Scientific Journal of Impact Factor (SJIF): 5.71
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 03, March -2018

ANALYZING GROWTH FACTORS OF STEM CELLS

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Abstract- *The stem cells have prodigious possible to develop into multiple different types of cells in the body during early life cycle and growth period. Stem cells are analyzed in the time-lapse image sequence. The focus of this study is to examine the growth factor of the stem cells using image processing techniques like pre-processing the input stem cells microscopy image, removes the noises through the filters and the stem cells are segmented using threshold segmentation and extracts of the stem cells is proceeded using Contradistinction Enhancement Algorithm.*

keywords- *Stem Cells, microscopy image, feature extration, pattern recognition and segmentation*

I. INTRODUCTION

Every organs and tissues in our body grew out of a cluster of stem cells early in embryonic development. A stem cell varies from other cell in the body by its ability to reinvigorate singularly. It can break up into many more cell just like it in our body. Stem cells can repair and replace tissue in the human body. In other words, stem cells have the power to heal. Think of our skin. The tissue in our skin needs constant renewal that could not take place without stem cells or muscle-stem cells in our muscles are what repair damaged tissue when we are injured. Early in life, stem cells have the extraordinary potential to develop into any type of cell in the human body. They start in the embryo as unprogrammed cells, and then become specialized to create bone, muscle, skin, the heart, the brain, and over 250 other types of specialized cells. These are called pluripotent stem cells.

Stem cells can also be taken from umbilical cord blood just after birth.All stem cell types, autologous harvesting involves the least risk. By definition, autologous cells are obtained from one's own body, just as one may bank his or her own blood for elective surgical procedures.Adult stem cells are frequently used in various medical therapies [1]. Stem cells can now be artificially grown and transformed (differentiated) into specialized cell types with characteristics consistent with cells of various tissues such as muscles or nerves.

Embryonic cell lines and autologous embryonic stem cells generated through somatic cell nuclear transfer or dedifferentiation have also been proposed as promising candidates for future therapies. The classical definition of a stem cell requires that it possesses two properties: Self-renewal: the ability to go

through numerous cycles of cell division while maintaining the undifferentiated state. Potency: the capacity to differentiate into specialized cell types. In the strictest sense, this requires stem cells to be either totipotent or -to be able to give rise to any mature cell type, although multipotent or unipotent progenitor cells are sometimes referred to as stem cells. Apart from this it is said that stem cell function is regulated in a feedback mechanism.

In some organs, such as the gut and bone marrow, stem cells regularly divide to repair and replace worn out or damaged tissues. The existing methodology for stem cell analysis image segmentation makes use of a morphological technique applied on the fluorescent cells so as to get a clear cut segmented image [2]. Mesenchymal stem cells (MSC) [3] contained in the bone marrow that provide an indispensable source for for bone reconstruction.

The nature of a stem cell is evaluated in three steps: segment ation,feature extraction and pattern recognition. Segmentation [4] partitions the image into many segments based on the intensity making the image homogeneous thus providing a newer representation for better analysis. Secondly the feature extraction helps to discriminate the healthy cells from the cell image. Lastly the pattern recognition is done on the basis of feature vectors.Stem cell region recognition in microscopy images using Convolutional Neural Networks.

Growth factors of stem cell provide biochemical cure and used to develop new strategies to treat human diseases by investi-gating cellular processes controlling development, aging, and tissue regeneration.

