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Image Processing-A Review

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ABSTRACT: Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

The following libraries are involved in performing Image processing in python;

- Scikit-image
- OpenCV
- Mahotas
- SimpleITK
- SciPy
- Pillow
- Matplotlib

KEYWORDS: image, information, processing, signal, digital, libraries

I. INTRODUCTION

Image processing is often regarded as improperly exploiting the image in order to achieve a level of beauty or to support a popular reality. However, image processing is most accurately described as a means of translation between a human viewing system and digital imaging devices. The human viewing system does not see the world in the same way as digital cameras, which have additional sound effects and bandwidth. Significant differences between human and digital detectors will be demonstrated, as well as specific processing steps to achieve translation. Image editing should be approached in a scientific way so that others can reproduce, and validate human results. This includes recording and reporting processing actions and applying the same treatment to adequate control images.[1]

Image processing mainly involves the following three steps:

- Importing an image with image detection tools;
- Exploring and manipulating the image;
- An outcome where it can be improved or reported that is built on image analysis.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 10, October 2017

The data we collect or produce is mainly immature data, which means it should not be used in applications directly for many possible reasons. Therefore, we need to analyze it first, do the necessary processing in advance, and then apply it.[2]

For example, suppose we were trying to build a cat separation. Our system will take the image as input and tell us whether the image contains a cat or not. The first step in creating this separator would be to collect hundreds of cat pictures. One common problem is that all the images we have taken would not have been the same size/size, so before giving them a training model, we will need to re-measure / process them all in standard size.

This is one of the many reasons why image processing is so important in any computer vision application. [3]

-> Image improvement for human perception.

Goal – to improve subjective image quality.

-> Image improvement for machine perception

Goal – to simplify the subsequent image analysis and recognition.

-> Image transformation for technical purposes

e.g. change of image resolutions and aspect ratio for display on mobile devices.

-> Pure entertainment (visual effects)

.Goal- to get the artistic impression from the cool visual effect.

Image Acquisition: This is the first digital step in image processing. Digital image detection to create specific images, such as a real or real situation internal arrangement of an object. This word is commonly expected to accept processing, congestion, storage, printing, and display of such images. Image acquisition may humble as considering the pre-existing image digital form.

Image Enhancement: Image enhancement is a process of switching digital images to more results suitable for display or multiple image analysis. Because for example, you can turn off sound, sharpen, or turn on image, which makes it easier to identify key features.

Image Restoration: Image Restoration is a function of taking an unethical / noisy image and measuring an unused, new image. Exploitation can occur in many ways such as action blurring, sound and camera focus. The purpose of image restoration techniques is to reduce noise and reclaim the loss of decision.

Coloring Image Processing: Color Image Processing it requires an understanding of the physics of light as well as color vision psychology. The color of human use details of classification of materials, building materials, food, places and time of day. Color for the purpose of separation image processing process is used.

Wavelets Processing and Multiple Solutions: When a decorated photo through atmosphere, clouds, trees, and flowers, you will use a different level brush depending on the size of topographies. Wavelets are likened to those brushes. Wavelets transform is an effective tool for image representation. The wavelet transform allows for the investigation of multiple solutions of the image.

Image compression: Image compression is a type of data useful pressure digital photography, reducing their costs last or spread. Processes can reap visual benefits awareness and asset data image assets to complex effects related to normal pressure strategies.[4]

Character recognition: Optical character binding, commonly accessed by OCR, machine operated or electronic replacement of scanned images or kindly or typed text that is, computer-readable text. It is often used as a presence to access records from the minute a new type of data source, whether paper, invoice, bank statement, income, business cards, number of printed records or email. It's a common way to make digital printed manuscripts such as those that can be by electronic means sorted, searched, and stored in the machine processes

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Vol. 6, Issue 10, October 2017

such as machine conversion and display online, text-to-speech, retrieval of key data and text mining. OCR is a plethora of research on intelligence, pattern and computer concept.

