ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

Detection of Neovascularization on Optic Disk Region based on Kernalized Fuzzy C-Means and ANN Classifier

Vanitha L. B, Prof. Preethi. S

Dept. of Computer Science & Engineering, Cambridge Institute of Technology, Bangalore, India

Associate Professor, Dept. of Information Science & Engineering, Cambridge Institute of Technology

Bangalore, India

ABSTRACT: NVD detection on optical disk is the most difficult procedure it medical imaging. This disease is can be identified in two ways i.e. identifying the new blood vessels in eye boll or formation of blood vessels in optic disk. Retina is the most sensitive part of the human eye. Where increasing in diabetic disease leads to the different retinal diseases. In medical imaging so many research have been conducted in NVD detection at it early stage. In this paper we proposed new medical imaging technique. Here we mainly concentrated on NVD detection on optic disk, using KFCM segmentation algorithm we segment the new vessels present on the disk. Based on the segmentation and feature extraction we are classifying the affected retinal images by using ANN classification.

KEYWORDS: Retinal Fundus Images, Weiner filtering, KFCM segmentation, PHOG and Tensor LPP and ANN Classifier.

I. INTRODUCTION

Human camera system i.e. retinal system is most difficult, complex and dedicated nerve system of the body. Retina includes blood vessel s. For proper functioning of the retinal system it is significance to pass the proper amount of blood and oxygen level. A person may lead to the disease like hypertension, heart problem and stroke when the retina not received the proper amount of blood and oxygen level. So the activities of the blood vessels are seriously monitoring in disease prediction. When working the retinal fundus images, only blood vessels are separated from the input eye boll image. This technique is defined as segmentation. Using segmentation model the effected retinal image can be easily identified. Mainly in digital image processing image segmentation handle with different techniques. But still the disease identification not reached up to the level in term of vessel detection i.e. small and thin in vessel structure are difficult to segment and respective retinal area the detection of blood vessel may be poor.

The retinal disease comes into the picture when there is slight change body functionality for example diabetics. Diabetic is leading disease in recent time, which causes the different retinal disease termed as diabetic retinopathy. In this retinal disease there is no visible sign, at its initial stage but as time grows the abnormal conditions completely uncontrollable. This may lead to complete loss of visibility i.e. blindness. In diabetic retinopathy retinal capillaries are sighted changed, this changed property block the blood in blood vessels. The new blood vessels are generated due to lack oxygen levels. Here hard exudates and soft exudates are some more disease. In hard exudates the weak blood vessels discharge the lipid formation. Microinfarct is one retinal disease, occurred when blood vessels are interfering with each other. The respective retinal disease images are shown in Figure 1.

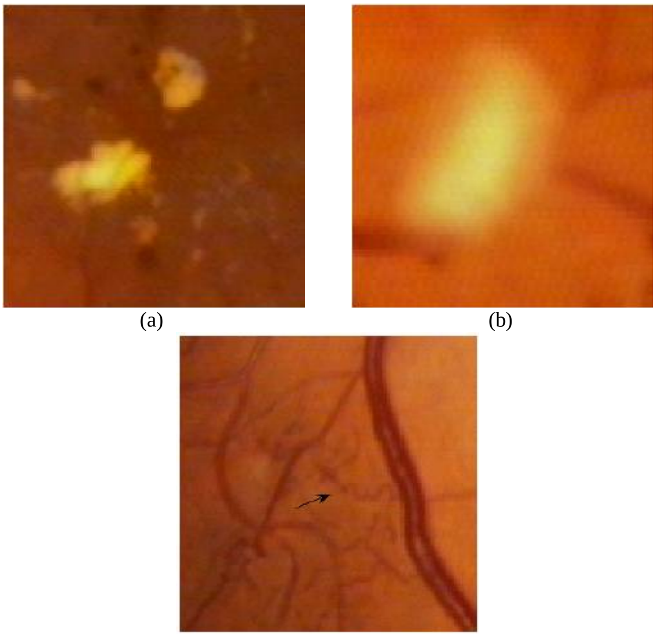
ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017



(a) (b) (c)

Figure 1: (a) Hard Exudates; (b) Soft Exudates; (c) NVD Images

In this paper we mainly concentrate on new blood vessels which are formed in optic disk. The section 2 briefly explains the research work carried on NVD detection in medical field. Implemented new NVD detection system is explained in section 3. The system performance is explained with experimental section 4.