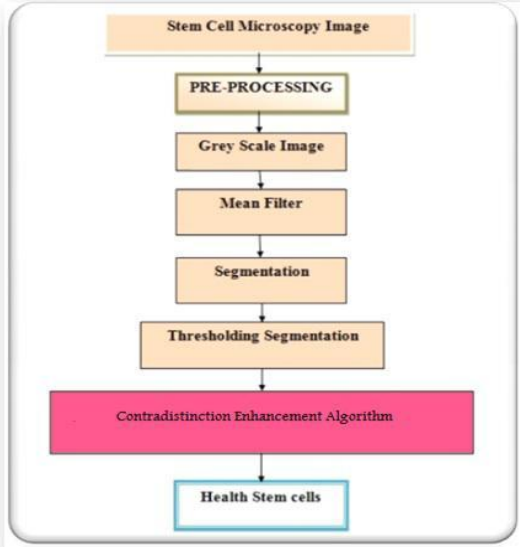
II. MATERIALS AND METHODS

A. STEM CELLS MICROSCOPY IMAGE

Stem Cells are proficient by equipping a traditional micro-scope with a motorized xyz-stage and a climatization chamber. This time-lapse microscope produces snapshots of the stem cells, normally at equidistant time points, resulting in large image stacks.

B. IMAGE PRE-PROCESSING

Image Pre-processing involves various aspects such as Contrast Stretching, Noise Filtering, Histogram modification etc. It generally focused on removing the noise and any kind of deformity present in an image. Image Preprocessing is the technique of enhancing data images antecedent to computational processing. Several filters operations which escalate or reduce certain image details enable a facile and rapid evaluation.



C. GRAY SCALE IMAGE

In Colorimetry , Computing and Photography, a digitalized grayscale image is displayed in which the assess of each pixel is a single sample, that is, it carries only vigour information. It commonly deals with the resultant of measuring the intensity of light at each pixel according to a particular weighted combination of frequencies. Images of this sort, also known as black-and-white or monochrome, formulated exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

D. MEAN FILTER

Mean filtering is a simple, intuitive and easy to implement method that reduces the amount of intensity variation between one pixel and the next. It replaces the center value in the window with average of all the pixel values in the window. The mean filters are used on the Stem Cells microscopy images to reduce the noise from the images.

E. THRESHOLDING SEGMENTATION

Thresholding is a simple method, yet effective, way of partitioning an image into a foreground and background. From a grayscale image, thresholding can be used to create binary images. Thresholding is most effective in images with high levels of contrast. This method replace each pixel in an image with a black pixel if the image intensity is less than some fixed value, or a white pixel if the image intensity is greater than that fixed constant value.

F. EXTRACTING STEM CELLS BY CONTRADISTINCTION ENHANCEMENT ALGORITHM

The proposed method is based on the selection of appro-priate seed point and the threshold value. If the current pixel satisfies the threshold value then it is added to the foreground otherwise to background. Once the foreground and background are enhanced individually, they are combined to form the final enhanced image. The Steps of proposed Algorithm are as follows:

STEPS :
Step I: Select a pixel in the input microscopy image and make it a seed point. Add the seed value pixel into an empty queue. Step II: From top of the queue start finding immediate 8-connected neighbors of each unprocessed pixel and for each neighbor point, check whether the gray level value of that neighbor pixel is within the specified deviation from the seed pixels gray level value. The proposed deviation method is specified as: (f (m, n)-seed) <¡= i (1).
Where f (m,n) is the gray level value of the current pixel and the threshold i = 0.5 . If the current pixel satisfies the criteria then it is added to the foreground queue, otherwise to background queue.

Step III: The Step II is repeated till all the pixels in queue are processed. If some pixel is encountered that is already on the queue then ignore it and process the next pixel in the queue. Step IV: Alter the gray level values of each pixel in the foreground buffer by power law transformation.

Step V: Alter the gray level values of each pixel obtained after Step IV by adaptive histogram equalization.
Step VI: Combine the pixels in foreground and background buffer to form the enhanced image.
Step VII: Display the final enhanced image.

G. SEGMENTED STEM CELLS IMAGE
Once the Stem Cells Image is extracted the segmented Stem Cells is displayed as the output.

H. MEASURING THE GROWTH RANGE OF THE STEM CELLS
The segmented stem cells are measured using global thresh-old value. The measurement is based on from zero hour to 168 hours. Then the reading are noted in each hours.