II. OBSERVATION

An **image processor**, also known as an **image processing engine**, **image processing unit (IPU)**, or **image signal processor (ISP)**, is a type of media processor or specialized digital signal processor (DSP) used for image processing, in digital cameras or other devices.^{[1][2]} Image processors often employ parallel computing even with SIMD or MIMD technologies to increase speed and efficiency. The digital image processing engine can perform a range of tasks. To increase the system integration on embedded devices, often it is a system on a chip with multi-core processor architecture.[5]



Nikon EXPEED, a system on a chip including an image processor, video processor, digital signal processor (DSP) and a 32-bit microcontroller controlling the chip

Image editing encompasses the processes of altering images, whether they are digital photographs, traditional photo-chemical photographs, or illustrations. Traditional analog image editing is known as photo retouching, using tools such as an airbrush to modify photographs or editing illustrations with any traditional art medium. Graphic software programs, which can be broadly grouped into vector graphics editors, raster graphics editors, and 3D modelers, are the primary tools with which a user may manipulate, enhance, and transform images. Many image editing programs are also used to render or create computer art from scratch.[6]

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Vol. 6, Issue 10, October 2017



A colorized version of originally black and white photo, colorized using GIMP



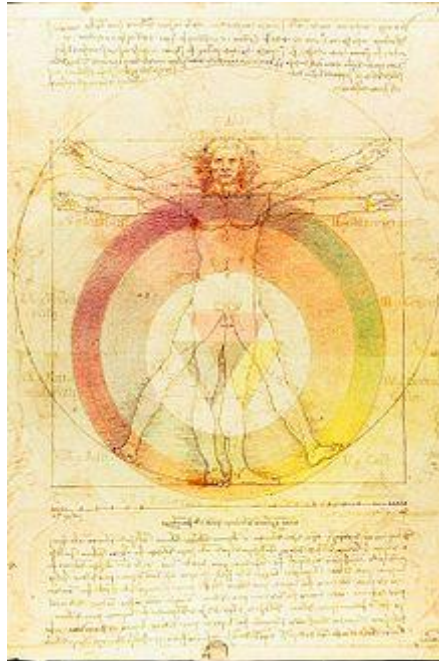
Original black and white photo: *Migrant Mother*, showing Florence Owens Thompson, taken by Dorothea Lange in 1936.

International Journal of Innovative Research in Science, Engineering and Technology

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Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017



Leonardo da Vinci's Vitruvian Man overlaid a soft light layer Moses Harris's Color Wheel and a soft light layer of Ignaz Schiffermüller's Color Wheel. Soft light layers have a darker, more translucent look than screen layers.

III. DISCUSSION

Computer art is any in which computers played a role in production or display. Such art can be an image, sound, animation, video, CD-ROM, DVD, video [7] game, website, algorithm, performance or gallery installation. Many traditional disciplines are now integrating digital technologies and, as a result, the lines between traditional works of art and new media works created using computers have been blurred. For instance, an artist may combine traditional painting with algorithmic art and other digital techniques. As a result, defining computer art by its end product can be difficult. Nevertheless, this type of art is beginning to appear in art museum exhibits, though it has yet to prove its legitimacy as a form unto itself and this technology is widely seen in contemporary art more as a tool rather than a form as with painting. On the other hand, there are computer-based artworks which belong to a new conceptual and postdigital strand, assuming the same technologies, and their social impact, as an object of inquiry.[8]

