



## A METHOD FOR TWO-DIMENSIONAL ARRAY ILLUSTRATION OF DIGITAL IMAGE PIXELS

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### ABSTRACT

Digital Image Pixel Processing and 2D convolution have been presented in this paper. Digital image exists as collection of pixels in network taking sparkle which stands as utility of rows and columns. Digital image is considered as 2-D signal with luminance principles stands as utility of pixel state on hydroplane. A digital image is a two-dimensional array or two-dimensional sequence of pixels. The simplest and efficient way to represent the above equation into graphical form is convolution. The convolution summation can exist as multiplying two classifications  $x(k_1, k_2)$  and  $h(n_1 - k_1, n_2 - k_2)$  which exist variables of the functions  $k_1$  and  $k_2$  and summing the product over altogether integers values of  $k_1$  and  $k_2$ .

### 1. DIGITAL IMAGE PROCESSING

Digital image stands as an experimented illustration of correspondent image. Therefore it signifies as image by means of a predictable gathering of illustrations. Image is collected as essential unit named as *Pixel*. A Digital image is 2D sequence of pixels and collection of pixels organized in a significant order expresses an image. The recognition of conventional appearances in pictures is a shared constraint in the appreciation of various patterns. Image processing is well known as processing of a multi-dimensional indication that is utilized to improve, transform, extract data, wrapping and convert images into signals of multivariate. Generally image can remain preserved such as signal of spatial or two dimensional. The conventional technique in signal processing like clarifying, mitigating, etc is stretched to copy appearance in the arrangement of processing of an image. The latest technology with mechanism of visualization comprehensively depends on processing of digital image for extracting data designed for directing the automaton process.

### 2. Literature Review:

Numerous methods must exist since various years in image processing, then again are computationally demanding. Some of them are Hakan Cevikalp et al [1] introduced a strong technique for semi-supervised research on neural networks designed for multi-label image grouping. Rizwan Qureshi et al [2] reported the performance for pattern appreciation to predictable 3 channel images in RGB. Ji Zhang et al [3] suggested visual semantic tree successfully establish significant image classifications and accuracy rates. Jianqiang Song et al [4] recommended a great design 'multi-layer discriminative dictionary learning (MDDL)' through section limitation in classification of an image. Douglas C.Yoon et al [5] presented the digital Radiographic Image Processing and Investigation. Lei Wang et al [6] introduced an extraordinary structure of photography in 3D motion. Hamilton, P, W [7] described "process of digital images in histopathology, cytopathology and pathology-centric research". Yohan, T et al [8] recommended a technique for procurement of lower and upper limits of acceptable spin approaches by means of centre angles in digital images. Lin, P, L et al [9] described a well-organized and operative scheme of digital watermarking used for appearance interfere recognition and retrieval. Franck Xia [10] stated straight in 2D images and utilized for dump recognition to several flattening process. Rosenfeld, A et al [11] specified the image topology of pixel pair of neighbouring, opposite in a 2D digital image. Hemd, J, F [12] existing a modest procedure which usage of "fast fourier transformer (FFT)" for quick division to identify straight lines of a stated measurement. Biswas, S et al [13] designated set of rules for execution several responsibilities and reducing dissimilarities in image processing.

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### 3. DIGITAL IMAGE PIXELS

Image can be described as longitudinal scattering on a plane. Statistically longitudinal glow scattering is labelled as constant utility of 2 dimensional images. Processors cannot switch constant imaginings but then again single array of numbers in digital. Therefore a numerical appearance characterises as 2 dimensional collections of pixels. Two-dimensional array illustration of digital image pixels are shown in figure 1.

The spot of a pixel stands specified in the standard symbolisation used for matrices. The first index  $m$  symbolized the place of row, second  $n$  symbolized the place of column. Suppose digital image comprises  $M \times N$  pixels, i.e., is symbolized as  $M \times N$  matrix, the key  $n$  runs from 0 to  $N - 1$  and key  $m$  runs from 0 to  $M - 1$ . Every pixel symbolizes not objective of a point in the image then again somewhat a rectangular section, the fundamental compartment of the setting selection. The significance related by means of the pixel requirement represents the normal glow in the consistent chamber in a suitable technique. Using big pixel (cells) dimensions the spatial determination reduced however similarly the gray significance breaks at the pixel edges seem as troubling the image. By way of the pixels converted into less significant, the influence develops a smaller amount marked up to the impression of a spatially incessant image. The pixels converted into less significant than the longitudinal determination of photographic structure. A rectangular network remains individual the modest geometry in lieu of a digital image and additional measures of the pixels are also potential and shown in figure 2.