I. BAR CHART REPRESENTATION OF STEM CELLS GROWTH RATE
The reading are taken from zero hour till 168 hours are noted and plotted as the bar chart.

III. RESULTS AND ANALYSIS

The code is applied based on mean filters to reduce noise and the threshold values are detected using image segmenta-tion techniques and morphological operations, the output is listed below as a tabular column for clear understanding.
and comparatively its higher values are coming correspond-ing to the proposed method as compared to other contrast enhancement techniques.

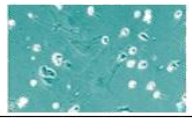
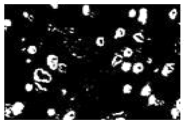
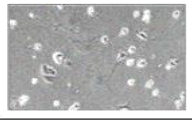
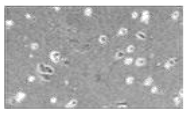
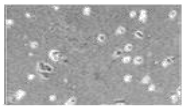
FILTERS	OUTPUTS
Normal Microscopy stem cells image	
Gaussian Noise	
Arithmetic Mean Filter	
Geometric Mean Filter	
Harmonic Mean Filter	

Table 3.1 Mean Filters

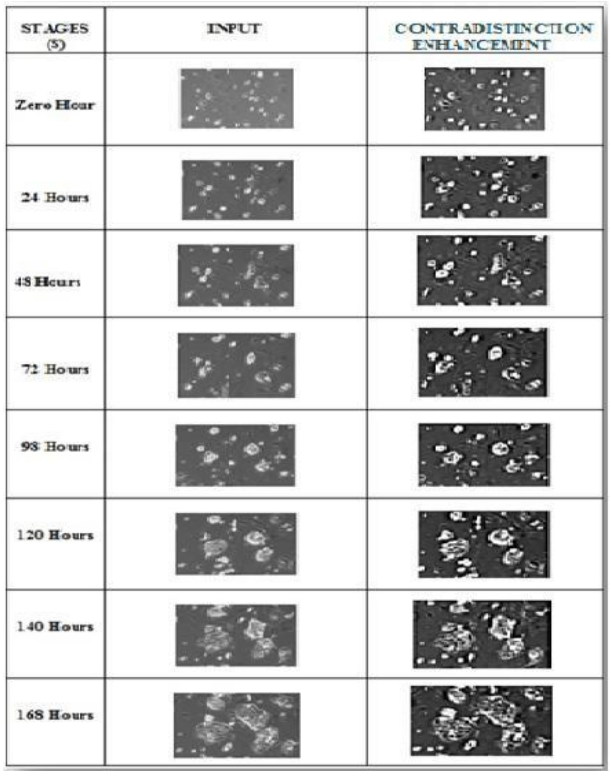


Table 3.2 Growth Factor Of Stem Cells

The range of Entropy and Tenengrad (TEN) is not defined, but a higher value of these matrices are always considered good and comparatively its higher values are coming correspond-ing to the proposed method as compared to other contrast enhancement techniques.

Sr. No.	Image	Quality Metric	Power Law Transformation	Unsharp Masking	Proposed Algorithm
1.	Pelvis	Entropy	6.5462	6.7387	7.1210
		TEN	187710000	174819484	521450816
2.	Hand	Entropy	5.8734	6.2129	6.8787
		TEN	202240000	191577232	501326562

