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The Degree of Skin Burns Images Recognition using Convolutional Neural Network

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Abstract

In recent years, Convolutional Neural Network (CNN) model is the stat of art model successful for image analysis. In this research, we suggest integrating CNN model for burn images recognition, one kind of medical images. The aim of this paper is to build to automated computer aided for identifying the degrees of burn images. The burn images dataset has been collected from Burn faculty of Cho Ray hospital, Vietnam and published by the collaboration research project of Cho Ray doctors, and the Information Technology lab of Ho Chi Minh University of Pedagogy. The pre-processing involves Local Binary Pattern (LBP) operators based on the burning expert's suggestion. CNN model was adapted to be automated method of burn images classification into 4 degrees following the classification of burning patients in Cho Ray hospital. Let it called Burn Convolutional Neural Network (B-CNN). The experimental results showed the feasibility of the proposed model B-CNN. This burns analysis will be helpful for remote hospital in Vietnam where the hospital service must be improved. The remote doctors could use this computer aided module to classify the degrees of burns, and give the suitable medical decision.

Keywords: Burn Convolutional Neural Network (B-CNN), Burn Image Classification, Local Binary Pattern (LBP), Object Tracking, Skin Burn Images, Skin Burn Images

1. Introduction

In Vietnam health sector, the treatment has many stages and over load of the quality and quantity of patients. Therefore, using medical computer aided system in hospitals is mandatory in Vietnam. Although the medical device supported doctors, doctors need the application of machine learning in order to improve the doctors' performance, especially, medical image processing. There are many types of medical images which has distinct characteristics, technologies, and challenges.

In this research, we focus on skin burn images recognition. The aim of this research is build the suitable machine learning for solving skin burn recognition based on Vietnam medical system. Specifically, we adhere to the burning classification system of Cho Ray hospital, addressed a superlative burning treatment in Vietnam. Skin burning[1] is often encountered to accidents caused by various triggers such as to sun exposure, heat exposure, electronics, due to friction, chemistry. Skin include Epidermis, Dermis, Fat, and Muscle.

However, to classify the level of skin burns, we need to analysis and diagnostic test the depth of burn wounds. In Vietnam, burning doctors often classify the degree of burn into 4 levels: degree I, degree II, degree III, and degree IV[2]. The aim of skin burn images recognition is how to automatically identify the degree of burn from skin burn images of patients.

In Vietnam, applying machine learning for Image Recognition got some success such as some face detection/recognition applications[3], many fingerprint recognition

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system[4]. Medical Burn Images recognition is still in the first researching stage. There are a few of research about skin image processing such as skin burn classification methods using Template Matching (TM), K nearest neighbor classifier (kNN) and Support Vector Machine (SVM)[5], segmentation and classification of burn images using color and texture feature[6]. Recently, CNN is the state of art for image feature extraction, image classification, image retrieval, and image recognition. This technology got success in the general images, and on some specific images.

Thus this research will customize CNN technique to solve skin burn images recognition based on the suggestion from burning doctor in Cho Ray hospital, Vietnam. Let it called Burn Convolutional Neural Network (B-CNN).

2. Background and ReLATED WORK

2.1 Degree of Skin Burn Images Regconition

In diagnosing clinical burning, patient need to be classified into 4 degrees of burn based on the skin's thickness, the depth of burns and scalds, and some diagnosis related

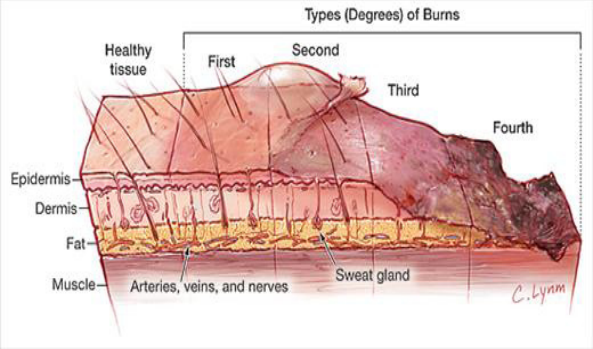

Figure 1. Degree of Burn Analysis.

