

# Image Enhancement and Feature Extraction of Cytomegalovirus Image using Hierarchical Ranking Convolutional Neural Network (HR-CNN)



K.Deepa , S. Suganya

**Abstract:** Human Cytomegalovirus is becoming a common issue around the globe, mainly it deals with the infection of the fetus in the womb. Digital image processing plays a vital role in various fields especially in the field of medicine to have a better quality of image of viruses in various forms. To have better clarity of images even in microscopic images there might be some flaws in detection of viruses because of the intensities which occur due to atmospheric lights, to overcome the flaws in microscopic images there comes a technique image enhancement to overcome noise in images especially distortion free images to be produced based on some image quality assessment and to reduce noise in an image without any loss of information. In this paper the proposed methodology called Hierarchical Ranking Convolution Neural Network is introduced based on Upward/Downward hierarchy and Forward/Backward Hierarchy to extract features and to provide intensified image of the virus. Image quality assessment is done with the parameters and evaluated using Mean Square Error, Peak signal to Noise Ratio, Root Mean Square Error, Structure Similarity Index, Mean Structure Similarity Index to prove the accuracy.

**Keywords:** Image Enhancement, HR-CNN, Acquisition, Cytomegalovirus.

## I. INTRODUCTION

Image Enhancement is a technique widely used in the field of biomedical to have a better clarity of images. The image processing technique includes basic identification of image quality apart from human visual perception, the statistical analysis can be done based on different computations to identify the results of various effects of images. Digital image processing plays a vital role in various fields especially in space exploration, medical field and many more areas. Image Enhancement mainly deals with noise removal of images. This paper gives an analysis of the image and to convert the image into intensified image using background subtraction and noise removal through HR-CNN (Hierarchical Ranking of Convolution neural network). The digital image processing is one of the integral part of medical imaging.

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## II. RELATED WORK

Image analysis of biomedical images involves in examining every particles of the images and remove the problems such as non-uniform illumination and to provide a uniform background [1]. The process of enhancing the appearance of an image or a subset of the image to have a better contrast or visualization of image features and to mitigate an accurate subsequent image analysis and in the medical field complex diagnostic process can be enhanced by providing the quantitative data extracted from the images like semen, blood cell, body fluids and many more.. [2]. The main aim of image enhancement is to provide the visual appearance of the image and to better transform the representation of an image [3].

### A. Convolution Neural Network

The Convolution neural network is used in the field of medicine and also used in image processing. It deals with image classification and image recognition problems [15]. The neural network is multilayered, it is the most classical and common deep learning tasks. CNN also propose the ranking filters which are composed by vectors [7]. The relation classification is done through ranking of CNN training procedures [17]. The convolution neural network has the multi-label classification it is usually performed in a coarse-to-fine-learning style and it also provides impressed performance [18]. The proposed work is to remove noise and to make the image more intensified so that the clarity of the image is done for further process.

## III. PROPOSED METHODOLOGY

The proposed methodology deals with the Image Acquisition, followed by image background subtraction to have a better view of the image, so the intensity of the image is important to find out the best results of images. The source of the image might have little misconception. So to overcome that image background subtraction is used. After the image background subtraction, next is noise removal is done through Hierarchical Ranking Convolution Neural Network (HR-CNN). After the noise removal the filtration is used to have a better quality of images using guided filter and Box filter.

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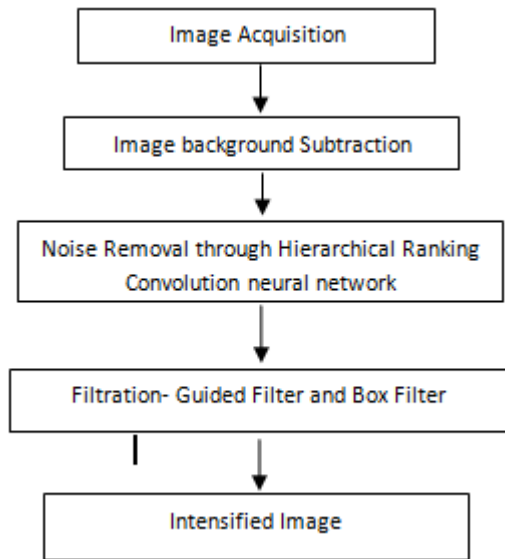


Figure3.1. Block Diagram of Proposed methodology

## A. Image Acquisition.

Image acquisition is the process of retrieving images from a source which is unprocessed. Without an image, no processing is possible. In this proposed methodology a virus named cytomegalovirus image is taken and it is processed in several ways to make the image a better clarity for further processing.