Table 3.3 Quality measure on Different Images

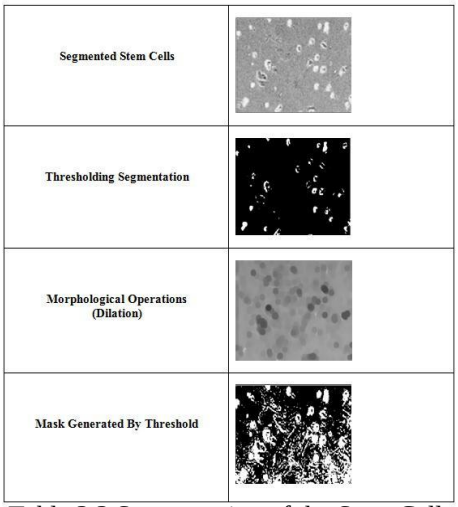


Table 3.3 Segmentation of the Stem Cells

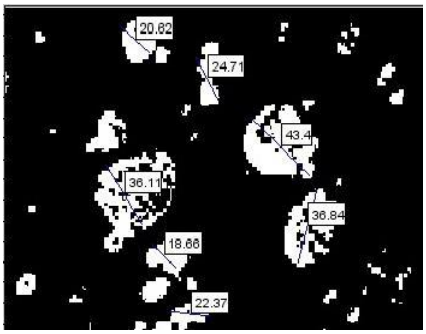


Table 3.1 Mean Filters

!16.09	18.8	19.48	34.31	36.62
!				!
!15.27	16.51	13.95	17.64	19.66
!				!
!10.85	11.5	13.95	20.86	22.37
!				!
!10.3	13.72	14.3	20.69	24.71
!				!
!12.4	14.88	23.65	16.82	36.84

Fig 3.1 Measuring the Stem Cells

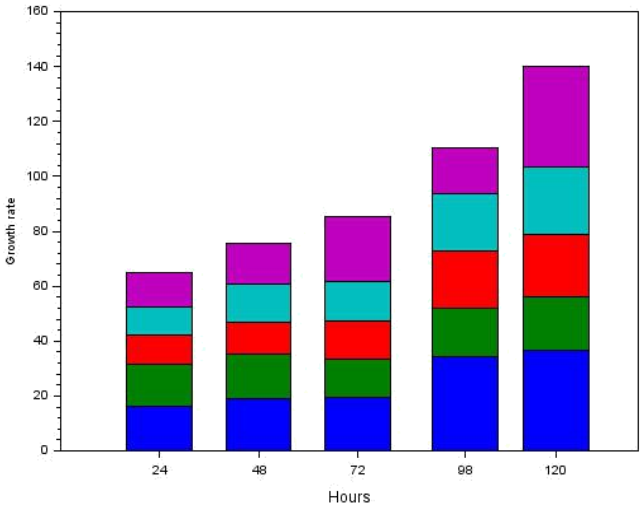


Fig 3.2 Bar chart representation of the Stem Cells growth rate

By this chart representation, the growth rate of the stem cells can be monitored. Some stem cells have the sequence growth factor and some stem cells are in irregular growth.

IV. CONCLUSIONS

Stem cells Identification and Segmentation from microscopy image is challenging due to the asymmetrical structure of the stem cells. In this paper, health growth factor of the stem cells is evaluated.By using the Microscopy image of stem cells the growth factor of the stem cells are examined. The proposed method segments the stem cells using global threshold and then by identifying the healthy nature of stem cells are calculated. The proposed method is invariant in terms of size and shapes of stem cells. Growth factors of

stem cell provide biochemical cure and used to develop new strategies to treat human diseases by investigating cellular processes controlling development,cancer,Spinal cord injury, Stroke, Diabetes, Heart muscle cells that could repair damage after a heart attack, aging, and tissue regeneration.

ACKNOWLEDGMENT

I would like to acknowledge the efforts of the teaching staff members of department of M.Sc. CST, Womens Christian College, TamilNadu for providing the impetus to successfully complete this study.

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APPENDIX

A.CERTIFICATE OF PARTICIPATION In Madras Institute Of Technology, Anna University,College
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CERTIFICATE OF
PARTICIPATION
ANNA UNIVERSITY
MADRAS INSTITUTE OF TECHNOLOGY
This is to certify that Mr/Ms SANGEETHA M of
WOMEN'S CHRISTIAN COLLEGE has participated in the event
PAPER PRESENTATION of SAMHITA '18, a national level technical
symposium held on February 16th and 17th, 2018 organised by Information Technology Association,
Department of Information Technology, Madras Institute of Technology,
Anna University, Chennai.
POORVIKA