Table 1. CNN for images recognition

Method	Type of images
Convolution neural network (CNN)[7]	Visual hand gesture
Adaptive CNN[8]	Human Face
Deep learning convolution neural network (DLCNN)[9]	Digital breast tomosynthesis
Guest Editorial Deep Learning: Future Promise[10]	Medical Imaging

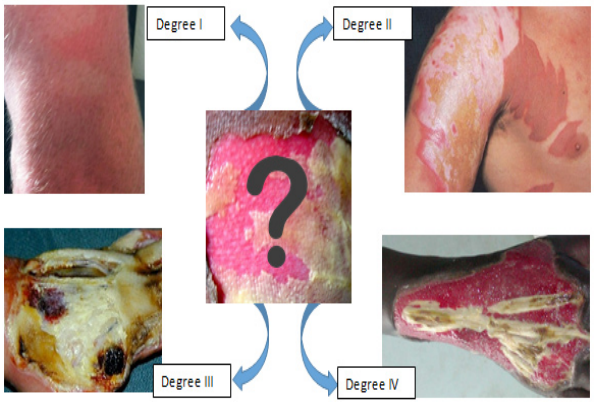

Figure 2. The Degree of Skin Burns Images Recognition.

groups. The degree of kin burn images recognition is a category of image recognition. Therefore, we can apply computer vision technique integrated machine learning for burn image recognition. The computer vision technique can be used in the image acquisition, and preprocessing, while the machine learning can be used in the training/recognition phase.

Serrano, Carmen, and Laura M. Roa[6] proposed a burn images pre-processing, and segmentation using color and texture features with Euclidean distances on color space (L u v). These features are suitable input for Fuzzy Neural Network. It classifies burn into three types: superficial dermal, deep dermal and full thickness. They are different with 4 types of burn in Vietnam hospital classification system. Besides, Euclidean distances are not reflecting in the color analysis of doctor.

Suvarna, Malini, and U. C. Niranjan tried to use some classifier such as TM, k-NN, SVM work as an automatic skin burn wound analyzer[5]. After that a suitable burn image classification using One-Class SVM[2] has been proposed to degree of burn image recognition because of unbalance pre-labeled burn images data in Vietnam.

Recently, CNN is the current trend of image recognition in the world. CNN is not only success on some general types of images such as natural scenes, human, visual, but also able to use in medical image. That is the reason why we investigate to apply CNN for Vietnam skin burn image recognition problem.

2.2 Convolution Neural Network (CNN) Apply for Skin Burn Images

CNN model for skin burn images works as automatic skin burn wound recognition and computer aided in the burning victims diagnosis.

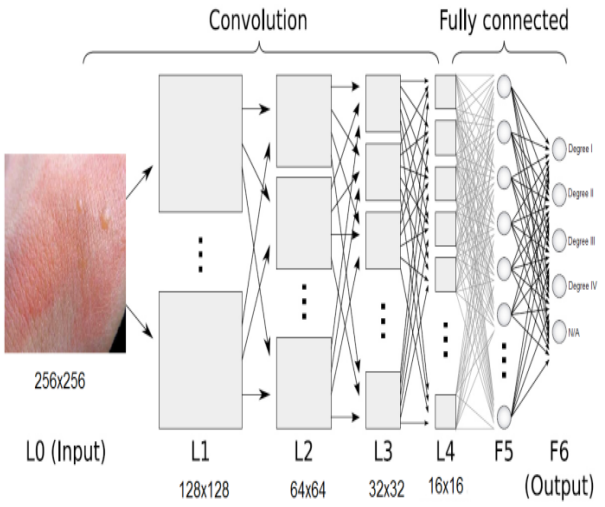

Figure 3. CNN for Burn Images Analysis.

3. The Adaption of CNN Model for Skin Burn Image Classification

In this research, we suggest integrating CNN model for burn images recognition, one kind of medical images. The aim of this paper is to build to automated computer aided for identifying the degrees of burn images. The pre-processing involves Local Binary Pattern (LBP) operators based on the burning expert's suggestion. CNN model was adapted to be automated method of burn images classification into 4 degrees following the classification of burning patients in Cho Ray hospital. Let it called Burn Convolutional Neural Network (B-CNN).

Process: B-CNN model for Burn Image Analysis

Input:

$X = \{x_1, x_2, \ldots, x_n\}$ with x_i burn images of re-size 256x256

Where i=1..n.

$Y = \{y_1, y_2, \ldots, y_n\}$ with y_i the degree of burn image x_i where i =1..n

$y_i \varepsilon$ {I, II, III, IV, N/A}.