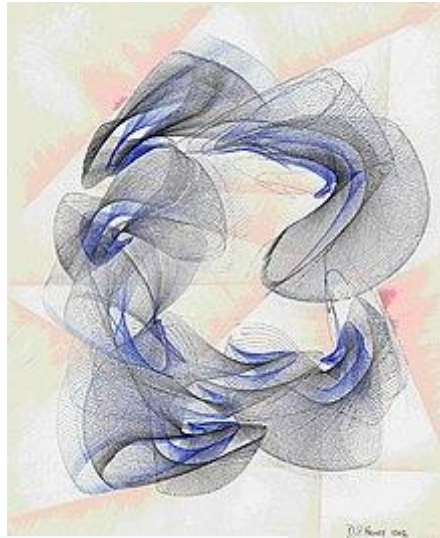
Computer usage has blurred the distinctions between illustrators, photographers, photo editors, 3-D modelers, and handicraft artists. Sophisticated rendering and editing software has led to multi-skilled image developers. Photographers may become digital artists. Illustrators may become animators. Handicraft may be computer-aided or use computer-generated imagery as a template. Computer clip art usage has also made the clear distinction between visual arts and page layout less obvious due to the easy access and editing of clip art in the process of paginating a document, especially to the unskilled observer.[9]

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Vol. 6, Issue 10, October 2017



Desmond Paul Henry, Picture by Drawing Machine 1, c. 1960

In 1972, the engineer from British company EMI Housfield invented the X-ray computed tomography device for head diagnosis, which is what is usually called CT (computer tomography). The CT nucleus method is based on the projection of the human head section and is processed by computer to reconstruct the cross-sectional image, which is called image reconstruction. In 1975, EMI successfully developed a CT device for the whole body, which obtained a clear tomographic image of various parts of the human body. In 1979, this diagnostic technique won the Nobel Prize. Digital image processing technology for medical applications was inducted into the Space Foundation Space Technology Hall of Fame in 1994.[10]

IV. RESULTS

Digital filters are used to blur and sharpen digital images. Filtering can be performed by:

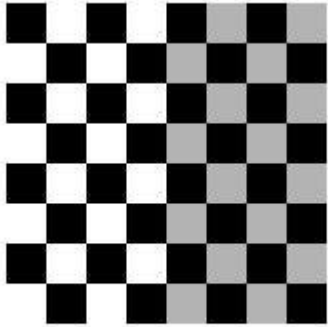
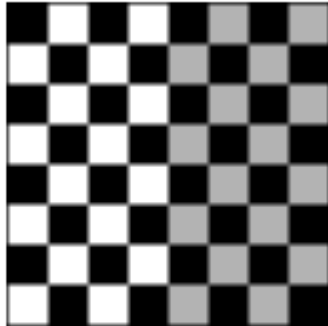
- convolution with specifically designed kernels (filter array) in the spatial domain
- masking specific frequency regions in the frequency (Fourier) domain

International Journal of Innovative Research in Science, Engineering and Technology

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Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

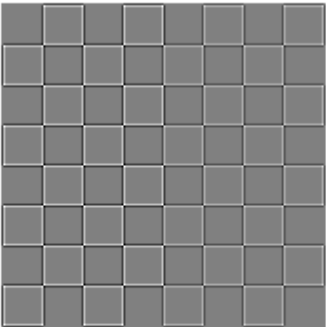
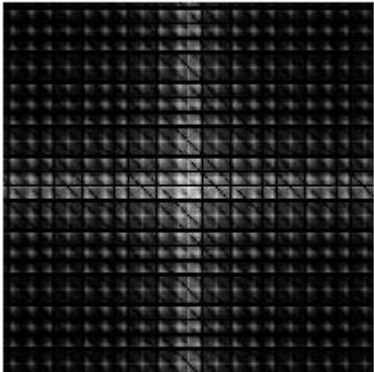
Filter type	Kernel or mask	Example
Original Image		<p>Identity (Original)</p> 
Spatial Lowpass		<p>3 × 3 Mean Blur</p> 

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Vol. 6, Issue 10, October 2017

<p>Spatial Highpass</p>		<p>Laplacian Edge Detection</p> 
<p>Fourier Representati on</p>	<p>Pseudo-code: image = checkerboard F = Fourier Transform of image Show Image: log(1+Absolute Value(F))</p>	<p>FFT Representation</p> 

International Journal of Innovative Research in Science, Engineering and Technology

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Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