II. LITERATURE SURVEY

Diabetic is the most improving disease which leads to severe eye disease, for this disease identification a several research has been conducted. H. Yu et.al [02] has proposed a optic segmentation model using filtering and level set methods. The possibility of retinal disease related with the optical disk is increases day by day. if these disease not identified at it initial stage , it is totally uncontrolled and harmful for the patient. In the referred paper author provides the automatic OD segmentation system used to separate the OD from retinal fundus images. The system performance is verified by MESSIDOR standard dataset. Template matching, filtering, and basic morphological techniques are frequently used to segment the OD of the input image.

M. Usman Akram et. al [03] has proposed NVD detection model. According to the survey diabetic lead to the severe eye disease. In NVD the initially new blood vessel will not affect the visual system but it is harmful for the visual system as its density increases. In the referred paper author designed a m based classifier model which can easily segment the normal blood vessel and abnormal blood vessels. Based on the segmentation result the thresholding and hough algorithm collect the pattern features of the segmented image. Using these features classifier classifies the input retinal image as a healthy and unhealthy.

R. A. Welikala et. al [04] has proposed a blood vessel detection model. To segment the blood vessels from the retinal image, author preferred line based segmentation and standard novel based segmentation algorithms. The output from both segmentation algorithms is processed individually. A segmented blood vessel features are collected individually. A support vector machine classifier used to classify both collected feature vector individually. In next step both classified output is combined to produce final decision on retinal images. At the result section they explained that sensitivity of the designed model good with respect to the trained data sets.

M. M. Fraz et. al [05] proposed enhanced and automatic PDR detection model. The entire model preferred a dual classification techniques, Here an input retinal image segmented by using two different segmentation methods. The application of feature extraction generate 4 – D feature vector individually. Totally 21 – D features are passed to

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

generic algorithm for features selection based on the features SVM classify the image individually. The individual result is combined to get final result.

The survey reveals that the research till meet the saturation points, where we need to enhance the automatic disease detection related with retina. Below section III explain our proposed system design and in Section IV we explain our system performance with respect to the input image.

III. METHODOLOGY

As explained in section 2, there are many research work is carried on the proposed methodology. Our designed system block diagram is shown in Figure 1. Initially a set healthy and unhealthy retinal fundus images are trained and each image features are extracted by using Tensor LPP and PHOG features algorithm. The extracted features collected created features vector, this set of features are trained by using ANN training set and form the system knowledge base. This knowledge is used during real time data testing.

During System performance we are considering retinal image. Before proceeding further image analysis process, we passed the retinal image to pre-processing block. Here we are using wiener filtering technique to reduce the noise the content present in the input image. The operational flow of the filtering model is explained in below section.

2.1 Weiner Filter

While capturing and transmitting retinal image from one place to another noise element frequently added in the input image. This addition of noise may affect medical data during disease analysis. Hence is so important to minimize those unwanted noise. Wiener filtering is one of the frequent image denosing techniques available in image processing. The mathematical structure of the wiener filter is analysed in space domain and frequency domain.

Consider an example, here $A(i,j)$ denote the input captured image and $X(i,j)$ denotes the unwanted noise added in the input image. The resultant noise affected image is mathematical represented as

$$Z(i,j) = A(i,j) + X(i,j) \qquad (1)$$

The equivalent image is termed as degraded image. The main theme of the filtering model to collect the original image $B(i,j)$ from the noise affected image$Z(i,j)$. Here we are assuming that the restored image approximately equal to the input image.