## B. Image Background Subtraction.

The image background subtraction has been proposed for an image mainly to perform partition foreground regions and background regions to be ignored [4]. The pixel intensity values will be higher in some areas of the image and low pixel intensity in some areas of the image, so when the image is processed with background subtraction then there will be the higher level of accuracy. Resizing of images are done for subsequent steps.[5] If the image is bright then there intensity is higher if the portion of the image is darker then the intensity level is low, hence by using the image background subtraction one could see the better clarity of images. Low intensity identification windowing techniques have been proposed to perform light estimation because the image may consists of light and there would be some noise and to remove noise this windowing technique is used.

## C. Noise Removal through Hierarchical Ranking Convolution Neural Network (HR-CNN)

The Convolution neural network consists of various multiple building blocks such as convolution layers, pooling layers, and fully connected layers. Convolution layer is the fundamental component of CNN architecture and it performs feature extraction which typically consists of linear and non-linear operations [6]. The resulting image might have low contrast and low quality images will only degenerate the performance of many computer vision and also degrades the aesthetics of images [8]. The architecture of CNN provides good results and to provide intuitions behind their usefulness [9]. CNN is trained for a very large image classification task for feature extraction [11][16]. In this proposed work CNN is introduced with Hierarchical

Ranking Convolution Neural Network(HR-CNN) for the noise removal .As convolution neural network consists of the basic 15 layers, in the proposed work the upward-downward hierarchy, forward-backward hierarchy with the ranking is used, so that the features can be differentiated before and after ranking with the hierarchy.

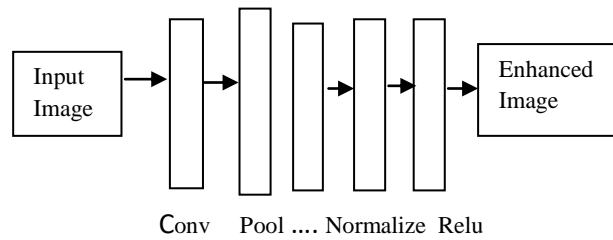


Figure 3.2 Convolution Neural Network

The concept of CNN over the years have been processed the image enhancement with some loss. The new concept in the proposed work is done with the upward-downward direction and forward-backward direction so that the 15 layers are used twice means that 15 layers are done first and then rearrange the features and again the 15 layers process is done. So the features are clear based on the ranking of Convolution neural network. The Single image Dark Channel prior may encounter color distortion in a bright region so that transmission threshold was determined [12][16]. The complexity of calculation to refine the transmission map is optimized using guided filter. The method shows to eliminate color distortion and visibility is enhanced [7][15][17].

## Algorithm of HRCNN

- Step1: The 15 layers of Convolution Neural Network is taken.
- Step 2: The forward /backward hierarchy is done using the layers.
- Step3: The features are rearranged and sorted to do the next hierarchy.
- Step4: The upward/downward hierarchy is done using the 15 layers again.
- Step5: Matconvnet is used to perform the Ranking of Convolution Neural Network
- Step6: Using this type of HR-CNN there will not be any loss of information.

The image quality assessment is done and various evaluation methods are used.

The PSNR, MSE, RMSE, MSSIM, SSIM these are used to have a better quality of images. The objective measurement deals with the distortion free images. [12][18].