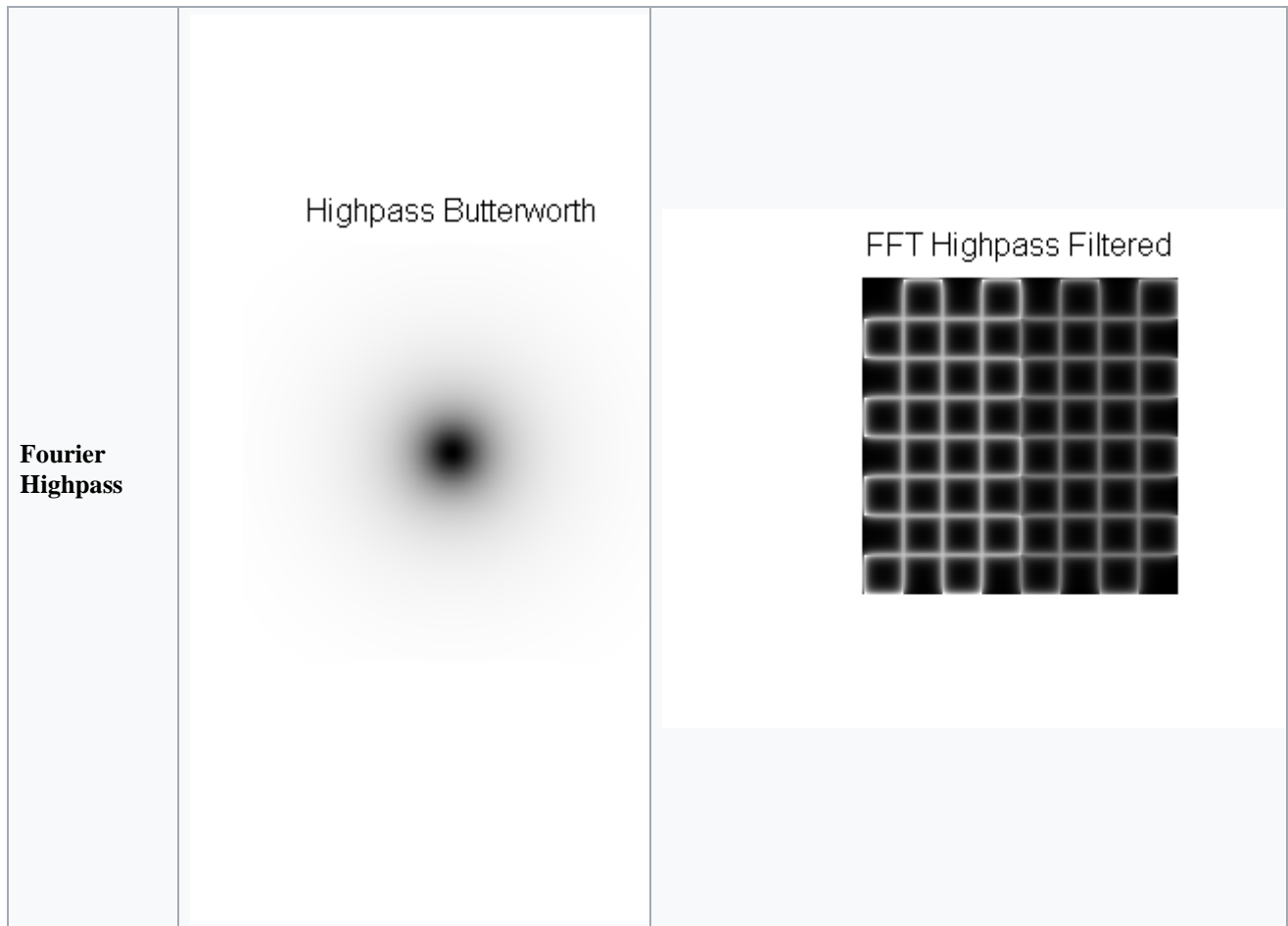
Fourier Lowpass	<p data-bbox="406 645 703 683">Lowpass Butterworth</p> 	<p data-bbox="1023 629 1334 667">FFT Lowpass Filtered</p> 
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Vol. 6, Issue 10, October 2017