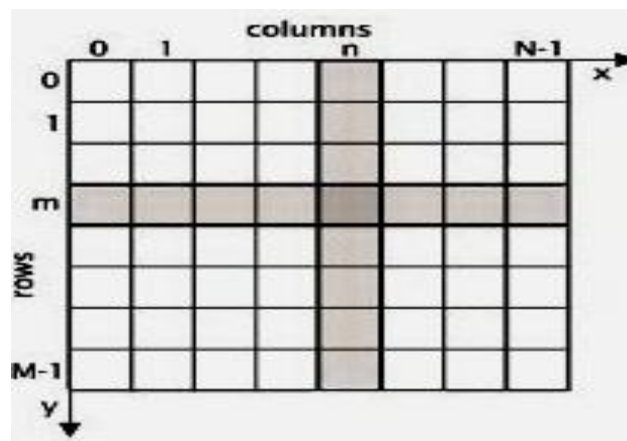


Figure 1: Two-dimensional array illustration of digital image pixels

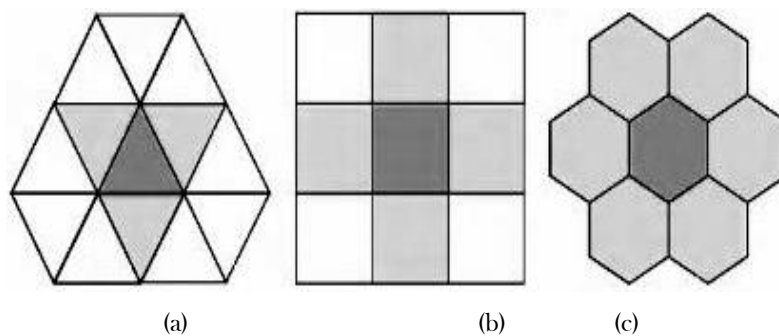


Figure 2: Arrangements of pixels:

(a) triangular, (b) rectangular and (c) hexagonal grids

### 4. TWO-DIMENSIONAL SIGNAL ANALYSIS

Digital image exists as collection of pixels in network taking sparkle which stands as utility of rows and columns. Digital image is considered as 2-D signal with luminance principles stands as utility of pixel state on hydroplane. The mandate of image process is essential to recognize 2-D indications. A scalar 2-D signal  $s(n_1, n_2)$  is statistically a compound bi-sequence and it is utilized to plotting the 2-D figures into the compound hydroplane. The main resolution is signal  $s$  is distinct used for completely determinate principles of the situation digit influences  $n_1, n_2$  by means of zero lining as essential. The simplified period categorization is adopted completed further accurate bi-sequence.

### 4.1 Two-dimensional Signals

#### Unit Impulse

A simple example of a 2-D signal is the impulse defined as follows :

$$\delta(n_1, n_2) = \begin{cases} 1 & \text{for } (n_1, n_2) = (0, 0) \\ 0 & \text{for } (n_1, n_2) \neq (0, 0) \end{cases}$$

Figure 3 shows the plot of 2-D impulse function. This plot has been obtained using MATLAB signal processing tools.

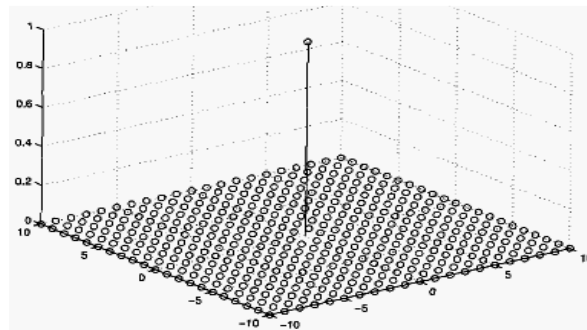


Figure 3: A plot of a 2-D spatial impulse signal

2-D signal can exist by means of immeasurable summation completed with cleaned impulses and specified as:

$$x(n_1, n_2) = \sum_{k_1, k_2} x(k_1, k_2) \delta(n_1 - k_1, n_2 - k_2)$$

The abstract exists as digit pairs  $(k_1, k_2)$ . By means of 2-D impulse definition every point  $(n_1, n_2)$  is accurately unique duration arranged at right side with nonzero, the term  $x(n_1, n_2) * 1$  and therefore the prior equality is right. This equation is known as shifting illustration of signal x.