- a) MSE (Mean Square Error): Most Common estimator of image quality assessment. It is between the images to be processed between the original image and the processed image [13][14].

$$MSE = \frac{1}{MN} \sum \sum [I(x, y) - I'(x, y)]^2 \quad \text{---(1)}$$

- $x=1 \quad y=1$
- b) RMSE (Root Mean Square Error): It is the difference between the predicted value by the estimator and the actual value.

$$RMSE(\bar{\theta}) = \sqrt{MSE(\theta)} \quad \text{---(2)}$$

- c) PSNR (Peak Signal to Noise Ratio): This is used to calculate the maximum possibility of the image data. The absolute error representation in the form of dB.

$$PSNR = N \log_{10} \frac{255}{\sqrt{MSE}} \quad \text{---(3)}$$

- d) SSIM (Structural Similarity Index): This mainly used for the image degradation is considered the change of perception in structural information. Interdependent on pixels.

$$SSIM(x, y) = [l(x, y)]^\alpha \cdot [c(x, y)]^\beta \cdot [s(x, y)]^\gamma \quad \text{---(4)}$$

- e) MSSIM (Mean SSIM): This is used to calculate the statistical value in the small area and calculate the formula as

$$MSSIM(x, y) = \frac{1}{M} \sum_j SSIM(x_j, y_j) \quad \text{---(5)}$$

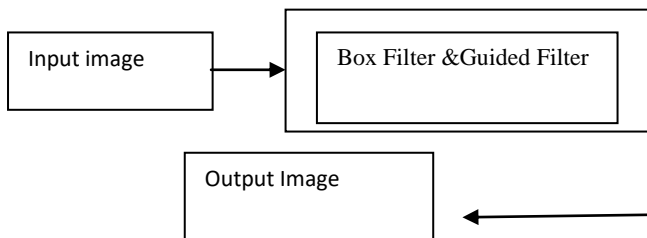
**D. Filtration:**

The Filtration process is used to detect the high frequencies in the images. The main cause for filtration is to provide smoothness or sharpening of the images, noise removal, edge detection[19]. There are two types of filtering is applied in this work. The box filter is used to perform the average value of pixels to provide the smoothness of the image. The guided filter is an application of box filter which performs edge preserving filters[20]. The output of guided filter for the coloured image is

$$q_i = \bar{a}_i J_i + \bar{b}_i \quad \text{---(6)}$$

$$\bar{a}_i = \frac{1}{|\omega|} \sum_{k \in \omega_i} a_k, \quad \bar{b}_i = \frac{1}{|\omega|} \sum_{k \in \omega_i} b_k \quad \text{---(7)}$$

The Guided filter is used for the smoothness of the image .

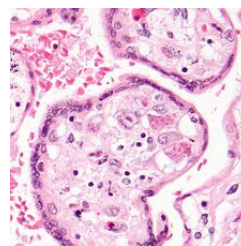


**Figure 4.1 Filtration (Box filter & Guided filter )**

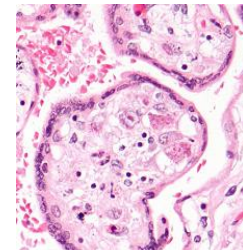
The main aim of the guided filter is to filter the input images by considering the content of the guidance image [10].

**IV. EXPERIMENTAL RESULTS AND DISCUSSIONS:**

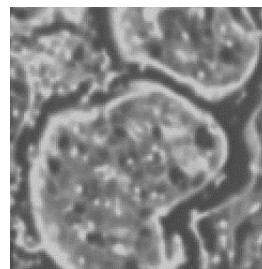
As far as considered the single image intensification is done to improve better quality of images so that classification and clustering would be fine for further processing. The various forms of identification of image is illustrated in the figures. The Fig 5.1 illustrate the input image of cytomegalovirus, based on this image the atmospheric light estimation is done in Fig 5.2. The Hierarchical Ranking Convolution Neural Network is implemented to have feature extraction and the transmission map of the image is developed to have filtration as box filtering and guide filter is done to have refined transmission map to have the features of the image as an intensified image to have a better clarification of the detailed features that are extracted for betterment of images and can be further processed to achieve enhancement results. The features has been transformed to provide the identification of the high frequencies of images with the help of filtrations in Fig.5.3 HRCNN transmission and Fig5.4. Refined HRCNN Transmission Map. In Fig 5.5. The Dark Channel image is shown it provides haze free images. The pixel values of the image is low (i.e) which is based on the key observation of a statistics due to the patches of images whose atmospheric absorption and scattering , whose intensity is low can be solved. The Fig 5.6 The Intensified image is shown in gray scale and In Fig 5.7 The output intensified image of color channel is shown.