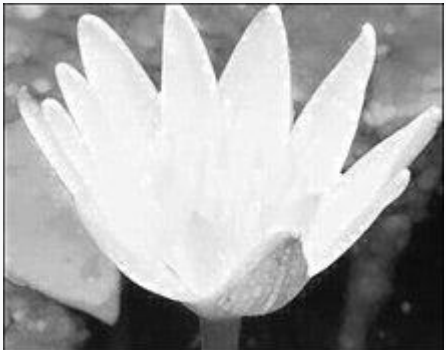
An opening method is just simply erosion first, and then dilation while the closing method is vice versa. In reality, the D(I,B) and E(I,B) can implemented by Convolution[12]

International Journal of Innovative Research in Science, Engineering and Technology

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Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

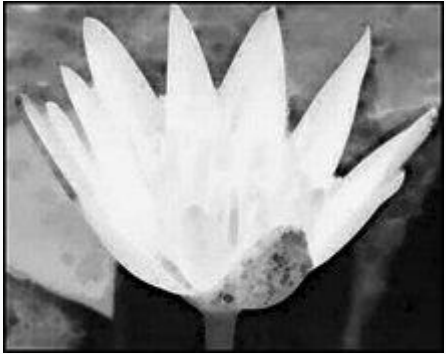
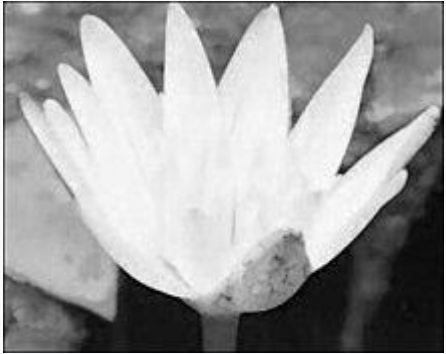
Structuring element	Mask	Code	Example
Original Image	None	Use Matlab to read Original image	 <p>original lotus</p>
		<pre>original = imread('scene.jpg'); image = rgb2gray(original); [r, c, channel] = size(image); se = logical([1 1 1 ; 1 1 1 ; 1 1 1]); [p, q] = size(se); halfH = floor(p/2); halfW = floor(q/2); time = 3; % denoising 3 times with all method</pre>	
Dilation		<pre>Use Matlab to dilation imwrite(image, "scene_dil.jpg") extractmax = zeros(size(image), class(image)); for i = 1 : time dil_image = imread('scene_dil.jpg'); for col = (halfW + 1) : (c - halfW) for row = (halfH + 1) : (r - halfH) dpointD = row - halfH; dpointU = row + halfH; dpointL = col - halfW; dpointR = col + halfW; dneighbor = dil_image(dpointD:dpointU, dpointL:dpointR); filter = dneighbor(se); extractmax(row, col) = max(filter); end end imwrite(extractmax, "scene_dil.jpg"); end</pre>	 <p>denoising picture with dilation method</p>

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

Erosion	<p>Use Matlab to erosion</p> <pre> imwrite(image, 'scene_ero.jpg'); extractmin = zeros(size(image), class(image)); for i = 1: time ero_image = imread('scene_ero.jpg'); for col = (halfW + 1): (c - halfW) for row = (halfH + 1): (r - halfH) pointDown = row-halfH; pointUp = row+halfH; pointLeft = col-halfW; pointRight = col+halfW; neighbor = ero_image(pointDown:pointUp,pointLeft:pointRight) ; filter = neighbor(se); extractmin(row, col) = min(filter); end end imwrite(extractmin, "scene_ero.jpg"); end </pre>	
Opening	<p>Use Matlab to Opening</p> <pre> imwrite(extractmin, "scene_opening.jpg") extractopen = zeros(size(image), class(image)); for i = 1 : time dil_image = imread('scene_opening.jpg'); for col = (halfW + 1): (c - halfW) for row = (halfH + 1) : (r - halfH) dpointD = row - halfH; dpointU = row + halfH; dpointL = col - halfW; dpointR = col + halfW; dneighbor = dil_image(dpointD:dpointU, dpointL:dpointR); filter = dneighbor(se); extractopen(row, col) = max(filter); end end imwrite(extractopen, "scene_opening.jpg"); end </pre>	