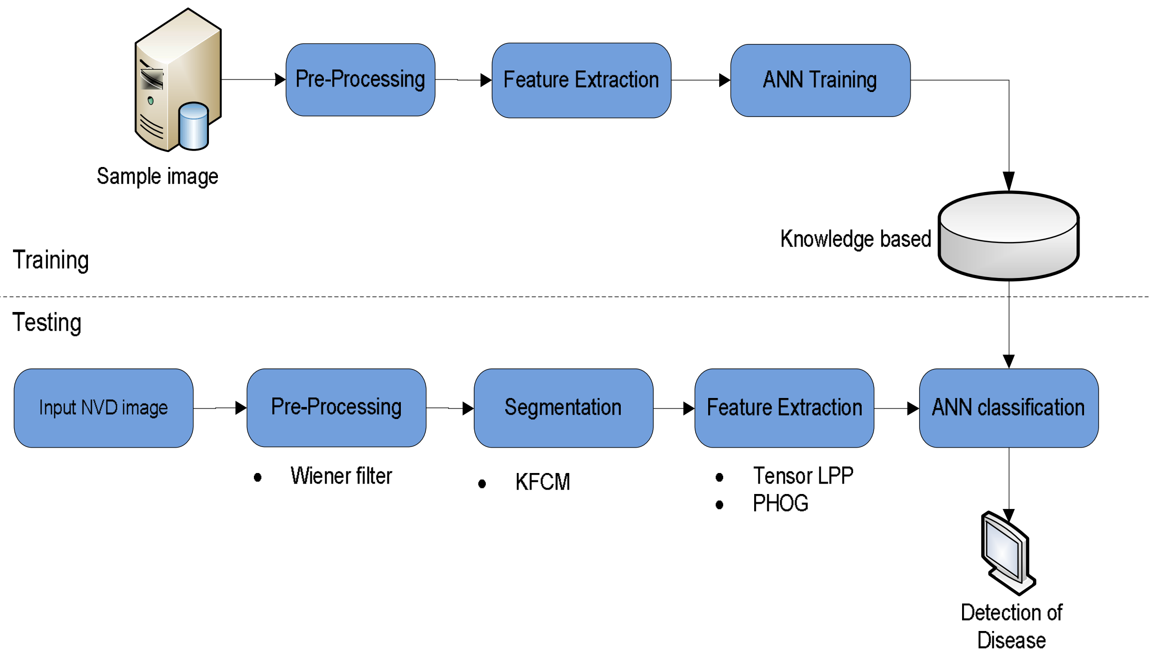


Figure 2: The Block Diagram of Proposed System

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

2.2 Optic Disc Segmentation

In proposed system we mainly concentrated on newly blood vessels formed at the optic disc region, before going to retinal blood vessel extraction we segment the optic disc region by using Circular Hough Transformation (CHT). The retinal blood vessel locations and orientation is analyzed using circular Hough transform. It includes the shape parameter specification of the given object like line or circle. In our case, it is a circle its mathematical equation is given as

$$r^2 = (x-a)^2 + (y-b)^2 \qquad (2)$$

Coordinates of circle centre which passes the x, y plane is denoted by a and b variable limited radius r. Form above equation it is cleared that CHT is a 3D space in circle object recognition. Edge detection is the initial step of CHT, where it identifies the connected component of the input gray scale image. After edge detection an accumulator matrix is generated to update the number of circle formed in edges with centre radius r, these process is repeated for all the data elements of the image. Finally input image scaled such that is value come under 0 and 1 and applying a thresholding value to leave only highly probable circles. A mask of ring shape of circle is generated on best circle region of the input image.

Using CHT we segment the optic disc region, further morphological operational is applied to the segmented optic disc region to extract the blood vessels on an OD, using noise removal method we identify the newly formed blood vessels.

2.3 Feature Extraction

Image features are the key elements in image classification. Based on the application area there are massive number of feature algorithm are designed by the researcher. A single image is analysed with is three different features i.e. colour, pattern and regional boundaries of an object present the input image. In our proposed system a texture based Tensor LPP and PHOG algorithm used to collect the segmented retinal images features. Each algorithm brief explanation is presented in below section.