Output: B-CNN

Pre-Processing: Re-size Burn image 256x256 and apply Local Binary Pattern operator to be the input of CNN model.

Calculating the distribution of training data to identify the sampling probability.

$\#y_i$ = No training images in Degree y_i.

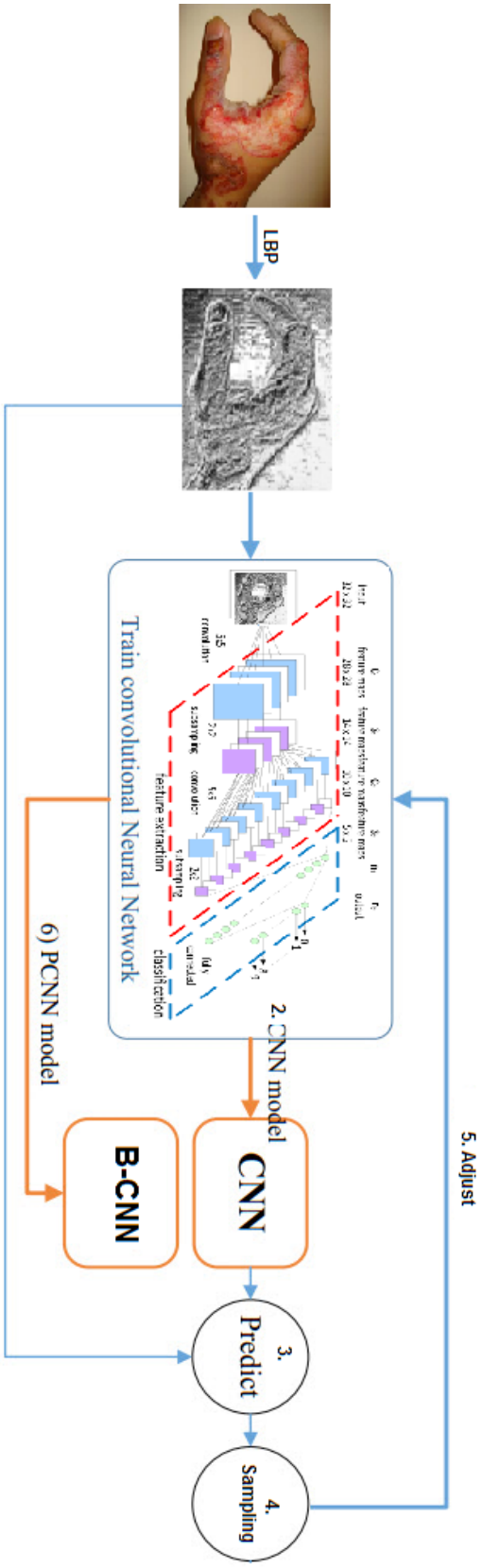

Figure 4. Block diagram of B-CNN model.

#Total = #Degree_I + #Degree_II + #Degree_III + #Degree_IV

P(I) = #Degree_I /#Total

P(II) = #Degree_II /#Total

P(III) = #Degree_III/#Total

P(IV) = #Degree_IV /#Total

- Train convolution neural network CNN with input X and Y.
- Let S ε R^{nx2} be the scores of X predicted using CNN
- Loop s_iε S

  Remove x_i from X with probability $P(y_i)$ based on the distribution of training burn images data.

  End loop
- Let X' is the remaining training from X.
- Adjust CNN with X' to get B-CNN
- Return B-CNN

4. Experimental Result and Discussion

Inour experiments, the B-CNN developed based on ConvNetJS[11]. We evaluate the proposed method on the Burn Image dataset getting from Cho Ray hospital, Vietnam. It was published in the research project site. http://fit.hcmup.edu.vn/medical_image_project/[2]. The error rate and training time are employed as evaluation metrics.

Some skin burn images in degree I in the training dataset are below:

Some skin burn images in degree II in the dataset are below:

Some skin burn images in degree III in the dataset are below:

Some skin burn images in degree IV in the dataset are below:

The graphical user interfaces of demo application for experimental in Vietnamese due to the requirement of Vietnamese doctors in Cho Ray hospital. See below:

In the training phase, the experimental application can load all data from the folder. After that, users can set some parameters to start training. In this research phase, we have just developed for configure learning rate, and use the suggestion weight decay = 0.001 in the current versions of application.