#### Unit Step

Impulses are separately from a elementary 2-D indication period is step function, probably greatest common of first quadrant element phase function  $u(n_1, n_2)$  is as follows:

$$u(n_1, n_2) = \begin{cases} 1, & \text{for } n_1 \geq 0, n_2 \geq 0 \\ 0 & \text{for elsewhere} \end{cases}$$

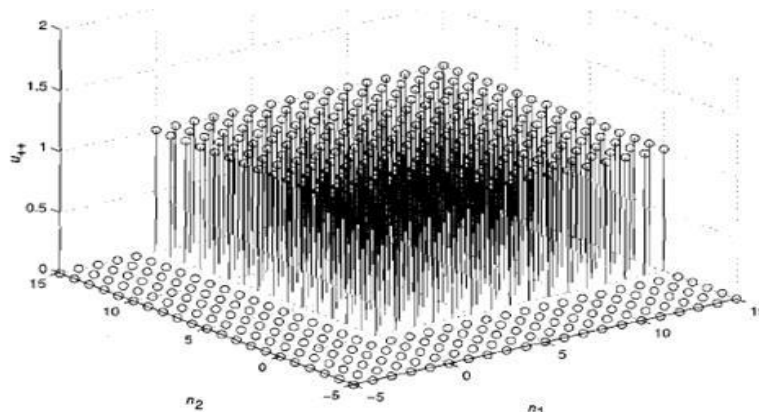


Figure 4: Plot of a unit step bi-sequence  $u(n_1, n_2)$

In two dimensions here numerous phase functions of attention and known as first quadrant element stage function and represented as  $u_{++}(n_1, n_2)$ . The remaining three element phase functions are represented in remaining three quadrants those are represented as  $u_{-+}, u_{+-}$  and  $u_{--}$  these are in 2<sup>nd</sup>, 4<sup>th</sup> and 3<sup>rd</sup> quadrants correspondingly. A actual illustration of a determinate 2-D classification is a digital image and shown in Figure 5.

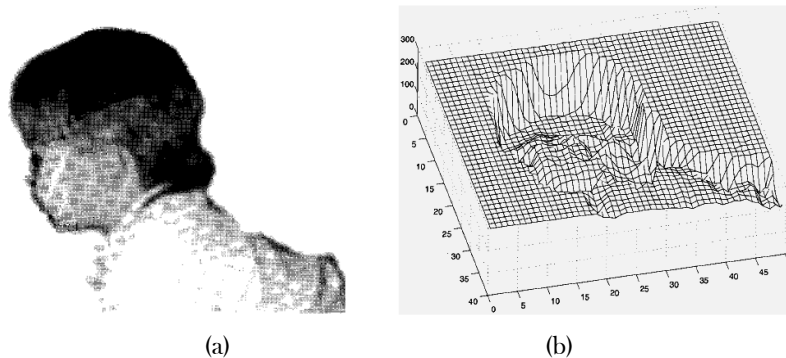


Figure 5: Different plots for 2d signals:

(a) Intensity Plot and (b) Mesh plot

Figure 5(a) represented an 8 bit (256) gray scale image and named as strength plot it is a bi-sequence with different co-ordinates. Figure 5(b) represented the mesh plot for (a).

**Separable signals**

A separable signal (sequence) satisfies the equ.

$$x(n_1, n_2) = x(n_1) \cdot x(n_2),$$

for all  $n_1$  and  $n_2$

for some 1D signals

$$x(n_1) \text{ and } x(n_2)$$

In the finite support case  $x(n_1, n_2)$  is denoted as a matrix,  $x(n_1)$  and  $x(n_2)$  is denoted as vectors of column and row. The distinguishable similarity of the corresponding matrix  $x$  denoted as the outer invention  $x = x_1 x_2^T$ . It is also called as singular value decomposition (SVD). Note that though an  $N \times N$  matrix  $x$  has  $N^2$  units in multidimensional signal processing.