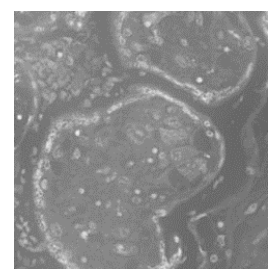
**Figure 5.1 Input Image**



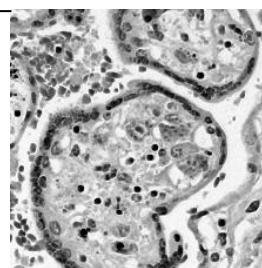
**Figures 5.2. Atmospheric Light Estimation**



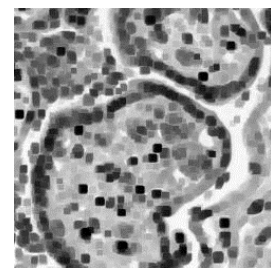
**5.3.HRCNN transmission**



**5.4. Refined HRCNN Transmission Map**



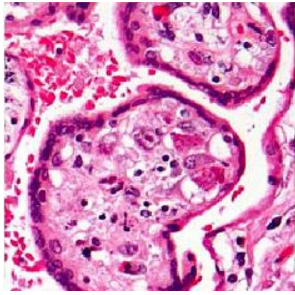
**5.5. Dark Channel Image**



**5.6.Intensity Identified**

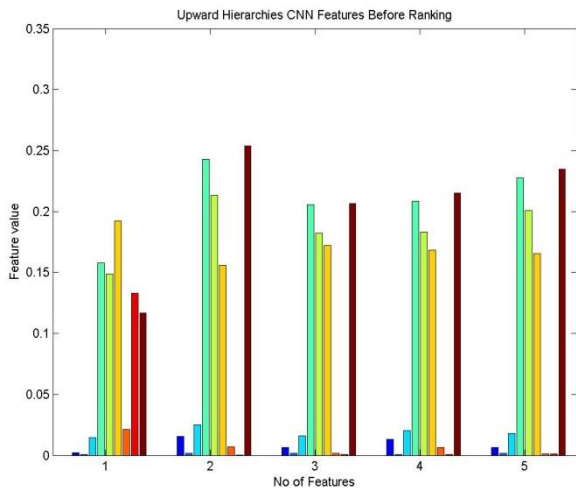


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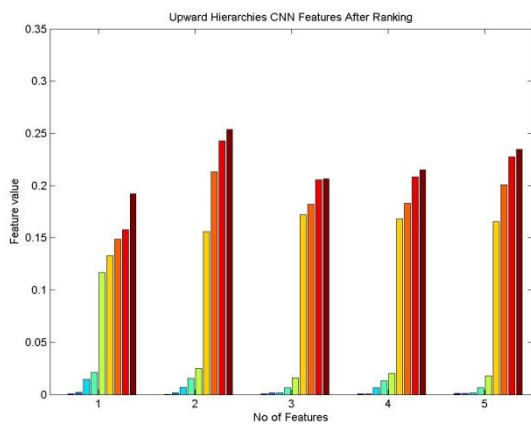