In the testing phase, users can load a skin burn image, and the pre-train B-CNN model will automatically classify the input skin burn image into the predict degree. In the above image, the input skin burn image has been recognized as Degree III as doctor's predicted.

The experimental with learning rate from 0.1 to 0.9 are below:

It is easy to see that the good learning rate parameter of B-CNN model for skin burn image recognition is B-CNN

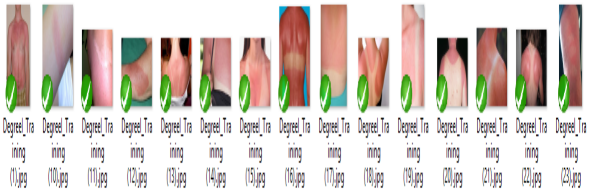

Figure 5. Some skin burn images in degree I in training dataset.

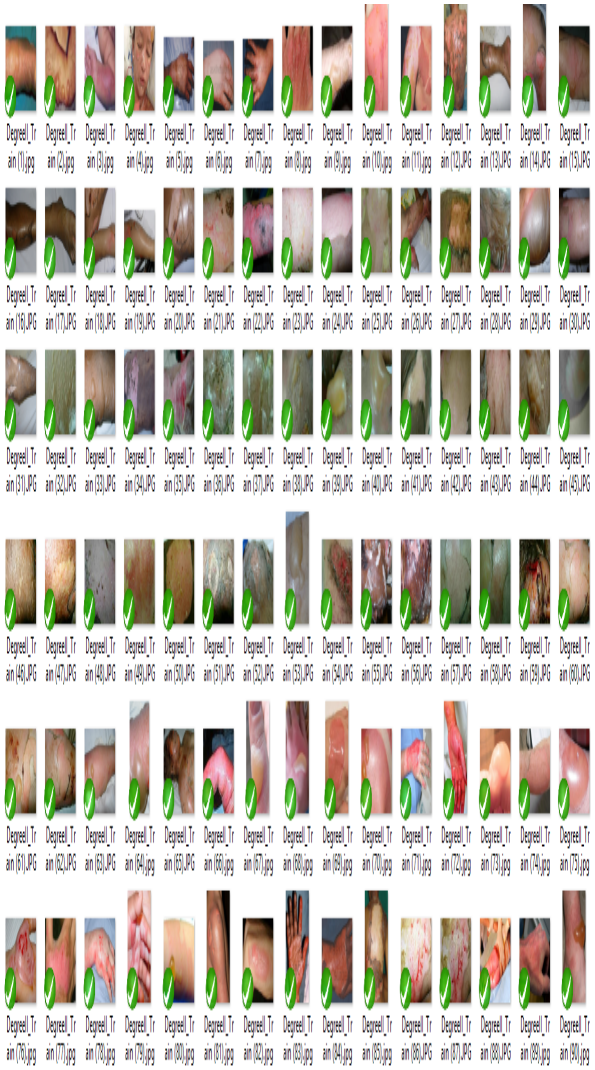

Figure 6. Some skin burn images in degree II in training dataset.

