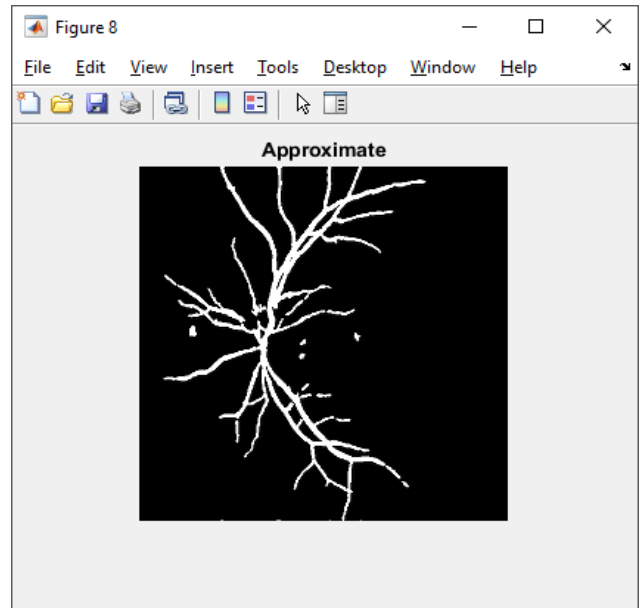
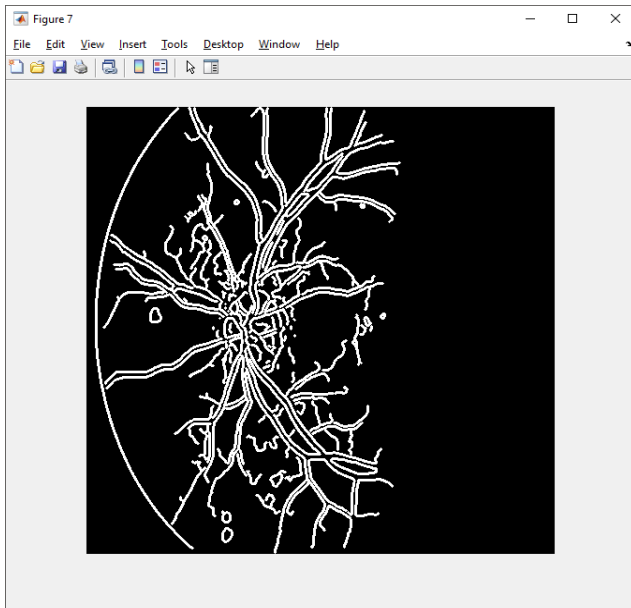
Advanced feature representation methods are becoming necessary when it comes to dealing with the local image content or with spatio-temporal characteristics or with the statistical image content.

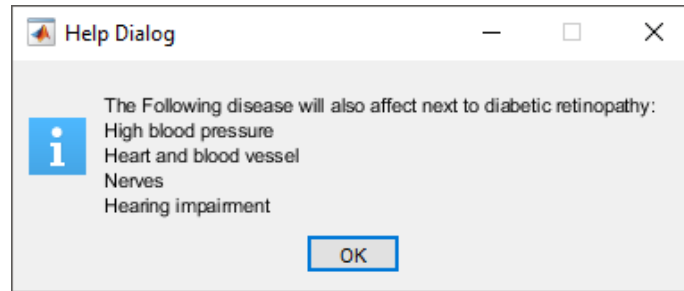
### **3.4 Classification**

As a rule, the classifying person also locates specific training sites on the image to identify the classes. The resulting training sites are areas representing each known land cover category that appear fairly homogeneous on the image. For each class thus outlined, mean values and variances of each band used to classify them are calculated from all the pixels enclosed in each site. More than one polygon is usually drawn for any class. The classification program then acts to classify the data representing each class. When the classification for a class is plotted as a function of the band the result is a spectral signature or spectral response curve for that class. The multiple spectral signatures so obtained are for all of the materials within the site that interact with the incoming radiation.

### IV. IMPLEMENTATION







## V. CONCLUSION

In this document, we propose a profound MIL technique for DR identification by combining the complementary benefits of MIL and profound learning: only image-level annotation is required to detect both DR pictures and DR lesions, while characteristics and classifiers are learned from information together. To obtain the patch-level DR estimation, the pre-trained AlexNet is adjusted and deeply tuned in our context. To assist better manage irregular DR lesions, an end-to-end multi-scale framework is implemented. Our technique considerably increases the detection efficiency compared to current MIL techniques for DR detection. We will integrate methods such as semi-supervised learning and active learning into our profound MIL technique in future job to further attain precise segmentation of DR lesions.

## REFERENCES

- [1] Kandemir, M., Haussmann, M., Diego, F., et al.: 'Variational weakly supervised Gaussian processes'. Proc. British Machine Vision Conf. (BMVC 2016), 2016.
- [2] Xu, Y., Mo, T., Feng, Q., et al.: 'Deep learning of feature representation with multiple instance learning for medical image analysis'. 2014 IEEE Int. Conf. Acoustics, Speech, and Signal Processing (ICASSP), 2014, pp. 1626-1630.
- [3] Oquab, M., Bottou, L., Laptev, I., et al.: 'Weakly supervised object recognition with convolution neural networks'. Proc. Neural Information Processing Systems (NIPS), 2014.
- [4] Yan, Z., Zhan, Y., Peng, Z., et al.: 'Multi-instance deep learning: discover discriminative local anatomies for bodypart recognition', IEEE Trans. Med. Imaging, 2016, 35, (5), pp. 1332-1343.
- [5] Hou, L., Samaras, D., Kurc, T.M., et al.: 'Patch-based convolutional neural network for whole slide tissue image classification'. Proc. IEEE Conf. Computer Vision and Pattern Recognition, 2016, pp. 2424-2433.