A 2-D system is represented as a common mathematical operator T that plots every signal input  $x(n_1, n_2)$  into a distinctive output  $y(n_1, n_2)$ .

$$y(n_1, n_2) = T[x(n_1, n_2)]$$

T is the general system operator and it make available a unique mapping for each input arrangement x and output sequence y.

**4.2 Two-dimensional convolution**

Shift – invariant linear systems can be represented by convolution.

Shift invariance of a 2 – D system is given by :

$$T[x(n - m)] = y(n - m) \text{ for shift vector } m$$

If a system is linear shift – invariant (LSI),

then we can write, using the shift representation

$$y(n_1, n_2) = L \left| \sum_{k_1, k_2} x(k_1, k_2) \delta(n_1 - k_1, n_2 - k_2) \right|$$

where L is a linear operator.

$$y(n_1, n_2) = \sum_{k_1, k_2} x(k_1, k_2) L[\delta(n_1 - k_1, n_2 - k_2)]^2$$

And

$$y(n_1, n_2) = \sum_{k_1, k_2} x(k_1, k_2) h(n_1 - k_1, n_2 - k_2)$$

where the sequence h is called the impulse response, defined as

$$h(n_1, n_2) = L[\delta(n_1, n_2)]$$

It then follows for a 2-D LSI (Linear Shift Invariant) system,

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$$\begin{aligned} y(n_1, n_2) &= (x * h)(n_1, n_2) \\ &= (h * x)(n_1, n_2) \end{aligned}$$

**Example of 2D convolution:**

The simplest and efficient way to represent the above equation into graphical form is convolution. The convolution summation can exist as multiplying two classifications  $x(k_1, k_2)$  and  $h(n_1 - k_1, n_2 - k_2)$  which exist variables of the functions  $k_1$  and  $k_2$  and summing the product over altogether integers values of  $k_1$  and  $k_2$ . The output is a function of  $n_1$  and  $n_2$ , is the result of convolving  $x(n_1, n_2)$  and  $h(n_1, n_2)$  and its illustrations are shown in figure 6(a) and (b).

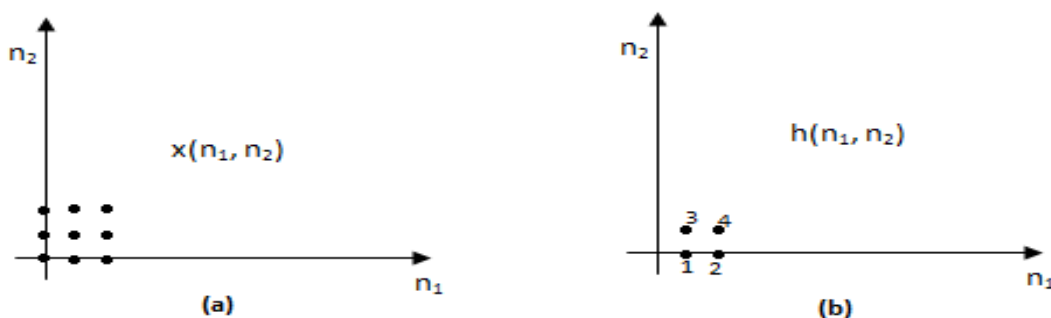


Figure 6 (a, b): Convolution of two sequences

Convolution from  $x(n_1, n_2)$  and  $h(n_1, n_2)$ ,  $x(k_1, k_2)$  and  $h(n_1 - k_1, n_2 - k_2)$  are the functions of  $k_1$  and  $k_2$  and represented as figures 6(c) to 6(f).