- Tensor Locality Preservative Projection

The segmented image pixel values are changed into a vector form, for these vector data points computing the mean values and generating the affinity matrix. The mathematical equation of affinity matrix is given in below Eq. (5).

$$s_{i,j} = \exp\left(-\left\|A_i - A_j\right\|_f^2 / t\right) \qquad (3)$$
$$if\ A_i \epsilon O(k, A_i) or\ A_i \epsilon O(k, A_j)$$

$O(k, A_j)$ is the kernel nearer point of data elements and t is positive element. Based on the graph matrix eigen values are computed and stored as tensor features. The functional steps of Tensor LPP are summarized in Algorithm 1.

Algorithm 1: **Tensor LPP Algorithm**

Inputs: Data Points $D_1 \ldots\ldots D_n$ *from* $N \subset \mathbb{R}^{I_1 \ldots\ldots\ldots\ldots \times I_k}$ *and* $l_1 \ldots \ldots . l_k$

Output: Eigen Values $U_i = U_i^p \in \mathbb{R}^{l_i \times I_i} \quad (i = 1, \ldots, K)$

1. *Calculate neighborhood graph G and affinity matrix S*
2. *Calculate the eigen values using below steps*

for $p = 1, \ldots . P_{max}$ *do*

for $q = 1, \ldots . k$ *do*

$$x_i^q = D_{i \times 1} U_{1 \ldots\ldots\ldots \times f-1} U_{f-1 \times f+1} U_{f+1 \ldots\ldots \times k} U_k \qquad (4)$$
$$x_i^q \Longrightarrow q\ X_i^{(q)} \qquad (5)$$
$$B_1 = \sum_{i,j} \left(X_i^{(q)} - X_j^{(q)}\right)\left(X_i^{(q)} - X_i^{(q)}\right)^P S_{ij} \qquad (6)$$

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

$$B_2 = \sum_i X_i^{(q)} X_i^{(q)P} d_{ii} \quad (7)$$

$$B_1 U_q^p = B_2 U_q^p \Lambda_k, U_q^p \in \mathbb{R}^{l_q * l_q} \quad (8)$$

$if \parallel U_q^p = U_q^{p-1} \parallel F < E \; for \; each \; q \; then$

break;
end if
end for
end for
end for

- PHOG

PHOG is improved version of histogram oriented gradient algorithm (HOG), this is pyramid level of gradient representation of the segmented image. Here the image is dividing into 3×3 blocks. it is termed as a different pyramid level. PHOG is mainly worked on the edges of the segmented image, analyse each image in different pyramid levels. For the respective cell a histogram of the pixel at different angle is computed and finally stored as PHOG vector features. The operational flow of feature vector extraction of both Tensor LPP and PHOG algorithm is as shown in below Figure 3.

2.1 ANN Classification

Automatic disease classification is final operational step of proposed system. Here the model is designed by using one of the most flexible classifier i.e. Artificial Neuron Network. Here collected segmented retinal features are compared with trained knowledge base vector. Based on the vector comparison retinal image is classified either as a healthy image or NVD affected image. Figure 3 represent the function flow of feature vector collection.