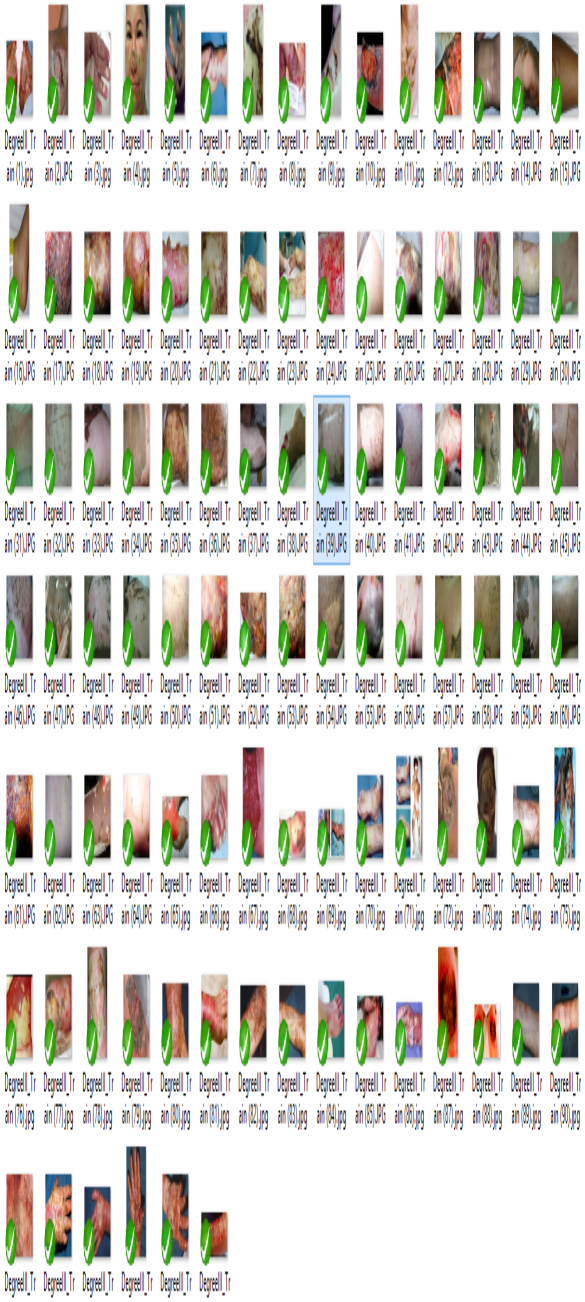

Figure 7. Some skin burn images in degree III in training dataset.

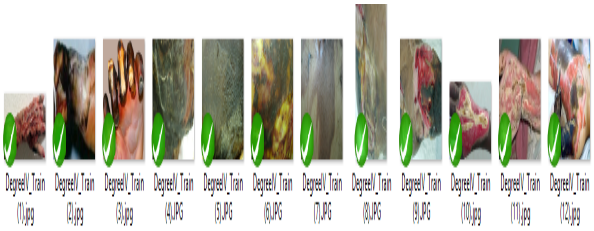

Figure 8. Some skin burn images in degree IV in training dataset.

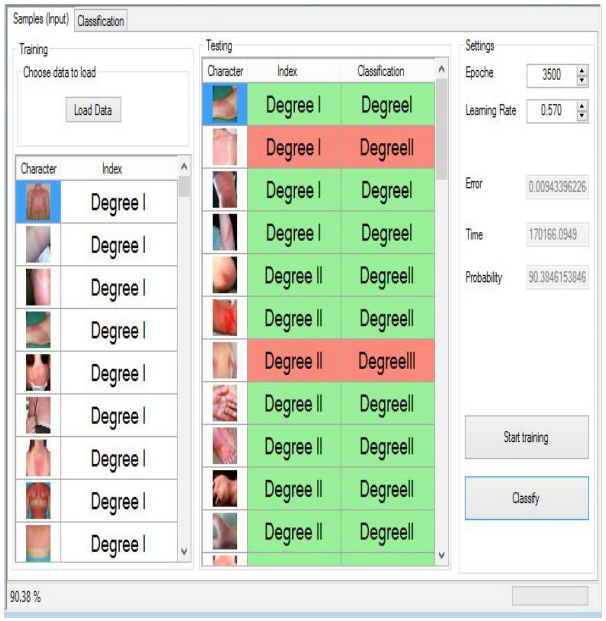

Figure 9. Samples (Input) B-CNN training phase.

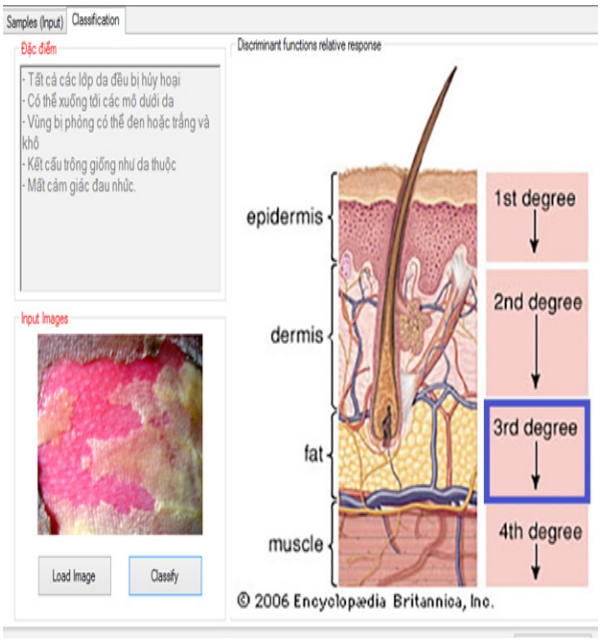

Figure 10. Classification for B-CNN testing phase.