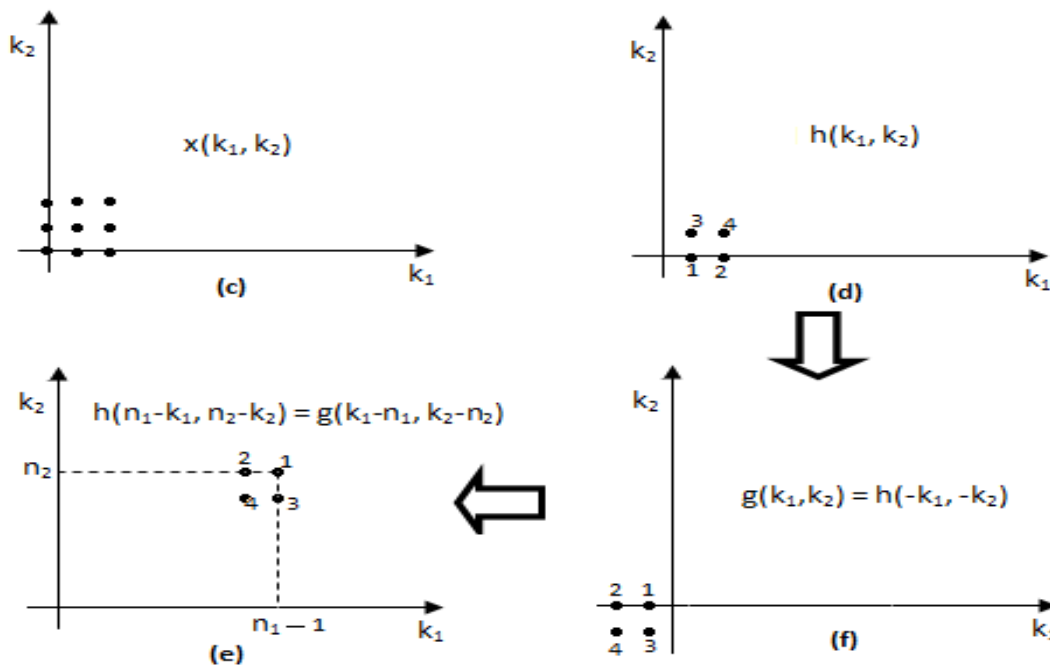


Figure 6 (c, d, e, f): Convolving two sequences

Note that  $g(n_1 - k_2, n_2 - k_2)$  is the  $g(k_1, k_2)$  shifted in the positive  $k_1$  and  $k_2$  directions by  $n_1$  and  $n_2$ , respectively. Figures 6(d) to 6(f), show how to obtain  $h(n_1 - k_1, n_2 - k_2)$  as a function of  $k_1$  and  $k_2$  from  $h(n_1, n_2)$  in three steps. It is suitable to remember how to attain  $h(n_1 - k_1, n_2 - k_2)$  directly from  $h(n_1, n_2)$ . One simple way is to first change the variables  $n_1$  and  $n_2$  to  $k_1$  and  $k_2$ , flip the sequence with respect to the origin, and then shift the result in the positive  $k_1$  and  $k_2$  directions by  $n_1$  and  $n_2$  points correspondingly. Once  $x(k_1, k_2)$  and  $h(n_1 - k_1, n_2 - k_2)$  are obtained, they can be multiplied and summed ended  $k_1$  and  $k_2$  to produce the output at each different value of  $n_1$  and  $n_2$  and represented as figure 6(g).

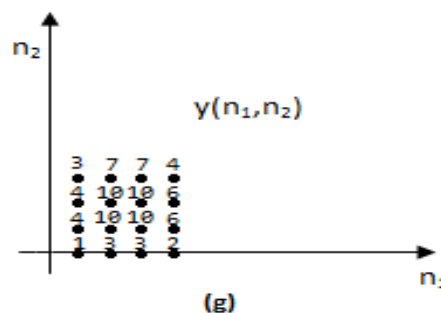


Figure 6 (g): Convolving two sequences

### 5. CONCLUSION

A simple method of digital Image Pixel Processing and 2D convolution is presented in this paper. Digital image exists as collection of pixels in network taking sparkle which stands as utility of rows and columns. Digital image is considered as 2-D signal with luminance principles stands as utility of pixel state on hydroplane. A digital image is a two-dimensional array or two-dimensional sequence of pixels. The simplest and efficient way to represent the above equation into graphical form is convolution. The convolution summation can exist as

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