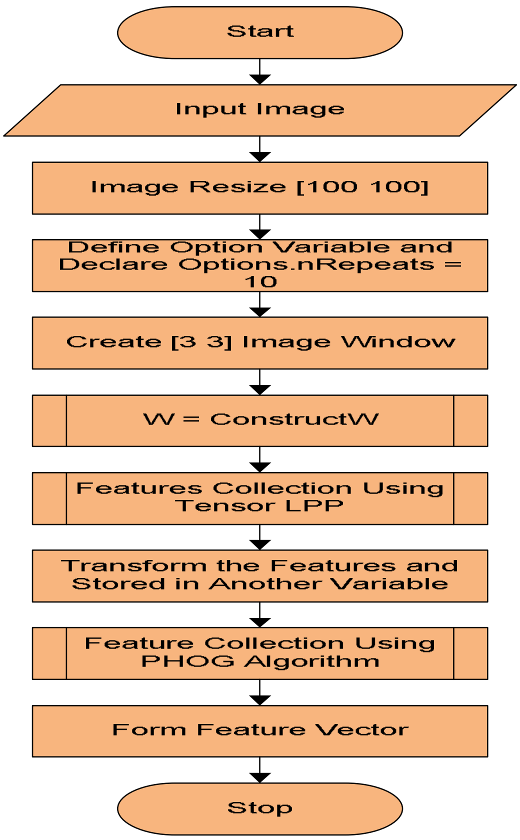


Figure 3: Flow Chart of Feature Extraction

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

ANN classifier work similarly as a biological neuron network, artificial neuron is basic building functional block of the ANN. Here entire classifier is divided into input layer, weights and output layer. The collected features are given as input to the input layer and processed with weight bias at the hidden layer finally processed output is available at the output layer. The functional architecture of ANN classifier is shown in Figure 4.

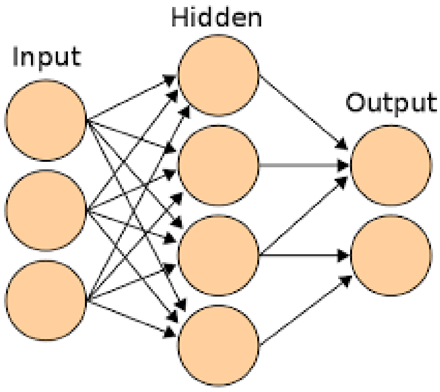


Figure 4: Functional Architecture of ANN Classifier

IV. EXPERIMENTAL RESULT

We worked on standard diabetic retinopathy images, the input retinal fundus image, pre processed image is shown in below Figure 5.

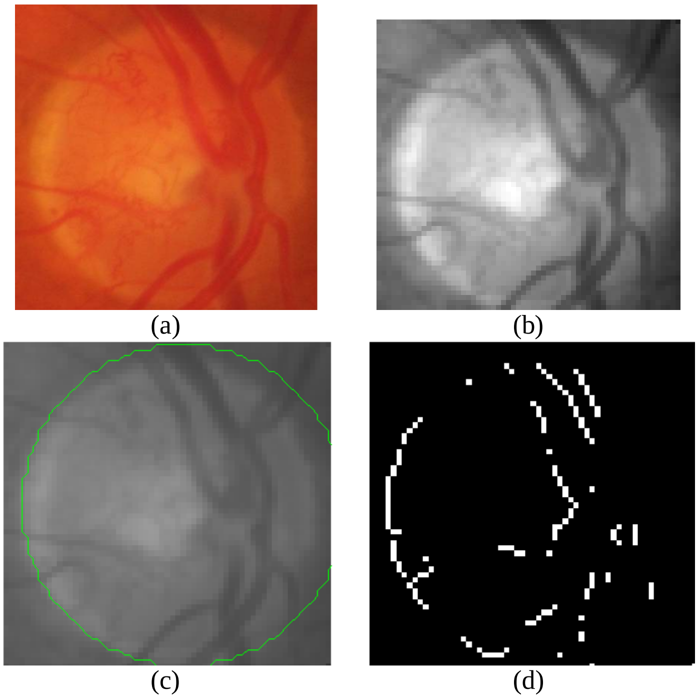


Figure 5: (a) Input Retinal Fundus Image ;(b) Input Gray Scale Image;(c) Optic Disk Recognition using CHT ;(d) Edge Detected of Segmented OD Image.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