(Learning Rate =from 0.5 to 0.6). After that we had experiments for smaller learning rate from 0.5 to 0.6 in order to identity the best learning rate value. See results below:

It is easy to see that the best learning rate parameter of B-CNN model for skin burn image recognition is B-CNN (Learning Rate =from 0.57). We used this value for developing the demo application to doctors' in Cho Ray hospital, Vietnam.

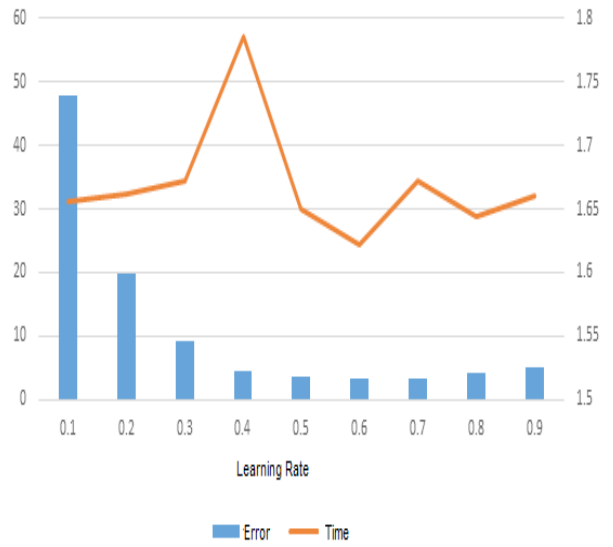

Figure 11. Experimental Results of B-CNN model.

Figure 12. Experimental Results of identify the best learning rate value for B-CNN model in skin burn images dataset.

5. Conclusion

In this research, we proposed a Convolutional Neural Network (CNN) model for the degree of skin burn image recognition. Let it called Burn Convolutional Neural Network (B-CNN). It is an adaptive CNN model.

B-CNN model uses the probability distribution of degree of skin burn training data information to calculate the sampling probability one-by-one degree of skin burn images training data.

The experimental results showed the feasibility of the proposed model B-CNN. This burns analysis will be helpful for remote hospital in Vietnam where the hospital service must be improved. The remote doctors could use this computer aided module to classify the degrees of burns, and give the suitable medical decision. The best learning rate parameter for B-CNN has been discovered by experimental results, while identifying the suitable weight decay is an open problem with skin burn image recognition.

6. References

1. Torpy Janet M, Cassio Lynm, and Richard M Glass. Burn injuries. JAMA. 2009; 302(16):1828-28.
2. Hai Tran, Triet Le, Thai Le and Thuy Nguyen. Burn Image Classification Using One-Class Support Vector Machine. Springer International Publishing: International Conference on Context-Aware Systems and Applications. 2015.
3. Hai Tran, Thai Le and Thuy Nguyen. Facial Expression Classification Using Artificial Neural Network and K-Nearest Neighbor. International Journal of Information Technology and Computer Science (IJITCS). 2015; 7(3):27.
4. Thai Hoang Le and Hoang Thien Van. Fingerprint reference point detection for image retrieval based on symmetry and variation. Pattern Recognition. 2012; 45(9):3360-72.
5. Suvarna Malini and Niranjan UC. Classification methods of skin burn images. International Journal of Computer Science & Information Technology 2013; 5(1):109.
6. Serrano Carmen and Laura M Roa. Segmentation and classification of burn images by color and texture information. Journal of Biomedical Optics. 2005; 10(3):034014-03401411.
7. Han Mengmeng, et al. Visual hand gesture recognition with convolution neural network. IEEE, 2016 17th IEEE/ACIS International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD). 2016.
8. Zhang Yuanyuan, et al. Adaptive Convolutional Neural Network and Its Application in Face Recognition. Neural Processing Letters. 2016; 43(2):389-99.
9. Samala Ravi K, et al. Deep-learning convolution neural network for computer-aided detection of microcalcifications in digital breast tomosynthesis. SPIE Medical Imaging. International Society for Optics and Photonics. 2016.
10. Greenspan Hayit, Bram van Ginneken and Ronald M Summers. Guest Editorial Deep Learning in Medical Imaging: Overview and Future Promise of an Exciting New Technique. IEEE Transactions on Medical Imaging. 2016; 35(5):1153-59.
11. Available from: http://cs.stanford.edu/people/karpathy/convnetjs/.