International Journal of Innovative Research in Science, Engineering and Technology

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Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017




Closing		Use Matlab to Closing	 <p>denoising picture with closing method</p>
		<pre> imwrite(extractmax, "scene_closing.jpg") extractclose = zeros(size(image), class(image)); for i = 1 : time ero_image = imread('scene_closing.jpg'); for col = (halfW + 1) : (c - halfW) for row = (halfH + 1) : (r - halfH) dpointD = row - halfH; dpointU = row + halfH; dpointL = col - halfW; dpointR = col + halfW; dneighbor = ero_image(dpointD:dpointU, dpointL:dpointR); filter = dneighbor(se); extractclose(row, col) = min(filter); end end imwrite(extractclose, "scene_closing.jpg"); end </pre>	

Image quality can be influenced by camera vibration, over-exposure, gray level distribution too centralized, and noise, etc. For example, noise problem can be solved by Smoothing method while gray level distribution problem can be improved .[11]



Improvem ent method	Issue	Before improvement	Process	After improvement
Smoothing method	noise with Matlab, salt & pepper with 0.01 paramete r is added to the original image in order to create a noisy image.		<ol style="list-style-type: none"> 1. read image and convert image into grayscale 2. convolution the grayscale image with the mask 3. denoisy image will be the result of step 2. 	

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 10, October 2017

Histogram Equalization	Gray level distribution too centralized		Refer to the Histogram equalization	
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V. CONCLUSION

Image processing is often viewed as arbitrarily manipulating an image to achieve an aesthetic standard or to support a preferred reality. However, image processing is more accurately defined as a means of translation between the human visual system and digital imaging devices. The human visual system does not perceive the world in the same manner as digital detectors, with display devices imposing additional noise and bandwidth restrictions[12]. Salient differences between the human and digital detectors will be shown, along with some basic processing steps for achieving translation. Image processing must be approached in a manner consistent with the scientific method so that others may reproduce, and validate, one's results. This includes recording and reporting processing actions, and applying similar treatments to adequate control images.[7,8]

VI. FUTURE SCOPE

The future of image processing will involve scanning the heavens for other intelligent life out in space. Also new intelligent, digital species created entirely by research scientists in various nations of the world will include advances in image processing applications. Due to advances in image processing and related technologies there will be millions and millions of robots in the world in a few decades time, transforming the way the world is managed. Advances in image processing and artificial intelligence [12] will involve spoken commands, anticipating the information requirements of governments, translating languages, recognizing and tracking people and things, diagnosing medical conditions, performing surgery, reprogramming defects in human DNA, and automatic driving all forms of transport. With increasing power and sophistication of modern computing, the concept of computation can go beyond the present limits and in future, image processing technology will advance and the visual system of man can be replicated. The future trend in remote sensing will be towards improved sensors that record the same scene in many spectral channels. Graphics data is becoming increasingly important in image processing applications. The future image processing applications of satellite based imaging ranges from planetary exploration to surveillance applications.[6]

Using large scale homogeneous cellular arrays of simple circuits to perform image processing tasks and to demonstrate pattern-forming phenomena is an emerging topic. The cellular neural network is an implementable alternative to fully connected neural networks and has evolved into a paradigm for future imaging techniques. The usefulness of this technique has applications in the areas of silicon retina, pattern formation, etc.[10,11]

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International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 10, October 2017

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