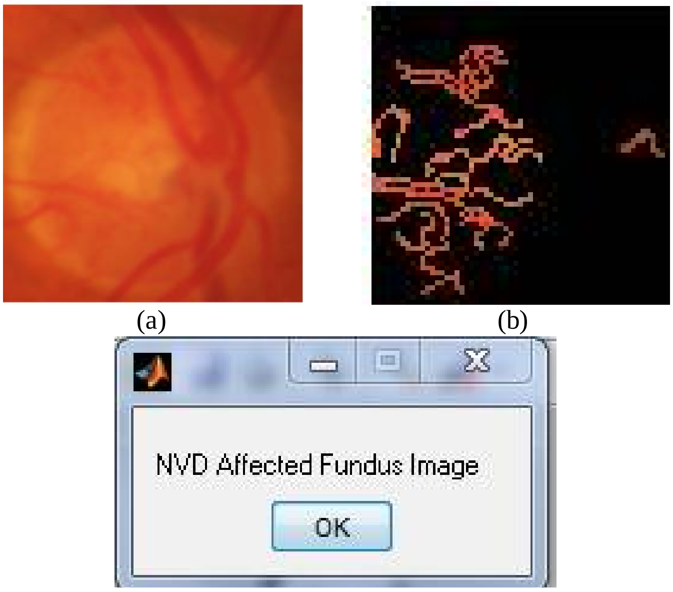
International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

From the entire retinal image as we only concentrated on the optic disk region, that region is segmented by circular hough transform techniques. The intermediate result of the segmentation module is shown in Figure 6.



(a) (b) (c)

Figure 6: (a) OD Region; (b) New Blood Vessels Detection; (c) ANN Classified Output

The classified output i.e. whether input retinal is NVD affected or normal healthy is identified based on the trained features values. ANN classifier is implemented for disease classification.

V. CONCLUSION

The designed model is totally non-invasive NVD identification system. The system performance is examined by using DIAREDB1 standard dataset. The operation step includes wiener filtering technique, KFCM clustering model, to segment the blood vessels present on the optic disk. The application twsso feature collection algorithms enhance the sensitivity of the proposed system. From the result section we proved that proposed system performance is good.

REFERENCES

[1] Adhithya Kusuma Whardha and Nanil Suciati, "A Simple Method for Optic Disk Segmentation form Retinal Fundus Image", I.J. Image, Graphic and Signal Processing, 2014.
[2] H. Yu, E. S. Barriga, C. Agurto, S. Echegaray, M. S. Pattichis, W. Bauman and P. Soliz, "Fast Localization and Segmentation of Optic Disk in Retinal Images Using Directional Matched Filttering and Level Sets", IEEE, Vol. 16, No. 4, 2012.
[3] M. Usman Akram, Shehzad Khalid, Anam Tariq and M. Younus Javed, "Detection of Neovascularization in Retinal Images using Multivariate m – Mediods Based Classifier", Elsevier, 2013.
[4] R. A. Welikala, J. Dehmeshki, A. Hoppe, V. Tah, S. Mann, T. H. Williamson, S. A. Barman, "Automated Detection of Proliferetive Diabetic Retinopathy using a Modified Line Operator and Dual Classification", Elsevier, 2014.
[5] R. A. Welikala, J. Dehmeshki, A. Hoppe, V. Tah, S. Mann, T. H. Williamson, S. A. Barman, "Genetic Algorithm Based Feature Selection Combined with Dual Classification for the Automated Detection pf Proliferative Diabetic retinopathy", Elesvier, 2015.
[6] F. Jin, P.Fieguth, L. Winger and E. Jemigan, "Adaptive Wiener Filtering of Noisy Images and Image Sequences", IEEE, 2003.
[7] Karianne Bergen, Jean Baptiste Boin and Sahianz Sanjani, "Image Processing for Blood Vessel Segmentation", IEEE 2012.
[8] Guang Dai and Dit Yan Yeung, "Tensor Embeddign Methods" 21st National Conference on Artificial Intelligence, Vol. 1, pp. 330 – 335, 2006.
[9] Kosuke Mizuno, Yosuke Terachi, Kentha Takagi, Shintaro Izumi, Hiroshi Kawaguchi and Masahiko Yoshimato, "Architectural Study of HOG Features Extraction Processor for Real – Time Object Detection", IEEE, Vol. 20, pp. 197 – 201, 2012.
[10] Saravanan K and S. Sasithra, "Review of Classification Based on Artificial Neural Networks", International Journal of Ambient System and Applications, Vol. 2, No. 4, 2014.