## 5.7. Output Intensified Image

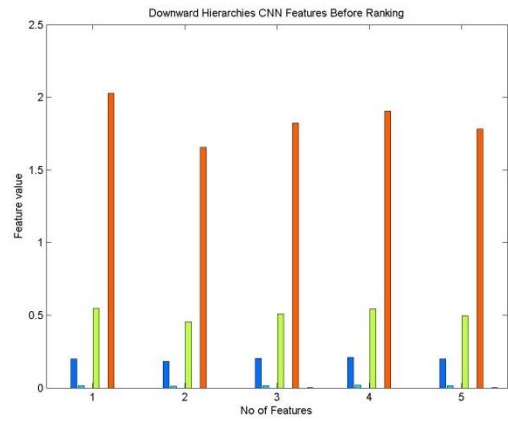
The Figures below shows the features before and after ranking HR-CNN. The Figure 5.8. Shows the chart which provides the features before ranking of convolution neural network the upward hierarchies CNN Features. Figure 5.9 shows the chart upwards hierarchies CNN Features After Ranking. Similarly Figure 5.10. depicts the Downward Hierarchies features CNN before ranking and Figure 5.11 depicts the Downward Hierarchies Features CNN after ranking. The Figure 5.12. depicts the backward layer CNN features before ranking and Figure 5.13 depicts the backward Layer CNN features after ranking. The Ranking Hierarchies are provided such that the images are extracted and are done without any loss of information.



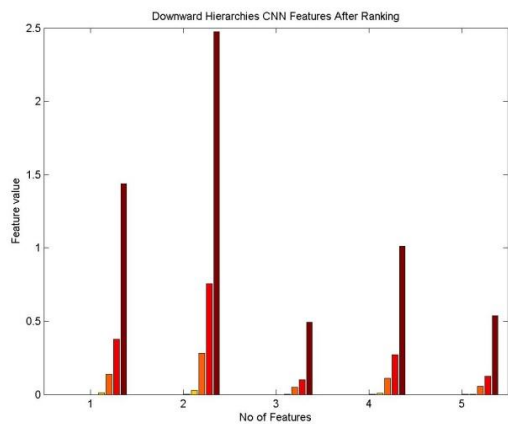
**Fig5.8.Upward Hierarchies CNN Before Ranking**



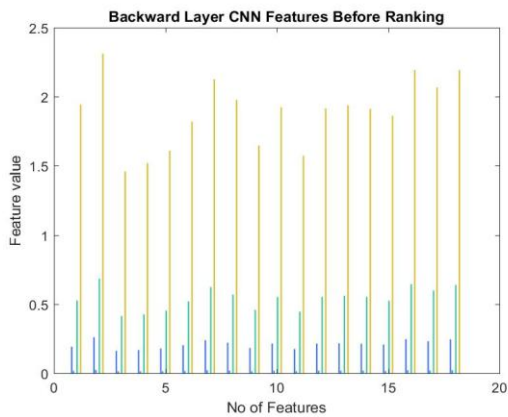
**Fig 5.9.Downward Hierarchies CNN after Ranking**



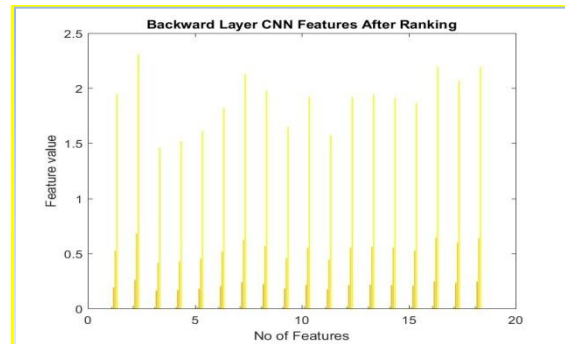
**Figure 5.10.Downward Hierarchies CNN before Ranking**



**Figure 5.11. Downward Hierarchies CNN after Ranking**



**Figure 5.12. Backward Layer CNN Before Ranking**



**Figure 5.13.Backward Layer CNN after Ranking**

## IV.CONCLUSION

Image processing plays a vital role in medical field. The Research is based on the image of cytomegalovirus which can be processed to show the major clarifications of the virus to explicit its impact on pregnant women. In this paper we have presented the single image intensification for cytomegalovirus to show the image as intensified image with the process of Hierarchical Ranking Convolution Neural Network for noise removal Image is taken as input and processed with image background subtraction and filtration is used to get intensified image .This process is robust and simple to implement. This intensified image can be used for further classification and clustering.

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